2024 Plan for the 2012 Annual PM2.5 Standard

Adopted June 20, 2024

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT®

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EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

This *2024 Plan for the 2012 Annual PM2.5 Standard* (Plan) uses extensive science and research, state-of-the-art air quality modeling, and the best available information in developing a strategy to attain the federal health-based 2012 national ambient air quality standard (standard, or NAAQS) for fine particulate matter (PM2.5) as expeditiously as practicable. The San Joaquin Valley Air Pollution Control District (District) and the California Air Resources Board's (CARB) attainment strategy builds upon comprehensive strategies already in place from previously adopted attainment plans and measures. The District and CARB's multi-faceted approach to reducing emissions in the San Joaquin Valley (Valley) for this Plan consists of a combination of innovative regulatory and non-regulatory measures that achieve the massive emissions reductions needed to bring the Valley into attainment.

Key elements of the San Joaquin Valley's journey in meeting the 2012 PM2.5 Standard and the updated strategy in the *2024 Plan for the 2012 Annual PM2.5 Standard* include:

- **Significant Progress Made and Need for Additional Emissions Reductions:** The San Joaquin Valley has achieved significant emissions reductions over the last several decades through a comprehensive control strategy; however, additional emissions reductions are needed to meet the 2012 annual PM2.5 standard.

- **Plan Includes Updated PM2.5 Strategy Based on Latest Science and Research:** The District and California Air Resources Board (CARB) submitted a plan to the U.S. Environmental Protection Agency (EPA) in 2018 to address Serious nonattainment area requirements. In response to EPA action, an updated Plan has been developed to meet the 2012 PM2.5 Standard using the latest science and analysis of potential control measures. This new *2024 PM2.5 Plan* demonstrates attainment of the 2012 annual PM2.5 standard and is seeking a 5-year extension to 2030 to ensure that even the most challenged areas of the Valley successfully meet the standard.

- **Plan Achieves Significant Emissions Reductions in Coming Years:** Overall, the aggressive control strategy included in the *2024 PM2.5 Plan* will reduce emissions of PM2.5 by 10.8 tons per day (tpd) (16%) and NOx by 148.7 tpd (66%) between 2017 and 2030, through the implementation of adopted District and CARB regulations, in addition to reductions to be achieved through new regulatory and incentive-based commitments for stationary, area, and mobile sources.

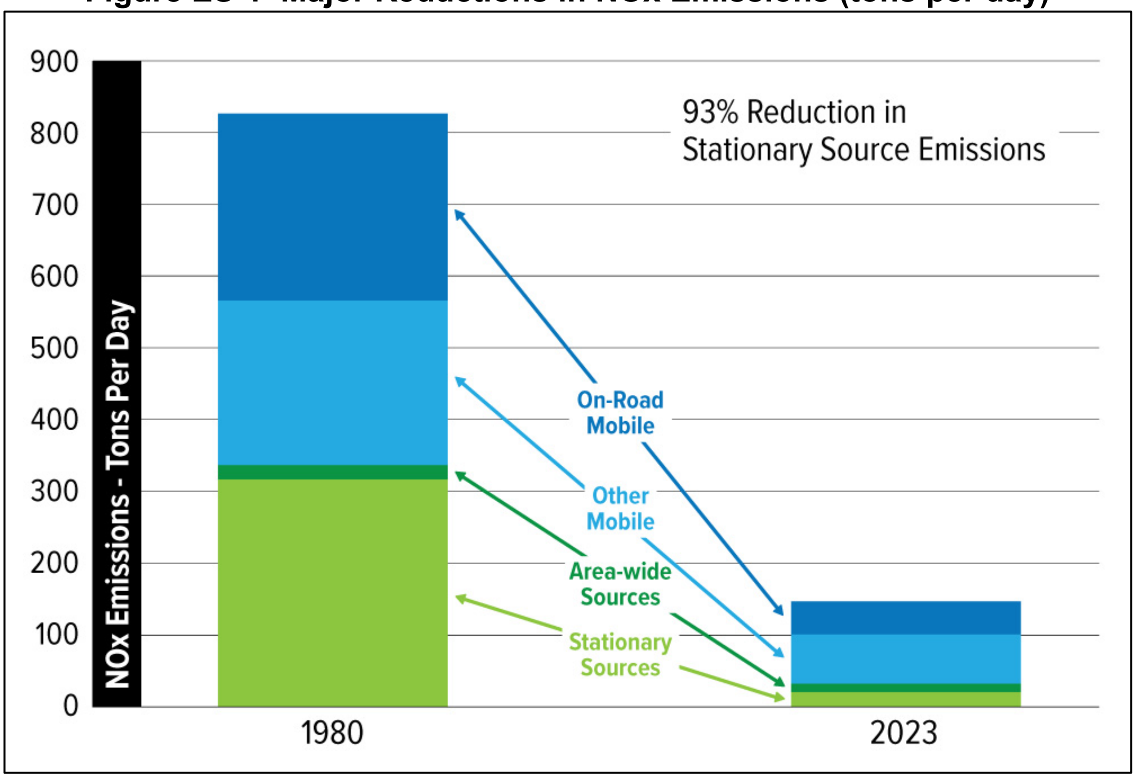
- **Plan Brings Entire Valley into Attainment of Standard as Expeditiously as Possible:** Through the comprehensive attainment strategy, the District estimates that the majority of the Valley population is currently in attainment of the 2012 standard, 90% will be in attainment by 2027, and 100% will be in attainment by 2030.

- **Plan Strategies Improve Public Health**: Through this Plan, the District continues to carry out its mission to improve health and quality of life for all Valley residents through efficient, effective and entrepreneurial air quality management strategies. The strategies included in this Plan will result in direct public health benefits to Valley residents as they are implemented in the coming years.

- **Plan Developed Through Strong Public Engagement:** This *2024 PM2.5 Plan* was developed through a robust public process, with multiple opportunities for the public to provide input, comments, and suggestions.

Despite substantial progress made to improve the air quality in the Valley through the implementation of existing plans and clean air investments by Valley businesses and residents (Figure ES-1), the Valley continues to face significant challenges in attaining the federal PM2.5 standards. Significant additional emissions reductions are needed, particularly with respect to mobile sources under California Air Resources Board (CARB) and U.S. Environmental Protection Agency (EPA) jurisdiction, as these sources make up over 80% of remaining oxides of nitrogen (NOx) emissions in the Valley. In addition to mobile source measures, this Plan includes a comprehensive suite of fiscally responsible local measures for stationary and area sources, including new measures to further reduce emissions from residential wood combustion and agricultural operations.

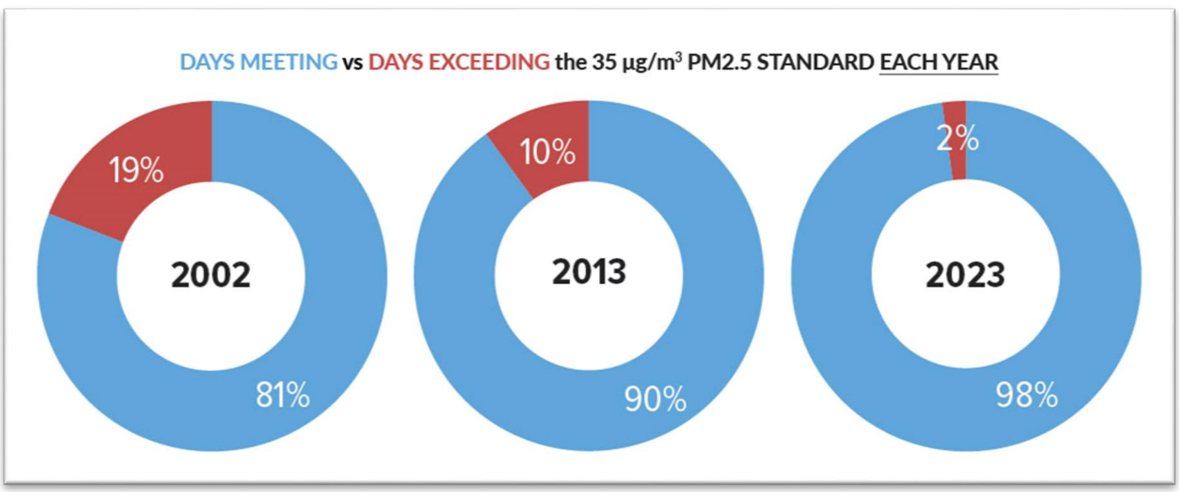
Figure ES-1 Major Reductions in NOx Emissions (tons per day)



Under previous District attainment plans, the District has implemented generations of emissions control measures for stationary and area sources under its jurisdiction. Similarly, CARB has adopted stringent regulations for mobile sources. Together, these efforts represent the nation's toughest air pollution emissions controls. In addition to the stringent regulatory program, the District also operates amongst the most effective and efficient incentive grants program, investing over $6.2 billion in public/private funding towards clean air projects to date that have achieved over 268,000 tons of emissions reductions.

Due to significant investments from the District to implement strategies from past attainment plans, the Valley's ozone and PM2.5 precursor emissions are at historically low levels, and air quality has improved significantly, providing Valley residents with associated health benefits. Notably, the Valley has already attained the 1987 standard for particulate matter 10 microns or less in diameter (PM10) and the 1979 1-hour ozone standard. Additionally, on January 28, 2022, EPA determined that the Valley attained the 1997 24-hour PM2.5 standard of 65 micrograms per cubic meter (μg/m^3) by the attainment date of December 31, 2020.[1] 2023 marked a record-breaking year with the highest number of days meeting health standards, signaling continued positive progress in air quality improvement.

Figure ES-2 Progress in Improving Valley PM2.5



Plan Addresses Federal 2012 Annual PM2.5 Standard

This Plan addresses the 2012 annual PM2.5 standard of 12 μg/m³. The District addressed the Serious Plan requirements for the 2012 annual standard, along with other PM2.5 standards, as part of the integrated *2018 Plan for the 1997, 2006, and*

[1] EPA. *Partial Approval and Partial Disapproval of Air Quality Implementation Plans and Determination of Attainment by the Attainment Date; California; San Joaquin Valley Serious Area and Section 189(d) Plan for Attainment of the 1997 24-hour PM2.5 NAAQS; Final Rule*. 87 Fed. Reg. 19, pp. 4503-4508. (January 28, 2022). Retrieved from: https://www.federalregister.gov/documents/2022/01/28/2022-01728/partial-approval-and-partial-disapproval-of-air-quality-implementation-plans-and-determination-of

2012 PM2.5 Standards (*2018 PM2.5 Plan*), years earlier than required in order to achieve early emissions reductions. In December 2021, EPA proposed approval of the Serious Plan for the 2012 PM2.5 standard,[2] then reversed the decision and proposed disapproval in October 2022, citing additional interest in information for the ammonia precursor demonstration and building heating emissions.[3] In response to EPA's reversal, CARB withdrew the Plan for the 2012 standard with District concurrence.

The District and CARB, in close coordination with EPA to address questions and feedback, developed an updated Plan for the 2012 standard through a robust public process. Initial elements, including an updated emissions inventory, precursor demonstration, Best Available Control Measure (BACM), and New Source Review (NSR) requirements, were addressed through the District and CARB's *Initial SIP Requirements for the 2012 Annual PM2.5 Standard*, as adopted by the District Governing Board on October 19, 2023, and subsequently submitted to EPA through CARB. This Plan addresses the remaining nonattainment area SIP requirements pursuant to the Clean Air Act (CAA), including additional information to address EPA's comments in their proposed October 2022 disapproval.

Comprehensive Attainment Strategy

Despite the significant progress to date, more emissions reductions are needed to meet the 2012 annual PM2.5 standard. This Plan builds upon comprehensive strategies already in place from adopted District plans and CARB state-wide strategies. The District's current rules and regulations reflect technologies and methods that are beyond control levels established under the CAA. Overall, the aggressive control strategy included in the *2024 PM2.5 Plan* will reduce emissions of PM2.5 by 10.8 tons per day (tpd) (16%) and NOx by 148.7 tpd (66%) between 2017 and 2030, contributing to the Valley's progress toward attainment of the 2012 annual PM2.5 standard. In addition to the regulatory strategy contained in the Plan, the District and state's incentive programs will also reduce emissions from mobile sources in the coming years. This comprehensive strategy that will bring the Valley into attainment includes the following:

> *District Regulatory measures* achieving new emission reductions during this Plan period, in addition to new stationary and area source measures to further strengthen requirements to achieve greater emissions reductions from residential wood combustion and agricultural operations.
>
> *Incentive-based measures* that accelerate the deployment of cleaner vehicles and technologies in a variety of sectors, including agricultural equipment and residential wood combustion.

[2] EPA. *Clean Air Plans; 2012 Fine Particulate Matter Serious Nonattainment Area Requirements; San Joaquin Valley, California; Proposed Rule*. 86 Fed. Reg. 247, pp. 74310-74352. (December 29, 2021). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2021-12-29/pdf/2021-27796.pdf

[3] EPA. *Clean Air Plans; 2012 Fine Particulate Matter Serious Nonattainment Area Requirements; San Joaquin Valley, California; Proposed Rule*. 87 Fed. Reg. 192, pp. 60494-60531. (October 5, 2022). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2022-10-05/pdf/2022-21492.pdf

State mobile source strategy that reduces emissions from mobile sources under state and federal jurisdiction, including heavy-duty trucks, agricultural equipment, locomotives, and off-road equipment.

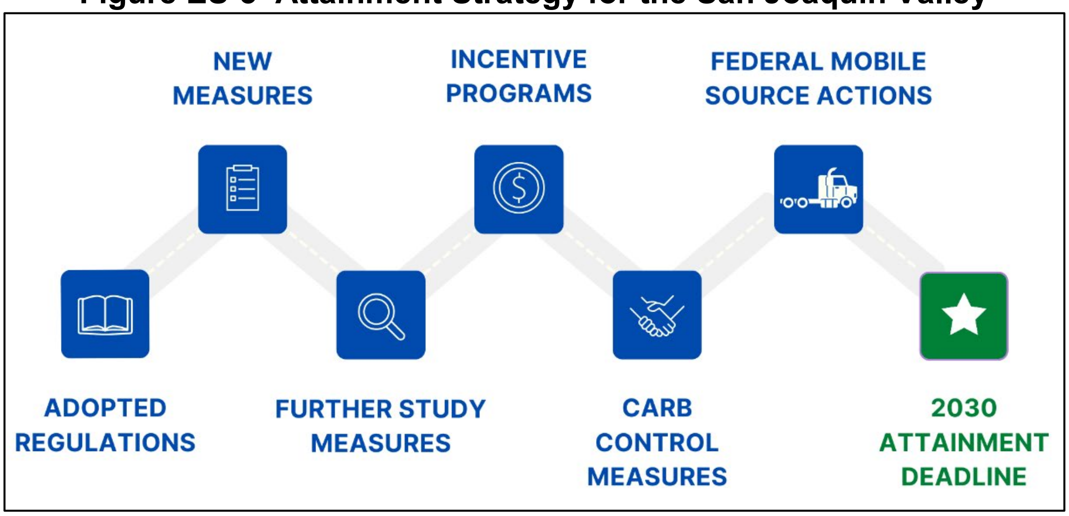
Public outreach and education that encourages and empowers the public to understand air quality issues, take advantage of District tools to stay informed regarding local air quality, take actions to protect themselves when necessary, understand the Valley's unique air quality challenges, and take actions to reduce emissions and improve the Valley's air quality.

Technology advancement and demonstration efforts to advance technology and accelerate the deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable.

Transition to zero-emission technologies across all sectors where feasible, through close collaboration with federal, state, and local governments, industry, and the public to support the development and rapid deployment of new technologies and needed infrastructure, ensuring equitable transition.

Call for action by the state and federal governments to do their part in taking responsibility for regulating, and taking actions, to reduce emissions in the Valley. This includes working together to advocate for and secure the significant new funding required to achieve the enormous emissions reductions necessary for attainment under this Plan through incentive-based measures.

Figure ES-3 Attainment Strategy for the San Joaquin Valley

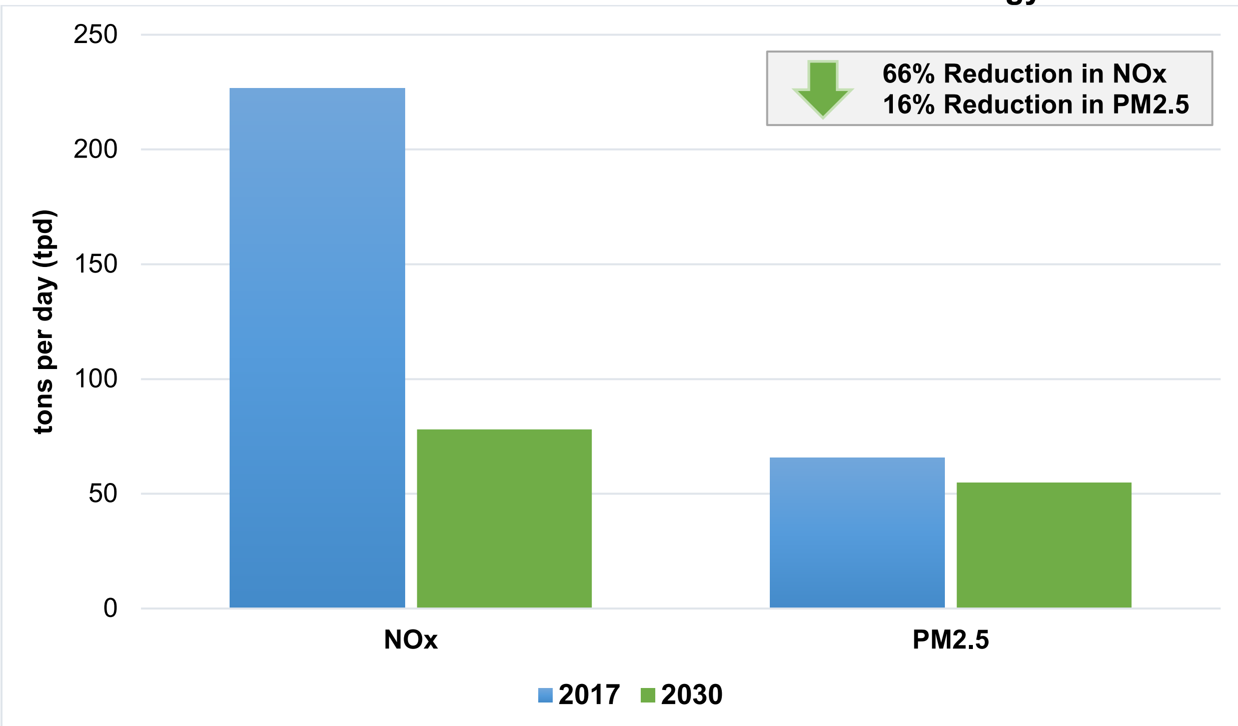


This Plan builds on numerous existing plans and measures adopted by the District and CARB to address multiple federal air quality standards. In fact, over 128 tpd of NOx and 10 tpd of directly emitted PM2.5 emissions will be reduced by the 2030 attainment date through adopted measures. In developing this Plan, the District and CARB conducted an extensive evaluation of sources of emissions for potential strategies to further reduce emissions in the Valley. Along with comprehensive efforts at the local level to reduce emissions, reducing mobile source emissions that are not under the direct authority of the District are critical to attaining the standard. This Plan includes additional mobile source measures that will provide significant new emissions reductions in the coming years. In addition to reducing direct emissions of PM2.5, this Plan focuses on reducing NOx emissions, which is a predominant pollutant not only in the formation of PM2.5 in the Valley, but is also the focus of the District's ozone reduction strategies. This overlapping significance and emphasis on reducing NOx emissions helps to address both of the Valley's biggest air quality challenges, PM2.5 and ozone.

The District has a history of success in reducing particulate and ozone-forming emissions through a variety of ground-breaking rules and strategies. This success provides assurance that similar strategies employed in the future will provide the desired results in helping to improve the Valley's air quality. These innovative strategies, such as the first-of-their-kind Indirect Source Review and Employer Trip Reduction regulations that reduce the growth in NOx and PM emissions from mobile and area sources associated with construction and operation of new development projects and reduce passenger vehicle miles traveled (and associated emissions) from workers employed by large employers in the Valley, have proven to be highly effective, as evidenced by the steady rate of improvement in the Valley's air quality. The District's highly successful and acclaimed incentive program has become an increasingly important and effective strategy for reducing mobile source emissions with a public and private combined investment of $6.2 billion reducing over 268,000 tons of emissions since 1992. The District's landmark Conservation Management Practice (CMP) rule proved critical in assisting the Valley to eliminate exceedances of the federal PM10 standard and attain the standard in 2005. In addition to reducing emissions from Valley businesses, significant emissions have been reduced by the general public, such as through the residential wood burning curtailment efforts that have been critical in helping to reduce PM2.5 concentrations.

In addition to the significant ongoing reductions achieved and maintained through the District's current adopted air quality regulations, the *2024 PM2.5 Plan* includes a number of measures committing the District to explore and implement a variety of stationary and area source emission reduction opportunities. The District is committing in this Plan to achieve additional emissions reductions from new prohibitory and incentive-based measures for agricultural sources and residential wood combustion, as necessary for expeditious attainment demonstrated through modeling conducted by CARB. Notably, the incentive-based measures are based on already received funding. In addition, while the District's and CARB's programs are the most aggressive and innovative in the nation, the District is committing to evaluate the next generation of innovative control technologies and seek additional emission reduction opportunities across a number of stationary and area source sectors, including residential and commercial heating, stationary NOx and PM2.5 sources, energy and climate change programs, clean landscaping equipment and practices, and other innovative measures to pursue additional emission reduction opportunities as technologies, practices, and policies evolve in the future.

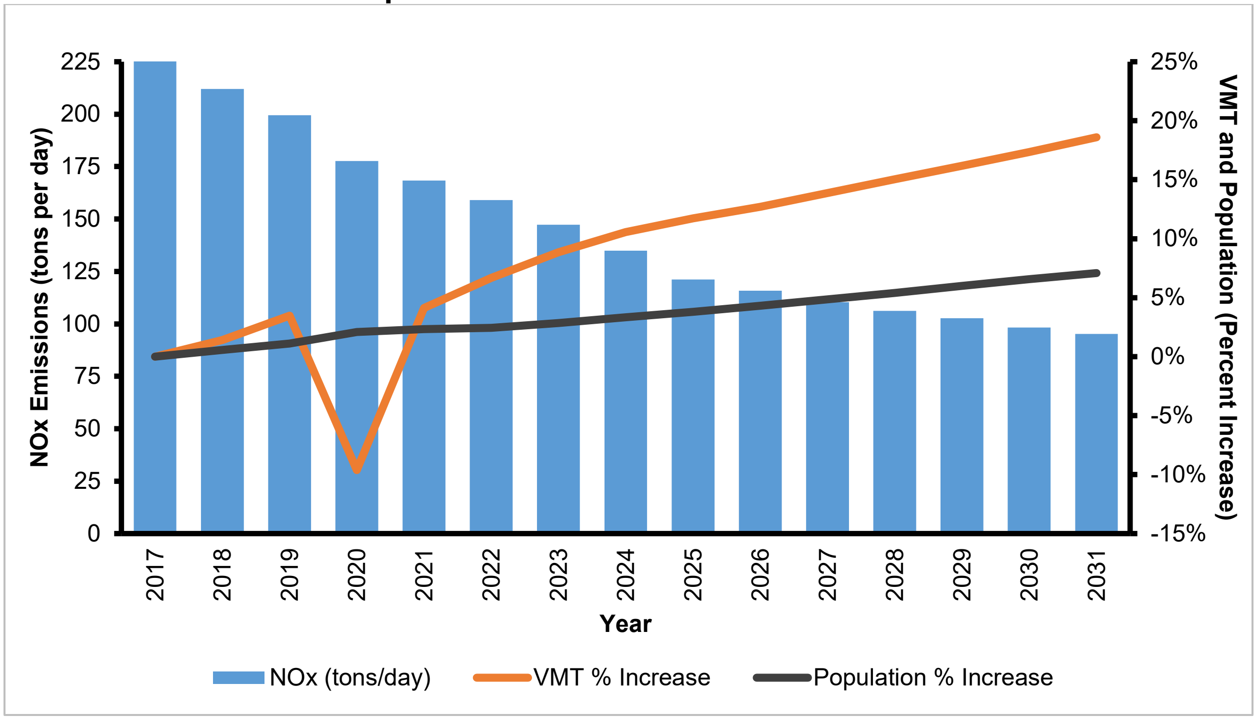
Figure ES-4 Reduction in NOx (PM2.5 precursor) and Direct PM2.5 Emissions under District and CARB Attainment Strategy



Notably, the Valley continues to be one of California's fastest growing regions in terms of population and vehicle miles traveled. While such growth is generally associated with increased precursor emissions, Figure ES-5 shows the significant emissions reductions that are being achieved under the District and CARB's currently adopted control strategy, despite this concurrent growth. Photochemical modeling for this Plan demonstrates the significant emissions reductions achieved under the District's current regulatory control strategy (including several recently adopted regulations for industrial sources), coupled with CARB's 2022 State SIP Strategy, are expected to bring the Valley into attainment of the 2012 annual PM2.5 standard by 2030.

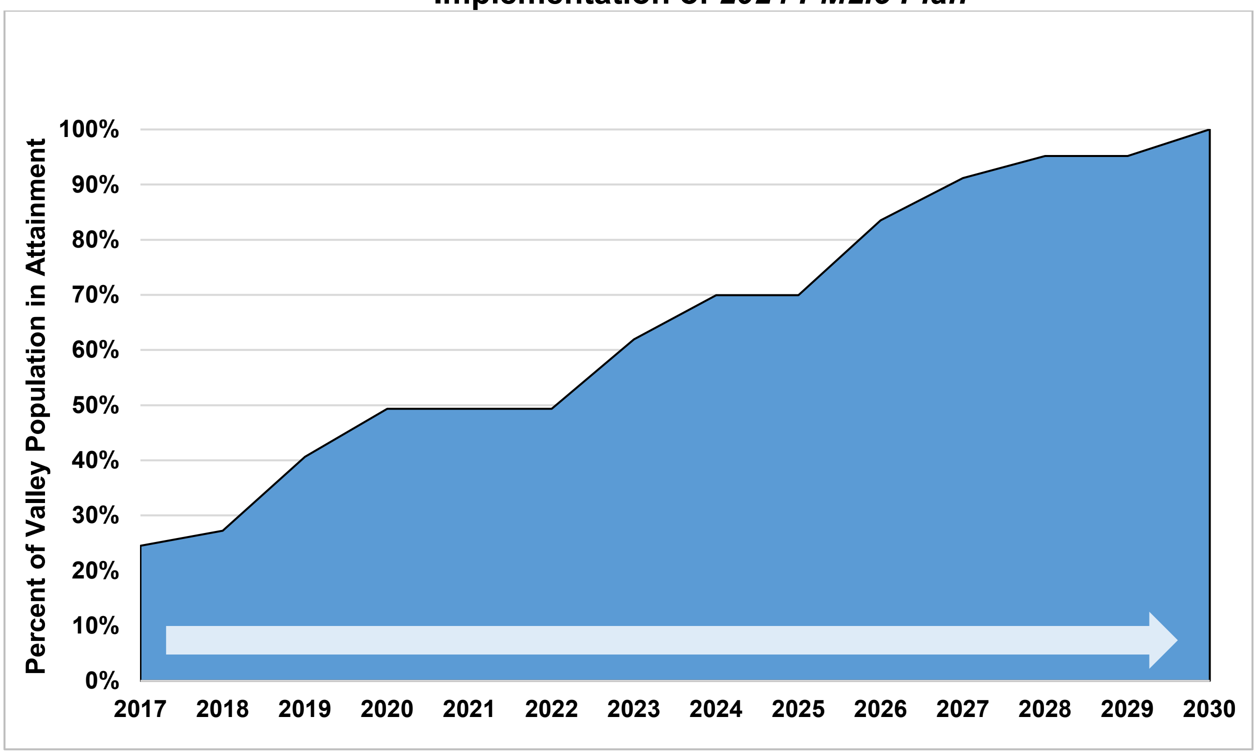
Attaining federal health-based standards is an important milestone for improving public health. Through the strategy outlined in this plan, the Valley as a whole is projected to attain the federal 2012 annual PM2.5 standard by 2030. Under federal regulation, while every area of the Valley must achieve attainment of the standard in order for the entire Valley to be considered in attainment, the majority of Valley residents are in areas currently in attainment or will see attainment much sooner than the projected date of 2030. Figure ES-6 illustrates the Valley's journey to attainment under this Plan.

Figure ES-5 Plan Emissions Reductions as Compared to San Joaquin Valley Population and Vehicle Miles Traveled Growth*



*Does not include new measures identified in this Plan

Figure ES-6 Estimated Percent of Valley Population in Attainment through Implementation of *2024 PM2.5 Plan*



As the Valley's population progresses towards experiencing air quality that meets the 2012 PM2.5 standard, by the attainment target year of 2030, a number of health benefits are also projected to be achieved. In CARB's health benefits analysis, in the year 2030, the implementation of the strategy for this Plan is expected to reduce 111 cases of premature death (cardiopulmonary related). In addition, a number of other health outcomes are also projected to be reduced, including heart attacks, emergency room visits, onset of asthma and related symptoms, lost work days, hospital admissions for Alzheimer's and Parkinson's disease, and others. These projected health benefits provide compelling justification for the implementation of this attainment plan for the 2012 PM2.5 standard.

Importance of Federal Mobile Source Reductions

As the San Joaquin Valley and other regions continue facing challenges in meeting federal ambient air quality standards, it is essential that EPA cooperate in this effort to improve air quality and public health in the San Joaquin Valley by reducing emissions from sources under its control that comprise an increasingly significant portion of air pollution, air toxics impacts, and greenhouse gas emissions in the San Joaquin Valley, South Coast, and other areas of the state. CARB and the San Joaquin Valley have long advocated for new heavy-duty mobile source standards, and recent federal funding actions have created unprecedented opportunities for the San Joaquin Valley to receive much needed investments to reduce emissions from mobile sources. Given the Valley's air quality challenges and significant number of disadvantaged communities, it will be imperative that EPA and other federal agencies prioritize and integrate these new opportunities in this Plan, as well as other SIPs for Extreme ozone nonattainment and Serious PM2.5 nonattainment areas.

Plan Prepared with Extensive Public Input

In developing attainment plans and regulations, the District conducts a robust public process to ensure meaningful public engagement. Throughout the public process for the development of this Plan, the District provided opportunities for the public and interested stakeholders to offer comments and suggestions to help guide strategy development. The District and CARB hosted 5 public workshops throughout the development of this Plan. The public was notified in advance of public workshops via the District's email lists and website. To promote an equitable public process, workshop materials were made available in English and Spanish, and the District provided simultaneous Spanish interpretation during all plan development workshops. Simultaneous interpretation in other languages was made available upon request. In addition, the District conducted the workshops through a hybrid approach, where members of the public are welcome to attend either in person, or join virtually through a real-time webinar environment. This allows for access and engagement opportunities for members of the public who may not be able to attend in person. Finally, through the public process, the District provided regular updates at District Governing Board meetings, Citizens Advisory Committee (CAC) meetings, and Environmental Justice

Advisory Group (EJAG) meetings. Notably, the CAC provided their support of the proposed Plan at the June 2024 CAC meeting.

The District provided 30 days for public review of plan documents, and invited public comment throughout the entire process. The comments received as a result of this robust engagement effort were integrated into the Plan as feasible.

Plan Demonstrates Attainment of the 2012 Annual PM2.5 Standard

This Plan satisfies applicable CAA requirements and demonstrates attainment for the 2012 annual PM2.5 standard as expeditiously as practicable. The Valley will attain the 2012 PM2.5 standard by December 31, 2030.

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Acronyms, Abbreviations, and Initialisms

AADT: Annual Average Daily Trips
AB: Assembly Bill
ACC: Advanced Clean Cars
ACF: Advanced Clean Fleets
ACM2: Asymmetric Convective Model Version 2
ACT: Alternative Control Techniques
ACT: Advanced Clean Trucks
ADF: Alternative Diesel Fuel
AERO: Advanced Emission Reduction Options
AFO: Animal Feeding Operation
AgTech: Agricultural Technical Committee
AIM: Aerosol Inorganics Model
AMMP: Alternative Manure Management Practices
AO: Agricultural Operations
APA: Administrative Procedures Act
APCD: Air Pollution Control District
APCO: Air Pollution Control Officer
APU: Auxiliary Power Units
AQ: Air Quality
AQI: Air Quality Index
AQIP: Air Quality Improvement Program
AQMD: Air Quality Management District
ARB: California Air Resources Board
ASM: Acceleration Simulation Mode
ATCM: Airborne Toxic Control Measure
ATV: All-Terrain Vehicles
BAAQMD: Bay Area Air Quality Management District
BACM: Best Available Control Measure
BACT: Best Available Control Technology
BAM: Beta-Attenuation Method
BAR: Bureau of Automotive Repair
BDSNP: Berkeley-Dalhousie Soil NOx Parameterization
BEEP: Building Energy, Energy and Power
BEV: Battery Electric Vehicle
bhp: Brake Horsepower
BMP: Best Management Practice
BTU: British Thermal Units
CAA: Clean Air Act
CAC: Citizens Advisory Committee
CAEP: Committee on Aviation Environmental Protection
CAF: Confined Animal Facility
CAPP: Community Air Protection Program
CAPCOA: California Air Pollution Control Officers Association
CARB: California Air Resources Board

CaRFG: California Reformulated Gasoline
CASAC: Clean Air Scientific Advisory Committee
cc: cubic centimeters
CC4A: Clean Cars 4 All
CCDAQ: Clark County Department of Air Quality
CDFA: California Department of Food and Agriculture
CE: Cost Effectiveness
CEC: California Energy Commission
CEIDARS: California Emission Inventory Development and Reporting System
CEMS: Continuous Emissions Monitoring System
CEPAM: California Emissions Projection Analysis Model
CEQA: California Environmental Quality Act
CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act
CE-CERT: Center for Environmental Research and Technology
CFR: Code of Federal Regulations
CGYM: Clean Green Yard Machine
CH&SC: California Health and Safety Code
CHC: Commercial Harbor Craft
CHE: Cargo Handling Equipment
CI: Compression-Ignition
CLEEN: Continuous Low Energy, Emissions, and Noise
CM: Control Measures
CMAQ Model: Community Multiscale Air Quality Model
CMAQ: Congestion Mitigation and Air Quality
CMP: Conservation Management Practice
CMS: Clean Miles Standard
CNG: Compressed Natural Gas
CO: Carbon Monoxide
CO2: Carbon Dioxide
CORE: Clean Off-Road Equipment
CP: Crude Protein
CPUC: California Public Utilities Commission
CRPAQS: California Regional Particulate Air Quality Study
CSD: California Department of Community Services and Development
CSN: Chemical Speciation Network
CTG: Control Techniques Guidelines
CTM: Chemical Transport Model
DAC: Direct Annual Costs
DC: Direct Costs
DERA: Diesel Emission Reductions Act
DI: Direct Installation (cost)
DISCOVER-AQ: Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality
District: San Joaquin Valley Air Pollution Control District
DM: Dry matter
DMV: Department of Motor Vehicles

DOF: California Department of Finance
DPF: Diesel Particulate Filter
DPR: Department of Pesticide Regulation
DV: Design Value
e-AIM: Extended Aerosol Inorganics Model
EBI: Euler Backward Iterative Solver
EC: Elemental Carbon
EDCAQMD: El Dorado County Air Quality Management District
EF: Emission Factor
EFMP: Enhanced Fleet Modernization Program
EGR: Exhaust Gas Recirculation
EIA: Energy Information Administration
EIC: Emission Inventory Code
EIS: Emissions Inspection System
EJ: Environmental Justice
EJAG: Environmental Justice Advisory Group
EMFAC: Emission Factors Model
EO: Executive Order
EPA: U.S. Environmental Protection Agency
EPCRA: Emergency Planning and Community Right-to-Know Act
ERC: Emission Reduction Credits
ESP: Electrostatic Precipitator
EU 5: European Union 5 (standards)
EV: Electric Vehicle
FAA: Federal Aviation Administration
FARMER: Funding Agricultural Replacement Measures for Emission Reductions
FCEV: Fuel Cell Electric Vehicle
FDDA: Four Dimension Data Assimilation
FEM: Federal Equivalent Method
FFLDRS: Feed, Fertilizer and Livestock Drugs Regulatory Services
FHWA: Federal Highway Administration
FIAB: Fertilizer Inspection Advisory Board
FIP: Federal Implementation Plan
FMMP: Farmland Mapping and Monitoring Program
FMP: Flare Minimization Plan
FR: Federal Register
FREP: Fertilizer Research and Education Program
FRM: Federal Reference Method
FTA: Federal Transit Administration
FY: Fiscal Year
GEOS: Goddard Earth Observing System
GGRF: Greenhouse Gas Reduction Fund
GHG: Greenhouse Gas
g/kW-hr: grams per kilowatt-hour
g/m^2/day: Grams Per Square Meter Per Day
GSE: Ground Support Equipment

GVWR: Gross Vehicle Weight Rating
H2SO4: Sulfuric Acid
HAL: Healthy Air Living
HC: Hydrocarbon
HD: Heavy Duty
HD I/M: Heavy-Duty Inspection and Maintenance Program
HDPE: High Density Polyethylene
HDVIP: Heavy-Duty Vehicle Inspection Program
HHDV: Heavy Heavy-Duty Vehicles
HNO3: Nitric Acid
HP: Horsepower
HRRS: Heath Risk Reduction Strategy
HVIP: Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
I/M or I&M: Inspection and Maintenance
IAC: Indirect Annual Costs
IASI: Infrared Atmospheric Sounding Interferometer
IC: Internal Combustion
ICAO: International Civil Aviation Organization
ICEV: Internal Combustion Engine Vehicles
ICT: Innovative Clean Transit
IIJA: Infrastructure Investment Jobs Act
ILRP: Irrigated Lands Regulatory Program
IMPROVE: Interagency Monitoring of Protected Visual Environments
IOA: Index of Agreement
IRA: Inflation Reduction Act
IRP: Integrated Review Plan
IRR: Integrated Reaction Rate
ISA: Integrated Science Assessment
ISOR: Initial Statement of Reasons
ISR: Indirect Source Review
kg: Kilogram
kW: Kilowatt
kWH: Kilowatt-Hour
LAER: Lowest Achievable Emission Rate
LAI: Leaf Area Index
lb/MMBtu: Pounds per Million British Thermal Units of Heat Output
LCFS: Low Carbon Fuel Standard
LDT: Light-Duty Trucks
LEV: Low-Emission Vehicle
LHDV: Light Heavy-Duty Vehicles
LPG: Liquefied Petroleum Gas
LSI: Large Spark-Ignition
MATS: Model Attainment Test Software
MB: Mean Bias
MBARD: Monterey Bay Air Resources District
MCF: Thousand Cubic Feet

MCIP: Meteorology-Chemistry Interface Processor
ME: Mean Error
MEGAN: Model of Emissions of Gases and Aerosols from Nature
MFB: Mean Fractional Bias
MFE: Mean Fractional Error
MHDV: Medium Heavy-Duty Vehicles
MHP: Medium Horsepower
MOU: Memorandum of Understanding
MMBtu/hr: Million British Thermal Units per Hour
MOZART: Model for Ozone and Related Chemical Tracers
MPO: Metropolitan Planning Organization
MSM: Most Stringent Measure
MSW: Municipal Solid Waste
MV: Motor Vehicle
MVEB: Motor Vehicle Emissions Budgets
MW: Megawatts
MY: Model Year
N2O: Nitrous Oxide
NAAQS: National Ambient Air Quality Standards
NACAA: National Association of Clean Air Agencies
NAEMS: National Air Emissions Monitoring Study
NARR: North American Regional Reanalysis
NASA: National Aeronautics and Space Administration
NBPT: N-(n-butyl) thiophosphoric triamide
NCEI: National Centers for Environmental Information
NCR: National Center for Atmospheric Research
NESHAP: National Emission Standards for Hazardous Air Pollutants
ng/J: Nanograms per Joule of Heat Output
NG: Natural Gas
NH3: Ammonia
NH4NO3: Ammonium Nitrate
NIOSH: National Institute of Occupational Safety and Health
NMB: Normalized Mean Bias
NME: Normalized Mean Error
NMHC: Non-methane Hydrocarbons
NNSR: Nonattainment New Source Review
NSR: New Source Review
NO: Nitrogen Oxide
NO2: Nitrogen Dioxide
NOAA: National Oceanic Atmospheric Administration
NOx: Oxides of Nitrogen
NNSR: Nonattainment New Source Review
NPRM: Notice of Proposed Rulemaking
NRC: National Research Council
NRCS: Natural Resources Conservation Service
NSCR: Non-Selective Catalytic Reduction

NSPS: New Source Performance Standard
NSR: New Source Review
NWS: National Weather Service
OAQPS: Office of Air Quality Planning and Standards (EPA)
OBD: On-Board Diagnostics
OC: Organic Carbon
OGV: Ocean-Going Vessels
OHRV: Off Highway Recreational Vehicle
OM: Organic Matter
OYW: One Year’s Worth
PA: Policy Assessment
PAN: Peroxy Acetyl Nitrate
PAW: Public Advisory Workgroup
PBL: Planetary Boundary Layer
PCAPCD: Placer County Air Pollution Control District
PE: Purchase Equipment
PEC: Purchased Equipment Costs
PEER: Permit-Exempt Equipment Registration
PERP: Portable Equipment Registration Program
PHEV: Plug-In Hybrid Electric Vehicle
PM: Particulate Matter
PM0.1: Ultrafine Particles
PM10: Particulate Matter 10 micrometers in diameter and smaller
PM2.5: Particulate Matter 2.5 micrometers in diameter and smaller
ppb: parts per billion
ppm: parts per million
ppmv: parts per million by volume
psi: pounds per square inch
psig: pounds per square inch gauge
PSIP: Periodic Smoke Inspection Program
PTO: Permit to Operate
PUC: Public Utilities Commission
RAAN: Real-Time Air Quality Advisory Network
RACM: Reasonable Available Control Measures
RACT: Reasonably Available Control Technology
RCTP: Restaurant Charbroiler Technology Partnership
REA: Risk/Exposure Assessment
RECLAIM: Regional Clean Air Incentives Market
RFG: Reformulated Gasoline
RFP: Reasonable Further Progress
RFP: Request for Proposals
RH: Relative Humidity
RMA: Roadmap to a Million Acres
RMSE: Root Mean Square Error
ROG: Reactive Organic Gases
RRF: Relative Response Factor

RTO: Regenerative Thermal Oxidizer
RVP: Reid Vapor Pressure
RWC: Residential Wood Combustion
SANDWICH: Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbon Hybrid material balance
SAPRC: Statewide Air Pollution Research Center
SASS: Spiral Aerosol Speciation Sampler
SB: Senate Bill
SBCAPCD: Santa Barbara County Air Pollution Control District
SCAQMD: South Coast Air Quality Management District
SCR: Selective Catalytic Reduction
SCS: Sustainable Community Strategies
SDAPCD: San Diego County Air Pollution Control District
SGMA: Sustainable Groundwater Management Act
SI: Spark-Ignition
SIP: State Implementation Plan
SJV: San Joaquin Valley
SJVAPCD: San Joaquin Valley Air Pollution Control District
SJVUAPCD: San Joaquin Valley Unified Air Pollution Control District
SLAMS: State and Local Air Monitoring Stations
SLOCAPCD: San Luis Obispo County Air Pollution Control District
SMAQMD: Sacramento Metropolitan Air Quality Management District
SMAT: Speciated Modeled Attainment Test
SMAT-CE: Software for the Modeled Attainment Test – Community Edition
SMS: Smoke Management System
SNCR: Selective Non-Catalytic Reduction
SOA: Secondary Organic Aerosol
SORE: Small Off-Road Engines
SOx: Oxides of Sulfur
SRIA: Standardized Regulatory Impact Assessment
SUV: Sports Utility Vehicle
SWCV: Solid Waste Collection Vehicle
SwRI: Southwest Research Institute
TAC: Toxic Air Contaminant
TAP: Technology Advancement Program
TASC: Technical Advisory Subcommittee
TCI: Total Capital Investments
TCM: Transportation Control Measure
TNC: Transportation Network Company
TOG: Total Organic Gases
tpd: Tons per Day
tpy: Tons per Year
TRP: Truck Replacement Program
TRU: Transport Refrigeration Unit
TSD: Technical Support Document
TSI: Two-Speed Idle

TxLED: Texas Low Emission Diesel Program
U.S. EPA: United States Environmental Protection Agency
UC ANR: University of California Agricultural and Natural Resources
UCCR: University of California Cooperative Extension
UDS: Unified Diagnostic Services
UK: United Kingdom
ULN: Ultra-low NOx
ULNB: Ultra-low NOx Burner
ULSD: Ultra Low Sulfur Diesel
UNECE: United Nations Economic Commission for Europe
UP: Union Pacific
US: United States
USDA: United States Department of Agriculture
USDA-ARS: United States Department of Agriculture-Agricultural Research Service
USDA-NRCS: United States Department of Agriculture-Natural Resources Conservation Service
U.S. EPA: United States Environmental Protection Agency
USG: Unhealthy for Sensitive Groups
Valley CAN: Valley Clean Air Now
VCAPCD: Ventura County Air Pollution Control District
VDE: Visible Dust Emissions
VDEC: Verified Diesel Emission Control Strategy
VDT: Vehicle Daily Trip
VFA: Volatile Fatty Acids
VMT: Vehicle Miles Traveled
VOC: Volatile Organic Compounds
VW: Volkswagen
WDG: Wet Distillers Grain
WDR: Waste Discharge Requirements
WRF: Weather and Research Forecasting
YSAQMD: Yolo-Solano Air Quality Management District
ZEB: Zero-Emission Bus
ZEE: Zero-Emission Equipment
ZELE: Zero-Emission Landscaping Equipment
ZEM: Zero-Emission Motorcycle
ZEV: Zero-Emission Vehicle
µg/m3: Micrograms per Cubic Meter

Chapter 1
INTRODUCTION

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Chapter 1: Introduction

Over the years, the San Joaquin Valley Air Pollution Control District (District) and the California Air Resources Board (CARB) have adopted numerous attainment plans (State Implementation Plans, or SIPs), which serve as the primary vehicles for improving air quality in the San Joaquin Valley (Valley). These SIPs use extensive science and research, state of the art air quality modeling, and the best available information to develop a strategy to bring the Valley into attainment with federal health-based air quality standards. Following the adoption of each attainment plan, the District implements plan strategies through regulatory development, outreach, continued research, and incentive programs. As each attainment plan strategy builds upon previous strategies being implemented from other planning efforts, this attainment plan is just one milestone in the District's continued effort to improve air quality in the Valley.

The federal Clean Air Act (CAA) prompts the U.S. Environmental Protection Agency (EPA) to establish health-based national ambient air quality standards (NAAQS), designate nonattainment areas, and promulgate planning requirements. EPA established standards for particulate matter less than 2.5 microns in diameter (PM2.5) in 1997, 2006, and 2012. The District addressed the Serious Plan requirements for the 2012 annual standard, along with other PM2.5 standards, as part of the integrated *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (*2018 PM2.5 Plan*), years earlier than required in order to achieve early emissions reductions. In December 2021, EPA proposed approval of the Serious Plan for the 2012 PM2.5 standard,[1] then reversed the decision and proposed disapproval in October 2022.[2] In response to EPA's reversal, CARB withdrew the Plan for the 2012 standard with District concurrence.

The District and CARB worked together through a robust public process to develop an updated Serious Plan for the 2012 standard. Initial Plan elements, including an updated emissions inventory, precursor demonstration, Best Available Control Measure (BACM), and New Source Review (NSR) requirements, were addressed through the District and CARB's *Initial SIP Requirements for the 2012 Annual PM2.5 Standard*, as adopted by the District Governing Board on October 19, 2023 and subsequently submitted to EPA through CARB. This Plan addresses the remaining nonattainment area SIP requirements pursuant to the CAA.

1.1 NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER

EPA is responsible for the promulgation of the federal air quality standards. CAA Sections (§) 108 and 109 govern the establishment, review, and revision of the NAAQS

[1] EPA. *Clean Air Plans; 2012 Fine Particulate Matter Serious Nonattainment Area Requirements; San Joaquin Valley, California; Proposed Rule*. 86 Fed. Reg. 247, pp. 74310-74352. (December 29, 2021). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2021-12-29/pdf/2021-27796.pdf

[2] EPA. *Clean Air Plans; 2012 Fine Particulate Matter Serious Nonattainment Area Requirements; San Joaquin Valley, California; Proposed Rule*. 87 Fed. Reg. 192, pp. 60494-60531. (October 5, 2022). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2022-10-05/pdf/2022-21492.pdf

for six criteria pollutants, including PM2.5. The CAA requires periodic review of the science upon which the standards are based, and review of the standards themselves. Reviewing the NAAQS is a complex process based on a comprehensive review of relevant scientific literature, as further described below.

1.1.1 EPA's Standard Setting Process

The review process for a federal air quality standard starts with a planning phase, where EPA holds a science policy workshop to gather input from the scientific community and the public regarding policy-relevant issues. Based on input received during this initial planning phase, EPA formulates an Integrated Review Plan (IRP) that presents the schedule and process for the standard review.

Since 2008, EPA's Integrated Science Assessments (ISAs) have formed the scientific foundation for the review of NAAQS. An ISA is a comprehensive review, synthesis, and evaluation of the most policy-relevant science to help inform the risk and exposure assessments for criteria pollutants. EPA considers thousands of peer-reviewed scientific studies as it formulates its proposed standard. The ISA for particulate matter (PM) is publicly available on EPA's website.[3]

Building on the information presented in the ISA, EPA scientists complete a Risk/Exposure Assessment (REA) to develop quantitative characterizations of exposures to the specific pollutant and associate risk to human health or the environment from air quality conditions. This assessment includes a report of the uncertainties of REA findings. A Policy Assessment (PA) is then formulated, which provides an analysis of the scientific assessments completed in the ISA and the REA, and alternative policy options that could be considered by the EPA Administrator.

The above technical reports are provided to the EPA Clean Air Scientific Advisory Committee (CASAC), an independent scientific committee that advises the EPA Administrator on the adequacy of existing standards and any revisions that should be considered. Section 109(d)(2) of the CAA requires that an independent scientific review committee "shall recommend to the Administrator any new…standards and revisions of existing criteria and standards as may be appropriate." CASAC is comprised of seven members appointed by the EPA Administrator. These members include experts from outside of the EPA in topics such as air quality, health effects, ecological effects, and risk assessment methods. The seven-member CASAC is supported by sub-committee panels for each NAAQS review, which may be augmented by additional subject-matter experts. The panel for each NAAQS review will analyze the ISA, REA, and other available research to provide objective advice to EPA on the technical basis for the standard.

Finally, taking into account the information contained in the ISA, REA, PA, and the advice of CASAC, the EPA Administrator develops and publishes a notice of proposed

[3] EPA. Integrated Science Assessment (ISA) for Particulate Matter. (2018). Retrieved from: https://www.epa.gov/isa/integrated-science-assessment-isa-particulate-matter

rulemaking. After public review and comment on the proposed standard and associated draft reports, the EPA Administrator promulgates the NAAQS.

1.1.2 Implementation of PM Standards

After a standard is set, EPA designates areas as attainment or nonattainment based on the most recent three years of air quality data available. For PM standards, EPA automatically classifies nonattainment areas as Moderate pursuant to CAA[4] requirements, with six years from the initial nonattainment designation date to reach attainment (though two one-year extensions are available in certain circumstances). Nonattainment areas may request reclassification to "Serious," with ten years from the initial attainment designation date to reach attainment.

EPA interprets CAA requirements and adopts an Implementation Rule[5] for each standard as guidance for states and local air districts as they develop SIPs to ensure compliance with CAA requirements and attainment of each standard. While EPA cannot consider costs or difficulty in setting the standards, costs and difficulty are inescapable for states and local air districts as they determine the best way to bring areas into attainment. That being said, local air districts must meet planning and attainment requirements to improve public health and to avoid federal sanctions. Upon development of an attainment strategy, an area submits the adopted plan to EPA for approval. Once EPA approves a plan as an amendment to the SIP, that plan becomes federally enforceable.

There are a number of serious penalties and risks associated with any failure to submit approvable attainment strategies for meeting federal standards. If EPA finds that an area has failed to submit an approvable plan on time; has failed to submit a revised plan or rule in response to an EPA disapproval; or has failed to implement commitments included in the plan after the plan has been approved, then the following sanctions may be applied to the area under authority of the federal Clean Air Act:

- Two-to-one offset requirement for major sources, leading to permitting barriers for new and expanding businesses
- Loss of federal highway funds
- A federal implementation plan (FIP), which would result in a loss of local control

1.2 2012 PM2.5 ANNUAL STANDARD

On January 15, 2013, EPA revised the annual average PM2.5 standard to 12 µg/m³ (2012 PM2.5 standard).[6] In 2015, EPA designated the Valley as Moderate

[4] Clean Air Act Section 188(a)

[5] Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements; Final Rule. 81 Fed. Reg. 164, pp. 58010-58162. (August 24, 2016). (Codified at 40 CFR Parts 50, 51, and 93). Retrieved from: https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

[6] EPA. *National Ambient Air Quality Standards for Particulate Matter; Final Rule.* 78 Fed. Reg. 10, pp. 3086-3287 (January 15, 2013). (Codified at 40 CFR Parts 50, 51, 52 et al.). Retrieved from: http://www.gpo.gov/fdsys/pkg/FR-2013-01-15/pdf/2012-30946.pdf

nonattainment for the 2012 PM2.5 standard, with an attainment deadline of December 31, 2021.[7] Due to the impracticability of achieving the standard by the Moderate area attainment date, the District adopted the *2016 Moderate Area Plan for the 2012 PM2.5 Standard* (*2016 Moderate Plan*), including an attainment impracticability demonstration and a request for reclassification of the Valley from Moderate nonattainment to Serious nonattainment. Effective December 27, 2021, EPA finalized partial approval of the District's *2016 Moderate Plan* and reclassified the District as a Serious nonattainment area for the 2012 PM2.5 NAAQS, with an attainment deadline of December 31, 2025.[8] Due to the impracticability of attaining the annual 12 µg/m³ standard by 2025, the District is requesting an attainment deadline extension to 2030. Table 1-1 provides a summary of the 2012 PM2.5 NAAQS and EPA, CARB, and District actions related to the standard consistent with CAA requirements.

Table 1-1 2012 PM2.5 NAAQS and Associated Actions

	2012 PM2.5 NAAQS
2012	EPA establishes 2012 PM2.5 NAAQS (1/15/13): 24-hr: 35 µg/m³ **Annual: 12 µg/m³**
2013	D.C. Circuit Court found EPA erred in implementing 1997 NAAQS pursuant solely to General Implementation provisions of CAA Subpart 1, without also considering the PM-specific provisions of Subpart 4 (1/4/13)
2015	EPA designates Valley: Moderate nonattainment (1/15/15)
2016	District adopts *2016 Moderate Plan* (9/15/16) Moderate Plan due (10/15/16) CARB tables adoption of *2016 Moderate Plan,* does not submit to EPA, commits to revisit Plan at a later date (10/20/16) EPA issues Implementation Rule to address CAA Subpart 4 requirements (8/24/16)
2018	District adopts *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards*, addressing Serious Plan requirements in advance of 2023 due date (11/15/18)
2019	CARB adopts *2018 Plan* and *2016 Moderate Plan* (1/24/19)
2021	EPA approves *2016 Moderate Plan*, except contingency measures, and reclassifies Valley to Serious (11/26/21) EPA proposes approval of portions of *2018 Plan* related to 2012 standard, except contingency measures (12/26/21)
2022	EPA reverses prior proposed approval and proposes to disapprove portions of *2018 Plan* related to 2012 standard (10/5/22) District and CARB withdraw portions of *2018 Plan* related to 2012 standard (10/27/22)

[7] EPA. *Air Quality Designations for the 2012 Primary Annual Fine Particle (PM2.5) NAAQS; Final Rule*. 80 Fed. Reg. 10, pp. 2206-2284. (January 15, 2015). Retrieved from: http://www.gpo.gov/fdsys/pkg/FR-2015-01-15/pdf/2015-00021.pdf

[8] EPA. *Clean Air Plans; California; San Joaquin Valley Moderate Area Plan and Reclassification as Serious Nonattainment for the 2012 PM2.5 NAAQS; Contingency Measures for the 2006 PM2.5 NAAQS; Final Rule.* 86 Fed. Reg. 225, pp. 67343-67350. (November 26, 2021). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2021-11-26/pdf/2021-25616.pdf

	2012 PM2.5 NAAQS
2023	EPA issues draft guidance on SIP provisions that address contingency measures (3/17/23) District adopts contingency measure package to meet contingency requirements for PM2.5 standards (5/18/23) District and CARB adopted *Initial SIP Requirements for the 2012 Annual PM2.5 Standard* (10/19/23) EPA proposes to promulgate a FIP that consists of contingencies measures for PM2.5 standards (8/8/23) EPA proposes approval of two SIP submissions addressing contingency requirements for PM2.5 standards, including the area's contingency measure plan element and two specific measures (residential wood burning heaters and fireplaces, and non-agricultural, rural open areas) (12/20/23) EPA made interim final determination that the Valley has satisfied CAA requirements for nonattainment areas classified as Serious for the 1997 annual standard and for contingency measures for the 2006 24-hour and 2012 annual PM2.5 standards (12/20/23)
2024	District to adopt *2024 PM2.5 Plan* addressing Serious Plan requirements
2025	Serious area attainment deadline (12/31/25)
2030	5-year extension attainment deadline (12/31/30)

1.2.1 Federal Requirements

CAA Subparts 1 and 4 contain multiple statutory requirements that must be demonstrated in this Plan. Subpart 1 contains general requirements and Subpart 4 contains requirements specific to PM2.5 nonattainment areas. These requirements are summarized in Table 1-2 below.

Table 1-2 Statutory Requirements

Requirement	Federal CAA	Description	Location in Plan
CAA Subpart 1 – Nonattainment Areas in General			
Reasonable Further Progress	§172(c)(2)	Plan provisions shall require reasonable further progress (RFP)	Appendix G
Emissions Inventory	§172(c)(3)	A comprehensive, accurate, current inventory of actual emissions from all sources of the relevant pollutant or pollutants	Adopted in *Initial SIP Requirements for the 2012 Annual PM2.5 Standard*, updated in Appendix B

Requirement	Federal CAA	Description	Location in Plan
Contingency Measures	§172(c)(9)	Fully adopted rules or control measures that are ready to be implemented should EPA issue a final rulemaking that the Valley failed to meet a regulatory requirement necessitating implementation of a contingency measure. Contingency measures must take effect without significant additional action by the state, local agency or by EPA.	Appendix G
CAA Subpart 4 – Additional Provisions for Particulate Matter Nonattainment Areas			
Permit Program	§189(a)(1)(A)	A permit program providing that permits are required for the construction and operation of new and modified major stationary sources of PM	Appendix H
Attainment Demonstration – Serious Areas	§188(c)(2) §189(b)(1)(A)	Attainment date shall be as expeditiously as practicable but no later than the end of the tenth calendar year after the areas designation as nonattainment	Appendix J
Extension of Attainment Date for Serious Areas	§188(e)	Demonstrations that 1) attainment by the attainment date is impracticable, 2) the State has complied with all requirements and commitments pertaining to the area in the implementation Plan, 3) the State demonstrates that the Plan includes the most stringent measures (MSM) feasible for the area, and 4) attainment as expeditiously as practicable	Chapter 5 Appendix C Appendix D Appendix J
Reasonably Available Control Measures	§189(a)(1)(C)	Provisions to assure that reasonably available control measures (RACM) for the control of PM2.5 shall be implemented no later than 4 years after designation/classification as a Moderate nonattainment area	Adopted in *2016 Moderate Area Plan for the 2012 PM2.5 Standard*
Best Available Control Measures and Best Available Control Technology	§189(b)(1)(B)	Serious Areas – Provisions to assure that the best available control measures (BACM) for the control of PM2.5 shall be implemented no later than 4 years after the date the area is classified (or reclassified) as a Serious nonattainment area	Adopted in *Initial SIP Requirements for the 2012 Annual PM2.5 Standard*, included in Appendices C and D
New Source Review Program Major Source Thresholds	§189(b)(3)	For any Serious Area – the terms "major source" and "major stationary source" include any stationary source or group of stationary sources located within a contiguous areas and under common control that emits, or has the potential to emit, at least 70 tons per year of PM2.5	District Rule 2201 (*New and Modified Stationary Source Rule*), Appendix H

Requirement	Federal CAA	Description	Location in Plan
Quantitative Milestones	§189(c)(1)	The Plan shall contain quantitative milestones which are to be achieved every three years until the area is redesignated attainment and which demonstrate reasonable further progress toward attainment by the applicable attainment date	Appendix G
PM2.5 Precursors	§189(e)	Control requirements applicable to major stationary sources of PM2.5 shall also apply to major stationary sources of PM2.5 precursors, except where EPA determines that such sources do not contribute significantly to PM2.5 levels which exceed the standard in the area	Adopted in *Initial SIP Requirements for the 2012 Annual PM2.5 Standard*, included in Appendix F

1.3 EXTENSIVE PUBLIC PROCESS

This *2024 PM2.5 Plan* was prepared through an involved public process that provided multiple opportunities for the public and interested stakeholders to offer suggestions and comments for improving and strengthening the Plan, as summarized in Table 1-3.

The District presented regular updates on the development of this Plan at public meetings, including meetings of District Governing Board, Citizens Advisory Committee (CAC), and Environmental Justice Advisory Group (EJAG), and each update was followed by an opportunity for the public to ask questions or request additional information.

The District and CARB also hosted 5 public workshops to discuss, present, and receive feedback on the development of this Plan. The public was notified in advance of public workshops via the District's email lists and website. To promote an equitable public process, workshop materials were made available in English and Spanish, and the District provided simultaneous Spanish interpretation during all plan development workshops. Simultaneous interpretation in other languages was made available upon request. In addition, the District conducted the workshops through a hybrid approach, where members of the public are welcome to attend either in person, or join virtually through the Zoom webinar environment. This allows for access and engagement opportunities for members of the public who may not be able to attend in person.

In addition, the District provided multiple additional resources to the public, including the following:

- A new web page to provide updates, presentations, documents and other information related to the development of the Plan: http://www.valleyair.org/pmplans/
- A public mailing list, so members of the public can sign up to receive email notifications about activities related to this and future PM2.5 Plans: https://ww2.valleyair.org/about/sign-up/
- An email address specifically for the public to submit comments: airqualityplanning@valleyair.org

Table 1-3 *2024 PM2.5 Plan* Public Process

Date	Meeting Summary
Throughout 2023-2024	Ongoing updates to the District's Governing Board, Citizen's Advisory Committee, and Environmental Justice Advisory Committee meetings.
3/23/2023	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard, and solicit suggestions for more robust public engagement and suggestions for discussion topics for future workshops.
5/11/2023	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard, and solicit suggestions for sources of interest, and potential emission reduction opportunities to be included in BACM/MSM analysis.
8/28/2023	Publication of the *Draft Initial SIP Requirements* on the District website.
9/7/2023	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard, including results of the precursor and BACM/MSM analyses, and solicit feedback on the *Draft Initial SIP Requirements*.
9/19/2023	Publication of the Proposed Initial SIP Requirements on the District website, with paper copies available upon request for public review and comment.
10/19/2023	District Governing Board adoption of the *Proposed Initial SIP Requirements* at a public hearing with opportunities for public comment.
2/15/2024	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard.
4/26/2024	Publication of draft chapters of the *2024 PM2.5 Plan* on the District website, with paper copies available upon request for public review and comment.
4/29/2024	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard.
5/21/2024	Publication of the Proposed *2024 PM2.5 Plan* on the District website, with paper copies available upon request for public review and comment.
6/20/2024	Public hearing for the adoption of the Proposed *2024 PM2.5 Plan* with opportunities for public comment.

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Chapter 2

AIR QUALITY CHALLENGES AND PROGRESS

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Chapter 2: Air Quality Challenges and Progress

2.1 PM2.5 CHALLENGES

The San Joaquin Valley (Valley) faces significant challenges in attaining ever-tightening federal national ambient air quality standards (NAAQS) due to the Valley's natural environment (including topography, meteorology, drought and wildfires). The Valley's natural environment supports one of the most productive agricultural regions in the country; the Sierra Nevada provides the necessary water for growing the abundance of crops, and a temperate climate provides a long growing season. However, these same natural factors present significant challenges for air quality: the surrounding mountains trap pollution and block airflow, and the mild climate keeps pollutant-scouring winds at bay most of the year. Temperature inversions, while present to some degree throughout the year, can last for days during the winter, holding in nighttime accumulations of pollutants. Emissions from wildfires can further impact public health and exacerbate the region's attainment challenges.

There are also social aspects to the Valley's air quality challenges. The Valley is experiencing more population growth than most other areas of California, and increased population can contribute to increases in air pollutant emissions as people drive more and use more consumer products. The Valley is home to major transportation corridors for goods movement. State and federal law limits the District's ability to regulate the vast majority of air pollutant emissions in the region.

Despite these challenges, the District is making progress in attaining the NAAQS and improving public health for Valley citizens. Due to the significant investments made by Valley businesses and residents and stringent regulatory programs by the District and the California Air Resources Board (CARB), the Valley's ozone and fine particulate matter (PM2.5) forming precursor emissions are at historically low levels, and air quality over the past few years has been better than any other time on record. Across all of the air monitoring sites operating in the Valley, the observed PM2.5 air quality index (AQI) data for the 2002-2023 timeframe shows an improvement in PM2.5 air quality. Over these 20+ years, the frequency of Good AQI days increased, coupled with a decrease in the frequency of the Moderate, Unhealthy for Sensitive Groups (USG), and Unhealthy AQI days, as shown in Appendix A.

This chapter discusses PM2.5 formation, the Valley's unique challenges, and the Valley's progress in reducing PM2.5 concentrations.

2.1.1 Nature and Formation of Primary and Secondary PM2.5

The nature and formation of PM2.5 in the Valley is highly complex, and attainment of a PM2.5 standard is not a one-size-fits-all effort. Significant regional differences in natural environments and the relative contribution of precursor emissions requires regionally-specific modeling and regionally-specific control strategies. Differences within PM2.5 itself (i.e., directly emitted PM2.5 versus secondary PM2.5 forming in the atmosphere through series of chemical reactions) adds to the complexity inherent in modeling and planning efforts.

This complexity is accounted for in the modeling and other scientific analyses conducted for this *2024 Plan for the 2012 PM2.5 Standard*. The District, CARB, and researchers have developed and refined these analytical tools, including regional modeling, over many years. The regional modeling protocol for this Plan notes that the Valley is one of the most studied airsheds in the world in terms of the number of publications in peer-reviewed scientific journals and other major reports. Such scientific analyses, and the field studies providing data for these analyses, are the foundation of the modeling efforts for this Plan. Public and private sector partnership through the Study Agency provided funding and coordination for many of these studies.

PM is a mixture of solid particles and liquid droplets in the air. PM10 refers to particulate matter that is 10 microns or less in diameter, and the PM2.5 subset includes smaller particles. Unlike ozone, which is a fairly simple molecule of three oxygen atoms, PM2.5 can be composed of any material that has a diameter of 2.5 microns or less.

PM2.5 can be emitted directly from an emission source, and can be solid, liquid, or gaseous. When PM2.5 is emitted directly from an emission source, it is known as primary PM2.5; however, PM2.5 can also be formed secondarily through chemical reactions in the atmosphere, usually downwind from the original emission source[1]. Naturally occurring emissions from biogenic sources, such as plants and trees, can also add to the formation of PM2.5. The resulting ambient PM2.5 mixture can include aerosols (fine airborne solid particles and liquid droplets) consisting of components of nitrates, sulfates, elemental carbon compounds, organic carbon compounds, acid aerosols, trace metals, geological materials, and more.

Some examples of emission sources of PM2.5 include: mobile on-road and off-road vehicles, residential wood burning, commercial cooking operations, and certain industrial processes and operations. For more information about emission sources and emission inventory data, please refer to Section 2.3.2 of this document.

Secondary PM2.5 can be formed in the atmosphere through reactions of gaseous precursors, like nitrogen oxides (NOx), sulfur oxides (SOx), and ammonia (NH3), which both come from mobile and industrial sources. The time needed for PM2.5 precursors to react and form PM2.5 is highly variable and dependent upon the precursor chemical, temperature, and humidity. The nature and formation of PM2.5 is also significantly different from season to season, with wintertime conditions being more favorable for formation of PM2.5.

[1] EPA. *Particulate Matter Basics*. Retrieved from: www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM

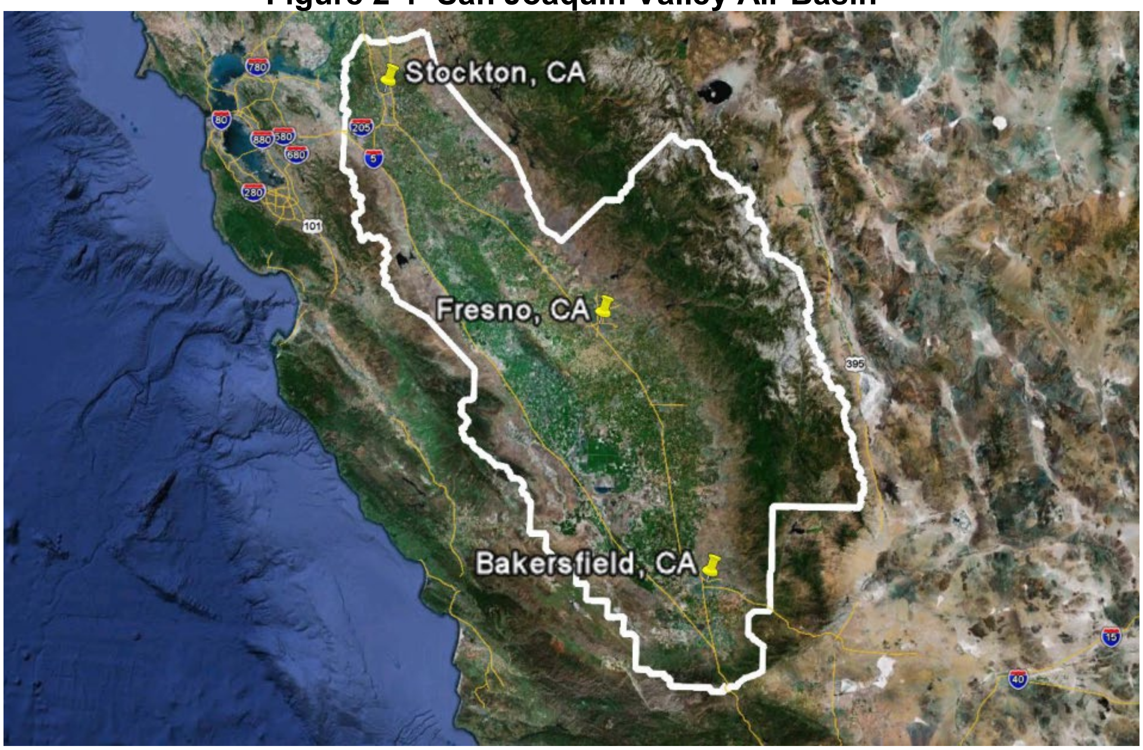
2.2 AIR QUALITY CHALLENGES

2.2.1 Challenges of the Valley's Natural Environment

2.2.1.1 Topography

The challenge to attaining the federal air quality standards in the Valley is grounded in the unique topographical and meteorological conditions found in the region. The Valley, as seen in Figure 2-1, is an inter-mountain valley encompassing nearly 25,000 square miles. Surrounded by mountain ranges to the west, east, and south; the airflow through the Valley can be blocked, leading to severely constrained dispersion. During the winter, high-pressure systems can cause the atmosphere to become stagnant for longer periods of time, where wind flow is calm and air movement is minimal. These stagnant weather systems can also cause severe nighttime temperature inversions, which exacerbate the build-up of PM2.5 and related precursors beneath the evening inversion layer.

Figure 2-1 San Joaquin Valley Air Basin

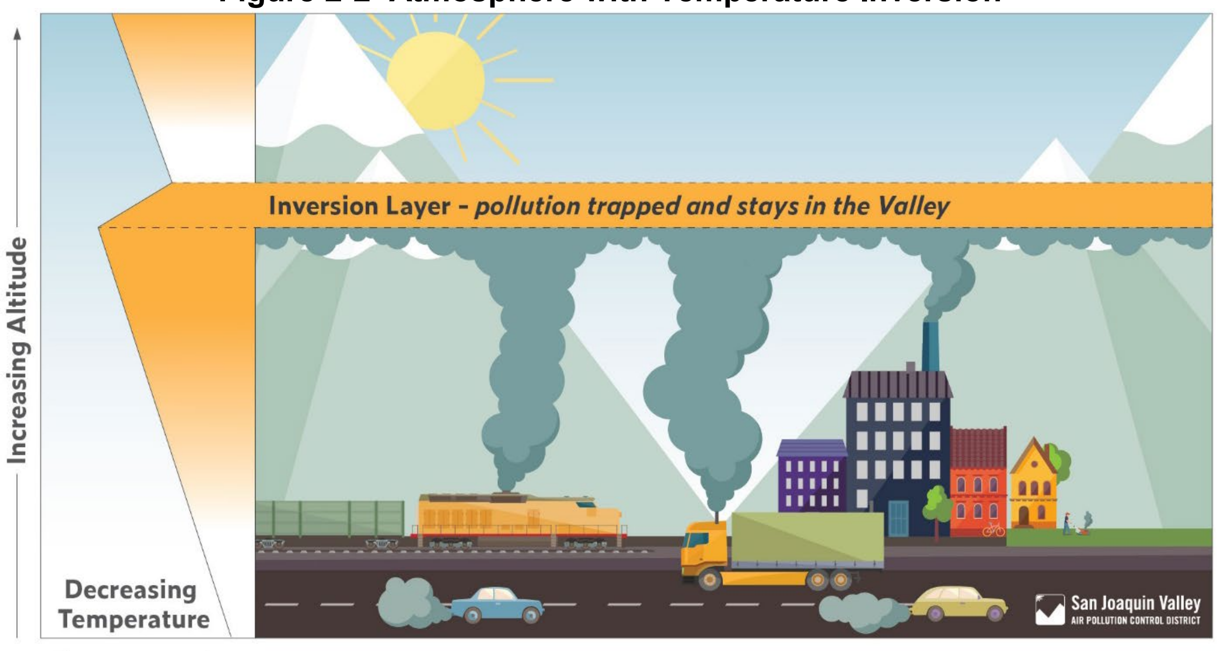


Under ideal conditions, temperature decreases with increasing altitude, but during temperature inversions the temperature gradient is reversed, with temperatures increasing with altitude, causing warmer air to be above cooler air. Temperature inversions prohibit vertical mixing of an air mass, thus trapping pollutants near the earth's surface. PM2.5 precursors can then react and form secondary PM2.5 species, which can in turn build up concentrations from day to day under a prolonged period of atmospheric stagnation.

Figure 2-2 shows that this reversal of the ideal pattern impedes the upward flow of air, causes poor dispersion, and traps pollutants near the earth's surface. When horizontal dispersion (surface winds) and vertical dispersion (rising air) are minimized, PM2.5 concentrations can build quickly. These naturally occurring meteorological conditions have the net effect of spatially concentrating direct PM2.5 emissions near their sources and promoting the formation and regional buildup of secondary species, particularly ammonium nitrate and chemically aged organic carbon species.

Given these hosts of challenges, the District continues to pursue more effective emissions reductions to attain the PM2.5 standards through its numerous air quality attainment plans, a regulatory control strategy and innovative non-regulatory emission reduction strategy that includes robust incentive programs, a comprehensive legislative platform, and rigorous outreach and education efforts.

Figure 2-2 Atmosphere with Temperature Inversion



2.2.1.2 The Valley's Carrying Capacity

In the context of air quality, "carrying capacity" refers to the density of emissions that an air basin can "absorb" or "carry" and still meet ambient air quality standards for a given pollutant. The key factors that shape variations in a regional carrying capacity include meteorology, climate, and topography. The Valley's carrying capacity for PM2.5 is greatly affected by prevailing weather during the winter months and the region's topography (surrounding mountains). Temperature inversions are common during the winter months in the Valley. During these sometimes-lengthy stagnant air episodes, PM2.5 emissions from daily activities rapidly build up to levels above the standard. When these events occur, or are forecasted to occur, the District's Residential Wood

Smoke Reduction program and the Real-Time Air Quality Advisory Network (RAAN) system are utilized to reduce PM2.5 emissions in the Valley.

2.2.1.3 Population Growth in the San Joaquin Valley

Although California remains, by far, the most populous state in the U.S., its population has been decreasing slightly over the past couple of years. In contrast to this, in the fiscal year 2021-2022, population growth remained positive in the Valley. Madera County's population grew by 943 persons, or 0.6% from January 1, 2022 to January 1, 2023. Both San Joaquin and Merced counties observed a growth of 0.4%, or 3,334 persons in San Joaquin County and 1,207 in Merced County from January 1, 2022 to January 1, 2023.[2] Additional Valley population estimates are shown in Table 2-1.

The District will continue to monitor these short-term population trends, though short-term trends cannot replace longer-term trends for planning purposes. The Population Research Unit of the California Department of Finance (DOF) periodically releases population counts and growth estimates. The revised population growth projections in July 2021 demonstrate how significantly the Valley's population is expected to grow in the coming years.

Based on the revised 2020 to 2035 DOF data, the Valley's population is expected to increase by 13.9% from 2020 to 2035 (Table 2-1). In contrast, the total population for the State is projected to increase by 7.4% over the same time period. Increasing population generally means increases in air pollutant emissions as a result of increased consumer product use and more automobile and truck vehicle miles traveled (VMT). In addition to increased VMT resulting from increased Valley population, the Valley will also see increased vehicular traffic along the State's major goods and people movement arteries, both of which run the length of the Valley.

While increased population can lead to increased emissions that offset some of the benefits of regulation, directly emitted PM2.5 and PM2.5 precursor emissions have decreased significantly under CARB and District regulations. These emissions reductions have resulted in measurable improvements for the Valley's PM2.5 concentrations, as discussed later in this chapter. As PM2.5 concentrations decrease, the Valley's public health improves.

[2] California Department of Finance. *Demographic Research Unit. Report P-2A: Total Population Projections, California Counties, 2010-2060. Sacramento: California.* https://dof.ca.gov/forecasting/demographics/projections/

Table 2-1 Estimated Valley County and State Populations, 2020-2035[3]

County	2020	2025	2030	2035
Fresno	1,026,358	1,053,955	1,096,638	1,135,837
Kern*	912,975	961,629	1,019,221	1,075,952
Kings	154,745	159,733	165,752	171,517
Madera	158,794	168,293	178,070	187,842
Merced	284,761	298,184	314,690	330,805
San Joaquin	776,068	810,495	853,661	891,642
Stanislaus	555,955	581,308	606,128	627,883
Tulare	480,788	496,657	516,810	535,463
VALLEY TOTAL	**4,350,444**	**4,530,254**	**4,750,970**	**4,956,941**
CALIFORNIA TOTAL	**39,782,419**	**40,808,001**	**41,860,549**	**42,718,403**

*Kern County population includes entire Kern County

While the bulk of the Valley's remaining emissions come from mobile sources outside of the District's regulatory authority, under the Clean Air Act (CAA) the responsibility to bring the region into attainment with the federal standards rests with the local air district. Additionally, the region will be subject to sanctions that will be devastating to the Valley's economy if mobile sources under federal regulatory authority are not adequately controlled. Given the enormity of the reductions needed for attainment, mobile sources, particularly in the goods movement sector, must transition to zero or near-zero emission levels through the implementation of transformative measures. The District does not have the authority to implement regulations requiring ultra-low tailpipe emissions standards on mobile sources. New state and federal regulations coupled with a robust incentive-based emission reduction strategy are necessary to achieve the enormous reductions that are necessary to attain the federal standards. The U.S. Environmental Protection Agency (EPA) must take responsibility for implementing regulatory and incentive-based measures for sources under their jurisdiction. The District continues to work closely with CARB to develop an attainment strategy that includes significant emissions reductions from mobile sources.

2.2.1.4 Environmental Justice Areas

Not all populations face the same environmental challenges. EPA defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and

[3] California Department of Finance. Demographic Research Unit. Report P-2A: Total Population Projections, California Counties, 2010-2060. Sacramento: California. https://dof.ca.gov/forecasting/demographics/projections/

policies.[4] Environmental injustices occur when a group of people bears a disproportionate share of negative environmental consequences.

Air pollution can have localized impacts in disadvantaged communities throughout California and beyond. Studies show that certain communities, including communities of color and low-income communities, tend to have higher air pollution burden. As identified by the California Office of Environmental Health Hazard Assessment's (OEHHA) CalEnviroScreen, seven of the ten most disadvantaged communities in California are located in the Valley.[5]

Federal, state, and regional agencies are all putting more focus on EJ issues than in the past. At the federal level, Executive Order 12898 directed federal agencies to develop EJ strategies to help federal agencies address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations. At the state level, Senate Bill (SB) 535 and Assembly Bill (AB) 1550 designated CalEPA as the agency responsible for identifying "Disadvantaged Communities" (DACs) and established specific requirements for minimum funding levels allocated to DACs.

Several initiatives provide opportunities to improve air quality in the Valley's EJ areas. California AB 617 requires CARB and air districts to develop and implement additional emissions reporting, monitoring, reduction plans and measures in an effort to reduce air pollution exposure in disadvantaged communities. The District continues to work closely with four Valley communities – South Central Fresno, Shafter, Stockton, and Arvin/Lamont – to focus resources and implement community-identified clean air measures to reduce air pollution and increase community engagement at the local level. Additionally, the District established the Environmental Justice Advisory Group (EJAG) to work collaboratively to educate the public and stakeholders about current District activities and air quality awareness, and to review and provide feedback on overarching District programs and strategies.

Attainment plans like this *2024 Plan for the 2012 PM2.5 Standard* are, per federal legal requirements, focused on regional attainment of federal standards. However, air quality improvements under this plan will yield air quality benefits for the Valley's AB 617 and other EJ communities.

2.2.1.5 Summer Wildfires

Air pollution generated from wildfires is enormous and can well exceed the total industrial and mobile source emissions in the Valley, overwhelming all control measures and resulting in periods of excessively high particulate matter and ozone concentrations that cause significant impacts to public health. In addition to excessive fuel build-up in

[4] EPA. "Learn About Environmental Justice". Retrieved from: https://www.epa.gov/environmentaljustice/learn-about-environmental-justice
[5] CalEnviroScreen 4.0; Retrieved from: https://oehha.ca.gov/calenviroscreen https://oehha.ca.gov/media/downloads/calenviroscreen/document/calenviroscreen40resultsdatadictionaryf2021.zip

the state's wildlands due to decades of fire-suppression and widespread drought-driven tree mortality, higher temperatures and drier climate conditions in recent years have contributed to extended and more intense wildfire seasons in the western United States.

For example, nine of the top twenty largest wildfires in California history occurred in 2020 and 2021.[6] In 2020, over 8,600 wildfires were recorded in California with nearly 4.3 million acres burned,[7] and in 2021, over 7,300 wildfires and more than 2.5 million acres were burned statewide.[8] The District compiles up-to-date wildfire information on its website to keep the public informed about real-time air quality impacts from wildfires.[9] The District and CARB also assess long-term impacts through the attainment planning process. More information on recent wildfire seasons is available in Appendix A.

2.2.1.6 Drought in the San Joaquin Valley

Through daily forecasting as well as through longer-term analysis, the District tracks ongoing drought conditions and drought impacts on air quality across the Valley. In general, drought conditions are often associated with warmer temperatures and longer periods of poor dispersion, which can lead to higher concentrations of pollutants in the Valley.

According to the California Department of Water Resources, California is no stranger to drought, experiencing a 5-year event between 2012 and 2016.[10] The 2015-2016 winter season represented the fifth consecutive year of drought conditions in the Valley, and 2013-2014 was by far the driest winter during this time. Many cities in California, including those in the Valley, had record low rainfall totals during the 2013 calendar year, with some nearly 100-year old records being broken. On January 17, 2014, the Governor of California declared a drought emergency for all of California, that was finally lifted three years later, on April 7, 2017. Just four years later, beginning in April 2021 and through October 2021, the Governor of California declared a State of Emergency due to severe drought conditions and signed a set of four new emergency proclamations directing state agencies to take immediate action to bolster drought resilience across the state.[11,12,13]

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[6] CalFire. *Top 20 Largest Wildfires*. October 24, 2022 update. Retrieved from: https://34c031f8-c9fd-4018-8c5a-4159cdff6b0d-cdn-endpoint.azureedge.net/-/media/calfire-website/our-impact/fire-statistics/featured-items/top20_acres.pdf?rev=be2a6ff85932475e99d70fa9458dca79&hash=A355A978818640DFACE7993C432ABF81
[7] CalFire. *2020 Incident Archive*. Retrieved from: https://www.fire.ca.gov/incidents/2020/
[8] CalFire. *2021 Incident Archive*. Retrieved from: https://www.fire.ca.gov/incidents/2021/
[9] SJVAPCD. *Wildfire Prevention and Response*. Retrieved from: https://ww2.valleyair.org/air-quality-information/wildfire-information/
[10] CA Dept of Water Resources. Drought. Retrieved from: https://water.ca.gov/Water-Basics/Drought
[11] Executive Department, State of California. *State of Emergency Proclamation*. April 2021. Retrieved from: https://www.gov.ca.gov/wp-content/uploads/2021/04/4.21.21-Emergency-Proclamation-1.pdf
[12] Executive Department, State of California. *State of Emergency Proclamation*. May 2021. Retrieved from: https://www.gov.ca.gov/wp-content/uploads/2021/05/5.10.2021-Drought-Proclamation.pdf
[13] Executive Department, State of California. *State of Emergency Proclamation*. October 2021. Retrieved from: https://www.gov.ca.gov/wp-content/uploads/2021/10/10.19.21-Drought-SOE-1.pdf

According to the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) statewide climatological rankings,[14] the January 2022 to April 2022 period was one of the driest 4-month periods on record for California, with a 9.7 inch precipitation deficit. Further, the May 2019 to April 2022 period was the driest 36-month period on record with a 22.8 inch rainfall deficit. Figure 2-3 depicts the extent and severity of drought conditions affecting California between May 2021 and May 2022.

Above-normal winter precipitation between 2022-2023 brought major drought relief to the west coast, allowing for the roll back of many of the drought emergency provisions in California.[15,16] Increased precipitation amounts allowed for all of California to measure between no drought and moderate drought, with no drought indicated in the entire San Joaquin Valley in May of 2023. The District will continue to monitor these drought conditions for potential impacts to ozone and particulate matter concentrations.

Table 2-2 Rainfall Totals for Select Cities Across California

Region	City	1983-2020	2021	2022	2023	Record Low Rainfall (1983-2023)	
		Average (inches)	Total (inches)	Total (inches)	Total (inches)	Year	Total (inches)
Northern California [17]	Sacramento	19.10	21.83	13.42	25.5	2013	3.38
	San Francisco	17.82	18.9	11.19	18.91	2013	5.81
San Joaquin Valley [18]	Stockton	13.19	14.17	11.4	16.93	2013	4.59
	Modesto	12.17	13.76	9.06	15.85	2013	4.69
	Fresno	10.86	10.38	6.44	13.64	2013	3.01
	Hanford	8.43	8.22	5.41	12.68	2013	2.23
	Visalia	9.73	9.72	5.61	15.33	2013	1.41
	Bakersfield	6.11	5.58	4.22	9.95	1989	2.88
Southern California [19]	Los Angeles	11.95	12.09	6.4	25.36	2013	3.65
	San Diego	9.86	7.85	5.9	14.43	1989	3.83

[14] NOAA NCEI. California Precipitation Rankings, April 2022. Retrieved from: https://www.ncdc.noaa.gov/cag/statewide/rankings/4/pcp/202204

[15] National Integrated Drought Information System. *Water Year 2023 Snow Drought Conditions Summary and Impacts in the West.* June 15, 2023. Retrieved from: www.drought.gov/drought-status-updates/water-year-2023-snow-drought-conditions-summary-and-impacts-west-2023-06-15. Accessed 2023.

[16] Office of Governor. *Governor Newsom Eases Drought Restrictions.* March 24 2023. Retrieved from: www.gov.ca.gov/2023/03/24/governor-newsom-eases-drought-restrictions/.

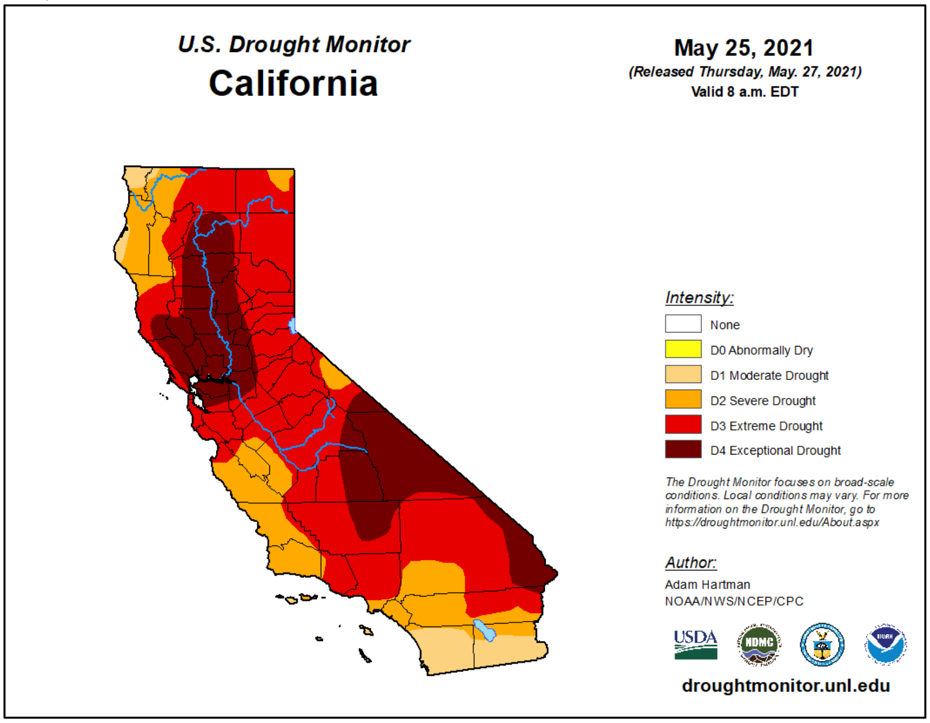
[17] NOWData – NOAA Online Weather Data. https://nowdata.rcc-acis.org/sto/ Retrieved May 1, 2024.

[18] NOWData – NOAA Online Weather Data. https://www.weather.gov/wrh/climate?wfo=hnx Retrieved May 1, 2024.

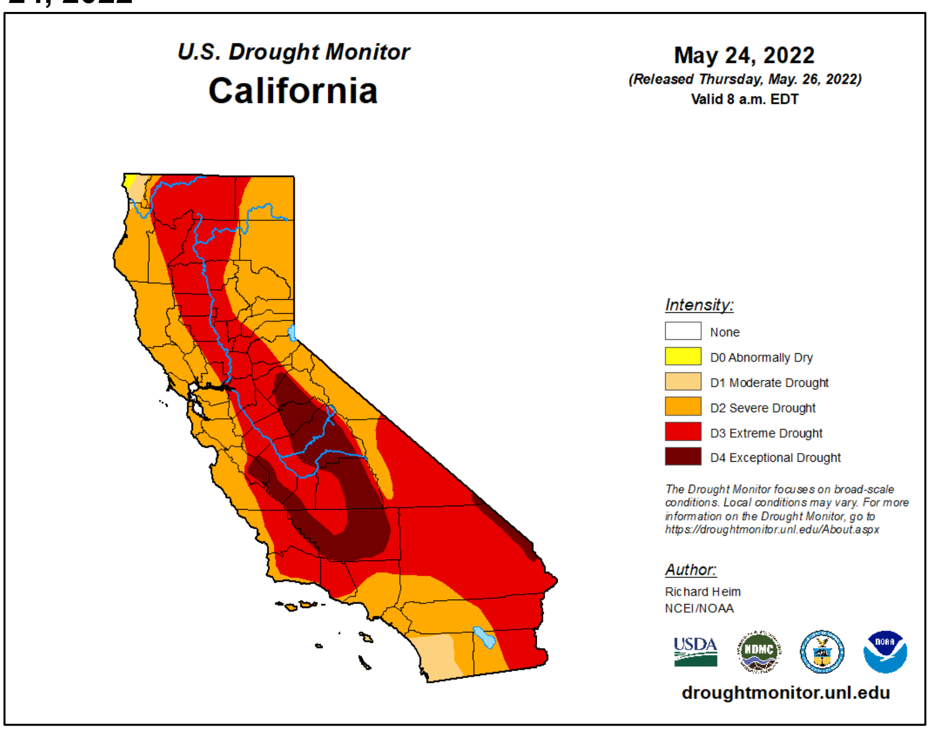
[19] NOWData – NOAA Online Weather Data. https://nowdata.rcc-acis.org/lox/ Retrieved May 1, 2024.

Figure 2-3 (a-c) Drought Extent and Severity in California[20]

a) May 25, 2021

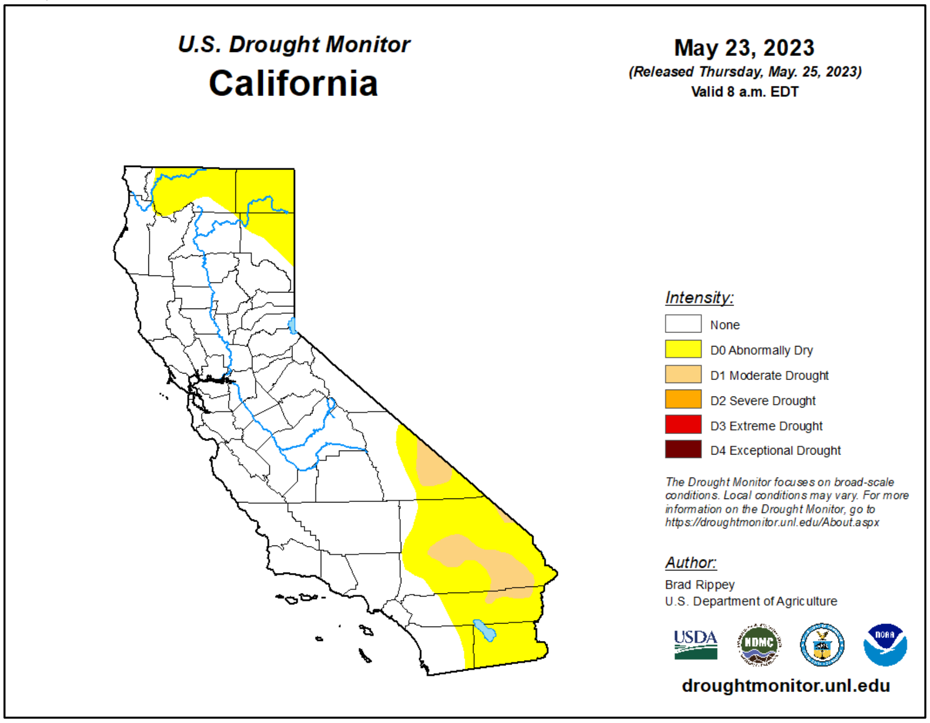


b) May 24, 2022



[20] U.S. Drought Monitor California. Retrieved May 25, 2023. https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

c) May 23, 2023



2.3 PM2.5 AIR QUALITY TRENDS

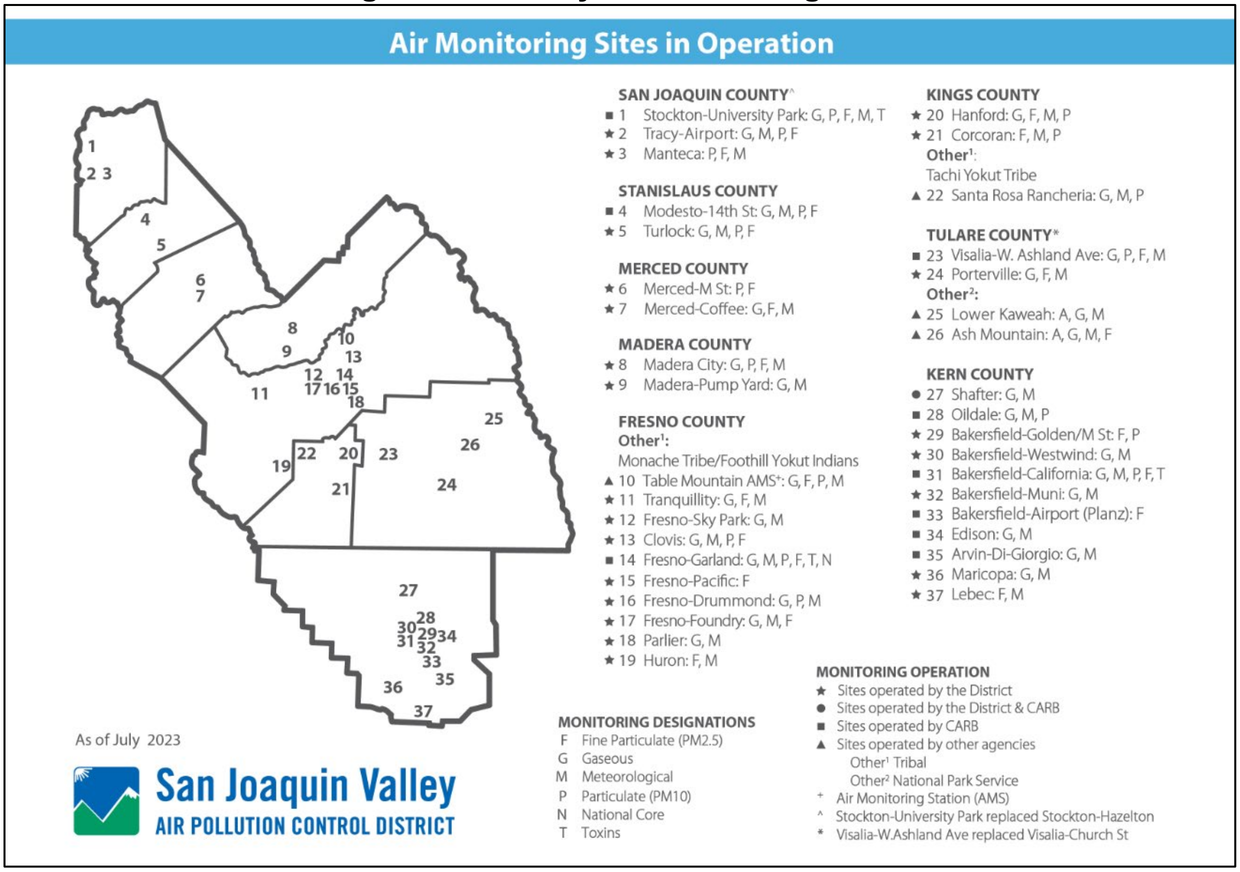
As a public health agency charged with monitoring Valley air quality and ensuring progress toward meeting national air quality standards, the District, CARB, and other agencies have established an extensive air monitoring network that provides ongoing data for evaluating such progress. Information from this monitoring network, which began measuring PM2.5 concentrations in 1999, allows the District to track air quality trends that show progress toward attainment and inform the planning process for reaching attainment.

2.3.1 Air Monitoring Network

Numerous pollutants and meteorological parameters are measured throughout the Valley on a daily basis using an extensive air-monitoring network managed by the District, CARB, and other agencies. This network measures pollutant concentrations necessary to show progress toward attainment of the NAAQS. The network also provides real-time air quality measurements used for daily air quality forecasts, Smoke Management System (SMS) burn allocations, hazard reduction and prescribed burning allocations, residential wood-burning declarations, Air Quality Alerts, and RAAN.

In general, air quality monitoring networks are designed to monitor areas with high population densities, areas with high pollutant concentrations, areas impacted by major pollutant sources, and areas representative of background concentrations. Together, the District, CARB, and other agencies operate 37 air-monitoring stations throughout the Valley (Figure 2-4). Most air monitoring sites in the Valley represent population exposures and/or maximum concentrations representative of neighborhood and regional scales. Of the 37 air monitoring stations throughout the Valley, there are 23 PM2.5 air-monitoring sites (see Table 2-3).

Figure 2-4 Valley Air Monitoring Sites



2.3.1.1 PM2.5 Monitoring Network

EPA requires air-monitoring agencies to include a variety of monitoring site types in their air monitoring networks. The monitoring site types within the District's PM2.5 monitoring network measure concentrations for population exposure, highest concentrations, regional transport, and background levels. Often more than one monitoring site type applies to a given location. The Valley's PM2.5 monitoring network includes: federal reference method (FRM) monitors, federal equivalent method (FEM) monitors, and non-FEM monitors. Four PM2.5 monitoring sites are non-FEM PM2.5 monitors that are not required by the EPA. The District operates these sites for various reasons, including complying with state laws (Huron), as a settlement to a lawsuit (Tracy-Airport), and for purposes of helping the District's RAAN and forecasting programs (Porterville and Lebec).

PM2.5 is measured and expressed as the mass of particles contained in a cubic meter of air (micrograms per cubic meter, or $\mu g/m^3$). The data collected from the network of PM2.5 monitors in the Valley is used to track progress toward attainment of the federal standards and to calculate design values for the 24-hour and annual PM2.5 standards, as outlined in EPA guidance and regulations.[21] Table 2-3 identifies the monitoring site types for the PM2.5 monitoring sites operating in the Valley Air Basin.

Table 2-3 PM2.5 Monitoring Site Types in 2023

Site Name	Population Exposure	Highest Concentration
Stockton-University Park*	✓	✓
Tracy-Airport		
Manteca		✓
Modesto-14th Street*	✓	
Turlock	✓	✓
Merced-M St	✓	✓
Merced-Coffee	✓	
Madera City	✓	
Tranquillity	✓	
Clovis		✓
Fresno-Garland*		
Fresno-Pacific		✓
Fresno-Foundry		✓
Huron		
Hanford	✓	
Corcoran	✓	✓
Visalia-W. Ashland*	✓	✓
Porterville		
Ash Mountain^		
Bakersfield-Golden	✓	
Bakersfield-California*	✓	✓
Bakersfield-Airport (Planz)*	✓	✓
Lebec		

* Monitor operated by CARB
^ Monitor operated by the National Park Service

2.3.2 PM2.5 Emissions Inventory Trends

The emissions inventory is the foundation for the attainment planning process. The District and CARB maintain an accounting of PM2.5 and precursor emissions for the Valley based on known sources both within and outside of the region that influence Valley air quality (inter-region transport). The District requires detailed accounting of emissions from regulated sources throughout the Valley. CARB makes detailed estimations of emissions from mobile, area, and geologic sources using known emissions factors for each source or activity and accounting for relevant economic and population data. Together, these inform the emissions inventory that represents an estimate of how much direct pollution is entering the Valley air basin as a result of the pollutant-generating activities and sources.

[21] 40 CFR Part 50 www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50#ap40.2.50_119.n

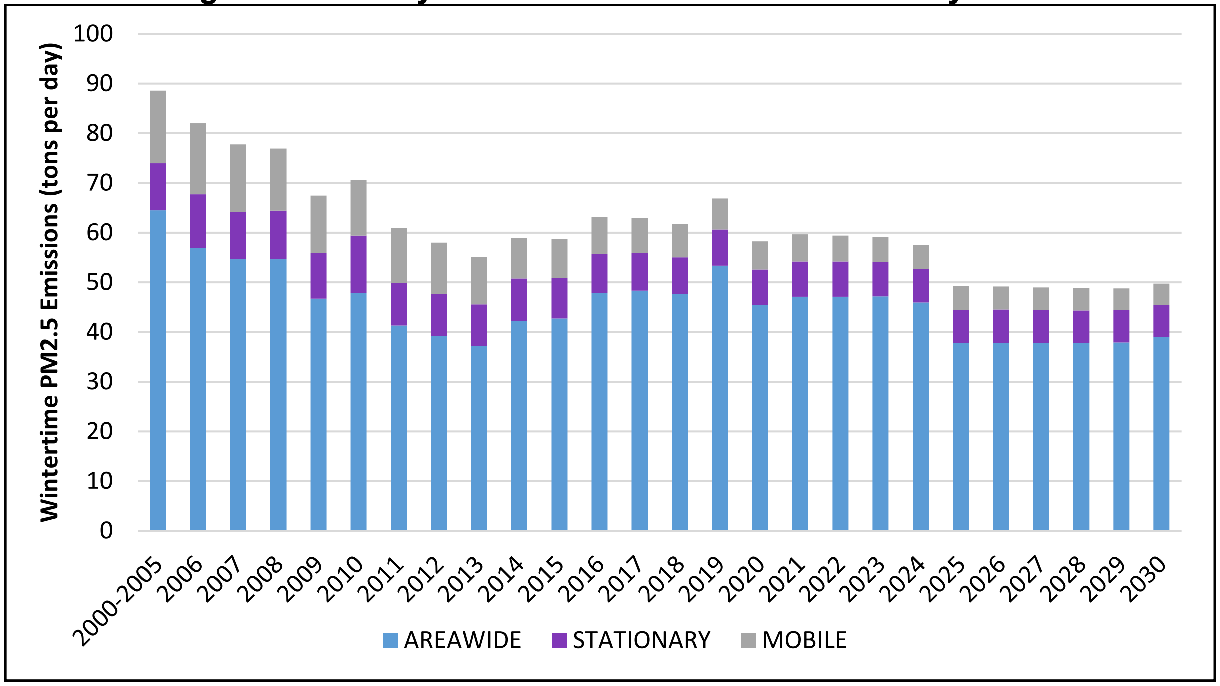
The District uses the emissions inventory to develop control strategies, determine the effectiveness of permitting and control programs, provide input into air quality modeling, fulfill reasonable further progress requirements, and screen regulated sources for compliance investigations.

The following general list represents the major inventory categories for which emissions are recorded and tracked. Appendix B to this Plan contains the detailed accounting of the emissions inventory with projected emissions based on anticipated growth of each source and the anticipated control (regulatory or non-regulatory) of each source, if applicable.

- **Mobile sources** – motorized vehicles
  - On-road sources include automobiles, motorcycles, buses, and trucks
  - Other or off-road sources include farm and construction equipment, lawn and garden equipment, forklifts, locomotives, boats, aircraft, and recreational vehicles
- **Stationary sources** – fixed sources of air pollution
  - Power plants, refineries, and manufacturing facilities
  - Aggregated point sources, i.e. facilities that are not typically inventoried individually, but are estimated as a group and reported as a single source category (such as gas stations and dry cleaners)
- **Area sources** – human activity that takes place over a wide geographic area
  - Includes consumer products, residential wood burning, controlled burning, tilling, and unpaved road dust
- **Natural sources** – naturally occurring emissions
  - Geologic sources, such as petroleum seeps
  - Biogenic sources, such as emissions from plants and trees
  - Wildfire sources

Emissions inventory trends show the progress made through progressive regulatory and non-regulatory activities; as rules are amended with tighter emission limits, or as reduction technologies improve, overall emissions decrease. Winter PM2.5 emissions have decreased significantly, in large part due to the effectiveness of Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) and the ongoing phase-out of open agricultural burning. Figure 2-5 shows the PM2.5 winter emissions inventory trend for the mobile, stationary, and area source categories.

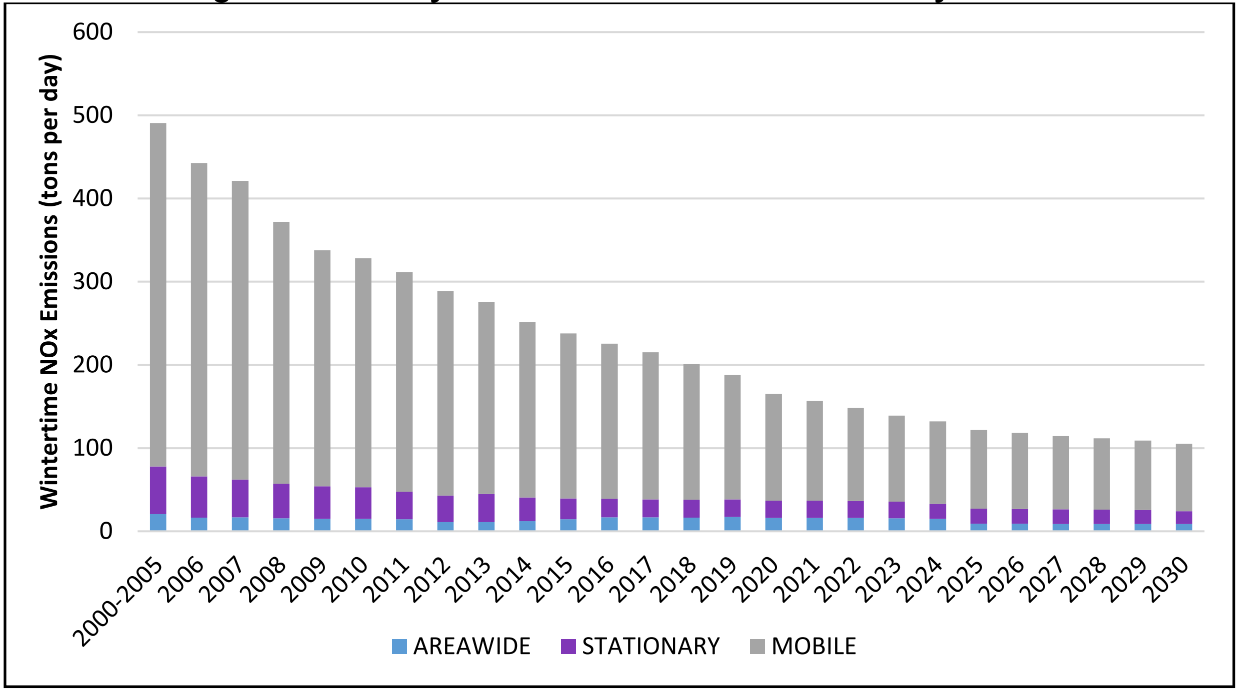
Figure 2-5 Valley PM2.5 Winter Emissions Inventory Trend[22]



Because NOx is a significant PM2.5 precursor, due to the Valley being NOx-limited for the formation of ammonium nitrate, which is a significant component of wintertime PM2.5, the District relies heavily on NOx emissions reductions to reduce PM2.5 emissions. Figure 2-6 summarizes the NOx winter emissions inventory trends for the mobile, stationary, and area source categories. District and CARB control strategies for NOx play a significant role and are a cornerstone in the strategies to reduce both ozone and PM2.5 concentrations.

[22] CEPAM: 2022 PM2.5 Plans - Baseline Emission Projections – Tool Panel. https://ww2.arb.ca.gov/criteria-pollutant-emission-inventory-data Retrieved March 23, 2023.

Figure 2-6 Valley NOx Winter Emissions Inventory Trend[23]



Continued emissions reductions are based on current control strategies that will continue to take effect into the future. In light of the Valley's projected increase in population, the projected emissions reductions highlight the success of the control measures adopted and enforced by the District, CARB, and other regulatory agencies.

2.3.3 Air Quality Progress

Air quality progress can be assessed in several ways. The calculation of design values is the official method used to determine whether an area is in attainment of a standard; however, other indicators, like the number of days the Valley exceeded the 2006 24-hour 35 µg/m³ standard, can reveal more about the progress being made toward attaining that standard. Comparing the days per year when each monitor exceeded the 24-hour PM2.5 NAAQS from year to year shows the progress in reducing the number of days with the highest concentrations, while quarterly averages can help to show progress with respect to seasonal peaks in concentration levels.

Rather than using yearly maximum concentrations, as is the case for other federal standards, EPA requires the use of design values as the attainment metric for the PM2.5 standards, which represents a three-year average of air quality data. Details on how PM2.5 design values are calculated are provided in Appendix A of this Plan. As seen in Figure 2-7 and Figure 2-8, the Valley maximum 24-hour and annual average PM2.5 design value trends show that although there is some year-to-year variation, progress has been made in reducing PM2.5 concentrations over the long-term sampling

[23] CEPAM: 2022 PM2.5 Plans - Baseline Emission Projections – Tool Panel. https://ww2.arb.ca.gov/criteria-pollutant-emission-inventory-data Retrieved March 23, 2023.

record in the Valley. The Valley's peak 24-hour design value has decreased by over 38% over the 1999-2023 period, while the peak annual design value has decreased by 24% over the same period.

The number of days a region exceeded the 2006 24-hour 35 μg/m³ standard is a good indicator of the air quality, as a region may still be considered in attainment while experiencing a limited number of days above the standard. Figure 2-9 shows the trend of the number of days the Valley exceeded the 2006 24-hour PM2.5 standard of 35 μg/m³. There is an overall decrease in the number of exceedances of the 35 μg/m³ standard since PM2.5 has been monitored.

The District strives to provide a comprehensive analysis of air quality in the Valley, and in order to do so, has developed a gap-filling method for determining historic 24-hour PM2.5 concentrations. This method is used to account for a previously less robust air monitoring network and to provide a holistic perspective of historic air quality in the San Joaquin Valley. Figure 2-9 uses this gap filling methodology to compare the number of days over the 2006 24-hour standard between 2002 and 2023. For more information on gap-filling, see Appendix A.

As these design value trends show, the District continues to progress toward attainment of the 2006 24-hour PM2.5 standard and 2012 annual PM2.5 standard, despite years influenced by drought, exceptionally poor dispersion conditions, and wildfires. It is important to note that recent years, namely 2020 and 2021, were heavily influenced by wildfire emissions which resulted in very high concentrations of PM2.5 across the Valley. In spite of these challenges, the design value trends show continued improvement, due in large part to efforts by the District, CARB, and Valley businesses and residents. A more detailed discussion of design values in the Valley is available in Appendix A.

When observing the change in days over a long period when the Valley's counties exceeded the federal 24-hour PM2.5 standard of 35 μg/m³, a significant change is clear. As shown in Figure 2-10, when comparing the winter season of 2002-03 to the recent 2023-24 season, the number of days when the Valley's counties exceeded this standard decreased from 39% to only 5%, while the days when the federal standard was met increased from 61% to 95%. Similarly, when this comparison is focused on the calendar years between 2002 and 2023, the number of days exceeding the standard decreased from 19% to only 2%, while the number of days meeting this standard increased from 81% to 98%. With 98% of the days during the year 2023 meeting the 24-hour PM2.5 standard, this increase is indicative of the positive progress the Valley is making towards minimizing peak concentrations throughout the region.

Figure 2-7 Valley 24-hour PM2.5 Design Value Trend

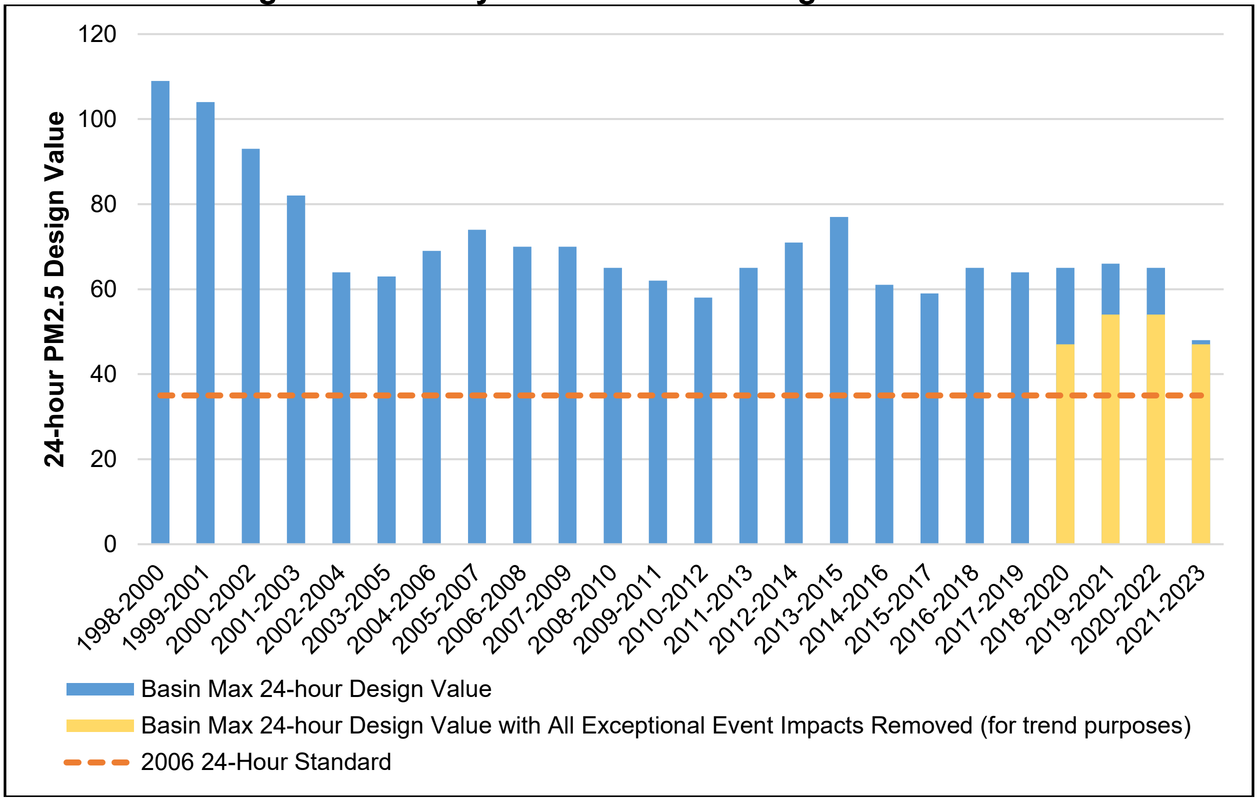


Figure 2-8 Valley Annual PM2.5 Design Value Trend

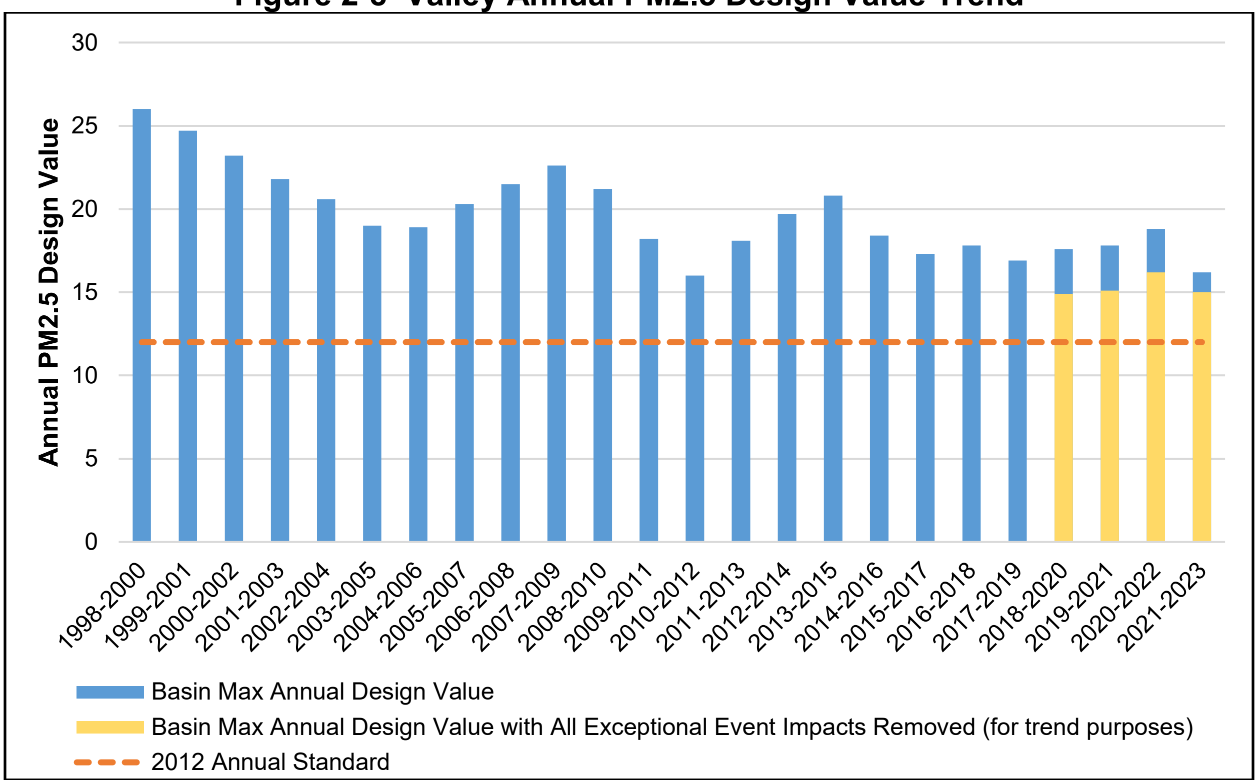


Figure 2-9 Number of Days Valley Exceeded the 24-hour 35 µg/m³ Standard

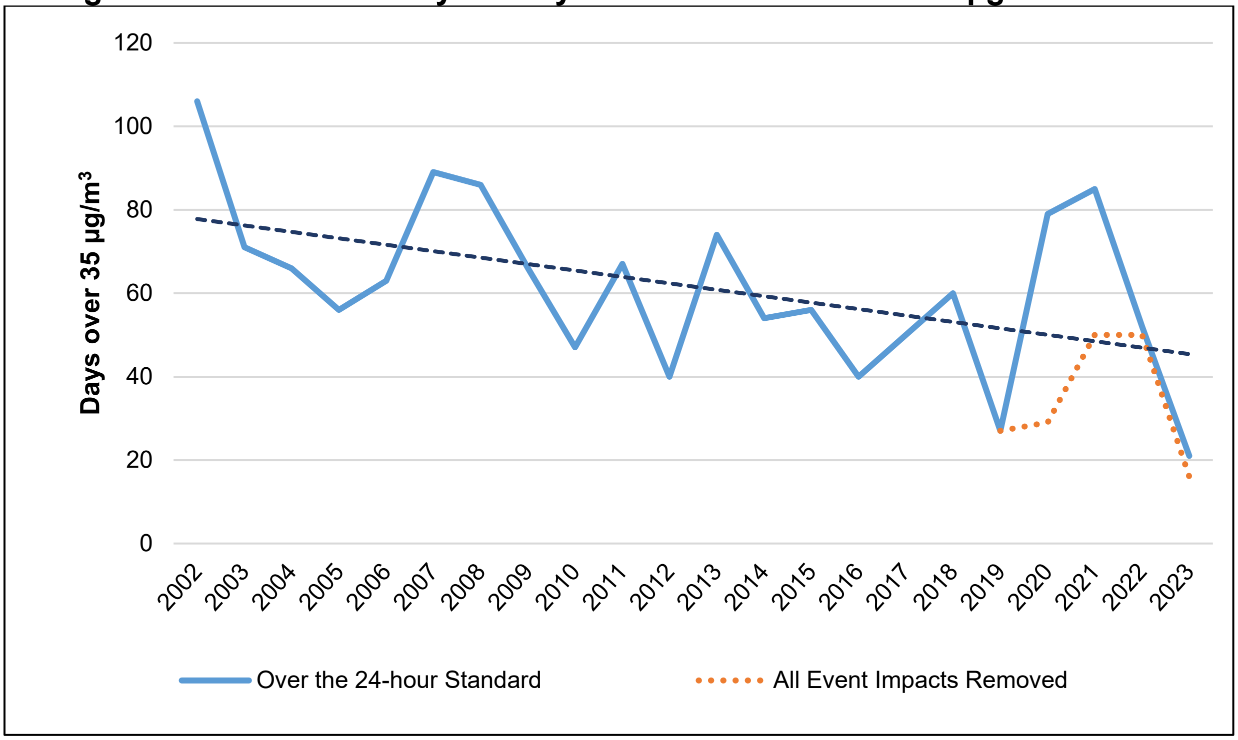
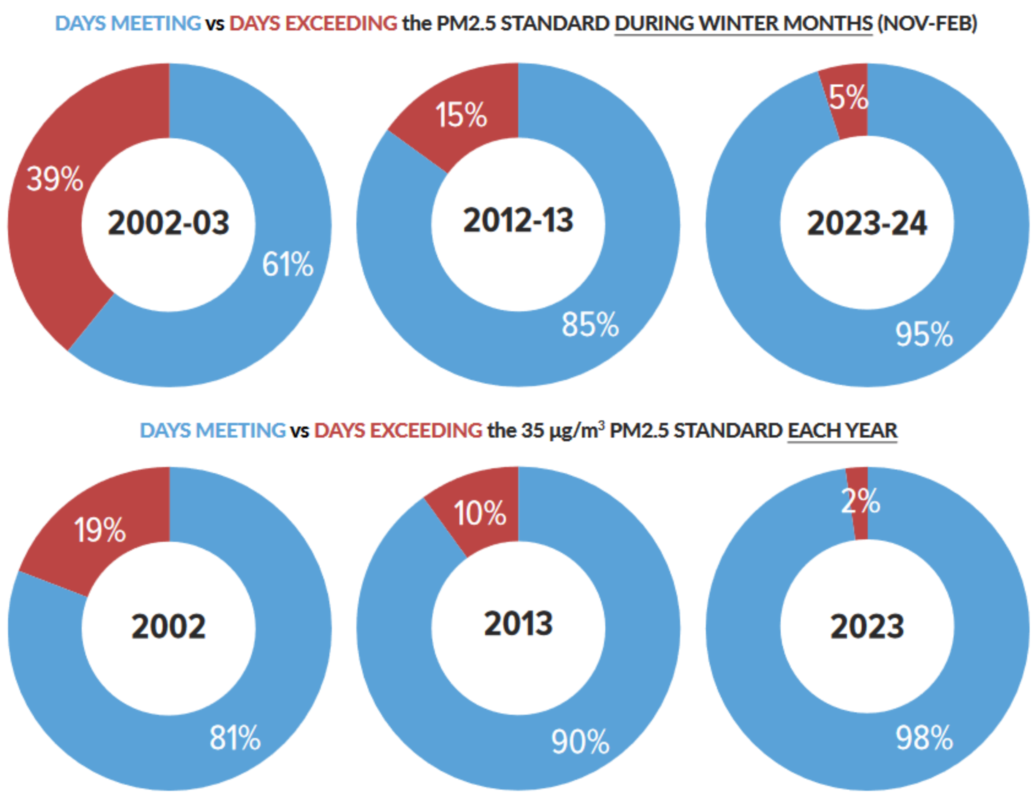
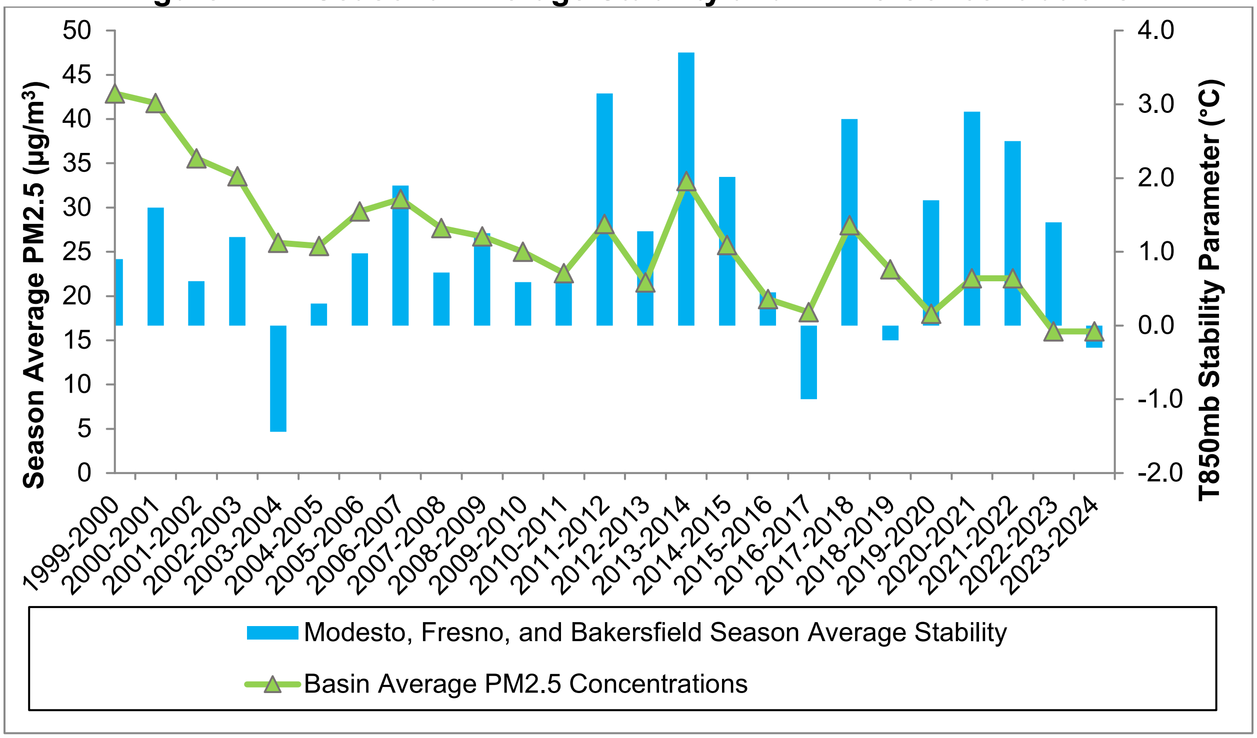


Figure 2-10 Progress in Reducing Days Exceeding 24-hour PM2.5 Standard



As demonstrated in Figure 2-11, the winter average PM2.5 concentration throughout the Valley has decreased over the period, despite low precipitation totals and elevated atmospheric stability in recent years. In this figure, the more positive the stability parameter (magnitude of the blue bars above the zero line), the more conducive the winter season meteorology is for the formation of PM2.5 and the more likely high concentrations of PM2.5 will be observed. Even with higher stability in recent winter seasons, overall PM2.5 concentrations (green line) have continued to decline. This provides strong evidence that the District and CARB's comprehensive strategies have been achieving permanent emissions reductions.

Figure 2-11 Seasonal Average Stability and PM2.5 Concentrations



2.4 CONCLUSION

Although there are significant challenges in meeting the federal PM2.5 standards, the control measures and strategies adopted by the District and CARB have resulted in substantial emissions reductions, as reflected in the improving PM2.5 metrics above. Air quality will continue to improve as the measures and strategies discussed in this plan are implemented in the coming years.

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Chapter 3
HEALTH IMPACTS AND HEALTH RISK REDUCTION STRATEGY

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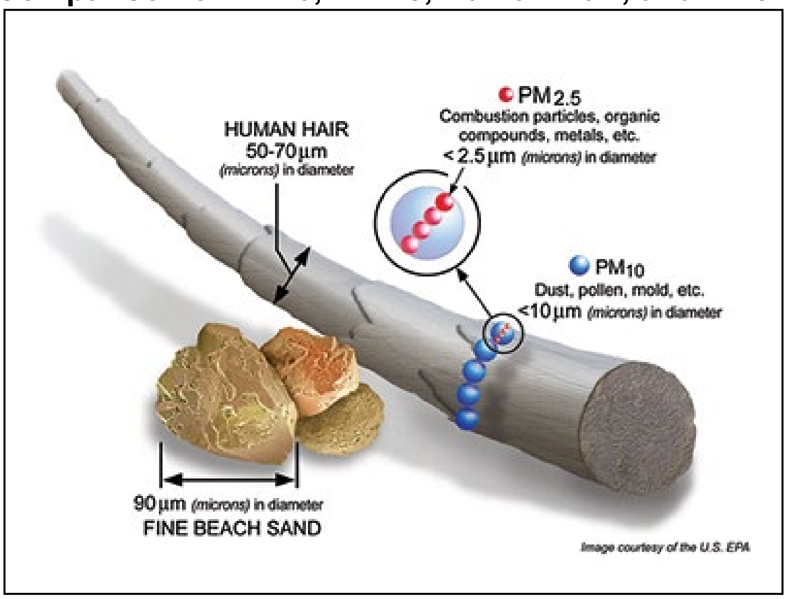
3.1 PM2.5 POLLUTION DEFINED

Particulate matter (PM) is a mixture of solid particles and liquid droplets in the air. PM can be emitted directly into the atmosphere (primary PM), or can form as secondary particulates in the atmosphere through the photochemical reactions of precursors (when precursors are energized by sunlight). Thus, PM is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. PM10 is particulate matter that is 10 microns or less in diameter, and the PM2.5 subset includes smaller particles that are 2.5 microns or less in diameter (Figure 3-1).

Figure 3-1 Comparison of PM10, PM2.5, Human Hair, and Fine Beach Sand



3.1.1 PM2.5 Composition in the Valley

PM2.5 can be emitted directly from an emission source or formed secondarily through chemical reactions in the atmosphere. The nature and formation of PM2.5 in the San Joaquin Valley is highly complex and may consist of components of nitrate, components of sulfur, organic carbon, elemental carbon, soil and more, as summarized in Table 3-1 and shown in Figure 3-2 to Figure 3-5 below. Speciation data collection started in 2000 with the Chemical Speciation Network (CSN), and in 2004, additional speciation monitoring came online with the Interagency Monitoring of Protected Visual Environments (IMPROVE) network.

The analysis of specific elements and compounds from PM2.5 speciation data networks is valuable in understanding the potential effects on monitored air quality from emissions and activity in the Valley, and how these components have changed in response to air quality improvement strategies implemented in the region.

Speciation data from both the CSN and IMPROVE networks have been instrumental to understanding temporal trends, diurnal trends, and seasonal variations of PM2.5 species throughout the Valley. Seasonal variations of PM2.5 species reflect the importance of using seasonally dependent control strategies like Rule 4901, which mitigates PM2.5 pollution in the San Joaquin Valley due to residential wood burning in the winter. PM2.5 speciation data is also helpful in understanding changes in emissions sources such as windblown dust, vehicle emissions, and burning of biomass, including residential wood burning, open burning, and wildfires.

The complex mixture of PM2.5 is attributable to stationary, mobile, and area-wide sources, as well as naturally occurring emissions. Although the list of components contributing to PM2.5 in the Valley is lengthy, it can be grouped into broader representative categories. Table 3-1 provides summary descriptions of each of these broader categories. Refer to Chapter 2, Section 2.1.1 for more information on the nature and formation of PM2.5.

While not all sites measure all types of components, understanding the different components that make up the total PM2.5 mass is helpful for identifying the sources that contribute to PM2.5 pollution in the Valley. Figure 3-2 to Figure 3-5 show the percentage breakdown of PM2.5 speciation based on the 2020-2022 three-year average, as well as the percentage breakdown of just the highest PM2.5 values (top 10%) measured during that same period at the PM2.5 speciation sites in the Valley.

Understanding the various PM2.5 species, including how each species is formed or emitted, how much each contributes to the Valley's total PM2.5 concentrations, how each is linked to different public health impacts, and emission sources, is of the utmost importance for the development of an effective, health-protecting control strategy.

Table 3-1 Summaries of PM2.5 Components

PM2.5 Components	Description
Organic Carbon	Directly emitted, primarily from combustion sources (e.g., residential wood combustion). In addition, smaller amounts attached to geologic material and road dusts. May also be emitted directly by natural/biogenic sources.
Elemental Carbon	Also called soot or black carbon; formed during incomplete combustion of fuels (e.g., diesel engines).
Soil (Geologic Material)	Road dust and soil dust that are entrained in the air from activity, such as soil disturbance or airflow from traffic.
Trace Metals	Identified as components from soil emissions, or found in other particulates emitted in connection with combustion, engine wear, brake wear, and similar processes. Can also be emitted from fireworks.
Sea Salt	Sodium chloride in sea spray where sea air is transported into the Valley. At this time this component is only measured at the Fresno and Bakersfield sites.
Ammonium Nitrate	Reaction of ammonia and nitric acid, where the nitric acid is formed from nitrogen oxide emissions, creating nitric acid in photochemical processes or nighttime reactions with ozone.
Ammonium Sulfate	Reaction of ammonia and sulfuric acid, where the sulfuric acid is formed primarily from sulfur oxide emissions in photochemical processes, with smaller amounts forming from direct emissions of sulfur.
Combined Water	A water molecule attached to one of the above molecules.

Figure 3-2 Modesto PM2.5 Speciation

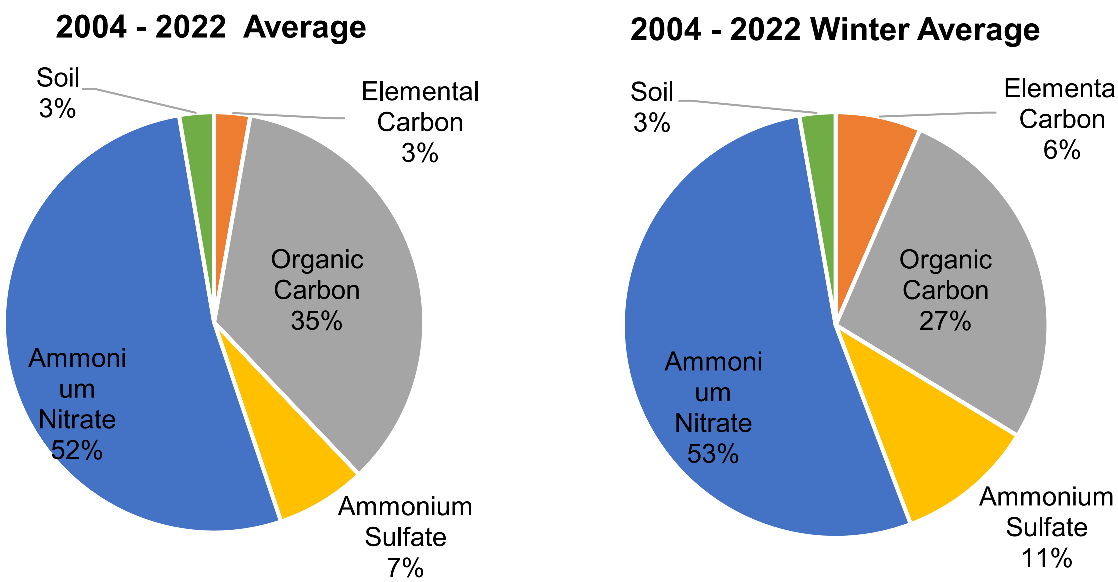


Figure 3-3 Fresno PM2.5 Speciation

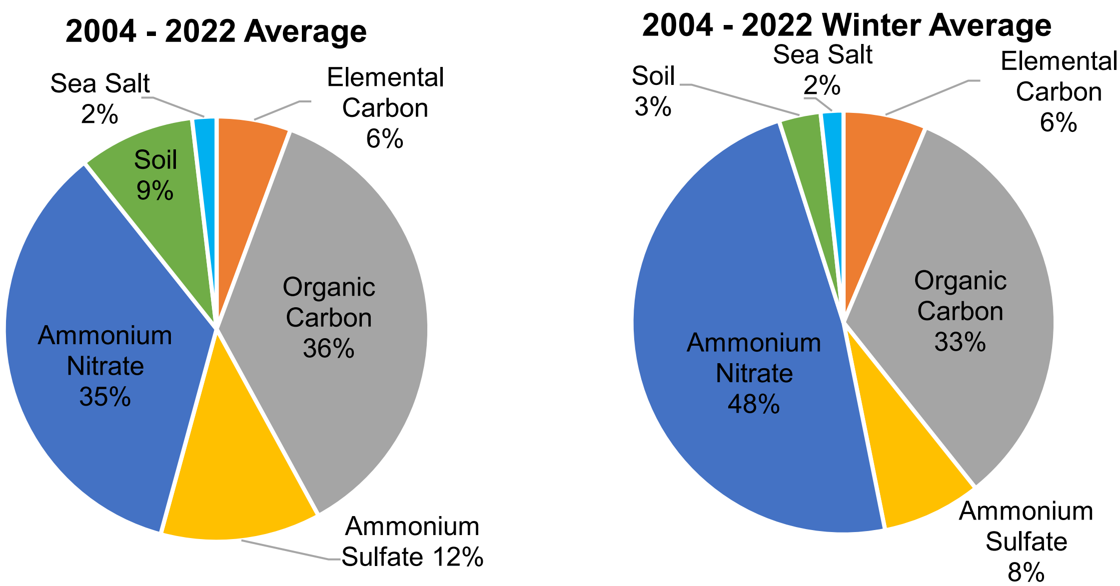


Figure 3-4 Visalia PM2.5 Speciation

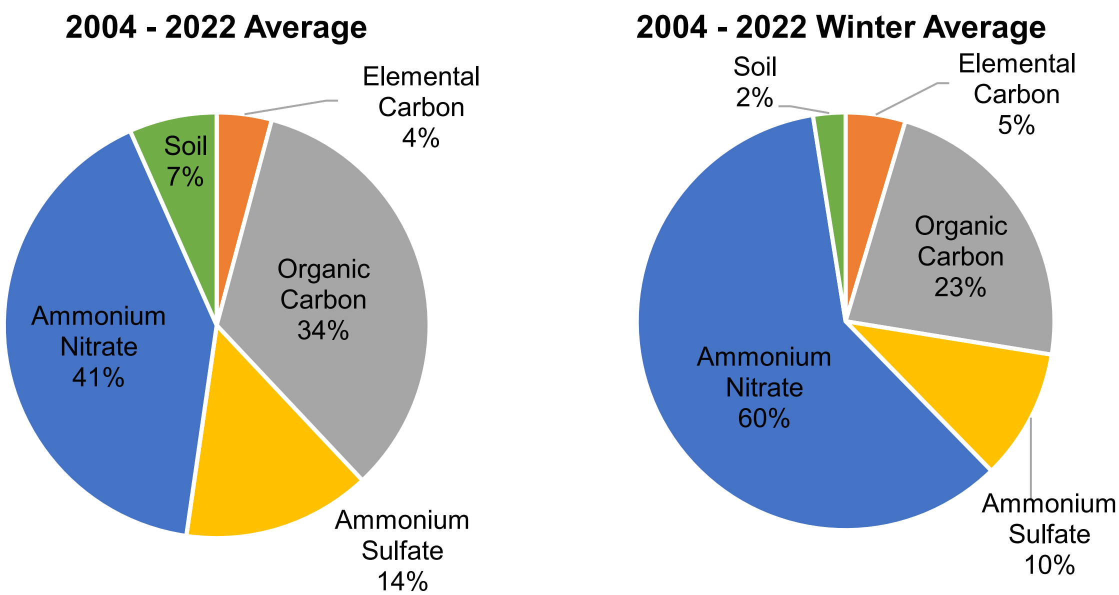
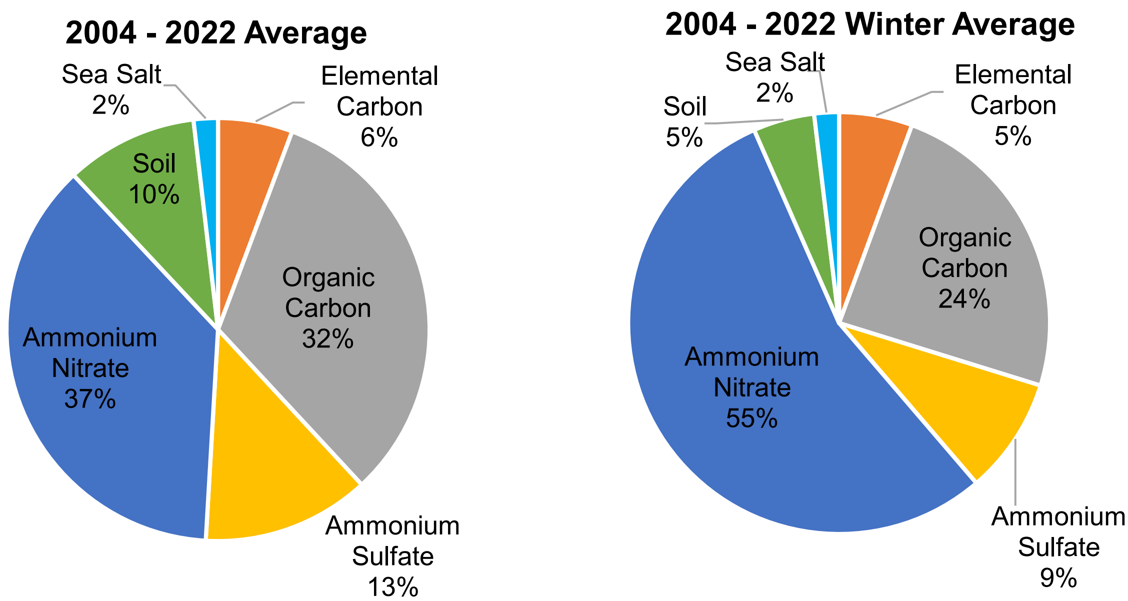


Figure 3-5 Bakersfield PM2.5 Speciation



3.2 HEALTH IMPACTS OF PM2.5

Any particles 10 microns or less are considered respirable, meaning they can be inhaled into the body through the mouth or nose. PM10 can generally pass through the nose and throat and enter the lungs. PM2.5 can be inhaled more deeply into the gas exchange tissues of the lungs, where it can be absorbed into the bloodstream and carried to other parts of the body.[1]

The potential health impacts of particle pollution are linked to the size of the particles, with smaller particles having larger impacts, as smaller particles are able to be absorbed by the alveoli and enter other organs through lung aeration. Numerous studies link PM2.5 to a variety of health problems, including aggravated asthma, increased respiratory symptoms (irritation of the airways, coughing, difficulty breathing), decreased lung function in children, development of chronic bronchitis, irregular heartbeat, non-fatal heart attacks, increased respiratory and cardiovascular hospitalizations, lung cancer, type 2 diabetes, and premature death.[2] Children, older adults, and individuals with heart or lung diseases are the most likely to be affected by PM2.5.[3] Many studies have quantified and documented the health benefits of attaining the U.S. Environmental Protection Agency (EPA) air quality standards for PM. The specific impacts of PM2.5 and supporting research studies are further discussed in the sections below.

In addition to affecting human health, air pollution also affects the health of the natural environment. In cases such as smoke produced from wildfires, PM2.5 can be transported from sources hundreds of miles away to contribute to visibility problems at remote locations, such as the Sierra Nevada mountain range and associated national parks. As fine particulate matter settles out of the air, it can make lakes and streams acidic, change an ecosystem's nutrient balance, and affect ecosystem diversity. PM2.5 can affect vegetation by damaging foliage, disrupting the chemical processes within plants, reducing light adsorption, and disrupting photosynthesis. As the Valley progresses toward attainment of EPA's human-health-based PM2.5 standards, there will also be less harmful impacts to the surrounding natural environment.

3.3 HEALTH RISK REDUCTION STRATEGY

As discussed in Chapter 1, the EPA National Ambient Air Quality Standards (NAAQS or standards) are health-protective air quality standards set by the US EPA Administrator. NAAQS for different pollutants are set by EPA based on technical recommendations from the EPA Clean Air Scientific Advisory Committee (CASAC). CASAC formulates

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[1] Xing, Yu-Fei, et al. *The Impact of PM2.5 on the Human Respiratory System*. Journal of Thoracic Disease. January 2016. Retrieved from: www.ncbi.nlm.nih.gov/pmc/articles/PMC4740125/

[2] Cong Liu, Changyuan Yang, Yaohui Zhao, Zongwei Ma, Jun Bi, Yang Liu, Xia Meng, Yafeng Wang, Jing Cai, Haidong Kan, Renjie Chen. *Associations between long-term exposure to ambient particulate air pollution and type 2 diabetes prevalence, blood glucose and glycosylated hemoglobin levels in China*. Environment International, Volumes 92–93. 2016. Pages 416-421, ISSN 0160-4120. Retrieved from: https://doi.org/10.1016/j.envint.2016.03.028

[3] EPA. Research on Health Effects from Air Pollution. Retrieved from: https://www.epa.gov/air-research/research-health-effects-air-pollution

their advice for air quality standards after a comprehensive review of scientific studies on air pollution and health impacts. These standards are the primary driving force for new emissions controls that result in air quality improvements and health benefits to Valley residents. In the conventional planning process for attaining these standards, success in protecting public health is defined by whether the standards are met at all air monitors. In effect, the reduction in PM2.5 mass, which shows progress toward attainment of the standard, serves as the surrogate for population exposure and risk.

NAAQS, as currently established, are essentially *mass-based* standards. In the case of PM2.5, the current standards do not account for particle size distribution, chemical species composition, surface area, and other factors of health risk. In contrast, recent health-science research has substantially deepened knowledge of air pollutant health risk beyond the current Clean Air Act (CAA) framework and EPA standards. There is a growing recognition within the scientific community that the NAAQS alone can be incomplete measures of public exposure to air pollution. Thus, while the CAA, NAAQS, and state implementation plan (SIP) process is motivated by public health, the process alone does not fully address public health impacts of ambient air pollution. To fully address potential public health benefits, an attainment strategy can use a more comprehensive, multidimensional population exposure assessment approach that goes beyond ambient mass measurements.[4]

The District Governing Board adopted the Health Risk Reduction Strategy (HRRS) to prioritize protection of public health by maximizing public health improvements resulting from the District's attainment strategies and related initiatives. The HRRS works in parallel with the District's other strategies to minimize cumulative population exposure to air pollution and the corresponding regional health risk.

3.3.1 Background of the Health Risk Reduction Strategy

As a response to mounting epidemiological evidence that PM2.5 was more harmful than PM10, EPA established a PM2.5 NAAQS in 1997 to accompany the previously established PM10 NAAQS. PM10 occurs at larger mass concentrations than PM2.5, so the shift to PM2.5 somewhat conflicted with the time-tested toxicological precept of "the dose (mass) makes the poison." Particulate inhalation studies have found that the smaller PM2.5 particles penetrate more deeply into the lungs, where particles more effectively avoid immune system defenses. In spite of decreasing levels of air pollution over the last decade, recent epidemiological studies have found correlations between adverse health effects and exposure to air pollution, particularly exposure to PM2.5 pollution and mortality at levels below the current NAAQS.[5] Toxicological analyses of PM2.5 identified chemical species that acted differentially to promote respiratory and

[4] Lippmann M, Chen L-C, Gordon T, Ito K, Thurston GD. (2013). *National Particle Component Toxicity (NPACT) Initiative: Integrated Epidemiologic and Toxicologic Studies of the Health Effects of Particulate Matter Components*. Research Report 177. Health Effects Institute, Boston, MA. Retrieved from: https://www.healtheffects.org/publication/national-particle-component-toxicity-npact-initiative-integrated-epidemiologic-and

[5] Dominici F, Schwartz J, Di Q, Braun D, Choirat C., Zanobetti A. (2019). *Assessing Adverse Health Effects of Long-Term Exposure to Low Levels of Ambient Air Pollution: Phase 1.* Research Report 200. Health Effects Institute, Boston, MA. Retrieved from: https://www.healtheffects.org/system/files/dominici-rr-200-report.pdf

cardiovascular inflammation. While it was unclear at that time which PM2.5 chemicals were the most harmful, the scientific consensus was that the health risks stemmed from the chemicals rather than the particle mass themselves.

In the years since the first PM2.5 NAAQS was established, scientists have conducted numerous studies that have identified which chemical species of PM2.5 are most harmful and have pinpointed their sources.[6] Combustion and non-combustion sources have been found to produce fine particles of different toxicities.[7] PM2.5 exposure may also relate to an increased risk of cardiac arrhythmias in both adults and adolescents.[8] This smaller-is-more-dangerous phenomenon parallels the previous discovery regarding the higher toxicity of PM2.5 particles compared to larger and heavier PM10 particles. In each case, the dose-makes-the-poison assumption governing the NAAQS for carbon monoxide, lead, ozone, and the other criteria pollutants does not apply to particulates.

Addressing the complexity of health risks posed by particulate pollution has been a motivating factor in the development and application of the HRRS. Rather than ignore this growing body of scientific knowledge, the District's HRRS seeks to embrace it to the extent possible within the current CAA to maximize public health benefits. In practice, this knowledge provides the District with the necessary scientific foundation for justifying and prioritizing the pollution control measures that are necessary for demonstrating attainment of federal standards. The outcome is stronger and more health-protective plans that reflect the current trajectory of scientific knowledge toward a more complete understanding of population risk from PM2.5 particles.

The NAAQS-SIP process and the HRRS are complimentary strategies, not an either-or scenario. The HRRS should not be interpreted as a zero-sum tradeoff that emphasizes controls on certain forms and sources of high-risk PM2.5 while ignoring others. The current mass-based indicator (micrograms per cubic meter of air) will continue to serve as the final yardstick for PM2.5 attainment and as a surrogate for achieving significant health benefits. A number of the District programs have been influenced by the underlying principles and goals of the HRRS and provide a model of the success and added potential benefits possible under this strategy.

- **The District's residential wood burning emission reduction strategy** includes wood burning curtailments implemented through District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters), in conjunction with the District's incentive grant program for fireplace and woodstove change-outs, and robust public education and outreach efforts. This approach is designed to improve public health by reducing toxic wood smoke emissions in Valley neighborhoods during the peak PM2.5 winter season (November through

[6] EPA. (2009). *Integrated Science Assessment for Particulate Matter*: Final Report. Washington, D.C.: EPA/600/R-08/139F. Retrieved from: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=216546
[7] Park, M., Joo, H.S., Lee, K. et al. *Differential toxicities of fine particulate matters from various sources*. Sci. Rep 8, 17007. (2018). Retrieved from: https://doi.org/10.1038/s41598-018-35398-0
[8] Fan He PhD, Jeff D. Yanosky ScD, Julio Fernandez-Mendoza PhD, Vernon M. Chinchilli PhD, Laila Al-Shaar PhD, Alexandros N. Vgontzas MD, Edward O. Bixler PhD, and Duanping Liao MD, PhD. (2022). *Acute Impact of Fine Particulate Air Pollution on Cardiac Arrhythmias in a Population-Based Sample of Adolescents: The Penn State Child Cohort*. thttps://www.ncbi.nlm.nih.gov/pmc/articles/PMC9683666/

February), and has proven to be extremely effective in advancing the District's objectives to attain the PM2.5 federal standards and protect public health. Additionally, through the District's Residential Wood Smoke Reduction Program, which is based on Rule 4901, the District has declared and enforced episodic wood burning curtailments, also called "No Burn" days, since 2003. The District's Residential Wood Smoke Reduction Program and District Rule 4901 reduce harmful species of PM2.5 when and where those reductions are most needed, in impacted urbanized areas when the local weather is forecast to hamper particulate matter dispersion.

Commitments in the District's *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards (2018 PM2.5 Plan)* included rulemaking for Rule 4901 to further lower wood burning curtailment levels, as well as enhancements to the District's incentive grant funding levels, public outreach and education, enforcement, and air quality forecasting programs. In 2019, the District amended Rule 4901 to lower curtailment thresholds for older, higher-polluting wood burning heaters, open hearth fireplaces, and non-registered wood burning heaters in the Hot Spot counties of Madera, Fresno, and Kern. In the remaining Valley counties, the previous curtailment thresholds remain in place. These more stringent curtailment thresholds established in the Hot Spot counties are coupled with increased Fireplace and Woodstove Change-Out Program incentive amounts to cover nearly the entire cost of replacing high polluting wood burning units with natural gas units. To complement the regulatory and incentives changes, the District has implemented an education and outreach campaign to increase public awareness of the health benefits from residential wood smoke reduction program, along with focused rule enforcement efforts in Hot Spot counties and in areas of concern. The District also continues to investigate and employ the latest air quality modeling tools and techniques to support the air quality forecasting component of the program.

In addition, consistent with the District's *2018 PM2.5 Plan*, the District added a contingency provision to Rule 4901 for the 1997, 2006, and 2012 PM2.5 standards. On May 18, 2023 the District amended Rule 4901 to establish a sequence of increasingly stringent contingency Level One and Level Two episodic wood burning curtailment thresholds for all Valley counties that would be triggered 60 days after the issuance of a final determination by EPA, pursuant to 40 CFR §51.1014(a), that the District has failed to meet one of four required trigger elements for any of the PM2.5 NAAQS. Already the most stringent residential wood combustion control strategy in the nation, these contingency provisions further enhance the stringency of the Rule and the District's residential wood smoke reduction program.

- **District grant programs** reach beyond the current CAA NAAQS-SIP process to reduce emissions in advance of or beyond regulations. For example, through the District's popular Clean Green Yard Machine incentive grant program, the District has awarded over $2.7 million for over 15,000 pieces of electric residential lawn and garden equipment, and through the Zero-Emission Landscaping Equipment

Voucher Program, approximately $2.3 million for the replacement of over 924 pieces of gas- and diesel-powered commercial landscape maintenance equipment.[9] Through the Fireplace & Woodstove Change-Out Program (formerly known as the Burn Cleaner Program), the District has replaced approximately 30,000 high-polluting wood burning devices with cleaner alternatives.[10] These grant programs result in a decrease in urban, localized health risks associated with the use of gas-powered equipment and wood burning devices.

- **The District's information and educational programs, such as the Real-Time Air Advisory Network (RAAN),** also contribute to the HRRS. Users of RAAN are able to subscribe to automated mobile device updates, via email or text, when local ozone or PM2.5 concentrations threaten health, allowing users the ability to make informed decisions about when outdoor activities should be limited.[11] Subscribers can better plan outdoor activities for times with the best air quality, reducing potential air quality health risks.

- **The District tracks and sponsors health and PM2.5 research.** As part of the District's HRRS, the District is playing an active role in supporting leading-edge health research focusing on the Valley population. Previously, the District sponsored the first major epidemiological investigation of health effects of air pollution in the Valley, focusing on the populations of Modesto, Fresno, and Bakersfield.[12] The study found that daily exposure to high PM2.5 concentrations was significantly correlated with increased daily hospital and emergency room admission rates for asthma and other respiratory and cardiovascular diseases. To follow up on this study, the District sponsored another epidemiological study to examine which of the chemical species found in Valley PM2.5 are most highly correlated with hospital admission rates. In more detail, the study explored statistical associations between varying concentrations of PM2.5 components (e.g., ammonium nitrate, ammonium sulfate, organic carbon, and elemental carbon) and health outcomes, including emergency department visits and hospitalizations associated with selected cardiovascular and respiratory conditions.

  The District also sponsored a pilot study of PM0.1 (ultrafine particles) in Fresno, where UCSF-Fresno investigated the quantity and spatial distribution of PM0.1 plumes from motor vehicles, lawn care equipment, wood burning, and restaurants.[13] Following this study, the District funded a UC Davis research project to develop a model of PM0.1 population exposure in the Valley based on

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[9] As of March 31, 2024
[10] As of March 20, 2024
[11] SJVAPCD. Using the Real-Time Air Quality Advisory Network. (2019). https://www.valleyair.org/Programs/RAAN/documents/RAAN-Users-Guide.pdf
[12] Capitman, J.A., and Tyner, T.R. (2011). *The Impacts of Short-term Changes in Air Quality on Emergency Room and Hospital Use in California's San Joaquin Valley*. California State University, Fresno, Fresno CA. https://chhs.fresnostate.edu/cvhpi/documents/aqr-web.pdf
[13] Capitman, J.A., and Tyner, T.R. (2011). *The Impacts of Short-term Changes in Air Quality on Emergency Room and Hospital Use in California's San Joaquin Valley*. California State University, Fresno, Fresno CA. https://chhs.fresnostate.edu/cvhpi/documents/aqr-web.pdf

previous Valley observational research.[14] PM0.1 exposure was correlated with short- and long-term health effects by making use of the large body of Valley epidemiological data generated by the previous studies described above.

In addition, the District sponsored a project with Providence Engineering to examine differences in exposure to PM2.5 in residential neighborhoods. In this field project, Providence Engineering deployed approximately 30 passive PM samplers in neighborhoods across the Fresno area to provide a better spatial understanding of concentration variation in the urban area.[15] The samples were analyzed later in a laboratory to provide particle size, mass, and speciation estimates, followed by source apportionment analysis. Overall, the project provided the District with a finer understanding of how the health risk of fine particles varies in different urban locations.

The District continues to seek out opportunities to support research that furthers the understanding of PM-related impacts on public health, while also monitoring ongoing external PM-related research.

3.4 TOXICITY OF CHEMICAL SPECIES

PM2.5 particles vary in their toxicity depending on their chemical composition. Recent research into regional variability in the health response to PM2.5 exposure indicates that health outcomes may be influenced by differential toxicity of different PM species.[16] PM2.5 particles are characterized by diverse combinations of chemicals depending on unique regional combinations of meteorology, topography, and pollution sources. In addition to experimental and clinical research that has identified these toxicity differences, epidemiological studies have found regional differences in health impacts despite comparable regional PM2.5 mass exposure.[17] Beyond the intrinsic toxicity of individual chemicals, the unique combinations of chemicals generated by some sources can actually magnify health risk above and beyond what their mass concentrations would suggest.[18]

Many emissions sources evaluated in this Plan are sources of direct (primary) PM2.5 emissions, characterized by unique combinations of chemical species. Other sources emit chemical species such as ammonia and nitrogen oxides (NOx), precursors that contribute to the formation of secondary PM2.5 species. The PM2.5 chemical species

[14] Qi Ying, Jin Lu, Michael Kleeman. *Modeling air quality during the California Regional PM10/PM2.5 Air Quality Study (CPRAQS) using the UCD/CIT source-oriented air quality model – Part III. Regional source apportionment of secondary and total airborne particulate matter*. Atmospheric Environment, Volume 43, Issue 2. (2009). Pages 419-430, ISSN 1352-2310. Retrieved from: https://doi.org/10.1016/j.atmosenv.2008.08.033

[15] Zeng Y. *A comprehensive particulate matter monitoring system and dosimetry-based ambient particulate matter standards*. J Air Waste Manag Assoc. 2006 Apr;56(4):518-29. doi: 10.1080/10473289.2006.10464528. PMID: 16681216.

[16] Kodros JK, Volckens J, Jathar SH, Pierce JR. *Ambient Particulate Matter Size Distributions Drive Regional and Global Variability in Particle Deposition in the Respiratory Tract*. Geohealth. 2018 Oct 17;2(10):298-312. doi: 10.1029/2018GH000145. PMID: 32159003; PMCID: PMC7007101.

[17] Bell, M.L. (2012). *Assessment of the Health Impacts of Particulate Matter Characteristics*. Research Report 161. Boston: MA. Health Effects Institute.

[18] Kelly, F.J. (2006). *Oxidative Stress: Its Role in Air Pollution and Adverse Health Effects*. Occupational Environmental Medicine, 60, 612–616.

categories adopted in the exposure characterization model include elemental carbon (black carbon), organic carbon compounds (OC), metals (elements), ammonium nitrate, ammonium sulfate, and geological material. PM2.5 is regularly speciated at several Valley monitoring sites. The following discussion provides an overview of PM2.5 species and their associated health impacts.

Organic carbon (OC): OC species found in PM2.5 aerosol are generated as primary organic aerosol (POA), predominantly through the combustion of hydrocarbons. Key POA sources include cooking, industrial processes, mobile source exhaust, prescribed burning, tire wear, and wood burning.[19] Secondary organic aerosols (SOA) are formed from the oxidation of motor vehicle hydrocarbons, prescribed burning, wood burning, solvent use, and industrial processes.

OC is recognized as one of the most biologically reactive PM2.5 chemical species categories, with ample evidence of high toxicity found in experimental, clinical, and epidemiological studies. OC, often in combination with metals such as iron, has been shown to generate reactive oxygen species (ROS) that drive several different mechanisms of pulmonary inflammation, including disruption of normal immune system functioning.[20] Alveolar macrophages and epithelial cells are the first cellular responders to inhaled PM2.5 in the respiratory tract and macrophages clear and process inhaled PM2.5.[21] OC and metals have been shown to indirectly stimulate ROS production by macrophages, which are responsible for defending the lungs from pathogens and aerosols, in a process called respiratory burst. When there is excessive ROS production due to exposure to PM2.5, it can lead to damage of key cellular components, oxidative stress, or cell death.[22]

One of the primary OC species categories is polycyclic aromatic hydrocarbons (PAH). PAH species fall into two categories: a high molecular weight fraction and a low molecular weight fraction. The former is found in diesel exhaust and engine oil, and is a significant risk factor for lung cancer.[23] Low molecular weight PAH is found in other hydrocarbon combustion particles and serves as a precursor to the formation of an important OC species category known as quinones. Formed from atmospheric processing of PAH or within the body (in vivo), quinones have been shown to be one of the most important drivers of pulmonary oxidative stress, resulting in a host of negative

[19] EPA. *Air Quality Criteria for Particulate Matter: Final Report*. Washington, D.C.: EPA 600/P-99/002aF-bF. (October 2004).
[20] Ayres, J.G., Borm, P., Cassee, F.R., Castranova, V., Donaldson, K., Ghio, A. … Froines, J. (2008). *Evaluating the Toxicity of Airborne Particulate Matter and Nanoparticles by Measuring Oxidative Stress Potential—A Workshop Report and Consensus Statement*. Inhalation Toxicology 20, 75–99. doi: 10.1080/08958370701665517
[21] Hiraiwa K, van Eeden SF. *Contribution of lung macrophages to the inflammatory responses induced by exposure to air pollutants*. Mediators Inflamm. 2013;2013:619523. doi: 10.1155/2013/619523. Epub 2013 Aug 22. PMID: 24058272; PMCID: PMC3766602.
[22] Traboulsi H, Guerrina N, Iu M, Maysinger D, Ariya P, Baglole CJ. *Inhaled Pollutants: The Molecular Scene behind Respiratory and Systemic Diseases Associated with Ultrafine Particulate Matter*. International Journal of Molecular Sciences. 2017; 18(2):243. Retrieved from: https://doi.org/10.3390/ijms18020243
[23] Landvik, N.E., Gorria, M., Arlt, V.M., Asare, N., Solhaug, A., Lagadic-Gossmann, D., & Holme, J.A. (2007). *Effects of Nitrated-Polycyclic Aromatic Hydrocarbons and Diesel Exhaust Particle Extracts on Cell Signalling Related to Apoptosis: Possible Implications for their mutagenic and Carcinogenic Effects*. Toxicology, 231, 159–174. doi: 10.1016/J.tox.2006.12.009

spillover effects on immune system functioning.[24] Quinone formation via chemical aging of PAH occurs during multi-day winter stagnation events in the Valley. A District-funded clinical study of asthmatic patients in Fresno found that quinone levels in urine correlated with sustained (multi-day) high ambient concentrations of PM2.5 and was accompanied by decreased lung function.[25]

OC in PM2.5 can also act as a promoter of tumor formation. After OC is inhaled into the respiratory tract, it undergoes metabolic activation and produces electrophile epoxides, which then causes DNA damage and chromosomal abnormalities, increasing the risk of cancer.[26]

Elemental carbon (EC): Elemental carbon is found in combustion-based aerosols produced by mobile exhaust (mainly diesel), wood burning, and cooking (especially charbroiling). Compared to OC species, there is limited evidence of comparable impacts on ROS production, pulmonary inflammation, and immune system disruption. For example, EC appears not to be a significant agent for the induction of inflammation in macrophage cells, indicating a significantly lower toxicity level relative to OC species.[27]

Characterization of health effects of elemental carbon from human exposure studies is complicated by the high correlation between EC, OC, and metals emitted by diesel exhaust. Ambient EC concentrations have been associated with an increase in systolic pressure and heart rate variability. In one study, hypertensive rats were exposed to urban-industrial aerosol.[28] EC was found to consistently have the strongest association of any PM2.5 component with changes in heart rate and heart rate variability amongst the hypertensive rats. Blood pressure changes were found to be more influenced by variations in EC than in OC, with the EC1 fraction associated with acute cardiovascular responses.

Metals: A combination of clinical, experimental, and epidemiological studies have implicated several of the metals found in PM2.5 with negative respiratory or cardiovascular outcomes, sometimes in conjunction with the action of OC species. One of the most important is iron because of its ability to catalyze the production of hydrogen peroxide, leading to highly reactive hydroxyl radicals (OH). In turn, these highly reactive chemicals stimulate the production and action of cytokines by macrophages. Cytokines

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[24] Bolton, J., Trush, M.A., Penning, T.M., Dryhurst, G., & Monks, T.J. (2000). *Role of Quinones in Toxicology*. Chemical Research in Toxicology, *13(3)*, 135–160. doi: 10.1021/tx99

[25] Ikeda, A., Vu, K.K.-T., Lim, D., Tyner, T.R., Krishnan, V.V., & Hasson, A.L. (2012). *An Investigation of the Use of Urinary Quinones as Environmental Biomarkers for Exposure to Ambient Particle-Borne Pollutants*. Science of the Total Environment (submitted).

[26] Yifan Wang, Siyao Xiao, Yuhan Zhang, Howard Chang, Randall V. Martin, Aaron Van Donkelaar, Audrey Gaskins, Yang Liu, Pengfei Liu, Liuhua Shi. *Long-term exposure to PM2.5 major components and mortality in the southeastern United States*. Environment International, Volume 158, 2022, 106969, ISSN 0160-4120. Retrieved from: https://doi.org/10.1016/j.envint.2021.106969

[27] Vogel, C.F., Sciullo, E., Wong, P., Kuzmicky, P., Kado, N. & Matsumura, F. (2005). *Induction of Proinflammatory Cytokines and C-Reactive Protein in Human Macrophage Cell Line U937 Exposed to Air Pollution Particulates*. Environmental Health Perspectives 113(11), 1536–1541. doi: 10.1289/ehp.8094

[28] Wagner, J.G., Kamal, A.S., Morishita, M. *et al. PM2.5-induced cardiovascular dysregulation in rats is associated with elemental carbon and temperature-resolved carbon subfractions*. Part Fibre Toxicol 11, 25 (2014). Retrieved from: https://doi.org/10.1186/1743-8977-11-25

are cell-signaling molecules that are critical to normal functioning of the immune system. A recent experimental study examined the impact of iron in silica particles in triggering respiratory toxicity.[29] Compared to silica particles with no iron, silica particles with iron were found to have a significantly greater effect on oxidative stress via hydrogen peroxide production with subsequent stimulus of cytokines by macrophages.

Extensive research relates exposure in metals (particularly nickel and vanadium) in PM2.5 to cardiovascular effects. A national epidemiological study recently found that communities with higher fractions of nickel, vanadium, and EC in their PM2.5 also had higher risk of cardiovascular and respiratory hospitalization.[30] Specifically, cardiovascular hospitalizations were 26% higher in counties with a nickel fraction in the 75th percentile versus counties with nickel in the 25% percentile. In an investigation of the relatively higher association between PM2.5 daily concentrations and daily rates of cardiovascular mortality in New York City, the exceptionally high level of nickel and vanadium resulting from residual oil fly ash used for heating and as fuel for ships were identified as a principle cardiovascular risk factor.[31] In a related study, rats exposed to PM2.5 with high fractions of chromium, iron, and nickel fractions responded with significantly reduced heart rate variability and increased heart rates, each being an indicator of cardiovascular disruption and risk.[32]

Chromium, another metallic component of PM2.5, is typically emitted from combustion processes, metal industries, cement-manufacturing plants, tobacco smoke, and chromium-based automotive catalytic converter pollution. Chromium exposure has been associated with various health conditions, such as nasal septum atrophy and cancer.[33] Chromium can be cancerous to both children and adults.[34] Hexavalent chromium (CrVI), one of the valence states of elemental chromium, is an endocrine disruptor, capable of mimicking or interfering with the body's hormones, or endocrine system.[35]

In conclusion, metals found in PM2.5 produced from combustion of coal, residual oil, diesel fuel, and motor oil are recognized as chemical drivers of cardiovascular and

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[29] Premasekharan, G., Nguyen, K., Contreras, J., Ramon, V., Leppert, V.J. & Forman, H.J. (2011). *Iron-Mediated Lipid Peroxidation and Lipid Raft Disruption in Low-Dose Silica-Induced Macrophage Cytokine Production*. Free Radical Biology and Medicine, 51(6), 1184–1194. doi: 10.1016/j.freeradbiomed.2011.06.018

[30] Bell, M.L., Ebisu, K., Peng, R.D., Samet, J.M. & Dominici, F. (2009). *Hospital Admissions and Chemical Composition of Fine Particle Air Pollution*. American Journal of Respiratory Critical Care, 179, 1115–1120. doi: 10.1164/rccm.200808-1240OC

[31] Lippmann, M., Ito, K., Hwang, J-S., Maciejczyk, P., & Chen, L-C. (2006). Car*diovascular Effects of Nickel in Ambient Air*. Environmental Health Perspectives, 114(11), 1662–1669. doi: 10.1289/ehp.9150

[32] Chen, L.C., & Lippmann, M. (2009). *Effects of Metals within Ambient Air Particulate Matter (PM) on Human Health*. Inhalation Toxicology, 21(1), 1–31. doi: 10.1080/08958370802105405

[33] Olivia S. Ryder, Jennifer L. DeWinter, Steven G. Brown, Keith Hoffman, Betsy Frey, Ali Mirzakhalili. *Assessment of particulate toxic metals at an Environmental Justice community*. Atmospheric Environment: X, Volume 6, 2020, 100070, ISSN 2590-1621. Retrieved from: https://doi.org/10.1016/j.aeaoa.2020.100070

[34] Cheng, X., Huang, Y., Zhang, S.P., Ni, S.J. and Long, Z.J. (2018). Charac*teristics, Sources, and Health Risk Assessment of Trace Elements in PM10 at an Urban Site in Chengdu, Southwest China*. Aerosol Air Qual. Res. 18: 357-370. Retrieved from: https://doi.org/10.4209/aaqr.2017.03.0112

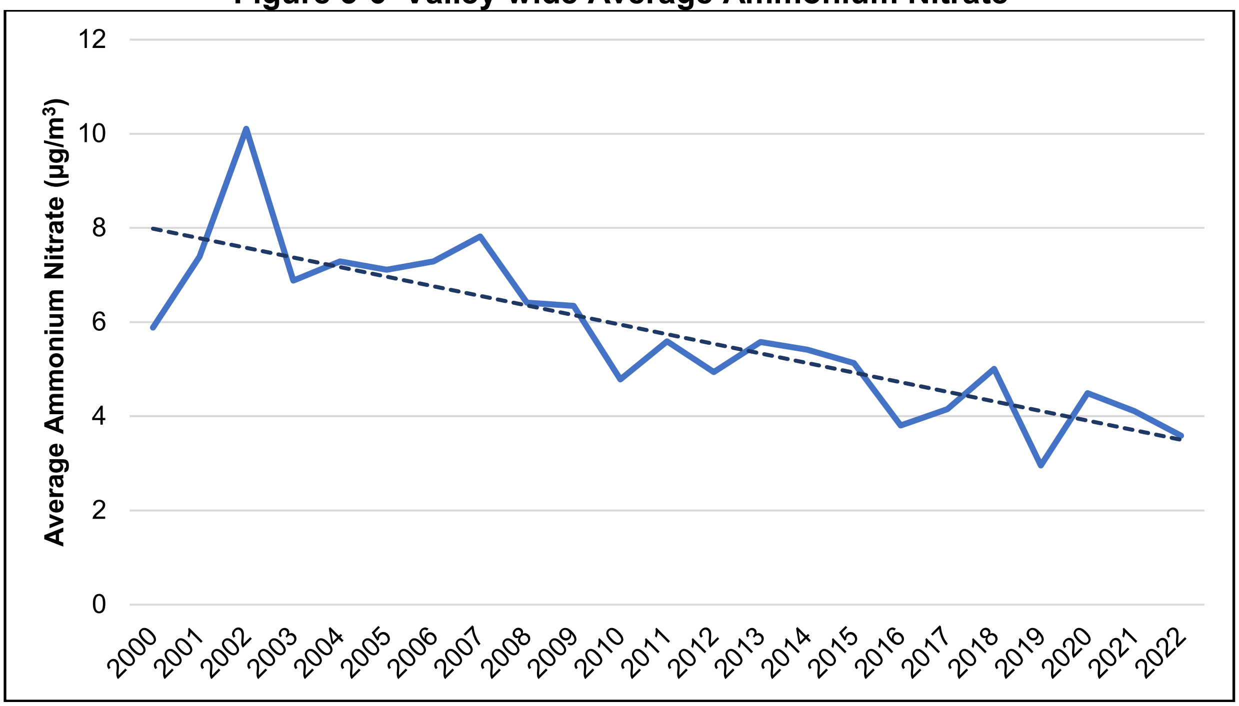
[35] Sakhila K Banu, Jone A Stanley, Kirthiram K Sivakumar, Joe A Arosh, Robert J Taylor, Robert C Burghardt. *Chromium VI − Induced developmental toxicity of placenta is mediated through spatiotemporal dysregulation of cell survival and apoptotic proteins*. Reproductive Toxicology, Volume 68, 2017, Pages 171-190, ISSN 0890-6238. Retrieved from: https://doi.org/10.1016/j.reprotox.2016.07.006

respiratory morbidity and mortality. This has led some researchers to conclude that regional differences in U.S. cardiovascular mortality that cannot be explained by differences in average daily PM2.5 concentrations are likely to be caused by regional differences in coal combustion and resultant exposure to metals and OC.[36] Children are the most vulnerable to toxic metallic elements in the natural environment, and exposure can lead to learning disabilities, memory and attention deficits, and/or psychiatric complications.[37]

Ammonium nitrate: Ammonium nitrate is classified as a secondary inorganic species of PM2.5, formed by atmospheric reactions between two precursors: ammonia and nitric acid. Prior to this reaction, nitric acid generally originates from the chemical processing of nitrogen oxides (NOx), largely from fuel combustion during multiday stagnation events.

Figure 3-6 shows the Valley-wide average ammonium nitrate trend between 2002 and 2022. Overall, average ammonium nitrate concentrations have decreased over the past 20 plus years, largely as a result of the District's comprehensive emissions reduction strategy.

Figure 3-6 Valley-wide Average Ammonium Nitrate



The relative toxicity of ammonium nitrate is an important issue given its substantial mass contribution to regional PM2.5. The oral toxicity of nitrate is very low, with an

[36] Lippmann M, Chen L-C, Gordon T, Ito K, Thurston GD. (2013). *National Particle Component Toxicity (NPACT) Initiative: Integrated Epidemiologic and Toxicologic Studies of the Health Effects of Particulate Matter Components*. Research Report 177. *Health Effects Institute*, Boston, MA.
[37] Lin, Y.C., Li, Y.C., Amesho, K.T.T., Chou, F.C. and Cheng, P.C. (2020). *Filterable $PM_{2.5}$, Metallic Elements, and Organic Carbon Emissions from the Exhausts of Diesel Vehicles*. Aerosol Air Qual. Res. 20: 1319–1328. Retrieved from: https://doi.org/10.4209/aaqr.2020.02.0081

LD50 (dose causing death for 50% of the exposed subjects) reported to be two thirds that of table salt. This raises the question as to whether other factors intrinsic to inhalation could lead to health effects at considerably lower exposure concentrations. As seen in the case of OC species, the most compelling evidence of species toxicity is built on a foundation of experimental, clinical, and epidemiological research. In particular, epidemiological studies draw their inferences only from statistical associations between exposure variables and health outcomes. Uncovering the actual mechanisms of harm, therefore, requires further isolation of mechanisms through experimental and clinical research.

In the case of ammonium nitrate, evidence of toxicity is largely limited to epidemiological research alone. For example, a recent epidemiological study of traffic air toxics and pre-term birth in Los Angeles found statistical associations between nitrate mass, PAH, and several other air pollutants and the increased likelihood of pre-term birth.[38] The authors point to other experimental studies that identified very high oxidative stress potential resulting from PAHs, metals, and other OC species collected from Los Angeles traffic sources as being the likely mechanism for pre-term birth. They conclude by emphasizing the need to further study the links between pre-term birth and PAH exposure.

In another study, PM2.5 from ammonium nitrate and ammonium sulfate was found to be associated with increased prevalence of myocardial infarctions and coronary artery disease. The study found that ammonium nitrate was associated with 15% increased odds of coronary artery disease and 36% increased odds of myocardial infarctions.[39]

Ammonium sulfate: Ammonium sulfate (sulfate) is also classified as a secondary inorganic species. It is formed when sulfuric acid, itself a product of oxidation of sulfur, reacts with ammonia. Fossil fuel combustion is the primary source of sulfate in the Valley, but unlike nitrate, mass concentrations of sulfate are not appreciably different in cold and hot seasons.

Research findings regarding the toxicity of sulfate are comparable to that of nitrate; however, some studies suggest that sulfate may be more harmful than nitrate.[40] The acidity of sulfur compounds in PM2.5 is more harmful because the acidity makes transition metals in particles more bioavailable, leading to oxidative stress when inhaled

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[38] Wilhelm, M., Ghosh, J.K., Su, J., Cockburn, M., Jerrett, M. & Ritz, B. (2011). *Traffic-Related Air Toxics and Preterm Birth: A Population-Based Case-Control Study in Los Angeles County, California*. Environmental Health 10: 89. doi: 10.1186/1476-069X-10-89

[39] Slawsky E, Ward-Caviness CK, Neas L, Devlin RB, Cascio WE, Russell AG, Huang R, Kraus WE, Hauser E, Diaz-Sanchez D, Weaver AM. *Evaluation of $PM_{2.5}$ air pollution sources and cardiovascular health*. Environ Epidemiol. 2021 May 20;5(3):e157. doi: 10.1097/EE9.0000000000000157. PMID: 34131618; PMCID: PMC8196100.

[40] Masselot P, Sera F, Schneider R, Kan H, Lavigne É, Stafoggia M, Tobias A, Chen H, Burnett RT, Schwartz J, Zanobetti A, Bell ML, Chen BY, Guo YL, Ragettli MS, Vicedo-Cabrera AM, Åström C, Forsberg B, Íñiguez C, Garland RM, Scovronick N, Madureira J, Nunes B, De la Cruz Valencia C, Hurtado Diaz M, Honda Y, Hashizume M, Ng CFC, Samoli E, Katsouyanni K, Schneider A, Breitner S, Ryti NRI, Jaakkola JJK, Maasikmets M, Orru H, Guo Y, Valdés Ortega N, Matus Correa P, Tong S, Gasparrini A. *Differential Mortality Risks Associated With PM2.5 Components: A Multi-Country, Multi-City Study*. Epidemiology. 2022 Mar 1;33(2):167-175. doi: 10.1097/EDE.0000000000001455. PMID: 34907973; PMCID: PMC7612311.

and systemic health effects in the human body.[41] Simply put, when sulfate is inhaled deep into the lungs, it creates an acidic environment that promotes the absorption of metallic elements of PM2.5.[42] Effects of ammonium sulfate exposure can increase asthmatic and inflammatory responses, and inhalation of ammonium nitrate and ammonium sulfate may induce adverse effects on sperm motility and motion, thus affecting male fertility.[43]

Geological: Winter season and annual average PM2.5 found in the Valley contains a very small fraction of species that are termed *crustal*, i.e., having their origins in the earth's crust. Suspended dust consists mainly of oxides of aluminum, silicon, calcium, titanium, iron, and other metal oxides. The precise combination of these components depends on the geology, industrial processes, and agricultural processes of the area. The geologic fraction of PM2.5 found in the Valley makes a relatively small contribution to overall PM2.5 mass and, by itself, has relatively low toxicity. Silica, a component of geological material, can be deposited in the lungs and destroy respiratory function, whereas heavy metals, which are also found in geological material, can accumulate in the blood and bones and cause damage to the nervous system.[44]

3.5 PARTICLE SIZE AND DEPOSITION

Particle size has a significant bearing on bodily deposition, net exposure, and corresponding health risk, even within the PM2.5 size fraction. Inhaled PM2.5 deposits deep within pulmonary tissues, interacts and activates local cells, and modifies endogenous structures.[45] Key metrics for deposition assessment include the percentage of inhaled particles that remain deposited and not exhaled (known as the deposition fraction) and the location where particles are deposited within the body.[46] Within the PM2.5 size range, particles less than 0.1 microns (PM0.1) and greater than 10 microns are least likely to be exhaled, and thus have higher deposition fractions.[47]

The biological pathways by which PM2.5 promotes cardiovascular disease are summarized below in Figure 3-7. PM2.5 components, specifically metals and organic

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[41] Maciejczyk P, Chen L-C, Thurston G. The Role of Fossil Fuel Combustion Metals in $PM_{2.5}$ Air Pollution Health Associations. *Atmosphere*. 2021; 12(9):1086. https://doi.org/10.3390/atmos12091086

[42] Yifan Wang, Siyao Xiao, Yuhan Zhang, Howard Chang, Randall V. Martin, Aaron Van Donkelaar, Audrey Gaskins, Yang Liu, Pengfei Liu, Liuhua Shi. *Long-term exposure to PM2.5 major components and mortality in the southeastern United States*. Environment International, Volume 158, 2022, 106969, ISSN 0160-4120. Retrieved from: https://doi.org/10.1016/j.envint.2021.106969

[43] Jeong-Won Bae, Hong Ju Kwon, So-Hye Kim, Lei Ma, Hobin Im, Eungyung Kim, Myoung Ok Kim, Woo-Sung Kwon. *Inhalation of ammonium sulfate and ammonium nitrate adversely affect sperm function*, Reproductive Toxicology, Volume 96, 2020, Pages 424-431, ISSN 0890-6238. Retrieved from: https://doi.org/10.1016/j.reprotox.2020.08.009

[44] Yifan Wang, Siyao Xiao, Yuhan Zhang, Howard Chang, Randall V. Martin, Aaron Van Donkelaar, Audrey Gaskins, Yang Liu, Pengfei Liu, Liuhua Shi. *Long-term exposure to PM2.5 major components and mortality in the southeastern United States*. Environment International, Volume 158, 2022, 106969, ISSN 0160-4120. Retrieved from: https://doi.org/10.1016/j.envint.2021.106969

[45] Sanjay Rajagopalan, Sadeer G. Al-Kindi, Robert D. Brook. *Air Pollution and Cardiovascular Disease: JACC State-of-the-Art Review*. Journal of the American College of Cardiology, Volume 72, Issue 17, 2018, Pages 2054-2070, ISSN 0735-1097. Retrieved from: https://doi.org/10.1016/j.jacc.2018.07.099

[46] International Commission on Radiological Protection [ICRP]. (1995). *Human Respiratory Tract Model for Radiological Protection*. ICRP Publication 66. *Annals of the ICRP 24,* 1–3.

[47] EPA. *Air Quality Criteria for Particulate Matter*: Final Report. (2004, October). Washington, D.C.: EPA 600/P-99/002aF-bF.

species, are mediators of oxidative stress, which instigates a local inflammatory response, even when exposure to PM2.5 may be short-term.[48] This is indicative of heightened impact from long-term exposure to PM2.5.

Deposition of very small particles in the alveolar region of the lungs results in the delivery of their chemicals into the bloodstream where they promote cardiovascular disruption and immune system sensitization.[49] These chemicals can trigger heart attacks and premature death among individuals with pre-existing heart conditions.[50] Extremely small particles can also be absorbed into the brain via the nasal tract, bypassing the protection provided by the blood-brain barrier.[51] The effects of particles deposited primarily in the tracheobronchial region center on respiratory function.[52]

Particle deposition and associated health risk is magnified by exercise in several ways. First, during exercise, higher minute ventilation occurs, leading to higher inhalation of pollutants.[53] Second, breathing harder means that particles are more likely to penetrate the alveolar region of the lungs where absorption into the bloodstream occurs; PM2.5 was observed to primarily deposit in the head, pulmonary and tracheobronchial regions.[54] A 2018 study found that lung function improved with physical activity, but this beneficial effect decreased when air pollution concentrations were higher.[55] Another study from 2021 found that during moderate to vigorous activity, individuals increase their risk of inhaling harmful pollutants, resulting in reduced lung function.[56] Although physical exercise is recommended to improve health, air pollution levels should be considered, as there are several adverse health effects from PM inhalation.[57]

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[48] Sanjay Rajagopalan, Sadeer G. Al-Kindi, Robert D. Brook. *Air Pollution and Cardiovascular Disease: JACC State-of-the-Art Review*. Journal of the American College of Cardiology, Volume 72, Issue 17, 2018, Pages 2054-2070, ISSN 0735-1097. Retrieved from: https://doi.org/10.1016/j.jacc.2018.07.099

[49] Delfino, R.J., Sioutas, C., & Malik, S. (2005). *Potential Role of Ultrafine Particles in Associations between Airborne Particle Mass and Cardiovascular Health*. Environmental Health Perspectives 113(8), 934–946.

[50] Nel A. (2005). *Air Pollution-Related Illness: Effects of Particles*. Science, 308(5723), 804–806. doi: 10.1126/science.1108752

[51] Oberdorster, G., Sharp, Z., Atudorei, V., Elder, A., Gelein, R., Kreyling, W., & Cox, C. (2004). *Translocation of Inhaled Ultrafine Particles to the Brain*. Inhalation Toxicology, 16(6-7), 437–445. doi: 10.1080/08958370490439597

[52] EPA. *Integrated Science Assessment for Particulate Matter*: Final Report. (2009). Washington, D.C.: EPA/600/R-08/139F.

[53] Pasqua LA, Damasceno MV, Cruz R, Matsuda M, Garcia Martins M, Lima-Silva AE, Marquezini M, Saldiva PHN, Bertuzzi R. *Exercising in Air Pollution: The Cleanest versus Dirtiest Cities Challenge*. Int J Environ Res Public Health. 2018 Jul 17;15(7):1502. doi: 10.3390/ijerph15071502. PMID: 30018189; PMCID: PMC6069042.

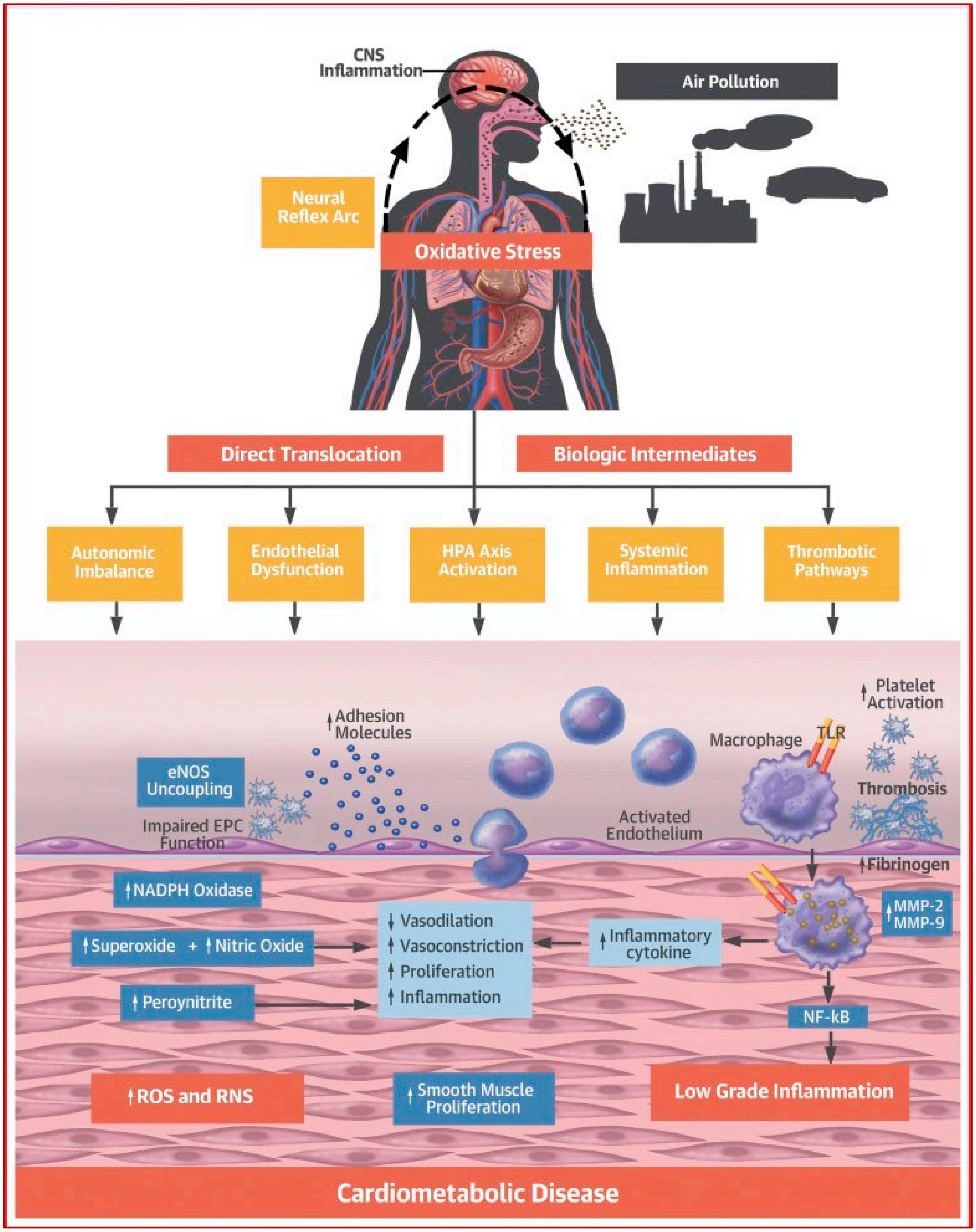
[54] N. Manojkumar, B. Srimuruganandam, S.M. Shiva Nagendra. *Application of multiple-path particle dosimetry model for quantifying age specified deposition of particulate matter in human airway*. Ecotoxicology and Environmental Safety, Volume 168, 2019, Pages 241-248, ISSN 0147-6513. Retrieved from: https://doi.org/10.1016/j.ecoenv.2018.10.091

[55] Laeremans, Michelle & Dons, Evi & Avila-Palencia, Ione & Carrasco-Turigas, Glòria & Orjuela, Juan & Anaya Boig, Esther & Cole-Hunter, Tom & Nazelle, Audrey & Nieuwenhuijsen, Mark & Standaert, Arnout & Van Poppel, Martine & De Boever, Patrick & Int Panis, Luc. (2018). *Black Carbon Reduces the Beneficial Effect of Physical Activity on Lung Function*. Medicine & Science in Sports & Exercise. 50. 1. 10.1249/MSS.0000000000001632.

[56] Lovinsky-Desir S, Jung KH, Montilla M, Quinn J, Cahill J, Sheehan D, Perera F, Chillrud SN, Goldsmith J, Perzanowski M, Rundle A, Miller R. *Locations of Adolescent Physical Activity in an Urban Environment and Their Associations with Air Pollution and Lung Function*. Ann Am Thorac Soc. 2021 Jan;18(1):84-92. doi: 10.1513/AnnalsATS.201910-792OC. PMID: 32813558; PMCID: PMC7780976.

[57] Pasqua LA, Damasceno MV, Cruz R, Matsuda M, Garcia Martins M, Lima-Silva AE, Marquezini M, Saldiva PHN, Bertuzzi R. *Exercising in Air Pollution: The Cleanest versus Dirtiest Cities Challenge*. Int J Environ Res Public Health. 2018 Jul 17;15(7):1502. doi: 10.3390/ijerph15071502. PMID: 30018189; PMCID: PMC6069042.

Figure 3-7 Biological Pathways whereby PM2.5 Promotes Cardiovascular Events[58]

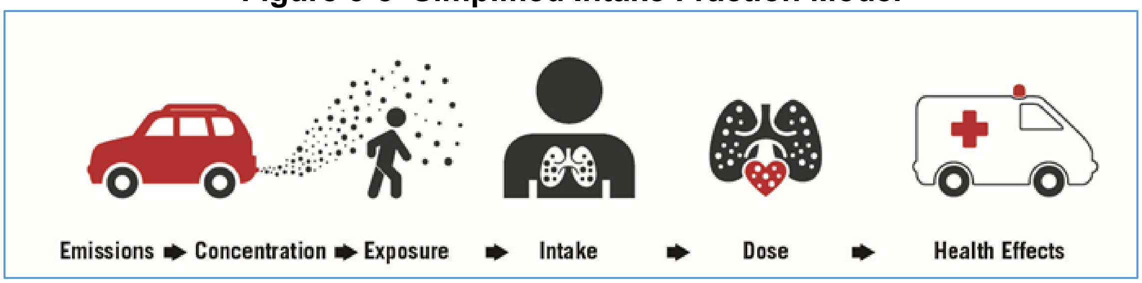


[58] Sanjay Rajagopalan, Sadeer G. Al-Kindi, Robert D. Brook. *Air Pollution and Cardiovascular Disease: JACC State-of-the-Art Review*. Journal of the American College of Cardiology, Volume 72, Issue 17, 2018, Pages 2054-2070, ISSN 0735-1097. Retrieved from: https://doi.org/10.1016/j.jacc.2018.07.099

3.6 POPULATION PROXIMITY AND INTAKE FRACTION

Estimating total exposure and net health risk from a given source of PM2.5 requires that population proximity and population density be considered in addition to the source's toxicity and contribution to the regional PM2.5 emissions inventory. In addition to factors governing net deposition of inhaled particles reviewed above, net population exposure from the source in question is also shaped by the number of exposed individuals who inhale the emissions, and the duration of exposure in conjunction with aerosol concentration levels (see Figure 3-8). Known as the intake fraction, this measure of population exposure is defined empirically as the pollutant mass inhaled divided by the mass emitted.[59] Intake fraction is useful in connecting emissions to health risk because the mass inhaled is a better indicator of health risk than the mass emitted or airborne concentration. Two different pollutant sources with very comparable emission rates of the same pollutant can nonetheless have significantly different intake fractions depending on the surrounding population density. For example, sources of PM2.5 located in rural areas may have an intake fraction that is 10 to 100 times smaller than a comparable source located within a densely populated city.

Figure 3-8 Simplified Intake Fraction Model



The relevance of the intake fraction concept can be seen in a 2018 study on transportation-related air pollution impacts on disadvantaged communities in southern California.[60] The study investigated how spatially targeted emission-reductions could reduce environmental injustice by examining how reducing emissions of a known carcinogen (PM2.5 from diesel engines) would affect total exposure, exposure efficiency, exposure inequality, and exposure injustice. This study used intake fraction as a measurement for exposure efficiency. Furthermore, this study also examined two types of emission reduction strategies that are in use in hundreds of cities worldwide: low-emission zones and truck re-routing. The study found that targeting emission reductions in certain locations can yield disproportionately large advantages for impact, efficiency, equity, and justice.

In a similar study from 2017, intake fraction was used to quantify how emissions from different regions proportionally contribute to human exposure of both primary and secondary particulate matter species over four seasons for twenty-five regions in the United States. It was found that sulfate inhalation occurs over larger distances than

[59] Marshall, J.D., & Nazaroff, W.W. (2004, October). *Using Intake Fraction to Guide CARB Policy Choices: The Case of Particulate Matter*. Unpublished California Air Resources Board Report.
[60] Nam P Nguyen and Julian D Marshall. (2018). *Impact, efficiency, inequality, and injustice of urban air pollution: variability by emission location*. Environmental Resource Letters, 13 024002 DOI 10.1088/1748-9326/aa9cb5.

other particulate matter species, regardless of the season. The study also found that approximately 75% of inhalation occurs within 50km for all seasons and pollutants, increasing in distance by approximately 20% in the wintertime, demonstrating that emission reductions during the winter will have large impacts on health improvement.[61]

In another study, intake fraction was used to examine emissions-to-exposure for wildfires. This study found that not only were localized communities near large fires exposed to wildfire smoke, but exposure to wildfire smoke can extend long distances and affect distant larger urban areas.[62] PM2.5 concentrations are influenced by weather conditions, smoke dispersion, fuel type, and fire behavior; therefore, smoke impacts will be different for each wildfire. This study highlighted the importance of quantifying air quality impacts from wildfires to develop strategies to protect public health with the expected increase of fire season in the Western United States due to climate change.

3.7 SUMMARY OF HEALTH IMPACTS AND HEALTH RISK REDUCTION STRATEGY

Understanding the results of any health risk reduction strategy is critical to assessing the overall value and success of that strategy. As the District continues to develop air quality attainment plans in future years to address the increasingly more stringent NAAQS, the District will evaluate health benefits for Valley residents resulting from adopted air quality attainment plans.

[61] Carmen Lamancusa, Fatema Parvez, Kristina Wagstrom. *Spatially resolved intake fraction estimates for primary and secondary particulate matter in the United States*. Atmospheric Environment, Volume 150, 2017, Pages 229-237, ISSN 1352-2310. Retrieved from: https://doi.org/10.1016/j.atmosenv.2016.11.010
[62] Kathleen M. Navarro, Ricardo Cisneros, Susan M. O'Neill, Don Schweizer, Narasimhan K. Larkin, and John R. Balmes. *Air-Quality Impacts and Intake Fraction of PM2.5 during the 2013 Rim Megafire*. Environmental Science & Technology 2016 *50* (21), 11965-11973. September 21, 2016. DOI: 10.1021/acs.est.6b02252

Chapter 4
ATTAINMENT STRATEGY

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Chapter 4: Attainment Strategy

Over the past decades, under previous San Joaquin Valley Air Pollution Control District (District) attainment plans (*2007 Ozone Plan*, *2008 PM2.5 Plan*, *2012 PM2.5 Plan*, *2013 Plan for the Revoked 1-hour Ozone Standard*, *2015 Plan for the 1997 PM2.5 Standard*, *2016 Plan for the 2008 8-Hour Ozone Standard*, *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards*, and *2022 Plan for the 2015 8-Hour Ozone Standard*) the District and the California Air Resources Board (CARB) have implemented generations of emissions control measures for stationary, area, and mobile sources in the San Joaquin Valley (Valley). Together, these efforts represent the nation's toughest air pollution emissions controls. In addition to having the toughest air regulations in the nation, the District also operates the most effective and efficient incentive grants program, investing over $6.2 billion in public/private funding towards clean air projects to date that have achieved over 268,000 tons of emissions reductions. Due to the significant investments made by Valley businesses and residents, and stringent regulatory programs by the District and CARB, the Valley's fine particulate matter (PM2.5) and PM2.5 precursor emissions are at historically low levels. Air quality in the Valley has improved significantly, providing Valley residents with associated health benefits. As the District and CARB continue to implement adopted control measures, Valley PM2.5 concentrations will continue to improve.

Despite the progress made to improve the Valley's air quality through implementation of multiple attainment plans adopted by the District and clean air investments by Valley businesses and residents, substantial additional emissions reductions are needed, particularly from mobile sources under CARB and U.S. Environmental Protection Agency (EPA) jurisdiction that make up over 80% of remaining Valley nitrogen oxide (NOx) emissions. The District and CARB must build on decades of effective control strategies and reach beyond regulations alone to expedite air quality improvements. This chapter outlines the new regulatory and incentive-based measures proposed by both the District and CARB, combined with adopted measures achieving new emissions reductions, which collectively will achieve the emissions reductions necessary to attain the 2012 annual PM2.5 standard.

4.1 COMPREHENSIVE CONTROL STRATEGY

This Plan contains a comprehensive suite of regulatory and incentive-based measures to be implemented by the District and CARB to attain the 2012 annual PM2.5 standard as expeditiously as practicable, as evidenced by the photochemical air quality modeling performed by CARB (Appendix J). This Plan demonstrates the District's ongoing efforts to improve air quality in the Valley through a comprehensive strategy that includes:

- ***District regulatory measures*** achieving new emission reductions during this Plan period, as shown in Table 4-2, in addition to new stationary and area source measures to further strengthen requirements to achieve greater emissions reductions from residential wood combustion and agricultural operations.

- ***Incentive-based measures*** that accelerate the deployment of cleaner vehicles and technologies in a variety of sectors, including agricultural equipment and residential wood combustion.

- ***State mobile source strategy*** that reduces emissions from mobile sources under state and federal jurisdiction, including heavy-duty trucks, agricultural equipment, locomotives, and off-road equipment.

- ***Public outreach and education*** that encourages and empowers the public to understand air quality issues, take advantage of District tools to stay informed regarding local air quality, take actions to protect themselves when necessary, understand the Valley's unique air quality challenges, and take actions to reduce emissions and improve the Valley's air quality.

- ***Technology advancement and demonstration*** efforts to accelerate the development and deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable.

- ***Transition to zero-emission technologies*** across all sectors where feasible, through close collaboration with federal, state, and local governments, industry, and the public to support the development and rapid deployment of new technologies and needed infrastructure, ensuring equitable transition.

- ***Call for action*** by the federal government to do their part in taking responsibility for regulating, and taking actions, to reduce emissions in the Valley. This includes working together to advocate and secure significant new funding required to achieve the enormous emissions reductions necessary for attainment under this Plan through incentive-based measures.

4.2 DISTRICT CONTROL STRATEGY

The District's regulatory authority is limited to stationary sources and some area-wide sources. Since 1992, the District has adopted over 670 rules to implement an aggressive on-going control strategy to reduce emissions in the Valley from these sources. Many current rules are fourth- or fifth-generation, meaning that they have been revised and emission limits have been lowered, as new emission control technologies become available, technologically feasible, and cost-effective. Additionally, the District has recently adopted many technology-forcing rules, including recent amendments to District rules for agricultural burning and boilers, steam generators, and process heaters. The District has also adopted innovative regulations such as the Indirect Source Review and Employer-based Trip Reduction rules to reduce emissions from mobile sources.

The District's current rules and regulations reflect technologies and methods that extend well beyond required control levels. The stringent regulations already adopted under previous attainment plans serve as the foundation of the control strategy for this Plan. These adopted regulations reduce directly emitted PM2.5 and NOx as they are fully implemented. These rules, along with the numerous adopted rules and regulations that have achieved emissions reductions before 2017, contribute to the Valley's progress toward attainment. **The emissions inventory for this plan shows reductions of approximately 10.1 tons per day (tpd) of directly emitted PM2.5 emissions and 128.5 tpd of NOx from 2017 to the final attainment year of 2030** (Appendix B). These emissions reductions represent a 15.4% reduction in PM2.5 and 56.7% reduction in NOx, based on measures included in the current control strategy. Emission reductions from stationary and area sources under the adopted control program are presented in Table 4-1 below. The District's recently amended regulations achieving reductions in and after 2017 are summarized in Section 4.2.1 below.

Table 4-1 San Joaquin Valley Baseline Stationary and Area Source Emissions[1]

Pollutant	2017 Emissions (tpd)	2030 Emissions (tpd)	Change
PM2.5	57.3	50.4	-12%
NOx	35.3	22.5	-36%

In addition to the significant ongoing reductions achieved and maintained through the District's current adopted air quality regulations, the District is committing in this Plan to achieve aggregate emissions reductions from new prohibitory and incentive-based measures, as necessary for expeditious attainment demonstrated through modeling conducted by CARB. Notably, the incentive-based measures are based on already received funding. Although the District has only quantified reductions from one measure at this time in the aggregate commitment, the other measures will achieve additional reductions, and will be submitted to the SIP. Final measures as proposed for adoption into the SIP may provide more or less emission reductions as will be determined through the extensive public rule development process for each regulatory measure. If the total emission reductions from the newly adopted rules or measures are less than those committed to in the Plan, the District commits to adopt, submit, and implement substitute rules and measures that achieve equivalent reductions in emissions of direct PM2.5 or PM2.5 precursors in the same implementation timeframes or in the timeframes needed to meet CAA milestones. These commitments will ensure that emission reductions will be achieved by the timeframes necessary under this Plan to attain the 2012 standard as expeditiously as practicable.

The District's comprehensive control strategy is summarized in the table below.

[1] Source: 2022 PM2.5 CEPAM v1.00; represents the current baseline emissions with adopted CARB and district measures

Table 4-2 District Control Strategy Measures and Schedule

District Rule		Action Date	Implementation Begins
Adopted Regulations Achieving Reductions on and after 2017			
2201	New and Modified Stationary Source Review Rule	2023	Ongoing
4103	Open Burning	2021	2021-2025
4308	Boilers, Steam Generators, and Process Heaters - 0.075 MMBtu/hr to Less than 2.0 MMBtu/hr	2013	2015-2034
4311	Flares	2020	2024
4306/ 4320	Boilers, Steam Generators, and Process Heaters Greater than 5.0 MMBtu/hr	2020	2024
4352	Solid Fuel Fired Boilers, Steam Generators, and Process Heaters	2021	2024
4354	Glass Melting Furnaces	2021	2024, 2030
4550	Conservation Management Practices	2004	Ongoing
4702	Internal Combustion Engines	2021	2024, 2030
4901	Wood Burning Fireplaces and Wood Burning Heaters	2023	2019
4902	Residential Water Heaters	2009	2010-2024
4905	Natural Gas-Fired, Fan-Type Central Furnaces	2024	2015-2045
9510	Indirect Source Review	2017	Ongoing
9610	State Implementation Plan Credit for Emission Reductions Generated Through Incentive Programs	2013	Ongoing
Reg. VIII	Fugitive PM10 Prohibitions	2004	Ongoing
New Regulatory and Incentive-Based Commitments			
4550	Conservation Management Practices	2026	2028
4901	Residential Wood Burning	2025	2026
-	Fireplace and Woodstove Change-Out Program	Ongoing	Ongoing
-	Low-Dust Nut Harvester Replacement Program	Ongoing	Ongoing

Table 4-3 Emission Reductions from Control Strategy

Measures		PM2.5 (tpd)	NOx (tpd)
Adopted Control Strategy for Stationary and Area Sources		**6.9**	**12.8**
New Regulatory and Incentive-Based Aggregate Commitments			
4550	Conservation Management Practices	NYQ	NYQ
4901	Residential Wood Burning	0.02	NYQ
-	Fireplace and Woodstove Change-Out Program	NYQ	NYQ
-	Low-Dust Nut Harvester Replacement Program	NYQ	NYQ
	Total Aggregate Commitment from New Measures	***0.02***	***0.00***
	Total Reductions	**6.92**	**12.8**

"NYQ" means not yet quantified, emissions reductions to be quantified during regulatory/SIP submission process

The new proposed commitments will require significant further analysis, and additional investment for the development and deployment of new technology and equipment modifications. The District and CARB are committed to a robust and transparent public rule development process that includes stakeholder, industry, and other-agency input at every step possible to ensure feasibility. After rules are adopted, businesses will need sufficient time to design, finance, and install new controls or modify existing equipment to comply with new requirements.

In addition, the District is already implementing highly successful incentive programs in the Valley. Through the above incentive-based measures, the District will be obtaining SIP credit for emission reductions achieved through existing programs, as discussed in Section 4.2.2.

4.2.1 Adopted District Regulations

4.2.1.1 Rule 2201 (New and Modified Stationary Source Review Rule)

Rule 2201 applies to all proposals for new or modified sources of pollution that must obtain a permit from the District. The rule requires that the proposed emissions from any such new or modified equipment be controlled with the Best Available Control Technology (BACT), and that large projects offset their increased emissions by surrendering emission reduction credits that have been generated by companies that have voluntarily reduced their emissions. Compliance with this rule must be demonstrated prior to the District issuing a permit and prior to constructing the new or modified source of pollution.

4.2.1.2 Rule 4103 (Open Burning)

The District first adopted Rule 4103 on June 18, 1992, to regulate and coordinate the use of open burning while minimizing smoke impacts on the public. In 2003, California Senate Bill (SB) 705 (Florez, 2003) established a schedule to phase out the open burning of agricultural material, including consideration of technical and economic factors in implementing the phase-out. As approved by the Governing Board on June 17, 2021, and approved by CARB on June 18, 2021, the District developed updated requirements establishing the near-complete phase-out of remaining open burning by January 1, 2025.

4.2.1.3 Rule 4308 (Boilers, Steam Generators, and Process Heaters 0.075 to <2 MMBtu/hr)

Adopted in 2005 and amended in 2009 and 2013 to include more stringent NOx limits, Rule 4308 controls emissions from boilers, steam generators, and process heaters in the size range of 0.075 to less than 2 million British thermal units per hour (MMBtu/hr). This rule has resulted in more than 93% control of emissions from this source category. As a point-of-sale rule, emissions continue to be reduced as consumers replace older units with new, low-NOx units.

4.2.1.4 Rule 4311 (Flares)

Rule 4311 limits emissions of NOx, sulfur dioxide (SOx), and volatile organic compound (VOC) emissions from the operation of flares in the Valley. In December 2020, the District Governing Board amended Rule 4311 to remove exemptions for non-major source facilities and landfill facilities, and to establish requirements for the installation of ultra-low NOx control systems for flares used in oil and gas operations, at landfills, and at wastewater treatment facilities. Operators are required to reduce flaring below applicable thresholds, or to install ultra-low NOx flare technology by 2024. The adopted requirements in Rule 4311 are estimated to achieve emission reductions of 0.19 tpd NOx, 0.03 tpd PM2.5, and 0.39 tpd VOCs by 2024.

4.2.1.5 Rules 4306/4320 (Boilers, Steam Generators, and Process Heaters >5 MMBtu/hr)

Rules 4306 and 4320 control emissions from boilers, steam generators, and process heaters from a wide range of industries, including but not limited to electrical utilities, cogeneration, oil and gas production, petroleum refining, manufacturing and industrial processes, food and agricultural processing, and service and commercial facilities. The District Governing Board adopted amendments to Rules 4306 and 4320 in December 2020 to include lower NOx emissions limits for a variety of unit classes and categories, as well as establish dates for the submission of required emission control plans, authority to construct applications, and final compliance deadlines. Overall, the amendments are estimated to achieve emission reductions of 0.19 tpd NOx in 2024, and additional 0.03 tpd NOx by 2030. The adopted amendments to Rule 4320 are estimated to achieve an additional 0.45 tpd NOx emission reductions in 2024.

4.2.1.6 Rule 4352 (Solid Fuel Fired Boilers, Steam Generators, and Process Heaters)

Rule 4352 controls emissions from boilers, steam generators, and process heaters fired on a variety of solid fuels: coal, petroleum coke, biomass, tire-derived fuel, and municipal solid waste (MSW). On December 16, 2021, the District Governing Board adopted amendments to Rule 4352 to include even more stringent NOx emission limits for solid fuel fired boilers, steam generators, and process heaters operating in the Valley, as well as establish particulate matter (PM) and SOx emission limits. The compliance schedule would take place over two years, with full compliance with the emissions limits required by January 1, 2024. The adopted amendments to Rule 4352 are estimated to result in emissions reductions of 0.28 tpd PM2.5 and 0.71 tpd NOx in 2024.

4.2.1.7 Rule 4354 (Glass Melting Furnaces)

Rule 4354, adopted in 1994 and subsequently amended seven times, is one of the most stringent rules in the nation for controlling emissions from industrial glass manufacturing plants that make flat glass (window and automotive windshields), container glass (bottles and jars), and fiberglass (insulation). On December 16, 2021, the District Governing Board adopted amendments to Rule 4354 to include even more stringent NOx, SOx, and particulate matter 10 micrometers in diameter or smaller (PM10) emission limits for glass melting facilities operating in the Valley. The amended rule includes a phased-in compliance schedule which will result in emissions reductions of 0.13 tpd PM2.5 and 1.67 tpd NOx by 2030.

4.2.1.8 Rule 4550 (Conservation Management Practices)

Rule 4550 is the District's Conservation Management Practices (CMP) rule. Rule 4550 was the first rule of its kind in the nation to reduce fugitive particulate emissions from agricultural operations through the reduction of passes of agricultural equipment and implementation of other conservation practices. Rule 4550 uses a menu approach of control techniques to accommodate the variability of agricultural industries in the Valley. Agricultural operations are required to maintain detailed records verifying use of the approved CMPs. Approved CMP plans are enforced through onsite inspections and operators are required to submit applications and modify their plans when changing their CMPs.

4.2.1.9 Rule 4702 (Internal Combustion Engines)

Internal combustion (IC) engines are used in a variety of different Valley operations including schools, agriculture, oil and gas production, petroleum refining, and electrical power generation. On August 19, 2021, the District Governing Board adopted amendments to Rule 4702 to lower emission limits for NOx and VOCs for several categories of engines, establish PM requirements for all categories of IC engines affected by the rule, and establish SOx control requirements for agricultural engines. Compliance with these lower emission limits is required by 2024. The amendments result in emission reductions of 0.62 tpd NOx by 2024, and an additional 0.70 tpd NOx by 2030.

4.2.1.10 Rule 4901 (Wood-Burning Fireplaces and Wood-Burning Heaters)

The District takes a multifaceted and proactive approach to reducing emissions from wood burning fireplaces and wood burning heaters in the Valley. Rule 4901 reduces emissions from residential burning through stringent curtailment requirements during the wood-burning season. Through the District Residential Woodsmoke Reduction Program, the District has declared and enforced episodic wood burning curtailments, also called "No Burn" days, since 2003. The Residential Woodsmoke Reduction Program, including regulatory curtailments under District Rule 4901, reduces harmful species of PM2.5 when and where those reductions are most needed, in impacted urbanized areas when the local weather is forecast to hamper particulate matter dispersion. The District amended Rule 4901 in June 2019, establishing the most stringent regulatory curtailments in the nation. Most recently, the District amended Rule 4901 on May 18, 2023, to further strengthen contingency provisions and enhance the stringency of this rule.

4.2.1.11 Rule 4902 (Residential Water Heaters)

Rule 4902 controls NOx emissions from natural gas-fired residential water heaters with heat input rates less than or equal to 75,000 Btu/hr, by enforcing a NOx emissions limit of 40 nanograms of NOx per Joule (ng/J) of heat output. The District amended Rule 4902 in 2009 to further reduce emissions by lowering the limit to 10 ng/J for new or replacement water heaters and to a limit of 14 ng/J for tankless/instantaneous water heaters. As a point-of-sale rule, emissions will continue to be reduced as older units are replaced through attrition. The 2012 requirements were estimated to achieve 1.06 tpd NOx reductions by 2024.

4.2.1.12 Rule 4905 (Natural Gas-Fired, Fan-Type Residential Central Furnaces)

Rule 4905 limits NOx emissions from central furnaces supplied, sold, or installed in the Valley with a rated heat input capacity of less than 175,000 Btu/hour. Amendments in January 2015 lowered the NOx emissions limit from 40 ng/J to 14 ng/J with an associated sell-through period and emissions fee period to allow manufacturers time to develop new compliant furnaces. Due to the limited number of certified compliant units that would have been available by the deadlines set in the 2015 amendment, the rule has been amended to extend the emissions fee periods for certain unit types, with deadlines ranging from 2019-2025, depending on unit size and category. As a point-of-sale rule, emissions will continue to be reduced as older units are replaced through attrition. The 2015 amendments will result in 2.10 tpd NOx reductions by 2045.

4.2.1.13 Rule 9510 (Indirect Source Review)

District Rule 9510 is the only rule of its kind in the state of California and throughout the nation that applies to new development projects, including residential and commercial development projects, and transportation and transit projects. The District’s rule is recognized as the benchmark, or best available control, for regulating these indirect sources of emissions. The purpose of this rule is to reduce the growth in emissions from mobile and area sources associated with construction and operation of new development projects in the Valley. This is achieved by encouraging clean air designs to be incorporated into the development project, or, if insufficient emissions reductions can be designed into the project, by paying a mitigation fee used to fund off-site emissions reduction projects.

4.2.1.14 Rule 9610 (State Implementation Plan Credit for Emission Reductions Generated Through Incentive Programs)

Rule 9610, adopted on June 20, 2013, serves as an administrative mechanism for the District to receive credit towards SIP requirements for emission reductions achieved in the Valley through incentive programs administered by the District, the Natural Resources Conservation Service (NRCS), and CARB. Through program implementation and reporting, the goal is to receive credit for incentive-based emission reductions that satisfy EPA requirements.

4.2.1.15 Regulation VIII (Fugitive PM10 Prohibitions)

The Regulation VIII rules were adopted in November 2001, and subsequently amended in 2004 to incorporate more stringent requirements. These rules reduce fugitive dust from construction sites, earthmoving activities, parking and staging areas, open areas, agricultural operations, carryout and trackout, paved and unpaved roads, and material storage sites.

4.2.2 New District Emission Reduction Measures

4.2.2.1 Rule 4550 (Conservation Management Practices)

Rule 4550 was adopted to help bring the Valley into attainment of federal PM10 standards, and applies to on-field farming and agricultural operation sites located within the Valley. Rule 4550 was the first rule of its kind in the nation to target fugitive particulate emissions from agricultural operations, and it has served as a model for other regions. The District worked extensively with numerous stakeholders, growers, and the Agricultural Technical Committee for the San Joaquin Valleywide Air Pollution Study Agency (AgTech) for two years prior to developing the CMP Rule. The District also worked with agricultural stakeholders and other agencies, such as NRCS, following rule adoption to ensure affected sources were assisted as much as possible in understanding and complying with the requirements of Rule 4550. Implementation of Rule 4550 by agricultural operations has resulted in the reduction of PM2.5 emissions through the reduction of passes of agricultural equipment and implementation of other conservation practices. Through this rule, PM emissions have been reduced by 35.3 tpd.

While attainment modeling has demonstrated that additional CMPs will not significantly contribute to our attainment efforts, to further develop the District's understanding of the effectiveness of CMP measures on controlling PM2.5 emissions in the Valley, the District is committing to continue supporting and reviewing scientific research on the PM2.5 content, constituents, and stability during wind events of the many soil types found throughout the Valley. This ongoing evaluation will be conducted in close coordination with NRCS, agricultural sources, researchers through established processes including the San Joaquin Valleywide Air Pollution Study Agency, Policy Committee, and AgTech.

Although Rule 4550 already meets BACM and MSM for this source category, the District will go beyond MSM in this Plan and is committing to evaluate the feasibility and effectiveness of CMPs on fallow lands that are tilled or otherwise worked with implements of husbandry to reduce windblown PM2.5 emissions from disturbed fallowed acreage. This evaluation will rely on ongoing review of research, in coordination with NRCS, agricultural sources, and researchers, which recognizes the Valley's unique soil characteristics and agricultural practices to ensure that Valley-specific solutions are considered in this process. This commitment is being carried over from the District's *2018 PM2.5 Plan.* The District is currently conducting a robust rule development process to evaluate these opportunities, working collaboratively with industry stakeholders, NRCS, and other agencies to develop proposed rule amendments.

4.2.2.2 Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters)

The District's residential wood burning emission reduction strategy includes wood burning curtailments implemented through District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters), in conjunction with the District's incentive grant program for fireplace and woodstove change-outs, and robust public education and outreach efforts. This approach is designed to improve public health by reducing toxic wood smoke emissions in Valley neighborhoods during the peak PM2.5 winter season (November through February), and has proven to be extremely effective in advancing the District's objectives to attain the PM2.5 federal standards and protect public health.

While the District meets or exceeds BACM and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the 2012 annual PM2.5 standard, the District commits to further reduce PM2.5 emissions from wood burning fireplaces and heaters by extending the wood burning season through March 31.

4.2.2.3 Fireplace and Woodstove Change-Out Program

The District currently operates the Fireplace & Woodstove Change-Out Program (formerly known as the Burn Cleaner Program) to reduce emissions from residential wood burning. The Program helps Valley residents replace their current high-polluting wood-burning devices and open hearth fireplaces with cleaner alternatives such as natural gas or EPA-certified wood/pellet devices, and electric heat pumps. Through this Program, residents reduce directly emitted PM2.5 emissions in areas and times where those reductions are needed most. Given the potentially high cost of these new devices, this Program provides a reduced upfront cost to low-income qualified applicants to encourage their participation by applying the incentive at point of purchase. In 2022, the District Governing Board approved the latest enhancements to the Program, which includes increased incentives for the installation of natural gas or electric devices to offset rising prices of device and labor costs due to inflation. In addition to increased incentives, a new component for fireplace decommissioning was incorporated into the Program.

The Program has replaced approximately 30,000 wood burning devices with EPA-certified devices, clean-burning natural gas or electric heat pumps to date. The District encourages Valley residents to transition from older, higher polluting, wood burning fireplaces to cleaner alternatives by decreasing the number of allowable burn days for these types of devices while also increasing the number of burn days allowed for registered clean wood burning devices through the District's Rule 4901 tiered episodic wood burning curtailment program.

On November 28, 2023, EPA finalized approval of the incentive measure into the SIP, making the determination that the program complies with CAA requirements.[2]

[2] 88 FR 83034. Retrieved from: https://www.govinfo.gov/content/pkg/FR-2023-11-28/pdf/2023-26013.pdf

However, as part of the approval, EPA did not include SIP credit for the quantified emission reductions achieved by the measure. The significant emission reductions achieved through this successful program contribute towards expeditious attainment of the 2012 annual PM2.5 standard and are necessary to demonstrate attainment of the standard by 2030. Therefore, as part of this Plan's attainment strategy, the District is requesting that EPA provide the District SIP credit for the emissions reductions achieved by this program. In addition, the District will be quantifying and requesting SIP credit, through the existing quantification methodology approved by EPA, for projects completed through 2026.

4.2.2.4 Low-Dust Nut Harvester Replacement Program

Over the past decade, there has been a significant increase in acreage devoted to nut crops in the San Joaquin Valley. Given the highly visible particulate emissions associated with nut harvesting activities, the agricultural community, in partnership with the District and USDA-NRCS, has been working to develop and promote a variety of best practices and new technologies for reducing harvest-related particulate emissions.

While modeling conducted for the District's Plan indicates that reducing nut harvester emissions in rural areas do not significantly impact the Valley's peak urban PM2.5 locations that drive the Valley's federal attainment mandates, the District has prioritized identifying cost-effective measures for reducing particulate emissions from this sector. Although mobile source emissions are under the jurisdiction of CARB and EPA, in an effort to continue to reduce dust and local emissions due to harvesting activities, the District, in partnership with CARB, U.S. EPA, USDA-NRCS, and the agricultural sectors, have invested in incentivizing the turnover of traditional nut harvesting technology with low-dust alternatives.

To support these goals of reducing localized dust emissions from harvesting activities, the District Board has long supported efforts to conduct research and evaluate technologies to reduce emissions in the Valley, including dust from nut harvesting operations. In line with this priority, the District, in partnership with other agencies and the agricultural industry, has conducted studies to demonstrate that low-dust nut harvesting technology can be effective at reducing localized PM emissions associated with harvesting activities, with results showing reductions of localized PM emissions by more than 40%, and in some cases up to nearly 80%. Additionally, working with agricultural stakeholders, a scientific survey was conducted that concluded that a significant portion of nut crop growers and custom harvesters were interested in demonstrating new lower-emitting harvest technologies if provided with meaningful financial incentives.

In 2017, the District Governing Board established the Community-Level Targeted Strategy, which led to the development of the first-in-the-nation Low-Dust Nut Harvester Replacement Program in partnership with Valley Agriculture. Through success in competing for and leveraging local and federal funds, the District has been successful in replacing nut harvesters throughout the Valley with lower-dust alternatives, leading to significant emission reductions from these activities, and reducing dust exposure in nearby communities. The program builds upon more than a decade of significant investments made in the San Joaquin Valley to develop low-dust nut harvesting technologies and to understand the potential benefits in reducing PM emissions from the use of these new technologies. To date, the District has successfully obligated over $20.7 million to replace 241 pieces of nut-harvesting equipment with low-dust nut harvesting equipment through the Low-Dust Nut Harvester Replacement Program, which has resulted in the reduction of more than 11,000 tons of PM10 and 1,400 tons of PM2.5. Most recently in May 2023, the District Governing Board accepted EPA's award under the Targeted Airshed Grant Program which included an additional $10,000,000 in funding to deploy this new equipment, which reflects the District's ongoing commitment and success in working with Valley agriculture to accelerate the deployment of cleaner technologies through innovative locally-developed programs.

Additionally, to facilitate the transition to low-dust nut harvesting technology, in April 2024, based on recommendations from the San Joaquin Valley-wide Air Pollution Study Agency AgTech Committee, the District added Low-Dust Nut Harvesters to the approved CMP list for Nut Crops. Through Rule 4550's menu-based approach, as upheld in court, nut farmers may now select to use a low-dust harvester as part of complying with the requirements of the Rule. This represents the District's latest efforts to promote the use of low-dust nut harvesters in the Valley, leading the nation on the deployment of this technology.

In order to successfully continue efforts to reduce emissions from harvesting in the San Joaquin Valley and achieve ongoing localized community benefits, ongoing discussion and evaluation of the challenges and opportunities in the coming years is warranted. The San Joaquin Valley has demonstrated tremendous success in developing and deploying new technologies for reducing emissions from nut harvesting, and ongoing efforts to replace existing nut harvesting equipment and practices with new technology must be developed in light of evolving and difficult market conditions that, if not carefully considered, could significantly impact the future success of this effort. To continue progress in reducing emissions from nut harvesting, the District will pursue the following strategy in close collaboration with industry stakeholders, AgTech, USDA-NRCS, CARB, and EPA:

- Evaluate potential enhancements to the District's emission reduction strategy for nut harvesting emissions (Low-Dust Nut Harvester Replacement Incentive Program, CMP Program, collaborative outreach efforts, etc.) to continue supporting the accelerated deployment of low-dust harvesters.
- Building on prior successful research efforts conducted in partnership with Valley agriculture and agencies, support research efforts aimed at furthering the understanding of the amount and type of harvesters operating in the San Joaquin Valley, and potential emissions reductions achievable through newly available harvester technologies (including evolving practices such as the use of conditioning equipment).
- Continue incentive-based efforts supporting the accelerated deployment of cleaner technologies for nut harvesting, including the current allocation of $25 million in funding for the Low-Dust Nut Harvester Replacement Program in the

Adopted 2023-24 District Budget and Recommended 2024-25 District Budget. Based on historical program participation, this funding is estimated to facilitate the replacement of approximately 350 additional harvesters with low-dust nut harvesting equipment. The District will also continue to advocate for additional state and federal funding in support of this effort.

4.2.3 Evaluating Control Measures for New Control Strategy Opportunities

The District expended extensive efforts to identify and evaluate potential emission reductions opportunities from each control measure source category. As part of the regulatory evaluation, District rules and source categories were compared to federal and state air quality regulations and standards, and the regulations and standards in other air districts. District rules and regulations were compared to federal regulations and guidance documents including Control Techniques Guidelines (CTG), Alternative Control Techniques (ACT),[3] and New Source Performance Standards (NSPS).[4] California state regulations, due to regulatory authority, are primarily applicable to mobile sources and consumer products. State regulations also include the California Health and Safety Code (CH&SC) and CARB Airborne Toxic Control Measures (ATCM) requirements, which are applicable to stationary and area sources.[5] The District's regulatory evaluation includes state guidelines that are applicable to the source category.

All potential best available control measures (BACM) and most stringent measures (MSM) identified through this regulatory evaluation were thoroughly evaluated using the key factors defined in EPA's 2016 *Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements*, to determine if potential opportunities qualify as BACM/MSM for the Valley.

In addition to evaluating measures adopted by other air quality agencies, the District looked for any control technologies not already required that might be available to further reduce emissions from sources of air pollution in the Valley. This includes new technologies and technologies that may not have been cost effective in the past. The technologies used in BACT guidelines; permits; and other air districts' rules, regulations, guidelines, and studies were reviewed for their feasibility, including how commercially available the technology currently is and whether the technology has been achieved in practice. Cost effectiveness analyses of various control measures include examining the added cost, in dollars per year, of the control technology or technique, divided by the emissions reductions achieved, in tons per year. The District does not have a pre-determined cost effectiveness threshold, but control options that have extremely high costs per ton of pollutant reduced are generally unreasonable and not feasible for regulation.

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[3] EPA. Alternative Control Techniques. Retrieved from: https://www.epa.gov/ground-level-ozone-pollution/control-techniques-guidelines-and-alternative-control-techniques

[4] EPA. 40 CFR 60 – Standards of Performance for New Stationary Sources (NSPS). Retrieved from: https://www.epa.gov/stationary-sources-air-pollution/new-source-performance-standards

[5] CARB. Airborne Toxic Control Measures (ATCMs). Retrieved from: https://ww2.arb.ca.gov/resources/documents/airborne-toxic-control-measures

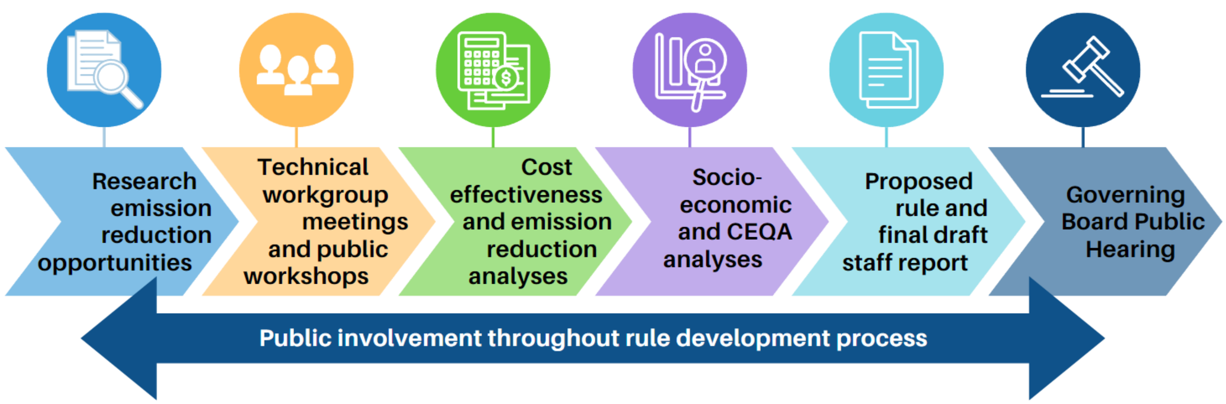
Efforts to identify feasible emission reduction opportunities also include the evaluation of additional control technologies or practices, if any, not already included in previously mentioned BACM/MSM evaluations for the area. This evaluation process considers any emission reduction opportunities that were previously adopted by the District plans that were determined to be beyond reasonably available control technology (RACT) at that time, and any new emission reduction opportunities adopted in California state implementation plans (SIP), SIPs in other states, or achieved in practice in other areas. Any potential BACM/MSM identified were then thoroughly evaluated for technological and economic feasibility. In evaluating the technological and economic feasibility of potential BACM/MSM, the District reviews staff reports and studies from other air districts, EPA technical guidance documents, and applicable study data from the scientific community. The District has evaluated all sectors and equipment types for additional emission reduction opportunities, as presented in Appendix C.

This Plan demonstrates that all District rules continue to meet or exceed measures identified by the EPA as BACM and MSM as defined above and demonstrated in Appendix C.

4.2.4 Implementation of Regulatory Measures

After plan adoption, the District adopts or amends rules per the plan's regulatory control measure commitments. In these efforts, the District is committed to a transparent public process that includes stakeholder, industry, and other-agency input at every step possible.

Figure 4-1 Rule Development Process



Contrasting the broader plan development effort, the rule development process allows greater focus on a single sector or technology area. Early in the rule development process, prior to preparing a draft rule, staff researches technologies and explores options for emissions reductions, gathering preliminary data and performing literature reviews of relevant studies. Through a series of public workshops and focus group meetings, staff presents draft rule concepts and receives feedback on specific technology costs, technical insight, and general public comments. Staff uses this information gathering and discussion to refine the rule throughout the rule development process. Using this iterative process of gathering the most up-to-date cost and technical information, staff analyzes cost-effectiveness and potential emissions reductions. These analyses are shared with the public throughout the rule development process.

During the ongoing public workshop process, the District enlists the services of an economic consultant to analyze the proposed rule's socioeconomic impact, pursuant to CH&SC Section 40728.5. As with draft versions of the rule, the District gives the public and stakeholders the opportunity to review the analysis and provide further feedback. To the extent possible, the District minimizes significant economic and socioeconomic impacts by evaluating viable alternatives, adjusting proposed limits, or extending compliance schedules.

Staff presents the final draft version of the staff report and proposed rule, including the cost-effectiveness analysis, socioeconomic impact report, emissions reductions analysis, RACT analysis, and California Environmental Quality Assessment (CEQA), to the Governing Board during a public hearing. The Governing Board ultimately determines the balance between air quality improvement and rule impacts when adopting proposed rules.

Once adopted, the District forwards the rule through CARB to EPA for inclusion into the SIP, as appropriate. EPA evaluates the rule, determines if the rule meets federal requirements, and provides an opportunity for further public comment. After this review and comment period, EPA will amend the SIP to include the new rule, as appropriate.

Beyond the rule development and adoption process, District staff will continue to engage the public and affected source operators throughout implementation and compliance. Additionally, District staff continues public outreach and education through notifications to stakeholders of the rule adoption, issuance of compliance assistance bulletins, and assistance through the District's Small Business Assistance program.

4.2.5 Areas for Further Study

While the District and CARB's programs are the most aggressive and innovative in the nation, the District is committing to evaluate the next generation of innovative control technologies and seek additional emission reduction opportunities across a number of stationary and area source sectors, including residential and commercial heating, stationary NOx and PM sources, energy and climate change programs, clean landscaping equipment and practices, and other innovative measures to pursue additional emission reduction opportunities as technologies, practices, and policies evolve in the future. The District identified the following stationary and area source sectors and potential measures for further study, which are discussed in more detail below. The District will be evaluating these further study measures through the Plan's attainment year of 2030.

- Residential and Commercial Heating Measures
- Commercial Charbroiling Measures
- Stationary Combustion NOx Measures

- Stationary Source PM Measures
- Energy and Climate Change Programs
- Clean Landscaping Equipment and Practices
- Other Innovative Measures

4.2.5.1 Residential and Commercial Heating Measures

Many appliances and devices, such as water heaters and furnaces, use natural gas or liquefied petroleum gas (fossil fuel) as a fuel source. These appliances have the potential to emit a significant amount of NOx during combustion and VOCs from gas leaks. The District enforces stringent requirements through 4308 (Boilers, Steam Generators, and Process Heaters – 0.075 MMBtu/HR to Less Than 2.0 MMBtu/HR), District Rules 4902 (Residential Water Heaters), and 4905 (Natural Gas-Fired, Fan-Type Central Furnaces), to reduce emissions from these source categories. In addition to reducing emissions from this source category through regulatory requirements, the District offers incentives through the Fireplace and Woodstove Change-Out Program to purchase and install cleaner space-heating devices such as heat pumps.

Zero-NOx alternatives to natural gas-fired appliances are currently available through electric options such as the aforementioned heat pump space heaters, but also heat pump water heaters. However, a number of barriers have prevented widespread electrification throughout the Valley, state, and nation. Important factors that must be considered before implementing zero-NOx appliance standards include technical feasibility, costs and affordability, power supply and grid capacity, and consumer acceptance, adoption, awareness, and readiness. There are considerable economic barriers to adopting a zero-NOx appliance standard that would require electrification, particularly with respect to lower income households, given the significantly higher upfront costs associated with electrical infrastructure upgrades and the devices themselves. Infrastructure upgrades include new electrical panels with increased amperage breakers and heavier, lower gauge, wiring run through the structure to support the devices. Careful equity considerations must be taken into account as new measures are developed, and the District must evaluate the specific economic challenges that exist for Valley residents. Additionally, a concerted effort is needed across all levels of government, utilities, appliance manufacturers, developers, contractors, households, and businesses to achieve this goal successfully and equitably.

Over 70 California cities and counties have adopted local ordinances requiring varying degrees of electrification for new buildings. The first of these ordinances, passed in the City of Berkeley in August 2019, enacted a building code prohibiting natural gas piping into new buildings. However, this ordinance was invalidated when the U.S. Ninth Circuit Court of Appeals held that the ban on natural gas was preempted by federal energy efficiency laws, setting precedent that blocks local government from using similar bans.[6]

[6] U.S. Courts for the Ninth Circuit. California Restaurant Association v. City of Berkeley. Retrieved from: https://www.ca9.uscourts.gov/cases-of-interest/california-restaurant-association-v-city-of-berkeley/

Following the ruling, a number of cities and counties with adopted natural gas bans have suspended enforcement of their ordinances.

In an effort to identify potential emission reduction opportunities, the District's *2022 Plan for the 2015 8-Hour Ozone Standard* (*2022 Ozone Plan*) included a further study commitment to evaluate current and upcoming work from CARB and other agencies related to reducing emissions from residential and commercial combustion sources, and to evaluate the feasibility of implementing a zero-NOx standard for these sources in the Valley. Through this effort, the District will also evaluate opportunities to advocate for funding under the Inflation Reduction Act (IRA), Bipartisan Infrastructure Law, and other funding sources, which are prioritizing funding opportunities for electrification of appliances to reduce greenhouse gas (GHG) emissions. The District will continue to closely track regulations being developed by CARB, South Coast Air Quality Management District (SCAQMD), Bay Area Air Quality Management District (BAAQMD), and others.

The District continues to support CARB in the development and implementation of a statewide zero-NOx appliances measure, as it will result in direct air quality and public health benefits for the Valley. Additionally, as part of this Plan, the District commits to further evaluating potential opportunities to reduce NOx emissions from natural gas building appliances in the Valley. As part of this evaluation, the District will consider the implementation of zero-NOx requirements earlier than CARB's statewide measure, to the extent that measures are technologically and economically feasible in the Valley. The District will collaborate with utilities, agencies, and organizations to help leverage funding and coordinate incentives with existing programs.

4.2.5.2 Commercial Charbroiling Measures

District Rule 4692 reduces PM emissions by requiring catalytic oxidizers for chain-driven charbroilers, including those used in many typical fast-food restaurants. Rule 4692 is among the most stringent rules in the nation for controlling emissions from commercial charbroiling operations. The original rule, adopted in March 2002, reduced PM2.5 emissions from chain-driven charbroilers by 84%. The September 2009 rule amendment expanded rule applicability to more chain-driven charbroilers. Rule 4692 has been fully implemented since 2011.

In addition to the existing emissions reductions already achieved through control requirements for chain-driven commercial charbroilers, the District continues to seek to achieve additional emission reductions from commercial underfired charbroilers. While there are ongoing improvements in the technology available for commercial cooking emissions, many technological and economic challenges remain, specifically for underfired charbroilers, as detailed in Appendix C.

The need to reduce PM2.5 from commercial charbroiling continues to grow as EPA promulgates more stringent PM2.5 NAAQS. The lack of commercially available and feasibly demonstrated control technologies has been the primary barrier in moving forward with control strategies for reducing emissions from restaurants equipped with commercial charbroilers. Other air districts in California and other regions have encountered similar difficulties in identifying and requiring emissions control technologies for underfired charbroilers. Based on the importance of underfired charbroiling emissions as it relates to attainment of the federal PM2.5 standards in the future, collaborative work is needed to further understand the emissions from underfired charbroiling, including potential control strategy opportunities to reduce emissions from this category.

The District has previously collaborated with other agencies including CARB, SCAQMD, and BAAQMD to evaluate and implement control strategies for underfired charbroilers. While significant work has been done, to date, barriers still exist to the commercial deployment of underfired charbroiler technology.

The District has recently formed the Charbroiler Collaborative Workgroup, consisting of the District, SCAQMD, BAAQMD, and CARB, to assist in overcoming all obstacles, including costs and emissions control issues preventing widespread control of underfired charbroilers. Through this collaborative and internally, the District commits to ongoing evaluation of potential controls for underfired charbroilers.

4.2.5.3 Stationary Combustion NOx Measures

The District’s current NOx control measures, coupled with the rule-strengthening commitments included in this Plan, represent the most stringent measures feasible for stationary combustion sources in the Valley. The District’s regulations have reduced NOx emissions from stationary sources by over 93%, and the commitments included in this Plan to strengthen regulatory measures for stationary gas turbines and boilers, steam generators, and process heaters, will further reduce NOx emissions that contribute to PM2.5 formation in the Valley.

Although the District is currently implementing stringent regulations for stationary combustion sources throughout the Valley, technology continues to evolve and improve, resulting in significant advancements in performance and NOx removal efficiencies. The District will continue to evaluate the feasibility and potential of emerging technologies, including zero-emission technologies, as they become available through the Plan’s attainment year of 2030.

4.2.5.4 Stationary Source PM Measures

The District’s current stationary source control program, further strengthened by the commitments included in this Plan, represents one of the most stringent stationary source control programs in the nation, including wide-ranging controls for PM. In addition to the commitments to expand control requirements and enhance incentive programs for residential and commercial sources of PM, the District will continue to evaluate the feasibility and potential of emerging technologies, including zero-emission technologies, as they become available through the Plan’s attainment year of 2030.

4.2.5.5 Energy and Climate Change Programs

Federal, state, and local mandates and programs aim to reduce GHG emissions and energy usage, and improve energy efficiency. The District's traditional air quality strategies focus on regulatory measures to reduce emissions of criteria air pollutants (NOx, VOC, PM2.5, etc.). However, in an effort to pursue all available opportunities, the District will continue to identify opportunities to gain co-benefits from existing and future programs related to greenhouse gas reductions, energy efficiency, energy usage, and other climate change initiatives, and seek opportunities to provide incentive funding to promote building decarbonization throughout the Valley. In particular, there are unprecedented funding opportunities through the Bipartisan Infrastructure Law,[7] which provides $550 billion over fiscal years 2022 through 2026 in new federal investment in infrastructure, and the IRA,[8,9] which seeks to reduce GHG emissions and energy usage through tax credits or rebates. The District will collaborate with federal, state, and local air districts and other agencies to identify and evaluate opportunities, including advocating for incentives from state and federal sources.

4.2.5.6 Clean Landscaping Equipment and Practices

The District has long supported efforts to address emissions from the use of landscaping equipment, including through the deployment of clean zero-emissions equipment under the Clean Green Yard Machines (CGYM) Residential Rebate Program and Zero-Emission Landscaping Equipment (ZELE) Voucher Program, which provide funding for the replacement of old gas-powered lawn and garden equipment with new electric equipment. The Residential CGYM program, launched in 2001, provides rebates to San Joaquin Valley residents through the below two options. This program has issued over 15,000 rebates for electric lawn care equipment for a total of over $2.7 million in funding.

- Option 1: Replacing an old gas-powered lawn mower with a new electric lawn mower, and requiring the permanent destruction/dismantling of the old lawn mower.
- Option 2: Purchasing eligible new electric lawn and garden equipment such as lawn mowers, hedge trimmers, edgers, string trimmers, pole saws and chainsaws. Applicants are not required to destroy/dismantle an old piece of equipment under this option.

In May 2019, the District launched the Commercial CGYM Program to assist commercial operators with the purchase of new electric landscaping equipment. To further support the program, the District applied for and was awarded over $6 million in state funding in 2022. With this additional funding, the Commercial CGYM program was

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[7] Congress. *H.R.3684 - Infrastructure Investment and Jobs Act (IIJA)*. (November 15, 2021). Retrieved from: https://www.congress.gov/117/bills/hr3684/BILLS-117hr3684enr.pdf
[8] Congress. *H.R.5376 - Inflation Reduction Act of 2022*. (August 16, 2022). Retrieved from: https://www.congress.gov/bill/117th-congress/house-bill/5376/text
[9] The White House. *By the Numbers: The Inflation Reduction Act*. (August 15, 2022). Retrieved from: https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/15/by-the-numbers-the-inflation-reduction-act/

relaunched as the ZELE Voucher program in May 2023 to streamline the administration of the program and align its implementation with state guidelines.

Through the ZELE Voucher program, funding is provided to commercial landscaping equipment operators through a voucher process. As part of the program requirements, applicants must replace their existing, in-use gas-powered landscaping equipment with zero-emission electric options, and the old equipment must be rendered permanently inoperable by a licensed dismantling facility. In addition to new equipment, ZELE vouchers can be used to purchase batteries and/or chargers necessary to ensure that the equipment is capable of operating a full day of work. Since the launch of the ZELE Voucher Program, the District has awarded 924 vouchers for a total of over $2.3 million in funding (as of March 31, 2024).

Existing CARB and EPA emission standards for small off-road engines (SORE), which primarily includes lawn and garden equipment, have led to substantial emission reductions in California. Since 2000, emissions of pollutants that contribute to ozone and PM2.5 formation from SORE have decreased by 50 percent. Even so, in California, SORE emit more NOx and reactive organic gases (ROG) than light-duty passenger cars, both in summer and annually.[10] However, recently amended SORE regulations approved by CARB in December 2021 require most newly manufactured SORE engines be zero-emission starting in 2024, which will help achieve further emission reductions from lawn and garden equipment.[11]

In light of new opportunities, the District will work with landscaping services and local jurisdictions to pursue options for accelerating the deployment of newly available commercial zero-emissions equipment, promoting landscaper training and green certification programs, and promoting best practices to reduce exposure through episodic and zoning recommendations (e.g. limiting leaf blower use around children during school hours, “green zones”).

4.2.5.7 Other Innovative Measures

The District will continue to evaluate innovative, out of the box measures to pursue additional emission reduction opportunities as technologies, practices, and policies evolve in the future. These measures could include enhancements to the District’s public outreach and communication strategy and continued support of enhanced forest management strategies for wildfire prevention in the context of unprecedented funding at the state and federal level and State/Federal Roadmap to a Million Acres (RMA).

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[10] CARB. *Staff Report: Initial Statement of Reasons for the Proposed Amendments to the Small Off-Road Engine Regulations: Transition to Zero Emissions.* (October 12, 2021). Retrieved from: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/sore21/isor.pdf

[11] CARB. *CARB approves updated regulations requiring most new small off-road engines be zero emission by 2024.* (December 9, 2021). Retrieved from: https://ww2.arb.ca.gov/news/carb-approves-updated-regulations-requiring-most-new-small-road-engines-be-zero-emission-2024

4.3 CARB COMMITMENT FOR THE SAN JOAQUIN VALLEY

[*Section provided by the California Air Resources Board*]

4.3.1 Overview of Commitment

SIPs may contain enforceable commitments to achieve the level of emissions necessary to meet federal air quality standards, as defined by the attainment demonstration. CARB's *2022 State Strategy for the State Implementation Plan* (2022 State SIP Strategy) lists new SIP measures for which potential emissions reduction SIP commitments for the San Joaquin Valley in 2030 are now estimated based on the measures identified and quantified to date. Adoption of the 2022 State SIP Strategy and the measure schedule by the CARB Board on September 22, 2022 formed the basis of the commitments for emission reductions by the 2030 attainment deadline for the San Joaquin Valley that will be proposed for CARB Board consideration alongside the 2024 San Joaquin Valley PM2.5 Plan. The commitments consist of two components:

1. A commitment to bring an item to the CARB Board for defined new measures or take other specified actions within CARB's authority; and
2. A commitment to achieve aggregate emission reductions by specific dates.

As part of each SIP needing emission reductions from the State, the total aggregate emission reductions and the obligation to make certain proposals to the CARB Board or take other actions within CARB's authority specified in the 2022 State SIP Strategy would become enforceable upon approval by U.S. EPA. While the 2022 State SIP Strategy discusses a range of measures and actions, those measures and actions are still subject to CARB's formal approval process and would not be final until the CARB Board takes action.

4.3.1.1 Commitment to Act on Measures

For each of the SIP measures shown in Table 4-4, CARB committed in the 2022 State SIP Strategy to address each measure as described. For each measure committed to, CARB staff would undertake the actions detailed for each measure. In the instance of measures that involve the development of a rule under CARB's regulatory authority, CARB committed to bring a publicly noticed item before the CARB Board that is either a proposed rule, or is a recommendation that the CARB Board direct staff to not pursue a rule covering that subject matter at that time. This recommendation would be based on an explanation of why such a rule is unlikely to achieve the relevant emission reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. This public process and CARB hearing would provide additional opportunity for public and stakeholder input, as well as ongoing technology review, and assessments of costs and environmental impacts.

The measures, as proposed by staff to the CARB Board or adopted by the CARB Board, may provide more or less than the initial emission reduction estimates. In addition, action by the CARB Board may include any action within its discretion.

Table 4-4 2022 State SIP Strategy Measures and Schedule

Measure	Action	Implementation Begins
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	2023	2024
Zero-Emissions Trucks Measure	2028	2030
On-Road Light-Duty		
Clean Miles Standard	2021	2023
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	2025	2029
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	2022	2024
Transport Refrigeration Unit Regulation Part 2	2026	2028
Commercial Harbor Craft Amendments	2022	2023
Cargo Handling Equipment Amendments	2027	2030
Other		
Zero-Emission Standard for Space and Water Heaters	2025	2030
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	2023	2024

4.3.1.2 Commitment to Achieve Emission Reductions

The following section describes the estimated emission reduction and potential commitment from the SIP measures identified and quantified to date for the San Joaquin Valley. The aggregate commitment of emissions reductions from State sources to be proposed for CARB Board consideration will be found in CARB's staff report for the 2024 San Joaquin Valley PM2.5 Plan when it is brought to the CARB Board and is summarized below.

While CARB includes estimates of the emission reductions in 2030 from each of the individual new measures, CARB's overall commitment is to achieve the total emission reductions necessary from State-regulated sources to attain the federal air quality standards, reflecting the combined reductions from the existing control strategy and new measures. Therefore, if a particular measure does not get its expected emission reductions, the State's overall commitment to achieving the total aggregate emission reductions still exists. If actual emission decreases occur that exceed the projections reflected in the current emission inventory, CARB will submit an updated emissions inventory to U.S. EPA as part of a SIP revision. The SIP revision would outline the changes that have occurred and provide appropriate tracking to demonstrate that aggregate emission reductions sufficient for attainment are being achieved through enforceable emission reduction measures. CARB's emission reduction commitments may be achieved through a combination of actions including but not limited to the implementation of control measures; the expenditure of local, State or federal incentive funds; or through other enforceable measures.

4.3.2 Emissions Reductions

CARB's control programs, including the measures in the 2022 State SIP Strategy provide emission reduction benefits throughout the State. Although the existing control program will provide mobile source emission reductions necessary to meet the attainment needs of many areas of the State, the remaining measures from CARB's *2016 State Strategy for the State Implementation Plan* (2016 State SIP Strategy) and new measures in the 2022 State SIP Strategy are needed to provide further reductions to achieve the 12 ug/m^3 PM2.5 annual standard in the San Joaquin Valley and enhance statewide air quality progress towards the 9 ug/m^3 annual PM2.5 standard promulgated in 2024.

4.3.2.1 Emission Reductions from Current Programs

Table 4-5 provides the mobile source emissions under CARB and district current programs for the San Joaquin Valley. Ongoing implementation of current control programs is projected to reduce mobile source emissions of direct PM2.5 and NOx by 3.2 tpd and 115.7 tpd, in San Joaquin Valley in 2030 compared to 2017 levels, respectively. Achieving the benefits projected from the current control program will continue to require significant efforts for implementation and enforcement and thus represents an important element of the overall strategy.

Table 4-5 San Joaquin Valley Baseline Mobile Source Emissions[12]

Pollutant	2017 Emissions (tpd)	2030 Emissions (tpd)	Change
PM2.5	8.4	5.2	-38%
NOx	191.4	75.7	-60%

4.3.2.2 Emission Reductions from 2022 State SIP Strategy Measures

In addition to controlling direct PM2.5, air quality modeling has determined that NOx is a significant precursor for the 12 ug/m3 annual PM2.5 standard in the San Joaquin Valley. Air quality modeling indicates that both direct PM2.5 and NOx emissions from all sources in San Joaquin Valley will need to decrease in order to attain the 12 ug/m^3 annual PM2.5 standard in 2030. A significant fraction of the needed reductions will come from the existing control program already in the baseline emission inventory. In addition, as described below, one measure commitment included in the 2016 State SIP Strategy has not yet been acted upon, and a number of measure commitments included in both the 2016 and 2022 State SIP Strategies were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 4-7 and Table 4-8 below.

[12] Source: 2022 PM2.5 CEPAM v1.00; represents the current baseline emissions with adopted CARB and district measures

The measures contained in the 2022 State SIP Strategy commitment reflect a variety of State actions across on-road and off-road vehicle and appliance sectors. Collectively, emissions reductions from CARB's current control program, reductions from the 2016 and 2022 State SIP Strategy measures adopted but not yet in the baseline, reductions from the remaining 2016 State SIP Strategy measures, and reductions estimated from the future measures identified in the 2022 State SIP Strategy and quantified below will provide the reductions needed from State sources to support attainment of the 12 ug/m^3 annual PM2.5 standard in the San Joaquin Valley. Table 4-6, Table 4-7, Table 4-8, and Table 4-9 summarize the reductions from the identified and quantified measures. In Table 4-6, the reductions estimated from the remaining 2016 State SIP Strategy measure and future measures identified in the 2022 State SIP Strategy are included as CARB's aggregate emissions reductions commitment for the year 2030.

Table 4-6 2030 San Joaquin Valley Emissions Reductions from CARB Programs[13]

CARB Programs in San Joaquin Valley	2030 NOx (tpd)	2030 PM2.5 (tpd)
Current Mobile Source Control Program[14]	115.6	3.2
2016 and 2022 State SIP Strategy Measures Adopted (Not yet in baseline inventory)	12.9	0.5
CARB Aggregate Emissions Reductions Commitment	7.3	0.2
2016 State SIP Strategy Measure Remaining	3.0	<0.1
2022 State SIP Strategy Measures Remaining	4.3	0.2
Total Reductions	**136.0**	**3.9**

Table 4-7 reflects the 2016 and 2022 State SIP Strategy measure commitments that the CARB Board has recently adopted. The associated emissions reductions from these recently adopted measures are not yet all accounted for in the baseline emissions inventory. Nonetheless, CARB measure commitments are achieving emissions reductions and will contribute towards attainment of the 12 ug/m^3 annual PM2.5 standard in San Joaquin Valley in 2030.

[13] Numbers may not add up due to rounding.
[14] Current Control Program represents the current baseline emissions with adopted CARB and district measures (Source 2022 PM2.5 CEPAM v1.00)

Table 4-7 San Joaquin Valley Expected Emissions Reductions from 2016 and 2022 State SIP Strategy Recently Adopted Measures[15]

Adopted 2016 and 2022 State SIP Strategy Measures	2030 NOx (tpd)	2030 PM2.5 (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	1.6	<0.1
Total On-Road Heavy-Duty Reductions	1.6	<0.1
On-Road Light-Duty		
Advanced Clean Cars II	0.3	0.1
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	0.3	0.1
Off-Road Equipment		
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	1.4	0.1
Commercial Harbor Craft Amendments	<0.1	<0.1
Transport Refrigeration Unit Part I	0.2	<0.1
Total Off-Road Equipment Reductions	1.6	0.1
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	9.2	0.2
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	9.2	0.2
Emissions Reductions	**12.9**	**0.5**

Although most of the CARB measure commitments from the 2016 State SIP Strategy have been adopted, there remains the Zero-Emission Forklift measure which will be acted upon by the CARB Board in 2024. In addition, there is one other measure commitment from the *San Joaquin Valley Supplement to the 2016 State Strategy to the State Implementation Plan*, the Accelerated Turnover of Agricultural Equipment measure, for which CARB has estimated reductions in 2030. While CARB adopted a SIP-creditable incentive measure to fulfill this commitment in 2019, CARB staff proposes to develop another SIP-creditable incentive measure to fully document the incentive projects from this Accelerated Turnover of Agricultural Equipment measure that provide for SIP credible emissions reductions in the 2030 attainment year. The 2030 quantification of these projects will be brought to the CARB Board for consideration in 2030. Table 4-8 below shows the timeline and anticipated emission reductions for these measures.

[15] Numbers may not add up due to rounding.

Table 4-8 San Joaquin Valley Reductions from Remaining 2016 State SIP Strategy Measures[16]

Remaining 2016 State SIP Strategy Measure	Action	Implementation Begins	2030 NOx (tpd)	2030 PM2.5 (tpd)
Zero-Emission Forklift	2024	2026	<0.1	<0.1
Accelerated Turnover of Agricultural Equipment	2030	Ongoing	3.0	NYQ
Total			**3.0**	**<0.1**

Finally, Table 4-9 reflects the CARB measures from the 2022 State SIP Strategy still to be brought to the CARB Board for consideration that will provide the final 4.3 tpd of NOx and 0.2 tpd of direct PM2.5 emissions reductions needed from State measures to support attainment of the 12 ug/m^3 annual PM2.5 standard in San Joaquin Valley in 2030.

Table 4-9 San Joaquin Valley Expected Emissions Reductions from the Remaining 2022 State SIP Strategy Measures[17]

Remaining 2022 State SIP Strategy Measures	2030 NOx (tpd)	2030 PM2.5 (tpd)
On-Road Heavy-Duty		
Zero-Emissions Trucks Measure	1.1	<0.1
Total On-Road Heavy-Duty Reductions	1.1	<0.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	0.6	<0.1
Transport Refrigeration Unit Part 2	1.3	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Total Off-Road Equipment Reductions	2.0	<0.1
Other		
Zero-Emission Standard for Space and Water Heaters	1.1	0.1
Total Other Reductions	1.1	0.1
Emissions Reductions	**4.3**	**0.2**

4.3.3 CARB Measures

4.3.3.1 On-Road Heavy-Duty

4.3.3.1.1 Advanced Clean Fleets Regulation

The Advanced Clean Fleets Regulation was adopted by CARB on April 27, 2023. This measure accelerates zero-emission vehicle (ZEV) adoption in the medium- and heavy-duty sectors by setting zero-emission requirements for fleets and a 100% ZEV sales requirement in California for manufacturers of Class 2b through 8 vehicles starting

[17] Numbers may not add up due to rounding.

in 2036. The Advanced Clean Fleets Regulation focuses on strategies that ensure the cleanest vehicles are deployed by government, business, and other entities in California while meeting their transportation needs. The requirements are phased-in on varying schedules for different fleets including drayage trucks, high priority private and federal fleets, and state and local government fleets. All drayage trucks operating at seaports and intermodal railyards are required to be zero-emission by 2035. Drayage trucks also have new registration and reporting requirements, starting in 2023. High priority private and federal fleets must only add ZEVs or near-zero-emission vehicles with minimum all electric range to the California fleet starting January 1, 2024. However, to provide flexibility, these fleets may opt into the ZEV milestone schedule which is a ZEV phase-in as a percentage of the California fleet and targets vehicles that are well suited for electrification starting in 2025. State and local government fleets are required to phase-in a ZEV purchase requirement starting at 50% of new purchases in 2024 and 100% starting in 2027 or these fleets may opt into the ZEV milestone schedule.

4.3.3.1.2 Zero-Emission Trucks Measure

This measure would increase the number of ZEVs and require cleaner engines to achieve emissions reductions from fleets that are not affected by the Advanced Clean Fleets Regulation. This would include potential zero-emissions zone concepts around warehouses and sensitive communities if CARB is given new authority to enact indirect source rules in combination with strategies to upgrade older trucks to newer and cleaner engines. This would be a transitional strategy to achieve zero-emissions medium- and heavy-duty vehicles everywhere feasible by 2045.

4.3.3.2 On-Road Light-Duty

4.3.3.2.1 Clean Miles Standard

The Clean Miles Standard was adopted by CARB on May 20, 2021. The primary goals of this measure are to reduce GHG emissions from ride-hailing services offered by transportation network companies (TNCs) and promote electrification of the fleet by setting an electric vehicle mile target, while achieving criteria pollutant co-benefits. TNCs would be required to achieve zero grams CO_2 emissions per passenger mile traveled and 90% electric VMT by 2030.

4.3.3.3 Off-Road Equipment

4.3.3.3.1 Tier 5 Off-Road Vehicles and Equipment

This measure would reduce NOx and particulate matter (PM) emissions from new off-road compression-ignition (CI) engines by adopting more stringent exhaust standards for all power categories, including those that do not currently utilize exhaust aftertreatment such as diesel particulate filters and selective catalytic reduction. This measure would be more stringent than required by current CARB, U.S. EPA and European Stage V nonroad regulations and would require the latest generations of emission control technologies.

For this measure, CARB staff would develop and propose standards for new off-road CI engines including the following: lower PM standards for engines less than 19 kilowatt (kW) (25 horsepower [hp]), lower NOx and PM standards for engines greater than or equal to 19 kW (25 hp) and less than 56 kW (75 hp), and more stringent aftertreatment-based PM and NOx standards for engines greater than or equal to 56 kW (75 hp). Other possible elements include new manufacturer-based in-use testing requirements, proposing more representative useful life periods, and developing a low load certification test cycle. It is expected that this comprehensive offroad Tier 5 regulation would rely heavily on technologies that manufacturers are developing to meet the recently approved low NOx standards and enhanced in-use requirements for on-road heavy-duty engines.

4.3.3.3.2 Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation

The amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation were adopted by CARB on November 17, 2022. This measure further reduces NOx and PM emissions from the in-use off-road diesel equipment sector by adopting more stringent requirements that target the oldest and dirtiest equipment that were previously allowed to operate indefinitely.

The amendments include a phase out schedule for most Tier 0, 1, and 2 engines between 2024 and 2036. This will allow a 12-year phase out of these oldest engines. Along with the engine tier phase out, adding vehicle provisions in the current regulation are extended to phase in a restriction on the adding of vehicles with Tier 3 and Tier 4 interim engines to fleets. The amendments also include new requirements for fleets to use renewable diesel (with some limited exemptions), new contracting requirements for prime contractors and public works awarding bodies to increase the enforceability and awareness of the regulation, and two optional flexibility provisions for fleet adoption of zero-emission vehicles. Additional modifications include clarifications to implementation, sunset of year-by-year low use, the addition of flexibility to permanent low-use, and the sunset of a provision that would have allowed small fleets to continue to operate vehicles that could not be retrofitted with a verified diesel emission control strategy indefinitely.

4.3.3.3.3 Transport Refrigeration Unit Regulation Part 2 (Non-Truck TRUs)

This measure is the second part of a two-part rulemaking to transition diesel-powered transport refrigeration units (TRUs) to zero-emission technologies. This measure would require zero-emission equipment for non-truck TRUs (trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets).

4.3.3.3.4 Commercial Harbor Craft Amendments

The amendments to the Commercial Harbor Craft Regulation were adopted by CARB on March 24, 2022. The amended regulation requires that starting in 2023 and phasing in through 2031, most commercial harbor crafts (CHCs) (except for commercial fishing vessels and categories listed below) are required to meet the cleanest possible standard (Tier 3 or 4) and retrofit with diesel particulate filters (DPFs) based on a compliance schedule. The prior regulated CHC categories are ferries, excursion, crew and supply, tug/tow boats, barges, and dredges. The amendments impose in-use requirements on the rest of vessel categories except for commercial fishing vessels, including workboats, pilot vessels, commercial passenger fishing, and all barges over 400 feet in length or otherwise meeting the definition of an ocean-going vessel. The amendments require engines on new build commercial fishing vessels to meet the most stringent marine standards (Tier 3 or Tier 4) or Tier 4 Final off-road emission standards. The amendments also remove the exemption for engines less than 50 hp.

The regulation also requires that, starting in 2025, all new and newly acquired excursion vessels to be plug-in hybrid vessels that are capable of deriving 30% or more of combined propulsion and auxiliary power from a zero-emission tailpipe emission source. Starting in 2026, all new, newly acquired and in-use short run ferries are required to be zero-emission; and starting in 2030 and 2032, all in-use commercial fishing vessels would need to meet a Tier 2 standard at minimum.

4.3.3.3.5 Cargo Handling Equipment Amendments

This measure would start transitioning Cargo Handling Equipment (CHE) to full zero-emission by 2030, with over 90% penetration of ZE equipment by 2036. Based on the current state of zero-emission CHE technological developments, the transition to zero-emission would most likely be achieved largely through the electrification of CHE. This assumption about aggressive electrification is supported by the fact that currently some electric rubber-tired gantry cranes, electric forklifts, and electric yard tractors are already commercially available. The zero-emission phase-in schedule will be determined by technology feasibility determinations and discussions with public stakeholders during the rulemaking process.

4.3.3.3.6 Accelerated Turnover of Agricultural Equipment

This measure would quantify the emission reduction benefits in 2030 from the Accelerated Turnover of Agricultural Equipment measure in the *San Joaquin Valley Supplement to the 2016 State Strategy to the State Implementation Plan*. The first SIP-creditable measure for the Accelerated Turnover of Agricultural Equipment measure was adopted by the CARB Board in December 2019 as the *San Joaquin Valley Agricultural Equipment Incentive Measure* and approved by U.S. EPA in December 2021.[18] The Accelerated Turnover of Agricultural Equipment measure uses incentive funds to achieve emissions reductions through accelerated turnover of older agricultural equipment to cleaner agricultural equipment. This measure builds upon the previous success of the agricultural community using incentives to turnover agricultural equipment. The Accelerated Turnover of Agricultural Equipment measure committed to achieving emissions reductions in 2024 and 2025, but many of the projects for which emissions reductions were quantified will continue to provide benefits in 2030 in the San

[18] 86 FR 73106

Joaquin Valley. In a SIP-creditable incentive measure to be brought to the CARB Board in 2030, CARB staff would fully quantify the emissions reductions benefits and document the relevant and previously completed projects from the Accelerated Turnover of Agricultural Equipment measure that are creditable through the 2030 attainment year.

Some of the most significant sources of mobile source emissions in the SJV are heavy-duty diesel engines, like those used in heavy duty trucks, locomotives, and agricultural engines. Incentive funds, like Carl Moyer and FARMER, have also been an important mechanism to accelerate emission reductions from these heavy-duty diesel engines. The State is working to provide additional incentives to the San Joaquin Valley Air Pollution Control District to help replace the dirtiest diesel engines with zero-emissions equipment where feasible. This new equipment will significantly reduce emissions of oxides of nitrogen and directly emitted diesel PM2.5, both critical to reducing PM2.5 levels and reaching attainment of the PM2.5 ambient air quality standard in the San Joaquin Valley. Moving diesel equipment to zero emissions where feasible is essential for the area, both for reaching attainment of the standard and reducing nearby risk for communities. Funding cleaner locomotives, zero emission trucks, zero and near zero emission off-road equipment and zero emission infrastructure will improve PM2.5 air quality and the health of San Joaquin Valley residents. The State and the San Joaquin Valley Air Pollution Control District continue to work diligently and together on solutions to the PM2.5 and other complex air quality challenges in the region.

4.3.3.4 Other

4.3.3.4.1 Zero-Emission Standard for Space and Water Heaters

For this measure, CARB would develop and propose zero-emission GHG standards for new space and water heaters sold in California; CARB could also work with air districts to further tighten district rules to drive zero-emission technologies. This measure would not mandate retrofits in existing buildings, but some buildings would require retrofits to be able to use the zero-emission technology that this measure would require. Beginning in 2030, 100% of sales of new space and water heaters (for either new construction or replacement of burned-out equipment in existing buildings) would need to meet zero-emission standards. It is expected that this regulation would rely heavily on heat pump technologies currently being sold to electrify new and existing buildings.

4.3.3.5 Primarily-Federally and Internationally Regulated Sources – CARB Measures

In addition to reducing emissions from the above sources, it is critical to achieve emissions reductions from sources that are primarily regulated at the federal and international level. It is imperative that the federal government and other relevant regulatory entities act decisively to reduce emissions from these primarily-federally and internationally regulated sources of air pollution. CARB and the air districts in California have taken actions to not only petition federal agencies for action, but also to directly reduce emissions using programmatic mechanisms within our respective authorities. CARB continues to explore additional actions, many of which may require a waiver or authorization under the Clean Air Act, as described below.

4.3.3.5.1 In-Use Locomotive Regulation

The In-Use Locomotive Regulation was adopted by CARB April 27, 2023. This measure uses mechanisms available under CARB's regulatory authority to accelerate the adoption of advanced, cleaner technologies, and include zero-emission technologies for locomotive operations. The In-Use Locomotive Regulation applies to all locomotives operating in the State of California with engines that have a total rated power of greater than 1,006 horsepower, excluding locomotive engines used in training of mechanics, equipment designed to operate both on roads and rails, and military locomotives. The measure reduces emissions by increasing use of cleaner diesel locomotives and zero-emission locomotives through a spending account, in-use operational requirements, and by an idling limit. By July 1, 2024, a spending account is established for each locomotive operator. Funds in the account are only to be used toward Tier 4 or cleaner locomotives until 2030, and at any time toward zero-emission locomotives, zero-emission pilot or demonstration projects, or zero-emission infrastructure.

For the in-use operational requirements, beginning January 1, 2030, only locomotives built after January 1, 2007, may operate in California. Each year after January 1, 2030, only locomotives less than 23 years old may operate in California. Additionally, under the in-use operational requirements, starting January 1, 2030, all switch, industrial, and passenger locomotives operating in California with an original engine build date 2030 or newer will be required to be zero-emission. Starting January 1, 2035, all freight line haul locomotives operating in California with an original engine build date 2035 or newer must be zero-emission. Locomotives equipped with automatic engine stop/start systems are to idle no more than 30 minutes unless an exemption applies. Also, locomotive operators would report locomotive engine emissions levels and activity on an annual basis.

4.4 FEDERAL CALL FOR ACTION

The CAA is a system of "cooperative federalism," where regions, states, and federal agencies work together to improve air quality and public health. As described above, for decades, the District has promulgated and implemented measures to reduce emissions from sources of air pollution under its regulatory authority. The District has also deployed innovative measures to reduce emissions from mobile and indirect sources of air pollution that fall outside its traditional regulatory authority with stationary sources. The District continues to seek additional local emissions reductions, but the Valley has reached a point where attainment of the health-based standards established under the CAA is not viable without significant quantifiable and enforceable reductions in emissions from mobile sources that fall exclusively under federal jurisdiction, such as interstate heavy-duty trucks, locomotives, aircraft, and other mobile sources. The South Coast air basin and other nonattainment areas find themselves in similar situations, and with ever-tightening federal air quality standards, many other regions throughout the nation will also face similar difficulties.

The District has jurisdiction over stationary and area sources, which make up less than 15% of the total NOx emissions inventory. With over 80% of the Valley's remaining ozone and PM2.5 precursor emissions now coming from mobile sources, of which 39% are under the federal government's jurisdiction, additional reductions from heavy-duty trucks and other mobile sources are needed for the Valley to reach federal air quality standards. The District has previously submitted petitions to the federal government requesting that they reduce their fair share of emissions in an equitable manner through more stringent national standards for heavy-duty trucks and locomotives. Similarly, in April 2017, CARB petitioned EPA to adopt more stringent emission standards for locomotives, in order to provide critical NOx and PM2.5 reductions specifically for disadvantaged communities surrounding railyards.[19] CARB asked EPA to update standards, to take effect for remanufactured locomotives in 2023 and for newly built locomotives in 2025. In response to the District and similar petitions submitted by CARB and SCAQMD, on January 24, 2023, EPA finalized a rule to reduce emissions from new heavy-duty trucks nationwide.[20] Additionally on November 9, 2022, EPA committed to evaluating and identifying potential regulatory actions to address emissions from locomotives.[21]

On November 8, 2023, EPA finalized changes to locomotive preemption regulations,[22] preserving the ability of California to adopt and enforce certain emission standards regulating non-new locomotives and engines if EPA has authorized such standards, and allowing other states to adopt those same California standards. EPA must continue to work towards addressing harmful emissions from new locomotives and new locomotive engines, which remain exclusively under federal authority. Most recently, on March 20, 2024, EPA announced a final rule for multi-pollutant emission standards for light-duty and medium-duty vehicles, to be phased in over model years 2027 through 2032.[23] Soon after, on March 29, 2024, EPA announced a final rule for GHG emissions standards for heavy-duty vehicles, also phased in over model years 2027 through 2032.[24] The District closely followed and participated in these rulemaking processes to advocate for the Valley's need for emissions reductions from this sector, and will continue to do so for future actions.

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[19] CARB. *Petition for Rulemaking: Seeking the Amendment of the Locomotive Emission Standards.* (April 13, 2017). Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_locomotive_petition_and_cover_letter_4_3_17.pdf

[20] 88 FR 4296 https://www.govinfo.gov/content/pkg/FR-2023-01-24/pdf/2022-27957.pdf

[21] EPA. *Regulations for Emissions from Vehicles and Engines – Petitions to Address Harmful Emissions from Locomotives.* Retrieved from: https://www.epa.gov/regulations-emissions-vehicles-and-engines/petitions-address-harmful-emissions-locomotives

[22] 88 FR 77004 https://www.govinfo.gov/content/pkg/FR-2023-11-08/pdf/2023-24513.pdf

[23] EPA. *Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles; Final Rule.* 89 Fed. Reg. 76, pp. 27842-28215. (April 18, 2024). Retrieved from: https://www.epa.gov/system/files/documents/2024-03/lmdv-veh-standrds-ghg-emission-frm-2024-03.pdf

[24] EPA. *Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3; Final Rule.* 89 Fed. Reg. 78, pp. 29440-29831. (April 22, 2024). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2024-04-22/pdf/2024-06809.pdf

CARB's primary regulatory authority is the regulation of mobile sources of emissions. Mobile sources are the largest contributor to criteria pollutant and air toxic emissions in the San Joaquin Valley and throughout the State. In recent Valley attainment plans for PM2.5 and ozone, a large piece of the overall emissions reduction commitment has come from mobile source measures under the jurisdiction of CARB. CARB's progress in developing and implementing these measures has contributed to the substantial improvements in Valley air quality, and will continue to do so in the future. Although CARB has promulgated stringent mobile source measures for vehicles and fleets in California, emissions from interstate heavy-duty trucks, locomotives, and other federal mobile sources have not been reduced as significantly. Considering the continuing emissions reductions from sources regulated by the District and CARB, and the remaining challenges under federal air quality standards, it is increasingly critical that the federal government take action to reduce emissions from sources under federal regulatory control.

Chapter 5

DEMONSTRATION OF FEDERAL REQUIREMENTS FOR THE 2012 ANNUAL PM2.5 STANDARD

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5.1 THE VALLEY'S ATTAINMENT CLASSIFICATION FOR THE 2012 PM2.5 NAAQS

The U.S. Environmental Protection Agency's (EPA) 2012 PM2.5 national ambient air quality standard (NAAQS, or standard) revised the annual average PM2.5 standard to 12 micrograms per cubic meter (µg/m³), while retaining the 24-hour standard of 35 µg/m³ set in 2006.[1] In 2015, EPA designated the Valley as Moderate nonattainment for the 2012 PM2.5 standard, with an attainment deadline of December 31, 2021. Under the federal Clean Air Act (CAA) Subpart 4, nonattainment areas are initially classified as "Moderate," with six years from its initial nonattainment designation date to reach attainment (though two one-year extensions are available in certain circumstances).[2] Areas may request reclassification to "Serious," with ten years from its initial attainment designation date to reach attainment.

Modeling and analysis by the San Joaquin Valley Air Pollution Control District (District) and the California Air Resources Board (CARB) demonstrated that the San Joaquin Valley (Valley) could not practicably attain the 2012 annual PM2.5 standard by the end of the sixth calendar year following the effective date of designation of the area (2021). Due to the impracticability of achieving the standard by the Moderate area attainment date, the District adopted the *2016 Moderate Area Plan for the 2012 PM2.5 Standard* (*2016 Moderate Plan*), including an attainment impracticability demonstration and a request for reclassification of the Valley from Moderate nonattainment to Serious nonattainment. Effective December 27, 2021, EPA finalized partial approval of the District's *2016 Moderate Plan* and reclassified the District as a Serious nonattainment area for the 2012 PM2.5 NAAQS, with an attainment deadline of December 31, 2025.[3]

The District and CARB previously addressed the Serious area requirements for the 2012 PM2.5 standard earlier than required as part of the integrated *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (*2018 PM2.5 Plan*). The Serious area requirements were included in the *2018 PM2.5 Plan* in anticipation of EPA's reclassification of the Valley to Serious for the 2012 PM2.5 standard, years earlier than required in order to achieve early emissions reductions. In December 2021, EPA proposed approval of the Serious Plan for the 2012 PM2.5 standard, then reversed the decision and proposed disapproval in October 2022. In response to EPA's reversal, CARB withdrew the Serious Plan for the 2012 PM2.5 standard with District concurrence, and through revised and updated analysis developed this *2024 PM2.5 Plan* to address the Serious area requirements for the 2012 standard.

Despite the significant progress and stringent regulations on stationary and mobile sources, attainment by the current deadline of 2025 is not practicable, and extensive

[1] 78 FR 3086 (January 15, 2013). https://www.govinfo.gov/content/pkg/FR-2013-01-15/pdf/2012-30946.pdf
[2] 80 FR 2206 (January 15, 2015). https://www.govinfo.gov/content/pkg/FR-2015-01-15/pdf/2015-00021.pdf
[3] 86 FR 67343 (November 26, 2021). https://www.govinfo.gov/content/pkg/FR-2021-11-26/pdf/2021-25616.pdf

modeling demonstrates that the Valley will need additional emission reductions to meet the 2012 PM2.5 standard (Appendix J). Through this Serious Plan, the District is formally requesting an extension of the attainment deadline from 2025 to 2030 for the 2012 PM2.5 standard, pursuant to CAA §188(e).

5.2 FEDERAL REQUIREMENTS

This attainment Plan satisfies statutory requirements for a Serious nonattainment State Implementation Plan (SIP) submission and attainment extension request. Table 5-1 provides a summary of the requirements that are included in this Plan.

Table 5-1 Summary of Serious Nonattainment Area Plan Requirements

Serious Plan and Extension Request Elements	Source of Requirement	Location of Plan Where Element Satisfied
Current Attainment Date is Impracticable	40 CFR §51.1005(b)(1)(i)	Section 5.2.1 Appendix J
Compliance with Applicable SIP	40 CFR §51.1005(b)(1)(ii)	Section 5.2.2
Base Year and Attainment Projected Emissions Inventory	40 CFR §§51.1003(b), 51.1005(b)(2)(i) and 51.1008(b)	Appendix B
Identify Pollutants to be Addressed	CAA §189(e)	Appendices F and J
Best Available Control Measures (BACM) and Most Stringent Measures (MSM)	40 CFR §§51.1003(b), 51.1005(b)(1)(iii), and 51.1005(b)(2)(ii)	Section 5.2.3 Appendices C and D Attachment A
Attainment Demonstration and Modeling	40 CFR §§51.1005(b)(2)(iii) and 51.1011	Section 5.2.4 Appendices I and J
Reasonable Further Progress	40 CFR §§51.1005(b)(2)(iv) and 51.1012	Section 5.2.5 Appendix G
Quantitative Milestones	40 CFR §§51.1005(b)(2)(v) and 51.1013	Section 5.2.6 Appendix G
Contingency Measures	40 CFR §§51.1005(b)(2)(vi) and 51.1014	Section 5.2.7 Appendix G
Nonattainment New Source Review Plan Requirements	40 CFR §§51.1005(b)(2)(vii) and 51.165	Section 5.2.8 Appendix H
Transportation Conformity	40 CFR §51.1003(b and d)	Section 5.2.9 Appendix D

5.2.1 Demonstration of Impracticability

An impracticability demonstration uses modeling to show that the implementation of all best available control measures (BACM) and best available control technologies (BACT) will not bring the area into attainment by the statutory Serious area attainment date.[4] Modeling for this Plan (see Appendix J) demonstrates that the Valley cannot practicably attain the 2012 PM2.5 standard before the statutory deadline of December 31, 2025.

[4] CAA §189(b)(1)(A)

5.2.2 Compliance with the Applicable SIP

EPA interprets compliance with the applicable SIP to mean that "the state has implemented the control measures in the SIP revisions it has submitted to address the applicable requirements in CAA §§172 and 189."[5] The District's current SIP for the 2012 PM2.5 standard is the *2016 PM2.5 Plan*, which EPA approved as meeting Moderate area plan requirements (except for contingency measures), effective December 27, 2021.[6]

As a part of the development of the *2016 PM2.5 Plan*, the District followed EPA guidance for the control measure evaluation process for reasonably available control measures (RACM) and reasonably available control measures (RACT), and additional reasonable measures. The District did not identify any emission reduction opportunities that would qualify as RACT or additional feasible measures that could be made into commitments for rule amendments or rule adoptions to expedite attainment in the Valley and demonstrate RACM. Thus, the District satisfies the requirement for compliance with the applicable SIP.

5.2.3 Best Available Control Measures (BACM) and Most Stringent Measures (MSM)

As a part of the Serious area attainment demonstration for this standard, in addition to implementing all feasible measures identified as RACM and RACT through the Moderate area analysis, the District is required to identify, adopt, and implement the best available control measures feasible for implementation on sources of direct PM2.5 and significant PM2.5 precursors. The attainment plan submission must include provisions for the implementation of BACM no later than 4 years after reclassification of the area to Serious. As EPA reclassified the District to Serious nonattainment for the 2012 PM2.5 standard effective December 27, 2021, the District is required to implement BACM by 2025.

Additionally, to qualify for any extension of a Serious area attainment date, CAA §188(e) requires a state to ''demonstrate to the satisfaction of the Administrator that the Plan for the area includes the most stringent measures that are included in the implementation plan of any state, or are achieved in practice in any state, and can feasibly be implemented in the area.'' The process for determining what qualifies as MSM includes the following:

a) Update emissions inventories (Appendix B);
b) Identify potential MSM (Appendices C and D);
c) Compare to control measures already adopted (Appendices C and D); and
d) Adopt and implement any technologically and economically feasible MSM that are more stringent than measures that are already approved into the SIP (Chapter 4).

[5] 81 FR 58094 (August 24, 2016). https://www.govinfo.gov/content/pkg/FR-2016-08-24/pdf/2016-18768.pdf
[6] 86 FR 67343 (November 26, 2021). https://www.govinfo.gov/content/pkg/FR-2021-11-26/pdf/2021-25616.pdf

EPA requires that implementation of MSM be as expeditious as practicable but no later than 1 year prior to the alternate Serious area attainment date. As the District is requesting an attainment date extension to 2030, MSM must be implemented no later than 2029.

To address initial elements required by the CAA for Serious PM2.5 nonattainment areas, the District and CARB developed the *Initial SIP Requirements for the 2012 Annual PM2.5 Standard* (*Initial SIP Requirements*), adopted by the District's Governing Board on October 19, 2023, and subsequently submitted to EPA through CARB on November 17, 2023, for inclusion in the SIP. The *Initial SIP Requirements* included an updated emissions inventory, precursor demonstration, and the demonstration that BACM requirements continue to be satisfied in the Valley.

Building on the analyses included in the *Initial SIP Requirements*, as part of this Plan, the District and CARB evaluated controls beyond BACM to identify potential MSM and determine the feasibility of implementing such measures in the Valley. Refer to Appendices C and D for these analyses. Additionally, Valley Metropolitan Planning Organizations evaluated local transportation control measures for potential MSM; this analysis is included in Attachment A. As discussed further in Chapter 4, all feasible control measures identified through these analyses will be implemented no later than 2029, satisfying MSM requirements.

5.2.4 Attainment Demonstration and Modeling

The Serious area Plan must demonstrate attainment, using air quality modeling, by the most expeditious date practicable after the statutory Serious area attainment date.[7] Although the Valley has some of the most stringent regulations in the nation that will continue to bring about significant reductions into the future, the Valley will need enormous additional emission reductions, specifically from sources that are under state and federal jurisdiction, in order to meet this standard. As shown below, and discussed in detail in Appendix J, attainment is not possible by the mandated Serious nonattainment area deadline of 2025 (based on 2017-2019 data). Air quality modeling demonstrates expeditious attainment of the standard in 2030.

5.2.4.1 Summary of Modeling Results

[This section provided by the California Air Resources Board]

Photochemical modeling plays a crucial role in demonstrating attainment of the national ambient air quality standards based on projected future year emissions. Currently, San Joaquin Valley (SJV or Valley) is designated as a serious nonattainment area for the 2012 annual $PM_{2.5}$ standard (12 µg/m^3) with an attainment deadline of 2030. Consistent with U.S. EPA guidance for model attainment demonstrations (U.S. EPA, 2018), photochemical modeling was used to project $PM_{2.5}$ design values (DVs) to the future.

[7] CAA §189(b)(1)(A)

2030 annual $PM_{2.5}$ DVs at each monitor in the Valley show attainment of the 2012 annual $PM_{2.5}$ standard.

The findings from the model attainment demonstration are summarized below. A detailed description of the model inputs, modeling procedures, and attainment test can be found in the Modeling Protocol and Attainment Demonstration Appendix of this document.

The current modeling approach draws on the products of large-scale, scientific studies as well as past $PM_{2.5}$ SIPs in the region, collaboration among technical staff at state and local regulatory agencies, and from participation in technical and policy groups in the region. In this work, the Weather Research and Forecasting (WRF) model version 4.21 was utilized to generate the annual meteorological fields. The Community Multiscale Air Quality (CMAQ) Model version 5.3.3 with state-of-the-science chemistry and aerosol treatment was used for modeling annual $PM_{2.5}$ in the Valley. Other model inputs and configuration, including the modeling domain definition, chemical mechanism, initial and boundary conditions, and emission processing can be found in the Modeling Protocol and Attainment Demonstration Appendix and Modeling Emissions Inventory Appendix.

The U.S. EPA modeling guidance (U.S. EPA, 2018)[8] recommends using modeling in a "relative" rather than "absolute" sense. Based on analysis of recent years' ambient $PM_{2.5}$ levels and meteorological conditions leading to elevated $PM_{2.5}$ concentrations, the year 2017 was selected for baseline modeling calculations. In particular, in 2017 SJV experienced one of the worst years for $PM_{2.5}$ pollution in the Valley within the last decade.

Specifying the baseline design value is a key consideration in the model attainment test, because this value is projected forward to the future and used to test for future attainment of the standard at each monitor. To minimize the influence of year-to-year variability in demonstrating attainment, the U.S. EPA modeling guidance recommends using the average of three DVs, where one of the DV years is the same as the baseline emissions inventory and modeling year. This average DV is referred to as the baseline (or reference) DV. Here, the average DVs from 2017, 2018, and 2019 are used to calculate baseline DVs (see Table 5-3 below for the baseline DVs utilized in the attainment demonstration modeling).

In order to use the modeling in a relative sense, three simulations were conducted: 1) base year simulation for 2017, which demonstrated that the model reasonably reproduced the observed $PM_{2.5}$ concentrations in the Valley; 2) reference (or baseline) year simulation for 2017, which was the same as the base year simulation, but excluded exceptional event emissions such as wildfires; and 3) future year simulations for 2030, which was the same as the reference year simulation, except projected anthropogenic emissions for 2030 were used in lieu of the 2017 emissions.

[8] U.S. EPA. (2018, 11 29). *Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze.* Retrieved from https://www.epa.gov/scram/sip-modeling-guidance-documents

Table 5-2 shows the 2017, 2030 baseline and 2030 attainment scenario SJV annual anthropogenic emissions for the five $PM_{2.5}$ precursors. These emission totals were calculated from the modeling inventory based on CEPAM 2019 version 1.04. Since the modeling inventory includes day-specific adjustments that are not included in the planning inventory, such as weekday/weekend differences in on-road mobile emissions, day-to-day changes in residential wood burning activity, and the effects of meteorology on ammonia emissions, the planning and modeling inventories are expected to be comparable but not identical. From 2017 to the 2030 attainment scenario, anthropogenic emissions in the SJV will drop approximately 64%, 12%, 19%, 2%, and 2% for Nitrogen Oxides (NOx), Reactive Organic Gases (ROG), primary $PM_{2.5}$, Sulfur Oxides (SOx), and NH_3, respectively. Among these five precursors, anthropogenic NOx emissions show the largest relative reduction, dropping from 216 tons/day in 2017 to 77 tons/day in 2030. Anthropogenic PM]$_{2.5}$ emissions will drop from 62 tons/day to 50 tons/day, reflecting a 19% reduction from 2017 to 2030. Compared to the 2030 baseline emissions, additional NOx and $PM_{2.5}$ emission reductions were implemented in the 2030 attainment inventories. Details about these additional emission reductions can be found in the Modeling Protocol and Attainment Demonstration Appendix, while the actual emission commitments are outlined in the SIP.

Table 5-2 SJV Model-Ready Annual Emissions for 2017, 2030 (baseline), and 2030 (attainment)

	Source Category	Stationary	Area	On-road Mobile	Other Mobile	Total	Change from 2017 to 2030
2017 (ton/day)	NOx	22.9	12.0	95.3	86.0	216.2	
	ROG	89.0	159.9	27.7	42.4	319	
	PM2.5	7.9	44.9	2.6	6.1	61.5	
	SOx	5.1	0.3	0.6	0.2	6.2	
	NH3	13.0	292.9	4.6	0.	310.5	
2030 baseline (ton/day)	NOx	18.5	6.0	20.3	53.3	98.1	-55%
	ROG	91.6	153.3	12.9	26.9	284.7	-11%
	PM2.5	6.8	38.2	1.4	4.1	50.5	-18%
	SOx	5.1	0.3	0.5	0.3	6.1	-2%
	NH3	14.2	284.3	6.7	0.1	305.2	-2%
2030 attainment (ton/day)	NOx	18.1	5.3	16.8	37.2	77.4	-64%
	ROG	91.6	153.1	12.7	23.6	281.0	-12%
	PM2.5	6.8	38.0	1.3	3.5	49.6	-19%
	SOx	5.1	0.3	0.5	0.3	6.1	-2%
	NH3	14.2	284.3	6.3	0.1	304.8	-2%

In the relative modeling approach, the fractional change (or ratio) in $PM_{2.5}$ concentration between the modeled future year (2030) and modeled baseline year (or reference year, 2017) are calculated. These ratios are called relative response factors (RRFs). Since $PM_{2.5}$ is comprised of different chemical species, which respond differently to changes in emissions of various pollutants, separate RRFs were calculated for individual $PM_{2.5}$ species. In addition, because of potential seasonal differences in $PM_{2.5}$ formation mechanisms, RRFs for each species were also calculated separately for each quarter.

The RRF for a specific $PM_{2.5}$ component j for each quarter is calculated using the following expression:

$$RRF_j = \frac{[C]_{j,\ future}}{[C]_{j,\ reference}} \qquad (1)$$

Where for the annual $PM_{2.5}$ standard, $[C]_{j,\ future}$ is the modeled quarterly mean concentration for component j predicted for the future year averaged over the 3x3 array of grid cells surrounding the monitor, and $[C]_{j,reference}$ is the same, but for the reference year simulation.

The measured FRM/FEM (i.e., Federal Reference Method/Federal Equivalent Method) $PM_{2.5}$ must be separated into its various chemical components. Species concentrations were obtained from the four $PM_{2.5}$ chemical speciation sites in the Valley. These four speciation sites are located at: Bakersfield – California Avenue, Fresno – Garland, Visalia – North Church, and Modesto – 14th Street. Since not all of the 17 FRM/FEM $PM_{2.5}$ sites in the Valley have collocated speciation monitors, the speciated $PM_{2.5}$ measurements at one of the four speciation sites were utilized to represent the speciation profile at each of the FRM/FEM sites based on geographic proximity, analysis of local emission sources, and measurements from previous field studies. Based on completeness of the data, $PM_{2.5}$ speciation data from 2015 – 2019 were utilized. For each quarter, percentage contributions from individual chemical species to FRM/FEM $PM_{2.5}$ mass were calculated as the average of the corresponding quarter from 2015-2019 for the annual standard calculation. [9]

Projected 2030 annual $PM_{2.5}$ DVs for all sites are given in Table 5-3. For the annual standard, the Bakersfield-Planz site has the highest projected DV at 12.0 $\mu g/m^3$, rounded to the nearest tenths digit following the U.S. EPA's guidance (U.S. EPA 2018). This DV meets the 2012 annual $PM_{2.5}$ standard of 12 $\mu g/m^3$. Since projecting future year $PM_{2.5}$ DVs is performed by projecting individual $PM_{2.5}$ components and then summing those components to get the total $PM_{2.5}$, it is useful to examine the RRFs associated with individual components to evaluate how the changes in each component contribute to the overall change in $PM_{2.5}$. From 2017 to 2030, there are substantial reductions projected for ammonium nitrate, Elemental Carbon (EC), and Organic Matter (OM), a slight decrease in sulfate, but a slight increase in crustal material (i.e., other primary $PM_{2.5}$ such as fugitive dust emissions). The reduction in ammonium nitrate is a direct result of NO_x emission reductions in 2030 compared to 2017, while EC and OM reductions are primarily tied to the reduction in primary $PM_{2.5}$ emissions. Detailed RRFs and base/future year concentrations for each individual species can be found in the Modeling Protocol and Attainment Demonstration Appendix.

To evaluate the impact of reducing emissions of different $PM_{2.5}$ precursors to $PM_{2.5}$ DVs, a series of model sensitivity simulations were performed, for which anthropogenic emissions within the SJV were reduced by a certain percentage from the baseline

[9] Frank, N. H. (2006). Retained Nitrate, Hydrated Sulfates, and Carbonaceous Mass in Federal Reference Method Fine Particulate Matter for Six Eastern U.S. Cities. *Journal of the Air & Waste Management Association, 56*(4), 500-511. doi:10.1080/10473289.2006.10464517

emissions. Following U.S. EPA precursor demonstration guidance (U.S. EPA, 2016) [10] as well as considering SJV's control strategies, sensitivity runs involving 30% emission reductions were performed for NOx and direct $PM_{2.5}$. For other precursors (i.e., ammonia, VOCs, and SOx), both 30% and 70% emission reductions were performed. In addition, sensitivity simulations were performed for years 2017 and 2030. The key conclusion from the sensitivity runs is that in 2030, reductions of direct $PM_{2.5}$ and NOx emissions will continue to have a significant impact on annual $PM_{2.5}$ DVs, while reductions of ammonia, ROG, and SOx have a much smaller impact compared to that of direct $PM_{2.5}$ and NOx.

The U.S. EPA attainment modeling guidance also recommends conducting an unmonitored area analysis to ensure that there are no regions outside of the existing monitoring network that could exceed the standard if a monitor was present at that location. Following the U.S. EPA recommended methodology, this unmonitored area analysis shows that in 2030, every modeling grid cell within the SJV meets the 2012 annual $PM_{2.5}$ standards except for a small area surrounding the Lemoore military facility due to emissions from the operations at that facility.

Table 5-3 2017 baseline and projected 2030 future year annual $PM_{2.5}$ DVs at each monitor

Site AQS ID	Name	Base DV (μg/m³)	2030 Annual DV (μg/m³)	2030 Annual DV (μg/m³, rounded to the tenths digit)
60290016	Bakersfield - Planz	16.97	11.98	12.0
60311004	Hanford	15.73	11.04	11.0
60290010	Bakersfield - Golden	15.52	10.82	10.8
61072002	Visalia	15.43	10.50	10.5
60290014	Bakersfield - Cal. Ave.	15.12	10.52	10.5
60310004	Corcoran	14.95	10.90	10.9
60195025	Fresno - Hamilton	13.99	9.81	9.8
60190011	Fresno - Garland	13.69	9.49	9.5
60990006	Turlock	12.7	9.69	9.7
60195001	Clovis	12.69	8.99	9.0
60470003	Merced - S. Coffee	12.28	9.31	9.3
60771002	Stockton	12.21	10.16	10.2
60392010	Madera	12.11	8.75	8.8
60472510	Merced - M. Street	11.73	8.73	8.7
60990005	Modesto	11.16	8.54	8.5
60772010	Manteca	10.37	8.38	8.4
60192009	Tranquility	8.19	6.37	6.4

[10] U.S. EPA. (2016). *PM2.5 Precursor Demonstration Guidance.* Retrieved from: https://www.epa.gov/sites/production/files/2016-11/documents/transmittal_memo_and_draft_pm25_precursor_demo_guidance_11_17_16.pdf

5.2.4.2 Attainment Demonstration

Attaining federal health-based air quality standards is an important milestone for improving public health. As detailed in Appendix J, this Plan demonstrates that the Valley will attain the federal 2012 PM2.5 standard as expeditiously as practicable, with all feasible measures and strategies being implemented to accomplish this goal.

The attainment demonstration for this Plan includes the benefits of CARB and District control programs that provide ongoing emission reductions, as well as new measure commitments that will be implemented according to the schedule included in Chapter 4. The PM2.5 and NOx reductions result from implementation of MSM, which includes the ongoing implementation of stringent regulations for stationary and area sources under the District's jurisdiction, in addition to the implementation of stringent requirements for mobile sources under CARB's jurisdiction. Appendices C and D contain the evaluations of BACM and MSM feasible for implementation in the Valley.

Given the expeditious timeframe of the District and CARB's aggressive control strategy that will achieve the enormous amount of emissions reductions necessary to bring the Valley into attainment, this Plan demonstrates that the Valley will attain the standard as expeditiously as practicable, as validated in Appendix G. Modeling performed by CARB and the District demonstrates the Valley will attain the 2012 PM2.5 standard in 2030. See above for the summary of modeling results and Appendix J for more detail.

5.2.5 Reasonable Further Progress (RFP)

This CAA §189(d) Plan must demonstrate Reasonable Further Progress (RFP) pursuant to 40 CFR §§51.1003(c)(1)(v) and 51.1012.[11] RFP is the incremental emission reductions leading to the attainment date of a standard for an area. Refer to Appendix G for a full description and the RFP demonstration.

5.2.6 Quantitative Milestones

CAA Subpart 4 §189(c)(1) requires Plans submitted to EPA to contain quantitative milestones which are to be achieved every three years until the area is re-designated attainment and which demonstrate reasonable further progress as defined in CAA §171.

For a Serious nonattainment area, the quantitative milestones shall be achieved no later than milestone dates of 7.5 and 10.5 years from the date of designation. The Valley was designated Nonattainment for the 2012 PM2.5 NAAQS effective on April 15, 2015.[12] Therefore, the future quantitative milestones dates for the 2012 PM2.5 NAAQS for the San Joaquin Valley are 2025, 2028, and 2031.[13] Please refer to Appendix G for specific quantitative milestones.

[11] See also 81 FR 58103-58104
[12] 80 FR 2206 (January 15, 2015). https://www.govinfo.gov/content/pkg/FR-2015-01-15/pdf/2015-00021.pdf
[13] 40 CFR 51.1013(a)

5.2.7 Contingency Measures

All PM2.5 attainment Plans must contain contingency measures that are consistent with CAA §172(c)(9) and 40 CFR §51.1014. Contingency measures are additional control measures to be implemented in the event that EPA issues final rulemaking that the Valley failed to meet a regulatory requirement necessitating implementation of a contingency measure. Due to the difficulty nonattainment areas face in addressing CAA contingency requirements in light of the recent court decisions, described further in Appendix G, the District, CARB, and other agencies have urged EPA to provide updated federal guidance. In response, EPA developed the *Draft Guidance on the Preparation of State Implementation Plan Provisions that Address the Nonattainment Area Contingency Measure Requirements for Ozone and Particulate Matter* (*Draft Guidance*)[14] on March 17, 2023. The District and CARB have addressed contingency measure requirements for this Plan pursuant to the *Draft Guidance*, as presented in Appendix G.

5.2.8 Fulfillment of Serious Area Permitting Requirements

Pursuant to The District's New and Modified Stationary Source Review Rule (Rule 2201) is designed to meet state and federal NNSR requirements, and applies to new and modified stationary sources that emit NOx, VOC, PM10, PM2.5, SOx, CO, and other pollutants subject to District permitting requirements. Subpart 4 §189(b)(3) of the CAA requires areas designated as Serious nonattainment to establish the "major stationary source" threshold at 70 tpy. Rule 2201 sets the major source emission thresholds at 10 tpy for NOx and 70 tpy for PM2.5, which meets the CAA requirements specified in Subpart 4 §189(b)(3) for areas designated as Serious nonattainment.

The District adopted amendments to Rule 2201 on August 15, 2019, which CARB submitted to EPA for inclusion in California's SIP on November 20, 2019. EPA published findings in the Federal Register on July 29, 2022, of its evaluation of the rule for meeting the applicable CAA requirements for state NSR programs, as well as other CAA general requirements for SIP submittals. From its evaluation, EPA proposed approval of the majority of the District's amendments, and also provided specific comments.[15] The District adopted amendments to Rule 2201 on April 20, 2023, to address EPA's comments, which CARB submitted to EPA for inclusion in California's SIP on October 13, 2023.

[14] EPA. *DRAFT: Guidance on the Preparation of State Implementation Plan Provisions that Address the Nonattainment Area Contingency Measure Requirements for Ozone and Particulate Matter.* March 17, 2023. Retrieved from: https://www.epa.gov/system/files/documents/2023-03/CMTF%202022%20guidance%203-17-23.pdf

[15] 87 FR 45730, *Limited Approval and Limited Disapproval of California Air Plan Revisions; San Joaquin Valley Air Pollution Control District; Stationary Source Permits*

5.2.9 Transportation Conformity

This CAA §189(d) Plan must include transportation conformity budgets for the attainment year pursuant to 40 CFR §51.1003(d).[16] Refer to Appendix D for more information.

5.2.10 Title VI of the Civil Rights Act of 1964

Title VI of the U.S. Civil Rights Act of 1964 (Title VI) provides that no person in the United States shall, on the basis of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.[17] Other relevant federal laws prohibit discrimination in the use of federal funds based on disability, sex and age.[18] As a recipient of federal funds and assistance from EPA, CARB and the District must ensure they comply with Title VI and U.S. EPA's Title VI implementation regulations in its relevant programs and activities.[19]

5.2.10.1 District Compliance with Title VI

The District has a long history of robust community engagement and dedication to the achievement of environmental justice in all of its programs, originating from Governing Board adopted Core Values that were laid down over a decade ago and are key to the District's commitment to a culture of inclusivity, including:

> **Respect for the Opinions and Interest of All Valley Residents** – The District shall respect the interests and opinions of all Valley residents and fully consider these opinions, seeking collaboration with federal, state, and local agencies, agriculture, businesses, community groups and residents in carrying out the District's mission.
>
> **Robust Public Outreach and Education on Valley Air Quality Progress and Continuing Air Quality Efforts** – As we move forward in achieving our mission, the District shall continue its ongoing efforts to educate the public about air quality, and the significant clean air investments and air quality progress that have been made in the Valley.
>
> **Accountability to the public** – The District serves, and is ultimately accountable to, the people of the Valley for the wise and appropriate use of public resources, and for accomplishing the District's mission with integrity and honesty.

[16] See also 81 FR 58103.
[17] 42 U.S.C. Section 2000d to 2000d-7
[18] Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. §794; Title IX of the Education Amendments of 1972, as amended, 20 U.S.C. §§1681 et seq.; Age Discrimination Act of 1975, 42 U.S.C. §§6101 et seq.; and Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500 §13, 86 Stat. 903 (codified as amended at 33 U.S.C. §1251 (1972))
[19] 40 CFR Part 7; §7.15

Open and transparent public processes – The District shall continue to provide meaningful opportunities for public input and be responsive to all public inquiries.

The District's Core Values provide the backdrop for fair and equal access to the benefits of any program or activity administered by the District, and to prohibit and prevent discrimination against any person(s) seeking to participate in, or receive the benefits of, any program or activity offered or conducted by the District.

In accordance with the District's Accessibility and Non-Discrimination Notice and Policy, the District is committed to an open and transparent public participation process in all activities including the permitting process, rulemaking, plan development and enforcement. The District's policy is to also prohibit and prevent retaliation or intimidation against any individual or group because they have exercised their rights to participate in any program or activity offered or conducted by the District, or to oppose any action prohibited by this Policy. Members of the public who believe they or others were unlawfully denied full and equal access to a District program or activity may file a discrimination complaint with the District under this policy. This non-discrimination policy also applies to other people or entities affiliated with the District, including contractors or grantees that the District utilizes to provide benefits and services to members of the public who must administer its programs and activities without regard to race, color, national original, sex, age, disability, socioeconomic status, or any other legally protected basis. More information regarding the District's Accessibility and Non-Discrimination Notice and Policy is available on the District's website at https://ww2.valleyair.org/about/accessibility-and-non-discrimination/.

As an important component of the District's public participation process, the District solicits input from the Citizen's Advisory Committee (CAC), which includes representatives from industrial, governmental and environmental interests. The CAC was formed under the California Health and Safety Code for the purpose of soliciting public input and sharing information with the public regarding District activities.

In addition, the District is dedicated to the achievement of Environmental Justice to protect the health of Valley residents that may be disproportionately affected by air pollution. To this endeavor, the District has a long standing Environmental Justice Strategy, which is a living document that was developed beginning in 2004, formally adopted in 2007, and amended several times, most recently in 2015.[20] The District developed this Environmental Justice Strategy to identify and address any gaps in existing programs, policies, and activities that may impede the achievement of environmental justice. This strategy is the overarching environmental justice vision for the District. It sets forth the mission and goals that will guide the District in further integrating environmental justice into programs, policies and activities. The Environmental Justice Strategy is the product of collaboration between District staff and environmental justice advocates. Out of the Environmental Justice Strategy came the Environmental Justice Advisory Group (EJAG) that meets monthly in a public forum to

[20] SJVAPCD. *Environmental Justice Strategy.* Amended May 7, 2015. Retrieved from: https://ww2.valleyair.org/media/xzhpycbe/ej-strategy.pdf

provide advice and guidance to the District with respect to the implementation of the Environmental Justice Strategy. The EJAG also works to collaboratively educate the public and community stakeholders about current District activities and air quality in general.

More recently, through meaningful and effective implementation of Assembly Bill 617 (AB 617), the District has been actively participating with and facilitating full engagement of all sectors within each of the Valley's selected disadvantaged communities. AB 617, signed into law in July 2017, initiated a statewide effort to monitor and reduce localized air pollution, and highly improve public health, in communities that experience disproportionate burdens from exposure to air pollutants through new community-focused and community-driven actions. The communities of South Central Fresno, Shafter, Stockton, and Arvin/Lamont have been prioritized by the District and subsequently selected by CARB as communities in the San Joaquin Valley to receive clean air resources available under AB 617, based on a technical analysis of several pollution and poverty-related criteria. AB 617 provides mechanisms and resources to implement community-specific air quality monitoring networks; to develop, implement, and track emission reduction programs; to improve availability of data and other technical information; and to invest substantial funding in the community through voluntary incentive funding measures. Importantly, these measures are guided by advice and knowledge of local community members, through their input and involvement on Steering Committees for each AB 617-selected community.

The District has a long history of building partnerships to find effective, efficient, and innovative strategies for improving air quality and protecting the health of the Valley's most vulnerable populations. Ensuring Valley residents have equitable access to all District programs and resources is crucial to the District's mission of improving public health in the Valley. To support these efforts, the District continuously seeks community input in the implementation of environmental justice strategies to help communities disproportionately impacted by economic and environmental inequities. The District has committed to continuously work closely with Valley residents and stakeholders to help communities disproportionately impacted by economic and environmental inequities by forging new partnerships with businesses, and identifying and leveraging clean air opportunities. The District has prioritized outreach efforts in communities most in need by building partnerships with schools and community based organizations, attending community events, and ensuring engagement materials and presentations are available in multiple languages. To provide equitable access to the District's programs, the District has continued to work directly in impacted communities and ensure events are accessible to those that need it most.

Consistent with the District's mission and efforts mentioned above, the District conducts a robust public process to ensure meaningful public engagement in developing attainment plans and regulations. In March 2023, the District held an initial workshop to begin the public process for this Plan, and to solicit suggestions for actions the District could take to encourage and facilitate more robust public engagement throughout plan development. The District received requests to hold workshops in the evenings to accommodate those who work during the day, provide timely public notice of workshops, and provide adequate opportunity for the public to comment on specific control measures for this Plan's strategy. In response to these requests, the District scheduled all subsequent workshops in the evening and notified the public of workshops as early as possible. Additionally, throughout the public process for the development of this Plan, the District presented all potential control measures evaluated as part of this Plan, including those suggested by the public, and provided opportunities for the public and interested stakeholders to offer comments and suggestions to help guide strategy development.

The public was notified in advance of public workshops via the District's email lists and website, and other public forums. To promote an equitable public process, workshop materials were made available in English and Spanish, and the District provided simultaneous Spanish interpretation during all plan development workshops. Simultaneous interpretation in other languages was made available upon request. In addition, the District conducted the workshops through a hybrid approach, where members of the public are welcome to attend either in person, or join virtually through a real-time webinar environment. Finally, through the public process, the District provided regular updates at District Governing Board meetings, CAC meetings, and EJAG meetings.

The District provided 30 days for public review of plan documents, and invited public comment throughout the entire public process. The comments received as a result of this robust engagement effort were integrated into the Plan as feasible. Measures suggested by the public that are included as proposed measures/strategies in this Plan include further reductions from residential wood burning, and ongoing evaluation of building electrification opportunities. Further information on the public process for the development of this Plan, including details of public meetings, is included in Chapter 1.

5.2.10.2 CARB Compliance with Title VI

In developing the 2022 State SIP Strategy's robust suite of control measures, CARB staff engaged in a thorough public process that addresses the requirements of Title VI. CARB will continue to address the requirements of Title VI in implementation of the 2022 State SIP Strategy and related Clean Air Act implementation activities. Written guidance from U.S. EPA is needed to provide additional detail on Title VI requirements and expectations and support for effective implementation efforts.

Many low-income and disadvantaged communities in nonattainment areas, and across the State, continue to experience disproportionately high levels of air pollution and the resulting detrimental impacts to their health. Research shows large disparities in exposure to pollution between disadvantaged communities and other communities. There are disparities between white and non-white populations in California, with Black and Latino populations experiencing significantly greater air pollution impacts than white populations. Mobile source pollution exposures show some of the highest disparities. Mobile sources are the largest sources of pollution exposure disparity for Black populations and disadvantaged community residents, when compared to the average population in California. Specifically, mobile sources accounted for 45% of exposure disparity for the Black population, and 37% of exposure disparity for people in disadvantaged communities.[21] While significant progress has been made in reducing mobile and stationary source pollution in California through regulatory and other program activities, disparities in the location of pollution and cumulative exposures continue.

In 2023, CARB adopted the following Vision for Racial Equity to guide our external work, including the implementation of the Community Air Protection Program. CARB commits to just social change by working at all levels within the organization and externally to address environmental injustices and advance racial equity in the achievement of its mission. CARB works toward a future where all Californians breathe healthy and clean air, benefit from actions to address climate change, and where race is no longer a predictor of life outcomes. In working to realize this vision, CARB prioritizes environmental justice, uses tools to operationalize racial equity, and conducts meaningful community engagement in its policy and planning efforts and programs to address the longstanding environmental and health inequities from elevated levels of toxic air contaminants, criteria pollutants, and secondary impacts of climate change. It is imperative to optimize California's control programs to maximize emissions reductions and provide targeted near-term benefits in those communities that continue to bear the brunt of poor air quality. Specific efforts include a commitment to apply a racial equity lens in considering benefits and burdens of CARB's programs and policies, including regulatory actions. A racial equity lens is a set of questions to estimate impacts and benefits on the basis of race, ethnicity or other relevant categories, and considering alternatives.

Using a racial equity lens also requires a commitment to meaningful community engagement. In support of this commitment as part of the development of the 2022 State SIP Strategy, CARB contracted a number of community experts to vet and refine a model framework for community engagement. As noted above, while significant progress has been made to address air pollution statewide and in local communities, ensuring all Californians have access to healthy air quality is imperative.

In addition to these important efforts, the 2022 State SIP Strategy measures such as the Advanced Clean Fleets and In-Use Locomotive Regulations will reduce mobile source emissions from heavy-duty trucks and other sources around warehouses, railyards, and ports, as well as reducing other emissions, which in turn will reduce corresponding health risk in California's most impacted communities.

CARB prioritized public participation as an essential part of developing the measures included in the 2022 State SIP Strategy. CARB initiated the public process for the 2022 State SIP Strategy with a workshop in July 2021. After the workshop, CARB staff reached out to and met with a number of community-based organizations who provided input on the potential control measures. CARB released the 2022 State SIP Strategy: Draft Measures document which considered the input from the community-based organizations and comments received during the first workshop.

[21] Apte et al (2019). A Method to Prioritize Sources for Reducing High PM2.5 Exposures in Environmental Justice Communities in California. CARB Research Contract Number 17RD006

CARB staff held a second workshop discussing the Draft Measures document in October 2021 and received additional input from a broad array of interested parties. The workshop provided a detailed discussion on the potential measures and allowed for the public and interested parties to comment on every facet of each potential measure. CARB staff also participated in the San Joaquin Valley measure workshops as part of their SIP development process. CARB staff released the Draft 2022 State SIP Strategy in January 2022, prior to a third workshop, and presented an informational update to the Board at the Board Meeting in February 2022 to discuss and obtain public feedback. The input from numerous interested parties and community-based organizations framed the control measures in the Strategy such as the Zero-Emissions Trucks and Pesticide Measures.

These workshops and Board updates provided forums in both English and Spanish and afforded any special accommodations if requested to facilitate discussing the proposed measures in a public setting and to provide additional opportunity for public feedback, input, and ideas. And finally, CARB released the Proposed 2022 State SIP Strategy and hosted our 4th workshop in August 2022, prior to the CARB Board adopting the 2022 State SIP Strategy in September 2022. The workshops were well attended by a wide range of interested parties including community-based organizations. CARB staff listened to interested parties, evaluated their recommendations, and included some of these recommendations as measures that were appropriate for the 2022 State SIP Strategy. In order for a public suggestion to be included as a SIP measure, it needed to meet U.S. EPA-required integrity elements. SIP measures are required to be quantifiable, enforceable, surplus, and permanent. Measures suggested by the public that were ultimately adopted in the 2022 State SIP Strategy include a regulation to reduce emissions of reactive organic gas from pesticides in collaboration with the California Department of Pesticide Regulation and a zero-emission truck measure to help ensure that smaller trucking companies have more consistent access to zero-emission truck incentives.

Following the Board's approval of the 2022 State SIP Strategy, the public engagement process continues as each measure within the strategy goes through its own public process to engage with impacted communities and interested parties to further develop the measures prior to being brought to the Board for consideration as a regulation or other program. As development and implementation of these measures progress, CARB staff will continue to identify and implement opportunities to mitigate air pollution associated with racial inequities and meaningfully engage and partner with communities most impacted to address long standing disparities and challenges. As CARB cannot do this alone, CARB will also continue to partner with other authorities such as air districts including the San Joaquin Valley APCD, other State agencies, and the federal government to ensure emissions reduction are achieved.

These connected efforts, as well as interagency efforts, will provide additional pathways to address Title VI requirements and support achieving the goal where ZIP Code or race does not predict air pollution exposures. CARB has reviewed U.S. EPA and U.S. Department of Justice resources for Title VI and environmental justice policies, and looks forward to written guidance from U.S. EPA to address Clean Air Act section 110(a)(2)(E) as the State develops future clean air plans.

Civil Rights Policy and Discrimination Complaint Process

Under CARB's written Civil Rights Policy and Discrimination Complaint process (Civil Rights Policy), CARB has a policy of nondiscrimination in its programs and activities and implements a process for discrimination complaints filed with CARB, which is available on CARB's website. The Civil Rights Officer coordinates implementation of CARB's nondiscrimination activities, including as the Equal Employment Opportunity (EEO) Officer for employment purposes, and who can be reached at *EEOP@arb.ca.gov*, or (279) 208-7110.[22]

The Civil Rights Policy and Discrimination Complaint Process provides the following information about the nondiscrimination policy and its applicability:

> It is CARB policy to provide fair and equal access to the benefits of a program or activity administered by CARB. CARB will not tolerate discrimination against any person(s) seeking to participate in, or receive the benefits of, any program or activity offered or conducted by CARB. Members of the public who believe they were unlawfully denied full and equal access to a CARB program or activity may file a civil rights complaint with CARB under this policy. This non-discrimination policy also applies to people or entities, including contractors, subcontractors, or grantees that CARB utilizes to provide benefits and services to members of the public. [. . .]

As described in the Civil Rights Policy and Discrimination Complaint Process, the Civil Rights Officer coordinates implementation of nondiscrimination activities:

> CARB's Executive Officer will have final authority and responsibility for compliance with this policy. CARB's Civil Rights Officer, on behalf of the Executive Officer, will coordinate this policy's implementation within CARB, including work with the Ombudsman's Office, Office of Communications, and the staff and managers within a program or activity offered by CARB. The Civil Rights Officer coordinates compliance efforts, receives inquiries concerning non-discrimination requirements, and ensures CARB is complying with state and federal reporting and record retention requirements, including those required by Code of Federal Regulations, title 40, section 7.10 et seq.

The Civil Rights Policy and Discrimination Complaint Process also describes in detail the complaint procedure, as follows:

[22] CARB. California Air Resources Board and Civil Rights. *https://ww2.arb.ca.gov/california-air-resources-board-and-civil-rights*; Civil Rights Policy and Discrimination Compliant Process. November 1, 2016. *https://ww2.arb.ca.gov/sites/default/files/2023-01/2016-11-03%20CARB%20Civil%20Rights%20Policy%20Revised%20Final.pdf*

> A Civil rights complaint may be filed against CARB or other people or entities affiliated with CARB, including contractors, subcontractors, or grantees that CARB utilizes to provide benefits and services to members of the public. The complainant must file his or her complaint within one year of the alleged discrimination. This one-year time limit may be extended up to, but no more than, an additional 90 days if the complainant first obtained knowledge of the facts of the alleged violation after the expiration of the one-year time limit. [. . .]
>
> The Civil Rights Officer will review the facts presented and collected and reach a determination on the merits of the complaint based on a preponderance of the evidence. The Civil Rights Officer will inform the complainant in writing when CARB has reached a determination on the merits of the discrimination complaint. Where the complainant has articulated facts that do not appear discriminatory but warrants further review, the Civil Rights Officer, in his or her discretion, may forward the complaint to a party within CARB for action. The Civil Rights Officer will inform the complainant, either verbally or in writing, before facilitating the transfer. [. . .]
>
> CARB will not tolerate retaliation against a complainant or a participant in the complaint process. Anyone who believes that they have been subject to retaliation in violation of this policy may file a complaint of retaliation with CARB following the procedures outlined in this policy.

There is a Civil Rights Complaint Form available[23] on the webpage, which should be used by members of the public to file a complaint of discrimination against CARB that an individual believes occurred during the administration of its programs and services offered to the public. As described on CARB's webpage, for all complaints submitted, the Civil Rights Officer will review the complaint to determine if there is a prima facie complaint (which means, if all facts alleged were true, would a violation of the applicable policy exist). If the Civil Rights Officer identifies a prima facie complaint in the jurisdiction of the Civil Rights Office, the Civil Rights Office will investigate and determine whether there is a violation of the policy.

The laws and regulations that CARB implements through this policy include:

- Code of Federal Regulations, Title 40 Parts 5 and 7;
- Title VI of the U.S. Civil Rights Act of 1964, as amended;
- Section 504 of the Rehabilitation Act of 1973;
- Age Discrimination Act of 1975;
- Title IX of the Education Amendments of 1972;
- California Government Code, title 2, Division 3, Part 1, Chapter 2, Article 9.5, *Discrimination*, section 11135 et seq.; and
- California Code of Regulations, title 2, section 10000 et seq.

[23] CARB. Civil Rights Complaint Form. July 2019. *https://ww2.arb.ca.gov/sites/default/files/2023-01/eo_eeo_033_civil_rights_complaints_form.pdf*

As part of its overarching civil rights and environmental justice efforts, CARB is in the process of updating its Civil Rights Policy and will make those publicly available once complete. These updates will reflect available U.S. EPA and U.S. Department of Justice resources for Title VI and environmental justice policies. CARB encourages U.S. EPA to issue additional guidance to further clarify Title VI requirements and expectations to assist state implementation efforts.

Chapter 6

MOBILE SOURCE ADVOCACY AND LEVERAGING NEW OPPORTUNITIES

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The San Joaquin Valley Air Pollution Control District (District) and the California Air Resources Board (CARB) have promulgated and implemented extensive measures to reduce emissions from sources of air pollution under their regulatory authority that constitute the most stringent regulatory control program in the nation. The District has also deployed innovative measures to reduce emissions from mobile and indirect sources of air pollution that fall outside its traditional regulatory authority. While the District continues to seek additional local emissions reductions, the San Joaquin Valley (Valley) has reached a point where attainment of the health-based standards established under the Federal Clean Air Act (CAA) is not viable without significant reductions in emissions from mobile sources primarily under state and federal jurisdiction. While CARB has promulgated and should continue to implement stringent mobile source measures for vehicles and fleets in California, it is imperative that emissions are also reduced from mobile sources that fall exclusively under federal jurisdiction such as interstate heavy-duty trucks, locomotives, aircraft and other mobile sources.

As the Valley and other regions continue facing challenges in meeting federal ambient air quality standards, it will be essential that the U.S. Environmental Protection Agency (EPA) do its fair share to improve air quality and public health in the Valley by reducing emissions from sources under its control that comprise an increasingly significant portion of air pollution, air toxics impacts, and greenhouse gas emissions in the Valley, South Coast, and other areas of the state. For example, as part of supporting State Implementation Plan (SIP) efforts in California and throughout the nation, EPA should work to more quickly finalize a strong, nitrogen oxide (NOx)-focused, heavy-duty truck standard and expedite recent commitments to consider and develop new standards for locomotives.

As an important development that could play a major role in assisting the Valley and other Extreme nonattainment areas, recent state and federal budget and funding actions have created unprecedented opportunities for investing in transformational clean technology changes across the mobile source sector. At the state level, the 2023-2024 budget, building on prior years, allocates a total of approximately $52.3 billion for climate related investments over six years. At the federal level, recent authorizations under the Infrastructure Investment Jobs Act (IIJA) and Inflation Reduction Act (IRA) provide funding for a variety of important clean technology and infrastructure programs. Notably, IRA includes an estimated $369 billion in funding for climate and energy-related programs, and over $20 billion in new funding for sustainable agriculture and programs of importance to the Valley. Given the Valley's air quality challenges and significant number of disadvantaged communities, it will be imperative that EPA and other federal and state agencies prioritize and integrate these new funding opportunities with SIPs for Extreme ozone nonattainment and Serious PM2.5 nonattainment areas.

In light of recent state and federal opportunities and consistent with the District Governing Board's adopted legislative and policy positions, this Chapter discusses opportunities for increased advocacy to leverage funding and accelerate emissions reductions in the Valley, especially from state and federal mobile sources, as needed to meet health-based federal ambient air quality standards.

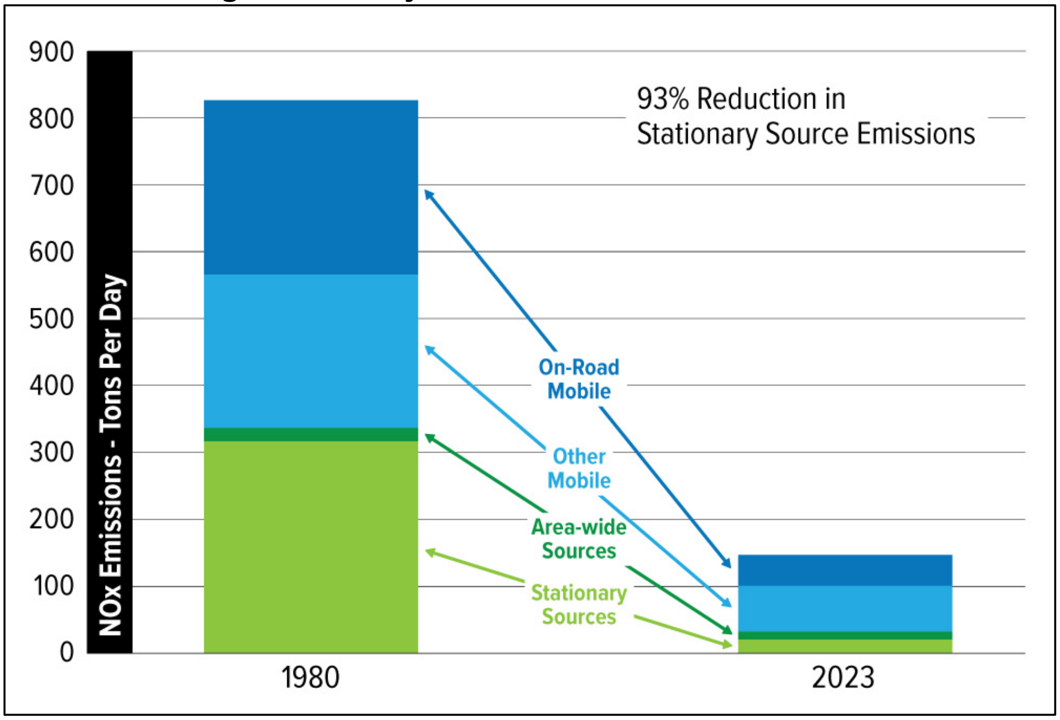
6.1 IMPORTANCE OF FUNDING

The Valley's challenges in meeting national ambient air quality standards (NAAQS) are unmatched anywhere in the nation due to the region's unique geography, meteorology and topography. Since 1992, the District has adopted over 670 rules to implement an aggressive on-going control strategy to reduce emissions in the Valley in order to reach attainment of the federal mandates, resulting in air quality benefits throughout the Valley.

Over the past decades, the District has implemented multiple generations of emissions control measures for stationary and area sources under its jurisdiction. Similarly, CARB has adopted regulations for mobile sources. Together, these efforts represent the nation's toughest air pollution emissions controls. In addition to having the most stringent air regulations in the nation, the District also operates the most effective and efficient incentive grants programs, investing over $6.2 billion in public/private funding towards clean air projects to date that have achieved over 268,000 tons of emissions reductions.

Through these ongoing efforts by the District, and significant efforts by CARB to reduce emissions from mobile sources, NOx emissions across the Valley have been reduced by over 75%, while stationary source emissions, which are under the District's jurisdiction, have been reduced by over 93% since 1980 (Figure 6-1). Although significant progress has been made in reducing emissions, substantial additional emissions reductions are still needed to meet the federal fine particulate matter (PM2.5) and ozone standards. These additional reductions will be needed across the Valley as the population across the region continues to grow, bringing additional vehicle emissions, goods movement emissions, and other emissions.

Figure 6-1 Major Reductions in Air Pollution



The District's incentive programs operate amongst the most cost-effective and comprehensive in the nation, accelerating emissions reductions and achieving community level benefits through clean air grant funding for a variety of projects. These programs provide an effective way to encourage technology advancement and deployment, accelerating emissions reductions from a number of sources, particularly from mobile sources primarily under state and federal jurisdiction. Given that over 80% of the NOx emissions in the Valley come from mobile sources, these successful voluntary incentive grant programs help the Valley achieve highly cost-effective emissions reductions that are surplus of regulatory emissions reductions.

The District's incentive programs offer grant funding in a number of areas, including agricultural irrigation pump engines, agricultural equipment replacements, off-road equipment repowers, alternatives to agricultural open burning, heavy-duty trucks, school bus retrofits, school bus replacements, landscaping equipment replacements, fireplace change-outs, locomotive replacements, new alternative-fuel light-duty vehicles, bicycle infrastructure projects (bike paths), light-duty vehicle repairs, high-emitting vehicle replacements, alternative fuel infrastructure (EV charging, etc.), and more. These programs and efforts have achieved significant additional emissions reductions that go beyond local and state regulations, which have all contributed to the Valley's air quality progress to-date, and will continue to secure emissions reductions for future progress.

6.1.1 Need for Mobile Source Emissions Reductions

The District continues to seek additional local emissions reductions, but the Valley has reached a point where attainment of the health-based standards established under the

Federal CAA is not viable without significant quantifiable and enforceable reductions in emissions from mobile sources that fall exclusively under federal jurisdiction such as interstate heavy-duty trucks, locomotives, aircraft and other mobile sources. Many nonattainment areas find themselves in similar situations, and with newly established federal air quality standards, many other regions throughout the nation will also face similar difficulties.

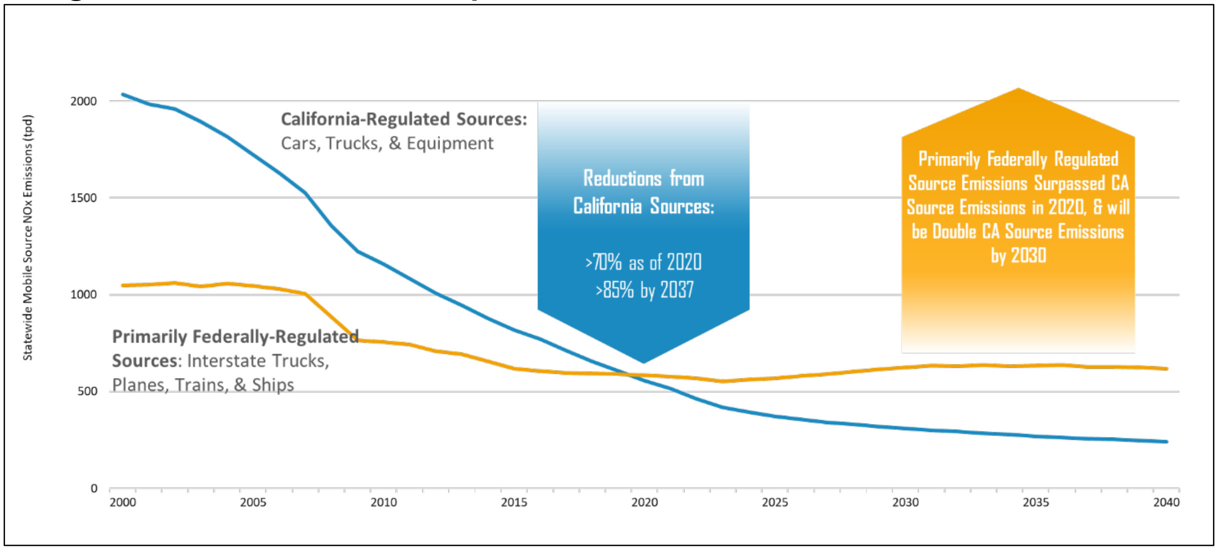
Under current law, local jurisdictions could be subject to devastating federal sanctions even though failure to attain the standards may be due to emissions from sources under federal jurisdiction. These federal sanctions include:

- Permitting barriers for new and expanding businesses (2:1 offset requirement)
- Loss of federal highway funds ($2.5 billion and numerous jobs lost in the San Joaquin Valley)
- Federal takeover and loss of local control
- Expensive federal nonattainment penalties

CARB's primary regulatory authority is the regulation of mobile sources of emissions, which are the largest contributor to criteria pollutant and air toxic emissions in the Valley and throughout the State. CARB's progress in developing and implementing mobile source measures has contributed to the substantial improvements in Valley air quality, and will continue to do so in the future through commitments included in the *2024 PM2.5 Plan* and other SIPs. Given the significant need for emissions reductions in the coming years, the District will continue to support ongoing development of state mobile source control measures and advocate for additional state support in reducing emissions from a variety of mobile sources, including passenger vehicles, heavy-duty trucks, off-road equipment, cargo handling equipment, and other sources.

Although CARB has promulgated stringent mobile source measures for vehicles and fleets in California, emissions from interstate heavy-duty trucks, locomotives, and other federal mobile sources have not been reduced as significantly through federal measures. Considering the continuing emissions reductions from sources regulated by the District and CARB, and the remaining challenges under federal ozone and PM2.5 standards, it is increasingly critical that federal government take action to reduce emissions from sources under federal regulatory control. As an example of this, and as displayed in Figure 6-2, the level of NOx emissions from mobile sources across the state is now dominated by federal sources under the jurisdiction of the federal EPA, highlighting the importance of the advocacy for tighter national emissions standards for interstate sources like heavy-duty trucks, locomotives, and aircraft. Ongoing emissions reductions from these sources will be key for the Valley to improve air quality and meet the latest federal air quality standards.

Figure 6-2 Jurisdiction Comparison of Statewide Mobile Source Emissions



With stringent planning requirements and shortened attainment timeframes under the CAA for PM2.5, securing additional NOx reductions from federal mobile sources is vital. In light of EPA currently reviewing the PM2.5 standards for potential updates, and beginning another tight planning and attainment deadline cycle, increasing the stringency of federal emissions standards and funding support for interstate mobile sources is imperative in supporting States and air agencies.

At the beginning of each year, the District Governing Board approves the legislative platform that guides the District's advocacy efforts. The policy positions outlined in the legislative platform provide guidance on legislative and regulatory actions, and reflect current priorities involving air quality issues in the Valley. Securing additional state and federal funding and policies for clean air projects throughout the Valley and other Serious and Extreme nonattainment areas, with particular focus on disadvantaged communities, is a key goal of the District's adopted legislative and policy positions.

As the District continues to work with CARB and EPA on addressing the 2012 PM2.5 standard through this Plan as well as other federal air quality standards, there are a number of time-sensitive opportunities for achieving significant additional emissions reductions from mobile sources. As an important component of considering the *2024 PM2.5 Plan*, EPA must evaluate opportunities for further reducing emissions from federally regulated mobile sources, and direct funding and regulatory actions to assist the San Joaquin Valley in reaching expedited attainment of the 2012 PM2.5 standard and other NAAQS. A brief summary of potential opportunities include, but are not limited to:

- **National Standards for On-Road Heavy-Duty Trucks, Locomotives, and other Mobile Sources under Federal Jurisdiction:** The District has jurisdiction over stationary and area sources, which make up less than 15% of the total NOx emissions inventory. With over 80% of the Valley's remaining ozone and PM2.5 precursor emissions now coming from mobile sources, additional reductions from heavy-duty trucks and other mobile sources are needed for the Valley to reach federal air quality standards. The Governing Board has previously submitted petitions to the federal government requesting that they reduce their fair share of emissions in an equitable manner through more stringent national standards for heavy duty trucks and locomotives.[1]

In response to the District and similar petitions submitted by CARB and South Coast Air Quality Management District (SCAQMD), on March 28, 2022, EPA proposed a rule to reduce emissions from new heavy-duty trucks nationwide, finalizing the rule on January 24, 2023.[2] Additionally, on November 9, 2022, EPA committed to evaluating and identifying potential regulatory actions to address emissions from locomotives,[3] and on November 8, 2023, finalized changes to the locomotive preemption regulations.[4] EPA must continue to work towards addressing harmful emissions from new locomotives and new locomotive engines, which remain exclusively under federal authority. More recently, on March 20, 2024, EPA announced a final rule for multi-pollutant emission standards for light-duty and medium-duty vehicles, to be phased in over model years 2027 through 2032.[5] Soon after, on March 29, 2024, EPA announced a final rule for greenhouse gas emissions standards for heavy-duty vehicles, also phased in over model years 2027 through 2032.[6] The District closely followed and participated in these rulemaking processes to advocate for the Valley's need for emissions reductions from this sector, and will continue to do so for future actions.

- **Inflation Reduction Act:** The Inflation Reduction Act of 2022 (IRA) was signed into law on August 16, 2022, and presents many new opportunities for incentive funding. The Act includes an estimated $369 billion in funding for climate and energy-related programs, including additional funding in existing programs, such as the Diesel Emissions Reductions Act (DERA) and CAA sections 103 and 105 grants. Additionally, IRA also includes over $20 billion in funding for a wide variety of sustainable agricultural practices and technologies. IRA also includes

[1] SJVAPCD. *Petition Requesting that EPA Adopt New National Standards for On-Road Heavy-Duty Trucks and Locomotives under Federal Jurisdiction.* Retrieved from: https://www.epa.gov/sites/default/files/2016-11/documents/san_joaquin_valley_petition_for_hd_and_locomotive.pdf

[2] EPA. *Control of Air Pollution From New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards; Final Rule.* 88 Fed. Reg. 4296. (January 24, 2023). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2023-01-24/pdf/2022-27957.pdf

[3] EPA. Regulations for Emissions from Vehicles and Engines – Petitions to Address Harmful Emissions from Locomotives. Retrieved from: https://www.epa.gov/regulations-emissions-vehicles-and-engines/petitions-address-harmful-emissions-locomotives

[4] EPA. *Locomotives and Locomotive Engines; Preemption of State and Local Regulations; Final Rule*. 88 Fed. Reg. 215, pp. 77004-77009. (November 8, 2023). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2023-11-08/pdf/2023-24513.pdf

[5] EPA. *Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles; Final Rule.* 89 Fed. Reg. 76, pp. 27842-28215. (April 18, 2024). Retrieved from: https://www.epa.gov/system/files/documents/2024-03/lmdv-veh-standrds-ghg-emission-frm-2024-03.pdf

[6] EPA. *Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3; Final Rule.* 89 Fed. Reg. 78, pp. 29440-29831. (April 22, 2024). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2024-04-22/pdf/2024-06809.pdf

significant funding for energy efficiency and weatherization (including funding for solar panel, electric heat pump, and home weatherization installation) and agricultural conservation.

- **Federal Infrastructure Investments/Federal Budget:** The recently enacted infrastructure bill ("BIL" or "IIJA") and additional budget packages currently under negotiation at the federal level has the potential for including substantial investments for a wide variety of clean mobile source and energy technologies, advanced technologies including zero and near-zero emission heavy-duty vehicles, zero and near-zero transit buses, zero-emission school buses, clean transportation corridors that support passenger and heavy-duty vehicle fueling networks, and other clean air opportunities.

- **USDA Climate Smart Initiative/Farm Bill Investments:** The United States Department of Agriculture (USDA) is implementing a new Climate Smart Forestry and Agriculture Initiative that will include funding for a variety of investments in sustainable agriculture. Additionally, leading up to the next Farm Bill re-authorization, there has been congressional interest in developing a package to provide incentives for programs to support climate smart agriculture, in addition to existing air quality programs.

- **State Air Quality/Climate Funding Opportunities for Clean Vehicles/Technologies:** The District will continue to advocate for transformative technologies across various Valley sectors, obtain environmental benefits, and provide economic stimulus. Key areas of funding focus include sustainable agriculture (e.g. FARMER, ag burning alternatives, addressing air quality impacts of drought and Sustainable Groundwater Management Act, zero-emission agricultural funding, and methane reduction), low carbon vehicle and equipment deployment programs (across all mobile source sectors), and the Community Air Protection Program.

As part of its commitment, the District maintains close communication with EPA regarding needed assistance in reducing federal mobile source emissions; and works collaboratively with EPA, CARB, SCAQMD, and other agency partners through new interagency collaborative efforts to identify opportunities for accelerating the reduction of federal mobile source emissions. The District also continues to work with state and federal legislators and agencies to ensure that the Valley is well positioned to receive significant new funding in support of transitioning fleets to zero and near-zero technologies, deploying sustainable agricultural practices and technologies, and other clean air opportunities in the Valley. Further, the District is committed to improving and strengthening its partnerships with Valley metropolitan planning organizations, municipalities, transportation agencies, school districts, other public agencies, businesses, non-governmental organizations, and other Valley partners to assist in maximizing new state and federal resources coming to the Valley in support of clean air initiatives.

6.1.2 Need for Agricultural Burning Alternatives

In 2003, state law was amended to require the District to limit open burning of agricultural material in accordance with a phased-in schedule of deadlines. The District has long worked to identify alternatives and phase-out open burning in the Valley, and the challenge has been exacerbated by significantly reduced bioenergy capacity, extreme drought, water shortages, and fluctuating crop economics. As the latest action on this issue, in June 2021, the District adopted final phase-out requirements that will prohibit the majority of remaining agricultural burning by the end of 2024. In adopting this state-mandated phase-out schedule, the District and CARB recognized that significant new state funding would be needed to support the deployment of recently emerging alternatives to burning.

To support the Valley's ongoing phase-out of agricultural open burning, in 2018, the District's Governing Board authorized the creation of the Ag Burn Alternatives Grant Program.[7] This program provides financial incentives to commercial agricultural operations located within the District boundaries to utilize an alternative practice for the disposition of agricultural material from orchard and vineyard removals as an alternative to open burning. Alternative measures include, but are not limited to, soil incorporation of chipped material, on-site land application on agricultural land, off-site beneficial re-use (mulch, composting, land application near roadways for dust suppression, and other District approved beneficial re-use of the chipped material). Since 2018, the District Governing Board has allocated over $65,000,000 in local and State funding to this program.

On August 19, 2021, the District accepted $178,200,000 in additional state funding to be used in the District's Ag Burn Alternatives Grant Program.[8] This funding is the result of significant advocacy from the District and Valley agricultural stakeholders and is designated to assist the District in developing new alternative practices, increase fleet capacity for chipping in the Valley, and offset the significant incremental cost of implementing new alternatives to open burning.

The District's agricultural open burning phase-out strategy, along with the Ag Burn Alternatives Grant Program are working effectively to reduce emissions from agricultural open burning. New alternatives to open burning have emerged and are being implemented and Valley growers are utilizing the incentive program at a high rate. As a result, the current funding expenditure rate continues to increase. The initial allocation of State funding was expected to last until the end of 2024, however, it was exhausted approximately 11 months ahead of schedule. The early exhaustion of funds resulted in the District allocating additional local and state funds to the program.

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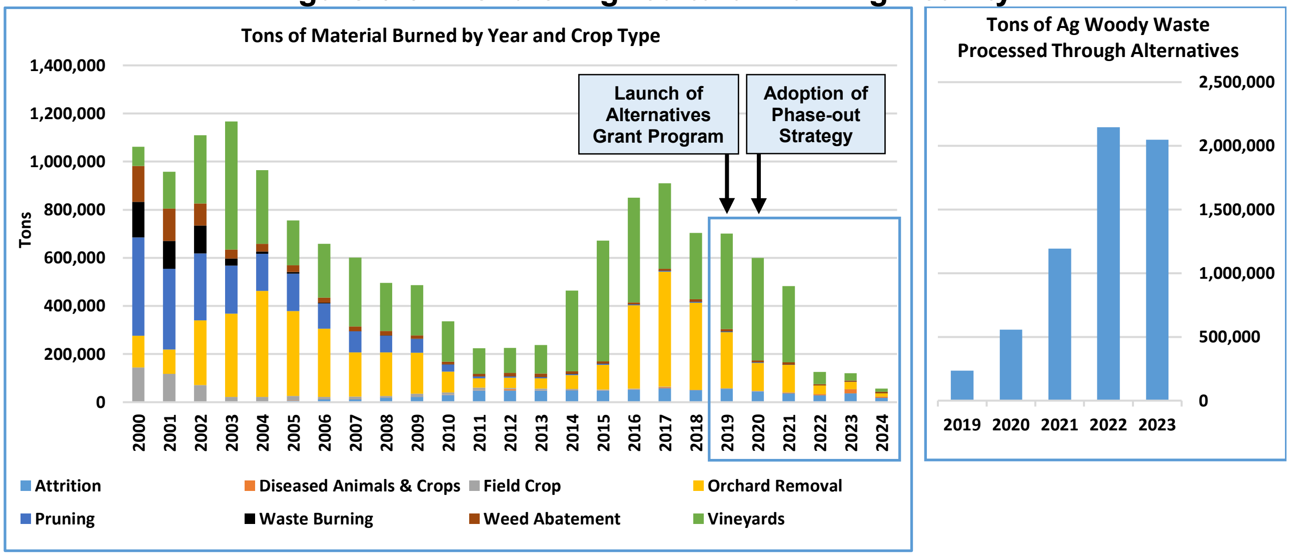
[7] District Ag Burn Alternatives Grant Program. Retrieved from: https://ww2.valleyair.org/grants/ag-burn-alternatives-grant-program/

[8] SJVAPCD. *Accept and Appropriate $178,200,000 in State Funding and Approve Enhancements to Alternatives to Agricultural Open Burning Incentive Program*. (August 19, 2021). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2021/August/final/10.pdf

Overall, the program has resulted in the deployment of alternative practices at over 251,500 acres, for over 6,800,000 tons of agricultural materials, resulting in the reduction of 13,299 tons of NOx, 24,705 tons of PM and 21,013 tons of reactive organic gas (ROG) emissions.

Figure 6-3 Trend of Agricultural Burning Activity



Ongoing funding for the District's program is crucial in supporting the continued transition away from agricultural open burning for the remaining crop categories. The state and federal government must continue to prioritize funding for alternatives to open burning in the Valley in order to provide cost effective alternatives to agricultural burning and to further the success of the program. The District works collaboratively with CARB, other public agencies, and agricultural industry partners to ensure adequate funds are secured and applied effectively, and to continue efforts to reduce emissions from the agricultural sector and support clean air goals in the Valley.

Appendix A
AMBIENT PM2.5 DATA ANALYSIS

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Appendix A: Ambient PM2.5 Data Analysis

The concentration of ambient particulate matter that is 2.5 microns or less in diameter (PM2.5) at any given location in the San Joaquin Valley (Valley) is a function of meteorology, the natural environment, atmospheric chemistry, and emissions of directly emitted PM2.5 and PM2.5 precursors from regulated and unregulated sources. The San Joaquin Valley Air Pollution Control District (District), the California Air Resources Board (CARB), and other agencies[1] monitor PM2.5 concentrations throughout the Valley,[2] using filter-based monitoring (starting in 1999) and real-time concentration monitoring (starting in 2002). The U.S. Environmental Protection Agency (EPA) serves as the official repository of ambient PM2.5 data and analysis.[3]

The District uses the collected data to show air quality improvement through the standardized design value (DV) calculations, using EPA protocols to document basin-wide improvement and attainment of the National Ambient Air Quality Standards (NAAQS). As shown in this appendix, the design value data shows steady, long-term air quality improvement that will lead to the attainment of the federal PM2.5 standards.

The District also uses the data to evaluate the impact of changing daily, quarterly, and annual PM2.5 concentrations on public health. These trend analyses provide the District with critical information about how to develop control measures and incentive programs that contribute to the greatest public health improvements and greatest progress toward EPA air quality standards.

This appendix provides the technical details used to evaluate and analyze the District's PM2.5 concentration data. It also shows the multiple factors that affect ambient PM2.5 concentrations in the Valley (e.g. meteorology, exceptional events) and the evidence for air quality improvement through District regulatory actions, including the District's highly successful Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters).

A.1 PM2.5 CONCENTRATIONS – MEASUREMENT AND INFLUENCES

The District, CARB, and other agencies manage an extensive air monitoring network throughout the Valley. Information obtained from the PM2.5 monitors within this network provides the District with necessary information for demonstrating attainment of the NAAQS and valuable information for protecting public health throughout the year. The monitoring network captures the spatial, seasonal, daily, weekly, and annual variations in PM2.5 concentrations throughout the Valley that result from changing meteorology, the occurrence of exceptional events (e.g., high winds and wildfires), and PM2.5 emissions from regulated and unregulated sources.

[1] Other air monitoring site operators in the Valley include the Monache Tribe and Foothill Yokut Indians, the Tachi Yokut Tribe, and the National Park Service (NPS).
[2] SJVAPCD. *2022 Air Monitoring Network Plan.* October 11, 2022. Retrieved from: https://www.valleyair.org/aqinfo/Docs/2022-Air-Monitoring-Network-Plan.pdf
[3] EPA. Air Quality System (AQS): *AQS Web Application.* (2010). Retrieved from: https://www.epa.gov/aqs

A.1.1 PM2.5 Monitor Types

The District and CARB use four types of PM2.5 monitors in the Valley:

- Filter-based federal reference method (FRM) monitors, defined as the standard for data collection;
- Real-time beta-attenuation method (BAM) monitors designated as federal equivalent method (FEM) monitors, and hereafter referred to as FEM monitors;
- BAMs not designated as FEM and hereafter referred to as non-FEM; and
- Filter-based speciation monitors, similar to FRM monitors.

Only FRM and FEM monitors produce data that is suitable for comparison with the NAAQS, and are therefore used for design value calculations. Real-time monitors (FEM and non-FEM) produce hourly measurements that the District uses to produce daily air quality forecasts, wood burning declarations, public health notifications, and Real-Time Air Advisory Network (RAAN) notifications for schools and the public.

Filter-based speciation monitors operate similarly to standard FRM monitors; however, due to the specific analysis requirements for the different PM2.5 species (e.g. metals, carbon, organics), multiple filter media are required, hence a multi-filter collection system. The evaluation and analysis of multiple PM2.5 species is critical to the development of an effective attainment strategy.

A.1.2 Meteorological Influences on PM2.5 Concentrations

Particulates in the atmosphere are dispersed by horizontal and vertical mixing within an air mass. Wind flow (horizontal mixing) and temperature instability (decreasing temperature with height allowing for vertical mixing) are the strongest mechanisms to allow for dispersing pollutants. Wind speed can greatly influence the pollutant concentrations by horizontally mixing and dispersing pollutants over a large area. Generally, the higher the wind speed, the lower the PM2.5 concentrations; however, in some cases, excessive winds may cause elevated PM2.5 levels as high winds may entrain particulate matter with a diameter of 10 microns or less (PM10), as well as PM2.5.

Vertical mixing of the air mass can result from atmospheric instability. Alternatively, vertical mixing of an air mass can be inhibited and pollutants can remain trapped near the surface under a temperature inversion (when temperature increases with increasing height). Prolonged periods of high pressure and stable conditions with low wind speeds can cause stagnant conditions that can also trap pollutants near the surface. PM2.5 concentrations increase during these poor dispersion periods. Conversely, during low-pressure events, unstable conditions and stronger wind speeds occur. The magnitude of decreasing PM2.5 concentrations can vary depending on the strength and characteristics of the low-pressure system.

A.1.2.1 Valley Drought

According to the U.S. Geological Survey, California experienced its worst drought in over a century between 2011 and 2015. The 2015-2016 winter season represented the fifth consecutive year of drought conditions in the Valley, and 2013-2014 was by far the driest winter during this time. On January 17, 2014, the Governor of California declared a drought emergency for all of California, which was lifted three years and two months later on April 7, 2017. Just four years later, beginning in April 2021 and through October 2021, the Governor of California declared a State of Emergency due to severe drought conditions and signed a set of four new emergency proclamations directing state agencies to take immediate action to bolster drought resilience across the state.[4,5,6,7] Above normal winter precipitation between 2022-2023 brought major drought relief to the west coast, allowing for the roll back of many of the drought emergency provisions in California.[8,9] Increased precipitation amounts allowed for all of California to measure between no drought and moderate drought, with no drought indicated in the entire San Joaquin Valley in May of 2023. The District will continue to monitor these drought conditions for potential impacts to ozone and particulate matter concentrations. Figure A-1 (a-c) are maps produced by the National Drought Mitigation Center depicting the extent and severity of the drought conditions affecting California between May 25, 2021 to May 24, 2022, and measured improvements by May 23, 2023.[10]

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[4] Executive Department, State of California. State of Emergency Proclamation. April 2021. Retrieved from: https://www.gov.cA gov/wp-content/uploads/2021/04/4.21.21-Emergency-Proclamation-1.pdf

[5] Executive Department, State of California. State of Emergency Proclamation. May 2021. Retrieved from: https://www.gov.cA gov/wp-content/uploads/2021/05/5.10.2021-Drought-Proclamation.pdf

[6] Executive Department, State of California. State of Emergency Proclamation. July 2021. Retrieved from: https://www.caloes.cA gov/wp-content/uploads/Legal-Affairs/Documents/Proclamations/7.8.21-Drought-SOE-Proc-attested.pdf

[7] Executive Department, State of California. State of Emergency Proclamation. October 2021. Retrieved from: https://www.gov.cA gov/wp-content/uploads/2021/10/10.19.21-Drought-SOE-1.pdf

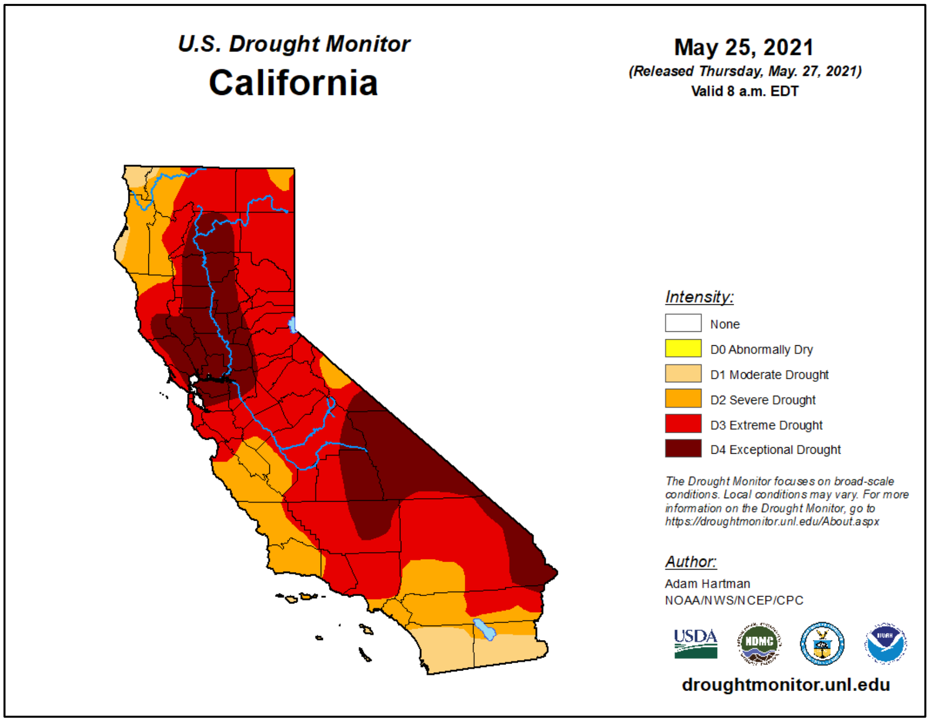
[8] "Water Year 2023 Snow Drought Conditions Summary and Impacts in the West: June 15, 2023." Drought.Gov, www.drought.gov/drought-status-updates/water-year-2023-snow-drought-conditions-summary-and-impacts-west-2023-06-15. Accessed 22 Aug. 2023.

[9] California, State of. "Governor Newsom Eases Drought Restrictions." California Governor, 24 Mar. 2023, https://www.gov.cA gov/wp-content/uploads/2023/03/3.24.23-Drought-update-executive-order.pdf

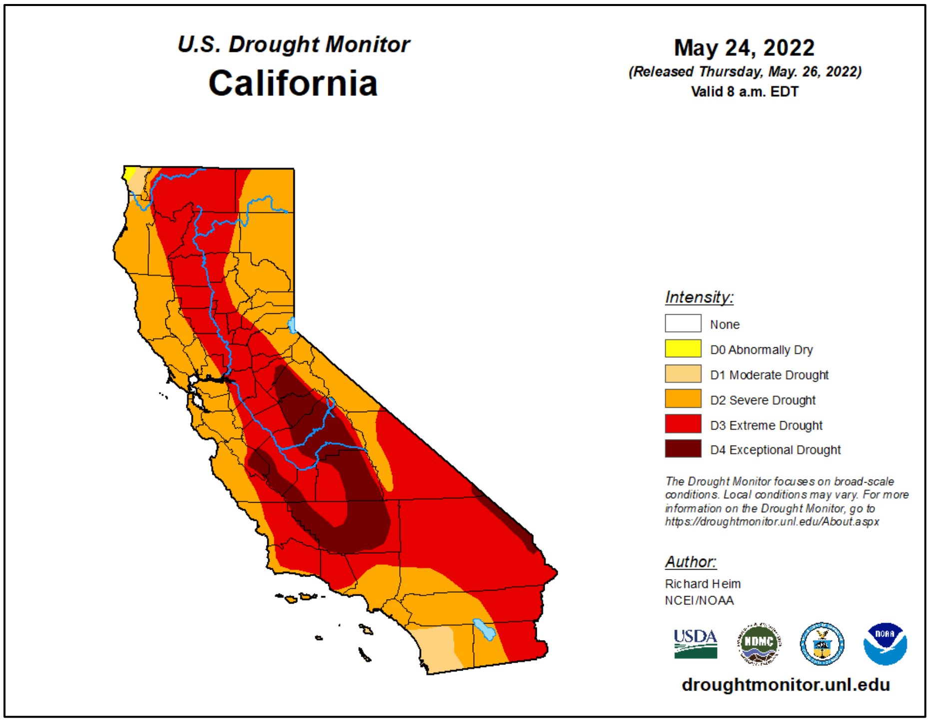
[10] U.S. Drought Monitor California. Retrieved May 25, 2023. https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Figure A-1 (a-c) Drought Extent and Severity in California

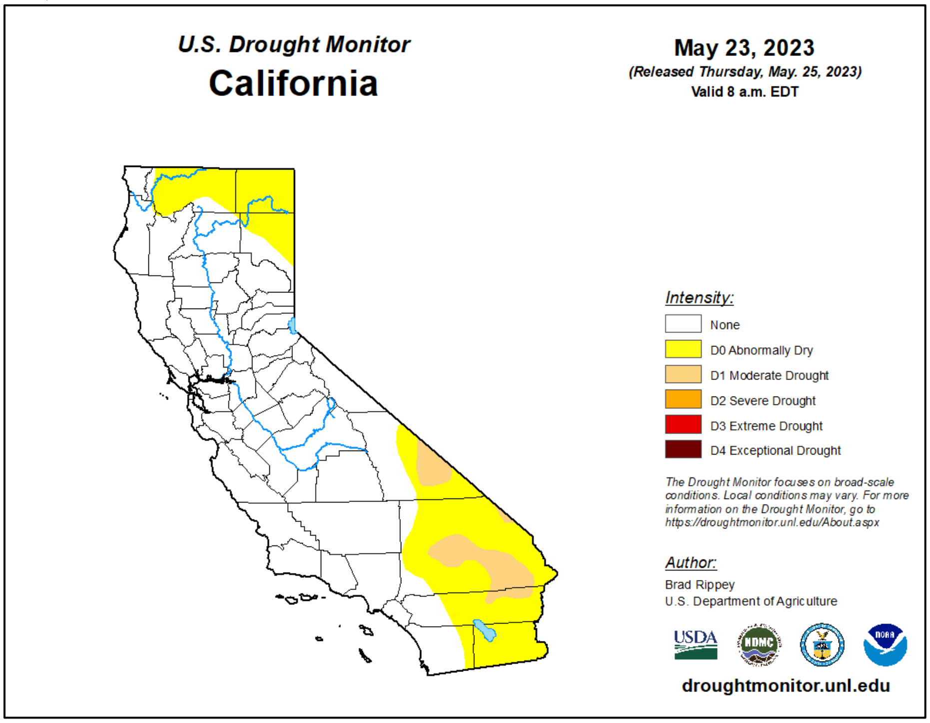
a) May 25, 2021



b) May 24, 2022



c) **May 23, 2023**



Many cities in California, including those in the Valley, had record low rainfall totals during the 2013 calendar year, with some nearly 100-year old records being broken. Although rainfall totals slowly increased between 2020 and 2022, drought conditions continued to persist with no distinct improvement until 2023, as noted in Table A-1.

Table A-1 Rainfall Totals for Select Cities across California

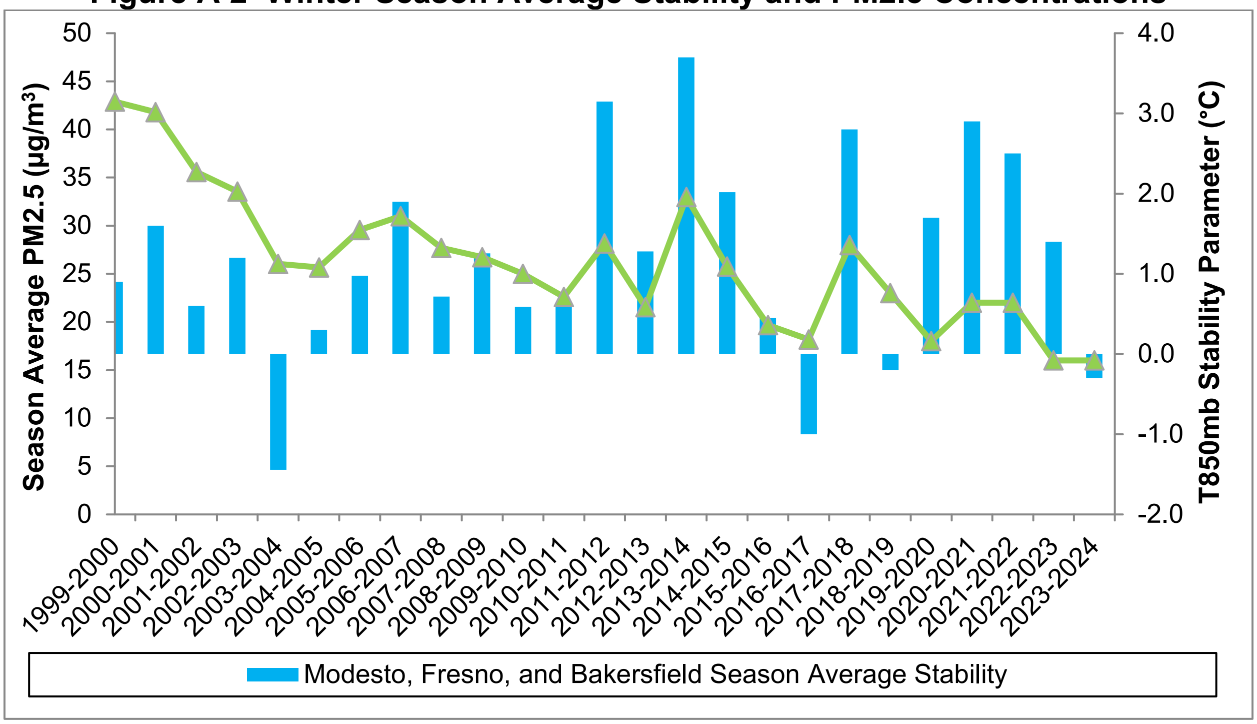
Region	City	1983-2020 Average (inches)	2021 Total (inches)	2022 Total (inches)	2023 Total (inches)	Record Low Rainfall (1983-2023) Year	Record Low Rainfall (1983-2023) Total (inches)
Northern California[11]	Sacramento	19.10	21.83	13.42	25.5	2013	3.38
	San Francisco	17.82	18.9	11.19	18.91	2013	5.81
San Joaquin Valley [12]	Stockton	13.19	14.17	11.4	16.93	2013	4.59
	Modesto	12.17	13.76	9.06	15.85	2013	4.69
	Fresno	10.86	10.38	6.44	13.64	2013	3.01
	Hanford	8.43	8.22	5.41	12.68	2013	2.23
	Visalia	9.73	9.72	5.61	15.33	2013	1.41
	Bakersfield	6.11	5.58	4.22	9.95	1989	2.88
Southern California[13]	Los Angeles	11.95	12.09	6.4	25.36	2013	3.65
	San Diego	9.86	7.85	5.9	14.43	1989	3.83

[11] NOWData – NOAA Online Weather Data. Retrieved March 6, 2023. https://nowdata.rcc-acis.org/sto/
[12] NOWData – NOAA Online Weather Data. Retrieved March 6, 2023. https://www.weather.gov/wrh/climate?wfo=hnx
[13] NOWData – NOAA Online Weather Data. Retrieved March 6, 2023. https://nowdata.rcc-acis.org/lox/

During 2011-2015 winter seasons, as well as the 2019-2022 winter seasons, extended periods of stagnation, and lack of ample precipitation were components of the historic drought that challenged the Valley's air quality. These conditions overwhelmed the District's emissions control strategies, and contributed to higher than expected PM2.5 concentrations and exceedances of the NAAQS. During the 2023-2024 winter season there were progressive weather patterns that rendered atmospheric instability more prominent and resulted in lower monthly average stability across the Valley. When compared to prior seasons, such as the 2016-2017 and 2018-2019 seasons with similar or even more favorable average stability as the recent 2023-2024 season, the Valley experienced levels significantly below the comparable prior seasons.

As shown in Figure A-2, the Valley winter season average PM2.5 concentration follows an overall downward trend since PM2.5 monitoring began in the early 2000s. This improvement is despite periods of low precipitation totals, increases in atmospheric stability, and wildfire impacts. Specifically, 2018, 2020, and 2021 were significantly impacted by wildfire activity in California. This provides strong evidence that the District and CARB's comprehensive emission reduction strategies have been achieving permanent emissions reductions, and improved meteorology is not wholly responsible for improved air quality in the District.

Figure A-2 Winter Season Average Stability and PM2.5 Concentrations



A.1.2.2 Wildfire Impacts

The quantity of emissions generated from wildfires is enormous and can well exceed the total industrial and mobile source emissions in the San Joaquin Valley, overwhelming all control measures and resulting in periods of excessively high particulate matter and ozone concentrations that cause significant impacts to public health. In addition to excessive fuel build-up in the state's wildlands due to decades of fire-suppression and widespread drought-driven tree mortality, higher temperatures and drier climate conditions in recent years have contributed to extended and more intense wildfire seasons in the western United States.

For example, in 2020, over 4 million acres were burned due to California wildfires, as shown in Table A-2.[14] The 2021 wildfire season also saw significant wildfire activity, with over 2.5 million acres burned across the state.[15] The District compiles up-to-date wildfire information on its website to keep the public informed about real-time air quality impacts from wildfires.[16] The District and CARB also assess long-term impacts through the attainment planning process.

Table A-2 Number of Acres Burned by Wildfires in California

Timeframe	Acres Burned
January 1 through December 31, 2020[17]	4,304,379
January 1 through December 31, 2021[18]	2,569,386
January 1 through December 31, 2022[19]	331,360
5-Year Average (same interval)	1,891,499

Source: Cal Fire

2020 Wildfire Season

In 2020, according to CalFire, over 8,600 wildfires were recorded in California, with over 4.3 million acres burned across the state, more than double the previous statewide record of approximately 2 million acres burned in 2018.[20,21] In addition, five of the top 20 largest wildfires in California history occurred during the 2020 wildfire season, highlighting the severity of recent wildfire seasons. A new record for the largest wildfire in state history also occurred in 2020, with the August Complex in northern California alone burning over 1 million acres. These points contribute to the understanding of how extreme and extensive the wildfire seasons have become for California in recent years.

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[14] 2020 Incident Archive. Retrieved March 6, 2023. https://www.fire.cA gov/incidents/2020
[15] CalFire 2021 Incident Archive, https://www.fire.cA gov/incidents/2021/
[16] San Joaquin Valley Air District, Wildfire Prevention and Response, https://ww2.valleyair.org/air-quality-information/wildfire-information/
[17] 2020 Incident Archive. Retrieved March 6, 2023. https://www.fire.cA gov/incidents/2020
[18] 2021 Incident Archive. Retrieved March 6, 2023. https://www.fire.cA gov/incidents/2021
[19] 2022 Incident Archive. Retrieved March 6, 2023. https://www.fire.cA gov/incidents/2022
[20] 2020 Wildfire Activity Statistics. Retrieved from: https://34c031f8-c9fd-4018-8c5a-4159cdff6b0d-cdn-endpoint.azureedge.net/-/media/calfire-website/our-impact/fire-statistics/2020_redbook_final.pdf?rev=72030b4d2cb7466aa573754ecb4f656e&hash=337DB407876BE384081C7D722D82B1BF
[21] CalFire 2020 Incident Archive. Retrieved from: https://www.fire.cA gov/incidents/2020

Leading to the most severe period of the 2020 wildfire season, dry conditions and hot summer temperatures continued to scorch and desiccate the Californian landscape during July and August 2020. On August 15, 2020 a dry lightning storm, later named the August 2020 Lightning Siege, passed through California resulting in over 14,000 lightning strikes to the ground and hundreds of new fires erupting across the state simultaneously. On September 4, 2020, another dry lightning storm passed through California, which caused hundreds of new fires to erupt, including the Creek Fire that burned in Fresno and Madera counties. Major fires that adversely affected air quality in the Valley during the August-September 2020 period include:

- Hills Fire burned 2,121 acres (Fresno County)
- Lake Fire burned 31,089 acres (Los Angeles County)
- SCU Lightning Complex burned 396,624 acres (Stanislaus and San Joaquin Counties)
- CZU Lightning Complex burned 86,509 acres (San Mateo and Santa Cruz Counties)
- Creek Fire burned 379,895 acres (Fresno and Madera Counties)
- SQF Complex burned 174,178 acres (Tulare County)
- August Complex burned 1,032,648 acres (Colusa, Glenn, Humboldt, Lake, Mendocino, Tehama, and Trinity Counties)

The SQF Complex eventually burned nearly 175,000 acres, becoming the 18th largest fire in California history. The SQF Complex reached 100% containment on January 6, 2021, and afterward produced minimal smoke until the fire was fully extinguished. The Creek Fire ignited in late summer on September 4, 2020 and burned nearly 380,000 acres. The Creek Fire went on to become one of the largest single non-complex fires in California history, second only to the Dixie Fire which would burn over 960,000 acres in 2021. The Creek Fire was declared 100 percent contained on December 24, 2020.

The enormous amount of wildfire smoke from these fires significantly impacted the Valley's air quality for nearly three months, leading to some of the worst air quality in recent history and unhealthy conditions across the entire region for a prolonged period of time, particularly for particulate matter.

2021 Wildfire Season

In 2021, more than 7,300 wildfires were recorded in California, with over 2.5 million acres burned across the state, resulting in one of the most severe wildfire seasons in California history, second only to the unprecedented and historic 2020 wildfire season.[22,23] In addition, four of the top 20 largest wildfires in California history all

[22] 2021 Wildfire Activity Statistics. Retrieved from: https://34c031f8-c9fd-4018-8c5a-4159cdff6b0d-cdn-endpoint.azureedge.net/-/media/calfire-website/our-impact/fire-statistics/2021_redbook_final.pdf?rev=525959073bbe4bbe816d67624911e4c3&hash=CFD17F879B2CE984AB5BA9FEA4F73A56
[23] CalFire 2021 Incident Archive. Retrieved from: https://www.fire.cA gov/incidents/2021

occurred during the 2021 season. A new record for the largest single, non-complex wildfire in state history also occurred in 2021, with the Dixie Fire in northern California alone burning over 960,000 acres. These points underscore how extreme and extensive the 2021 wildfire season was for California. Major fires that adversely impacted air quality in the Valley during the August-October 2021 period include:

- Dixie Fire burned 963,309 acres (northern California counties)
- River Complex burned 199,359 acres (Trinity and Siskiyou counties)
- French Fire burned 26,535 (Kern County)
- Walkers Fire burned 8,777 acres (Tulare County)
- KNP Complex burned 88,307 acres (Tulare County)
- Windy Fire burned 97,528 acres (Tulare County)
- River Fire burned 9,656 (Mariposa County)

Both the KNP Complex and the Windy Fire significantly and directly impacted the Valley's air quality beginning in September. Combined, these fires in Tulare County burned over 185,000 acres. These Tulare County fires were declared 100 percent contained by December 16, 2021. The Dixie Fire, and many other significant fires in northern California, severely impacted air quality in the San Joaquin Valley and the western U.S. during the 2021 wildfire season. The enormous amount of wildfire smoke from these fires significantly impacted the Valley's air quality over a three-month period, leading to very poor air quality and unhealthy conditions across the entire region for prolonged periods of time. As in 2020, these wildfires affected particulate matter as well as ozone concentrations.

2022 Wildfire Season

In 2022, approximately 7,400 wildfires were recorded in California, with over 300,000 acres burned across the state.[24] Although the acres burned in 2022 was below the 5-year average, and less than what was measured in 2020-2021, there were still a significant number of wildfires in California in 2022. Major fires that adversely impacted air quality in the Valley during the July-October 2022 period included:

- Oak Fire burned 19,244 acres (Mariposa County)
- Six Rivers Lightning Complex burned 41,600 acres (Humboldt and Trinity counties)
- Mountain Fire burned 13,440 acres (Siskiyou County)
- Fairview Fire burned 28,098 acres (Riverside County
- McKinney Fire burned 60,138 acres (Siskiyou County)
- Mosquito Fire burned 76,788 acres (Placer and El Dorado counties)

The Mosquito Fire was active for 51 days before it was contained, beginning on September 6, 2022, and eventually burning over 76,000 acres. The Mosquito Fire and

[24] CalFire 2022 Incident Archive, https://www.fire.cA gov/incidents/2022

other significant fires in California impacted the Valley's air quality over a four-month period, leading to a deterioration in air quality and poor conditions across the region.

The District works collaboratively with the public, media, land managers, school districts, county public health officers, and other stakeholders to alert the public of poor air quality and increase the understanding of the devastating public health impacts of wildfires, as well as the need for improved management of the public forests. The District continues to pursue enhanced forest management efforts at the state and federal level to address the extraordinary build-up of fuels in our surrounding forests and minimize wildfire impacts in the future.

A.2 ATTAINMENT DEMONSTRATION – DESIGN VALUES

Design values represent the official metric for assessing air quality improvements and attainment of the NAAQS per the federal Clean Air Act (CAA) and EPA regulations. PM2.5 design value calculations are three-year averages that follow EPA protocols for rounding, averaging conventions, data completeness, sampling frequency, data substitutions, and data validity. The results provide consistency and transparency to determine basin-wide attainment for both the 2006 24-hour PM2.5 standard of 35 µg/m³, and the 2012 annual PM2.5 standard of 12 µg/m³. If any monitoring site within the air basin has either a 24-hour or an annual PM2.5 design value higher than the respective standards, then the entire air basin is designated nonattainment.

Table A-3 provides the generalized descriptions of how the 24-hour and annual design values are calculated for PM2.5. EPA provides detailed procedures for the calculation and data handling methodologies.[25]

Table A-3 General PM2.5 Design Value Calculation Methods

Averaging Period	Level	Calculation Method
24-hour	35 µg/m³ (2006)	**Step 1:** *Determine the 98th percentile value for each year over a consecutive three-year period.* **Step 2:** *Average the three 98th percentile values.* **Step 3:** *Round the resulting value to the nearest 1.0 µg/m³.* **Step 4:** *Compare the result to the standard.*
Annual	12.0 µg/m³ (2012)	**Step 1:** *Calculate the average of each quarter of each year over a three-year period.* **Step 2:** *Average the four quarters in a calendar year to determine the average for each year (the annual mean).* **Step 3:** *Average the three annual mean values.* **Step 4:** *Round the resulting value to the nearest 0.1 µg/m³.* **Step 5:** *Compare the result to the standard.*

[25] 40 CFR Appendix-N-to-Part-50 1.0(a) Retrieved May 11, 2023. https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50/appendix-Appendix%20N%20to%20Part%2050

Table A-4 through Table A-7 show the trend of the 24-hour 98th percentile and annual mean values for each PM2.5 monitoring site in the Valley by year, as well as the three-year average design values through the year 2022.

24-hour single-year 98th-percentile averages (Table A-4) are used to generate the three-year average 24-hour design values (Table A-5). Single-year average PM2.5 concentrations (Table A-6) are used to generate the three-year average annual design values (Table A-7). This data is shown in Figure A-3 through Figure A-18 for sites within each county in the Valley.

Average ambient PM2.5 concentrations vary by monitoring site within the Valley. In general, monitoring sites in the northern part of the Valley record the lowest ambient PM2.5 concentrations, with concentrations increasing toward the central and southern portions of the Valley. With PM2.5 concentrations continuing to improve, both 24-hour and annual design values are trending downward across the Valley, bringing the region closer to attaining the federal PM2.5 standards. Note that the following tables and figures include data that were impacted by wildfire emissions, and therefore recent values for the years 2020, 2021, and 2022 are skewed high due to these impacts.

Note that the Fresno-Foundry air monitoring site in Fresno County serves as the near-road site in the area, meeting the federal NO2 monitoring criteria. Per EPA requirements, this site also measures PM2.5, and since this site became operational in 2020, it has measured higher PM2.5 than other sites in Fresno County. However, based on the analysis, strategy, and modeling for this plan, the Fresno-Foundry site is projected to meet the 12 $\mu g/m^3$ annual PM2.5 standard by 2030, along with the rest of the Valley.

Table A-4 Single Year 24-hour Average PM2.5 98th Percentile Values (μg/m³)

SJV Monitoring Sites	Average 2000-2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Stockton-University Park	47.3	42.0	48.0	61.6	40.4	29.7	44.8	33.9	56.3	44.5	39.1	32.4	44.2	92.3	32.9	65.9	39.5	35.2	35.4*
Manteca						44.0*	38.9	30.9	40.2	40.0	42.7	29.3	36.4	96.9	26.8*	66.9	37.4	33.1*	29.5
Modesto-14th Street	59.3	52.0	57.4	53.9	54.5	37.3	54.7	40.8	56.4	49.5	30.8*	36.2	51.1	100.4	28.4	67.1	43.1	36.4	32.5
Turlock				67.4*	53.1	43.5	57.4	45.4	55.4	51.2	47.3	38.5	48.0	88.6	36.0	67.7	42.2	34.5	33.2
Merced-M St	52.6	52.5	53.0	53.6*	49.8	39.1	38.5	41.8	67.3	45.9	39.0	34.6	40.3	52.7	29.5	77.1	40.9	31.3	31.8
Merced-Coffee					41.4*	39.9	47.4	35.6	42.3	43.8	40.3	32.8	44.7	56.0	23.4	78.3	40.7	28.7	28.6
Madera-City						57.0*	59.1	43.2	54.6	56.0	43.7	35.7	45.8	50.2	23.9	87.7	47.0	31.5	27.7
Clovis-Villa	62.3	60.5	61.2	49.7	49.0	44.3	68.5	48.0	56.2	59.3	45.7	37.7	50.0	57.0	28*	99.5	49.6	32.9	24.0
Fresno-Garland	69.8	51.0	67.0	57.4	55.8	48.8	64.5	52.6	63.8	66.7	52.0	42.7	68.0	63.5	36.9	85.0	53.5	43.1	33.3
Fresno-Pacific	64.7	65.0	57.9	46.4	52.3	40.2	67.5	51.3	71.6	61.8	42.0	40.0	73.2	65.5	37.1	81.0	48.6	42.4	39.5
Fresno-Foundry																63.9	53.5	40.6	34.6
Tranquility					35.8*	27*	27.5	26.9	35.7	31.2*	35.8	27.0	34.4	51.4	17.1	92.5	32.0	22.0	21.0
Corcoran-Patterson	71.5	63.8	59.5	47.9	53.4	47.2	40.8*	40.0*	66.0	71.0	99.2*	45.9	69.7	78.0	45.1	69.0	51.6	41.8	29.9
Hanford-Irwin						48.5	64.6	48.3	67.6	81.9	51.4	43.3	68.7	78.2	41.1	72.6	56.4	42.7	37.0
Visalia-W. Ashland Avenue	72.5	50.0	59.7	62.1	53.9	36.3	50.7	53.8	62.5	75.4	45.8	40.7	74.6	63.4	45.5	83.4	69.3	41.2	33.6
Bakersfield-Golden / M St	78.3	75.2	69.4	60.9*	68.6	†	†	†	†	107.2*	51.5	51.4	71.3	60.9	44.3	76.9	54.3	51.8	37.5
Bakersfield-California	72.3	60.5	73.0	64.5	66.7	53.3	65.5	56.4	71.8	79.9	57.2	47.0	71.8	69.2	43.4	79.2	56.9	48.5	36.0
Bakersfield-Airport (Planz)	65.9	64.7	72.2	72.3	65.5	56.2	43.2	40.6	96.7	76.7	56.5	50.7	69.7	60.8	46.7	57.1	54.8	45.7	37.5

*The site does not meet completeness criteria for the year, pursuant to Appendix N to Part 50, Title 40.
†Site was not in operation.

Table A-5 24-hour Average PM2.5 Design Values (Three-Year Averages, µg/m³)

SJV Monitoring Sites	Average 2000-2007	2006-2008	2007-2009	2008-2010	2009-2011	2010-2012	2011-2013	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020	2019-2021	2020-2022	2021-2023
Stockton-University Park	48	51	50	44	38	36	45	45	47	39	39	56	56	64	51	52	37*
Manteca				44*	41*	38*	37	37	41	37	36	54	53*	59*	52*	54*	33*
Modesto-14th Street	60	54	55	49	49	44	51	49	46*	39*	39*	63	60	65	51	54	37
Turlock		67*	60*	55*	51	49	53	51	51	46	45	58	58	64	55	55	37
Merced-M St	54	53	52	48	42	40	49	52	51	40	38	43	41	53	49	50	35
Merced-Coffee			41*	41*	43*	41	42	41	42	39	39	45	41	53	47	49	33
Madera-City				57*	58*	53*	52	51	51	45	42	44	40	53	53	55	35
Clovis-Villa	62	57	53	48	54	54	58	55	54	48	44	48	45*	62*	59*	61	36
Fresno-Garland	69	58	60	54	56	55	60	61	61	54	54	58	56	62	58	61	43
Fresno-Pacific	64	56	52	46	53	53	63	62	58	48	52	60	59	61	56	57	44
Fresno-Foundry														64*	71*	61	43
Tranquillity			36*	31*	30*	27*	30	31*	34*	31*	32	38	34	54	47	49	25
Corcoran-Patterson	70	57	54*	50*	47*	43*	49*	59	79*	72*	72*	65	64	64	60	59	41
Hanford-Irwin				49	57	54	60	66	67	59	54	63	63	64	61	62	45
Visalia-W. Ashland Avenue	70	57	59	51	47	47	56	64	61	54	54	60	61	64	66	65	48
Bakersfield-Golden / M St	77	69*	66*	65*	69*	†	†	107*	79*	70*	58	61	59	61	59	61	48
Bakersfield-California	72	66	68	62	62	58	65	69	70	61	59	63	61	64	60	62	47
Bakersfield-Airport (Planz)	64	70	70	65	55	47	60	71	77	61	59	60	59	63	61	61	46

* The site does not meet completeness criteria for the year, pursuant to Appendix N to Part 50, Title 40.
†Site was not in operation.

Table A-6 Single Year Annual Mean PM2.5 Concentrations (µg/m^3)

SJV Monitoring Sites	Average 2000-2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Stockton-University Park	14.2	13.1	12.9	14.4	11.3	10.6	11.3	12.4	17.7	12.1	12.8	11.8	12.1	17.6	9.3	14.0	12.8	10.2	10.7*
Manteca						17.6*	10.7	8.1	11.6	9.8	12.6	9.8	11.1	13.4	8.1*	14.8	11.7	9*	7.9
Modesto-14th Street	15.8	14.8	15.0	16.0	13.0	12.1	14.7	11.9	14.3	11.4	9.1*	11.1	12.9	15.2	7.7	14.5	15.0	13.4	10.5
Turlock				30.3*	16.1	12.7	17.1	14.8	15.0	12.3	14.2	12.6	12.7	17.2	10.6	15.5	12.8	10.8	10.1
Merced-M St	15.8	14.8	15.2	14.9*	13.6	11.2	10.4	9.5	13.5	11.2	12.6	11.2	12.6	14.2	9.6	15.5	11.1	10.5	9.6
Merced-Coffee					22.7*	16.3	15.6	11.0	13.3	10.8	12.7	11.9	13.3	15.1	9.1	14.7	11.3	9.8	8.4
Madera-City						21.1*	20.4	16.0	17.8	14.0	13.8	12.0	12.5	14.0	9.7	16.9	12.4	10.4	9.9
Clovis-Villa	16.6	16.4	16.4	16.2	18.3	14.6	17.9	15.4	15.9	14.8	15.0	12.5	13.1	14.3	10.2*	18.4	15.1	10.5	8.6
Fresno-Garland	18.4	16.8	18.8	17.4	15.1	13.0	15.5	14.1	16.8	15.1	14.4	12.7	14.9	16.2	11.1	19.2	15.6	12.7	10.5
Fresno-Pacific	18.3	17.6	16.8	16.5	14.6	13.4	15.4	12.7	15.9	13.8	14.1	13.0	15.0	17.1	11.2	18.6	13.8	13.5	12.6
Fresno-Foundry																20.3	17.2	14.8	12.5
Tranquillity					11.8*	7*	8.2	7.0	8.3	7.6*	10.0	7.7	8.3	11.1	5.8	11.5	8.9	6.7	4.8
Corcoran-Patterson	18.0	16.9	18.4	15.8	17.7	17.9	12.8*	16.5*	15.6	15.4	35.8*	14.8	16.0	17.1	12.1	19.1	14.8	14.7	10.1
Hanford-Irwin						14.5	18.0	14.8	18.2	17.5	16.5	15.5	17.2	17.7	12.2	19.9	15.6	14.2	12.5
Visalia-W. Ashland Avenue	20.6	18.8	20.4	19.8	16.0	13.6	16.1	14.8	18.9	17.9	16.1	14.7	16.3	17.3	12.9	19.6	20.7	14.9	11.7
Bakersfield-Golden / M St	20.9	18.6	19.9	17.9*	20.0	†	†	†	†	18.1*	16.7	14.8	16.2	18.1	12.4	19.5	17.9	16.6	13.6
Bakersfield-California	20.0	18.7	22.0	21.9	19.0	14.2	16.2	13.0	20.0	18.6	16.3	14.8	15.9	17.7	11.9	19.7	16.6	15.8	12.0
Bakersfield-Airport (Planz)	19.9	19.3	21.8	23.5	22.5	17.6	14.5	14.7	22.8	21.6	17.9	15.9	18.2	19.4	13.0	20.3	20.0	16.1	12.5

* The site does not meet completeness criteria for the year, pursuant to Appendix N to Part 50, Title 40.
†Site was not in operation.

Table A-7 Annual PM2.5 Design Values (Three-Year Averages, µg/m^3)

SJV Monitoring Sites	Average 2000-2007	2006-2008	2007-2009	2008-2010	2009-2011	2010-2012	2011-2013	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020	2019-2021	2020-2022	2021-2023
Stockton-University Park	14.7	13.5	12.9	12.1	11.1	11.4	13.8	14.0	14.2	12.2	12.2	13.8	13.0	13.7	12.1	12.4	11.2*
Manteca				17.6*	14.2*	12.1*	10.2	9.8*	11.3*	10.7	11.2	11.5	10.9*	12.2*	11.6*	11.8*	9.5
Modesto-14th Street	16.7	15.3	14.7	13.7	13.3	12.9	13.6	12.5	11.6*	10.5*	11.0*	13.1	11.9	12.5	12.4	14.3	13.0
Turlock		30.3*	23.2*	19.7*	15.3	14.9	15.7	14.0	13.8	13.0	13.2	14.2	13.5	14.5	13.0	13.1	11.3
Merced-M St	16.4	15.0	14.5	13.2	11.7	10.4	11.1	11.4	12.5	11.7	12.1	12.7	12.2	13.1	12.1	12.3	10.4
Merced-Coffee			22.7*	19.5*	18.2*	14.3	13.3	11.7	12.3	11.8	12.7	13.4	12.5	13.0	11.7	11.9	9.8
Madera-City				22.0*	21.2*	19.2*	18.1	15.9	15.2	13.3	12.8	12.8	12.0	13.5	13.0	13.3	10.9
Clovis-Villa	17.2	16.4	17.0	16.4	17.0	16.0	16.4	15.3	15.2	14.1	13.5	13.3	12.5*	14.3*	14.6*	14.7	11.4
Fresno-Garland	20.1	17.7	17.1	15.2	14.6	14.2	15.5	15.4	15.4	14.1	14.0	14.6	14.1	15.5	15.3	15.8	13.0
Fresno-Pacific	18.2	17.0	16.0	14.9	14.5	13.8	14.7	14.1	14.6	13.6	14.0	15.0	14.5	15.7	14.6	15.3	13.3
Fresno-Foundry														20.3*	18.8*	17.5	14.8
Tranquillity			11.8*	9.4*	9.0*	7.4*	7.8	7.7*	8.7*	8.5*	8.7	9.1	8.4	9.5	8.8	9.1	6.8
Corcoran-Patterson	17.5	17.0	17.3*	17.1*	16.2*	15.8*	15.0*	15.8	22.2*	22.0*	22.2*	16.0	15.1	16.1	15.4	16.2	13.2
Hanford-Irwin				14.7	16.4	15.8	17.0	16.8	17.4	16.5	16.4	16.8	15.7	16.6	15.9	16.6	14.1
Visalia-W. Ashland Avenue	21.3	19.7	18.8	16.5	15.2	14.8	16.6	17.2	17.6	16.2	15.7	16.1	15.5	16.7	17.8	18.5	15.7
Bakersfield-Golden / M St	21.3	18.8*	19.3*	19.0*	20.0*	†	†	18.1*	17.4*	16.5*	15.9	16.4	15.5	16.6	16.6	18.0	16.0
Bakersfield-California	20.5	20.9	21.0	18.4	16.5	14.5	16.4	17.2	18.3	16.5	15.7	16.1	15.2	16.4	16.1	17.4	14.8
Bakersfield-Airport (Planz)	20.0	21.5	22.6	21.2	18.2	15.6	17.3	19.7	20.8	18.4	17.3	17.8	16.9	17.6	17.8	18.8	16.2

* The site does not meet completeness criteria for the year, pursuant to Appendix N to Part 50, Title 40.
†Site was temporarily not in operation.

Figure A-3 San Joaquin County 24-Hour Design Value Trend

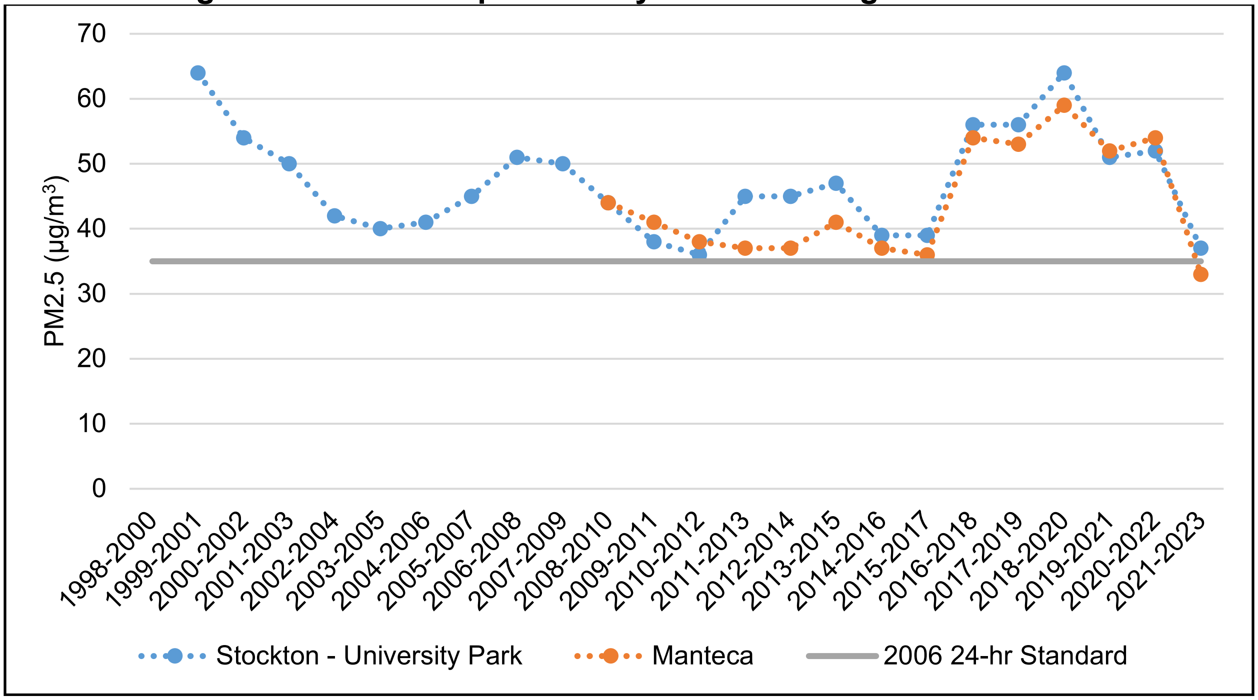


Figure A-4 San Joaquin County Annual Design Value Trend

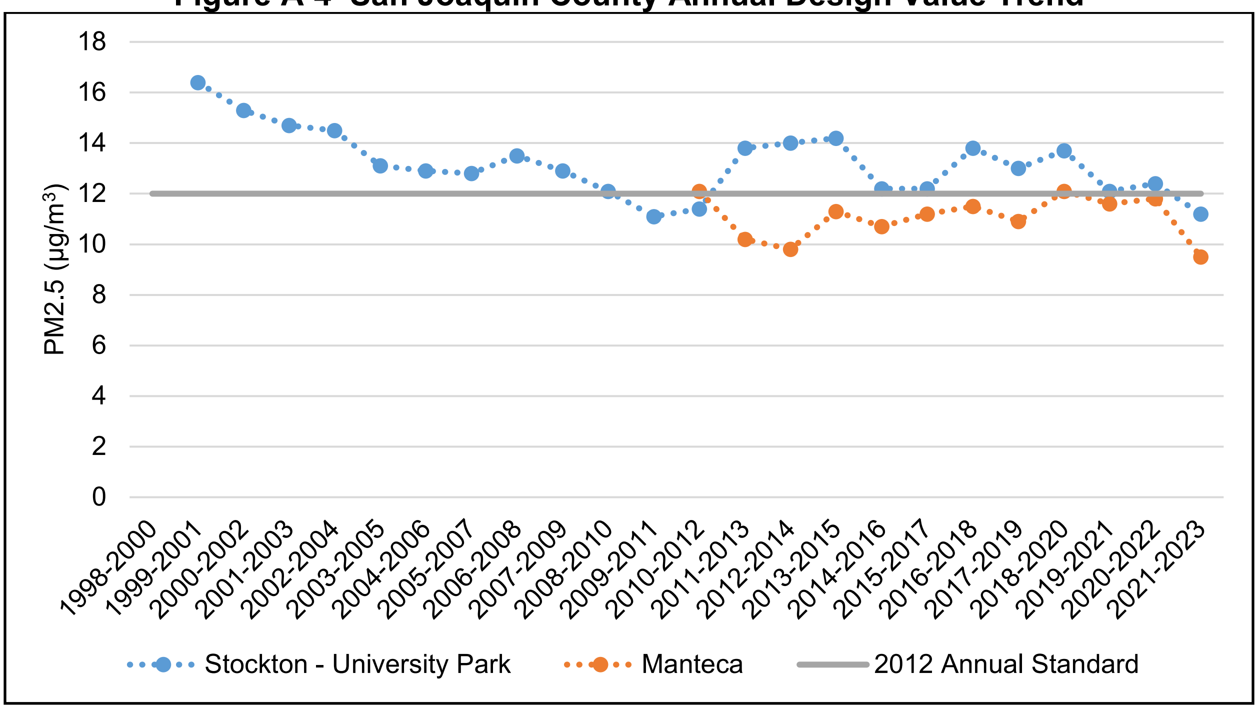


Figure A-5 Stanislaus County 24-Hour Design Value Trend

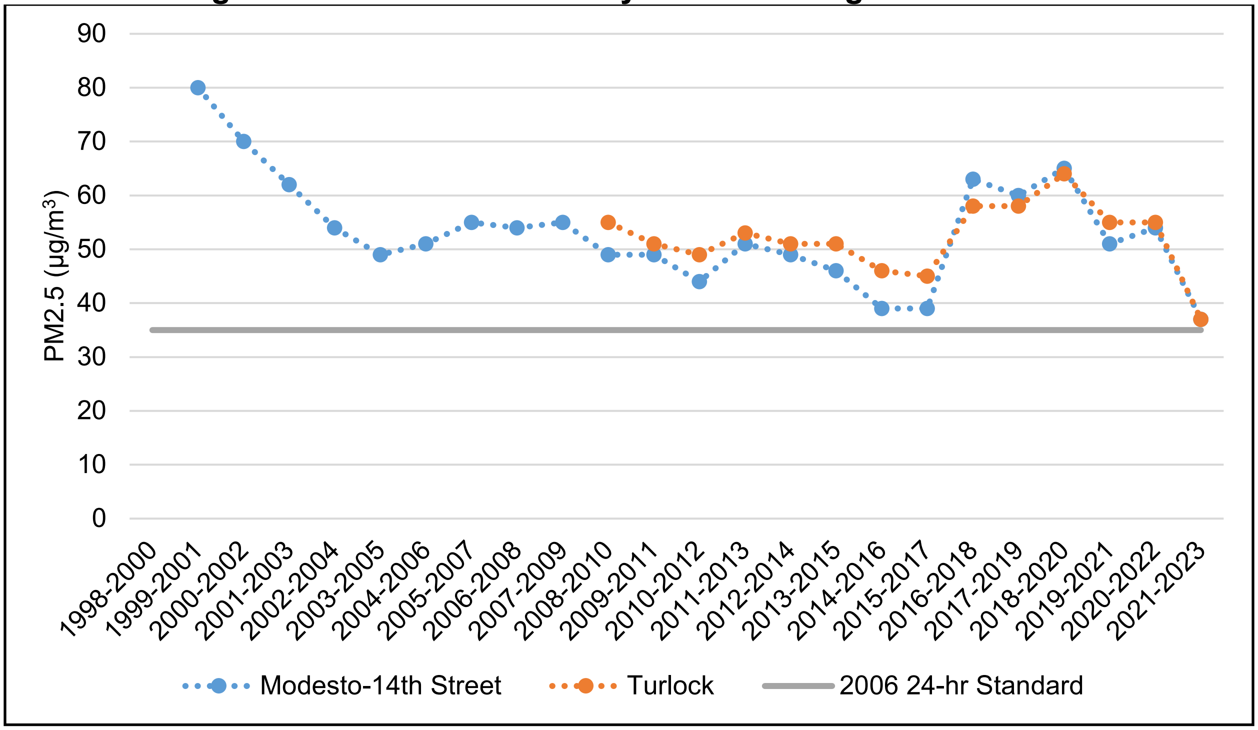


Figure A-6 Stanislaus County Annual Design Value Trend

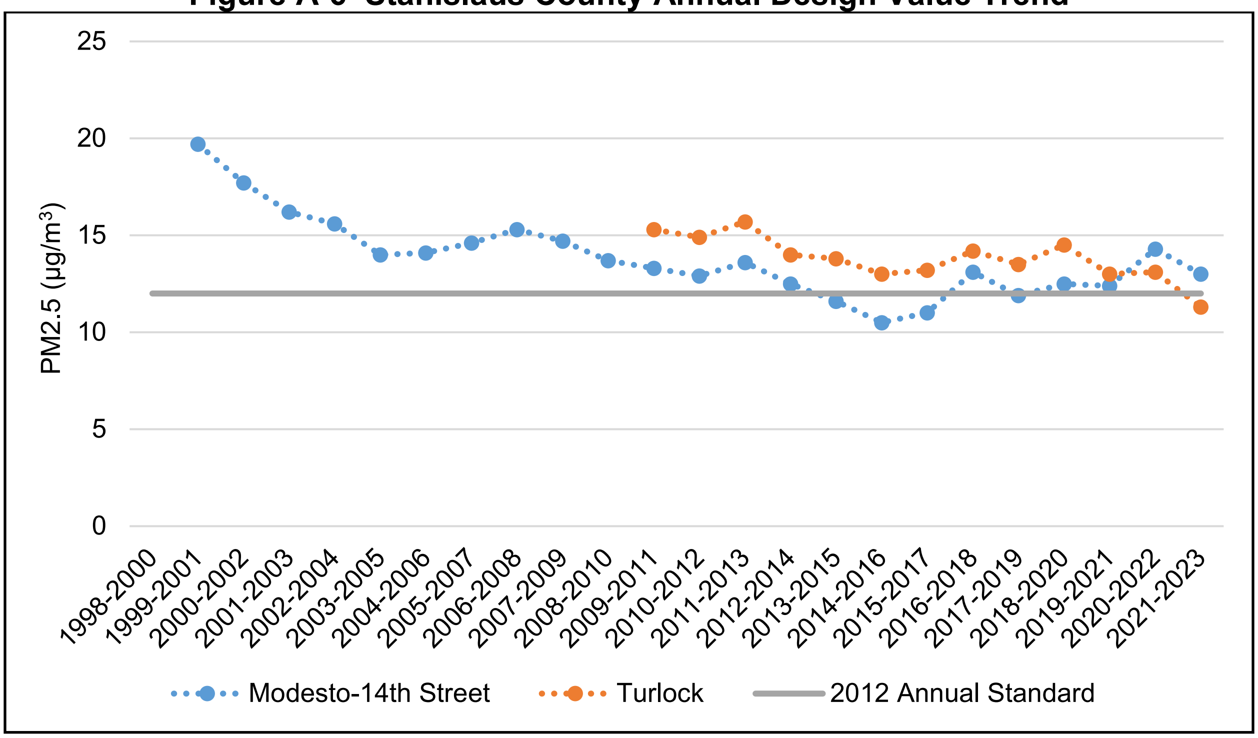


Figure A-7 Merced County 24-Hour Design Value Trend

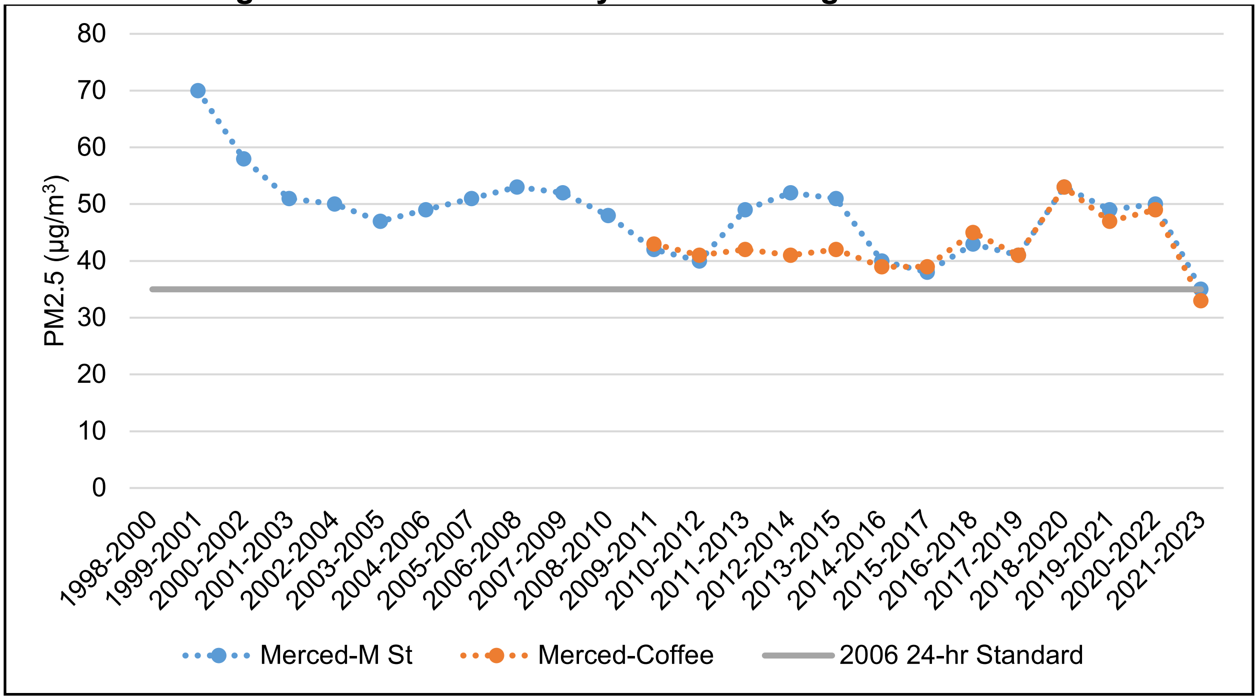


Figure A-8 Merced County Annual Design Value Trend

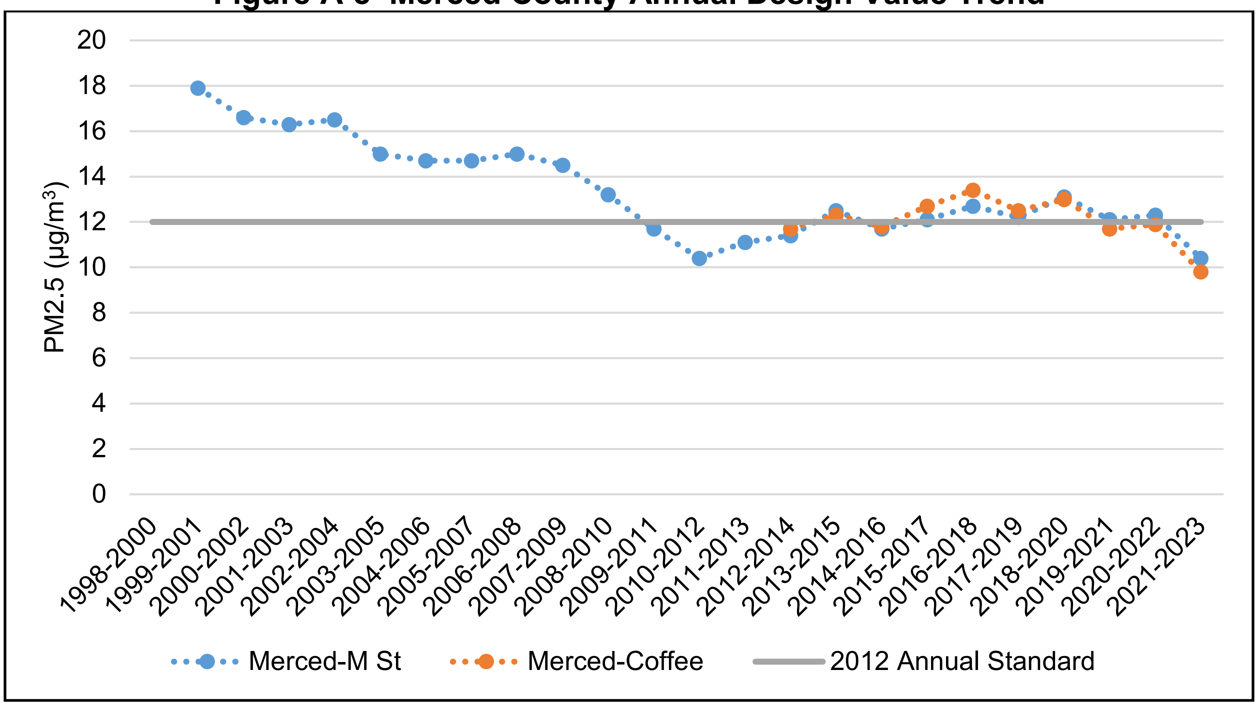


Figure A-9 Madera County[26] 24-Hour Design Value Trend

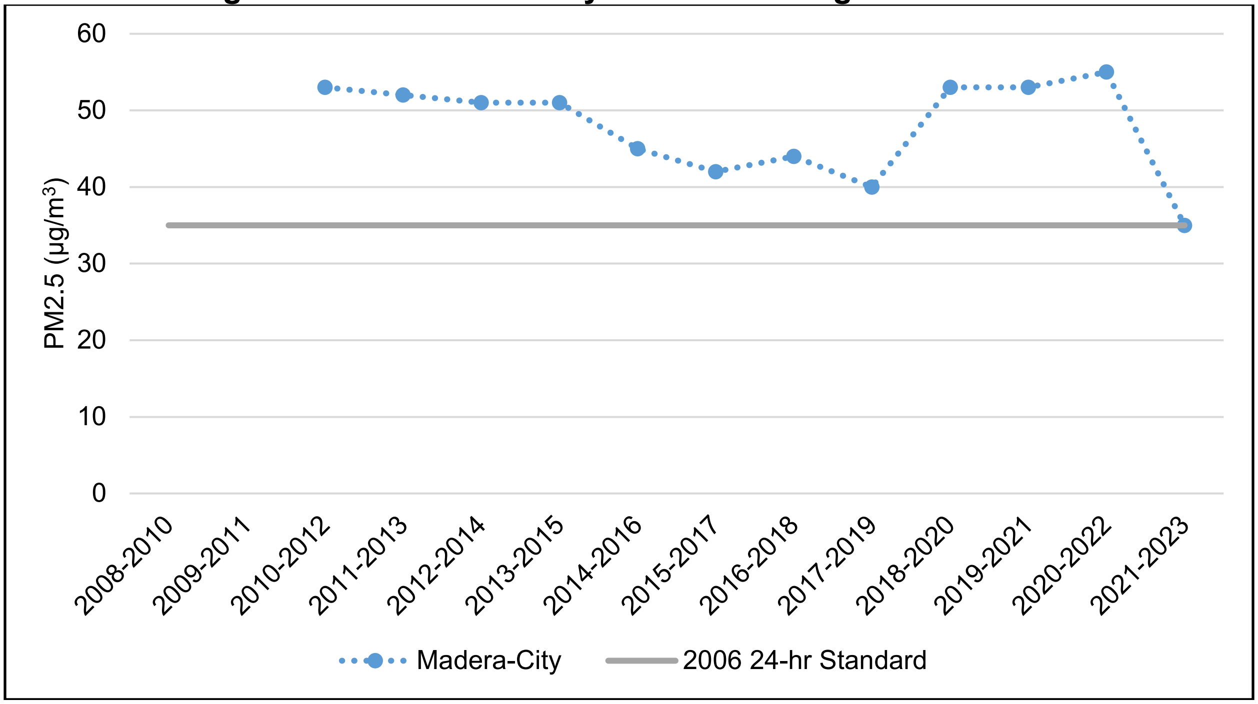
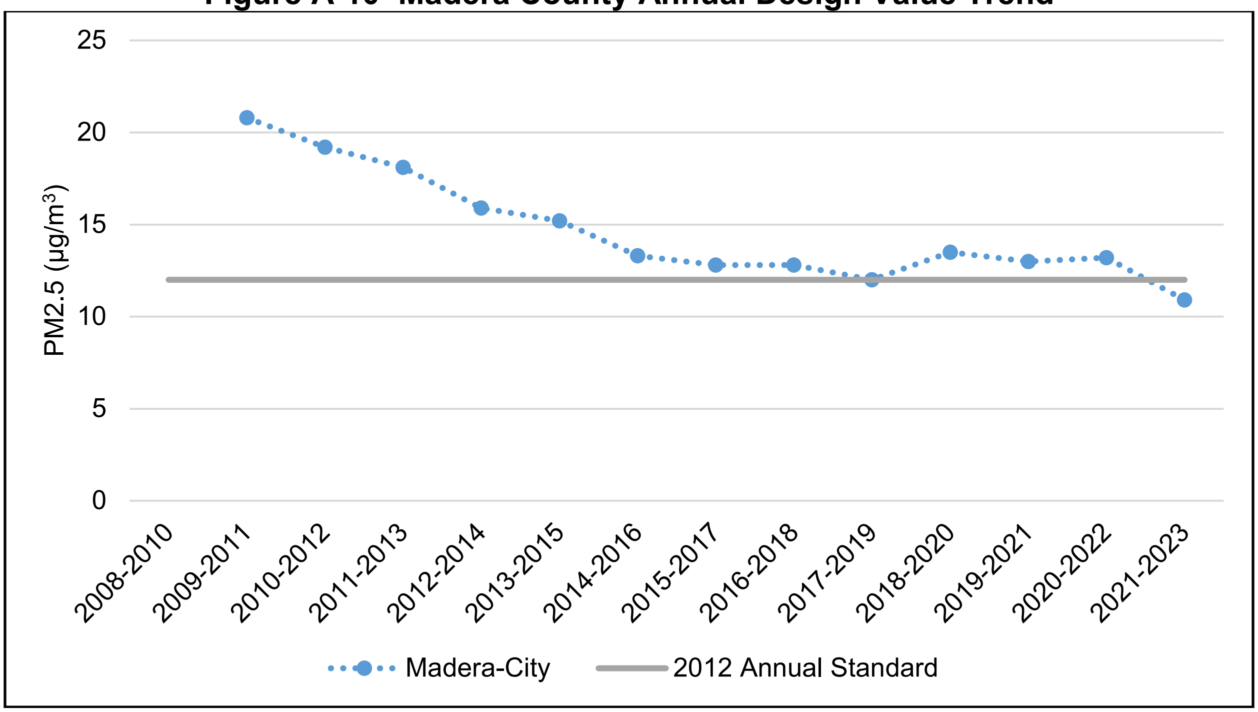


Figure A-10 Madera County Annual Design Value Trend



[26] PM2.5 monitoring in Madera County began in 2010.

Figure A-11 Fresno County 24-Hour Design Value Trend

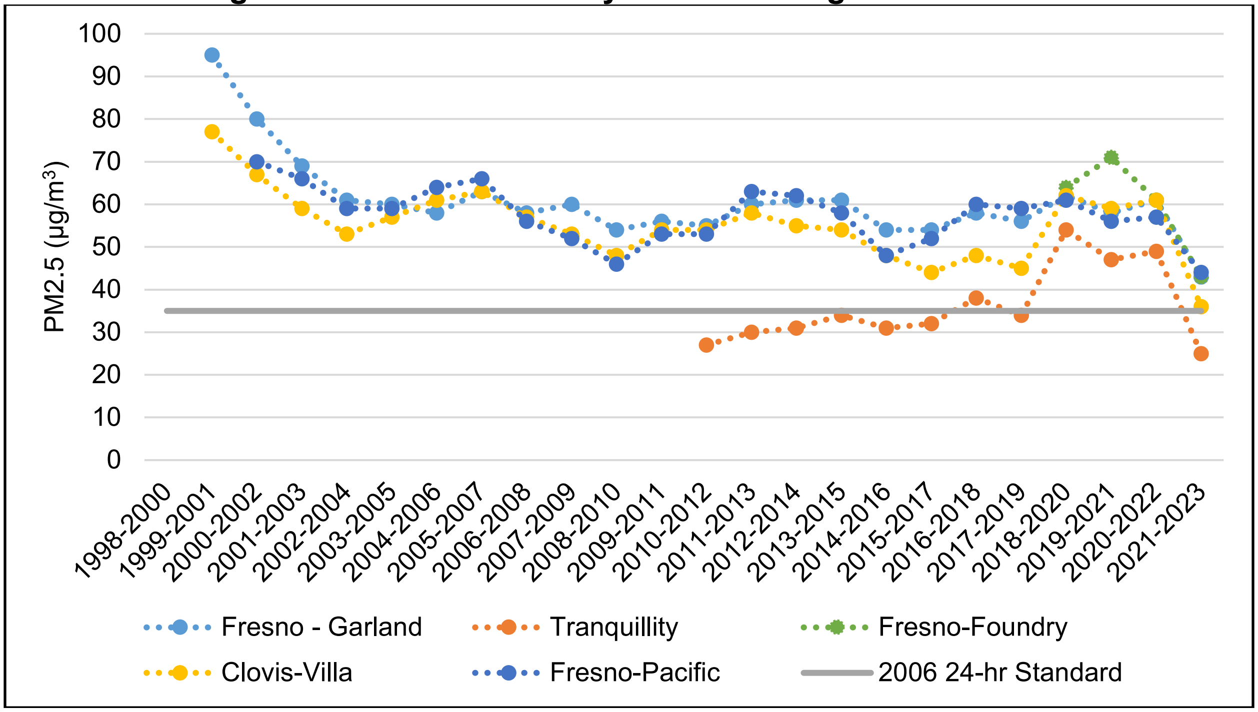


Figure A-12 Fresno County Annual Design Value Trend

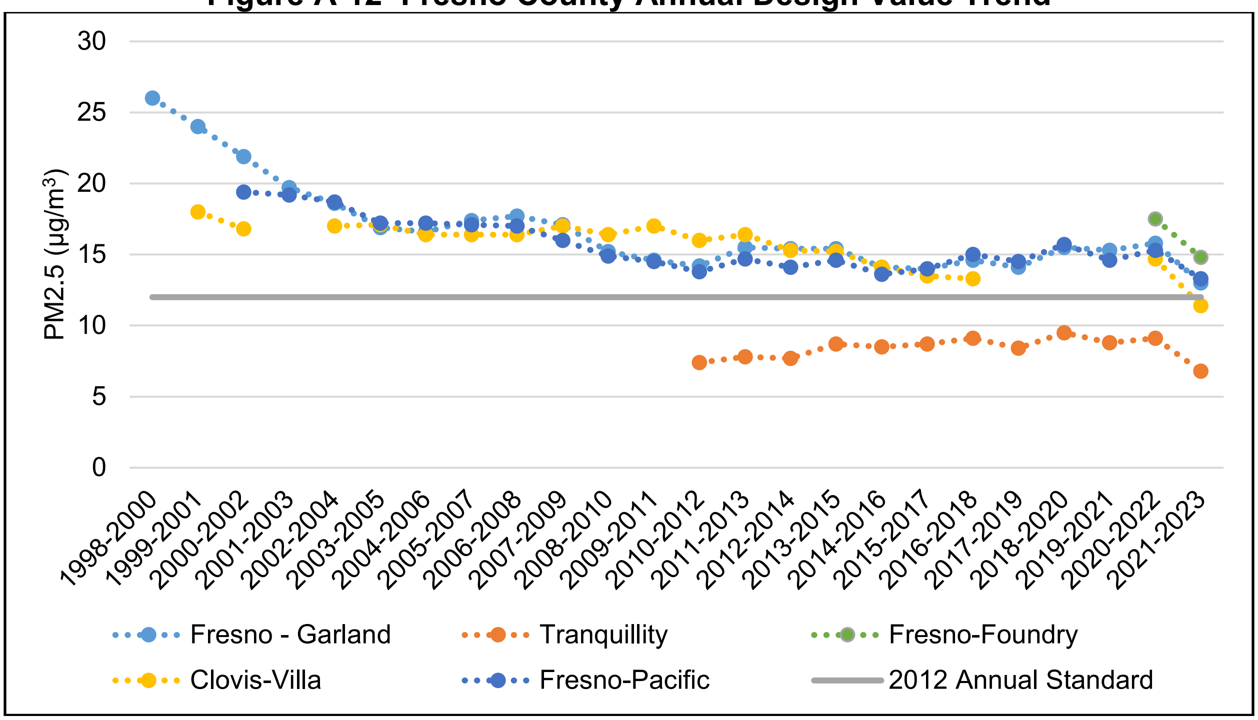


Figure A-13 Kings County 24-Hour Design Value Trend

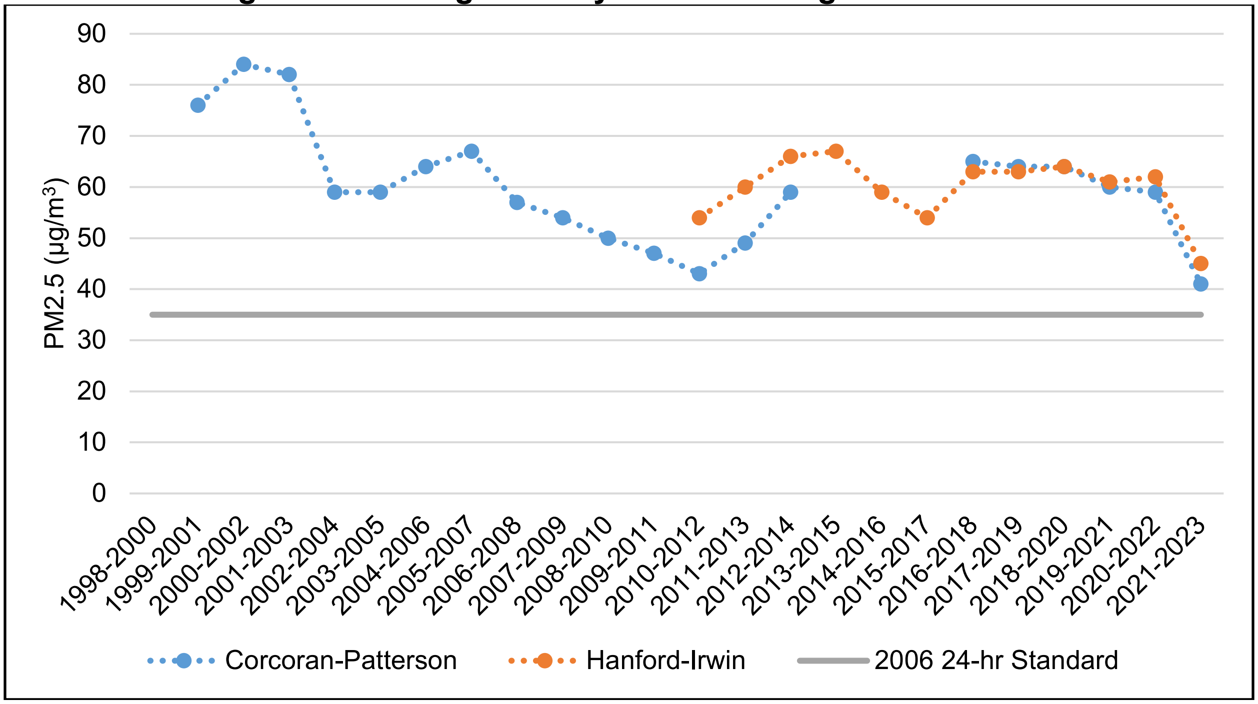


Figure A-14 Kings County Annual Design Value Trend

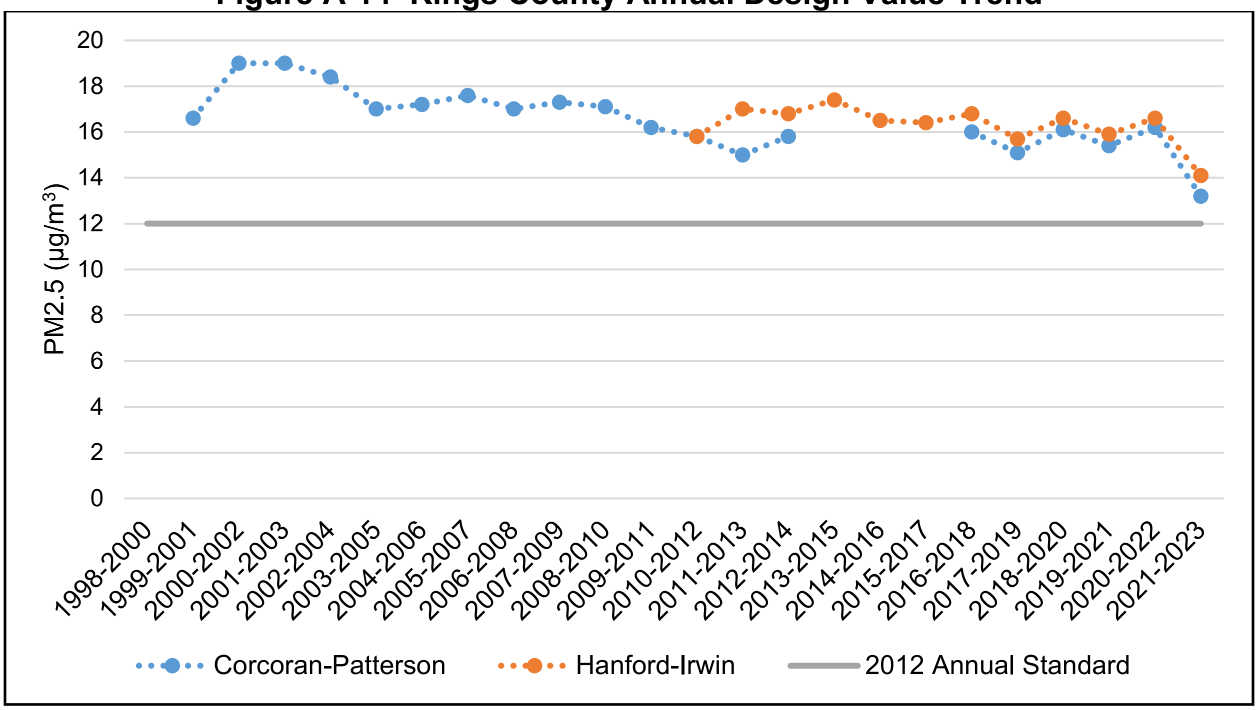


Figure A-15 Tulare County 24-Hour Design Value Trend

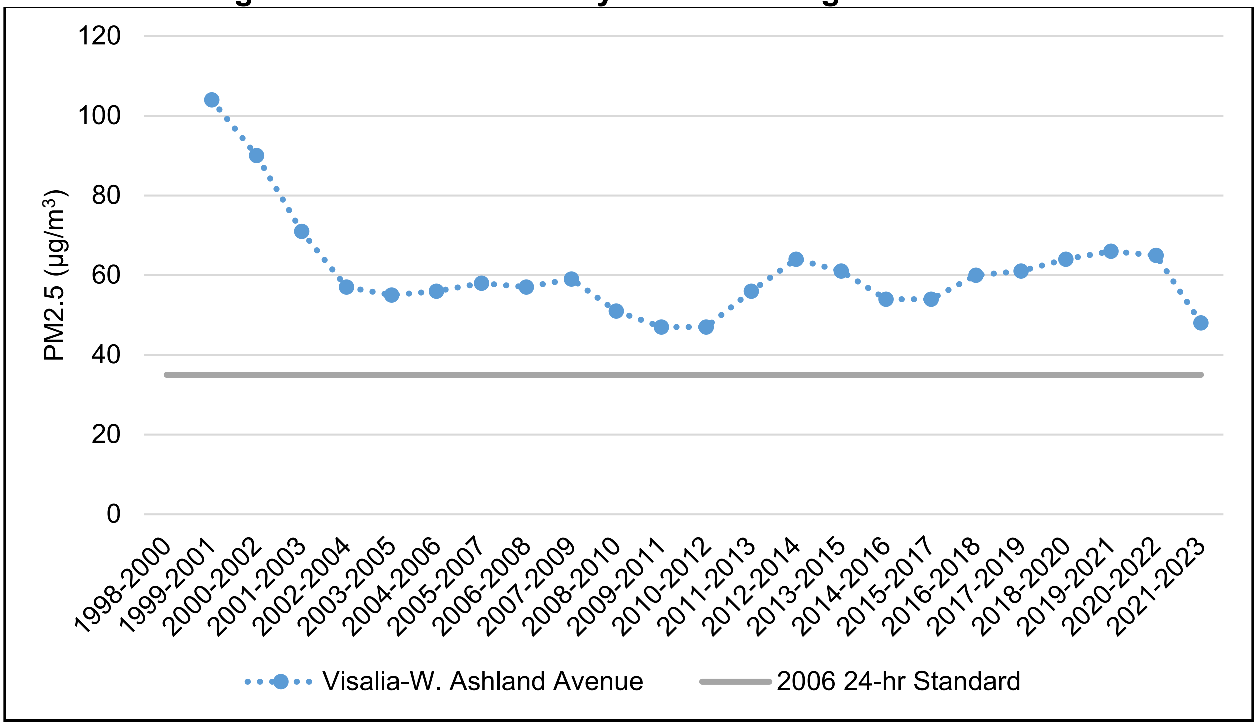


Figure A-16 Tulare County Annual Design Value Trend

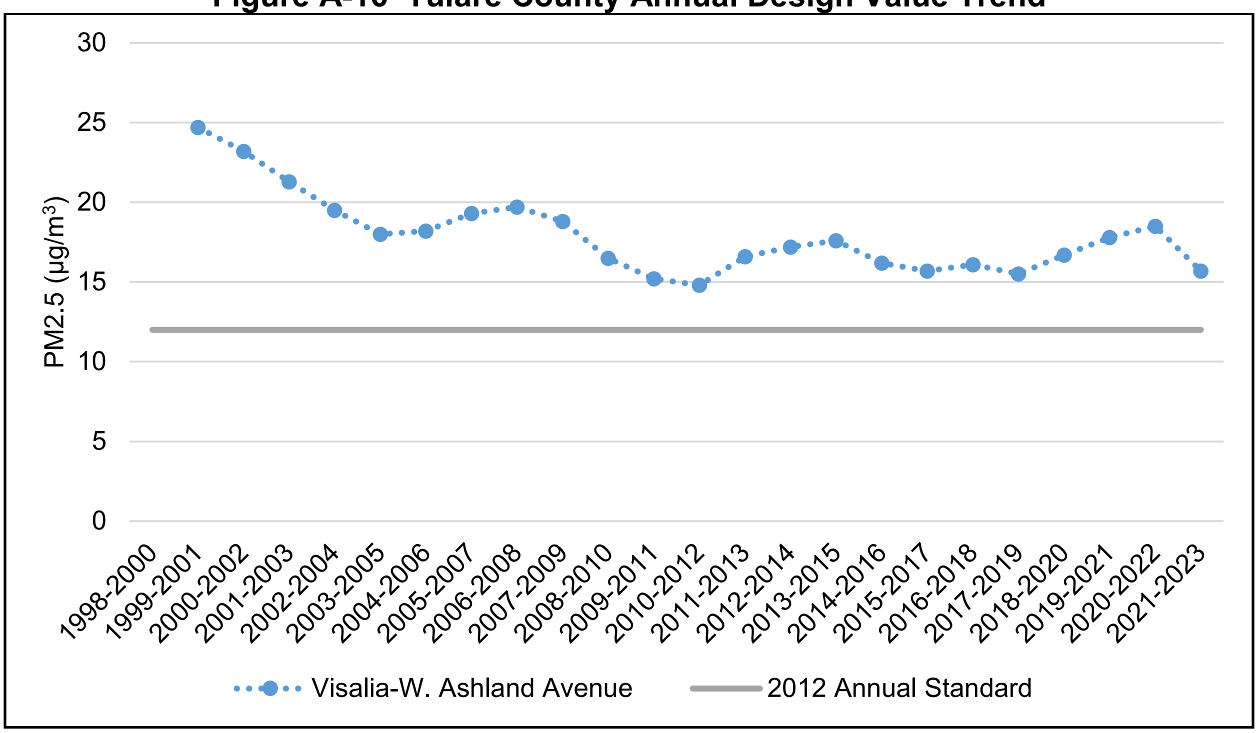


Figure A-17 Kern County 24-Hour Design Value Trend

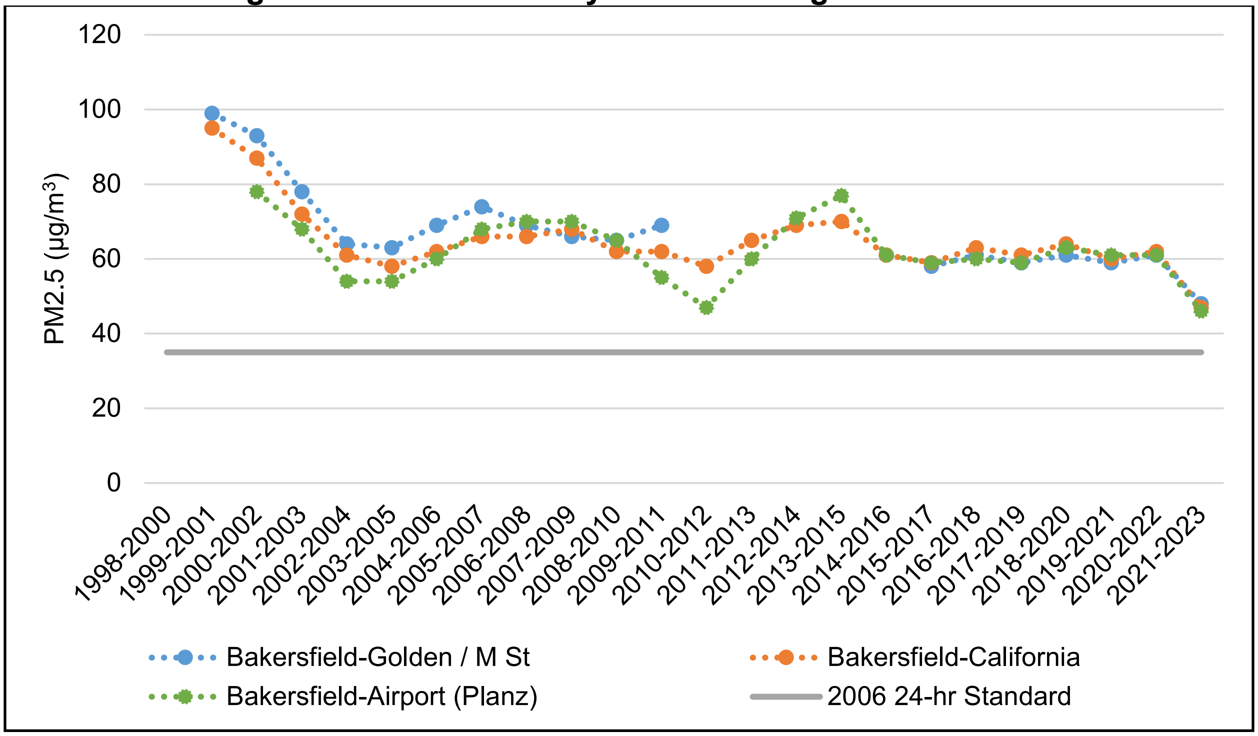
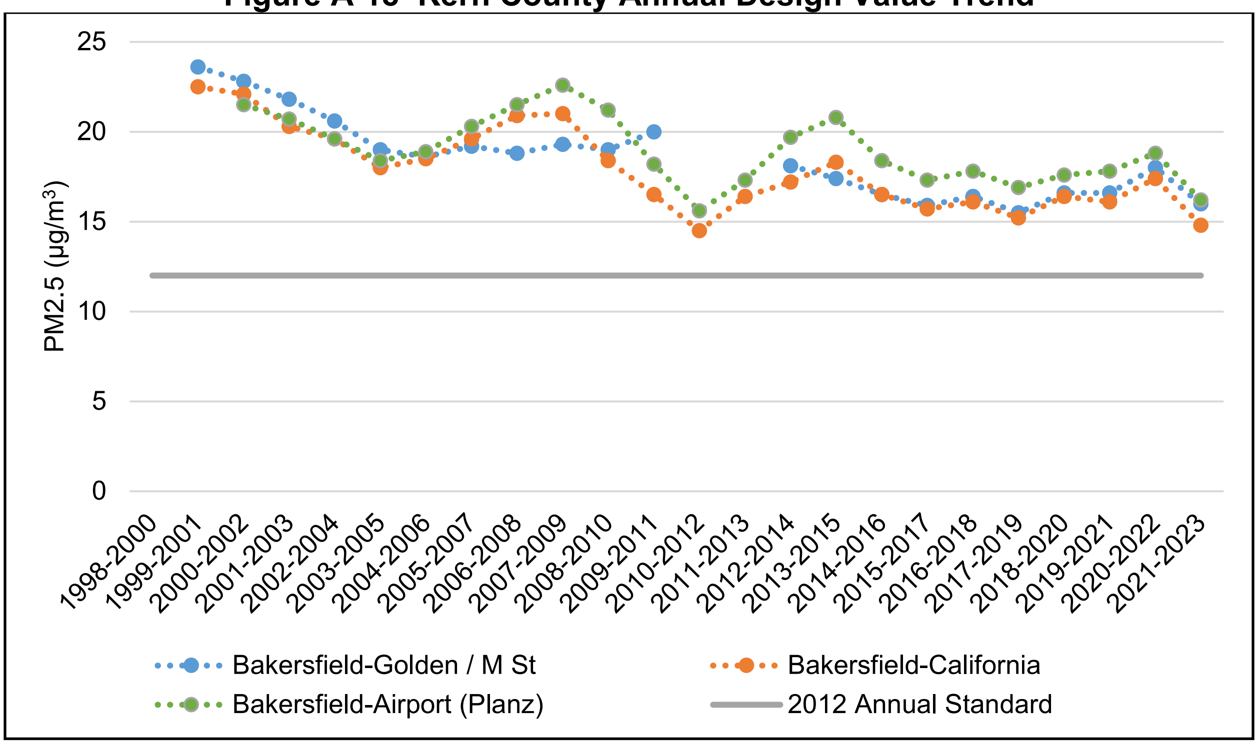


Figure A-18 Kern County Annual Design Value Trend



A.3 AMBIENT PM2.5 CONCENTRATION DATA TRENDS

A design value is a metric for summarizing data for a three-year time period from a monitoring site for comparison to the NAAQS. Although these parameters are required for attainment demonstrations, design values alone do not reveal the hourly, daily, weekly, seasonal, and regional PM2.5 effects on public health, nor do they track air quality improvements within such parameters. The District uses data from air monitoring sites to analyze air quality trends for a deeper understanding of changes in ambient PM2.5 concentrations as they relate to the implementation of District programs. Trends also inform the attainment planning process and Health Risk Reduction Strategy.

A.3.1 Days Over the 24-Hour PM2.5 Standard of 35 µg/m³

Design value calculations for the 24-hour standard use the 98th-percentile concentration value from each monitoring site (higher values in the 99th and 100th percentiles represent extreme outliers and are not used for comparing to the NAAQS). Because of this, a region may experience a limited number of days over the standard and still be considered in attainment.

The number of days over the 24-hour PM2.5 standard is another indicator of air quality progress. Figure A-19 shows the trend of the number of days the Valley exceeded the 2006 24-hour PM2.5 standard of 35 µg/m³. There is an overall decrease in the number of exceedances of the 35 µg/m³ standard since PM2.5 has been monitored.

During the height of the drought years from 2013 to 2015, the Valley experienced an increase in the number of days exceeding this standard. As previously mentioned in Section A.1.2.2, 2020 and 2021 were heavily impacted by wildfires. Increases in atmospheric stability over recent years also caused an increase in PM2.5 concentrations, as shown in Figure A-2.

As shown in Figure A-20 to Figure A-27, the Valley has experienced a drop in exceedances in each county within the District's jurisdiction. As an example of the progress that has been made, Figure A-24 shows that Fresno County recorded 81 exceedances in 2002, and recorded 10 exceedances in the year 2023, which is an 87.7% improvement. Similarly, Figure A-27 shows that Kern County recorded 78 exceedances in 2002, and recorded 9 exceedances in the year 2023, which is a decrease of 88.5%. As these trends display, exceedances of the 2006 24-hour PM2.5 standard have decreased in the Valley, despite some years influenced by drought, wildfires, or exceptionally poor dispersion conditions.

Over the past quarter of a century, the District has worked to develop and operate a robust PM2.5 air monitoring network; however, there was not a complete record of daily PM2.5 measurements for each county in the Valley until about the past decade, from around 2010 forward. Even after 2010, with the intermittent monitoring schedule at the FRM monitoring sites (e.g., 1 sample every 3 days), a complete daily record of PM2.5 measurements has not been available for all counties in the Valley. In order to compare the count of days over the standard from year to year, the District's gap-filling methods were used to create a daily PM2.5 record for each county in the Valley. Spatial interpolation and regional models are often used to estimate air quality between monitors. Regression equations were developed to estimate missing observations by using other sites in the network as independent variables. The estimated PM2.5 concentrations are representative of air quality beginning in the early 2000s and are thus comparable to concentrations collected by the District's modern day air monitoring network for the purpose of determining the number of county days above or below the respective standards. The gap-filling method is not used in the calculation of design values or when determining attainment status of a NAAQS.

Figure A-19 Number of Days Valley Exceeded the 24-hour 35 μg/m³ Standard

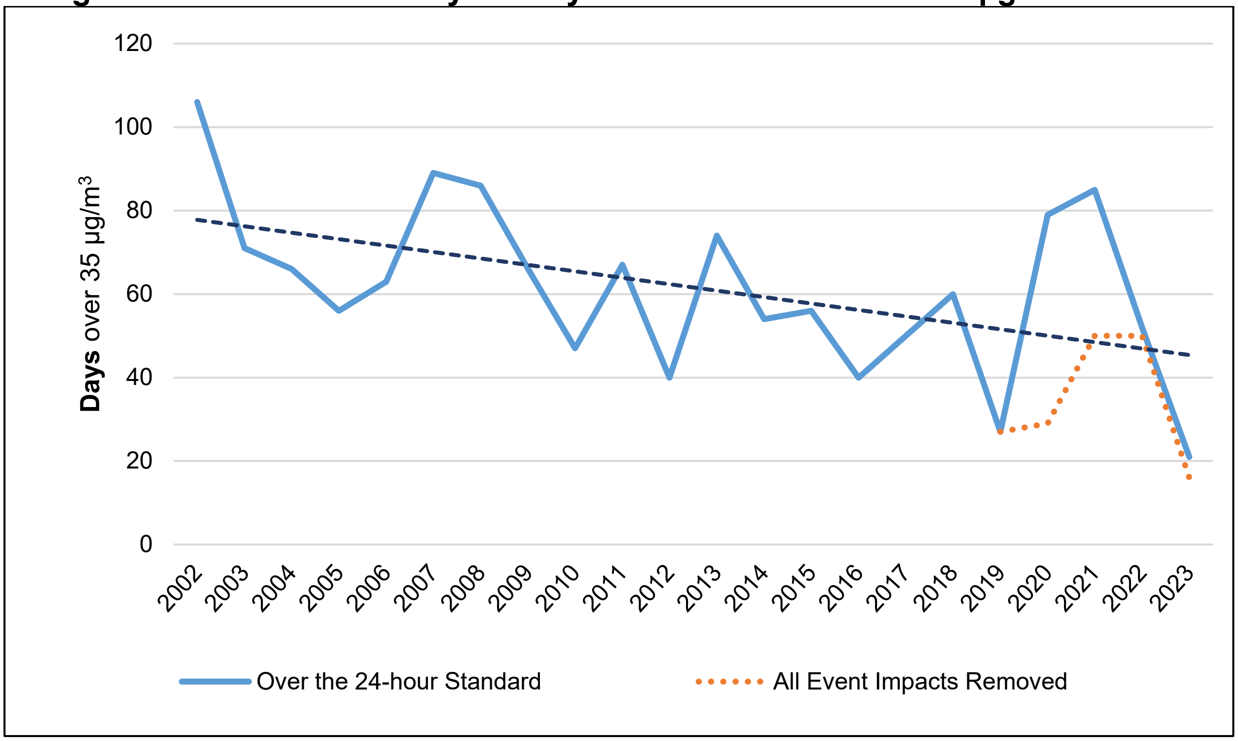


Figure A-20 San Joaquin County - Days Over the 24-hour 35 μg/m³ Standard

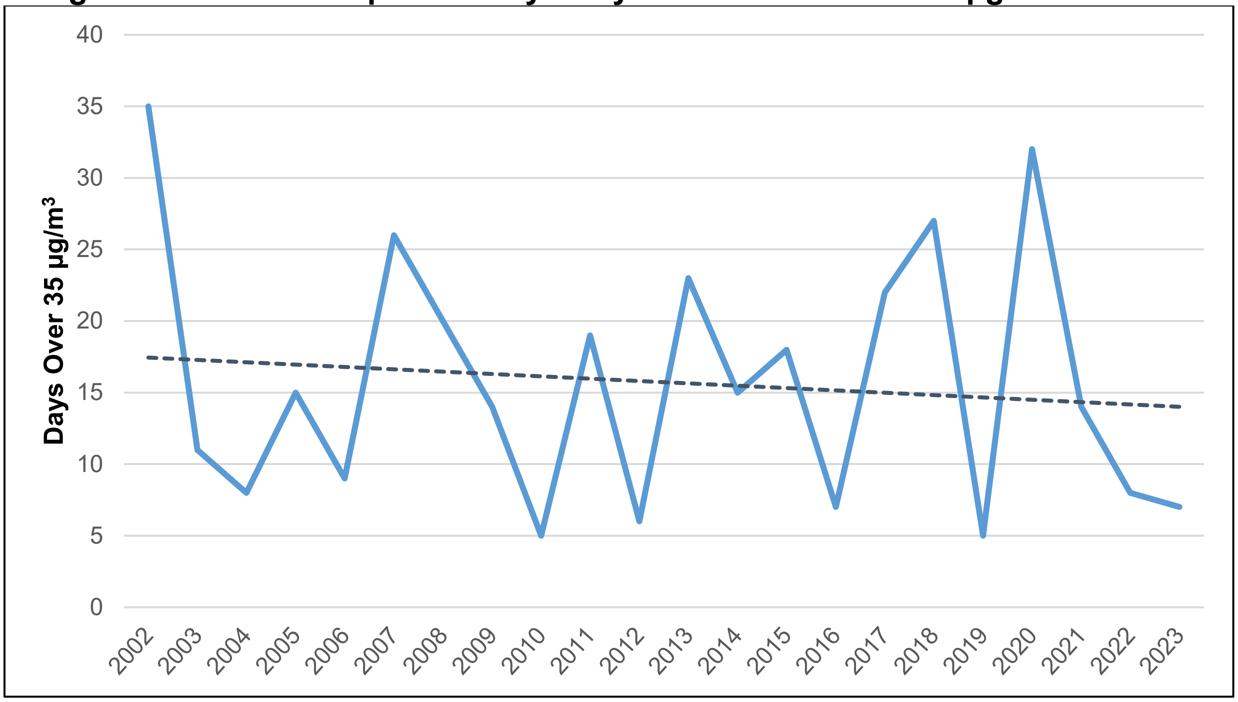


Figure A-21 Stanislaus County - Days Over the 24-hour 35 μg/m³ Standard

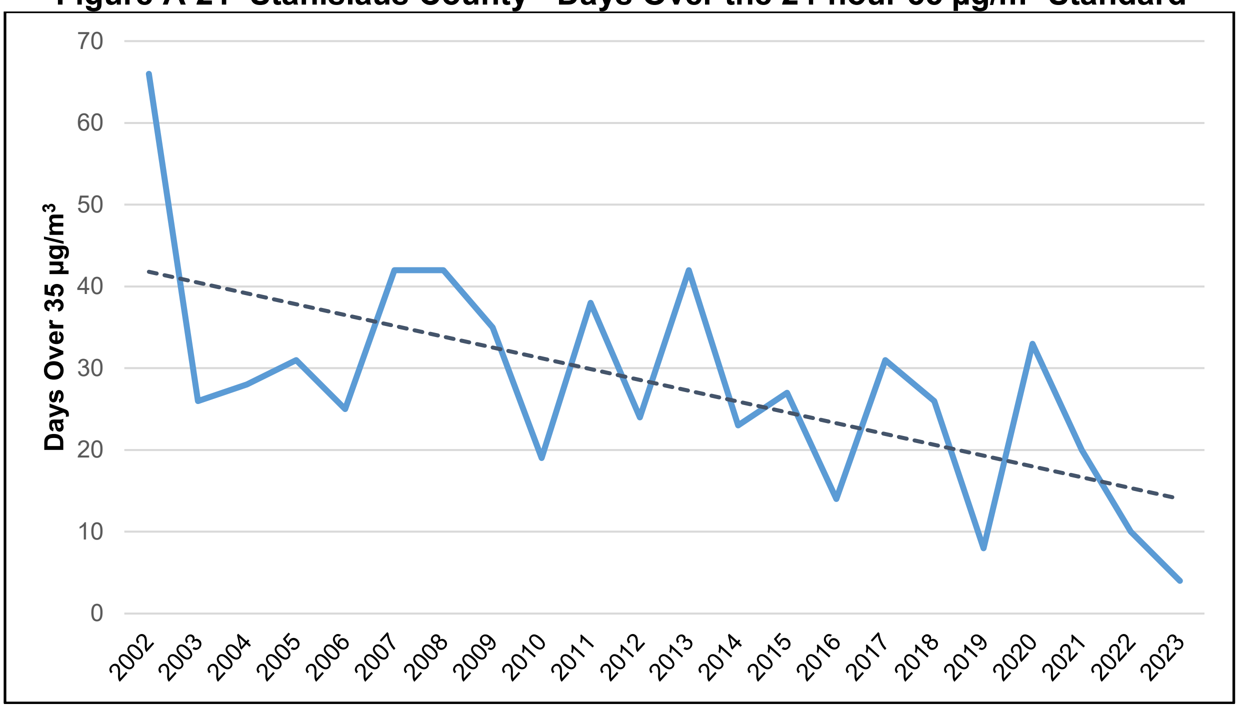


Figure A-22 Merced County - Days Over the 24-hour 35 µg/m³ Standard

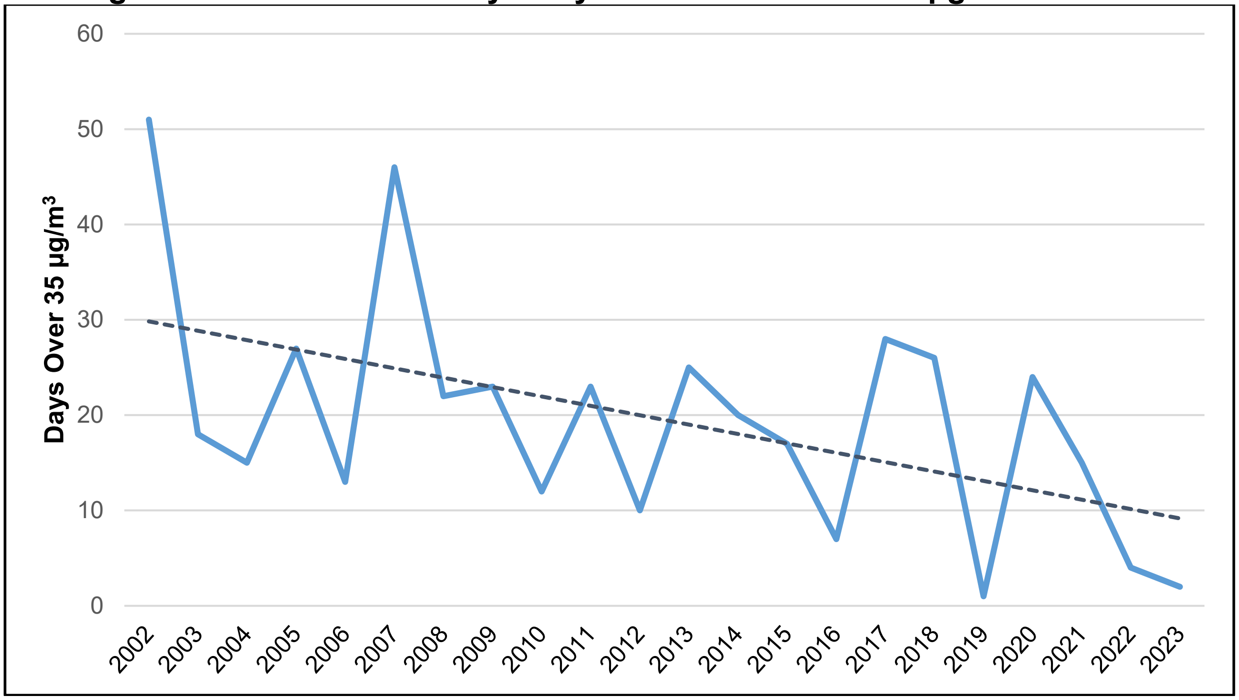
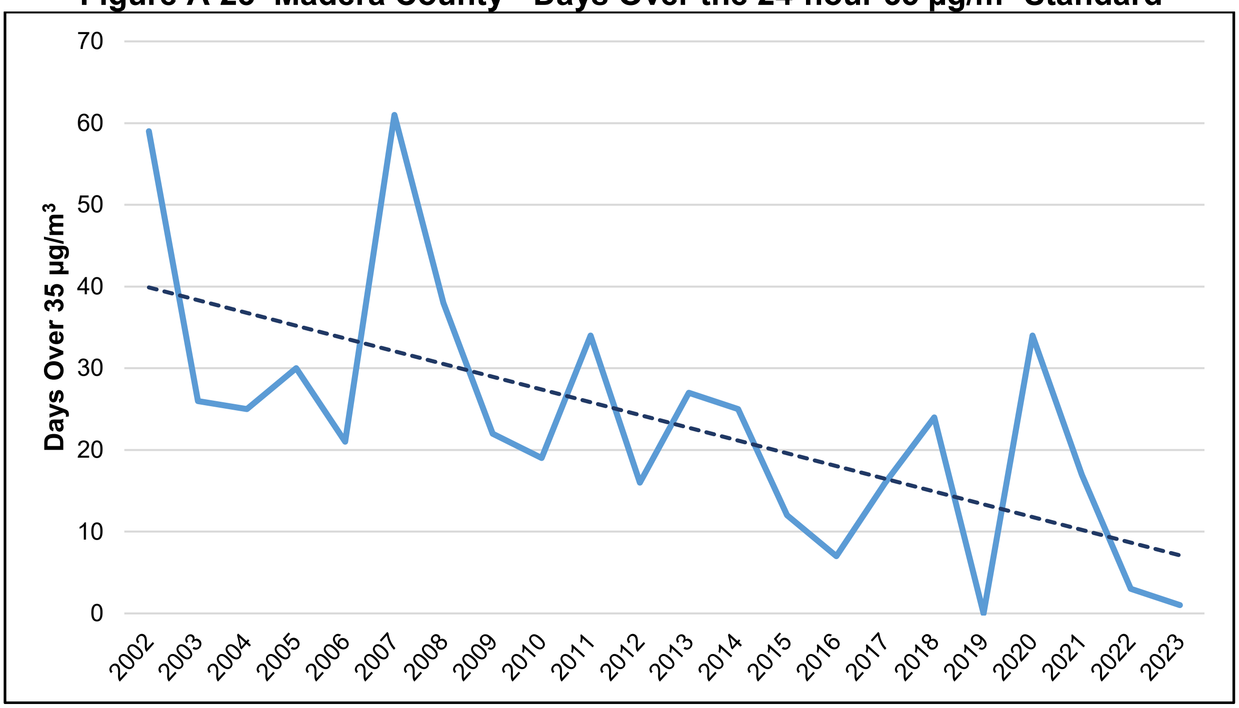


Figure A-23 Madera County - Days Over the 24-hour 35 µg/m³ Standard



* PM2.5 monitoring in Madera County began in 2010.

Figure A-24 Fresno County - Days Over the 24-hour 35 µg/m³ Standard

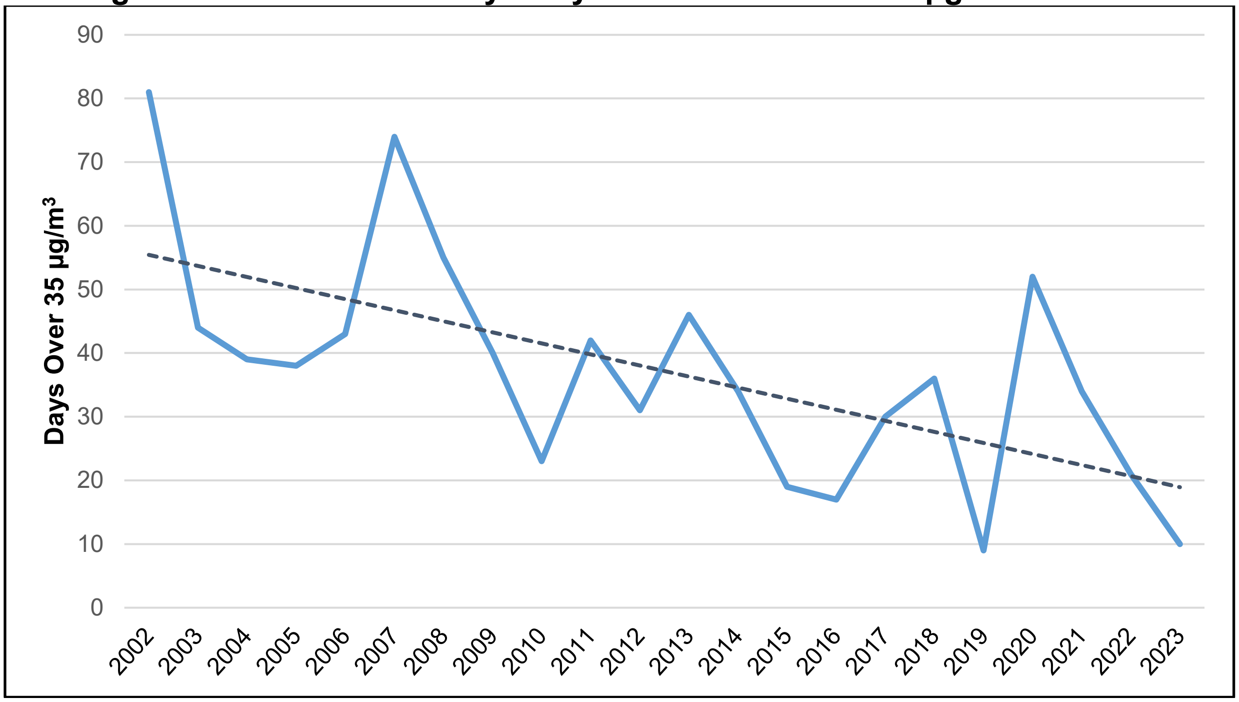


Figure A-25 Kings County - Days Over the 24-hour 35 µg/m³ Standard

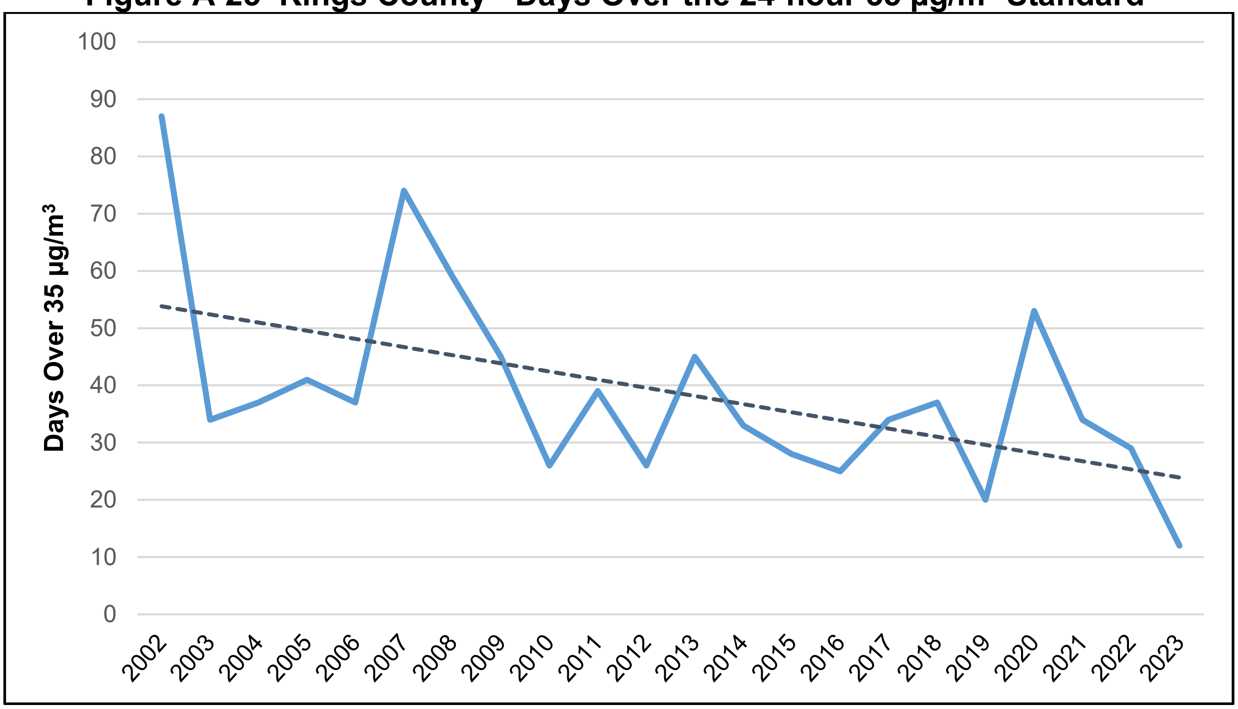


Figure A-26 Tulare County - Days Over the 24-hour 35 µg/m³ Standard

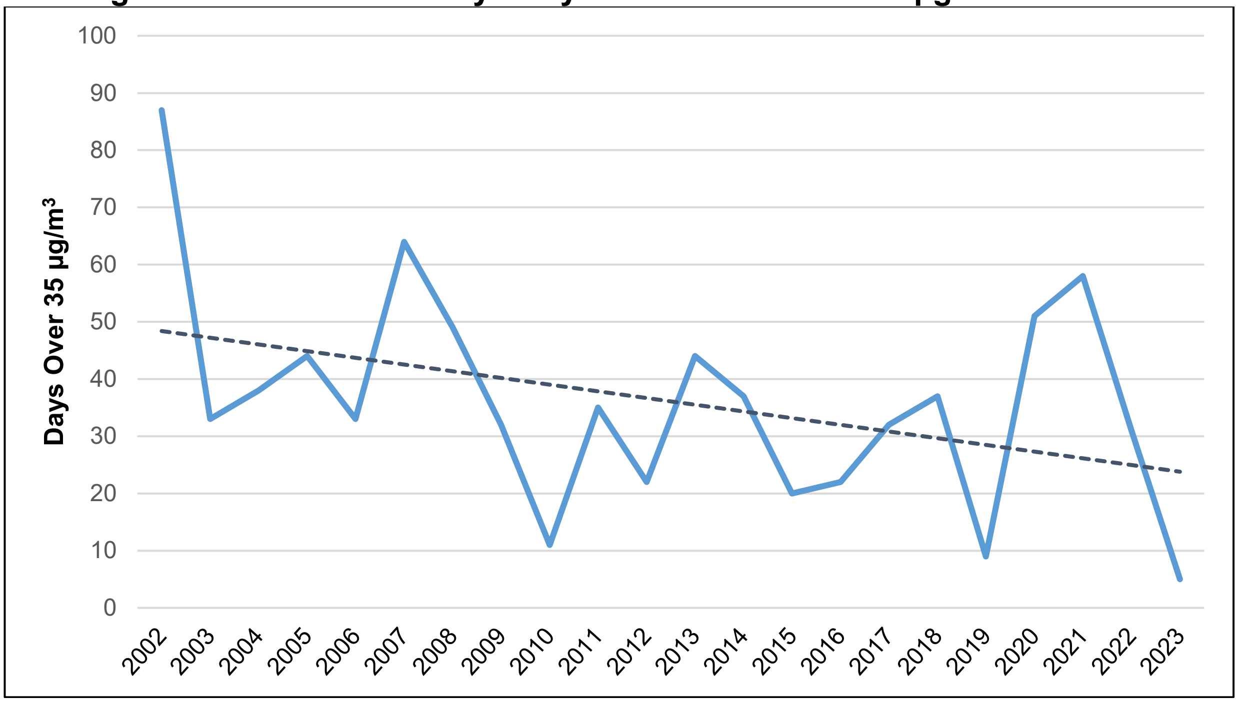


Figure A-27 Kern County - Days Over the 24-hour 35 µg/m³ Standard

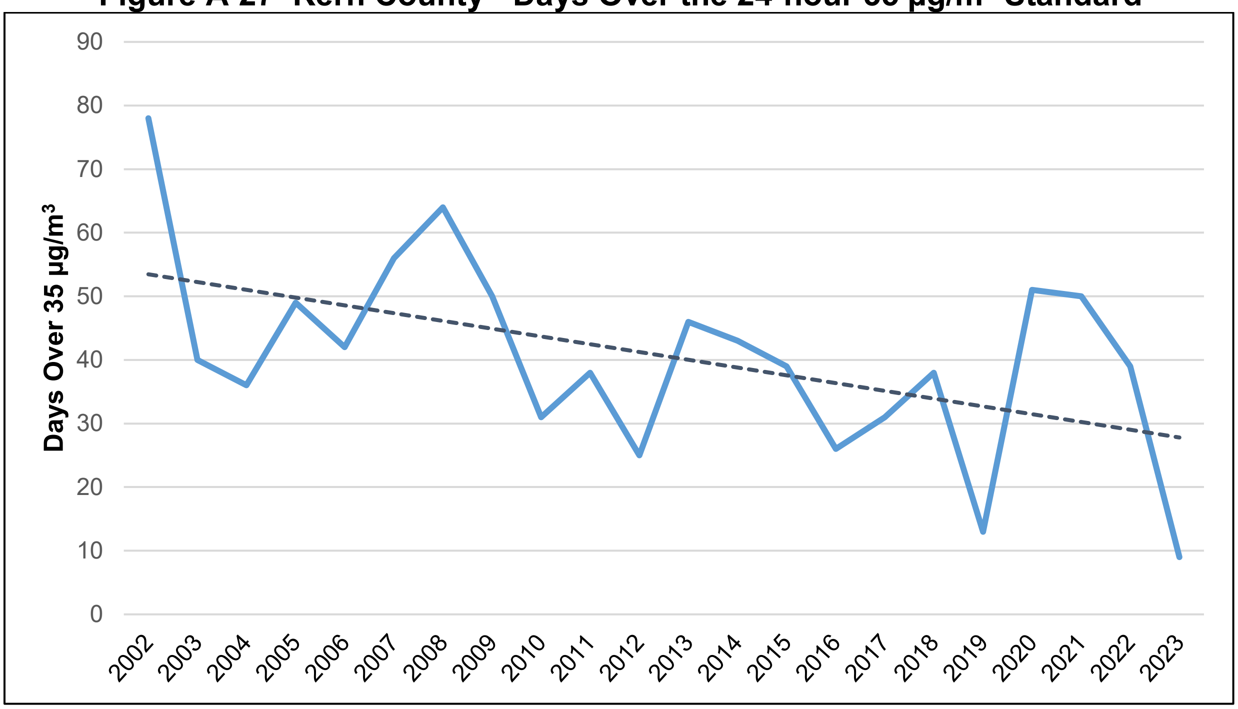


Table A-8 shows the number of days per month the Valley exceeded the 2006 24-hour PM2.5 standard of 35 µg/m³. The data are grouped by winter season (November – February) instead of calendar year (January – December) to highlight the decrease in PM2.5 per season when concentrations are the highest in the year.

Starting in 2008, the District began to increase the number of real-time PM2.5 analyzers operating throughout its air monitoring network, allowing for more daily samples instead of collecting samples every three or six days through filter-based methods. Through this change, the PM2.5 monitoring record is able to better demonstrate the day-to-day air quality trends throughout the Valley. As shown in Table A-8, the Valley has seen a significant drop in the number of exceedances of 35 $\mu g/m^3$ standard, even with additional real-time analyzers added to the network.

In the 2000-2001 winter season, there were 83 days where the 2006 24-hour PM2.5 standard was exceeded across the District. Comparing this to the 35 exceedances that occurred in the 2022-2023 period, this represents a 57.8% decrease in the number of violations throughout the District even with the addition of real-time monitors, and even with the poor dispersion conditions that occurred in November and December of 2022. This difference demonstrates the progress that the District has made in improving the PM2.5 air quality throughout the Valley.

As noted in Section A.1.2.1, the 2011-2012, 2013-2014, 2019-2020, 2020-2021, and 2021-2022 winter seasons had very stable atmospheric stagnation periods, which, combined with California's drought conditions, increased the District's PM2.5 concentrations. Despite the increase during the drought, the District has still experienced a downward trend in the number of exceedances of the 35 $\mu g/m^3$ standard compared to the beginning of PM2.5 measurements in the Valley during the 1999-2000 period, highlighting the efficacy of the Valley's attainment strategy.

Table A-8 Number of Days Valley Exceeded 35 µg/m³ PM2.5 Standard

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2000-2001				5	23	27	18	7	3				**83**
2001-2002	1			4	18	15	25	16		1			**80**
2002-2003		7		9	24	14	23	9	1				**87**
2003-2004				3	14	9	17	4	4				**51**
2004-2005	1			5	18	12	4	10	3				**53**
2005-2006				4	15	15	11	12					**57**
2006-2007			3	2	11	18	25	10					**69**
2007-2008	2		2	4	21	13	13	10	2		1	8	**76**
2008-2009	6		2	6	18	16	24	5					**77**
2009-2010				8	14	21	10	8		1			**62**
2010-2011	1		2	4	14	10	14	5				1	**51**
2011-2012				8	9	28	22	2					**69**
2012-2013					11	5	20	6	1		1		**44**
2013-2014	4	2		1	15	27	27	3				3	**82**
2014-2015	1			1	13	5	23	11					**54**
2015-2016		3	2		6	8	6	8					**33**
2016-2017			1		11	12	2	2	1				**29**
2017-2018	1		3	4	9	28	13	7					**65**
2018-2019	4	13			16	11	10						**54**
2019-2020	1			2	14	2	3	1					**23**
2020-2021	2	12	22	17	14	18	15	4					**104**
2021-2022	1	12	10	17	18	12	21	10					**101**
2022-2023	1			1	14	13	4	2					**35**

Note: Months with no data represent zero exceedances. 2017, 2020, 2021 impacted by wildfires.

A.3.2 PM2.5 Driven Air Quality Index Analysis

The EPA and the District use the Air Quality Index (AQI) to provide daily information about the Valley's air quality, educate the public about how they can protect their health, and to inform the public about how unhealthy air may affect them. AQI scales exist for all of the criteria pollutants regulated under the CAA, including PM2.5. The current 24-hour average PM2.5 AQI scale is shown in Table A-9 below.

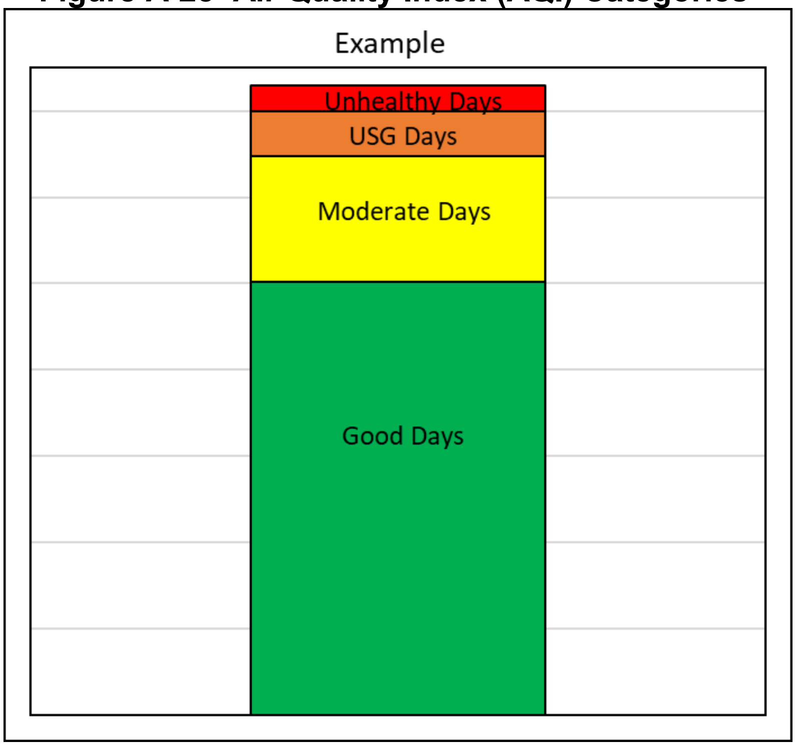
Table A-9 PM2.5 AQI Scale

AQI Category	Index Values	Concentration (µg/m³, 24-hr average)
Good	0 – 50	0 – 12.0
Moderate	51 – 100	12.1 – 35.4
Unhealthy for Sensitive Groups (USG)	101 – 150	35.5 – 55.4
Unhealthy	151 – 200	55.5 – 150.4
Very Unhealthy	201 – 300	150.5 – 250.4
Hazardous	301+	250.5+

For this analysis, the AQI trends are based upon PM2.5 concentrations only, and do not include ozone, PM10, or other pollutants. By excluding the other pollutants, the District is able to isolate the change in air quality trends related to PM2.5.

Figure A-28 is shown as a reference for interpreting the AQI trends shown in Figure A-29 through Figure A-36. The stacked bars represent the percentage of days within each year that fell within each of the AQI categories. Within each stacked bar, the categories are ordered as Good, Moderate, etc. from the bottom up.

Figure A-28 Air Quality Index (AQI) Categories



For the majority of the Valley sites, the observed PM2.5 AQI data for the 2009-2023 timeframe shows an improvement in PM2.5 air quality. Over these 14 years, the frequency of Good PM2.5 AQI days increased, coupled with a decrease in the frequency of the Moderate, Unhealthy-for-Sensitive-Groups (USG), and Unhealthy PM2.5 AQI days. For example, in Fresno County (Figure A-33), the number of Good days increased from 147 in 2009, to 224 in 2023. At the same time, the USG and higher PM2.5 AQI days decreased from 40 to 10.

A similar pattern occurred in other counties, with the frequency of Good PM2.5 AQI days increasing and the frequency of the Moderate and USG AQI days decreasing. For example, in Kern County (Figure A-36), the number of Good days increased from 122 in 2002 to 209 in 2023. In Figure A-29 to Figure A-36, the annual count of PM2.5 AQI county days is based on the highest daily PM2.5 AQI observed from any air monitoring site in the county. These figures, arranged from north to south by county, show that the northern sites have more Good PM2.5 AQI days than the southern sites. For example, San Joaquin County in the northern portion of the Valley averaged nearly 75% Good

AQI days in 2023, about 18% more days in the Good AQI category than Kern County, which averaged around 57% Good AQI. Analysis of Figure A-29 to Figure A-36 demonstrates that the dominant annual PM2.5 AQI categories are the Good and Moderate across the Valley.

In the Valley, PM2.5 concentrations tend to be highest during winter nights as a result of a strong temperature inversion that can trap PM2.5 near the surface, including pollution from residential wood burning. Temperature inversions, in which temperatures increase with altitude, impede the upward flow of air and trap pollutants near the Earth's surface. During these inversions, population exposure to wood smoke increases. In recent winter seasons between 2018 and 2022, a persistent and strong high-pressure ridge over the eastern Pacific Ocean and the western United States effectively blocked weather disturbances from entering California that would normally have removed and replenished the Valley's air with clean air. The historic strength and longevity of this high pressure resulted in a lack of rainfall and stagnation conditions leading to a subsequent increase in the suspended particulate matter in the atmosphere. In addition, the Valley was also impacted by multiple wildfires, which significantly elevated PM2.5 concentrations in 2018, 2020, and 2021. This caused the exceptionally high PM2.5 concentrations found in the Valley and throughout the state of California.

During the 2022-2023 winter season, the weather pattern did fluctuate; however, stable conditions were more prevalent during November due to a prolonged period of high pressure that lasted half of the month. In contrast, the remainder of the 2022-2023 winter season was characterized by unstable conditions as a progressive weather pattern produced a series of dispersive low pressure systems that passed through California during December, January, and February. It should be noted that the progressive weather pattern did alternate between high pressure and low pressure systems at times; however, the high pressure systems were short-lived and not strong enough to offset the degree of instability that governed much of the season. Despite fluctuating dispersion patterns and impacts from wildfires, air quality has improved over the entire period of PM2.5 monitoring in the Valley, as this analysis indicates. During the end of 2023, November and December both saw significant periods of high-pressure stability.

Figure A-29 San Joaquin County PM2.5 AQI Trend

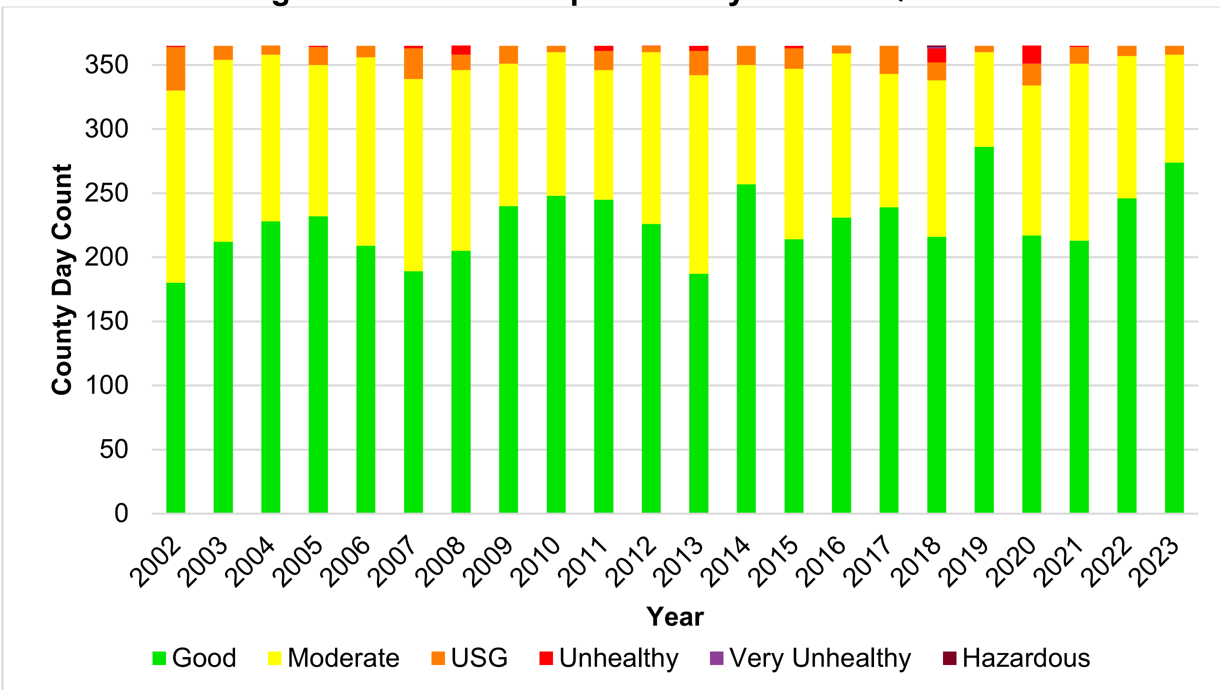


Figure A-30 Stanislaus County PM2.5 AQI Trend

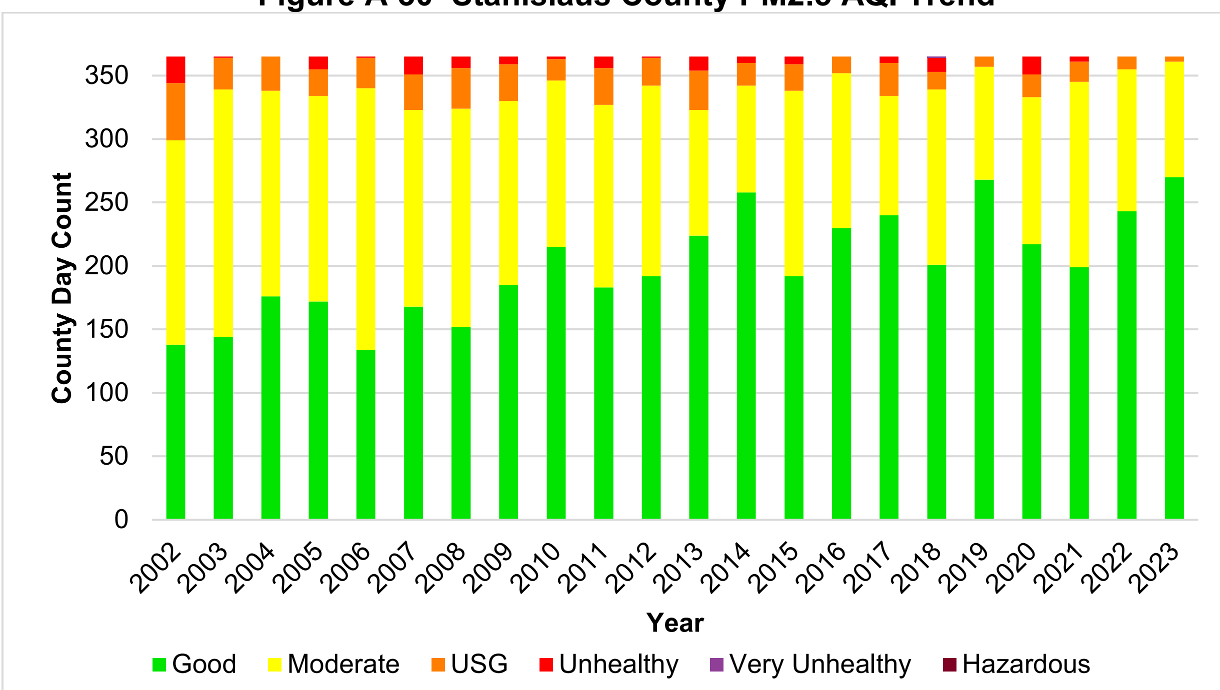


Figure A-31 Merced County PM2.5 AQI Trend

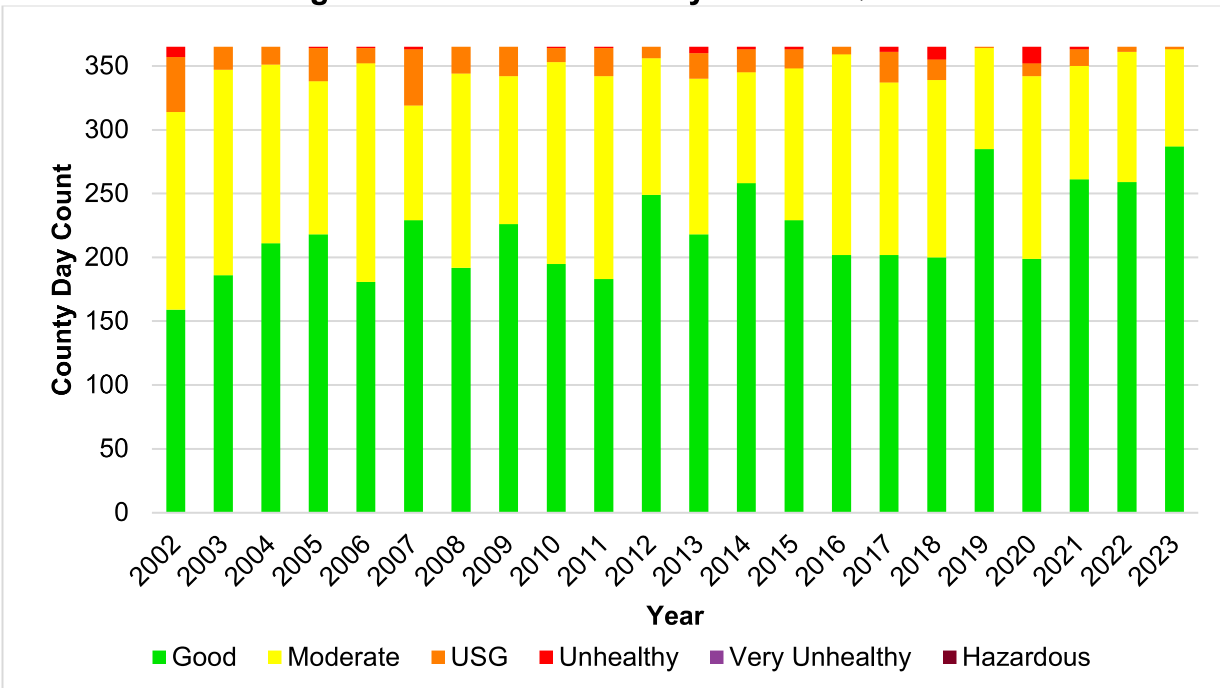
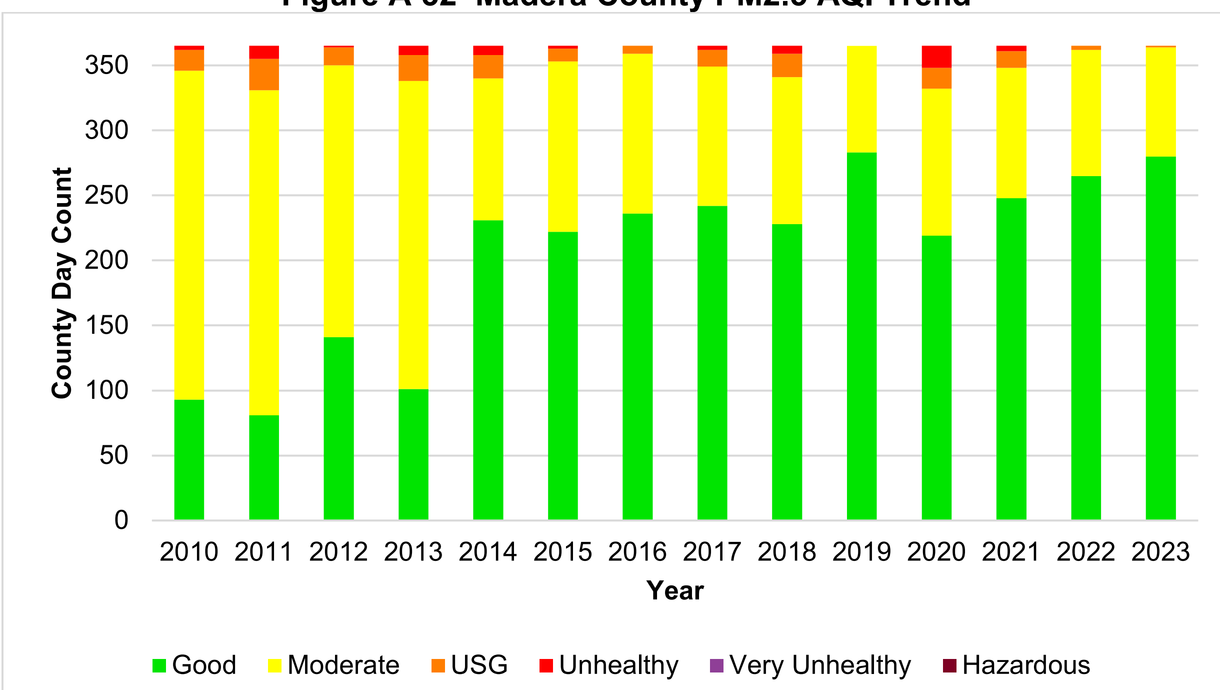


Figure A-32 Madera County PM2.5 AQI Trend



*PM2.5 monitoring in Madera County started in 2010.

Figure A-33 Fresno County PM2.5 AQI Trend

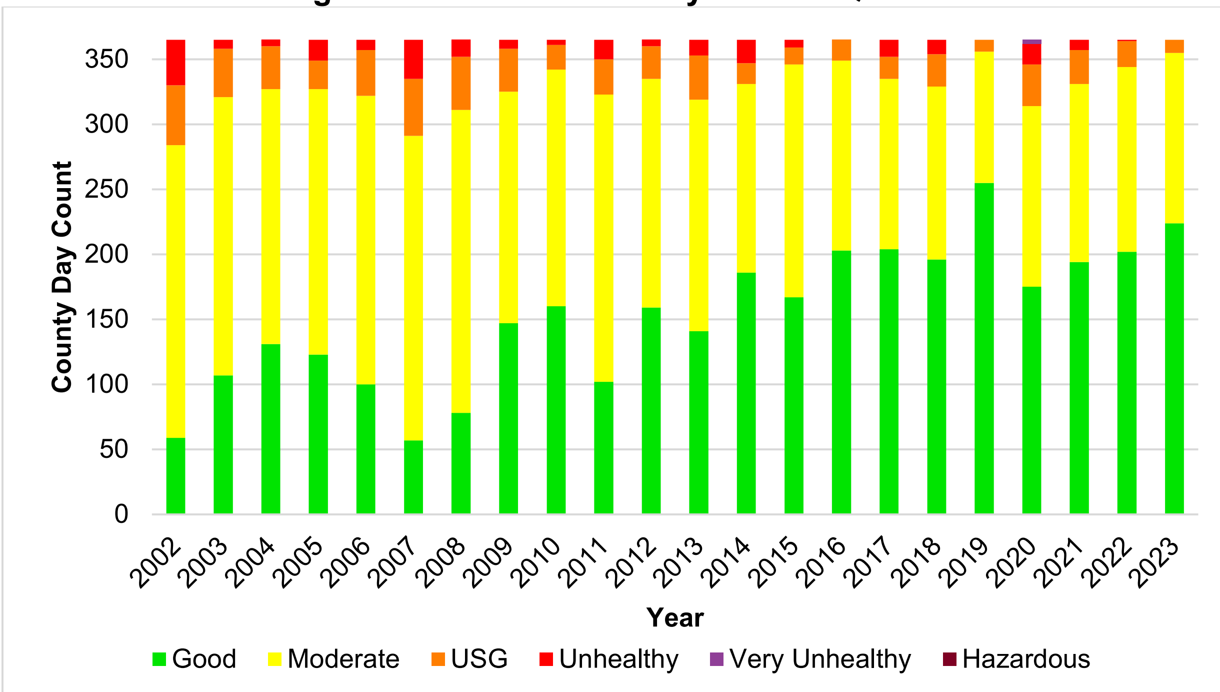


Figure A-34 Kings County PM2.5 AQI Trend

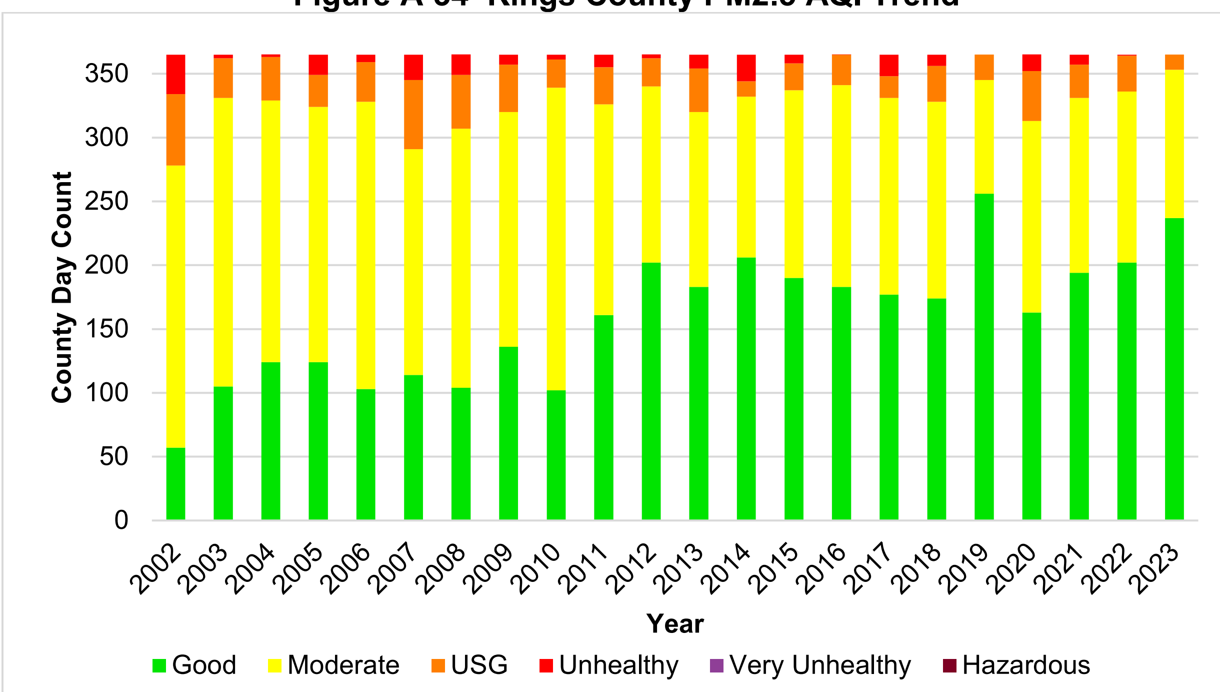


Figure A-35 Tulare County PM2.5 AQI Trend

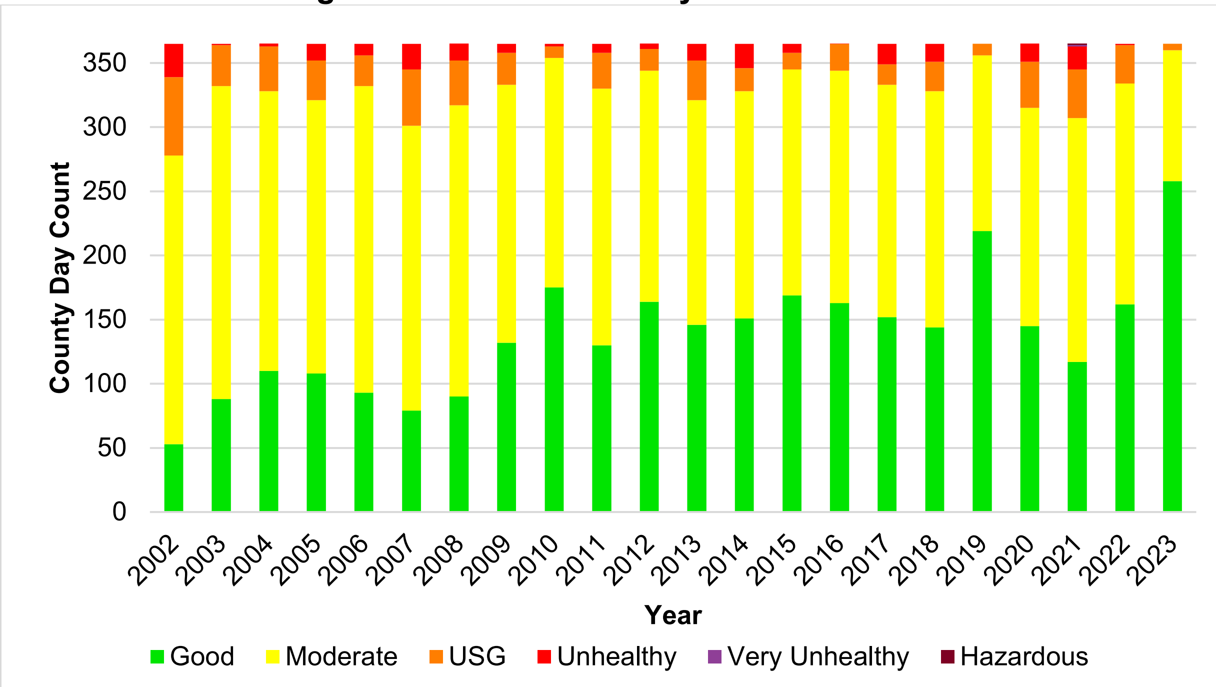


Figure A-36 Kern County PM2.5 AQI Trend

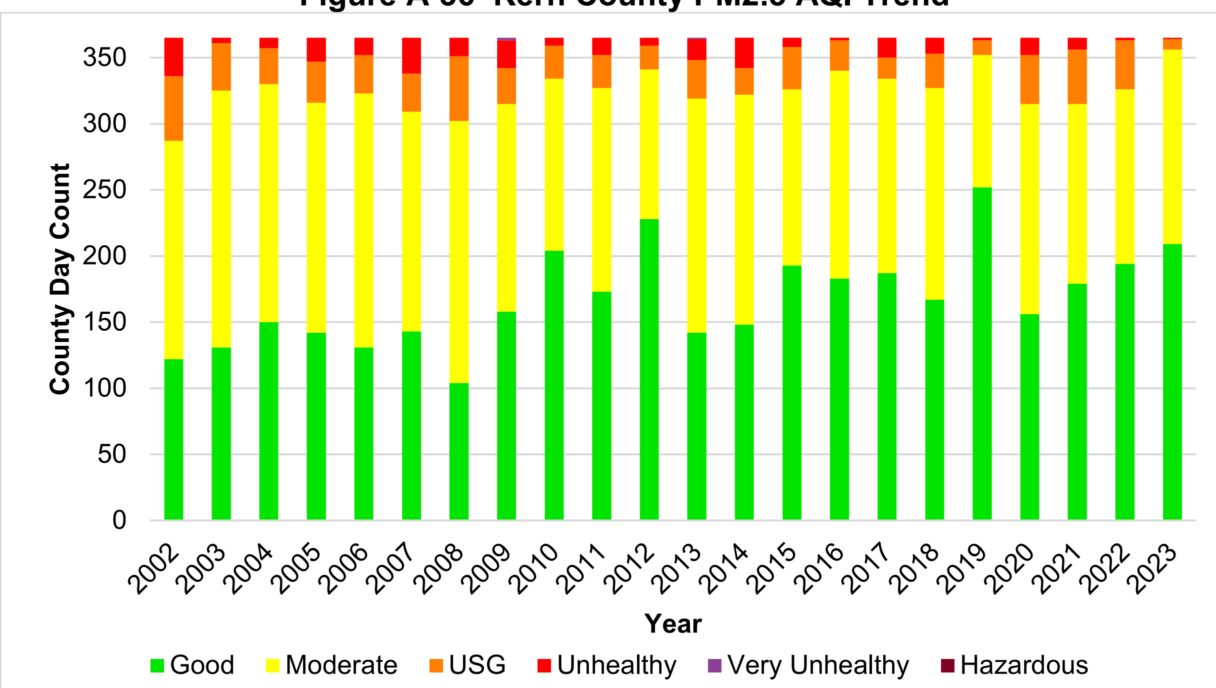


Figure A-37 shows the AQI category frequencies among all of the Valley's counties during the winter season and further illustrates the continuing trend of improving air quality. The 2022-2023 winter season recorded a lower number of days in the USG AQI category and a higher number of Good AQI category days, marking a notable achievement for the region. Over the entire period since the 2000-2001 season, this analysis shows that the Valley has significantly increased its number of Good days and has decreased its number of Unhealthy days, both indicative of improving air quality.

Figure A-37 Basin-Day AQI Frequencies during the Winter Season

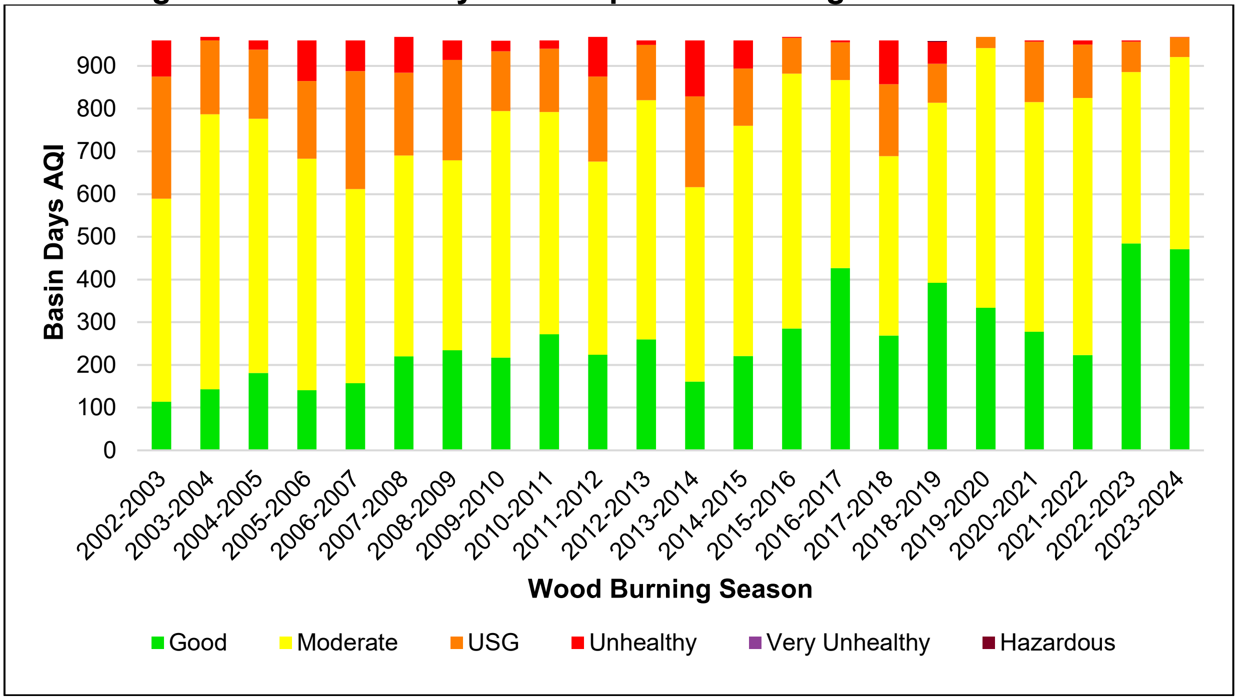


Figure A-38 to Figure A-43 compare the AQI categories for PM2.5 from 2002 and 2023 in San Joaquin, Fresno, and Kern counties. Each county shows a significant improvement within 20 years. San Joaquin County shows an increase in Good and Moderate PM2.5 AQI categories from 330 days in 2002 to 358 days in 2023, representative of an increase of 7.8%. Fresno County observed 284 days in the Good and Moderate AQI categories for 2002, and in 2023 increased to 355 days, an increase of 20%. Kern County changed from 287 days in 2002 to 356 days in 2023, an increase of nearly 18.7% for Good and Moderate AQI days. These figures also show that the USG and Unhealthy AQI categories have decreased for PM2.5. San Joaquin County had 9 days in the Unhealthy AQI category in 2002, and in 2023, there were zero. Fresno County had 100 Unhealthy days and 22 Very Unhealthy days in 2002. In 2023, Fresno County reported zero Unhealthy days and zero Very Unhealthy days. A similar trend was experienced in Kern County, where in 2002, there were 101 Unhealthy days reported compared to 1 Unhealthy day in 2023.

Figure A-38 Percent AQI Days in San Joaquin County 2002

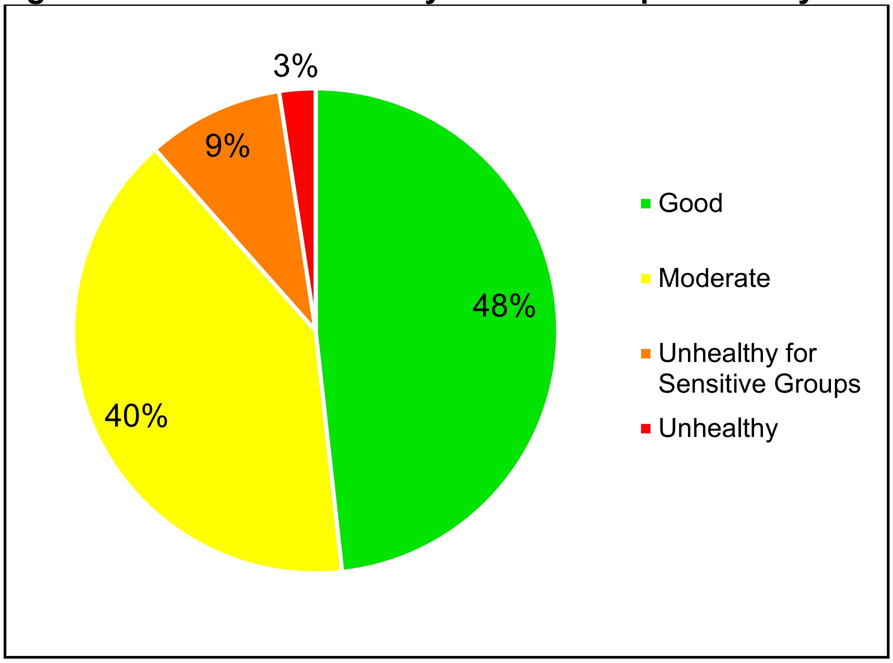


Figure A-39 Percent AQI Days in San Joaquin County 2023

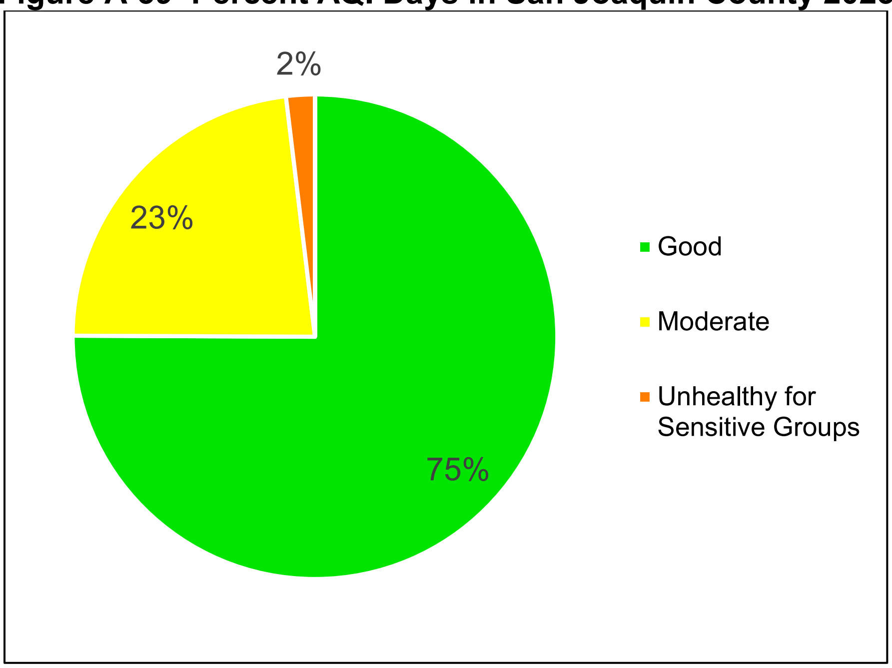


Figure A-40 Percent AQI Days in Fresno County 2002

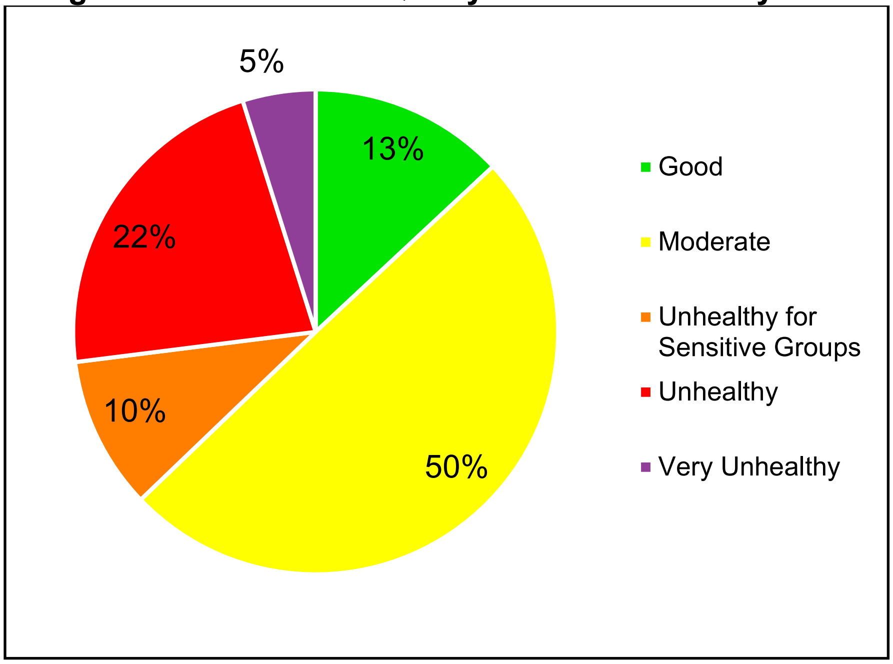


Figure A-41 Percent AQI Days in Fresno County 2023

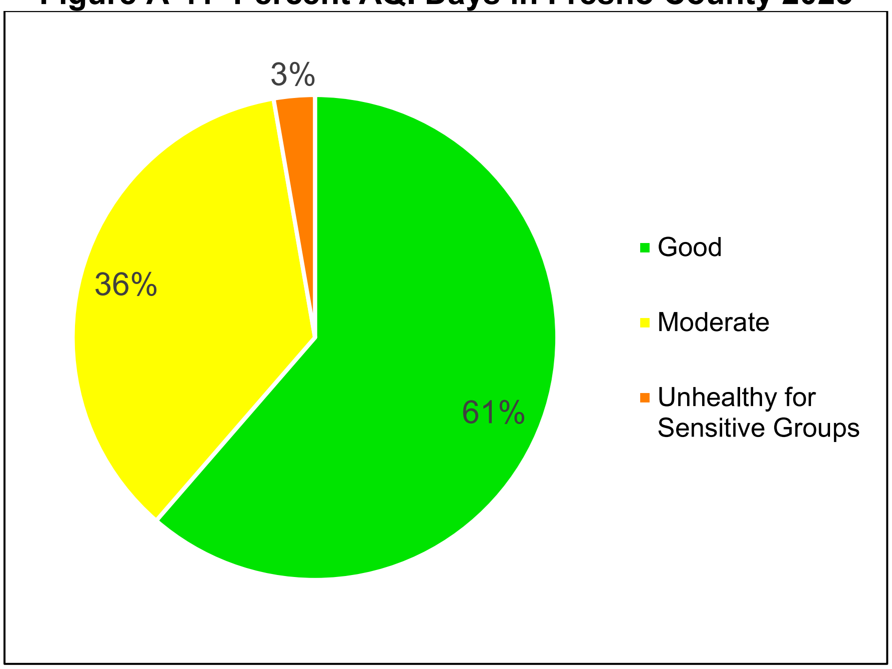


Figure A-42 Percent AQI Days in Kern County 2002

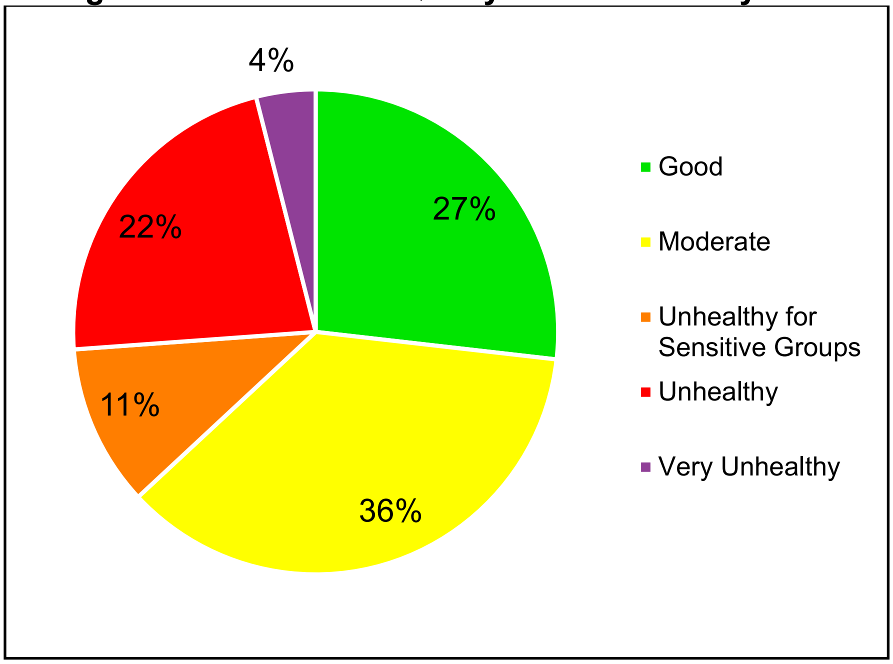
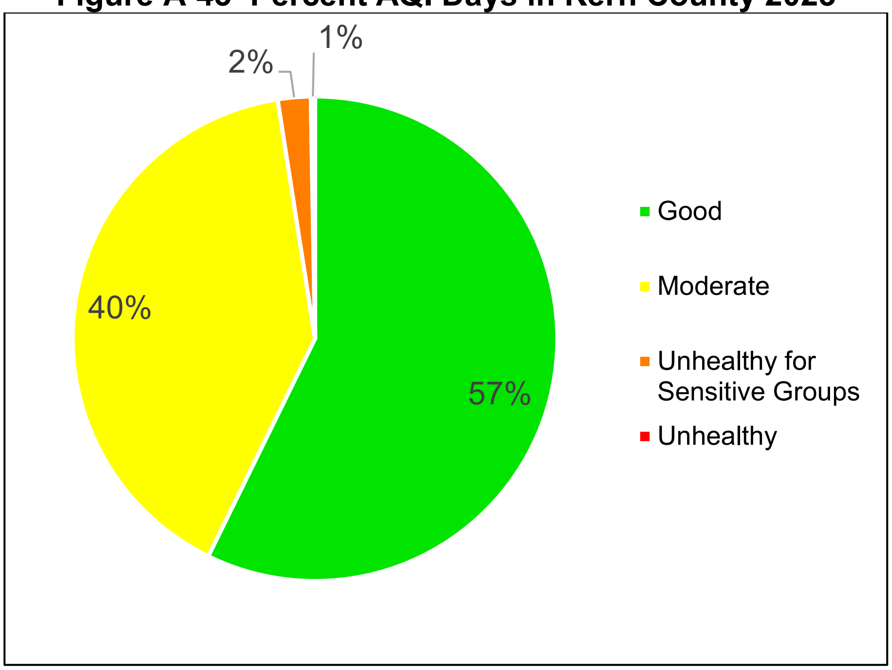
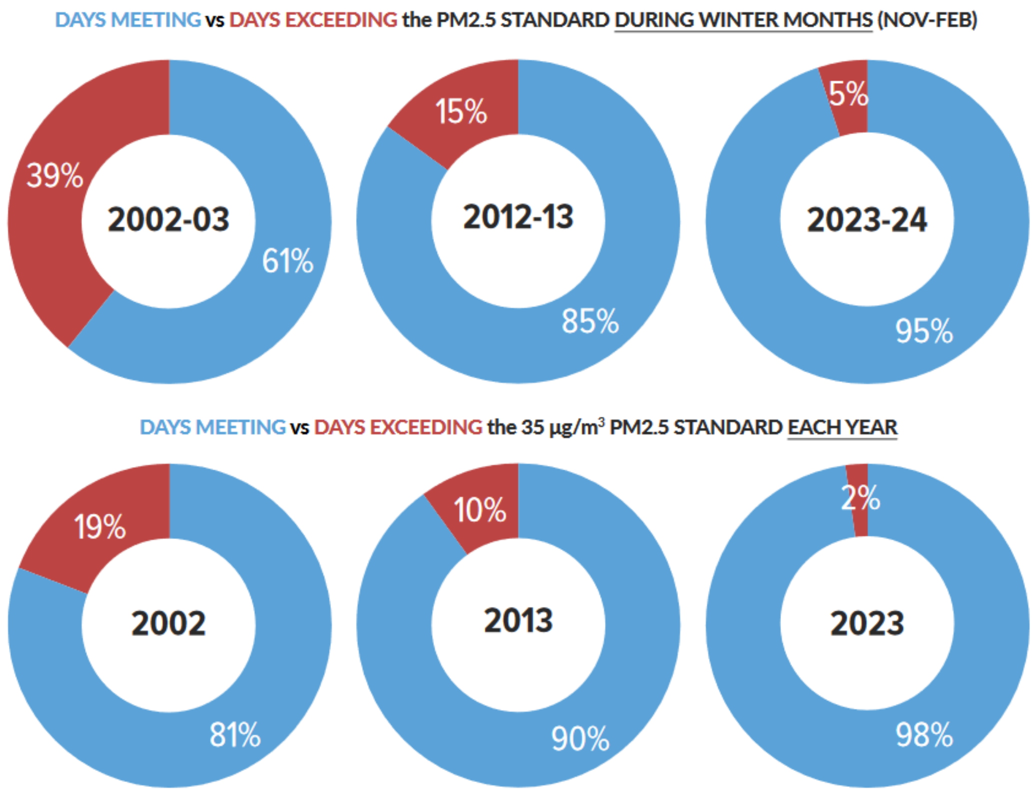


Figure A-43 Percent AQI Days in Kern County 2023



When observing the change in days over a long period when the Valley's counties exceeded the federal 24-hour PM2.5 standard of 35 µg/m^3, a significant change is clear. As shown in Figure A-44, when comparing the winter season of 2002-03 to the recent 2023-24 season, the number of days when the Valley's counties exceeded this standard decreased from 39% to only 5%, while the days when the federal standard was met increased from 61% to 95%. Similarly, when this comparison is focused on the calendar years between 2002 and 2023, the number of days exceeding the standard decreased from 19% to only 2%, while the number of days meeting this standard increased from 81% to 98%. With 98% of the days during the year 2023 meeting the 24-hour PM2.5 standard, this increase is indicative of the positive progress the Valley is making towards minimizing peak concentrations throughout the region.

Figure A-44 Progress in Reducing Days Exceeding 24-hour PM2.5 Standard



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Appendix B
EMISSIONS INVENTORY

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Appendix B: Emissions Inventory

Emissions inventories are one of the fundamental building blocks in the development of an attainment plan. Emissions inventories serve as 1) a primary input to air quality modeling used in attainment demonstrations; 2) the emissions data used for developing control strategies; and 3) a means to track progress in meeting the emission reduction commitments. The inventories in this appendix are used to study and propose control measures, to track emissions for Reasonable Further Progress (RFP), to establish motor vehicle conformity budgets for transportation planning, and to assist in demonstrating attainment.

Emissions inventories are an estimate of the air pollution emissions that are actually released into the environment. They are not measurements of ambient concentrations. The following are examples of pollution sources by key sectors:

- Industrial or stationary point sources (e.g., power plants and oil refineries);
- Area-wide sources (e.g., consumer products and residential fuel combustion);
- On-road sources (e.g., passenger vehicles and heavy-duty trucks);
- Off-road mobile sources (e.g., aircraft, trains, ships, recreational boats, construction equipment and farm equipment); and
- Non-anthropogenic (natural) sources (e.g., biogenic or vegetation, geogenic (petroleum seeps), and wildfires).

Emissions inventories are usually developed at various geographical resolutions encompassing district, air basin, and county levels. The inventories presented in this appendix are the emissions for the San Joaquin Valley Air Basin.

This appendix includes emissions for the San Joaquin Valley Air Basin for the years 2017 through 2031.[1] The tables in this section include:

- Table B-1 Directly Emitted PM2.5
- Table B-2 NOx
- Table B-3 SOx
- Table B-4 VOC
- Table B-5 Ammonia

Tables B-1 through B-5 are followed by an overview of emissions inventory calculations and revisions.

[1] Emission Inventory data source is CEPAM v.1.00.

B.1 EMISSIONS INVENTORY TABLES

Table B-1 Directly Emitted PM2.5

SUMMARY CATEGORY NAME	PM2.5 Annual Average (tons/day)							PM2.5 Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
STATIONARY SOURCES														
FUEL COMBUSTION														
ELECTRIC UTILITIES	1.1	1.0	1.0	0.9	0.8	0.7	0.7	1.1	1.0	1.0	0.9	0.8	0.7	0.7
COGENERATION	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
OIL AND GAS PRODUCTION (COMBUSTION)	1.9	1.8	1.6	1.5	1.4	1.3	1.3	1.9	1.8	1.6	1.5	1.4	1.3	1.3
PETROLEUM REFINING (COMBUSTION)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MANUFACTURING AND INDUSTRIAL	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
FOOD AND AGRICULTURAL PROCESSING	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4
SERVICE AND COMMERCIAL	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
OTHER (FUEL COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL FUEL COMBUSTION**	**4.7**	**4.5**	**4.2**	**4.0**	**3.8**	**3.6**	**3.6**	**4.6**	**4.4**	**4.1**	**3.9**	**3.7**	**3.5**	**3.5**
WASTE DISPOSAL														
SEWAGE TREATMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LANDFILLS	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
INCINERATORS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOIL REMEDIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (WASTE DISPOSAL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL WASTE DISPOSAL**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
CLEANING AND SURFACE COATINGS														
LAUNDERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEGREASING	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

SUMMARY CATEGORY NAME	PM2.5 Annual Average (tons/day)							PM2.5 Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
COATINGS AND RELATED PROCESS SOLVENTS	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
PRINTING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADHESIVES AND SEALANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (CLEANING AND SURFACE COATINGS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL CLEANING AND SURFACE COATINGS**	**0.3**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**
PETROLEUM PRODUCTION AND MARKETING														
OIL AND GAS PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM REFINING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM MARKETING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL PETROLEUM PRODUCTION AND MARKETING**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
INDUSTRIAL PROCESSES														
CHEMICAL	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
FOOD AND AGRICULTURE	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.4	0.4	0.4	0.5	0.5	0.5	0.5
MINERAL PROCESSES	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
METAL PROCESSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOOD AND PAPER	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
GLASS AND RELATED PRODUCTS	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1
ELECTRONICS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (INDUSTRIAL PROCESSES)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
*** TOTAL INDUSTRIAL PROCESSES**	**2.6**	**2.6**	**2.5**	**2.5**	**2.5**	**2.5**	**2.6**	**2.3**	**2.3**	**2.3**	**2.2**	**2.2**	**2.3**	**2.3**
***** TOTAL STATIONARY***	***7.9***	***7.6***	***7.4***	***7.1***	***6.9***	***6.8***	***6.8***	***7.5***	***7.3***	***7.1***	***6.7***	***6.5***	***6.4***	***6.4***

SUMMARY CATEGORY NAME	PM2.5 Annual Average (tons/day)							PM2.5 Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
AREAWIDE SOURCES														
SOLVENT EVAPORATION														
CONSUMER PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PESTICIDES/FERTILIZERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ASPHALT PAVING / ROOFING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL SOLVENT EVAPORATION**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
MISCELLANEOUS PROCESSES														
RESIDENTIAL FUEL COMBUSTION	3.3	3.1	3.0	3.0	3.0	3.0	3.0	6.1	5.6	5.5	5.5	5.5	5.5	5.5
FARMING OPERATIONS	13.2	13.1	13.0	12.9	12.8	12.7	12.7	9.4	9.3	9.2	9.1	9.0	9.0	9.0
CONSTRUCTION AND DEMOLITION	1.3	1.4	1.5	1.7	1.7	2.8	1.8	1.2	1.3	1.4	1.6	1.5	2.6	1.7
PAVED ROAD DUST	4.7	4.9	5.0	5.2	5.4	5.5	5.6	4.5	4.6	4.8	5.0	5.2	5.3	5.3
UNPAVED ROAD DUST	3.7	3.7	3.7	3.7	3.7	3.7	3.7	2.6	2.6	2.6	2.6	2.6	2.6	2.6
FUGITIVE WINDBLOWN DUST	7.4	7.3	7.3	7.2	7.1	7.1	7.1	4.7	4.6	4.6	4.5	4.4	4.4	4.4
FIRES	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
MANAGED BURNING AND DISPOSAL	13.2	16.1	13.2	6.0	6.0	5.9	5.9	15.8	21.1	14.9	5.1	5.1	5.0	5.0
COOKING[2]	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.3	2.4	2.4	2.5	2.5	2.6	2.6
OTHER (MISCELLANEOUS PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL MISCELLANEOUS PROCESSES**	**49.4**	**52.2**	**49.4**	**42.4**	**42.4**	**43.6**	**42.6**	**46.8**	**51.8**	**45.6**	**36.1**	**36.1**	**37.3**	**36.3**
***** TOTAL AREAWIDE***	***49.4***	***52.2***	***49.4***	***42.4***	***42.4***	***43.6***	***42.6***	***46.8***	***51.8***	***45.6***	***36.1***	***63.1***	***37.3***	***36.3***

[2] The emissions inventory methodology for commercial cooking has been updated. The revised methodology is available at: https://ww2.valleyair.org/media/zeyfmb4q/commercialcooking2019.pdf

PM2.5														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
MOBILE SOURCES														
ON-ROAD MOTOR VEHICLES														
LIGHT DUTY PASSENGER (LDA)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
LIGHT DUTY TRUCKS - 1 (LDT1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIGHT DUTY TRUCKS - 2 (LDT2)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MEDIUM DUTY TRUCKS (MDV)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LIGHT HEAVY DUTY TRUCKS - 1 (LHDT1)	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.2	0.2	0.2	0.1
LIGHT HEAVY DUTY TRUCKS - 2 (LHDT2)	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0
MEDIUM HEAVY DUTY TRUCKS (MHDT)	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.3	0.2	0.1	0.0	0.0	0.0	0.0
HEAVY HEAVY DUTY TRUCKS (HHDT)	1.5	1.1	0.6	0.5	0.5	0.5	0.6	1.5	1.1	0.6	0.5	0.5	0.5	0.6
MOTORCYCLES (MCY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOTOR HOMES (MH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL ON-ROAD MOTOR VEHICLES**	**2.7**	**2.2**	**1.6**	**1.4**	**1.3**	**1.3**	**1.3**	**2.7**	**2.3**	**1.6**	**1.4**	**1.3**	**1.3**	**1.3**
OTHER MOBILE SOURCES														
AIRCRAFT	1.2	1.7	1.7	1.7	1.7	1.7	1.7	1.2	1.7	1.7	1.7	1.7	1.7	1.7
TRAINS	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
OCEAN GOING VESSELS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMERCIAL HARBOR CRAFT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RECREATIONAL BOATS	0.6	0.6	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2
OFF-ROAD RECREATIONAL VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OFF-ROAD EQUIPMENT	0.9	0.8	0.8	0.6	0.5	0.5	0.4	0.8	0.7	0.7	0.6	0.5	0.4	0.4
OFF-ROAD EQUIPMENT (PERP)	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
FARM EQUIPMENT	2.4	1.9	1.6	1.3	1.1	0.9	0.9	1.5	1.2	1.0	0.8	0.7	0.6	0.6

PM2.5														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
FUEL STORAGE AND HANDLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL OTHER MOBILE SOURCES**	**5.7**	**5.5**	**5.0**	**4.5**	**4.1**	**3.9**	**3.8**	**4.4**	**4.4**	**4.1**	**3.7**	**3.4**	**3.3**	**3.2**
***** TOTAL MOBILE***	***8.4***	***7.7***	***6.6***	***5.9***	***5.4***	***5.2***	***5.1***	***7.1***	***6.6***	***5.6***	***5.1***	***4.8***	***4.6***	***4.5***

GRAND TOTAL FOR SAN JOAQUIN VALLEY	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
	65.7	**67.5**	**63.3**	**55.3**	**54.7**	**55.6**	**54.4**	**61.4**	**65.7**	**58.3**	**47.9**	**47.4**	**48.3**	**47.3**

Table B-2 NOx

SUMMARY CATEGORY NAME	NOx Annual Average (tons/day)							NOx Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
STATIONARY SOURCES														
FUEL COMBUSTION														
ELECTRIC UTILITIES	2.8	2.6	2.5	2.5	2.3	2.2	2.2	2.8	2.6	2.5	2.4	2.3	2.2	2.2
COGENERATION	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
OIL AND GAS PRODUCTION (COMBUSTION)	2.8	2.5	2.2	1.8	1.6	1.4	1.4	2.7	2.5	2.2	1.8	1.6	1.4	1.4
PETROLEUM REFINING (COMBUSTION)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
MANUFACTURING AND INDUSTRIAL	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2
FOOD AND AGRICULTURAL PROCESSING	5.5	5.0	4.4	3.8	3.3	3.0	2.9	3.9	3.6	3.1	2.7	2.4	2.2	2.1
SERVICE AND COMMERCIAL	4.7	4.9	4.8	4.3	4.2	4.1	4.1	5.1	5.3	5.2	4.7	4.6	4.5	4.5
OTHER (FUEL COMBUSTION)	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4
*** TOTAL FUEL COMBUSTION**	**18.7**	**18.0**	**16.8**	**15.1**	**14.1**	**13.5**	**13.3**	**17.3**	**16.7**	**15.7**	**14.2**	**13.3**	**12.8**	**12.6**
WASTE DISPOSAL														
SEWAGE TREATMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LANDFILLS	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
INCINERATORS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOIL REMEDIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (WASTE DISPOSAL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL WASTE DISPOSAL**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**
CLEANING AND SURFACE COATINGS														
LAUNDERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEGREASING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRINTING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SUMMARY CATEGORY NAME	NOx Annual Average (tons/day)							NOx Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
ADHESIVES AND SEALANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (CLEANING AND SURFACE COATINGS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL CLEANING AND SURFACE COATINGS**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
PETROLEUM PRODUCTION AND MARKETING														
OIL AND GAS PRODUCTION	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1
PETROLEUM REFINING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM MARKETING	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL PETROLEUM PRODUCTION AND MARKETING**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.1**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.1**
INDUSTRIAL PROCESSES														
CHEMICAL	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
FOOD AND AGRICULTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MINERAL PROCESSES	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
METAL PROCESSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOOD AND PAPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GLASS AND RELATED PRODUCTS	3.1	3.1	3.4	2.8	2.8	1.7	1.7	3.1	3.1	3.4	2.8	2.8	1.7	1.7
ELECTRONICS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (INDUSTRIAL PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL INDUSTRIAL PROCESSES**	**3.6**	**3.7**	**3.9**	**3.3**	**3.3**	**2.3**	**2.3**	**3.6**	**3.7**	**3.9**	**3.3**	**3.3**	**2.3**	**2.3**
***** TOTAL STATIONARY***	***23.0***	***22.3***	***21.3***	***18.8***	***17.8***	***16.2***	***16.0***	***21.5***	***21.0***	***20.2***	***17.9***	***17.0***	***15.5***	***15.3***

SUMMARY CATEGORY NAME	NOx Annual Average (tons/day)							NOx Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
AREAWIDE SOURCES														
SOLVENT EVAPORATION														
CONSUMER PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PESTICIDES/FERTILIZERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ASPHALT PAVING / ROOFING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL SOLVENT EVAPORATION**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
MISCELLANEOUS PROCESSES														
RESIDENTIAL FUEL COMBUSTION	5.3	5.2	4.9	4.7	4.6	4.5	4.4	7.5	7.4	6.9	6.6	6.4	6.3	6.3
FARMING OPERATIONS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION AND DEMOLITION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNPAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FUGITIVE WINDBLOWN DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FIRES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MANAGED BURNING AND DISPOSAL	6.9	7.2	6.8	1.8	1.8	1.8	1.8	9.1	9.6	8.9	2.3	2.2	2.2	2.2
COOKING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (MISCELLANEOUS PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL MISCELLANEOUS PROCESSES**	**12.3**	**12.4**	**11.7**	**6.5**	**6.4**	**6.3**	**6.2**	**16.7**	**17.0**	**15.9**	**8.9**	**8.7**	**8.6**	**8.5**
***** TOTAL AREAWIDE***	***12.3***	***12.4***	***11.7***	***6.5***	***6.4***	***6.3***	***6.2***	***16.7***	***17.0***	***15.9***	***8.9***	***8.7***	***8.6***	***8.5***

SUMMARY CATEGORY NAME	NOx Annual Average (tons/day)							NOx Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
MOBILE SOURCES														
ON-ROAD MOTOR VEHICLES														
LIGHT DUTY PASSENGER (LDA)	7.3	5.8	4.2	3.2	2.6	2.2	2.1	8.1	6.4	4.7	3.6	2.9	2.5	2.3
LIGHT DUTY TRUCKS - 1 (LDT1)	2.0	1.8	1.2	0.8	0.6	0.4	0.4	2.2	2.0	1.4	0.9	0.6	0.5	0.4
LIGHT DUTY TRUCKS - 2 (LDT2)	5.9	4.3	3.2	2.4	2.0	1.7	1.6	6.5	4.8	3.6	2.7	2.2	1.9	1.8
MEDIUM DUTY TRUCKS (MDV)	7.7	6.4	4.6	3.1	2.2	1.8	1.6	8.6	7.2	5.1	3.5	2.4	2.0	1.8
LIGHT HEAVY DUTY TRUCKS - 1 (LHDT1)	8.4	7.4	6.0	4.5	3.3	2.7	2.4	8.6	7.6	6.2	4.6	3.4	2.8	2.5
LIGHT HEAVY DUTY TRUCKS - 2 (LHDT2)	2.1	1.9	1.6	1.2	1.0	0.8	0.8	2.2	2.0	1.6	1.3	1.0	0.8	0.8
MEDIUM HEAVY DUTY TRUCKS (MHDT)	9.6	7.7	3.6	2.3	1.7	1.5	1.3	9.8	7.8	3.7	2.3	1.8	1.5	1.4
HEAVY HEAVY DUTY TRUCKS (HHDT)	59.2	45.4	28.7	13.8	11.0	10.2	9.9	60.3	46.3	29.3	14.1	11.3	10.4	10.2
MOTORCYCLES (MCY)	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.4	0.3	0.3	0.3	0.2	0.2	0.2
BUSES	1.6	1.2	0.8	0.6	0.5	0.4	0.4	1.6	1.2	0.8	0.6	0.5	0.4	0.4
MOTOR HOMES (MH)	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.3	0.3	0.2	0.2	0.2	0.1	0.1
*** TOTAL ON-ROAD MOTOR VEHICLES**	**104.3**	**82.4**	**54.4**	**32.4**	**25.1**	**22.0**	**20.8**	**108.5**	**85.8**	**56.9**	**34.1**	**26.4**	**23.2**	**21.8**
OTHER MOBILE SOURCES														
AIRCRAFT	2.5	4.6	4.5	4.5	4.5	4.5	4.5	2.4	4.5	4.5	4.5	4.5	4.5	4.5
TRAINS	13.1	14.3	15.0	15.5	16.1	16.5	16.6	13.1	14.3	15.0	15.5	16.1	16.5	16.6
OCEAN GOING VESSELS	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1
COMMERCIAL HARBOR CRAFT	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
RECREATIONAL BOATS	2.7	2.6	2.5	2.4	2.4	2.4	2.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2
OFF-ROAD RECREATIONAL VEHICLES	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
OFF-ROAD EQUIPMENT	21.2	19.4	16.6	13.8	11.7	10.6	10.2	18.5	17.0	14.6	12.2	10.5	9.6	9.2
OFF-ROAD EQUIPMENT (PERP)	5.9	5.1	3.3	2.6	2.2	2.2	2.2	5.9	5.1	3.3	2.6	2.2	2.2	2.2
FARM EQUIPMENT	41.5	36.1	29.6	24.2	19.7	17.3	16.2	25.8	22.6	18.5	15.1	12.3	10.8	10.1

NOx														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
FUEL STORAGE AND HANDLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL OTHER MOBILE SOURCES**	**87.1**	**82.3**	**71.7**	**63.3**	**56.8**	**53.7**	**52.2**	**67.2**	**64.9**	**57.3**	**51.4**	**47.0**	**45.0**	**44.0**
***** TOTAL MOBILE***	***191.4***	***164.7***	***126.1***	***95.7***	***82.0***	***75.7***	***73.0***	***175.7***	***150.7***	***114.1***	***85.5***	***73.4***	***68.1***	***65.8***

GRAND TOTAL FOR SAN JOAQUIN VALLEY	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
	226.7	199.5	159.1	121.1	106.2	98.2	95.2	213.9	188.8	150.2	112.3	99.2	92.2	89.6

Table B-3 SOx

SOx														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
STATIONARY SOURCES														
FUEL COMBUSTION														
ELECTRIC UTILITIES	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
COGENERATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OIL AND GAS PRODUCTION (COMBUSTION)	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.7	0.6	0.6	0.5	0.5	0.5	0.4
PETROLEUM REFINING (COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MANUFACTURING AND INDUSTRIAL	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FOOD AND AGRICULTURAL PROCESSING	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
SERVICE AND COMMERCIAL	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
OTHER (FUEL COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL FUEL COMBUSTION**	**1.6**	**1.6**	**1.5**	**1.4**	**1.4**	**1.3**	**1.3**	**1.6**	**1.6**	**1.5**	**1.4**	**1.4**	**1.3**	**1.3**
WASTE DISPOSAL														
SEWAGE TREATMENT	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LANDFILLS	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
INCINERATORS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOIL REMEDIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (WASTE DISPOSAL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL WASTE DISPOSAL**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
CLEANING AND SURFACE COATINGS														
LAUNDERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEGREASING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRINTING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SOx														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
ADHESIVES AND SEALANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (CLEANING AND SURFACE COATINGS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL CLEANING AND SURFACE COATINGS**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
PETROLEUM PRODUCTION AND MARKETING														
OIL AND GAS PRODUCTION	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.5	0.4	0.4	0.4	0.3	0.3	0.3
PETROLEUM REFINING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM MARKETING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL PETROLEUM PRODUCTION AND MARKETING**	**0.5**	**0.5**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.5**	**0.5**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**
INDUSTRIAL PROCESSES														
CHEMICAL	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FOOD AND AGRICULTURE	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2
MINERAL PROCESSES	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
METAL PROCESSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOOD AND PAPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GLASS AND RELATED PRODUCTS	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.5	1.5	1.5	1.5
ELECTRONICS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (INDUSTRIAL PROCESSES)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
*** TOTAL INDUSTRIAL PROCESSES**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.9**	**2.9**	**2.5**	**2.5**	**2.6**	**2.5**	**2.6**	**2.6**	**2.6**
***** TOTAL STATIONARY***	***5.1***	***5.0***	***5.0***	***4.8***	***4.8***	***4.8***	***4.8***	***4.8***	***4.8***	***4.7***	***4.6***	***4.5***	***4.5***	***4.5***

SOx														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
AREAWIDE SOURCES														
SOLVENT EVAPORATION														
CONSUMER PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PESTICIDES/FERTILIZERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ASPHALT PAVING / ROOFING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL SOLVENT EVAPORATION**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
MISCELLANEOUS PROCESSES														
RESIDENTIAL FUEL COMBUSTION	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FARMING OPERATIONS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION AND DEMOLITION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNPAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FUGITIVE WINDBLOWN DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FIRES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MANAGED BURNING AND DISPOSAL	0.3	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.6	0.3	0.2	0.2	0.2	0.2
COOKING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (MISCELLANEOUS PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL MISCELLANEOUS PROCESSES**	**0.6**	**0.7**	**0.6**	**0.5**	**0.5**	**0.5**	**0.5**	**0.7**	**1.0**	**0.6**	**0.5**	**0.5**	**0.5**	**0.5**
***** TOTAL AREAWIDE***	***0.6***	***0.7***	***0.6***	***0.5***	***0.5***	***0.5***	***0.5***	***0.7***	***1.0***	***0.6***	***0.5***	***0.5***	***0.5***	***0.5***

SOx														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
MOBILE SOURCES														
ON-ROAD MOTOR VEHICLES														
LIGHT DUTY PASSENGER (LDA)	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LIGHT DUTY TRUCKS - 1 (LDT1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIGHT DUTY TRUCKS - 2 (LDT2)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MEDIUM DUTY TRUCKS (MDV)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LIGHT HEAVY DUTY TRUCKS - 1 (LHDT1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIGHT HEAVY DUTY TRUCKS - 2 (LHDT2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEDIUM HEAVY DUTY TRUCKS (MHDT)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEAVY HEAVY DUTY TRUCKS (HHDT)	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1
MOTORCYCLES (MCY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOTOR HOMES (MH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL ON-ROAD MOTOR VEHICLES**	**0.6**	**0.6**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
OTHER MOBILE SOURCES														
AIRCRAFT	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
TRAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCEAN GOING VESSELS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMERCIAL HARBOR CRAFT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RECREATIONAL BOATS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OFF-ROAD RECREATIONAL VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OFF-ROAD EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OFF-ROAD EQUIPMENT (PERP)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FARM EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SOx														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
FUEL STORAGE AND HANDLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL OTHER MOBILE SOURCES**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
***** TOTAL MOBILE***	***0.8***	***0.9***	***0.8***	***0.8***	***0.8***	***0.8***	***0.8***	***0.7***	***0.8***	***0.8***	***0.8***	***0.8***	***0.7***	***0.7***

GRAND TOTAL FOR SAN JOAQUIN VALLEY	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
	6.43	**6.64**	**6.39**	**6.15**	**6.08**	**6.04**	**6.04**	**6.24**	**6.58**	**6.15**	**5.87**	**5.79**	**5.75**	**5.74**

Table B-4 VOC

VOC														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
STATIONARY SOURCES														
FUEL COMBUSTION														
ELECTRIC UTILITIES	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1
COGENERATION	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
OIL AND GAS PRODUCTION (COMBUSTION)	1.1	1.1	1.0	0.9	0.8	0.8	0.8	1.1	1.1	1.0	0.9	0.8	0.8	0.8
PETROLEUM REFINING (COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MANUFACTURING AND INDUSTRIAL	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2
FOOD AND AGRICULTURAL PROCESSING	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SERVICE AND COMMERCIAL	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7
OTHER (FUEL COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL FUEL COMBUSTION**	**3.3**	**3.2**	**3.1**	**2.9**	**2.8**	**2.7**	**2.7**	**3.2**	**3.1**	**3.0**	**2.8**	**2.7**	**2.6**	**2.6**
WASTE DISPOSAL														
SEWAGE TREATMENT	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LANDFILLS	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.5	1.5	1.6	1.6	1.6	1.7	1.7
INCINERATORS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOIL REMEDIATION	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
OTHER (WASTE DISPOSAL)	21.6	21.9	21.7	22.7	23.5	24.2	24.6	21.5	21.9	21.7	22.7	23.5	24.2	24.6
*** TOTAL WASTE DISPOSAL**	**23.2**	**23.6**	**23.4**	**24.5**	**25.3**	**26.0**	**26.4**	**23.2**	**23.6**	**23.4**	**24.5**	**25.3**	**26.0**	**26.4**
CLEANING AND SURFACE COATINGS														
LAUNDERING	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
DEGREASING	1.8	1.8	1.8	1.9	2.0	2.0	2.1	1.8	1.8	1.8	1.9	2.0	2.0	2.1
COATINGS AND RELATED PROCESS SOLVENTS	8.8	8.9	9.5	10.1	10.3	10.5	10.6	8.8	8.9	9.5	10.1	10.3	10.5	10.6
PRINTING	5.6	5.5	5.3	5.3	5.3	5.4	5.4	5.6	5.5	5.3	5.3	5.3	5.4	5.4

SUMMARY CATEGORY NAME	VOC Annual Average (tons/day)							VOC Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
ADHESIVES AND SEALANTS	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
OTHER (CLEANING AND SURFACE COATINGS)	7.0	7.0	7.5	8.0	8.0	8.1	8.1	7.0	7.0	7.5	8.0	8.0	8.1	8.1
*** TOTAL CLEANING AND SURFACE COATINGS**	**24.0**	**24.0**	**24.9**	**26.1**	**26.4**	**26.7**	**27.0**	**24.0**	**24.0**	**24.9**	**26.1**	**26.3**	**26.7**	**27.0**
PETROLEUM PRODUCTION AND MARKETING														
OIL AND GAS PRODUCTION	11.5	10.8	9.9	9.0	8.2	7.8	7.6	11.5	10.8	9.9	9.0	8.2	7.8	7.5
PETROLEUM REFINING	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
PETROLEUM MARKETING	5.1	4.8	4.4	4.1	3.9	3.8	3.8	5.1	4.8	4.4	4.1	3.9	3.8	3.8
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL PETROLEUM PRODUCTION AND MARKETING**	**17.0**	**16.0**	**14.8**	**13.6**	**12.6**	**12.1**	**11.8**	**17.0**	**16.0**	**14.7**	**13.6**	**12.6**	**12.1**	**11.8**
INDUSTRIAL PROCESSES														
CHEMICAL	2.6	2.6	2.5	2.6	2.6	2.7	2.8	2.6	2.6	2.4	2.6	2.6	2.7	2.7
FOOD AND AGRICULTURE	12.4	12.4	12.6	13.3	13.9	14.4	14.7	11.9	12.0	12.2	12.8	13.4	13.9	14.2
MINERAL PROCESSES	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
METAL PROCESSES	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
WOOD AND PAPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GLASS AND RELATED PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ELECTRONICS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (INDUSTRIAL PROCESSES)	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9
*** TOTAL INDUSTRIAL PROCESSES**	**16.0**	**16.0**	**16.1**	**16.9**	**17.6**	**18.2**	**18.6**	**15.7**	**15.7**	**15.8**	**16.6**	**17.3**	**17.9**	**18.2**
***** TOTAL STATIONARY***	***83.5***	***82.9***	***82.2***	***84.0***	***84.7***	***85.7***	***86.5***	***83.0***	***82.5***	***81.8***	***83.6***	***84.2***	***85.3***	***86.0***

SUMMARY CATEGORY NAME	VOC Annual Average (tons/day)							VOC Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
AREAWIDE SOURCES														
SOLVENT EVAPORATION														
CONSUMER PRODUCTS	25.8	26.7	27.2	28.4	29.5	30.4	30.9	25.8	26.7	27.2	28.4	29.5	30.4	30.9
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	6.0	6.1	6.3	6.5	6.7	6.8	6.9	5.3	5.4	5.6	5.7	5.9	6.0	6.1
PESTICIDES/FERTILIZERS	18.1	17.4	17.7	17.6	17.4	17.3	17.3	15.4	14.3	16.5	16.4	16.2	16.2	16.1
ASPHALT PAVING / ROOFING	1.0	1.1	1.2	1.2	1.3	1.3	1.3	1.0	1.1	1.2	1.2	1.3	1.3	1.3
*** TOTAL SOLVENT EVAPORATION**	**51.0**	**51.4**	**52.4**	**53.7**	**54.9**	**55.9**	**56.4**	**47.5**	**47.6**	**50.5**	**51.7**	**52.9**	**53.9**	**54.5**
MISCELLANEOUS PROCESSES														
RESIDENTIAL FUEL COMBUSTION	3.7	3.4	3.3	3.3	3.3	3.3	3.3	6.9	6.4	6.2	6.2	6.3	6.3	6.3
FARMING OPERATIONS	93.8	93.7	93.6	93.5	93.5	93.4	93.4	93.8	93.7	93.6	93.5	93.4	93.4	93.4
CONSTRUCTION AND DEMOLITION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNPAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FUGITIVE WINDBLOWN DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FIRES	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2
MANAGED BURNING AND DISPOSAL	17.3	24.4	17.6	11.2	11.2	11.2	11.2	18.3	31.3	16.2	7.7	7.7	7.7	7.7
COOKING	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
OTHER (MISCELLANEOUS PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL MISCELLANEOUS PROCESSES**	**115.3**	**122.0**	**115.1**	**108.6**	**108.6**	**108.6**	**108.6**	**119.5**	**131.8**	**116.6**	**108.0**	**107.9**	**107.9**	**107.9**
***** TOTAL AREAWIDE***	***166.3***	***173.5***	***167.5***	***162.3***	***163.5***	***164.4***	***165.0***	***167.0***	***179.4***	***167.0***	***159.7***	***160.8***	***161.8***	***162.3***

SUMMARY CATEGORY NAME	VOC Annual Average (tons/day) 2017	2019	2022	2025	2028	2030	2031	VOC Winter Average (tons/day) 2017	2019	2022	2025	2028	2030	2031
MOBILE SOURCES														
ON-ROAD MOTOR VEHICLES														
LIGHT DUTY PASSENGER (LDA)	9.6	8.3	7.0	5.9	5.2	4.7	4.4	9.5	8.2	6.9	5.8	5.1	4.7	4.4
LIGHT DUTY TRUCKS - 1 (LDT1)	2.5	2.4	1.9	1.3	1.0	0.8	0.8	2.5	2.4	1.8	1.3	1.0	0.8	0.7
LIGHT DUTY TRUCKS - 2 (LDT2)	4.8	3.9	3.5	3.1	2.8	2.6	2.5	4.8	3.9	3.5	3.1	2.9	2.6	2.5
MEDIUM DUTY TRUCKS (MDV)	6.0	5.5	4.7	3.9	3.3	2.9	2.7	6.2	5.7	4.8	4.0	3.3	2.9	2.8
LIGHT HEAVY DUTY TRUCKS - 1 (LHDT1)	1.6	1.5	1.3	1.0	0.9	0.7	0.7	1.6	1.5	1.3	1.0	0.8	0.7	0.6
LIGHT HEAVY DUTY TRUCKS - 2 (LHDT2)	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2
MEDIUM HEAVY DUTY TRUCKS (MHDT)	0.7	0.6	0.2	0.1	0.1	0.1	0.1	0.7	0.6	0.2	0.1	0.1	0.1	0.1
HEAVY HEAVY DUTY TRUCKS (HHDT)	2.2	1.6	0.7	0.6	0.6	0.6	0.6	2.2	1.6	0.7	0.6	0.6	0.6	0.6
MOTORCYCLES (MCY)	2.2	2.1	2.0	1.9	1.8	1.7	1.7	2.2	2.1	2.0	1.8	1.7	1.7	1.6
BUSES	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
MOTOR HOMES (MH)	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
*** TOTAL ON-ROAD MOTOR VEHICLES**	**30.2**	**26.5**	**21.6**	**18.2**	**15.9**	**14.4**	**13.7**	**30.2**	**26.4**	**21.5**	**18.1**	**15.8**	**14.3**	**13.6**
OTHER MOBILE SOURCES														
AIRCRAFT	3.0	3.9	3.9	3.9	3.9	3.9	3.9	3.0	3.9	3.9	3.9	3.9	3.9	3.9
TRAINS	0.6	0.6	0.7	0.6	0.7	0.7	0.7	0.6	0.6	0.7	0.6	0.7	0.7	0.7
OCEAN GOING VESSELS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMERCIAL HARBOR CRAFT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RECREATIONAL BOATS	14.1	12.9	11.3	10.0	8.9	8.2	7.9	6.8	6.2	5.4	4.8	4.3	4.0	3.8
OFF-ROAD RECREATIONAL VEHICLES	2.4	2.3	2.2	2.0	1.7	1.5	1.5	2.8	2.7	2.5	2.2	1.9	1.7	1.7
OFF-ROAD EQUIPMENT	12.4	12.0	11.8	10.6	8.3	7.1	6.6	11.8	11.4	11.2	10.0	7.9	6.8	6.3
OFF-ROAD EQUIPMENT (PERP)	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.5	0.4	0.3	0.3	0.3	0.3	0.3
FARM EQUIPMENT	7.4	6.8	5.7	4.9	4.1	3.7	3.5	5.0	4.5	3.8	3.2	2.7	2.4	2.3

VOC														
SUMMARY CATEGORY NAME	Annual Average (tons/day)							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
FUEL STORAGE AND HANDLING	1.5	1.4	1.3	1.2	1.2	1.2	1.2	1.3	1.3	1.2	1.1	1.1	1.1	1.1
*** TOTAL OTHER MOBILE SOURCES**	**41.9**	**40.3**	**37.2**	**33.5**	**29.0**	**26.6**	**25.6**	**31.9**	**31.0**	**29.0**	**26.2**	**22.7**	**20.8**	**20.0**
***** TOTAL MOBILE***	***72.2***	***66.8***	***58.8***	***51.7***	***44.9***	***41.0***	***39.3***	***62.0***	***57.4***	***50.4***	***44.3***	***38.5***	***35.1***	***33.7***

GRAND TOTAL FOR SAN JOAQUIN VALLEY	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
	321.9	**323.2**	**308.5**	**298.0**	**293.0**	**291.2**	**290.8**	**312.0**	**319.3**	**299.3**	**287.6**	**283.6**	**282.2**	**282.0**

Table B-5 Ammonia

SUMMARY CATEGORY NAME	Ammonia Annual Average (tons/day)†							Ammonia Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
STATIONARY SOURCES														
FUEL COMBUSTION														
ELECTRIC UTILITIES	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.7	0.7	0.7	0.6	0.6	0.5	0.5
COGENERATION	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3
OIL AND GAS PRODUCTION (COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM REFINING (COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MANUFACTURING AND INDUSTRIAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD AND AGRICULTURAL PROCESSING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SERVICE AND COMMERCIAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (FUEL COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL FUEL COMBUSTION**	**1.2**	**1.1**	**1.1**	**1.1**	**1.0**	**1.0**	**1.0**	**1.2**	**1.1**	**1.1**	**1.0**	**1.0**	**0.9**	**0.9**
WASTE DISPOSAL														
SEWAGE TREATMENT	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LANDFILLS	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.8	0.8	0.8
INCINERATORS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOIL REMEDIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (WASTE DISPOSAL)	10.9	11.1	11.1	11.5	11.9	12.2	12.4	10.9	11.1	11.1	11.5	11.9	12.2	12.4
*** TOTAL WASTE DISPOSAL**	**11.7**	**11.9**	**11.9**	**12.4**	**12.8**	**13.1**	**13.3**	**11.7**	**11.9**	**11.9**	**12.4**	**12.8**	**13.1**	**13.3**
CLEANING AND SURFACE COATINGS														
LAUNDERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEGREASING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRINTING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SUMMARY CATEGORY NAME	Ammonia Annual Average (tons/day)†							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
ADHESIVES AND SEALANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (CLEANING AND SURFACE COATINGS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL CLEANING AND SURFACE COATINGS**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
PETROLEUM PRODUCTION AND MARKETING														
OIL AND GAS PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM REFINING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM MARKETING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL PETROLEUM PRODUCTION AND MARKETING**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
INDUSTRIAL PROCESSES														
CHEMICAL	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FOOD AND AGRICULTURE	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MINERAL PROCESSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METAL PROCESSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOOD AND PAPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GLASS AND RELATED PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ELECTRONICS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (INDUSTRIAL PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL INDUSTRIAL PROCESSES**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
***** TOTAL STATIONARY***	***13.0***	***13.1***	***13.0***	***13.5***	***13.9***	***14.2***	***14.4***	***13.0***	***13.1***	***13.0***	***13.5***	***13.9***	***14.2***	***14.3***

SUMMARY CATEGORY NAME	Ammonia Annual Average (tons/day)[†]							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
AREAWIDE SOURCES														
SOLVENT EVAPORATION														
CONSUMER PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PESTICIDES/FERTILIZERS	115.2	114.3	113.0	111.7	110.6	109.9	109.5	95.8	95.0	93.9	92.8	91.8	91.2	90.9
ASPHALT PAVING / ROOFING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL SOLVENT EVAPORATION**	**115.2**	**114.3**	**113.0**	**111.7**	**110.6**	**109.9**	**109.5**	**95.8**	**95.0**	**93.9**	**92.8**	**91.8**	**91.2**	**90.9**
MISCELLANEOUS PROCESSES														
RESIDENTIAL FUEL COMBUSTION	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7
FARMING OPERATIONS	169.8	169.3	168.6	168.0	167.4	167.1	167.0	169.8	169.2	168.5	167.9	167.4	167.1	166.9
CONSTRUCTION AND DEMOLITION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNPAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FUGITIVE WINDBLOWN DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FIRES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MANAGED BURNING AND DISPOSAL	0.6	1.0	0.6	0.6	0.6	0.6	0.6	0.5	1.2	0.4	0.4	0.4	0.4	0.4
COOKING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (MISCELLANEOUS PROCESSES)	6.5	6.6	6.7	6.9	7.1	7.3	7.3	6.5	6.6	6.7	6.9	7.1	7.3	7.3
*** TOTAL MISCELLANEOUS PROCESSES**	**177.3**	**177.2**	**176.3**	**175.9**	**175.6**	**175.4**	**175.3**	**177.6**	**177.8**	**176.4**	**176.0**	**175.7**	**175.5**	**175.5**
***** TOTAL AREAWIDE***	***292.6***	***291.5***	***289.3***	***287.6***	***286.2***	***285.3***	***284.9***	***273.4***	***272.8***	***270.3***	***268.8***	***267.5***	***266.7***	***266.4***

SUMMARY CATEGORY NAME	Ammonia Annual Average (tons/day)†							Ammonia Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
MOBILE SOURCES														
ON-ROAD MOTOR VEHICLES														
LIGHT DUTY PASSENGER (LDA)	1.3	1.5	1.6	1.7	1.9	2.0	2.0	1.3	1.5	1.6	1.7	1.9	2.0	2.0
LIGHT DUTY TRUCKS - 1 (LDT1)	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1
LIGHT DUTY TRUCKS - 2 (LDT2)	0.5	0.6	0.7	0.8	0.9	1.0	1.0	0.5	0.6	0.7	0.8	0.9	1.0	1.0
MEDIUM DUTY TRUCKS (MDV)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
LIGHT HEAVY DUTY TRUCKS - 1 (LHDT1)	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3
LIGHT HEAVY DUTY TRUCKS - 2 (LHDT2)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MEDIUM HEAVY DUTY TRUCKS (MHDT)	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.2	0.2	0.3	0.3	0.4	0.4	0.4
HEAVY HEAVY DUTY TRUCKS (HHDT)	1.5	1.7	2.0	2.2	2.3	2.3	2.4	1.5	1.7	2.0	2.2	2.3	2.3	2.4
MOTORCYCLES (MCY)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUSES	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MOTOR HOMES (MH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL ON-ROAD MOTOR VEHICLES**	**4.8**	**5.3**	**6.0**	**6.5**	**6.8**	**6.9**	**7.0**	**4.8**	**5.3**	**6.0**	**6.5**	**6.8**	**6.9**	**7.0**
OTHER MOBILE SOURCES														
AIRCRAFT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCEAN GOING VESSELS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMERCIAL HARBOR CRAFT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RECREATIONAL BOATS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OFF-ROAD RECREATIONAL VEHICLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OFF-ROAD EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OFF-ROAD EQUIPMENT (PERP)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FARM EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Ammonia														
SUMMARY CATEGORY NAME	Annual Average (tons/day)†							Winter Average (tons/day)						
	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
FUEL STORAGE AND HANDLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL OTHER MOBILE SOURCES**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
***** TOTAL MOBILE***	***4.8***	***5.4***	***6.1***	***6.5***	***6.9***	***7.0***	***7.1***	***4.8***	***5.4***	***6.1***	***6.5***	***6.8***	***7.0***	***7.1***

†Ammonia annual averages included in the *Proposed 2024 Plan for the 2012 PM2.5 Standard* published May 21, 2024, incorrectly displayed winter averages. The values here have been corrected and are consistent with CEPAM v.1.00 and the inventory included in Chapter 5 of the 2023 *Initial SIP Requirements* that was adopted and submitted to EPA.

GRAND TOTAL FOR SAN JOAQUIN VALLEY	2017	2019	2022	2025	2028	2030	2031	2017	2019	2022	2025	2028	2030	2031
	310.4	310.1	308.5	307.7	306.9	306.5	306.3	291.2	291.3	289.4	288.9	288.2	287.9	287.8

[The following sections provided by the California Air Resources Board]

B.2 EMISSIONS INVENTORY BACKGROUND

Emissions inventories are required by the Clean Air Act (Act) and the PM2.5 SIP Requirements Rule for the 2012 12 µg/m3 annual PM2.5 National Ambient Air Quality Standards (NAAQS) (PM2.5 Implementation Rule). Specifically, they are required for those areas that exceed the health-based NAAQS. These areas are designated as nonattainment based on monitored exceedances of these standards. These nonattainment areas must develop an emissions inventory as the basis of a State Implementation Plan (SIP) that demonstrates how they will attain the standards by specified dates. This document describes the emissions inventory included in the San Joaquin Valley (SJV or Valley) 12 µg/m3 annual PM2.5 SIP (2024 PM2.5 SIP).

B.3 EMISSIONS INVENTORY OVERVIEW

Emissions inventories are estimates of the amount and type of pollutants emitted into the atmosphere by facilities, mobile sources, and areawide sources. They are fundamental components of an air quality plan and serve critical functions such as:

1. the primary input to air quality modeling used in attainment demonstrations;
2. the emissions data used for developing control strategies; and
3. a means to track progress in meeting the emission reduction commitments.

The California Air Resources Board (CARB) and the San Joaquin Valley Air Pollution Control District (District) have developed a comprehensive current emissions inventory consistent with the requirements set forth in Section 182(a)-(f) of the Act[3]. CARB and District staff conducted a thorough review of the inventory to ensure that the emission estimates reflect accurate emissions reports for point sources and that estimates for mobile and areawide sources are based on the most recent approved models and methodologies.

CARB also reviewed the growth profiles for point and areawide source categories and updated them as necessary to ensure that the emission projections are based on data that reflect historical trends, current conditions, and recent economic and demographic forecasts.

The United States Environmental Protection Agency (U.S. EPA) regulations require that the emissions inventory for a PM2.5 SIP contains emissions data for directly emitted PM2.5 and its precursors; oxides of nitrogen (NOx), oxides of sulfur (SOx), volatile organic compounds (VOC)[4] and ammonia (NH3). The inventory included in this plan

[3] Section 182(a)-(f) of the Act. https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart2-sec7511a.htm
[4] Section 182(a)(1) of the Act. https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart2-sec7511a.htm

substitutes VOC with reactive organic gases (ROG), which, in general, represent a slightly broader group of compounds than those in U.S. EPA's list of VOCs.

B.3.1 Inventory Base Year

40 CFR 51.1315(a) requires that the inventory year be selected consistent with the baseline year for the reasonable further progress (RFP) plan as required by 40 CFR 51.1310(b)[5], which states that the base year emissions inventory shall be the emissions inventory for the most recent calendar year of which a complete triennial inventory is required to be submitted to U.S. EPA under the provisions of subpart A of 40 CFR part 51, Air Emissions Reporting Requirements, 40 CFR 51.1– 50. States may also use an alternative baseline emissions inventory provided that the year selected corresponds with the year of the effective date of designation as nonattainment for that NAAQS[6].

2017 Base Year Inventory Justification for 2024 PM2.5 SIP

CARB and the District are selecting 2017 as the planning inventory base year for the 2024 PM2.5 Plan for the 12 µg/m3 PM2.5 standard. The PM2.5 Implementation Rule specifies that the inventory base year can be one of the years for the PM2.5 design values used to reclassify the area to Serious or the State can justify the use of a different technically appropriate inventory base year if those years are not appropriate[7].
U.S. EPA's final action to reclassify the San Joaquin Valley PM2.5 nonattainment area from Moderate to Serious nonattainment for the 2012 annual PM2.5 standard was based on the agency's determination that the Valley could not practicably attain the standard by the Moderate area attainment date of December 31, 2021. The base year of the Serious area SIP could therefore be any of the three years used to make the determination of impracticability—in this case, 2019, 2020, and 2021; however, CARB and the District believe that 2019, 2020, and 2021 are not technically appropriate base years for the emission inventory and instead determined that 2017 is technically appropriate to use as the base year inventory. In selecting 2017 as the base year, CARB and the District relied on the Emission Inventory Guidance[8], which allows agencies to consider the availability of data, the implementation of rule requirements, and consistency in the base year across planning and modeling inventories in choosing an appropriate baseline inventory year.

Availability of Data
The PM2.5 Implementation Rule specifies that the base year inventory must be actual emissions; follow the Air Emissions Reporting Requirements (AERR), 40 CFR part 51, subpart A for the emissions thresholds for point sources; and use the level of detail as

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[5] 40 CFR 51.1315(a). https://www.govinfo.gov/content/pkg/CFR-2021-title40-vol2/pdf/CFR-2021-title40-vol2-sec51-1315.pdf.
[6] 40 CFR 51.1310(b). https://www.govinfo.gov/content/pkg/CFR-2020-title40-vol2/pdf/CFR-2020-title40-vol2-sec51-1310.pdf.
[7] 2016 PM2.5 SIP Requirements Rule, 40 CFR 51
https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-51/subpart-Z
51.1008(a)(1)(i) and in (b)(2) for Serious areas Emissions inventory requirements. 51.1011 (a)(3) and (b)(3)
[8] Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations (epa.gov)

prescribed by the AERR. The National Emissions Inventory (NEI) years follow the AERR reporting requirements for point sources and are the most robust inventories of actual emissions available from stationary point sources and area sources. NEI years also undergo a thorough quality assurance/quality control (QA/QC) review performed by U.S. EPA. For these reasons, CARB and the District would prefer to use an NEI year as the base year for the inventory. The two most recent NEI years are 2020 and 2017. In 2020, the COVID-19 pandemic affected a range of industries economy-wide, making 2020 emissions atypical; therefore, 2020 is unsuitable for use as a base year for the inventory. 2017 did not experience any similar disruption and reflects typical emissions, while retaining the benefits of being an NEI year with actual data thoroughly QA/QC'd by U.S. EPA. The rigor associated with an NEI year does not apply to 2019 or 2021, the other two years eligible for consideration as a base year for the 2024 PM2.5 Plan.

Implementation of Rule Requirements

On June 20, 2019, the District adopted amendments to Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) which addresses emissions from residential wood combustion. Residential wood burning is a significant source of emissions in the San Joaquin Valley, and Rule 4901 provides critical controls for this key emission source. The June 2019 amendments strengthened the rule by:

- Enhancing requirements for significant remodels of a fireplace and chimney that require the removal of open-hearth fireplaces or replacement to cleaner devices;
- Requiring only seasoned wood to be burned;
- Enhancing compliance during transfers of residential real property;
- Restricting installations of new wood burning devices;
- Enhancing visible emission limitations; and
- Establishing lower curtailment thresholds for hot spot counties (Madera, Fresno, and Kern.

Amendments to Rule 4901 went into effect in the fall of 2019. Because of the importance of the emissions source and the control measure, the full year's worth of emission reduction benefits from Rule 4901 are critical to predicting future PM2.5 concentrations. Selecting a base year prior to implementation of these important rule amendments ensures that this rule is accurately reflected in the inventory and credited appropriately for Reasonable Further Progress (RFP). Use of the 2017 NEI year as the inventory base year would meet this criterion.

Consistency in Planning and Modeling Inventories

The Emission Inventory Guidance indicates that a common reason for choosing an alternate base year is the desire to have the base year for planning inventories be consistent with the base year for modeling inventories. The modeling base year is determined in part by meteorology that is conducive to formation of ambient levels of PM2.5 that are above the 12 µg/m3 PM2.5 standard. For modeling purposes, 2019, 2020, and 2021 are not years with representative air quality suitable for modeling future air quality. Modeled attainment demonstrations are based on a five-year weighted design value centered around the base year inventory, giving the base year the most weight. To ensure the model is accurately predicting air quality, it is best to have the base year not be a year of extensive wildfires. Wildfires have become more intense in California. The two largest wildfire years on record occurred in 2020 and 2021. In the San Joaquin Valley, these extensive wildfires impacted air quality throughout the Valley for months. 2020 and 2021 are also unusual, non-representative years due to COVID-19 impacts. Furthermore, in 2020, Valley sites collected incomplete speciation data—which are critical for PM2.5 modeling—due to laboratory and monitoring site shutdowns because of the pandemic.

While 2019 is not impacted by wildfires or COVID-19, the five-year weighted PM2.5 design value with a 2019 base year would include 2020 and 2021, capturing those years' significant wildfire and COVID-19 impacts. With a 2017 base modeling year, the five-year weighted PM2.5 design value would include 2017, 2018, and 2019. 2018 did have some wildfire days but not to the extent of 2020 and 2021. Using 2017 as the base modeling year ensures that anthropogenic emissions are accurately reflected, speciation data are available and robust, and the model can more accurately reflect the impacts of control strategies; therefore, CARB is using 2017 as the base modeling year for the attainment demonstration. Selecting 2017 for the planning inventory base year would allow for more consistency across the planning and modeling inventories used in the 2024 PM2.5 Plan.

After consideration of all the above, CARB has determined that the 2017 base year inventory is technically appropriate for the San Joaquin Valley 2024 PM2.5 Plan since it is based on actual data, reflects typical emission conditions, can account for the benefits of a new rule related to residential wood burning, and is consistent with the modeling base year inventory.

B.3.2 Forecasted Inventories

In addition to base year emissions, emissions projections are needed for a variety of reasons, including redesignation maintenance plans, the attainment projected inventory for a nonattainment area (NAA), and air quality modeling for attainment plans[9].

For stationary and area sources, forecasted inventories are a projection of the base year inventory that reflects expected growth trends for each source category and emissions reductions due to adopted control measures. CARB develops emission forecasts by applying growth and control profiles to the base year inventory. The stationary and area source emissions inventories for the 2024 PM2.5 SIP are modeled by the California Emission Projection Analysis Model (CEPAM), 2022 PM2.5 Plans Emission Projections, Version 1.00.

Growth profiles for point and areawide sources are derived from surrogates, such as economic activity, fuel usage, population, and housing units, that best reflect the expected growth trends for each specific source category. Growth projections were obtained primarily from government entities with expertise in developing forecasts for specific sectors, or, in some cases, from econometric models. Control profiles, which account for emission reductions resulting from adopted rules and regulations, are derived

[9] 40 CFR 51.114. https://www.govinfo.gov/content/pkg/CFR-2000-title40-vol2/pdf/CFR-2000-title40-vol2-sec51-114.pdf.

from data provided by the regulatory agencies responsible for the affected emission categories.

Projections for on-road mobile source emissions are generated by CARB's EMFAC2021 model, which predicts activity rates and vehicle fleet turnover by vehicle model year, along with activity inputs from the metropolitan planning organizations (MPOs). Off-road mobile sources are forecasted with category-specific models or, where not available, CARB's OFFROAD2007. CEPAM integrates the emission projections derived from these mobile source models to develop a comprehensive forecasted emission inventory. As with stationary sources, the mobile source models include control algorithms that account for adopted regulatory actions.

B.3.3 Temporal Resolution

The 12 µg/m3 NAAQS is an annual average standard; therefore, the emission inventory employed for this 2024 PM2.5 SIP is an annual average basis.

B.3.4 Quality Assurance and Quality Control

CARB has established a quality assurance and quality control (QA/QC) process to ensure the integrity and accuracy of the emission inventories used in the development of air quality plans. QA/QC occurs at the various stages of SIP emission inventory development. Base year emissions are assembled and maintained in the California Emission Inventory Development and Reporting System (CEIDARS). CARB inventory staff works with air districts, which are responsible for developing and reporting point source emission estimates, to verify these data are accurate. The locations of point sources, including stacks, are checked to ensure they are valid. Area-wide source emissions estimates are developed by both CARB and district staff, and the methodologies are reviewed by both agencies before their inclusion in the emissions inventory. Mobile categories are verified with CARB mobile source staff for consistency with the on-road and off-road emission models. Additionally, CEIDARS is designed with automatic system checks to prevent errors, such as double counting of emission sources. At the final stage, CEPAM is thoroughly reviewed to validate the accuracy of growth and control application, and the output emissions are compared against prior approved versions of CEPAM to identify data anomalies.

B.4 EMISSION INVENTORY COMPONENTS

A summary of the components that make up 2024 PM2.5 SIP emissions inventory is presented in the following sections. These include mobile (on- and off-road) sources, stationary point sources, areawide sources, and natural sources.

B.4.1 Mobile Source Emissions

CARB develops the emission inventory for the mobile sources using various modeling methods. These models account for the effects of various adopted regulations, technology types, fleet turnover, and seasonal conditions on emissions. Mobile sources in the emission inventory are composed of both on-road and off-road sources, described in the sections below.

On-Road Mobile Source Emissions

Emissions from on-road mobile sources, which include passenger vehicles, buses, and trucks, were estimated using outputs from CARB's EMFAC2021 v1.0.2 model. The on-road emissions were calculated by applying EMFAC2021 emission factors to the transportation activity data provided by the local MPOs based on the 2022 Regional Transportation Plan.

The EMFAC2021 model incorporates data on California's car and truck fleets, as well as travel activity. The light-duty motor vehicle fleet age, vehicle type, and vehicle population were updated based on 2019 California Department of Motor Vehicles (DMV) data. Moreover, the model also reflects the emissions benefits of CARB's recent rulemakings such as the Advanced Clean Trucks, Heavy-Duty Omnibus, as well as CARB's Truck and Bus Rule and previously adopted rules for other on-road diesel fleets.

EMFAC2021 utilizes a socio-econometric regression modeling approach to forecast new vehicle sales and to estimate future fleet mix. Light-duty passenger vehicle population includes 2019 DMV registration data along with updates to emission rates based on test data and the inclusion of plug-in hybrid electric vehicles. For heavy-duty vehicles, model year specific emission factors based on new test data were used, along with population estimates using DMV data for in-state trucks and International Registration Plan (IRP) data for out-of-state vehicles.

Additional information and documentation on the EMFAC2021 model are available at: *https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation*

EMFAC2021 Heavy-Duty Inspection and Maintenance Off-Model Adjustment

On December 9, 2021, CARB adopted the Heavy-Duty Inspection and Maintenance (HD I/M) program, which controls emissions effectively from non-gasoline on-road heavy-duty vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 pounds. Starting from calendar year 2023, the program drastically reduces NOx and PM2.5 emissions by enforcing periodic testing and inspections for heavy-duty trucks operating in California.

The HD I/M regulation impacts some of the underlying assumptions in CARB's EMFAC2021 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors based on off-model analysis with EMFAC2021 to reflect the regulation. More information on this analysis is provided in Appendix D of the HD I/M staff report. Since this regulation was adopted after the release of EMFAC2021, these adjustment factors were calculated based on emission estimates under two scenarios: (1) EMFAC2021 default, plus HD I/M factors applied; and (2) EMFAC2021 default, which is the baseline before HD I/M. These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2021 model by the CEPAM external adjustment module to account for the impact of HD I/M. These off-model adjustment factors were applied to all heavy-duty diesel categories.

EMFAC2021 Advanced Clean Cars II

On November 30, 2022, CARB adopted Advanced Clean Cars II (ACC II), which requires all light-duty cars, trucks, and SUVs sold in California be zero emission vehicles by 2035. ACC II will be implemented in 2026 and is projected to substantially reduce NOx, PM2.5, and ROG emissions by decreasing the number of internal combustion engines in the light-duty fleet.

ACC II impacts some of the underlying assumptions in CARB's EMFAC2021 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors based on off-model analysis with EMFAC2021 to reflect the regulation. More information on this analysis is provided in Appendix D of the ACC II staff report. Since this regulation was adopted after the release of EMFAC2021, these adjustment factors were calculated based on emission estimates under two scenarios: (1) EMFAC2021 default, plus ACC II factors applied; and (2) EMFAC2021 default, which is the baseline before ACC II. These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2021 model by the CEPAM external adjustment module to account for the impact of ACC II. These off-model adjustment factors were applied to all light-duty categories.

B.4.2 Off-Road Mobile Source Emissions

Emissions from off-road sources are estimated using a suite of category-specific models or, where a new model was not available, the OFFROAD2007 model. Many of the newer models are developed to support recent regulations, including in-use off-road equipment, ocean-going vessels, and others. The sections below summarize the updates made by CARB to specific off-road categories.

Recreational Marine Vessels

Pleasure craft or recreational marine vessel (RMV) is a broad category of marine vessel that includes gasoline-powered spark-ignition marine watercraft (SIMW) and diesel-powered marine watercraft. It includes outboards, sterndrives, personal watercraft, jet boats, and sailboats with auxiliary engines. This emissions inventory was last updated in 2014 to support the evaporative control measures. The population, activity, and emission factors were revised using new surveys, DMV registration information, and emissions testing.

Staff used economic data from a 2014 UCLA Economic Forecast to estimate the near-term annual sales of RMV (2014 to 2019). To forecast long-term annual sales (2020 and later), CARB staff used an estimate of California's annual population growth as a surrogate.

Additional information is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

Recreational Vehicles

Off-highway recreational vehicles include off-highway motorcycles (OHMC), all-terrain vehicles (ATV), off-road sport vehicles, off-road utility vehicles, sand cars, golf carts, and snowmobiles. A new model was developed in 2018 to update emissions from recreational vehicles. Input factors such as population, activity, and emission factors were re-assessed using new surveys, DMV registration information, and emissions testing. OHMC population growth is determined from two factors: incoming population as estimated by future annual sales and the scrapped vehicle population as estimated by the survival rate.

Additional information is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

Fuel Storage and Handling

Emissions from portable fuel containers (gas cans) were estimated based on past surveys and CARB in-house testing. This inventory uses a composite growth rate that depends on occupied household (or business units), percent of households (or businesses) with gas cans, and average number of gas cans per household (or business) units.

Additional information is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

Small Off-Road Engines (SORE)

Small off-road engines (SORE) are spark-ignition engines rated at or below 19 kilowatts (i.e., 25 horsepower). Typical engines in this category are used in lawn and garden equipment as well as other outdoor power equipment and cover a broad range of equipment. The majority of this equipment belongs to the Lawn & Garden (e.g., lawnmower, leaf blower, trimmer) and Light Commercial (e.g., compressor, pressure washer, generator) categories of CARB's SORE emissions inventory model.
The newly developed, stand-alone SORE2020 Model reflects the recovering California economy from the 2008 economic recession and incorporates emission results from CARB's recent in-house testing as well as CARB's most recent Certification Database. CARB also has conducted an extensive survey of SORE operating within California through the Social Science Research Center (SSRC) at the California State University, Fullerton (CSUF). Data collected through this survey provides the most up-to-date information regarding the population and activity of SORE equipment in California. The final SORE emissions included the adopted SORE rule in December 2021 as well as the

15-day changes after the CARB hearing which allowed the pressure washers (greater than 5 hp) extra time for meeting the regulation. The SORE annual sales were forecasted using historic growth of the number of California households (DOF household forecasts, 2000 – 2008 and 2009 - 2018).

Additional information on SORE baseline emissions (without the adopted rule and 15-day changes) is available at:
https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020_Technical_Documentation_2020_09_09_Final_Cleaned_ADA.pdf

Ocean Going Vessels

Ocean going vessels (OGVs) were updated in 2021 based on AIS (transponder) data. This data, along with vessel information supplied by South Coast AQMD and IHS Fairplay provides vessel visit counts, speed, engine size, and other vessel characteristics. The inventory adopts US EPA's methodology for emissions based on vessel speed, engine model year and horsepower. The inventory includes transit, maneuvering, anchorage and at-berth emissions, updating the 2019 at-berth-only inventory. The comprehensive national model Freight Analysis Framework (FAF) was used to develop growth rates for forecasting.

Additional information on CARB's general OGV update is available at:
https://ww2.arb.ca.gov/sites/default/files/2022-03/CARB_2021_OGV_Documentation_ADA.pdf

Commercial Harbor Craft

Commercial Harbor Crafts (CHC) are grouped into 18 vessel types: articulated tug barge (ATB), bunker barge, towed petrochemical barge, other barge, dredge, commercial passenger fishing, commercial fishing, crew and supply, catamaran ferry, monohull ferry, short run ferry, excursion, ATB tug, push and tow tug, escort/ship assist tug, pilot boat, research boat, and work boat.

The CHC inventory was updated in 2021 and includes vessels used around harbors such as tug and tow boats, fishing vessels, research vessels, barges, and similar. The inventory was updated based on CARB's reporting data for these vessels, as well as inventories from the Ports of Los Angeles and Long Beach and Oakland and Richmond. This supplied vessel characteristics, and the population was scaled up to match U.S. Coast Guard data on the annual number of vessels in California waters. Activity and load factors were based on a mix of reporting data and port-specific inventories. Emission factors were based on certification data for harbor craft engines. Population and activity growth factors were estimated based on historical trends in the past decade.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/chc2021/apph.pdf

Locomotives

All locomotive inventories were updated in 2020 and include linehaul (large national companies), switchers (used in railyards), passenger, and Class 3 locomotives (smaller regional companies). Data for each sector was supplied by rail operations, including Union Pacific and Burlington Northern, and Santa Fe Railway (BNSF) for linehaul and switcher operations. Data for other categories was supplied by the locomotive owners. Emission factors for all categories were based on U.S. EPA emission factors for locomotives. The inventory reflects the 2005 memorandum of understanding (MOU) with Union Pacific and BNSF. Growth rates were primarily developed from the FAF.

More information is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

Military and Industry Locomotives

This new category includes military and Industrial (M&I) locomotive emission inventory and relies on the annual fuel consumption and engine information collected from 2011 to 2018. The M&I locomotive data was supplied by 39 private companies and 4 military rail groups, with a total of 85 locomotives. The subject locomotives typically consist of smaller, older switchers and medium horsepower (MHP, 2,301 to 3,999 hp) locomotives operating within the boundaries of a granary, plant, or industrial facility.

The methodology is available at:
https://ww2.arb.ca.gov/sites/default/files/2022-07/2022%20MI%20Locomotive%20Emission%20Inventory%20Document%2007112022%20ADA%20Checked.pdf

Diesel Agricultural Equipment

The agricultural equipment inventory covers all off-road vehicles used on farms or first processing facilities (of all fuel types). It was updated in 2021 using a 2019 survey of California farmers and rental facilities, and the 2017 U.S. Department of Agriculture (USDA) agricultural census. Emission factors are based on the 2017 off-road diesel emission factor update. The inventory reflects incentive programs for agricultural equipment that were implemented earlier than August 2019. Agricultural growth rates were developed using historical data from the County Agricultural Commissioners' reports.

Additional information is available at:
https://ww2.arb.ca.gov/sites/default/files/2021-08/AG2021_Technical_Documentation_0.pdf

In-Use Off-Road Equipment

This category covers off-road diesel vehicles over 25 horsepower in construction, mining, industrial, and oiling drilling categories. The inventory was updated in 2022 based on the DOORS registration program. Activity was updated based on a 2021 survey of registered equipment owners, and emission factors were based on the 2017 off-road diesel emission factor update. The inventory reflects the In-Use Off-Road Equipment Regulations, as amended in 2011.

The methodology is available at:
https://ww2.arb.ca.gov/sites/default/files/2022-10/2022InUseDieselInventory.pdf

Cargo Handling Equipment

The Cargo Handling Equipment (CHE) inventory covers equipment (of all fuels) used at California ports and intermodal railyards, such as cranes, forklifts, container handling equipment, and more. The inventory population and activity were updated in 2021 based on the port inventories for the Ports of Los Angeles and Long Beach and Richmond, and the CARB reporting data for other ports and railyards, which had a more comprehensive inventory than available through reporting. Load factors were based on the previous inventory in 2007, and emission factors were based on the 2017 off-road diesel emission factor update. The inventory reflects the CHE Airborne Toxic Control Measures (ATCM), adopted in 2005 and completed in 2017.

The updated methodology is currently in the process of being posted online. When it is completed, the methodology will be available at:

https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

Transportation Refrigeration Units

The Transportation Refrigeration Units (TRU) inventory was updated in 2020 based on the TRU reporting program at CARB. The activity was developed based on 2010 surveys of facilities served by TRUs and 2017 to 2019 telematics data purchased from TRU manufacturers. Emission factors were developed specifically for TRUs based on TRU engine certification data reported to U.S. EPA as of 2018. The inventory reflects the TRU ATCM and 2021 amendments. Forecasting was based on IBISWorld reports forecast for related industries, and turnover forecasting was based on the past 20 years equipment population trends.

Additional information is available at:
https://ww2.arb.ca.gov/sites/default/files/barcu/board/rulemaking/tru2021/apph.pdf

Portable Equipment

Portable equipment inventory includes non-mobile diesel, such as generators, pumps, air compressors, chippers, and other miscellaneous equipment over 50 horsepower. This inventory was developed in 2017 based on CARB's registration program, 2017 survey of registered owners for activity and fuel, and the 2017 off-road diesel emission factor update. The inventory also reflects the Portable ATCM and 2017 amendments.

Because registration in Portable Equipment Registration Program (PERP) is voluntary, the PERP registration data was used as the basis for equipment population, with an adjustment factor used to represent the remaining portable equipment in the state. Estimates of future emissions beyond the base year were made by adjusting base year estimates for population growth, activity growth, and the purchases of new equipment (i.e. natural and accelerated turnover).

Additional information is available at:
https://ww3.arb.ca.gov/msei/ordiesel/perp2017report.pdf

Large Spark Ignition/Forklifts

The large spark ignition (LSI) inventory includes gasoline and propane forklifts, sweeper/scrubbers, and tow tractors. The inventory was updated in 2020 based on the LSI/forklift registration in the DOORS reporting system at CARB, and the sales data was provided by the Industrial Truck Association (ITA). Activity was based on a survey of equipment owners in the DOORS system, and emission factors were based on U.S. EPA's latest guidance for gasoline and propane engines. The inventory reflects the LSI regulation requirements and 2016 amendments.
The updated methodology is currently in the process of being posted online. When it is completed, the methodology will be available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

Forestry Equipment

The new 2021 forestry diesel equipment emissions inventory was developed to replace the previous emissions inventory for diesel forestry equipment based on OFFROAD2007. This inventory includes equipment used in forestry and in milling. This includes foresting operations, such as feller/bunchers and dragline operations, equipment used to build roads to reach forested areas, and forklifts or loaders used in milling operations. The inventory was based on a 2019 survey of forestry operations and mills (for calendar year 2017), as well as the 2019 California Department of Tax and Fee Administration data on the annual timber harvest, with emission factors from the 2017 off-road diesel emission factor update. This sector does not include any emission reduction measures or strategies. The model projects forestry equipment population and emissions in future years by predicting the retirement and purchasing habits of forestry equipment. The model attempts to predict a business as usual (BAU) behavior based on the 2017 survey data.

Additional information is available at:
https://ww2.arb.ca.gov/sites/default/files/2021-10/2021_Forestry_Inventory_Technical_Document_FINAL_09302021.pdf

B.4.3 Stationary Point and Stationary Aggregated Sources

The stationary source inventory is composed of point sources and area-wide sources. The data elements in the inventory are consistent with the data elements required by the AERR. The inventory reflects actual emissions from industrial point sources reported to the District by the facility operators through calendar year 2017.

More information regarding the District's facility point source inventory is available at:
https://www.valleyair.org/busind/pto/Tox_Resources/emissions_inventory.htm

Stationary point sources also include smaller point sources, such as gasoline dispensing facilities and laundering, that are not inventoried individually, but are estimated as a group and reported as a single source category, Stationary Aggregated. Emissions from these sources are estimated using various models and methodologies. Estimation methods include source testing, direct measurement by continuous emissions monitoring systems, or engineering calculations. Emissions for these categories are estimated by both CARB and the District.

The District's methodologies are available at:
http://www.valleyair.org/Air_Quality_Plans/EmissionsMethods/EmissionsMethods.htm

Estimates for the categories below were developed by CARB and have been reviewed by CARB staff to reflect the most up-to-date information.

Stationary Nonagricultural Diesel Engines

This category includes emissions from backup and prime generators and pumps, air compressors, and other miscellaneous stationary diesel engines that are widely used throughout the industrial, service, institutional, and commercial sectors. The emission estimates, including emission forecasts, are based on a 2003 CARB methodology derived from the OFFROAD2007 model.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/arbfuelcombother.htm

Agricultural Diesel Irrigation Pumps

This category includes emissions from the operation of diesel-fueled stationary and mobile agricultural irrigation pumps. The emission estimates are based on a 2003 CARB methodology using statewide population and include replacements due to the Carl Moyer Program. Emissions are grown based on projected acreage for irrigated farmland from the California Department of Conservation's Farmland Mapping and Monitoring Program (FMMP), 2008.

Additional information on this category is available at:
https://ww3.arb.ca.gov/ei/areasrc/fullpdf/full1-1.pdf

Wine Fermentation and Aging

This category includes emissions from the fermentation and aging of wine. Wine fermentation volumes in California are reported by the U.S. Alcohol and Tobacco Tax and Trade Bureau. CARB staff derived the emission factors from a computer model developed by Williams and Boulton. Emissions were initially estimated for 2002 and grown to later years using beverage manufacturing (Alcoholic & Non-Alcoholic) economic output.

An emission factor for brandy was derived by Hugh Cook of the Wine Institute. Emissions were initially estimated for 1992 then grown to 2012 using economic output for food manufacturing. Emissions were grown from 2012 to 2017 using beverage manufacturing economic output per Regional Economic Models, Inc. (REMI). Growth for future years is based on REMI forecast version 2.4.5.

Additional information on this methodology is available at:
http://www.arb.ca.gov/ei/areasrc/arbindprofandag.htm

Laundering

This category includes emissions from perchloroethylene (perc) dry cleaning establishments. The emission estimates are based on a 2002 CARB methodology that used nationwide perc consumption rates allocated to the county level based on population and an emission factor of 10.125 pounds per gallon used. Emissions were grown based on the California Department of Finance (DOF) population forecasts, 2020.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/arbcleanlaund.htm

Degreasing

This category includes emissions from solvents in degreasing operations in the manufacturing and maintenance industries. The emissions estimates are based on a 2000 CARB methodology using survey and industry data, activity factors, emission factors and a user's fraction. Emissions were grown based on CARB/REMI industry-specific economic output, version 2.4.5.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/arbcleandegreas.htm

Coatings and Thinners

This category includes emissions from coatings and related process solvents. Auto refinishing emissions estimates are based on a CARB methodology using production data and a composite emission factor derived from a 2002 survey. These estimates were grown based on CARB's on-road mobile sources model version EMFAC2017. Estimates for industrial coatings emissions are based on a 1990 CARB methodology using production and survey data, and emission factors derived from surveys. Estimates for thinning and cleaning solvents are based on a 1991 CARB methodology, census data and a default emission factor developed by CARB. These estimates were grown based on REMI county economic forecasts, version 2.4.5.

Additional information on these methodologies is available at:
https://ww3.arb.ca.gov/ei/areasrc/arbcleancoatreproc.htm

Adhesives and Sealants

This category includes emissions from solvent-based and water-based solvents contained in adhesives and sealants. Emissions are estimated based on a 1990 CARB methodology using production data and default emission factors. Estimates were grown based on REMI county economic forecasts, version 2.4.5.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-cleaning-and-surface-coating-methodologies-adhesives-and-sealants

Gasoline Dispensing Facilities

This category uses a 2015 CARB methodology to estimate emissions from fuel transfer and storage operations at gasoline dispensing facilities (GDFs). The methodology addresses emissions from underground storage tanks, vapor displacement during vehicle refueling, customer spillage, and hose permeation. The updated methodology uses emission factors developed by CARB staff that reflect more current in-use test data and also accounts for the emission reduction benefits of onboard refueling vapor recovery (ORVR) systems. The emission estimates are based on 2012 statewide gasoline sales data from the California Board of Equalization that were apportioned to the county level using fuel consumption estimates from EMFAC 2014. Emissions were grown based on the EMFAC2017 version model.

Additional information on this category is available at:
https://ww2.arb.ca.gov/arb-petroleum-production-and-marketing-methodologies-petroleum-marketing

Gasoline Cargo Tank

This category uses a 2002 CARB methodology to estimate emissions from gasoline cargo tanks. These emissions do not include the emissions from loading and unloading of gasoline cargo tank product; they are included in the gasoline terminal inventory and gasoline service station inventory. Pressure-related fugitive emissions are volatile organic vapors leaking from three points: fittings, valves, and other connecting points in the vapor collection system on a cargo tank. 1997 total gasoline sales were obtained from the California Department of Transportation. The emission factors are derived from the data in the report, "Emissions from Gasoline Cargo Tanks, First Edition," published by the Air and Waste Management Association in 2002.

The initial emission estimates for 1997 were grown to 2012 using a growth parameter developed by Pechan based on gasoline and oil expenditures data. Emissions were grown to 2017 and beyond according to fuel consumption from CARB's EMFAC 2017 mobile sources emission factors model.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/arb-petroleum-production-and-marketing-methodologies-petroleum-marketing

Marine Petroleum Loading

These categories are used to inventory 1987 hydrocarbon emissions associated with loading crude oil, residual oil, gasoline, and jet fuel into marine tankers and gasoline into barges. Emissions result from the displacement of vapors existing in the tank before loading and those generated as new product is loaded.

The amounts of crude oil, gasoline, jet fuel, and residual oil shipped off from California ports were obtained from a United States Army Corps of Engineers report "Waterborne Commerce of the United States, Calendar Year 1986" Part 4.

The emission factor for crude oil loading into tankers was obtained from the report "Hydrocarbon Emissions During Marine Loading of Crude Oils" from Western Oil and Gas Association (1977). The gasoline emission factors for loading into tankers and barges and jet fuel into tankers were obtained from CARB's "Report to the Legislature on Air Pollutant Emissions from Marine Vessels" (1984). The emission factor for residual oil loading into tankers was obtained from the "Inventory of Emissions from Marine Operations within California Coastal Waters, Preliminary Draft" report by Scott Environmental Technology, Inc. (1980). No growth was assumed for these emissions.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/arb-petroleum-production-and-marketing-methodologies-petroleum-marketing

Marine Petroleum Unloading

These categories are used to estimate hydrocarbon emissions associated with lightering crude oil and ballasting marine vessels after unloading crude oil or gasoline.

The amounts of crude oil and gasoline unloaded at California ports were obtained from the United States Army Corps of Engineers report "Waterborne Commerce of the United States, Calendar Year 1986" Part 4.

Crude oil lightering data was obtained from the Bay Area AQMD for 1987. Crude oil and gasoline ballasting data for San Luis Obispo for 1987 was obtained from the Army Corps of Engineers. The volume of water used for ballasting following a cargo discharge was obtained from CARB's "Report to the Legislature on Air Pollutant Emissions from Marine Vessels" (1984).

The crude oil lightering emission factor was obtained from "Hydrocarbon Emissions During Marine Loading of Crude Oils," Western Oil and Gas Association (1977).

Ballasting crude oil and gasoline vessels emission factors were obtained from "Inventory of Emissions from Marine Operations within the California Coastal waters," by Scott Environmental Technology, Inc. (1981). No growth is assumed for this category.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/arb-petroleum-production-and-marketing-methodologies-petroleum-marketing

Oil and Gas Production

The oil and natural gas production inventory is estimated by a 2015 CARB methodology. This category is related to fugitive emissions from production-related fuel consumption, fugitive losses (sumps, pits, pumps, compressors, well heads, separators, valves, and fittings), vapor recovery and flares, tank and truck working and breathing losses, wastewater treatment, tertiary production, and wet and dry gas stripping. Emissions were calculated using U.S. EPA's Oil and Natural Gas Tool v1.4 with default emissions factors from ENVIRON Int'l Corp's 2012 report, "2011 Oil and Gas Emission Inventory Enhancement Project for CenSARA States," and activity data taken from California's Division of Oil, Gas, and Geothermal Resources (DOGGR) (which was renamed to Geologic Energy Management Division (CalGEM) in 2020). CARB also incorporated data from the 2007 Oil and Gas Industry Survey (e.g., typical component counts) and feedback from individual air districts (e.g., minimum controls required to operate in a certain district, with associated control factors) to improve these parameters and further adjust the tool's output. Emissions were grown to 2017 based on CalGEM historical statewide production. Growth in future years an assumed 2.9% annual decline, which reflects the statewide CalGEM trend from 2000 through 2016.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/resources/documents/oil-and-gas-industry-survey
https://ww3.arb.ca.gov/ei/areasrc/oilandgaseifinalreport.pdf

B.4.4 Area-Wide Sources

Area-wide sources include categories where emissions take place over a wide geographic area, such as consumer products. Emissions from these sources are estimated using various models and methodologies. Estimation methods include source testing, direct measurement by continuous emissions monitoring systems, or engineering calculations. Emissions for these categories are estimated by both CARB and the District.

The District's methodologies are available at:
http://www.valleyair.org/Air_Quality_Plans/EmissionsMethods/EmissionsMethods.htm

Estimates for the categories below were developed by CARB and have been reviewed by CARB staff to reflect the most up-to-date information:

Consumer Products and Aerosol Coatings

The Consumer Product emission estimates utilized sales and formulation data from the CARB's mandatory survey of all consumer products sold in California for calendar years 2013 through 2015 (2015 Consumer Product Survey). The aerosol coatings estimates utilized sales and formulation data from a survey conducted by CARB in 2010. Based on the survey data, CARB staff determined the total product sales and total VOC emissions for the various product categories. Growth for personal care products are based on real disposable personal income projections per REMI version 2.4.5. No growth is assumed for aerosol coatings. Growth for all other consumer products are based on DOF population projections, 2020.

Additional information on CARB's consumer products surveys is available at:
https://ww2.arb.ca.gov/our-work/programs/consumer-products-program/consumer-commercial-product-surveys

The methodology is available at:
Solvent Evaporation Methodologies - Aerosol Coatings and Consumer Products | California Air Resources Board

Architectural Coatings

Architectural coatings are coatings applied to stationary structures and their accessories. They include house paints, stains, industrial maintenance coatings, traffic coatings, and many other products. Industrial maintenance coatings are high performance architectural coatings formulated for application to substrates, including floors, exposed to extreme environmental conditions (e.g., immersion in water, chronic exposure to corrosive agents, frequent exposure to temperatures above 121°C, repeated heavy abrasion). The architectural coatings category reflects emission estimates based on a 2014 comprehensive CARB survey for the 2013 calendar year. The emission estimates include benefits of the 2007 CARB Suggested Control Measures. These emissions are grown based on DOF households forecast, 2020.

Additional information about CARB's architectural coatings program is available at: https://ww2.arb.ca.gov/carb-solvent-evaporation-methodologies-architectural-coatings-and-cleaningthinning-solvents

Pesticides

The California Department of Pesticide Regulation (DPR) develops month-specific emission estimates for agricultural and structural pesticides. Each calendar year, DPR updates the inventory based on the Pesticides Use Report, which provides updated information from 1990 through the 2020 calendar year. Agricultural pesticide emission forecasts for years 2021 and beyond are based on the average of the most recent five years. Growth for agricultural pesticides is based on CARB projections of farmland acres per FMMP, 2016. Growth for structural pesticides is based on DOF households growth projections, 2020.

Additional information about CARB's pesticides program is available at: https://ww2.arb.ca.gov/carb-solvent-evaporation-methodologies-agricultural-and-non-agricultural-pesticides

Residential Wood Combustion

Emissions were estimated for 2012 using a 2015 District methodology. The methodology is based on CARB's 2011 methodology, with several refinements based on a 2014 District survey. The inventory reflects the regional distribution and use of wood burning devices, refined fuel usage rates for several types of devices, and emissions reductions from the District's Burn Cleaner Program. The emissions estimates reflect emission factors from U.S. EPA's 2002 National Emission Inventory (NEI). CARB assumes no growth for this category based on the relatively stagnant residential wood fuel use over the past decade (according to the American Community Survey and US Energy Information Administration).

Additional information on CARB's 2011 methodology is available at: https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

Residential Natural Gas Combustion

CARB staff updated the methodology to reflect 2017 fuel use from the California Energy Consumption Database. The emissions estimates reflect the most recent emissions factors from U.S. EPA's AP-42 for residential natural gas combustion. Growth is based on California Energy Commission (CEC) projections for natural gas consumption, 2019.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

Residential Distillate Oil and Liquefied Petroleum Gas

The residential distillate oil/liquefied petroleum gas (LPG) category includes emissions occurring in the residential sector. Distillate oil for heating is generally used in older homes and remote areas where natural gas lines are not available.

Activity is based on the number of housing units, population, and LPG and distillate oil capacities. The 1991 Fuels Report Working Paper published by the CEC was used to determine energy demand by fuel type in terms of the number of houses heated by a specific fuel in a particular area. Heating degree days (HDD) are used to estimate how many heating days are likely to occur in a particular area.

This category uses emission factors from U.S. EPA's AP-42. The emissions were initially calculated in 1993 then grown to 2012 using housing unit data from the DOF, 2013. Emissions were grown from 2012 to 2017 using a ‘no growth’ profile developed by Pechan (2012). Emissions post-2017 were grown based on EIA – SEDS, and no growth was assumed.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

Farming Operations

Tilling and Harvesting:
Emissions for Agricultural Land Preparation Operations and Agricultural Harvest Operations were updated based on 2012 harvested crop acreage from the USDA’s National Agricultural Statistics Service (NASS). NASS data are based on reports compiled by County Agricultural Commissioner staff. Emission estimates for both categories are based on CARB methodologies and reflect crop and operation specific emission factors. Temporal profiles were updated based on crop specific activity profiles. Activity profiles for land preparation operations were developed by CARB, based on monthly harvesting activity for 20 representative crops. Temporal profiles for harvesting operations were developed by the District, based on monthly harvesting activity for 46 representative crops. The District expanded the number of crop profiles to more completely characterize distinctions among groups of crops.

Activity profiles for harvesting were developed by the District and reflect refinements to Harvesting Growth is based on farmland acres per FMMP farmland acreage which results in a slight annual decline. The inventory also reflects the emission reductions from District Rule 4550.

Livestock:
CARB staff updated the non-cattle Livestock Husbandry methodology to reflect livestock population data based on the USDA's 2017 Census of Agriculture. Cattle emissions are primarily based on the 2012 Census of Agriculture. A seasonal adjustment was added to account for the suppression of dust emissions in months in which rainfall occurs. Growth profiles are based on CARB's projections of Census of Agriculture's historical livestock population trends, 2012. No growth is assumed for dairy and feedlots.

Additional information on CARB's methodology for farming operations is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-farming-operations

Construction and Demolition

Emission estimates for building construction and road construction operations are based on CARB methodologies. Emissions are estimated by applying emission factors developed by Midwest Research Institute (MRI) to the acreage disturbed by construction.

For building construction, the emission estimates in 2017 were grown from CARB estimates developed in 2002. The growth profile for building construction is based on construction jobs projections from the REMI county economic forecast model.

For road construction, the 2017 emissions were updated based on the average of lane miles constructed between 2005 and 2019 based on the 2019 FTIP data provided by the SJV transportation planning agencies (TPAs). The growth profile for road construction is based on the future planned construction from the 2019 FTIP.

The inventory reflects emission reductions from District Regulation VIII. Additional information on these methodologies is available at:
https://www.arb.ca.gov/ei/areasrc/arbmiscprocconstdem.htm

Paved Road Dust

Paved road dust emissions for 2017 were estimated in 2021 using a CARB methodology consistent with the current U.S. EPA method (AP-42). Data from CARB's EMFAC2017 model, the District, and the Valley MPOs were used to estimate region specific vehicle miles traveled (VMT). VMT were distributed using 2017 travel fractions calculated using California Department of Transportation (Caltrans) Highway Performance Monitoring System (HPMS) data, by COADBIS, for each of five road types: freeway, major, collector, and local/local urban, and local rural. Emissions were grown using MPO VMT projections.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-paved-road-dust

Unpaved Road Dust – Farm Roads

Emissions for unpaved farm roads are based on CARB's methodology and 2012 harvested crop acreage from NASS. Emissions reflect crop specific VMT rates and an emission factor based on California test data conducted by the University of California, Davis (UC Davis), and the Desert Research Institute (DRI). Temporal profiles are based on crop specific activity profiles. Growth for this category is based on projected FMMP farmland acreage, 2016.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/fullpdf/full7-11_2016.pdfe

Unpaved Nonfarm Road Dust

Emissions from unpaved nonfarm roads were estimated from 2008 unpaved road data collected from the California Statewide Local Streets and Roads Needs Assessment, Caltrans, and local agencies. Dust emissions were calculated using an emission factor derived from tests conducted by UC Davis and DRI. In addition, a rainfall adjustment factor was applied. CARB staff assumed no growth for this category based on the assumption that existing unpaved roads tend to get paved as vehicle traffic on them increases, which counteracts any additional emissions from new unpaved roads.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/fullpdf/full7-10_2012.pdf

Fugitive Windblown Dust from Agriculture Lands (Non-Pasture) and Pasture Lands

Fugitive windblown dust emissions were estimated using CARB's 1997 methodology. The methodology is based on 1993 harvested crop acreage and a wind erosion equation that incorporates climate, soil, and vegetative cover attributes. Emissions for agricultural lands were grown based on projections of acreage from FMMP Acreage, 2016. Emissions for pasture lands were grown from FMMP Grazing, 2016.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/onehtm/one7-12.htm

Windblown Dust from Unpaved Roads and Associated Areas

Emissions for this source category were estimated based on a 1997 CARB methodology reflecting unpaved road mileage and local parameters that affect wind erosion. The estimates assume no growth.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/onehtm/one7-13.htm

Fires

Emissions from structural and automobile fires were estimated based on a 1999 CARB methodology using the number of fires and the associated emission factors. Estimates for structural fires are calculated using the amount of the structure that is burned, the amount and content of the material burned, and emission factors derived from test data. Estimates for automobile fires are calculated using the weight of the car and components and composite emission factors derived from AP-42 emission factors. Structural fire growth is based on DOF households forecasts, 2020, and automobile fire growth is based on DOF population forecasts, 2020.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-fires

Managed Burning & Disposal – Forest Management

Forest Management Managed Burning and Disposal category provides emission estimates from prescribed burning performed in natural vegetation types such as forests and woodlands.

Burn project perimeters and ignition dates are provided by the 2019 California Department of Forestry and Fire Protection (FRAP) geodatabase. Forest management prescribed burning emissions are estimated using the First Order Fire Effects Model (FOFEM 6.7) and a custom geoprocessing tool (Emission Estimation System, EES) developed for CARB by researchers at UC Berkeley. Future year estimates are based on a 10-year average, held flat in the forecast.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/district-miscellaneous-process-methodologies-managed-burning-and-disposal

Managed Burning & Disposal – Range Improvement

The Range Improvement Managed Burning and Disposal category provides emission estimates from prescribed burning performed in natural vegetation types (principally grasslands) for the purpose of forage or habitat improvement. Burn project parameters and ignition dates are provided by the 2019 California Department of Forestry and Fire Protection (FRAP) geodatabase. Range Improvement prescribed burning emissions are estimated using the First Order Fire Effects Model (FOFEM 6.7) and a custom geoprocessing tool (Emission Estimation System, EES) developed for CARB by researchers at UC Berkeley. Future year estimates are based on a 10-year average, held flat in the forecast.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/district-miscellaneous-process-methodologies-managed-burning-and-disposal

B.4.5 Natural Sources

Biogenic Vegetation (ROG) and Soil (NOx)

Biogenic emissions were generated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN3.0) biogenics emissions model (https://bai.ess.uci.edu/megan). MEGAN3.0 incorporates a new pre-processor (MEGAN-EFP) for estimating biogenic emission factors based on available landcover and emissions data. The MEGAN3.0 default datasets for plant growth form, eco-type, and emissions were utilized. Leaf Area Index (LAI) for non-urban grid cells was based on the 8-day 500 m resolution Moderate Resolution Imaging Spectroradiometer (MODIS) Terra/Aqua combined product (MCD15A2H) for 2017 (https://earthdata.nasa.gov/). The LAI data was converted to LAIv, which represents the LAI for the vegetated fraction within each grid cell, by dividing the gridded MODIS LAI values by the Maximum Green Vegetation Fraction for each grid cell (https://archive.usgs.gov/archive/sites/landcover.usgs.gov/green_veg.html). The MODIS LAI product does not provide information on LAI in urban regions, so urban LAIv was estimated from the US Forest Service's Forest Inventory and Analysis urban tree plot data, processed through the i-Tree v6 software (*https://www.itreetools.org/tools/i-tree-eco*). Hourly meteorology for MEGAN was provided by the 4 km WRF simulation described above, and all stress factor adjustments were turned off.

MEGAN implemented the parameterized scheme Yiener-Levy (YL95) to estimate soil NOx (Yienger et al., 1995). Main features include separate exponential temperature dependence for wet soils and linear dependence for dry soils. An optimal temperature above which flux becomes temperature independent, scalar adjustments to account for both "pulsing" and canopy reduction, synoptic-scale temperature and precipitation forcing, an explicit linear dependence of emission on fertilizer rate.

References:

Guenther, A. B., X. Jiang, C. L. Heald, T. Sakulyanontvittaya, T. Duhl, L. K. Emmons, and X. Wang (2012). The Model of Emissions of Gases and Aerosols from Nature version 2.1 (MEGAN2.1): an extended and updated framework for modeling biogenic emissions, *Geosci. Model Dev.*, *5*(6), 1471-1492.

Guenther, A., Huang, L., Shah, T., Wentland, A., Jung, J., Beardsley, R., Johnson, J., Hsieh, W., Kemball-cook, S., and Yarwood, G. (2017). A Next Generation Modeling System for Estimating Texas Biogenic VOC Emissions. (AQRP Project 16-011).

Yienger, J. and Levy, H.: Empirical model of global soil-biogenic NOx emissions, J. Geophys. Res.-Atmos., 100, 11447–11464, 1995.

Wildfires

The wildfires category provides emission estimates from wildfires that occurred in natural vegetation types such as forests, woodlands, shrublands and grasslands.

Wildfire perimeters and ignition dates are provided by the 2019 California Department of Forestry and Fire Protection (FRAP) geodatabase. Wildfire emissions are estimated using the First Order Fire Effects Model (FOFEM 6.7) and a custom geoprocessing tool (Emission Estimation System, EES) developed for CARB by researchers at UC Berkeley. Future year estimates are based on a 10-year average, held flat in the forecast.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-natural-non-anthropogenic-source-methodologies-wildfires

B.4.6 Point and Areawide Source Emissions Forecasting

Emission forecasts (2018 and subsequent years) are based on growth profiles that in many cases incorporate historical trends up to the base year or beyond. The growth surrogates used to forecast the emissions from these categories are presented below in Table B-6. The emissions inventory also reflects emission reductions from point and areawide sources subject to District rules and CARB regulations. The rules and regulations reflected in the inventory are listed below in Table B-7.

Table B-6 Growth Surrogates for Point and Areawide Sources

Source Category	Subcategory	Growth Surrogate
Electric Utilities	Natural Gas	California Energy Commission (CEC) Integrated Energy Policy Report forecast, 2019
	Other Fuels	Energy Information Administration (EIA) Annual Energy Outlook, 2019
Cogeneration	All	CEC forecast, 2019
Oil and Gas Production (Combustion)	All	CalGEM statewide total oil production. Assumed 2.9% annual decline reflecting CalGEM historical trend, 2000 through 2016
Petroleum Refining (Combustion)	All	No growth assumption
Manufacturing and Industrial	Natural Gas	CEC forecast, 2019
	Other Fuels	EIA forecast, 2018
Food and Agricultural Processing	Ag Irrigation I. C. Engines	FMMP irrigated farmland acreage, 2008
	Natural Gas	CEC forecast, 2019
	Others	REMI economic forecast, version 2.4.5; EIA forecast, 2018
Service and Commercial	Natural Gas	CEC forecast, 2019
	Other Fuels	EIA forecast, 2018
Other (Fuel Combustion)	Diesel	Modeled estimate, 2003
	Other than diesel	EIA forecast, 2018
Waste Disposal	All	DOF population forecast, 2020
Laundering	Dry Cleaning	DOF population forecast, 2020
Degreasing	All	CARB/REMI economic forecast, version 2.4.5
Coatings & Thinners	Auto Refinishing	Vehicles from CARB EMFAC2017 model
	Others	REMI economic forecast, version 2.4.5
Printing	All	REMI economic forecast, version 2.4.5
Adhesives & Sealants	All	REMI economic forecast, version 2.4.5
Oil and Gas Production	All	Assumed 2.9% annual decline reflecting CalGEM historical trend, 2000 through 2016
Petroleum Refining	All	No growth assumption
Petroleum Marketing	Natural Gas Transmission	CEC forecast, 2019
	Gas Dispensing Facilities and Cargo Tanks	Fuel use from CARB EMFAC2017 model

Source Category	Subcategory	Growth Surrogate
	Other Point Sources	REMI economic forecast, version 2.4.5
Chemical	All	REMI economic forecast, version 2.4.5
Food & Agriculture	All	REMI economic forecast, version 2.4.5
Mineral Processes	All	REMI version 2.4.5; EIA forecast, 2018
Metal Processes	All	REMI economic forecast, version 2.4.5
Glass and Related Products	Container Glass, Other Glass	No growth assumption
	Flat Glass	Modeled estimate, 2012
Other Industrial Processes	All	REMI economic forecast, version 2.4.5
Consumer Products	Personal Care Products	Real Disposable Personal Income per REMI, version 2.4.5
	Other Consumer Products	DOF population forecast, 2020
	Aerosol Coatings	No growth
Architectural Coatings & Related Process Solvents	All	DOF households forecast, 2020
Pesticides & Fertilizers	Agricultural Pesticides	CARB projection of farmland acres per FMMP, 2016
	Structural Pesticides	DOF households forecast, 2020
Asphalt Paving & Roofing	All	DOF construction jobs forecast, 2020; CARB projection
Residential Fuel Combustion	Natural Gas	CEC forecast, 2019
	Other Fuels	EIA – SEDS – No growth
Farming Operations	Tilling and Harvesting	CARB projection of farmland acres per FMMP, 2016
	Dairy / Feedlots	No growth
	Other Livestock	CARB projection of livestock population per Census of Agriculture, 2012
Construction and Demolition	Building Construction	MI economic forecast, version 2.4.5
	Road Construction	MPOs / 2019 FTIP Planned Lane Miles

Source Category	Subcategory	Growth Surrogate
Paved Road Dust	All	MPO VMT projections, 2019
Unpaved Road Dust	City and County Roads, U.S. Forest, B.L.M	No Growth
	Farm Roads	FMMP Acreage, 2016
Fugitive Windblown Dust	Agricultural Lands (Non-Pasture	FMMP Acreage, 2016 FMMP Grazing, 2016
Fires	Structural	DOF households forecast, 2020
	Automobile	DOF population forecast, 2020
Managed Burning and Disposal	Agricultural Burning, Pruning & Field Crops	FMMP farmland acreage projection, 2016
	Non-Agricultural Open Burning	Rural counties: DOF population forecast, 2020. Urban counties: no growth.
	Unspecified Waste Burning	DOF population forecast, 2020
	Forest Management and Range Improvement	10-year average, held flat
	Others	No growth
Cooking	All	DOF population forecast, 2020
Natural Sources:	Biogenics Vegetation	Held flat in the projection
	Soil NOx	Held flat in the projection. Soil NOx is being presented as a line item in the plan
	Wildfires	10-year average, held flat

Table B-7 District and CARB Control Rules and Regulations Included in the Inventory for Stationary Sources

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
SJU_APCD	4103	Open Burning	Agricultural burning
SJU_APCD	4305	Boilers, Process Heaters, and Steam Generators - Phase 2	Fuel combustion / Boilers, Process Heaters, and Steam Generators
SJU_APCD	4306	Boilers, Process Heaters, and Steam Generators - Phase 3	Fuel combustion / Boilers, Process Heaters, and Steam Generators
SJU_APCD	4307	Boilers, Process Heaters, and Steam Generators - 2.0 MMBTU/HR to 5.0 MMBTU/HR	Fuel combustion / Boilers, Process Heaters, and Steam Generators
SJU_APCD	4308	Boilers, Process Heaters, and Steam Generators - 0.075 MMBTU/HR to Less Than 2.0 MMBTU/HR	Fuel combustion / Boilers, Process Heaters, and Steam Generators
SJU_APCD	4309	Dryers, Dehydrators, and Ovens	Industrial processes - dryers, dehydrators and ovens
SJU_APCD	4311	Flares	Oil and gas production- Vapor Recovery
SJU_APCD	4351	Boilers, Process Heaters, and Steam Generators - Phase 1	Fuel combustion / Boilers, Process Heaters, and Steam Generators
SJU_APCD	4352	Solid Fuel Fired Boilers, Steam Generators and Process Heaters	Fuel combustion / Boilers, Process Heaters, and Steam Generators
SJU_APCD	4354	Glass Melting Furnaces	Glass manufacturing
SJU_APCD	4401	Steam-Enhanced Crude Oil Production Wells	Oil and gas production - vapor recovery
SJU_APCD	4402	Crude Oil Production Sumps	Oil and gas production - fugitive losses
SJU_APCD	4408	Glycol Dehydration Systems	Oil and gas production - dehydrators
SJU_APCD	4409	Components at Light Crude Oil Production Facilities, Natural Gas Production Facilities, and Natural Gas Processing Facilities	Oil and gas production - fugitive losses
SJU_APCD	4455	Components at Petroleum Refineries, Gas Liquids Processing Facilities, and Chemical Plants	Petroleum refining - fugitive losses

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
SJU_APCD	4550	Conservation Management Practices	Tilling and Harvesting, Unpaved Road Dust, and Fugitive Windblown Dust
SJU_APCD	4565	Biosolids, Animal Manure, and Poultry Litter Operations	Composting operations
SJU_APCD	4566	Organic Material Composting Operations	Composting operations
SJU_APCD	4570	Confined Animal Facilities	Livestock operations
SJU_APCD	4601	Architectural Coatings	Architectural coatings and related process solvents
SJU_APCD	4602	Motor Vehicle and Mobile Equipment Coating Operations	Coatings and related process solvents - auto refinishing
SJU_APCD	4603	Surface Coating of Metal Parts and Products, Plastic Parts and Products, and Pleasure Crafts	Coatings and related process solvents - metal parts and products coatings
SJU_APCD	4604	Can and Coil Coating Operations	Coatings and related process solvents - can and coil coatings
SJU_APCD	4605	Aerospace Assembly and Component Coating Operations	Coatings and related process solvents - aerospace assembly and component coatings
SJU_APCD	4606	Wood Coating Operations	Coatings and related process solvents - wood coatings operations
SJU_APCD	4607	Graphic Arts and Paper, Film, Foil and Fabric Coatings	Printing, coatings and related process solvents
SJU_APCD	4610	Glass Coating Operations	Coatings and related process solvents - glass coating operations
SJU_APCD	4612	Automotive Coatings	Coatings and related process solvents - auto refinishing
SJU_APCD	4621	Gasoline Transfer into Stationary Storage Containers, Delivery Vessels, and Bulk Plants	Petroleum marketing - gasoline transfer
SJU_APCD	4622	Gas Transfer into Vehicle Storage Fuel Tanks	Petroleum marketing - vehicle refueling
SJU_APCD	4623	Storage of Organic Liquids	Petroleum refining; petroleum marketing, oil and gas production - organic liquid storage

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
SJU_APCD	4624	Organic Liquid Loading	Petroleum marketing - organic liquid loading
SJU_APCD	4625	Wastewater Separators	Petroleum refining - waste water treatment
SJU_APCD	4641	Cutback, Slow Cure, and Emulsified Asphalt Paving and Maintenance Operations	Asphalt paving or roofing
SJU_APCD	4642	Solid Waste Disposal Sites	Landfills; waste disposal
SJU_APCD	4651	Volatile Organic Compound Emissions from Decontaminated Soil	Waste disposal / Soil remediation
SJU_APCD	4653	Adhesives and Sealants	Adhesives & sealants
SJU_APCD	4661	Organic Solvents	Coatings and related process solvents; cleaning and surface coatings
SJU_APCD	4662	Organic Solvent Degreasing Operations	Degreasing
SJU_APCD	4663	Organic Solvent Cleaning, Storage and Disposal	Degreasing; cleaning & surface coating
SJU_APCD	4672	Petroleum Solvent Dry Cleaners	Laundering
SJU_APCD	4681	Rubber Tire Manufacturing	Rubber and rubber products manufacturing
SJU_APCD	4682	Polystyrene, Polyethylene, and Polypropylene Products Manufacturing	Plastic and plastic products manufacturing
SJU_APCD	4684	Polyester Resin Operations	Fiberglass and fiberglass products manufacturing
SJU_APCD	4691	Vegetable Oil Processing Operations	Food and agriculture
SJU_APCD	4692	Commercial Charbroiling	Cooking
SJU_APCD	4693	Bakery Ovens	Bakeries
SJU_APCD	4701	Internal Combustion Engines (Phase 1)	Fuel combustion - internal combustion engines
SJU_APCD	4702	Internal Combustion Engines (Phase 2)	Fuel combustion - internal combustion engines
SJU_APCD	4703	Stationary Gas Turbines	Fuel combustion - stationary gas turbines
SJU_APCD	4901	Wood Burning Fireplaces and Wood Burning Heaters	Residential wood combustion
SJU_APCD	4902	Residual Water Heaters	Residential fuel combustion

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
SJU_APCD	4905	Natural Gas-Fired, Fan-Type Central Furnaces	Service and Commercial / Residential Fuel Combustion - Space Heating
SJU_APCD	REG8	Regulation VIII PM controls	Fugitive Dust
CARB	ARB_R003 & ARB_R003_A	Consumer Product Regulations & Amendments	Consumer products
CARB	ARB_R007	Aerosol Coating Regulations	Aerosol coatings
CARB	GDF_HOSREG	Gasoline Dispensing Facility Hose Emission Regulation	Petroleum marketing - gasoline dispensing facility hoses
CARB	ORVR	Fueling emissions from ORVR vehicles	Petroleum marketing - fueling emissions from ORVR vehicles
CARB	AG_IC_ENG	AG IC Engine Emission Scalars	Agricultural IC Engines
CARB	NONAGICENG	Non-Ag IC Engine Emission Scalars	Non-agricultural IC Engines

B.4.7 External Adjustments

External adjustments were made in CEPAM to account for military growth and other unaccounted regulatory factors. The external adjustments reflected in the CEPAM 2022 PM2.5 Plans v1.00 inventory are listed below in Table B-8.

Table B-8 External Adjustment IDs and Descriptions

Adjustment ID	Adjustment Description
HD_I/M	Heavy-Duty Inspection and Maintenance (HD I/M) Regulation adopted by CARB, Dec 2021
ACC_II	Advanced Clean Cars (ACC II) Regulation adopted by CARB, Nov 2022
LEMOORE	External adjustments for NAS Lemoore
NonAg_ICE	Non-ag internal combustion engines adjustment to reflect 2003 ATCM and 2010 rule amendment
SJV_Const	SJV Construction and Mining Equipment -- Recession/Recovery Adjustment (period 2011-2019)

B.5 CONDENSABLE PARTICULATE MATTER

B.5.1 Background

Condensable particulate matter (PM) is material that is vapor phase at stack conditions, but which condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid PM immediately after discharge from the stack. Condensable PM is a component of primary PM, which is the sum of condensable and filterable PM. Filterable PM comprises particles that are directly emitted by a source as a solid or liquid [aerosol] at stack or release conditions. All condensable PM is assumed to be smaller than 2.5 microns (μm) in diameter.

The AERR requires states to report annual emissions of filterable and condensable components of PM2.5 and PM10, "as applicable," for large sources every inventory year and for all sources every third inventory year, beginning with 2011.[10] Subsequent emissions inventory guidance[11] from the U.S. EPA clarifies the meaning of the phrase "as applicable" by providing a list of source types for which condensable PM is expected by the AERR. These source types are stationary point and nonpoint combustion sources that are expected to generate condensable PM and include, for instance, commercial cooking, fuel combustion at electric generating utilities, industrial processes like cement or chemical manufacturing, and flares or incinerators associated with waste disposal. The condensable PM from stationary and areawide sources in this inventory is calculated using the methodology outlined below. Condensable PM is not required to be calculated for mobile sources.

B.5.2 Methodology

For the current inventory, the District has collected data on primary PM only, containing both filterable and condensable components without distinguishing between the two. Consequently, to be able to report emissions of the condensable component of PM2.5 separately as required by the AERR, primary PM2.5 is augmented to condensable PM using recommended fractions from U.S. EPA, which are published within their Emissions Inventory System (EIS) Gateway[12]. Because these factors are assigned to Source Classification Codes (SCC), CARB Emission Inventory Codes (EICs) are crosswalked to SCC codes. These factors are then directly applied (multiplied) to primary PM2.5 to calculate condensable PM.

[10] 40 CFR §51.15(a)(1) and §51.30(b)(1)
[11] U.S. EPA. Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. May 2017. https://www.epa.gov/sites/production/files/2017-07/documents/ei_guidance_may_2017_final_rev.pdf
[12] EIS Gateway downloaded on 08/20.2022. https://www.epa.gov/air-emissions-inventories/emissions-inventory-system-eis-gateway

Appendix C
DISTRICT CONTROL MEASURE EVALUATIONS

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OVERVIEW

The San Joaquin Valley (Valley) faces significant challenges in meeting federal air quality standards (also called National Ambient Air Quality Standards, or NAAQS) for fine particulate matter (PM2.5) and ozone. The San Joaquin Valley Air Pollution Control District (District) has demonstrated leadership in developing and implementing groundbreaking regulatory strategies to reduce emissions. Tough and innovative rules, such as those for indirect source review, residential wood burning, glass manufacturing, and agricultural burning, have set benchmarks for California and the nation.

Over the years, the District's numerous air quality plans (State Implementation Plans, or SIPs) have been a primary vehicle for improving air quality in the Valley. Each plan builds upon the work of prior plans while establishing the path for continued air quality improvements. Consistent with this planning continuity, the District's control measure evaluation in this section is built upon analyses under the District's prior attainment plans, including but not limited to the *2007 Ozone Plan,*[1] *2008 PM2.5 Plan,*[2] *2012 PM2.5 Plan,*[3] *2013 Plan for the Revoked 1-Hour Ozone Standard,*[4] *2015 Plan for the 1997 PM2.5 Standard,*[5] *2016 Plan for the 2008 8-Hour Ozone Standard* (*2016 Ozone Plan*),[6] *2016 Moderate Area Plan for the 2012 PM2.5 Standard* (*2016 PM2.5 Plan*),[7] *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (*2018 PM2.5 Plan*),[8] and the *2022 Plan for the 2015 8-Hour Ozone Standard* (*2022 Ozone Plan*).[9]

This section reflects the comprehensive evaluation performed by the District to examine emissions sources in the Valley to ensure that the best available control measures (BACM) and most stringent measures (MSM) for directly emitted PM2.5 and all significant PM2.5 precursors are implemented as required for Serious PM2.5 nonattainment areas requesting an attainment date extension under Part D, Subpart 4 of the Clean Air Act (CAA).

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[1] SJVAPCD. *2007 Ozone Plan*. (April 30, 2007). Retrieved from: http://www.valleyair.org/air_quality_plans/docs/AQ_Ozone_2007_Adopted/2007_8HourOzone_CompletePlan.pdf
[2] SJVAPCD. *2008 PM2.5 Plan*. (April 30, 2008). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/AQ_Final_Adopted_PM25_2008.htm
[3] SJVAPCD. *2012 PM2.5 Plan*. (December 20, 2012). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/PM25Plan2012/CompletedPlanbookmarked.pdf
[4] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard*. (September 19, 2013). Retrieved from: https://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf
[5] SJVAPCD. *2015 Plan for the 1997 PM2.5 Standard*. (April 16, 2015). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm
[6] SJVAPCD. *2016 Ozone Plan for 2008 8-Hour Ozone Standard*. (June 16, 2016). Retrieved from: http://valleyair.org/Air_Quality_Plans/Ozone-Plan-2016/Adopted-Plan.pdf
[7] SJVAPCD. *2016 Moderate Area Plan for the 2012 PM2.5 Standard*. (September 15, 2016). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/docs/PM25-2016/2016-Plan.pdf
[8] SJVAPCD. *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards*. (November 15, 2018). Retrieved from: https://www.valleyair.org/pmplans/documents/2018/pm-plan-adopted/2018-Plan-for-the-1997-2006-and-2012-PM2.5-Standards.pdf
[9] SJVAPCD. *2022 Plan for the 2015 8-Hour Ozone Standard*. (December 15, 2022). Retrieved from: https://ww2.valleyair.org/media/q55posm0/0000-2022-plan-for-the-2015-8-hour-ozone-standard.pdf

This section consists of a literature review and evaluation of emission reduction opportunities for stationary and area source categories. District staff in multiple departments with expertise in these various sectors contributed to this effort. The evaluations in this section are intended to capture relevant background information, examine emission reduction opportunities for technological and economic feasibility, make recommendations for appropriate District actions moving forward, solicit public input during the Plan development process, and demonstrate compliance with CAA control strategy requirements for PM2.5 nonattainment areas.

Clean Air Act Requirements

With respect to Plan requirements for Serious nonattainment areas, the CAA requires provisions for the implementation of BACM under Section 189(b)(1)(B), and MSM for Serious non-attainment areas seeking an extension under section 188(e). The guidelines for demonstrating compliance with these requirements are provided in the U.S. Environmental Protection Agency's (EPA) 2016 PM2.5 Implementation Rule.[10] Pursuant to the implementation rule, EPA requires the implementation of BACM no later than 4 years after the date an area is reclassified to Serious, and implementation of MSM as expeditious as practicable but no later than 1 year prior to the alternate Serious area attainment date. Thus, the District is required to implement BACM and MSM by 2025 and 2029, respectively.

Demonstration of BACM

The District and CARB developed the *Initial SIP Requirements for the 2012 Annual PM2.5 Standard* to address initial elements required by the CAA for Serious nonattainment areas, including a demonstration that BACM requirements continue to be satisfied in the Valley. These elements were adopted by the District Governing Board on October 19, 2023, and subsequently submitted to EPA through CARB. This Plan also contains the necessary supporting information to demonstrate compliance with requirements for BACM.

Demonstration of MSM

EPA interprets the term MSM to mean "*the maximum degree of emission reduction that has been required or achieved from a source or source category in any other attainment plans or in practice in any other states and that can feasibly be implemented in the area seeking the extension.*" This Plan contains the necessary supporting information to demonstrate compliance with requirements for MSM, including the following:

[10] EPA. *Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements; Final Rule*. 81 Fed. Reg. 164, pp. 58010-58162. (August 24, 2016). (Codified at 40 CFR Parts 50, 51, and 93). Retrieved from: https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

- ✓ A list of all emissions source categories, sources and activities in the nonattainment area that emit direct PM2.5 or any PM2.5 precursor (Appendix B)
- ✓ An analysis of all potential control measures achieved in practice or identified as potential MSM in other regions, as obtained from:
  - A comprehensive review of other air district plans and regulations;
  - A review of the RACT/BACT/LAER Clearinghouse;
  - A review of measures included in EPA's Menu of Control Measures document
- ✓ An analysis of measures rejected as BACM/BACT in previous District attainment plans to see if they were feasible for implementation given the longer time before the attainment date
- ✓ Evaluation of measures already implemented in the Valley to see if an increase in coverage of the measure would increase emission reductions from the source category
- ✓ A reasoned justification for any potential MSM which was found to be technologically or economically infeasible for implementation in the Valley by 2029

This appendix demonstrates all prohibitory stationary source measures currently in place meet or exceed MSM. Measures that go beyond MSM which were found to be technologically and economically feasible for implementation in the Valley are proposed as commitments for this Plan in Chapter 4.

Significant Precursors

Pursuant to CAA §189(e), the sole explicit reference to the regulation of precursors in CAA Subpart 4, the control requirements applicable under plans addressing a PM2.5 NAAQS shall apply to major stationary sources of PM2.5 precursors, except where EPA determines that such sources do not contribute significantly to PM2.5 levels which exceed the standard in the area. As provided in Appendix F of this document, modeling demonstrates that volatile organic compounds (VOC), ammonia, and sulfur oxides (SOx) are not significant precursors for the formation of PM2.5 in the Valley. Therefore, CARB and the District have excluded controls for VOC, SOx, and ammonia from this evaluation.

Although the District is not required to evaluate sources of ammonia as stated above, the District and CARB conducted a full analysis of the potential control of ammonia sources. This analysis is included within the precursor demonstration in Appendix F.

EVALUATION METHODOLOGY

Each stationary and area source control measure evaluation in this appendix follows a thorough and consistent analysis methodology, modeled after EPA's guidance for MSM requirements as described in the section above. This methodology includes sections for the following discussions and analyses:

- Emissions inventory
- Rule description
- Regulatory evaluation of federal, state, and local regulations, including an assessment of MSM
- Summary of potential emission reduction opportunities identified and the associated analyses of such opportunities
- Summary of the evaluation findings

Although the District follows this methodology for each individual stationary and area source control measure evaluation, additional sections may be added as appropriate to provide a more complete summary of the analyses performed. The following is a more detailed description of the sections in the control measure analyses.

Emissions Inventory

Each control measure evaluation contains an emissions inventory table that identifies PM2.5 and NOx emissions for the respective source category. The emissions data in each table is provided as an annual average, as well as a wintertime average (November through April), which is the period in which PM2.5 concentrations in the Valley are the highest. The data provided in this section is a compilation of the data sources identified in the emissions inventory section. See Appendix B (Emissions Inventory) for additional information.

Rule Description

This section provides an overview of the rule, including rule applicability, types of sources subject to rule requirements, rule adoption/amendment history, and any other additional pertinent details, as relevant to the control measure evaluation.

How does the District Rule compare with federal and state rules and regulations?

As part of the regulatory evaluation, District rules and source categories are compared to federal and state air quality regulations and standards. The following regulations and guidelines are referenced in the comparisons:

Federal Regulations
Federal regulations include the following regulations and guidance documents:

- Control Techniques Guidelines (CTG)[11]
- Alternative Control Techniques (ACT)[12]
- New Source Performance Standards (NSPS)[13]

State Regulations
Generally, state regulations are specific to mobile sources and consumer products. However, there are some California Health and Safety Code (CH&SC) requirements and CARB Airborne Toxic Control Measures (ATCM)[14] that apply to stationary and area sources. While most of the rules evaluated in this Plan do not have a state regulation associated with their source category, any relevant state guidelines are evaluated within this section.

How does the District Rule compare to rules in other air districts?

The District compared every control measure to analogous regulations adopted by California's most progressive air districts. Investigation of control strategies and measures in other air districts and agencies includes, but is not limited to, the following air districts:

- Bay Area Air Quality Management District (BAAQMD)[15]
- South Coast Air Quality Management District (SCAQMD)[16]
- Sacramento Metropolitan Air Quality Management District (SMAQMD)[17]
- Ventura County Air Pollution Control District (VCAPCD)[18]

Local and regional agencies tailor their regulations, analysis, and innovation based on their unique situations. Therefore, regional regulations will differ in language and structure due to differences in local needs and priorities. Thus, comparing individual lines of regulatory text from a range of jurisdictions out of context does not establish MSM on its own. Instead, the District carefully reviews differences between rules with focus on what the regulation as a whole accomplishes while acknowledging differences in regional situations.[19] All potential measures were thoroughly evaluated using the key

[11] EPA. Control Techniques Guidelines. Retrieved from: http://www.epa.gov/groundlevelozone/SIPToolkit/ctgs.html
[12] EPA. Alternative Control Techniques. Retrieved from: http://www.epa.gov/groundlevelozone/SIPToolkit/ctgs.html
[13] EPA. 40 CFR 60 – Standards of Performance for New Stationary Sources (NSPS). Retrieved from: http://www.tceq.state.tx.us/permitting/air/rules/federal/60/60hmpg.html
[14] CARB. Airborne Toxic Control Measures (ATCMs). Retrieved from: http://www.arb.ca.gov/toxics/atcm/atcm.htm
[15] Bay Area Air Quality Management District (BAAQMD). Rules and Regulations. Retrieved from: http://www.baaqmd.gov/Divisions/Planning-and-Research/Rules-and-Regulations.aspx
[16] South Coast Air Quality Management District (SCAQMD). Rules and Regulations. Retrieved from: http://www.aqmd.gov/home/regulations/rules/scaqmd-rule-book/table-of-contents
[17] Sacramento Metropolitan Air Quality Management District (SMAQMD). Rules and Regulations. Retrieved from: http://www.airquality.org/rules/
[18] Ventura County Air Pollution Control District (VCAPCD). Rules and Regulation. Retrieved from: http://www.vcapcd.org/Rulebook/RuleIndex.htm
[19] Similarly, when EPA acts on control measure analysis, EPA considers a rule "as a whole." See, e.g., EPA's Technical Support Document, *EPA Evaluation of BACM/MSM for the San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS* at page 5, supporting final BACM/MSM approval available at 85 FR 44192.

factors identified in EPA's 2016 Implementation Rule[20] to determine if potential opportunities qualify as MSM for the Valley.

Potential Emission Reduction Opportunities

The District reviewed the following areas to identify any additional potential measures:

- Any emission reduction opportunities identified/considered in previously adopted District plans that were determined to be infeasible at that time.
- New emission reduction opportunities adopted in California SIPs, SIPs in other states, or achieved in practice in other areas.

All potential MSM identified were then thoroughly evaluated for technological and economic feasibility:

- **Technological feasibility** – The technological feasibility analysis determines if a potential opportunity to reduce emissions is viable for existing facilities and operators in the Valley, given their current operating needs and restrictions. This analysis includes a literature review of District permits; environmental and technological studies; EPA and CARB guideline documents; and other air districts' rules, regulations, and guidelines, to identify potential opportunities and determine the technological feasibility of any identified potential opportunities.
- **Economic feasibility** – To determine economic feasibility, the District conducts a cost effectiveness analysis to evaluate the economic reasonableness of an air pollution control measure or technology as it applies to entities/residents in the Valley. A cost effectiveness analysis examines the added cost, in dollars per year, of the control technology or technique, divided by the emissions reductions achieved, in tons per year (tpy).

The District reviewed staff reports and studies from other air districts, EPA technical guidance documents, and applicable study data from the scientific community to assist in evaluating the technological and economic feasibility of potential MSM.

Evaluation Findings

This section completes the control measure evaluation and provides a summary of the District's findings based on the control measure evaluation.

[20] EPA. *Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements; Final Rule*. 81 Fed. Reg. 164, pp. 58010-58162. (August 24, 2016). (Codified at 40 CFR Parts 50, 51, and 93). Retrieved from: https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

SUMMARY OF CONTROL MEASURES

The District's stringent regulations already adopted under previous attainment plans also serve as control measures for this Plan. These adopted regulations reduce directly emitted PM2.5 and NOx and contribute to the Valley's progress toward attainment of PM2.5 standards as they are fully implemented. Each control measure evaluated within this appendix and the District's resulting conclusion is summarized in Table C-1 below.

Table C-1 District Control Measures Evaluated for MSM

District Rule		Date Adopted or Last Amended	Conclusion
4103	Open Burning	6/17/2021	MSM
4104	Reduction of Animal Matter	12/17/1992	MSM
4106	Prescribed Burning and Hazard Reduction Burning	6/21/2001	MSM
4203	Particulate Matter Emissions from Incineration of Combustible Refuse	12/17/1992	MSM
4204	Cotton Gins	2/17/2005	MSM
4301	Fuel Burning Equipment	12/17/1992	MSM
4306/ 4320	Boilers, Steam Generators, and Process Heaters, >5 MMBtu/hr	12/17/2020	MSM
4307	Boilers, Steam Generators, and Process Heaters, 2-5 MMBtu/hr	4/21/2016	MSM
4308	Boilers, Steam Generators, and Process Heaters, 0.075-2 MMBtu/hr	11/14/2013	MSM
4309	Dryers, Dehydrators, and Ovens	12/15/2005	MSM
4311	Flares	12/17/2020	MSM
4313	Lime Kilns	3/27/2003	MSM
4352	Solid Fuel Fired Boilers, Steam Generators, and Process Heaters	12/16/2021	MSM
4354	Glass Melting Furnaces	12/16/2021	MSM
4550	Conservation Management Practices	8/19/2004	MSM
4692	Commercial Charbroiling	6/21/2018	MSM
4702	Internal Combustion Engines	8/19/2021	MSM
4703	Stationary Gas Turbines	9/20/2007	MSM
4901	Wood Burning Fireplaces and Wood Burning Heaters	5/18/2023	MSM
4902	Residential Water Heaters	3/19/2009	MSM
4905	Natural Gas-Fired, Fan-type Central Furnaces	12/16/2021	MSM
8011	General Requirements	8/19/2004	MSM
8021	Construction, Demolition Excavation, Extraction, and Other Earthmoving Activities	8/19/2004	MSM
8031	Bulk Materials	8/19/2004	MSM
8041	Carryout and Trackout	8/19/2004	MSM
8051	Open Areas	8/19/2004	MSM
8061	Paved and Unpaved Roads	8/19/2004	MSM
8071	Unpaved Vehicle/Equipment Traffic Areas	9/16/2004	MSM
8081	Agricultural Sources	9/16/2004	MSM

C.1 RULE 4103 (OPEN BURNING)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	9.20	9.14	9.05	1.79	1.78	1.77	1.77
NOx	6.55	6.51	6.44	1.48	1.47	1.46	1.46
	Winter Average - Tons per day						
PM2.5	12.47	12.38	12.25	2.45	2.43	2.42	2.42
NOx	8.84	8.78	8.69	2.00	1.99	1.98	1.97

District Rule 4103 Description

Historically, agricultural materials such as prunings and orchard removals have been disposed of through burning to prevent the spread of plant diseases and to control weeds and pests in an economical and timely manner. The District first adopted Rule 4103 (Open Burning) on June 18, 1992, to regulate and coordinate the use of open burning while minimizing smoke impacts on the public. The District has since amended and increased the stringency of Rule 4103 seven times. In 2003, California Senate Bill (SB) 705 (Florez, 2003), codified in CH&SC §§41855.5 and 41855.6, established a schedule to phase out the open burning of agricultural material, including consideration of technical and economic factors in implementing the phase-out. The District incorporated the phase-out requirements of SB 705 into Rule 4103.

Phase-Out of Agricultural Burning

The San Joaquin Valley is the only region in California and the nation with stringent requirements to phase out agricultural open burning. Through the implementation of state law under SB 705, the District has adopted prohibitions that have significantly reduced open burning, supported by continued efforts to identify and demonstrate new alternatives to reduce open burning. As the most recent activity in this ongoing effort, the District, in collaboration with CARB, adopted a final phase-out strategy in 2021 for remaining agricultural burning by the end of 2024.[21] This strategy is supported by significant new incentive funding to help offset the high cost associated with new alternatives to burning, with enhanced focus on smaller growing operations.

Since adoption of the District's final phase-out strategy, the Valley has seen a tremendous reduction in open burning through the adoption of new practices. In 2023, the reductions in agricultural open burning and use of alternatives reached record levels for the Valley since the institution of agricultural burning restrictions. Additional

[21] SJVAPCD. *Final Supplemental Report and Recommendations on Agricultural Burning.* (June 17, 2021). Retrieved from: https://ww2.valleyair.org/media/aldmsd0b/final-supplemental-report-and-recommendations-on-agricultural-burning.pdf

requirements for smaller growers implemented at the end of 2023 will continue to provide further reductions in open burning prior to the phase-out by the end of 2024.

Alternatives to Open Agricultural Burning Incentive Program

To support the Valley's ongoing phase-out of agricultural open burning, in 2018, the District's Governing Board authorized the creation of the Ag Burn Alternatives Grant Program.[22] This program provides financial incentives to commercial agricultural operations located within the District boundaries to utilize an alternative practice for the disposition of agricultural material from orchard and vineyard removals as an alternative to open burning. Alternative measures include, but are not limited to, soil incorporation of chipped material, on-site land application on agricultural land, off-site beneficial re-use (mulch, composting, land application near roadways for dust suppression, and other District approved beneficial re-use of the chipped material). Since 2018, the District Governing Board has allocated over $65,000,000 in local and State funding to this program.

On August 19, 2021, the District accepted $178,200,000 in additional state funding to be used in the District's Ag Burn Alternatives Grant Program.[23] This funding is the result of significant advocacy from the District and Valley agricultural stakeholders and is designated to assist the District in developing new alternative practices, increase fleet capacity for chipping in the Valley, and offset the significant incremental cost of implementing new alternatives to open burning.

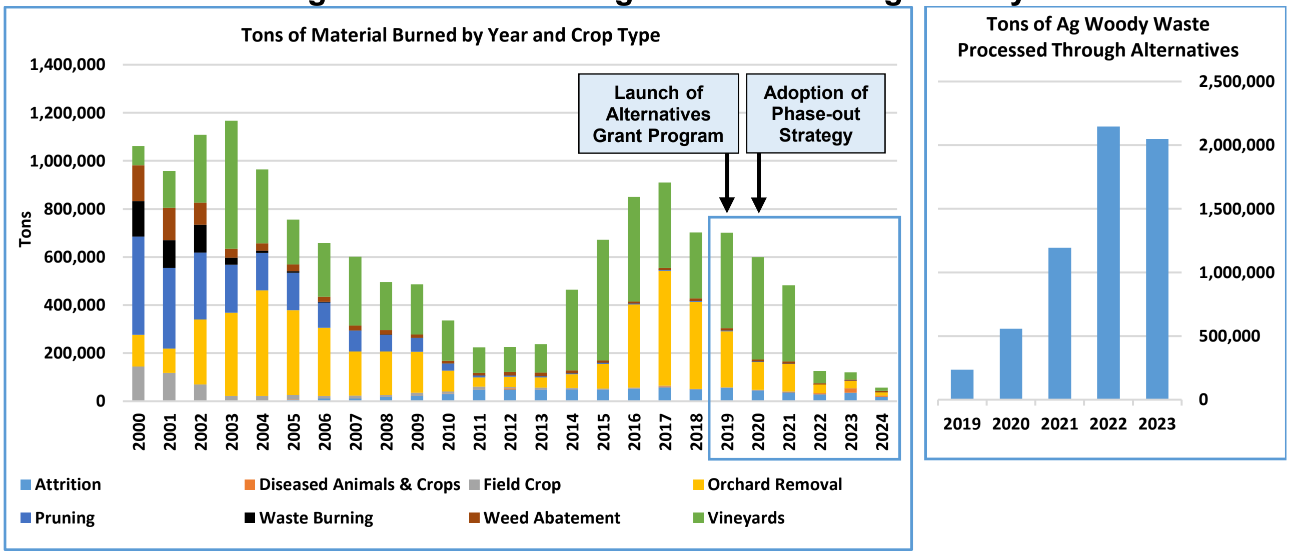
The District's agricultural open burning phase-out strategy, along with the Ag Burn Alternatives Grant Program are working effectively to reduce emissions from agricultural open burning. New alternatives to open burning have emerged and are being implemented and Valley growers are utilizing the incentive program at a high rate. As a result, the current funding expenditure rate continues to increase. The initial allocation of State funding was expected to last until the end of 2024, however, it was exhausted approximately 11 months ahead of schedule. The early exhaustion of funds resulted in the District allocating additional local and state funds to the program.

Overall, the program has resulted in the deployment of alternative practices at over 251,500 acres, for over 6,800,000 tons of agricultural materials, resulting in the reduction of 13,299 tons of NOx, 24,705 tons of PM and 21,013 tons of reactive organic gas (ROG) emissions.

[22] District Ag Burn Alternatives Grant Program. Retrieved from: https://ww2.valleyair.org/grants/ag-burn-alternatives-grant-program/

[23] SJVAPCD. *Accept and Appropriate $178,200,000 in State Funding and Approve Enhancements to Alternatives to Agricultural Open Burning Incentive Program*. (August 19, 2021). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2021/August/final/10.pdf

Figure C-1 Trend of Agricultural Burning Activity



Smoke Management System

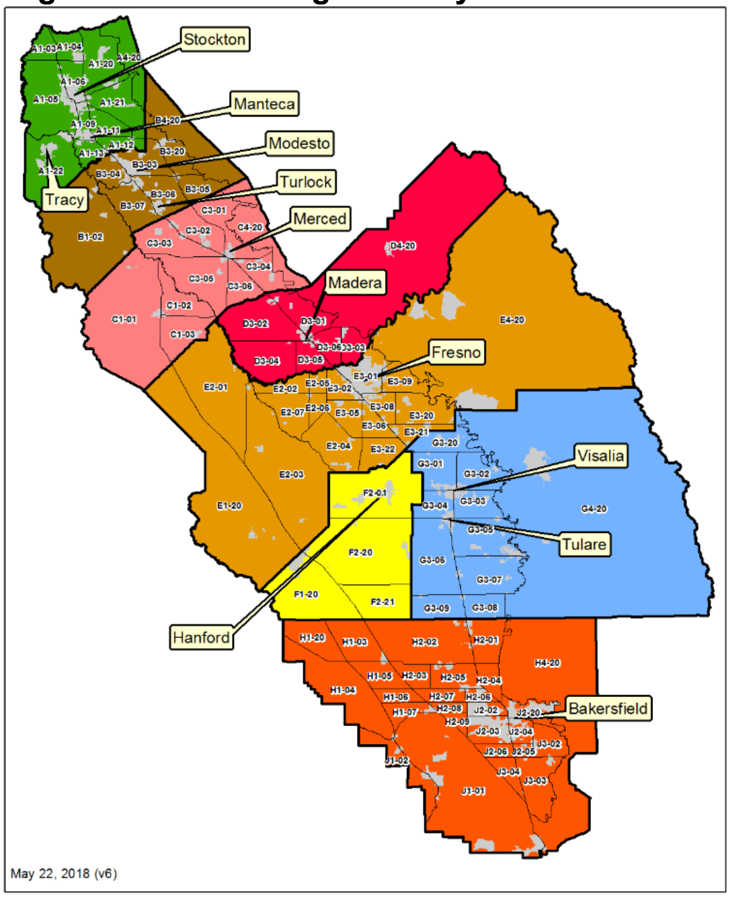
To implement SB 705 and enhance the effectiveness of the District's burn reduction efforts, in 2004, the District established the Smoke Management System (SMS), which the District uses to authorize or prohibit individual burns based on modeled smoke impacts.

Individuals requesting authorization to burn is required to complete the proper application to report the acreage, type of material, location, and date of the burn. The District uses SMS to calculate emissions by multiplying the tons of fuel burned by a crop-specific emission factor. SMS uses real-time meteorological information to analyze the impact of burning on air quality and appropriately limit burn allocations by area. The District only authorizes burns of allowable materials when the SMS emissions analysis indicates that the burn will not cause or contribute to exceedances of federal air quality standards, cause a public nuisance, or impact nearby smoke-sensitive areas. The District enforces these requirements through permits, project inspections, proactive surveillance, and complaint response.

Each year, open burning windows narrow due to unprecedented wildfires and stagnant winters with little precipitation. Open burning is strictly prohibited from November through February each year if there is an episodic residential wood burning curtailment under District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters). These Rule 4901 curtailments are becoming increasingly frequent, with the majority of winter days now declared as No Burn days for residential wood burning, resulting in fewer agricultural open burn days each winter.

The District's SMS program divides the Valley into 97 allocation zones (see Figure C-2 below) based on a number of criteria, such as crop distribution throughout the Valley, historical burning activities, nearby sensitive receptors, and known geographic boundaries. The amount of burning allowed in a given zone on a specific day is based on factors such as the local meteorology, air quality conditions, atmospheric holding capacity, amount of burning already approved or happening in a given area, and potential impacts on downwind populations.

Figure C-2 Figure Smoke Management System Burn Allocation Zones



How does District Rule 4103 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

State Regulations

- *CH&SC §§41850-41866 (Agricultural Burning)*
- *17 California Code of Regulations (CCR) §§80100-80330 (Smoke Management Guidelines for Agricultural and Prescribed Burning)*

The District implements the above state regulation requirements through Rule 4103. In 2003, SB 705, incorporated into CH&SC §§41855.5 and 41855.6, required the District to regulate the burning of diseased crops, establish best management practices (BMP) for the maintenance and control of weeds, and phase out the open burning for numerous crop categories. SB 705 established a schedule for specific types of agricultural material to no longer be burned in the field, but provided for a postponement of the phase-out where justified by technical and economic impediments. In addition to the requirements of CH&SC §41855.5, state law requires the District to postpone the burn prohibition dates for specific types of agricultural material if the District makes three specific determinations and CARB concurs.[24] The determinations are: (1) there are no economically feasible alternatives to open burning for that type of material; (2) open burning for that type of material will not cause or substantially contribute to a violation of an air quality standard; and (3) there is no long-term federal or state funding commitment for the continued operation of biomass facilities in the Valley or the development of alternatives to burning.

The District has complied with state requirements in preparing five reports on agricultural burning activities in the Valley since 2010. These reports have evaluated every crop category for feasible alternatives to open burning and provided recommendations for allowing or prohibiting the open burning of each crop category as outlined by SB 705. The most recent *Supplemental Report* established an updated schedule for the near-complete phase-out of remaining agricultural open burning in the Valley by January 1, 2025.

How does District Rule 4103 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4103 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 5 (Amended November 20, 2019)[25]
- Sacramento Metropolitan AQMD Rule 501 (Amended April 3, 1997)[26]
- South Coast AQMD Rule 444 (Amended July 12, 2013)[27]
- Ventura County APCD Rule 56 (Amended November 11, 2003)[28]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4103 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rule is demonstrated below.

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[24] CH&SC §41855.6
[25] BAAQMD. *Regulation 5 (Open Burning).* (Amended November 25, 2019). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/regulation-5/documents/20191120_r0500_final-pdf.pdf?la=en&rev=51124978dd4b4e598ba56bfe2a1c23df
[26] SMAQMD. *Rule 501 (Agricultural Burning).* (Amended April 3, 1997). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule501.pdf
[27] SCAQMD. *Rule 444 (Open Burning).* (Amended July 12, 2013). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-444.pdf?sfvrsn=4
[28] VCAPCD. *Rule 56 (Open Burning).* (Amended November 11, 2003). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2056.pdf

Bay Area AQMD

- BAAQMD Regulation 5 (Open Burning)

<table>
<tr><th></th><th>SJVAPCD Rule 4103</th><th>BAAQMD Reg 5</th></tr>
<tr><td>Applicability</td><td>Open burning, with the exception of prescribed burning and hazard reduction burning (regulated under Rule 4106).</td><td>Open burning.</td></tr>
<tr><td>Exemption</td><td>Fires used for cooking, campfires, and religious fires where the fuel is clean, dry wood, or charcoal
Emergency burning by a fire agency, the respectful burning of an unserviceable American flag, bags used for agricultural chemicals, and raisin trays
Specific exemptions and provisions for burning contraband and emergency agricultural burns that would cause economic loss if denied</td><td>Fires set only for cooking of food for human beings
Fires burning as safety flares or for the combustion of waste gases
Use of flame cultivation when the burning is performed with liquefied petroleum gas (LPG) or natural gas (NG) fired burners designed and used to kill seedling grass and weeds and the growth is such that the combustion will not continue without the burner
Fires set for the purposes of fire training using one gallon or less of flammable liquid per fire
Further requirements for conditional exemptions (similar to SJV)</td></tr>
<tr><td>Requirements</td><td>No burning of garbage or other materials. Burning shall be allocated by the APCO dependent on dispersion conditions and shall avoid negative impacts to receptors.

No permit shall be issued for the burning of the following categories of agricultural waste, except under specific conditions in Rule, and approved by the District Governing Board and CARB:
Field Crops
Prunings
Weed Abatement, except for categories covered by Best Management Practices in Rule
Orchard Removals
Vineyard Removal Materials
Surface Harvested Prunings
Other Materials
Additional requirements for burning times, drying times, contraband burning. Permit required for the burning of Russian Thistle, and a conditional burning permit required for diseased materials with specific requirements, burn plans required for fire suppression training, burning of contraband, BMP selection required for weed maintenance.</td><td>No specific crop phase-outs or bans.

Recreational fires allowed on non-curtailment days.

On permissive burn days the following fires are allowed with permission from the APCO (specific requirements for each category): disease and pest, crop replacement, orchard pruning and attrition, double cropping stubble, stubble, hazardous materials (hazard reduction burning), fire training, flood debris, irrigation ditches, flood control, range management, forest management, marsh management, contraband, filmmaking, and public exhibition.</td></tr>
</table>

BAAQMD Regulation 5 was last amended on November 20, 2019 to reduce potential cost barriers associated with prescribed burning in alignment with statewide efforts to prevent larger, more destructive wildfires through increased prescribed burning. Specifically, the amendments include exemptions for public agencies from paying Open Burning Fees when conducting prescribed burns for the purpose of wildfire prevention. The District evaluated the requirements contained within BAAQMD's Regulation 5 and found no requirements that were more stringent than those already in Rule 4103. District Rule 4103 is as stringent as or more stringent than BAAQMD Regulation 5.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District performed an extensive review of the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future. As demonstrated above, in adherence with applicable state laws instituted under SB 705, the Valley has the toughest restrictions on agricultural burning in the state. The District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

The District's robust agricultural burning rule and efforts to phase out agricultural burning to date, further made more stringent with the recent action to phase out of agricultural burning by January 1, 2025, support that the District's rule is the most stringent in the nation. Rule 4103 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.2 RULE 4104 (REDUCTION OF ANIMAL MATTER)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.01	0.01	0.01	0.01	0.01	0.01	0.01
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.01	0.01	0.01	0.01	0.01	0.01	0.01
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

District Rule 4104 Description

Adopted in 1992, District Rule 4104 limits the air contaminants from operations used for the reduction of animal matter by requiring gases, vapors, and gas-entrained effluent from the process to be incinerated at temperatures not less than 1,200 degrees Fahrenheit or processed in an equally effective manner. The reduction of animal matter source category includes rendering, cooking, drying, dehydration, digesting, evaporating, and protein concentration processes.

The criteria pollutant emissions from this category are relatively small. The primary cause of concern from this source category is odor, which rule requirements minimize with the use of a venturi scrubber, cyclone, or packed bed scrubber for PM control, followed by a thermal oxidizer for VOC control. These facilities generally use steam from a boiler (indirect-fired) or rotary dryer (direct-fired) for their operations, which generate NOx emissions. The emissions from these combustion units are controlled by and accounted for in other District rules.

How does District Rule 4104 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4104 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4104 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 12, Rule 2 (Adoption Date N/A)[29]
- Monterey Bay ARD Rule 414 (Amended August 21, 2002)[30]
- Sacramento Metropolitan AQMD Rule 410 (Amended August 3, 1977)[31]
- San Diego County APCD Rule 64 (Amended August 21, 1981)[32]
- South Coast AQMD Rules 472 (Adopted May 7, 1976)[33]
- Ventura County APCD Rule 58 (Amended May 23, 1972)[34]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4104 continues to implement requirements as stringent as or more stringent than these other areas.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District performed an extensive review of the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

PM2.5 Emission Control Technologies

Packed Bed Scrubbers

The District evaluated the potential opportunity to reduce emissions if facilities were to replace their thermal oxidizers with packed bed scrubbers. In certain installations, packed bed scrubbers may be more efficient at removing PM from the exhaust, and additionally do not generate NOx or SOx emissions. However, retrofitting an existing facility by replacing an existing thermal oxidizer with a packed bed scrubber system may take some design and experimentation on the part of the facility to ensure it does not cause an increase in nuisance and odors or effect the operation. The retrofit costs associated with the capture and control using a packed bed scrubber would be significant. Additionally, operators would need to replace the filter media used in the

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[29] BAAQMD. *Regulation 12, Rule 2 (Rendering Plants).* (Adoption Date N/A, Approved by EPA 1981). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-12-rule-2-rendering-plants/documents/rg1202.pdf?la=en&rev=bdc8a980e3174c4b8b2f483142394f1e

[30] MBARD. *Rule 414 (Reduction of Animal Matter).* (Amended August 21, 2002). Retrieved from: https://ww2.arb.ca.gov/sites/default/files/classic/technology-clearinghouse/rules/RuleID1646.pdf

[31] SMAQMD. *Rule 410 (Reduction of Animal Matter).* (Amended August 3, 1977). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule410.pdf

[32] SDAPCD. *Rule 64 (Reduction of Animal Matter).* (Amended August 21, 1981). Retrieved from: https://www.sdapcd.org/content/dam/sdapcd/documents/rules/current-rules/Rule-64.pdf

[33] SCAQMD. *Rule 472 (Reduction of Animal Matter).* (Adopted May 7, 1976). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-472.pdf?sfvrsn=4

[34] VCAPCD. *Rule 58 (Reduction of Animal Matter).* (Amended May 23, 1972). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2058.pdf

scrubber periodically, adding to the cost of upkeep. Existing thermal oxidizer installations do not present similar issues. In addition, facilities subject to Rule 4104 produce only a very small amount of directly emitted PM2.5 and are otherwise already required to have a high level of control for emissions, as shown in the emissions inventory table at the beginning of this section.

Zero-Emission Opportunities

The District evaluated all available opportunities for reducing emissions from this source category and did not identify any available zero-emission technologies or any instances of zero-emission requirements for these operations. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

The District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

Rule 4104 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.3 RULE 4106 (PRESCRIBED BURNING AND HAZARD REDUCTION BURNING)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	4.01	6.95	4.17	4.17	4.17	4.18	4.18
NOx	0.35	0.65	0.32	0.33	0.33	0.33	0.33
	Winter Average - Tons per day						
PM2.5	3.37	8.73	2.61	2.61	2.62	2.62	2.62
NOx	0.30	0.83	0.25	0.25	0.25	0.26	0.26

District Rule 4106 Description

District Rule 4106, adopted in June 2001, is applicable to range improvement burning, forest management burning, wildland vegetation management burning, and hazard reduction burning within the Valley. Prescribed burning generally includes forest waste, fire hazard reduction, rangeland management, wildlife habitat improvement, and ecosystem (forest health) burning. The adoption of Rule 4106 incorporated provisions made necessary by the March 23, 2000 amendment of Title 17 of the California Code of Regulations. EPA approved Rule 4106 into the SIP in February 2002.[35]

Recognizing the importance of both prescribed burning and hazard reduction burning, the purpose of Rule 4106 is to permit, regulate, and coordinate the use of prescribed burning and hazard reduction burning while minimizing smoke impacts on the public. Through this rule, the District has expended considerable resources to ensure that the ignition of burn projects are only permitted when air quality and dispersion conditions are favorable, thus lessening health impacts on Valley citizens and on air quality in the Valley.

How does District Rule 4106 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Technique Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

[35] EPA. *Revisions to the California State Implementation Plan, San Joaquin Valley Unified Air Pollution Control District*. 67 FR 8894-8897. (Codified at 40 CFR Part 52). (February 27, 2002). Retrieved from: https://www.federalregister.gov/articles/2002/02/27/02-4526/revisions-to-the-california-state-implementation-plan-san-joaquin-valley-unified-air-pollution

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4106 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4106 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 5 (Amended November 20, 2019)[36]
- Placer County APCD Rule 301 (Amended August 9, 2018)[37]
- Placer County APCD Rule 303 (Amended February 9, 2012)[38]
- Sacramento Metropolitan AQMD Rule 501 (Amended April 3, 1997)[39]
- South Coast AQMD Rule 444 (Amended July 12, 2013)[40]
- Ventura County APCD Rule 56 (Amended November 11, 2003)[41]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4106 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

Bay Area AQMD
- BAAQMD Regulation 5 (Open Burning)

	SJVAPCD Rule 4106	BAAQMD Regulation 5
Applicability	All prescribed burning, and hazard reduction burning in wildland/urban interface.	Open burning.
Exemptions	None.	• Fires set only for cooking of food for human beings • Fires burning as safety flares or for the combustion of waste gases • Use of flame cultivation when the burning is performed with LPG or NG-fired burners designed and used to kill seedling grass and weeds and the

36 BAAQMD. *Regulation 5 (Open Burning).* (Amended November 20, 2019). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/regulation-5/documents/20191120_r0500_final-pdf.pdf?la=en&rev=51124978dd4b4e598ba56bfe2a1c23df
37 PCAPCD. *Rule 301 (Nonagricultural Burning Smoke Management).* (Amended August 9, 2018). Retrieved from: https://placerair.org/DocumentCenter/View/2221/Rule-301-PDF
38 PCAPCD. *Rule 303 (Prescribed Burning Smoke Management).* (Amended February 9, 2012). Retrieved from: https://placerair.org/DocumentCenter/View/2223/Rule-303-PDF
39 SMAQMD. *Rule 501 (Agricultural Burning).* (Amended April 3, 1997). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule501.pdf
40 SCAQMD. *Rule 444 (Open Burning).* (Amended July 12, 2013). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-444.pdf?sfvrsn=4
41 VCAPCD. *Rule 56 (Open Burning).* (Amended November 11, 2003). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2056.pdf

	SJVAPCD Rule 4106	BAAQMD Regulation 5
		growth is such that the combustion will not continue without the burner • Fire training using one gallon or less of flammable liquid per fire • Further requirements for conditional exemptions (similar to SJV)
Requirements	No burning of garbage or green waste. The District shall allocate burning based on the predicted meteorological conditions and whether the total tonnage to be emitted would allow the volume of smoke and other contaminants to impact smoke sensitive areas, or create or contribute to an exceedance of an ambient air quality standard. Specific requirements for minimizing smoke, using approved ignition devices, and having vegetation be free of dirt, soil, and moisture. **Prescribed Burning:** Prescribed burn conductors shall have taken a prescribed burning smoke management training class approved by the APCO. Additional prescribed burn requirements detailed by project size. **Hazard Reduction Burning:** No Hazard Reduction Burning shall take place without a permit. A permit shall be valid only on those days during which burning is not prohibited by CARB, the District, or other designated agencies. Further administrative requirements and Smoke Management Plan requirements are outlined by project size.	Recreational fires allowed on non-curtailment days; on permissive burn days the following fires are allowed with permission from the APCO (specific requirements for each category): disease and pest, crop replacement, orchard pruning and attrition, double cropping stubble, stubble, hazardous materials (hazard reduction burning), fire training, flood debris, irrigation ditches, flood control, range management, forest management, marsh management, contraband, filmmaking, and public exhibition.

The District evaluated the requirements contained within BAAQMD's Regulation 5 and concluded that District Rule 4106 is as stringent as or more stringent than BAAQMD Regulation 5.

Placer County APCD

- PCAPCD Rule 301 (Nonagricultural Burning Smoke Management)

	SJVAPCD Rule 4106	PCAPCD Rule 301
Applicability	All prescribed burning, and hazard reduction burning in wildland/urban interface.	All burning except where otherwise prohibited by a local jurisdiction.
Exemptions	None.	• Burning conducted pursuant to rules for: agricultural waste burning, prescribed burning, land development

	SJVAPCD Rule 4106	PCAPCD Rule 301
		burning, residential allowable burning, open burning of nonindustrial wood waste at designated disposal sites • Fire hazard or health hazard burning conducted under a Public Officer waiver • Recreational or cooking fire, provided not used for waste disposal purposes • Burning, in a respectful and dignified manner, of an unserviceable American flag that is no longer fit for display • Open burning conducted by Public Officers, if conducted under other rule requirements • Burning of standing green vegetation which is part of right-of-way clearing, levee, ditch, and reservoir maintenance • APCO may grant exemption to drying times requirements if denial of such burning would threaten imminent and substantial economic loss
Requirements	No burning of garbage or green waste. The District shall allocate burning based on the predicted meteorological conditions and whether the total tonnage to be emitted would allow the volume of smoke and other contaminants to impact smoke sensitive areas, or create or contribute to an exceedance of an ambient air quality standard. Specific requirements for minimizing smoke, using approved ignition devices, and having vegetation be free of dirt, soil, and moisture. **Prescribed Burning:** Prescribed burn conductors shall have taken a prescribed burning smoke management training class approved by the APCO. Additional prescribed burn requirements detailed by project size. **Hazard Reduction Burning:** No Hazard Reduction Burning shall take place without a permit. A permit shall be valid only on those days during which burning is not prohibited by CARB, the District, or other designated agencies. Further administrative requirements and Smoke Management Plan requirements are outlined by project size.	No person shall use an open outdoor fire (including the use of a burn barrel) for the purpose of disposal or burning of any disallowed combustibles. The only allowable combustibles is vegetation originating on the premises which is reasonably free of dirt, soil, and visible surface moisture. A person shall not ignite or allow open outdoor burning without first obtaining a valid burn permit for Fire Hazard Reduction, Mechanized Burner, Open Burning Conducted by Public Officers, Right of Way Clearing, Levee, Ditch and Reservoir Maintenance, subject to burn day validity requirements. Sources must comply with preparation and drying time requirements. Burns subject to ignition devices, wind, and other requirements. Other administrative and recordkeeping requirements.

The District evaluated the requirements contained within PCAPCD Rule 301 and found that District Rule 4106 is as stringent as or more stringent than PCAPCD Rule 301.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District reviewed the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

While there are many factors that need to be evaluated and addressed in the pursuit of minimizing fuel buildup, more effective use of prescribed burning is an area where the District has direct regulatory authority and can take action. The District has long been supportive of fuel reduction efforts including prescribed burns, advocating that reducing fuels in a responsible way will improve the health of the forests and improve future air quality by lessening the severity of wildfires. Despite these efforts, the forest fuel buildup has continued to increase at an alarming rate over the years due to decades of forest mismanagement, with fire danger being at an all-time high due to the recent catastrophic tree mortality from the drought and pest infestation. This long-term buildup of forest fuel poses a significant risk of large-scale wildfires with potential devastating impacts on air quality and public health. This has increased the need and urgency for greater forest fuel reductions. Based on direction received from the District's Governing Board in November 2015, and input from land management agencies, the District has become even more flexible when identifying permissive burn days for prescribed burning, which has assisted in a more rapid reduction of fuels. Additionally, in June 2019, the District's Governing Board authorized the District to enter into a Memorandum of Understanding (MOU) with the California Air Pollution Control Officers Association (CAPCOA) to participate in the new statewide Prescribed Burn Reporting and Monitoring Support Program in an effort to facilitate increased levels of prescribed burning across the state. These efforts have assisted in furthering the use of prescribed burning as a measure to prevent catastrophic wildfires while simultaneously minimizing health impacts for local residents.

Mechanical Removal of Forest Biomass

Given the catastrophic nature of wildfires, contradictory environmental concerns that preclude the use of mechanized equipment to dispose of fuel supplies need further examination. On one hand, there is concern that the transportation and operation of logging equipment can damage wildland ecosystems and impact endangered and threatened species, and that mechanical harvesting of vegetative fuel supplies could lead to overharvesting of the forests. On the other hand, if left unchecked, fuel buildup can lead to large wildfires that cause the destruction of the very species intended to be protected by policies such as those under the federal Wilderness Act, and in turn result in devastating public health impacts due to air pollution. The District will work with federal land managers and environmental stakeholders to ascertain the wildland areas where ecosystem and species impacts are of less concern, and support mechanical fuel reduction methods as appropriate.

The District analyzed the possibility of mechanical removal as an alternative to prescribed burning, but found that mechanical removal of forest biomass was infeasible as a required alternative to prescribed burning, due to the inaccessibility of mountain terrain and the extreme amount of forest acreage needing biomass management. However, the District will support the use of mechanical removal where feasible. Fire agencies are procuring and deploying chippers, portable saw mills, masticators and air curtain burners throughout the state, but primarily in the forested land surrounding the Valley. This process has been facilitated by emergency exemptions that have been invoked by CARB to waive the requirements for portable equipment and certain off-road equipment.

District Support of Forest-Specific Biomass Projects

The District will also explore other avenues to encourage and support forest-specific biomass projects, such as the North Fork Community Power project in Madera County. This 2 MW power plant will gasify hazard-reduction forest material, where the gas is then burned in an exhaust-controlled environment that produces very low levels of NOx. This project has been permitted and construction has commenced. The successful operation of this plant will be an important demonstration of gasification technology as a viable alternative to the open burning of forest debris. The operation of this project complements the Governor’s October 30, 2015, State of Emergency Proclamation that directs state agencies to implement a number of measures to accelerate the removal of fuel in the state’s forests, and which includes extending and expediting power purchase agreements with biomass facilities, seeking additional funding for biomass facilities to help offset higher feedstock costs, and exempting projects under the proclamation from California Environmental Quality Act requirements.

Due to the scale of acreage that requires management and due to access issues to remote forest areas, this is not a technologically feasible regulatory alternative to prescribed burning. However, the District will work to support forest-specific biomass projects in an effort to reduce transport emissions created from hauling forest biomass to the Valley floor for further processing.

Zero-Emission Opportunities

The District evaluated all available opportunities for reducing emissions from this source category and did not identify any available zero-emission technologies or any instances of zero-emission requirements for prescribed burning. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

The District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

Rule 4106 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.4 RULE 4203 (PARTICULATE MATTER EMISSIONS FROM INCINERATION OF COMBUSTIBLE REFUSE)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

District Rule 4203 Description

District Rule 4203 was originally adopted on May 21, 1992, and was subsequently amended on December 17, 1992. Rule 4203 limits the concentration of PM emissions based on process weight rates, and prohibits the discharge of visible emissions from the incineration of combustible refuse. The rule applies to any person, operation, or facility who uses an incinerator or other equipment to dispose of or process combustible refuse by incineration. The only Valley facility subject to this rule currently implements BACT level requirements, using a baghouse to control particulate emissions and lime slurry dry scrubber for the control of SO_2 and acid gas emissions.

How does District Rule 4203 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Technique Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4203 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4203 to comparable requirements in rules from the following California nonattainment areas:

- South Coast AQMD Rule 473 (Adopted May 7, 1976)[42]
- Ventura County APCD Rule 57 (Amended January 11, 2005)[43]

Bay Area AQMD and Sacramento Metropolitan AQMD do not have analogous rules for this source category.

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4203 continues to implement requirements as stringent as or more stringent than these other areas.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District reviewed the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

Zero-Emission Opportunities

The District evaluated all available opportunities for reducing emissions from this source category and did not identify any available zero-emission technologies or any instances of zero-emission requirements for these operations. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

The District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

Particularly since the emissions inventory for this source category is zero, Rule 4203 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

[42] SCAQMD. *Rule 473 (Disposal of Solid and Liquid Wastes).* (Adopted May 7, 1976). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-473.pdf?sfvrsn=4
[43] VCAPCD. *Rule 57 (Incinerators).* (Amended January 11, 2005). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2057.pdf

C.5 RULE 4204 (COTTON GINS)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.05	0.05	0.05	0.05	0.05	0.05	0.06
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.07	0.07	0.07	0.08	0.08	0.09	0.09
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

District Rule 4204 Description

Rule 4204 was adopted on February 17, 2005, as part of the District's strategy to reduce PM10 emissions and to attain the federal standards for the *2003 PM10 Plan*. Rule 4204 limits particulate matter emissions from cotton ginning operations. Cotton ginning is the process of separating the lint from the seed. Cotton gins have been operating within the Valley for decades and have become a highly efficient industry producing millions of bales of cotton. Modern ginning uses pneumatic conveyance, in the form of fans blowing air, which moves the cotton material throughout the ginning process. PM emissions are the unwanted byproducts of this efficient means of transferring massive quantities of cotton material from one process to the next process, such as from the unloading stage to drying and cleaning stages. Since cotton gins use large quantities of air for conveying, cyclones are used for air pollution abatement. PM emissions from cotton ginning facilities occur mostly during a three-month period from October to December.

While the principle function of the cotton gin is to separate lint from seed, the gin must also be able to remove foreign matter, moisture, and other contaminants that significantly reduce the value of the ginned lint. Currently, all cotton gins in the Valley are required to operate using high-efficiency 1D3D cyclones.

How does District Rule 4204 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Technique Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

State Regulations

No California state regulations have been identified that are applicable to cotton gins. However, the District has identified regulations in other states that have requirements applicable to cotton gins. These include the following regulations:

- New Mexico Administrative Code (NMAC) 20.2.66.1 (Adopted April 7, 2005)[44]
- North Carolina Administrative Code (NCAC) Title 15A, Subchapter 2D, Section .0542 (Readopted November 1, 2020)[45]
- South Carolina Department of Health and Environmental Control (SCDHEC), Regulation 61-62.5, Standard No. 4, Section V (Amended September 23, 2016)[46]
- Oklahoma Department of Environmental Quality (ODEQ), Air Pollution Control, 252:100-23 (Amended June 15, 2007)[47]
- Texas Commission on Environmental Quality (TCEQ), Air Quality Standard Permit for Cotton Gin Facilities and Cotton Burr Tub Grinders (Adopted April 7, 2010)[48]

North Carolina Administrative Code Title 15A, Subchapter 2D, Section .0542 (Control of Particulate Emissions from Cotton Ginning Operations)

	SJVAPCD Rule 4204	15A NCAC 02D .0542
Applicability	All cotton ginning facilities.	All existing, new, and modified cotton ginning operations.
Exemption	Cotton ginning facilities used for research purposes and limited to throughputs of not more than 4,000 pounds of seed cotton processed per day (equivalent to 4 bales/day at a trash-to-cotton ratio of 1-to-1).	Existing facilities with a maximum rated capacity <20 bales/hour that do not have cyclones on lint cleaners and battery condensers are not required to add emission control devices to lint cleaning exhausts and/or batter condenser exhausts if emissions from the lint cleaning and/or battery condenser are controlled by fine mesh screens.
Requirements	All emission points shall be controlled by 1D3D cyclones or rotary drum filters. New cyclones or replacement parts of existing 1D3D cyclones shall have the dimensional characteristics of the Enhanced 1D3D cyclone, or the 1D3D with a 2D2D inlet and an expansion chamber trash outlet.	Control all high pressure exhausts and lint cleaning exhausts with an emission control system that includes: • One or more 1D3D or 2D2D cyclones to achieve 95% efficiency; or • A device with at least a 95% efficiency.

[44] NMAC. *Administrative Code 20.2.66.1 (Cotton Gins).* (Adopted April 7, 2005). Retrieved from: https://www.srca.nm.gov/parts/title20/20.002.0066.html
[45] NCAC. *Administrative Code Title 15A, Subchapter 2D, Section .0542 (Control of Particulate Emissions from Cotton Ginning Operations).* (Readopted November 1, 2020). Retrieved from: https://deq.nc.gov/media/17395/download
[46] SCDHEC. *Regulation 61-62.5, Standard No. 4, Section V (Cotton Gins).* (Amended September 23, 2016). Retrieved from: https://scdhec.gov/sites/default/files/Library/Regulations/R.61-62.5_Std.4.pdf
[47] ODEQ. *Title 252, Chapter 100, Subchapter 23 (Control of Emissions from Cotton Gins).* (Amended June 15, 2007). Retrieved from: https://www.deq.ok.gov/wp-content/uploads/deqmainresources/100.pdf
[48] TCEQ. *Air Quality Standard Permit for Cotton Gin Facilities and Cotton Burr Tub Grinders.* (Adopted April 7, 2010). Retrieved from: https://www.tceq.texas.gov/assets/public/permitting/air/NewSourceReview/ag/cotton_sp_final.pdf

	SJVAPCD Rule 4204	15A NCAC 02D .0542
	Drive-under or pull-through trash collection system for load-out purposes shall not load trash into a hopper or trailer unless one or more the following are utilized: • The trash loading area has an enclosure with four sides that are higher than the trash auger; at least two sides shall be solid and the remaining sides shall: have a flexible wind barrier, which extends below the top of the trash trailer sides; or have solid doors that remain shut while trash trailers are being loaded, except as necessary to accommodate trailer movement; or have a combination of flexible wind barriers and solid doors. • A solid-sided trailer is used when there is no enclosure, and the trash auger and opening of the loading device have a flexible shroud that extends just below the top of the trailer's solid sides, or • Fugitive PM10 emissions from load-out areas are reduced by an alternative method, which is approved by the APCO and EPA. An owner/operator shall not operate a trash conveyance system dumping directly into a pile unless it meets the following requirements: • Both sides of the trash auger shall be equipped with wind barriers that extend, as measured vertically prior to trash pile build-up, one foot above and three feet below the auger or with an alternative control approved by the APCO and EPA. • After the pile has built up to the height of the trash auger, removing material from the pile shall be performed in such a way as to prevent free-falling trash from the stockpiling system. Dust management plans for facilities are subject to the requirements in District Rules 8011, 8021, 8031, 8041, 8051, 8061, 8071, and 8081.	Control all low pressure exhausts, except lint cleaning exhausts, with an emission control system that includes: • One or more 1D3D or 2D2D cyclones to achieve 90% efficiency; or • A device with at least a 90% efficiency. Minimize fugitive emissions by designing and maintaining trash systems, the gin yard, and the traffic area according to the guidelines in the regulation.

The NCAC regulation requires the use of 2D2D or 1D3D cyclones while District Rule 4204 requires 1D3D cyclones. District Rule 4204 also requires that new cyclones be Enhanced 1D3D cyclones with high control efficiency, which exceeds the standard 1D3D cyclone control efficiency. For cyclones controlling exhaust on high-pressure systems, the NCAC also specifies a 95% control efficiency. Texas A&M reports tested efficiencies of 97% for 1D3D cyclones and up to 99% for Enhanced 1D3D cyclones. Therefore, District Rule 4204 requiring the use of 1D3D cyclones on all systems, and also requiring that new cyclones be Enhanced 1D3D cyclones with PM control efficiency up to 99%, exceeds NCAC requirements for high-pressure systems with 95% PM control efficiency.

On low-pressure systems, the NCAC regulation requires the use of 2D2D or 1D3D cyclones and identifies a 90% PM control efficiency. As discussed above, District Rule 4204 requires the use of 1D3D cyclones or Enhanced 1D3D cyclones when installing new cyclones. As mentioned, Texas A&M reports tested efficiencies of 97% for 1D3D cyclones and up to 99% for Enhanced 1D3D cyclones. Therefore, District Rule 4204 requiring the use of 1D3D cyclones or new Enhanced 1D3D cyclones with PM control efficiency up to 99% exceeds NCAC requirements for low-pressure systems with 90% PM control efficiency.

The NCAC regulation also provides an exemption for operations processing less than 20 bales per hour, which could represent approximately 20,000 bales per season. Since the District rule does not have such exemption (only contains a research-targeted exemption at less than four bales/day), District Rule 4204 is more stringent in this area as well.

Therefore, overall, District Rule 4204 is more stringent than the NCAC 02D.0542 regulation applying to cotton gin operations.

South Carolina Department of Health and Environmental Control, Regulation 61-62.5, Standard No. 4, Section V (Cotton Gins)

	SJVAPCD Rule 4204	SCDHEC Reg §61-62.5.4.V
Applicability	All cotton ginning facilities.	All existing, new, and modified cotton ginning operations.
Exemption	Cotton ginning facilities used for research purposes and limited to throughputs of not more than 4,000 pounds of seed cotton processed per day (equivalent to 4 bales/day at a trash-to-cotton ratio of 1-to-1).	Existing facilities with a maximum gin stand rated capacity (or documented equipment limitation) of <20 bales/hour that do not have cyclones on lint cleaning system exhausts and battery condenser exhausts if emissions from these exhausts are controlled by fine mesh screens.
Requirements	All emission points shall be controlled by 1D3D cyclones or rotary drum filters. New cyclones or replacement parts of existing 1D3D cyclones shall have the dimensional characteristics of the Enhanced 1D3D cyclone, or the 1D3D with a 2D2D inlet and an expansion chamber trash outlet.	Each cotton ginning operation shall install and operate a particulate emission control system on all high- and low-pressure exhausts and lint cleaning system exhausts that includes one or more 1D3D or 2D2D cyclones. Trash stacker areas shall contain 1 of the following: • A 3-sided enclosure with a roof whose sides are high enough above the

	SJVAPCD Rule 4204	SCDHEC Reg §61-62.5.4.V
	Drive-under or pull-through trash collection system for load-out purposes shall not load trash into a hopper or trailer unless one or more the following are utilized: • The trash loading area has an enclosure with four sides that are higher than the trash auger; at least two sides shall be solid and the remaining sides shall: have a flexible wind barrier, which extends below the top of the trash trailer sides; or have solid doors that remain shut while trash trailers are being loaded, except as necessary to accommodate trailer movement; or have a combination of flexible wind barriers and solid doors. • A solid-sided trailer is used when there is no enclosure, and the trash auger and opening of the loading device have a flexible shroud that extends just below the top of the trailer's solid sides, or • Fugitive PM10 emissions from load-out areas are reduced by an alternative method, which is approved by the APCO and EPA. An owner/operator shall not operate a trash conveyance system dumping directly into a pile unless it meets the following requirements: • Both sides of the trash auger shall be equipped with wind barriers that extend, as measured vertically prior to trash pile build-up, one foot above and three feet below the auger or with an alternative control approved by the APCO and EPA. • After the pile has built up to the height of the trash auger, removing material from the pile shall be performed in such a way as to prevent free-falling trash from the stockpiling system. Dust management plans for facilities are subject to the requirements in District Rules 8011, 8021, 8031, 8041, 8051, 8061, 8071, and 8081.	opening of the dumping device to prevent wind from dispersing dust or debris; or • A device to provide wet suppression at the dump area of the trash cyclone and minimize free fall distance of waste material exiting the trash cyclone. Minimize fugitive emissions by designing and maintaining trash systems, the gin yard, and the traffic area according to the guidelines in the regulation.

The SCDHEC regulation requires the use of 2D2D or 1D3D cyclones, while District Rule 4204 requires 1D3D cyclones and requires that new cyclones be Enhanced 1D3D cyclones with high control efficiency. Texas A&M reports tested efficiencies of 97% for 1D3D cyclones and up to 99% for Enhanced 1D3D cyclones. Therefore, District Rule

4204 requirements result in higher PM control efficiency as compared to SCDHEC regulation requirements.

The SCDHEC regulation also provides an exemption for operations processing less than 20 bales per hour, which could represent approximately 20,000 bales per season. Since the District rule does not have such an exemption, District Rule 4204 is more stringent in this area as well.

While the SCDHEC regulation requires the trash stacker be contained in a three-sided enclosure, District Rule 4204 requires that the trash loading area be an enclosure with four sides higher than the trash auger, which is more stringent.

Therefore, District Rule 4204 is more stringent than the SCDHEC Regulation 62.5, Std. 4, Section V requirements applying to cotton gin operations.

How does District Rule 4204 compare to rules in other air districts?

Bay Area AQMD, Sacramento Metropolitan AQMD, South Coast AQMD, and Ventura County APCD do not have analogous rules for this source category.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District reviewed the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

PM2.5 Emission Control Technologies

Baghouses

The District evaluated baghouses as a potential control device, however, these technologies are generally not feasible for cotton ginning operations due to a number of factors. A typical cotton ginning operation relies on an air cleaning system handling fibrous materials such as cotton and cotton waste in a cotton gin. This air cleaning system uses high volumes of air to move the cotton throughout the ginning operation. Usually, these high volumes of air are much higher than any volumes of air passing through a baghouse. Throughout the various processes of the cotton gin operation, air velocities range from 1,500 ft/min to 5,000 ft/min.[49] Higher-than-average gas volumes and PM cause bag blinding,[50] where the increased velocity allows dust to penetrate into the fabric, and the cleaning system is unable to remove it.

In addition to the high volume of air, the baghouse would also see higher than normal temperature excursions, which can shorten bag life considerably. This same effect occurs when seed cotton is first dried in large dryers using heated air to reduce

[49] Reference Agriculture Handbook No. 503 – Cotton Ginners Handbook, July 1977, page 59.
[50] Blinding (*define*) – A closing of the filter medium pores which results in either a reduced gas flow or an increased pressure drop across the medium.

moisture content, and if the seed cotton requires additional drying, it is often run through a second or third dryer.

Excess moisture is common to cotton grown in the more humid regions of the Cotton Belt, while cotton produced in the Southwest can be too dry because of the region's arid climate. Lack of moisture at ginning can lower the quality of the fiber and contribute to ginning problems. For these reasons, moisture is added with a special humidifier that blows warm, humid air through the gin's conveyor pipes. Moisture on the bags tends to alter the adhesion of the dust cake on and within the fabric structure, and "mudding" or blinding of the bags may occur because the cleaning system cannot remove this dust.

The District determined that due to the requirements for high volumes of air, blinding from the fibrous material, temperature excursions across fabric filters, and introduction of moisture during the ginning operation, baghouses would not be a feasible control device for cotton ginning operations.

1D3D Cyclones with Expansion Chamber

Currently, all cotton gins in the Valley are required to operate using a 1D3D cyclone. There are currently 28 such units, and about two thirds of the 1D3D cyclones used in the Valley have an expanded chamber outlet. Research has shown that an expansion chamber allows for more air flow since it is not as narrow. In initial tests, a larger D/3 size expanded chamber exit produced PM10 emissions that were about 8% lower than those resulting from use of the standard, small-diameter (D/4) exit.[51] A USDA study[52] on PM2.5 emissions from cotton gins provided a PM2.5/PM10 ratio for emissions from cotton gins, however did not extend to the expected PM2.5 control efficiencies of control devices at cotton gins; the District has found no completed research indicating the effectiveness of reducing PM2.5 by installing an expansion chamber. As noted above, expansion chambers result in a minor increase in efficiency for PM10 emissions control, but PM2.5 is a very small fraction of the overall particulate in these systems and does not respond as well as PM10 to air flow changes, such as those induced by an expansion chamber. Therefore, expansion chambers would not be a feasible control for PM2.5.

Mechanical Conveyance

The District considered mechanical conveyance for the main trash handling system as a potential opportunity to reduce emissions, however it has only been demonstrated as feasible for newly constructed or rebuilt cotton gins. Mechanical conveyance reduces emissions from cotton gin trash handling exhaust streams, which are otherwise moved pneumatically. The cotton gin trash handling systems only comprise a fraction of the emissions that are released from the full cotton ginning process.

Newer or rebuilt cotton gins are able to accommodate a mechanical conveyance system since operators are able to design the cotton gin around the equipment and space

[51] Baker R.V. and Hughs S.E. (1998). *Influence of Air Inlet and Outlet Design and Trash Exit Size on 1D3D Cyclone Performance*. Transactions of the ASAE, vol. 42(1): 17-21.
[52] USDA, Agricultural Research Service. *Characterization of Cotton Gin Particulate Matter Emissions.* (2013). Retrieved from: http://buser.okstate.edu/air-quality/cotton-gin/national-study/

needed. Operators that have installed a mechanical conveyance system for their cotton gin have had to build a lower floor, below the main level containing the major cotton gin equipment, to house the mechanical conveyors. Therefore, as confirmed by equipment manufacturers, it is not technologically feasible to retrofit existing cotton gins with mechanical conveyance systems to replace existing trash handling equipment.

Zero-Emission Opportunities

The District evaluated all available opportunities for reducing emissions from this source category and did not identify any available zero-emission technologies or any instances of zero-emission requirements for these operations. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

Based on this review, the District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

Rule 4204 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.6 RULE 4301 (FUEL BURNING EQUIPMENT)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Winter Average - Tons per day						
PM2.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a

The emission inventory is not specific to Rule 4301. See Rules 4306, 4307, 4308, 4309, and 4352 for the individual emissions inventories.

District Rule 4301 Description

District Rule 4301 applies to all types of fuel burning equipment, except air pollution control equipment. The purpose of this rule is to limit emissions of air contaminants from fuel burning equipment by specifying maximum emission rates for SOx, NOx, and PM (identified in the rule as combustion contaminant emissions). EPA finalized approval of the 1992 amendments to Rule 4301 on May 18, 1999.

Rule 4301 limits the concentration of combustion contaminants to 0.1 grain per standard cubic feet of gas and limits maximum emissions rates of SOx to 200 pounds per hour, NOx to 140 pounds per hour, and combustion contaminants to 10 pounds per hour from fuel burning equipment.

Rule 4301 has a very broad applicability, as it applies to all types of fuel burning equipment. Several District rules with more stringent NOx requirements for specific types of fuel burning equipment supersede this rule. See the control measure evaluations for Rules 4306, 4307, 4308, 4309, 4320, and 4352 for more specific information about the individual fuel burning equipment source categories.

How does District Rule 4301 compare with federal and state rules and regulations?

Facilities subject to Rule 4301 are subject to various state rules and federal requirements. However, several District rules have superseded Rule 4301 with more stringent requirements. The control measure evaluations for those rules include comparisons of those District rules to the applicable federal and state regulations.

How does District Rule 4301 compare to rules in other air districts?

Several District rules with more stringent NOx requirements for specific types of fuel burning equipment supersede this rule. See Rules 4306, 4307, 4308, 4309, 4320, and 4352 for comparisons of those rules to applicable rules in other air districts.

Potential Emission Reduction Opportunities

Several District rules with more stringent requirements have superseded Rule 4301. The control measure evaluations for those rules discuss any potential emission reduction opportunities for this source category.

Evaluation Findings

Several District rules with more stringent NOx requirements for specific types of fuel burning equipment supersede this rule. See the control measure evaluations for Rules 4306, 4307, 4308, 4309, 4320, and 4352.

C.7 RULE 4306 AND 4320 (BOILERS, STEAM GENERATORS, AND PROCESS HEATERS, GREATER THAN 5.0 MMBTU/HR)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	2.39	2.28	2.13	2.01	1.90	1.83	1.80
NOx	3.53	3.29	2.94	2.44	2.19	2.03	1.96
	Winter Average - Tons per day						
PM2.5	2.35	2.25	2.09	1.97	1.86	1.79	1.76
NOx	3.42	3.19	2.85	2.36	2.11	1.95	1.88

District Rules 4306 and 4320 Description

Rules 4306 and 4320 apply to any gaseous fuel or liquid fuel fired boiler, steam generator, or process heater with a total rated heat input greater than 5 million British thermal units per hour (MMBtu/hr). The purpose of these rules is to limit emissions from boilers, steam generators, and process heaters of this size range. Facilities with units subject to these rules represent a wide range of industries, including but not limited to electrical utilities, cogeneration, oil and gas production, petroleum refining, manufacturing and industrial processes, food and agricultural processing, and service and commercial facilities.

The purpose of Rule 4306 is to limit emissions of NOx and carbon monoxide (CO) from applicable units. Rule 4320 establishes more stringent limits for NOx, CO, oxides of sulfur (SO2), and PM10, and provides Advanced Emission Reduction Options for rule compliance, where an operator can either meet the specific NOx emission and PM control requirements, or pay an annual emissions fee to the District and meet the PM control requirements.

The District Governing Board adopted amendments to Rules 4306 and 4320 on December 17, 2020, to reduce emissions from boilers, process heaters, and steam generators in the Valley. These amendments were based on a comprehensive technical analysis, in-depth review of local, state, and federal regulations, and a robust public process. Modifications to Rules 4306 and 4320 included lowering NOx emissions limits for a variety of unit classes and categories, and establishing dates for emission control plans, authorities to construct, and compliance deadlines. Additionally, the District updated the unit categories in Rule 4306 to account for differences in technologically achievable and cost effective limits, which vary between different types and sizes of units. Updated category groupings also establish consistency in the categories included in Rule 4306 as well as Rule 4320. The District also added definitions and updated test methods in Rules 4306 and 4320 to improve clarity, and reflect changes to rule requirements and the latest version of test methodology available.

In situations where a retrofit may not be the best option given the technology forcing nature of the limits, operators have the option of paying an annual emissions fee based on the actual emissions of the unit during the previous calendar year while the facility continually evaluates the feasibility of potential controls. These fees may then be used by the District to support cost effective emission reductions and other pollution reduction activities. Fees would be paid annually and continue until the unit complies with the applicable limit. The affected sources will have the option, on an annual basis, to stop the fee option and install controls specified in the rule. The amended Rules 4306 and 4320 include the most effective controls that are available and technologically feasible, and are the most stringent regulations in the country for the subject type of units.

How do District Rules 4306 and 4320 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines applicable to this source category.

A. Alternative Control Techniques (ACT)

- *Alternative Control Techniques Document – NOx Emissions from Process Heaters (EPA-453/R-93-034 1993/09)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Process Heaters and found no requirements that were more stringent than those already in Rules 4306 and 4320.

- *Alternative Control Techniques Document – NOx Emissions from Industrial/Commercial/Institutional Boilers (EPA-453/R-94-022 1994/03)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Industrial/Commercial/Institutional Boilers and found no requirements that were more stringent than those already in Rules 4306 and 4320.

- *Alternative Control Techniques Document – NOx Emissions from Utility Boilers (EPA-453/R-94-023 1994/03)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Utility Boilers and found no requirements that were more stringent than those already in Rules 4306 and 4320.

B. New Source Performance Standards (NSPS)

- *40 CFR 60 Subpart D – Standards of Performance for Fossil-Fuel Fired Steam Generators (2007/06)*

The District evaluated the requirements contained within 40 CFR 60 Subpart D and found no requirements that were more stringent than those already in Rules 4306 and 4320.

- *40 CFR 60 Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units (2007/06)*

The District evaluated the requirements contained within 40 CFR 60 Subpart Db and found no requirements that were more stringent than those already in Rules 4306 and 4320.

- *40 CFR 60 Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units (2012/04)*

The District evaluated the requirements contained within 40 CFR 60 Subpart Dc and found no requirements that were more stringent than those already in Rules 4306 and 4320.

State Regulations

There are no state regulations applicable to this source category.

How do District Rules 4306 and 4320 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rules 4306 and 4320 to comparable requirements in rules from the following nonattainment areas:

- Bay Area AQMD Regulation 9, Rule 7 (Amended May 4, 2011)[53]
- Bay Area AQMD Regulation 9, Rule 10 (Amended November 3, 2021)[54]
- Bay Area AQMD Regulation 9, Rule 11 (Amended May 17, 2000)[55]

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[53] BAAQMD. *Regulation 9, Rule 7 (Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)*. (Amended May 4, 2011). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-7-nitrogen-oxides-and-carbon-monoxide-from-industrial-institutional-and-commercial-boiler/documents/rg0907.pdf?la=en&rev=ab95f36c2dd146528f1cf3c10596bce3

[54] BAAQMD. *Regulation 9, Rule 10 (Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators, and Process Heaters in Petroleum Refineries).* (Amended November 3, 2021). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/refinery-rules-definitions/rg0910_20211103-pdf.pdf?la=en&rev=6e3872940d924000b45ea05f05b5a309

[55] BAAQMD. *Regulation 9, Rule 11 (Nitrogen Oxides and Carbon Monoxide from Utility Electric Power Generating Boilers)*. (Amended May 17, 2000). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-

- Sacramento Metropolitan AQMD Rule 411 (Amended August 23, 2007)[56]
- South Coast AQMD Rule 1146 (Amended December 4, 2020)[57]
- South Coast AQMD Rule 1109.1 (Adopted November 5, 2021)[58]
- Ventura County APCD Rule 74.15 (Amended November 10, 2020)[59]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rules 4306 and 4320 continue to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

Bay Area AQMD

- BAAQMD Regulation 9, Rule 10 (Boilers, Steam Generators and Process Heaters in Refineries)

BAAQMD amended Regulation 9, Rule 10 on November 3, 2021. The 2021 amendments were administrative and did not affect the stringency of rule requirements implemented prior to EPA's approval of the District meeting BACM/MSM for the *2018 PM2.5 Plan*. The District found no requirements in BAAQMD Regulation 9, Rule 10 that were more stringent than those in Rules 4306 and 4320.

South Coast AQMD

- SCAQMD Rule 1146 (Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

	SJVAPCD Rules 4306 and 4320	SCAQMD Rule 1146
Applicability	Any gaseous fuel or liquid fuel fired boiler, steam generator, or process heater with a total rated heat input >5 MMBtu/hr.	Boilers, steam generators, and process heaters of ≥5 MMBtu/hr rated heat input capacity used in industrial, institutional, and commercial operations.
Exemptions	• Units regulated by other District rules such as solid fuel fired units, dryers, glass melting furnaces, kilns, and smelters • Any units while burning any fuel other than PUC quality natural gas that: o Burns non-PUC gas no more than 168 hr/yr plus 48 hr/yr for equipment testing o NOx emissions do not exceed 150 ppm	• Boilers used by electric utilities to generate electricity • Boilers and process heaters with a rated heat input capacity >40 MMBtu/hr that are used in petroleum refineries • Sulfur plant reaction boilers

11-nitrogen-oxides-and-carbon-monoxide-from-utility-electric-power-generating-boilers/documents/rg0911.pdf?la=en&rev=cf79907f652d454c9b52a55ae3e95903

56 SMAQMD. *Rule 411 (NOx from Boilers, Process Heaters, and Steam Generators).* (Amended August 23, 2007). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule411.pdf

57 SCAQMD. *Rule 1146 (Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters).* (Amended December 4, 2020). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1146.pdf

58 SCAQMD. *Rule 1109 (Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations).* (Amended December 4, 2020). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1109-1.pdf?sfvrsn=8

59 VCAPCD. *Rule 74.15 (Boilers, Steam Generators, and Process Heaters).* (Amended November 10, 2020). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.15.pdf

<table>
<tr><th></th><th colspan="2">SJVAPCD Rules 4306 and 4320</th><th>SCAQMD Rule 1146</th></tr>
<tr><th>Requirements</th><th>Rule 4306</th><th>Rule 4320</th><th></th></tr>
<tr><td>Category A
Units 5-20 MMBtu/hr Except Categories C through G units</td><td>7 ppmv for fire tube units
9 ppmv for all other units</td><td>5 ppmv for fire tube units
9 ppmv for units at schools, units fired on digester gas, and thermal fluid heaters
5 ppmv for all other units</td><td>Non-RECLAIM
7 ppmv for fire tube units
9 ppmv for all other units
RECLAIM
9 ppmv for fire tube units
12 ppmv for all other units</td></tr>
<tr><td>Category B
Units >20 MMBtu/hr Except Categories C through G units</td><td>20-75 MMBtu/hr: 7 ppmv
≥75 MMBtu/hr: 5 ppmv</td><td>2.5 ppmv</td><td>20-75 MMBtu/hr:
Non-RECLAIM
7 ppmv for fire tube units
9 ppmv (units with previous NOx limit ≤12 and >5 ppmv prior to 12/7/18)
5 ppmv (all other units)
RECLAIM
9 ppmv for fire tube units
12 ppmv for all other units

≥75 MMBtu/hr:
Non-RECLAIM: 5 ppmv
RECLAIM: 9 ppmv</td></tr>
<tr><td>Category C.1
Oilfield Steam Generators
5-20 MMBtu/hr</td><td>9 ppmv</td><td>6 ppmv</td><td rowspan="4">SCAQMD Rule 1146 applies to Industrial, Institutional, and Commercial Units. Oilfield steam generators do not fall into these categories per definitions in the rule. Additionally, SCAQMD indicated there are no oilfield steam generators within their district.</td></tr>
<tr><td>Category C.2
Oilfield Steam Generators
20-75 MMBtu/hr</td><td>9 ppmv</td><td>5 ppmv</td></tr>
<tr><td>Category C.3
Oilfield Steam Generators >75 MMBtu/hr</td><td>7 ppmv</td><td>5 ppmv</td></tr>
<tr><td>Category C.4
Oilfield Steam Generators fired on <50% PUC quality gas</td><td>15 ppmv</td><td>5 ppmv</td></tr>
<tr><td>Category D.1
Refinery Boilers
5-40 MMBtu/hr</td><td>30 ppmv
5 ppmv for replacement units</td><td>5 ppmv</td><td rowspan="4">SCAQMD Rule 1146 applies to Industrial, Institutional, and Commercial Units. Petroleum Refineries do not fall into these categories per definitions in the rule.</td></tr>
<tr><td>Category D.2
Refinery Boilers
40-110 MMBtu/hr</td><td>9 ppmv
5 ppmv for replacement units</td><td>5 ppmv</td></tr>
<tr><td>Category D.3
Refinery Boilers
>110 MMBtu/hr</td><td>5 ppmv</td><td>2.5 ppmv</td></tr>
<tr><td>Category D.4
Refinery Process Heaters
5-40 MMBtu/hr</td><td>30 ppmv
9 ppmv for replacement units</td><td>5 ppmv</td></tr>
</table>

<table>
<tr><th></th><th colspan="2">SJVAPCD Rules 4306 and 4320</th><th>SCAQMD Rule 1146</th></tr>
<tr><td>Category D.5
Refinery Process Heaters
40-110 MMBtu/hr</td><td>15 ppmv
9 ppmv for replacement units</td><td>5 ppmv</td><td rowspan="2"></td></tr>
<tr><td>Category D.6
Refinery Process Heaters
>110 MMBtu/hr</td><td>5 ppmv</td><td>2.5 ppmv</td></tr>
<tr><td>Category E
Units with annual heat input >1.8 billion Btu/yr but <30 billion Btu/yr</td><td>No NOx limits for units ≤9 billion Btu/yr, must tune up twice a year.

Other units: 30 ppmv</td><td>9 ppmv</td><td>No NOx limits for units ≤9 billion Btu/yr, must tune up twice a year.

Other units would be subject to applicable category limits in rule.</td></tr>
<tr><td colspan="4">Additional Categories Included in SCAQMD Rule 1146</td></tr>
<tr><td><u>Atmospheric Units</u>
These units would be subject to the limits in Category A or B in District Rules</td><td rowspan="4"><u>Category A</u>
7 ppmv fire tube boilers
9 ppmv other units

<u>Category B</u>
20-75 MMBtu/hr: 7 ppmv
>75 MMBtu/hr: 5 ppmv enhanced</td><td rowspan="4"><u>Category A</u>
5 ppmv for fire tube units
9 ppmv for units at schools, units fired on digester gas, and thermal fluid heaters
5 ppmv for all other units

<u>Category B</u>
2.5 ppmv</td><td>12 ppmv (natural gas)</td></tr>
<tr><td><u>Digester gas</u>
These units would be subject to the limits in Category A or B in District Rules</td><td>15 ppmv</td></tr>
<tr><td><u>Landfill gas</u>
These units would be subject to the limits in Category A or B in District Rules</td><td>25 ppmv</td></tr>
<tr><td><u>Other units fired on gaseous fuel</u>
Covered under multiple categories in District Rules</td><td>30 ppmv</td></tr>
</table>

District Rules 4306 and 4320 have a broader applicability than SCAQMD Rule 1146, and include limits for units that are not included in SCAQMD's rule, such as oilfield steam generators. In discussions with SCAQMD, the District has confirmed that SCAQMD does not have these types of units within their district, and therefore there is no limit to be compared. For the categories that can be compared, District Rule 4306 generally contains limits equal to or more stringent than SCAQMD Rule 1146. For Category B units in the table above, SCAQMD requires a NOx limit of 5 ppmv only for units that were previously at limits higher than 12 ppmv. At the time of their rule amendment, SCAQMD determined that it was not cost-effective to require units with a NOx emission limit of 12 ppmv or less to meet a limit of 5 ppmv, and thus only required these units to meet a limit of 9 ppmv. Comparatively, for units of this category in the District, Rule 4306 previously required an already highly controlled level of 9 ppmv, and now requires a limit of 7 ppmv. Additionally, District Rule 4320 establishes an even more stringent limit of 2.5 ppmv for these units.

The District evaluated the requirements contained within SCAQMD's Rule 1146 and the District concludes that overall the requirements in Rules 4306 and 4320 are as stringent as or more stringent than SCAQMD Rule 1146.

- SCAQMD Rule 1109.1 (Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations)

	SJVAPCD Rules 4306 and 4320		SCAQMD Rule 1109.1
Applicability	Any gaseous fuel or liquid fuel fired boiler, steam generator, or process heater with a total rated heat input >5 MMBtu/hr.		Owners or operators of facilities with units at petroleum refineries and facilities with related operations to petroleum refineries.
Exemptions	• Units regulated by other District rules such as solid fuel fired units, dryers, glass melting furnaces, kilns, and smelters. • Any units while burning any fuel other than PUC quality natural gas that: ○ Burns non-PUC gas no more than 168 hr/yr plus 48 hr/yr for equipment testing ○ NOx emissions do not exceed 150 ppm		• Boilers or process heaters ≤2 MMBtu/hr • Boilers and process heaters with a rated heat input capacity <40 MMBtu/hr that operate <200 hr/yr • Boilers and process heaters with a rated heat input capacity <40 MMBtu/hr that are fired at <15% maximum rated heat input capacity per year • Boilers or process heaters operating only the pilot prior to startup or after shutdown
Requirements	**Rule 4306**	**Rule 4320**	
Category A Units 5-20 MMBtu/hr Except Categories C through G units	7 ppmv for fire tube units 9 ppmv for all other units	5 ppmv for fire tube units 9 ppmv for units at schools, units fired on digester gas, and thermal fluid heaters 5 ppmv for all other units	SCAQMD Rule 1109.1 only applies to units at petroleum refineries
Category B Units >20 MMBtu/hr Except Categories C through G units	20-75 MMBtu/hr: 7 ppmv ≥75 MMBtu/hr: 5 ppmv	2.5 ppmv	SCAQMD Rule 1109.1 only applies to units at petroleum refineries
Category C.1 Oilfield Steam Generators 5-20 MMBtu/hr	9 ppmv	6 ppmv	
Category C.2 Oilfield Steam Generators 20-75 MMBtu/hr	9 ppmv	5 ppmv	SCAQMD Rule 1109.1 only applies to units at petroleum refineries
Category C.3 Oilfield Steam Generators >75 MMBtu/hr	7 ppmv	5 ppmv	

	SJVAPCD Rules 4306 and 4320		SCAQMD Rule 1109.1
Category C.4 Oilfield Steam Generators fired on <50% PUC quality gas	15 ppmv	5 ppmv	
Category D.1 Refinery Boilers 5-40 MMBtu/hr	30 ppmv 5 ppmv for replacement units	5 ppmv	40 ppmv 5 ppmv after burner replacement
Category D.2 Refinery Boilers 40-110 MMBtu/hr	9 ppmv 5 ppmv for replacement units	5 ppmv	Limits ranging from 5-50 ppmv due to conditional limits, interim limits, and alternative compliance options
Category D.3 Refinery Boilers >110 MMBtu/hr	5 ppmv	2.5 ppmv	Limits ranging from 5-50 ppmv due to conditional limits, interim limits, and alternative compliance options
Category D.4 Refinery Process Heaters 5-40 MMBtu/hr	30 ppmv 9 ppmv for replacement units	5 ppmv	40 ppmv 9 ppmv after replacement of burners
Category D.5 Refinery Process Heaters 40-110 MMBtu/hr	15 ppmv 9 ppmv for replacement units	5 ppmv	Limits ranging from 5-50 ppmv due to conditional limits, interim limits, and alternative compliance options
Category D.6 Refinery Process Heaters >110 MMBtu/hr	5 ppmv	2.5 ppmv	Limits ranging from 5-22 ppmv due to conditional limits, interim limits, and multiple alternative compliance options
Category E Units with annual heat input >1.8 billion Btu/yr but <30 billion Btu/yr	No NOx limits for units ≤9 billion Btu/yr, must tune up twice a year. Other units: 30 ppmv	9 ppmv	No NOx limit for boilers and process heaters with rated heat input capacity <40 MMBtu/hr that operate <200 hr/yr, or are fired <15% maximum rated heat input capacity per year

District Rules 4306 and 4320 have a broader applicability than SCAQMD Rule 1109.1, which only applies to units at petroleum refineries. SCAQMD Rule 1109.1 has NOx emission limits for some categories of refinery units that could be seen as being more stringent than District Rule 4306. However, for these categories of units, SCAQMD Rule 1109.1 has higher conditional limits, higher interim limits, and multiple alternative compliance options are available, thus making the NOx limits less stringent than the firmly established NOx limits in Rule 4306. Additionally, Rule 4320 contains limits as stringent as or more stringent than limits in SCAQMD Rule 1109.1. The District concludes that overall Rules 4306 and 4320 are as stringent as or more stringent than SCAQMD Rule 1109.1.

Ventura County APCD

- VCAPCD Rule 74.15 (Boilers, Steam Generators, and Process Heaters)

	SJVAPCD Rules 4306 and 4320		VCAPCD Rule 74.15
Applicability	Any gaseous fuel or liquid fuel fired boiler, steam generator, or process heater with a total rated heat input >5 MMBtu/hr.		Boilers, steam generators and process heaters, >5 MMBtu/hr used in all industrial, institutional and commercial operations.
Exemptions	• Units regulated by other District rules such as solid fuel fired units, dryers, glass melting furnaces, kilns, and smelters • Any units while burning any fuel other than PUC quality natural gas that: ○ Burns non-PUC gas no more than 168 hr/yr plus 48 hr/yr for equipment testing ○ NOx emissions do not exceed 150 ppm		• Units fired on alternate fuel during natural gas curtailment • Emergency standby units • Cold Startup
Requirements	**Rule 4306**	**Rule 4320**	
Category A Units 5-20 MMBtu/hr Except Categories C through G units	7 ppmv for fire tube units 9 ppmv for all other units	5 ppmv for fire tube units 9 ppmv for units at schools, units fired on digester gas, and thermal fluid heaters 5 ppmv for all other units	40 ppmv After Jan. 1, 2027: 9 ppmv for boilers 12 ppmv for process heaters
Category B Units >20 MMBtu/hr Except Categories C through G units	20-75 MMBtu/hr: 7 ppmv ≥75 MMBtu/hr: 5 ppmv	2.5 ppmv	40 ppmv After Jan. 1, 2027: 9 ppmv for boilers 12 ppmv for process heaters
Category C.1 Oilfield Steam Generators 5-20 MMBtu/hr	9 ppmv	6 ppmv	40 ppmv After Jan. 1, 2027: 9 ppmv
Category C.2 Oilfield Steam Generators 20-75 MMBtu/hr	9 ppmv	5 ppmv	
Category C.3 Oilfield Steam Generators >75 MMBtu/hr	7 ppmv	5 ppmv	
Category C.4 Oilfield Steam Generators fired on <50% PUC quality gas	15 ppmv	5 ppmv	
Category D.1 Refinery Boilers 5-40 MMBtu/hr	30 ppmv 5 ppmv for replacement units	5 ppmv	40 ppmv After Jan. 1, 2027: 9 ppmv

	SJVAPCD Rules 4306 and 4320		VCAPCD Rule 74.15
Category D.2 Refinery Boilers 40-110 MMBtu/hr	9 ppmv 5 ppmv for replacement units	5 ppmv	40 ppmv After Jan. 1, 2027: 9 ppmv
Category D.3 Refinery Boilers >110 MMBtu/hr	5 ppmv	2.5 ppmv	40 ppmv After Jan. 1, 2027: 9 ppmv
Category D.4 Refinery Process Heaters 5-40 MMBtu/hr	30 ppmv 9 ppmv for replacement units	5 ppmv	40 ppmv After Jan. 1, 2027: 12 ppmv
Category D.5 Refinery Process Heaters 40-110 MMBtu/hr	15 ppmv 9 ppmv for replacement units	5 ppmv	40 ppmv After Jan. 1, 2027: 12 ppmv
Category D.6 Refinery Process Heaters >110 MMBtu/hr	5 ppmv	2.5 ppmv	40 ppmv After Jan. 1, 2027: 12 ppmv
Category E Units with annual heat input >1.8 billion Btu/yr but <30 billion Btu/yr	No NOx limits for units ≤9 billion Btu/yr, must tune up twice a year. Other units: 30 ppmv	9 ppmv	No NOx limits for units <9 billion Btu/yr, must tune up twice a year. Other units: 40 ppmv After Jan. 1, 2027: 9-30 billion Btu/yr: 9 ppmv for boilers 12 ppmv for process heaters

The District evaluated the requirements contained within VCAPCD's Rule 74.15 and the District concludes that overall Rules 4306 and 4320 are as stringent as or more stringent than VCAPCD Rule 74.15.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District reviewed the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

NOx Emission Control Technologies

The two primary methods of controlling NOx emissions from boilers, steam generators, and process heaters are either to change the combustion parameters (i.e., combustion modification) to reduce NOx formation, or to treat the NOx formed before it is emitted into the atmosphere with the use of selective catalytic reduction (SCR).

Through SCR, NOx is reduced to molecular nitrogen by adding a flue gas treatment system consisting of a catalyst module and a reagent injection system located after the boiler firebox. SCR units operate at a certain temperature range to effectively reduce NOx in the exhaust gas by injecting either ammonia stored in aqueous form, anhydrous form, generated on demand, or released from urea into the post-combustion zone of the boiler. SCR systems are generally paired with low-NOx burners (LNB).

While many operations have successfully installed SCR and other latest generation control systems through Rule 4306/4320 implementation and New Source Review BACT requirements, these control technologies have not yet been proven to be technologically feasible and cost effective as retrofit options for all source categories and applications, such as oilfield steam generators, as further discussed below. For many facilities, this technology is not an option due to space constraints and other physical limitations.

SCR has significant initial capital costs, requires large footprints that impact other operations (resulting in significant additional costs), and requires additional construction costs to accommodate the large size of the catalyst and the storage of the injection reagent (such as anhydrous ammonia). The temperature required for SCR units to function effectively (400-800 °F) in relation to existing exhaust temperatures (i.e. ~250 °F for oilfield steam generators) poses significant and potentially insurmountable feasibility and cost challenges to operators. For example, in many situations, steam generators would have to be cut open to retrofit an SCR unit into the convection section of the steam generator to operate the SCR system at the correct temperature. This would cause heat loss, preventing the production of the steam necessary for the oil field operation.

The District also evaluated lower NOx limits, as low as 5 ppmv, for steam generators, and has included a cost effectiveness analysis below.

SCR for Oilfield Steam Generators

Oilfield steam generators are significantly different than industrial boilers due to the higher operating efficiency and lower exhaust temperatures. While SCR technology is not a common NOx emission control technology for oilfield steam generators due to a variety of factors, the District has conducted extensive research, including engaging with industry and technology vendors, to evaluate the feasibility of using SCR to further reduce emissions from oilfield steam generators, as summarized below.

The temperature required for SCR to work (400-800 F) is higher than the temperature that of oilfield steam generator exhaust (~250 F). The gas temperature entering the SCR must be maintained above the temperature at which ammonium bisulfate forms. The formation of ammonium bisulfate degrades the SCR’s NOx removal efficiency resulting in shorter catalyst life. Therefore, to operate the SCR system properly, steam generators would have to be cut open to retrofit SCR into the convection section of the steam generator to operate the SCR system at the correct temperature. This would cause heat loss, preventing the production of the steam necessary for the oil field operation. Regardless, the exhaust temperature of the steam generator would have to be increased which would increase costs of the SCR installation/operation and could potentially increase emissions (if supplemental combustion is utilized). Additionally, feasibility limitations associated with the installation of SCR for oil field steam generators include space limitations within installed infrastructure, and concerns with the storage of anhydrous ammonia in the remotely located, unsecured oil fields where these types of units operate.

Additionally, unlike industrial boilers that are located in a building/facility where maintenance staff is nearby and can respond to any upset conditions in a short amount of time; oilfield steam generators are not always located nearby and can take additional time to arrive to the units. As the emission limits continue to decrease, the tolerances for upset conditions continue to tighten and the advancement of control and monitoring technologies increases. Having units located at remote locations with these tight operating conditions will also increase the operating costs of the facilities as they will need to employ additional qualified staff to monitor critical parameters and when necessary, respond and fix upset conditions. Due to these factors and existing recently adopted stringent emissions limitations that meet BACM and MSM levels, SCR is not a feasible control system for use on oil field steam generators at this time.

Low NOx limits for Steam Generators

Newer burners have the ability to reduce NOx emissions to as low as 5 ppmv, however, in some situations, a complete replacement of the steam generator may be required to meet 5 ppmv. There are many factors that go into determining the type of control needed to meet this limit. The District has presented a cost effectivenvess analysis below that includes a range of costs.

62.5 MMBtu/hr Steam Generator Retrofit - 9 ppmv to 5 ppmv

Description of Cost	Cost Factor	Cost	Source
Direct Costs			
Purchase equipment costs (PE)			
5 ppmv - New burner, FGR fan, controls + boiler mods	A	553,500	Avg cost data
Instrumentation and controls	0.01 A	5,535	OAQPS
Sales Tax	0.0725 A	40,129	Kern County sales tax rate*
Freight	0.05A	27,675	OAQPS
Purchase equipment cost, PEC		626,839	
Direct Installation Costs (DI)			
Foundation & supports	0.08 B	0	Included in captial cost quote
Handling and erection	0.14 B	0	Included in captial cost quote
Electrical	0.04 B	0	Included in captial cost quote
Piping	0.02 B	0	Included in captial cost quote
Insulation and ductwork	0.01 B	0	Included in captial cost quote
Painting	0.01 B	0	Included in captial cost quote
Direct Installation Costs	0.30 B	0	
Site Preparation	As required, SP		See table footnote

Buildings	As required, Bldg.		
Total Direct Costs, DC		626,839	
Indirect Costs (Installation)			
Engineering	0.10 B	0	Included in captial cost quote
Construction and field expenses	0.05 B	0	Included in captial cost quote
Contractor fees	0.10 B	0	Included in captial cost quote
Contingencies	0.03 B	0	Included in captial cost quote
Start-up	0.02 B	0	Included in captial cost quote
Performance test	0.01 B	0	Included in captial cost quote
Total Indirect Costs, IC	0.31 B	0	
Total Capital Investments (TCI = DC + IC)		**626,839**	
Annualized TCI (10 years @ 4% interest), $/yr	0.1233 TCI	77,289	
Direct Annual Costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	0.015 TCI		OAQPS
Reagent costs (anhydrous ammonia)	--	--	Not estimated
Electrictity cost	$0.123/kWH	16,082	Estimate 25 hp increase in FGR fan motor
Catalyst replacement cost	--	--	Not estimated
Total DAC		16,082	
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	0.01 TCI		OAQPS
Property tax	--	--	See table footnote
Admininstrative	--	--	See table footnote
Total IAC		0	
Total Annual Cost (DAC + IAC)		**16,082**	
Total Annual Cost (Annualized TCI + Total Annual Cost), $/yr		**93,371**	

*Per EPA's Air Pollution Control Cost Manual (6th Edition), EPA/452/B-02-001 (1/02), operating and supervisory, overhead, administrative costs would be insignificant for an SCR system. In general, SCR does not require site preparation or additional buildings, and property taxes do not apply to capital improvements such as air pollution control equipment.

Emission Reductions		
NOx Emissions (lb/year) at current 9 ppmv limit (80% utilization)	8760 hr/year x 62.5 MMBtu/hr x 0.8 x 0.0109 lb-NOx/MMBtu	4,774
NOx Emissions (lb/year) at 5 ppmv limit (80% utilization)	8760 hr/year x 62.5 MMBtu/hr x 0.8 x 0.0061 lb-NOx/MMBtu	2,672
NOx Reduced (lb/year)		2,102
NOx Reduced (tons/year)		**1.05**
Cost Effectiveness ($/ton)	**$88,823**	

Description of Cost	Cost Factor	Cost	Source
Direct Costs			
Purchase equipment costs (PE)			
5 ppmv - New burner, FGR fan, controls + boiler mods	A	2,000,000	Aera Quote
Instrumentation and controls	0.01 A	20,000	OAQPS
Sales Tax	0.0725 A	145,000	Kern County sales tax rate*
Freight	0.05A	100,000	OAQPS
Purchase equipment cost, PEC		2,265,000	
Direct Installation Costs (DI)			
Foundation & supports	0.08 B	0	Included in captial cost quote
Handling and erection	0.14 B	0	Included in captial cost quote
Electrical	0.04 B	0	Included in captial cost quote
Piping	0.02 B	0	Included in captial cost quote
Insulation and ductwork	0.01 B	0	Included in captial cost quote
Painting	0.01 B	0	Included in captial cost quote
Direct Installation Costs	0.30 B	0	
Site Preparation	As required, SP		See table footnote
Buildings	As required, Bldg.		
Total Direct Costs, DC		2,265,000	
Indirect Costs (Installation)			
Engineering	0.10 B	0	Included in captial cost quote
Construction and field expenses	0.05 B	0	Included in captial cost quote
Contractor fees	0.10 B	0	Included in captial cost quote
Contingencies	0.03 B	0	Included in captial cost quote
Start-up	0.02 B	0	Included in captial cost quote
Performance test	0.01 B	0	Included in captial cost quote
Total Indirect Costs, IC	0.31 B	0	
Total Capital Investments (TCI = DC + IC)		**2,265,000**	
Annualized TCI (10 years @ 4% interest), $/yr	0.1233 TCI	279,275	
Direct Annual Costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	0.015 TCI		OAQPS
Reagent costs (anhydrous ammonia)	--	--	Not estimated
Electrictity cost	$0.123/kWH	16,082	Estimate 25 hp increase in FGR fan motor
Catalyst replacement cost	--	--	Not estimated
Total DAC		16,082	
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	0.01 TCI		OAQPS
Property tax	--	--	See table footnote
Admininstrative	--	--	See table footnote
Total IAC		0	
Total Annual Cost (DAC + IAC)		**16,082**	
Total Annual Cost (Annualized TCI + Total Annual Cost), $/yr		**295,357**	

*Per EPA's Air Pollution Control Cost Manual (6th Edition), EPA/452/B-02-001 (1/02), operating and supervisory, overhead, administrative costs would be insignificant for an SCR system. In general, SCR does not require site preparation or additional buildings, and property taxes do not apply to capital improvements such as air pollution control equipment.

Emission Reductions		
NOx Emissions (lb/year) at current 9 ppmv limit (80% utilization)	8760 hr/year x 62.5 MMBtu/hr x 0.8 x 0.0109 lb-NOx/MMBtu	4,774
NOx Emissions (lb/year) at 5 ppmv limit (80% utilization)	8760 hr/year x 62.5 MMBtu/hr x 0.8 x 0.0061 lb-NOx/MMBtu	2,672
NOx Reduced (lb/year)		2,102
NOx Reduced (tons/year)		**1.05**
Cost Effectiveness ($/ton)	**$280,971**	

85 MMBtu/hr Steam Generator Retrofit - 7 ppmv to 5 ppmv

Description of Cost	**Cost Factor**	**Cost**	**Source**
Direct Costs			
Purchase equipment costs (PE)			
5 ppmv -new burner, FGR, and A/F controls upgrade	A	184,500	Avg cost data
Instrumentation and controls	0.01 A	1,845	OAQPS
Sales Tax	0.0725 A	13,376	Kern County sales tax rate*
Freight	0.05A	9,225	OAQPS
Purchase equipment cost, PEC	B = 1.14 A	208,946	
Direct Installation Costs (DI)			
Foundation & supports	0.08 B	0	Included in captial cost quote
Handling and erection	0.14 B	0	Included in captial cost quote
Electrical	0.04 B	0	Included in captial cost quote
Piping	0.02 B	0	Included in captial cost quote
Insulation and ductwork	0.01 B	0	Included in captial cost quote
Painting	0.01 B	0	Included in captial cost quote
Direct Installation Costs	0.30 B	0	
Site Preparation	As required, SP		See table footnote
Buildings	As required, Bldg.		
Total Direct Costs, DC		208,946	
Indirect Costs (Installation)			
Engineering	0.10 B	0	Included in captial cost quote
Construction and field expenses	0.05 B	0	Included in captial cost quote
Contractor fees	0.10 B	0	Included in captial cost quote

Contingencies	0.03 B	0	Included in captial cost quote
Start-up	0.02 B	0	Included in captial cost quote
Performance test	0.01 B	0	Included in captial cost quote
Total Indirect Costs, IC	0.31 B	0	
Total Capital Investments (TCI = DC + IC)		**208,946**	
Annualized TCI (10 years @ 4% interest), $/yr	0.1233 TCI	25,763	
Direct Annual Costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	0.015 TCI	0	OAQPS
Reagent costs (anhydrous ammonia)	--	--	Not estimated
Electrictity cost	$0.123/kWH	8,172	Estimate 15 hp increase in FGR fan motor
Catalyst replacement cost	--	--	Not estimated
Total DAC		8,172	
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	0.01 TCI	0	OAQPS
Property tax	--	--	See table footnote
Admininstrative	--	--	See table footnote
Total IAC		0	
Total Annual Cost (DAC + IAC)		**8,172**	
Total Annual Cost (Annualized TCI + Total Annual Cost), $/yr		**33,935**	
*Per EPA's Air Pollution Control Cost Manual (6th Edition), EPA/452/B-02-001 (1/02), operating and supervisory, overhead, administrative costs would be insignificant for an SCR system. In general, SCR does not require site preparation or additional buildings, and property taxes do not apply to capital improvements such as air pollution control equipment.			

Emission Reductions		
NOx Emissions (lb/year) at current 7 ppmv limit (80% utilization)	8760 hr/year x 85 MMBtu/hr x 0.8 x 0.0085 lb-NOx/MMBtu	5,063
NOx Emissions (lb/year) at 5 ppmv limit (80% utilization)	8760 hr/year x 85 MMBtu/hr x 0.8 x 0.0061 lb-NOx/MMBtu	3,634
NOx Reduced (lb/year)		1,429
NOx Reduced		**0.71**
Cost Effectiveness ($/ton)	**$58,539**	

Description of Cost	**Cost Factor**	**Cost**	**Source**
Direct Costs			
Purchase equipment costs (PE)			
5 ppmv -new burner, FGR, and A/F controls upgrade	A	750,000	Aera Cost Data
Instrumentation and controls	0.01 A	7,500	OAQPS
Sales Tax	0.0725 A	54,375	Kern County sales tax rate*
Freight	0.05A	37,500	OAQPS
Purchase equipment cost, PEC	B = 1.14 A	849,375	

Direct Installation Costs (DI)			
Foundation & supports	0.08 B	0	Included in captial cost quote
Handling and erection	0.14 B	0	Included in captial cost quote
Electrical	0.04 B	0	Included in captial cost quote
Piping	0.02 B	0	Included in captial cost quote
Insulation and ductwork	0.01 B	0	Included in captial cost quote
Painting	0.01 B	0	Included in captial cost quote
Direct Installation Costs	0.30 B	0	
Site Preparation	As required, SP		See table footnote
Buildings	As required, Bldg.		
Total Direct Costs, DC		849,375	
Indirect Costs (Installation)			
Engineering	0.10 B	0	Included in captial cost quote
Construction and field expenses	0.05 B	0	Included in captial cost quote
Contractor fees	0.10 B	0	Included in captial cost quote
Contingencies	0.03 B	0	Included in captial cost quote
Start-up	0.02 B	0	Included in captial cost quote
Performance test	0.01 B	0	Included in captial cost quote
Total Indirect Costs, IC	0.31 B	0	
Total Capital Investments (TCI = DC + IC)		**849,375**	
Annualized TCI (10 years @ 4% interest), $/yr	0.1233 TCI	104,728	
Direct Annual Costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	0.015 TCI	0	OAQPS
Reagent costs (anhydrous ammonia)	--	--	Not estimated
Electrictity cost	$0.123/kWH	8,172	Estimate 15 hp increase in FGR fan motor
Catalyst replacement cost	--	--	Not estimated
Total DAC		8,172	
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	0.01 TCI	0	OAQPS
Property tax	--	--	See table footnote
Admininstrative	--	--	See table footnote
Total IAC		0	
Total Annual Cost (DAC + IAC)		**8,172**	
Total Annual Cost (Annualized TCI + Total Annual Cost), $/yr		**112,900**	

*Per EPA's Air Pollution Control Cost Manual (6th Edition), EPA/452/B-02-001 (1/02), operating and supervisory, overhead, administrative costs would be insignificant for an SCR system. In general, SCR does not require site preparation or additional buildings, and property taxes do not apply to capital improvements such as air pollution control equipment.

Emission Reductions		
NOx Emissions (lb/year) at current 7 ppmv limit (80% utilization)	8760 hr/year x 85 MMBtu/hr x 0.8 x 0.0085 lb-NOx/MMBtu	5,063
NOx Emissions (lb/year) at 5 ppmv limit (80% utilization)	8760 hr/year x 85 MMBtu/hr x 0.8 x 0.0061 lb-NOx/MMBtu	3,634
NOx Reduced (lb/year)		1,429
NOx Reduced		**0.71**
Cost Effectiveness ($/ton)	**$169,008**	

This analysis shows that the cost of NOx control on steam generators with these technologies ranges between $58,539 and $280,971 per ton of NOx emissions reduced. Therefore, use of these emission control technologies to control NOx emissions from steam generators is not cost effective.

PM2.5 Emission Control Technologies

Baghouses (Pulse Jet[60]/Reverse Air,[61] Ceramic Dust Collectors[62])

Baghouses force exhaust through filters which capture PM by impingement. Filter media may be cloth/paper bags, pleated cloth in cartridge form, or even packed ceramic media within cages. Per EPA fact sheets for this technology, Cloth/paper filters can only control filterable PM. Per manufacturer data, ceramic media can only provide limited control (≤20%) of condensable PM.

Wet[63]/Dry[64] Electrostatic Precipitators

Electrostatic Precipitators (ESPs) use ionized gas and/or electromagnetic field to impart static charge to particles in the exhaust stream which are then attracted to collection plates held at high voltage. To clean the collection plates, dry ESPs use mechanical or acoustical methods, while wet ESPs use wash liquid. Per EPA fact sheets for this technology, dry ESPs can only control filterable PM and can have difficulty collecting particles with an aerodynamic diameter of 0.1 to 1 micron. Since all of the PM from NG-fuel combustion is assumed to be less than 1 micron in size, the PM2.5 control efficiency of a dry ESP is assumed to be 90%. Particle size is less of a factor for wet ESPs, however capital and operating costs are generally higher due to noncorrosive

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60 EPA-452/F-03-025 https://www3.epa.gov/ttnchie1/mkb/documents/ff-pulse.pdf
61 EPA-452/F-03-026 https://www.epa.gov/sites/default/files/2020-10/documents/ff-revar.pdf
62 Correspondence from Clean Air Systems
63 EPA-452/F-03-029 https://www3.epa.gov/ttn/chief/mkb/documents/fwespwpi.pdf#:~:text=An%20ESP%20is%20a%20particulate%20%20control%20device%20that,effluent%20is%20collected%2C%20andoften%20treated%20on-%20site%20%28EPA%2C%201998%29
64 EPA-452/F-03-027 https://www3.epa.gov/ttn/catc/dir1/fdespwpi.pdf

materials requirements, increased water usage, and treatment and disposal of waste water.

***Venturi Scrubbers*[65]**

Venturi scrubbers introduce an atomized liquid into the exhaust stream upon which PM agglomerates. The liquid mist is subsequently removed by cyclonic separator and/or mist eliminator. Venturi Scrubbers require high differential pressure (20 to 24 inches water column) which may require additional fans.

Table C-2 Typical Applications of Control Technologies

Control Technology	Recommended Inlet Loading (gr-PM2.5/ft^3)	Inlet Temp (°F)	PM2.5 Control Efficiency
Baghouse Cloth/Paper Filter	0.5 – 10	<500	99% of filterable, 0% of condensable
Baghouse Ceramic Filter	0.5 – 10	<800	99% of filterable, 20% of condensable
Wet ESP	0.5 – 5	<200	98% of total
Dry ESP	0.5 – 5	<500	90% of filterable, 0% of condensable
Venturi/Wet Scrubber	0.1 – 50	<750	99% of total

As shown in the table above, the recommended inlet PM2.5 loading concentrations where these control technologies are applied are orders of magnitude above the typical exhaust PM2.5 concentrations produced by NG-fired boilers and steam generators. As the control device must be sized to accommodate the airflow, these devices must be substantially oversized for the quantity of PM they will control. All of these control technologies are able to provide good control efficiency of filterable PM. However, since the majority of total PM2.5 from NG boilers and steam generators is condensable PM2.5, baghouses with cloth/paper/ceramic filter media and dry ESPs are not well suited to control PM2.5 emissions from NG-fired boilers and steam generators because these emission control technologies have minimal to no ability to control condensable PM2.5 emissions.

Nonetheless, cost analyses for all of these control technologies listed in Table C-2 above is presented in the following section.

<u>Cost Effectiveness</u>

Since the cost to deploy these technologies on a 50 MMBtu/hr boiler is similar to that of a 62.5 MMBtu/hr steam generator, a cost analysis is performed for each control

[65] EPA-452/F-03-017 https://www3.epa.gov/ttnchie1/mkb/documents/fventuri.pdf#:~:text=EPA-452%2FF-03-017%20Air%20Pollution%20Control%20Technology%20Fact%20Sheet%20Name,venturi%20jet%20scrubbers%2C% 20gas-atomizing%20spray%20scrubbers%2C%20and%20ejector-venturiscrubbers

technology for units at two heat input sizes: 20 MMBtu/hr and 62.5 MMBtu/hr. Purchased equipment costs were provided by equipment vendors.

20 MMBtu/hr NG-Fired Boiler Controlled by a Fabric Filter Baghouse

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	Western Pneumatics (7,300 acfm)	$100,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$5,000.00
C	Sales Tax	8.25% PEC	$8,250.00
D	Direct Installation Costs	25% PEC	$25,000.00
E	Total Direct Capital Costs	A+B+C+D	$138,250.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$5,000.00
G	Engineering	10% PEC	$10,000.00
H	Process Contingency	5% PEC	$5,000.00
I	Total Indirect Capital Costs	F+G+H	$20,000.00
J	Project Contingency	20% PEC	$20,000.00
K	Total Capital Costs	E+I+J	$178,250.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$21,924.75
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	0.1694/kw-hr EPA Cost Manual (452/B-02-001), Section 6, Chapter 1, Formula 1.14	$10,196.00
R	Total Direct Annual Costs	M+N+O+P+Q	$54,680.38
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$2,000.00
U	Insurance	0.01 x PEC	$1,000.00
V	Property Tax	0.01 x PEC	$1,000.00
W	Capital Recovery	0.13 x PEC	$13,000.00
X	Total Indirect Annual Costs	S+T+U+V+W	$43,690.63
Total Annualized Cost		L+R+X	**$120,295.76**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	526
Z	Filterable PM10 (lb/year)	8760 hr/year x MMBtu/hr x 0.00075	131
AB	PM10 Captured by Baghouse (lb/year)	99% control of filterable	130
	PM10 Captured (tons/year)	AB/2000	**0.065**

Cost Effectiveness ($/ton)	**$1,850,704.00**

62.5 MMBtu/hr NG-Fired Boiler Controlled by a Fabric Filter Baghouse

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	Western Pneumatics (17,400 acfm)	$180,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$9,000.00
C	Sales Tax	8.25% PEC	$14,850.00
D	Direct Installation Costs	25% PEC	$45,000.00
E	Total Direct Capital Costs	A+B+C+D	$248,850.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$9,000.00
G	Engineering	10% PEC	$18,000.00
H	Process Contingency	5% PEC	$9,000.00
I	Total Indirect Capital Costs	F+G+H	$36,000.00
J	Project Contingency	20% PEC	$36,000.00
K	Total Capital Costs	E+I+J	$320,850.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$39,464.55
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	0.1694/kw-hr EPA Cost Manual (452/B-02-001), Section 6, Chapter 1, Formula 1.14	$24,302.00
R	Total Direct Annual Costs	M+N+O+P+Q	$68,786.38
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$3,600.00
U	Insurance	0.01 x PEC	$1,800.00
V	Property Tax	0.01 x PEC	$1,800.00
W	Capital Recovery	0.13 x PEC	$23,400.00
X	Total Indirect Annual Costs	S+T+U+V+W	$57,290.63
Total Annualized Cost		L+R+X	**$165,541.56**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	1,643
Z	Filterable PM10 (lb/year)	8760 hr/year x MMBtu/hr x 0.00075	411
AB	PM10 Captured by Baghouse (lb/year)	99% control of filterable	407
	PM10 Captured (tons/year)	AB/2000	**0.204**

Cost Effectiveness ($/ton)	**$811,478.24**

20 MMBtu/hr NG-Fired Boiler Controlled by a Ceramic Filter Baghouse

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	Western Pneumatics (7,300 acfm)	$100,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$5,000.00
C	Sales Tax	8.25% PEC	$8,250.00
D	Direct Installation Costs	25% PEC	$25,000.00
E	Total Direct Capital Costs	A+B+C+D	$138,250.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$5,000.00
G	Engineering	10% PEC	$10,000.00
H	Process Contingency	5% PEC	$5,000.00
I	Total Indirect Capital Costs	F+G+H	$20,000.00
J	Project Contingency	20% PEC	$20,000.00
K	Total Capital Costs	E+I+J	$178,250.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$21,924.75
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	0.1694/kw-hr EPA Cost Manual (452/B-02-001), Section 6, Chapter 1, Formula 1.14	$10,196.00
R	Total Direct Annual Costs	M+N+O+P+Q	$54,680.38
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$2,000.00
U	Insurance	0.01 x PEC	$1,000.00
V	Property Tax	0.01 x PEC	$1,000.00
W	Capital Recovery	0.13 x PEC	$13,000.00
X	Total Indirect Annual Costs	S+T+U+V+W	$43,690.63
Total Annualized Cost		L+R+X	**$120,295.76**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	526
Z	Filterable PM10 (lb/year)	8760 hr/year x MMBtu/hr x 0.00075	131
AA	Condensable PM10 (lb/year)	Y-Z	395
AB	PM10 Captured by Baghouse (lb/year)	0.99*Z+0.2*AA	209
	PM10 Captured (tons/year)	AB/2000	**0.105**

Cost Effectiveness ($/ton)	**$1,145,673.90**

62.5 MMBtu/hr NG-Fired Boiler Controlled by a Ceramic Filter Baghouse

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	Western Pneumatics (17,400 acfm)	$180,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$9,000.00
C	Sales Tax	8.25% PEC	$14,850.00
D	Direct Installation Costs	25% PEC	$45,000.00
E	Total Direct Capital Costs	A+B+C+D	$248,850.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$9,000.00
G	Engineering	10% PEC	$18,000.00
H	Process Contingency	5% PEC	$9,000.00
I	Total Indirect Capital Costs	F+G+H	$36,000.00
J	Project Contingency	20% PEC	$36,000.00
K	Total Capital Costs	E+I+J	$320,850.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$39,464.55
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	0.1694/kw-hr EPA Cost Manual (452/B-02-001), Section 6, Chapter 1, Formula 1.14	$24,302.00
R	Total Direct Annual Costs	M+N+O+P+Q	$68,786.38
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$3,600.00
U	Insurance	0.01 x PEC	$1,800.00
V	Property Tax	0.01 x PEC	$1,800.00
W	Capital Recovery	0.13 x PEC	$23,400.00
X	Total Indirect Annual Costs	S+T+U+V+W	$57,290.63
Total Annualized Cost		L+R+X	**$165,541.56**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	1,643
Z	Filterable PM10 (lb/year)	8760 hr/year x MMBtu/hr x 0.00075	411
AA	Condensable PM10 (lb/year)	Y-Z	1,232
AB	PM10 Captured by Baghouse (lb/year)	0.99*Z+0.2*AA	653
	PM10 Captured (tons/year)	AB/2000	**0.327**

Cost Effectiveness ($/ton)	**$506,243.30**

20 MMBtu/hr NG-Fired Boiler Controlled by a Wet ESP

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	Envitech (7,000 acfm quencher & ESP)	$900,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$45,000.00
C	Sales Tax	8.25% PEC	$74,250.00
D	Direct Installation Costs	25% PEC	$225,000.00
E	Total Direct Capital Costs	A+B+C+D	$1,244,250.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$45,000.00
G	Engineering	10% PEC	$90,000.00
H	Process Contingency	5% PEC	$45,000.00
I	Total Indirect Capital Costs	F+G+H	$180,000.00
J	Project Contingency	20% PEC	$180,000.00
K	Total Capital Costs	E+I+J	$1,604,250.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$197,322.75
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	Envitech 25kW; 0.1694/kw-hr	$37,098.60
R	Total Direct Annual Costs	M+N+O+P+Q	$81,582.98
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$18,000.00
U	Insurance	0.01 x PEC	$9,000.00
V	Property Tax	0.01 x PEC	$9,000.00
W	Capital Recovery	0.13 x PEC	$117,000.00
X	Total Indirect Annual Costs	S+T+U+V+W	$179,690.63
Total Annualized Cost		L+R+X	**$458,596.36**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	526
AB	PM10 Captured by ESP (lb/year)	98% control efficiency, Z*0.98	515
	PM10 Captured (tons/year)	AB/2000	**0.258**

Cost Effectiveness ($/ton)	**$1,777,505.27**

62.5 MMBtu/hr NG-Fired Boiler Controlled by a Wet ESP

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	Envitech (17,000 acfm quencher & ESP)	$1,125,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$56,250.00
C	Sales Tax	8.25% PEC	$92,812.50
D	Direct Installation Costs	25% PEC	$281,250.00
E	Total Direct Capital Costs	A+B+C+D	$1,555,312.50
	Indirect Capital Costs		
F	Facilities	5% PEC	$56,250.00
G	Engineering	10% PEC	$112,500.00
H	Process Contingency	5% PEC	$56,250.00
I	Total Indirect Capital Costs	F+G+H	$225,000.00
J	Project Contingency	20% PEC	$225,000.00
K	Total Capital Costs	E+I+J	$2,005,312.50
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$246,653.44
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	Envitech 50kW; 0.1694/kw-hr	$74,197.20
R	Total Direct Annual Costs	M+N+O+P+Q	$118,681.58
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$22,500.00
U	Insurance	0.01 x PEC	$11,250.00
V	Property Tax	0.01 x PEC	$11,250.00
W	Capital Recovery	0.13 x PEC	$146,250.00
X	Total Indirect Annual Costs	S+T+U+V+W	$217,940.63
Total Annualized Cost		L+R+X	**$583,275.65**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	1,643
AB	PM10 Captured by ESP (lb/year)	98% control efficiency, Z*0.98	1,610
	PM10 Captured (tons/year)	AB/2000	**0.805**

Cost Effectiveness ($/ton)	**$724,566.02**

20 MMBtu/hr NG-Fired Boiler Controlled by a Dry ESP

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	Envitech (7,000 acfm ESP)	$750,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$37,500.00
C	Sales Tax	8.25% PEC	$61,875.00
D	Direct Installation Costs	25% PEC	$187,500.00
E	Total Direct Capital Costs	A+B+C+D	$1,036,875.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$37,500.00
G	Engineering	10% PEC	$75,000.00
H	Process Contingency	5% PEC	$37,500.00
I	Total Indirect Capital Costs	F+G+H	$150,000.00
J	Project Contingency	20% PEC	$150,000.00
K	Total Capital Costs	E+I+J	$1,336,875.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$164,435.63
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	Envitech 25kW; 0.1694/kw-hr	$37,098.60
R	Total Direct Annual Costs	M+N+O+P+Q	$81,582.98
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$15,000.00
U	Insurance	0.01 x PEC	$7,500.00
V	Property Tax	0.01 x PEC	$7,500.00
W	Capital Recovery	0.13 x PEC	$97,500.00
X	Total Indirect Annual Costs	S+T+U+V+W	$154,190.63
Total Annualized Cost		L+R+X	**$400,209.24**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	526
Z	Filterable PM10 (lb/year)	8760 hr/year x MMBtu/hr x 0.00075	131
AB	PM10 Captured by ESP (lb/year)	90% control of filterable	118
	PM10 Captured (tons/year)	AB/2000	**0.059**

Cost Effectiveness ($/ton)	**$6,783,207.46**

62.5 MMBtu/hr NG-Fired Boiler Controlled by a Dry ESP

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	Envitech (17,000 acfm ESP)	$750,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$37,500.00
C	Sales Tax	8.25% PEC	$61,875.00
D	Direct Installation Costs	25% PEC	$187,500.00
E	Total Direct Capital Costs	A+B+C+D	$1,036,875.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$37,500.00
G	Engineering	10% PEC	$75,000.00
H	Process Contingency	5% PEC	$37,500.00
I	Total Indirect Capital Costs	F+G+H	$150,000.00
J	Project Contingency	20% PEC	$150,000.00
K	Total Capital Costs	E+I+J	$1,336,875.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$164,435.63
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	Envitech 50kW; 0.1694/kw-hr	$74,197.20
R	Total Direct Annual Costs	M+N+O+P+Q	$118,681.58
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$15,000.00
U	Insurance	0.01 x PEC	$7,500.00
V	Property Tax	0.01 x PEC	$7,500.00
W	Capital Recovery	0.13 x PEC	$97,500.00
X	Total Indirect Annual Costs	S+T+U+V+W	$154,190.63
Total Annualized Cost		L+R+X	**$437,307.84**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	4,161
Z	Filterable PM10 (lb/year)	8760 hr/year x MMBtu/hr x 0.00075	411
AB	PM10 Captured by ESP (lb/year)	90% control of filterable	370
	PM10 Captured (tons/year)	AB/2000	**0.185**

Cost Effectiveness ($/ton)	**$2,363,826.16**

20 MMBtu/hr NG-Fired Boiler Controlled by a Venturi Scrubber

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	EnviroCare Micromist (7,000 acfm)	$400,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$20,000.00
C	Sales Tax	8.25% PEC	$33,000.00
D	Direct Installation Costs	25% PEC	$100,000.00
E	Total Direct Capital Costs	A+B+C+D	$553,000.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$20,000.00
G	Engineering	10% PEC	$40,000.00
H	Process Contingency	5% PEC	$20,000.00
I	Total Indirect Capital Costs	F+G+H	$80,000.00
J	Project Contingency	20% PEC	$80,000.00
K	Total Capital Costs	E+I+J	$713,000.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$87,699.00
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	0.1694/kw-hr EPA Cost Manual (452/B-02-001), Section 6, Chapter 1, Formula 1.14	$45,124.00
R	Total Direct Annual Costs	M+N+O+P+Q	$89,608.38
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$8,000.00
U	Insurance	0.01 x PEC	$4,000.00
V	Property Tax	0.01 x PEC	$4,000.00
W	Capital Recovery	0.13 x PEC	$52,000.00
X	Total Indirect Annual Costs	S+T+U+V+W	$94,690.63
Total Annualized Cost		L+R+X	**$271,998.01**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	526
AB	PM10 Captured by Baghouse (lb/year)	99% efficiency	521
	PM10 Captured (tons/year)	AB/2000	**0.261**

Cost Effectiveness ($/ton)	**$1,042,137.97**

62.5 MMBtu/hr NG-Fired Boiler Controlled by a Venturi Scrubber

	Item	Method of Calculation	Cost
	Direct Capital Costs		
A	Total Purchased Equip Cost	EnviroCare Micromist (20,000 acfm)	$520,000.00
B	Freight	5% Purchased Equip Cost (PEC)	$26,000.00
C	Sales Tax	8.25% PEC	$42,900.00
D	Direct Installation Costs	25% PEC	$130,000.00
E	Total Direct Capital Costs	A+B+C+D	$718,900.00
	Indirect Capital Costs		
F	Facilities	5% PEC	$26,000.00
G	Engineering	10% PEC	$52,000.00
H	Process Contingency	5% PEC	$26,000.00
I	Total Indirect Capital Costs	F+G+H	$104,000.00
J	Project Contingency	20% PEC	$104,000.00
K	Total Capital Costs	E+I+J	$926,900.00
L	**Annualized Capital Costs (10 Years @ 4%)**	0.123*K	$114,008.70
	Direct Annual Costs		
	Operating Costs		
M	Operator	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
N	Supervisor	15% of operator	$3,421.88
	Maintenance Costs		
O	Labor	0.5 hr/shift, $25/hr, 3 shifts/day	$13,687.50
P	Material	100% of Labor Cost	$13,687.50
	Utility Costs		
Q	Electricity Costs	0.1694/kw-hr EPA Cost Manual (452/B-02-001), Section 6, Chapter 1, Formula 1.14	$128,925.00
R	Total Direct Annual Costs	M+N+O+P+Q	$173,409.38
	Indirect Annual Costs		
S	Overhead	60% of O&M (M+N+O+P)	$26,690.63
T	Administrative	0.02 x PEC	$10,400.00
U	Insurance	0.01 x PEC	$5,200.00
V	Property Tax	0.01 x PEC	$5,200.00
W	Capital Recovery	0.13 x PEC	$67,600.00
X	Total Indirect Annual Costs	S+T+U+V+W	$115,090.63
Total Annualized Cost		L+R+X	**$402,508.71**

	Emission Reductions		
Y	Total PM10 Emissions (lb/year)	8760 hr/year x MMBtu/hrx 0.003	1,643
AB	PM10 Captured by Baghouse (lb/year)	99% efficiency	1,627
	PM10 Captured (tons/year)	AB/2000	**0.814**

Cost Effectiveness ($/ton)	**$494,482.44**

The cost effectiveness values above are based on assumed full time (8,760 hr/yr) operation at full capacity, which results in the largest possible PM2.5 emission reductions. In reality, boilers and steam generators typically do not operate 8,760 hr/yr. Reduction in operational hours would reduce PM2.5 emissions proportionally. Since the design capacity of these control devices must be suited to maximum flow, reductions in operational time would not reduce purchase and operational costs of the control device to the same extent. Therefore, the cost effectiveness values presented herein represent a lower limit, and the true cost of reductions are expected to be higher.

As discussed above, the typical exhaust PM2.5 concentration from NG-fired boilers and steam generators is significantly below the recommended range of inlet loading concentrations for all of the PM2.5 emission control technologies assessed. Further, with the exception of wet ESP and Venturi Scrubbers, these control technologies offer poor control of condensable PM2.5 and therefore poor control of total PM2.5 emissions from NG-fired boilers and steam generators.

Furthermore, this analysis shows that the cost of direct PM2.5 control on NG-fired boilers and steam generators with these technologies ranges between $494,482 and $6,783,207 per ton of PM2.5 emissions reduced. Therefore, use of these emission control technologies to control direct PM2.5 emissions from NG-fired boilers and steam generators is not cost effective.

Based on this review, the District did not identify additional emission reduction opportunities at this time. The District will continue to work with operators of boilers, steam generators, and process heaters to develop, demonstrate, and deploy new emission control technologies. As part of this continued effort, the District will evaluate any advancements in addressing the above feasibility issues.

<u>Zero-Emission Opportunities</u>

Electrification of Units

Electric boilers and process heaters are becoming more commercially available but not for all sizes and applications. The cost to operate on electricity is much higher than on natural gas. The District found that the electricity generation required to operate units larger than 5 MMBtu/hr would produce more NOx than units operating at the NOx limits in Rule 4306. For example, a 5 MMBtu/hr fire tube boiler would cost nearly seven times as much to operate on electricity compared to natural gas, and the NOx emitted from the electric utility grid to operate the unit would be twice as much as a natural gas fired unit operating at 7 ppmv NOx.

Currently, there are no electric steam generators capable of meeting the demands of conventional steam generators. One of the largest electric generators produces 4,882 lb/hr @ 135 pounds per square inch gauge (psig). This flow rate is only 1/10 of the rate needed from one conventional steam generator and the pressure rating of 135 psig is far below the needed pressure of 800-900 psig.

Furthermore, a typical conventional natural gas-fired steam generator is rated (designed) to burn up to 62.5 million Btu/hr of natural gas and consumes approximately 50 million Btu/hr (i.e. 80% firing rate). This will require, on average, 13.75 MW of electricity to replace one conventional steam generator. Therefore, the electricity needs to replace one conventional steam generator with electric steam generation would be the equivalent electricity demand of over 10,000 homes. To replace conventional steam generators operating in the Valley with electric steam generation would require approximately 5,160 MW, which would be the equivalent electricity demand of 3,800,000 homes. The immense amount of power needed to electrify all steam generators in the District would require significant infrastructure upgrades to California's power grid. Therefore, electric steam generators are not feasible at this time.

Solar Powered Oilfield Steam Generation

Emissions from oilfield steam generators that provide steam to reduce the viscosity of oil in thermally enhanced oil recovery operations have been significantly reduced through decades of increasingly stringent rule requirements. Instead of fuel oil, steam generators today are powered by natural gas or field gas which are significantly cleaner. To ensure that all potential emission reduction opportunities are evaluated, the District performed a comprehensive review of solar powered steam generators.

In the Valley, two small pilot projects were conducted to demonstrate the feasibility of solar powered steam generation technologies and found that such technologies were not feasible:

Berry Petroleum Company: This company installed a small pilot test facility designed to use solar energy to pre-heat feed water for the existing natural gas fired steam generators. The system consisted of mirrors in a glass greenhouse (supplied by Glasspoint Solar). The mirrors were designed to focus solar energy onto a pipe carrying water to heat the water. The heated water would then be sent to the input of the steam generators. The facility had a designed heat production of 300 kW. This project operated for a short time and was ultimately shut down based on the following shortcomings:

1) Significant heat loss: The heat losses to the water from the pipe runs from the solar installation to the actual steam generator locations were such that the water delivered to the steam generators was ambient or slightly warmer.
2) Excessively large footprint requirement: The footprint of the solar steam generators needed to provide the thermal output of one 85 MMBtu steam generator would be excessively large.
3) Inconsistent steam quality: The inability of the solar steam generators to consistently generate the quality of steam that is needed for injection that is currently supplied by the steam generators.
4) Unreliable power: The solar steam generators would still need to be supplemented by gas fired steam generators at night and during cloudy days.

Chevron: This company installed a pilot solar thermal steam plant near Coalinga, consisting of 7,600 mirrors that would direct solar energy towards a single solar collector tower (supplied by Brightsource Energy). The heat collected in the tower would turn water into steam. The installation had a footprint of 100 acres. This system discontinued operation in 2014. Although information from Chevron on their findings on the performance of this project is unavailable, based on news articles,[66] the system was excessively costly. A news article referencing the manufacturer's SEC filings stated the company realized a 40 million dollar loss on the project.

Aera Energy: Despite the above-described challenges, in 2019, Aera Energy in collaboration with GlassPoint Solar considered the installation of a large 770-acre solar steam generation system adjacent to an Aera Energy oil production operation in western Kern County. However, in April of 2020, GlassPoint cancelled the project due to a lack of funding. This system would have generated the steam equivalent to approximately 10 gas-fired steam generators. The solar steam generators would still need to be supplemented by gas-fired steam generators at night and during cloudy days.

Based on discussions with Aera Energy, the project heavily relied on solar tax credits, the generation and sale of low carbon fuel standard credits, and the reduction in costs of greenhouse gas allowances for Aera. According to Aera Energy, there is no economic benefit to implementing such technologies. In fact, without the LCFS credits, the cost of steam using this solar technology would be as much as three times the current cost.

The project also faced technical challenges, similar to the above pilot projects. Furthermore, the gas-fired steam generators that are required to supplement the system could face difficulty meeting current rule limits due to the need to ramp up and down. There has not been a successful large scale implementation of such technologies.

In summary, solar powered oilfield steam generators are not yet feasible and still face significant technical and economic challenges as outlined below:

- **Costs:** The use of solar steam generation rely on a complex set of funding sources to make the operations economically feasible, including the Federal 30% tax credit, the value of California low-carbon fuel standards credits that may be generated as a result of using solar steam generation to produce oil, and a reduction in the costs for the oil producer of AB32 cap-and-trade credits required for their operations in California. The value of the GHG credits generated varies based on the price of credits on the open market. As the value of the credits is not fixed, the economic viability of a project may change depending on the value of the credits prior to construction and during operation. Even with available credits, the costs continue to be a challenge.

- **Land Availability:** Adequate open land next to the steam injection wells is needed to house the solar collectors. Both the amount of land and the distance

[66] http://www.naturalgasintel.com/articles/103562-potential-for-solar-assisted-eor-in-california-oilfield-still-unfulfilled and https://gigaom.com/2011/10/12/brightsources-solar-steam-project-went-way-over-budget/

of the land to the injection point are important factors. It is estimated that to create the steam needed to replace one steam generator would require 60 acres of solar generation. Finding the required amount of land available next to oilfield operations may be difficult. The solar systems have to be close to the steam injection wells. Otherwise, additional solar capacity will need to be developed to account for the heat loss because of travel distance.

- **Variability of Solar Steam Generation Output:** Solar steam generation plants need sunny days to be able to collect enough energy to make steam. During cloudy days and also during the night, the solar equipment would not make enough steam. Oilfield operators will need to supplement the solar operation with natural gas fired steam generators for when the solar equipment is not producing enough steam. On partly cloudy days, the natural gas steam generators would need to cycle on and off depending on the cloud cover. This may cause operational difficulties as the gas fired steam generators are tuned to operate at constant load. A variable load could cause emissions variability and potentially have emissions higher than that allowed in permit limits and/or District prohibitory rules.

Evaluation Findings

Rules 4306 and 4320 provide for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.8 RULE 4307 (BOILERS, STEAM GENERATORS, AND PROCESS HEATERS - 2.0 MMBTU/HR TO 5.0 MMBTU/HR)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	2.39	2.28	2.13	2.01	1.90	1.83	1.80
NOx	3.53	3.29	2.94	2.44	2.19	2.03	1.96
	Winter Average - Tons per day						
PM2.5	2.35	2.25	2.09	1.97	1.86	1.79	1.76
NOx	3.42	3.19	2.85	2.36	2.11	1.95	1.88

District Rule 4307 Description

The District adopted Rule 4307 on December 15, 2005, and subsequently amended the rule April 21, 2016. The purpose of Rule 4307 is to limit NOx and CO emissions from boilers, steam generators, and process heaters. The rule applies to any gaseous fuel or liquid fuel fired boiler, steam generator, and process heater with a rated heat input of 2.0 MMBtu/hr up to and including 5.0 MMBtu/hr. This source category includes a wide range of industries including but not limited to medical facilities, educational institutions, office buildings, prisons, military facilities, hotels, and industrial facilities, achieving emission limits as low as 9 ppmv NOx.

How does District Rule 4307 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines or New Source Performance Standards applicable to this source category.

A. Alternative Control Techniques (ACT)

- *Alternative Control Techniques Document – NOx Emissions from Process Heaters (EPA-453/R-93-034 1993/09)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Process Heaters and found no requirements that were more stringent than those already in Rule 4307.

- *Alternative Control Techniques Document – NOx Emissions from Industrial/Commercial/Institutional Boilers (EPA-453/R-94-022 1994/03)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Industrial/Commercial/Institutional Boilers and found no requirements that were more stringent than those already in Rule 4307.

- *Alternative Control Techniques Document – NOx Emissions from Utility Boilers (EPA-453/R-94-023 1994/03)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Utility Boilers and found no requirements that were more stringent than those already in Rule 4307.

State Regulations

There are no state regulations that apply to this source category.

How does District Rule 4307 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4307 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 9, Rule 7 (Amended May 4, 2011)[67]
- Bay Area AQMD Regulation 9, Rule 10 (Amended November 3, 2021)[68]
- Sacramento Metropolitan AQMD Rule 411 (Amended August 23, 2007)[69]
- San Diego County APCD Rule 69.2.2 (Adopted September 9, 2021)[70]
- South Coast AQMD Rule 1146.1 (Amended December 7, 2018)[71]
- South Coast AQMD Rule 1150.3 (Adopted February 5, 2021)[72]

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[67] BAAQMD. *Regulation 9, Rule 7 (Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)*. (Amended May 4, 2011). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-7-nitrogen-oxides-and-carbon-monoxide-from-industrial-institutional-and-commercial-boiler/documents/rg0907.pdf?la=en&rev=ab95f36c2dd146528f1cf3c10596bce3

[68] BAAQMD. *Regulation 9, Rule 10 (Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators, and Process Heaters in Refineries)*. (Amended November 3, 2021). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/refinery-rules-definitions/rg0910_20211103-pdf.pdf?la=en&rev=6e3872940d924000b45ea05f05b5a309

[69] SMAQMD. *Rule 411 (NOx from Boilers, Process Heaters, and Steam Generators)*. (Amended August 8, 2007). Retrieved from: https://www.airquality.org/ProgramCoordination/Documents/rule411.pdf

[70] SCAQMD. *Rule 69.2.2 (Medium Boilers, Process Heaters, and Steam Generators)*. (Adopted September 9, 2021). Retrieved from: https://www.sdapcd.org/content/dam/sdapcd/documents/rules/current-rules/Rule-69.2.2.pdf

[71] SCAQMD. *Rule 1146.1 (Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)*. (Amended December 7, 2018). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1146-1.pdf

[72] SCAQMD. *Rule 1150.3 (Emissions of Oxides of Nitrogen from Combustion Equipment at Landfills)*. (Amended February 5, 2021). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1150-3.pdf?sfvrsn=10

- Ventura County APCD Rule 74.15.1 (Amended June 23, 2015)[73]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4307 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

Bay Area AQMD

- BAAQMD Regulation 9, Rule 10 (Boilers, Steam Generators and Process Heaters in Refineries)

BAAQMD amended Regulation 9, Rule 10 on November 3, 2021. The 2021 amendments were administrative and did not affect the stringency of rule requirements implemented prior to EPA's approval of the District meeting BACM/MSM for the *2018 PM2.5 Plan*. The District found no requirements in BAAQMD Regulation 9, Rule 10 that were more stringent than those in Rule 4307.

San Diego County APCD

- SDAPCD Rule 69.2.2 (Medium Boilers, Process Heaters, and Steam Generators)

	SJVAPCD Rule 4307	SDAPCD Rule 69.2.2
Applicability	Gaseous fuel or liquid fuel fired boilers, steam generators and process heaters rated ≥2 MMBtu/hr to ≤5 MMBtu/hr.	Boilers, steam generator and process heaters >2 MMBtu/hr to <5 MMBtu/hr.
Exemptions	• Solid fuel fired units • Dryers and glass melting furnaces • Kilns, humidifiers, and smelters where products of combustion come in direct contact with material to be heated • Unfired or fired waste heat recovery boilers used to recover or augment heat from exhaust of combustion turbines or internal combustion engines • Burning other fuel during PUC quality natural gas curtailment as long as other fuel not be burned for more than 168 hr/yr plus 48 hr/yr for equipment testing, and NOx emissions shall not exceed 150 ppmv or 0.215 lb/MMBtu	• Waste heat recovery boilers • Furnaces, kilns, and any combustion equipment where the material being heated is in direct contact with the products of combustion • Thermal oxidizers and associated waste heat recovery equipment • Units which burn liquid fuel only during periods of natural gas curtailment, emergencies, or equipment testing for the purpose of maintaining the fuel oil back-up system

[73] VCAPCD. *Rule 14.15.1 (Boilers, Steam Generators, and Process Heaters).* (Amended June 23, 2015). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.15.1.pdf

	SJVAPCD Rule 4307	SDAPCD Rule 69.2.2
Requirements	***NOx Emission Limits:** New and Replacement units • 12 ppmv (atmospheric units) • 9 ppmv (non-atmospheric units) Existing units limited to 1.8 billion Btu/yr • Install and maintain non-resettable fuel flow meter; AND • Tune-up the unit twice per calendar year, OR • Operate and maintain the stack O2 concentrations at 3% by vol. or less on a dry basis, OR • Certify unit to comply with 30 ppmv NOx and 400 ppmv CO (gaseous fuel) when annual limit is exceeded; if unit is replaced then comply with limits of New and Replacement units Existing atmospheric units in oilfield or refinery; each glycol reboiler; or each unit with heat input >1.8 to <5 billion Btu/yr • 30 ppmv (gaseous fuel) • 40 ppmv (liquid fuel)	***NOx Emission Limits:** Existing or relocated units • Tune the unit once per year (no two tuning events shall occur within 90 days of each other) New Units (effective July 1, 2021) • 30 ppmv (gaseous fuel) • 40 ppmv (liquid fuel) • 400 ppmv CO
	PM Control Requirements: • Use PUC quality natural gas, propane, butane, LPG or a combination of such gases, OR • Limit fuel sulfur content to no more than 5 grains/100 scf of gas; OR • Install and operate control system that reduces SO2 emissions at least 95% by wt., or limit exhaust SO2 concentration to ≤9 ppmv @ 3% O2; AND • Liquid fuel shall be used only during a PUC quality natural gas curtailment period provided the fuel does not contain 15 ppmv sulfur	**PM Control Requirements:** None

*Unless otherwise stated, all ppmv values are on a dry basis and corrected to 3% stack oxygen by volume.

District Rule 4307 contains NOx limits for existing units, while SDAPCD Rule 69.2.2 does not, and District Rule 4307 contains more stringent NOx limits for new units. Therefore, District Rule 4307 is as stringent as or more stringent than SDAPCD Rule 69.2.2.

South Coast AQMD

- SCAQMD Rule 1146.1 (Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

	SJVAPCD Rule 4307	SCAQMD Rule 1146.1
Applicability	Gaseous fuel or liquid fuel fired boilers, steam generators and process heaters rated ≥2 MMBtu/hr to ≤5 MMBtu/hr.	Boilers, steam generator and process heaters >2 MMBtu/hr to <5 MMBtu/hr.
Exemptions	• Solid fuel fired units • Dryers and glass melting furnaces • Kilns, humidifiers, and smelters where products of combustion come in direct contact with material to be heated • Unfired or fired waste heat recovery boilers used to recover or augment heat from exhaust of combustion turbines or internal combustion engines • Burning other fuel during PUC quality natural gas curtailment as long as other fuel not be burned for more than 168 hr/yr plus 48 hr/yr for equipment testing, and NOx emissions shall not exceed 150 ppmv or 0.215 lb/MMBtu	• Units at a RECLAIM or former RECLAIM facility subject to a NOx limit in a different rule • Units at municipal sanitation service facility subject to a NOx emission limit in Reg XI adopted or amended after 12/7/18
Requirements	***NOx Emission Limits:** New and Replacement units • 12 ppmv (atmospheric units) • 9 ppmv (non-atmospheric units) Existing units limited to 1.8 billion Btu/yr • Install and maintain non-resettable fuel flow meter; AND • Tune-up the unit twice per calendar year, OR • Operate and maintain the stack O2 concentrations at 3% by vol. or less on a dry basis, OR • Certify unit to comply with 30 ppmv NOx and 400 ppmv CO (gaseous fuel) when annual limit is exceeded; if unit is replaced then comply with limits of New and Replacement units Existing atmospheric units in oilfield or refinery; each glycol reboiler; or each unit with heat input >1.8 to <5 billion Btu/yr • 30 ppmv (gaseous fuel) • 40 ppmv (liquid fuel)	***NOx Emission Limits:** Existing units (in operation prior to 9/5/08, at non-RECLAIM facilities, or in operation prior to 12/7/19 at RECLAIM or former RECLAIM) limited to ≤1.8 billion Btu/yr • Operate and maintain stack O2 concentrations at 3% by vol. or less for any 15-consecutive-minute averaging period, OR • Tune-in the unit twice per year (4 to 8 months apart) All Other Units • 30 ppmv for units not mentioned below: • 7 ppmv for any fire-tube boilers fired on natural gas, excluding units with ≤12 ppmv and >9 ppmv prior to 12/7/18** • 9 ppmv for natural gas-fired units excluding fire-tube boilers subject to the above, atmospheric units, and thermal fluid heaters*** • 12 ppmv for natural gas-fired atmospheric units • 12 ppmv for natural gas-fired thermal fluid heaters**** • 15 ppmv for digester gas fired units • 25 ppmv for landfill gas fired units

	SJVAPCD Rule 4307	SCAQMD Rule 1146.1
		• Weight average limit for multi-fuel units (e.g., units using both natural gas and digester gas, etc.) ***Units with ≤9 ppmv NOx installed, modified, or issued permits prior to 12/7/18, at a non-RECLAIM facility will become subject to the 7 ppmv NOx limit when 50% or more of unit's burners are replaced, or by 12/7/33, whichever is earlier.* ****Units with ≤12 ppmv NOx and >9 ppmv NOx installed, modified or issued permits prior to 9/5/08, at a non-RECLAIM facility will become subject to the 9 ppmv NOx limit when 50% or more of unit's burners are replaced, or by 12/7/33, whichever is earlier.* *****Units with ≤30 ppmv NOx installed, modified, or issued permits prior to 12/7/18, at a non-RECLAIM facility will become subject to the 12 ppmv NOx limit when 50% or more of unit's burners are replaced, or by 12/7/33, whichever is earlier.*
	PM Control Requirements: • Use PUC quality natural gas, propane, butane, LPG or a combination of such gases, OR • Limit fuel sulfur content to no more than 5 grains/100 scf of gas; OR • Install and operate control system that reduces SO2 emissions at least 95% by wt., or limit exhaust SO2 concentration to ≤9 ppmv @ 3% O2; AND • Liquid fuel shall be used only during a PUC quality natural gas curtailment period provided the fuel does not contain 15 ppmv sulfur	**PM Control Requirements:** None

*Unless otherwise stated, all ppmv values are on a dry basis and corrected to 3% stack oxygen by volume.

SCAQMD Rule 1146.1 regulates NOx and CO emissions from small industrial, institutional, and commercial boilers, steam generators, and process heaters. The District compared the emission limits in District Rule 4307 with SCAQMD Rule 1146.1 and concluded that NOx requirements in the District rule are at least equivalent or more stringent than the SCAQMD rule limits for similarly rated units. Therefore, District Rule 4307 is as stringent as or more stringent than SCAQMD Rule 1146.1.

- SCAQMD Rule 1150.3 (Emissions of Oxides of Nitrogen From Combustion Equipment at Landfills)

This rule includes limits for units operating at landfills. The District does not currently have any applicable boilers, steam generators, or process heaters operating at landfills.

Ventura County APCD

- VCAPCD Rule 74.15.1 (Boilers, Steam Generators, and Process Heaters)

	SJVAPCD Rule 4307	VCAPCD Rule 74.15.1
Applicability	Gaseous fuel or liquid fuel fired boilers, steam generators and process heaters rated ≥2 MMBtu/hr to ≤5 MMBtu/hr.	Gaseous fuel or liquid fuel fired boilers, steam generators, or process heaters rated ≥1 MMBtu/hr and <5 MMBtu/hr.

Exemptions	• Solid fuel fired units
	• Dryers and glass melting furnaces
	• Kilns, humidifiers, and smelters where products of combustion come in direct contact with material to be heated
	• Unfired or fired waste heat recovery boilers used to recover or augment heat from exhaust of combustion turbines or internal combustion engines
	• Burning other fuel during PUC quality natural gas curtailment as long as other fuel not be burned for more than 168 hr/yr plus 48 hr/yr for equipment testing, and NOx emissions shall not exceed 150 ppmv or 0.215 lb/MMBtu
		• Any unit operated on alternate fuel under following conditions:
		  ○ Alternate fuel use required due to natural gas curtailment period.
		  ○ Alternative fuel use is required to maintain the alternate fuel system, and in this case use shall not exceed 50 hr/yr
		• Portable oil well dewaxing process heater is not subject to 30 ppmv NOx, if annual heat input rate is <2.8 billion Btu

Requirements	***NOx Emission Limits:** <u>New and Replacement units</u> • 12 ppmv (atmospheric units) • 9 ppmv (non-atmospheric units) <u>Existing units limited to 1.8 billion Btu/yr</u> • Install and maintain non-resettable fuel flow meter; AND • Tune-up the unit twice per calendar year, OR • Operate and maintain the stack O2 concentrations at 3% by vol. or less on a dry basis, OR • Certify unit to comply with 30 ppmv NOx and 400 ppmv CO (gaseous fuel) when annual limit is exceeded; if unit is replaced then comply with limits of New and Replacement units <u>Existing atmospheric units in oilfield or refinery; each glycol reboiler; or each unit with heat input >1.8 to <5 billion Btu/yr</u> • 30 ppmv (gaseous fuel) • 40 ppmv (liquid fuel)	***NOx Emission Limits:** <u>Units with heat input rate ≥1.8 billion Btu/yr</u> • 30 ppmv <u>New and Replacement Units ≥1 to ≤2 MMBtu/hr</u> • 20 ppmv (natural gas-fired) <u>New and Replacement Units >2 to <5 MMBtu/hr</u> • 12 ppmv (natural gas, atmospheric) • 9 ppmv (natural gas, pressurized) • 25 ppmv (landfill gas) • 15 ppmv (biogas) • 20 ppmv (LPG) • 15 ppmv (produced oilfield gas, atmospheric) • 12 ppmv (produced oilfield gas, pressurized) <u>Units ≥0.3 billion Btu/yr and <1.8 billion Btu/yr</u> Comply with one of the following: • Units shall be tuned every 6 months or after 750 hours of operation, but in no case less than once per calendar year; OR • The unit shall comply with the emission and testing requirements (20-30 ppmv NOx)

	SJVAPCD Rule 4307	VCAPCD Rule 74.15.1
	PM Control Requirements: • Use PUC quality natural gas, propane, butane, LPG or a combination of such gases, OR • Limit fuel sulfur content to no more than 5 grains/100 scf of gas; OR • Install and operate control system that reduces SO2 emissions at least 95% by wt., or limit exhaust SO2 concentration to ≤9 ppmv @ 3% O2; AND • Liquid fuel shall be used only during a PUC quality natural gas curtailment period provided the fuel does not contain 15 ppmv sulfur	**PM Control Requirements:** None

*Unless otherwise stated, all ppmv values are on a dry basis and corrected to 3% stack oxygen by volume.

VCAPCD Rule 74.15.1 regulates NOx and CO emissions from boilers, steam generators, and process heaters. The District compared the emission limits in District Rule 4307 with VCAPCD and concluded that Rule 4307 is overall as stringent as VCAPCD Rule 74.15.1.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District reviewed the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

NOx Emission Control Technologies

Most units subject to Rule 4307 are fired on Public Utilities Commission (PUC) quality natural gas, and are able to install established control technologies. The following potential control techniques are evaluated to achieve further reductions:

Retrofitting with SCR

SCR technology is predominantly used to reduce NOx emissions from boilers, steam generators, and process heaters. While many of existing units already use SCR to control NOx emissions, enhanced SCR systems may be required to further reduce emissions. As confirmed by a local vendor, the cost of SCR systems to further reduce emissions including the SCR housing, catalyst, ammonia injection system, and ammonia flow control system could cost approximately $220,000. This information is used as a basis to estimate the annualized cost for this control technique.

Description of Cost	Cost Factor	Cost	Source
Direct Costs			
Purchase equipment costs (PE):			
SCR system	A	220,000	Boiler vendor
Instrumentation and controls	0.01 A	--	Included above

Description of Cost	Cost Factor	Cost	Source
Sales taxes	0.08 A	17,600	
Freight	0.05 A	11,000	OAQPS
Purchased equipment cost, PEC	B = 1.14 A	248,600	
Direct installation costs (DI):			
Foundation & supports	0.08 B	19,888	OAQPS
Handling and erection	0.14 B	34,804	OAQPS
Electrical	0.04 B	9,944	OAQPS
Piping	0.02 B	4,972	OAQPS
Insulation and ductwork:	0.01 B	2,486	OAQPS
Painting	0.01 B	2,486	OAQPS
Direct installation costs	0.30 B	74,580	
Site preparation	As required, SP	--	See table footnote
Buildings	As required, Bldg.	--	
Total Direct Costs, DC	1.30B + SP + Bldg.	323,180	
Indirect Costs (Installation)			
Engineering	0.10 B	24,860	OAQPS
Construction and field expenses	0.05 B	12,430	OAQPS
Contractor fees	0.10 B	24,860	OAQPS
Contingencies	0.03 B	7,458	OAQPS
Start-up	0.02 B	4,972	OAQPS
Performance test	0.01 B	2,486	OAQPS
Total indirect costs, IC	0.31 B	77,066	
Total Capital Investments (TCI = DC + IC):	**1.61 B + SP + Bldg.**	400,246	
Annualized TCI (10 years @ 10% interest)	0.1627 TCI	**65,120**	
Direct Annual Costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	0.015 TCI	6,004	OAQPS
Reagent costs (anhydrous ammonia)		--	Not estimated
Electricity cost	$0.08848/kWH	--	Not estimated
Catalyst replacement	--	--	Catalyst presumed to last at least over 10 years
Total DAC:		6,004	
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	0.01 TCI	4,002	OAQPS
Property tax	--	--	See table footnote
Administrative	--	--	See table footnote
Total IAC:		4,002	
Total Annual Cost (DAC + IAC)		10,006	
Total annual cost (Annualized TCI + Total annual cost)		**75,126**	

*Per EPA's Air Pollution Control Cost Manual (6th Edition), EPA/452/B-02-001 (1/02), operating and supervisory, overhead, administrative costs would be insignificant for an SCR system. In general, SCR does not require site preparation or additional buildings, and property taxes do not apply to capital improvements such as air pollution control equipment.

The potential NOx emission reduction for each category is determined by taking the difference between the potential emissions and the emissions that could be reliably achievable by an SCR system. SCR is expected to reliably achieve 5 ppmv NOx @ 3%

O2. The total cost for each category is determined by multiplying the number of units and $75,126 for a typical annual cost of an SCR system.

Type of unit	Number of units	Potential NOx Reductions with SCR Technology (tons/yr)	Total annualized cost of NOx Reductions with SCR Technology ($/yr)	Cost effectiveness ($/ton of emission reduction)
New and replacement units, 12 ppmv NOx	36 (35*+1**)	5.0 (4.9*+0.1**)	2,704,536	**$540,907/ton**
New and replacement units, 9 ppmv NOx	209 (192*+17**)	17.2 (15.8*+1.4**)	15,701,334	**$912,868/ton**
Existing units – gaseous fuel, 30 ppmv NOx	260 (244*+16**)	138.8 (132.4*+6.4**)	19,532,760	**$140,726/ton**
Existing units – gaseous fuel, low-use, ≤1.8 billion Btu/yr	102*	8.8*	7,662,852	**$870,779/ton**
Existing units – gaseous fuel, ≤5 billion Btu/yr	1*	--	--	--
Existing units – liquid fuel, ≤5 billion Btu/yr	1*	--	--	--
Existing units – gaseous fuel with diesel backup, 15 ppmv NOx	3**	0.8**	225,378	**$281,723/ton**
Existing units – gaseous fuel with diesel backup, 20 ppmv NOx	7**	2.7**	525,882	**$194,771/ton**
Miscellaneous – existing units with gaseous or liquid fuels	9**,***	--	--	--

*Active PEERs, **Active PTOs, ***4 units out of 9 units are dormant

Retrofitting with Ultra Low-NOx Burner

A boiler, steam generator, or process heater can be retrofitted with an ultra-low NOx burner (ULNB) to reliably achieve 9 ppmv NOx @ 3% O2. As provided by a local vendor, the cost of a ULNB would be about $70,000. However, retrofitting an existing boiler may not always be feasible and if feasible, it may involve upgrades to various systems such as fuel trains to comply with current codes, and upgrades to air intake fans, as these units require more air for the burner to operate at its optimum level. These additional items are not included in the calculations below, but can add considerable costs to the retrofit.

Description of Cost	Cost Factor	Cost	Source
Direct Costs			
Purchase equipment costs (PE):			
Burner system (replacement burner, controls, and fuel train systems)	A	77,000	Local vendor
Instrumentation and controls	0.01 A	--	Included above
Sales taxes	0.08 A	6,160	
Freight	0.05 A	3,850	OAQPS
Purchased equipment cost, PEC		87,010	
Direct installation costs (DI):			
Foundation & supports	0.08 B	--	See footnote

Description of Cost	Cost Factor	Cost	Source
Handling and erection	0.14 B	12,181	OAQPS
Electrical	0.04 B	3,480	OAQPS
Piping	0.02 B	1,740	OAQPS
Insulation and ductwork:	0.01 B	870	OAQPS
Painting	0.01 B	870	OAQPS
Direct installation costs		19,141	
Site preparation	As required, SP	--	See table footnote
Buildings	As required, Bldg.	--	
Total Direct Costs, DC		106,151	
Indirect Costs (Installation)			
Engineering	0.10 B	8,701	OAQPS
Construction and field expenses	0.05 B	4,351	OAQPS
Contractor fees	0.10 B	8,701	OAQPS
Contingencies	0.03 B	2,610	OAQPS
Start-up	0.02 B	1,740	OAQPS
Performance test	0.01 B	870	OAQPS
Total indirect costs, IC	0.31 B	26,973	
Total Capital Investments (TCI = DC + IC):		133,125	
Annualized TCI (10 years @ 10% interest)	0.1627 TCI	**21,659**	
Direct annual costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	--	--	
Electricity cost	$0.08848/kWH	--	Not estimated
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	--	--	See table footnote
Property tax	--	--	See table footnote
Administrative	--	--	See table footnote
Total Annual Cost (DAC + IAC)		--	
Total annual cost (annualized TCI + Total annual cost)		**21,659**	

*The existing foundation and supports will not be replaced; direct annual cost and indirect annual costs are presumed to be same as the existing burner

The potential NOx emission reduction for each category is determined by taking the difference between the potential emissions and the emissions that could be reliably achievable by a ULNB system. A ULNB is expected to reliably achieve 9 ppmv NOx @ 3% O2. Each unit is presumed to be operated for 8,760 hours per year at the maximum rated capacity. The total cost for each category is determined by multiplying the number of units and $21,659, a typical annual cost of a ULNB system.

Type of unit	Number of units	Potential NOx Reductions with ULNB Technology (tons/yr)	Total annualized cost of NOx Reductions with burner retrofit ($/yr)	Cost effectiveness ($/ton of emission reduction)
New and replacement units, 12 ppmv NOx	36 (35*+1**)	2.1 (2.1*+0.0*)	779,724	**$371,297/ton**
New and replacement units, 9 ppmv NOx	209 (192*+17**)	Not needed, units are already equipped with 9 ppmv burner		

Existing units – gaseous fuel, 30 ppmv NOx	260 (244*+16**)	116.6 (111.2*+5.4**)	5,631,340	**$48,296/ton**
Existing units – gaseous fuel, low-use, ≤1.8 billion Btu/yr	102*	8.3*	2,209,218	**$266,171/ton**
Existing units – gaseous fuel, ≤5 billion Btu/yr	1*	--	--	--
Existing units – liquid fuel, ≤5 billion Btu/yr	1*	--	--	--
Existing units – gaseous fuel with diesel backup, 15 ppmv NOx	3**	0.5**	64,977	**$129,954/ton**
Existing units – gaseous fuel with diesel backup, 20 ppmv NOx	7**	2.0**	151,613	**$75,807/ton**
Miscellaneous – existing units with gaseous or liquid fuels	9**,***	--	--	--

*Active PEERs, **Active PTOs, ***4 units out of 9 units are dormant

Replacing Older Unit with New Unit (Achieving 9 ppmv NOx)

Replacement of an older boiler in many cases may be the only way to reduce NOx emissions. New units can reliably achieve 9 ppmv NOx @ 3% O2. The cost of these units depends on the heat input rate, use of unit (steam, hot water, etc.), control system, and heat recovery systems (economizer etc.). Per a local vendor, the cost of a steam boiler rated at 5.0 MMBtu/hr (300 psi) would be $165,000. The majority (>90%) of the units are greater than 2.0 MMBtu/hr; therefore, it is reasonable to use this cost data for the cost effectiveness analysis.

Description of Cost	Cost Factor	Cost	Source
Direct Costs			
Purchase equipment costs (PE):			
Replacing an older unit	A	165,000	Local vendor
Instrumentation and controls	0.01 A	1,650	OAQPS
Sales taxes	0.08 A	13,200	
Freight	0.05 A	8,250	OAQPS
Purchased equipment cost, PEC		188,100	
Direct installation costs (DI):			
Foundation & supports	0.08 B	15,048	See footnote
Handling and erection	0.14 B	26,334	OAQPS
Electrical	0.04 B	7,524	OAQPS
Piping	0.02 B	3,762	OAQPS
Insulation and ductwork:	0.01 B	1,881	OAQPS
Painting	0.01 B	1,881	OAQPS
Direct installation costs		56,430	
Site preparation	As required, SP	--	See table footnote
Buildings	As required, Bldg.	--	
Total Direct Costs, DC		244,530	
Indirect Costs (Installation)			
Engineering	0.10 B	18,810	OAQPS
Construction and field expenses	0.05 B	9,405	OAQPS
Contractor fees	0.10 B	18,810	OAQPS

Description of Cost	Cost Factor	Cost	Source
Contingencies	0.03 B	5,643	OAQPS
Start-up	0.02 B	3,762	OAQPS
Performance test	0.01 B	1,881	OAQPS
Total indirect costs, IC	0.31 B	58,311	
Total Capital Investments (TCI = DC + IC):		302,841	
Annualized TCI (10 years @ 10% interest)	0.1627 TCI	**49,272**	
Direct annual costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	--	--	
Electricity cost	$0.08848/kWH	--	Not estimated
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	--	--	See table footnote
Property tax	--	--	See table footnote
Administrative	--	--	See table footnote
Total Annual Cost (DAC + IAC)		--	
Total annual cost (Annualized TCI + Total annual cost)		**49,272**	

*Direct annual cost and indirect annual costs are presumed to be same as the existing unit

The potential NOx emission reduction for each category is determined by taking the difference between the potential emissions and the emissions that could be reliably achievable by the use of a new unit equipped with a ULNB system. A ULNB is expected to reliably achieve 9 ppmv NOx @ 3% O2. Each unit is presumed to be operated for 8,760 hours per year at the maximum rated capacity. The total cost for each category is determined by multiplying the number of units and $49,272, a typical annual cost of a unit with a ULNB system.

Type of unit	Number of units	Potential NOx reductions w/ new unit equipped w/ ULNB Technology (tons/yr)	Total annualized cost of NOx reductions w/ new unit equipped w/ ULNB Technology ($/yr)	Cost effectiveness ($/ton of emission reduction)
New and replacement units, 12 ppmv NOx	36 (35*+1**)	2.1 (2.1*+0.0*)	1,773,792	**$844,663/ton**
New and replacement units, 9 ppmv NOx	209 (192*+17**)	Not needed, units equipped with 9 ppmv burner		
Existing units – gaseous fuel, 30 ppmv NOx	260 (244*+16**)	116.6 (111.2*+5.4**)	12,810,720	**$109,869/ton**
Existing units – gaseous fuel, low-use, ≤1.8 billion Btu/yr	102*	8.3*	5,025,744	**$605,511/ton**
Existing units – gaseous fuel, ≤5 billion Btu/yr	1*	--	--	--
Existing units – liquid fuel, ≤5 billion Btu/yr	1*	--	--	--

Existing units – gaseous fuel with diesel backup, 15 ppmv NOx	3**	0.5**	147,816	**$295,632/ton**
Existing units – gaseous fuel with diesel backup, 20 ppmv NOx	7**	2.0**	344,904	**$172,452/ton**
Miscellaneous – existing units with gaseous or liquid fuels	9**,***	--	--	--

*Active PEERs, **Active PTOs, ***4 units out of 9 units are dormant

Replacing Older Unit with New Unit and SCR System (Achieving 5 ppmv NOx)

The District confirmed with a boiler vendor that a boiler between 2.0-5.0 MMBtu/hr cannot achieve 5 ppmv NOx @ 3% O2 with the use of a ULNB alone. A new boiler must be equipped with an SCR system to reliably achieve 5 ppmv NOx for this heat input range. The capital cost of a new boiler with an SCR system is estimated to be at least $385,000.

Description of Cost	Cost Factor	Cost	Source
Direct Costs			
Purchase equipment costs (PE):			
New steam-boiler + SCR system to achieve 5 ppm	A	385,000	Local Vendor
Instrumentation and controls	0.01 A	3,850	OAQPS
Sales Taxes	0.08 A	30,800	
Freight	0.05 A	19,250	OAQPS
Purchased equipment cost, PEC		438,900	
Direct installation costs (DI):			
Foundation & supports	0.08 B	35,112	See footnote
Handling and erection	0.14 B	61,446	OAQPS
Electrical	0.04 B	17,556	OAQPS
Piping	0.02 B	8,778	OAQPS
Insulation and ductwork:	0.01 B	4,389	OAQPS
Painting	0.01 B	4,389	OAQPS
Direct installation costs		131,670	
Site preparation	As required, SP	--	See table footnote
Buildings	As required, Bldg.	--	
Total Direct Costs, DC		570,570	
Indirect Costs (Installation)			
Engineering	0.10 B	43,890	OAQPS
Construction and field expenses	0.05 B	21,945	OAQPS
Contractor fees	0.10 B	43,890	OAQPS
Contingencies	0.03 B	13,167	OAQPS
Start-up	0.02 B	8,778	OAQPS
Performance test	0.01 B	4,389	OAQPS
Total Indirect Costs, IC	0.31 B	136,059	
Total Capital Investments (TCI = DC + IC):		706,629	
Annualized TCI (10 years @ 10% interest)	0.1627 TCI	**114,969**	

Description of Cost	Cost Factor	Cost	Source
Direct Annual Costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	--	--	
Electricity cost	$0.08848/kWH	--	Not estimated
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	--	--	See table footnote
Property Tax	--	--	See table footnote
Administrative	--	--	See table footnote
Total Annual Cost (DAC + IAC)		--	
Total annual cost (Annualized TCI + Total annual cost)		**114,969**	

*Direct annual cost and indirect annual costs are presumed to be same as the existing unit

The potential NOx emission reduction for each category is determined by taking the difference between the potential emissions and the emissions that could be reliably achievable by the use of a new unit equipped with an SCR system. A unit with an SCR is expected to reliably achieve 5 ppmv NOx @ 3% O2. Each unit is presumed to be operated for 8,760 hours per year at the maximum rated capacity. The total cost for each category is determined by multiplying the number of units and $114,969, a typical annual cost of a unit with an SCR system.

Type of unit	Number of units	Potential NOx reductions w/ new unit equipped w/SCR Technology (tons/yr)	Total annualized cost of NOx reductions w/ new unit equipped w/ SCR Technology ($/yr)	Cost effectiveness ($/ton of emission reduction)
New and replacement units, 12 ppmv NOx	36 (35*+1**)	5.0 (4.9*+0.1**)	4,138,884	**$827,777/ton**
New and replacement units, 9 ppmv NOx	209 (192*+17**)	17.2 (15.8*+1.4**)	24,028,521	**$1,397,007/ton**
Existing units – gaseous fuel, 30 ppmv NOx	260 (244*+16**)	138.8 (132.4*+6.4**)	29,891,940	**$215,360/ton**
Existing units – gaseous fuel, low-use, ≤1.8 billion Btu/yr	102*	8.8*	11,726,838	**$1,332,595/ton**
Existing units – gaseous fuel, ≤5 billion Btu/yr	1*	--	--	--
Existing units – liquid fuel, ≤5 billion Btu/yr	1*	--	--	--
Existing units – gaseous fuel with diesel backup, 15 ppmv NOx	3**	0.8**	344,907	**$431,134/ton**
Existing units – gaseous fuel with diesel backup, 20 ppmv NOx	7**	2.7**	804,783	**$298,068/ton**
Miscellaneous – existing units with gaseous or liquid fuels	9**,***	--	--	--

*Active PEERs, **Active PTOs, ***4 units out of 9 units are dormant

Use of EMx System

The District researched post-combustion controls such as EMx, the second generation of the SCONOx technology that reduces NOx, SOx, CO, and VOC emissions. Per EmeraChem, manufacturer/vendor of the technology, this technology has not been achieved in practice for natural gas fired boilers. SCONOx and EMx systems have only been used by power plants for the control of turbine emissions. The cost of an EMx system would be anywhere from $3 to $5 million, or even up to $8 million in some cases for large power plant installations. Moreover, an EMx system is ideal for a new installation, but becomes extremely challenging and sometimes nearly impossible to retrofit to an existing unit. In fact, cost effectiveness analyses conducted by the District for the installation of SCONOx/EMx units on large power plant turbine installations within the Valley have shown that this technology is not cost effective. Given the high cost effectiveness demonstrated for turbines and lack of demonstrated practice with boilers, this technology is not feasible or cost effective for reducing emissions from this category.

Zero-Emission Opportunities

The District did not identify any feasible opportunities to require zero-emission technologies for units in the Valley. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

Based on this analysis, the District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

Rule 4307 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.9 RULE 4308 (BOILERS, STEAM GENERATORS, AND PROCESS HEATERS - 0.075 MMBTU/HR TO LESS THAN 2.0 MMBTU/HR)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	2.39	2.28	2.13	2.01	1.90	1.83	1.80
NOx	3.53	3.29	2.94	2.44	2.19	2.03	1.96
	Winter Average - Tons per day						
PM2.5	2.35	2.25	2.09	1.97	1.86	1.79	1.76
NOx	3.42	3.19	2.85	2.36	2.11	1.95	1.88

District Rule 4308 Description

The purpose of this rule is to limit NOx and CO emissions from units within this source category. As a point-of-sale rule, Rule 4308 achieves emissions reductions as operators with units subject to the rule replace their equipment over time. This point-of-sale approach allows the District to achieve NOx emission reductions without forcing immediate replacement of existing units to comply with rule requirements and thus placing an undo financial burden on the consumer. This rule has resulted in more than 93% control of emissions from this source category.

The District adopted Rule 4308 on October 20, 2005, to establish NOx emissions limits for units that were previously exempt from District regulations because of their small size. The rule was amended in December 2009 to lower the NOx emissions limits to 20 ppmv for units fired on natural gas, with the exception of instantaneous water heaters and pool heaters greater than or equal to 0.075 MMBtu/hr but less than or equal to 0.4 MMBtu/hr. The District subsequently amended Rule 4308 in 2013 to lower the NOx emission limit for instantaneous water heaters 0.075 MMBtu/hr to 0.4 MMBtu/hr to 20 ppmv.

How does District Rule 4308 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines or New Source Performance Standards applicable to this source category.

A. Alternative Control Techniques (ACT)

ACTs address potential emission control techniques for units with the potential to emit more than 25 tons of NOx per year. No units subject to District Rule 4308 have the potential to emit 25 tons per year; therefore, ACTs are not directly applicable to this source category. However, ACTs do discuss various control technologies, so the District has examined them.

- *Alternative Control Techniques Document – NOx Emissions from Process Heaters) (EPA-453/R-93-034 1993/09)*

The District evaluated the ACT for NOx Emissions from Process Heaters and found no applicable control requirements. As such, Rule 4308 is more stringent.

- *Alternative Control Techniques Document – NOx Emissions from Industrial/Commercial/Institutional Boilers (EPA-453/R-94-022 1994/03)*

The District evaluated the ACT for NOx Emissions from Industrial/Commercial/Institutional Boilers and found no applicable control techniques that were more stringent than those already in Rule 4308.

- *Alternative Control Techniques Document – NOx Emissions from Utility Boilers (EPA-453/R-94-023 1994/06)*

The District evaluated the ACT for NOx Emissions from Utility Boilers and found no applicable control techniques that were more stringent than those already in Rule 4308.

State Regulations

There are no state regulations that apply to this source category.

How does District Rule 4308 compare to rules in other air districts?

The District compared the emission limits, optional control requirements, and work practice standards in District Rule 4308 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 9, Rule 6 (Amended March 15, 2023)[74]
- Bay Area AQMD Regulation 9, Rule 7 (Amended May 4, 2011)[75]
- Bay Area AQMD Regulation 9, Rule 10 (Amended November 3, 2021)[76]

[74] BAAQMD. *Regulation 9, Rule 6 (Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters).* (Amended March 15, 2023). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230315_rg0906-pdf.pdf?la=en

[75] BAAQMD. *Regulation 9, Rule 7 (Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters).* (Amended May 4, 2011). Retrieved from: https://www.baaqmd.gov/rules-and-compliance/rules/reg-9-rule-7-nitrogen-oxides-and-carbon-monoxide-from-industrial-institutional-and-commercial-boiler

[76] BAAQMD. *Regulation 9, Rule 10 (Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators, and Process Heaters in Petroleum Refineries).* (Amended November 3, 2021). Retrieved from: https://www.baaqmd.gov/rules-and-compliance/rules/reg-9-rule-10-nitrogen-oxides-and-carbon-monoxide-from-boilers-steam-generators-and-process-heaters

- Sacramento Metropolitan AQMD Rule 411 (Amended August 23, 2007)[77]
- Sacramento Metropolitan AQMD Rule 414 (Amended October 25, 2018)[78]
- San Diego County APCD Rule 69.2.1 (Adopted July 8, 2020)[79]
- South Coast AQMD Rule 1146.2 (Amended December 7, 2018)[80]
- South Coast AQMD Rule 1147 (Amended May 6, 2022)[81]
- Ventura County APCD Rule 74.11.1 (Amended September 11, 2012)[82]
- Ventura County APCD Rule 74.15.1 (Amended June 23, 2015)[83]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4308 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

Bay Area AQMD

- BAAQMD Regulation 9, Rule 6 (Natural Gas-Fired Boilers and Water Heaters)

	SJVAPCD Rule 4308	BAAQMD Reg 9, Rule 6
Applicability	Boilers, steam generators and process heaters with rated heat input capacity ≥0.075 MMBtu/hr and <2 MMBtu/hr.	Any person who sells, installs, or offers for sale a natural gas-fired water heater and any manufacturer who intends to sell or distribute for sale or installation a natural gas-fired water heater.
Exemptions	• Units installed in manufactured homes • Units installed in recreational vehicles • Hot water pressure washers	• Units with rated heat input capacity >2 MMBtu/hr • Units used in recreational vehicles • Water heaters using a fuel other than natural gas • Natural gas-fired pool/spa heaters with <0.4 MMBtu/hr rated heat input capacity used exclusively to heat swimming pools, hot tubs or spas
Requirements	***NOx Emission Limits:** Units ≥0.075 to ≤0.4 MMBtu/hr (except instantaneous water heaters and pool heaters below):	***NOx Emission Limits:** Natural gas-fired boilers and instantaneous water heaters >0.075 to ≤0.4 MMBtu/hr: • 14 ng/J (20 ppmv) for units manufactured after Jan. 1, 2013;

[77] SMAQMD. *Rule 411 (NOx from Boilers, Process Heaters, and Steam Generators)*. (Amended August 23, 2007). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule411.pdf
[78] SMAQMD. *Rule 414 (Water Heaters, Boilers, and Process Heaters Rated Less Than 1,000,000 BTU Per Hour)*. (Amended October 25, 2018). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule414.pdf
[79] SDAPCD. *Rule 69.2.1 (Small Boilers, Process Heaters, Steam Generators, and Large Water Heaters)*. (Adopted July 8, 2020). Retrieved from: https://www.sdapcd.org/content/dam/sdapcd/documents/rules/current-rules/Rule-69.2.1.pdf
[80] SCAQMD. *Rule 1146.2 (Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters)*. (Amended December 7, 2018). Retrieved from: http://www.aqmd.gov/home/rules-compliance/rules/support-documents/rule-1146-2-details
[81] SCAQMD. *Rule 1147 (NOx Reductions from Miscellaneous Sources)*. (Amended May 6, 2022). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1147.pdf?sfvrsn=4
[82] VCAPCD. *Rule 74.11.1 (Large Water Heaters and Small Boilers)*. (Amended September 11, 2012). Retrieved from: http://vcapcd.org/Rulebook/Reg4/RULE%2074.11.1.pdf
[83] VCAPCD. *Rule 74.15.1 (Boilers, Steam Generators, and Process Heaters).* (Amended June 23, 2015). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.15.1.pdf

	SJVAPCD Rule 4308	BAAQMD Reg 9, Rule 6
	• PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Units >0.4 to <2 MMBtu/hr (except instantaneous water heaters and pool heaters below): • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu) Instantaneous water heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Instantaneous water heaters >0.4 to <2 MMBtu/hr: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Pool heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 55 ppmv (0.068 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Pool heaters >0.4 to <2 MMBtu/hr: • PUC gas: 20 ppmv (0.068 lb/MMBtu); • Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu)	• 0.0 ng/J of heat output for units manufactured after Jan. 1, 2031 Natural gas-fired boilers and instantaneous water heaters >0.4 to ≤2 MMBtu/hr: • 14 ng/J (20 ppmv) for units manufactured after Jan. 1, 2013; • 0.0 ng/J of heat output for units manufactured after Jan. 1, 2031 Natural gas-fired pool/spa heaters >0.4 to ≤2 MMBtu/hr: • 14 ng/J (20 ppmv) for units manufactured after Jan. 1, 2013

*Unless otherwise stated, all ppmv values in the table are ppmv @ 3% O2

BAAQMD Regulation 9, Rule 6 regulates NOx and CO emissions from natural gas-fired boilers and water heaters. The District compared the emission limits in District Rule 4308 and BAAQMD's Regulation 9, Rule 6 and concluded that NOx emission limits in the District rule are equivalent to the BAAQMD rule limits for similarly rated units at this time. For units manufactured after January 1, 2031, BAAQMD's NOx limit will be more stringent than SJVAPCD Rule 4308 limit for natural gas-fired boilers and water heaters rated at greater than 0.075 to 2 MMBtu/hr. Notably, this limit takes effect beyond the 2029 date by which the District is required to implement MSM. BAAQMD selected this future compliance date for the zero-NOx limit due to the current lack of available zero-emission technologies, and the complexities of installations of units in this category. For these reasons, BAAQMD's future limit cannot be considered as establishing MSM at this time.

- BAAQMD Regulation 9, Rule 10 (Boilers, Steam Generators and Process Heaters in Refineries)

BAAQMD amended Regulation 9, Rule 10 on November 3, 2021. The 2021 amendments were administrative and did not affect the stringency of rule requirements implemented prior to EPA's approval of the District meeting BACM/MSM for the *2018 PM2.5 Plan*. The District found no requirements in BAAQMD Regulation 9, Rule 10 that were more stringent than those in Rule 4308.

Sacramento Metropolitan AQMD

- SMAQMD Rule 414 (Water Heaters, Boilers and Process Heaters Rated Less than 1 MMBtu/hr)

	SJVAPCD Rule 4308	SMAQMD Rule 414
Applicability	Boilers, steam generators and process heaters with rated heat input capacity ≥0.075 MMBtu/hr and <2 MMBtu/hr.	Boilers, steam generators, and process heaters fired on gaseous or non-gaseous fuels with a rated capacity <1 MMBtu/hr.
Exemptions	• Units installed in manufactured homes • Units installed in recreational vehicles • Hot water pressure washers	• Water heaters in recreational vehicles • Pool/spa heaters <0.075 MMBtu/hr • Water heaters, boilers and process heater fired on LPG fuel • Hot water pressure washers fired with gaseous or liquid fuels
Requirements	***NOx Emission Limits:** <u>Units ≥0.075 to ≤0.4 MMBtu/hr (except instantaneous water heaters and pool heaters below)</u>: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) <u>Units >0.4 to <2 MMBtu/hr (except instantaneous water heaters and pool heaters below)</u>: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu) <u>Instantaneous water heaters ≥0.075 to ≤0.4 MMBtu/hr</u>: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) <u>Instantaneous water heaters >0.4 to <2 MMBtu/hr</u>: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) <u>Pool heaters ≥0.075 to ≤0.4 MMBtu/hr</u>: • PUC gas: 55 ppmv (0.068 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) <u>Pool heaters >0.4 to <2 MMBtu/hr</u>: • PUC gas: 20 ppmv (0.068 lb/MMBtu);	***NOx Emission Limits:** <u>Units ≥0.075 to <0.4 MMBtu/hr</u>: • Pool/spa units: 40 ng/J (55 ppmv); • All other units: 14 ng/J (20 ppmv) <u>Units ≥0.4 to <1 MMBtu/hr</u>: • 14 ng/J (20 ppmv)

	SJVAPCD Rule 4308	SMAQMD Rule 414
	• Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu)	

*Unless otherwise stated, all ppmv values in the table are ppmv @ 3% O2

The District evaluated the requirements contained within SMAQMD Rule 414, and found no requirements to be more stringent than those already in District Rule 4308. Therefore, District Rule 4308 is as stringent as or more stringent than SMAQMD Rule 414.

San Diego County APCD

- SDAPCD Rule 69.2.1 (Small Boilers, Process Heaters, Steam Generators, and Large Water Heaters)

	SJVAPCD Rule 4308	SDAPCD Rule 69.2.1
Applicability	Boilers, steam generators and process heaters with rated heat input capacity ≥0.075 MMBtu/hr and <2 MMBtu/hr.	Any person who manufactures, sells, offers for sale or distributes, or installs a new boiler, process heater, steam generator, or water heater with a heat input rating 75,000 Btu/hr to 2 MMBu/hr.
Exemptions	• Units installed in manufactured homes • Units installed in recreational vehicles • Hot water pressure washers	• Waste heat recovery boilers used to recover heat from the exhaust of gas turbines, internal combustion engines, or other combustion equipment • Furnaces, kilns, and any combustion equipment where the material being heated is in direct contact with the products of combustion • Thermal oxidizers and associated waste heat recovery equipment • Hot water pressure washers
Requirements	***NOx Emission Limits:** Units ≥0.075 to ≤0.4 MMBtu/hr (except instantaneous water heaters and pool heaters below): • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Units >0.4 to <2 MMBtu/hr (except instantaneous water heaters and pool heaters below): • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu) Instantaneous water heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Instantaneous water heaters >0.4 to <2 MMBtu/hr: • PUC gas: 20 ppmv (0.024 lb/MMBtu);	***NOx Emission Limits:** Units ≥0.075 to ≤0.4 MMBtu/hr (except pool heaters): • PUC gas: 20 ppmv; • Non-PUC or liquid: 77 ppmv Units >0.4 to <2 MMBtu/hr (except pool heaters): • PUC gas: 20 ppmv; • Non-PUC or liquid: 30 ppmv Pool heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 55 ppmv

	SJVAPCD Rule 4308	SDAPCD Rule 69.2.1
	• Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Pool heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 55 ppmv (0.068 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Pool heaters >0.4 to <2 MMBtu/hr: • PUC gas: 20 ppmv (0.068 lb/MMBtu); • Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu)	

*Unless otherwise stated, all ppmv values in the table are ppmv @ 3% O2

The District evaluated the requirements contained within SDAPCD Rule 69.2.1 and found no requirements to be more stringent than those already in District Rule 4308. Therefore, District Rule 4308 is as stringent as or more stringent than SDAPCD Rule 69.2.1.

South Coast AQMD

- SCAQMD Rule 1146.2 (Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters)

	SJVAPCD Rule 4308	SCAQMD 1146.2
Applicability	Boilers, steam generators and process heaters with rated heat input capacity ≥0.075 MMBtu/hr and <2 MMBtu/hr.	Natural gas-fired water heaters, boilers and process heaters with rated heat input capacity of ≤2 MMBtu/hr.
Exemptions	• Units installed in manufactured homes • Units installed in recreational vehicles • Hot water pressure washers	• Units used in recreational vehicles • Units subject to SCAQMD Rule 1121 (Control of NOx from Residential Type, Natural Gas-Fired Water Heaters) - applies to units rated at <0.075 MMBtu/hr • Units at a RECLAIM or former RECLAIM facility subject to a NOx limit in a different rule • Units at municipal sanitation service facility subject to a NOx limit in Reg XI adopted or amended after 12/07/18 • Exempt from some rule requirements: ○ Any residential unit ○ Units with >0.4 and ≤2 MMBtu/hr, demonstrated to use <9,000 therms during every calendar year
Requirements	***NOx Emission Limits:** Units ≥0.075 to ≤0.4 MMBtu/hr (except instantaneous water heaters and pool heaters below): • PUC gas: 20 ppmv (0.024 lb/MMBtu) Units >0.4 to <2 MMBtu/hr (except instantaneous water heaters and pool heaters below):	***NOx Emission Limits:** Units >0.4 to ≤2 MMBtu/hr: • 14 ng/J (20 ppmv) Units ≤0.4 MMBtu/hr (except pool heaters): • 14 ng/J (20 ppmv)

	SJVAPCD Rule 4308	SCAQMD 1146.2
	• PUC gas: 20 ppmv (0.024 lb/MMBtu) Instantaneous water heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 20 ppmv (0.024 lb/MMBtu) Instantaneous water heaters >0.4 to <2 MMBtu/hr: • PUC gas: 20 ppmv (0.024 lb/MMBtu) Pool heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 55 ppmv (0.068 lb/MMBtu) Pool heaters >0.4 to <2 MMBtu/hr: • PUC gas: 20 ppmv (0.068 lb/MMBtu)	

*Unless otherwise stated, all ppmv values in the table are ppmv @ 3% O2

The District evaluated the requirements contained within SCAQMD Rule 1146.2, and found no requirements to be more stringent than those already in District Rule 4308. Therefore, District Rule 4308 is as stringent as or more stringent than SCAQMD Rule 1146.2.

- SCAQMD Rule 1147 (NOx Reductions from Miscellaneous Sources)

	SJVAPCD Rule 4308	SCAQMD 1147
Applicability	Boilers, steam generators and process heaters with rated heat input capacity ≥0.075 MMBtu/hr and <2 MMBtu/hr.	Manufacturers, distributors, retailers, installers, owners, and operators of gaseous and/or liquid fuel fired combustion equipment with NOx emissions that require a SCAQMD permit and when other SCAQMD Regulation XI rules are not applicable to the unit.
Exemptions	• Units installed in manufactured homes • Units installed in recreational vehicles • Hot water pressure washers	• Units rated <325,000 Btu/hr • Charbroilers or food ovens • Flares subject to SCAQMD Rules 1118 or 1118.1 • Flares, afterburners, degassing units, thermal or catalytic oxidizers or vapor incinerators in which a fuel is used only to maintain a pilot for vapor ignition or is used for ≤5 minutes to bring a unit up to Minimum Operating Temperature • Municipal solid waste incinerators with permit operating before 12/05/08 • Afterburner or vapor incinerator with permit operating before 12/05/08 that has an integrated thermal fluid heat exchanger that captures heat from the afterburner or vapor incinerator and an oven or furnace exhaust in order to reduce fuel consumption by an oven or the afterburner or vapor incinerator

	SJVAPCD Rule 4308	SCAQMD 1147
		• Flare, afterburner, degassing unit, remediation unit, thermal oxidizer, catalytic oxidizer or vapor incinerator process in which PM, air toxics, VOCs, landfill gas, digester gas or other combustible vapors are mixed in the unit's burner with combustion air or fuel, including but not limited to natural gas, propane, butane or LPG, prior to or at incineration in the unit, in order to maintain vapor concentration above the upper explosion limit or a manufacturer specified limit in order to maintain combustion or temperature in the unit • Solid fuel-fired combustion equipment
Requirements	***NOx Emission Limits:** Units ≥0.075 to ≤0.4 MMBtu/hr: • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Units >0.4 to <2 MMBtu/hr (except instantaneous water heaters below): • Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu) Instantaneous water heaters >0.4 to <2 MMBtu/hr: • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu)	***NOx Emission Limits:** All liquid fuel-fired units: <1,200°F: 40 ppmv (0.053 lb/ MMBtu) ≥1,200°F: 60 ppmv (0.073 lb/ MMBtu)

*Unless otherwise stated, all ppmv values in the table are ppmv @ 3% O2

The District evaluated the requirements contained within SCAQMD Rule 1147 for liquid fuel-fired units, and found no requirements to be more stringent than those already in District Rule 4308. Therefore, District Rule 4308 is as stringent as or more stringent than SCAQMD Rule 1147.

Ventura County APCD

- VCAPCD Rule 74.15.1 (Boilers, Steam Generators, and Process Heaters)

	SJVAPCD Rule 4308	VCAPCD Rule 74.15.1
Applicability	Boilers, steam generators and process heaters with rated heat input capacity ≥0.075 MMBtu/hr and <2 MMBtu/hr.	Any gaseous fuel or liquid fuel fired boiler, steam generator, or process heater with a rated heat input capacity ≥1 MMBtu/hr and <5 MMBtu/hr.

Exemptions	• Units installed in manufactured homes
	• Units installed in recreational vehicles
	• Hot water pressure washers
		• Any unit operated on alternate fuel under following conditions:
		  ○ Alternate fuel use required due to natural gas curtailment period.
		  ○ Alternative fuel use is required to maintain the alternate fuel system,

	SJVAPCD Rule 4308	VCAPCD Rule 74.15.1
		and in this case use shall not exceed 50 hr/yr • Portable oil well dewaxing process heater is not subject to 30 ppmv NOx, if annual heat input rate is <2.8 billion Btu
Requirements	***NOx Emission Limits:** Units ≥0.075 to ≤0.4 MMBtu/hr (except instantaneous water heaters and pool heaters below): • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Units >0.4 to <2 MMBtu/hr (except instantaneous water heaters and pool heaters below): • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu) Instantaneous water heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Instantaneous water heaters >0.4 to <2 MMBtu/hr: • PUC gas: 20 ppmv (0.024 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Pool heaters ≥0.075 to ≤0.4 MMBtu/hr: • PUC gas: 55 ppmv (0.068 lb/MMBtu); • Non-PUC or liquid: 77 ppmv (0.093 lb/MMBtu) Pool heaters >0.4 to <2 MMBtu/hr: • PUC gas: 20 ppmv (0.068 lb/MMBtu); • Non-PUC or liquid: 30 ppmv (0.036 lb/MMBtu)	***NOx Emission Limits:** Units ≥1.8 billion Btu/yr: • 30 ppmv Units ≥1 to ≤2 MMBtu/hr: • 20 ppmv (natural gas-fired) Units ≥0.3 billion Btu/yr and <1.8 billion Btu/yr: Comply with one of the following: • Units shall be tuned every 6 months or after 750 hours of operation, but not less than once per calendar year; OR • The unit shall comply with the emission and testing requirements

*Unless otherwise stated, all ppmv values in the table are ppmv @ 3% O2

The District evaluated the requirements contained within VCAPCD Rule 74.15.1, and found no requirements to be more stringent than those already in District Rule 4308. Therefore, District Rule 4308 is as stringent as or more stringent than VCAPCD Rule 74.15.1.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District has evaluated the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

NOx Emission Control Technologies

Use of SCR system

SCR technology is predominantly used to reduce NOx emissions from large boilers, steam generators, and process heaters. Presuming units between 0.075 to <2 MMBtu/hr can be equipped with SCR system, the total annualized cost of deploying such technology would be at least $75,126 per year.[84]

Assuming an SCR system reliably reduces NOx emissions from 20 ppmv @ 3% O2 to 5 ppmv @ 3% O2 for a 1.99 MMBtu/hr unit that operates 8,760 hours per year, the potential reductions would be 310 lb/year[85] (0.155 tons-NOx/yr).

The cost of achieving these potential NOx reductions would be at least $484,684/ton of emissions reduced. As such, this technology is not cost effective for reducing emissions from this category.

Use of ULNB technology

ULNBs can reliably achieve at least 9 ppmv NOx @ 3% O2 and are available for units rated between 2-5 MMBtu/hr. Presuming that this technology is also available for small size boilers for a given application, a unit may be equipped with a ULNB system. Per a local vendor, the cost of a 2 MMBtu/hr boiler would be $35,000 for a hot water boiler. The cost effectiveness analysis is included below for this technology.

Description of Cost	Cost Factor	Cost	Source
Direct Costs			
Purchase equipment costs (PE):			
Burner system	A	$35,000	Local vendor
Instrumentation and controls	0.01 A	$350	OAQPS
Sales taxes	0.08 A	$2,828	
Freight	0.05 A	$1,750	OAQPS
Purchased equipment cost, PEC		$39,928	
Direct installation costs (DI):			
Foundation & supports	0.08 B	$3,194	OAQPS
Handling and erection	0.14 B	$5,590	OAQPS
Electrical	0.04 B	$1,597	OAQPS
Piping	0.02 B	$799	OAQPS
Insulation and ductwork:	0.01 B	$399	OAQPS
Painting	0.01 B	$399	OAQPS
Direct installation costs		$51,906	

[84] See Rule 4307 control measure analysis. Note that there is no significant price difference for an SCR system on 2-5 MMBtu/hr unit or smaller units.

[85] Potential NOx reduction = (0.024-0.0062) lb-NOx/MMBtu x 1.99 MMBtu/hr x 8,760 hr/yr = 310 lb-NOx/yr

Site preparation	As required, SP	--	See table footnote
Buildings	As required, Bldg.	--	
Total Direct Costs, DC		$51,906	

Description of Cost	Cost Factor	Cost	Source
Indirect Costs (Installation)			
Engineering	0.10 B	$3,993	OAQPS
Construction and field expenses	0.05 B	$1,996	OAQPS
Contractor fees	0.10 B	$3,993	OAQPS
Contingencies	0.03 B	$1,198	OAQPS
Start-up	0.02 B	$799	OAQPS
Performance test	0.01 B	$399	OAQPS
Total indirect costs, IC	0.31 B	$12,378	
Total Capital Investments (TCI = DC + IC):		**$64,284**	
Annualized TCI (10 years @ 10% interest)	0.1627 TCI	**$10,459**	
Direct annual costs (DAC)			
Operating and supervisory labor	--	--	See table footnote
Maintenance costs (labor and material)	--	--	
Electricity cost	--	--	Not estimated
Indirect Annual Costs (IAC)			
Overhead	--	--	See table footnote
Insurance	--	--	See table footnote
Property Tax	--	--	See table footnote
Administrative	--	--	See table footnote
Total Annual Cost (DAC + IAC)		--	
Total annual cost (Annualized TCI + Total annual cost)		**$10,459**	

*Direct annual cost and indirect annual costs are presumed insignificant for new units and will likely be same when existing unit is being replaced

Assuming a ULNB system reliably reduces NOx emissions from 20 ppmv @ 3% O2 to 9 ppmv @ 3% O2 for a 1.99 MMBtu/hr unit that operates 8,760 hours per year, the potential reductions would be 227 lb/year[86] (0.114 tons-NOx/yr).

The cost of achieving these potential NOx reductions would be at least $91,746/ton of emissions reduced. As such, this technology is not cost effective for reducing emissions from this category.

Use of EMx System

The District researched post-combustion controls such as EMx, the second generation of the SCONOx technology that reduces NOx, SOx, CO, and VOC emissions. Per EmeraChem, manufacturer/vendor of the technology, this technology has not been AIP for natural gas fired boilers. SCONOx and EMx systems have only been used by power plants for the control of turbine emissions. The cost of an EMx system would be anywhere from $3 to $5 million or even up to $8 million in some cases for large power plant installations. Moreover, the EMx system is ideal for new installation, but becomes extremely challenging and sometimes nearly impossible to retrofit to an existing unit. In

[86] Potential NOx reduction = (0.024 – 0.011) lb-NOx/MMBtu x 1.99 MMBtu/hr x 8,760 hr/yr = 227 lb-NOx/yr

fact, cost effectiveness analyses conducted by the District for the installation of SCONOx/EMx units on large power plant turbine installations within the Valley have shown that this technology is not cost effective. Given the high cost effectiveness demonstrated for turbines and lack of demonstrated practice with boilers, especially very small boilers such as those covered by this rule, this technology is not feasible or cost effective for reducing emissions from this category.

PM2.5 Emission Control Technologies

The majority of units 0.075 to less than 2 MMBtu/hr in the Valley combust PUC quality natural gas; PUC quality natural gas contains a very low sulfur content and inherently has low emissions. Few boilers in the Valley use alternative fuels for their combustion processes, which include digester gas, produced gas, and liquid fuel. Units fired on digester gas or produced gas are already required to use inlet gas scrubbers to meet District rule requirements. The District also explored the feasibility of adding PM2.5 limits for units using liquid fuel to reduce PM emissions as part of this comprehensive control measure evaluation.

The District evaluated three technologies as potential control options for reducing PM emissions: baghouses, ESPs, and wet scrubbers. Baghouses control total PM and PM2.5 emissions by 90-99%; ESPs control total PM and PM2.5 emissions by 90-99%; and wet scrubbers control large particulates (>PM5) by 99% and PM2.5 emissions by approximately 50%. Baghouses are typically not used with liquid-fired boilers due to the potential clogging of the baghouse and are therefore not a recommended technology due to infeasibility and safety issues.[87] Furthermore, the District is unaware of installations of these types of controls on the small boilers covered by this regulation, generally due to the extraordinary cost associated with doing so. See below for cost and cost effectiveness calculations for the other two technologies.

Potential Emissions Reductions

The District calculated the potential PM emissions reductions that could result from the use of an ESP and scrubber. For the purposes of these calculations, the following assumptions were made:

1. The analysis will evaluate the cost effectiveness of these technologies for total PM reductions from liquid fuel fired units.
2. The PM combustion EF = 0.024 lb/MMBtu, based on maximum permitted EF for boilers 2-5 MMBtu/hr with option to use diesel fuel during natural gas curtailment.
3. Max rating of burner = 1.99 MMBtu/hr and assumed to operate 8,760 hours/yr.
4. The PM control efficiency of an ESP is 99%.
5. The PM control efficiency of a scrubber is 99%.
6. Due to lack of units in the Valley, the analysis is based on one known unit.

The potential PM emissions reductions were calculated as follows:

[87] Northeast States for Coordinated Air Use Management. *Applicability and Feasibility of NOx, SO2, and PM Emissions Control Technologies for Industrial, Commercial, and Institutional (ICI) Boilers.* (November 2008). Retrieved from: https://www.nescaum.org/documents/ici-boilers-20081118-final.pdf

Potential Emissions Reductions $_{(ESP)}$ = (PM Emissions) x (Control Efficiency)
Potential Emissions Reductions $_{(ESP)}$ = (0.024 lb-PM/MMBtu x 1.99 MMBtu/yr x 8,760 hr/yr x ton/2,000 lb) tons/year x 0.99
Potential Emissions Reductions $_{(ESP)}$ = 0.209 tons/yr x 0.99
Potential Emissions Reductions $_{(ESP)}$ = 0.207 tons/year

Potential Emissions Reductions $_{(scrubber)}$ = (PM Emissions) x (Control Efficiency)
Potential Emissions Reductions $_{(scrubber)}$ = 0.209 tons/year x 0.99
Potential Emissions Reductions $_{(scrubber)}$ = 0.207 tons/year

Annualized Cost
The capital cost for the installation of an ESP for a 1-5 MMBtu/hr boiler ranges from \$90,000-\$100,000 and the annual maintenance cost ranges from \$1,000-\$2,000.[88] For the wet scrubber system, EPA estimated the annualized cost at \$5,300-\$102,000 per sm^3/sec at an average air flow rate of 0.7-47 sm^3/sec.[89] The following assumptions were made for this analysis:

1. The capital cost of an ESP is assumed to be the median of the range above (\$95,000).
2. The annual maintenance cost of an ESP is assumed to be the median of the range above (\$1,500).
3. The annualized cost of a wet scrubber system is assumed to be the median of the range above (\$53,650 per sm^3/sec).
4. The average air flow rate for a wet scrubber system is assumed to be the median of the range above (23.85 sm^3/sec).
5. The total capital and maintenance cost of an ESP will be calculated by multiplying the cost of 1 unit by the total number of units.
6. The total annualized cost of a wet scrubber will be calculated by multiplying the annualized cost of 1 unit by the total number of units.
7. Lifetime of the ESP is 10 years at 10% interest. To account for this, the annualized capital cost will be calculated by multiplying the total capital cost by the capital recovery factor of 0.1627 and adding the annual maintenance costs.

The annualized cost of an ESP and Wet Scrubber was calculated as follows:

Annual Cost $_{(ESP)}$ = (Total Capital Cost) x (0.1627) + (Annual Maintenance Cost)
Annual Cost $_{(ESP)}$ = (\$95,000 x 1) x (0.1627) + (\$1,500 x 1)
Annual Cost $_{(ESP)}$ = \$16,957/year

[88] Catherine Roberts. (March 2009). *Information on Air Pollution Control Technology for Woody Biomass Boilers.* Environmental Protection Agency Office of Air Quality Planning and Standards and Northeast States for Coordinated Air Use Management.
[89] EPA. (2002). *Air Pollution Control Technology Fact Sheet: Spray-Chamber/Spray-Tower Wet Scrubber.* Retrieved from: https://www3.epa.gov/ttncatc1/dir1/fsprytwr.pdf

Annual Cost $_{\text{(scrubber)}}$ = (Annualized Cost of 1 unit) x (Number of Units) x (Average Flow Rate)
Annual Cost $_{\text{(scrubber)}}$ = (\$53,650/ sm^3/sec) x (1) x (23.85 sm^3/sec)
Annual Cost $_{\text{(scrubber)}}$ = \$1,279,553/year

Cost Effectiveness
The cost effectiveness of an ESP and Wet Scrubber was calculated as follows:

Cost effectiveness = Annual Cost / Annual Emissions Reductions

Cost effectiveness $_{\text{(ESP)}}$ = (\$16,957/year) / (0.207 tons/year)
Cost effectiveness $_{\text{(ESP)}}$ = \$81,918/ton of PM

Cost effectiveness $_{\text{(scrubber)}}$ = (\$1,279,553/year) / (0.207 tons/year)
Cost effectiveness $_{\text{(scrubber)}}$ = \$6,181,413/ton of PM

As illustrated above, neither PM control technology is cost effective. Furthermore, the above calculations for ESP technology did not include costs of retrofitting equipment and/or the facility or compliance monitoring, thus the total costs for implementing this technology would be even higher than what is estimated here. The District concludes that this is not a feasible control measure for this source category.

Zero-Emission Opportunities

Electrification of Units
While electric alternatives to some water heaters and boilers are currently available, feasibility and cost issues have previously prevented widespread electrification around the nation given the significantly higher costs associated with electrical infrastructure and devices. To date, only one region (BAAQMD) has adopted zero-emission requirements for this category in their SIP and implementation does not begin until 2031, which is beyond the attainment date for this Plan. BAAQMD cites the complexities of installations in multifamily and larger commercial buildings where these units are typically installed as their reasoning for this delayed compliance date.[90] At this time, electrification requirements are not cost effective or feasible for sources subject to Rule 4308. Statewide action is critical for supporting the advancement and wide-scale deployment of zero-emission technologies.

In an effort to identify potential emission reduction opportunities, the District's *2022 Ozone Plan* includes a further study commitment to evaluate current and upcoming work from CARB and other agencies related to reducing emissions from residential and commercial combustion sources, and evaluate the feasibility of implementing zero-emission or low-NOx requirements for these sources in the Valley. Through this effort,

[90] BAAQMD. *Final Staff Report for the Proposed Amendments to Building Appliance Rules – Regulation 9, Rule 4: Nitrogen Oxides from Fan Type Residential Central Furnaces and Rule 6: Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters.* (March 2023). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230307_fsr_rules0904and0906-pdf.pdf?la=en

the District will also evaluate opportunities to advocate for funding under the Inflation Reduction Act, Bipartisan Infrastructure Law, and other funding sources, which are prioritizing funding opportunities for electrification of appliances to reduce greenhouse gas emissions. The District will continue to closely track regulations being developed by CARB, SCAQMD, BAAQMD, and others. Additionally, the District remains committed to pursuing zero-emission opportunities, taking into consideration equitable and feasible strategies.

Based on this review, the District did not identify additional emission reduction opportunities for this source category at this time.

Evaluation Findings

Rule 4308 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.10 RULE 4309 (DRYERS, DEHYDRATORS, AND OVENS)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.78	0.77	0.76	0.75	0.74	0.74	0.74
NOx	0.29	0.29	0.29	0.28	0.28	0.28	0.28
	Winter Average - Tons per day						
PM2.5	0.78	0.77	0.76	0.74	0.73	0.73	0.74
NOx	0.26	0.26	0.26	0.26	0.25	0.25	0.25

District Rule 4309 Description

The District adopted Rule 4309 on December 15, 2005, to limit NOx and CO emissions from dryers, dehydrators, or ovens fired on gaseous, liquid, or gaseous and liquid fuel sequentially that have a total rated heat input for the unit of 5.0 MMBtu/hr or greater. The rule limits NOx emissions to between 3.5-12 ppmv for four categories of equipment. The adoption of Rule 4309 has considerably reduced NOx emissions from this source category.

How does District Rule 4309 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines or New Source Performance Standards applicable to this source category.

A. Alternative Control Techniques (ACT)

- *Alternative Control Techniques Document – NOx Emissions from Cement Manufacturing (EPA-453/R-94-004 1994/03)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Cement Manufacturing and found no applicable requirements that would be more stringent than those already in Rule 4309.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4309 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4309 to comparable requirements in rules from the following California nonattainment areas:

- Sacramento Metropolitan AQMD Rule 419 (Amended October 25, 2018)[91]
- South Coast AQMD Rule 1147 (Amended May 6, 2022)[92]
- South Coast AQMD Rule 1147.1 (Adopted August 6, 2021)[93]
- Ventura County APCD Rule 74.34 (Adopted December 13, 2016)[94]

Bay Area AQMD does not have an analogous rule for this source category.

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4309 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

Sacramento Metropolitan AQMD

- SMAQMD Rule 419 (NOx from Miscellaneous Combustion Units)

	SJVAPCD Rule 4309	SMAQMD Rule 419
Applicability	Dryer, dehydrator, or oven that is fired on gaseous fuel, liquid fuel, or is fired on gaseous and liquid fuel sequentially, and the total rated heat input for the unit is ≥5 MMBtu/hr.	Any misc. combustion units and cooking units with a total rated heat input capacity of ≥2 MMBtu/hr located at a major stationary source of NOx, and any misc. combustion unit or cooking unit with a total rated heat input capacity of ≥5 MMBtu/hr not located at a major stationary source of NOx.
Exemptions	• Column-type or tower dryers used to dry grains, or tree nuts • Units to pre-condition onions or garlic prior to dehydration • Smokehouses or units used for roasting • Units to bake or fry food for human consumption • Charbroilers • Units used to dry lint cotton or cotton at cotton gins • Units with no stack for the exhaust gas and one or more sides open to the atmosphere	• Operations subject to SMAQMD rules for: ○ Boilers, process heaters, and steam generators ○ Stationary IC engines at major sources ○ Stationary gas turbines ○ Water heaters, boilers, and process heaters <1 MMBtu/hr • Units exempt from SMAQMD general permit requirements • Air pollution control devices • Duct burners • Specific combustion units: ○ Any unit that is used exclusively by an electric utility to generate electricity

[91] SMAQMD. *Rule 419 (NOx from Miscellaneous Combustion Units)*. (Amended October 25, 2018). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule419.pdf
[92] SCAQMD. *Rule 1147 (NOx Reductions from Miscellaneous Sources)*. (Amended May 6, 2022). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1147.pdf?sfvrsn=4
[93] SCAQMD. *Rule 1147.1 (NOx Reductions from Aggregate Dryers)*. (Adopted August 6, 2021). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1147-1.pdf?sfvrsn=7
[94] VCAPCD. *Rule 74.34 (NOx Reductions from Miscellaneous Sources)*. (Adopted December 13, 2016). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.34.pdf

<table>
<tr><th></th><th colspan="2">SJVAPCD Rule 4309</th><th colspan="2">SMAQMD Rule 419</th></tr>
<tr><td></td><td colspan="2">• Units subject to District Rules 4305, 4306, 4307, or 4351</td><td colspan="2">○ Gas flares
○ Internal combustion engines
○ Cooking units
○ Crematories
○ Dryers used in asphalt manufacturing operations
○ Furnaces
○ Incinerators
○ Kilns
○ Roasters</td></tr>
<tr><td rowspan="9">Requirements (NOx Limits)</td><td colspan="4">Gaseous Fuel-Fired Equipment</td></tr>
<tr><td colspan="2">ppmv corrected to 19% O2, dry unless otherwise specified</td><td colspan="2">ppmv corrected to 3% O2, dry unless otherwise specified</td></tr>
<tr><td>Dehydrators</td><td>-</td><td>Dehydrator, Dryer, Heater, or Oven</td><td><u><1,200°F</u>
30 ppmv or 0.036 lb/MMBtu (3.3 ppmvd @ 19% O2)

<u>≥1,200°F</u>
60 ppmv or 0.073 lb/MMBtu (6.5 ppmvd @ 19% O2)</td></tr>
<tr><td>Asphalt/Concrete Plants</td><td>4.3 ppmv (0.0492 lb/MMBtu)</td><td>-</td><td>-</td></tr>
<tr><td>Milk, Cheese and Dairy Processing (<20 MMBtu/hr)</td><td>3.5 ppmv (0.04 lb/MMBtu)</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>Milk, Cheese and Dairy Processing (≥20 MMBtu/hr)</td><td>5.3 ppmv (0.061 lb/MMBtu)</td></tr>
<tr><td>Other processes not described above</td><td>4.3 ppmv (0.0492 lb/MMBtu)</td><td>-</td><td>-</td></tr>
<tr><td colspan="4">Liquid Fuel-Fired Equipment</td></tr>
<tr><td>All Liquid Fuel-Fired Units</td><td>Varies from 3.5 ppmv to 12 ppmv (0.04 lb/MMBtu to 0.14 lb/MMBtu)</td><td>All misc. combustion units when liquid fuel-fired</td><td><u><1,200°F</u>
40 ppmv or 0.051 lb/MMBtu (4.3 ppmvd @ 19% O2)

<u>≥1,200°F</u>
60 ppmv or 0.073 lb/MMBtu (6.5 ppmvd @ 19% O2)</td></tr>
</table>

SMAQMD Rule 419 establishes emission limits based on the process temperature and does not consider the equipment categories, whereas District Rule 4309 does not consider the process temperature and instead establishes emissions limits based on the equipment categories. Under SMAQMD's Rule 419, the NOx limits vary from 3.3 to 6.5 ppmv at 19% O2 with an average of 4.9 ppmv, while District Rule 4309 limits NOx emissions from 3.5 to 5.3 ppmv with most categories limited to 4.3 ppmv at 19% O2, independent of the process temperature. Overall, District Rule 4309 is as stringent as or more stringent than SMAQMD Rule 419.

South Coast AQMD

- SCAQMD Rule 1147 (NOx Reductions from Miscellaneous Sources)

<table>
<tr><th></th><th colspan="2">SJVAPCD Rule 4309</th><th colspan="2">SCAQMD Rule 1147</th></tr>
<tr><td>Applicability</td><td colspan="2">Dryer, dehydrator, or oven that is fired on gaseous fuel, liquid fuel, or is fired on gaseous and liquid fuel sequentially, and the total rated heat input for the unit is ≥5 MMBtu/hr.</td><td colspan="2">Manufacturers, distributors, retailers, installers, owners, and operators of gaseous and/or liquid fuel fired combustion equipment with NOx emissions that require a SCAQMD permit and when other SCAQMD Regulation XI rules are not applicable to the unit.</td></tr>
<tr><td>Exemptions</td><td colspan="2">• Column-type or tower dryers used to dry grains, or tree nuts
• Units to pre-condition onions or garlic prior to dehydration
• Smokehouses or units used for roasting
• Units to bake or fry food for human consumption
• Charbroilers
• Units used to dry lint cotton or cotton at cotton gins
• Units with no stack for the exhaust gas and one or more sides open to the atmosphere
• Units subject to District Rules 4305, 4306, 4307, or 4351</td><td colspan="2">• Units rated <325,000 Btu/hr
• Charbroilers or food ovens
• Flares subject to SCAQMD Rules 1118 or 1118.1
• Flares, afterburners, degassing units, thermal or catalytic oxidizers or vapor incinerators in which a fuel is used only to maintain a pilot for vapor ignition or is used for ≤5 minutes to bring a unit up to Minimum Operating Temperature
• Municipal solid waste incinerators with permit operating before 12/05/08
• Afterburner or vapor incinerator with permit operating before 12/05/08 that has an integrated thermal fluid heat exchanger that captures heat from the afterburner or vapor incinerator and an oven or furnace exhaust in order to reduce fuel consumption by an oven or the afterburner or vapor incinerator
• Flare, afterburner, degassing unit, remediation unit, thermal oxidizer, catalytic oxidizer or vapor incinerator process in which PM, air toxics, VOCs, landfill gas, digester gas or other combustible vapors are mixed in the unit's burner with combustion air or fuel, including but not limited to natural gas, propane, butane or LPG, prior to or at incineration in the unit, in order to maintain vapor concentration above the upper explosion limit or a manufacturer specified limit in order to maintain combustion or temperature in the unit
• Solid fuel-fired combustion equipment</td></tr>
<tr><td rowspan="5">Requirements (NOx Limits)</td><td colspan="4">Gaseous Fuel-Fired Equipment</td></tr>
<tr><td colspan="2">(ppmv corrected to 19% O2, dry unless otherwise specified)</td><td colspan="2">(ppmv corrected to 3% O2, dry unless otherwise specified)</td></tr>
<tr><td>Dehydrators</td><td>-</td><td rowspan="3">Oven, Dehydrator, Dryer</td><td rowspan="3"><u><1,200°F</u>:
20-30 ppmv (0.024-0.036 lb/ MMBtu)

<u>≥1,200°F</u>:
30-60 ppmv (0.036-0.073 lb/ MMBtu)</td></tr>
<tr><td>Milk, Cheese and Dairy Processing (<20 MMBtu/hr)</td><td>3.5 ppmv (0.04 lb/MMBtu)</td></tr>
<tr><td>Milk, Cheese and Dairy Processing (≥20 MMBtu/hr)</td><td>5.3 ppmv (0.061 lb/MMBtu)</td></tr>
</table>

	SJVAPCD Rule 4309		SCAQMD Rule 1147	
	Asphalt/Concrete Plants	4.3 ppmv (0.0492 lb/MMBtu)	See evaluation for SCAQMD Rule 1147.1 below.	
	Other processes not described above	4.3 ppmv (0.0492 lb/MMBtu)	Burn-off Furnace or Burnout Oven	30-60 ppmv (0.036-0.073 lb/MMBtu)
			Tenter Frame or Fabric or Carpet Dryer	20-30 ppmv (0.024-0.036 lb/MMBtu)
			Rotary Dryer	30 ppmv (0.036 lb/MMBtu)
	Liquid Fuel-Fired Equipment			
	All Liquid Fuel-Fired Units	Varies from 3.5-12 ppmv (0.04-0.14 lb/MMBtu)	All Liquid Fuel-Fired Units	≤1,200°F: 40 ppmv (0.053 lb/MMBtu) ≥1,200°F: 60 ppmv (0.073 lb/MMBtu)

District Rule 4309 has previously been established as being at least as stringent as SCAQMD Rule 1147. The recently adopted SCAQMD Rule 1147 (Adopted May 6, 2022) maintained previous emission limits for existing units, which are consistent with the District's limits, and established lower limits for some categories of units that are phased in based on a unit's age. These newer limits are required after July 1, 2023 when a unit reaches up to 32 years of age, extending the compliance date for these limits to as late as June 30, 2055. Notably, the emission levels established within SCAQMD Rule 1147 are not demonstrated to be achieved in practice or adopted in any other regions, and therefore go beyond MSM levels of control.

- SCAQMD Rule 1147.1 (NOx Reductions from Aggregate Dryers)

	SJVAPCD Rule 4309		SCAQMD Rule 1147.1	
Applicability	Any dryer, dehydrator, or oven that is fired on gaseous fuel, liquid fuel, or is fired on gaseous and liquid fuel sequentially, and the total rated heat input for the unit is ≥5 MMBtu/hr.		Owners or operators of gaseous fuel-fired aggregate dryers with NOx emissions ≥1 lb/day with rated heat input ≥2 MMBtu/hr.	
Requirements	Asphalt/Concrete Plants	4.3 ppmvd @ 19% O2	Aggregate Dryers	30-40 ppmvd @ 3% O2 (3.3-4.3 ppmvd @ 19% O2)

District Rule 4309 has previously been established as being at least as stringent as SCAQMD Rule 1147. The recently adopted SCAQMD Rule 1147.1 (Adopted August 6, 2021) established separate requirements for gaseous-fueled aggregate dryers previously subject to SCAQMD Rule 1147. Rule 1147.1 maintained the previous emission limit for existing units, which is consistent with the District's limit, and established a lower limit to be phased in based on burner age. This newer limit is required when a unit reaches up to 32 years of age. Notably, the emission levels established within SCAQMD Rule 1147.1 are not demonstrated to be achieved in practice or adopted in any other regions, and therefore go beyond MSM levels of control.

Ventura County APCD

- VCAPCD Rule 74.34 (NOx Reductions from Miscellaneous Sources)

<table>
<tr><th></th><th colspan="2">SJVAPCD Rule 4309</th><th colspan="2">VCAPCD Rule 74.34</th></tr>
<tr><td>Applicability</td><td colspan="2">Dryer, dehydrator, or oven that is fired on gaseous fuel, liquid fuel, or is fired on gaseous and liquid fuel sequentially, and the total rated heat input for the unit is ≥5 MMBtu/hr.</td><td colspan="2">Dryers, furnaces, heaters, incinerators, kilns, ovens, and duct burners. This rule applies to any unit where the total rated heat input for the unit is ≥5 MMBtu/hr.</td></tr>
<tr><td>Exemptions</td><td colspan="2">• Column-type or tower dryers used to dry grains, or tree nuts
• Units to pre-condition onions or garlic prior to dehydration
• Smokehouses or units used for roasting
• Units to bake or fry food for human consumption
• Charbroilers
• Units used to dry lint cotton or cotton at cotton gins
• Units with no stack for the exhaust gas and one or more sides open to the atmosphere
• Units subject to District Rules 4305, 4306, 4307, or 4351</td><td colspan="2">• Combustion equipment whose primary function is to operate as an air pollution control device
• Duct burners operating upstream of and controlled by a properly working SCR add-on NOx control unit
• Gas flares
• External combustion equipment subject to VCAPCD Rule 74.15 (Boilers, Steam Generators, and Process Heaters)</td></tr>
<tr><td rowspan="8">Requirements (NOx Limits)</td><td colspan="2">SJVAPCD Rule 4309</td><td colspan="2">VCAPCD Rule 74.34</td></tr>
<tr><td colspan="2">(ppmv corrected to 19% O2, dry unless otherwise specified)</td><td colspan="2">(ppmv corrected to 3% O2, dry unless otherwise specified)</td></tr>
<tr><td>Dehydrators</td><td>-</td><td colspan="2">Dehydrators not listed under applicability of the rule.</td></tr>
<tr><td>Asphalt/Concrete Plants</td><td>4.3 ppmv
(0.0492 lb/MMBtu)</td><td colspan="2">40 ppmv or 0.048 lb/MMBtu
(4.3 ppmvd @ 19% O2)</td></tr>
<tr><td>Milk, Cheese and Dairy Processing (<20 MMBtu/hr)</td><td>3.5 ppmv
(0.04 lb/MMBtu)</td><td colspan="2" rowspan="2">Equipment not listed, so it would be subject to emission limits of other processes (the last category listed below).</td></tr>
<tr><td>Milk, Cheese and Dairy Processing (≥20 MMBtu/hr)</td><td>5.3 ppmv
(0.061 lb/MMBtu)</td></tr>
<tr><td rowspan="2">Other processes not described above</td><td rowspan="2">4.3 ppmv
(0.0492 lb/MMBtu)</td><td>Sand and Gravel Processing (dryers)</td><td rowspan="2">40 ppmv or 0.048 lb/MMBtu
(4.3 ppmvd @ 19% O2)</td></tr>
<tr><td>Paper Products Manufacturing (Hot Air Furnace, Duct Burner, Paper Dryer)</td></tr>
</table>

	SJVAPCD Rule 4309		VCAPCD Rule 74.34	
			Metal Heat Treatment/Metal Melting Furnace	60 ppmv or 0.072 lb/MMBtu (6.5 ppmvd @ 19% O2)
			Kiln	80 ppmv or 0.096 lb/MMBtu (8.7 ppmvd @ 19% O2)
			Oven, Dryer (besides asphalt, sand or paper dryer), Heater, Incinerator, Other Furnaces, or Other Duct Burner	<1,200°F: 30 ppmv or 0.036 lb/MMBtu (3.3 ppmvd @ 19% O2) ≥1,200°F: 60 ppmv or 0.072 lb/MMBtu (6.5 ppmvd @ 19% O2)

VCAPCD Rule 74.34 establishes emission limits based on the process temperature whereas District Rule 4309 does not consider the process temperature and instead establishes emissions limits based on the equipment categories. Where the rules can be compared, the District rule is more stringent in several categories, such as metal heat treatment, metal melting furnace, kiln, etc. In other categories, the NOx limits under the VCAPCD rule vary from 3.3 to 6.5 ppmv at 19% O2 with an average of 4.9 ppmv, while District Rule 4309 limits NOx emissions from 3.5 to 5.3 ppmv with most categories limited to 4.3 ppmv at 19% O2, independent of the process temperature. Therefore, overall, District Rule 4309 is as stringent as or more stringent than VCAPCD Rule 74.34.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District reviewed the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

Zero-Emission Opportunities

The District did not identify any instances of zero-emissions technology being required or installed for these types of units. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

Based on this review, the District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

Rule 4309 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.11 RULE 4311 (FLARES)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.17	0.17	0.17	0.13	0.13	0.13	0.13
NOx	0.52	0.51	0.50	0.30	0.30	0.30	0.30
	Winter Average - Tons per day						
PM2.5	0.17	0.17	0.17	0.13	0.13	0.13	0.13
NOx	0.52	0.51	0.50	0.30	0.30	0.30	0.30

District Rule 4311 Description

District Rule 4311 applies to any operation involving the use of a flare. This source category currently includes flares associated with oil and gas production, methane and VOC gases extracted from landfills, municipal sewage treatment, wastewater treatment at food production facilities, petroleum refining, and VOC control of blowing agents at plastics product manufacturing. Flaring is a high temperature oxidation process used to burn combustible components, mostly hydrocarbons, of waste gases from industrial operations. 95% of the waste gases flared are natural gas, propane, pentane, ethylene, propylene, butadiene, and butane. Rule 4311 contains operational requirements, flare minimization requirements for certain flares, and NOx and VOC emission limits for enclosed flares and any flare used over industry-based thresholds.

Based on a comprehensive technical analysis, in-depth review of local, state, and federal regulations, and a robust public process, the District adopted amendments to Rule 4311 in December 2020 to reduce emissions from flaring in the Valley. These amendments removed the exemptions for flares operating at non-major source facilities as well as at landfills, and established low-NOx emissions limits for multiple categories of facilities with flares used over specified annual flaring throughput thresholds.

The 2020 amendments to Rule 4311 were designed to encourage flare operators to find beneficial alternative uses of gas combusted, or to deploy the cleanest flaring technologies to achieve additional NOx emission reductions from this sector. Specific limits were established depending on the applicability of the ultra-low NOx (ULN) technology to different flaring processes with industry specific considerations. The installation of ULN flare technology is required for flares that combust the majority of gas in the Valley. This requires installation of ULN flares associated with 65% of total gas flared from all categories. Operators of flares subject to Rule 4311 are required to either demonstrate flare use below annual throughput thresholds specific to the type of facility, or meet flare emissions limits appropriate to the facility type.

The District evaluated various approaches to determining thresholds to require flare operators to take action to reduce emissions. The only other rule in the nation requiring ultra-low NOx flares is South Coast Air Quality Management District (SCAQMD) Rule

1118.1. SCAQMD Rule 1118.1 sets thresholds for action based on a percentage of capacity used annually. Applying a percentage-based approach would have excluded some of the most highly used flares in the Valley. As an alternative to this approach, the District evaluated a set of annual throughput thresholds by flare type, with the goal of achieving emissions reductions in greater quantity and more cost effectively than those achievable under the approach included in SCAQMD Rule 1118.1. The approach included in the District's amended rule is estimated to achieve a 37.2% reduction in NOx emissions and 19.4% reduction in PM2.5 emissions from flares. These emissions reductions are greater than reductions achieved by the approach included in SCAQMD Rule 1118.1 at approximately half the cost, by focusing on flares with the highest usage, resulting in a more effective rule.

The Rule 4311 emission limits were established based on the currently available control technologies that have been proven to be technologically feasible for each specific type of flaring operation, taking into consideration the gas composition and flow. Operators of flares that exceed the annual throughput thresholds must install a ULN flare/incinerator that meets these low emission limits, or else implement a beneficial use project to otherwise reduce flaring activity at the facility. Compliance dates within the rule ensure emission reductions are achieved in 2024 and 2025, as committed to in the *2018 PM2.5 Plan*, to support attainment of the PM2.5 standards.

The District adopted these amendments to reduce emissions from flaring in the Valley by requiring operators to install the cleanest ultra-low NOx flaring/incineration technology, and encouraging operators to seek beneficial uses for waste gas, rather than flaring in the most cost effective manner. The ultra-low NOx flaring technology represents the lowest emission flares/incinerators available, and this requirement makes Rule 4311 the most stringent flare rule in the nation.

How does District Rule 4311 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines or Alternative Control Techniques applicable to this source category.

A. New Source Performance Standards (NSPS)

- *40 CFR 60.18 – General Control Device and Work Practice Requirements (2008/12)*
- *40 CFR 65.147 – Flares (2000/12)*
- *40 CFR 60 Subpart OOOOa – Standards of Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification, or Reconstruction Commenced After September 15, 2015 (2016/06)*
- *40 CFR 60 Subpart Ja – Standards of Performance for Petroleum Refineries for Which Construction, Reconstruction, or Modification Commenced After May 14, 2007 (2013/12)*

The District evaluated the requirements contained within the NSPS above, and found no requirements that were more stringent than those already in Rule 4311.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4311 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4311 to comparable requirements in rules from the following nonattainment areas:

- Bay Area AQMD Regulation 12, Rule 11 (Amended November 3, 2021)[95]
- Bay Area AQMD Regulation 12, Rule 12 (Amended November 3, 2021)[96]
- San Diego County APCD Rule 69.7 (Adopted March 9, 2023)[97]
- Santa Barbara County APCD Rule 359 (Amended June 28, 1994)[98]
- South Coast AQMD Rule 1118 (Amended January 6, 2023)[99]
- South Coast AQMD Rule 1118.1 (Adopted January 4, 2019)[100]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4311 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

Bay Area AQMD

- BAAQMD Regulation 12, Rule 11 (Flare Monitoring at Refineries)
- BAAQMD Regulation 12, Rule 12 (Flares at Refineries)

The District's Rule 4311 includes requirements that correspond to both BAAQMD Regulation 12 Rules 11 and 12. Therefore, the following table compares District Rule 4311 to the requirements from both BAAQMD rules.

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[95] BAAQMD. *Regulation 12, Rule 11 (Flare Monitoring at Refineries).* (Amended November 3, 2021). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/refinery-rules-definitions/rg1211_20211103-pdf.pdf?la=en&rev=694ca947de004a788d889ad213e7955b

[96] BAAQMD. *Regulation 12, Rule 12 (Flares at Refineries).* (Amended November 3, 2021). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/refinery-rules-definitions/rg1212_20211103-pdf.pdf?la=en&rev=7db93f23469747fc8eca3b3f2dc773ff

[97] SDAPCD. *Rule 69.7 (Landfill Gas Flares)*. (Adopted March 9, 2023). Retrieved from: https://www.sdapcd.org/content/dam/sdapcd/documents/rules/current-rules/Rule-69.7.pdf

[98] SBCAPCD. *Rule 359 (Flares and Thermal Oxidizers).* (Adopted June 28, 1994). Retrieved from: https://ww2.arb.ca.gov/sites/default/files/classic/technology-clearinghouse/rules/RuleID2475.pdf

[99] SCAQMD. *Rule 1118 (Control of Emissions from Refinery Flares).* (Amended January 6, 2023). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1118.pdf?sfvrsn=4

[100] SCAQMD. *Rule 1118.1 (Control of Emissions from Non-Refinery Flares).* (Adopted January 4, 2019). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/R1118-1.pdf?sfvrsn=9

	SJVAPCD Rule 4311	BAAQMD Reg 12, Rule 11 BAAQMD Reg 12, Rule 12
Applicability	All flares.	Flares used at refineries.
Exemptions	• Flares operated at municipal solid waste landfills that combust <2,000 MMscf of landfill gas per calendar year and that have ceased accepting waste • Flares that combust only propane, butane, or a combination of propane and butane • Flares used for well testing, tank degassing, and pipeline degassing operations • Flares that combust regeneration gas	• Flares and thermal oxidizers used for: ○ Emissions from organic liquid storage vessels (subj. to R. 8-5) ○ Emissions from loading racks (subj. to R. 8-6, 8-33, or 8-39) ○ Emissions from marine vessel loading terminals (subj. to R. 8-44) • Thermal oxidizers used for: ○ Emissions from wastewater treatment systems (subj. to R. 8-8) ○ Emissions from pump seals (subj. to R. 8-18) (except when emissions from pump are routed to flare header) <u>Reg 12, Rule 11 Only</u>: • Monitoring and reporting total HC or methane composition doesn't apply to flare that burns flexicoker gas if weekly sampling shows methane/non-methane content of vent gas flared is <2%/<1% by volume.
Requirements	Requires flare operators to limit flare operation not to exceed flare throughput threshold based on vocation for 2 consecutive years or meet NOx limits: • Flares used at oil and gas operations, and chemical operations: 25,000 MMBtu/yr or 0.005 lb-VOC/MMBtu, 0.018 lb-NOx/MMBtu; • Flares at landfill operations: 90,000 MMBtu/yr or 0.038 lb-VOC/MMBtu and 0.025 lb-NOx/MMBtu; • Flares at digester operations at a major source facility: 100,000 MMBtu/yr or 0.038 lb-VOC/MMBtu and 0.025 lb-NOx/MMBtu; • Flares at digester operations not at a major source facility: 100,000 MMBtu/yr or 0.060 lb-NOx/MMBtu; • Flares at organic liquid loading operations: 25,000 MMBtu/yr or 0.034 lb-NOx/MMBtu. Recordkeeping and reporting. Flare minimization plan for refinery flares or flares ≥5 MMBtu/hr at major sources of NOx or VOC, except landfill operations.	No emission limit requirements.

The District evaluated the requirements contained within BAAQMD's Regulation 12, Rules 11 and 12 and found no requirements that were more stringent than those in Rule

4311. Therefore, District Rule 4311 is as stringent as or more stringent than BAAQMD Regulation 12, Rule 11 and 12.

San Diego County APCD

- SDAPCD Rule 69.7 (Landfill Gas Flares)

	SJVAPCD Rule 4311	SDAPCD Rule 69.7
Applicability	All flares.	Landfill gas flares at a municipal solid waste landfill where emissions from such flares are at or above the federal major source threshold for NOx.
Exemptions	• Flares operated at municipal solid waste landfills that combust <2,000 MMscf of landfill gas per calendar year and that have ceased accepting waste • Flares that combust only propane, butane, or a combination of propane and butane • Flares used for well testing, tank degassing, and pipeline degassing operations • Flares that combust regeneration gas	• Existing open landfill gas flares are exempt from standards, test methods, and source test requirements of rule
Requirements	Requires flare operators to limit flare operation not to exceed flare throughput threshold based on vocation for 2 consecutive years or meet NOx limits: • Flares used at oil and gas operations, and chemical operations: 25,000 MMBtu/yr or 0.005 lb-VOC/MMBtu, 0.018 lb-NOx/MMBtu; • Flares at landfill operations: 90,000 MMBtu/yr or 0.038 lb-VOC/MMBtu and 0.025 lb-NOx/MMBtu; • Flares at digester operations at a major source facility: 100,000 MMBtu/yr or 0.038 lb-VOC/MMBtu and 0.025 lb-NOx/MMBtu; • Flares at digester operations not at a major source facility: 100,000 MMBtu/yr or 0.060 lb-NOx/MMBtu; • Flares at organic liquid loading operations: 25,000 MMBtu/yr or 0.034 lb-NOx/MMBtu. Recordkeeping and reporting. Flare minimization plan for refinery flares or flares ≥5 MMBtu/hr at major sources of NOx or VOC, except landfill operations.	A person shall not install and/or operate an enclosed landfill gas flare unless NOx emissions do not exceed 0.06 lbs/MMBtu. Operational, monitoring, recordkeeping, testing requirements.

The District evaluated the requirements contained within SDAPCD's Rule 69.7 and found no requirements that were more stringent than those in Rule 4311. In fact, District Rule 4311 includes requirements for flares in other facility types beyond municipal solid waste. Therefore, District Rule 4311 is as stringent as or more stringent than SDAPCD Rule 69.7.

South Coast AQMD

- SCAQMD Rule 1118 (Control of Emissions from Refinery Flares)

	SJVAPCD Rule 4311	SCAQMD Rule 1118
Applicability	All flares.	Flares used at petroleum refineries, sulfur recovery plants, and hydrogen production plants.
Exemptions	• Flares operated at municipal solid waste landfills that combust <2,000 MMscf of landfill gas per calendar year and that have ceased accepting waste • Flares that combust only propane, butane, or a combination of propane and butane • Flares used for well testing, tank degassing, and pipeline degassing operations • Flares that combust regeneration gas	• Exempt from sampling and analyses for higher heating values and sulfur concentration for flare event that: ○ Results from catastrophic event ○ Is safety hazard to sampling personnel • SOx from flaring events caused by: ○ External power curtailment beyond operator’s control ○ Natural disasters ○ Acts of war or terrorism (Not exempt from flare monitoring system requirements)
Requirements	Limit flare operation not to exceed a flare throughput threshold based on vocation for two consecutive years or meet NOx limits: • Flares used at oil and gas operations, and chemical operations: 25,000 MMBtu/yr or 0.005 lb-VOC/MMBtu, 0.018 lb-NOx/MMBtu; • Flares at landfill operations: 90,000 MMBtu/yr or 0.038 lb-VOC/MMBtu and 0.025 lb-NOx/MMBtu; • Flares at digester operations at a major source facility: 100,000 MMBtu/yr or 0.038 lb-VOC/MMBtu and 0.025 lb-NOx/MMBtu; • Flares at digester operations not at a major source facility: 100,000 MMBtu/yr or 0.060 lb-NOx/MMBtu; • Flares at organic liquid loading operations: 25,000 MMBtu/yr or 0.034 lb-NOx/MMBtu. Recordkeeping and reporting. Flare minimization plan for refinery flares or flares ≥5 MMBtu/hr at major sources of NOx or VOC, except landfill operations.	No emission limit requirements.

The District evaluated the requirements contained within SCAQMD's Rule 1118 and found no requirements that were more stringent than those in Rule 4311. Therefore, District Rule 4311 is as stringent as or more stringent than SCAQMD Rule 1118.

South Coast AQMD

- SCAQMD Rule 1118.1 (Control of Emissions from Non-Refinery Flares)

	SJVAPCD Rule 4311	SCAQMD Rule 1118.1
Applicability	All flares.	Flares that require a SCAQMD permit used at non-refinery facilities, including, but not limited to oil and gas production facilities, wastewater treatment facilities, landfills, and organic liquid handling facilities.
Exemptions	• Flares operated at municipal solid waste landfills that combust <2,000 MMscf of landfill gas per calendar year and that have ceased accepting waste • Flares that combust only propane, butane, or a combination of propane and butane • Flares used for well testing, tank degassing, and pipeline degassing operations • Flares that combust regeneration gas	• Flares at asphalt plants, biodiesel plants, hydrogen production plants fueled in part with refinery gas, petroleum refineries, sulfuric acid plants, and sulfur recovery plants • Flares routing only natural gas to the burner that are subject to SCAQMD Misc. Source NOx rule • Flares combusting only propane, butane, or a combination of propane and butane • Flares at closed landfills collecting <2,000 MMscf of landfill gas per calendar year • Flares with a various location permit • Flares combusting regeneration gas • Flares emitting <30 lb-NOx/month • Flares with an annual throughput limit equivalent to 200 hr/year • Gas combusted during a utility pipeline curtailment is not used to calculate exceedance of use requirements
Requirements	Requires flare operators to limit flare operation not to exceed flare throughput threshold based on vocation for 2 consecutive years or meet NOx limits: • Flares used at oil and gas operations, and chemical operations: 25,000 MMBtu/yr or 0.005 lb-VOC/MMBtu, 0.018 lb-NOx/MMBtu; • Flares at landfill operations: 90,000 MMBtu/yr or 0.038 lb-VOC/MMBtu and 0.025 lb-NOx/MMBtu; • Flares at digester operations at a major source facility: 100,000 MMBtu/yr or 0.038 lb-VOC/MMBtu and 0.025 lb-NOx/MMBtu; • Flares at digester operations not at a major source facility: 100,000 MMBtu/yr or 0.060 lb-NOx/MMBtu;	Throughput limits for new or replacement flares of 110% of replaced flare or 45 MMscf/year. New flare emission limits based on type of gas flared: • Produced gas: 0.018 lb-NOx/MMBtu, 0.01 lb-CO/MMBtu, 0.008 lb-VOC/MMBtu; • Landfill gas, and digester gas at a major facility: 0.025 lb-NOx/MMBtu, 0.06 lb-CO/MMBtu, 0.038 lb-VOC/MMBtu; • Digester gas at a minor facility, and other flare gas: 0.06 lb-NOx/MMBtu; • Organic liquid storage: 0.25 lb-NOx/MMBtu, 0.37 lb-CO/MMbtu;

	SJVAPCD Rule 4311	SCAQMD Rule 1118.1
	• Flares at organic liquid loading operations: 25,000 MMBtu/yr or 0.034 lb-NOx/MMBtu. Recordkeeping and reporting. Flare minimization plan for refinery flares or flares ≥5 MMBtu/hr at major sources of NOx or VOC, except landfill operations.	• Organic liquid loading: 0.034 lb-NOx/1,000 gallons loaded, 0.05 lb-CO/1,000 gallons loaded. Establishes requirements for existing flares not meeting the above emission limits based on exceeding a vocation based fractional use of total capacity in two consecutive calendar quarters. Fraction limits are: 5% for produced gas or any open flare; 70% for digester gas; and 20% for landfill gas. Units exceeding these limits must reduce flaring or replace with a new flare meeting emission limit requirements.

The District evaluated the requirements contained within SCAQMD's Rule 1118.1 and found no requirements that were more stringent than those in Rule 4311. Therefore, District Rule 4311 is as stringent as or more stringent than SCAQMD Rule 1118.1.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District reviewed the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

Zero-Emission Opportunities

The District evaluated all available opportunities for reducing emissions from this source category and did not identify any available zero-emission technologies or any instances of zero-emission requirements for these operations. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

Based on this review, the District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

Rule 4311 currently provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.12 RULE 4313 (LIME KILNS)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The emissions inventory for the lime kiln source category is 0.00 tpd because there are no lime kilns in operation in the Valley.

District Rule 4313 Description

District Rule 4313 was adopted in 2003 to limit NOx emissions from the operation of lime kilns. Lime kilns can be used in a variety of manufacturing and processing operations, including food and agriculture. At the time of rule adoption, there were a total of three lime kilns in operation in the Valley. These lime kilns were operated at two sugar processing plants; however, these plants have been non-operational since 2008. There are currently no lime kilns operating in the Valley. If any lime kilns were to begin operation in the Valley in the future they would be required to meet District BACT requirements, per District Rule 2201 (New and Modified Stationary Source Review Rule). There are no lime kilns currently going through the District's permitting process to become operational in the Valley, and the District does not expect any lime kilns to operate in the Valley in the future.

How does District Rule 4313 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Technique Guidelines or Alternative Control Techniques applicable to this source category.

A. New Source Performance Standards (NSPS)

- *40 CFR 60 Subpart HH – Standards of Performance for Lime Manufacturing Plants (1984/04)*

The District evaluated the requirements contained within 40 CFR 60 Subpart HH and found no requirements that were more stringent than those already in Rule 4313.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4313 compare to rules in other air districts?

Bay Area AQMD, Sacramento Metropolitan AQMD, South Coast AQMD, and Ventura County APCD do not have analogous rules for this source category.

Potential Emission Reduction Opportunities

There are currently no lime kilns in operation in the Valley. Therefore, the District did not identify any additional emission reduction opportunities at this time.

Evaluation Findings

There are no lime kilns in operation in the Valley, nor are any expected to be operated in the Valley in the future. However, if a lime kilns were to begin operating in the Valley, it would be required to meet District BACT requirements. As such, Rule 4313 meets or exceeds federal BACM and MSM requirements for this source category.

C.13 RULE 4352 (SOLID FUEL FIRED BOILERS, STEAM GENERATORS, AND PROCESS HEATERS)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.18	0.18	0.18	0.13	0.13	0.14	0.14
NOx	1.87	1.86	1.88	1.53	1.54	1.64	1.65
	Winter Average - Tons per day						
PM2.5	0.18	0.18	0.18	0.13	0.13	0.14	0.14
NOx	1.87	1.86	1.88	1.53	1.54	1.64	1.64

District Rule 4352 Description

The purpose of Rule 4352 is to limit NOx, CO, PM10, and SOx emissions from any boiler, steam generator or process heater fired on solid fuel. Operations use these units in a broad range of industrial, commercial, and institutional settings. These units have the ability to fire on a variety of solid fuels, including coal, petroleum coke, biomass, tire-derived fuel, and municipal solid waste (MSW). The District currently permits ten biomass fired units in the Valley; however, only five biomass fired units are currently operating. All five operating units generate electricity for electric utilities. The remaining five units are closed and dormant. Two solid fuel fired units permitted within the District use MSW as their energy source. The MSW fired units are located at a single facility that generates electricity for electric utilities.

The adoption of Rule 4352 on September 14, 1994, established NOx limits of 200 ppmv for MSW facilities, 0.35 lb/MMBtu for biomass facilities, and 0.20 lb/MMBtu for all other solid fuel fired units. The District has amended this rule four times since adoption.

The District Governing Board adopted the most recent amendments to Rule 4352 on December 16, 2021. Based on a comprehensive technical analysis, in-depth review of local, state, and federal regulations, and a robust public process, the District adopted several modifications to Rule 4352 to include even more stringent NOx limits, and to establish PM10 and SOx emission limits for applicable units operating in the Valley. The amendments to Rule 4352 also added language to clarify definitions, remove expired language, and establish compliance timelines.

Table C-3 Rule 4352 NOx, CO, PM10, and SOx Emission Limits

Fuel Type	Emission Limits effective on and after January 1, 2024			
	NOx	**CO**	**PM10**	**SOx**
MSW	110 ppmv corrected to 12% CO2 [A] 90 ppmv corrected to 12% CO2 [C]	400 ppmv corrected to 3% O2 [A]	0.04 lbs/MMBtu or 0.02 gr/dscf @ 12% CO2	0.03 lbs/MMBtu [C] or 12 ppmv @ 12% CO2 [C] 0.064 lbs/MMBtu [A] or 25 ppmv @ 12% CO2 [A]
Biomass	65 ppmv corrected to 3% O2 [A]		0.03 lbs/MMBtu	0.02 lbs/MMBtu [B] 0.035 lbs/MMBtu [A]
All Others	65 ppmv corrected to 3% O2 [A]		0.03 lbs/MMBtu	0.02 lbs/MMBtu [B] 0.035 lbs/MMBtu [A]

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Rolling 12-month average

How does District Rule 4352 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines applicable to this source category.

A. Alternative Control Techniques (ACT)

- *Alternative Control Techniques Document – NOx Emissions from Industrial, Commercial, and Institutional Boilers (EPA-453/R-94-022 1994/03)*
- *Alternative Control Techniques Document – NOx Emissions from Utility Boilers (EPA-453/R-94-023 1994/03)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Industrial/Commercial/Institutional Boilers and the ACT for NOx Emissions from Utility Boilers and found no requirements that were more stringent than those already in Rule 4352.

B. New Source Performance Standards (NSPS)

- *40 CFR 60 Subpart Cb – Emission Guidelines and Compliance Times for Large Municipal Waste Combustors that are Constructed On or Before September 20, 1994 (1995/12)*

The District evaluated the requirements contained within 40 CFR 60 Subpart Cb and found no requirements that were more stringent than those already in Rule 4352.

- *40 CFR 60 Subpart D – Standards of Performance for Fossil-Fuel-Fired Steam Generators (2007/06)*

The District evaluated the requirements contained within 40 CFR 60 Subpart D and found no requirements that were more stringent than those already in Rule 4352.

- *40 CFR 60 Subpart Da – Standards of Performance for Electric Utility Steam Generating Units (2013/04)*
- *40 CFR 60 Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units (2007/06)*
- *40 CFR 60 Subpart Dc – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units (2014/02)*

The District evaluated the requirements contained within the 40 CFR 60 Subpart Da, Db and Dc and found no requirements that were more stringent than those already in Rule 4352.

- *40 CFR 60 Subpart Ea – Standards of Performance for Municipal Waste Combustors for Which Construction is Commenced After December 20, 1989 and On or Before September 20, 1994 (1995/12)*
- *40 CFR 60 Subpart Eb – Standards of Performance for Municipal Waste Combustors for Which Construction is Commenced After September 20, 1994 or for Which Modification or Reconstruction is Commenced After June 19, 1996 (2007/03)*

The District evaluated the requirements contained within 40 CFR 60 Subparts Ea and Eb and found no requirements that were more stringent than those already in Rule 4352.

- *40 CFR 60 Subpart AAAA – Standards of Performance for Small Municipal Waste Combustion Units for Which Construction is Commenced After August 30, 1999 or for Which Modification is Commenced After June 6, 2001 (2003/01)*
- *40 CFR 60 Subpart BBBB – Standards of Performance for Small Municipal Waste Combustion Units Constructed On or Before August 30, 1999 (2003/01)*

The District evaluated the requirements contained within 40 CFR 60 Subparts AAAA and BBBB and found no requirements that were more stringent than those already in Rule 4352.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4352 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4352 to comparable requirements in rules from the following:

- Bay Area AQMD Regulation 9, Rule 7 (Amended May 4, 2011)[101]
- Bay Area AQMD Regulation 9, Rule 11 (Adopted May 17, 2000)[102]
- El Dorado County AQMD Rule 232 (Amended September 25, 2001)[103]
- Placer County APCD Rule 233 (Amended June 14, 2012)[104]
- Sacramento Metropolitan AQMD Rule 411 (Amended August 23, 2007)[105]
- South Coast AQMD Rule 476 (Amended October 8, 1976)[106]
- South Coast AQMD Rule 1135 (Amended January 7, 2022)[107]
- South Coast AQMD Rule 1146 (Amended December 7, 2018)[108]
- Yolo-Solano AQMD Rule 2-43 (Amended November 10, 2010)[109]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4352 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

South Coast AQMD

- SCAQMD Rule 476 (Steam Generating Equipment)

	SJVAPCD Rule 4352	SCAQMD Rule 476
Applicability	Any boiler, steam generator, or process heater fired on solid fuel.	Steam generating equipment.
Exemptions	None	None

[101] BAAQMD. *Regulation 9, Rule 7 (Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters).* (Amended May 4, 2011). Retrieved from: https://www.baaqmd.gov/rules-and-compliance/rules/reg-9-rule-7-nitrogen-oxides-and-carbon-monoxide-from-industrial-institutional-and-commercial-boiler

[102] BAAQMD. *Regulation 9, Rule 11 (Nitrogen Oxides and Carbon Monoxide from Utility Electric Power Generating Boilers).* (Adopted May 17, 2000). Retrieved from: https://www.baaqmd.gov/rules-and-compliance/rules/reg-9-rule-11-nitrogen-oxides-and-carbon-monoxide-from-utility-electric-power-generating-boilers

[103] EDCAQMD. *Rule 232 (Biomass Boilers).* (Amended September 25, 2001). Retrieved from: https://ww2.arb.ca.gov/sites/default/files/classic/technology-clearinghouse/rules/RuleID819.pdf

[104] PCAPCD. *Rule 233 (Biomass Boilers).* (Amended June 14, 2012). Retrieved from: https://www.placerair.org/DocumentCenter/View/2205/Rule-233-PDF

[105] SMAQMD. *Rule 411 (NOx from Boilers, Process Heaters and Steam Generators)*. (Amended August 23, 2007). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule411.pdf

[106] SCAQMD. Rule 476 (*Steam Generating Equipment*). (Amended October 8, 1976). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-476.pdf

[107] SCAQMD. *Rule 1135 (Emissions of Oxides of Nitrogen from Electricity Generating Facilities).* (Amended January 7, 2022). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1135.pdf?sfvrsn=4

[108] SCAQMD. *Rule 1146 (Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters).* (Amended December 7, 2018). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1146.pdf

[109] YSAQMD. *Rule 2-43 (Biomass Boilers).* (Amended November 10, 2010). Retrieved from: https://www.ysaqmd.org/wp-content/uploads/2020/05/2.43.pdf

	SJVAPCD Rule 4352	SCAQMD Rule 476
Requirements	**<u>NOx emission limits</u>** *Effective on and after Jan. 1, 2024* <u>MSW</u> 110 ppmv corrected to 12% CO_2^A 90 ppmv corrected to 12% CO_2^C <u>Biomass</u> 65 ppmv NOx corrected to 3% O_2^A <u>All others</u> 65 ppmv NOx corrected to 3% O_2^A ^{A} Block 24-hour average ^{B} Rolling 30-day average ^{C} Rolling 12-month average **<u>PM10 Emission Limits</u>** *Effective on and after Jan. 1, 2024* <u>MSW</u> 0.04 lbs/MMBtu or 0.02 gr/dscf @ 12% CO_2 <u>Biomass</u> 0.03 lbs/MMBtu <u>All others</u> 0.03 lbs/MMBtu	**<u>NOx emission limits</u>** A person shall not discharge into the atmosphere from any equipment having a maximum heat input rate of more than 12.5 million kilogram calories (50 million BTU) per hour used to produce steam, for which a permit to build, erect, install or expand is required after May 7, 1976, air contaminants that exceed the following NOx limits, calculated at 3% O_2 on a dry basis: • Gas: 125 ppm NOx • Liquid or Solid: 225 ppm NOx

The District found the requirements contained within SCAQMD Rule 476 are not more stringent than those already in District Rule 4352. Therefore, District Rule 4352 is as stringent as or more stringent than SCAQMD Rule 476.

South Coast AQMD

- SCAQMD Rule 1135 (Emissions of Oxides of Nitrogen from Electricity Generating Facilities)

	SJVAPCD Rule 4352	SCAQMD Rule 1135
Applicability	Any boiler, steam generator, or process heater fired on solid fuel.	Electric Generating Units at a facility owned or operated by an investor-owned electric utility or a publicly owned electric utility that has one or more electric generating units, or has electric generating units with a combined generation capacity ≥50 MW of electric power for distribution in the state or local electric grid system. Includes gas turbines with the exception of cogeneration units.
Exemptions	None	• Combined cycle gas turbines installed prior to 11/02/18 have conditional exemptions if they have a 2.5 ppmv permit limit for NOx as of 11/02/18

	SJVAPCD Rule 4352	SCAQMD Rule 1135	
		• Low use units installed prior 11/02/18 have conditional exemptions if they maintain an annual capacity factor below 25% in each calendar year and average calendar year capacity factor below 10% on a 3-year rolling basis	
Requirements	**NOx emission limits** *Effective on and after Jan. 1, 2024* MSW 110 ppmv corrected to 12% CO2[A] 90 ppmv corrected to 12% CO2[C] Biomass 65 ppmv NOx corrected to 3% O2[A] All others 65 ppmv NOx corrected to 3% O2[A] [A] Block 24-hour average [B] Rolling 30-day average [C] Rolling 12-month average **PM10 Emission Limits** *Effective on and after Jan. 1, 2024* MSW 0.04 lbs/MMBtu or 0.02 gr/dscf @ 12% CO2 Biomass 0.03 lbs/MMBtu All others 0.03 lbs/MMBtu	**NOx Emission Limits** (@ 15% O2) *Prior to Jan. 1, 2024:* *For Southern Cal Edison* 0.15 lb/MWh *For City of Glendale* 0.20 lb/MWh *For City of Burbank* 0.20 lb/MWh *For City of Pasadena* 0.20 lb/MWh	*After Jan. 1, 2024:* ***For units constructed after 11/02/18:*** *Combined Cycle:* Gas Fuel - 2 ppmv on 60 minute rolling average *Simple Cycle:* Gas Fuel - 2.5 ppmv on 60 minute rolling average ***For units where operator applied for initial ATC prior to 11/02/18:*** Same limits as above, with limited exceptions to be at 2.5 ppmv for combined cycle along with using the rolling average time requirements specified in the PTO on 11/02/18

SCAQMD Rule 1135 applies to electric generating units at electricity generating facilities, and it lists a NOx standard of 5 ppmv @ 3% O2 for boilers. Section (c)(3) of this rule defines “boiler” as “any combustion equipment fired with liquid and/or gaseous fuel, which is primarily used to produce steam that is expanded in a turbine generator used for electric power generation.” Based on this definition, the requirements of this rule do not apply to solid fuel-fired boilers.

South Coast AQMD

- SCAQMD Rule 1146 (Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

	SJVAPCD Rule 4352	SCAQMD Rule 1146
Applicability	Any boiler, steam generator, or process heater fired on solid fuel.	Boilers, steam generators, and process heaters ≥5 MMBtu/hr rated heat input capacity used in all industrial, institutional, and commercial operations and fired on fossil fuels.
Exemptions	None	• Units with rated heat input capacity ≤5 MMBtu/hr • Units used exclusively to produce electricity
Requirements	**NOx emission limits** *Effective on and after Jan. 1, 2024* MSW 110 ppmv corrected to 12% CO2[A] 90 ppmv corrected to 12% CO2[C] Biomass 65 ppmv NOx corrected to 3% O2[A] All others 65 ppmv NOx corrected to 3% O2[A] [A] Block 24-hour average [B] Rolling 30-day average [C] Rolling 12-month average **PM10 Emission Limits** *Effective on and after Jan. 1, 2024* MSW 0.04 lbs/MMBtu or 0.02 gr/dscf @ 12% CO2 Biomass 0.03 lbs/MMBtu All others 0.03 lbs/MMBtu	No applicable limits for units similar to those in the San Joaquin Valley.

SCAQMD Rule 1146 specifically exempts units that are used exclusively to produce electricity for sale. Therefore, this rule cannot be compared to District Rule 4352.

Potential Emission Reduction Opportunities

Zero-Emission Opportunities

The District evaluated all available opportunities for reducing emissions from this source category and did not identify any available zero-emission technologies or any instances of zero-emission requirements for these operations. Notably, the units in this source category produce electricity, and therefore cannot be electrified. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

NOx Emission Control Technologies

The District evaluated several technology options to lower the NOx emissions at the municipal solid waste facility in the District. The new NOx limit of 90 ppm requires the installation of Covanta LN technology. Other more stringent control options evaluated included SCR, Gore De-NOx, Covanta LN with SCR, and Covanta LN with Gore De-NOx. The cost effectiveness for these control options is presented in the table below.

Table C-4 NOx Cost Effectiveness Analysis for Units fired on MSW

Evaluated Alternative Emissions Limit (ppm)	Potential Control Technology	Annualized Cost ($/year)	Annual Emission Reductions (tons/year)	Cost Effectiveness ($/ton)
60	Gore De-NOx	$7,533,966	130.5	$78,508
50	SCR	$7,673,984	156.9	$124,965
45	Covanta LN + SCR	$9,797,335	179.2	$82,634
35	Covanta LN + Gore De-NOx	$9,076,110	170.2	$82,911

The District also evaluated several technology options to lower the NOx emissions for biomass fueled units. Other more stringent control options evaluated included SCR, Gore De-NOx, new boilers with SCR, and new boilers with Gore De-NOx. The cost effectiveness for these control options is presented in the table below.

Table C-5 NOx Cost Effectiveness Analysis for Units fired on Biomass

Evaluated Alternative Emissions Limit (ppm)	Technology	Annualized Cost ($/year)	Annual Emission Reductions (tons/year)	Cost Effectiveness ($/ton)
50	SCR	$24,742,095	329.5	$115,517
50	Gore De-Nox	$18,674,087	329.5	$86,972
40	New Boiler with SCR	$114,360,450	510.3	$289,568
40	New Boiler with Gore De-NOx	$101,744,410	510.3	$257,620

The cost effectiveness analysis did not demonstrate that any of the alternative control technologies were cost effective. Facilities are still in the process of complying with the most recent amendments by January 1, 2024. The District did not identify any additional emission reduction opportunities at this time.

Evaluation Findings

Rule 4352 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.14 RULE 4354 (GLASS MELTING FURNACES)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.27	0.27	0.28	0.18	0.18	0.19	0.19
NOx	3.37	3.42	3.65	3.08	3.08	2.05	2.05
	Winter Average - Tons per day						
PM2.5	0.27	0.27	0.28	0.18	0.18	0.19	0.19
NOx	3.37	3.42	3.64	3.07	3.08	2.05	2.05

District Rule 4354 Description

The provisions of Rule 4354 are applicable to glass melting furnaces in the Valley. The purpose of this rule is to limit NOx, SOx, VOC, CO, and PM10 emissions from glass melting furnaces.

The District adopted Rule 4354 on September 14, 1994, and subsequently amended the rule seven times. The District most recently adopted amendments to Rule 4354 on December 16, 2021. These amendments implement even more stringent NOx, SOx, and PM emissions limits for glass melting furnaces, including NOx limits as low as 0.75 pounds of NOx per ton of glass pulled, establishing requirements that are more stringent than any other rule in non-attainment areas in California and the nation. Due to the high costs associated with the control technology necessary to comply with the proposed final NOx emissions limits, a phased compliance schedule was adopted in which operators must comply with Phase I NOx emissions limits by 2024, and then with final NOx emissions limits by 2030 or upon the completion of the next furnace rebuild, whichever is sooner.

How does District Rule 4354 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines applicable to this source category.

A. Alternative Control Techniques (ACT)

- *Alternative Control Techniques Document – NOx Emissions from Glass Manufacturing (EPA-453/R-94-37 1994/06)*

The District evaluated the requirements contained within the ACT for NOx Emissions from glass melting furnaces and found no requirements that were more stringent than those already required by Rule 4354.

B. New Source Performance Standards (NSPS)

- *40 CFR 60 Subpart CC – Standards of Performance for Glass Manufacturing Plants (2000/10)*

The District evaluated the requirements contained within 40 CFR 60 Subpart CC and found that none of the glass plants located within the Valley are subject to its requirements.

- *40 CFR 60 Subpart PPP – Standards of Performance for Wool Fiberglass Manufacturing Plants (2000/10)*

The District evaluated the requirements contained within Subpart PPP and found no requirements that were more stringent than those already in Rule 4354.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4354 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4354 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 9, Rule 12 (Adopted January 19, 1994)[110]
- South Coast AQMD Rule 1117 (Amended June 5, 2020)[111]

Sacramento Metropolitan AQMD and Ventura County APCD do not have an analogous rule for this source category.

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4354 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rule is demonstrated below.

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[110] BAAQMD. *Regulation 9, Rule 12 (Nitrogen Oxides from Glass Melting Furnaces).* (Adopted January 19, 1994). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-12-nitrogen-oxides-from-glass-melting-furnaces/documents/rg0912.pdf?la=en&rev=29e7064c0e39439c9dee09b104af8dff

[111] SCAQMD. *Rule 1117 (Emissions from Container Glass Melting and Sodium Silicate Furnaces).* (Amended June 5, 2020). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1117.pdf?sfvrsn=4

South Coast AQMD

- SCAQMD Rule 1117 (Emissions of Oxides of Nitrogen from Container Glass Melting and Sodium Silicate Furnaces)

<table>
<tr><th></th><th colspan="2">SJVAPCD Rule 4354</th><th>SCAQMD Rule 1117</th></tr>
<tr><td>Applicability</td><td colspan="2">Any glass melting furnace for the production of, container glass, fiberglass, and flat glass.</td><td>This rule limits the emission of NOx from facilities producing container glass and sodium silicate.</td></tr>
<tr><td>Exemption</td><td colspan="2">• Furnaces which heat is provided by electric current from electrodes</td><td>• Furnaces which are limited by permit to 100 tons of product pulled per calendar year
• Glass remelt facilities using exclusively glass cullet, marbles, chips, or similar feedstock in lieu of basic glass-making raw materials
• Furnaces used in the melting of glass for the production of fiberglass exclusively</td></tr>
<tr><td rowspan="17">Requirements</td><td colspan="3">Container Glass:</td></tr>
<tr><td>NOx Phase I (by no later than 12/31/2023)</td><td>1.1 lb/ton[B]</td><td rowspan="2">0.75 lb/ton[B]</td></tr>
<tr><td>NOx Phase II (by no later than 12/31/2029)</td><td>0.75 lb/ton[B]</td></tr>
<tr><td>PM10 (Until 12/31/2023)</td><td>0.50 lb/ton[A]</td><td rowspan="2">No Limit Specified</td></tr>
<tr><td>PM10 (On and after 1/1/2024)</td><td>0.20 lb/ton[A]</td></tr>
<tr><td colspan="3">Fiberglass:</td></tr>
<tr><td rowspan="2">NOx</td><td>1.3 lb/ton[A, C]</td><td rowspan="2">No Limit Specified, Exempt from Rule</td></tr>
<tr><td>3.0 lb/ton[A, D]</td></tr>
<tr><td>PM10</td><td>0.50 lb/ton[A]</td><td>No Limit Specified, Exempt from Rule</td></tr>
<tr><td colspan="3">Flat Glass:</td></tr>
<tr><td rowspan="2">NOx Phase I (by no later than 12/31/2023)</td><td>2.8 lb/ton[A]</td><td rowspan="4">No Limits Specified, Outside of Rule Applicability</td></tr>
<tr><td>2.5 lb/ton[B]</td></tr>
<tr><td rowspan="2">NOx Phase II (by no later than 12/31/2029)</td><td>1.7 lb/ton[A]</td></tr>
<tr><td>1.5 lb/ton[B]</td></tr>
<tr><td>PM10 (Until 12/31/2023)</td><td>0.70 lb/ton[A]</td><td rowspan="2">No Limits Specified, Outside of Rule Applicability</td></tr>
<tr><td>PM10 (On and after 1/1/2024)</td><td>0.20 lb/ton[A]</td></tr>
</table>

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Not subject to California Public Resources Code Section 19511
[D] Subject to California Public Resources Code Section 19511

The District evaluated the control requirements in SCAQMD Rule 1117, and found that District Rule 4354 is as stringent as or more stringent than SCAQMD Rule 1117.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District performed an extensive review of the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

Zero-Emission Opportunities

Electric Glass Melting Furnaces

The District considered the feasibility of using electric furnaces to reduce emissions. One of the container glass manufacturing facilities in the Valley is permitted to operate an electric glass melting furnace. However, this electric furnace has been out of glass production operation for more than ten years. During staff research, the District concluded that electric furnaces require a limited pull rate, and have a production capacity limited to a maximum of about 300 tons of glass per day. Furthermore, the District determined that electric furnace technology is only compatible with container glass manufacturing, and not compatible for flat glass production due to the technological design of electric furnaces and the need for a substantial float to provide heat insulation. The District did not identify any electric furnaces operating as the primary glass melting unit for flat glass manufacturing facilities. For container glass operations, multiple electric furnaces would need to be purchased to replace one existing natural-gas fired furnace, and operators would incur significant additional O&M costs, as compared to the operation of a furnace fired on natural gas. The typical electric furnace life is 4 years, compared to 10-12 years of that of a natural gas furnace with electric boost, further increasing the costs associated with operating an electric furnace in lieu of a natural gas-fired furnace.

Furthermore, electric furnaces consume more total energy per ton of glass, and would require much higher electricity capacity than is currently available from the electrical grid. For example, a modern 230 ton per day electric furnace has an electricity consumption rating of approximately 7.5 megawatts (MW), compared to a 430 ton per day natural gas furnace with electric boost where the maximum energy consumption is about 2.6 MW. More than 10 MW of additional electrical capacity at a glass production plant would be required to replace just one 430 ton per day furnace. The associated draw on the electrical grid to support required glass production levels for plants operating in the Valley would not be feasible or supported through the current electrical infrastructure or capacity in the region. While electric furnaces may be used for small production operations, or to provide additional heating boosts as an auxiliary unit at large manufacturing plants, the District determined that the use of electric furnaces as the primary glass melting furnace for large production operations is not currently feasible or cost effective due to the above considerations.

Based on this exhaustive review, the District did not identify additional emission reduction opportunities at this time.

Evaluation Findings

Rule 4354 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.15 RULE 4550 (CONSERVATION MANAGEMENT PRACTICES)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	18.46	18.33	18.15	17.99	17.84	17.75	17.70
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	12.06	11.95	11.80	11.66	11.55	11.47	11.44
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

District Rule 4550 Description

Rule 4550 was adopted on August 19, 2004, to help bring the Valley into attainment of federal PM10 standards, and applies to on-field farming and agricultural operation sites located within the Valley. Rule 4550 was the first rule of its kind in the nation to target fugitive particulate emissions from agricultural operations, and it has served as a model for other regions. The District worked extensively with numerous stakeholders, growers, and the Agricultural Technical Committee for the San Joaquin Valleywide Air Pollution Study Agency (AgTech) for two years prior to developing the Conservation Management Practices (CMP) Rule. The District also worked with agricultural stakeholders and other agencies, such as the Natural Resources Conservation Service (NRCS), following rule adoption to ensure affected sources were assisted as much as possible in understanding and complying with the requirements of Rule 4550. Implementation of Rule 4550 by agricultural operations has resulted in the reduction of PM2.5 emissions through the reduction of passes of agricultural equipment and implementation of other conservation practices. Through this rule, PM10 emissions have been reduced by 35.3 tons per day. Rule 4550 has since served as a model for other regions seeking to reduce fugitive PM10 emissions from agricultural sources.

EPA finalized approval of Rule 4550 on February 14, 2006 and determined that the rule met BACM requirements.[112] Subsequent to EPA's approval of Rule 4550, two separate lawsuits were filed challenging EPA's approval of the rule as satisfying BACM. The Ninth District Court of Appeals, in both cases, agreed with EPA's approval and reaffirmed EPA's finding that the District's Rule 4550 meets BACM requirements.[113,114]

[112] 71 FR 7683-7688. *Revisions to the California State Implementation Plan; San Joaquin Valley Unified Air Pollution Control District.* (February 14, 2006). Retrieved from: http://www.gpo.gov/fdsys/pkg/FR-2006-02-14/pdf/06-1311.pdf
[113] U.S. Court of Appeals for the Ninth Circuit. *Latino Issues Forum v. EPA.* Retrieved from: http://njlaw.rutgers.edu/collections/resource.org/fed_reporter/NEWcircs/cir9/0671907_cir9.html
[114] SJVAPCD. *Court rules in favor of Air District ag rule.* (March 6, 2009). Retrieved from: https://www.valleyair.org/recent_news/Media_releases/2009/PR%20Court%20decision%20favors%20District%20ag%20rule.pdf

Most recently, in April 2024, based on recommendations from the AgTech Committee, the District added Low-Dust Nut Harvesters to the approved CMP list for Nut Crops based on the guidelines established by District Rule 4550.

In an effort to further reduce emissions from this source category, the District's *2018 PM2.5 Plan* included a commitment to evaluate the feasibility and effectiveness of CMPs on fallow lands that are tilled or otherwise worked with implements of husbandry to reduce windblown PM2.5 emissions from disturbed fallowed acreage. This evaluation would rely on additional research, in coordination with USDA-NRCS, agricultural sources, and researchers, which recognizes the Valley's unique soil characteristics and agricultural practices to ensure that Valley-specific solutions are considered in this process.

The District committed to undertake scientific research on the PM2.5 content, constituents, and stability during wind events of the many soil types found throughout the Valley. This research would be conducted in close coordination with USDA-NRCS, agricultural sources, researchers through established processes including the San Joaquin Valleywide Air Pollution Study Agency, Policy Committee, and Agricultural Technical Subcommittee.

The District is currently conducting a robust rule development process to evaluate these opportunities, working collaboratively with industry stakeholders, USDA-NRCS, and other agencies to develop proposed rule amendments.

Source Category

This rule is applicable to on-field farming and agricultural operation sites located within the Valley, and was adopted to reduce emissions of PM10 from such operations. Rule 4550 limits fugitive dust emissions from farming operations by requiring CMP plans for farms with 100 acres or more, dairies with 500 or more mature cows, cattle feedlots with 190 or more cows, turkey ranches with 55,000 or more turkeys, chicken ranches with 125,000 or more chickens, and chicken egg ranches with 82,000 or more laying hens.

Rule 4550 specifies that agricultural operations must select at least one CMP from each of the identified applicable CMP categories discussed below, and as many as three CMPs per category, to control PM10 emissions. There are five CMP categories for the cropland source category, four CMP categories for the dairy source category, four CMP categories for the feedlot source category, and five CMP categories for the poultry source category. Animal feeding operation (AFO) sources subject to Rule 4550 that also grow field crops must select CMPs for their field crops, as well as their AFO. The selected CMPs must be noted on the applications provided and then submitted to the District for approval. Completed applications constitute a CMP Plan once approved by the District.

Emissions from agricultural operations vary by many factors, some beyond the control of the agricultural operations. Particulate emissions (primarily PM10) are generated during land preparation activities, harvest activities, and post-harvest activities.

Emissions are caused by the mechanical disturbance of the soil by implements and the tractors pulling them, resulting in the entrainment of soil or plant materials into the air. Wind blowing across exposed agricultural land also causes the entrainment of particulates into the air. In addition, particulate emissions can also become entrained from vehicular travel over unpaved roads and unpaved parking/equipment areas. Conservation management practices fall into several broad categories and are intended to reduce emissions as follows:

- The reduction of soil or manure disturbance;
- Soil protection from wind erosion;
- Equipment modifications to physically produce less particulates; and
- Application of water or dust suppressants on unpaved roads and other travel areas to reduce emissions entrained by moving vehicles and equipment.

Low-Dust Nut Harvesters in the San Joaquin Valley

Over the past decade, there has been a significant increase in acreage devoted to nut crops in the San Joaquin Valley. Given the highly visible particulate emissions associated with nut harvesting activities, the agricultural community, in partnership with the District and USDA-NRCS, has been working to develop and promote a variety of best practices and new technologies for reducing harvest-related particulate emissions.

While modeling conducted for the District's Plan indicates that reducing nut harvester emissions in rural areas do not significantly impact the Valley's peak urban PM2.5 locations that drive the Valley's federal attainment mandates, the District has prioritized identifying cost-effective measures for reducing particulate emissions from this sector. Although mobile source emissions are under the jurisdiction of CARB and EPA, in an effort to continue to reduce dust and local emissions due to harvesting activities, the District, in partnership with CARB, U.S. EPA, USDA-NRCS, and the agricultural sectors, have invested in incentivizing the turnover of traditional nut harvesting technology with low-dust alternatives.

To support these goals of reducing localized dust emissions from harvesting activities, the District Board has long supported efforts to conduct research and evaluate technologies to reduce emissions in the Valley, including dust from nut harvesting operations. In line with this priority, the District, in partnership with other agencies and the agricultural industry, has conducted studies to demonstrate that low-dust nut harvesting technology can be effective at reducing localized PM emissions associated with harvesting activities, with results showing reductions of localized PM emissions by more than 40%, and in some cases up to nearly 80%. Additionally, working with agricultural stakeholders, a scientific survey was conducted that concluded that a significant portion of nut crop growers and custom harvesters were interested in demonstrating new lower-emitting harvest technologies if provided with meaningful financial incentives.

In 2017, the District Governing Board established the Community-Level Targeted Strategy, which led to the development of the first-in-the-nation Low-Dust Nut Harvester

Replacement Program in partnership with Valley Agriculture. Through success in competing for and leveraging local and federal funds, the District has been successful in replacing nut harvesters throughout the Valley with lower-dust alternatives, leading to significant emission reductions from these activities, and reducing dust exposure in nearby communities. The program builds upon more than a decade of significant investments made in the San Joaquin Valley to develop low-dust nut harvesting technologies and to understand the potential benefits in reducing PM emissions from the use of these new technologies. To date, the District has successfully obligated over $20.7 million to replace 241 pieces of nut-harvesting equipment with low-dust nut harvesting equipment through the Low-Dust Nut Harvester Replacement Program, which has resulted in the reduction of more than 11,000 tons of PM10 and 1,400 tons of PM2.5. Most recently in May 2023, the District Governing Board accepted EPA's award under the Targeted Airshed Grant Program which included an additional $10,000,000 in funding to deploy this new equipment, which reflects the District's ongoing commitment and success in working with Valley agriculture to accelerate the deployment of cleaner technologies through innovative locally-developed programs.

Additionally, to facilitate the transition to low-dust nut harvesting technology, in April 2024, based on recommendations from the AgTech Committee, the District added Low-Dust Nut Harvesters to the approved CMP list for Nut Crops. Through Rule 4550's menu-based approach, as upheld in court, nut farmers may now select to use a low-dust harvester as part of complying with the requirements of the Rule. This represents the District's latest efforts to promote the use of low-dust nut harvesters in the Valley, leading the nation on the deployment of this technology.

In order to successfully continue efforts to reduce emissions from harvesting in the San Joaquin Valley and achieve ongoing localized community benefits, ongoing discussion and evaluation of the challenges and opportunities in the coming years is warranted. The San Joaquin Valley has demonstrated tremendous success in developing and deploying new technologies for reducing emissions from nut harvesting, and ongoing efforts to replace existing nut harvesting equipment and practices with new technology must be developed in light of evolving and difficult market conditions that, if not carefully considered, could significantly impact the future success of this effort. Looking ahead, building on the successful work done to date, the District will engage with industry stakeholders, USDA-NRCS, CARB, and EPA to evaluate potential enhancements to the District's Low-Dust Nut Harvester Replacement Program, advocate for local, state, and federal additional funding to support the ongoing transition to clean technology, support and conduct research on the efficiency of low-dust harvesters as practices evolve, and conduct a survey to understand the number and type of harvesters operating in the Valley, as summarized below.

1. **Potential Enhancements to the District's Low-Dust Nut Harvester Replacement Program:** Through implementation of the District's Low-Dust Nut Harvester Replacement Program, the District has continued to collaborate with state and federal agencies and the agricultural industry to identify funding opportunities, deploy low-dust technologies, and understand industry practices as they evolve. As discussed earlier, EPA awarded the District an additional

$10,000,000 in funding to deploy low-dust nut harvesting equipment under the competitive, nation-wide Targeted Airshed Grant Program, which reflects the District's ongoing commitment and success in working with agricultural stakeholders to accelerate the deployment of cleaner technologies through innovative locally-developed programs. The total project is expected to result in the reduction of approximately 7,280 tons of PM10 and 910 tons of PM2.5. In addition to this funding, the District's 2023-2024 Budget Incentives Spending Plan includes an additional $5,000,000 for the Low-Dust Nut Harvester Replacement Program, and the District is currently in the process of considering the new 2024-25 Budget which currently includes an additional allocation of $10,000,000. Based on historical program participation, this funding is estimated to facilitate the replacement of approximately 350 additional harvesters with low-dust nut harvesting equipment (assuming total allocation of at least $25,000,000 in 2023-24 and 2024-25 fiscal years).

While the program has been successful to date, moving forward, the nut industry is facing significant challenges, which may continue to affect the success of the program and jeopardize the critical reductions needed in this area. These challenges include ongoing pricing decline in the nut industry and water issues related to the Sustainable Groundwater Management Act (SGMA), among others. These factors may pose significant challenges in maintaining strong participation in the program. To ensure that this program remains effective, and to ensure that small growers have equitable access to available incentive funding in this program, the District recommends engaging with growers, agricultural representatives, and equipment manufacturers to discuss potential changes to the program guidelines, including increased incentive levels and enhanced small farmer funding.

2. **Advocating for Additional Funding Opportunities:** While the District has been successful in competing for funding for this fiscal year, given the amount of nut acreage in the Valley, ongoing funding is critical to accomplish further transitions of traditional harvesters to low-dust nut harvesting technologies. In particular, there is substantial unprecedented funding available at the federal level under the Inflation Reduction Act for projects designed to reduce greenhouse gas and criteria pollutant emissions, which could be used for this program to continue the deployment of low-dust nut harvesting equipment throughout the Valley. The District will continue to pursue this, and other funding, working closely with partner agencies, such as USDA-NRCS to further expand the current program as necessary for new emerging technologies.

3. **Importance of Supporting Ongoing Research:** Past research focused on the efficacy of methods to control dust from nut harvesting equipment has played a critical role in setting the foundation for emission control programs for this activity, including the District's Low-Dust Nut Harvester Replacement Program.

   Since these studies were conducted, the almond industry has continued to evolve and has in recent years altered their practices to address shifting industry standards. A major shift that has occurred is the decision made by some almond processors to no longer accept materials from almond producers that contain debris, such as sticks, leaves and dirt that is collected as part of the almond harvesting process. This excess material requires additional processing by the almond processors and results in significant wear and tear of the processer's equipment. In response, some almond producers have had to invest in additional equipment such as conditioners that are specifically designed to remove this debris. Conditioners work similarly to the harvesters by picking up the almonds in the rows by separating and removing the debris and laying the almonds back down in the row to dry. Once the almonds are dry, the harvesting equipment is then used to pick up the nuts. Due to this, the overall impact on total emissions from nut-harvesting is unclear, including the overall efficacy of the low-dust nut harvesters using conditioners. The District recommends further research to better understand the emissions profile of this evolving harvesting practice.

In addition, new equipment is emerging that completes the harvesting process in less passes, including shaking, sorting out debris, and windrowing the nuts, compared to the traditional harvesting process. Further research and demonstrations on the emerging equipment compared to a typical operation are needed to better understand the air quality emissions reductions possible.

As industry harvest practices have been changing and newer low-dust technologies are coming to market, it is unclear, industry-wide, as to the number of growers who are transitioning to these technologies and the types of equipment and practices that are currently being employed during nut-harvesting. Due to this, further work, in close collaboration with Valley agriculture and partner agencies including the need to conduct surveys or additional research will be imperative to shape the strategy moving forward.

Through the implementation of the District's strategy as outlined above, ongoing success can be achieved with respect to deploying low-dust nut harvesters in the San Joaquin Valley. The District notes that incentives are key to the deployment of this technology, and the menu-based approach of Rule 4550 allows operations to select the conservation management practices that are best suited for their operations. The District is the only agency in the nation to have a strategy to reduce emissions specifically from nut harvesting, and the multi-pronged incentive and regulatory approach is the Best Available Control Measure, or BACM, in addition to the Most Stringent Measure, or MSM.

Under the Clean Air Act, any identified BACM need to be implemented through the District's attainment plan no later than 4 years from the effective date of reclassification (by December 27, 2025). While the District's existing efforts extend well beyond BACM and MSM, the District will continue to evaluate the feasibility of additional options for the continued accelerated deployment of low-dust harvesters as part of the upcoming CMP Program evaluation. In examining this issue moving forward, a number of key factors must be taken under consideration, including technological feasibility for the wide variety of agricultural operations in the Valley, economic feasibility (particularly with respect to small and mid-sized operations), manufacturers' capacity and lead time for new equipment, efficacy of emissions control for emerging equipment and practices, role of SGMA and other policies in transitioning the agricultural sector, and other factors. Any additional strategies aimed at accelerating the replacement of conventional harvesters with low-dust nut harvesters would continue to require extensive stakeholder and partner agency coordination and feedback to ensure feasibility and effectiveness.

Fugitive PM2.5 Dust Emissions from Agricultural Operations

Rule 4550 was intended and designed to reduce PM10, and it has been successful in doing so, reducing 35.3 tons per day of PM10 from agricultural operations. However, as discussed in more detail below, recent studies have indicated that the PM2.5 fraction of emissions makes up a small portion of the total particulate emissions from agricultural operations, and therefore Rule 4550 and other conservation management-based rules are less effective at reducing PM2.5.

Additionally, particulate emissions from agricultural operations are geologic in nature (dust). Analysis of data from ambient PM2.5 monitors has demonstrated that these geologic particulate emissions make up a relatively small portion of the overall PM2.5 concentrations during the winter season.[115] In addition, these geologic particulate emissions in the San Joaquin Valley have relatively low toxicity relative to the organic carbon fraction of PM2.5 and to re-suspended road dust.[116]

Accordingly, particulate emissions from agricultural sources do not play a significant role with regard to attainment of the PM2.5 standards addressed by this plan, and Rule 4550 remains primarily a PM10 reduction strategy. For example, the latest available speciation analyses of PM2.5 from the Speciated Trends Network in Bakersfield, Fresno, Modesto, and Visalia found that the annual average geologic fraction during 2020-2022 was 12%, 10%, 8%, and 14%, respectively. Given that PM2.5 emissions from agricultural field operations are generally subject to deposition near their source, the predominant source of this geologic PM2.5 would be urban re-suspended road dust with relatively little contribution from agricultural activities.[117]

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[115] CARB. *Meeting PM2.5 Standards in the San Joaquin Valley.* Public Workshop. Fresno, CA. (December 1, 2016). Retrieved from: https://www.arb.ca.gov/planning/sip/sjvpm25/workshopslides.pdf; and
CARB. *Staff Report: Proposed Revision to the PM2.5 State Implementation Plan (SIP) for the San Joaquin Valley, Appendix B: Weight of Evidence Analysis.* Retrieved from: https://www.arb.ca.gov/planning/sip/sjvpm25/2012plan_appendix_b.pdf

[116] Veranth, J., Rielly, C.A., Veranth, M.M., Moss, T.A., Langelier, C.R., Lanza, D.L., & Yost, G.S. (2004). Inflammatory Cytokines and Cell Death in BEAS-2B Lung Cells Treated with Soil Dust, Lipopolysaccharide, and Surface-Modified Particles. *Toxicological Science 82(1)*, 88–96. Retrieved from: http://toxsci.oxfordjournals.org/content/82/1/88.full.pdf+html; and
Rogge, W. F., Hildemann, L. M., Mazurek, M. A., Cass, G. R. and Simoneit, B. R. T. (1993). *Sources of Fine Organic Aerosol—3. Road Dust, Tire Debris, and Organometallic Brake Lining Dust—Roads as Sources and Sinks.* Environmental Science & Technology 27(9), 1892-1904.

[117] Countess, R. (2001). *Methodology for Estimating Fugitive Windblown and Mechanically Resuspended Road Dust Emissions Applicable for Regional Air Quality Modeling*, 10th Annual EPA Emissions Inventory Meeting, Denver, CO. May 1-3, 2001. Retrieved from: https://www3.epa.gov/ttnchie1/conference/ei10/fugdust/countess.pdf

As discussed below, the most recent science has demonstrated that PM2.5 emissions from agricultural field operations had previously been significantly over-estimated in absolute terms due to species differences between the fine and coarse fractions of geologic emissions. For example, in 2003, Countess Environmental estimated the PM2.5/PM10 ratios for the predominant trace elements found in fugitive dust using Valley ambient measurements of such elements. The average ratio for aluminum and silicon was 0.05 and ranged between 0.10 to 0.16 for calcium, titanium, and iron. Based on the relative abundances of these elements in fugitive dust, the overall PM2.5/PM10 ratio was estimated to be 0.06 (6%).[118] This ratio estimate is substantially lower than the ratio of 0.20 that Midwest Research Institute (MRI) previously recommended, based on limited supporting data and broad assumptions, as an interim revision to the PM2.5/PM10 ratio for agricultural crops nationwide in 1996. Note that the MRI's 1996 interim revision to the PM2.5/PM10 ratios for fugitive dust sources was meant to improve the PM2.5/PM10 ratios that MRI had previously developed based on data from cascade impactors in the 1980's, which had also been shown to significantly overestimate PM2.5 emissions. As described by Thomas Pace of EPA at the 2005 US EPA Emissions Inventory Conference, MRI's 1996 interim revision to the PM2.5/PM10 ratios for fugitive dust still appeared to overestimate PM2.5 emissions. Pace's review of the most recent research on PM2.5/PM10 ratios nationally shows a consistent mid-point estimate of between 0.10 and 0.12, which is consistent with the higher-end values seen in the Valley. To summarize, PM2.5 comprises a small fraction of total PM10 emissions from agricultural field operations in the Valley, approximately 6% to 12%.

Pace concludes that both PM2.5 emissions from agricultural field operations as well as their contribution to ambient PM2.5 concentrations had previously been significantly overestimated. Factors that contributed to this previous overestimation of PM2.5 emissions from agricultural operations included: (1) the multiplier used to infer PM2.5 from PM10 emissions, (2) difficulty in obtaining activity data to apply to emission factor algorithms, and (3) modeling transport over-estimation (especially in the treatment of particles near their point of emissions).[119]

In respect to over-estimation of PM2.5 transport, much of the ground level fugitive dust from soil disturbance is likely to be removed close to the source.[120] This is due to the low release height and turbulence which keeps particles temporarily close to the surface where they are subject to removal by impaction on nearby surfaces, including

[118] Countess, R. (2003). *Reconciling Fugitive Dust Emission Inventories with Ambient Measurements*, 12th Annual EPA Emissions Inventory Meeting, San Diego, CA. April 29-May 1, 2003. Retrieved from:
https://www.epa.gov/ttn/chief/conference/ei12/fugdust/countess.pdf
https://www.epa.gov/ttn/chief/conference/ei12/fugdust/present/countess.pdf
[119] Pace, T.G., US EPA. (2005). Examination of the Multiplier Used to Estimate PM2.5 Fugitive Dust Emissions from PM10, 14th Annual EPA Emissions Inventory Meeting, Las Vegas, Nevada, April 11 - 14, 2005. Retrieved from:
https://www3.epa.gov/ttnchie1/conference/ei14/session5/pace.pdf
https://www3.epa.gov/ttnchie1/conference/ei14/session5/pace_pres.pdf
[120] Countess, R. (2001). *Methodology for Estimating Fugitive Windblown and Mechanically Resuspended Road Dust Emissions Applicable for Regional Air Quality Modeling*, 10th Annual EPA Emissions Inventory Meeting, Denver, CO. May 1-3, 2001. Retrieved from: https://www3.epa.gov/ttnchie1/conference/ei10/fugdust/countess.pdf; and
Fitz, D., Pankratz, D., Philbrick, R., and Li, G. (2003). *Evaluation of Fugitive Dust Deposition Rates Using Lidar*, 12th Annual EPA Emissions Inventory Meeting, San Diego, CA. April 29-May 1, 2003. Retrieved from:
https://www3.epa.gov/ttnchie1/conference/ei12/fugdust/fitz.pdf
https://www.epa.gov/ttn/chief/conference/ei12/fugdust/present/fitz.pdf

vegetation and structures. Equally significant in respect to the previous over-estimation of PM10 and PM2.5, earlier grid models ignored all removal processes in the grid cell where the emissions originate. Given that 4 kilometers is a typical grid dimension, a considerable fraction of PM2.5 emitted under normal field operations could and often would be deposited within that cell, but models ignored such deposition.

Wind-blown Dust in the Valley

Although the Valley may occasionally experience wind-blown dust events from time to time, these events typically do not coincide with the winter period in which the PM2.5 concentrations in the Valley are the highest. For example, both Fresno and Bakersfield have seasonal variation in wind speeds throughout the year with the highest average wind speeds in Fresno occurring from April to July with highest wind speeds in late May and early June, and the highest average wind speeds in Bakersfield occurring from late March to mid-July with the highest wind speeds typically in late May.[121] These high wind events are less likely to occur during the winter season, in which PM2.5 concentrations are elevated during stagnation events that are characterized by low wind speeds, moderate temperatures, vertical atmospheric stability, and high relative humidity.

These high wind events primarily cause higher PM10 concentrations, but rarely result in elevated PM2.5 concentrations. In addition to the rarity of elevated PM2.5 concentrations during high-wind events, the PM2.5 values recorded during the strong stagnation periods of the winter season are usually much higher than those recorded during wind events. Because of this, the Valley's PM2.5 design values are driven primarily by high winter-time concentrations, mostly due to organic carbon and the secondary formation of ammonium nitrate. Comparatively, the geologic component of the Valley's peak PM2.5 concentrations is only a fraction of the mass formed through secondary processes and other sources (less than 6%).[122]

As a result of the facts discussed above, the wind events experienced in the Valley are not a significant contributor to the 24-hr PM2.5 attainment challenges for the region, and have essentially no impact on annual PM2.5 averages.

How does District Rule 4550 compare with federal and state rules and regulations?

Federal Regulations

There are no Alternative Control Techniques, Control Techniques Guidelines, or New Source Performance Standards applicable to this source category.

[121] Retrieved from: https://weatherspark.com

[122] CARB. *Staff Report: Proposed Revision to the PM2.5 State Implementation Plan (SIP) for the San Joaquin Valley, Appendix B: Weight of Evidence Analysis.* (2012). Retrieved from: https://www.arb.ca.gov/planning/sip/sjvpm25/2012plan_appendix_b.pdf

State Regulations

There are no state regulations that are applicable to this source category.

How does District Rule 4550 compare to rules in other air districts?

Rule 4550 has served as a model for other regions seeking to reduce fugitive particulate emissions from agricultural sources. For this evaluation, the PM2.5 reduction requirements and applicability of Rule 4550 were compared to analogous rules in other air districts and states to determine the stringency of Rule 4550 compared to those other rules. The District found four analogous rules, in Arizona, Eastern Kern APCD, Imperial County APCD, and South Coast AQMD.

Notably, the District's examination found that each of these rules were developed to reduce PM10 emissions from agricultural operations in PM10 non-attainment areas. This was the situation for the District CMP rule, as well – in fact, the District believes that this ground-breaking CMP program was a significant contributor to the Valley's subsequent attainment of the PM10 standard.

None of these rules were developed or modified for the purpose of generating PM2.5 reductions, or as a part of a PM2.5 attainment planning process. As discussed above, PM2.5 is a small fraction of the PM10 from agricultural operations, and the effectiveness of controlling PM2.5 with such measures is not as well understood as the effectiveness of controlling PM10. Since the degree of effectiveness in controlling PM2.5 is not well understood, the corresponding cost effectiveness of implementing CMPs for the purposes of controlling PM2.5 is also unknown. Because of these factors, none of the three rules listed below can be considered as establishing BACM or MSM for PM2.5.

Nonetheless, the District compared emission limits, optional control requirements, and work practice standards in District Rule 4550 to comparable requirements in rules from the following areas:

- Arizona Department of Environmental Quality R18-2-610.01, R18-2-610.02, and R18-2-610.03 (Amended July 2, 2015, July 2, 2015, and November 3, 2021, respectively)[123]
- Eastern Kern APCD Rule 402.2 (Amended January 13, 2022)[124, 125]
- Imperial County APCD Rule 806 (Amended October 16, 2012)[126]
- South Coast AQMD Rule 403 (Amended June 3, 2005)[127]

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[123] Arizona Department of Environmental Quality. Arizona Administrative Code Title 18, Chapter 2, pp. 22-2, pp. 90-97. Retrieved from: https://apps.azsos.gov/public_services/Title_18/18-02.pdf
[124] EKAPCD. *Rule 402.2 (Agricultural Operations)*. (Amended January 13, 2022). Retrieved from: http://www.kernair.org/Rule%20Book/4%20Prohibitions/402_2%20Agricultural_Operations.pdf
[125] Note: EKAPCD Rule 402.2 was originally adopted in March 2015. EKAPCD withdrew the 2015 version of Rule 402.2 from the SIP through formal request on March 4, 2021, based on rule deficiencies identified by U.S. EPA. EKAPCD adopted the new version of Rule 402.2 on January 13, 2022.
[126] ICAPCD. *Rule 806 (Conservation Management Practices)*. (Amended October 16, 2012). Retrieved from: https://apcd.imperialcounty.org/wp-content/uploads/2020/05/1RULE806.pdf
[127] SCAQMD. *Rule 403 (Fugitive Dust)*. (Amended June 3, 2005). Retrieved from: https://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-403.pdf?sfvrsn=4

In their 2020 approval of the District's *2018 PM2.5 Plan* for the 2006 PM2.5 NAAQS, EPA concluded that Rule 4550 continues to establish BACM and MSM control requirements for this source category. In their Technical Support Document,[128] EPA specifically cited the significantly superior enforcement mechanisms in Rule 4550, including:

- It is the only rule to require applications to be filed, specifying the CMPs to be employed;
- It requires an approval process of the chosen CMPs, unlike the other analogous rules; and
- It is the only rule to require owner/operators to maintain records for five years.

The District finds that Rule 4550 continues to implement the most stringent levels of control when compared to analogous rules from other areas. Therefore, no additional comparison is needed at this time.

Evaluation Findings

Rule 4550 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

Although Rule 4550 already meets BACM and MSM for this source category, and while attainment modeling and analysis has demonstrated that additional CMPs will not significantly contribute to our attainment efforts, the District will go beyond MSM in this Plan and is committing to the following comprehensive strategy, in close collaboration with industry stakeholders, AgTech, USDA-NRCS, CARB, and EPA:

- Continue supporting and reviewing scientific research on the PM2.5 content, constituents, and stability during wind events of the many soil types found throughout the Valley.
- Evaluate the feasibility and effectiveness of CMPs on fallow lands that are tilled or otherwise worked with implements of husbandry to reduce windblown PM2.5 emissions from disturbed fallowed acreage, recognizing the Valley's unique soil characteristics and agricultural practices to ensure that Valley-specific solutions are considered in this process.
- Evaluate potential enhancements to the District's emission reduction strategy for nut harvesting emissions (Low-Dust Nut Harvester Replacement Incentive Program, CMP Program, collaborative outreach efforts, etc.) to continue supporting the accelerated deployment of low-dust harvesters.
- Building on prior successful research efforts conducted in partnership with Valley agriculture and agencies, support research efforts aimed at furthering the

[128] EPA. *Technical Support Document*, *EPA Evaluation of BACM/MSM for the San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS*, pp. 26-30. (February 2020). Retrieved from: https://www.regulations.gov/document/EPA-R09-OAR-2019-0318-0005

understanding of the amount and type of harvesters operating in the San Joaquin Valley, and potential emissions reductions achievable through newly available harvester technologies (including evolving practices such as the use of conditioning equipment).

- Continue incentive-based efforts supporting the accelerated deployment of cleaner technologies for nut harvesting, including the current allocation of $25 million in funding for the Low-Dust Nut Harvester Replacement Program in the Adopted 2023-24 District Budget and Recommended 2024-25 District Budget. Based on historical program participation, this funding is estimated to facilitate the replacement of approximately 350 additional harvesters with low-dust nut harvesting equipment. The District will also continue to advocate for additional state and federal funding in support of this effort.

C.16 RULE 4692 (COMMERCIAL CHARBROILING)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	1.47	1.50	1.53	1.57	1.62	1.66	1.47
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	1.47	1.50	1.53	1.57	1.62	1.66	1.47
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

District Rule 4692 Description

District Rule 4692, adopted March 21, 2002, requires the installation and operation of PM control devices on chain-driven commercial charbroilers that cook 400 pounds of meat or more per week. Charbroiler exhaust transfers through the catalytic oxidizer with little loss of temperature. As high-temperature exhaust goes through the heated catalyst, PM and VOC are oxidized to carbon dioxide and water vapor. This chemical reaction releases energy that heats the catalyst and transfers it to a heat recovery system. Through current Rule 4692 requirements, affected chain-driven commercial charbroilers are required to have emissions control devices that achieve 83% control efficiency for PM and 86% control efficiency for VOC.

The District has attempted to impose similar requirements for underfired charbroiling operations, however the unavailability of a feasible and cost-effective control technology has been a barrier to establishing these requirements. Other air districts in California have encountered similar difficulties in identifying and requiring compliant control technologies for underfired charbroilers.

The District has contributed substantial time and effort into researching the emissions produced by underfired charbroilers in order to form a sound approach to controlling the emissions. Since 2009, the District has partnered with SCAQMD, BAAQMD, and EPA to further the research and evaluation of emission control technologies for underfired charbroilers. Through this effort, underfired charbroiler technology assessments have been conducted at UC Riverside College of Engineering's Center for Environmental Research & Technology (CE-CERT). The District provided in-kind technical support and the research was funded with over $500,000 in contributions from SCAQMD, BAAQMD, and EPA. This effort led to the establishment of published testing methodology, SCAQMD Method 5.1, which has been used as a benchmark methodology to standardize the testing of control efficiencies of kitchen exhaust pollution control units.

Rule 4692 was amended on June 21, 2018, to better understand emissions from underfired charbroilers in the Valley, and as an early measure in support of the District's commitment in the *2018 PM2.5 Plan*. The 2018 amendments added reporting and registration requirements for commercial underfired charbroiler units, including Permit-Exempt Equipment Registration (PEER) requirements for units with a meat throughput greater than 400 pounds/week, or greater than 10,800 pounds/year, not to exceed 875 pounds/week. Upon adoption of the regulatory amendment, the District conducted outreach to affected restaurants, with the vast majority of restaurants subject to the reporting requirement now having submitted the required information. To date, the District has received over 4,100 one-time reports, of which 878 restaurants have reported operation of an underfired charbroiler. Of these 878 restaurants, 145 have reported a cooking throughput of at least 400 lbs of meat per week and have subsequently obtained a required PEER.

Additionally, the District created the Restaurant Charbroiler Technology Partnership (RCTP) program with the goal of reducing PM2.5 emissions from underfired commercial charbroilers. The program was initially allocated with $750,000 of incentive funding to fully cover all emissions control device installation costs as well as two years of device maintenance. RCTP initially struggled to find restaurants interested in participating in the program despite the program’s willingness to cover all associated costs. Despite the District’s efforts in promoting available funding under the RCTP program, the District has faced difficulty in finding restaurants willing to partner with the District to demonstrate new technologies. To date, only one restaurant, the Habit Burger Grill, has successfully completed two years of demonstration of a Molitron wet scrubber in their Stockton restaurant. Initially, the project experienced hood fan sizing issues, resulting in the restaurant being smoked out and forced to close temporarily. The Habit Burger Grill has subsequently installed these control devices on additional new restaurants, with some of these installations in the Valley.

In 2019, the District made an even larger concerted effort to conduct outreach to restaurants in the San Joaquin Valley regarding incentives available through RCTP. Through this outreach effort, the District received only 15 RCTP interest cards out of the over 4,200 restaurants that were contacted to comply with the 2018 Rule 4692 reporting and registration requirements. After discussing RCTP with these restaurants in more detail, none of these restaurants considered moving forward after this additional outreach.

In addition, the District tailored its approach and made direct contact with five prominent Valley restaurants, which resulted in a great deal of interest to evaluate the feasibility of installing the underfired emission control technology on their existing operations, with the understanding that all costs of the technology and two year maintenance would be covered through the RCTP program. District staff conducted multiple site visits to these operations, working with the restaurant owner/operator, engineering consultants, and technology vendors. Initial control system designs, quotes from vendors, and installation quotes from contractors were obtained and the feasibility of the technologies were fully assessed for each of the restaurants. However, after conducting a lengthy detailed analysis, none of the restaurants moved forward with the demonstration due to feasibility issues related to the installation of the control devices and local permitting challenges, as further described below, and concerns about the cost of maintenance after the funded two-year demonstration period concluded under RCTP. The District is still actively pursuing restaurants for demonstration opportunities in the Valley.

How does District Rule 4692 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4692 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4692 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 6, Rule 2 (Amended December 5, 2007)[129]
- New York Department of Environmental Protection Title 24 of the Administrative Code, Section 24-149.4 (Amended November 6, 2016)[130]
- South Coast AQMD Rule 1138 (Adopted November 14, 1997)[131]
- Ventura County APCD Rule 74.25 (Adopted October 12, 2004)[132]

In their 2020 approval of the District's *2018 PM2.5 Plan* for the 2006 PM2.5 NAAQS, EPA found that Rule 4692 continues to establish BACM and MSM control requirements for this source category. In their Technical Support Document,[133] EPA stated the following:

> *"Rule 4692 implements the most stringent measures adopted or demonstrated to be technically and economically feasible for commercial chain-driven charbroilers, and we are not aware of control measures for existing under-fired*

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[129] BAAQMD*. Regulation 6 Rule 2 (Commercial Cooking Equipment).* (Amended December 5, 2007). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-6-rule-2-commercial-cooking-equipment/documents/rg0602.pdf?la=en&rev=42fc0966398c43f9b585572708a5ea70

[130] New York Department of Environment Protection*. Title 24 of the Administrative Code, Section 24-149.4 (Commercial Char Broilers).* (Amended November 6, 2016). Retrieved from: https://www1.nyc.gov/assets/dep/downloads/pdf/air/air-pollution-control-code.pdf

[131] SCAQMD. *Rule 1138 (Control of Emissions from Restaurant Operations).* (Adopted November 14, 1997). Retrieved from: https://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1138.pdf?sfvrsn=4

[132] VCAPCD. *Rule 74.25 (Restaurant Cooking Operations).* (Adopted October 12, 2004). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.25.pdf

[133] EPA. *Technical Support Document*, *EPA Evaluation of BACM/MSM for the San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS*, pp. 30-36. (February 2020). Retrieved from: https://www.regulations.gov/document/EPA-R09-OAR-2019-0318-0005

charbroilers that are technologically and economically feasible for implementation in the SJV."

The District reviewed all rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4692 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rule is demonstrated below.

New York Department of Environmental Protection (NYDEP)

- City of New York Title 24 of the Administrative Code, Section 24-149.4 (Emission Reduction Technologies for Char Broilers)

	SJVAPCD Rule 4692	NYDEP Title 24 §24-149.4
Applicability	Chain-driven charbroilers and underfired charbroilers at commercial cooking operations.	Chain-driven charbroilers and underfired charbroilers at commercial cooking operations.
Exemption	Charbroilers that cook <400 lbs of meat per week, or ≤10,800 lbs of meat per year and the total amount of meat cooked per week is <875 lbs.	Charbroilers that cook <875 lbs of meat per week.
Requirements	Requires that chain-driven charbroilers reduce PM emissions by 83% through the installation of an approved catalytic oxidizer. Registration requirements for under-fired charbroilers. Weekly record-keeping requirement for both charbroiler categories.	Requires catalytic oxidizer or control of PM10 by 75% for chain-driven charbroilers. Registration requirement for existing under-fired units. New under-fired units required to install control devices to limit PM emissions by 75% (currently unenforced).

The NYC DEP regulation, adopted in May 2016, requires the installation of control devices certified to provide at least 75% emissions reductions for new restaurants with underfired charbroilers that cook 875 pounds or more of meat per week. Based on staff-level discussions, NYC DEP does not currently have any known installations of these devices. Therefore, the requirements of District Rule 4692 are more stringent that those found in NYC's Section 24-149.4 for chain-driven charbroilers.

Potential Emission Reduction Opportunities

Although a variety of technologies for capturing emissions from underfired charbroilers have been tested over the years, ESPs and mechanical or media filtration are the most widely installed technologies for controlling particulate emissions from commercial underfired charbroilers. Below are general descriptions of each technology.

- **Electrostatic Precipitator (ESP):** This technology uses electrostatic processes to capture particles on electrically charged plates. ESPs are complex technology, but highly automated, and the operation costs include electricity and water usage. In addition, wastewater collection and discharge requirements must be met, which involves washing collection plates. ESPs are more expensive to install initially, but have lower maintenance costs than the mechanical filtration units (generally about half of the maintenance costs of the filter units) and have a more effective control of the small particulates emitted by charbroiling.

- **Filtration (Mechanical or Media):** This technology uses groups of mechanical filters to capture particles. It is mechanically simpler than other technologies and the operation costs include electricity and filter replacements. Mechanical filtration units have been widely installed as pollution control devices for kitchen emissions, but maintenance of these units may be cost-prohibitive for mid-to high-volume underfired charbroiling operations due to the ongoing expense of changing the filters, and the large footprint of the units can make installation potentially infeasible.

- **Regenerative Filters:** Regenerative filters capture particles often on a catalyst surface, which then safely removes the particles during the regeneration process, thus allowing the filter to continue capturing particles with little maintenance or filter replacements. Regenerative filters are an emerging technology that has yet to be commercially proven in this source category. The District has had discussions with PureFlame and KhanTec to evaluate the feasibility of their technology. Notably, both technologies lack UL 8782 certification, and do not have installations in the United States.

- **Wool Filters:** Wool filters are another form of media filtration that uses wool instead of traditional filter media. A significant portion of PM2.5 produced by underfired charbroilers measure less than one micron, however, wool filters lack the ability to filter submicron particles at a high control efficiency thus rendering wool filters less efficient at reducing PM2.5.

The evaluation of installing emissions control technology on existing Valley restaurants through RCTP provided many insights as to the cost and technological feasibility of available controls. In addition to supporting and evaluating Valley-based underfired charbroiler control technology demonstrations, District staff has conducted an extensive review and assessment of underfired charbroiler control technology installations. This review included reaching out to other regulatory agencies in California and across the nation, technology manufacturers, and restaurants both inside and outside of the Valley to better understand the control technologies available for underfired charbroilers and real-world costs and experiences related to these technologies. While the District's evaluation has been successful in identifying potential underfired charbroiling control technologies, many questions remain with respect to understanding the feasibility and cost of these technologies, and whether restaurants can successfully operate and maintain these systems, as described in more detail below:

- **Installation cost of controls can be prohibitively expensive:** The cost of control units themselves are expensive, ranging from $42,500 up to $149,303 for the device itself. This does not take into account additional ducting, exhaust fan upgrades, or operation and maintenance costs. Recent discussions with control device manufacturers indicated that maintenance costs are significant and can quickly outweigh purchase costs within a few year. This fact is also supported by the previous District demonstration project, which required $23,956 of annual maintenance.

- **Retrofitting controls on existing restaurants can be prohibitively expensive and technologically infeasible:** Based on discussions with restaurant operators, technology vendors, and other regulatory agencies, it can be extremely difficult and cost-prohibitive to add controls on existing restaurants. The installation process may require structural, electrical, or water-line modifications that substantially increase total project costs compared to new restaurants. In addition to significant purchase and installation costs, the installation process may require the restaurant to temporarily shut down, resulting in loss of revenue. The District's control strategy seeks to not disrupt business from being carried out, therefore adding another layer of cost and complexity to manage for existing restaurants. Furthermore, the existing restaurant may not have the authority to make changes to the building if the space is leased and the landlord is unwilling to accommodate any changes.

- **Maintenance of controls can be prohibitively expensive:** Regular maintenance of control devices is critical to ensure control effectiveness is maintained. All commercial technologies applicable to control underfired charbroilers are designed to capture PM2.5 and require regular maintenance to remove particles, ensure proper airflow, and maintain control efficiency. ESPs require regular cleaning of the plates capturing particles, as ESPs lose control efficiency when these plates are covered in grease particles and filters clog over time. Discussions with manufacturers indicate that maintenance costs are dependent on the control technology implemented and the type and volume of food cooked, and that most facilities require maintenance on a weekly to monthly basis.

- **Maintenance requires specially trained staff that may not be accessible to all restaurants:** Control device cleaning can be a complex process, requiring specially trained staff. Many manufacturers recommend that their staff or a trusted professional company perform maintenance. Training restaurant staff to perform this task are often not be feasible, and service companies capable of performing the maintenance may not be readily available nearby. Travel costs are another factor that needs be taken into account when determining maintenance costs. Any delays in required maintenance could cause significant economic impacts to restaurants.

- **Regenerative filters lack UL 8782 certification:** Regenerative filters appear to be a promising technology that seek to limit the amount of maintenance required to control PM2.5 since the device is self-cleaning by design. However, regenerative filters have not been commercially demonstrated to control underfired charbroiler emissions in the US. The lack of UL 8782 certification currently prevents two manufacturers, PureFlame and KhanTec, from entering the market. The District has had previous working relationship with KhanTec and struggled to install their device due to fire safety concerns since the device had not received UL 8782 certification. Discussions with PureFlame also present the same concerns, as well as lacking a fire suppression system. The District cannot recommend using a control device that may become a safety hazard.

Cost Analysis for New Restaurants

District Rule 4692 reduces emissions by requiring catalytic oxidizers for chain-driven charbroilers that meet rule applicability thresholds. Charbroiler exhaust transfers through the catalytic oxidizer with little loss of temperature. As high-temperature exhaust goes through the heated catalyst, PM and VOC are oxidized to carbon dioxide and water vapor. This chemical reaction releases energy that heats the catalyst and transfers it to a heat recovery system. Rule 4692 requires emission controls for chain-driven charbroilers that cook 400 pounds of meat or more per week.

A variety of technologies for capturing emissions from underfired charbroilers have been tested over the years, including ESPs, mechanical or media filtration, and wet scrubbers. ESPs and mechanical or media filtration are the most widely installed technologies for controlling PM from commercial underfired charbroilers. However, District analysis found no cost-effective technologies have been demonstrated as achieved in practice to date. As such, the rule currently does not have control requirements specific to underfired charbroilers.

This analysis uses the meat throughput data from each facility required to obtain a PEER for their operation, which cook over a threshold amount of meat and meat substitute products on an underfired charbroiler. According to the District's PEER data, 157 restaurants cooked at least 10,800 pounds of meat annually. Using the District's commercial cooking methodology,[134] the median PM2.5 emissions from each of these restaurants was 808 pounds annually.

The District conducted a cost analysis using the methods in EPA's Cost Manual.[135] The Cost Manual has relative estimates of all costs associated with ESPs including purchase price, installation, engineering, fabrication, contractors, and many more. The Cost Manual begins with the purchase price, then estimates all other costs based on a percentage of the purchase price.

The total capital investment required for ESPs was calculated using the formula in Table 3.16 of the Cost Manual. The formula from Table 3.16 was used to evaluate the lower and upper end of ESP purchase costs of $42,500 and $149,303 respectively. The Cost Manual estimates the total capital investment of $112,336 needed for ESPs with a purchase cost of $42,500. The total capital investment increases to $394,638 for devices with a $149,303 purchase cost. Notably, these capital costs do not include site preparation or building modifications, which would require additional investment from the facility.

When combined with operation and maintenance costs, even less expensive ESP devices are not cost effective solutions to reducing emissions from this source category.

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[134] SJVAPCD. 2006 Area Source Emissions Inventory Methodology 690 – Commercial Cooking Operations. Retrieved from: https://www.valleyair.org/Air_Quality_Plans/EmissionsMethods/MethodForms/Current/CommercialCookin g2006.pdf

[135] EPA. *Air Pollution Control Cost Manual, Section 6, Particulate Matter Controls, Chapter 3: Electrostatic Precipitators*. (September 1999). Retrieved from: https://www.epa.gov/sites/default/files/2020-07/documents/cs6ch3.pdf

Based on previous District experience and discussions with manufacturers, the District estimates that $12,000 to $24,000 of annual operation and maintenance costs are required to keep pollution control devices performing properly. Maintenance typically includes but is not limited to media filter replacements, carbon filter replacements, duct or hood cleaning, or ESP plate cleaning. As one example, the District's demonstration of a wet scrubber with media filtration through the RCTP had reported $23,956 of annual maintenance costs. Notably, regular maintenance is required to keep ESPs control efficiency, which can drop to below 30% if not properly maintained. Although facilities are required to install a control device, it is only effective if maintenance is performed regularly. The District has recently had discussions with various vendors that have integrated automated cleaning functions; however, these units still require professional cleaning on a regular basis.

Table C-6 Direct Costs

	EPA Cost Manual Formula	Low Estimate	High Estimate
ESP + auxiliary equipment	1.0 A	$42,500	$149,303
Instrumentation	0.1 A	$4,250	$14,930
Sales Tax	0.03 A	$1,275	$4,479
Freight	0.05 A	$2,125	$7,465
Direct Cost Total	**B = 1.18 A**	**$50,150**	**$176,178**

Table C-7 Direct Installation Costs

	EPA Cost Manual Formula	Low Estimate	High Estimate
Foundations and Supports	0.04 B	$2,006	$7,047
Handling and Fabrication	0.50 B	$25,075	$88,089
Electrical	0.08 B	$4,012	$14,094
Piping	0.01 B	$502	$1,762
Insulation for Ductwork	0.02 B	$1,003	$3,524
Painting	0.02 B	$1,003	$3,524
Direct Installation Costs Total	**0.67 B**	**$33,601**	**$118,039**

Table C-8 Indirect Costs

	EPA Cost Manual Formula	Low Estimate	High Estimate
Engineering	0.20 B	$10,030	$35,236
Construction	0.20 B	$10,030	$35,236
Contractor	0.10 B	$5,015	$17,618
Start-up	0.01 B	$502	$1,762
Performance Test	0.01 B	$502	$1,762
Model Study	0.02 B	$1,003	$3,524
Contingencies	0.03 B	$1,505	$5,285
Total Indirect Costs	**0.57 B**	**$28,586**	**$100,421**

Table C-9 Other Costs

	EPA Cost Manual Formula	Low Estimate	High Estimate
Site Preparation	SP	As Required	As Required
Buildings	Bldg	As Required	As Required

Table C-10 Total Capital Investment

	EPA Cost Manual Formula	Low Estimate	High Estimate
Total	2.24 x B	**$112,336** + *SP and Bldg*	**$394,638** + *SP and Bldg*

The cost effectiveness was calculated twice to give a low and high total capital investment estimate by summing annualized one-time costs (annualized over a 10-year period using a 4 percent discount rate) and annual operation and maintenance costs. The District estimates a cost effectiveness of $74,424 per ton of PM2.5 controlled for ESP devices costing $42,500. These costs inflate to $209,180 per ton of PM2.5 controlled for ESP devices costing $149,303. As expected, the elevated purchase costs leads to excessive costs that will not be feasible for restaurant owners to incur an annual cost ranging from $25,850 to $72,655 of annual costs to control emissions. The average Valley restaurant only expects to profit $44,000 annually, which would require the owner to sacrifice approximately 2.80 to 9.87 years' worth of profits to cover the total capital investment.[136]

Table C-11 Cost Effectiveness Analysis for Underfired Charbroiler Controls

	Purchase Costs	Total Capital Investment	O&M (annual)	Annualized Cost	Cost Effectiveness (PEER Median Emissions)
Lowest Cost Estimate	$42,500	$112,336	$12,000	$25,850	**$74,424**
Highest Cost Estimate	$149,303	$394,638	$24,000	$72,655	**$209,180**

Cost Analysis for Existing Restaurants

Based on discussions with restaurant operators, technology vendors, and other regulatory agencies, it can be extremely difficult and cost-prohibitive to add controls on existing restaurants. The installation may require structural, electrical, or water-line modifications that may not be feasible. This makes installation costs much higher for existing restaurants compared to new restaurants that can integrate emissions controls into the design. The existing structure may not have the necessary space or structural support for the control unit. Furthermore, the existing restaurant may not have the authority to make changes to the building if the space is leased and the property owner is unwilling to accommodate. EPA's Cost Manual estimates that the total capital investment for existing restaurants would be 1.3 to 1.5 times more expensive than the total capital investment for new restaurants, with an estimated total capital investment ranging from $146,036 to $591,957, which would be far less cost effective than the already high cost effectiveness values shown previously for new restaurants.

[136] SJVAPCD. *Proposed Commercial Underfired Charbroiling Emission Reduction Strategy*. (December 17, 2020). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2020/December/final/11.pdf

District Commercial Underfired Charbroiling Emission Reductions Strategy

In recognition of the above mentioned challenges, the District Governing Board adopted a multipronged strategy to promote emission reductions from this category, while minimizing the impact on restaurants during the COVID-19 pandemic. This strategy, approved by the Governing Board in December 2020, will require significant effort by the District through creating enhancements to the RCTP program, developing and providing guidance to local agencies for the development of ordinances, providing education to local agencies on the health impact of commercial cooking emissions, working with CARB as they consider developing a statewide Suggested Control Measure, working with CARB/EPA in making improvements to the emissions inventory for commercial underfired charbroiling, and formalizing the restaurant workgroup to stay in touch with current industry conditions and to continue to develop and deploy underfired charbroiler technology. In addition to this effort, the District continues to coordinate with CARB and EPA on feasibility of technology, and advocates for EPA and CARB to establish a new state/federal underfired charbroiler technology certification and demonstration program. To help address community impacts associated with commercial underfired charbroiling operations, this program would establish uniform certification requirements for vendors of emissions control technologies, and support the real-life demonstration of these technologies. Currently, there is no uniform certification program in place, and no technologies have been certified under regional programs. Given the community-level importance of reducing emissions from large underfired charbroiling operations, establishing a uniform certification and demonstration program would significantly accelerate the development and deployment of these technologies.

Evaluation Findings

Rule 4692 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

In addition to the existing emissions reductions already achieved through control requirements for chain-driven commercial charbroilers, the District continues to seek to achieve additional emission reductions from commercial underfired charbroilers. While there are ongoing improvements in the technology available for commercial cooking emissions, many technological and economic challenges remain, specifically for underfired charbroilers, as detailed above.

The need to reduce PM2.5 from commercial charbroiling continues to grow as EPA promulgates more stringent PM2.5 NAAQS. The lack of commercially available and feasibly demonstrated control technologies has been the primary barrier in moving forward with control strategies for reducing emissions from restaurants equipped with commercial charbroilers. Other air districts in California and other regions have encountered similar difficulties in identifying and requiring emissions control technologies for underfired charbroilers. Based on the importance of underfired charbroiling emissions as it relates to attainment of the federal PM2.5 standards in the future, collaborative work is needed to further understand the emissions from underfired charbroiling, including potential control strategy opportunities to reduce emissions from this category.

The District has previously collaborated with other agencies including CARB, SCAQMD, and BAAQMD to evaluate and implement control strategies for underfired charbroilers. While significant work has been done, to date, barriers still exist to the commercial deployment of underfired charbroiler technology.

The District has recently formed the Charbroiler Collaborative Workgroup, consisting of the District, SCAQMD, BAAQMD, and CARB, to assist in overcoming all obstacles, including costs and emissions control issues preventing widespread control of underfired charbroilers. Through this collaborative and internally, the District commits to ongoing evaluation of potential controls for underfired charbroilers.

C.17 RULE 4702 (INTERNAL COMBUSTION ENGINES)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.36	0.34	0.31	0.28	0.26	0.24	0.24
NOx	6.68	6.26	5.52	4.86	4.36	4.02	3.93
	Winter Average - Tons per day						
PM2.5	0.29	0.28	0.25	0.24	0.22	0.21	0.21
NOx	5.02	4.74	4.20	3.72	3.38	3.14	3.08

District Rule 4702 Description

District Rule 4702 applies to any internal combustion (IC) engine rated at 25 brake horsepower (bhp) or greater. The purpose of this rule is to limit NOx, CO, VOC, PM, and SOx emissions from units subject to this rule. Facilities with units subject to this control measure represent a wide range of industries, including but not limited to oil and gas production, petroleum refineries, landfills, wastewater treatment plants, water districts, schools, and electrical power generation facilities.

Rule 4702 was adopted in August 2003, and has been amended several times. Most recently, on August 19, 2021, the District Governing Board adopted rule-strengthening amendments that were based on the results of a comprehensive review of the existing engine inventory in the Valley, available control technology, requirements in other air districts, and a cost-effectiveness analysis of requiring further controls for existing engines. As part of these regulatory efforts, hundreds of engines in the Valley have been equipped with the best available NOx and PM control technologies.

Rule 4702 contains stringent emission limits for NOx, CO, and VOCs, PM requirements for all categories of IC engines affected by the rule, and SOx control requirements for agricultural engines. Additionally, under Rule 4702, new and replacement compression ignition (CI) engines are required to be Tier 4, the cleanest certified engine available. As a result, Rule 4702 has significantly reduced emissions from non-agricultural and agricultural IC engines, with substantial investments made by the affected sources to comply with the rule.

How does District Rule 4702 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines applicable to this source category.

A. Alternative Control Techniques (ACT)

- *Alternative Control Techniques Document – NOx Emissions from Stationary Reciprocating Internal Combustion Engines (EPA-453/R-93-032 1993/07, updated 2000/09)*

The District evaluated the requirements contained within the ACT for Stationary Reciprocating Internal Combustion Engines and found no requirements that were more stringent than those already in Rule 4702.

B. New Source Performance Standards (NSPS)

- *40 CFR 60 Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (2020/12 and 2021/06)*

The District evaluated the requirements contained within Subpart IIII and found no requirements that were more stringent than those already in Rule 4702.

- *40 CFR 60 Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (2020/12 and 2021/06)*

The District evaluated the requirements contained within Subpart JJJJ and found no requirements that were more stringent than those already in Rule 4702.

State Regulations

- *17 CCR §93114 – Airborne Toxic Control Measure to Reduce Particulate Emissions from Diesel-Fueled Engines—Standards for Nonvehicular Diesel Fuel (2003/07)*
- *17 CCR §93115 – Airborne Toxic Control Measure for Stationary Compression-Ignition Engines (2004/02)*

The District implements the requirements of 17 CCR §§93114 and 93115 through Rule 4702 and the District’s new source review permitting program (Rule 2201).

- *17 CCR §93116 – Airborne Toxic Control Measure for Diesel Particulate Matter from Portable Engines Rated at 50 Horsepower and Greater (2018/08)*

The District evaluated the requirements contained within 17 CCR §93116 and found no requirements that were more stringent than those already in Rule 4702.

How does District Rule 4702 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4702 to comparable requirements in rules from the following nonattainment areas:

- Bay Area AQMD Regulation 9, Rule 8 (Amended July 25, 2007)[137]
- Sacramento Metropolitan AQMD Rule 412 (Adopted June 1, 1995)[138]
- San Diego County APCD Rule 69.4.1 (Adopted July 8, 2020)[139]
- South Coast AQMD Rule 1110.2 (Amended November 1, 2019)[140]
- Ventura County APCD Rule 74.9 (Amended November 8, 2005)[141]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4702 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

San Diego County APCD

- SDAPCD Rule 69.4.1 (Stationary Reciprocating Internal Combustion Engines)

	SJVAPCD Rule 4702	SDAPCD Rule 69.4.1
Applicability	IC engines rated at ≥25 bhp.	IC engines rated at ≥50 bhp.
Exemptions	• Limited to operate ≤100 hrs/yr • De-rated engine that has been physically limited and restricted by permit to an operational level of <50 hp not used in agricultural operation (prior to 06/01/04) • De-rated engine that has been physically limited and restricted by permit to an operational level of <50 bhp used in agricultural operation (prior to 06/01/05)	• Engines used exclusively in connection with a structure designed for and used as a dwelling for not more than four families • Engines used exclusively in agricultural operations for the growing of crops or the raising of fowl or animals • Any engine when operated exclusively within a permitted test cell solely for the research, development, or testing of gas turbine engines, reciprocating IC engines, or their components • Any engine used exclusively in conjunction with military tactical support equipment

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137 BAAQMD. *Regulation 9, Rule 8 (Nitrogen Oxides and Carbon Monoxide from Stationary Internal Combustion Engines)*. (Amended July 25, 2007). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-8-nitrogen-oxides-and-carbon-monoxide-from-stationary-internal-combustion-engines/documents/rg0908.pdf?la=en

138 SMAQMD. *Rule 412 (Stationary Internal Combustion Engines Located at Major Stationary Sources of NOx)*. (Adopted June 1, 1995). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule412.pdf

139 SDAPCD. *Rule 69.4.1 (Stationary Reciprocating Internal Combustion Engines)*. (Adopted July 8, 2020). Retrieved from: https://www.sdapcd.org/content/dam/sdapcd/documents/rules/current-rules/Rule-69.4.1.pdf

140 SCAQMD. *Rule 1110.2 (Emissions from Gaseous- and Liquid-Fueled Engines)*. (Amended November 1, 2019). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1110-2.pdf

141 VCAPCD. *Rule 74.9 (Stationary Internal Combustion Engines)*. (Amended November 8, 2005). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.9.pdf

	SJVAPCD Rule 4702		SDAPCD Rule 69.4.1
Requirements			
Non-Agricultural Operation IC Engines (ppmv @ *15% oxygen on a dry basis)*			
Rich-Burn	Waste Gas-Fueled	11	50
	Cyclic Loaded, Field Gas Fueled	11	No Such Category
	Limited Use	11	No Such Category
	Not Listed Above	11	Existing: 25 New/Replacement: 11
Lean-Burn	Limited Use	11	No Such Category
	Used for Gas Compression	40, or 93% reduction	No Such Category
	Waste Gas-Fueled	40, or 90% reduction	65
	Not Listed Above	11	65
Agricultural Operation Spark-Ignited IC Engines (ppmv @ *15% oxygen on a dry basis)*			
Rich-Burn[142]	11, or 0.15 g/bhp-hr		New/Replacement: 90
Lean-Burn[143]	43, or 0.6 g/bhp-hr		New/Replacement: 150
Agricultural Operation Compression-Ignited IC Engines[144] (ppmv @ *15% oxygen on a dry basis)*			
	Tier 3 or Tier 4 Certified IC Engine		Exempt

The District found the requirements contained within SDAPCD Rule 69.4.1 are not more stringent than those already in District Rule 4702. Therefore, District Rule 4702 is as stringent as or more stringent than SDAPCD Rule 69.4.1.

South Coast AQMD

- SCAQMD Rule 1110.2 (Emissions from Gaseous- and Liquid-Fueled Engines)

	SJVAPCD Rule 4702	SCAQMD Rule 1110.2
Applicability	IC engines rated at ≥25 bhp.	Stationary and portable IC engines rated >50 bhp.
Exemptions	• Limited to operate ≤100 hrs/yr • De-rated engine that has been physically limited and restricted by permit to an operational level of <50 hp not used in agricultural operation (prior to 06/01/04) • De-rated engine that has been physically limited and restricted by permit to an operational level of <50 bhp used in agricultural operation (prior to 06/01/05)	• Engines powering orchard wind machines • Emergency engines permitted to operate no more than 200 hrs/yr • Laboratory engines used in research and testing purposes • Engines operated for purposes of performance verification and testing • Auxiliary engines used to power other engines or gas turbines during start-ups

142 There are only 2 rich-burn spark ignited engines operating in SCAQMD per discussions with SCAQMD staff.
143 There are no lean-burn spark ignited ag engines operating in SCAQMD per discussions with SCAQMD staff.
144 Information from SCAQMD indicates that there are no stationary non-emergency diesel IC engines that operate in the SCAQMD.

	SJVAPCD Rule 4702		SCAQMD Rule 1110.2
			• Portable engines that are registered under the state Portable Equipment Registration Program (PERP) • Engines operating on San Clemente Island • Tier 4 certified stationary agricultural IC engines for which the electric utility rejected an application for an electrical line extension to the engine location or that do not qualify for Carl Moyer Program funding • IC engine start-up periods, until sufficient operating temperatures are reached for proper operation of emission control equipment or for the tuning of the engines and/or emission control equipment, and engine shutdown periods. The periods shall not exceed 30 minutes, unless a longer period, not exceeding two hours, is approved in writing • IC engine start-ups, after an engine overhaul or major repair, or the replacement of catalytic emission control equipment, for a period not to exceed four operating hours • Initial commissioning of a new engine for a period not exceeding 150 operating hours • Engines rated ≤100 bhp used exclusively for electrical generation at remote two-way radio transmission towers where no utility, electricity, or natural gas is available within a ½ mile radius, and is fired exclusively on diesel #2, compressed natural gas, or LPG • NOx emissions from existing IC engines subject to SCAQMD RECLAIM Program (pursuant to SCAQMD Rule 2001 – RECLAIM Applicability) • Engines operated in either the Southern California Coastal Waters or Outer Continental Shelf Waters that power cranes and are certified to meet the Tier 4 Final emission standards • The facility operator of MM PRIMA DESHECHA ENERGY, LLC provided that a plan was submitted before 07/01/16, for the permanent shutdown of all subject equipment by 10/01/22 • Engines located at landfills or publicly owned treatment works that are subject to a NOx emission limit in a Regulation XI rule adopted/amended after 11/01/19
Requirements			
Non-Agricultural Operation IC Engines (ppmv @ *15% oxygen on a dry basis)*			
Rich-Burn	Waste Gas-Fueled	11	11
	Cyclic Loaded, Field Gas Fueled	11	No Such Category

	SJVAPCD Rule 4702		SCAQMD Rule 1110.2
	Limited Use	11	No Such Category
	Not Listed Above	11	11
Lean-Burn	Limited Use	11	No Such Category
	Used for Gas Compression	40, or 93% reduction	No Such Category
	Waste Gas-Fueled	40, or 90% reduction	11
	Not Listed Above	11	11
Agricultural Operation Spark-Ignited IC Engines (ppmv @ *15% oxygen on a dry basis)*			
Rich-Burn[145]	11, or 0.15 g/bhp-hr		11
Lean-Burn[146]	43, or 0.6 g/bhp-hr		11
Agricultural Operation Compression-Ignited IC Engines[147] (ppmv @ *15% oxygen on a dry basis)*			
	Tier 3 or Tier 4 Certified IC Engine		11, or Tier 4 Certified IC Engine

Many of the engine applications found in the San Joaquin Valley vary considerably from engine applications in SCAQMD. Outside of the few major urban centers, the vast majority of the 25,000 square miles of land in the Valley is rural land primarily used for agriculture. Agricultural IC engines can be located nearly anywhere in the Valley, including remote locations that are many miles away from the Valley's major urban centers. For example, some spark-ignited agricultural IC engines are located over 35 miles from an urbanized area, with engines operating in farms that may cover tens of thousands of acres of land. In contrast, SCAQMD is primarily an urban area with far fewer farms, with a very limited number of agricultural engines, and all natural gas fired agricultural engines operating within or very near urban areas.

A majority of the engines subject to District Rule 4702 are used in agricultural operations as described above, while there are only two rich-burn agricultural engines, and no lean-burn agricultural engines operating in SCAQMD. Due to the stark differences between the urban environment of the South Coast engines and the very rural and expansive environment of the Valley, the operation of these agricultural engines at a lower limit has not been achieved in practice as it relates to the conditions of the Valley. For comparable units, District Rule 4702 has similar limits to SCAQMD Rule 1110.2, and both rules have significantly lower emission limits than other California District rules. Therefore, District Rule 4702 is as stringent as or more stringent than SCAQMD Rule 1110.2.

[145] There are only 2 rich-burn spark ignited engines operating in SCAQMD per discussions with SCAQMD staff.
[146] There are no lean-burn spark ignited ag engines operating in SCAQMD per discussions with SCAQMD staff.
[147] Information from SCAQMD indicates that there are no stationary non-emergency diesel IC engines that operate in the SCAQMD.

Potential Emission Reduction Opportunities

Over the years, the District has adopted numerous generations of rules and rule amendments for engines that have significantly reduced NOx and VOC emissions from this source category. As part of these regulatory efforts, hundreds of engines in the Valley have been equipped with the best available NOx and VOC control technologies. Notably, EPA approved District Rule 4702 as BACM/MSM in their approval of the Plan for the 2006 PM2.5 Standard (*2018 PM2.5 Plan)* in July of 2020.

Most recently, in August 2021, the District Governing Board adopted amendments to Rule 4702 that included even more stringent emission limits for internal combustion engines operating in the Valley. Emissions limits were determined based on the results of a comprehensive review of the existing engine inventory in the Valley, available control technology (including BACT requirements), requirements in other air districts, and a cost-effectiveness analysis of requiring further controls for existing engines. The amendments included compliance deadlines of December 31, 2023, and December 31, 2029, depending on unit type; therefore facilities have either recently complied or are still in the process of complying with the recent amendments.

<u>NOx Emission Control Technologies</u>

SCR to Reduce Emissions from Lean-Burn Agricultural IC Engines to 11 ppmv NOx @ 15% O_2

This analysis will consider two scenarios:

1. A lean-burn agricultural IC Engine currently achieving NOx emissions of 150 ppmvd @ 15% O2, reducing emissions to 11 ppmvd @ 15% O2.
2. A lean-burn agricultural IC Engine currently achieving NOx emissions of 43 ppmvd @ 15% O2, reducing emissions to 11 ppmvd @ 15% O2.

<u>Assumptions</u>

- Previous Rule 4702 NOx Emission Limit for Lean-Burn Agricultural IC Engines: 150 ppmv NOx @ 15% O_2, approximately 2.1 g-NOx/bhp-hr
- Current Rule 4702 NOx Emission Limit for Lean-Burn Agricultural IC Engines: 43 ppmv NOx @ 15% O_2, approximately 0.6 g-NOx/bhp-hr
- Potential NOx Emission Limit for Lean-Burn Agricultural IC Engines evaluated: 11 ppmv NOx @ 15% O_2, approximately 0.15 g-NOx/bhp-hr
- Based on District permitting system, typical size of lean-burn agricultural IC engines in District that have emissions over upcoming Rule 4702 limit: 266 bhp
- Based on information previously provided by the District's Grants Department, agricultural engines powering irrigation pumps operate an average of approximately 1,800 hours per year
- Load Factor (maximum annual operating load) for agricultural IC engines: 80%

Calculation of Emission Reductions

Scenario 1 (150 ppmvd to 11 ppmvd):
The NOx emission reductions from lowering the NOx emission limit from 150 ppmv NOx @ 15% O_2 (2.1 g-NO_X/bhp-hr) to 11 ppmv NOx @ 15% O_2 (0.15 g-NO_X/bhp-hr) are calculated as follows:

(2.1 g-NO_X/bhp-hr - 0.15 g-NO_X/bhp-hr) x 266 bhp x 1,800 hr/year x 0.8 ÷ 453.59 g/lb
= 460 lb-NO_X/year

1,647 lb-NO_X/year ÷ 2,000 lb/ton = **0.824 ton-NO_X/year**

Scenario 2 (43 ppmvd to 11 ppmvd):
The NOx emission reductions from lowering the NOx emission limit from 43 ppmv NOx @ 15% O_2 (0.6 g-NO_X/bhp-hr) to 11 ppmv NOx @ 15% O_2 (0.15 g-NO_X/bhp-hr) are calculated as follows:

(0.6 g-NO_X/bhp-hr - 0.15 g-NO_X/bhp-hr) x 266 bhp x 1,800 hr/year x 0.8 ÷ 453.59 g/lb
= 460 lb-NO_X/year

460 lb-NO_X/year ÷ 2,000 lb/ton = **0.19 ton-NO_X/year**

Annualized Cost of SCR System to Reduce NOx Emissions to 11 ppmvd @ 15% O_2

- The District Rule 4702 staff report (August 2021) states that the installed cost of an SCR system for a lean-burn IC engine is estimated to be over $120,000 to $300,000 (avg $210,000), depending on the size of the unit, and that the annual operation and maintenance cost for an SCR system is between $16,000 and $60,000 (avg $38,000), depending on the size of the unit.
- Based on District Policy APR 1305 - Best Available Control Technology (BACT), the current interest rate used for cost-effectiveness calculations is 4% with an assumed equipment life of 10 years.

The estimated range of the annualized costs for an SCR system to reduce NOx emissions from IC engines are calculated below in accordance with District Policy APR 1305. The cost for the purchase of the SCR system will be spread over the estimated 10-year life of the system using the capital recovery equation shown below. As stated above, a 4% interest rate will used. It will be assumed that the equipment has no salvage value at the end of the ten-year cycle.

$$A = [P \times i(i+1)^n]/[(i+1)^n-1]$$

Where:

A = Annual Cost
P = Present Value
i = Interest Rate (4%)
n = Equipment Life (10 years)

Average Annualized Cost Estimate for an SCR system for an Agricultural IC Engine

Annualized Capital Cost (Avg Estimate):
$A = [210{,}000 \times 0.04(1.04)^{10}]/[(1.04)^{10}-1] = \$25{,}891/\text{year}$

Annual Operating Cost (Avg Estimate): $38,000/year

Total Annual Cost (Avg Estimate): $25,891/year + $38,000/year = $63,891/year

Assumptions	Source	Value
Average AG lean-burn IC Engine Size	District Permitted Inventory	266 bhp
Engine load factor	District Grant Program for Ag ICE powering irrigation pumps	80%
Operating Hours		1,800 hrs

Direct Capital Cost		
SCR system	District Rule 4702 Staff Report (August 2021)	$210,000
Annualized Capital Cost (10 years @ 4% interest)	District Policy APR 1305	$25,891
Direct Annual Cost		
Operating Cost	District Rule 4702 Staff Report (August 2021)	$38,000
Total Annual Cost		
Annualized Capital Cost + Direct Annual Cost		**$63,891**

Type of Installation	Power Rating (bhp)	Current NOx Emission Factor (ppmvd @ 15% O2)	Potential NOx Emission Factor (ppmvd @ 15% O2)	NOx Reduction (tons/yr)	Total Annual Cost ($)	Cost Effectiveness ($/ton)
Retrofit lean-burn AG IC engine with SCR system	266	150	11	0.824	$63,891	**$77,538**
		43	11	0.19	$63,891	**$336,268**

As demonstrated above, retrofitting a lean-burn agricultural IC engine with SCR is not a cost effective measure for reducing NOx emissions from these units.

In addition to the analysis included in this Plan, the District has conducted extensive analysis of the feasibility of additional potential controls for lean-burn agricultural engines in recent years, as part of the *2018 PM2.5 Plan*, through the rulemaking process for the 2021 amendements to Rule 4702, and in the *Initial SIP Requirements*, which addressed BACM requirements for the 2012 PM2.5 standard. These analyses have consistently demonstrated that both technical and economic feasibility challenges persist with regards to retrofitting or replacing these engines with controls to achieve 11 ppmv. These challenges, as validated by EPA in their 2020 evaluation of BACM/MSM for the 2006 PM2.5 NAAQS,[148] include:

- Engine power losses from adding controls
- Existing engines may require overhaul
- Existing engines cannot meet lower emissions levels due to narrower margin of compliance
- Control systems must be custom designed
- Errors generated during control system installation
- Retrofit controls can damage an engine
- Engine can damage a control system
- Compliance costs
- Engines operated in remote locations

As noted in their evaluation, EPA allows for consideration of factors such as a source's processes and operating procedures, raw materials, physical plant layout, and potential environmental impacts such as increased water pollution, waste disposal and energy requirements in determining whether a measure is technologically feasible. In addition, with respect to determining whether a given control measure is technologically feasible for an area or mobile source, the EPA allows for consideration of a number of additional relevant factors, such as the condition and extent of needed infrastructure, population size, or workforce type and habits, which may prohibit certain potential control measures from being implementable. In this document, EPA concludes that the District's analysis concerning the feasibility of additional control measures for these engines is reasonable, and that the rule satisfied BACM/MSM requirements. Since this evaluation, emission limits in other regions have remained the same, while the District has amended Rule 4702 to lower limits even further; therefore the District continues to meet or exceed BACM/MSM.

Zero-Emission Opportunities

The District has long pursued feasible opportunities to transition agricultural IC engines to electric alternatives and has found great success through effective incentive-based approaches. In 2005, the District partnered with Pacific Gas and Electric Company (PG&E) and Southern California Edison (SCE) to provide greater incentives for ag customers to replace their diesel pump engines with electric motors. Through these successful partnerships, the program encouraged agricultural customers to convert to electric use by offering a reduced electric rate, equal to approximately 20% (increasing 1.5% per year for 10 years), and providing line extension adders over and above standard line extension allowance. Additionally, the District matched the line extension adder provided by utilities in situations where it was needed, and met Carl Moyer cost-

[148] EPA. *Technical Support Document*, *EPA Evaluation of BACM/MSM for the San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS*, pp. 42-45. (February 2020). Retrieved from: https://www.regulations.gov/document/EPA-R09-OAR-2019-0318-0005

effectiveness thresholds. Over the course of this program, nearly 2,300 agricultural IC engines were electrified throughout the San Joaquin Valley.

More recently, the District has facilitated the voluntary replacement of thousands of high-polluting diesel agricultural irrigation pump engines with cleaner, zero or near-zero emission technology through the Agricultural Irrigation Pump Engine Repower Program. In fact, over the past 15 years alone, the District has replaced more than 1,660 older, high-polluting engines with cleaner technology, with over 1,300 being replaced with electric motors. This program provides Valley growers up to 85% of the eligible costs associated with replacing older high-polluting diesel engines with the cleanest available diesel technology or zero-emission electric motors, including electric line extension costs. The program provides an economic benefit to Valley growers to upgrade to more efficient equipment while achieving significant, cost-effective emissions reductions from agricultural operations throughout the Valley. The District has partnered with the California Public Utilities Commission (PUC) and local utilities to provide additional incentives and for line extensions as well as beneficial electric rate schedules, to further incentivize the shift to cleaner technology. Eligible projects are funded with a variety of local, state, and federal sources, including but not limited to District Indirect Source Review mitigation fees, Carl Moyer Program funding, AB 923 funding, Federal Designated Funding, and Federal Diesel Air Shed Grant funding.

Through the efforts described above, the District has been successful in transitioning agricultural engines to electric where feasible. However, there are significant challenges to electrifying the diesel engines that remain. Due to a lack of existing electric infrastructure in many areas of the Valley, there would be considerable costs associated with the line extension and other technology necessary to gain access to electricity in these remote locations. Additionally, in many cases, it would take 1-2 years, and often even longer, for utility companies to provide electrical access in these remote areas. The installation and maintenance of these systems could raise the costs of an electric engine significantly, with estimated cost effectiveness values of $150,000-$260,000, or higher, per ton of emissions reduced for each unit installed, depending on the size of the engine. Economic impacts would also be influenced by the increasing cost of electricity in California as electricity rates rose 48% from 2010 to 2020 (9.8 cents/kW-hr to 14.55 cents/kW-hr), based on annual data for 2020 provided by the U.S. Energy Information Administration.[149] The California Energy Commission projects that electricity prices will further rise by an average of 15% between 2020 to 2035 across all sectors.[150]

Due to technological and economic challenges, it is not feasible for the District to set a standard requiring engines to be replaced with electric motors or solar-powered motors at this time. The District will continue to work with agricultural operations to further reduce NOx emissions from this source category through a regulatory approach

[149] U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report, U.S. Energy Information Administration, Form EIA-861, Annual Electric Power Industry Report, U.S. Energy Information Administration, Form EIA-923, Power Plant Operations Report and predecessor forms.
[150] California Energy Commission. *Electricity Rate Scenarios*. September 30, 2021. Retrieved from: https://www.energy.ca.gov/sites/default/files/2021-09/1%20Electricity%20Rate%20Forecast%20Updates_ADA.pdf

supported by an incentive-based program with continued focus on electrification, as technologically and economically feasible.

Evaluation Findings

Rule 4702 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.18 RULE 4703 (STATIONARY GAS TURBINES)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	1.36	1.25	1.20	1.16	1.08	0.98	0.98
NOx	2.66	2.47	2.37	2.29	2.15	1.98	1.97
	Winter Average - Tons per day						
PM2.5	1.33	1.22	1.18	1.14	1.06	0.96	0.96
NOx	2.62	2.43	2.34	2.26	2.12	1.95	1.95

District Rule 4703 Description

District Rule 4703 limits NOx and CO emissions from stationary gas turbines with ratings equal to or greater than 0.3 MW or a maximum heat input of more than 3.0 MMBtu/hr. The main rule requirement is the limitation of NOx emissions. Laboratory units used in research and testing for the advancement of gas turbine technology, units limited by permit condition to be operated exclusively for firefighting and/or flood control, and emergency standby units limited by permit condition to operate less than 100 hours per calendar year for maintenance and testing purposes are not subject to the emission requirements of this rule.

How does District Rule 4703 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines applicable to this source category.

A. Alternative Control Techniques (ACT)

- *Alternative Control Techniques Document – NOx Emissions from Stationary Gas Turbines (EPA-453/R-93-007 1993/01)*

The District evaluated the requirements contained within the ACT for NOx Emissions from Stationary Gas Turbines and found no requirements that were more stringent than those already in Rule 4703.

B. New Source Performance Standards (NSPS)

- *40 CFR 60 Subpart GG – Standards of Performance for Stationary Gas Turbines (2009/03)*

The District evaluated the requirements contained within Subpart GG and found no emission requirements that were more stringent than those already in Rule 4703.

- *40 CFR 60 Subpart KKKK – Standards of Performance for Stationary Combustion Turbines*

The District evaluated the requirements contained within Subpart KKKK and found no emission requirements that were more stringent than those already in Rule 4703.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4703 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4703 to comparable requirements in rules from the following nonattainment areas:

- Bay Area AQMD Regulation 9, Rule 9 (Amended December 6, 2006)[151]
- Sacramento Metropolitan AQMD Rule 413 (Amended March 24, 2005)[152]
- San Diego County APCD Rule 69.3.1 (Adopted December 9, 2021)[153]
- South Coast AQMD Rule 1109.1 (Adopted November 5, 2021)[154]
- South Coast AQMD Rule 1134 (Amended February 4, 2022)[155]
- South Coast AQMD Rule 1135 (Amended January 7, 2022)[156]
- South Coast AQMD Rule 1150.3 (Adopted February 5, 2021)[157]

[151] BAAQMD. *Regulation 9, Rule 9 (Nitrogen Oxides from Stationary Gas Turbines).* (Amended December 6, 2006). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-9-nitrogen-oxides-and-carbon-monoxide-from-stationary-gas-turbines/documents/rg0909.pdf?la=en&rev=fed388c23f264d6ebd5e6e40096bdf79
[152] SMAQMD. *Rule 413 (Stationary Gas Turbines).* (Amended March 24, 2005). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule413.pdf
[153] SDAPCD. *Rule 69.3.1 (Stationary Gas Turbine Engines)*. (Adopted December 9, 2021). Retrieved from: https://www.sdapcd.org/content/dam/sdapcd/documents/rules/current-rules/Rule-69.3.1.pdf
[154] SCAQMD. *Rule 1109.1 (Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations).* (Adopted November 5, 2021). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1109-1.pdf?sfvrsn=8
[155] SCAQMD. *Rule 1134 (Emissions of Oxides of Nitrogen from Stationary Gas Turbines).* (Amended February 4, 2022). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1134.pdf?sfvrsn=4.
[156] SCAQMD. *Rule 1135 (Emissions of Oxides of Nitrogen from Electricity Generating Facilities).* (Amended January 7, 2022). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1135.pdf?sfvrsn=4
[157] SCAQMD. *Rule 1150.3 (Emissions of Oxides of Nitrogen from Combustion Equipment at Landfills)*. (Adopted February 5, 2021). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1150-3.pdf?sfvrsn=10

- South Coast AQMD Rule 1179.1 (Adopted October 2, 2020)[158]
- Ventura County APCD Rule 74.23 (Amended November 12, 2019)[159]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4703 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

San Diego County APCD

- SDAPCD Rule 69.3.1 (Stationary Gas Turbine Engines)

	SJVAPCD Rule 4703	SDAPCD Rule 69.3.1
Applicability	Gas turbines ≥0.3 MW or a maximum heat input rating of 3 MMBtu/hr.	Stationary gas turbines ≥0.3 MW or greater.
Exemptions	• Laboratory turbines used in research and testing for the advancement of gas turbine technology • Units limited by permit condition to be operated exclusively for firefighting and/or flood control • Emergency standby turbines limited by permit condition to operate <100 hr/yr for maintenance and testing	• Gas turbine engine when operated exclusively for research, development, or testing of gas turbine engines • Any portable gas turbine engine • Any stationary gas turbine engine with power rating ≤0.4 MW used in conjunction with military tactical support equipment operated at military site, provided operations do not exceed 1,000 hr/yr • NOx limits do not apply to any emergency unit provided that operation for testing or maintenance to ensure operability in event of an emergency situation is ≤80 hr/yr
	***NOx Emission Limits:** **<u>Units Rated <3 MW</u>** Gas Fuel - 9 ppmv Liquid Fuel - 25 ppmv **<u>Units Rated ≥3 MW and <10 MW</u>** *<u>Pipeline Gas</u>:* Steady State - 8 ppmv Non-Steady State - 12 ppmv Liquid Fuel - 25 ppmv *<u><877 hr/yr</u>:* Gas Fuel - 9 ppmv Liquid Fuel - 25 ppmv *<u>≥877 hr/yr and not listed above</u>:* Gas Fuel - 5 ppmv Liquid Fuel - 25 ppmv	***NOx Emission Limits:** **<u>Units Rated ≥0.3 and <2.9 MW</u>** Gas Fuel - 42 ppmv Liquid Fuel - 65 ppmv **<u>Units Rated ≥2.9 and <10 MW</u>** Gas Fuel - 25 ppmv Liquid Fuel - 65 ppmv **<u>Units Rated <4 MW Operating <877 hr/yr</u>** Gas Fuel - 42 ppmv Liquid Fuel - 65 ppmv **<u>Units Rated ≥*10 MW*</u>** *<u>Without installed post-combustion air pollution control equipment</u>* Gas Fuel - 15 ppmv Liquid Fuel - 42 ppmv

[158] SCAQMD. *Rule 1179.1 (Emission Reductions from Combustion Equipment at Publicly Owned Treatment Works Facilities).* (Adopted October 2, 2020). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1179-1.pdf?sfvrsn=10

[159] VCAPCD. *Rule 74.23 (Stationary Gas Turbines).* (Amended November 12, 2019). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.23.pdf

	SJVAPCD Rule 4703	SDAPCD Rule 69.3.1
	Units Rated ≥10 MW *Combined Cycle:* Gas Fuel - 5 ppmv (standard) Gas Fuel - 3 ppmv (enhanced) Liquid Fuel - 25 ppmv *Simple Cycle and ≥877 hr/yr:* Gas Fuel - 5 ppmv (standard) Gas Fuel - 3 ppmv (enhanced) Liquid Fuel - 25 ppmv *Simple Cycle and >200 hr/yr and <877 hr/yr:* Gas Fuel - 5 ppmv Liquid Fuel - 25 ppmv *Simple Cycle and ≤200 hr/yr:* Gas Fuel - 25 ppmv Liquid Fuel - 42 ppmv	*With installed post-combustion air pollution control equipment* Gas Fuel - 9 ppmv Liquid Fuel - 25 ppmv

*Referenced at 15% O_2

The District evaluated the requirements contained within SDAPCD's Rule 69.3.1 and found no requirements that were more stringent than those already in Rule 4703. Therefore, District Rule 4703 is as stringent as or more stringent than SDAPCD Rule 69.3.1.

South Coast AQMD

- SCAQMD Rule 1109.1 (Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations)

This rule includes limits for gas turbines operating at petroleum refineries. The District does not currently have any gas turbines operating at petroleum refineries.

- SCAQMD Rule 1134 (Emissions of Oxides of Nitrogen from Stationary Gas Turbines)

	SJVAPCD Rule 4703	SCAQMD Rule 1134
Applicability	Gas turbines rated ≥0.3 MW or with a maximum heat input rating of >3 MMBtu/hr.	Gas turbines rated ≥0.3 MW output or with a maximum heat input rating of >3 MMBtu/hr and operated on gaseous and/or liquid fuel.
Exemptions	• Laboratory turbines used in research and testing for the advancement of gas turbine technology • Units limited by permit condition to be operated exclusively for firefighting and/or flood control • Emergency standby turbines limited by permit condition to operate <100 hr/yr for maintenance and testing	• Laboratory turbines used in research and testing • Gas turbines used exclusively for firefighting and/or flood control • Emergency standby units used to provide electrical power, water pumping for flood control or firefighting, potable water pumping, or sewage pumping provided non-resettable engine hour requirement and operate <200 hr/yr • Gas turbines subject to SCAQMD rules for NOx emissions from electricity generating

<table>
<tr><th></th><th>SJVAPCD Rule 4703</th><th colspan="2">SCAQMD Rule 1134</th></tr>
<tr><td></td><td></td><td colspan="2">facilities; petroleum refineries and related operations, landfills, or publicly owned treatment works facilities
• Combined cycle gas turbines installed prior to 04/05/19 have conditional exemptions
• Low use installed prior to 04/05/19 have specific exemptions and subject to NOx limits at 12 ppmv</td></tr>
<tr><td>Requirements</td><td>*NOx Emission Limits:

<u>Units Rated <3 MW</u>
Gas Fuel - 9 ppmv
Liquid Fuel - 25 ppmv

<u>Units Rated ≥3 MW and <10 MW</u>
<u>Pipeline Gas</u>:
Steady State - 8 ppmv
Non-Steady State - 12 ppmv
Liquid Fuel - 25 ppmv

<u><877 hr/yr</u>:
Gas Fuel - 9 ppmv
Liquid Fuel - 25 ppmv

<u>≥877 hr/yr and not listed above</u>:
Gas Fuel - 5 ppmv
Liquid Fuel - 25 ppmv

<u>Units Rated ≥10 MW</u>
<u>Combined Cycle</u>:
Gas Fuel - 5 ppmv (standard)
Gas Fuel - 3 ppmv (enhanced)
Liquid Fuel - 25 ppmv

<u>Simple Cycle and ≥877 hr/yr:</u>
Gas Fuel - 5 ppmv (standard)
Gas Fuel - 3 ppmv (enhanced)
Liquid Fuel - 25 ppmv

<u>Simple Cycle and >200 hr/yr and <877 hr/yr</u>:
Gas Fuel - 5 ppmv
Liquid Fuel - 25 ppmv

<u>Simple Cycle and ≤200 hr/yr</u>:
Gas Fuel - 25 ppmv
Liquid Fuel - 42 ppmv</td><td>*NOx Emission Limits:
Prior to Jan. 1, 2024:

<u>Units Rated <2.9 MW</u>
Gas Fuel - 25 ppmv

<u>Units Rated ≥2.9 MW and <10 MW</u>
<u>No SCR</u>
Gas Fuel - 15 ppmv
<u>With SCR</u>
Gas Fuel - 9 ppmv

<u>Units Rated ≥10 MW</u>
<u>No SCR</u>
Gas Fuel - 12 ppmv
<u>With SCR</u>
Gas Fuel - 9 ppmv</td><td>
After Jan. 1, 2024:

<u>Natural Gas – Combined Cycle/Cogeneration Turbine</u>
2 ppmv or 2.5 ppmv if currently at that limit

<u>Natural Gas – Simple Cycle Turbine</u>
2.5 ppmv

<u>Produced Gas</u>
9 ppmv

<u>Other Gas Turbine</u>
12.5 ppmv

<u>Natural Gas – Compressor Gas Turbine</u>
3.5 ppmv

Shall not burn liquid fuel in a stationary gas turbine except for:
• Those located in the Outer Continental Shelf (NOx limit of 30 ppmv)
• Those providing power for health facility during force majeure natural gas curtailment (no limit specified)</td></tr>
</table>

*Referenced at 15% O2

In EPA's evaluation of BACM/MSM for the *2018 PM2.5 Plan*,[160] District Rule 4703 requirements were compared to the requirements in SCAQMD Rule 1134, and it was

[160] EPA. *Technical Support Document, Evaluation of BACM/MSM, San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS.* (February 2020). Retrieved from: https://www.regulations.gov/document/EPA-R09-OAR-2019-0318-0005

determined that Rule 4703 implemented BACM and MSM for this source category. SCAQMD recently implemented lower limits on January 1, 2024, from previous limits ranging from 9 ppmv to 25 ppmv. Notably, many units were excluded from previous rule requirements. For these reasons, at the time of SCAQMD's rule amendments, a majority of units were permitted at high limits; thus limits as low as 2 ppmv were demonstrated to be cost-effective and feasible. District Rule 4703 currently requires units to meet limits as low as 3 ppmv, and as such, adopting the slightly lower SCAQMD limits would in many cases result in only a 1 ppmv marginal improvement in NOx emission reductions and therefore would not be cost-effective. South Coast also made a similar determination in their rulemaking, and thus included a near-limit exemption for units that have limits close to the new limit.

- SCAQMD Rule 1135 (Emissions of Oxides of Nitrogen from Electricity Generating Facilities)

	SJVAPCD Rule 4703	SCAQMD Rule 1135
Applicability	Gas turbines rated ≥0.3 MW or with a maximum heat input rating of >3 MMBtu/hr.	Electric Generating Units at a facility owned or operated by an investor-owned electric utility or a publicly owned electric utility that has one or more electric generating units, or has electric generating units with a combined generation capacity ≥50 MW of electric power for distribution in the state or local electric grid system. Includes gas turbines with the exception of cogeneration units.
Exemptions	• Laboratory turbines used in research and testing for the advancement of gas turbine technology • Units limited by permit condition to be operated exclusively for firefighting and/or flood control • Emergency standby turbines limited by permit condition to operate <100 hr/yr for maintenance and testing	• Combined cycle gas turbines installed prior to 11/02/18 have conditional exemptions if they have a 2.5 ppmv permit limit for NOx as of 11/02/18 • Low use units installed prior 11/02/18 have conditional exemptions if they maintain an annual capacity factor below 25% in each calendar year and average calendar year capacity factor below 10% on a 3-year rolling basis
Requirements	***NOx Emission Limits:** **Units Rated <3 MW** Gas Fuel - 9 ppmv Liquid Fuel - 25 ppmv **Units Rated ≥3 MW and <10 MW** *Pipeline Gas:* Steady State - 8 ppmv Non-Steady State - 12 ppmv Liquid Fuel - 25 ppmv *<877 hr/yr:* Gas Fuel - 9 ppmv Liquid Fuel - 25 ppmv	***NOx Emission Limits:** *Prior to Jan. 1, 2024:* *For Southern Cal Edison* 0.15 lb/MWh *For City of Glendale* 0.20 lb/MWh *For City of Burbank* 0.20 lb/MWh *For City of Pasadena* 0.20 lb/MWh *After Jan. 1, 2024:* ***For units constructed after 11/02/18:*** *Combined Cycle:* Gas Fuel - 2 ppmv on 60 minute rolling average *Simple Cycle:* Gas Fuel - 2.5 ppmv on 60 minute rolling average

	SJVAPCD Rule 4703	SCAQMD Rule 1135	
	≥877 hr/yr and not listed above: Gas Fuel - 5 ppmv Liquid Fuel - 25 ppmv **Units Rated ≥10 MW** *Combined Cycle*: Gas Fuel - 5 ppmv (standard) Gas Fuel - 3 ppmv (enhanced) Liquid Fuel - 25 ppmv *Simple Cycle and ≥877 hr/yr*: Gas Fuel - 5 ppmv (standard) Gas Fuel - 3 ppmv (enhanced) Liquid Fuel - 25 ppmv *Simple Cycle and >200 hr/yr and <877 hr/yr*: Gas Fuel - 5 ppmv Liquid Fuel - 25 ppmv *Simple Cycle and ≤200 hr/yr*: Gas Fuel - 25 ppmv Liquid Fuel - 42 ppmv		***For units where operator applied for initial ATC prior to 11/02/18:*** Same limits as above, with limited exceptions to be at 2.5 ppmv for combined cycle along with using the rolling average time requirements specified in the PTO on 11/02/18

*Referenced at 15% O2

Similar to the above discussion regarding SCAQMD Rule 1134, the new limits in SCAQMD Rule 1135 were only recently implemented on January 1, 2024. Many units in South Coast, such as combined and simple cycle units, either met the proposed limit or were exempt from retrofitting due to the low-use exemption in Rule 1135. District Rule 4703 currently requires units to meet limits as low as 3 ppmv, and as such, adopting the slightly lower SCAQMD limits would in many cases result in only a 1 ppmv marginal improvement in NOx emission reductions and therefore would not be cost-effective. South Coast also made a similar determination in their rulemaking, and thus included a near-limit exemption for units that have limits close to the new limit.

- SCAQMD Rule 1150.3 (Emissions of Oxides of Nitrogen from Combustion Equipment at Landfills

This rule includes limits for gas turbines operating at landfills. The District does not currently have any gas turbines operating at landfills.

- SCAQMD Rule 1179.1 (Emission Reductions from Combustion Equipment at Publicly Owned Treatment Works Facilities).

This rule includes limits for gas turbines operating at publicly owned treatment works facilities. The District does not currently have any permitted gas turbines operating at publicly owned treatment works facilities.

Ventura County APCD

- VCAPCD Rule 74.23 (Stationary Gas Turbines)

	SJVAPCD Rule 4703	VCAPCD Rule 74.23
Applicability	Gas turbines ≥0.3 MW or a maximum heat input rating of 3 MMBtu/hr.	Gas turbines ≥0.3 MW or greater.
Exemptions	• Laboratory turbines used in research and testing for the advancement of gas turbine technology • Units limited by permit condition to be operated exclusively for firefighting and/or flood control • Emergency standby turbines limited by permit condition to operate <100 hr/yr for maintenance and testing	• Laboratory units used in research and testing for the advancement of gas turbine technology • Units operated exclusively for firefighting and/or flood control • Units operated <200 hr/yr • Emergency standby units operating during either an emergency or maintenance operation. Maintenance operation is limited to 104 hr/yr
Requirements	***NOx Emission Limits:** **Units Rated <3 MW** Gas Fuel - 9 ppmv Liquid Fuel - 25 ppmv **Units Rated ≥3 MW and <10 MW** *Pipeline Gas:* Steady State - 8 ppmv Non-Steady State - 12 ppmv Liquid Fuel - 25 ppmv *<877 hr/yr:* Gas Fuel - 9 ppmv Liquid Fuel - 25 ppmv *≥877 hr/yr and not listed above:* Gas Fuel - 5 ppmv Liquid Fuel - 25 ppmv **Units Rated ≥10 MW** *Combined Cycle:* Gas Fuel - 5 ppmv (standard) Gas Fuel - 3 ppmv (enhanced) Liquid Fuel - 25 ppmv *Simple Cycle and ≥877 hr/yr:* Gas Fuel - 5 ppmv (standard) Gas Fuel - 3 ppmv (enhanced) Liquid Fuel - 25 ppmv *Simple Cycle and >200 hr/yr and <877 hr/yr:* Gas Fuel - 5 ppmv Liquid Fuel - 25 ppmv *Simple Cycle and ≤200 hr/yr:* Gas Fuel - 25 ppmv	***NOx Emission Limits:** *Prior to Jan. 1, 2024:* **Units Rated <2.9 MW** Gas Fuel - 42 ppmv Liquid Fuel - 65 ppmv **Units Rated ≥2.9 MW and <10 MW** Gas Fuel - 42 ppmv Liquid Fuel - 65 ppmv **Units Rated ≥10 MW** *<877 hr/yr:* Gas Fuel - 42 ppmv Liquid Fuel - 65 ppmv *No SCR* Gas Fuel - 15 ppmv Liquid Fuel - 42 ppmv *With SCR* Gas Fuel - 9 ppmv Liquid Fuel - 25 ppmv *After Jan. 1, 2024:* Liquid Fuel - 30 ppmv Natural Gas - 2.5 ppmv Digester Gas - 9 ppmv Rule also includes a provision for alternative means of producing equivalent emission reductions at the facility site or in the community for units where compliance with the below limits would exceed the established cost effectiveness thresholds of the district.

	SJVAPCD Rule 4703	VCAPCD Rule 74.23
	Liquid Fuel - 42 ppmv	

*Referenced at 15% O2

VCAPCD amended Rule 74.23 in November 2019 to lower NOx emission limits only recently implemented on January 1, 2024. At the time of VCAPCD's rule amendments, a majority of units were permitted at high limits; thus limits as low as 2.5 ppmv were demonstrated to be cost-effective and feasible. District Rule 4703 currently requires units to meet limits as low as 3 ppmv, and as such, adopting the slightly lower VCAPCD limit would in many cases result in only a 0.5 ppmv marginal improvement in NOx emission reductions and therefore would not be cost-effective. Furthermore, VCAPCD's Rule 74.23 includes an alternative compliance option for facilities that exempts units from meeting the limits under certain conditions, including unfavorable cost effectiveness.

Potential Emission Reduction Opportunities

Beyond the review of current regulations and rule requirements, the District reviewed the feasibility of technologies and measures implemented in other regions and potential new technologies and measures that may be feasible for implementation in the near future.

NOx Emission Control Technologies

The District has adopted numerous rule amendments to Rule 4703 that have successfully and significantly reduced NOx emissions from this source category in the Valley. In an effort to identify potential NOx emission reduction opportunities, the District has evaluated the economic feasibility of requiring limits as low as 2 ppmv NOx @ 15% O2 for combined-cycle gas turbines and 2.5 ppmv NOx @ 15% O2 for simple cycle gas turbines.

Almost all of the combustion turbines permitted in the SJVAPCD are currently equipped with SCR systems for NOx control. Furthermore, while most combustion turbine units already have SCR installed, the District utilized the full installation cost of a SCR system since these installations cannot simply modify their existing controls to achieve lower NOx emission limits. Additional catalyst beds and upgraded ammonia injection systems are needed to ensure continuous compliance with significantly lower NOx limits. In discussions with operators and vendors, many facilities are unable to add more catalyst beds due to existing constraints with their catalyst reactor housing. In cases where the SCR unit is able to accommodate more catalyst beds, the ammonia injection system would need to be redesigned to be capable of handling the additional injection capacity and to ensure optimal reagent dispersion throughout the catalyst media to achieve optimal NOx control, which also poses significant feasibility issues. Based on these factors, this evaluation assumes that existing SCR systems serving turbine installations would need to be completely replaced with a new SCR system to reliably comply with the lower NOx limits.

SCR Systems

An SCR operates as an external control device where flue gases and ammonia reagent are passed through an appropriate catalyst. Ammonia is injected upstream of the catalyst where it reacts and reduces NOx, over the catalyst bed, to form elemental nitrogen and other by-products. In simple-cycle turbines, SCR is placed downstream of a dilution fan and oxidation catalyst (CO control device), whereas, in combined-cycle configuration, SCR is placed downstream of multiple pieces of equipment (e.g. duct burner, heat recovery steam generator (HRSG), oxidation catalyst, etc.).

Typically there is enough room available in a simple cycle power plants to retrofit the unit with a modern SCR system capable of meeting 2.5 ppmv NOx without moving other components. In contrast, combined-cycle power plants are compact and will usually require system components to be moved in order to accommodate a modern SCR system capable of meeting 2.0 ppmv NOx.

As previously discussed, to achieve NOx limits of 2 or 2.5 ppmv, an existing SCR system would either have to be expanded or replaced with a new modern SCR system. The SCR system typically involves SCR housing, catalyst, ammonia injection system, an ammonia flow monitor and control system, and ammonia tanks.

To be consistent with the existing categories in Table 5-3 of Rule 4703, the District has conducted cost effectiveness analyses to retrofit existing gas turbines with SCR systems for the following four scenarios:

1. Retrofit cost for a modern SCR system for units less than 3 MW unit to comply with 2 ppmvd NOx @ 15% O2*
2. Retrofit cost for a modern SCR system for units between 3 MW to 10 MW to comply with 2 ppmvd NOx @ 15% O2*
3. Retrofit cost of an SCR system for units greater than 10 MW simple cycle unit to comply with 2.5 ppmvd NOx @ 15% O2
4. Retrofit cost of an SCR system for units greater than 10 MW combined cycle to comply with 2 ppmvd NOx @ 15% O2

* Nearly all the permitted units rated less than 10 MW are cogeneration units. Therefore, the cost analyses for #1 and #4 above assume the turbine is a cogeneration unit.

<u>Calculation Methodology</u>

First, total annual cost is calculated using the SCR retrofit cost for each category. Then, the potential NOx emission reduction for each turbine category is determined by taking the difference between the potential emissions and the emissions that could be reliably achievable by retrofitting the system with the latest SCR technology capable of achieving 2.0 ppmv NOx @ 15% O2 for cogeneration turbines and 2.5 ppmv NOx @ 15% O2 for simple cycle turbines. Each unit is conservatively assumed to be operated for 8,760 hours per year at the maximum rated heat input capacity (MMBtu/hr).

<u>NOx Reductions (tons/yr)</u>

= (Current NOx Emission Factor – Potential NOx Emission Factor) ppmv (@ 15% O2) x 10^{-6} x 46 lb-NO2/lb-mol x 8,578 ft^3-exhaust/MMBtu x (20.95/(20.95 – 15)) x

1 lb-mol/379.5 ft^3-exhaust x Heat Input Rate (MMBtu/hr) x Operating Hours (hr/yr) x ton/2,000 lbs

Cost Effectiveness ($/ton)
= Total Annual Cost ($/yr) ÷ NOx Reductions (tons/yr)

1. Retrofit cost of units less than 3 MW unit with an SCR system capable of achieving 2 ppmv NOx @ 15% O2

Item	Value	Units/Source	Cost
Turbine Rating	2	MW	
SCR Cost/KW	475	$/kW, District facility*	
Operating Hours	8,760	hr/yr	
Direct Capital Costs			
Total Purchased Equip Cost (PEC)	$/kW x 1000 kW		$950,000
Freight	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$47,500
Sales Tax	8.25% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$78,375
Direct Installation Costs	25% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$237,500
Total Direct Capital Costs			$1,313,375
Indirect Capital Costs			
Facilities	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$47,500
Engineering	10% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$95,000
Process Contingency	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$47,500
Total Indirect Capital Costs			$190,000
Project Contingency	20% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$190,000
Total Capital Costs (TCC)	Direct Capital + Indirect Capital + Project Contingency		$1,693,375
Annualized Capital Costs (10 years @ 4% interest)	0.1233 TCC		$208,793
Direct Annual Costs			
Operating Costs			
Operator	0.5 hr/shift, $25/hr	OAQPS	$13,688
Supervisor	15% of operator cost	OAQPS	$2,053
Maintenance Costs			
Labor	0.5 hr/shift, $25/hr	OAQPS	$13,688
Materials	100% of labor cost	OAQPS	$13,688
Utility Costs			
Electricity Costs		not included	
Catalyst Replacement		not included	
Catalyst Disposal		not included	

Item	Value	Units/Source	Cost
Ammonia		not included	
NH3 Injection Skid		not included	
Total Direct Annual Costs			$43,116
Indirect Annual Costs			
Overhead	60% of operating and maintenance	OAQPS	$25,869
Administrative	2% PEC	OAQPS	$19,000
Insurance	1% PEC	OAQPS	$9,500
Property Tax	1% PEC	OAQPS	$9,500
Capital Recovery	0.13 x PEC (10% int. rate, 15 yr. period)	OAQPS	$123,500
Total Indirect Annual Costs			$187,369
Total Annual Costs	Annualized capital + Direct Annual + Indirect Annual		**$439,278**

**Per power consultant (Former SCR designer for John Zink), cost to retrofit is highly variable, ranging from $100 to $850 per kW. Large range because cost is highly dependent upon on how much equipment needs to be moved. Most units in valley are cogeneration units which would require equipment to be reconfigured. Thus, $475/kw average cost was chosen for the average retrofit.*

Cost Effectiveness Results

Type of Installation	Power Rating MW	Heat Input Rate MMBtu/hr	Current NOx Emission Factor (ppmvd @ 15% O2)	Potential NOx Emission Factor (ppmvd @ 15% O2)	NOx Reduction (tons/yr)	Total Annual Cost ($)	Cost Effectiveness ($/ton)
SCR system on a cogen system	2	30	9	2	1.26	$439,278	**$348,633.33**

2. Retrofit cost of an SCR system for units between 3 MW to 10 MW to comply with 2 ppmvd NOx @ 15% O2

Item	Value	Units/Source	Cost
Turbine Rating	3.5	MW	
SCR Cost/KW	475	$/kW, District facility*	
Operating Hours	8,760	hr/yr	
Direct Capital Costs			
Total Purchased Equip Cost (PEC)	$/kW x 1000 kW		$1,662,500
Freight	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$83,125
Sales Tax	8.25% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$137,156
Direct Installation Costs	25% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$415,625
Total Direct Capital Costs			$2,298,406
Indirect Capital Costs			
Facilities	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$83,125

Item	Value	Units/Source	Cost
Engineering	10% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$166,250
Process Contingency	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$83,125
Total Indirect Capital Costs			$332,500
Project Contingency	20% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$332,500
Total Capital Costs (TCC)	Direct Capital + Indirect Capital + Project Contingency		$2,963,406
Annualized Capital Costs (10 years @ 4% interest)	0.1233 TCC		$365,388
Direct Annual Costs			
Operating Costs			
Operator	0.5 hr/shift, $25/hr	OAQPS	$13,688
Supervisor	15% of operator cost	OAQPS	$2,053
Maintenance Costs			
Labor	0.5 hr/shift, $25/hr	OAQPS	$13,688
Materials	100% of labor cost	OAQPS	$13,688
Utility Costs			
Electricity Costs		not included	
Catalyst Replacement		not included	
Catalyst Disposal		not included	
Ammonia		not included	
NH3 Injection Skid		not included	
Total Direct Annual Costs			$43,116
Indirect Annual Costs			
Overhead	60% of operating and maintenance	OAQPS	$25,869
Administrative	2% PEC	OAQPS	$33,250
Insurance	1% PEC	OAQPS	$16,625
Property Tax	1% PEC	OAQPS	$16,625
Capital Recovery	0.13 x PEC (10% int. rate, 15 yr. period)	OAQPS	$216,125
Total Indirect Annual Costs			$308,494

Total Annual Costs	Annualized capital + Direct Annual + Indirect Annual		**$716,998**

**Per power consultant (Former SCR designer for John Zink), cost to retrofit is highly variable, ranging from $100 to $850 per kW. Large range because cost is highly dependent upon on how much equipment needs to be moved. Most units in valley are cogeneration units which would require equipment to be reconfigured. Thus, $475/kw average cost was chosen for the average retrofit.*

Cost Effectiveness Results

Type of Installation	Power Rating MW	Heat Input Rate MMBtu/hr	Current NOx Emission Factor (ppmvd @ 15% O2)	Potential NOx Emission Factor (ppmvd @ 15% O2)	NOx Reduction (tons/yr)	Total Annual Cost ($)	Cost Effectiveness ($/ton)
SCR system on a cogen system	3.5	51.7	5	2	0.93	$716,998	**$770,965.59**

3. Retrofit cost of an SCR system for units greater than 10 MW simple cycle unit to comply with 2.5 ppmvd NOx @ 15% O2

Item	Value	Units/Source	Cost
Turbine Rating	50	MW, Simple Cycle	
SCR Cost	4,100,000	From SCR Consultant*	
Operating Hours	8,760		
Direct Capital Costs			
Total Purchased Equip Cost (PEC)		See Above	$4,100,000
Freight	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$205,000
Sales Tax	8.25%PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$338,250
Direct Installation Costs	25% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$1,025,000
Total Direct Capital Costs			$5,668,250
Indirect Capital Costs			
Facilities	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$205,000
Engineering	10% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$410,000
Process Contingency	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$205,000
Total Indirect Capital Costs			$820,000
Project Contingency	20% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$820,000
Total Capital Costs (TCC)	Direct Capital + Indirect Capital + Project Contingency		$7,308,250
Annualized Capital Costs (10 years @ 4% interest)	0.1233 TCC		$901,107
Direct Annual Costs			
Operating Costs			
Operator	0.5 hr/shift, $25/hr	OAQPS	$13,688
Supervisor	15% of operator cost	OAQPS	$2,053
Maintenance Costs			
Labor	0.5 hr/shift, $25/hr	OAQPS	$13,688
Materials	100% of labor cost	OAQPS	$13,688
Utility Costs			
Electricity Costs		not included	$0

Item	Value	Units/Source	Cost
Cat Replacement, Ammonia Reagent, and Loss of Power from Backpressure		EPA Combustion Turbine NOx Technology Memo (Jan. 2022)	$70,000
Total Direct Annual Costs			$113,116
Indirect Annual Costs			
Overhead	60% of operating and maintenance	OAQPS	$25,869
Administrative	2% PEC	OAQPS	$82,000
Insurance	1% PEC	OAQPS	$41,000
Property Tax	1% PEC	OAQPS	$41,000
Capital Recovery	"0.13 x PEC		
(10% int. rate, 15 yr. period)"	OAQPS	$533,000	
Total Indirect Annual Costs			**$722,869**

Total Annual Costs	Annualized capital + Direct Annual + Indirect Annual		**$1,737,092**

**Per power consultant (Former SCR designer for John Zink), cost to retrofit is highly variable, ranging from $100 to $850 per kW. Large range because cost is highly dependent upon on how much equipment needs to be moved. Most units in valley are cogeneration units which would require equipment to be reconfigured. Thus, $475/kw average cost was chosen for the average retrofit.*

Cost Effectiveness Results

Type of Installation	Power Rating MW	Heat Input Rate MMBtu/hr	Current NOx Emission Factor (ppmvd @ 15% O2)	Potential NOx Emission Factor (ppmvd @ 15% O2)	NOx Reduction (tons/yr)	Total Annual Cost ($)	Cost Effectiveness ($/ton)
Retrofit - Simple Cycle	50	500	5	2.5	7.48	$1,737,092	**$232,231.55**

4. Retrofit cost of an SCR system for units greater than 10 MW combined cycle to comply with 2 ppmvd NOx @ 15% O2

Item	Value	Units/Source	Cost
Turbine Rating	90	MW, Simple Cycle	
SCR Cost	6,200,000	Combustion Turbine NOx Technology Memo (Jan. 2022)	
Operating Hours	8,760		
Direct Capital Costs			
Total Purchased Equip Cost (PEC)		See Above	$6,200,000
Freight	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$310,000
Sales Tax	8.25% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$511,500
Direct Installation Costs	25% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$1,550,000
Total Direct Capital Costs			$8,571,500

Item	Value	Units/Source	Cost
Indirect Capital Costs			
Facilities	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$310,000
Engineering	10% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$620,000
Process Contingency	5% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$310,000
Total Indirect Capital Costs			$1,240,000
Project Contingency	20% PEC	2015 Plan for the 1997 PM 2.5 Standard - Rule 4703 Control Measure Analysis	$1,240,000
Total Capital Costs (TCC)	Direct Capital + Indirect Capital + Project Contingency		$11,051,500
Annualized Capital Costs (10 years @ 4% interest)	0.1233 TCC		$1,362,650
Direct Annual Costs			
Operating Costs			
Operator	0.5 hr/shift, $25/hr	OAQPS	$13,688
Supervisor	15% of operator cost	OAQPS	$2,053
Maintenance Costs			
Labor	0.5 hr/shift, $25/hr	OAQPS	$13,688
Materials	100% of labor cost	OAQPS	$13,688
Utility Costs			
Electricity Costs		not included	$0
Cat Replacement, Ammonia Reagent, and Loss of Power from Backpressure		EPA Combustion Turbine NOx Technology Memo (Jan. 2022)	$300,000
Total Direct Annual Costs			$343,116
Indirect Annual Costs			
Overhead	60% of operating and maintenance	OAQPS	$25,869
Administrative	2% PEC	OAQPS	$124,000
Insurance	1% PEC	OAQPS	$62,000
Property Tax	1% PEC	OAQPS	$62,000
Capital Recovery	"0.13 x PEC		
(10% int. rate, 15 yr. period)"	OAQPS	$806,000	
Total Indirect Annual Costs			$1,079,869

Total Annual Costs	Annualized capital + Direct Annual + Indirect Annual		**$2,785,635**

**Per power consultant (Former SCR designer for John Zink), cost to retrofit is highly variable, ranging from $100 to $850 per kW. Large range because cost is highly dependent upon on how much equipment needs to be moved. Most units in valley are cogeneration units which would require equipment to be reconfigured. Thus, $475/kw average cost was chosen for the average retrofit.*

Cost Effectiveness Results

Type of Installation	Power Rating MW	Heat Input Rate MMBtu/hr	Current NOx Emission Factor (ppmvd @ 15% O2)	Potential NOx Emission Factor (ppmvd @ 15% O2)	NOx Reduction (tons/yr)	Total Annual Cost ($)	Cost Effectiveness ($/ton)
Retrofit - Combined Cycle	90	1,100	5	2	19.74	$2,785,635	**$141,116.26**

As demonstrated above, the District determined that the cost effectiveness of achieving these lower NOx limits ranges from $141,116.26/ton - $770,965.59/ton, depending on the specifications of the unit.

Zero-Emission Opportunities

Potential zero-emission opportunities for this source category include the replacement of turbines with fuel cells or electrification of facility operations. The District did not identify any instances of fuel cells or electrification being required for these types of units. However, the District will continue to closely track the development of new zero-emissions technologies and control measures for this source category.

Evaluation Findings

Rule 4703 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.19 RULE 4901 (WOOD BURNING FIREPLACES AND WOOD BURNING HEATERS)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	2.82	2.58	2.53	2.53	2.53	2.53	2.53
NOx	0.42	0.38	0.38	0.38	0.38	0.38	0.38
	Winter Average - Tons per day						
PM2.5	5.47	5.02	4.92	4.92	4.92	4.92	4.92
NOx	0.81	0.74	0.73	0.73	0.73	0.73	0.73

District Rule 4901 Description

The District's residential wood burning emission reduction strategy includes wood burning curtailments implemented through District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters), in conjunction with the District's incentive grant program for fireplace and woodstove change-outs, and robust public education and outreach efforts. This approach is designed to improve public health by reducing toxic wood smoke emissions in Valley neighborhoods during the peak PM2.5 winter season (November through February), and has proven to be extremely effective in advancing the District's objectives to attain the PM2.5 federal standards and protect public health. Commitments in the District's *2018 PM2.5 Plan* included rulemaking for Rule 4901 to further lower wood burning curtailment levels, as well as enhancements to the District's incentive grant funding levels, public outreach and education, enforcement, and air quality forecasting programs.

Through the District's Residential Wood Smoke Reduction Program, which is based on Rule 4901, the District has declared and enforced episodic wood burning curtailments, also called "No Burn" days, since 2003. The District's Residential Wood Smoke Reduction Program and District Rule 4901 reduce harmful species of PM2.5 when and where those reductions are most needed, in impacted urbanized areas when the local weather is forecast to hamper particulate matter dispersion.

Rule 4901 was first adopted in 1993, and has been subsequently amended five times. The 1993 adoption of Rule 4901 established a public education program on techniques to reduce wood burning emissions. It also enforced EPA Phase II requirements for new wood burning heaters, prohibited the sale of used wood burning heaters, established a list of prohibited fuel types, and required the District to request voluntary curtailment of wood burning on days when the ambient air quality was unhealthy.

In 2003, the rule was amended to add episodic wood burning curtailments when air quality was forecast to be at 150 or higher on the air quality index (AQI), which was equivalent to a PM2.5 concentration of 65 µg/m³ at the time; restrictions on the installation of wood burning devices in new residential developments, based on housing density; and a requirement that during the transfer of a residential property, sellers provide a statement of compliance to the District and buyer for residential real properties with non-compliant wood burning devices.

In 2008, the rule was amended and lowered the mandatory curtailment level to a PM2.5 concentration of 30 μg/m^3, and added an attainment plan contingency measure that would lower the wood burning curtailment level to 20 μg/m^3 if EPA were to find that the Valley did not attain the 1997 PM2.5 NAAQS in 2014.

In 2014, Rule 4901 was amended again to lower the No Burn threshold for high polluting wood burning heaters and fireplaces from 30 μg/m^3 to 20 μg/m^3 and establish a separate No Burn threshold for cleaner certified wood burning devices. The amendment doubled the number of No Burn days for high polluting units that were the source of over 95% of the wintertime residential wood smoke emissions.

In 2019, the District amended Rule 4901 to lower the curtailment threshold from 20 to 12 μg/m^3 for older, higher-polluting wood burning heaters, open hearth fireplaces, and non-registered wood burning heaters in the Hot Spot counties of Madera, Fresno, and Kern. Within these same Hot Spot counties, the cleaner, registered wood burning heaters are allowed to burn when air quality is forecast to be between 12 and 35 μg/m^3. In these counties, no wood burning is allowed when air quality is forecast to be above 35 μg/m^3. In the remaining Valley counties, the previous curtailment thresholds remain in place. The more stringent curtailment thresholds established in the Hot Spot counties are with increased *Fireplace and Woodstove Change-Out Program* incentives amounts to cover nearly the entire cost of replacing high polluting wood burning units with natural gas units. To complement the regulatory and incentives changes, the District has implemented an education and outreach campaign to increase public awareness of the program, along with focused rule enforcement efforts in Hot Spot counties and in areas of concern. The District also continues to investigate and employ the latest air quality modeling tools and techniques to support the air quality forecasting component of the program.

Following these amendments, EPA recognized in their February 2020 evaluation of BACM and MSM for the *2018 PM2.5 Plan* for the 2006 PM2.5 NAAQS that Rule 4901 implements BACM and MSM levels of control.[161] In July 2020, EPA took final action to approve the 2019 amendments to Rule 4901 and provide SIP credit for emissions reductions achieved through the strategy.[162]

Most recently, on May 18, 2023, the District amended Rule 4901 to establish a sequence of increasingly stringent contingency curtailment thresholds for all counties that would be triggered upon 60 days after the issuance of a final determination by EPA,

[161] EPA. *Technical Support Document, Evaluation of BACM/MSM, San Joaquin Valley PM2.5 Plan for the PM2.5 Plan for the 2006 PM2.5 NAAQS*. (February 2020). Retrieved from: https://www.regulations.gov/document/EPA-R09-OAR-2019-0318-0005
[162] EPA. *Air Plan Approval; California; San Joaquin Valley Unified Air Pollution Control District*. 85 FR 44206-44209. (July 22, 2020). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2020-07-22/pdf/2020-14298.pdf

pursuant to 40 CFR §51.1014(a), that the District has failed to meet any of the following elements for any of the PM2.5 NAAQS to:

1. Meet any RFP requirement;
2. Meet any quantitative milestone in an approved attainment plan;
3. Submit a quantitative milestone report; or
4. Attain the applicable PM2.5 NAAQS by the applicable attainment date.

The following table depicts the sequence of increasingly stringent contingency curtailment thresholds to be enforced following each contingency trigger.

Table C-12 District Contingency Curtailment Thresholds

Contingency Concept	Hot-Spot County (µg/m^3)		Non Hot-Spot County (µg/m^3)	
	Level 1	Level 2	Level 1	Level 2
Current Requirements	12	35	20	65
Contingency Measure 1	12	35	12	35
Contingency Measure 2	11	35	11	35

Hot-spot counties: Madera, Fresno, Kern
Non Hot-spot counties: San Joaquin, Stanislaus, Merced, Kings, Tulare

The contingency provisions, if triggered, would achieve 0.69 tpd of PM2.5 and 0.10 tpd NOx on an annual average basis, as calculated in the *PM2.5 Contingency Measure State Implementation Plan Revision*.[163]

Incentives and Outreach

The District's *Fireplace and Woodstove Change-Out Program* plays a key role in reducing emissions from residential wood burning by encouraging a transition from the use of higher polluting wood burning heaters and fireplaces to cleaner alternatives. Through the program, the District offers financial incentives for the change-out of old, high-polluting open-hearth fireplaces or uncertified devices with new cleaner, certified units. The program has provided the resources necessary for thousands of Valley resident to make positive changes in their residential wood-burning practices and is a significant part of the District's overall strategy to reduce the impacts of residential wood burning. The *Fireplace and Woodstove Change-Out Program* also continues to offer higher incentives for low-income households throughout the Valley (up to $4,150 for a new gas device, and up to $5,000 for an electric heat pump) to provide additional assistance towards the purchase of a new, cleaner unit. Since 2009, the District has issued over 30,000 vouchers with more than $64.3 million in program funding allocated to date.

To complement the regulatory and incentives changes, the District has implemented an education and outreach campaign to increase public awareness of the program, along with focused rule enforcement efforts in Hot Spot counties and in areas of concern. The

[163] SJVAPCD. *Proposed San Joaquin Valley Contingency Measure State Implementation Plan Revision.* (April 18, 2023). Retrieved from: https://www.valleyair.org/Workshops/postings/2023/05-18-23_r4901/proposed-sip.pdf?v=04.19.23

District also continues to investigate and employ the latest air quality modeling tools and techniques to support the air quality forecasting component of the program.

Residential Wood Burning Survey

Given the significant public health benefits that can be realized cost effectively from reductions in wood smoke emissions and to ensure continued effectiveness of the rule enhancements, on June 15, 2017, the District entered into a contract with Gomez Research to conduct a bilingual scientific survey in late 2017 to assess residential wood burning behaviors in the Valley.[164] Gomez Research surveyed over 1,500 Valley residents through an approach that consisted of both a general, random population of residents throughout the Valley as well as a supplemental sample, or "high-incidence area," of 500 residents living in targeted zip codes believed to have higher concentrations of wood burning devices. Overall, the large survey response by Valley residents provides statistically significant results that can be relied upon to enhance our understanding of residential wood burning behavior in the San Joaquin Valley. The survey results, as detailed in the District's Final Draft Staff Report from the 2018 rule amendments,[165] supported lowering the residential wood burning curtailment thresholds, coupled with enhanced public outreach and increased incentive amounts for the *Fireplace and Woodstove Change-Out Program*.

How does District Rule 4901 compare with federal and state rules and regulations?

There are no Control Techniques Guidelines or Alternative Control Techniques applicable to this source category.

A. New Source Performance Standards (NSPS)

- *40 CFR Part 60 Subpart AAA – Standards of Performance for New Residential Wood Heaters (2020/04)*

The District evaluated the requirements contained within Subpart AAA and found no emission requirements that were more stringent than those already in Rule 4901.

State Regulations

No California state regulations have been identified that are applicable to this source category. However, the District has identified regulations in other states that have wood burning requirements. These include the following regulations:

[164] Gomez Research. *Residential Wood Burning Survey*. (January 18, 2018). Retrieved from: http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2018/January/final/10.pdf
[165] SJVAPCD. *Final Draft Staff Report with Appendices for Proposed Amendments to District's Residential Wood Burning Emission Reduction Strategy*, pp. 20-22. (June 20, 2019). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2019/June/final/13.pdf

- ***Albuquerque City Ordinance § 9-5***

	SJVAPCD Rule 4901	Albuquerque City Ordinance § 9-5
EPA Certified Exemption	EPA certified units are not exempt from rule requirements.	Certified heaters may be operated during a no burn period provided that no visible emissions are produced beyond a 20-minute startup period.
Sole Source Exemption	Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	• If wood burning device is the sole source of heat • Medical necessity of a wood burning device • Low income status
Limited Exemption: Loss of NG and/or Electrical Power	Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	Emergency situations such as failure of residence's primary heating system.
Wood Burning Season	November through February	October through February
No Burn Day	**<u>Level 1 Curtailment</u>** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 20 $\mu g/m^3$ but not exceed 65 $\mu g/m^3$ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 12 $\mu g/m^3$ but not exceed 35 $\mu g/m^3$ for the geographic region. • Registered wood burning heater may be operated provided it's fired on approved fuel, maintained, and operated according to manufacturer instructions, and has no visible smoke.	No burn periods shall be declared by the Director upon review of available meteorological data and a determination that expected atmospheric conditions will not reasonably disperse wood smoke.

	SJVAPCD Rule 4901	Albuquerque City Ordinance § 9-5
	Level 2 Curtailment • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 65 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 35 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region.	
Visible Emissions	• Under normal operating conditions, no person shall cause or allow any visible smoke from a registered wood burning heater. • Under normal operating conditions, no person shall cause or allow from a wood burning fireplace or nonregistered wood burning heater a visible emission of any air contaminant, other than uncombined water vapor, that exceeds No. 1 on the Ringelmann Chart or 20% opacity for a period or periods aggregating more than 3 minutes in any one (1) hour.	Certified wood heaters may be operated during a no burn period provided that no visible emissions are produced beyond a 20-minute start up period.

The District evaluated the requirements contained within Albuquerque City Ordinance §9-5 and found that District Rule 4901 is as stringent as or more stringent than the ordinance.

- ***City of Portola Municipal Code, Chapter 15.10*** [166]

	SJVAPCD Rule 4901	Portola Mun. Code, Ch. 15.10
Exemptions	• Devices that are exclusively gaseous-fueled. • Cook stoves, as described in 40 CFR §60.531.	• Open outdoor fires used only for cooking food for human consumption,

[166] Portola, California Municipal Code Title 15 Chapter 15.10. Retrieved from: https://library.municode.com/ca/portola/codes/code_of_ordinances?nodeId=TIT15BUCO_CH15.10WOSTFIORPROPBUYAWA_15.10.010PU

	SJVAPCD Rule 4901	Portola Mun. Code, Ch. 15.10
	• Any burning occurring on the ground is open burning and is subject to requirements of District Rule 4103. • Locations where natural gas is not available are not subject to episodic curtailments (propane and butane are not considered natural gas). • Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	for recreational fires, or for ceremonial fires • Fire department training burns • Burning of combustibles for health and safety of the public, with special permit
Wood Burning Season	November through February	November through February
No Burn Day (Nov-Feb)	**Level 1 Curtailment** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 20 µg/m³ but not exceed 65 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 12 µg/m³ but not exceed 35 µg/m³ for the geographic region. • Registered wood burning heater may be operated provided it's fired on approved fuel, maintained, and operated according to manufacturer instructions, and has no visible smoke. **Level 2 Curtailment** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 65 µg/m³ or a PM10 concentration is	• No person shall operate a wood-burning heater, wood-burning fireplace, wood-fired fire pit or wood-fired cookstove within the city limits when a mandatory curtailment is in effect unless the device is an approved and currently registered EPA-certified wood-burning heater. • The Air District will declare a mandatory curtailment whenever it determines that the 24-hr average PM2.5 concentration may exceed 30 µg/m³ and when adverse meteorological conditions are expected to persist.

	SJVAPCD Rule 4901	Portola Mun. Code, Ch. 15.10
	forecast to equal or exceed 135 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 35 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region.	
Sale, Resale, or Installation of Wood-Burning Devices	Sale or transfer of wood burning heaters: • New: No person shall advertise, sell, offer for sale, supply, install, or transfer a new wood burning heater unless it is either EPA certified under the NSPS at the time of purchase or installation and at least as stringent as EPA Phase II requirements, or a pellet-fueled wood burning heater that is exempt from EPA certification pursuant to requirements in the NSPS, until such time that amendments to the NSPS are finalized to remove exemptions for pellet-fueled wood burning heaters, then all new wood burning heaters must comply with the above. • Used: No person shall advertise, sell, offer for sale, supply, install, or transfer a used wood burning heater unless it has been rendered permanently inoperable, satisfies NSPS, or is a low mass fireplace, masonry heater, or other wood burning device of a make and model that meets all federal requirements and has been approved in writing by the APCO.	• Wood-Burning Heaters: No person shall advertise, sell, offer for sale, supply, transfer or install in any residence or other structure any wood-burning heater within the city limits unless it is an EPA certified wood-burning heater at the time of sale or transfer. • Wood-Burning Fireplaces: No local government authority within the city limits may issue a building permit to any person to install a wood-burning fireplace unless it is an EPA-qualified fireplace or EPA-certified fireplace.
Requirements for Real Property	No person shall sell or transfer any real property which contains a wood burning heater without first assuring that each wood burning heater included in the real property: • Meets certification under the NSPS at the time of purchase or installation and is at least as stringent as EPA Phase II requirements, • Is a pellet-fueled wood burning heater that was exempt from EPA certification pursuant to requirements in the NSPS at the time of purchase or installation, or	• In order to complete any escrow transaction, on any residential or commercial property, the current property owner must obtain either: 1) a certificate of compliance, or 2) a notice of exemption. • It is prohibited for any person to complete, or allow the completion of any escrow transaction upon any residence or mobile home, or other parcel containing a building within the city limits unless each building on the parcel has been issued a certificate of compliance by the control officer as having no more than two wood-

	SJVAPCD Rule 4901	Portola Mun. Code, Ch. 15.10
	• Is rendered permanently inoperable and removed from property. Upon the sale or transfer of any residential real property in the San Joaquin Valley, the seller shall provide to the buyer of the real property and to the APCO, documentation certifying the following: • The type(s) and number(s) of wood burning heaters and wood burning fireplaces included in the real property transaction. If no wood burning heaters or wood burning fireplaces are included in the real property transaction, this should be documented. • Any action(s) taken to comply with the above requirements for sale or transfer of real property. • Documents required shall be retained by the seller and shall again be made available to the APCO upon request.	burning heaters which are EPA-certified and no uncertified wood-burning heaters. • Upon a change of ownership, no more than two EPA certified wood-burning heaters per building may remain in any property within the city limits, except for the low emitting devices. • Upon a change of ownership, no uncertified wood-burning heater may remain in any property within the city limits.

Requirements for Remodels	Remodel of wood burning fireplace or chimney where total cost exceeds $15,000, local building permit is required, and application for building permit is submitted on or after Jan. 1, 2020:
	• A person may only install a gas-fueled, electric, exempt, or EPA certified wood burning heater that meets requirements of NSPS at the time of installation.
		In New Construction and Remodels:
		• The number of EPA certified wood-burning heaters installed on any residential or non-residential property for which a building permit is required shall not exceed one per individual dwelling unit; and
		• The number of EPA-qualified fireplaces installed on any residential or non-residential property for a which a building permit is required shall not exceed one per individual dwelling unit; and
		• Wood-burning devices shall not be considered the sole source of heat in any new construction within the city limits; and
		• The above limitations do not apply to devices that are defined as low emitting:
		  ○ EPA-certified pellet fueled wood heater;
		  ○ Devices that are exclusively gaseous- or liquid-fueled; and
		  ○ EPA-certified wood-burning devices that meet a certified emission rate of 1 g/hr or less of PM.

Requirements for Buildings	Limitations on wood burning fireplaces or wood burning heaters • At elevations below 3,000 feet in areas with natural gas service, no person shall install a wood burning	• Existing individual dwelling units with two or more existing EPA certified wood-burning heaters may not install additional wood-burning heaters (certified or uncertified). The above

	SJVAPCD Rule 4901	Portola Mun. Code, Ch. 15.10
	fireplace, low mass fireplace, masonry heater, or wood burning heater. • At elevations at or above 3,000 feet or in areas without natural gas service, no more than two EPA certified wood burning heaters, that meet NSPS at time of installation, shall be installed per acre. ○ No person shall install more than one EPA certified wood burning heater, that meets NSPS at time of installation, per dwelling unit. ○ No person shall install a wood burning fireplace, low mass fireplace, masonry heater, or non-certified wood burning heater.	limitation does not apply to heaters that are defined as low emitting.
Solid Wood Fuel or Wood Sale	Advertising Requirements for Sale of Wood • No person shall sell, offer for sale, or supply any wood which is orally or in writing, advertised, described, or in any way represented to be "seasoned wood" unless the wood has a moisture content of ≤20% by weight. • The APCO may delegate another person or agency the authority to test wood for moisture content and determine compliance.	None.
Prohibited Fuels	No person shall cause or allow any of the following materials to be burned in a wood burning fireplace, wood burning heater, or outdoor wood burning device: garbage, treated wood, non-seasoned wood, plastic products, rubber products, waste petroleum products, paints and paint solvents, coal, or any other material not intended by a manufacturer for use as a fuel in a wood burning fireplace, wood burning heater, or outdoor wood burning device.	Burning of any fuels or materials in a wood-burning device other than the following fuels within city limits shall be in violation of this ordinance: • Seasoned wood (<20% moisture content) • Uncolored paper • Manufactured logs, pellets, and similar manufactured products (i.e., processed fire starters)

The City of Portola Municipal Code contains similar requirements for wood stoves and fireplaces as the District, banning the sale or transfer of uncertified wood burning devices and requiring removal of uncertified wood burning devices at the time of property sale or transfer. The City of Portola's episodic wood burning curtailment requirements are enacted November through February, banning the use of any uncertified wood burning device when the 24-hour average PM2.5 concentration may exceed 30 μg/m³. This curtailment threshold is much less stringent than the District's level 1 curtailment thresholds of 12 μg/m³ and 20 μg/m³. Additionally, Portola's ordinance does not include a curtailment threshold at which all burning would be banned. Therefore, District Rule 4901 is more stringent than the Portola ordinance.

- ***Puget Sound Clean Air Agency (PSCAA) Regulation I, Article 13: Solid Fuel Burning Device Standards***[167]

	SJVAPCD Rule 4901	PSCAA Reg I, Article 13
Sole Source Exemption	Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	A residence or commercial building that has no adequate source of heat other than a solid fuel heating device and the building: • was neither constructed nor substantially remodeled after July 1, 1992; or • was constructed or substantially remodeled after July 1, 1992; and • is outside an urban growth area; and • is outside an area designated as a PM2.5 or PM10 nonattainment area.

No Burn Day (Nov-Feb)	**Level 1 Curtailment**
	• For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 20 µg/m³ but not exceed 65 µg/m³ for the geographic region.
	• For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 12 µg/m³ but not exceed 35 µg/m³ for the geographic region.
	• Registered wood burning heater may be operated provided it's fired on approved fuel, maintained, and operated according to manufacturer instructions, and has no visible smoke.
	
	Level 2 Curtailment
	• For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 65 µg/m³ or a PM10 concentration is forecast to equal
		Stage 1 Burn Ban
		• For counties of King and Kitsap, a first stage of impaired air quality is reached when forecasted meteorological conditions are predicted to cause PM2.5 levels to exceed a 24-hr average of 35 µg/m³, within 48 hrs
		• For counties of Pierce and Snohomish, a first stage of impaired air quality is reached when forecasted meteorological conditions are predicted to cause PM2.5 levels to exceed a 24-hr average of 30 µg/m³, within 72 hrs
		• Exempt from Stage 1 burn ban:
		  ○ Nonaffected pellet stoves
		  ○ EPA-certified wood stoves
		  ○ Wood stoves meeting the Oregon Department of Enironmental Quality Phase 2 emission standards
		  ○ Solid fuel burning device approved by the Washington State Department of Ecology as meeting standards in the Code of Washington
		
		Stage 2 Burn Ban
		• Stage 2 is reached when Stage 1 has been in force and has not been sufficient to reduce the increasing PM2.5 trend, PM2.5 is at a 24-hr average of 25 µg/m³, and forecasted meteorological conditions are not expected to allow levels of PM2.5 to decline below 25 µg/m³ for a period of 24 hrs or more from the time that PM2.5 is measured at the trigger level
		• A second stage burn ban may be called without calling a first stage burn ban only when all of the following occur:

[167] Puget Sound Clean Air Agency. *Regulation I, Article 13 (Solid Fuel Burning Device Standards).* (Amended October 25, 2012). Retrieved from: https://pscleanair.gov/DocumentCenter/View/161/Regulation-I-Section-1303-PDF?bidId

	SJVAPCD Rule 4901	PSCAA Reg I, Article 13
	or exceed 135 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 35 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region.	(A) PM2.5 levels have reached or exceeded a 24-hr average of 25 µg/m³; (B) Meteorological conditions have caused PM2.5 levels to rise rapidly; (C) Meteorological conditions are predicted to cause PM2.5 levels to exceed a 24-hr average of 35 µg/m³ (or 30 µg/m³ in PM2.5 nonattainment areas), within 24 hrs; and (D) Meteorological conditions are highly likely to prevent sufficient dispersion of PM2.5 During either Stage 1 or Stage 2: • New solid fuel shall be withheld from any solid fuel burning device already in operation if device is restricted from operating. • Smoke visible from a chimney, flue, or exhaust duct after three hours has elapsed from the declaration of a first or a second stage of impaired air quality shall constitute prima facie evidence of unlawful operation of a solid fuel burning device if that solid fuel burning device is restricted from operating. This presumption may be refuted by demonstration that the smoke was not caused by a solid fuel burning device.
Sale, Resale, or Installation of Wood-Burning Devices	Sale or transfer of wood burning heaters: • New: No person shall advertise, sell, offer for sale, supply, install, or transfer a new wood burning heater unless it is either EPA certified under the NSPS at the time of purchase or installation and at least as stringent as EPA Phase II requirements, or a pellet-fueled wood burning heater that is exempt from EPA certification pursuant to requirements in the NSPS, until such time that amendments to the NSPS are finalized to remove exemptions for pellet-fueled wood burning heaters, then all new wood burning heaters must comply with the above. • Used: No person shall advertise, sell, offer for sale, supply, install, or transfer a used wood burning heater unless it has been rendered permanently inoperable, satisfies NSPS, or is a low mass fireplace,	A person shall not advertise to sell, offer to sell, sell, bargain, exchange, give away, or install a solid fuel burning device unless it meets both of the following: • It has been certified and labeled in accordance with procedures and criteria specified in "40 CFR 60 Subpart AAA - Standards of 12/12 13-7 Regulation I Performance for Residential Wood Heaters" as amended through July 1, 1990; and • It meets the following particulate air contaminant emission standards and the test methodology of EPA in effect on Jan. 1, 1991, or an equivalent standard under any test methodology adopted by EPA subsequent to such date: ○ Two and one-half grams per hour for catalytic woodstoves; and ○ Four and one-half grams per hour for all other solid fuel burning devices.

	SJVAPCD Rule 4901	PSCAA Reg I, Article 13

	masonry heater, or other wood burning device of a make and model that meets all federal requirements and has been approved in writing by the APCO.
	
	Limitations on wood burning fireplaces or wood burning heaters
	• At elevations below 3,000 feet in areas with natural gas service, no person shall install a wood burning fireplace, low mass fireplace, masonry heater, or wood burning heater.
	• At elevations at or above 3,000 feet or in areas without natural gas service, no more than two EPA certified wood burning heaters, that meet NSPS at time of installation, shall be installed per acre.
	  ○ No person shall install more than one EPA certified wood burning heater, that meets NSPS at time of installation, per dwelling unit.
	  ○ No person shall install a wood burning fireplace, low mass fireplace, masonry heater, or non-certified wood burning heater.
		Fireplaces. A person shall not advertise to sell, offer to sell, sell, bargain, exchange, give away, or install a factory-built fireplace unless it meets the 1990 EPA standards for wood stoves or an equivalent standard that may be established by the state building code council by rule.

Requirements for Non-Certified Units	Rule requires only EPA-certified units be sold in the area.	Any person who owns or is responsible for a wood stove that is both (a) not a certified wood stove and (b) is located in the Tacoma, Washington PM2.5 nonattainment area must remove and dispose of it or render it permanently inoperable by Sept. 30, 2015. Any person who owns or is responsible for a coal-only heater located in the Tacoma, Washington PM2.5 nonattainment area must remove and dispose of it or render it permanently inoperable by Sept. 30, 2015. Removal and disposal requirements for non-certified wood stoves located in the Tacoma, Washington PM2.5 nonattainment area do not apply to: • A person in a residence or commercial establishment that does not have an adequate source of heat without burning wood; or • A person with a shop or garage that is detached from the main residence or commercial establishment that does not have an adequate source of heat in the

	SJVAPCD Rule 4901	PSCAA Reg I, Article 13
		detached shop or garage without burning wood. The owner or person responsible for removing or rendering permanently inoperable a wood stove or a coal-only heater must provide documentation of the removal and disposal or rendering permanently inoperable to the Agency using the Agency's procedures within 30 days of the removal or rendering permanently inoperable. If the EPA makes written findings below, the use of wood stoves not meeting the standards set forth in the emission performance standards for solid fuel burning devices shall be prohibited within the area determined by the Agency to have contributed to the violation. This provision shall take effect one year after such a determination. • An area has failed to attain or maintain the NAAQS for PM10, and • In consultation with Ecology and the Agency, finds that the emissions from solid fuel burning devices are a contributing factor to such failure to attain or maintain the standard
Visible Emissions	• Under normal operating conditions, no person shall cause or allow any visible smoke from a registered wood burning heater. • Under normal operating conditions, no person shall cause or allow from a wood burning fireplace or nonregistered wood burning heater a visible emission of any air contaminant, other than uncombined water vapor, that exceeds No. 1 on the Ringelmann Chart or 20% opacity for a period or periods aggregating more than 3 minutes in any 1 hour.	A person shall not cause or allow emission of a smoke plume from any solid fuel burning device to exceed an average of 20% opacity for 6 consecutive minutes in any 1-hour period.
Prohibited Fuels	No person shall cause or allow any of the following materials to be burned in a wood burning fireplace, wood burning heater, or outdoor wood burning device: garbage, treated wood, non-seasoned wood, plastic products, rubber products, waste petroleum products, paints and paint solvents, coal, or any other material not intended by a manufacturer for use as a fuel in a	A person shall cause or allow only the following materials to be burned in a solid fuel burning device: • Properly seasoned fuel wood; or • An amount of paper necessary for starting a fire; or • Wood pellets; or • Biomass fire logs intended for burning in wood stove or fireplace; or • Coal with sulfur content <1.0% by weight burned in a coal-only heater.

	SJVAPCD Rule 4901	PSCAA Reg I, Article 13
	wood burning fireplace, wood burning heater, or outdoor wood burning device.	All other materials are prohibited from being burned.

PSCAA's stage 1 curtailment levels of either 30 µg/m³ or 35 µg/m³, depending on county, are significantly less stringent than the District's level 1 curtailment thresholds of 12 µg/m³ for hot spot counties, and 20 µg/m³ for non-hot-spot counties. The District's level 2 curtailment thresholds are 35 µg/m³ for hot spot counties, and 65 µg/m³ for non-hot-spot counties. PSCAA may declare a stage 2 burn ban when stage 1 has been in force and has not been sufficient to reduce the increasing PM2.5 trend, PM2.5 is at a 24-hr average of 25 µg/m³, and forecasted meteorological conditions are not expected to allow levels of PM2.5 to decline below 25 µg/m³ for a period of 24 hrs or more from the time that PM2.5 is measured at the trigger level. Notably, PSCAA has not declared a stage 2 burn ban in any county under their jurisdiction since January 2019.[168] Additionally, the District is more stringent with regards to fuel use, prohibiting the use of coal while PSCAA allows it in all but Tacoma, Washington. The District evaluated the requirements contained within Puget Sound Clean Air Agency Article 13 and found that overall, District Rule 4901 is more stringent.

- ***City of Santa Rosa Code of Ordinances, Title 17 Chapter 35***[169]

	SJVAPCD Rule 4901	Santa Rosa Title 17, Ch 35
Exemptions	• Devices that are exclusively gaseous-fueled. • Cook stoves, as described in 40 CFR §60.531. • Any burning occurring on the ground is open burning and is subject to requirements of District Rule 4103. • Locations where natural gas is not available are not subject to episodic curtailments (propane and butane are not considered natural gas). • Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	Any wood burning appliance specifically designed for cooking, outdoor wood burning appliances and all gas appliances, except for gas log fireplaces, shall be exempt from all provisions of this chapter.
Wood Burning Season	November through February	-
No Burn Day	**Level 1 Curtailment** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and	When an impaired air quality episode occurs within the region, the Bay Area Air Quality Management District may

[168] https://pscleanair.gov/504/Air-Quality-Burn-Ban-History
[169] City of Santa Rosa. Code of Ordinances, Title 17 Chapter 35. Retrieved from: https://ecode360.com/42966367

	SJVAPCD Rule 4901	Santa Rosa Title 17, Ch 35
	Tulare, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 20 µg/m³ but not exceed 65 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 12 µg/m³ but not exceed 35 µg/m³ for the geographic region. • Registered wood burning heater may be operated provided it's fired on approved fuel, maintained, and operated according to manufacturer instructions, and has no visible smoke. **Level 2 Curtailment** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 65 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 35 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region.	issue a "Spare the Air Tonight" warning. During this period, the City shall provide public notification requesting residents curtail the burning of wood.
Sale, Resale, or Installation of Wood-Burning Devices	Sale or transfer of wood burning heaters: • New: No person shall advertise, sell, offer for sale, supply, install, or transfer a new wood burning heater unless it is either EPA certified under the NSPS at the time of purchase or installation and at least as stringent as EPA Phase II requirements, or a pellet-fueled wood burning heater that is exempt from EPA certification pursuant to requirements in the NSPS, until such time that amendments to the NSPS are	It shall be unlawful to install a wood burning appliance that is not one of the following: • A pellet-fueled heater; • An EPA Certified Phase II wood heater or newer; • Solid fuel burning appliance certified for use by the Northern Sonoma County Air Pollution Control District; • Gas log fireplace; or • A fireplace certified by the EPA, should the EPA develop a fireplace certification program.

	SJVAPCD Rule 4901	Santa Rosa Title 17, Ch 35
	finalized to remove exemptions for pellet-fueled wood burning heaters, then all new wood burning heaters must comply with the above. • Used: No person shall advertise, sell, offer for sale, supply, install, or transfer a used wood burning heater unless it has been rendered permanently inoperable, satisfies NSPS, or is a low mass fireplace, masonry heater, or other wood burning device of a make and model that meets all federal requirements and has been approved in writing by the APCO.	The conversion of a gas log fireplace to burn wood shall constitute the installation of a wood burning appliance and shall be subject to the requirements of this chapter.
Requirements for Real Property	No person shall sell or transfer any real property which contains a wood burning heater without first assuring that each wood burning heater included in the real property: • Meets certification under the NSPS at the time of purchase or installation and is at least as stringent as EPA Phase II requirements, • Is a pellet-fueled wood burning heater that was exempt from EPA certification pursuant to requirements in the NSPS at the time of purchase or installation, or • Is rendered permanently inoperable and removed from property. Upon the sale or transfer of any residential real property in the San Joaquin Valley, the seller shall provide to the buyer of the real property and to the APCO, documentation certifying the following: • The type(s) and number(s) of wood burning heaters and wood burning fireplaces included in the real property transaction. If no wood burning heaters or wood burning fireplaces are included in the real property transaction, this should be documented. • Any action(s) taken to comply with the above requirements for sale or transfer of real property. • Documents required shall be retained by the seller and shall again be made available to the APCO upon request.	It is recommended that any noncertified (EPA or Northern Sonoma County Air Pollution Control District) wood heater, freestanding or insert, be removed by the transferor prior to the transfer of, or close of escrow on sale of, any residential real property located within the City of Santa Rosa. This section does not apply to fireplaces without an insert or to pellet-fueled heaters.
Requirements for Remodels	Remodel of wood burning fireplace or chimney where total cost exceeds	A noncertified (EPA or Northern Sonoma County Air Pollution Control District) wood heater, freestanding or

	SJVAPCD Rule 4901	Santa Rosa Title 17, Ch 35
	$15,000, local building permit is required, and application for building permit is submitted on or after Jan. 1, 2020: • A person may only install a gas-fueled, electric, exempt, or EPA certified wood burning heater that meets requirements of NSPS at the time of installation.	insert, shall be removed when both of the following conditions occur: • Remodel or renovation work which requires a building permit and consists of the opening of a wall within twelve inches of the appliance and in the same room; and • The valuation of the remodel or renovation works exceeds $2,500. This section does not apply to fireplaces without an insert or to pellet-fueled heaters.
Requirements for Buildings	Limitations on wood burning fireplaces or wood burning heaters • At elevations below 3,000 feet in areas with natural gas service, no person shall install a wood burning fireplace, low mass fireplace, masonry heater, or wood burning heater. • At elevations at or above 3,000 feet or in areas without natural gas service, no more than two EPA certified wood burning heaters, that meet NSPS at time of installation, shall be installed per acre. ○ No person shall install more than one EPA certified wood burning heater, that meets NSPS at time of installation, per dwelling unit. ○ No person shall install a wood burning fireplace, low mass fireplace, masonry heater, or non-certified wood burning heater.	None.

	SJVAPCD Rule 4901	Santa Rosa Title 17, Ch 35
Solid Wood Fuel or Wood Sale	Advertising Requirements for Sale of Wood • No person shall sell, offer for sale, or supply any wood which is orally or in writing, advertised, described, or in any way represented to be "seasoned wood" unless the wood has a moisture content of ≤20% by weight. • The APCO may delegate another person or agency the authority to test wood for moisture content and determine compliance.	None.
Prohibited Fuels	No person shall cause or allow any of the following materials to be burned in a wood burning fireplace, wood burning heater, or outdoor wood burning device: garbage, treated wood, non-seasoned wood, plastic products, rubber products, waste petroleum products, paints and paint solvents, coal, or any other material not intended by a manufacturer for use as a fuel in a wood burning fireplace, wood burning heater, or outdoor wood burning device.	Use of any of the following fuels in a wood burning appliance is prohibited: • Garbage; • Treated wood; • Plastic products; • Rubber products; • Waste petroleum products; • Paints; • Paint solvents; • Coal; • Glossy or colored paper; • Particle board; • Salt water driftwood. This section shall not apply to products designed and marketed specifically for use as a fuel in a wood burning appliance.
Requirements for Non-certified Units	Rule requires only EPA-certified units be sold in the area.	Effective 6/1/04, it shall be unlawful to use or operate a noncertified (EPA or Northern Sonoma County Air Pollution Control District) wood heater, freestanding or insert, on any property within the City of Santa Rosa. The Director of Community Development may grant an exception to this section in cases of hardship, including: • A residential sole source of heat; • A temporary sole source of heat; • An inadequate alternative source of heat.

The City of Santa Rosa's ordinance contains requirements for the installation of wood burning appliances and the removal and operation of noncertified wood heaters. The ordinance does not contain wood burning curtailment requirements; therefore, District Rule 4901 is more stringent than the City of Santa Rosa's ordinance regarding the enforcement of stringent wood burning curtailments Valley-wide. Similar to District Rule 4901, the Santa Rosa ordinance prohibits new installations of noncertified devices, and requires removal of noncertified devices at the time of permitted remodels. The ordinance prohibits the operation of noncertified devices, with sole source of heat exemptions, however, the mechanism of enforcement and ensuring compliance with the ordinance is unspecified beyond citizen complaints. The ordinance only recommends removal of noncertified wood heaters at the time of sale of a property, while District Rule 4901 requires it. Therefore, overall District Rule 4901 is more stringent.

- ***State of Alaska Admin Code, Title 18, Chapter 50: Air Quality Control***[170]

	SJVAPCD Rule 4901	18 AAC 50
General Exemptions	• Devices that are exclusively gaseous-fueled. • Cook stoves, as described in 40 CFR §60.531. • Any burning occurring on the ground is open burning and is subject to requirements of District Rule 4103.	Exempt from wood burning curtailments: • During a power outage • Those with no other adequate source of heat • Cases where owner/operator has obtained a temporary waiver, granted in cases of financial hardship or technical feasibility (exempt from Stage 1 in Fairbanks) • Controlled burning with approval • Firefighter training
Natural Gas Exemption	Locations where natural gas is not available are not subject to episodic curtailments (propane and butane are not considered natural gas).	-
Sole Source Exemption	Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	Those with no other adequate source of heat are not subject to curtailments.
Wood Burning Season	November through February	-
No Burn Day	**<u>Level 1 Curtailment</u>** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 20 µg/m³ but not exceed 65 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or	Episode types and thresholds for PM2.5 (24-hr average) are as follows: <u>Statewide Episodes:</u> A person may not operate a wood-fired heating device in an area for which the department has declared an air quality episode for SO2, PM10, or CO. A person may operate a solid fuel-fired heating device in an area for which the department has declared a PM2.5 air quality episode, only if visible emissions/opacity from the device is below limits identified in the announcement, with a waiver, or if the

[170] Alaska Admin Code, Title 18, Chapter 50. Retrieved from: https://www.akleg.gov/basis/aac.asp#18.50

	SJVAPCD Rule 4901	18 AAC 50
	exceed 12 µg/m³ but not exceed 35 µg/m³ for the geographic region. • Registered wood burning heater may be operated provided it's fired on approved fuel, maintained, and operated according to manufacturer instructions, and has no visible smoke. **Level 2 Curtailment** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 65 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 35 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region.	department has not prohibited operation. PM2.5 Episodes: • Air Alert: 35.5 µg/m³ • Air Warning: 55.5 µg/m³ • Air Emergency: 150.5 µg/m³ For Fairbanks and North Pole urban area:[171] • Stage 1: 20 µg/m³ • Stage 2: 30 µg/m³ During Stage 1 or 2 air alert, wood stoves, coal stoves, wood-fired hydronic heaters, coal-fired furnaces, fireplace inserts, pellet fuel burning appliances, masonry heaters, cook stoves, fireplaces, waste oil burning appliances, non-permitted outdoor incinerators, and burn barrels may not operate without a waiver. During Stage 2 air alert, campfires, bonfires, ceremonial fires, and fire pits are prohibited.
Sale, Resale, or Installation of Wood-Burning Devices	Sale or transfer of wood burning heaters: • New: No person shall advertise, sell, offer for sale, supply, install, or transfer a new wood burning heater unless it is either EPA certified under the NSPS at the time of purchase or installation and at least as stringent as EPA Phase II requirements, or a pellet-fueled wood burning heater that is exempt from EPA certification pursuant to requirements in the NSPS, until such time that amendments to the NSPS are finalized to remove exemptions for pellet-fueled wood burning heaters, then all new wood burning heaters must comply with the above. • Used: No person shall advertise, sell, offer for sale, supply, install, or transfer a used wood burning heater unless it has been rendered permanently inoperable, satisfies NSPS, or is a low mass fireplace,	A person may sell, lease, distribute, convey, or install a new wood-fired heating device if the buyer or operator of the device confirms in writing that the device will be installed in an area other than Fairbanks or North Pole urban area. A person may not install: • a pellet fueled wood-fired hydronic heater within 330 feet from the closest property line or within 660 feet from a school, clinic, hospital, or senior housing unit; • a wood-fired heating device as the primary or only heat source in (A) new construction, except new construction of a dry cabin located on a two acre or larger parcel; or (B) a structure used as a rental unit, unless the structure has been used as a rental prior to January 8, 2020 and qualifies for a No Other Adequate Heat Source waiver, as identified in a local air quality plan

[171] ADEC. Amendments to: State Air Quality Control Plan. Vol. II:III.D.7.12. Fairbanks Emergency Episode Plan. (November 19, 2019).

	SJVAPCD Rule 4901	18 AAC 50
	masonry heater, or other wood burning device of a make and model that meets all federal requirements and has been approved in writing by the APCO.	incorporated in the State Air Quality Control Plan. <u>Fairbanks and North Pole urban area:</u> A person may not install, reinstall, sell, lease, distribute, or convey the following devices for use: • a wood-fired hydronic heater; • a woodstove; • a wood-fired heating device with a manufacturer-rated heat output capacity of 350,000 Btu/hr or more The department will approve models of pellet fueled wood-fired hydronic heaters for use that: • have a manufacturer-rated heat output capacity under 350,000 Btu/hr; • have a valid certification from EPA; • meet an average PM emission level of 0.10 lb/MMBtu of heat output for each individual burn rate The department may approve specific models of woodstoves and pellet stoves that: • have a manufacturer-rated heat output capacity of less than 350,000 Btu per hour; • have a valid certification from EPA; and • meet a PM annual average emission limit of 2.0 g/hr The department may approve specific models of wood-fired heating devices with a manufacturer-rated heat output capacity of 350,000 Btu/hr or more if a laboratory with current EPA accreditation has tested the model to meet a PM emission limit of 2.0 g/hr.
Requirements for Real Property	No person shall sell or transfer any real property which contains a wood burning heater without first assuring that each wood burning heater included in the real property: • Meets certification under the NSPS at the time of purchase or installation and is at least as stringent as EPA Phase II requirements, • Is a pellet-fueled wood burning heater that was exempt from EPA certification pursuant to requirements in the NSPS at the time of purchase or installation, or	As applicable, the owner, vendor, or dealer of a wood-fired heating device shall register the device, using a form or method provided by the department upon the sale or conveyance of a device before closing, if the device is being sold, leased or conveyed as part of an existing building or other property.

	SJVAPCD Rule 4901	18 AAC 50
	• Is rendered permanently inoperable and removed from property. Upon the sale or transfer of any residential real property in the San Joaquin Valley, the seller shall provide to the buyer of the real property and to the APCO, documentation certifying the following: • The type(s) and number(s) of wood burning heaters and wood burning fireplaces included in the real property transaction. If no wood burning heaters or wood burning fireplaces are included in the real property transaction, this should be documented. • Any action(s) taken to comply with the above requirements for sale or transfer of real property. • Documents required shall be retained by the seller and shall again be made available to the APCO upon request.	
Requirements for Remodels	Remodel of wood burning fireplace or chimney where total cost exceeds $15,000, local building permit is required, and application for building permit is submitted on or after Jan. 1, 2020: • A person may only install a gas-fueled, electric, exempt, or EPA certified wood burning heater that meets requirements of NSPS at the time of installation.	None.

Requirements for Buildings	Limitations on wood burning fireplaces or wood burning heaters
	• At elevations below 3,000 feet in areas with natural gas service, no person shall install a wood burning fireplace, low mass fireplace, masonry heater, or wood burning heater.
	• At elevations at or above 3,000 feet or in areas without natural gas service, no more than two EPA certified wood burning heaters, that meet NSPS at time of installation, shall be installed per acre.
	  ○ No person shall install more than one EPA certified wood burning heater, that meets NSPS at time of installation, per dwelling unit.
	  ○ No person shall install a wood burning fireplace, low mass fireplace, masonry heater, or non-certified wood burning heater.
		None.

	SJVAPCD Rule 4901	18 AAC 50
Solid Wood Fuel or Wood Sale	Advertising Requirements for Sale of Wood • No person shall sell, offer for sale, or supply any wood which is orally or in writing, advertised, described, or in any way represented to be "seasoned wood" unless the wood has a moisture content of ≤20% by weight. • The APCO may delegate another person or agency the authority to test wood for moisture content and determine compliance.	In Fairbanks and North Pole urban area: • A commercial wood seller shall register with the department to sell or provide wood in the area • Non-commercial wood sellers may not sell wet wood in the area • A commercial wood seller who is required to register with the department may sell wet wood if they meet all registration requirements; the wood is sold in round logs 8 ft or more in length; and the seller confirms in writing the buyer's ability to properly dry the wood for use in the next winter season or beyond • Except as provided above, a commercial wood seller required to register with the department may only sell dry wood (≤20% moisture content)
Visible Emissions	• Under normal operating conditions, no person shall cause or allow any visible smoke from a registered wood burning heater. • Under normal operating conditions, no person shall cause or allow from a wood burning fireplace or nonregistered wood burning heater a visible emission of any air contaminant, other than uncombined water vapor, that exceeds No. 1 on the Ringelmann Chart or 20% opacity for a period or periods aggregating more than 3 minutes in any 1 hour.	A person may not operate a wood-fired heating device in a manner that causes: • black smoke; or • visible emissions that exceed 20% opacity for more than 6 minutes in any 1 hour in an area for which an air quality advisory is in effect, except during the first 15 minutes after initial firing of the device. In Fairbanks and North Pole urban area a person may not operate a solid fuel-fired heating device in a manner that causes visible emissions that exceed 20% opacity for more than 6 minutes in any 1 hour, except during the first 15 minutes after initial firing of the device, when the opacity limit must be less than 50 percent; and visible emissions to cross property lines.

	SJVAPCD Rule 4901	18 AAC 50
Prohibited Fuels	No person shall cause or allow any of the following materials to be burned in a wood burning fireplace, wood burning heater, or outdoor wood burning device: garbage, treated wood, non-seasoned wood, plastic products, rubber products, waste petroleum products, paints and paint solvents, coal, or any other material not intended by a manufacturer for use as a fuel in a wood burning fireplace, wood burning heater, or outdoor wood burning device.	• Wood that is: ○ Painted ○ Stained ○ Coated ○ Treated ○ Preserved • Asphalt • Rubber • Tar Products • Materials Contaminated with: ○ Petroleum ○ Petroleum Derivatives ○ Oily Wastes • Oil Cleanup Materials • Chlorinated or Halogenated Organic Compounds: ○ Plastics ○ Polyurethane Products ○ Pesticides ○ Herbicides ○ Fungicides • Compounds Containing: ○ Cyanide ○ Asbestos • Animal Carcasses • Putrescible Garbage
Requirements for Non-certified Units	Rule requires only EPA-certified units be sold in the area.	In Fairbanks and North Pole urban area, a person who owns a woodstove or pellet stove that does not have a valid certification from EPA or a non-pellet fueled wood-fired outdoor hydronic heater shall render the device inoperable before December 31, 2024; or before the device is sold, leased, or conveyed as part of an existing structure, whichever is earlier (May be waived in cases of financial hardship and technical feasibility).

The air quality regulations contained within the Alaska Admin Code are enforced by the Alaska Department of Environmental Conservation (ADEC). As demonstrated above, District Rule 4901 contains more stringent curtailment thresholds than ADEC. In all areas aside from the Fairbanks and North Pole urban area, ADEC issues an initial air alert when the PM2.5 24-hour average reaches 35.5 μg/m³, at which the emissions from operation of a solid fuel-fired device are required to meet certain opacity limits. There is no threshold at which all burning is prohibited. In Fairbanks and the North Pole urban area, burning curtailments begin when PM2.5 levels reach 20 μg/m³, with more stringent prohibitions once levels reach 30 μg/m³. In comparison, the District's level 1 curtailment thresholds are 12 μg/m³ for hot spot counties, and 20 μg/m³ for non-hot-spot counties. The District's level 2 curtailment thresholds are 35 μg/m³ for hot spot counties, and 65 μg/m³ for non-hot-spot counties. Additionally, District Rule 4901 requires that visible emission limits of 20% opacity not be exceeded at any time, while ADEC, in most areas, requires similar opacity limits only during an air quality alert.

ADEC's ordinance requires removal of uncertified devices in Fairbanks, AK, and the North Pole urban area, by December 31, 2024. Homes where there are no other adequate sources of heat are exempt from this provision, and waivers are allowed based on financial hardship and technical feasibility. The ADEC set removal date for uncertified stoves has not yet passed, and the enforcement mechanism within the rule is not stated. According to ADEC's website, they will solely rely on complaints for enforcement of the regulation. These additional requirements are discussed in more detail as part of the Potential Emission Reduction Opportunities section below. Overall, the District's requirements within Rule 4901 are more stringent than those in ADEC.

How does District Rule 4901 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4901 to comparable requirements in rules from the following nonattainment areas:

- South Coast AQMD Rule 445 (Amended October 27, 2020)[172]
- Sacramento Metropolitan AQMD Rule 417 (Adopted October 26, 2006)[173]
- Sacramento Metropolitan AQMD Rule 421 (Amended September 24, 2009)[174]
- Bay Area AQMD Regulation 6, Rule 3 (Amended November 20, 2019)[175]

Ventura County APCD does not have an analogous rule for this source category.

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4901 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

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[172] SCAQMD. *Rule 445 (Wood-Burning Devices).* (Amended October 27, 2020). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-445.pdf?sfvrsn=4

[173] SMAQMD. *Rule 417 (Wood Burning Appliances).* (Adopted October 26, 2006). Retrieved from: https://www.airquality.org/ProgramCoordination/Documents/rule417.pdf

[174] SMAQMD. *Rule 421 (Mandatory Episodic Curtailment of Wood and Other Solid Fuel Burning).* (Amended September 24, 2009). Retrieved from: https://www.airquality.org/ProgramCoordination/Documents/rule421.pdf

[175] BAAQMD. *Regulation 6, Rule 3 (Wood-Burning Devices).* (Amended November 20, 2019). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/regulation-6-rule-3/documents/20191120_r0603_final-pdf.pdf?la=en&rev=cbb545815c15468cb98f8c1b23c083d2

South Coast AQMD

- SCAQMD Rule 445 (Wood Burning Devices)

	SJVAPCD Rule 4901	SCAQMD Rule 445
Applicability	• Any person who manufactures, sells, offers for sale, or operates a wood burning fireplace, wood burning heater, or outdoor wood burning device. • Any person who sells, offers for sale, or supplies wood intended for burning in a wood burning fireplace or wood burning heater. • Any person who sells or transfers a real property. • Any person who installs a wood burning fireplace or wood burning heater.	• Any person that manufacturers, sells, offers for sale, or installs a wood-burning device. • Any commercial firewood seller that sells, offers for sale, or supplies wood or other wood-based fuels intended for burning in a wood-burning-device or portable outdoor wood-burning device. • Any property owner or tenant that operates a wood-burning device or portable outdoor wood-burning device.
General Exemptions	• Devices that are exclusively gaseous-fueled. • Cook stoves, as described in 40 CFR §60.531. • Any burning occurring on the ground is open burning and is subject to requirements of District Rule 4103.	• Wood-fired cooking devices designed and used for commercial purposes. • The provisions for new or used permanently installed indoor or outdoor wood-burning devises or gaseous-fueled devices shall not apply to an indoor or outdoor wood-burning device that is permanently installed and included in the sale or transfer of any existing development. • The provisions for new or used permanently installed indoor or outdoor wood-burning devises or gaseous-fueled devices shall not apply to properties that are registered as a historical site, or are contributing structures located in a Historic Preservation Overlay Zone, as determined by the applicable, federal, State, or local agency. Contributing structures are those buildings which are examples of the predominate styles of the area, built during the time period when the bulk of the structures were built in the Historic Preservation Overlay Zone. • The no burn provisions for any product not intended for use as fuel in a wood-burning device shall not apply to manufactured firelogs. • The labeling and sell-through provision shall not apply to wood-based fuel intended for the cooking, smoking, or flavoring of food. • The provisions of the wood-burning season PM2.5 mandatory burning curtailment, PM2.5 contingency

	SJVAPCD Rule 4901	SCAQMD Rule 445
		measures, and ozone contingency measures shall not apply under the following circumstances: ○ Residential or commercial properties where a wood-burning device is the sole source of heat; or ○ A low income household; or ○ Residential or commercial properties where there is no existing infrastructure for natural gas service within 150 feet of property line; or ○ Residential or commercial properties located 3,000 or more feet above mean sea level; or ○ Ceremonial fires exempted under Rule 444 (Open Burning).
Natural Gas Exemption	Locations where natural gas is not available are not subject to episodic curtailments (propane and butane are not considered natural gas).	Installation requirements for new developments shall not apply to new developments where there is no existing infrastructure for natural gas service within 150 feet of the property line or those 3,000 or more feet above mean sea level.
Sole Source Exemption	Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	The provisions of the wood-burning season PM2.5 mandatory burning curtailment, PM2.5 contingency measures, and ozone contingency measures shall not apply to residential or commercial properties where a wood-burning device is the sole source of heat.
No Burn Day (Nov-Feb)	**Level 1 Curtailment** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 20 µg/m³ but not exceed 65 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 12 µg/m³ but not exceed 35 µg/m³ for the geographic region. • Registered wood burning heater may be operated provided it's fired on approved fuel, maintained, and operated according to manufacturer	No person shall operate an indoor or outdoor wood-burning device, portable outdoor wood-burning device, or wood-fired cooking device on a calendar day during the wood-burning season for PM2.5 so declared to the public by the Executive Officer to be a mandatory wood-burning curtailment (No-Burn) day based on the specified geographic area below 3,000 feet above mean sea level and applicable daily PM2.5 air quality forecast as follows: • Basin-wide if the daily PM2.5 air quality forecast for any source receptor area exceeds 30 µg/m³, or • Subsequent to a determination by U.S. EPA, pursuant to 40 CFR §51.1014(a) of a failure to comply with either a referenced PM2.5 standard or reporting requirement; the applicable daily PM2.5 air quality forecast as set

	SJVAPCD Rule 4901	SCAQMD Rule 445
	instructions, and has no visible smoke. **Level 2 Curtailment** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 65 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 35 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region.	forth in the PM2.5 Contingency Measures requirements. Prohibitions on Permissive Burn Days or restrictions on Marginal Burn Days shall be in effect only if a No-Burn day is declared during any of the consecutive months of November, December, January, or February.
Sale, Resale, or Installation of Wood-Burning Devices	Sale or transfer of wood burning heaters: • New: No person shall advertise, sell, offer for sale, supply, install, or transfer a new wood burning heater unless it is either EPA certified under the NSPS at the time of purchase or installation and at least as stringent as EPA Phase II requirements, or a pellet-fueled wood burning heater that is exempt from EPA certification pursuant to requirements in the NSPS, until such time that amendments to the NSPS are finalized to remove exemptions for pellet-fueled wood burning heaters, then all new wood burning heaters must comply with the above. • Used: No person shall advertise, sell, offer for sale, supply, install, or transfer a used wood burning heater unless it has been rendered permanently inoperable, satisfies NSPS, or is a low mass fireplace, masonry heater, or other wood burning device of a make and model that meets all federal requirements and has been approved in writing by the APCO.	• No person shall sell, offer for sale, supply, or install, a new or used permanently installed indoor or outdoor wood-burning device or gaseous-fueled device unless it is one of the following: ○ EPA Certified wood-burning heater; or ○ Pellet-fueled wood-burning heater; or ○ A masonry heater; or ○ A dedicated gaseous-fueled fireplace
Requirements for Real Property	No person shall sell or transfer any real property which contains a wood burning heater without first assuring that each	EPA certification requirements do not apply to:

	SJVAPCD Rule 4901	SCAQMD Rule 445
	wood burning heater included in the real property: • Meets certification under the NSPS at the time of purchase or installation and is at least as stringent as EPA Phase II requirements, • Is a pellet-fueled wood burning heater that was exempt from EPA certification pursuant to requirements in the NSPS at the time of purchase or installation, or • Is rendered permanently inoperable and removed from property. Upon the sale or transfer of any residential real property in the San Joaquin Valley, the seller shall provide to the buyer of the real property and to the APCO, documentation certifying the following: • The type(s) and number(s) of wood burning heaters and wood burning fireplaces included in the real property transaction. If no wood burning heaters or wood burning fireplaces are included in the real property transaction, this should be documented. • Any action(s) taken to comply with the above requirements for sale or transfer of real property. • Documents required shall be retained by the seller and shall again be made available to the APCO upon request.	• Indoor or outdoor wood-burning device that is permanently installed and included in the sale or transfer of any existing development. • Properties that are registered as a historical site, or are contributing structures located in a Historic Preservation Overlay Zone, as determined by the applicable, federal, State, or local agency. Contributing structures are those buildings which are examples of the predominate styles of the area, built during the time period when the bulk of the structures were built in the Historic Preservation Overlay Zone.
Requirements for Remodels	Remodel of wood burning fireplace or chimney where total cost exceeds $15,000, local building permit is required, and application for building permit is submitted on or after Jan. 1, 2020: • A person may only install a gas-fueled, electric, exempt, or EPA certified wood burning heater that meets requirements of NSPS at the time of installation.	None.
Requirements for Buildings	Limitations on wood burning fireplaces or wood burning heaters • At elevations below 3,000 feet in areas with natural gas service, no person shall install a wood burning fireplace, low mass fireplace, masonry heater, or wood burning heater. • At elevations at or above 3,000 feet or in areas without natural gas service, no more than two EPA certified wood	No person shall permanently install a wood-burning device into any new development.

	SJVAPCD Rule 4901	SCAQMD Rule 445
	burning heaters, that meet NSPS at time of installation, shall be installed per acre. ○ No person shall install more than one EPA certified wood burning heater, that meets NSPS at time of installation, per dwelling unit. ○ No person shall install a wood burning fireplace, low mass fireplace, masonry heater, or non-certified wood burning heater.	
Solid Wood Fuel or Wood Sale	Advertising Requirements for Sale of Wood • No person shall sell, offer for sale, or supply any wood which is orally or in writing, advertised, described, or in any way represented to be "seasoned wood" unless the wood has a moisture content of ≤20% by weight. • The APCO may delegate another person or agency the authority to test wood for moisture content and determine compliance.	• A commercial firewood seller shall only sell seasoned wood from July 1 through the end of February the following year. Any commercial firewood seller may sell seasoned as well as non-seasoned wood during the remaining months. • No commercial firewood seller shall sell, offer for sale, or supply wood-based fuel without first attaching a permanently affixed indelible label to each package or providing written notice to each buyer at the time of purchase of bulk firewood that at a minimum states the following: "Use of this and other solid fuel products may be restricted at times by law. Please check (1-877-4NO-Burn) or (www.8774NOBURN.org) before burning." Labeling requirements do not apply to wood-based fuel intended for cooking, smoking, or flavoring of food. The Executive Officer shall specify guidelines for the aforementioned labeling requirements.
Prohibited Fuels	No person shall cause or allow any of the following materials to be burned in a wood burning fireplace, wood burning heater, or outdoor wood burning device: garbage, treated wood, non-seasoned wood, plastic products, rubber products, waste petroleum products, paints and paint solvents, coal, or any other material not intended by a manufacturer for use as a fuel in a wood burning fireplace, wood burning heater, or outdoor wood burning device.	No person shall burn any product not intended for use as fuel in a wood-burning device including, but not limited to, garbage, treated wood, particle board, plastic products, rubber products, waste petroleum products, paints, coatings or solvents, or coal. Manufactured logs are exempt from this requirement.

The District evaluated the requirements contained within SCAQMD Rule 445 and found that overall District Rule 4901 is as stringent as or more stringent than SCAQMD Rule 445.

Bay Area AQMD

- BAAQMD Regulation 6, Rule 3 (Wood-Burning Devices)

	SJVAPCD Rule 4901	BAAQMD Reg 6, Rule 3
Natural Gas Exemption	Locations where natural gas is not available are not subject to episodic curtailments (propane and butane are not considered natural gas).	No exemption.
Sole Source Exemption	Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	Any person whose sole source of heat is an EPA certified wood-burning device that is registered with the District per the requirements for registration of EPA certified wood heaters and registration renewal and who does not have available to them a permanently-installed NG, propane, or electric heating device. Any person seeking this exemption under must have previously registered their EPA certified wood heater in the District's registration program and must maintain documentation that the device is operated according to manufacturer's specifications. The following wood heaters are eligible to registered: • Wood heaters that are EPA certified to meet performance and emission standards of 7.5 g/hr or less • A pellet-fueled wood heater exempt from EPA certification requirements pursuant to 40 CFR 60 AAA at the time of purchase or installation
Limited Exemption: Loss of NG and/or Electrical Power	Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence. This includes times of temporary service outages, as determined by the gas or electrical utility service are exempt from wood burning curtailments.	Mandatory burn bans shall not apply to a person whose dwelling is in an area that has a temporary loss of gas and/or electric utility service and there is no alternate form of heat available. Qualification for exemption is subject to verification.
Limited Exemption: Non- Functional Permanently Installed Heater	Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence are not subject to level 1 and level 2 episodic wood burning curtailment requirements. This includes times of temporary service outages, as determined by the gas or electrical utility service.	Mandatory burn bans do not apply to any person whose only non-wood burning, permanently installed source of heat is non-functional and requires repair to resume operations. A dwelling may qualify for a 30-day exemption if there is no alternate form of heat and the non-functional heater is repaired to resume function within 30 days. Qualification for this exemption is subject to verification and must be supported by documentation of repair, which must be submitted to the District within 10 days of a receipt of a request for such records.

	SJVAPCD Rule 4901	BAAQMD Reg 6, Rule 3
No Burn Day (Nov-Feb)	**Level 1 Curtailment** • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 20 µg/m³ but not exceed 65 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 1 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to equal or exceed 12 µg/m³ but not exceed 35 µg/m³ for the geographic region. • Registered wood burning heater may be operated provided it's fired on approved fuel, maintained, and operated according to manufacturer instructions, and has no visible smoke.	Any period during which the air quality is forecast by the District to be unhealthy due to ambient levels of particulate matter exceeding 35 µg/m³ and burning wood or any solid fuels is illegal in the Bay Area. A Mandatory Burn Ban is announced through a Spare the Air Alert. • No person shall operate or combust wood or solid-fuel products in any wood-burning device during a Mandatory Burn Ban.
	Level 2 Curtailment • For the counties of San Joaquin, Stanislaus, Merced, Kings, and Tulare, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 65 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region. • For the counties of Madera, Fresno, and Kern, the APCO shall declare a Level 2 Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM2.5 concentration is forecast to exceed 35 µg/m³ or a PM10 concentration is forecast to equal or exceed 135 µg/m³ for the geographic region.	
Wood Heater Manufacturers & Retailers	Sale or transfer of wood burning heaters: • New: No person shall advertise, sell, offer for sale, supply, install, or transfer a new wood burning heater unless it is either EPA certified under the NSPS at the time of purchase or installation and at least as stringent as EPA Phase II requirements, or a	No manufacturer or retailer shall advertise, sell, offer for sale or resale, supply, install or transfer a new or used wood-burning device unless the device meets or exceeds 40 CFR 60 AAA • Any wood heater that is manufactured or sold at retail must meet an emissions rating of 2.5 g/hr if crib tested, or 2.0 g/hr if cordwood tested

	SJVAPCD Rule 4901	BAAQMD Reg 6, Rule 3
Sale, Resale, or Installation of Wood-Burning Devices	pellet-fueled wood burning heater that is exempt from EPA certification pursuant to requirements in the NSPS, until such time that amendments to the NSPS are finalized to remove exemptions for pellet-fueled wood burning heaters, then all new wood burning heaters must comply with the above. • Used: No person shall advertise, sell, offer for sale, supply, install, or transfer a used wood burning heater unless it has been rendered permanently inoperable, satisfies NSPS, or is a low mass fireplace, masonry heater, or other wood burning device of a make and model that meets all federal requirements and has been approved in writing by the APCO.	No person shall advertise, sell, offer for sale or resale, supply, install or transfer a new or used wood-burning device unless it meets 60 CFR 60 AAA. This requirement does not apply if a wood-burning device is an installed fixture in the sale or transfer of any real property.

	SJVAPCD Rule 4901	BAAQMD Reg 6, Rule 3
Requirements for Real Property	No person shall sell or transfer any real property which contains a wood burning heater without first assuring that each wood burning heater included in the real property: • Meets certification under the NSPS at the time of purchase or installation and is at least as stringent as EPA Phase II requirements, • Is a pellet-fueled wood burning heater that was exempt from EPA certification pursuant to requirements in the NSPS at the time of purchase or installation, or • Is rendered permanently inoperable and removed from property. Upon the sale or transfer of any residential real property in the San Joaquin Valley, the seller shall provide to the buyer of the real property and to the APCO, documentation certifying the following: • The type(s) and number(s) of wood burning heaters and wood burning fireplaces included in the real property transaction. If no wood burning heaters or wood burning fireplaces are included in the real property transaction, this should be documented. • Any action(s) taken to comply with the above requirements for sale or transfer of real property • Documents required shall be retained by the seller and shall again be made available to the APCO upon request.	Any person selling, renting or leasing a real property shall provide sale or rental disclosure documents that describe the health hazards of PM2.5 (in accordance with BAAQMD guidance) from burning wood or any solid fuel as a source.
Requirements for Rental Properties	None.	All real property offered for lease or rent in areas with natural gas service shall have a permanently-installed form of heat that does not burn solid fuel.

	SJVAPCD Rule 4901	BAAQMD Reg 6, Rule 3
Requirements for Buildings	Limitations on wood burning fireplaces or wood burning heaters: • At elevations below 3,000 feet in areas with natural gas service, no person shall install a wood burning fireplace, low mass fireplace, masonry heater, or wood burning heater. • At elevations at or above 3,000 feet or in areas without natural gas service, no more than two EPA certified wood burning heaters, that meet NSPS at time of installation, shall be installed per acre. ○ No person shall install more than one EPA certified wood burning heater that meets NSPS at time of installation, per dwelling unit. ○ No person shall install a wood burning fireplace, low mass fireplace, masonry heater, or non-certified wood burning heater.	No person or builder shall install a wood-burning device in a new building construction.
Requirements for Remodeling a Fireplace or Chimney	Remodel of wood burning fireplace or chimney where total cost exceeds $15,000, local building permit is required, and application for building permit is submitted on or after Jan. 1, 2020: • A person may only install a gas-fueled, electric, exempt, or EPA certified wood burning heater that meets requirements of NSPS at the time of installation.	No person shall remodel a fireplace or chimney unless a gas-fueled, electric, or EPA certified device is installed that meets requirements of 40 CFR 60 AAA. This requirement is triggered by a fireplace or chimney remodel where a total cost exceeds $15,000 and requires a local building permit.
Visible Emissions	• Under normal operating conditions, no person shall cause or allow any visible smoke from a registered wood burning heater. • Under normal operating conditions, no person shall cause or allow from a wood burning fireplace or nonregistered wood burning heater a visible emission of any air contaminant, other than uncombined water vapor, that exceeds No. 1 on the Ringelmann Chart or 20% opacity for a period or periods aggregating more than 3 minutes in any one (1) hour.	No person shall cause or allow a visible emission that exceeds Ringlemann 1 (20% opacity) for a period or periods aggregating more than 3 minutes in any hour. Visible emissions from startup shall not exceed 20 consecutive minutes in any consecutive four-hour period.

	SJVAPCD Rule 4901	BAAQMD Reg 6, Rule 3
Public Awareness Information	Retailers selling or offering for sale new wood burning heaters shall supply public awareness information with each sale in the form of pamphlets, brochures, or fact sheets on the following: proper installation, operation, and maintenance, fuel, health effects, weatherization methods for the home, proper sizing of wood burning heaters, and Burn Curtailments.	Any person offering for sale, selling or installing a new or used wood-burning device shall provide public awareness information to each purchaser of a wood-burning device in the form of pamphlets, brochures, or fact sheets. The information shall include the following statement: "Wood smoke contains harmful PM which is associated with numerous negative health impacts."
Solid Wood Fuel or Wood Sale	Advertising Requirements for Sale of Wood • No person shall sell, offer for sale, or supply any wood which is orally or in writing, advertised, described, or in any way represented to be "seasoned wood" unless the wood has a moisture content of ≤20% by weight. • The APCO may delegate another person or agency the authority to test wood for moisture content and determine compliance.	Any person offering for sale, selling or providing solid fuel or wood intended for use in a wood-burning device shall: • Attach a label to each package of solid fuel or wood sold that states "Use of this and other solid fuels may be restricted at times by law. Please check 1877-4-NO-BURN or www.8774noburn.org before burning." • If wood is seasoned (not to include manufactured logs), then the label must also state: "This wood meets air quality regulations for moisture content to be less then 20% by weight for cleaner burning." • If wood is NOT seasoned "This wood does NOT meet air quality regulations for moisture content and must be properly dried before burning."
Prohibited Fuels	No person shall cause or allow any of the following materials to be burned in a wood burning fireplace, wood burning heater, or outdoor wood burning device: garbage, treated wood, non-seasoned wood, plastic products, rubber products, waste petroleum products, paints and paint solvents, coal, or any other material not intended by a manufacturer for use as a fuel in a wood burning fireplace, wood burning heater, or outdoor wood burning device.	No person shall cause or allow any of the following materials to be burned in a wood-burning device: garbage, treated wood, non-seasoned wood, used or contaminated wood pallets, plastic products, rubber products, waste petroleum products, paints and paint solvents, coal, animal carcasses, glossy or colored paper, salt water driftwood, particle board, and any material not intended by the manufacturer for use as a fuel in a wood-burning device.

The District evaluated the requirements contained within BAAQMD Regulation 6, Rule 3 and found that District Rule 4901 is as stringent as or more stringent than BAAQMD Regulation 6, Rule 3.

Potential Emission Reduction Opportunities

Additional Requirements for Uncertified Devices

As previously referenced, Rule 4901 has been approved by EPA as the Most Stringent Measure in the nation for reducing residential wood burning emissions through a combination of enforceable requirements, coupled with strong education and incentive programs, aimed at eliminating the sale, transfer, and use of wood burning heaters and fireplaces. While a few cities have adopted local requirements or ordinances aimed at reducing the use of uncertified heaters, these requirements are generally limited to fairly small jurisdictions with little to no enforceability, and are not coupled with the much more stringent curtailment requirements imposed in the San Joaquin Valley that eliminate burning often for the vast majority of the winter in PM2.5-challenged regions of the Valley. While the District's regulation is the most stringent in the nation, the District will continue to evaluate additional options for developing enforceable mechanisms for reducing emissions from uncertified devices while also considering the stringent No Burn curtailments already imposed under the current regulation.

Extension of Wood Burning Season

Currently, the District's wood burning curtailment period as specified in Rule 4901 is implemented during the peak PM2.5 winter season (November through February), and has proven to be extremely effective in advancing the District's objectives to attain the PM2.5 federal standards and protect public health. Extending the curtailment period through March would result in additional emission reductions beyond what is currently achieved by the rule. The District has determined that this opportunity is both technologically and economically feasible for implementation in the Valley.

Evaluation Findings

Rule 4901 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

While the District meets or exceeds BACM and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the 2012 annual PM2.5 standard, the District commits to evaluating potential opportunities to further reduce PM2.5 emissions from wood burning fireplaces and heaters by extending the wood burning season through March 31.

C.20 RULE 4902 (RESIDENTIAL WATER HEATERS)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.20	0.20	0.20	0.20	0.20	0.21	0.21
NOx	1.32	1.31	1.22	1.16	1.17	1.19	1.19
	Winter Average - Tons per day						
PM2.5	0.26	0.27	0.27	0.27	0.27	0.27	0.27
NOx	1.76	1.74	1.62	1.55	1.56	1.58	1.58

District Rule 4902 Description

Adopted July 17, 1993, District Rule 4902 is a point-of-sale rule that limits NOx emissions from natural gas-fired residential water heaters with heat input rates less than or equal to 75,000 Btu/hr. The original rule enforced a NOx emissions limit of 40 nanograms of NOx per Joule of heat output (ng/J). Amendments in March 2009 strengthened the rule by enforcing a limit of 10 ng/J for new or replacement water heaters and a limit of 14 ng/J for instantaneous, or tankless, water heaters.

As a point-of-sale rule, Rule 4902 affects water heater manufacturers, plumbing wholesalers, retail home supply stores, plumbers and contractors, and homeowners. This source category encompasses several types of water heaters, including conventional storage water heaters, demand water heaters, heat pump water heaters, solar water heaters, and tankless coil and indirect water heaters. Water heater options also vary by fuel type, which includes electricity, fuel oil, geothermal energy, natural gas, propane, and solar energy.

Conventional storage water heaters are the most common. They have an insulated tank sized from 20 to 80 gallons and natural gas-fired units have a gas burner under the tank regulated by a thermostat. Demand water heaters, also known as instantaneous or tankless water heaters, heat water as it is required and do not use a storage tank. As soon as there is a demand for hot water, a gas burner heats cold water as it travels through a pipe in the unit. Natural gas-fired units generally provide hot water at a rate upwards of 5 gallons per minute.

A tankless coil water heater heats water flowing through a heat exchanger installed in a furnace or boiler. Similar to the tankless coil water heater, an indirect water heater uses a furnace or boiler. Fluid heated by the furnace or boiler circulates through a heat exchanger in a storage tank.

Manufacturers have focused on combustion modifications to meet the lower NOx limit, as required in other California air districts. Combustion modification systems reduce thermal NOx formation by changing the flame characteristics to reduce peak flame temperature. Different burner designs, such as low-NOx and ultra-low NOx burners, achieve combustion modification for residential water heaters. Some of the design principles used in low-NOx and ultra-low NOx burners include staged air burners, staged fuel burners, pre-mix burners, internal recirculation, and radiant burners.

Statewide Zero-Emission Standards for Building Appliances
CARB's *2022 State Strategy for the State Implementation Plan* (*2022 State SIP Strategy*) includes a commitment to develop and propose a zero-emissions standard for space and water heaters sold in the state to go into effect in 2030.[176] This goal is in alignment with California's climate strategy, which includes efforts towards building decarbonization, as laid out in CARB's *2022 Scoping Plan for Achieving Carbon Neutrality* (*2022 Scoping Plan*).[177] CARB has committed to conduct an extensive investigation into this measure, develop a proposed rule through meaningful public engagement, and bring the proposed rule before their Board by 2025. Upon fulfilling these commitments, the State expects to experience significant air quality and public health benefits.

In the development of the *2022 State SIP Strategy* and the *2022 Scoping Plan*, CARB examined the many factors involved in the transition to zero-emission appliances, and outlined the necessary process ahead to achieve building decarbonization. CARB's *2022 Scoping Plan* details a number of aspects that must be considered before implementing zero-emission appliance standards, including technical feasibility, costs and affordability, and consumer acceptance, adoption, awareness, and readiness. Additionally, CARB acknowledged the concerted effort needed across all levels of government, utilities, appliance manufacturers, developers, contractors, households, and businesses to achieve this goal successfully and equitably across the state.

CARB began the public process for the development of zero-emission appliance standards with a public workshop on May 10, 2023.[178] The District continues to support CARB in the development and implementation of this measure, as it will result in direct air quality and public health benefits for the Valley.

Zero-Emission Requirements in Other Areas
Other air districts around the State are considering strategies that are similar to that adopted by CARB under the *2022 Scoping Plan* and *2022 State SIP Strategy*. For example, on March 15, 2023, Bay Area AQMD adopted zero-emission requirements for new residential and commercial furnaces and water heaters, with compliance dates ranging from 2027-2031, depending on unit type and size. Similarly, South Coast AQMD has committed to adopt the zero-emission standard developed by CARB for new space and water heaters in new constructions and equipment replacement by 2030 in

[176] CARB. *2022 State Strategy for the State Implementation Plan*, pp. 101-103. September 22, 2022. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf
[177] CARB. *2022 Scoping Plan for Achieving Carbon Neutrality*. December 15, 2022. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf
[178] CARB Zero-Emission Appliance Standards Webpage, Meetings & Workshops. Retrieved from: https://ww2.arb.ca.gov/our-work/programs/building-decarbonization/zero-emission-appliance-standards/meetings-workshops

their *2022 Air Quality Management Plan*, in addition to low-NOx and incentive-based strategies.[179]

Over 70 cities and counties in California have adopted local ordinances requiring varying degrees of electrification for new buildings. The first of these ordinances, passed in the City of Berkeley in August 2019, enacted a building code prohibiting natural gas piping into buildings. However, this ordinance was overturned on April 17, 2023, when the U.S. Ninth Circuit Court of Appeals issued a ruling that cities and states cannot ban natural gas hookups in new buildings, because such action is preempted by the U.S. Energy Policy Conservation Act, which "expressly preempts state and local regulations concerning the energy use of many natural gas appliances, including those used in household and restaurant kitchens." The City of Berkeley filed a petition for *en banc* review of this ruling on May 31, 2023, but the request was denied on January 2, 2024. The court held that the ban on natural gas was preempted by federal energy efficiency laws, setting precedent that blocks local government from using similar bans to combat climate change.[180] Following this ruling, a number of cities and counties with adopted natural gas bans have suspended enforcement of their ordinances.

How does District Rule 4902 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

State Regulations

There are no state regulations applicable to this source category.

How does District Rule 4902 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4902 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 9, Rule 6 (Amended March 15, 2023)[181]

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[179] SCAQMD. *2022 Air Quality Management Plan*. (December 2, 2022). Retrieved from: http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/final-2022-aqmp.pdf?sfvrsn=10

[180] U.S. Courts for the Ninth Circuit. California Restaurant Association v. City of Berkeley. Retrieved from: https://www.ca9.uscourts.gov/cases-of-interest/california-restaurant-association-v-city-of-berkeley/

[181] BAAQMD. *Regulation 9, Rule 6 (Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters).* (Amended March 15, 2023). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230315_rg0906-pdf.pdf?la=en

- Sacramento Metropolitan AQMD Rule 414 (Amended October 25, 2018)[182]
- San Diego County APCD Rule 69.5.1 (Adopted June 24, 2015)[183]
- South Coast AQMD Rule 1121 (Amended September 3, 2004)[184]
- Ventura County APCD Rule 74.11 (Amended January 12, 2010)[185]

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4902 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

Bay Area AQMD

- BAAQMD Regulation 9, Rule 6 (Nitrogen Oxide Emissions from Natural Gas-Fired Boilers and Water Heaters)

	SJVAPCD Rule 4902	BAAQMD Reg 9, Rule 6
Applicability	Manufacturers, distributors, retailers, and installers of PUC quality natural gas-fired residential water heaters with heat input rates ≤75,000 Btu/hr.	Any person who sells, installs, or offers for sale a natural gas-fired water heater for use within the District and any manufacturer who intends to sell or distribute for sale or installation a natural gas-fired water heater for use within the District.
Exemptions	• PUC quality natural gas fired water heaters with rated heat input of >75,000 Btu/hr • Water heaters using fuels other than PUC quality natural gas • Water heaters used exclusively in recreational vehicles	The requirements below shall not apply to the following: • Natural gas-fired boilers and water heaters with a rated heat input capacity >2,000,000 Btu/hr • Natural gas-fired water heaters used in recreational vehicles • Water heaters using a fuel other than natural gas • Natural gas-fired pool/spa heaters with <400,000 Btu/hr rated heat input capacity used exclusively to heat swimming pools, hot tubs or spas
Requirements	No person shall manufacture for sale, distribute, sell, offer for sale, or install within the District any PUC quality natural gas-fired: • Water heater (excluding mobile home water heaters, instantaneous water heaters, and pool heaters) unless	No person shall sell, install, or offer for sale within the District any natural gas-fired boiler or water heater that emits more than the following NOx limits: • ≤75,000 Btu/hr: ○ 10 ng/J; ○ 0 ng/J for new units after Jan. 1, 2027 • Mobile home water heater: ○ 40 ng/J

[182] SMAQMD. *Rule 414 (Water Heaters, Boilers, and Process Heaters Rated Less than 1,000,000 BTU Per Hour).* (Amended October 25, 2018). Retrieved from: http://www.airquality.org/ProgramCoordination/Documents/rule414.pdf
[183] SDAPCD. *Rule 69.5.1 (Natural Gas-Fired Water Heaters).* (Adopted June 24, 2015). Retrieved from: https://www.sdapcd.org/content/dam/sdapcd/documents/rules/current-rules/Rule-69.5.1.pdf
[184] SCAQMD. *Rule 1121 (Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters).* (Amended September 3, 2004). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1121.pdf?sfvrsn=4
[185] VCAPCD. *Rule 74.11 (Natural Gas-Fired Water Heaters).* (Revised January 12, 2010). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.11.pdf

	SJVAPCD Rule 4902	BAAQMD Reg 9, Rule 6
	certified to a NOx emission level of ≤10 ng/J • Instantaneous water heater unless certified to a NOx emission level of ≤14 ng/J • Mobile home water heater unless certified to a NOx emission level of ≤40 ng/J • Pool heater unless certified to a NOx emission level of ≤40 ng/J	• Pool/spa heater 400,001 to 2,000,000 Btu/hr: o 14 ng/J

Currently, applicable water heaters in the Bay Area are subject to the same 10 ng/J NOx limit as units subject to District Rule 4902. Recent amendments to BAAQMD Regulation 9, Rule 6 established a zero-NOx standard for new residential water heaters, set to begin in 2027. BAAQMD acknowledges that there are uncertainties in their proposed implementation timeline for zero-NOx requirements, and has stated that their Governing Board may choose to consider amending the compliance dates should it be later determined that sufficient zero-NOx technologies are not available.[186] The District is closely tracking BAAQMD's efforts.

Sacramento Metropolitan AQMD

- SMAQMD Rule 414 (Water Heaters, Boilers and Process Heaters Rated Less than 1,000,000 BTU Per Hour)

	SJVAPCD Rule 4902	SMAQMD Rule 414
Applicability	Manufacturers, distributors, retailers, and installers of PUC quality natural gas-fired residential water heaters with heat input rates ≤75,000 Btu/hr.	Any person who manufactures, distributes, offers for sale, sells, or installs any type of water heater (such as tank or tankless/instantaneous), boiler or process heater, with a rated heat input capacity <1,000,000 Btu/hr, fired with gaseous or nongaseous fuels, for use in this District.
Exemptions	• PUC quality natural gas fired water heaters with rated heat input of >75,000 Btu/hr • Water heaters using fuels other than PUC quality natural gas • Water heaters used exclusively in recreational vehicles	• Water heaters used in recreational vehicles • Pool/spa heaters with a heat input rating <75,000 Btu/hr • Water heaters, boilers and process heaters fired with LPG • Hot water pressure washers fired with gaseous or liquid fuels
Requirements	No person shall manufacture for sale, distribute, sell, offer for sale, or install within the District any PUC quality natural gas-fired:	A person shall only distribute, offer for sale, sell, or install a water heater, boiler, or process heater with certified NOx and CO emissions less than or equal to the following limits:

[186] BAAQMD. *Final Staff Report for the Proposed Amendments to Building Appliance Rules – Regulation 9, Rule 4: Nitrogen Oxides from Fan Type Residential Central Furnaces and Rule 6: Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters.* (March 2023). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230307_fsr_rules0904and0906-pdf.pdf?la=en

	SJVAPCD Rule 4902	SMAQMD Rule 414
	• Water heater (excluding mobile home water heaters, instantaneous water heaters, and pool heaters) unless certified to a NOx emission level of ≤10 ng/J • Instantaneous water heater unless certified to a NOx emission level of ≤14 ng/J • Mobile home water heater unless certified to a NOx emission level of ≤40 ng/J • Pool heater unless certified to a NOx emission level of ≤40 ng/J	• <75,000 Btu/hr: o Mobile home: 40 ng/J; o All others: 10 ng/J • 75,000 to <400,000 Btu/hr: o Pool/Spa: 40 ng/J; o All others: 14 ng/J • 400,000 to <1 million Btu/hr: o All types: 14 ng/J NOx and 400 ppmv CO @ 3% O2

The District evaluated the requirements contained within SMAQMD Rule 414 and found no requirements that were more stringent than those already in District Rule 4902. Therefore, District Rule 4902 is as stringent as or more stringent than SMAQMD Rule 414.

San Diego County APCD

- SDAPCD Rule 69.5.1 (Natural Gas-Fired Water Heaters)

	SJVAPCD Rule 4902	SDAPCD Rule 69.5.1
Applicability	Manufacturers, distributors, retailers, and installers of PUC quality natural gas-fired residential water heaters with heat input rates ≤75,000 Btu/hr.	Manufacturers, distributors, retailers, and installers of natural gas-fired water heaters, with heat input rates <75,000 Btu/hr.
Exemptions	• PUC quality natural gas fired water heaters with rated heat input of >75,000 Btu/hr • Water heaters using fuels other than PUC quality natural gas • Water heaters used exclusively in recreational vehicles	• Water heaters with a rated heat input capacity of ≥75,000 Btu/hr • Water heaters used in recreational vehicles • Water heaters used exclusively to heat swimming pools and hot tubs • Water heaters using fuels other than natural gas • Instantaneous water heaters • Existing or relocated water heaters
Requirements	No person shall manufacture for sale, distribute, sell, offer for sale, or install within the District any PUC quality natural gas-fired: • Water heater (excluding mobile home water heaters, instantaneous water heaters, and pool heaters) unless certified to a NOx emission level of ≤10 ng/J • Instantaneous water heater unless certified to a NOx emission level of ≤14 ng/J • Mobile home water heater unless certified to a NOx emission level of ≤40 ng/J	• No person shall manufacture for sale, distribute, sell, offer for sale, or install any gas-fired water heaters unless it is certified to a NOx emission level of ≤10 ng/J; or 15 ppmv at 3% O2, dry • No person shall manufacture for sale, distribute, sell, offer for sale, or install any gas-fired mobile home water heater unless it is certified to a NOx emission level of ≤40 ng/J; or 55 ppmv at 3% O2, dry

	SJVAPCD Rule 4902	SDAPCD Rule 69.5.1
	• Pool heater unless certified to a NOx emission level of ≤40 ng/J	

The District evaluated the requirements contained within SDAPCD Rule 69.5.1 and found no requirements that were more stringent than those already in District Rule 4902. Therefore, District Rule 4902 is as stringent as or more stringent than SDAPCD Rule 69.5.1.

Potential Emission Reduction Opportunities

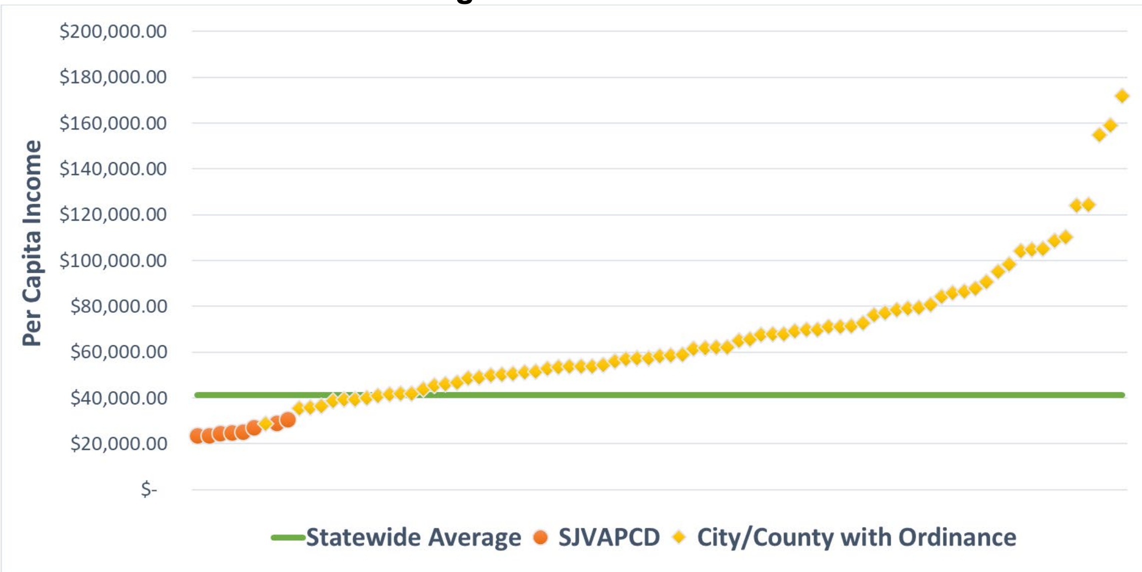
Zero-Emission Opportunities

While electric alternatives to natural gas-fired residential water heaters are currently available, feasibility and cost issues have previously prevented widespread electrification around the nation, particularly with respect to lower income households, given the significantly higher cost associated with electrical infrastructure and devices. As building electrification requirements pose potential significant impacts to low-income residents, careful equity considerations must be taken into account as new measures are developed. Though some areas in California have started implementing electrification requirements, given the number of region-specific factors that must be considered in adopting these requirements, it cannot be assumed that these policies are feasible for immediate implementation in all areas. Additionally, the Berkeley lawsuit, as discussed above, adds uncertainty to the implementation of electrification requirements.

The socioeconomic profiles of the cities and counties with building electrification requirements are vastly different from those found within the District. Based on recent U.S. Census Bureau estimates,[187] the per capita income for each District resident averaged $26,114 while cities and counties with building electrification ordinances averaged a per capita income of $68,845. The per capita income for each of the eight District counties and 76 cities and counties with building electrification ordinances is represented in Figure C-3 below, shown in comparison to the statewide average.

[187] U.S. Census Bureau. *Quick Facts*. Retrieved from: https://www.census.gov/quickfacts/fact/table/US/PST045222

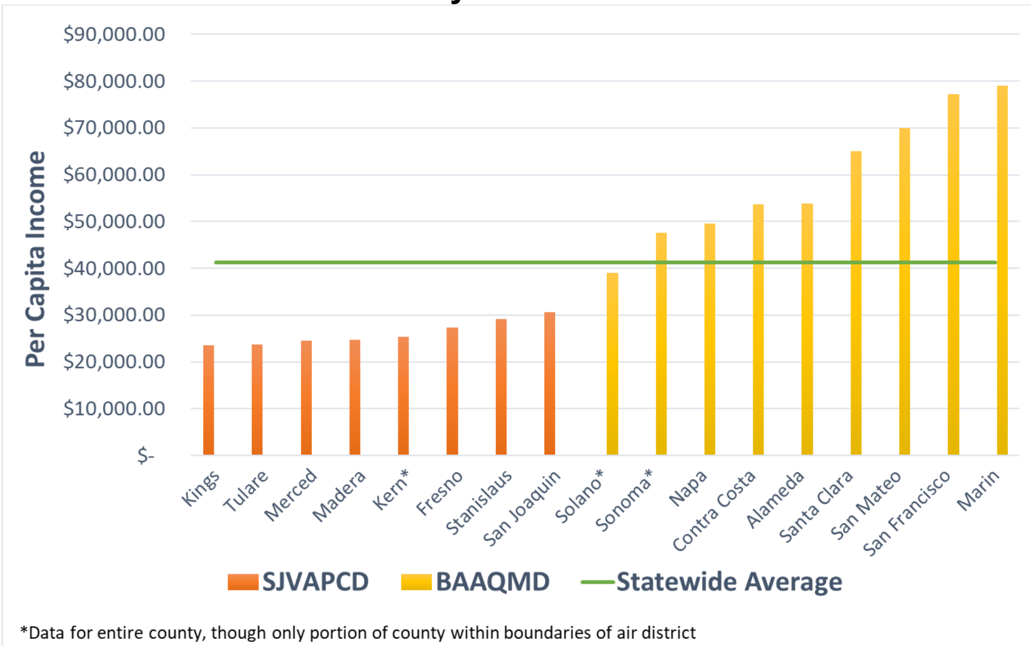
Figure C-3 Per Capita Income (in 2021 dollars), 2017-2021 for Cities and Counties with Building Electrification Ordinances



Through their rulemaking process, Bay Area evaluated the economic feasibility of these regulations under conditions specific to their region. Notably, the average income of Bay Area counties compared to that of Valley counties closely resembles the comparison made above to the cities and counties with building electrification ordinances (many of which fall within BAAQMD boundaries). According to recent U.S. Census Bureau estimates,[188] the per capita income in District counties averaged $26,114.38, while Bay Area counties averaged a per capita income of $59,443.67. Moreover, all eight counties within the District's jurisdiction fall under the average per capita income in California, and well below that of the nine counties within BAAQMD (Figure C-4). This disparity in income is an important consideration when comparing the feasibility of requiring zero-emission appliances in the Bay Area with that in the District, and demonstrates that economic feasibility in the Bay Area does not directly imply that a similar measure would be economically feasible to implement in the Valley within the same timeframe.

[188] U.S. Census Bureau. *Quick Facts*. Retrieved from: https://www.census.gov/quickfacts/fact/table/US/PST045222

Figure C-4 Per Capita Income (in 2021 dollars), 2017-2021 for San Joaquin Valley APCD and Bay Area AQMD Counties



CARB's *2022 Scoping Plan*[189] identifies costs and cost-savings of building decarbonization, which vary by end use and whether it is undertaken in new construction or in existing buildings. As part of this evaluation, CARB considered appliance and equipment capital costs, energy costs, new construction and retrofit costs, and the implications of such costs on low-income and disadvantaged communities. While CARB found that electric alternatives to gas appliances are becoming increasingly cost-competitive, their overall cost evaluation demonstrated that additional retrofit expenses and higher energy costs will place a disproportionate burden on lower-income households. As stated in the document, due to the higher upfront costs and financial challenges, low-income customers are less likely to adopt electric appliances first. Furthermore, as households begin to transition away from using fossil gas, "*those remaining on the fossil gas system are likely to pay an increasingly larger share of system wide costs, which could further widen the affordability gap between households that are able to decarbonize early and those that are not*."

Given the potential significant impacts to low-income residents, careful equity considerations must be taken into account as new measures are developed. The District must cautiously consider the specific economic challenges that exist in the Valley that may create significant barriers to adoption of a zero-emission standard for residential water heaters sooner than CARB's proposed measure.

[189] CARB. *2022 Scoping Plan for Achieving Carbon Neutrality*, *Appendix F: Building Decarbonization.* December 15, 2022. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-appendix-f-building-decarbonization.pdf

Existing District Commitments

In an effort to identify potential emission reduction opportunities, the District's *2022 Ozone Plan* includes a further study commitment to evaluate current and upcoming work from CARB and other agencies related to reducing emissions from residential and commercial combustion sources, and evaluate the feasibility of implementing zero-emission or low-NOx requirements for these sources in the Valley. Through this effort, the District will also evaluate opportunities to advocate for funding under the Inflation Reduction Act, Bipartisan Infrastructure Law, and other funding sources, which are prioritizing funding opportunities for electrification of appliances to reduce greenhouse gas emissions. The District will continue to closely track regulations being developed by CARB, South Coast AQMD, BAAQMD, and others. Additionally, although the District currently implements the most stringent measures feasible, the District remains committed to pursuing zero-emission opportunities, taking into consideration equitable and feasible strategies.

Evaluation Findings

Rule 4902 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

The District continues to support CARB in the development and implementation of a statewide zero-NOx appliances measure, as it will result in direct air quality and public health benefits for the Valley. Additionally, as part of this Plan, the District commits to further evaluating potential opportunities to reduce NOx emissions from natural gas building appliances in the Valley. As part of this evaluation, the District will consider the implementation of zero-NOx requirements earlier than CARB's statewide measure, to the extent that measures are technologically and economically feasible in the Valley. The District will collaborate with utilities, agencies, and organizations to help leverage funding and coordinate incentives with existing programs.

C.21 RULE 4905 (NATURAL GAS-FIRED, FAN-TYPE CENTRAL FURNACES)

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.28	0.29	0.29	0.29	0.29	0.29	0.29
NOx	3.45	3.39	3.11	2.84	2.58	2.41	2.32
	Winter Average - Tons per day						
PM2.5	0.35	0.37	0.37	0.37	0.37	0.37	0.37
NOx	4.37	4.30	3.94	3.60	3.26	3.05	2.94

District Rule 4905 Description

District Rule 4905 is a point of sale rule that applies to any person who sells, offers for sale, installs or solicits the installation of natural-gas-fired, fan-type central furnaces for use in the Valley with a rated heat input capacity of less than 175,000 Btu/hour, and for combination heating and cooling units with a rated cooling capacity of less than 65,000 Btu/hour. Adopted on October 20, 2005, Rule 4905 established NOx limits for residential central furnaces supplied, sold, or installed in the Valley. January 2015 amendments lowered the NOx emission limit for residential units from 40 ng/J (0.093 lb/MMBtu) to 14 ng/J, and expanded rule applicability to include commercial units with a NOx emission limit of 14 ng/J and units installed in manufactured homes with a NOx emission limit of 40 ng/J to be lowered to 14 ng/J in 2018. The amendments allowed for the sale of non-compliant units during an initial 36-month implementation period in exchange for the payment of an emissions fee for each non-compliant unit sold, distributed, or installed in the Valley. EPA approved these amendments into the SIP effective April 28, 2016.[190]

The District has subsequently amended District Rule 4905 several times to extend the implementation period for certain unit types as a response to the limited number of certified compliant units available by the compliance deadline dates. This allowed additional time necessary to continue technology development and the certification process, while providing strong incentive for accelerated deployment of compliant units.

The most common type of heating system for residential and commercial buildings are furnaces fueled by natural gas that use forced air distribution. A thermostat controls the central furnace, which sends a signal to turn the unit on or off when the building temperature does not match a chosen set point. A valve then opens to send natural gas to the burners, which combusts the gas directly into the heat exchangers. A blower pulls air from inside the building through a filter, across the heat exchanger, and through

[190] EPA. *Approval of California Air Plan Revisions, San Joaquin Valley Unified Air Pollution Control District and South Coast Air Quality Management District. Final Rule*. 81 FR 17390. (March 29, 2016). (Codified at 40 CFR Part 52). Retrieved from: https://www.gpo.gov/fdsys/pkg/FR-2016-03-29/pdf/2016-06962.pdf

a series of ducts and vents to different areas of the building. Exhaust from the combustion exits the building through a separate duct.

Condensing units use an additional heat exchanger to extract the latent heat in the flue (exhaust) gas by cooling the combustion gasses to near ambient temperature and thereby increase the heating efficiency by up to 10%. The water vapor in the flue gas is condensed, collected, and drained.

Units installed in manufactured homes use the same types of materials and operating principles as commercial and residential units; however, significant differences exist. Furnaces installed in manufactured homes use sealed combustion, pre-heat the air typically to 50-60°F, use a concentric vent, and exhaust gases are vented through the inside core of the vent pipe. Furnaces installed in manufactured homes also have to comply with strict space restrictions.[191]

Statewide Zero-Emission Standards for Building Appliances

CARB's *2022 State SIP Strategy* includes a commitment to develop and propose a zero-emissions standard for space and water heaters sold in the state to go into effect in 2030.[192] This goal is in alignment with California's climate strategy, which includes efforts towards building decarbonization, as laid out in CARB's *2022 Scoping Plan*.[193] CARB has committed to conduct an extensive investigation into this measure, develop a proposed rule through meaningful public engagement, and bring the proposed rule before their Board by 2025. Upon fulfilling these commitments, the State expects to experience significant air quality and public health benefits.

In the development of the *2022 State SIP Strategy* and the *2022 Scoping Plan*, CARB examined the many factors involved in the transition to zero-emission appliances, and outlined the necessary process ahead to achieve building decarbonization. CARB's *2022 Scoping Plan* details a number of aspects that must be considered before implementing zero-emission appliance standards, including technical feasibility, costs and affordability, and consumer acceptance, adoption, awareness, and readiness. Additionally, CARB acknowledged the concerted effort needed across all levels of government, utilities, appliance manufacturers, developers, contractors, households, and businesses to achieve this goal successfully and equitably across the state.

CARB began the public process for the development of zero-emission appliance standards with a public workshop on May 10, 2023.[194] The District continues to support

[191] U.S. Department of Energy. *Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnace Fans.* (July 7, 2014). Retrieved from: https://www.federalregister.gov/articles/2014/07/03/2014-15387/energy-conservation-program-for-consumer-products-energy-conservation-standards-for-residential

[192] CARB. *2022 State Strategy for the State Implementation Plan*, pp. 101-103. (September 22, 2022). Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf

[193] CARB. *2022 Scoping Plan for Achieving Carbon Neutrality*. (December 15, 2022). Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf

[194] CARB Zero-Emission Appliance Standards Webpage, Meetings & Workshops. Retrieved from: https://ww2.arb.ca.gov/our-work/programs/building-decarbonization/zero-emission-appliance-standards/meetings-workshops

CARB in the development and implementation of this measure, as it will result in direct air quality and public health benefits for the Valley.

Zero-Emission Requirements in Other Areas

Other air districts around the State are considering strategies that are similar to that adopted by CARB under the *2022 Scoping Plan* and *2022 State SIP Strategy*. For example, on March 15, 2023, Bay Area AQMD adopted zero-emission requirements for new residential and commercial furnaces and water heaters, with compliance dates ranging from 2027-2031, depending on unit type and size. Similarly, South Coast AQMD has committed to adopt the zero-emission standard developed by CARB for new space and water heaters in new constructions and equipment replacement by 2030 in their *2022 Air Quality Management Plan*, in addition to low-NOx and incentive-based strategies.[195]

Over 70 cities and counties in California have adopted local ordinances requiring varying degrees of electrification for new buildings. The first of these ordinances, passed in the City of Berkeley in August 2019, enacted a building code prohibiting natural gas piping into buildings. However, this ordinance was overturned on April 17, 2023, when the U.S. Ninth Circuit Court of Appeals issued a ruling that cities and states cannot ban natural gas hookups in new buildings, because such action is preempted by the U.S. Energy Policy Conservation Act, which "expressly preempts state and local regulations concerning the energy use of many natural gas appliances, including those used in household and restaurant kitchens." The City of Berkeley filed a petition for *en banc* review of this ruling on May 31, 2023, but the request was denied on January 2, 2024. The court held that the ban on natural gas was preempted by federal energy efficiency laws, setting precedent that blocks local government from using similar bans to combat climate change.[196] Following this ruling, a number of cities and counties with adopted natural gas bans have suspended enforcement of their ordinances.

How does District Rule 4905 compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

State Regulations

There are no state regulations applicable to this source category.

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[195] SCAQMD. *2022 Air Quality Management Plan*. (December 2, 2022). Retrieved from: http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/final-2022-aqmp.pdf?sfvrsn=10

[196] U.S. Courts for the Ninth Circuit. California Restaurant Association v. City of Berkeley. Retrieved from: https://www.ca9.uscourts.gov/cases-of-interest/california-restaurant-association-v-city-of-berkeley/

How does District Rule 4905 compare to rules in other air districts?

The District compared emission limits, optional control requirements, and work practice standards in District Rule 4905 to comparable requirements in rules from the following California nonattainment areas:

- Bay Area AQMD Regulation 9, Rule 4 (Amended March 15, 2023)[197]
- San Diego County APCD Rule 69.6 (Adopted June 17, 1998)[198]
- South Coast AQMD Rule 1111 (Amended September 1, 2023)[199]
- Ventura County APCD Rule 74.22 (Adopted November 9, 1993)[200]

Sacramento Metropolitan AQMD does not have an analogous rule for this source category.

The District reviewed rule requirements implemented prior to EPA's approval of BACM/MSM for the *2018 PM2.5 Plan*, and found that District Rule 4905 continues to implement requirements as stringent as or more stringent than these other areas. The District's evaluation of the more recently amended rules is demonstrated below.

Bay Area AQMD

- BAAQMD Regulation 9, Rule 4 (Nitrogen Oxides from Fan Type Residential Central Furnaces)

	SJVAPCD Rule 4905	BAAQMD Reg 9, Rule 4
Applicability	Residential and commercial furnaces with rated heat input capacity of <175,000 btu/hr or <65,000 btu/hr for combination heating and cooling units.	Any person who sells, installs, or offers for sale a natural gas-fired furnace and any manufacturer who intends to sell or distribute for sale or installation a natural gas-fired furnace, with rated heat input capacity of <175,000 btu/hr.
Exemptions	Natural gas furnace not exceeding NOx emissions of 40 ng/J and installed with propane conversion kit for propane firing only.	Furnaces used for mobile homes.

[197] BAAQMD. *Regulation 9, Rule 4 (Nitrogen Oxides from Fan Type Residential Central Furnaces).* (Amended December 7, 1983). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/documents/rg0904.pdf?la=en&rev=e67bf6e164d94de39b44caa30ce17fd7

[198] SDAPCD. *Rule 69.6 (Natural Gas-Fired Fan Type Central Furnaces).* (Adopted June 17, 1998). Retrieved from: https://www.sdapcd.org/content/dam/sdapcd/documents/rules/current-rules/Rule-69.6.pdf

[199] SCAQMD. *Rule 1111 (Reduction of NOx Emissions from Natural-Gas-Fired, Fan-Type Central Furnaces).* (Amended September 1, 2023). Retrieved from: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1111.pdf?sfvrsn=4

[200] VCAPCD. *Rule 74.22 (Natural Gas-Fired, Fan-Type Central Furnaces).* (Amended November 9, 1993). Retrieved from: http://www.vcapcd.org/Rulebook/Reg4/RULE%2074.22.pdf

	SJVAPCD Rule 4905	BAAQMD Reg 9, Rule 4
Requirements	Furnaces must not exceed a NOx limit of 14 ng/J.	A person shall not sell, install, or offer for sale any natural gas-fired fan type central furnace that emits more than: • 40 ng/J; • 14 ng/J for new units after Jan. 1, 2024; • 0.0 ng/J for new units after Jan. 1, 2029

Currently, applicable furnaces in the Bay Area are subject to the same 14 ng/J NOx limit as units subject to District Rule 4905. Recent amendments to BAAQMD Regulation 9, Rule 4 established a future zero-NOx standard for new furnaces that is set to begin in 2029. BAAQMD acknowledges that there are uncertainties in their proposed implementation timeline for zero-NOx requirements, and has stated that their governing board may choose to consider amending the compliance dates should it be later determined that sufficient zero-NOx technologies are not available.[201] The District is closely tracking BAAQMD's efforts.

South Coast AQMD

- SCAQMD Rule 1111 (Reduction of NOx Emissions from Natural-Gas-Fired, Fan-Type Central Furnaces)

	SJVAPCD Rule 4905	SCAQMD Rule 1111
Applicability	Residential and commercial furnaces with rated heat input capacity of <175,000 btu/hr or <65,000 btu/hr for combination heating and cooling units.	Residential and commercial furnaces with rated heat input capacity of <175,000 btu/hr or <65,000 btu/hr for combination heating and cooling units.
Exemptions	Natural gas furnace not exceeding NOx emissions of 40 ng/J and installed with propane conversion kit for propane firing only.	• Furnaces installed in mobile homes before Oct. 1, 2012 • Natural gas furnace installed with propane conversion kit for propane firing only • Downflow and large-sized (≥100,000 btu/hr) condensing and noncondensing furnaces, replacing existing furnaces in the high-altitude areas
Requirements	Furnaces must not exceed a NOx limit of 14 ng/J.	Furnaces must not exceed a NOx limit of 14 ng/J.

The District evaluated the requirements contained within SCAQMD Rule 1111 and found no requirements that were more stringent than those already in District Rule 4905. Therefore, District Rule 4905 is as stringent as or more stringent than SCAQMD Rule 1111.

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[201] BAAQMD. *Final Staff Report for the Proposed Amendments to Building Appliance Rules – Regulation 9, Rule 4: Nitrogen Oxides from Fan Type Residential Central Furnaces and Rule 6: Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters.* (March 2023). Retrieved from: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230307_fsr_rules0904and0906-pdf.pdf?la=en

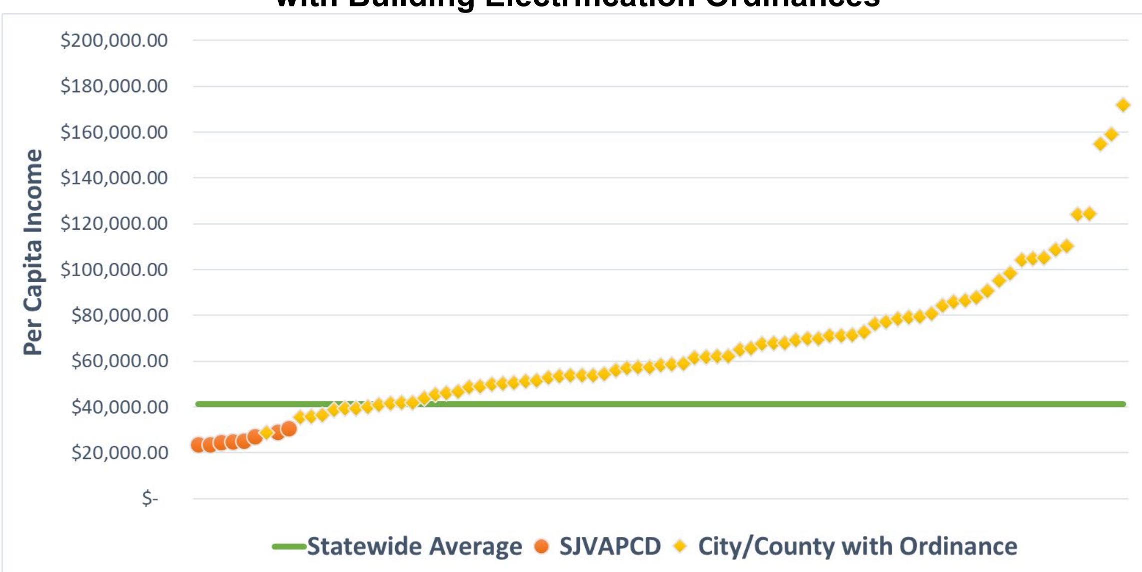
Potential Emission Reduction Opportunities

Zero-Emission Opportunities

While electric alternatives to natural gas-fired furnaces are currently available, feasibility and cost issues have previously prevented widespread electrification around the nation, particularly with respect to lower income households, given the significantly higher cost associated with electrical infrastructure and devices. As building electrification requirements pose potential significant impacts to low-income residents, careful equity considerations must be taken into account as new measures are developed. Though some areas in California have started implementing electrification requirements, given the number of region-specific factors that must be considered in adopting these requirements, it cannot be assumed that these policies are feasible for immediate implementation in all areas. Additionally, the Berkeley lawsuit, as discussed above, adds uncertainty to the implementation of electrification requirements.

The socioeconomic profiles of the cities and counties with building electrification requirements are vastly different from those found within the District. Based on recent U.S. Census Bureau estimates,[202] the per capita income for each District resident averaged $26,114 while cities and counties with building electrification ordinances averaged a per capita income of $68,845. The per capita income for each of the eight District counties and 76 cities and counties with building electrification ordinances is represented in Figure C-5 below, shown in comparison to the statewide average.

Figure C-5 Per Capita Income (in 2021 dollars), 2017-2021 for Cities and Counties with Building Electrification Ordinances

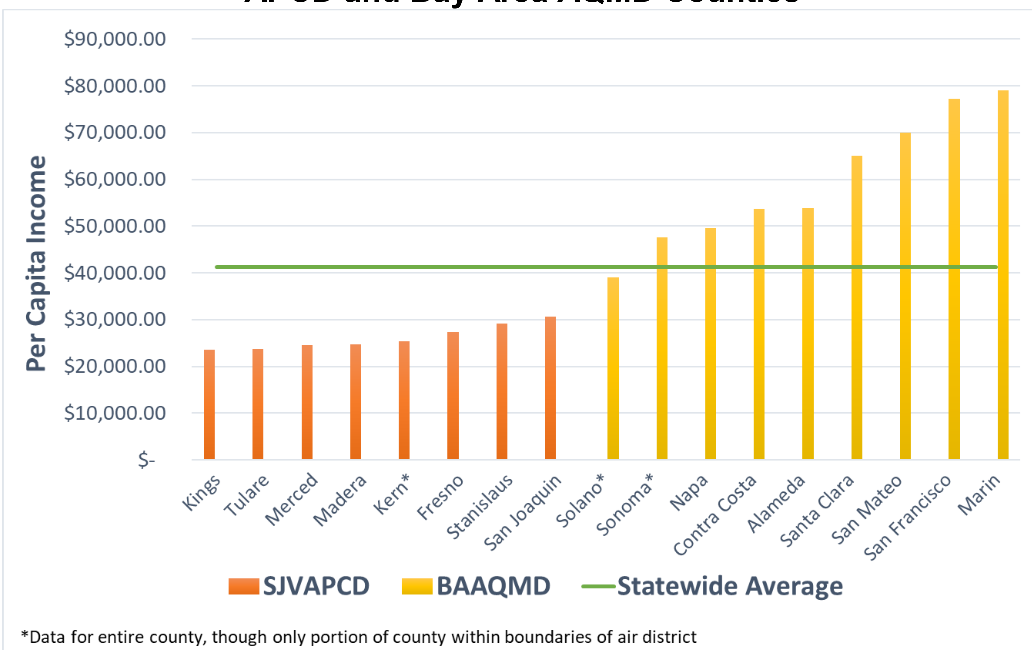


Through their rulemaking process, Bay Area evaluated the economic feasibility of these regulations under conditions specific to their region. Notably, the average income of Bay Area counties compared to that of Valley counties closely resembles the

202 U.S. Census Bureau. *Quick Facts*. Retrieved from: https://www.census.gov/quickfacts/fact/table/US/PST045222

comparison made above to the cities and counties with building electrification ordinances (many of which fall within BAAQMD boundaries). According to recent U.S. Census Bureau estimates,[203] the per capita income in District counties averaged $26,114.38, while Bay Area counties averaged a per capita income of $59,443.67. Moreover, all eight counties within the District's jurisdiction fall under the average per capita income in California, and well below that of the nine counties within BAAQMD (Figure C-6). This disparity in income is an important consideration when comparing the feasibility of requiring zero-emission appliances in the Bay Area with that in the District, and demonstrates that economic feasibility in the Bay Area does not directly imply that a similar measure would be economically feasible to implement in the Valley within the same timeframe.

Figure C-6 Per Capita Income (in 2021 dollars), 2017-2021 for San Joaquin Valley APCD and Bay Area AQMD Counties



CARB's *2022 Scoping Plan*[204] identifies costs and cost-savings of building decarbonization, which vary by end use and whether it is undertaken in new construction or in existing buildings. As part of this evaluation, CARB considered appliance and equipment capital costs, energy costs, new construction and retrofit costs, and the implications of such costs on low-income and disadvantaged communities. While CARB found that electric alternatives to gas appliances are becoming increasingly cost-competitive, their overall cost evaluation demonstrated that additional retrofit expenses and higher energy costs will place a disproportionate burden on lower-income households. As stated in the document, due to the higher upfront costs and financial challenges, low-income customers are less likely to adopt electric appliances first. Furthermore, as households begin to transition away from using fossil

[203] U.S. Census Bureau. *Quick Facts*. Retrieved from: https://www.census.gov/quickfacts/fact/table/US/PST045222
[204] CARB. *2022 Scoping Plan for Achieving Carbon Neutrality*, *Appendix F: Building Decarbonization.* December 15, 2022. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-appendix-f-building-decarbonization.pdf

gas, "*those remaining on the fossil gas system are likely to pay an increasingly larger share of system wide costs, which could further widen the affordability gap between households that are able to decarbonize early and those that are not*."

Given the potential significant impacts to low-income residents, careful equity considerations must be taken into account as new measures are developed. The District must cautiously consider the specific economic challenges that exist in the Valley that may create significant barriers to adoption of a zero-emission standard for residential furnaces sooner than CARB's proposed measure.

Existing District Commitments
In an effort to identify potential emission reduction opportunities, the District's *2022 Ozone Plan* includes a further study commitment to evaluate current and upcoming work from CARB and other agencies related to reducing emissions from residential and commercial combustion sources, and evaluate the feasibility of implementing zero-emission or low-NOx requirements for these sources in the Valley. Through this effort, the District will also evaluate opportunities to advocate for funding under the Inflation Reduction Act, Bipartisan Infrastructure Law, and other funding sources, which are prioritizing funding opportunities for electrification of appliances to reduce greenhouse gas emissions. The District will continue to closely track regulations being developed by CARB, South Coast AQMD, BAAQMD, and others. Additionally, although the District currently implements the most stringent measures feasible, the District remains committed to pursuing zero-emission opportunities, taking into consideration equitable and feasible strategies.

Evaluation Findings

Rule 4905 provides for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

The District continues to support CARB in the development and implementation of a statewide zero-NOx appliances measure, as it will result in direct air quality and public health benefits for the Valley. Additionally, as part of this Plan, the District commits to further evaluating potential opportunities to reduce NOx emissions from natural gas building appliances in the Valley. As part of this evaluation, the District will consider the implementation of zero-NOx requirements earlier than CARB's statewide measure, to the extent that measures are technologically and economically feasible in the Valley. The District will collaborate with utilities, agencies, and organizations to help leverage funding and coordinate incentives with existing programs.

C.22 REGULATION VIII (FUGITIVE PM10 PROHIBITIONS)

Emissions Inventory

Rule 8021: Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	1.32	1.44	1.54	1.74	1.65	2.84	1.82
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	1.21	1.32	1.42	1.59	1.51	2.60	1.66
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Rule 8031: Bulk Materials

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.03	0.03	0.03	0.03	0.03	0.03	0.03
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.03	0.03	0.03	0.03	0.03	0.03	0.03
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Rule 8041: Carryout and Trackout

The emissions from this source category are included in the inventory for Rule 8061 (Paved and Unpaved Roads).

Rule 8051: Open Areas

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.34	0.34	0.34	0.34	0.34	0.34	0.34
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.21	0.21	0.21	0.21	0.21	0.21	0.21
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Rule 8061: Paved and Unpaved Roads

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	6.68	6.82	7.00	7.20	7.40	7.50	7.54
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	5.80	5.93	6.10	6.29	6.48	6.58	6.62
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Rule 8071: Unpaved Vehicle/Equipment Traffic Areas

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.59	0.59	0.58	0.58	0.58	0.57	0.57
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.60	0.60	0.59	0.59	0.59	0.58	0.58
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Rule 8081: Agricultural Sources

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	1.18	1.17	1.16	1.15	1.14	1.14	1.14
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.73	0.72	0.72	0.71	0.71	0.70	0.70
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Rule Descriptions

The District's Regulation VIII series (Fugitive PM10 Prohibitions) was adopted in November 2001, and subsequently amended in 2004. This rule series contains a comprehensive suite of rules designed to reduce fugitive PM10 emissions from a range of sources, as further described below:

Rule 8011: General Requirements
The provisions of Rule 8011 are applicable to specified outdoor fugitive dust sources. The definitions, exemptions, general requirements, administrative requirements, recordkeeping requirements, and test methods set forth in this rule are applicable to all rules under District Regulation VIII. The rules were developed pursuant to EPA guidelines for serious PM10 nonattainment areas. In 2004, the District adopted

amendments to Regulation VIII to upgrade existing RACM level rules to meet the more stringent BACM level required in serious PM10 nonattainment areas.

Rule 8021: Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities
Rule 8021 applies to construction or demolition related disturbances of soil, including land clearing, grubbing, scraping, excavation, extraction, land leveling, grading, cut and fill operations, travel on the site, travel access roads to and from the site, and demolition activities. The rule also applies to construction of new landfill disposal sites or modifications to existing landfill disposal sites prior to commencement of landfilling activities. In 2004, Rule 8021 was amended to add dust suppression requirements, and to require submittal of Dust Control Plans on residential construction sites 10.0 acres or more in size and on non-residential construction sites 5.0 acres or more in size.

Rule 8031: Bulk Materials
Rule 8031 applies to the outside storage and handling of any unpackaged material, which emits or has the potential to emit dust when stored or handled. Rule 8031 requires bulk handling and storage facilities to restrict dust from material transfer, and reduce emissions from transport material and storage piles that emit dust. Facilities subject to Rule 8031 are required to use control measures to ensure that visible dust emissions (VDE) are limited to 20% opacity or less. These control measures can include application of water or other dust stabilizers, covering of bulk materials, construction of wind barriers, covering of haul trucks, and other measures. In 2004, Rule 8031 was amended to require the construction and maintenance of wind barriers when handling bulk materials.

Rule 8041: Carryout and Trackout
Rule 8041 applies to the prevention and cleanup of mud and dirt whenever it is deposited (carryout and trackout) onto public paved roads from activities subject to the requirements of Rules 8021, 8031, 8061, and 8071. The rule contains requirements for: removing carryout and trackout at the end of each workday; carryout and trackout thresholds for any site with 150 or more daily vehicle trips; addressing carryout and trackout in Dust Control Plans; removing carryout and trackout in urban areas; paved interior roads; and prevention of carryout and trackout. Rule 8041 was amended in 2004 to require a threshold for vehicles with three or more axles to takes actions for carryout and trackout. Amendments included a threshold for projects located in rural areas, a provision requiring actions within half an hour if specified measures are insufficient to prevent carryout and trackout, and specifications for dust collectors, gravel pads, and paved surfaces.

Rule 8051: Open Areas
Rule 8051 applies to any open area 0.5 acres or more within urban areas, or 3.0 acres or more within rural areas that contains at least 1,000 square feet of disturbed surface area. The rule has requirements for limiting VDE to 20% opacity, to comply with the conditions of a stabilized surface, and to install barriers to prevent unauthorized vehicles from accessing the stabilized areas. Rule 8051 was amended in 2004 to add applicability thresholds for rural and urban areas.

Rule 8061: Paved and Unpaved Roads
Rule 8061 establishes standards for the construction of new and modified paved roads in accordance with published guidelines by the American Association of State Highway and Transportation Officials for road construction, and applies to any paved, unpaved, or modified public or private road, street highway, freeway, alley way, access drive, access easement, or driveway. The rule also allows alternative means of achieving the same level of dust reduction. Rule 8061 establishes thresholds that, when exceeded, require roads to be treated to reduce VDE. Rule 8061 was amended in 2004 to replace the existing 75 maximum vehicle daily trip (VDT) threshold with a 26 annual average daily trips (AADT) threshold on unpaved roads, and to require that all new roads within urban areas be paved.

Rule 8071: Unpaved Vehicle/Equipment Traffic Areas
Rule 8071 is applicable to unpaved vehicle and equipment areas, including parking, fueling, service, shipping, receiving, and transfer areas. The rule contains requirements for when vehicle traffic reaches or exceeds specified thresholds, limitations on VDE, compliance requirements with the conditions of a stabilized surface, and lists control techniques, which could be implemented to limit VDE and to comply with the conditions of a stabilized surface. Rule 8071 was amended in 2004 to: remove the 1.0 acre or larger threshold; change the vehicle threshold from 75 VDT to 50 AADT; add a single day peak threshold of 150 VDT or require control for sources that exceed the 150 VDT threshold limit on at least 30 days per year; and add a requirement specific to whenever 25 or more three-axle vehicle trips occur on an unpaved vehicle/equipment traffic area.

Rule 8081: Agricultural Sources
Rule 8081 applies to “off-field” agricultural sources including, but not limited to, unpaved roads, unpaved vehicle and equipment traffic areas, and bulk materials. The rule contains requirements to limit VDE and/or to comply with the conditions of a stabilized surface, and lists control techniques that could be implemented to limit VDE and to comply with the conditions of a stabilized surface. Rule 8081 was amended in 2004 to: add an exemption to the rule for vehicle and equipment traffic areas if they are less than one acre in size and more than one mile from an urban area; expand rule applicability by updating the vehicle threshold from 75 VDT to 50 annual average vehicle trips; and add a requirement specific to whenever 26 or more three-axle vehicle trips will occur on an unpaved vehicle and equipment traffic area.

How does District Regulation VIII compare with federal and state rules and regulations?

Federal Regulations
There are no Control Techniques Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category. The following federal regulations apply to sources covered under Regulation VIII:

- *Rule 57 FR 13498 – General Preamble for Title I of CAA*

The District evaluated the requirements contained within the General Preamble and found no requirements that were more stringent than those already in Regulation VIII.

- *Fugitive Dust Background Document and Technical Information Document for BACM* (EPA-450/2-92-004 1992/09)

The District evaluated the requirements contained within the Fugitive Dust Background Document and Technical Information Document for BACM and found no requirements that were more stringent than those already in Regulation VIII.

State Regulations

There are no state regulations applicable to this source category.

How does District Regulation VIII compare to rules in other air districts?

Bay Area AQMD does not have an analogous rule for this source category.

SCAQMD
- Rule 1156 (Further Reductions of Particulate Emissions from Cement Manufacturing Facilities) (*Last amended November 6, 2015*)

The District evaluated the requirements contained within SCAQMD Rule 1156 and found that overall Regulation VIII is as stringent as or more stringent than Rule 1156.

- Rule 1157 (PM10 Emission Reductions form Aggregate and Related Operations) (*Last amended September 8, 2006*)

The District evaluated the requirements contained within SCAQMD Rule 1157 and found that overall Regulation VIII is as stringent as or more stringent than Rule 1157.

SMAQMD
- Rule 403 (Fugitive Dust) (*Last amended August 3, 1977*)

The District evaluated the requirements contained within SMAQMD Rule 403 and found that overall Regulation VIII is as stringent as or more stringent than Rule 403.

VCAPCD
- Rule 55 (Fugitive Dust) (*Adopted June 10, 2008*)

The District evaluated the requirements contained within VCAPCD Rule 55 and found that overall Regulation VIII is as stringent as or more stringent than Rule 55.

Clark County Department of Environment and Sustainability (CCDES)

- Section 41 (Fugitive Dust) (*Last amended January 21, 2020*)

The District evaluated the requirements contained within CCDES Section 41 and found that overall Regulation VIII is as stringent as or more stringent than Section 41.

- Section 91 (Fugitive Dust from Unpaved Roads, Unpaved Alleys, and Unpaved Easement Roads) (*Last amended April 15, 2014*)

The District evaluated the requirements contained within CCDES Section 91 and found that overall Regulation VIII is as stringent as or more stringent than Section 91.

- Section 92 (Fugitive Dust from Unpaved Parking Lots and Storage Areas) (*Last amended August 3, 2021*)

The District evaluated the requirements contained within CCDES Section 92 and found that overall Regulation VIII is as stringent as or more stringent than Section 92.

- Section 93 (Fugitive Dust from Paved Roads and Street Sweeping Equipment) (*Last amended January 21, 2020*)

The District evaluated the requirements contained within CCDES Section 93 and found that overall Regulation VIII is as stringent as or more stringent than Section 93.

- Section 94 (Permitting and Dust Control for Construction and Temporary Commercial Activities) (*Last amended August 3, 2021*)

The District evaluated the requirements contained within CCDES Section 94 and found that overall Regulation VIII is as stringent as or more stringent than Section 94.

Great Basin APCD Rule 433 (Control of Particulate Emissions at Owens Lake)

- Section 41 (Fugitive Dust) (*Adopted April 13, 2016*)

The District evaluated the requirements contained within Great Basin APCD Rule 433 and found that overall Regulation VIII is as stringent as or more stringent than Rule 433.

Potential Emission Reduction Opportunities

While District Regulation VIII was critical in the District's attainment of the PM10 standards, a variety of studies have been conducted which indicate that the PM2.5 fraction of the PM emissions from this source category may not be as significant as the PM coarse fraction. A better quantification of the PM2.5 fraction is required to develop a more accurate emissions inventory for the various activities under Rule 8021 and to indicate the level of significance of those PM2.5 emissions. Modeling results show that the geologic fraction of PM2.5 found in the Valley makes a relatively small contribution to overall PM2.5 mass.

As demonstrated above, Regulation VIII currently employs the best dust mitigation techniques. The District did not identify any additional emission reduction opportunities at this time.

Evaluation Findings

The District's Regulation VIII rules provide for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore meets or exceeds BACM and MSM requirements.

C.23 ALMOND PROCESSING

Emissions Inventory

	2017	2019	2022	2025	2028	2030	2031
	Annual Average - Tons per day						
PM2.5	0.47	0.47	0.47	0.50	0.52	0.54	0.55
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter Average - Tons per day						
PM2.5	0.22	0.22	0.22	0.23	0.24	0.25	0.25
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Description and Efforts to Date

The San Joaquin Valley is one of the largest agricultural producing regions in the nation, and the sole producer of 99% of the U.S. almond and walnut supply. In the early 2000s, there was a large transition to farming of nut crops due to market conditions. In 2012, there were a total of approximately 750,000 bearing acres of almond in the Valley, and by 2022, almonds were California's #1 crop by acreage with 7,600 farms containing over 1.3 million bearing acres.

The harvesting of almonds includes three processes: shaking, sweeping (and drying), and picking up the nuts in a harvester that separates the almonds from dirt and debris. After harvesting, almonds are transported to processing facilities, where they are hulled and shelled, leaving the nut, or meat. Processes for removing the debris and almond hulls and shells are potential sources of air emissions, primarily particulate matter due to dust generation from the movement of trash, hulls, shells, and meats. The quantity of PM emissions varies depending on the type of facility, harvest method, trash content, climate, production rate, and the type and number of controls used by the facility. Due to shifting industry practices, almond processing facilities are becoming less inclined to accept material containing debris, and therefore emissions from processing are expected to be lower than in the past.

Emission control systems at almond post-harvest processing facilities include both ventilation systems to capture the dust generated during handling and processing of almonds, shells, and hulls, and an air pollution control device to collect the captured PM. Practices of combining and controlling specific exhaust streams from various operations vary considerably among facilities. The exhaust stream from a single operation may be split and ducted to two or more control devices. Conversely, exhaust streams from several operations may be combined and ducted to a single control device. For decades, the District has required BACT with 99% of control for almond processing, hulling, and shelling facilities in the Valley. This can be achieved through deploying a combination of baghouses, fabric filters, cyclones, and sock filters. Through this ongoing regulatory control effort, the vast majority of almond processing, hulling, and shelling facilities are equipped with baghouse fabric filter or equivalent dust collection technologies.

How do District requirements for almond processing compare with federal and state rules and regulations?

Federal Regulations

There are no Control Techniques Guidelines, Alternative Control Techniques, or New Source Performance Standards applicable to this source category.

State Regulations

There are no state regulations applicable to this source category.

How do District requirements for almond processing compare to rules in other air districts?

Bay Area AQMD, Sacramento Metropolitan AQMD, South Coast AQMD, and Ventura County APCD do not have specific rules for this source category.

Potential Emission Reduction Opportunities

The District did not identify any additional emission reduction opportunities for this source category beyond the requirements already imposed through BACT.

Evaluation Findings

District requirements for almond processing provide for the maximum degree of emission reduction that has been required or achieved from this source category in any other attainment plans or in practice in any other states that can feasibly be implemented in the Valley, and therefore the District meets or exceeds BACM and MSM requirements for this source category.

C.24 RULE 9510 (INDIRECT SOURCE REVIEW)

The District's Indirect Source Review (ISR) rule was originally adopted in 2005, and later amended in 2017, to reduce the growth in both NOx and PM10 emissions from mobile and area sources associated with construction and operation of new industrial, commercial, residential, transit and other non-residential development projects in the Valley. The rule was the first of its kind in the nation that applies to new residential and non-residential development projects.

The ISR rule applies to any applicant that seeks to gain final discretionary approval for a development project, or any portions thereof, which upon full build-out will include any one of the following:

- 50 residential units
- 2,000 square feet of commercial space
- 9,000 square feet of educational space
- 10,000 square feet of government space
- 20,000 square feet of medical or recreational space
- 25,000 square feet of light industrial space (warehouse)
- 39,000 square feet of general office space
- 100,000 square feet of heavy industrial space (warehouse)
- 9,000 square feet of any land use not identified above

Additionally, the Indirect Source Review rule applies to any applicant that seeks to gain approval from a public agency for a large development project, which upon full build out will include any of the following:

- 250 residential units
- 10, 000 square feet of commercial space
- 45,000 square feet of educational space
- 50,000 square feet of governmental space
- 100,000 square feet of medical office or recreational space
- 125,000 square feet of light industrial space (warehouse)
- 195,000 square feet of general office space
- 500,000 square feet of heavy industrial space (warehouse)
- 45,000 of square feet of space not identified above

In addition to the above, a transit or transportation development project is subject to the Indirect Source Review rule if construction exhaust emissions equal or exceed two (2.0) tons of NOx or two (2.0) tons of PM10.

New development projects create air pollution during construction and operation by prompting more vehicle trips and other pollution-causing activities. To address the rule requirements and achieve emissions reductions at the project site and within local communities, developers incorporate clean air measures into their project designs to reduce emissions impacts at project locations. Some examples include: use of clean, newer model-year off-road construction equipment, zero-emission and or near-zero emission heavy duty on-road trucks and van fleets, zero and or near-zero emission on-site equipment, installation of electric vehicle charging infrastructure, solar power, installation of bike paths and sidewalks, and high-efficiency buildings.

If on-site clean air measures implemented by a developer do not achieve the emission reductions mandated by the ISR rule, the developer must pay an off-site mitigation fee for balance of the emission reductions required for the project. One hundred percent of off-site mitigation fees are used by the District to fund emission reduction projects through its incentive grant programs. Additionally, developers pay an administrative fee equal to four percent (4%) of the required off-site fees. This administrative fee is to cover the District's cost of administering the off-site emission reduction projects through the District's grants and incentives programs.

A significant improvement has occurred in the design of development projects in the Valley through the incorporation of features that result in reduced emissions. The use of clean air project design elements that reduce the vehicle miles travelled associated with a project, operational measures such as the use of clean trucking fleets, and construction measures such as the use of clean construction fleets, have resulted in more than 20,800 tons of NOx and PM10 reductions over the life of the program. In addition, off-site mitigation fees collected under ISR have generated more than 7,000 tons of NOx and PM10 reductions through the investment of approximately $60 million dollars towards local emission reduction projects utilizing the District's incentive programs.

In May 2021, SCAQMD replicated the District's success in the development of their own ISR rule, utilizing the District's experience and regulatory language to help guide their efforts. SCAQMD Rule 2305 applies to both the operators and owners of new and existing warehouses greater than or equal to 100,000 square feet in size, and targets exhaust emission from mobile sources. Implementation of this rule will require warehouses to be phased in over a 3-year period based on their size.

The general approach of the SCAQMD warehouse ISR rule is similar to the District's ISR rule in that it requires clean air project design elements to reduce NOx and particulate emissions, and payment of a mitigation fee, if necessary, to achieve remaining rule requirements. It differs in that it applies to operational mobile source emissions from existing and new warehouses only, whereas, the District's ISR rule applies to both construction and operational mobile and area source emissions from various new residential, commercial, industrial, transportation, and other development projects, including warehouses. The District will continue to evaluate potential opportunities for future enhancements of the District's ISR rule, including reviewing the early implementation of the SCAQMD warehouse ISR rule.

C.25 EMISSION INVENTORY CODE (EIC) TABLE

Control Measure	Emission Inventory Codes
Rule 4103 (Open Burning)	670-660-0262-0000; 670-660-0262-9842; 670-660-0262-9856; 670-660-0262-9862; 670-660-0262-9874; 670-660-0262-9884; 670-660-0262-9888; 670-660-0262-9892; 670-662-0262-0000; 670-662-0262-9866; 670-662-0262-9878; 670-662-0262-9882; 670-668-0200-9858; 670-668-0200-9872; 670-668-0200-9886; 670-995-0240-9848; 670-995-0240-9852; 670-995-0240-9854; 670-995-0240-9868
Rule 4104 (Reduction of Animal Matter)	420-995-6004-0000
Rule 4106 (Prescribed Burning and Hazard Reduction Burning)	670-664-0200-0000; 670-666-0200-0000; 670-668-0200-0000; 670-668-0200-9894; 670-670-0200-0000
Rule 4203 (Particulate Matter Emissions from Incineration of Combustible Refuse)	There is no specific emissions inventory associated with Rule 4203.
Rule 4204 (Cotton Gins)	420-418-6028-0000; 420-420-6028-0000
Rule 4301 (Fuel Burning Equipment)	There is no specific emissions inventory associated with Rule 4301.
Rule 4307 (Boilers, Steam Generators, and Process Heaters - 2.0 to 5.0 MMBtu/hr)	010-005-0110-0000; 010-005-0124-0000; 010-005-0130-0000; 010-005-0300-0000; 010-005-1220-0000; 010-005-1530-0000; 010-010-0110-0000; 020-005-0110-0000; 030-005-0110-0000; 030-005-0122-0000; 030-005-0124-0000; 030-005-0130-0000; 030-005-1220-0000; 030-005-1530-0000; 030-010-0100-0000; 030-010-0110-0000; 030-010-0130-0000; 030-010-1220-0000; 030-010-1500-0000; 030-010-1600-0000; 030-015-0110-0000; 030-015-0130-0000; 030-015-1500-0000; 040-005-0110-0000; 040-005-0124-0000; 040-005-0130-0000; 040-005-1530-0000; 040-010-0100-0000; 040-010-0110-0000; 040-010-0120-0000; 040-010-0130-0000; 040-010-1000-0000; 050-005-0110-0000; 050-005-0122-0000; 050-005-0124-0000; 050-005-0130-0000; 050-005-0300-0000; 050-005-1100-0000; 050-005-1220-0000; 050-005-1510-0000; 050-005-1520-0000; 050-005-1530-0000; 050-005-3220-0000; 050-010-0110-0000; 050-010-0120-0000; 050-010-0130-0000; 050-010-0320-0000; 050-010-1220-0000; 050-010-1224-0000; 052-005-0110-0000; 052-005-0122-0000; 052-005-0124-0000; 052-005-0130-0000; 052-005-0320-0000; 052-005-1100-0000; 052-005-1220-0000; 052-005-1510-0000; 052-005-1520-0000; 052-005-1530-0000; 052-010-0110-0000; 052-010-0120-0000; 052-010-1224-0000; 052-010-1500-0000; 060-005-0110-0000; 060-005-0122-0000; 060-005-0124-0000; 060-005-0130-0000; 060-005-0142-0000; 060-005-0144-0000; 060-005-1220-0000; 060-005-1510-0000; 060-005-1520-0000; 060-005-1530-0000; 060-010-0100-0000; 060-010-0110-0000; 060-010-0120-0000; 060-010-0142-0000; 060-010-1220-0000; 060-010-1500-0000 The EICs are the same for Rules 4306/4320, 4307, and 4308; the three rules share a combined emission inventory.

Control Measure	Emission Inventory Codes
Rule 4308 (Boilers, Steam Generators, and Process Heaters - 0.075 to less than 2.0 MMBtu/hr)	The EICs are the same for Rules 4306/4320, 4307, and 4308; the three rules share a combined emission inventory. See Rule 4307 for the EICs.
Rule 4309 (Dryers, Dehydrators, and Ovens)	050-012-0110-0000; 050-012-0120-0000; 052-012-0110-0000; 060-012-0110-0000; 060-012-0120-0000; 310-333-0100-0000; 430-422-7078-0000; 430-424-7000-0000; 430-424-7006-0000; 430-995-7000-0000; 499-995-0000-0000; 499-995-5630-0000
Rule 4311 (Flares)	110-132-0110-0000; 110-132-0130-0000; 110-132-0136-0000; 110-132-0146-0000; 120-132-0136-0000; 130-132-0110-0000; 130-132-0130-0000; 130-132-0136-0000; 140-130-0010-0000; 310-320-0010-0000; 310-320-0110-0000; 310-320-0120-0000; 310-320-0130-0000; 310-320-0136-0000; 320-320-0010-0000; 320-320-0110-0000; 320-320-0120-0000; 320-320-0130-0000; 330-320-0010-0000
Rule 4313 (Lime Kilns)	Lime kilns are not included in the CARB emissions inventory. There are no lime kilns currently operating in the Valley.
Rule 4306/4320 (Boilers, Steam Generators, and Process Heaters greater than 5.0 MMBtu/hr)	The EICs are the same for Rules 4306/4320, 4307, and 4308; the three rules share a combined emission inventory. See Rule 4307 for the EICs.
Rule 4352 (Solid Fuel Fired Boilers, Steam Generators, and Process Heaters)	010-005-0214-0000; 010-005-0218-0000; 010-005-0220-0000; 010-005-0240-0000; 010-005-0243-0000; 010-005-0254-0000; 020-005-0214-0000; 020-005-0218-0000; 020-005-0220-0000; 020-005-0230-0000; 030-005-0214-0000; 050-005-0214-0000; 050-005-0254-0000; 052-005-0212-0000; 052-005-0240-0000; 052-005-0254-0000; 060-005-0240-0000; 060-005-0243-0000; 060-005-0250-0000; 060-005-0264-0000
Rule 4354 (Glass Melting Furnaces)	410-403-5018-0012; 460-460-7025-0000; 460-460-7037-0000; 460-460-7038-0000; 460-460-7039-0000
Rule 4550 (Conservation Management Practices)	620-614-5400-0000; 620-615-5400-0000; 650-650-5400-0000; 650-651-5400-0000
Rule 4692 (Commercial Charbroiling)	690-680-6000-0000
Rule 4702 (Internal Combustion Engines)	010-040-0110-0000; 010-040-0142-0000; 010-040-1100-0000; 010-040-1200-0000; 020-040-0110-0000; 020-040-1200-0000; 030-040-0110-0000; 030-040-0124-0000; 030-040-0130-0000; 030-040-1100-0000; 030-040-1200-0000; 030-040-1210-0000; 030-040-1600-0000; 040-040-0110-0000; 050-040-0012-0000; 050-040-0110-0000; 050-040-0120-0000; 050-040-0122-0000; 050-040-0124-0000; 050-040-1100-0000; 050-040-1200-0000; 050-040-1210-0000; 050-040-1299-0000; 050-040-3220-0000; 052-040-0110-0000; 052-040-0124-0000; 052-040-0146-0000; 052-040-1100-0000; 052-040-1200-0000; 052-042-0110-0000; 052-042-1200-0000; 052-042-1200-0010; 052-042-1200-0011; 060-040-0012-0000; 060-040-0110-0000; 060-040-0120-0000; 060-040-0122-0000; 060-040-0124-0000; 060-040-0130-0000; 060-040-0142-0000; 060-040-0146-0000; 060-040-1100-0000; 060-040-1200-0000; 060-040-1210-0000; 060-995-1220-0000; 099-040-0136-0000; 099-040-1200-0000
Rule 4703 (Stationary Gas Turbines)	010-045-0110-0000; 010-045-0112-0000; 010-045-1200-0000; 020-045-0110-0000; 020-045-1200-0000; 030-045-0110-0000; 030-045-0130-0000; 030-045-1200-0000; 040-045-0134-0000; 040-045-1412-0000; 050-045-0110-0000; 050-045-1200-0000; 050-045-1299-0000;

Control Measure	Emission Inventory Codes
	052-045-0110-0000; 052-045-0146-0000; 052-045-1200-0000; 060-045-0012-0000; 060-045-0110-0000; 060-045-0146-0000; 060-045-1200-0000; 060-045-1400-0000; 060-045-1412-0000; 060-045-1420-0000; 060-045-1450-0000
Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters)	610-600-0230-0000; 610-602-0230-0000
Rule 4902 (Residential Water Heaters)	610-608-0110-0000
Rule 4905 (Natural Gas-Fired, Fan-Type Central Furnaces)	060-020-0110-0000; 610-606-0110-0000
Rule 8011 (General Requirements)	There is no specific emissions inventory associated with Rule 8011.
Rule 8021 (Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities)	430-426-7006-0000; 630-622-5400-0000; 630-624-5400-0000; 630-626-5400-0000; 630-628-5400-0000; 630-634-5400-0000
Rule 8031 (Bulk Materials)	410-436-5800-0000; 430-436-7006-0000; 430-436-7016-0000; 430-436-7018-0000; 430-436-7078-0000; 430-995-7006-0000; 430-995-7012-0000; 430-995-7016-0000; 430-995-7018-0000; 430-995-7050-0000; 430-995-7064-0000; 430-995-7072-0000
Rule 8041 (Carryout and Trackout)	The EICs are included in Rule 8061 (Paved and Unpaved Roads).
Rule 8051 (Open Areas)	650-652-5400-0000
Rule 8061 (Paved and Unpaved Roads)	640-635-5400-0000; 640-637-5400-0000; 640-639-5400-0000; 640-641-5400-0000; 640-643-5400-0000; 645-638-5400-0000; 645-640-5400-0000; 645-644-5400-0000; 645-648-5400-0000
Rule 8071 (Unpaved Vehicle/Equipment Traffic Areas)	645-645-5400-0000; 645-647-5400-0000. The CARB Emissions Inventory database does not contain emissions data on unpaved vehicle and equipment traffic areas.
Rule 8081 (Agricultural Sources)	645-646-5400-0000
Almond Processing	420-418-6003-0000

Appendix D
STATE CONTROL MEASURE EVALUATIONS

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Appendix D: State Control Measure Evaluations

[This section provided by the California Air Resources Board]

EXECUTIVE SUMMARY

The Clean Air Act (the Act) specifies required levels of emission controls in a State Implementation Plan (SIP), depending upon the severity of the air quality problem and amount of time in which a nonattainment area needs to meet the PM2.5 standard. The State has conducted this analysis for each State-regulated source category emitting direct PM2.5 and relevant precursors in the San Joaquin Valley (SJV or Valley). The suite of control measures that is currently being implemented by California Air Resources Board (CARB or Board) satisfies the applicable Most Stringent Measures (MSM) control requirements for the 12 $\mu g/m^3$ annual PM2.5 standard for the Valley. This analysis finds that California's mobile source control program is the most stringent and far-reaching suite of mobile source control measures that is currently implemented in the nation meeting the required levels of emissions controls. Furthermore, California has committed to adopting numerous new measures for mobile sources as well as setting a zero-emission standard for residential and commercial space and water heaters, which go beyond MSM requirements and will be the most stringent of any state regulation for each applicable category in the U.S., and exceed the stringency of federal requirements.

In conducting this analysis, CARB staff followed a four-step process of assessing California's control program. First, CARB staff identified mobile source and residential and commercial building appliance emissions as a significant contributor to ambient PM2.5 levels. Next, CARB staff identified potential control measures for each mobile source sector and the appliance sector, including an analysis of California's control program, other control measures in practice throughout the nation, control measures suggested by the public, and reconsideration of control measures that were previously considered to be infeasible (as applicable). Staff then assessed the stringency and feasibility of the potential control measures that were identified. And finally, while many of the measures identified in this analysis have already been adopted by CARB and submitted in the California SIP, additional control measures have been included in the 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy)[1] and will be commitments in the Valley's upcoming SIP for the 12 $\mu g/m^3$ annual PM2.5 standard. CARB's current control programs are already the most stringent in the country and thus meet MSM requirements; all 2022 State SIP Strategy measure commitments go beyond MSM requirements.

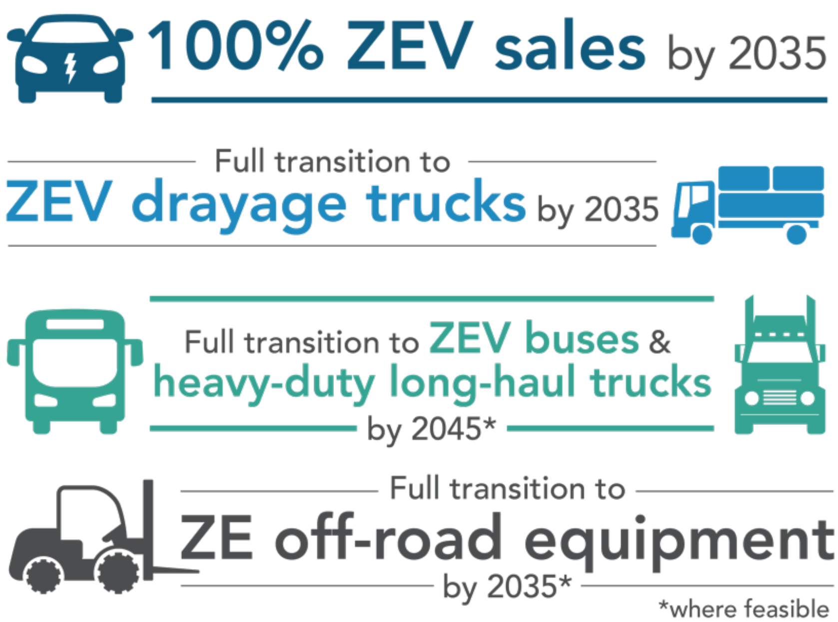
Given the severity of California's air quality challenges and the need for ongoing emission reductions, CARB has implemented the most comprehensive mobile source emissions control program in the nation. In aggregate, California's comprehensive suite of new vehicle and engine emission standards, in-use control measures, fuel

[1] 2022 State SIP Strategy https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy

specifications, and incentive programs for mobile sources represent the most stringent level of controls in the nation, and achieve the maximum feasible emission reductions for this category. CARB's comprehensive program relies on five fundamental approaches:

- Stringent emissions standards that minimize emissions from new vehicles and equipment;
- In-use programs that target the existing fleet and require the use of the cleanest vehicles and emissions control technologies;
- Cleaner fuels that minimize emissions during combustion;
- Incentive programs that remove older, dirtier vehicles and equipment and replace those vehicles with the cleanest technologies; and,
- Driving to zero-emissions for engines and powertrains where feasible, in accordance with the Governor's Executive Order N-79-20[2].

Figure D-1 Transition from Combustion



This multi-faceted approach has spurred the development of increasingly cleaner technologies and fuels, and achieved significant emission reductions across all mobile source sectors that go far beyond national programs or programs in other states. These efforts extend back to the first mobile source regulations adopted in the 1960s, and

[2] California Executive Order N-79-20 https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf

predate the Act of 1970, which established the basic national framework for controlling air pollution. In recognition of the pioneering nature of CARB's efforts, the Act provides California unique authority to regulate mobile sources more stringently than the federal government by providing a waiver of preemption for its new vehicle emission standards for on-road vehicles and engines under Section 209(b), and authorizations for new off-road emission standards under Section 209(e)(2). These waiver and authorization provisions preserve a pivotal role for California in the control of emissions from new motor vehicles and engines, recognizing that California serves as a laboratory for setting mobile source emission standards. Since then, CARB has consistently sought and obtained waivers and authorizations for its new motor vehicle and off-road regulations. CARB's history of progressively strengthening standards as technology advances, coupled with the waiver and authorization process requirements, ensures that California's regulations remain the most stringent in the nation.

In 1998, CARB identified diesel particulate matter as a toxic air contaminant. Since then, CARB adopted numerous regulations aimed at reducing exposure to diesel particulate matter while concurrently providing reductions in oxides of nitrogen (NOx) from freight transport sources like heavy-duty diesel trucks, transportation sources like passenger cars and buses, and off-road sources like large construction equipment. Phased implementation of these regulations will continue to produce emission reduction benefits through 2030 and beyond, as the regulated fleets are retrofitted, and as older and dirtier portions of the fleets are replaced with newer and cleaner models at an accelerated pace.

Further, CARB and District staff work closely on identifying and distributing incentive funds to accelerate cleanup of vehicles and engines. Key incentive programs include the Low Carbon Transportation, Air Quality Improvement Program, VW Mitigation Trust, Community Air Protection, Carl Moyer Program, Goods Movement Program, Clean Off-Road Equipment (CORE) and Funding Agricultural Replacement Measures for Emission Reductions (FARMER). These incentive-based programs work in tandem with regulations to accelerate deployment of cleaner technology.

California's programs are the most stringent in the nation for each category CARB regulates:

- California's control measures for the passenger vehicle fleet includes new vehicle emission standards, fuel specifications, and the most rigorous in-use inspection program for on-road light-and medium-duty vehicles in the country. The suite of on-road light-duty vehicle control measures included in the Valley's plan is anticipated to achieve the maximum feasible emission reductions possible, and is comprised of the most stringent level of control measures for this category in the nation.

- California's heavy-duty on-road vehicle and engine control program is comprised of the most stringent emission standards for new engines in the nation (i.e., new vehicle tailpipe emission and evaporative emission standards; certification, testing, and verification requirements; warranty and useful life requirements, and OBD system requirements). Additionally, to reduce in-use emissions and accelerate fleet turnover to cleaner engines, California's in-use control measures include, in aggregate, the most stringent inspection and maintenance program, idling requirements, and legacy fleet requirements for on-road heavy-duty fleets in the nation. Finally, California's clean diesel regulations provide the most stringent emission controls in the nation for conventional and renewable diesel fuels and diesel substitute fuels. The suite of on-road heavy-duty control measures that will be included in the Valley's plan is anticipated to achieve the maximum feasible emission reductions possible, and is comprised of the most stringent level of control measures for this category in the nation.

- California's off-road engine and equipment control program includes the most stringent emission standards for new engines in the nation, comprehensive in-use fleet requirements to address emissions from the legacy fleets, and the cleanest off-road diesel fuel specifications in the nation. California's in-use control measures are national models for aggressive and successful efforts to reduce in-use emissions and accelerate fleet turnover to cleaner engines. In aggregate, the suite of off-road mobile source control measures that will be included in the Valley's plan is anticipated to achieve the maximum feasible emission reductions possible, and is comprised of the most stringent level of control measures for this category in the nation.

- California's space and water heaters will include the most stringent emission standards of any state in the nation. For the first time, CARB will be setting an emission standard for space heaters and water heaters, to go into effect in 2030. CARB would adopt a statewide zero greenhouse gas (GHG) emission standard, which would have criteria pollutant co-benefits. Beginning in 2030, 100 percent of sales of new space heaters and water heaters would need to comply with the emission standard. Because no other state in the country has such a requirement, this emission standard would go beyond MSM requirements and would be the most stringent level of control measures for this category of any state in the nation.

D.1 SECTION I. CLEAN AIR ACT REQUIREMENTS FOR EMISSION CONTROL MEASURES

The particulate matter provisions in the Act establish a step-wise process for classifications and attainment dates:

- The first step is a Moderate area SIP, with an initial attainment date six years after the area is designated nonattainment;
- If attainment within six years is impracticable given the severity of the PM2.5 challenge in that area, then U.S. EPA re-classifies the area to Serious, and establishes requirements for a second SIP submittal that must show attainment within 10 years after the area was originally designated nonattainment.
- If the Serious area cannot show attainment within 10 years, the state can request an additional five-year extension if most stringent measures are in place and the State has met their obligations for the standard.

Likewise, the Act specifies a step-wise process for the required level of emission controls in a SIP, depending upon the severity of the air quality problem and amount of time a nonattainment area needs to meet the PM2.5 standard:

- For a Moderate nonattainment area, the required level of control is Reasonably Available Control Measures (RACM).[3]
- For a Serious PM2.5 nonattainment area, Best Available Control Measure (BACM) is the required level of control. U.S. EPA defines BACM to be the maximum degree of emission reductions achievable from a source or source category determined on a case-by-case basis considering energy, economic, and environmental impacts.[4]
- For a Serious PM2.5 nonattainment area for which air quality modeling demonstrates that the area cannot practicably attain by the end of the tenth calendar year (i.e. designated as "Serious with Extension"), MSM is the required level of control.[5] U.S. EPA defines MSM as, "the maximum degree of emission reductions that has been required or achieved from a source or source category in any other attainment plans or in practice in any other states and that can feasibly be implemented in the area."[6] MSM is also inclusive of BACM requirements.
- For a Serious PM2.5 nonattainment area that has not attained by the applicable attainment date (i.e., designated as "Serious – 5% Plan"), the required level of control is also MSM.[7]

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[3] RACM requirements are addressed in the Moderate SIP for the Valley. For further information see https://ww2.arb.ca.gov/our-work/programs/california-state-implementation-plans/nonattainment-area-plans/san-joaquin-valley

[4] U.S. EPA 1994 Addendum to the General Preamble p. 42010

[5] 40 CFR 51.1010(b)(2)(i)

[6] See U.S. EPA "Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements" pp. 326 July 2016 https://www.epa.gov/sites/production/files/2016-07/documents/pm25-naaqs-implementation-final-preamble-rule-signature.pdf

[7] 40 CFR 51.1003(c)(2)(i)

The Valley is a Serious nonattainment area for its upcoming SIP for the 12 µg/m^3 annual PM2.5 standard discussed in this plan and will include an extension beyond ten years.

REQUIRED STRINGENCY OF CONTROL MEASURES

Based on the Valley's current classification for 12 µg/m^3 annual PM2.5 standard, Table D-1 describes the level of control measures required. The Valley's control measures for this plan must satisfy U.S. EPA's increasingly stringent Most Stringent Measures (MSM) requirements.

Table D-1 Stringency of Control Measures Required[8]

Standard	Classification	Type of Plan	Control Measure Requirements
12 µg/m3 Annual (2012 Standard)	Serious with Extension	Most Stringent Measures (MSM)	**Most Stringent Measures** "The state shall identify, adopt, and implement the most stringent control measures that… can be feasibly implemented in the area." 40 CFR 51.1010(b)

DEFINING MOST STRINGENT MEASURES

MSM is the level of stringency required for the 2012 Annual Standards of 12 µg/m^3. The Act defines MSM as, "any permanent and enforceable control measure that achieves the most stringent emissions reductions in direct PM2.5 emissions and/or emissions of PM2.5 plan precursors from among those control measures which are either included in the SIP for any other National Ambient Air Quality Standard (NAAQS), or have been achieved in practice in any state, and that can feasibly be implemented in the relevant PM2.5 NAAQS nonattainment area."[9]

U.S. EPA guidance indicates that MSM is inclusive of the requirements and process for determining BACM.[10] The Act defines BACM as, "any technologically and economically feasible control measure that can be implemented in whole or in part within four years after the date of reclassification of a Moderate PM2.5 nonattainment area to Serious and that generally can achieve greater permanent and enforceable emissions reductions in direct PM2.5 emissions and/or emissions of PM2.5 plan precursors from

[8] The Valley's SIP has been developed to provide the necessary elements for the for the 12 µg/m3 Annual PM2.5 Standard, for which the Valley is classified as nonattainment. This appendix has been developed to meet a subset of these requirements; namely the requirement that staff demonstrate that the control strategies for the Valley's SIP for the 12 µg/m3 Annual PM2.5 Standard satisfy U.S. EPA's requirements for Serious area plan control strategy requirements, as set forth in § 51.1010, for the source categories of: mobile sources, and residential and commercial building appliances.
[9] Code of Federal Regulations (CFR) Title 40 – Protection of Environment § 51.1000 – Definitions https://www.gpo.gov/fdsys/pkg/CFR-2017-title40-vol2/xml/CFR-2017-title40-vol2-sec51-1000.xml
[10] U.S. EPA 2001 *Final TSD for Maricopa County PM10 Nonattainment Area*. Available at https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf

sources in the area than can be achieved through the implementation of RACM on the same source."[11] U.S. EPA has further clarified that BACM-level of controls are:[12]

- The maximum degree of emissions reductions achievable from a source or source category, which is determined on a case-by-case basis considering energy, economic and environmental impacts;
- More stringent than RACM, but less stringent than the lowest achievable emission rate (LAER), which doesn't take into consideration the cost effectiveness of implementing a particular control measure;
- Additive to RACM, as BACM will generally consist of a more extensive implementation of RACM measures; and
- Inclusive of Best Available Control Technology (BACT).

U.S. EPA defines BACT similarly to BACM as an emission limitation based on the, "maximum degree of reduction of each pollutant emitted from or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems, and techniques." [13] BACT is also at least as stringent as new source performance standards (NSPS) and national emissions standards for hazardous air pollutants (NESHAPs)[14]

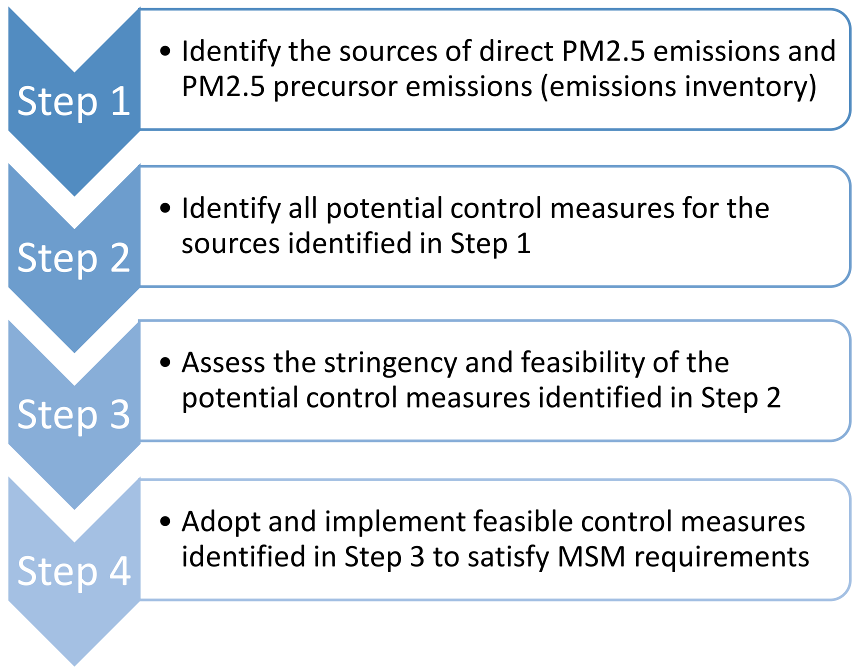
MSM is inclusive of the requirements for BACM, but with an additional step, comparing the potential MSMs identified against the measures already adopted in the area to determine if the existing measures are the most stringent.[15] Furthermore, U.S. EPA guidance defined MSM as "the maximum degree of emission reduction that has been required or achieved from a source or source category in any other attainment plans or in practice in any other states and that can feasibly be implemented in the area seeking the extension, such as what LAER represents for new or modified sources under the New Source Review permit program."[16]

[11] Code of Federal Regulations (CFR) Title 40 – Protection of Environment § 51.1000 – Definitions https://www.gpo.gov/fdsys/pkg/CFR-2017-title40-vol2/xml/CFR-2017-title40-vol2-sec51-1000.xml
[12] U.S. EPA 1994 "Addendum to the General Preamble" pp. 42009 -42013
[13] 42 U.S. Code § 7479 – Definitions https://www.gpo.gov/fdsys/pkg/USCODE-2011-title42/html/USCODE-2011-title42-chap85-subchapI-partC-subparti-sec7479.htm See § 7479(3) BACT
[14] U.S. EPA 1994 "Addendum to the General Preamble" pp. 42009 -42013
[15] U.S. EPA 2001 *Final TSD for Maricopa County PM10 Nonattainment Area*. Available at https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf
[16] U.S. EPA 1994. *Addendum to the General Preamble*, 59 FR 41998 page 42010

D.2 SECTION II. PROCESS FOR DETERMINING MSM

U.S. EPA prescribes a four-step process for the identification and determination of whether the control measures satisfy the Serious area plan control strategy requirements.

Figure D-2 Process for Determining MSM



The process for identifying MSM generally follow the same steps as the process for identifying BACM.[17] This is because the Serious area plan control strategy requirements described in § 51.1010 are additive as the plans become more stringent. That is to say, the MSM requirements are inclusive of the requirements for BACM, with additional requirements added to reflect the increased stringency in control levels that result from a bump-up in classification.[18]

This process starts with identifying the sources of PM2.5 emissions (both direct and precursor emissions); then expands the analysis in Step 2 to identify all potential control measures that would reduce emissions. Step 3 begins to narrow the scope of analysis by refining the list of all potential control measures to determine which of the control measures are sufficiently stringent to meet the applicable MSM requirements, and to identify which are technically and economically feasible. The final step to adopt any control measures identified through this process, if they are feasible to implement in the Valley.

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[17] In accordance with U.S. EPA's prescribed process described in the *TSD for the Maricopa County Serious Area PM10 Plan – 24-Hour Standard* (U.S. EPA 2001), which states, "Given this similarity between the BACM requirement and the MSM requirement, we believe that determining MSM should follow a process similar to determining BACM, but with one additional step, to compare the potentially most stringent measure against the measures already adopted in the area to determine if the existing measures are most stringent." Document is available at: https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf

[18] § 51.1003(b)(2)(iii) requires that a submittal requesting a Serious area attainment date extension that is simultaneous with the Serious area attainment plan shall meet the most stringent measure (MSM) requirements set forth at § 51.1010(b), in addition to the BACM and BACT and additional feasible measure requirements set forth at § 51.1010(a)". For more details, see the Serious area attainment plan control strategy requirements identified in 40 CFR § 51.1010(a)(5), § 51.1010(b)(5), and § 51.1010(c)(5)

Table D-2 delves more deeply into this process, showing each required element in the steps listed above for both of the applicable PM2.5 Standards.

Table D-2 MSM Requirements

Standard	12 µg/m³ Annual PM2.5 Standard (2012)
Classification	Serious with Extension
Control Strategy	MSM
Step 1: Identify sources of direct PM2.5 and precursor emissions (emissions inventory)	Required "The state shall identify all sources of direct PM2.5 emissions and sources of emissions of PM2.5 precursors in the nonattainment area in accordance with the emissions inventory requirements…" § 51.1010(b)(1)
Step 2: Identify all potential control measures	Required "The State shall identify all potential control measures to reduce emissions from all sources of direct PM2.5 emissions and sources of emissions of PM2.5 plan precursors" § 51.1010(b)(2)
Step 2(a): Begin with the area's current control measures	Recommended[19] "A state… should be able to start its process using the work already undertaken for the nonattainment area's RACM and BACM demonstrations and to make updates to the list of potential control measures"
Step 2(b): Survey other states and nonattainment areas for additional potential control measures	Required "The state shall identify the most stringent measures for reducing direct PM2.5 and PM2.5 plan precursors adopted into any SIP or used in practice to control emissions in any state" § 51.1010(b)(2)(i)
Step 2(c): Reconsider and reassess any measures previously rejected	Required "The state shall reconsider and reassess any measures previously rejected by the state during the development of any previous Moderate area or Serious area attainment plan control strategy" § 51.1010(b)(2)(ii)
Step 3: Assess potential control measures' stringency and feasibility	Required
Step 3(a): Evaluate stringency	Required MSM control levels required
Step 3(b): Assess technological and economic feasibility	Required "The state may make a demonstration that a measure identified… is not technologically or economically feasible to implement in whole or in part by 5 years after the applicable attainment date for the area, and may eliminate such whole or partial measure from further consideration" § 51.1010(b)(3) Assess the technological and economic feasibility of public measure suggestions submitted to CARB as potential control measures
Step 4: If found to be economically and technologically feasible, adopt control measures	Required "The state shall identify, adopt, and implement the most stringent control measures that are included in the attainment plan for any state or are achieved in practice in any state, and can be feasibly implemented in the area" § 51.1010(b)

[19] See U.S. EPA "Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements" July 2016 https://www.epa.gov/sites/production/files/2016-07/documents/pm25-naaqs-implementation-final-preamble-rule-signature.pdf

D.2.1 Step 1: Source Category Emissions of Direct PM2.5 and NOx

The first step required in the MSM evaluation process is to identify and quantify the sources of PM2.5, including direct PM2.5 emissions and emissions of precursor pollutants.

In the Valley, air quality measurements and modeling have shown that emissions from mobile sources – cars, trucks, and a myriad of off-road equipment – are a significant contributor to ambient PM2.5 levels. Overall, mobile sources contribute to approximately 40 to 50 percent of the particles that make up PM2.5 in the Valley. These contributions come through both directly emitted PM2.5 and gaseous precursors such as NOx, the key precursor to atmospheric formation of PM2.5 in the Valley. CARB modeling demonstrated that VOC, ammonia, and SOX do not contribute significantly to ambient PM2.5 levels exceeding the NAAQS.

Residential and commercial buildings in California are the source of about 66 tpd NOx statewide due to natural gas combustion.[20] Nearly 90 percent of building NOx emissions are due to space and water heating, with the remaining 10 percent attributable to cooking, clothes drying, and other miscellaneous end uses. Space and water heating comprise nearly 90 percent of all building-related natural gas demand. Buildings also contribute to approximately 25 percent of California's GHG emissions when accounting for fossil fuels consumed onsite and through electricity demand as well as refrigerants used in air conditioning systems and refrigerators. The fuels we use and burn in buildings, primarily natural gas, for space and water heating contribute significantly to building-related criteria pollutant and GHG emissions, and provide an opportunity for substantial emissions reductions where zero-emission technology is available.

D.2.2 Steps 2 and 3: Identification and Evaluation of Potential MSM Control Measures

The second and third steps required in the MSM evaluation process have been grouped together in this chapter so that the control measures for each sector can be more cohesively identified and evaluated.

STEP 2: IDENTIFICATION OF POTENTIAL MSM CONTROL MEASURES

Step 2 calls for the identification of all possible control measures for each of the sources of PM2.5 and NOx identified in Step 1.[21] To satisfy the Act's MSM requirements, this is a three-part process.

[20] CARB's Criteria Emission Inventory CEPAM: 2019 Version - Standard Emission Too

[21] In a departure from previous SIP guidance, EPA guidance indicates that are no *de minimis* source categories for this plan. Thus, emissions of direct PM2.5 and PM2.5 precursors (i.e. NOx) from all mobile source categories must be controlled in the Valley, and meet the applicable MSM requirements. See U.S. EPA April 2016 "SIP Requirements Rule" 81 FR 58010 https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

Step 2(a): California's Control Measures

The identification of all potential control measures begins with an analysis of California's control program. Due in part to the severity of its air quality needs, and in part to unique authority provided under the Act, California's mobile source controls go far beyond other states' and even national programs, and thus provides an excellent starting place in identifying a comprehensive range of mobile source control measures, as required by the Act. This approach also aligns with U.S. EPA guidance, which suggests starting the identification process with any controls previously identified in prior Moderate or Serious SIPs for the nonattainment area.[22]

Step 2(b): Other States' and Nonattainment Areas' Control Measures

The second component required to identify all potential MSM control measures is the identification of any additional control measures used in other states or nonattainment areas, and an assessment of their stringency relative to the control measures in the Valley's proposed SIP.[23, 24] The purpose is to identify whether there are additional potential MSM control measures used to control mobile emissions of direct PM2.5 and/or NOx in other states or nonattainment areas that are more stringent than the measures included in the Valley's SIP. If this assessment finds that there are more stringent measures in use elsewhere – and if they are found to be sufficiently stringent and technically and economically feasible to implement in the Valley (see Step 3) – the Act requires that any such measures are adopted and implemented in the Valley's plan (see Step 4), in order to meet the requirements that the area, "attain the standard as expeditiously as practicable."[25]

Identification

U.S. EPA guidance provides recommendations for possible resources to assist in the search for other control measures used in other states or nonattainment areas, including:[26]

- Other states' control programs (including those measures identified in U.S. EPA's list of national, state and/or local air quality agencies' control measures);[27]
- U.S. EPA's "Menu of Control Measures" for PM2.5; [28] and
- U.S. EPA's mobile-specific control measures for PM2.5.[29]

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[22] U.S. EPA "Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements" July 2016
[23] § 51.1010(a)(2)(i), § 51.1010(b)(2)(i), and § 51.1010(c)(2)(i)
[24] U.S. EPA "Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements" July 2016
[25] § 51.1010(b)(4) and § 51.1004(a)(3)
[26] U.S. EPA April 2016 "SIP Requirements Rule" 81 FR 58010 https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf
[27] U.S. EPA https://www.epa.gov/pm-pollution/epa-summaries-and-reports-several-state-and-local-pm-control-measures. Accessed April 24, 2018
[28] U.S. EPA 2016 "*Menu of Control Options*" Accessed April 2018 at https://www.epa.gov/air-quality-implementation-plans/menu-control-measures-naaqs-implementation
[29] U.S. EPA https://www.epa.gov/advance/control-measures-programs-pm. Accessed April 24, 2018

Beyond these suggested resources, CARB staff has also taken additional steps to identify any additional control measures currently in use in jurisdictions outside of California. This process included inquiries to U.S. EPA staff in Region 9, as well as inquiries to CARB technical staff that are engaged in developing control strategies across a wide range of sources throughout the agency, including passenger vehicles, heavy-duty trucks and buses, off-road equipment, and fuels. Furthermore, CARB staff has performed internet searches of other jurisdictions' control measures to ensure that our research process for this appendix identifies any control programs that have been more recently developed and which therefore may not otherwise be reflected in the abovementioned resources specified by U.S. EPA.

Assessment

In order to identify the most stringent suite of control measures currently, "adopted into any SIP or used in practice to control emissions in any state,"[30] CARB staff has identified in the tables included in Section IV Step 2(b) the most stringent suite of control measures in the nation, for each source category. Staff has assessed the relative stringency of measures based on the efficiency of a given measure or control technology to reduce the level of emissions from that source category – for example, by comparing the technical capacity for a given control measure to reduce in-use emissions from the on-road heavy-truck fleet, relative to other potential control measures that target the same emission source(s) for reductions. This assessment demonstrates that, for each source category, the suite of control measures included in the Valley's proposed SIP are, in aggregate, the most stringent that are in use in any state or adopted into any SIP and in many cases go beyond MSM requirements.

Step 2(c): Reconsideration and reassessment of any control measures previously rejected as infeasible

The final component required to identify all potential MSM control measures is to reconsider and reassess any control measures proposed in prior Moderate or Serious SIPs for the Valley that were previously rejected as infeasible.[31]

CARB staff reviewed all previous Valley PM2.5 SIPs[32] and found that we did not identify any mobile source control measures as infeasible in previous Moderate or Serious attainment plan control strategies for the Valley.

During the public process for the 2022 State SIP Strategy, community-based organizations and members of the public suggested additional control measures that CARB could develop. CARB also solicited additional public measure suggestions during the public process for the development of the 12 μg/m^3 SIP for the San Joaquin Valley,

[30] Per MSM requirements in 40 CFR § 51.1010(b)(2)(i) and § 51.1010(c)(2)(i), which call for the identification of the most stringent suite of control measures in any state or nonattainment area.
[31] Identification of any control measures that were previously rejected as infeasible in prior Moderate or Serious SIPs for the area is a requirement for MSM, not BACM. See 40 CFR § 51.1010(b)(2)(ii) and § 51.1010(c)(2)(ii)
[32] See CARB's list of San Joaquin Valley Air Quality Management Plans at https://www.arb.ca.gov/planning/sip/planarea/sanjqnvllysip.htm

including at public workshops held on March 23, 2023, and on May 11, 2023, but did not receive additional suggestions to add to those previously identified during the 2022 State SIP Strategy process. Some of the public member suggestions have been integrated into measures committed to in the 2022 State SIP Strategy, while CARB staff is exploring the feasibility of a few remaining suggestions. The public measure suggestions, and any applicable resultant measures within the 2022 State SIP Strategy, are discussed below, and discussed in more detail in Section IV, Step 3(b): Evaluation of Feasibility, for each relevant source category.

Light-Duty Public Measure Suggestions:

- Enhanced Transportation Choices
  CARB staff is continuing to explore this suggested measure and how it can meet the Act requirements for SIP measure approvability.

- Enhanced Bureau of Automotive Repair Consumer Assistance Program
  CARB staff is continuing to explore this suggested measure and how it can meet the Act requirements for SIP measure approvability.

- Light-Duty Vehicle Fleet Regulation
  CARB staff is continuing to explore this suggested measure. CARB staff anticipate that the recently adopted Advanced Clean Cars II regulation, along with existing CARB regulations and current State incentive programs, achieve a significant amount of the benefits that this suggested measure would accomplish.

Medium- and Heavy-Duty Public Measure Suggestions:

- On-Road Heavy-Duty Vehicle Useful Life Regulation
  CARB staff has developed the Zero-Emission Trucks measure in response to receiving this public measure suggestion.

- Additional Incentive Programs: Zero-Emission Trucks
  CARB staff has developed the Zero-Emission Trucks measure in response to receiving this public measure suggestion.

Facility-Based Public Measure Suggestion:

- Indirect Source Rule
  CARB staff has been investigating the feasibility and potential benefits of this suggested measure, and is continuing to explore this suggested measure and how it can meet the Act requirements for SIP measure approvability. Nonetheless, CARB staff have included an Indirect Source Rule as one potential element of the Zero-Emission Trucks measure.

Commercial and Residential Building Appliances Public Measure Suggestion:

- Additional Building Emission Standards
  CARB staff has developed the Zero Emission Standard for Space and Water Heaters measure in response to receiving this public measure suggestion.

Other Public Measure Suggestions:

In addition to the above-described public measure suggestions for source categories included in this analysis, CARB also received additional public measure suggestions for categories that are not included in the scope of this analysis. This includes public measure suggestions for stationary sources (the BACT/BARCT Determination public measure suggestion) and for pesticides (the Pesticide Regulation public measure suggestion). The Pesticide Regulation public measure was developed into a measure for the 2022 State SIP Strategy, but which is not described in this analysis because ROG emissions are not a significant precursor emission to PM formation in the Valley.

STEP 3: EVALUATION OF STRINGENCY AND FEASIBILITY

While the focus of Step 2 is on expanding the scope of analysis to ensure that all possible control measures are identified and incorporated into a list of potential MSM control measures, Step 3 focuses on narrowing that list to identify and discard from further consideration any measures that do not satisfy the applicable requirements for stringency and feasibility. Step 3 therefore calls for an evaluation of each of the potential MSM control measures identified in Step 2, in order to evaluate first whether they satisfy the required level of stringency of each control measure; and secondly, whether they are technically and economically feasible to implement in the Valley.

Step 3(a): Evaluating Stringency

For a potential control measure to meet the definition of MSM, CARB staff must demonstrate that the measure satisfies stringency requirements in terms of both:

(i) the efficiency of a given measure or control technology to reduce the level of emissions from a specific mobile source, relative to emission controls in place in other states and nonattainment areas; and
(ii) the timing of when each control measure will begin to be implemented, relative to each plan's timing milestones and deadlines.

The Act defines feasibility in terms of both technological and economic feasibility. For the purposes of this analysis of control measures, the Act defines technological feasibility as, "factors including but not limited to a source's processes and operating procedures, raw materials, physical plant layout, and potential environmental impacts such as increased water pollution, waste disposal, and energy requirements."[33] Economic feasibility considerations include capital costs, operating and maintenance

[33] 40 CFR § 51.1010(a)(3)(i)

costs, and cost effectiveness of the measure.[34] Much of the assessment required to evaluate the efficiency of the level of control provided by a given control measure or technology is included in Step 2(b), wherein CARB staff analyzes the control measures in the Valley's plan relative to those in other states and nonattainment areas.

The assessment of stringency also includes elements of timing, particularly regarding when a control measure will be implemented. U.S. EPA states that MSM should be implemented, "as expeditiously as practicable".[35] In its proposed disapproval of the San Joaquin Valley's Serious plan for the 2012 12 μg/m^3 annual PM2.5 standards,[36] U.S. EPA also clarified the requirement for the analyses of the potential control measures, stating that the analysis should include a determination of the earliest date by which a control measure or technology can be implemented in whole or in part. For the PM2.5 standard discussed in this plan, Table D-3 summarizes the required levels of control measures, and the required timeframe for implementation in order to meet the definition of MSM.

Table D-3 Implementation and Timing Requirements for MSM

Standard	12 μg/m^3 Annual PM2.5 Standard (2012)
Classification Status	Serious with Extension
Type of Plan Required	MSM
Control Measure Requirements	MSM
Definition of MSM (regarding timing)	MSM: implemented in whole or in part by 5 years after the applicable attainment date for the area[37]
Attainment deadline	2030
Timeframe for Implementation	MSM if implemented ≤ 2035

Comparing the Stringency of the Valley's Plan to the Current Control Program

The final step called for in U.S. EPA's process to demonstrate that the suite of control measures included in the Valley's plan satisfy the stringency definition for MSM is to compare the measures included in the Valley's plan against the measures already adopted in the Valley's SIP to determine if the existing control measures alone are more stringent.[38] CARB staff has compared the current control program to the control measures included in the Valley's plan, and has found that:

- The suite of control measures in the Valley's 12 μg/m^3 PM2.5 annual SIP include all of the potential MSM measures identified through the processes described above, including measures in the current control program, and new measure commitments that go beyond MSM requirements.

[34] 40 CFR § 51.1010(a)(3)(ii)
[35] U.S. EPA, 2001 *Final TSD for Maricopa County PM10 Nonattainment Area* (page 31). Available at https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf
[36] 87 FR 60494
[37] 40 CFR § 51.1010(b)(3)
[38] U.S. EPA's 2001 *Final TSD for Maricopa County PM10 Nonattainment Area* see page 32. Available at https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf

- The suite of control measures in the Valley's proposed SIP is more stringent than the existing control program alone because the plan encompasses both the existing suite of control programs and the new measures committed to in the 2016 and 2022 State SIP Strategies that have yet to be adopted. The new measures exceed the stringency of the current control program for control requirements applying to all mobile source categories, including the passenger vehicle fleet, the on-road heavy-duty fleet, and off-road equipment and engines, as well as residential and commercial building appliances source categories.

Step 3(b): Determination of Technical and Economic Feasibility

The second half of the required process for evaluating the potential MSM measures is an assessment of their economic and technical feasibility. As part of this process, the Act directs that the state may eliminate any control measures identified in Step 2 from further consideration if it is demonstrated to be technologically or economically infeasible to implement in the Valley within the specified timeframes.

Per U.S. EPA's guidance and precedence, this requirement is not required to be applied unless a potential MSM control measure is rejected from inclusion in the SIP on the grounds of feasibility.[39] Nonetheless, CARB staff has conducted an initial assessment of technical feasibility for many of the mobile source control measures in the 2016 State SIP Strategy, the Valley State Strategy, and the 2022 State SIP Strategy, as well as through the technology assessments that CARB staff has conducted in collaboration with the South Coast Air Quality Management District. These Technology Assessments identified the current technological potential for more stringent emission control measures for on- and off-road heavy-duty applications, together with the fuels necessary to power them, along with ongoing review of advanced vehicle technologies for the light-duty sector.[40]

Additionally, an economic impact analysis was conducted for the newly proposed measures that were committed to in the 2022 State SIP Strategy.[41] Furthermore, all control measures that are regulatory in nature must also undergo a rule-specific, rigorous public review process when proposed by staff and/or approved by the Board, as specified by the Administrative Procedures Act (APA). These requirements include an Initial Statement of Reasons (ISOR) prepared for each proposed CARB regulation, an Environmental Analysis to satisfy California Environmental Quality Act (CEQA) requirements, and an Economic Analysis, including a Standardized Regulatory Impact Assessment (SRIA) for any proposed regulation has an economic impact exceeding $50 million.

[39] See page 400 of U.S. EPA's 2001 *Technical Support Documentation for Maricopa County PM10 Nonattainment Area* https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd30102.pdf where EPA staff explain that they are applying to Maricopa County's SIP the decision from a Phoenix Serious SIP not to apply this requirement if no potential control measures are rejected.
[40] Technology and Fuel Assessments http://www.arb.ca.gov/msprog/tech/tech.htm
[41] CARB 2022 "2022 State SIP Strategy Appendix A: Economic Analysis" https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy

While these processes occur beyond the requirements addressed in this plan, these requirements ensure there will be further opportunity for public and stakeholder input, as well as ongoing technology review and a more refined assessment of costs and environmental impacts as the measures move through CARB's public process for development into proposed regulations.

D.2.3 Step 4: Adopt and Implement Feasible Control Measures

The final step required by this step-wise process is to adopt and implement the feasible control measures identified in Step 3, in order to satisfy MSM requirements. Board adoption of the proposed Valley SIP for the 12 $\mu g/m^3$ annual PM2.5 standard – including the control measures described in the 2022 State SIP Strategy – will satisfy the requirements of Step 4.

D.3 SECTION III. STEP 1: EMISSIONS OF DIRECT PM2.5 AND NOX

Tables 3-4, 3-5, and 3-6 show the emissions of direct PM2.5 and NOx, the key precursor to secondary formation of PM2.5 in the Valley.[42] It is important to note that, as this is an assessment of CARB's control measures for mobile sources and space and water heaters, these tables reflect only a subset of the total emissions in the Valley, and do not reflect emissions from stationary and areawide sources.

Table D-4 NOx Emissions (tpd) from Mobile Sources in the Valley

	2017	2030
On-Road Light-Duty Vehicles	13.7	4.1
On-Road Heavy-Duty Vehicles	84.4	16.6
Off-Road Federal and International Sources	15.7	21.2
Aircraft	2.5	4.6
Railroad	13.1	16.5
Off-Road Equipment	83.9	38.0
Total NOx from Mobile Sources	197.7	79.8

**Numbers may not add up due to rounding.*

Table D-5 Direct PM2.5 Emissions (tpd) from Mobile Sources in the Valley

	2017	2030
On-Road Light-Duty Vehicles	1.2	1.3
On-Road Heavy-Duty Vehicles	3.7	2.3
Off-Road Federal and International Sources	1.6	2.1
Aircraft	1.3	1.8
Railroad	0.3	0.4
Off-Road Equipment	4.8	2.2
Total Direct PM2.5 from Mobile Sources	11.3	7.9

**Numbers may not add up due to rounding.*

Many residential appliances, such as water heaters and furnaces, use natural gas or liquefied petroleum gas (fossil fuel) as a fuel source. These appliances have the potential to emit oxides of nitrogen (NOx) during combustion. While emissions from buildings represent a small component of total PM2.5 and precursor emissions, water and space heaters comprise a large portion of total building-related emissions. The emissions for those source categories are shown in Table D-6 below.

[42] Data from CEPAM 2016 Ozone SIP Version 1.05 with external adjustments http://outapp.arb.ca.gov/cefs/2016ozsip/index.php

Table D-6 NOx and Direct PM2.5 Emissions (tpd) from Space and Water Heaters in the Valley

	NOx		PM	
	2017	2030	2017	2030
Residential Space Heating	1.5	1.1	0.2	0.2
Residential Water Heating	0.9	0.8	0.2	0.2
Commercial Space Heating	1.0	0.7	0.1	0.1
Commercial Water Heating	0.6	0.7	0.1	0.1
Total: Space and Water Heater	**4.0**	**3.2**	**0.5**	**0.6**

D.4 SECTION IV. STEPS 2 AND 3: IDENTIFICATION AND EVALUATION OF POTENTIAL CONTROL MEASURES

The second and third steps required in the MSM evaluation process – the identification of potential MSM control measures, and the evaluation of their stringency and feasibility – have been grouped together so that CARB staff can more cohesively identify and analyze control measures for each sector. The sectors analyzed include mobile sources (which are further broken down into sub-categories of passenger vehicles, on-road heavy-duty trucks and buses, and off-road mobile sources), and residential and commercial building appliances.

SECTION 209 WAIVER AND AUTHORIZATION AUTHORITY

Before delving into the sector-specific analysis, however, it is important to discuss the unique position California holds within the Act. In recognition of California's early efforts and extent of air quality challenges, the State has unique authority to regulate emissions from some mobile source categories more stringently than the federal government under the Act's §209(b) waiver provision and §209(b) authorization provision. This waiver provision also allows California to seek a waiver from U.S. EPA to enact more stringent emission standards for passenger vehicles and heavy duty trucks. While U.S. EPA has primary authority for interstate trucks, aircraft, ships, locomotives, and some farm and construction equipment, the authorization provision allows California to seek authorization from U.S. EPA to enact more stringent emission standards for certain off-road vehicles and engines.

Due to California's unique waiver and authorization authority under the Act, no other state or nonattainment area has the authority to promulgate mobile source emission standards at levels that are more stringent than the federal standards. Other states can elect to match either the federal standards or the more stringent California standards. As such, no state or nonattainment area has a more stringent suite of mobile source emission control programs than California, implying a de-facto level of control at the level of MSM for CARB's current programs.

Over nearly five decades, CARB has consistently sought waivers and authorizations for its new motor vehicle regulations and has received waivers and authorizations for over 100 regulations. The most recent California standards and regulations that have received waivers and authorizations are:

- The Advanced Clean Cars (ACC) Regulations for light-duty vehicles (including the Zero-Emission Vehicle (ZEV) and the Low-Emission Vehicle III (LEV III) Regulations);
- On-Board Diagnostics II Requirements;
- The Advanced Clean Trucks Regulation;
- The Zero-Emission Airport Shuttle Bus Regulation;
- The Zero-Emission Power Train Certification;
- Heavy-Duty On-Board Diagnostics (HD OBD);

- The Heavy-Duty Vehicle and Engine Regulation;
- Heavy-Duty Vehicle and Engine Emission Warranty and Maintenance Provisions;
- Heavy-Duty Truck Idling Requirements;
- The Heavy-Duty Tractor-Trailer Greenhouse Gas (GHG) Standards;
- The In-Use Off-Road Diesel Fleets Regulation;
- The Non-Road Compression Ignition (CI) Regulation;
- The Large Spark Ignition (LSI) Engine and Fleets Regulation;
- The Portable Diesel Equipment Air Toxics Control Measure (ATCM);
- The Portable Equipment Registration Program (PERP);
- The Small Off-Road Equipment (SORE) Regulation;
- The Commercial Harbor Craft (CHC) Regulation;
- The Transport Refrigeration Unit (TRU) ATCM;
- The Off-Highway Recreational Vehicles Regulation;
- The Mobile Cargo Handling Equipment (CHE) Regulation; and
- The Spark Ignition Marine Engine and Boat Regulation.

Further, CARB has recently submitted waiver and authorization requests for:

- The Heavy-Duty Omnibus Regulation;
- The Small-Off Road Engine Standard (2021 Amendments);
- The Commercial Harbor Craft (CHC) Regulation (2022 Amendments); and
- The Transport Refrigeration Unit (TRU) Regulation Phase I (2022 Amendments).

CARB's history of progressively strengthening standards as technology advances, coupled with the waiver and authorization process requirements, ensures that California's regulations remain the most stringent in the nation, and that necessary emission reductions from the mobile sector continue. This provision preserves a critical role for California in the control of emissions from new motor vehicles, recognizing that California plays an important leadership role and serves as a "laboratory" state for more stringent motor vehicle emission standards. For example, CARB's LEV I and LEV II, and the ZEV Programs have resulted in the production and sales of over 1.5 million of ZEVs in California since first adopted them in 1990.

Additionally, CARB's 2022 2022 State SIP Strategy[43] has developed and evaluated potential strategies for mobile source categories under CARB's regulatory authority that will contribute to expeditious attainment of the standards. This effort builds on the measures and commitments already made in CARB's multi-pollutant planning effort that have identified the pathways forward to achieve the State's many air quality, climate, and community risk reduction goals: the 2016 State SIP Strategy, the 2018 Valley State SIP Strategy, and the 2020 Mobile Source Strategy.

With the 2022 State SIP Strategy, CARB explored and proposed an unprecedented variety of new measures to reduce emissions from the sources under our authority

[43] CARB 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy) https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy

using all mechanisms available. The measures included in the 2022 State SIP Strategy encompass actions to establish requirements for cleaner technologies (both zero-emissions and near zero-emissions), deploy these technologies into the fleet, and to accelerate the deployment of cleaner technologies through incentives. As such, the measures included in the 2022 State SIP Strategy have been identified to push beyond the stringency of controls required in the current control program, and thus go beyond MSM requirements.

The California regulations that comprise this rigorous suite of control measures are described in more detail in the following sections.

D.4.1 On-Road Light-Duty Vehicles

On-road light-duty vehicles, often referred to as passenger vehicles, include motorcycles, passenger cars, and light to mid-sized trucks and SUVs. The vast majority of these vehicles currently have gasoline powered internal combustion engines, however this sector is projected to increasingly rely on electric drive vehicles of varying types (e.g. battery electric, plug-in hybrid, or fuel cell electric vehicles).

STEP 2(A): CALIFORNIA'S LIGHT-DUTY CONTROL MEASURES

Since setting the nation's first motor vehicle exhaust emission standards in 1966 that led to the first pollution controls, California has dramatically tightened emission standards for light-duty vehicles. Through CARB regulations, today's new cars pollute 99 percent less than their predecessors did in 1975. In 1970, CARB required auto manufacturers to meet the first standards to control NOx emissions along with hydrocarbon emissions, which together form smog. The simultaneous control of emissions from motor vehicles and fuels led to the use of cleaner-burning reformulated gasoline (RFG) that has removed the emissions equivalent of 3.5 million vehicles from California's roads.

Light- and medium-duty vehicles are currently regulated under California's ACC program, which includes the LEV III and ZEV programs. The ACC program combines the control of smog, soot-causing pollutants, and greenhouse gas emissions into a single coordinated package of requirements for model years 2015 through 2025. Since CARB first adopted it in 1990, the Low Emission Vehicle Program (LEV and LEV II) and Zero-Emission Vehicle (ZEV) Program have resulted in the production and sales of over 1.5 million (ZEVs) in California. Advanced Clean Cars 2 (ACC2), a measure from the 2016 State SIP Strategy, is a significant effort critical to meeting air quality standards that was adopted in August 2022. ACC2 has the goal of cutting emissions from new combustion vehicles while taking all new vehicle sales to 100 percent zero-emission no later than 2035.

For passenger vehicles, the 2022 State SIP Strategy includes actions to increase the penetration of ZEVs by targeting ride-hailing services offered by transportation network companies through the Clean Miles Standard regulation in order to reduce GHG and criteria pollutant emissions, and promote electrification of the fleet. For motorcycles, the 2022 State SIP Strategy proposes more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds. The primary goal of the On-Road Motorcycle New Emissions Standard measure is to reduce emissions from new, on-road motorcycles by adopting more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds.

CARB is also active in implementing in-use programs for owners of older dirtier vehicles to retire them early. The "car scrap" programs, like Clean Cars 4 All and Clean Vehicle Rebate Project provide monetary incentives to replace old vehicles with zero-emission vehicles. Other California programs and goals, such as the 2012 Governor's Executive

Order to put 1.5 million zero-emission vehicles on the road by 2025 – which was attained two years early in 2023 – have produced substantial and cost-effective emission reductions from the light-duty vehicle sector.[44]

Taken together, California's emission standards, fuel specifications, and incentive programs for on-road light- and medium-duty vehicles represent all measures that are technologically and economically feasible within California. As a result of these efforts, light-duty vehicle emissions in the San Joaquin Valley have been reduced significantly since 1990 and will continue to go down through 2030. From today, light-duty vehicle NOx emissions are projected to decrease by nearly 70 percent by 2030.

Figure D-3 Light-Duty Control Measures

NEW VEHICLE STANDARDS

Emission Standards and ZEV Requirements

California is the only state with the authority to adopt and enforce emission standards for new motor vehicle engines that differ from the federal emission standards, which enables CARB to develop more stringent motor vehicle control measures than other states. Adopted in 2012, the ***ACC I*** program is a suite of regulations that ensure emission reductions from the State's passenger vehicle fleet. In 2013, U.S. EPA issued a waiver for the ACC I Program.[45]

[44] California Office of Governor, April 2023. "California Surpasses 1.5 Million ZEVs Goal Two Years Ahead of Schedule" https://www.gov.ca.gov/2023/04/21/california-surpasses-1-5-million-zevs-goal-two-years-ahead-of-schedule/
[45] U.S. EPA 2013 "California State Motor Vehicle Pollution Control Standards; Advanced Clean Car Program; Final Notice of Decision" Federal Register January 9, 2013 Volume 78, Number 6 pp. 2211 – 2145. https://www.gpo.gov/fdsys/pkg/FR-2013-01-09/pdf/2013-00181.pdf

CARB's ACC I program has in recent years been a major driver of turnover to and zero and near-zero emission vehicles in the light-duty sector, providing significant emission reduction benefits. ACC I brought together three major regulations that were previously separate, combining the control of criteria pollutants and greenhouse gas emissions into a single coordinated set of requirements for light-duty vehicles of model years 2015 through 2025.

- Two of these regulations, the ***LEV III GHG*** and ***LEV III Criteria Emission*** rules, are fleet average performance standards for new vehicles that provide for continued annual emission reductions as the stringency increases through 2025. When fully phased-in, these requirements will achieve near-zero emission levels from new light-duty vehicles. These programs apply to the entire light-duty fleet by setting an average emissions requirement across all new vehicles that creates inherent market flexibility for compliance.

- The third regulation, the ***ZEV Regulation***, focuses on advanced technology development and fleet penetration of ZEVs (i.e. battery electric vehicles and hydrogen fuel cell vehicles), and plug-in hybrid electric vehicles (PHEVs) in order to enable manufacturers to successfully meet 2018 and subsequent model year requirements. The ZEV regulation ensures that advanced electric drive technology is commercialized and brought to production scale for cost reductions by 2025, in order to ensure that these low-emission technology vehicles transition from demonstration phase to full commercialization in a reasonable timeframe to meet long-term emission reductions goals. The ZEV amendments for 2018 and subsequent model years in the ACC program are intended to achieve commercialization through simplifying the regulation and pushing technology to higher volume production in order to achieve cost reductions.

The ACC I program has ushered in a new zero emission passenger transportation system. The success of this program is evident: California is the world's largest market for Zero Emission Vehicles (ZEVs), with 119 passenger vehicle models available today, including battery-electric, plug-in hybrid electric, and fuel cell electric vehicles.[46] A wide variety are now available at lower price points, attracting new consumers. In April 2023, the Governor's 2012 target of 1.5 million ZEVs on the road by 2025 was attained two years early, facilitated in part by $2 billion in ZEV incentive funding and rebates that have been distributed to Californians through programs like the Clean Vehicle Rebate Project and Clean Cars 4 All.[47] Approximately 21 percent of all new cars sold in California in 2023 have been ZEVs. Californians, who drive only 10 percent of the nation's cars, account for over 40 percent of all zero-emission car sales in the country. The U.S. makes up about half of the world market. This movement towards commercialization of advanced clean cars has occurred due to CARB's ZEV requirements, part of ACC, which affects passenger cars and light-duty trucks.

[46] VELOZ, February 2023 "Electric Vehicle Market Report, Q4 2022" https://www.veloz.org/ev-market-report/

[47] California Office of Governor, April 2023. "California Surpasses 1.5 Million ZEVs Goal Two Years Ahead of Schedule" https://www.gov.ca.gov/2023/04/21/california-surpasses-1-5-million-zevs-goal-two-years-ahead-of-schedule/

In support of California's transition to zero-emission vehicles, in 2020, Governor Newsom signed Executive Order N 79 20,[48] which established a goal that 100 percent of California sales of new passenger cars and trucks be zero-emission by 2035. With this order and many other recent actions, Governor Newsom has recognized that air pollution remains a challenge for California that requires bold action. Zero-emission vehicle commercialization in the light-duty sector is well underway. Longer-range battery electric vehicles are coming to market that are cost-competitive with gasoline fueled vehicles and hydrogen fuel cell vehicles are now also seeing significant sales. Autonomous and connected vehicle technologies are being installed on an increasing number of new car models. A growing network of retail hydrogen stations is now available, along with a rapidly growing battery charger network.

Advanced Clean Cars II (ACC II), a measure in the 2016 State SIP Strategy that was adopted by the CARB Board in August 2022, imposes the next level of low-emission and zero-emission vehicle standards for model years 2026-2035 that contribute to meeting federal ambient air quality ozone standards and California's carbon neutrality targets. The ACC II regulations will rapidly scale down emissions of light-duty passenger cars, pickup trucks and SUVs starting with the 2026 model year through 2035. The ACC II regulation also takes the State's already growing zero-emission vehicle market and robust motor vehicle emission control rules and augments them to meet more aggressive tailpipe emissions standards and ramp up to 100 percent zero-emission vehicles by 2035 for all new passenger cars, trucks and SUVs sold in California. ACC II is two-pronged: it will drive the sales of zero emission vehicles (ZEV) and the cleanest-possible plug-in hybrid-electric vehicles (PHEV) to 100-percent in California by the 2035 model year through its ***Zero Emission Vehicle (ZEV) Regulation***, while also reducing smog-forming emissions from new Internal Combustion Engine Vehicles (ICEVs) through the ***Low Emission Vehicle (LEV) IV Regulation***.

The LEV IV regulation will further increase the stringency of CARB's criteria pollutant emission standards for light- and medium-duty vehicles for MY 2026 – 2035. LEV IV consists of multiple components:

- Prevents potential emission backsliding of ICEVs that is otherwise possible under the existing regulations by applying the exhaust and evaporative emission fleet average standards exclusively to combustion engines. Although the NMOG+NOx fleet average for light-duty vehicles remains at 30 mg/mi for MY 2026-2035, the medium-duty vehicle fleet average declines from 178 mg/mi to 150 mg/mi for Class 2b and from 247 mg/mi to 175 mg/mi for Class 3. Additionally, LEV IV eliminates the composite standard option for SFTP emissions to ensure maximum emissions control on all test cycles.
- For light-duty vehicles, lowers the maximum NMOG+NOx exhaust emission rate from 160 mg/mi in MY 2025 to 70 mg/mi in MY 2029; the US06 PM emission rate from 6 mg/mi to 3 mg/mi; and evaporative running loss emission rates from 0.05 g/mi to 0.01 g/mi. For medium-duty vehicles, lowers the maximum NMOG+NOx

[48] Executive Order N-79-20 https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf

exhaust emission rate from 250 mg/mi in MY 2025 to 170 mg/mi in MY 2028 for Class 2b and from 400 mg/mi to 230 mg/mi for Class 3.

- Reduces cold start emissions by applying the emission standards to a broader range of in-use driving conditions. (Starts after the vehicle engine has been shut-off for more than 12 hours are considered cold starts.)
- Medium-duty vehicles with gross combined weight rating above 14,000 lbs. would also be subject to in-use test standards to capture emissions while towing.

CARB will further increase the stringency of sales requirements for ZEVs and PHEVs through the ACC II program's ZEV regulation, which will require manufacturers to deliver for sale increasing percentages of ZEVs and PHEVs as a portion of their overall product deliveries between model years 2026 and 2034 and reach 100-percent ZEVs in 2035 (and after). ACC II also includes innovative charging and ZEV assurance measures, which include ZEV warranty and durability requirements, serviceability, and battery labeling requirements.

Brake and Tire Wear

Vehicles emit inhalable particles from two major sources: the exhaust system, which has been extensively characterized and regulated; and non-exhaust sources including brake wear, tire and road wear, clutch wear and road dust resuspension. The non-exhaust sources have not been regulated because they are difficult to measure and control. However, with increasingly stringent standards for exhaust emissions, the non-exhaust fraction has become increasingly important. Model predictions suggest that traffic-related emissions of both $PM_{2.5}$ and PM_{10} will eventually be dominated by non-exhaust sources.

Additionally, there is concern that exposure to these particles may increase in California because proposed regional land use and transportation plans may lead to denser cities and a higher proximity of people to major roadways. Under the ACC program, the regenerative braking of ZEVs and PHEV results in lower PM emissions from brake wear and thus provides non-exhaust PM2.5 emission benefits. As increasing numbers of ZEVs enter the fleet, which are characterized by regenerative braking and lower rolling resistance tires, these technologies offer opportunities to reduce PM2.5 emissions from the passenger vehicle fleet.

Clean Miles Standard

The ***Clean Miles Standard (CMS)*** regulation, which was adopted by CARB in 2021 and will be implemented by the California Public Utilities Commission (CPUC), is a regulation to reduce GHG emissions from ride-hailing services offered by transportation network companies (TNCs), on a per--passenger mile basis, and promote electrification of the fleet by setting an electric vehicle mile target. TNCs provide on-demand rides through a technology--based platform that connects passengers with drivers using personal or rented vehicles.

The CMS includes two annual targets – an eVMT target as well as a GHG target in the metric of g CO2/PMT. The eVMT target would require TNCs to achieve 90 percent eVMT by 2030. The GHG target would require TNCs to achieve 0 g CO2/PMT by 2030 through electrification as well as other strategies, including increasing shared rides on their platform, improving operational efficiency (route planning and reduced mileage without passengers), and obtaining optional GHG credits. Optional GHG credits may be requested by the TNCs and approved by the CPUC for ride-hailing trips that are connected to mass transit through a verified booking process, and for investing in bicycle and sidewalk infrastructure projects that support active transportation.

On-Board Diagnostic (OBD) Systems

OBD systems serve an important role in helping to ensure that engines and vehicles maintain low emissions throughout their full life. OBD systems are designed to identify when a vehicle's emission control systems or other emission-related computer-controlled components are malfunctioning, causing emissions to be elevated above the vehicle manufacturer's specifications. Many states currently use the OBD system as the basis for passing and failing vehicles in their inspection and maintenance programs, as is exemplified by California's Smog Check Program. For light-duty vehicles, all 2000 and newer MY vehicles are inspected by accessing the OBD system to verify that no emission-related faults are present.

California's first ***On Board Diagnostics Regulation (OBD I)*** required manufacturers to monitor some of the emission control components for passenger vehicles, light- and medium- duty vehicles, starting with the 1988 model year. In 1989, CARB adopted ***OBD II***, which required 1996 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines to be equipped with second-generation OBD systems, which standardized the system and addressed the shortcomings of the OBD I requirements (OBD I requirements monitored only a few of the emission-related components on a vehicle). U.S. EPA granted CARB a waiver of preemption for the OBD II regulation in 2016.[49]

The Board has modified the OBD II regulation in regular updates since initial adoption to address manufacturers' implementation concerns and, where needed, to strengthen specific monitoring requirements. Most recently, the Board amended the regulation in 2021 to require manufacturers to implement Unified Diagnostic Services (UDS) for OBD communications, which will provide more information related to emissions-related malfunctions that are detected by OBD systems, improve the usefulness of the generic scan tool to repair vehicles, and provide needed information on in-use monitoring performance. UDS implementation would be required for all 2027 and subsequent model year light- and medium-duty vehicles and engines, as well as some heavy-duty vehicles and engines.

[49] U.S. EPA 2016 "California State Motor Vehicle Pollution Control Standards; Malfunction and Diagnostic System Requirements for 2004 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines; Final Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2016-11-07/pdf/2016-26861.pdf November 7, 2016 Federal Register Volume 81, Number 215 pp. 78143-78149

Emissions Standards for Motorcycles

While representing a relatively small fraction of the emissions coming from the passenger vehicle fleet, CARB has also taken a comprehensive control approach for emissions from motorcycles. For the most part, motorcycles are on-road two-wheeled, self-powered vehicles with engine displacements of 50 cubic centimeters (cc) or greater. First adopted in 1975, ***California's On-Road Motorcycle Regulation*** obtained its first waiver of preemption from U.S. EPA in 1976. The 1975 regulation set emission standards for all motorcycles with engine displacements of at least 50 cc. The ***1998 Amendments to the California Motorcycle Regulation*** affected only Class 3 motorcycles (280 cc or greater) and set a Tier I and Tier II standard for 2004 and 2008 model years, respectively. While CARB has the same emission standard as the federal standard, the California standard applies to engines starting in 2008 rather than 2010 under the federal requirement. The California Motorcycle Regulation controls both exhaust emission standards and test procedures for on-road motorcycles and motorcycle engines. U.S. EPA granted CARB a waiver of preemption for the 1998 amendments in August 2006.[50] California's motorcycle exhaust emission test procedures are adopted from U.S. EPA's exhaust test procedures (CFR title 40, part 86, subparts E and F).

Since the 1990s, more stringent exhaust emissions standards have been developed by jurisdictions outside of the United States, most notably the European Union's EU5 standard which became effective in 2020. These stringent exhaust standards have prompted the development of cleaner motorcycles than what are currently required in California, or anywhere in the nation. Thus, the 2022 State SIP Strategy includes the ***On-Road Motorcycle New Emission Standard*** measure, CARB's latest commitment to reduce emissions from motorcycles. While CARB's existing motorcycle evaporative standards are on par with most other jurisdictions around the world, additional evaporative reductions are technically feasible and other vehicle categories regulated by CARB have adopted much lower evaporative emissions standards. For example, CARB's Off Highway Recreational Vehicle (OHRV) category, which includes vehicles closely related to motorcycles such as off-highway motorcycles, requires lower evaporative emissions limits with more robust test methods. Since 2017, CARB has been working closely with many other jurisdictions in the spirit of trying to achieve harmonization where possible on lower and more robust motorcycle emissions standards. Specifically, CARB has worked closely with U.S. EPA, Environment Climate Change Canada, the European Union, and the United Nations. California also currently has no inspection and maintenance program for motorcycles. CARB has determined that tampering with emissions controls is a significant problem for this category.

The On-Road Motorcycle New Emissions Standard is anticipated to reduce emissions from new, on-road motorcycles (motorcycles) by adopting more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds. The

[50] https://www.epa.gov/state-and-local-transportation/vehicle-emissions-california-waivers-and-authorizations See Code of Federal Regulations Volume 71, Number 149 pp. 44027-44029

exhaust standards would be more stringent than current U.S. EPA standards and largely harmonized with European Union 5 (EU 5) standards. The evaporative standards would be more stringent than current U.S. EPA and EU 5 standards. This measure will also require an increase in new Zero-Emissions Motorcycle (ZEM) sales, starting at 10 percent in 2028 and progressing to 50 percent in 2035. CARB staff is in the process of developing new exhaust emissions standards for hydrocarbons (HC), NOx, CO and nonmethane HC (NMHC) that achieve a large degree of harmonization with more aggressive current European motorcycle emissions standards. CARB would also develop new evaporative emissions standards that largely harmonize with more aggressive current CARB OHRV emissions standards.

REDUCING IN-USE EMISSIONS

Inspection and Maintenance (I/M) Program

Although new vehicles sold in California are the cleanest in the world, the millions of passenger vehicles on California roads, and the increasing miles they travel each day make them our single greatest source of NOx emissions. While the new vehicles in California may start out with very low emissions, improper maintenance or faulty components can cause vehicle emission levels to sharply increase. Studies estimate that approximately 50 percent of the total emissions from late-model vehicles are excess emissions, meaning that they are the result of emission-related malfunctions. California’s ***Smog Check Program*** works to ensure that the vehicles remain as clean as possible over their entire life. The Bureau of Automotive Repair (BAR) is the State agency charged with administration and implementation of the Smog Check Program. The Smog Check Program is designed to reduce air pollution from California registered vehicles by requiring periodic inspections for emission-control system problems, and by requiring repairs for any problems found. In 1998, the Enhanced Smog Check program began in which Smog Check stations relied on the BAR-97 Emissions Inspection System (EIS) to test tailpipe emissions with either a Two-Speed Idle (TSI) or Acceleration Simulation Mode (ASM) test depending on where the vehicle was registered. For instance, vehicles registered in urbanized areas received an ASM test, while vehicles in rural areas received a TSI test.

In 2009, the following requirements were added in to improve and enhance the Smog Check Program, making it more inclusive of motor vehicles and effective on smog reductions:

- Low pressure evaporative test;
- More stringent pass/fail cutpoints;
- Visible smoke test; and
- Inspection of light- and medium-duty diesel vehicles.

The next major change in the Smog Check Program was due to AB 2289, adopted in October 2010, a new law restructuring California’s Smog Check Program, streamlining and strengthening inspections, increasing penalties for misconduct, and reducing costs to motorists. This new law, supported by CARB and BAR, promised faster and less expensive Smog Check inspections by talking advantage of the second generation of OBD software installed on all vehicles. The new law also directs vehicles without this equipment to high-performing stations, helping to ensure that these cars comply with current emission standards. This program will reduce consumer costs by having stations take advantage of diagnostic software that monitors pollution-reduction components and tailpipe emissions. Beginning mid-2013, testing of passenger vehicles using OBD was required on all vehicles model years 2000 or newer.

In the San Joaquin Valley, Smog Check requirements are consistent with the most stringent of any other I/M program in the nation. Biennial, change of ownership, and initial registration Smog Check inspections ensure that the in-use passenger vehicle fleet continues to operate as cleanly as possible. Additionally, a portion of vehicles must receive their biennial Smog Check inspections at STAR certified test only or test/repair stations that are required to meet high inspection-based standards.

Based on recent CARB analysis in support of the Smog Check Performance Standard Modeling and Program Certification for the 70 Parts Per Billion 8-hour Ozone Standard (CARB Board meeting, March 23, 2023), the Smog Check Program meets the federal I/M requirements for all applicable nonattainment areas classified as Moderate or above, including the South Coast Air Basin, San Joaquin Valley, Coachella Valley, Western Mojave Desert, San Diego County, Sacramento Metro, Eastern Kern, and Ventura County nonattainment areas, and the 75 parts per billion 8-hour ozone standard for the San Diego County and Eastern Kern nonattainment areas.

CARB staff's discovery of Volkswagen's (VW's) use of illegal defeat devices—software designed to cheat on emissions tests—in certain 2009 to 2016 model year diesel cars that were sold in California illustrates the success and stringency of California's program to control emissions from the in-use passenger vehicle fleet, and to identify excess in-use emissions. Due to the discovery of VW's emissions cheating scandal and subsequent actions to remediate the environmental damages caused by these vehicles' excess emissions, the VW Environmental Mitigation Trust provides about $423 million for California to fund projects that accelerate the turnover of mobile sources to cleaner, lower-emitting vehicles and engines.

REDUCING VEHICLE MILES TRAVELLED (VMT)

In addition to the potential measures described above to control emissions from on-road mobile sources, reducing vehicle miles traveled (VMT) is also necessary to directly and immediately reduce mobile source NOx and ROG emissions. CARB works cooperatively with other State agencies, and the local air districts, metropolitan planning organizations (MPOs), and other local entities to implement the Sustainable Communities and Climate Protection Program and related efforts. This involves developing, adopting, and implementing Sustainable Communities Strategies (SCS), which include VMT reduction targets as required under Senate Bill 375. That said, reducing VMT is difficult; many factors influence an individual's travel choices, and these choices interact with one another in a complex manner that is not always well understood. In the 2020 Mobile Source Strategy, CARB identified several strategies that could be undertaken to assist in achieving additional reductions and support implementation of regional SCSs. Building on the strategies identified in the 2020 MSS, in the 2022 State SIP Strategy, CARB committed to the ***Enhanced Regional Emission Analysis in SIPs*** measure, which will reduce VMT from on-road mobile sources through a Transportation Control Measure (TCM), a strategy to reduce emissions or concentration of air pollutants by reducing the number of vehicle trips or VMT or improving traffic flow. This measure was originally proposed as a public measure suggestion, based on the input from community-based organizations and members of the public. During the development of the 2022 State SIP Strategy, CARB staff developed this public measure suggestion into a SIP measure commitment.

CARB is considering the following measures to further reduce ROG and NOx emissions from on-road motor vehicles by reducing VMT:

- Change MVEB Development Process:
  CARB would evaluate the existing MVEB development process, including tools and the latest planning assumptions used in the analysis. Based on the review, CARB could modify the framework for developing MVEBs when considering how to address gaps in emissions reductions needed to demonstrate attainment of different NAAQS. This framework could explore additional emissions reductions from the on-road sector to attain the 70 ppb 8-hour ozone standard and progress towards State air quality goals. This framework would need to ensure that the MVEB is consistent with other applicable requirements such as emission inventory, reasonable further progress, control measures, and attainment demonstration.
- RACM Analysis:
  CARB would compile a comprehensive list of TCMs implemented or considered by federal, state, regional, and local agencies. This list would provide more choices and new measures subject to RACM analysis for potential inclusion as an enforceable measure in the SIP. This effort may also evaluate the emission reduction potential, feasibility, and cost-effectiveness of each TCM on the list. In addition, CARB could consider providing a quantification methodology to improve and standardize the RACM analysis as part of SIPs across air districts. In pursuing this measure, CARB would work in a collaborative effort with U.S. EPA, California MPOs, and air districts to develop the guidance and implement each potential TCM identified through the RACM.
- Update Guidance for CMAQ and Motor Vehicle Fees:
  CARB would update the methodology and guidelines for estimating the cost-effectiveness of some of the most widely implemented transportation-related air quality projects using CMAQ and motor vehicle fees. Further, these guidelines would establish methods to quantify emission benefits and cost-effectiveness of new available transportation options and technologies. This update may also include critical inputs associated with emissions estimation to streamline the

quantification of cost-effectiveness of various transportation projects. This action will accelerate the penetration of new strategies and maximize the emissions reductions from the transportation sector in the near-term. CARB would work with FHWA, the California Department of Transportation, MPOs, and air districts in pursuing this measure.

FUELS

Cleaner fuel has an immediate impact in reducing emissions from the mobile source, and thus represent an important component in reducing NOx and ROG emissions from the passenger vehicle fleet. California's stringent air quality programs treat motor vehicles and their fuels holistically (as a system, rather than as separate components). As a result, CARB's fuels programs achieve significant reductions in criteria emissions from gasoline-fueled vehicles used in California.

California's Reformulated Gasoline program (CaRFG) sets stringent standards for California gasoline that produced cost-effective emission reductions from gasoline-powered vehicles resulting in California gasoline being the cleanest in the world. California's cleaner-burning gasoline regulation is one of the cornerstones of the State's efforts to reduce air pollution and cancer risk. Reformulated gasoline is fuel that meets specifications and requirements established by CARB. The results from cleaning up fuel can have an immediate impact as soon as it is sold in the State. Vehicle manufacturers design low-emission vehicles to take full advantage of cleaner-burning gasoline properties.

The CaRFG program has been implemented in three phases.

- Phase 1, which was implemented in 1991, eliminated lead from gasoline and set regulations for deposit control additives and reid vapor pressure (RVP).
- Phase 2 CaRFG (CaRFG2 in 1994) set specifications for sulfur, aromatics, oxygen, benzene, T50, T90, Olefins, and RVP and established a Predictive Model.
- The final and current phase, Phase 3 CaRFG, eliminated, in 1996, the use of methyl-tertiary-butyl-ether in California gasoline.

The use of cleaner-burning gasoline in the San Joaquin Valley has been required since December 2002. ***Phase 3 CaRFG*** also revised specifications for Phase 3 gasoline that reduces ozone precursor emissions (including aromatic hydrocarbons and olefins) by ~15 percent and toxic air contaminant emissions by about 40 percent, compared with CaRFG2. The regulation strengthened specification requirements for cleaner-burning gasoline, including:

- Reduced sulfur content. Sulfur inhibits the effectiveness of catalytic converters. Cleaner-burning gasoline enables catalytic converters to work more effectively and further reduce tailpipe emissions.

- Reduced benzene content. Benzene is known to cause cancer in humans. Cleaner-burning gasoline has about one-half the benzene of earlier gasoline, thus reducing cancer risks.
- Reduced levels of aromatic hydrocarbons (ozone precursor).
- Reduced levels of olefins (ozone precursor).
- Reduced reid vapor pressure, which ensures that gasoline evaporates less readily.
- Two specifications for reduced distillation temperatures, which ensure the gasoline burns more completely, and
- Use of an oxygen-containing additive, such ethanol, which also helps the gasoline burn more cleanly.

STEP 2(B): OTHER STATES' AND NONATTAINMENT AREAS' LIGHT-DUTY CONTROL MEASURES

Table D-7 summarizes the most stringent control measures currently in use in any state or nonattainment that have been identified and discussed for on-road light-duty vehicles. Each of the measures identified in this table are discussed in more detail in this section, below.

Table D-7 Comparison of Stringency – Light-Duty Measures

CARB Control Programs Compared to Federal Standards and Control Programs in Other States and Nonattainment Areas

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Light-Duty Vehicles			
New Vehicle Standards			
New Vehicle Standards: Emissions standards (passenger cars)	LEV III program (CARB) MY 2015 - 2025 (part of Advanced Clean Cars I program) LEV IV program (CARB) MY 2026 - 2035 (part of Advanced Clean Cars II program)	17 states have adopted California's Low Emission Vehicle III (LEV III) program, which set fleet average criteria pollutant performance standards for new light- and medium-duty vehicles for MY 2015 - 2025 CARB will further increase the stringency of CARB's criteria pollutant emission standards with LEV IV program, a part of ACC II, for MY 2026 – 2035. LEV IV consists of these components: • Prevents potential emission backsliding of ICEVs that is otherwise possible under the existing regulations by applying the exhaust and evaporative emission fleet average standards exclusively to combustion engines. Although the NMOG+NOx fleet average for light-duty vehicles remains at 30 mg/mi for MY 2026-2035, the medium-duty vehicle fleet average declines from 178 mg/mi to 150 mg/mi for Class 2b and from 247 mg/mi to 175 mg/mi for Class 3. Additionally, LEV IV eliminates the composite standard option for SFTP emissions to ensure maximum emissions control on all test cycles. • For light-duty vehicles, lowers the maximum NMOG+NOx exhaust emission rate from 160 mg/mi in MY 2025 to 70 mg/mi in MY 2029; the US06 PM emission rate from 6 mg/mi to 3 mg/mi; and evaporative running loss emission rates from 0.05 g/mi to 0.01 g/mi. For medium-duty vehicles, lower the maximum NMOG+NOx exhaust emission rate from 250 mg/mi in MY 2025 to 170 mg/mi in MY 2028 for Class 2b and from 400 mg/mi to 230 mg/mi for Class 3. • Reduces cold start emissions by applying the emission standards to a broader range of in-use driving conditions. (Starts after the vehicle engine has been shut-off for more than 12 hours are considered cold starts.) • Medium-duty vehicles with gross combined weight rating above 14,000 lbs. would also be subject to in-use test standards to capture emissions while towing.	17 States have adopted the LEV III requirements of ACC I under the provisions of Section 177: • NY, MA, VT, ME, PA, CT, RI, WA, OR, NJ, MD, DE, CO, MN, NV, VA, and NM LEV IV regulations will control emissions of criteria pollutants from the exhaust and fuel systems of conventional motor vehicles. They would apply to vehicles produced and delivered for sale in California beginning with the 2026 model year. They are more stringent than the existing federal Tier 3 standards for the same pollutants from motor vehicles for the 2025 and subsequent model years that were set by the U.S. EPA. Five other states have adopted the new LEV IV from ACC2 under Section 177: MA, OR, WA, VT, and NY
New Vehicle Standards: Zero-emission Requirements (passenger cars)	ZEV program (CARB) MY 2015 - 2025 (part of Advanced Clean Cars I program)	15 states have matched California's current ZEV Regulation for battery electric vehicles (BEVs), hydrogen fuel cell vehicles (FCEVs), and plug-in hybrid electric vehicles (PHEVs). CARB will further increase the stringency of sales requirements for ZEVs and PHEVs through the ACC II program's ZEV regulation, which will require manufacturers to deliver for sale	15 states have adopted the ZEV requirements of ACC I under the provisions of Section 177:

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Light-Duty Vehicles			
	ACC II's ZEV Program (CARB) MY 2026 – 2035 (part of Advanced Clean Cars II program)	increasing percentages of ZEVs and PHEVs as a portion of their overall product deliveries between model years 2026 and 2034 and reach 100-percent ZEVs in 2035 (and after). ACC II also includes innovative charging and ZEV assurance measures, which include ZEV warranty and durability requirements, serviceability, and battery labeling requirements	• NY, MA, VT, ME, CT, RI, WA, OR, NJ, MD, CO, MN, NV, VA, and NM Five other states have adopted the new ZEV standards from ACC2 under Section 177: MA, OR, WA, VT, and NY There are no comparable federal standards for sales of zero-emission vehicles.
New Vehicle Standards: On-Board Diagnostic (OBD) systems requirements	California OBD II Requirements (CARB)	CARB's On-Board Diagnostic II (OBD II) Systems Requirements exceed Federal requirements in stringency. OBD II ensures that the in-use fleet continues to operate as cleanly as possible.	In practice, virtually all vehicles sold in the U.S. are designed and certified to meet California's OBD II requirements, regardless of where in the U.S. they are sold.
New Vehicle Standards: Emissions standards (Motorcycles)	California's On-Road Motorcycle Regulation (CARB) Future Measure: *On-Road Motorcycle New Emissions Standards (CARB)*	CARB's emission standards and in-use testing for on-road motorcycles (California's On-Road Motorcycle Regulation) set a Tier I and Tier II standard for 2004 and 2008 model years, respectively, for Class 3 motorcycles (280 cc or greater). California's evaporative emission limits for motorcycles exceed the stringency of any other in the nation, while exhaust emission a limits and test procedures are consistent with U.S. EPA's. The 2022 State SIP Strategy committed to the On-Road Motorcycle New Emission Standard, which will further reduce emissions from new-on-road motorcycles through the adoption of more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds. The exhaust standards would be more stringent than current U.S. EPA standards and largely harmonized with European Union 5 (EU 5) standards. The evaporative standards would be more stringent than current U.S. EPA and EU 5 standards. This measure will also require an increase in new Zero-Emissions Motorcycle (ZEM) sales, starting at 10 percent in 2028 and progressing to 50 percent in 2035. *(Note: CARB has committed to pursue the On-Road Motorcycle New Emissions Standard measure, but this measure has yet to be proposed to the Board for approval/adoption)*	California is the only state with emission control requirements for on-road motorcycles that exceed the stringency of U.S. EPA requirements.
In-Use Emission Controls			
In-Use Emission Controls: Inspection and maintenance program (I/M program)	Smog Check Program (CARB and administered by the California Department of Consumer Affairs' Bureau of Automotive Repair)	The Inspection / Maintenance (I/M) Program testing and in-use emission controls in the San Joaquin Valley are consistent with the most stringent of any other I/M program in the nation. Biennial, change of ownership, and initial registration Smog Check inspections ensure that the in-use passenger vehicle fleet continues to operate as cleanly as possible. Additionally, a portion of vehicles must receive their biennial Smog Check inspections at STAR certified test only or test/repair stations that are required to meet high inspection-based standards. Based on recent CARB analysis in support of the Smog Check Performance Standard Modeling and Program Certification for the 70 Parts Per Billion 8-hour Ozone Standard (CARB Board meeting, March 23, 2023), the Smog Check Program meets the federal I/M requirements for all applicable nonattainment areas classified as moderate or above, including	32 states and areas have an I/M program in at least a portion of their state or area (AZ, CO, CA, CT, DE, GA, ID, IL, IN, LA, ME, MD, MA, MO, NV, NH, NJ, NM, NC, NY, OH, OR, PA, RI, UT, TN, TX, VA, VT, WA, WI, and DC).

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Light-Duty Vehicles			
		the South Coast Air Basin, San Joaquin Valley, Coachella Valley, Western Mojave Desert, San Diego County, Sacramento Metro, Eastern Kern, and Ventura County nonattainment areas, and the 75 parts per billion 8-hour ozone standard for the San Diego County and Eastern Kern nonattainment areas.	
In-Use Emission Controls: Fleet Rules	Clean Miles Standard (CARB)	The Clean Miles Standard (CMS) regulation, which was adopted by CARB in 2021, is to reduce GHG emissions from ride-hailing services offered by transportation network companies (TNCs), on a per--passenger mile basis, and promote electrification of the fleet by setting an electric vehicle mile target. TNCs provide on-demand rides through a technology--based platform that connects passengers with drivers using personal or rented vehicles. The CMS includes two annual targets – an eVMT target as well as a GHG target in the metric of g CO2/PMT. The eVMT target would require TNCs to achieve 90 percent eVMT by 2030. The GHG target would require TNCs to achieve 0 g CO2/PMT by 2030 through electrification as well as other strategies, including increasing shared rides on their platform, improving operational efficiency (route planning and reduced mileage without passengers), and obtaining optional GHG credits. Optional GHG credits may be requested by the TNCs and approved by the CPUC for ride-hailing trips that are connected to mass transit through a verified booking process, and for investing in bicycle and sidewalk infrastructure projects that support active transportation.	CARB staff is unaware of any other state or jurisdiction with VMT reduction programs via Transportation Network Companies (TNCs).
In-Use Emission Controls: Transportation Control Measure (TCM) Reducing Vehicle Miles Travelled (VMT)	Future Measure: *Enhanced Regional Emission Analysis in SIPs (CARB)*	CARB is considering the following measures to further reduce ROG and NOx emissions from on-road motor vehicles by reducing VMT: • Change MVEB Development Process: CARB would evaluate the existing MVEB development process, including tools and the latest planning assumptions used in the analysis. Based on the review, CARB could modify the framework for developing MVEBs when considering how to address gaps in emissions reductions needed to demonstrate attainment of different NAAQS. • RACM Analysis: CARB would compile a comprehensive list of TCMs implemented or considered by federal, state, regional, and local agencies to provide more choices and new measures for potential inclusion as an enforceable measure in the SIP. This effort may also evaluate the emission reduction potential, feasibility, and cost-effectiveness of each TCM on the list, and/or provide a quantification methodology to improve and standardize the RACM analysis as part of SIPs across air districts. • Update Guidance for CMAQ and Motor Vehicle Fees: CARB would update the methodology and guidelines for estimating the cost-effectiveness of some of the most widely implemented transportation-related air quality projects using CMAQ and motor vehicle fees. Further, these guidelines would establish methods to quantify emission benefits and cost-effectiveness of new available transportation options and technologies. This update may also include critical inputs associated with emissions estimation to streamline the quantification of cost-effectiveness of various transportation projects. *(Note: CARB has committed to pursue the Enhanced Regional Emission Analysis in SIPs measure, but this measure has yet to finalized)*	CARB staff is unaware of any other state or jurisdiction that is reducing VMT through similar programs.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Light-Duty Vehicles			
Fuel Controls			
Gasoline Standards	CaRFG Phase 3 (CARB)	The CaRFG Phase III program requires that California gasoline is the lowest-emitting and cleanest-burning in the nation. It includes more stringent requirements for emission controls than the applicable federal standard (U.S. EPA's RFG Phase II). Relative to federal gasoline, CARB's reformulated gasoline program reduces NOx emissions by 15 percent and TACs by 50 percent.	U.S. EPA RFG Phase II is currently required in nonattainment areas in 17 states and the District of Columbia (including the San Joaquin Valley) • Areas of CA, CT, DE, the District of Columbia, IL, IN, MD, NJ, NY, PA, TX, VA, WI Other "opt in" areas for Federal RFG Phase II • Entire states: CT and DE • Portions of states: IL, KT, MD, ME, MA, MS, NH, NJ, NY, RI, TX, VA

NEW VEHICLE STANDARDS

Emission standards and ZEV Regulation

CARB's new vehicle standards for on-road light-duty vehicles are consistent with the most stringent of any other area in the nation. Due to constraints in the Act, California is the only state that can set new vehicle standards (including control measures such as emission standards, ZEV sales mandates, warranty provisions, and on-board diagnostic (OBD) requirements) that are more stringent than U.S. EPA's national standards. Other states can adopt California programs for which U.S. EPA has provided California with waivers.[51] These states are also known as the "Section 177 States" in reference to this provision of the Act. The ability to set more stringent controls than U.S. EPA, however is unique to California, and thus ensures that the California current control measures for new vehicle and engine standards are at least equal in stringency to the most stringent controls in the nation.

As a result of CARB's efforts, and as provided for in the Act, other states have now adopted elements of CARB's ACC I program, including seventeen states that have adopted the equivalent of CARB's LEV III program, and fifteen states that have adopted the equivalent of CARB's ZEV program, as listed below in Table D-8.

[51] The Clean Air Act allows other states to adopt California's on- and off-road vehicle or engine emission standards under section 209 of the Clean Air Act. Section 209 requires, among other things, that such standards be identical to the California standards for which a waiver or authorization has been granted. States are not required to seek U.S. EPA approval to adopt standards identical to the California standards that have received a waiver or authorization.

Table D-8 ACC I Section 177 States: LD Emission Standards and ZEV Regulation

Section 177 States	2012 ZEV (MY 2015 – 2025)	2012 LEVIII (MY 2015 – 2025)
Colorado	X	X
Connecticut	X	X
Delaware		X
Maine	X	X
Maryland	X	X
Massachusetts	X	X
Minnesota	X	X
Nevada	X	X
New Jersey	X	X
New Mexico	X	X
New York	X	X
Oregon	X	X
Pennsylvania		X
Rhode Island	X	X
Washington	X	X
Vermont	X	X

Additionally, five other states have adopted the requirements of ACC II, including the LEV IV and ZEV requirements: Massachusetts, Oregon, Washington, Vermont, and New York.

On-Board Diagnostics (OBD) Requirements

California's OBD requirements for on-road light-duty vehicles are consistent with the most stringent of any other area in the nation. CARB's OBD II program requires that all 1996 and newer model year gasoline and alternate fuel passenger cars and trucks are required to be equipped from the factory with an OBD II system. All 1997 and newer model year diesel fueled passenger cars and trucks are required to meet the OBD II requirements.

U.S. EPA also requires all 1996 and newer model year passenger cars and trucks sold in any state to meet the U.S. EPA OBD requirements.[52] While U.S. EPA's OBD requirements differ slightly from California's OBD II requirements, virtually all vehicles sold in the U.S. are designed and certified to meet the more stringent California's OBD II requirements, regardless of where in the U.S. they are sold.[53] U.S. EPA issued a waiver for California's OBD II program in November 2016, indicating that the California OBD II system requirements are at least as protective of public health as U.S. EPA's OBD requirements.[54]

[52] CARB 2015 "On-Board Diagnostic II (OBD II) Systems - Fact Sheet / FAQs" https://www.arb.ca.gov/msprog/obdprog/obdfaq.htm
[53] CARB 2009 https://www.arb.ca.gov/msprog/smogcheck/march09/transitioning_to_obd_only_im.pdf
[54] U.S. EPA 2016 "California State Motor Vehicle Pollution Control Standards; Malfunction and Diagnostic System Requirements and Enforcement for 2004 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles and Engines; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2016-11-07/pdf/2016-26861.pdf Federal Register Vol. 81, No. 215 pp. 78143

Motorcycle emission standards and in-use emissions testing

CARB's emission standards and in-use testing for on-road motorcycles exceeds the stringency of any other in the nation. CARB's emission standards and in-use testing for on-road motorcycles (California's On-Road Motorcycle Regulation) set a Tier I and Tier II standard for 2004 and 2008 model years, respectively, for Class 3 motorcycles (280 cc or greater). California's evaporative emission limits for motorcycles exceed the stringency of any other in the nation, while exhaust emission a limits and test procedures are consistent with U.S. EPA's.

The 2022 State SIP Strategy committed to the On-Road Motorcycle New Emission Standard measure, which will further reduce emissions from new-on-road motorcycles through the adoption of more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds. The exhaust standards would be more stringent than current U.S. EPA standards and largely harmonized with the EU 5 standards. The evaporative standards would be more stringent than current U.S. EPA and EU 5 standards. This measure will also require an increase in new Zero-Emissions Motorcycle sales, starting at 10 percent in 2028 and progressing to 50 percent in 2035. California is the only state with emission control requirements for on-road motorcycles that exceed the stringency of U.S. EPA requirements.

REDUCING IN-USE EMISSIONS

The I/M Program testing and in-use emission controls in the Valley are consistent with the most stringent of any other I/M program in the nation. California's Smog Check Program is designed to reduce air pollution from California-registered passenger vehicles by requiring periodic inspections for emission control system problems, and by requiring repairs for any problems found. In California, technicians are required to perform an OBD II check (visual and functional) during the Smog Check inspection. On board, self-diagnostic equipment monitors a passenger vehicle's control components to ensure they are functioning correctly. Specifically, the technician visually checks to make sure the warning light is functional, and then the Smog Check test equipment communicates with the on-board computer for fault information. If a fault is currently causing the light to be on, the malfunctioning component must be repaired in order to pass the inspection.

- Stringency and Frequency of I/M Program

  The I/M Program testing and in-use emission controls in the San Joaquin Valley are consistent with the most stringent of any other I/M program in the nation. Biennial, change of ownership, and initial registration Smog Check inspections ensure that the in-use passenger vehicle fleet continues to operate as cleanly as possible. This is as frequent as Smog Check requirements as any other part of California and is consistent with the most stringent of any other area in the nation, and is the same frequency as the only other Extreme nonattainment area for ozone in the country, the South Coast. Additionally, a portion of vehicles must receive their biennial Smog Check inspections at STAR certified test only or test/repair stations that are required to meet high inspection-based standards.

Thirty-two other states and local areas have an I/M program in at least a portion of their state that is also consistent with the federal I/M program.

- Effectiveness of Inspection and Testing Methodology

  Nearly every state besides California that has an I/M program currently relies exclusively on vehicle OBD II system inspections as the basis for its emission inspections of 1996 and newer vehicles.[55] Only California and Colorado still use tailpipe testing: Colorado relies on tailpipe testing exclusively; California's Smog Check Program currently includes two overlapping inspection procedures. Under California's Smog Check program, each 1996 and newer model year vehicles vehicle is subjected to a tailpipe emission test, and also to an inspection of its OBD II system, which independently monitors the performance of the vehicle's emission control systems and related components during everyday driving.

  U.S. EPA acknowledges the viability of OBD II inspections by providing full emission credits to state I/M programs that are based on OBD II only inspections. While U.S. EPA and CARB have generally found that OBD II systems are more effective in detecting emission-related malfunctions on in-use vehicles compared to existing tailpipe testing procedures, the Smog Check Program utilizes both approaches – erring on the side of increased stringency – to ensure each vehicle passes both tests.[56]

  Furthermore, to ensure that California's Smog Check Program remains as effective as possible, CARB has committed in the 2016 State SIP Strategy to work with BAR staff to perform a joint agency, comprehensive evaluation of California's in use performance focused inspection procedures and, if necessary, make improvements to increase the Smog Check Program's effectiveness. CARB will conduct a study to further evaluate California's in-use performance inspection procedures through analysis of the Smog Check database and vehicle sampling obtained through BAR's Random Roadside Inspection Program. This will, as necessary: inform improvements in inspection test procedures; address program fraud; improve the effectiveness and durability of emission related repair work; and improve the regulations governing the design of in-use performance systems on motor vehicles.

FUELS

U.S. EPA administers federal RFG regulations requiring that gasoline sold in various areas of the country with poor air quality meet standards for federal reformulated

[55] CARB 2009 https://www.arb.ca.gov/msprog/smogcheck/march09/transitioning_to_obd_only_im.pdf

[56] California's Smog Check data indicates that vehicles are more than twice as likely to fail an OBD II-based inspection than the required tailpipe emissions test. CARB 2009 https://www.arb.ca.gov/msprog/smogcheck/march09/transitioning_to_obd_only_im.pdf

gasoline. Most gasoline sold in California is subject to the federal RFG standards as well as having to meet the CaRFG standards. All diesel fuel sold in California is subject to both California and federal standards. These standards work complimentarily.

Since 1995, U.S. EPA has required federal RFG to be used in the worst-polluted areas in the nation – including the Valley and other California nonattainment areas (Federal RFG Phase I 1995 requirements). Effective in 2000, U.S. EPA increased the stringency of the federal RFG requirements under the RFG II program. In 2014, U.S. EPA adopted its most recent amendments, Tier 3 Fuel standards, which require lower sulfur content in gasoline to a maximum of 10 ppm beginning in 2017 on an annual average basis, and lower Reid Vapor Pressure to zero, reducing fuel vapor emissions to near zero levels. The program also reduces PM emissions by approximately 70 percent, and NOx and VOCs emissions by approximately 80 percent, relative to the former federal Phase II levels (which were set in 1995). Sulfur content in gasoline is reduced from 30 parts per million (ppm) to 10 ppm on average.

In aggregate, the Tier 3 RFG requirements bring federal gasoline fuel controls in line with those already in place in California. However, CARB's gasoline specifications under the CaRFG requirements are still more stringent than the federal program. CARB significantly controls NOx emissions under requirements in CaRFG Phase 3 that are not mirrored by comparably stringent controls on NOx emissions under the federal RFG Phase 3 requirements. Relative to federal gasoline, CARB's reformulated gasoline program reduces NOx emissions by 15 percent and TACs by 50 percent. Additionally, CARB requires sulfur contents to be capped at 10 ppm, rather than an annual average of 10 ppm as required federally.

Beyond the Federal requirements described above, the Act also allows states to adopt unique fuel programs to meet local air quality needs, which are referred to as Boutique Fuel Programs. Most of these programs set lower gasoline volatility requirements than the federal standards, and most are effective for only part of the year. As of January 19, 2017, U.S. EPA provided as snapshot of these programs that had been approved in SIPs,[57] which are listed below in Table D-9 below. Table D-9 also compares the stringency of the boutique fuel requirements in these areas to CARB's CaRFG Phase 3. This comparison shows that the CaRFG Phase 3 program requires that California gasoline is the lowest-emitting and cleanest-burning in the nation.

[57] U.S. EPA, 2017 https://19january2017snapshot.epa.gov/gasoline-standards/state-fuels_.html

Table D-9 Boutique Gasoline Fuel Programs in the U.S.

Type of Fuel Control	State	Comparison to CaRFG Phase 3
Reid Vapor Pressure (RVP) of 7.8 psi	PA and IN (year-round) TX (May 1 – Oct 1)	CaRFG Phase III sets flat limits of RVP of 7.0 psi (oxygenated fuels) and 6.9 psi (non-oxygenated fuels)
RVP of 7.0 psi	KS, MI, MO, TX	CaRFG Phase III sets flat limits of RVP of 7.0 psi (oxygenated fuels) and 6.9 psi (non-oxygenated fuels)
Cleaner Burning Gasoline (Summer)	AZ	As of 2005, AZ requires CARB's CaRFG Phase III in certain areas
Cleaner Burning Gasoline (non-Summer)	AZ	As of 2005, AZ requires CARB's CaRFG Phase III in certain areas
Winter Gasoline (aromatics & sulfur)	NV	In 1999, Clark County (Las Vegas) adopted California sulfur and aromatics limits

STEP 3(A): EVALUATION OF STRINGENCY: LIGHT-DUTY CONTROL MEASURES

Step 3(a) calls for an evaluation of each of the potential control measures identified in Step 2, in order to evaluate their stringency and determine whether they meet all applicable requirements to satisfy the definitions of MSM as discussed in Section 1 and Section 2.

As shown in Table D-7 in Step 2(b), CARB's light-duty control measures are the most stringent in the nation. This comparison between CARB's control measures and the measures currently in place at the federal level and/or within other states and jurisdictions illustrates the stringency of the current CARB on-road light-duty vehicle control program, which meets the stringency requirements of MSM.

Furthermore, CARB staff have conducted an analysis of the timing of the mobile source control measures committed to in the 2022 State SIP Strategy, which go beyond the stringency of the current control program as it is now being implemented and thus beyond MSM. Many of these measures are still in their development phases and are not yet being implemented; the development timeline, however, is critical to allowing industry and technological advancements to progress sufficiently such that the newly emerging technologies called for in these regulatory actions (most of which are technology-inducing regulations) have sufficient time to attain market readiness. Table D-10, below, discusses the timeframe considerations for each of the applicable light-duty control measures, and indicates why a more expedited timeframe is neither technologically nor economically feasible. For these reasons, the measures meet the MSM requirement of being phased in as "expeditiously as practicable" and go beyond MSM requirements in terms of stringency.

Table D-10 Light-Duty Control Measures Stringency and Timeline for Implementation

Measures	Implementation Begins	12 μg/m³ Annual PM2.5 Standard (2012)
New Passenger Vehicle Standards		
Advanced Clean Cars (ACC) (Includes both LEV III and ZEV Program)	ongoing	MSM
Advanced Clean Cars 2 (ACC 2) (Includes both LEV IV and Amendments to the ZEV Program)	2026	MSM
Recently amended in 2022 to require that new vehicle sales are 100% ZEV by 2035, the ACC program requires increasingly stringent standards for gasoline cars and passenger trucks. The currently adopted standards and requirements, including the zero-emission requirements of ACC 1 and ACC 2, are technology-forcing and are the most stringent in the nation; further stringency would not be feasible. An accelerated timeline would also not be feasible as new car standards need years of lead time to be developed, certified, manufactured, and implemented.		
In-Use Emission Control Measures		
On-Board Diagnostics II (OBD II)	ongoing	MSM
Recently amended in 2021 to require program updates that address cold start emissions and diesel PM monitoring, many of the regulatory changes to OBD II are phased-in through 2027 to allow sufficient lead time for the necessary technological development, manufacturing, testing, certification, and implementation for the requisite hardware and software changes; accelerated timelines would not be feasible. OBD II requirements are the most stringent in the nation; further stringency would not be feasible.		
Smog Check	ongoing	MSM
Amended in 2010 to enhance program efficacy with new technologies and test methods. California Smog Check requirements are the most stringent passenger vehicle inspection and maintenance in the nation; further stringency would not be feasible.		
Control Measures to Reduce Vehicle Miles Traveled (VMT)		
Clean Miles Standard (2022 State SIP Strategy measure, adopted in 2021)	2023	MSM
Recently adopted in 2021 to set eVMT and GHG requirements for transportation network companies (TNCs). The Clean Miles Standard's zero-emissions technology requirements are the most stringent standard in the nation; further stringency would not be feasible. An accelerated timeline would also not be feasible as standards and fleet requirements need lead time to be implemented.		
Motorcycle Control Measures		
California On-Road Motorcycle Regulation	ongoing	MSM
On-Road Motorcycle New Emission Standards (2022 State SIP Strategy measure with commitment)	2025	Beyond MSM
Proposed amendments to California's on-road motorcycle program would require more stringent exhaust emissions standards that would harmonize with European standards, with a Board hearing date anticipated in 2023. Amendments may also include evaporative emissions standards and ZEM sales thresholds. With these amendments, the stringency of CARB's motorcycle program will exceed the stringency of any other U.S. jurisdiction, and will rely on recent developments in emission control technologies; further stringency would not be feasible. Accelerated timelines would also not be feasible as new standards need years of lead time for staff to evaluate feasibility, and for compliant motorcycle technologies to be developed, certified, and implemented.		
Fuels Control Measures		
California's Reformulated Gasoline (CaRFG) Phase III	ongoing	MSM
Amended in 2003 to require the removal of MTBE, and to included refinery limits and cap limits. CARB's gasoline standards and requirements are the most stringent in the world; it is not feasible to require further stringency of fuel specifications.		

STEP 3(B): EVALUATION OF FEASIBILITY: LIGHT-DUTY CONTROL MEASURES

Step 3(b) calls for an assessment of the feasibility of implementing any measure that is not included in the Valley's SIP, but which is identified as a potential MSM control measure in Step 2. During the public process for the 2022 State SIP Strategy, CARB staff received public measure suggestions for additional potential light-duty measures, as described below:

- Light-Duty Vehicle Fleet Regulation
  This measure would involve CARB developing a regulation to implement fleet requirements for public and rental passenger vehicle fleets. This could take the form similar to the recently adopted Clean Miles Standard, which requires an increasing number of electric miles service for ride hailing platforms, or it could take the form of a more traditional fleet rule that mandates the purchase of ZEVs. CARB has a suite of regulations in place to control emissions from light-duty vehicles, and continues to pursue new regulatory actions, in addition to incentives and other complementary programs that can help to accelerate emissions reductions. One such action is the recently adopted Advanced Clean Cars II program, which sets manufacturer sales requirements and continues to drive introduction of ZEVs into the light-duty fleet. Even so, additional fleet average requirements could potentially support a faster rate of transition to zero-emissions, especially in public and private passenger vehicle fleets, which are particularly suited for electrification.

  CARB staff is continuing to explore this suggested measure. CARB staff anticipate that the recently adopted ***Advanced Clean Cars II regulation***, along with existing CARB regulations and current State incentive programs, achieve a significant amount of the benefits that this suggested measure would accomplish. For this reason, it was not included as a measure in the 2022 State SIP Strategy.

- Enhanced Bureau of Automotive Repair Consumer Assistance Program
  This measure would involve CARB working with BAR to enhance the Consumer Assistance Program by expanding the eligibility threshold and/or amounts of funding offered for consumers towards repair assistance and vehicle replacement options. BAR has in place a Consumer Assistance Program[58] to offer eligible low-income consumers repair assistance and vehicle retirement options to help reduce emissions and improve air quality. The repair assistance program currently offers up to $1,200 for emissions-related repairs which correct problems contributing to a vehicle's failure to pass a Smog Check inspection. The vehicle retirement option currently offers income-eligible consumers $1,500 to retire their vehicle.

  CARB staff is continuing to explore this suggested measure and how it can meet the Act requirements for SIP measure approvability. For this reason, it is not

[58] Bureau of Automotive Repair (BAR) Consumer Assistance Program https://www.bar.ca.gov/consumer/consumer-assistance-program

included as a measure in the 2022 State SIP Strategy. Nonetheless, the recently adopted ***Advanced Clean Cars II regulation***, along with existing CARB regulations and current State incentive programs such as the ***Clean Cars 4 All Program***, achieve a significant amount of the benefits that this suggested measure would accomplish. Furthermore, the Clean Cars 4 All Program is under development for statewide expansion and will continue to focus on supporting the lowest income and disadvantaged communities.

- Enhanced Transportation Choices
  This suggested measure or measures would have CARB work with State and local transportation planning organizations, local governments, and communities to advance VMT reductions via enhanced choice. As the bulk of mobile source emissions come from existing vehicles, measures that provide Californians with additional choices as alternatives to using their personal vehicles, e.g. walking, biking, taking public transit, and/or adopting other transportation modes, at least some of the time, can significantly reduce emissions.

  Control measures for consideration could include, but are not limited to, travel demand management programs, incentive programs that fund enhanced transportation planning, or zoning changes that encourage dense, walkable, infill development. CARB staff is continuing to explore this suggested measure and how it can meet the Clean Air Act requirements for SIP measure approvability. For this reason, a SIP measure incorporating this suggestion was not integrated into the 2022 State SIP Strategy. Nonetheless, CARB is pursuing VMT reductions via other approaches, including through the ***Enhanced Regional Emission Analysis in State Implementation Plans measure***, which was committed to in the 2022 State SIP Strategy.

CARB staff continue to investigate the feasibility and potential emission reductions of these public measure suggestions, as well as whether they would meet the U.S. EPA's approvability criteria for SIP measures. Due to feasibility and approvability issues, these suggestions have not yet been formally developed into SIP control measures.

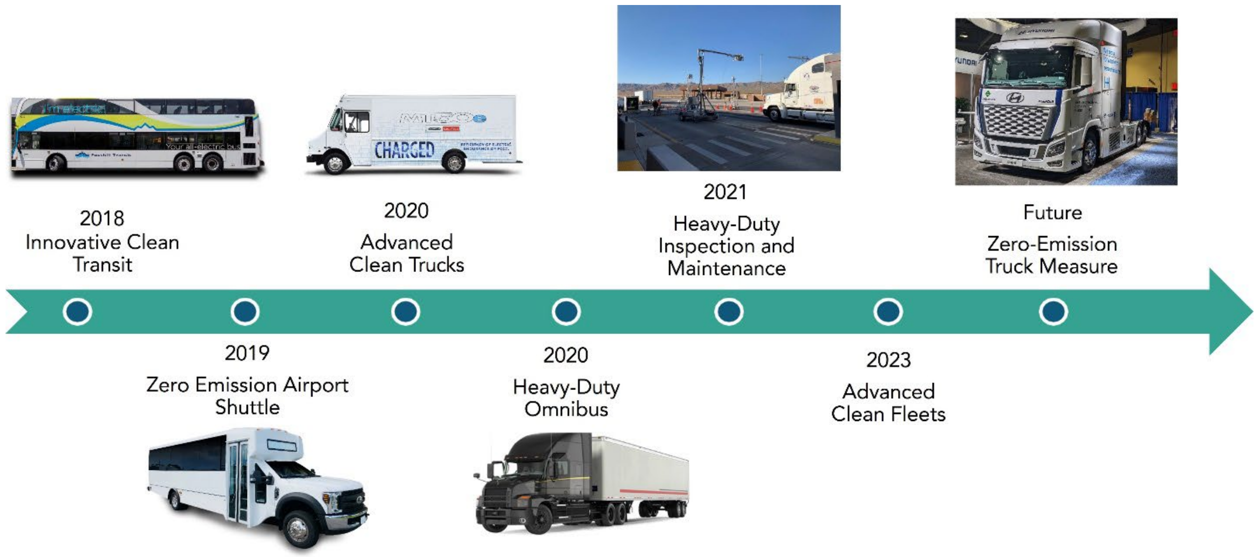
D.4.2 On-Road Medium- and Heavy-Duty Vehicles

On-road heavy-duty vehicles include buses and trucks over 8,500 pounds gross vehicle weight rate (GVWR), and include heavier pick-up trucks and walk-in vans, as well as a wide range of vocational and drayage trucks (big-rig trucks) and buses. These vehicles are one of the fastest growing transportation sectors in the United States, responsible for about 32 percent of total statewide NOx emissions, and are a significant source of statewide diesel PM and GHG emissions. The majority of these vehicles operate on diesel-cycle engines, especially in the higher weight classes. Gasoline and natural gas Otto-cycle spark-ignited engines are also used in heavy-duty trucks, to a lesser extent, and primarily in the lower weight classifications.

STEP 2(A): CALIFORNIA'S MEDIUM- AND HEAVY-DUTY CONTROL MEASURES

Through ongoing efforts, CARB has developed the most stringent and successful heavy-duty vehicle emission control program in the world. CARB has numerous programs currently in place to control emissions from medium- and heavy-duty vehicles including the Truck and Bus Regulation, Heavy-Duty Omnibus, Advanced Clean Trucks, as well as incentive programs such as the widely successful Carl Moyer Program. In addition, CARB recently adopted the Heavy-Duty Inspection and Maintenance regulation, a 2016 State SIP Strategy measure. Regulatory programs include requirements for increasingly tighter new engine standards, address vehicle idling, certification procedures, on-board diagnostics, emission control device verification, and requires accelerated turnover of the in-use fleet to cleaner, lower-emitting emission control and engine technologies. Due to the benefits of CARB's longstanding heavy-duty mobile source program, emissions in the San Joaquin Valley from this source category have been reduced significantly since 1990, and will continue to decrease through 2030. From today, medium- and heavy-duty NOx emissions are projected to decrease by over 80 percent in 2030, and emissions of direct PM are projected to decrease by nearly 39 percent in the same timeframe.

Figure D-4 Heavy-Duty Control Measures



The major regulatory and programmatic control measures that provide emission reductions in the on-road heavy-duty mobile source category are described below.

NEW VEHICLE AND ENGINE STANDARDS

Heavy-duty engine emission standards (mandatory standards)

California is the only state with the authority to adopt and enforce emission standards for new motor vehicle engines that differ from the federal emission standards. A central element of CARB's heavy-duty diesel vehicle program is requiring that new trucks, buses and on-road diesel engines meet increasingly stringent engine emission standards. CARB has phased-in implementation of these increasingly stringent ***new heavy-duty vehicle and engine emission standards*** since the mid 1980's, resulting in significant emission reductions.

As shown in Table D-11, California PM and NOx engine emission standards have historically been more stringent than applicable federal standards on several occasions, as indicated in the darker shaded portions of the table. In these instances, California has, functioning as a 'laboratory' state, paved the way for later federal increases in the stringency of PM and NOx emission standards. These standards reflect the increased efficiency in control technologies over time, as innovations in vehicles, engines, and emission-capturing technology progress. Since 1990, heavy-duty engine NOx emission standards have become dramatically more stringent, dropping from 6 grams per brake horsepower-hour (g/bhp-hr) in 1990 down to a 0.2 g/bhp-hr NOx standard, which took effect in 2010. Due to these requirements, new heavy-duty trucks sold since 2010 emit 98 percent less NOx and PM2.5 than new trucks sold in 1986.

On August 26, 2005, CARB obtained a waiver from the federal preemption for the Engine Standards for 2007 and Subsequent Model Year Heavy-Duty Diesel Engines/Vehicles regulation, which generally aligned California's mandatory heavy-duty emission exhaust standards with the federal standards for 2007 and subsequent model year vehicles and engines. Subsequent mandatory exhaust emission standards for heavy-duty engines that CARB has developed and adopted have aligned with federal standards until the 2021 ***Heavy-Duty Omnibus Regulation***, a measure in the 2016 State SIP Strategy, which further reduced California's NOx and PM limits for MY 2024 and subsequent years. When fully implemented in 2027, the Omnibus regulation will set NOx emission limits at 0.020 (miles ≤ 435,000), and 0.035 (435,000 - 600,000 miles), and PM emission limits at 0.005 g/bhp-hr.

Table D-11 Adopted California and Federal Heavy-Duty Engine Emission Standards

(for compression-ignition engines, shown in g/bhp-hr)

Model Year	California NOx		Federal NOx	California PM		Federal PM	
	General	Urban Buses		General	Urban Buses	General	Urban Buses
1985 -86	10.7		10.7	n/a		n/a	
1987	6.0		10.7	0.60		n/a	
1988 - 89	6.0		10.7	0.60		0.60	
1990	6.0		6.0	0.60		0.60	
1991 - 92	5.0		5.0	0.25	0.10	0.25	
1993	5.0		5.0	0.25	0.10	0.25	0.10
1994 - 95	5.0	5.0 3.50 - 0.50 Optional (1995+)	5.0	0.10	0.07	0.10	0.07
1996 - 97	5.0	4.0 2.50 - 0.50 Optional	5.0	0.10	0.05* *(*0.07 in-use)*	0.10	0.05* *(*0.07 in-use)*
1998 - 03	4.0 2.50 - 0.50 Optional		4.0	0.10 0.03 – 0.01 Optional (2002+)	0.05* *(*0.07 in-use)*	0.10	0.05* *(*0.07 in-use)*
2004 - 06	2.0	0.50 - 0.01	2.0	0.10 0.03 – 0.01 Optional	0.01	0.10	0.05* *(*0.07 in-use)*
2007 - 09	0.20* *phased-in (*fleet avg ~1.2)*	0.20	0.20* *phased-in (*fleet avg ~1.2)*	0.01		0.01	
2010 - 14	0.20		0.20	0.01		0.01	
2015 - 23	0.20 0.10 – 0.02 Optional		0.20	0.01		0.01	
2024 - 26	0.050 (0.020 Optional)		0.20	0.005		0.01	
2027 - 30	0.020 (miles ≤ 435,000), and 0.035 (435,000 - 600,000 miles) (0.010 Optional)		0.035	0.005		0.005	
2031+	0.020 (miles ≤ 435,000), and 0.040 (435,000 - 800,000 miles) (0.010 Optional)		0.035	0.005		0.005	

The Omnibus Regulation implemented two key measures in the 2016 State SIP Strategy: the Low-NOx Engine Standard, and the Lower In-Use Emission Performance Level measures. The Omnibus Regulation established stringent NOx and PM engine emission standards that, when fully implemented, will be 90 percent below current levels on existing certification cycles, and lower NOx standards on new certification cycles to control emissions over a broader range of vehicle operation, including idling, low load, and highway operation. In addition, the Omnibus Regulation revised the heavy-duty in-use testing program to make it more effective in ensuring compliance with the in-use emission standards over a broader range of vehicle operation and lengthened the useful life and emissions warranty period requirements to reflect the longevity of heavy-duty vehicles.

To support the Omnibus rulemaking, CARB, in partnership with federal and local air agencies and the heavy-duty engine industry, have funded over $5 million worth of research contracts with South Research Institute (SwRI) to evaluate various engine and emission control strategies to reduce NOx emissions from heavy-duty engines by 90 percent without or with minimal GHG impacts. The results from these contracts referred to as the Stage 1,[59] Stage 2,[60] and Stage 3[61] Heavy-Duty Low NOx Programs formed the bases for supporting the Omnibus Regulation. In addition, CARB had also contracted with the National Renewable Energy Laboratory to conduct a cost analysis for compliance with CARB's proposed lower NOx exhaust emission standards on current certification test cycles and a new low-load certification test cycle, as well as cost associated with increasing the useful life and emission warranty period requirements.[62]

Optional heavy-duty engine emission standards

In addition to mandatory NOx standards, CARB has also adopted several generations of ***optional lower NOx standards*** over the past 15 years. The optional standards allow local air districts and CARB to preferentially provide incentive funding to buyers of cleaner trucks, which encourages the development of cleaner engines, which in turn paves the way for future lower-NOx emission standards.

- From 1998 to 2003, optional NOx standards ranged from 0.5 g/bhp-hr to 2.5 g/bhp-hr, at 0.5 g/bhp-hr increments, which was much lower than the mandatory 4 g/bhp-hr limit.
- Starting in 2004, engine manufacturers could choose to certify to optional NOx + non--methane hydrocarbon (NMHC) standards ranging from 0.3 g/bhp-hr to 1.8 g/bhp-hr, at 0.3 g/bhp-hr increments, which was significantly below the mandatory 2.4 g/bhp-hr NOx+NMHC standard.
- In ongoing efforts to go beyond federal standards and achieve further reductions, CARB adopted in 2013 the ***Optional Reduced Emissions Standards for Heavy-Duty Engines*** regulation, which established the new generation of optional NOx emission standards for heavy-duty engines, and a certification pathway for a new generation of requirements for heavy-duty engines. Starting in 2015, engine manufacturers could certify to three optional NOx emission

[59] SwRI, 2017. "Evaluating Technologies and Methods to Lower NOx Emissions from Heavy-Duty Vehicles, Final Report" https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/13-312.pdf
[60] SwRI, 2020. "Heavy-Duty Engine Low-Load Emission Control Calibration, Low-Load Test Cycle Development, and Evaluation of Engine Broadcast Torque, and Fueling Accuracy During Low-Load Operations, Final Report" https://www.arb.ca.gov/lists/com-attach/1-hdomnibus2020-VDdXMFIhU2IAWQIw.pdf
[61] SwRI, 2021. "Further development and Validation of Technologies to Lower NOx Emissions from Heavy-Duty Vehicles, Final Report" https://www.arb.ca.gov/lists/com-attach/79-hdomnibus2020-Uj4AaQB2Aj8FbAhw.pdf
[62] NREL, 2020. "On-Road Heavy-Duty Low-NOx Technology Cost Study" https://www.nrel.gov/docs/fy20osti/76571.pdf

standards of 0.1 g/bhp-hr, 0.05 g/bhp-hr, and 0.02 g/bhp-hr (i.e., 50 percent, 75 percent, and 90 percent lower than then-current mandatory standard of 0.2 g/bhp-hr). This optional standard has resulted in substantial investments in California's heavy-duty fleets over the past decade in order to adopt modern, lower-emitting vehicles and equipment.

- Most recently, in ***2021, the Heavy-Duty Omnibus Regulation*** lowered CARB's optional NOx emission standards to 0.020 g/bhp-hr for MY 2024-26 and to 0.010 g/bhp-hr for MY 2027+.

Zero-Emission Truck Standards

Although ZEV technologies are not as mature for heavy-duty trucks as they are in the passenger vehicle sector, Class 3 - 7 delivery trucks and urban buses provide opportunities for the deployment of zero-emission technologies in targeted applications, due to their duty cycle, are well-suited to the initial introduction of heavy-duty zero-emission engines. Transit buses, last mile delivery vehicles, and airport shuttle buses are typically operated on short-distance fixed routes and are centrally housed and may be captive to a District – characteristics that make these applications ideally suited to deploying zero-emission vehicles in targeted heavier applications, preceding broader penetration in the heavy-duty engine market. These initial deployments provide a foundation for subsequent migration of zero-emission technology to other heavier platforms, in order to continue to expand heavy-duty ZEV requirements in the long term, especially in certain vocational classes and fleets that are under California regulatory authority.

In June 2020, CARB adopted the ***Advanced Clean Trucks Regulation (ACT),*** a measure in the 2016 State SIP Strategy, which is a first of its kind regulation requiring medium- and heavy-duty manufacturers to produce ZEVs as an increasing portion of their sales beginning in 2024. This regulation is expected to result in roughly 100,000 ZEVs by 2030, and nearly 300,000 ZEVs by 2035. The Advanced Clean Trucks Regulation is part of a holistic approach to accelerate a large-scale transition of zero-emission medium-and heavy-duty vehicles from Class 2b to Class 8. The regulation has a manufacturer sales requirement that requires manufacturers who certify Class 2b-8 chassis or complete vehicles with combustion engines to sell zero-emission trucks as an increasing percentage of their annual California sales from 2024 to 2035. By 2035, zero-emission truck/chassis sales would need to be 55 percent of Class 2b – 3 truck sales, 75 percent of Class 4 – 8 straight truck sales, and 40 percent of truck tractor sales. U.S. EPA recently issued a waiver of preemption for the Advanced Clean Trucks Regulation in March 2023.

In analyzing the feasibility of this regulation, CARB staff analyzed what types of trucks are currently suitable for electrification, the amount and variety of commercially available zero-emission trucks, as well as the cost of charging and ownership of battery electric trucks. Currently, medium- and heavy-duty electric drivetrains are well suited to operating in congested urban areas for stop-and-go driving where conventional engines are least efficient. Battery-electric and fuel-cell electric trucks, buses, and vans already are being used by fleets that operate locally and have predictable daily use where the trucks return to base to be charged or fueled. There are more than 70 different models of zero-emission vans, trucks and buses that already are commercially available from several manufacturers. Most trucks and vans operate less than 100 miles per day and several zero-emission configurations are available to serve that need. As technology advances, zero-emission trucks will become suitable for more applications. Most major truck manufacturers have announced plans to introduce market ready zero-emission trucks in the near future. The electricity cost to charge battery electric trucks varies based on how fast you charge, the utility rate, and the time of day. In many cases, a fleet owner who also owns charging stations and charges trucks overnight can have little to no net electricity costs after the Low Carbon Fuel Standard (LCFS) credits in California are included. Zero-emission trucks have higher upfront costs but have lower operating costs than conventional trucks. Currently, the total cost of ownership in California can be comparable to conventional trucks for certain duty cycles without grants or rebates. As battery prices fall and technology continues to improve, the total cost of ownership is expected to become more favorable. Incentives are currently available to offset some or all of the higher vehicle capital costs and some of the early infrastructure costs to help fleets begin transitioning to zero-emission vehicles now.

To date, six other states have adopted the California requirements of the Advanced Clean Trucks regulation under the provisions of Section 177 of the Act: Massachusetts, Vermont, New Work, New Jersey, Washington, and Oregon. 17 states, the District of Columbia, and the Province of Quebec, Canada, also have medium- and heavy-duty ZEV commitments.

Warranty Requirements and Useful Life

In 1978, CARB adopted ***Emission Warranty Regulations*** to clarify the rights and responsibilities of individual motor vehicle and engine owners, motor vehicle and engine manufacturers, and the service industry. The emission warranty is used to cover any repairs needed to correct defects in materials or workmanship which would cause an engine or vehicle not to meet its applicable emission standards. In 1982, CARB adopted regulations that established California's first in-use recall program. These regulations were intended to reduce vehicular emissions by ensuring that noncompliant vehicles are identified, recalled, and repaired to comply with the applicable emission standards and regulations during customer use, and to encourage manufacturers to improve the design and durability of emission control components to avoid the expense of a recall. Throughout the 1980's CARB adopted several regulations, such as the Emission Warranty Information Reporting program, which work in conjunction with the warranty regulations to identify malfunctioning emission control components and encourage repair. In 1982 and 1984, U.S. EPA promulgated heavy-duty vehicle useful life and warranty requirements identical to those adopted in California. Both U.S. EPA and CARB require that heavy-duty vehicles meet emission standards throughout their useful life periods. The current heavy-duty vehicle emission warranty period is 100,000 miles for all categories of heavy-duty vehicles with GVWR greater than 14,000 lbs.

Since the 2007 model year, all on-road heavy-duty diesel vehicles and heavy-duty diesel engines have been subject to stringent PM and NOx emission standards. Manufacturers have met these standards by equipping new heavy-duty diesel engines with diesel particulate filters (DPF) for control of PM, and beginning with the 2010 model year have also included systems for controlling NOx using exhaust gas recirculation (EGR) and selective catalytic reduction systems. These emission control systems can reduce NOx emissions by more than 95 percent and PM emissions by more than 99 percent. Therefore, if these components fail, an individual engine's and vehicle's emissions can dramatically increase. It is therefore crucial that these emission control systems continue to function as designed throughout a vehicle's life to ensure emissions remain low.

To update the on-road heavy-duty diesel vehicles warranty period, which had not changed substantially in California for almost 40 years (trucks were required to be covered by only a 5 year, 100,000 mile, or 3,000 hour emissions warranty period, whichever first occurred), CARB amended the warranty regulation for on-road heavy-duty vehicles with GVWR greater than 14,000 pounds in 2018 with the ***Amendments to California Emission Control System Warranty Regulations and Maintenance Provisions Regulation.*** For model year 2022 and later engines, these amendments lengthened existing warranty periods and maintenance provisions to better reflect the longevity and usage of modern vehicles, and to help ensure adequate durability and proper maintenance of the engine and emission controls. For MY 2022 - 2026, the useful life requirements for are the same for CARB and federal regulations. U.S. EPA warranty provisions cover 100,000 miles, or 5 years / 3,000 hours, for Class 4 – 8 trucks; California's more stringent warranty provisions cover:

- Class 8: 350,000 miles, or 5 years
- Class 6 – 7: 150,000 miles, or 5 years
- Class 4 – 5: 110,000 miles, or 5 years

The amendments also updated the minimum maintenance intervals so that vehicle owners do not inadvertently negate the proposed lengthened warranty periods, and explicitly link the heavy-duty On-Board Diagnostic (HD OBD) system to the definition of warranted parts, to help take full advantage of all of the tools available for ensuring the control of in-use emissions and to be consistent with the long-established link existing for light- and medium-duty vehicles.

Emissions warranties are intended to provide a level of assurance to the vehicle owner that the engine and its associated emission control systems are unlikely to experience defects in materials and workmanship that could result in the engine not performing as required. If such defects do occur during the warranty period, the manufacturer is liable for fixing them. Lengthened warranty periods may also reduce incidences of tampering and mal-maintenance. For example, there would be little incentive for a vehicle owner to tamper with the vehicle's emission control system, such as by coring out a DPF or bypassing a catalyst, when the manufacturer is obligated to pay for any defect-related repairs. Furthermore, vehicle owners would also have more of an incentive to timely perform scheduled maintenance so as not to void their lengthened warranty. Additionally, lengthened warranty periods are needed to protect heavy-duty vehicle owners from potentially high repair costs under the requirements of CARB's recent amendments to the Periodic Smoke Inspection Program (PSIP) and Heavy-Duty Vehicle Inspection Program (HDVIP), which include much stricter opacity limits intended to will spur more vehicle owners to make timely engine repairs and replace·DPFs.

CARB analyses of feasibility found evidence supporting the need for longer minimum warranties within manufacturers' warranty claim data for heavy-duty vehicles, as well as from recent CARB testing of in-use heavy-duty vehicles. Specifically, CARB's test programs had identified numerous heavy-duty vehicles with mileages within their applicable regulatory useful life periods, but beyond their warranty period, that had NOx emission levels significantly above their applicable certification standards.

In 2020, the ***Heavy-Duty Omnibus Regulation*** further amended the warranty and useful life provisions for heavy-duty engines. To help ensure emission controls are well-maintained and repaired when needed, and to help ensure more durable emission control systems, the Omnibus Regulation extends the criteria pollutant emissions warranty and useful life period requirements for heavy-duty vehicles and engines, as shown in Table D-12 Useful Life Periods and Table D-13 Warranty Periods. The revisions would be phased-in beginning with the 2027 model year engines with the final phase-in occurring in 2031.

Table D-12 Useful Life Periods

Model Year	Useful Life (miles)			
	Class 4 – 5 Diesel	Class 6 – 7 Diesel	Class 8 Diesel	Heavy-Duty Otto
Current – 2026	110,000 miles 10 years	185,000 miles 10 years	435,000 miles 10 years 22,000 hours	110,000 miles 10 years
2027–2030	190,000 miles 12 years	270,000 miles 11 years	600,000 miles 11 years 30,000 hours	155,000 miles 12 years
2031 and subsequent model years	270,000 miles 15 years	350,000 miles 12 years	800,000 miles 12 years 40,000 hours	200,000 miles 15 years

Table D-13 Warranty Periods

Model Year	Warranty (miles)			
	Class 4 – 5 Diesel	Class 6 – 7 Diesel	Class 8 Diesel	Heavy-Duty Otto
Current – 2026	110,000 miles 5 years	150,000 miles 5 years	350,000 miles 5 years	50,000 miles 5 years

2027–2030	150,000 miles 7 years / 7,000 hours	220,000 miles 7 years / 11,000 hours	450,000 miles 7 years 22,000 hours	110,000 miles 7 years / 6,000 hours
2031 and subsequent model years	210,000 miles 10 years / 10,000 hours	280,000 miles 10 years / 14,000 hours	600,000 miles 10 years 30,000 hours	160,000 miles 10 years / 8,000 hours

OBD Requirements

In addition to new vehicle emission standards for the heavy-duty fleet, CARB's suite of control measures also includes actions to ensure that the in-use fleet continues to operate as cleanly as possible through requiring that new vehicles come equipped with in-use inspections and on-board self-diagnostic equipment. OBD systems are designed to identify when a vehicle's emission control systems or other emission-related computer-controlled components are malfunctioning, causing emissions to be elevated above the vehicle manufacturer's specifications.

The first generation of OBD systems (referred to as OBD I) applied to medium-duty vehicles. OBD I was implemented by CARB in 1988 and required monitoring of only a few of the emission-related components on the vehicle. In 1989, CARB adopted regulations requiring a second generation of OBD systems (OBD II) that standardized the system and addressed the shortcomings of the OBD I requirements and required that all 1996 and newer medium-duty vehicles and engines to be equipped with OBD II systems.

In 2004, CARB adopted the first regulation requiring OBD systems on heavy-duty vehicles, knowns as the Engine Manufacturer Diagnostic (EMD) regulation. The EMD Regulation required manufacturers of heavy-duty engines and vehicles to implement diagnostic systems on all 2007 and subsequent MY on-road heavy-duty engines. The EMD Regulations were much less comprehensive than the OBD II regulations and were intended for heavy-duty manufacturers to achieve a minimum level of diagnostic capability. In 2005, CARB adopted ***Heavy-Duty Specific OBD Requirements (HD OBD)***, which applied to 2010 and subsequent model year heavy-duty engines and vehicles (i.e., vehicles with a gross vehicle weight rating greater than 14,000 pounds). This regulation required by 2013 that all heavy-duty engines offered for sale in California come equipped with OBD systems. U.S. EPA issued a waiver of preemption for the California 2010 Model Year Heavy-Duty Vehicle and Engine On-Board Diagnostic Standards in 2008, and has also issued two subsequent waivers for amendments CARB has made to the heavy-duty OBD requirements in later years to increase the stringency of these requirements.[63]

The emission "thresholds" for faults that must be detected by OBD systems are typically either a multiple of the exhaust emission standard (e.g., 2.0 times the applicable

[63] U.S. EPA 2012 "California State Motor Vehicle Pollution Control Standards; Amendments to the California Heavy-Duty Engine On-Board Diagnostic Regulation; Waiver of Preemption; Final Notice of Decision" Federal Register Volume 77, Number 237 pp. 73459-73461 https://www.gpo.gov/fdsys/pkg/FR-2012-12-10/pdf/2012-29792.pdf

standard), or an additive value above the standards (e.g., 0.2 g/bhp-hr above the applicable standards). For the most important emission control systems such as the PM filter and SCR system, the OBD regulation specifies malfunction criteria and emission thresholds for detecting a malfunction and illuminating the MIL based on emission increases (defined by additive and multiplicative factors) relative to the emission standard. For example, on 2016 and subsequent MY diesel engines, the OBD system must be designed to detect an SCR catalyst malfunction when the catalyst has deteriorated to the point that the engine's emissions are exceeding the NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the exhaust emission standard is 0.20 g/bhp-hr).

Under the ***Heavy-Duty Omnibus Regulation***, NOx emission standards will, upon full implementation with MY 2027 and later years, be reduced to a tenth of the current 0.20 g/bhp-hr standard, and PM standards to one half of today's standard. Because the OBD emission thresholds are often defined as an additive or multiplicative function of the standard, without amendments to the OBD threshold requirements, the OBD thresholds would similarly be reduced along with the proposed standards (e.g., the NOx threshold would become 2.0 times the new lower emission standard). While detection of faults at these proportionally lower levels will likely be required in the future as it will be necessary to ensure the maximum benefits of the proposed standards are maintained in-use, the engine manufacturers have expressed concern about not knowing with certainty what impact the lower standards will have on their OBD monitoring capability. As such, the engine manufacturers have requested interim relief until they have more certainty on what emission thresholds are achievable. To address engine manufacturers' concerns regarding not knowing with certainty at what emission levels their OBD systems will be able to detect faults, CARB staff is amending both the HD OBD Regulation and the OBD II Regulation (for engines used in medium-duty vehicles) with the Omnibus Regulation, which will provide an interim level of relief for manufacturers by maintaining OBD thresholds for NOx and PM effectively at the same levels as required for today's standards. With this relief, engine manufacturers can first focus on the necessary emission control solutions to meet the current standards before turning to improvements that may be necessary to ensure robust detection of faults at the lower emission levels. Omnibus also requires updates to address cold start emissions and diesel PM monitoring.

REDUCING IN-USE EMISSIONS

While increasingly stringent standards for new vehicles and engines collectively ensure that new vehicles are as clean as possible, older, higher-emitting heavy-duty vehicles with long useful lifecycles can remain on the road for many years. To address this legacy fleet, CARB has adopted heavy-duty vehicle in-use control measures to significantly reduce PM2.5 and NOx emissions from existing diesel vehicles operating in California. These measures fall within three categories: measures that utilize inspections and maintenance programs in order to improve in-use emission performance levels; truck idling requirements; and fleet turnover rules.

Inspection and Maintenance (I/M) Program

CARB also adopted a suite of control measures to lower in-use emission performance levels to ensure that the heavy-duty vehicles in the in-use fleet continue to operate at their cleanest possible level.

Opacity Limits

The ***Heavy-Duty Vehicle Inspection Program (HDVIP)***, adopted into law in 1988, requires heavy-duty vehicles to be inspected for smoke opacity (i.e., excessive smoke), tampering, and engine certification label compliance. Any heavy-duty vehicle operating in California, including vehicles registered in other states and foreign countries, may be inspected. Inspections are performed by CARB inspection teams at border crossings, California Highway Patrol weigh stations, fleet facilities, and randomly selected roadside locations.

To ensure that in-use heavy-duty vehicles continue to operate at their cleanest possible level CARB's 2018 amendments to the ***Periodic Smoke Inspection Program (PSIP)*** and HDVIP programs lowered the opacity limits for on-road heavy-duty trucks beyond the existing opacity limits (40 and 55 percent), which were no longer adequate to identify and require repairs of vehicles operating with damaged PM emission control components – even vehicles with heavily damaged and malfunctioning emission control systems emit exhaust at opacity levels below those opacity limits. To tighten these standards, and further control emissions form the many HD vehicles operating in California emitting excess PM emissions, staff developed lower opacity limits which reflect the current emission control technology equipped on today's HD diesel vehicles. The ***2018 Amendments to the Periodic Smoke Inspection Program (PSIP)*** require all California-based fleets of two or more heavy-duty diesel vehicles over 6,000 pounds GVWR with engines over four years old are required to perform annual smoke opacity tests (1998 and newer diesel vehicles between 6,000–14,000 pounds GVWR subject to biennial smog check are not subject to PSIP). Allowable levels of Smoke Opacity are shown in Table D-14 below.

Table D-14 Allowable Levels of Smoke Opacity

Engines Equipped with a Diesel Particulate Filter (DPF)	
5% Opacity Limit	
Pre-2007 Model Year (MY) Engines without a DPF	
1997– 2006 MY Engines	20% Opacity Limit
1991–1996 MY Engines	30% Opacity Limit
Pre-1991 MY Engines	40% Opacity Limit
Engines Equipped with a Level 2 Verified Diesel Emission Control Strategy (VDECS)	
20% Opacity Limit	
Two-Engine Cranes Driven by a non-DPF Off-Road Engine	
40% Opacity Limit	

The amendments also help to improve the identification and repair of malfunctioning PM emission control components on HD diesel vehicles in California. Lowering the opacity limits to the newer levels helps to ensure that the opacity limits are more representative of current PM emission control technology, and that vehicles operating with malfunctioning PM emission control components are more readily identified and repaired.

I/M Testing

All heavy-duty vehicles in California are subject to in-use inspections in order to control excessive smoke emissions and tampering. The ***Periodic Smoke Inspection Program (PSIP)***, adopted in 1990, requires heavy-duty vehicle fleet owners to conduct annual smoke opacity inspections of their vehicles, and have them repaired if excessive smoke emissions are observed. In addition, CARB has the authority to randomly audit these fleets, by reviewing the owners' maintenance and inspection records, and conducting opacity inspections on a representative sample of the vehicles. The current PSIP opacity limits are the same as for HDVIP (40 and 55 percent).

To ensure that in-use heavy-duty vehicles continue to operate at their cleanest possible level, the ***2020 Heavy-Duty Omnibus Regulation*** amended the Heavy-Duty In-Use Testing (HDIUT) Program by revising procedures to better represent heavy-duty vehicle operations in real world conditions, establishing clearer criteria for engine family pass/fail determination, and requiring OBD data during testing to verify the condition of the test vehicle and sensors. These amendments apply to 2024 and subsequent model year engines, and replace the current NTE-based methodology with a new three-bin moving average windows-based methodology. The three bins cover idle, low load, and medium to high load operation. Compliance would be determined by comparing the average NOx emissions for each bin to the in-use threshold, defined as one and a half times the applicable standard for the model year.

The Omnibus Regulation also established a new standardized methodology for demonstrating durability. The standardized methodology increases the default break-in period from the current 125 hours to 300 hours for on-road heavy-duty diesel engines, and requires standardized certification cycles for engine and aftertreatment system aging in order to validate component durability and determine exhaust emissions deterioration factors. It also requires additional engine aging (i.e., increased durability hours) compared to what existing certification requirements, allowing manufacturers to use accelerated aging cycles for a portion of the useful life demonstration for aftertreatment systems, provided that those manufacturers periodically submit in-use emissions data generated from their on-road heavy-duty diesel engines.

Additionally, heavy-duty vehicles registered in California are now required to demonstrate annual compliance with HD I/M program requirements in order to register with the Department of Motor Vehicles, under the ***Heavy-Duty Inspection and Maintenance Program (HD I/M).*** Senate Bill 210 (Leyva, Chapter 298, Statutes of 2019) directed CARB to develop and implement a comprehensive heavy-duty vehicle inspection and maintenance regulation requiring periodic vehicle emissions testing and reporting on nearly all heavy-duty vehicles operating in California. The Board approved the HD I/M regulation on December 9, 2021, with implementation to be phased in starting January 2023. Combining periodic vehicle testing with other emissions monitoring and expanded enforcement strategies, the HD I/M regulation ensures that vehicles' emissions control systems are properly functioning when traveling on California's roadways, and that polluting, poorly maintained heavy-duty vehicles operating in California are quickly identified and repaired. At full implementation, the HD I/M regulation will require heavy-duty vehicles to undergo periodic emissions testing to reduce particulate matter and NOx emissions, and to protect communities most impacted by air pollution.

Beginning in January 2023, CARB is using roadside emissions monitoring devices (REMD) to screen for vehicles that may have high emissions. Vehicles flagged as potential high emitters may be required to undergo follow-up vehicle compliance testing to ensure they are operating with properly functioning emissions control systems. If a vehicle is identified as a potential high emitter through REMD, the owner will receive a Notice to Submit to Testing (NST) from CARB. Upon receival, they will have 30 calendar days to submit to CARB a passing HD I/M compliance test performed by a HD I/M tester. The type of HD I/M compliance test a vehicle will undergo depends on whether it is equipped with OBD or not. OBD-equipped vehicles are required to undergo a scan of the engine's OBD data using a CARB-validated OBD test device. Diesel vehicles and diesel hybrids with 2013 and newer model year engines have OBD systems. For alternative fuel vehicles, 2018 and newer model year engines have OBD systems. Non-OBD vehicles, i.e., those that don't meet the engine model year requirements, are required to undergo a smoke opacity test and a visual inspection of the vehicle's emissions control equipment, referred to as the Vehicle Emissions Control Equipment Inspection. Vehicles that are currently subject to PSIP must still perform their annual compliance inspections.

Starting in mid-2023, vehicle owners will be required to create owner accounts in CARB's HD I/M database, verify the vehicles in their fleets, and pay the first annual compliance fee for each vehicle. Once enforcement begins, vehicle owners that don't comply with these requirements may be cited for non-compliance and/or have their DMV vehicle registrations blocked. Upon enforcement of the requirements to establish owner accounts with vehicle information as described above, freight contractors and brokers must verify that heavy-duty vehicles they contract with for services are in compliance with the HD I/M regulation. This also includes public agencies that contract for heavy-duty truck services. Furthermore, seaport and railyard facilities must also verify compliance with the HD I/M regulation for vehicles that enter their facilities.

HD I/M periodic compliance testing for all vehicles that operate in California will start no earlier than January 1, 2024. Upon implementation of HD I/M periodic compliance testing, nearly all vehicles will be required to undergo twice per year testing with results submitted to CARB. On-road agricultural vehicles and California-registered motorhomes only will be required to undergo testing once per year. Three years after the start of HD

I/M periodic compliance testing, OBD equipped vehicles will be required to undergo testing four times per year. On-road agricultural vehicles and California-registered motorhomes will remain on the once per year testing frequency, even if equipped with OBD.

Idling Requirements

To reduce idling emissions from new heavy-duty diesel vehicles and emissions from auxiliary power units used as alternatives to heavy-duty vehicle idling, the Airborne Toxic Control Measure (ATCM) to Limit Diesel-Fueled Commercial Motor Vehicle Idling ***(Heavy-Duty Diesel Vehicle Idling Reduction Program)*** requires, among other things, that drivers of diesel-fueled commercial motor vehicles with gross vehicle weight ratings greater than 10,000 pounds, including buses and sleeper berth equipped trucks, not idle the vehicle's primary diesel engine longer than five minutes at any location. First adopted in July 2004 and subsequently amended, the regulation consists of new engine and in-use truck requirements and emission performance requirements for technologies used as alternatives to idling the truck's main engine. Under the new engine requirements, 2008 and newer model year heavy-duty diesel engines need to be equipped with a non-programmable engine shutdown system that automatically shuts down the engine after five minutes of idling. In 2012, U.S. EPA issued a waiver of preemption for the most recent amendments made to the Idling Reduction Program in 2006, beginning in model year 2008.[64] The ***Heavy-Duty Omnibus Regulation*** reduces idling limits for heavy-duty diesel vehicles from 30 g/hr to 10 g/hr in MY 2024, and to 5 g/hr in MY 2027.

Fleet Rules

CARB's ***Cleaner In-Use Heavy-Duty Truck Regulation (Truck and Bus Regulation)*** impacts approximately one million inter- and intra-state vehicles and requires privately and federally owned diesel fueled trucks and buses and privately and publicly owned school buses to fully upgrade to newer, cleaner engines by 2023. This regulation leverages the benefits provided by new truck emission standards by accelerating introduction of the cleanest trucks. The Truck and Bus Regulation was adopted in December 2008, and was amended in both December 2010 and December 2014. The regulation represents a multi-year effort to turn over the legacy fleet of engines and replace them with the cleanest technology available. While heavy-duty engine technology has become significantly cleaner in the past few decades, the long useful lives of some heavy-duty engines means that older, higher-emitting trucks remain on the road for many years after newer generations of engine standards have gone into effect.

Starting in 2012, the Truck and Bus Regulation phased in requirements so that by 2014, nearly all vehicles operating in California will have PM emission controls, and by 2023

[64] U.S. EPA 2012 "California State Motor Vehicle and Nonroad Engine Pollution Control Standards; Truck Idling Requirements; Final Notice of Decision" Federal Register Volume 77, Number 32, pp. 9239-9250 http://www.gpo.gov/fdsys/pkg/FR-2012-02-16/pdf/2012-3690.pdf

nearly all vehicles meet 2010 model year engine emissions levels. The regulation applies to nearly all diesel fueled trucks and buses with a GVWR greater than 14,000 pounds that are privately or federally owned, including on-road and off-road agricultural yard goats, cargo handling equipment, drayage trucks, solid waste collection vehicles, and school buses. Moreover, the regulation applies to any person, business, school district, or federal government agency that owns, operates, leases or rents affected vehicles. The regulation also establishes requirements for any in-State or out-of-State motor carrier, California-based broker, or any California resident who directs or dispatches vehicles subject to the regulation. Finally, California sellers of a vehicle subject to the regulation must disclose the regulation's potential applicability to buyers of the vehicles. In January 2017, U.S. EPA granted a waiver of preemption for the portions of the Truck and Bus Regulation for which a waiver was required.[65]

To move beyond combustion engines toward electrification of the heavy-duty fleet, CARB recently approved the ***Advanced Clean Fleets Regulation***, which will accelerate the market for zero-emission trucks, vans, and buses by requiring fleets that are well suited for electrification, to transition to ZEVs where feasible. With the adoption of the Advanced Clean Trucks Regulation, CARB Resolution 20-19 directed staff to return to the Board with a zero-emission fleet rule and sets the following targets for transitioning sectors to ZEVs:

- 100 percent zero-emission drayage, last mile delivery, and government fleets by 2035;
- 100 percent zero-emission refuse trucks and local buses by 2040;
- 100 percent zero-emission-capable vehicles in utility fleets by 2040; and
- 100 percent zero-emission everywhere else, where feasible, by 2045.

Achieving these and other milestones also contributes to meeting the goals in the Governor's Executive Order N-79-20. With the Advanced Clean Fleets Regulation, CARB anticipates developing a regulatory action that will accelerate ZEV adoption in the medium- and heavy-duty sectors by setting zero-emission requirements for fleets. The ***Advanced Clean Fleets Regulation*** accelerates ZEV adoption in the medium-to heavy-duty sectors and for light-duty package delivery trucks by setting zero-emission requirements for fleets. This regulation targets drayage trucks, public fleets, and other high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments such as last mile delivery, drayage, and government fleets. The regulation will phase in ZEV requirements for different fleets, including components as follows:

- Beginning January 1, 2024, all additions to High Priority fleets (fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues) and federal fleets must be ZEVs, and all combustion vehicles must be removed from

[65] U.S. EPA 2017 "Final Notice of Decision - On-Highway Heavy-Duty Vehicle and Engine Regulations for 2007 and Subsequent Model Years" Accessed April 30, 2017 at https://www.gpo.gov/fdsys/pkg/FR-2017-01-17/pdf/2017-00940.pdf Federal Register / Vol. 82, No. 10 / Tuesday, January 17, 2017 pp. 4867

the California fleet at the end of their useful life, or fleets may opt to phase-in ZEV requirement where a portion of the fleet must be zero-emission based on a pre-determined schedule.
- State and local government fleets including cities, counties, special districts, and other municipalities would be required to add only ZEVs to their fleets starting at 50 percent of new additions in 2024 and 100 percent starting in 2027 or fleets may opt to phase-in ZEV requirement where a portion of the fleet must be zero-emission based on a pre-determined schedule. Small public fleets or those that are based in designated low population counties would begin with 100 percent ZEV additions starting in 2027.
- Beginning January 1, 2024, any truck added to drayage service would need to be a ZEV. All drayage trucks entering seaports and intermodal railyards would be required to be zero-emission by 2035.
- 100 percent of medium- and heavy-duty vehicle sales in California would be zero-emissions starting in 2036.

Due to the recently-approved Advanced Clean Fleets Regulation and the Advanced Clean Truck Regulation, the number of medium- and heavy-duty ZEVs operating in California will be about 1.7 million by 2045.

In analyzing the feasibility of this regulation, CARB staff found that medium- and heavy-duty ZEVs that are commercially available today are already capable of meeting the daily needs of most local and regional trucking operations, and a variety of vocational uses. Fleet owners reported information about their vehicles and operations as part of the Large Entity Reporting program;[66] data collected in 2021 that shows that the vast majority of trucks drive 100 miles or fewer per day. Today’s medium- and heavy-duty ZEVs have energy storage systems that can meet most of these daily operational requirements. As technology advances, zero-emission trucks will become suitable for more applications. Most major truck manufacturers have announced plans to introduce market ready zero-emission trucks in the near future.

Zero-emission truck availability (as of July 2022):

- 148 models in North America are available for order or pre-order. There are more than 70 different models of zero-emission vans, trucks and buses that already are commercially available from several manufacturers.
- 135 models are actively being produced and delivered to customers.
- At least 35 manufacturers are producing vehicle Class 2b through 8 ZEVs.

Another measure committed to in the 2022 State SIP Strategy, the ***Zero-Emission Trucks Measure,*** is also being developed, designed to accelerate the number of zero-emissions trucks beyond existing measures (including the Advanced Clean Fleets Regulation and Advanced Clean Truck Regulation): the previously adopted Advanced Clean Truck Regulation will result in almost 420,000 ZE trucks on the road by 2037, and

[66] Large Entity Reporting https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks/large-entity-reporting

the more recently adopted Advanced Clean Fleets Regulation would increase the number of ZE trucks by another 220,000 to a total of 640,000. However, in 2037, even after the implementation of the Advanced Clean Truck and Advanced Clean Fleets Regulations, about 480,000 heavy-duty combustion powered trucks will still be on the road. In this modified approach, staff would seek to upgrade these remaining heavy-duty combustion trucks to new or used ZE trucks rather than to trucks with cleaner combustion engines. For this measure, staff would implement regulatory strategies to achieve the goal of transitioning the remainder of the heavy-duty combustion fleet to ZE trucks. This measure was originally proposed as a public measure suggestion based on the input from community-based organizations and members of the public during the development of the 2022 State SIP Strategy. CARB staff decided to develop this public measure suggestion into a SIP measure commitment, which will go beyond MSM requirements.

Drayage Trucks

Drayage trucks are subject to requirements under the ***Truck and Bus Regulation***, which requires 2010 Model Year or newer engines to continue entering ports and rail yards starting on January 1, 2023.
Under the ***Advanced Clean Fleets Regulation***, CARB is further strengthening emission controls for drayage fleets; all drayage trucks entering seaports and intermodal railyards would be required to be zero-emission by 2035. Advanced Clean Fleets Regulations controls drayage emissions through three main components:

- Zero-emission drayage truck requirements
  Drayage trucks will be required to start transitioning to zero-emission technology beginning in 2024, with full implementation by 2035
- Drayage Truck Registration Requirements
  All drayage trucks intending to begin or continue operations at a California seaport or intermodal railyard must be registered with CARB. Beginning in 2035, all trucks in the CARB Online System will be required to be zero-emission.
- Removing Combustion-Powered Drayage Trucks from Service
  Non-zero-emission (legacy) drayage trucks with a 2010 or newer model year engine may register in the CARB Online System on or before January 1, 2024. Beginning in 2024, all legacy drayage trucks must visit a seaport or intermodal railyard at least once each year to remain in the CARB Online System. Legacy drayage trucks 12 years old must begin reporting their mileage annually in 2025 and, can remain in the system until they reach their minimum useful life (either 800,000 miles or the engine is older than 18 years, whichever comes first). Beginning in 2025, legacy drayage trucks will be removed from the CARB Online System if they did not meet the annual visit requirement, OR if they have exceeded their minimum useful life requirements.

Solid Waste Collection Vehicles

The ***Solid Waste Collection Vehicle Regulations*** were adopted in 2003 to reduce toxic diesel particulate matter (diesel PM) from approximately 12,000 diesel-fueled commercial and residential solid waste collection vehicle (SWCV) and recycling collection vehicles operated in California. The rule applies to all SWCVs of 14,000 pounds or more that run on diesel fuel, have engines in model years (MY) from 1960 through 2006, and collect waste for a fee. Additionally, SWCVs are subject to requirements under the ***Truck and Bus Regulation***, which requires 2010 Model Year or newer engines as of January 1, 2023.

The ***Advanced Clean Fleets Regulation***, approved by the CARB Board in April 2023, will accelerate ZEV adoption among solid waste collection vehicles. This regulation targets all state and local government fleets, and high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments. The Advanced Clean Fleets Regulation would phase in ZEV requirements for different fleets, including State and local government fleets and those owned by or contracted with municipalities, including waste fleets. 100 percent of solid waste collection vehicle sales in California would be zero-emissions starting in 2036.

Public Agency and Utility Vehicles

California's ***Diesel Particulate Matter Control Measure for Municipality or Utility On-Road Heavy-Duty Diesel Fueled Vehicles*** (***Public Agency and Utility Regulation***) requires a municipality or utility that owns, leases or operates on-road diesel fueled vehicles with engine model year 1960 or newer and GVWR greater than 14,000 pounds to reduce PM2.5 emissions to 0.01 g/bhp-hr. This can be done by repowering, retrofitting, or retiring the vehicle. Implementation of the rule started in 2007, with a compliance schedule based on the engine model year. Additionally, public agencies and utilities' fleets may be subject to requirements under the Truck and Bus Regulation.

The ***Advanced Clean Fleets Regulation***, approved by the CARB Board in April 2023, will accelerate ZEV adoption among public fleets. This regulation targets public fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments such as government fleets. The Advanced Clean Fleets Regulation will phase in ZEV requirements for different fleets, including requirements for State and local government fleets (including cities, counties, special districts, and other municipalities) to add only ZEVs to their fleets starting at 50 percent of new additions purchased in 2024 and 100 percent starting in 2027, or fleets may opt to phase-in ZEV requirement where a portion of the fleet must be zero-emission based on a pre-determined schedule. Small public fleets and those that are based in designated low population counties would begin with 100 percent ZEV additions starting in 2027.

Transit Agencies

Adopted in 2000, the ***Fleet Rule for Transit Agencies (Transit Fleet Rule)*** requires reductions in diesel PM and NOx emissions from urban buses and transit fleet vehicles and required future zero-emission bus purchases. Urban bus fleets were required to select either the diesel path or the alternative-fuel path. Transit agencies on the diesel path needed to demonstrate zero-emission buses, and to meet the zero-emission bus purchase requirements sooner, while agencies on the alternative-fuel path had to ensure that 85 percent of urban bus purchases were alternative fueled without a demonstration requirement. The Transit Fleet Rule was amended in 2004, and again in 2006. The 2006 amendments temporarily postponed the zero-emission bus purchase requirement (until 2011 and 2012, depending on the compliance path) and expanded the initial demonstration with a subsequent advanced technology demonstration phase. In 2009, CARB staff provided a technology update to the Board on the commercial readiness of zero-emission buses, and received Board direction to research and develop commercial readiness metrics to be used as criteria to initiate the zero-emission bus purchase requirement, and to conduct a technology assessment on the readiness of zero-emission bus technologies. U.S. EPA granted CARB a waiver of preemption for the Fleet Rule for Transit Agencies in 2013.[67] Additionally, transit fleets are subject to requirements under the Truck and Bus regulation.

In 2018, CARB adopted the ***Innovative Clean Transit (ICT) Regulation***, which requires all public transit agencies to gradually transition to a 100 percent zero-emission bus (ZEB) fleet. Beginning in 2029, 100 percent of new purchases by transit agencies must be ZEBs, with a goal for full transition by 2036. It applies to all transit agencies that own, operate, or lease buses with a gross vehicle weight rating (GVWR) greater than 14,000 lbs. It includes standard, articulated, over-the-road, double-decker, and cutaway buses. Under the ICT Regulation, requirements differ for large and small transit agencies. A transit agency is considered large if it operates at least 100 buses in annual maximum service in an urbanized area with a population of at least 200,000. However, if an agency operates in either the San Joaquin Valley or the South Coast Air Basins with more than 65 buses in annual maximum service, it is also considered a large transit agency. The ICT Regulation includes the following elements:

- A ZEB Rollout Plan required from each transit agency, approved by its Board, to show how it is planning to achieve a full transition to zero-emission technologies by 2040. Large transit agencies have to submit their Rollout Plan by July 1, 2020, and small transit agencies by July 1, 2023;
- ZEB purchases with various exemptions and compliance options to provide safeguards and flexibility to transit agencies;

[67] U.S. EPA 2013, "California State Motor Vehicle Pollution Control Standards; Urban Buses; Request for Waiver of Preemption; Final Notice of Decision" Federal Register July 23, 2013 Volume 78, Number 141 pp. 44112-44117 https://www.gpo.gov/fdsys/pkg/FR-2013-07-23/pdf/2013-17700.pdf

- Low NO_x engine purchases, unless the transit buses are dispatched from NO_x Exempt areas;
- Use of renewable diesel or renewable natural gas for large transit agencies; and
- Reporting and record keeping requirements.

As shown in Table D-15, ZEB purchase requirements begin in 2023 for large transit agencies and 2026 for small transit agencies, based on a percentage of new bus purchases each year that must be zero-emission. The ZEB purchase requirements for articulated, over-the-road, double-decker, or cutaway buses do not start until 2026 or later. These bus types remain exempt from the ZEB purchase requirements until they pass the Altoona testing.

Table D-15 ZEB Purchase Schedule
(ZEB Percentage of Total New Bus Purchases)

Year	Large Transit	Small Transit
2023	25%	-
2024	25%	-
2025	25%	-
2026	50%	25%
2027	50%	25%
2028	50%	25%
2029	100%	100%

Last Mile Delivery

California's emission controls for last mile delivery vehicles (Class 3-7 heavy-duty delivery trucks used to deliver freight from warehouses and distribution centers to the final point of sale or use) are the most stringent in the country. ***Truck and Bus Regulation*** requires MY 2010 or equivalent engines by 2023.

Further increases in the stringency of last mile delivery fleets are anticipated under the ***Advanced Clean Fleets*** Regulation. Approved by CARB in April 2023, the Advanced Clean Fleets Regulation will accelerate ZEV adoption in the medium- and heavy-duty sectors by setting zero-emission requirements for fleets. This regulation high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments. With this measure, staff anticipates bringing to the Board for consideration a regulation that would phase in ZEV requirements for different fleets, resulting in 100 percent of medium- and heavy-duty vehicle sales in California being zero-emissions starting in 2040.

Airport Shuttle Buses

The ***Zero-Emission Airport Shuttle Bus*** Regulation was adopted in 2019 and requires airport shuttle operators to transition to 100 percent zero-emission vehicle (ZEV) technologies. Airport shuttle operators must begin adding zero-emission shuttles to their fleets in 2027 and complete the transition to ZEVs by the end of 2035. The Regulation applies to airport shuttle operators who own, operate, or lease vehicles at any of the 13 California airports regulated under this rule (regulated airports), including Fresno Yosemite International Airport. Airport shuttle buses transport passengers between car parking lots, airport terminals, and airport car rental facilities. Airport shuttles that fall under the regulation include those with GVWR of 8,501 lbs or greater, which transport passengers to, from, or around a regulated airport, shuttles based or housed within 15 miles of a regulated airport that have round trip routes equal to or less than 30 miles, and shuttles with fixed destination routes that may include stops at locations such as rental car facilities, on-airport or off-airport parking, hotels, or other tourist destinations. (A fixed destination route is a predetermined route that transports passengers between the same locations, although the number of stops along the route may vary.)

Airport shuttle fleets must meet fleet ZEV requirements according to the compliance schedule in Table D-16. After January 1, 2023, a fleet owner choosing to replace a ZEV in the existing fleet must replace it with another ZEV. Model year 2026 (and later) airport shuttles greater than 14,000 lbs (GVWR) must comply with the Zero-Emission Powertrain Certification Regulation. Reporting and record keeping requirements begin in 2022.

Table D-16 Zero-Emission Airport Shuttle Regulation Requirements

Airport Shuttle Buses – Fleet ZEV Requirements	
Compliance Deadline	**Percent of Fleet that Must be Zero-Emission**
December 31, 2027	33%
December 31, 2031	66%
December 31, 2035	100%

School Buses

The ***Truck and Bus Regulation*** requires that all California school buses are equipped with diesel PM filters. Additionally, the ***School Bus Idling Airborne Toxic Control Measure*** (School Bus ATCM) limits bus and commercial motor vehicle idling near schools or at school bus destinations to only when necessary for safety or operational concerns. It has been in effect since July 16, 2003 and reduces emissions from more than 26,000 school buses that operate daily at or near schools. The program targets school buses, school pupil activity buses, youth buses, paratransit vehicles, transit buses, and heavy-duty commercial motor vehicles that operate at or near schools. In 2009, Senate Bill 124, Oropeza (SB 124) acknowledged and codified CARBs ATCM limiting school bus idling raising the minimum penalty for a violation of this rule from $100 to $300. The bill also clarifies local air district authority to enforce the State's school bus idling program. SB 124 became effective on January 1, 2010, and the existing regulation was revised to reflect this change.

While California's idling requirements for school buses are the most stringent in the nation, California does not currently have any proposed or current regulations that require electrification of the school bus fleet. New York State's enacted fiscal year 2022-2023 budget established a nation-leading commitment for all new school buses purchased to be zero emission by 2027 and all school buses in operation to be electric by 2035,[68] a mandate that was first introduced in New York Governor Kathy Hochul's 2022 State of the State Address.[69] Under the New York law, all school district purchases or leases of new vehicles for student transportation must be zero-emission by 2027. School districts can, upon request, be granted an extension for up to two years beyond the 2027 deadline, but all purchases and leases by school districts or transportation contractors will need to be electric by 2029. In 2035, when fully implemented, all school buses must be electric, including district-owned and leased vehicles.[70]

FUELS

In addition to new engine and in-use standards, cleaner burning fuels represent an important component in reducing emissions from on-road heavy-duty diesel trucks and buses. Cleaner fuel has an immediate impact in reducing emissions from the mobile source, and thus represent an important component in reducing NOx and diesel PM emissions from the on-road heavy-duty fleet. California's stringent air quality programs treat motor vehicles and their fuels holistically (as a system, rather than as separate components). As a result, CARB's fuels programs achieve significant reductions in criteria emissions from motor vehicles used in California.

CARB Diesel Fuel Regulations

The California diesel fuel program sets stringent standards for diesel fuel sold in California and ensures that in-use diesel engines continue to operate as cleanly as possible. CARB's Diesel Fuel Regulations have, over time, phased in more stringent requirements for fuel mixture specifications for aromatic hydrocarbons and sulfur (a precursor to formation of secondary PM), and have establish a lubricity standard which apply fuels used in on- and off-road applications in California. ***"CARB diesel" Specifications*** adopted in 1988 limited the allowable sulfur content of diesel fuel 500 parts per million by weight (ppmw), and the aromatic hydrocarbon content to 10 percent, and became effective in 1993.

In 2003, ***CARB's Ultra Low Sulfur Diesel (ULSD) Regulation*** increased the stringency of the sulfur content limits in to 15 ppm, which harmonized with the 1993

[68] New York Senate Bill S8006C https://www.nysenate.gov/legislation/bills/2021/S8006
[69] 2022 New York State of the State Book https://info.aee.net/hubfs/2022StateoftheStateBookNY.pdf
[70] Rockefeller Institute of Government, November 2022 https://rockinst.org/blog/meeting-new-yorks-electric-school-bus-mandate-takeaways-from-the-2022-school-finance-symposium/

U.S. EPA regulation that also limited sulfur in on-road diesel fuels to the same level. Both the California and federal ULSD regulations began implementation in 2006. CARB's ULSD Regulation had an immediate impact in reducing emissions from the in-use on-road heavy-duty fleet, while also enabling the use of advanced emissions control technologies, including the use of catalyzed diesel particulate filters, NOx after-treatment, and other advanced after-treatment based emission control technologies that higher sulfur levels would have inhibit the performance of (at the time of CARB's ULSD rulemaking, the average sulfur content of California diesel was approximately 140 ppmw).

Beyond the current fuels control program, CARB committed in the 2016 State SIP Strategy to develop a ***Low Emission Diesel*** Measure that will require diesel fuel providers to steadily decrease criteria pollutant emissions from their diesel products. The use of low-emission diesel in on-road vehicles and off-road equipment will reduce tailpipe NOx and PM emissions, in addition to other criteria pollutants. Some studies carried out to date on hydrotreated vegetable oil have reported NOx emission reductions of 6 percent to 25 percent and PM emission reductions of 28 percent to 46 percent, depending on the types of fuels, drive cycles tested, and diesel engines used. This standard is anticipated to both increase consumption of low-emission diesel fuels, and to reduce emissions from conventional fuels. This measure is anticipated to provide NOx benefits predominately from legacy (pre-2010) on-road heavy-duty vehicles, off-road engines, stationary engines, portable engines, marine vessels and locomotives, as well as NOx and diesel PM benefits in potentially all model year off-road engines, stationary engines, portable engines, marine vessels and locomotives. Interstate vehicles, even those registered out-of-State but operating on CARB diesel blended with low-emission diesel, are also anticipated to provide emission reduction benefits.

Controlling Criteria Emissions from Renewable Fuels

The ***Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF) Regulations,*** as amended in 2014, work together to reduce the carbon intensity of the California fuel supply. The regulations also limit criteria emissions from alternative fuels and/or alternative fuel mix blends (a mix of fuels made from renewable feedstocks, which are then blended with conventional gasoline or diesel).

STEP 2(B): OTHER STATES' AND NONATTAINMENT AREAS' ON-ROAD MEDIUM- AND HEAVY-DUTY CONTROL MEASURES

Table D-17 summarizes the most stringent control measures currently in use in any state or nonattainment that have been identified and discussed for on-road heavy-duty vehicles. Each of the measures identified in this table are discussed in more detail in this section, below.

Table D-17 Comparison of Stringency – Heavy-Duty Measures

CARB Control Programs Compared to Federal Standards and Control Programs in Other States and Nonattainment Areas

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
New Engine Standards			
New Vehicle and Engine Standards: Zero-Emission Requirements	Advanced Clean Trucks (CARB)	The Advanced Clean Truck Regulation is part of a holistic approach to accelerate a large-scale transition of zero-emission medium-and heavy-duty vehicles from Class 2b to Class 8. The regulation has two components including a manufacturer sales requirement, and a reporting requirement: • Zero-emission truck sales: Manufacturers who certify Class 2b-8 chassis or complete vehicles with combustion engines would be required to sell zero-emission trucks as an increasing percentage of their annual California sales from 2024 to 2035. By 2035, zero-emission truck/chassis sales would need to be 55% of Class 2b – 3 truck sales, 75% of Class 4 – 8 straight truck sales, and 40% of truck tractor sales.	CARB is leading the nation on the development and penetration of on-road heavy-duty ZEVs through the Advanced Clean Trucks Regulation Reg teams – what other States have adopted / are in the process of adopting the ACT regulation? MA, NJ, NY, OR, VT, & WA have adopted … others? ME has begun rulemaking process, where do CO, CT, DC, HI, MD, NC, OR, PA, RI, VA, stand? The following states have adopted ACT: MA, NJ, NY, OR, VT, and WA. Some other states are considering adoption. NC has an executive order directing state officials to begin adopting the ACT rule.
New Vehicle and Engine Standards: Heavy-duty internal combustion engine emission standards (mandatory standards)	Mandatory Heavy-Duty vehicle and engine emission standards (CARB and U.S. EPA) Heavy-Duty Omnibus Regulation (CARB)	California's emissions standards for on-road heavy-duty vehicles are the most stringent in the nation. CARB's current emission standards for heavy-duty engines (NOx and PM) are set at the same level of stringency as Federal standards for MY 2010– 2023 engines. With the Heavy-Duty Omnibus regulation, CARB has further increased the stringency of controls for MY 2024 and subsequent engines by lowering California NOx and PM emission standards on existing regulatory cycles as well as a new NOx standard on a new low load certification cycle. The NOx standards would be cut to about 75 percent below current standards beginning in 2024 and 90 percent below current standards in 2027. The limits are for MY 2024 - 2026: • NOx: 0.050 g/bhp-hr • PM: 0.005 g/bhp-hr For MY 2027-2030:	No other state has more stringent exhaust emission standards than California. Current CARB and U.S. EPA limit exhaust emissions to same levels (MY 2010 – 2023) • NOx: 0.20 g/bhp-hr • PM: 0.01 g/bhp-hr Five other States have also adopted the Omnibus regulation (MA, NY, OR, WA and VT). In MYs 2024-2026, California's standards will exceed the stringency of Federal standards, which are currently at 0.20 g/bhp-hr for NOx and 0.01 g/bhp-hr for PM, and will strengthen to 0.050 g/bhp-hr for NOx and 0.005 g/bhp-hr for PM.

<table>
<tr><th>Type of Control Measure</th><th>Most Stringent Control Program Identified</th><th>Summary of Findings from Analysis</th><th>Other Jurisdiction(s) Analyzed</th></tr>
<tr><th colspan="4">On-Road Heavy-Duty Vehicles</th></tr>
<tr><td></td><td></td><td>• NOx: 0.020 g/bhp-hr @ miles ≤ 435,000
0.035 g/bhp-hr @ 435,000 < miles ≤ 600,000
• PM: 0.005 g/bhp-hr

For 2031 and Subsequent MYs:
• NOx : 0.020 g/bhp-hr @ miles ≤ 435,000
0.040 g/bhp-hr @ 435,000 < miles ≤ 800,000
• PM: 0.005 /bhp-hr

In December 2022, U.S. EPA finalized new emissions standards for federally-certified vehicles beginning in 2027, though these are less stringent than those included in CARB's Heavy-Duty Omnibus Regulation: For MY 2027 and later years, federal certification limits will be set to 0.035 g/hp-hr for NOx and 0.005 g/hp-hr for PM</td><td></td></tr>
<tr><td>New Vehicle and Engine Standards: Optional heavy-duty internal combustion engine emission standards</td><td>Optional Heavy-Duty Low NOx Emission Standards (CARB)

Omnibus Regulation (CARB)</td><td>CARB's optional standards accelerate the pace of innovation and development of cleaner engine technologies by certifying engines that go beyond the stringency of existing standards. Starting in 2015, engine manufacturers could choose to certify to three optional NOx emission standards of 0.1 g/bhp hr, 0.05 g/bhp-hr, and 0.02 g/bhp-hr (i.e., 50 percent, 75 percent, and 90 percent lower than the existing mandatory standard of 0.2 g/bhp-hr). Together with the mandatory standards that harmonize with federal emission requirements, this program makes California's suite of HD engine emission controls the most stringent in the nation.

The Heavy-Duty Omnibus Regulation will lower the optional Low-NOx Emission Standards to 0.020 g/bhp-hr for MY 2024-26 and to 0.010 g/bhp-hr for MY 2027 and later.</td><td>California is the only state with optional exhaust emission standards for heavy-duty engines that exceed the stringency of U.S. EPA requirements.</td></tr>
<tr><td>New Vehicle and Engine Standards: Warranty Requirements and Useful Life</td><td>California Emission Control System Warranty Regulations and Maintenance Provisions (CARB)

Omnibus Regulation (CARB)</td><td>For Model Years 2022 and later, U.S. EPA warranty provisions cover 100,000 miles, or 5 years / 3,000 hours, for Class 4 – 8 trucks; California's more stringent warranty provisions cover:
• Class 8: 350,000 miles, or 5 years
• Class 6 – 7: 150,000 miles, or 5 years
• Class 4 – 5: 110,000 miles, or 5 years

CARB Useful Life:
<table>
<tr><th rowspan="2">Model Year</th><th colspan="4">Useful Life (miles)</th></tr>
<tr><th>Class 4 – 5 Diesel</th><th>Class 6 – 7 Diesel</th><th>Class 8 Diesel</th><th>Heavy-Duty Otto</th></tr>
<tr><td>Current – 2026</td><td>110,000 miles 10 years</td><td>185,000 miles 10 years</td><td>435,000 miles
10 years
22,000 hours</td><td>110,000 miles
10 years</td></tr>
</table></td><td>Currently, no other state has more stringent warranty requirements than California. California is the only state with the authority to initially adopt and enforce emission standards and test procedures for new motor vehicles and new motor vehicle engines that are more stringent than federal emission standards and test procedures.

For MY 2022 – 2026, CARB's warranty requirements are more stringent than Federal standards, and California's useful life requirements align with federal requirements. Under the 2021 Omnibus Regulation, California warranty and useful life requirements are at least as stringent as federal requirements for My 2027 – 2031+.</td></tr>
</table>

<table>
<tr><th>Type of Control Measure</th><th>Most Stringent Control Program Identified</th><th>Summary of Findings from Analysis</th><th>Other Jurisdiction(s) Analyzed</th></tr>
<tr><td colspan="4">On-Road Heavy-Duty Vehicles</td></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>2027–2030</td><td>190,000 miles 12 years</td><td>270,000 miles 11 years</td><td>600,000 miles
11 years
30,000 hours</td><td>155,000 miles
12 years</td></tr>
<tr><td>2031 and subsequent model years</td><td>270,000 miles
15 years</td><td>350,000 miles
12 years</td><td>800,000 miles
12 years
40,000 hours</td><td>200,000 miles
15 years</td></tr>
</table>
For older MY trucks and engines, both U.S. EPA and CARB require that heavy-duty vehicles meet emission standards throughout their useful life periods of 5 years / 100,000 miles (GVWR > 14,000 lbs.)</td><td></td></tr>
<tr><td>New Vehicle and Engine Standards:
OBD Requirements</td><td>Heavy-Duty OBD (CARB)</td><td>CARB and federal OBD regulations for heavy-duty vehicles generally align for MY2013 and newer engines, although CARB's program has been amended to be more stringent than U.S. EPA's for certain vehicle types. California OBD requirements are overall at least as stringent as applicable federal requirements. California OBD fault detection requirements are at least as stringent if not more stringent than U.S. EPA requirements. However in 2022, U.S. EPA updated their OBD requirements applicable to 2027 and subsequent model years to delete some California requirements and add some emission control system data parameters to be provided on demand and in the driver display.</td><td>No other state has more stringent OBD requirements than California</td></tr>
<tr><td colspan="4">In-Use Emission Controls</td></tr>
<tr><td>In-Use Emissions Controls:
I/M program (opacity limits)</td><td>Periodic Smoke Inspection Program (PSIP) (CARB)</td><td>California's in-use emission controls including opacity limits are the most stringent in the nation. The 2018 Amendments to the Periodic Smoke Inspection Program (PSIP) require all California-based fleets of two or more heavy-duty diesel vehicles over 6,000 pounds GVWR with engines over four years old are required to perform annual smoke opacity tests (1998 and newer diesel vehicles between 6,000–14,000 pounds GVWR subject to biennial smog check are not subject to PSIP).

Allowable levels of Smoke Opacity are shown below:
<table>
<tr><td colspan="2">Engines Equipped with a Diesel Particulate Filter (DPF)</td></tr>
<tr><td colspan="2">5% Opacity Limit</td></tr>
<tr><td colspan="2">Pre-2007 Model Year (MY) Engines without a DPF</td></tr>
<tr><td>1997– 2006 MY Engines</td><td>20% Opacity Limit</td></tr>
<tr><td>1991–1996 MY Engines</td><td>30% Opacity Limit</td></tr>
<tr><td>Pre-1991 MY Engines</td><td>40% Opacity Limit</td></tr>
<tr><td colspan="2">Engines Equipped with a Level 2 Verified Diesel Emission Control Strategy (VDECS)</td></tr>
<tr><td colspan="2">20% Opacity Limit</td></tr>
<tr><td colspan="2">Two-Engine Cranes Driven by a non-DPF Off-Road Engine</td></tr>
<tr><td colspan="2">40% Opacity Limit</td></tr>
</table></td><td>New Jersey's opacity limits range from 40% - 20%. California's in-use emission controls, including opacity limits, are the most stringent in the nation.</td></tr>
<tr><td>In-Use Emissions Controls:</td><td>Heavy-Duty Vehicle Inspection Program (HDVIP) (CARB)</td><td>California's in-use testing program (including the HD I/M, HDVIP and PSIP regulations) is the most stringent in the nation, with further increases in</td><td>Three other states also test OBD in heavy-duty vehicles (MA, NJ, and WI), but none aside from California are currently enforcing on OBD scans for</td></tr>
</table>

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
I/M program (Testing)	Periodic Smoke Inspection Program (PSIP) (CARB) The Heavy-Duty Omnibus Regulation (CARB) The Heavy-Duty Inspection and Maintenance Program (HD I/M) (CARB)	stringency going into effect in 2024. The Heavy-Duty Omnibus Regulation revised the heavy-duty in-use testing program to make it more effective in ensuring compliance with the in-use emission standards over a broader range of vehicle operation, and to better represent heavy-duty vehicle operations in real world conditions. The Omnibus regulation established clearer criteria for engine family pass/fail determination, and requires on-board diagnostic (OBD) data during testing to verify the condition of the test vehicle and sensors. These amendments apply to 2024 and subsequent model year engines, and replace the current NTE-based methodology with a new three-bin moving average windows-based methodology. Under the Heavy-Duty Inspection and Maintenance Program (HD I/M), heavy-duty vehicles registered in California will also be required to demonstrate annual compliance with HD I/M program requirements in order to register with the Department of Motor Vehicles. Beginning in January 2023, CARB is using roadside emissions monitoring devices (REMD) to screen for vehicles that may have high emissions. Vehicles flagged as potential high emitters may be required to undergo follow-up vehicle compliance testing to ensure they are operating with properly functioning emissions control systems. Upon full implementation of HD I/M periodic compliance testing, nearly all vehicles will be required to undergo twice per year testing with results submitted to CARB. Three years after the start of HD I/M periodic compliance testing, on board diagnostics (OBD) equipped vehicles will be required to undergo testing four times per year. On-road agricultural vehicles and California-registered motorhomes only will be required to undergo testing once per year.	vehicles >14,000 lb. GVWR. Additionally, they do not control emissions from out-of-state trucks, or include the potential use of telematics like CARB.
In-Use Emissions Controls: Idling requirements	Heavy-Duty Diesel Vehicle Idling Reduction Program (CARB) Heavy-Duty Omnibus Regulation (CARB)	California's idling requirements and comprehensive program for on-road heavy-duty vehicles limits idling time to five minutes, and requires that MY 2008 and newer engines are equipped to automatically shut down after five minutes of idling. While other jurisdictions have adopted similar idling time limits requirements – some with more stringent time limits than CARB – none surpassed the stringency of California's program in effect, because emission performance requirements for idle reduction technologies are unique to California's program. The Heavy-Duty Omnibus Regulation reduces idling limits for heavy-duty diesel vehicles from 30g/hr to 10g/hr in MY 2024 – 2026 engines, and to 5 g/hr in MY 2027+ engines.	Areas with more stringent time limits: • 2 minute restrictions, no exemptions: Philadelphia, PA • 2 minute restrictions, some exemptions: Salt Lake City and Salt Lake County, UT • 3 minute restrictions, some exemptions: CT, DC, City of Ketchum (ID), New York City (NY), the Village of Larchmont (NY), the Village of Mamaroneck (NY), the County of Westchester (NY), Park City (UT), and the City of Birmingham (VT) Areas with less stringent time limits: • 3 minute restrictions, some exemptions DE, Chicago (IL), NJ, Town of Mamaroneck (NY), and Rockland County (NY)
In-Use Emissions Controls:	Truck and Bus Regulation (CARB)	California's in-use emission controls for on-road heavy-duty vehicles are the most stringent in the nation. CARB's Truck and Bus regulation is the most	No other state requires diesel particulate filters (DPF) and MY 2010 + equivalent engines as a mandatory

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
Fleet Rules	Advanced Clean Fleets Regulation (CARB) Future Measure: *Zero-Emission Trucks Measure (CARB)*	comprehensive and stringent mandatory heavy-duty fleet turnover rule in the nation, affecting approximately one million inter- and intra-state on-road diesel vehicles. The regulation applies to nearly all privately or federally owned diesel-fueled trucks and buses > 14,000 lbs., GVWR, including on-road and off-road agricultural yard goats, cargo handling equipment, drayage trucks, solid waste collection vehicles, and school buses. Its phased-in requirements mandate diesel particulate filters in early years, eventually requiring vehicles to fully upgrade to newer, cleaner engines that meet MY 2010 engine equivalent emissions levels when fully implemented in 2023. Approved by CARB in April 2023, the Advanced Clean Fleets Regulation accelerates ZEV adoption in the medium-to heavy-duty sectors and for light-duty package delivery trucks by setting zero-emission requirements for fleets. This regulation targets drayage trucks, public fleets, and other high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments such as last mile delivery, drayage, and government fleets. The regulation will phase in ZEV requirements for different fleets, including components as follows: • Beginning January 1, 2024, all additions to High Priority and Federal fleets must be ZEVs, and all combustion vehicles must be removed from the California fleet at the end of their useful life, or fleets may opt to phase-in ZEV requirement where a portion of the fleet must be zero-emission based on a pre-determined schedule. • State and local government fleets including cities, counties, special districts, and other municipalities would be required to add only ZEVs to their fleets starting at 50 percent of new additions in 2024 and 100 percent starting in 2027 or fleets may opt to phase-in ZEV requirement where a portion of the fleet must be zero-emission based on a pre-determined schedule. Small public fleets or those that are based in designated low population counties would begin with 100 percent ZEV additions starting in 2027. • Beginning January 1, 2024, any truck added to drayage service would need to be a ZEV. All drayage trucks entering seaports and intermodal railyards would be required to be zero-emission by 2035; and • 100 percent of medium- and heavy-duty vehicle sales in California would be zero-emissions starting in 2036. Under the recently-approved regulation and the ACT regulation, the number of medium- and heavy-duty ZEVs operating in California will be about 1.7 million by 2045. The future Zero-Emission Trucks measure would accelerate the number of zero-emissions (ZE) trucks beyond existing measures (including the	fleet rule affecting nearly the entire on-road diesel fleet No other state has zero-emission requirements for heavy-duty vehicle fleets

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
		Advanced Clean Fleets regulation). This measure is anticipated to be implemented through one of two potential options: • Option A would use market signal tools, if given authority to implement differentiated registration fees, restrictions or fees for heavy-duty combustion trucks entering low/zero-emission zones, and/or indirect source rules to establish ZE zones by 2035. • Option B would likely be pursued if CARB is unable to implement the strategies and/or if new authorities outlined in Option A do not come to fruition. If so, CARB may need to implement an inflexible requirement for all fleets to phase-in ZEVs and to remove legacy trucks from service in California. *(Note: CARB has committed to pursue the Zero-Emission Trucks measure, but this measure has yet to be proposed to the Board for approval/adoption)*	
In-Use Emissions Controls: Fleet Rules (Drayage Trucks)	Truck and Bus Regulation (CARB) Advanced Clean Fleets Regulation (CARB)	California's in-use emission controls for drayage trucks are the most stringent in the nation. The Truck and Bus Regulation requires 2010 Model Year or newer engines at ports and rail yards starting in 2023. Approved by CARB in April 2023, the Advanced Clean Fleets (ACF) Regulation, CARB is further strengthening emission controls for drayage fleets; all drayage trucks entering seaports and intermodal railyards would be required to be zero-emission by 2035; ACF controls drayage emissions through three main components: • Zero-emission drayage truck requirements Drayage trucks will be required to start transitioning to zero-emission technology beginning in 2024, with full implementation by 2035 • Drayage Truck Registration Requirements All drayage trucks intending to begin or continue operations at a California seaport or intermodal railyard must be registered with CARB. Beginning in 2035, all trucks in the CARB Online System will be required to be zero-emission. • Removing Combustion-Powered Drayage Trucks from Service Non-zero-emission (legacy) drayage trucks with a 2010 or newer model year engine may register in the CARB Online System on or before January 1, 2024,. Beginning in 2024, all legacy drayage trucks must visit a seaport or intermodal railyard at least once each year to remain in the CARB Online System. Legacy drayage trucks 12 years old must begin reporting their mileage annually in 2025 and, can remain in the system until they reach their minimum useful life (either 800,000 miles or the engine is older than 18 years, whichever comes first). Beginning in 2025, legacy drayage trucks will be removed from the CARB Online System if they did not meet the annual visit requirement, OR if they have exceeded their minimum useful life requirements.	No other jurisdiction mandates more stringent fleet requirements for drayage trucks.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
In-Use Emissions Controls: Fleet Rules (Solid Waste Collection Vehicles)	Solid Waste Collection Vehicle Regulations (CARB) Truck and Bus Regulation (CARB) Advanced Clean Fleets Regulation (CARB)	California's in-use emissions controls for solid waste collection vehicles (SWCVs) are the most stringent in the nation. Compared to New York City's program, CARB's Solid Waste Collection Vehicles regulation limits PM emissions at approximately the same level of stringency. However, SWCV's with 2007-2009 engines were also subject to more stringent 2010 engine requirements under Truck and Bus, however, the overall level of emission controls are more stringent in California than any other jurisdiction. Approved by CARB in April 2023, the Advanced Clean Fleets Regulation accelerates ZEV adoption among solid waste collection vehicles. This regulation targets all state and local government fleets and high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments. The regulation will phase in ZEV requirements for different fleets, including State and local government fleets and those owned by or contracted with municipalities, including waste fleets. 100 percent of solid waste collection vehicle sales in California would be zero-emissions starting in 2036.	New York City (NY) requires that at least 90 percent of the ~8,300 qualifying privately and publicly-owned SWCVs meet the U.S. EPA's 2007 diesel standard for PM. Comparatively, CARB controls ~12,000 SWCVs (MYs 1960 through 2006) at approximately the same level of PM control for all trucks (i.e. equivalent to the 2007 MY standard of 0.01 g/bhp-hr).
In-Use Emissions Controls: Fleet Rules (Public fleets)	Public Agency and Utility Regulation (CARB) Truck and Bus Regulation (CARB) Advanced Clean Fleets Regulation (CARB)	California's in-use emissions controls for public fleets are the most stringent in the nation. CARB's Public Agency and Utility Regulation requires similar stringency in PM emissions limits as the Boston, MA program; because some utility fleets are also subject to more stringent requirements under Truck and Bus, the overall level of emission controls are more stringent in CA than any other jurisdiction. Approved by CARB in April 2023, the Advanced Clean Fleets Regulation accelerates ZEV adoption among public fleets. This regulation targets all public fleets in California. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments such as last mile delivery, drayage, and government fleets. The regulation will phase in ZEV requirements for different fleets. State and local government fleets – including cities, counties, special districts, and other municipalities – would be required to add only ZEVs to their fleets starting at 50 percent of new purchases in 2024 and 100 percent starting in 2027 or fleets may opt to phase-in ZEV requirement where a portion of the fleet must be zero-emission based on a pre-determined schedule. Small public fleets and those that are based in designated low population counties would begin with 100 percent ZEV additions starting in 2027.	The city of Boston (MA) requires by 2018 all pre-2007 diesel vehicles and equipment not previously retrofit to be controlled to achieve emission reductions of at least 85 percent (approximately equivalent to the 2007 PM standard of 0.01 g/bhp-hr). Comparatively, CARB limits are set equivalent to the 2007 MY standard of 0.01 g/bhp-hr for engine MY 1960 or newer, GVWR > 14,000 lbs.
In-Use Emissions Controls: Fleet Rules (Transit fleets)	Transit Fleet Rule (CARB) Innovative Clean Transit Regulation (CARB)	California's in-use emission controls for transit vehicles are the most stringent in the country. The Transit Fleet Rule requires emission reductions (PM and NOx) from urban buses and transit fleet vehicles, and required future zero-emission bus purchases.	No other jurisdiction mandates more stringent fleet requirements for transit fleets.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
		The Innovative Clean Transit (ICT) Regulation requires all public transit agencies to gradually transition to a 100 percent zero-emission bus (ZEB) fleet. Beginning in 2029, 100% of new purchases by transit agencies must be ZEBs, with a goal for full transition by 2036.	
In-Use Emissions Controls: Fleet Rules (Last mile delivery trucks)	Truck and Bus Regulation (CARB) Advanced Clean Fleets Regulation (CARB)	California's in-use emission controls for last mile delivery vehicles (Class 3-7 heavy-duty delivery trucks used to deliver freight from warehouses and distribution centers to the final point of sale or use) are the most stringent in the nation. Truck and Bus requires MY 2010 or equivalent engines for Class 4 – 8 engines by 2023. Approved by CARB in April 2023, the Advanced Clean Fleets Regulation accelerates ZEV adoption in the medium- to heavy-duty sectors and for light-duty package delivery trucks by setting zero-emission requirements for high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments. The regulation will phase in ZEV requirements for different fleets, resulting in 100 percent of medium- and heavy-duty vehicle sales in California being zero-emissions starting in 2036.	No other jurisdiction mandates more stringent fleet requirements for last mile delivery trucks.
In-Use Emissions Controls: Fleet Rules (Airport shuttle buses)	Truck and Bus Regulation (CARB) Zero-Emission Airport Shuttle Bus Regulation (CARB)	California's in-use emission controls for airport shuttle buses (vehicles used to transport passengers between car parking lots, airport terminals, and airport car rental facilities) are the most stringent in the nation. The Truck and Bus Regulation requires MY 2010 or equivalent engines by 2023. The Zero-Emission Airport Shuttle Bus Regulation requires airport shuttle operators to transition to 100 percent zero-emission vehicle (ZEV) technologies. Airport shuttle operators must begin adding zero-emission shuttles to their fleets in 2027, and complete the transition to ZEVs by the end of 2035. The regulation applies to airport shuttle operators who own, operate, or lease vehicles at any of the 13 California airports regulated under this rule (regulated airports), including the Fresno Yosemite International Airport.	No other jurisdiction mandates more stringent fleet requirements for airport shuttle buses.
In-Use Emissions Controls: Fleet Rules (School Buses)	Truck and Bus Regulation (CARB) School Bus Idling Airborne Toxic Control Measure (CARB) Omnibus Regulation (CARB) School Bus Incentive Program (CARB)	California's in-use emission controls for school buses are among the most stringent in the nation. The Truck and Bus regulation requires that all school buses are equipped with PM filters. Since 2003, California has also limited bus and vehicle idling time near schools or at school bus destinations through the School Bus ATCM, reducing emissions from >26,000 school buses operating daily at or near schools. Under the Omnibus Regulation, idling limits for diesel heavy-duty vehicles will be reduced from 30 g/hr currently to 10 g/hr in MY 2024 and to 5 g/hr in MY 2027. CARB has also used incentive funds as a key component of the strategy to reduce emissions from the school bus fleet. Over the past two decades,	Colorado (CO) controls emissions from school buses through a School Bus Retrofit Program funded by DERA Grants from U.S. EPA. This voluntary program began in 2009, and controls PM emissions through retrofits. CARB staff is unaware of any other jurisdictions that mandate retrofits. New York State requires all new school buses purchased to be zero emission by 2027, and all school buses in operation to be electric by 2035.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
		CARB's School Bus Incentive Program has invested over $1.2 billion to date to clean up old, higher-polluting school buses, which has supported about 1,800 zero emission school buses. Under this program, California leads the nation in deployment of zero emission school buses; by comparison, 888 zero emission school buses have been awarded, ordered, or deployed across the U.S. outside of California.	
Fuels Programs			
Fuels Standards: Diesel Standards	CARB Diesel Fuel Regulations and Ultra Low Sulfur Diesel (CARB) Future Measure: *Low Emission Diesel measure (CARB)*	California's fuel standards for diesel are the most stringent in the nation. CARB Diesel Fuel Regulations include stringent requirements for fuel mixture specifications for aromatic hydrocarbons and sulfur, and have establish a lubricity standard and applies to sales of fuel used in on-road vehicles and off-road vehicles and locomotives in California. CARB's ULSD program reduces NOx and PM emissions significantly relative to U.S. EPA requirements, providing approximately 7 percent more NOx reductions and 25 percent more dPM reductions than federal diesel. CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products. *(NOTE: CARB has committed to pursue the Low Emission Diesel measure, but it has not yet been proposed to the Board for approval/adoption.)*	No state requires cleaner burning diesel than California. The California diesel fuel regulations exceed federal requirements in stringency. CARB staff are aware of only one other state, Texas, who has a boutique diesel fuel program that is approved into the SIP. An independent analysis of The Texas Low Emission Diesel program (TxLED) showed that the TxLED fuel emissions performance does not provide as significant of emission reduction benefits as the California specifications.
Fuels Standards: Alternative Fuel Standards (Diesel substitutes)	Low Carbon Fuel Standard (CARB) Alternative Diesel Fuel Regulation (CARB)	California's fuel standards for diesel substitutes are the most stringent in the nation. The Low Carbon Fuel Standard and Alternative Diesel Fuel regulations work together to reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends.	No other state has set as stringent of criteria emission requirements on alternative fuels and alternative fuel blends than California. For low carbon fuel/clean fuel programs: • Oregon, and Washington have low carbon fuel standard programs, California participates in the Pacific Coast Collaborative with these states, and British Columbia. • Other states and countries that are considering a clean fuel regulation: NY, MI, MN, NM, VT, IL, MA.

NEW HEAVY-DUTY VEHICLE AND ENGINE STANDARDS

Heavy-duty engine emission standards

CARB's truck engine standards for on-road heavy-duty engines are consistent with the most stringent of any other area in the nation. CARB's current heavy-duty engine emission standards (MY 2010 - 2023) set exhaust emission standards for PM2.5 at 0.01 g/bhp-hr and NOx at 0.20 g/bhp-hr. This aligns with the applicable federal standards set by U.S. EPA, which are also set at the same levels of stringency.[71]

With the adoption and implementation of the Heavy-Duty Omnibus Regulation, CARB will further increase the stringency of these requirements to reduce NOx exhaust emissions standards to levels 90 percent lower than the current mandatory standard (for MY 2027 – 2030, mandatory emissions standards will be set to 0.020 g/bhp-hr at miles ≤ 435,000, and 0.035 g/bhp-hr at 435,000 - 600,000 miles). Massachusetts, New York, Oregon, Washington, and Vermont have also committed to adopt CARB's Omnibus Regulation. CARB's standards will exceed the stringency of Federal standards in MY 2024 – 2031.

In December 2022, U.S. EPA finalized new emissions standards for federally-certified vehicles beginning in 2027, though these are less stringent than those included in CARB's Heavy-Duty Omnibus Regulation: For MY 2027 and later years, federal certification limits will be set to 0.035 g/hp-hr for NOx and 0.005 g/hp-hr for PM.

In December 2022, U.S. EPA finalized their regulation, "Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards", which sets stronger NOx emission standards for MY 2027 and later heavy-duty vehicles and engines. For MY 2027 and later years, federal limits will be set to 0.05 g/bhp-hr for NOx and 0.005 g/bhp-hr for PM. Like the California standards, the new federal standards will also require lower NOX emissions over a much wider range of testing conditions both in the laboratory and when engines are operating on the road. Further, the regulation includes longer useful life periods, as well as significant increases in the emissions-related warranty periods.

As most Class 7 and 8 vehicles operating in California have been originally purchased outside of the State and are thus covered by U.S. EPA, rather than CARB standards, federal action is critical to achieving the needed emission reductions for the San Joaquin Valley and other California nonattainment areas to meet U.S. EPA's air quality standards. However, U.S. EPA's recently finalized Low-NOx rule is less stringent than the options previously suggested by U.S. EPA and CARB's Heavy-Duty Omnibus Regulation. Given the need for deep emissions reductions and the benefits of consistency in this area given the multiple jurisdictions in which trucks are purchased and used, CARB will advocate to align the federal CTP with CARB's Omnibus Regulations to the maximum degree possible.

[71] U.S. EPA 2016 "Heavy-Duty Highway Compression-Ignition Engines and Urban Buses: Exhaust Emission Standards" https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZZ.pdf accessed May 1, 2018.

U.S. EPA has also released two additional steps in their CTP, including a proposal for heavy-duty GHG standards for MY 2027 and later, under their "Phase 3" regulation, and multipollutant standards for light and medium-duty vehicles for MY 2027 and later. [72] U.S. EPA has issued final decisions in 2023 regarding several California waiver requests for California's heavy-duty vehicle and engine emission standards, including the 2018 Heavy-Duty Warranty Amendments, the Advanced Clean Truck (ACT) Regulation, the Zero-Emission Airport Shuttle Bus Regulation, and the Zero-Emission Powertrain Certification Regulation.[73] U.S. EPA has also signaled that they intend to issue a final decision on the waiver request for the Heavy-Duty Omnibus Regulation this year.[74] CARB will continue to call on U.S. EPA to move expeditiously in developing these requirements in recognition of the critical public health benefits they will provide.

Optional engine emission standards

To achieve further reductions and incentivize ongoing development of increasingly more efficient engine technologies, CARB has also provided since 2015 certification to optional emission standards at levels 50 percent, 75 percent, and 90 percent cleaner than currently mandated emission standards. This allows CARB and local air districts to preferentially incentivize and fund the purchase of cleaner trucks and engines than would have otherwise met the mandatory standard. CARB staff is unaware of any other state with a similar control program. With the Omnibus Regulation, the optional emission standards lower further, from current levels of 0.10 – 0.02 g/bhp-hr (through MY 2024), to 0.010 g/bhp-hr for MY 2027+.

Zero-Emission Trucks

CARB's Advanced Clean Truck Regulation has also been adopted by several states, including Massachusetts, New Jersey, New York, Oregon, Vermont, and Washington, while Maine has begun the rulemaking process to adopt.[75] Some other states are also considering adoption of the rule, while North Carolina has an executive order directing state officials to begin adopting the Advanced Clean Truck rule. Together with California, these states comprise approximately a quarter of the U.S. medium- and heavy-duty market. Additionally, sixteen states and the District of Columbia have signed a Memorandum of Understanding to spur the adoption of medium- and heavy-duty ZEVs.[76]

[72] U.S. EPA, 2023. "Proposed Rule: Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles – Phase 3" https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-greenhouse-gas-emissions-standards-heavy
[73] U.S. EPA, 2023. "California Waiver Requests for Heavy-Duty Vehicle Emission Regulations" https://www.epa.gov/regulations-emissions-vehicles-and-engines/california-waiver-requests-heavy-duty-vehicle-emission
[74] U.S. EPA, 2022. "Heavy-Duty 2027 and Beyond: Clean Trucks Final Rulemaking" https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P101695R.pdf
[75] ICCT 2021 https://theicct.org/wp-content/uploads/2022/01/state-level-hdv-emissions-reg-FS-dec21.pdf
[76] Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding, 2020 https://ww2.arb.ca.gov/sites/default/files/2020-07/Multistate-Truck-ZEV-Governors-MOU-20200714.pdf signatories include CA, CO, CT, DC, HI, ME, MD, MA, NJ, NY, NC, OR, PA, RI, VT, and WA. Virginia also signed in December

Useful Life and Warranty Requirements

CARB's useful life and warranty requirements for new on-road heavy-duty vehicles exceeds the stringency of any other in the nation for MY 2022 - 2026. Currently, no other state has more stringent warranty requirements than California. California is the only state with the authority to initially adopt and enforce emission standards and test procedures for new motor vehicles and new motor vehicle engines that are more stringent than federal emission standards and test procedures. For MY 2022 – 2026, CARB's warranty requirements are more stringent than federal standards, and California's useful life requirements align with federal requirements. Under the Omnibus Regulation, California warranty and useful life requirements are at least as stringent as federal requirements for My 2027 – 2031 and later model years.

Lower In-Use Emission Performance Standards and Test Procedures

CARB's in-use emission performance standards and test procedures for new on-road heavy-duty engines and vehicles exceeds the stringency of any other state in the nation. California is the only state with emission performance standards and test procedures for new on-road heavy-duty engines and vehicles that exceed the stringency of U.S. EPA requirements.

OBD Requirements

CARB and federal OBD regulations for heavy-duty vehicles generally align for MY2013 and newer engines, although CARB's program has been amended to be more stringent than U.S. EPA's for certain vehicle types. California OBD requirements are overall at least as stringent as applicable federal requirements, and California OBD fault detection requirements are at least as stringent if not more stringent than U.S. EPA requirements. However, in 2022, U.S. EPA updated their OBD requirements applicable to 2027 and subsequent model years to delete some California requirements and add some emission control system data parameters to be provided on demand and in the driver display. No other state has more stringent OBD requirements than California.

IN-USE EMISSION CONTROLS FOR HEAVY-DUTY VEHICLES

In-Use Inspection Program

The Inspection / Maintenance (I/M) Program testing and in-use emission controls in the Valley for on-road heavy-duty trucks and buses are consistent with the most stringent of any other I/M program in the nation.

2021 https://www.sierraclub.org/press-releases/2021/12/governor-northam-signs-virginia-multi-state-agreement-electrify-trucks-and

Opacity Limits

New Jersey has opacity limits that range from 40 percent to 20 percent.[77] Under the ***2018 Amendments to the Periodic Smoke Inspection Program,*** California opacity limits are the most stringent in the nation, ranging from 40 percent to 5 percent.

I/M Testing

CARB's HDVIP program requires heavy-duty trucks and buses to be inspected for excessive smoke and tampering, and engine certification label compliance, including all applicable OBD requirements. Any heavy-duty vehicle traveling in California, including vehicles registered in other states and foreign countries, may be tested. Tests are performed by CARB inspection teams at border crossings, weigh stations, fleet facilities, and randomly selected roadside locations. Owners of trucks and buses found in violation are subject to minimum penalties starting at $300 per violation. The PSIP program requires that diesel and bus fleet owners conduct annual smoke opacity inspections of their vehicles and repair those with excessive smoke emissions to ensure compliance. CARB randomly audits fleets, maintenance and inspection records and tests a representative sample of vehicles. All vehicles that do not pass the test must be repaired and retested. A fleet owner that neglects to perform the annual smoke opacity inspection on applicable vehicles is subject to a penalty of $500 per vehicle, per year.

Comparatively, three other states have efforts to include OBD testing on heavy-duty vehicles, which are summarized below:

- Massachusetts currently requires opacity testing for diesel engines over 14,000 lbs., GVWR, and OBD testing starting at 2007, with plans to develop a more stringent OBD testing program that will include OBD testing on vehicles 14,000 lbs., GVWR and above;
- New Jersey currently requires opacity testing for diesel engines over 18,000 lbs., GVWR, and has announced the award of a new program to include OBD testing on all diesels over 18,000 lbs., GVWR; and
- Wisconsin currently requires OBD testing for diesel engines up to 14,000 lbs., GVWR, which began in 2007. Wisconsin is considering an option to move toward testing OBD on 14,000 lbs., GVWR and above in the future.

While Massachusetts and New Jersey are developing similar I/M programs as California (all three states are collecting OBD test data for vehicles over 14,000 lbs., GVWR) no jurisdictions aside from California are currently enforcing on OBD scans for vehicles over 14,000 lb. GVWR. Furthermore, none include the potential use of telematics or are trying to also capture out-of-State trucks in the program as California's control program does. Thus, CARB's I/M testing controls program (including the HD I/M, HDVIP and

[77] For more information on the New Jersey Opacity Limits, please see http://www.nj.gov/dep/bmvim/bmvim_emisStds.htm

PSIP regulations) are the most stringent in the nation, with further increases in stringency going into effect in 2024.

Idling Requirements

The idling requirements in the Valley's plan are aligned with the most stringent in the nation. California has a 5-minute idling time restriction. In addition, it has emission performance requirements for alternative idle reduction technologies such as auxiliary power units (APU) and fuel-fired heaters. While other states have adopted similar HD idling requirements as California, none have surpassed the stringency of California requirements in effect, due to the unique exemptions provided California under the Act that enables CARB to set emissions performance requirements that exceed the stringency of those required by U.S. EPA. The following states, counties and cities have more stringent timing requirements for idling time restrictions. However, they do not set performance requirements for idle reduction technologies to reduce the intensity of emissions emitted over a given amount of time.

- The City of Philadelphia (PA) has the most stringent idling restriction of 2-minutes with no exemptions.
- Salt Lake City and Salt Lake County in Utah have also idling restrictions of 2 minutes with some exemptions but still more stringent than California idling restrictions.
- Connecticut, the District of Columbia, City of Ketchum (Idaho), New York City (NY), the Village of Larchmont (NY), the Village of Mamaroneck (NY), the County of Westchester (NY), Park City (Utah), and the City of Birmingham (Vermont) have idling time restriction of 3 minutes with some exemptions.
- Delaware, Chicago (Illinois), New Jersey, Town of Mamaroneck (NY), and Rockland County (NY) also have 3-minute idling restrictions, but their exemptions make their rules less stringent than California idling rule.

Only California has emission performance requirements for idle reduction technologies. Therefore, even if another jurisdiction has an idle time restriction shorter than California's 5-minute idling restriction, for sleeper cabs that use APUs as an alternative technology, California's regulation is more stringent because of the differences in APU emissions. Thus, all other state, county, or city idling rules are less stringent than California's idling restriction.

Heavy-Duty Fleet Rules

California's fleet rules for heavy-duty trucks and buses are the most stringent of any in the nation. The Truck and Bus Regulation requires that by 2014, nearly all vehicles operating in California will have PM emission controls, and by 2023 nearly all vehicles will meet 2010 model year engine emissions levels. The Regulation applies to nearly all diesel fueled trucks and buses with a gross vehicle weight rating greater than 14,000 pounds that are privately or federally owned, including on-road and off-road agricultural yard goats, and privately and publicly owned school buses. Moreover, the Regulation applies to any person, business, school district, or federal government agency that owns, operates, leases or rents affected vehicles. No other state requires diesel particulate filters and MY 2010 + equivalent engines as a mandatory fleet rule affecting nearly the entire on-road diesel fleet.

Approved by CARB in April 2023, the Advanced Clean Fleets Regulation is a nation-leading zero-emission fleet requirement. The Advanced Clean Fleets Regulation accelerates ZEV adoption in the medium-to heavy-duty sectors and for light-duty package delivery trucks by setting zero-emission requirements for fleets. This Regulation targets drayage trucks, public fleets, and other high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments such as last mile delivery, drayage, and government fleets. No other state has zero-emission requirements for heavy-duty vehicle fleets.

Additionally, California has adopted and implemented fleet-specific rules that are consistent with the most stringent in the nation.

Drayage Trucks

California's in-use emissions controls for drayage trucks are the most stringent in the nation. The Truck and Bus Regulation requires 2010 Model Year or newer engines at ports and rail yards starting in 2023. Under the recently approved Advanced Clean Fleets Regulation, CARB is further strengthening emission controls for drayage fleets; all drayage trucks entering seaports and intermodal railyards would be required to be zero-emission by 2035. No other jurisdiction mandates more stringent fleet requirements for drayage trucks.

Solid Waste Collection Vehicles

California's in-use emissions controls for SWCVs are the most stringent in the nation. New York City (NY) is implementing a control measure that began in 2017 to modernize the city's fleet of diesel-powered solid waste vehicles of approximately 2,000 trucks used for picking up residential waste and recyclables with newer, less-polluting models. This program requires that at least 90 percent of the approximately 8,300 qualifying vehicles must meet the tougher emission control standards for diesel trucks that the U.S. EPA set in 2007.[78] Comparatively, California's Solid Waste Collection Vehicle Regulation was adopted in 2003 to reduce toxic diesel PM from approximately 12,000 diesel fueled commercial and residential SWCV and recycling collection vehicles operated in California. The rule applies to all SWCVs of 14,000 pounds or more that run on diesel fuel, have engines in MYs from 1960 through 2006, and collect waste for a fee.

[78] https://www.nytimes.com/2016/08/19/opinion/how-garbage-trucks-can-drive-a-green-future.html

Compared to New York City's program, CARB's Solid Waste Collection Vehicles Regulation limits PM emissions at approximately the same level of stringency. However, SWCVs with 2007-2009 engines were also subject to more stringent 2010 engine requirements under Truck and Bus (which requires diesel particulate filters and MY 2010 + equivalent engines), meaning that the overall level of emission controls are more stringent in California than any other jurisdiction. Additionally, the Advanced Clean Fleets Regulation accelerates ZEV adoption among solid waste collection vehicles. The Regulation will phase in ZEV requirements for different fleets, including waste fleets. Starting in 2036, 100 percent of solid waste collection vehicle sales in California would be zero-emissions. No other state has zero-emission requirements for SWCVs.

Public Fleet Rules

California's in-use emissions controls for public fleets are the most stringent in the nation. The city of Boston (MA) requires that, all pre-2007 City-owned or operated vehicles to have equipment that reduces diesel emissions by at least 20 percent by the end of 2015, and that all pre-2007 diesel vehicles and equipment not previously retrofit would be required to have retrofits achieving at least 85-percent—or best available—pollution reductions by the end of 2018. Public fleets in California are subject to the Truck and Bus Regulation, which requires diesel particulate filters and MY 2010+ equivalent engines. California's statewide Public Agency and Utility Regulation requires any municipality or utility that owns, leases, or operates on-road diesel fueled vehicles with engine model year 1960 or newer and GVWR greater than 14,000 pounds to reduce PM2.5 emissions to 0.01 g/bhp-hr. This can be done by repowering, retrofitting, or retiring the vehicle. Implementation of the rule started in 2007, with a compliance schedule based on the engine model year. Comparatively, CARB's Public Agency and Utility Regulation requires similar stringency in PM emissions limits as the Boston, MA program; because some utility fleets are also subject to more stringent requirements under the Truck and Bus Regulation, the overall level of emission controls are more stringent in California than any other jurisdiction.

Additionally, the Advanced Clean Fleets Regulation will phase in ZEV requirements for public fleets in California. State and local government fleets – including cities, counties, special districts, and other municipalities – would be required to add only ZEVs to their fleets starting at 50 percent of new purchases in 2024 and 100 percent starting in 2027, or fleets may opt to phase-in ZEV requirement where a portion of the fleet must be zero-emission based on a pre-determined schedule. Small public fleets and those that are based in designated low population counties would begin with 100 percent ZEV additions starting in 2027.

Transit Fleets

California's in-use emission controls for transit vehicles are the most stringent in the country. CARB's Transit Fleet Rule requires emission reductions (PM and NOx) from urban buses and transit fleet vehicles and required future zero-emission bus purchases. Additionally, the Innovative Clean Transit Regulation requires all public transit agencies to gradually transition to a 100 percent ZEB fleet. Beginning in 2029, 100 percent of new purchases by transit agencies must be ZEBs, with a goal for full transition by 2036. No other jurisdiction mandates more stringent fleet requirements for transit fleets.

Last Mile Delivery Trucks

California's in-use emission controls for last mile delivery vehicles (Class 3-7 heavy-duty delivery trucks used to deliver freight from warehouses and distribution centers to the final point of sale or use) are the most stringent in the nation. Truck and Bus requires MY 2010 or equivalent engines by 2023. Additionally, the Advanced Clean Fleets Regulation accelerates ZEV adoption in the medium- to heavy-duty sectors and for light-duty package delivery trucks by setting zero-emission requirements for high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. The regulation will phase in ZEV requirements for different fleets, resulting in 100 percent of medium- and heavy-duty vehicle sales in California being zero-emissions starting in 2036. No other jurisdiction mandates more stringent fleet requirements for last mile delivery trucks.

Airport Shuttle Buses

California's emission controls for airport shuttle buses (vehicles used to transport passengers between car parking lots, airport terminals, and airport car rental facilities) are the most stringent in the nation. The Truck and Bus Regulation requires MY 2010 or equivalent engines by 2023. Additionally, the Zero-Emission Airport Shuttle Bus Regulation requires airport shuttle operators to transition to 100 percent ZEV technologies. Airport shuttle operators must begin adding zero-emission shuttles to their fleets in 2027, and complete the transition to ZEVs by the end of 2035. The Regulation applies to airport shuttle operators who own, operate, or lease vehicles at any of the 13 California airports regulated under this rule (regulated airports), including the Fresno Yosemite International Airport. No other jurisdiction mandates more stringent fleet requirements for airport shuttle buses.

School Buses

Colorado controls emissions from school buses through a School Bus Retrofit Program funded by DERA Grants from U.S. EPA. This program began in 2009, and reduces emissions of diesel exhaust by retrofitting school buses with proven emissions-reduction technologies, including diesel-oxidation catalysts, engine preheaters and closed-crankcase filtration systems. Comparatively, California's Truck and Bus regulation requires that all privately and publicly owned school buses are equipped with diesel PM filters. California also limits bus and vehicle idling time near schools or at school bus destinations through the School Bus ATCM. It has been in effect since 2003 and reduces emissions from more than 26,000 school buses that operate daily at or near schools. The School Bus ATCM targets school buses, school pupil activity buses, youth buses, paratransit vehicles, transit buses, and heavy-duty commercial motor vehicles that operate at or near schools.

Additionally, CARB's School Bus Incentive Program has invested over $1.2 billion to date to clean up old, higher-polluting school buses. The California Legislature recently appropriated an additional $1.8 billion for zero-emission school buses and associated charging infrastructure over the next five years. Over the last twenty years, the total $1.2 billion statewide investment made, including $255 million invested in school bus cleanup over the past year alone, has supported about 1,800 zero-emission school buses. More than 560 of those buses are already on California roadways, with 327 in the State's most pollution-burdened communities.[79]

New York State's enacted fiscal year 2022-2023 budget established a requirement for all new school buses purchased to be zero emission by 2027.[80] Under the New York law, all school buses must be electric, including district-owned and leased vehicles upon full implementation in 2035.[81] New York is the only state the nation with an in zero-emission school bus requirements. California, however, leads the nation with its deployment of about 1,800 zero-emission school buses. By comparison, 888 zero-emission school buses have been awarded, ordered, or deployed across the U.S. outside of California, as of 2021.[82] While CARB incentive programs have turned over the most school buses to zero-emission engines of any state to date, California does not currently have any proposed or current regulations that require electrification of the school bus fleet.

CARB utilizes incentive programs rather than mandating turnover through regulatory actions due to the costs of zero-emission school buses, and particularly due to the impact those costs would have on public school districts. Public school districts often do not have the funding to replace their aging school bus fleet. Based on a comprehensive assessment of funding for home-to-school transportation conducted by the Legislative Analyst's Office in 2014,[83] the primary responsibility for school transportation funding lies with public school districts through the State legislative process. Investing in California's school bus fleet is a collective effort amongst agencies on the local, state, and federal level. CARB and CEC have led the effort in dedicating funding and resources to turning over old, dirty school buses and investing in new technologies.[84] Together, CARB and CEC have made significant progress to make it easier for school districts to access zero-emission school bus and charging/fueling infrastructure incentives in a coordinated, streamlined manner. If CARB were to adopt a regulatory program that mandated zero-emission school buses, the ability to use incentive funds to help alleviate school districts of the burden of purchasing these new buses would be compromised, due to requirements in most of CARB's incentive funding programs that

[79] CARB, 2022 https://ww2.arb.ca.gov/news/new-report-shows-how-california-leading-nation-cleaning-school-buses
[80] New York Senate Bill S8006C https://www.nysenate.gov/legislation/bills/2021/S8006
[81] Rockefeller Institute of Government, November 2022 https://rockinst.org/blog/meeting-new-yorks-electric-school-bus-mandate-takeaways-from-the-2022-school-finance-symposium/
[82] CARB, 2022 https://ww2.arb.ca.gov/news/new-report-shows-how-california-leading-nation-cleaning-school-buses
[83] Legislative Analyst's Office, 2014. "Review of School Transportation in California" https://lao.ca.gov/reports/2014/education/school-transportation/school-transportation-022514.pdf
[84] CARB https://ww2.arb.ca.gov/sites/default/files/2022-10/fy2022_23_funding_plan_appendix_e.pdf

require that incentive dollars are spent on turning over vehicles and mobile equipment that exceed regulatory requirements.

FUELS

Diesel Fuel Regulations

U.S. EPA began regulating sulfur content in diesel in 1993. At that time, uncontrolled fuels (i.e. non-CARB diesel) contained approximately 5,000 parts per million (ppm) of sulfur. In 2006, U.S. EPA began to phase-in more stringent requirements under the federal Ultra-Low Sulfur Diesel (ULSD) regulations, which lowered the amount of sulfur in on-road diesel fuel to 15 ppm. The On-road (Highway) Diesel Fuel Standard was phased-in from 2006 to 2010, and since 2011 have required that all highway diesel fuel supplied to the market be ULSD, and that all highway diesel vehicles must use ULSD.

CARB's Ultra-Low Sulfur Diesel (ULSD) program limits sulfur content at the same levels as U.S. EPA's on-road ULSD program (i.e. at 15 ppm); however, due to other specifications that uniquely apply to CARB diesel, the California program reduces emissions significantly relative to federal diesel, providing about a 7 percent reduction in NOx and 25 percent in diesel PM.[85] Furthermore, CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products under ***the Low Emission Diesel measure***. No other state or nonattainment area controls criteria emissions from renewable fuels more stringently than CARB.

Beyond the federal diesel requirements described above, the Act also allows states to adopt unique fuel programs to meet local air quality needs, which are referred to as Boutique Fuel Programs. As of January 19, 2017, U.S. EPA identified only one boutique fuel programs that had been approved in a SIP,[86] the Low Emission Diesel Program in Texas (TxLED). The fuel specifications for the TxLED are based on CARB diesel requirements,[87] and fuel formulations approved by CARB are also considered approved by the Texas Commission on Environmental Quality, and may be used to comply with the TxLED regulations.[88] Additionally, independent analysis of TxLED, CARB ULSD and federal ULSD shows that the TxLED fuel emissions performance does not provide as significant of emission reduction benefits as the California specifications,[89] although U.S. EPA credited the TxLED program with providing approximately a 5 percent NOx

[85] Beyond sulfur limits at 15 ppm, CARB's program also requires the aromatic hydrocarbon content of the diesel fuel sold in the state not to exceed 10 percent by volume. Alternative diesel fuel formulations can be used to demonstrate equivalent compliance without actually meeting the aromatic limit.
[86] U.S. EPA, 2017 https://19january2017snapshot.epa.gov/gasoline-standards/state-fuels_.html
[87] Texas Administrative Code Title 30 Part I Chapter 114 Subchapter H, Division 2 Rule §114.312 http://texreg.sos.state.tx.us/public/readtac%24ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=114&rl=312
[88] Texas Commission on Environmental Quality https://www.tceq.texas.gov/assets/public/implementation/air/sip/texled/List%20of%20TCEQ-Approved%20Alternative%20Diesel%20Formulations.pdf
[89] American Transportation Research Institute (ATRI) 2008 "Energy and Other Fuel Property Changes with On-Road Ultra-Low Sulfur Diesel Fuel" http://www.atri-online.org/research/results/environmentalfactors/2008ATRIDiesel.pdf

emission reduction benefit over federal ULSD fuels.[90] Furthermore, the stringency of Texas' testing requirements are based on the federal Complex Model, which is less stringent and nuanced than the California Predictive Model that is used to determine compliance with California fuel requirements.

Controlling Criteria Emissions from Renewable Fuels

The Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF) regulations work together to limit criteria emissions from alternative fuels. Oregon and Washington State also have low carbon fuel standard programs modeled after the California regulation, California participates in the Pacific Coast Collaborative with these states, in addition to British Columbia. Seven other states are also considering a clean fuel regulation, including New York, Michigan, Minnesota, New Mexico, Vermont, Illinois, and Massachusetts.

While other states have adopted or are considering adopting similar programs to the California LCFS, no other state has set criteria emission requirements on alternative fuels. U.S. EPA's Renewable Fuel Standard (RFS II) does not specify criteria emission requirements for alternative fuels.

[90] U.S. EPA 2001, "Approval and Promulgation of Air Quality State Implementation Plans (SIP); Texas: Low Emission Diesel Fuel" https://www.federalregister.gov/documents/2001/11/14/01-27581/approval-and-promulgation-of-air-quality-state-implementation-plans-sip-texas-low-emission-diesel Federal Register Vol. 66, No. 220 pages 57196-57219

STEP 3(A): EVALUATION OF STRINGENCY: MEDIUM- AND HEAVY-DUTY CONTROL MEASURES

Step 3(a) calls for an evaluation of each of the potential control measures identified in Step 2, in order to evaluate their stringency and determine whether they meet all applicable requirements to satisfy the definitions of MSM as discussed in Section 1 and Section 2.

As shown in the Table D-17 in Step 2(b), CARB's programs are the most stringent in the nation. This comparison between CARB's control measures and the measures currently in place at the federal level and/or within other states and jurisdictions illustrates the stringency of the current CARB on-road heavy-duty control program, which meets the stringency requirements of MSM.

Furthermore, CARB staff have conducted an analysis of the timing of the new measures included in the 2022 State SIP Strategy, which go beyond the stringency of the current control program as it is now being implemented and thus beyond MSM. Many of these measures are still in their development phases and are not yet being implemented; the development timeline, however, is critical to allowing industry and technological advancements to progress sufficiently such that the newly emerging technologies called for in these regulatory actions (most of which are technology-inducing regulations) have sufficient time to attain market readiness. Table D-18, below, discusses the timeframe considerations for each of the applicable medium- and heavy-duty control measures, and indicates why a more expedited timeframe is neither technologically nor economically feasible. For these reasons, the measures meet the MSM requirement of being phased in as "expeditiously as practicable" and go beyond MSM requirements in terms of stringency.

Table D-18 Medium- and Heavy-Duty Control Measures – Stringency and Timeline for Implementation

Measures	Implementation Begins	12 µg/m³ Annual PM2.5 Standard (2012)
New Heavy-Duty Vehicle Standards		
Mandatory Emission Standards (Internal Combustion Engines)		
Heavy-Duty Emission Standards for New Vehicles and Engines (Mandatory)	ongoing	MSM
Heavy-Duty Omnibus Regulation (Mandatory Emission Standards)	2024	MSM
CARB's mandatory emission standards for heavy-duty vehicles and engines harmonize with federal standards for NOx and PM emission requirements though MY 2023. For MY 2024 and later, the Omnibus regulation established new low NOx and lower PM Standards that, when implemented, will be the lowest in the nation. Adopted in 2021, the omnibus regulation is a technology-forcing regulation; further stringency is infeasible. The Omnibus regulation also lengthened the useful life and emissions warranty provisions for heavy-duty diesel engines. Heavy-Duty emission standards for new vehicles and engines require years of lead time to be developed, certified, manufactured, and implemented; a more accelerated timeline is infeasible.		
Optional Emission Standards (Internal Combustion Engines)		
Optional Low-NOx Emission Standards for Heavy-Duty Engines	ongoing	MSM
Heavy-Duty Omnibus Regulation (Optional Emission Standards)	2024	MSM
CARB's optional Low-NOx emission standards are the most stringent in the nation, and are technology-forcing regulations that have driven the development and market readiness of the cleanest heavy-duty engines. The Omnibus regulation, when implemented, will further lower CARB's optional low-NOx emission standards to an even lower level; further increases in stringency are not feasible. Vehicle emission standards, including optional standards, are dependent on technological development, and require years of lead time to be developed, certified, manufactured, and implemented; a more accelerated timeline is infeasible.		
Zero-Emission Truck Standards – Sales and Manufacturer Requirements		
Advanced Clean Trucks	2024	MSM
Adopted in 2020, the Advanced Clean Trucks (ACT) regulation established manufacturer zero-emission truck sales requirements for Class 2b – Class 8 trucks beginning in 2024, as well as company and fleet reporting requirements. The ACT regulation has the most stringent zero-emission truck requirements in the nation. As a technology-forcing regulation, ACT will accelerate the development and deployment of Zero-Emission Heavy-Duty trucks and engines; further increases in stringency are not feasible. Manufacturer sales requirements need years of lead time to be implemented; it would be infeasible to implement on a more accelerated timeframe.		
Warranty, Useful Life, and On-Board Diagnostics (OBD) Requirements		
California Emission Control System Warranty and Maintenance Provisions	ongoing	MSM
Amendments to Useful Life & Warranty Provisions (as part of Omnibus)	2027	MSM
For MY 2022 - 2026 engines, California's Emission Control System Warranty and Maintenance Provisions are the most stringent in the nation. Adopted in 2021, the Omnibus Regulation further amended the warranty and useful life provisions for heavy-duty engines for MY 2027 and later years. To help ensure emission controls are well maintained and repaired when needed, and to help ensure more durable emission control systems, Omnibus extends the criteria pollutant emissions warranty and useful life period requirements for heavy-duty vehicles and engines. For My 2027 – 2031 and later years, California warranty and useful life requirements are at least as stringent as the federal requirements. As technology-forcing regulations, California's warranty and maintenance provisions are the most stringent in the nation; further increases in stringency are not feasible. Likewise, an accelerated timeline is not feasible; the requisite technological innovations and developments needed to meet California's level of stringency require years of lead time for implementation, as manufacturers must have sufficient time to develop, test, certify, and manufacture these needed advanced technologies.		
Heavy-Duty On-Board Diagnostics (HD OBD) and OBD II	ongoing	MSM
Amendments to Useful Life & Warranty Provisions (as part of Omnibus)	2024	MSM
The Heavy-Duty OBD regulation required that all MY 2013 and later engines offered for sale in California come equipped with OBD systems. CARB and federal OBD regulations for heavy-duty vehicles generally align for MY2013 – current engines, although CARB's program has been amended to be more stringent than U.S. EPA's for certain vehicle types. With the 2021 adoption of the Omnibus regulation, California's threshold for OBD requirements will become more stringent, concurrent with the phase-in of more stringent emission requirements. Omnibus also requires updates to address cold start emissions and diesel PM monitoring. Many of the regulatory changes are phased-in, as full implementation is not anticipated to be technologically feasible until 2027. As the most stringent requirements in the nation, for these technology-forcing regulations, further increases in stringency are not feasible. Furthermore, because OBD requirements need significant lead time to be developed, adopted, and implemented, they require sufficient lead time for		

Measures	Implementation Begins	12 µg/m³ Annual PM2.5 Standard (2012)
manufacturers to develop, test, and manufacture the needed hardware and/or software changes, and to verify via testing; an accelerated timeline for implementation is therefore not feasible.		
In-Use Emission Control Measures		
Inspection and Maintenance Provisions		
HD Diesel Vehicle Inspection Program (HDVIP)	ongoing	MSM
Periodic Smoke Inspection Program (PSIP)	ongoing	MSM
HD Inspection and Maintenance Program (HD I/M)	ongoing	MSM
Heavy-Duty In-Use Testing Program (HDIUT) (Part of Omnibus Regulation)	2024	MSM
California's in-use testing program (including the HD I/M, HDVIP and PSIP regulations) is the most stringent in the nation, with further increases in stringency going into effect in 2024 (HDIUT). • Amended in 2018, HDVIP requires heavy duty vehicles to be inspected for smoke opacity, tampering, and engine certification label compliance. PSIP identifies malfunctioning PM emission control components and requires their repair. The 2018 amendments to HDVIP and PSIP lowered the smoke opacity limits and required engines over four years old to be inspected annually. • Adopted in 2021, HD I/M is a comprehensive heavy-duty vehicle inspection and maintenance regulation requiring periodic vehicle emissions testing and reporting on nearly all heavy-duty vehicles operating in California. Combining periodic vehicle testing with other emissions monitoring and expanded enforcement strategies, the HD I/M regulation ensures that vehicles' emissions control systems are properly functioning when traveling on California's roadways, and that polluting, poorly maintained heavy-duty vehicles operating in California are quickly identified and repaired. As of 2023, CARB is using roadside emissions monitoring devices (REMD) to screen for vehicles that may have high emissions. • To ensure that in-use heavy-duty vehicles continue to operate at their cleanest possible level, the 2020 Omnibus regulation amended the Heavy-Duty In-Use Testing (HDIUT) Program by revising procedures to better represent heavy-duty vehicle operations in real world conditions, establishing clearer criteria for engine family pass/fail determination, and requiring on-board diagnostic (OBD) data during testing to verify the condition of the test vehicle and sensors. California's HD inspection and maintenance requirements are the most stringent in the nation; further increases in stringency are not feasible. Further increases in stringency under the Omnibus Regulation take effect next year and are phased-in in subsequent years to allow regulated parties and manufacturers sufficient lead time to comply with the regulation's stringency; a more accelerated timeline is infeasible.		
Diesel Idling Requirements		
HD Idling Reduction Program	ongoing	MSM
Reduced Idling Limits (as part of Omnibus)	2024	MSM
School Bus Idling ATCM	ongoing	MSM
The HD Idling Reduction Program requires that drivers of diesel-fueled commercial motor vehicles (GVWR < 10,000 lbs), including buses and sleeper berth equipped trucks, not idle the vehicle's primary diesel engine longer than five minutes at any location. The regulation also consists of new engine and in-use truck requirements and emission performance requirements for technologies used as alternatives to idling the truck's main engine. Under the new engine requirements, 2008 and newer model year heavy-duty diesel engines need to be equipped with a non-programmable engine shutdown system that automatically shuts down the engine after five minutes of idling. The Omnibus regulation further reduces diesel idling limits from 30 g/hr to 10 g/hr in MY 2024, and to 5 g/hr in MY 2027+ engines. In addition to the idling limits required under the HD Idling Reduction program and the Reduced Idling Limits as part of the Omnibus Regulation, the School Bus Idling Airborne Toxic Control Measure (School Bus ATCM) further limits bus and commercial motor vehicle idling near schools or at school bus destinations to only when necessary for safety or operational concerns. California's idling requirements are the most stringent in the nation; further increases in stringency are not feasible. Reduced idling limits from the Omnibus Regulation take effect next year (2024+) and are phased-in in subsequent years to allow regulated parties and manufacturers sufficient lead time to comply with the regulation's stringency; a more accelerated timeline is infeasible.		
Fleet Rules - General		
Truck and Bus	ongoing	MSM

Measures	Implementation Begins	12 µg/m³ Annual PM2.5 Standard (2012)
Advanced Clean Fleets (ACF) Regulation (2022 State SIP Strategy measure, adopted April 2023)	2024	MSM
Zero-Emission Trucks Measure (2022 State SIP Strategy measure with commitment)	2030	Beyond MSM
California's heavy-duty fleet rules are the most stringent in the nation, and have continually relied on the newest developments in advanced clean technologies that are spurred by CARB's new engine and vehicle standards. For the timeline of analysis for this document, there have been / will be three generations of fleet rules, which transition California's heavy-duty fleet from low-emission internal combustion engines to increasingly stringent requirements for zero-emission technologies: • Adopted in 2010, the Truck and Bus regulation requires heavy-duty diesel vehicles that operate in California to reduce exhaust emissions. By 2023, nearly all trucks and buses will be required to have 2010 or newer model year engines to reduce PM and NOx. • Building on the successful emission reductions from Truck and Bus, the Advanced Clean Fleets (ACF) regulation would transition CARB's fleet rules toward establishing zero-emission purchasing requirements for medium- and heavy-duty vehicle fleets (including state and local agencies, and drayage fleets, high priority, and federal fleets), beginning in 2024. ACF would also require 100% zero-emission new vehicle sales starting 2040. Under the recently-adopted ACF regulation, together with the ACT regulation, the number of medium- and heavy-duty ZEVs operating in California will be about 1.2 7 million by 2045. • The future Zero-Emission Trucks Measure would build on the rollout of ZE trucks through the Advanced Clean Trucks and Advanced Clean Fleets regulations by going beyond ACF requirements and further increasing the number of ZEVs, with the goal of achieving a full ZEV fleet by 2045 everywhere feasible. It would seek to expand the ZEV market in a manner that is economically feasible for more than 100,000 fleets where some cannot afford to purchase new trucks and will not be able to operate without access to retail ZEV infrastructure, especially for long-haul and inter-state vehicles. Fleet requirements need years of lead time to be implemented for reasons of technological and economic feasibility. As purchasing requirements and fleet turnover cannot happen immediately, it would be infeasible to accelerate the implementation schedule for new purchasing requirements. California's currently committed to heavy-duty fleet requirements are technology-forcing and are the most stringent in the nation, as they will eventually exclusively require zero-emission trucks and engines; further increases in stringency are not feasible.		
Fleet Rules - Drayage Trucks		
Truck and Bus	ongoing	MSM
Advanced Clean Fleets (ACF) Regulation (2022 State SIP Strategy measure, adopted April 2023)	2024	MSM
Drayage trucks are subject to requirements under the Truck and Bus Regulation, which requires MY 2010 or newer engines on drayage trucks entering ports and rail yards, beginning in on January 1, 2023. Under the Advanced Clean Fleets (ACF) Regulation, CARB will further strengthen emission controls for drayage fleets with zero-emission drayage truck requirements. Drayage trucks will be required to start transitioning to zero-emission technology beginning in 2024, with full implementation by 2035. Fleet requirements need years of lead time to be implemented for reasons of technological and economic feasibility. As purchasing requirements and fleet turnover cannot happen immediately, it would be infeasible to accelerate the implementation schedule for new purchasing requirements. California's fleet requirements for drayage trucks are technology-forcing and are the most stringent in the nation, as they will require zero-emission trucks and engines; further increases in stringency are not feasible.		
Fleet Rules - Solid Waste Collection Vehicles (SWCVs)		
Solid Waste Collection Vehicle Regulation	ongoing	MSM
Truck and Bus	ongoing	MSM
Advanced Clean Fleets (ACF) Regulation (2022 State SIP Strategy measure, adopted April 2023)	2024	MSM
Adopted in 2003, the Solid Waste Collection Vehicle Regulations reduce diesel PM from SWCVs by requiring engines equivalent to the 2007 MY standard of 0.01 g/bhp-hr. SWCVs are also subject to requirements under the Truck and Bus Regulation, which requires MY 2010 or newer engines as of January 1, 2023. The ACF regulation will accelerate ZEV adoption among SWCVs, with a goal of 100 percent ZE vehicle sales in California starting in 2036. Fleet requirements need years of lead time to be implemented for reasons of technological and economic feasibility. As purchasing requirements and fleet turnover cannot happen immediately, it would be infeasible to accelerate the implementation schedule for new purchasing requirements. California's fleet requirements for SWCVs are technology-forcing and are the most stringent in the nation, as they will require zero-emission trucks and engines; further increases in stringency are not feasible.		

Measures	Implementation Begins	12 µg/m³ Annual PM2.5 Standard (2012)
Fleet Rules - Public Agencies and Utilities		
Public Agency and Utility Regulation	ongoing	MSM
Truck and Bus	ongoing	MSM
Advanced Clean Fleets (ACF) Regulation (2022 State SIP Strategy measure, adopted April 2023)	2024	MSM
The Public Agency and Utility Regulation requires PM emission limits comparable to the 2007 MY standard of 0.01 g/bhp-hr for engine MY 1960 or newer. Some public and utility fleets are also subject to requirements of Truck and Bus, and must have MY 2010 or newer engines as of January 1, 2023. The ADF regulation accelerates ZEV adoption among all state and local government and utility fleets, starting with a 50% purchase requirement in 2024, with increasingly stringent requirements phased-in over subsequent years. Fleet requirements need years of lead time to be implemented for reasons of technological and economic feasibility. As purchasing requirements and fleet turnover cannot happen immediately, it would be infeasible to accelerate the implementation schedule for new purchasing requirements. California's fleet requirements for public and utility fleets are technology-forcing and are the most stringent in the nation, as they will require zero-emission trucks and engines; further increases in stringency are not feasible.		
Fleet Rules - Transit Agencies		
Fleet Rule for Transit Agencies	ongoing	MSM
Innovative Clean Transit	2023	MSM
The Transit Fleet Rule requires PM and NOx emission reductions from urban buses and transit fleet vehicles, and required future zero-emission bus purchases. Adopted in 2018, the Innovative Clean Transit (ICT) Regulation requires all public transit agencies to gradually transition to a 100 percent zero-emission bus (ZEB) fleet. Beginning in 2029, 100% of new purchases by transit agencies must be ZEBs, with a goal for full transition by 2040. Fleet requirements need years of lead time to be implemented for reasons of technological and economic feasibility. As purchasing requirements and fleet turnover cannot happen immediately, it would be infeasible to accelerate the implementation schedule for new purchasing requirements. California's fleet requirements for transit agencies are technology-forcing and are the most stringent in the nation, as they will require zero-emission trucks and engines; further increases in stringency are not feasible.		
Fleet Rules - Airport Shuttle Buses		
Truck and Bus	ongoing	MSM
Zero-Emission Airport Shuttle Buses	2027	MSM
The Truck and Bus Regulation requires airport shuttle buses to use MY 2010 or equivalent engines by 2023. The Zero-Emission Airport Shuttle Bus Regulation requires airport shuttle operators to transition to 100 percent zero-emission vehicle (ZEV) technologies. Airport shuttle operators must begin adding zero-emission shuttles to their fleets in 2027, and complete the transition to ZEVs by the end of 2035. Fleet requirements need years of lead time to be implemented for reasons of technological and economic feasibility. As purchasing requirements and fleet turnover cannot happen immediately, it would be infeasible to accelerate the implementation schedule for new purchasing requirements. California's fleet requirements for airport shuttle buses are technology-forcing and are the most stringent in the nation, as they will require zero-emission trucks and engines; further increases in stringency are not feasible.		
School Buses – In-Use Control Programs		
Truck and Bus	ongoing	MSM
School Bus Idling ATCM	ongoing	MSM
Heavy-Duty Omnibus Regulation	2024	MSM
School Bus Incentive Program	ongoing	MSM
The Truck and Bus regulation applies to school buses > 14,000 lbs., GVWR, and requires the use of diesel particulate filters. The School Bus Idling Airborne Toxic Control Measure (School Bus ATCM) further limits bus and commercial motor vehicle idling near schools or at school bus destinations to only when necessary for safety or operational concerns. Under the Omnibus Regulation, idling limits for diesel heavy-duty vehicles will be reduced from 30 g/hr currently to 10 g/hr in MY 2024 and to 5 g/hr in MY 2027. CARB also uses incentive funds as a key component of the strategy to reduce emissions from the school bus fleet. Over the past two decades, CARB's School Bus Incentive Program has invested over $1.2 billion to date to clean up old, higher-polluting school buses, which has supported about 1,800 zero emission school buses. California's requirements for in-use control programs for school buses are among the most stringent in the nation; it would be infeasible to accelerate the implementation schedule, or require further increases in stringency.		

Measures	Implementation Begins	12 µg/m^3 Annual PM2.5 Standard (2012)
Fuels Control Measures		
Conventional Diesel Fuel Standards		
CARB Ultra Low Sulfur Diesel (ULSD)	ongoing	MSM
Low-Emission Diesel Requirement (2016 State SIP Strategy measure, not yet adopted)	TBD	Beyond MSM
CARB's Ultra Low Sulfur Diesel (ULSD) regulation was last amended 2003 to establish more stringent standards for diesel fuel, lowering the sulfur limit to 15 ppmw. Relative to federal diesel requirements, CARB ULSD reduces NOx and PM emissions significantly. The Low Emission Diesel measure will require diesel fuel providers to steadily decrease criteria pollutant emissions from their fuels, which will reduce NOx and PM tailpipe emissions. CARB fuel regulations reduce emissions from even those vehicles registered out of state and therefore not subject to CARB's other mobile source control measures. CARB's diesel standards and requirements are the most stringent in the nation, and some of the most stringent in the world; it is not feasible to require further stringency of fuel specifications.		
Alternative Fuel Standards		
Low Carbon Fuel Standard (LCFS)	ongoing	MSM
Alternative Diesel Fuel (ADF) Regulation	ongoing	MSM
The LCFS and ADF regulations work together to reduce the carbon intensity of the California fuel supply. The regulations also limit criteria emissions from alternative fuels and/or alternative fuel mix blends. The regulations were amended in 2018 to extend the carbon intensity target of 20 percent to 2030. No other state or federal requirements have set as stringent of criteria emission requirements on alternative fuels and alternative fuel blends than California. The LCFS and ADF are technology-forcing regulations, and are the most stringent in the nation; further stringency would not be feasible. As it takes fuel producers years to develop, certify, and manufacture new alternative fuel types to meet the increasingly stringent requirements of the LCFS and ADF, an accelerated implementation timeframe would not be feasible.		

STEP 3(B): EVALUATION OF FEASIBILITY: MEDIUM- AND HEAVY-DUTY CONTROL MEASURES

Step 3(b) calls for an assessment of the feasibility of implementing any measure that is not included in the Valley's proposed SIP, but which is identified as a potential control measure in Step 2. During the public process for the 2022 State SIP Strategy, CARB staff received public measure suggestions for additional potential heavy-duty measures, as described below. Staff developed the Zero-Emission Trucks measure in response to these public measure suggestions.

- On-Road Heavy-Duty Vehicle Useful Life Regulation
  This suggestion would involve CARB developing a regulation, potentially paired with new incentives or legislative measures, to require on-road heavy-duty vehicles that have reached the end of their useful life as defined in Senate Bill 1,[91] as the earlier of 800,000 vehicles miles traveled or 18 years from the engine model year to retire, replace, retrofit, or repower the on-road heavy-duty vehicle or engine, and upgrade to zero-emission trucks.

  CARB staff has investigated the feasibility and potential benefits of this suggested measure and have included it as one potential option in the ***Zero-Emission Trucks measure*** in the 2022 State SIP Strategy.

- Additional Incentive Programs: Zero-Emission Trucks
  Additional incentive programs are needed to send clear signals to the market and support new scrap and replace regulatory programs, specifically to help ensure that smaller trucking companies have more consistent access to zero-emission truck incentives. This measure would involve CARB working to develop incentive programs which should include consideration of policies other jurisdictions have employed such as supporting local zero-emission zones and/or differentiated registration fees so that dirtier trucks pay more and zero-emission trucks have a consistent source of incentive funding.

  CARB staff has investigated the feasibility and potential benefits of this suggested measure, and have included it as one potential element of the ***Zero-Emission Trucks measure*** in the 2022 State SIP Strategy.

- Indirect Source Rule
  This measure could involve CARB writing a Suggested Control Measure which acts as a model rule to assist the air districts in the rule development process. An indirect source can be any facility, building, structure, or installation, or combination thereof, which attracts or generates mobile source activity that results in emissions – these include warehouses, railyards, ports, airports, and mobile sources attracted to those warehouses, railyards, ports, and airports. Only a few air districts in California have indirect source rules to limit emissions of this

[91] Beall, Chapter 5, Statutes of 2017
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB1

nature on a facility basis.

CARB staff have investigated the feasibility and potential benefits of this suggested measure, and have included an Indirect Source Regulation as one potential element of the Zero-Emission Trucks measure in the 2022 State SIP Strategy. In addition, CARB staff will explore opportunities to expand existing State law to provide partnership opportunities for CARB and air districts to work together to develop, adopt, and implement indirect source rules.

CARB staff do not recommend eliminating any of the potential medium- and heavy-duty control measures identified on the basis of technical or economic infeasibility.

D.4.3 Off-Road Sources

Off-road mobile sources include a wide variety of engines ranging from locomotives, ships, and aircraft, to equipment used in the agricultural, construction, mining, and freight / goods movement industries. This category is composed of off-road compression ignition (diesel) engines and equipment, small spark ignition off-road engines and equipment less than 25 hp (including lawn and garden equipment, and small industrial equipment), off-road large spark ignition (gasoline and liquefied petroleum gas) engines and equipment 25 hp and greater (including industrial equipment, forklifts, and portable generators), airport ground support equipment, and cargo handling equipment used at railyards, warehouses, and the Port of Stockton.

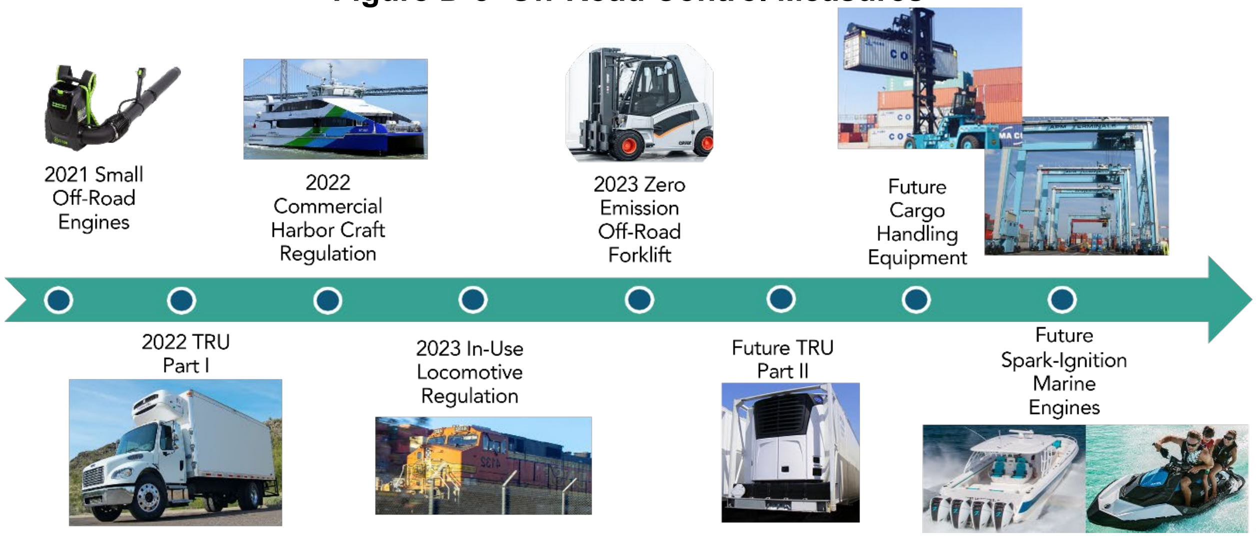
As the Valley is home to one of the most productive agricultural regions in the world, farm equipment is also an important off-road source category for the Valley. The farm equipment category is composed of agricultural equipment that includes tractors, agricultural tractor-trailers, harvesting equipment, sprayers, and other agricultural equipment and engines. Similar to the on-road sectors, California has a comprehensive program for reducing emissions from off-road equipment that goes well beyond current requirements in place elsewhere in the nation.

While emission standards for locomotives are set by U.S. EPA, CARB has accelerated reductions from these sources through efforts that have focused on cleaner fuel requirements, and increasing use of cleaner locomotives. CARB staff and the Class I railroads have also been implementing a memorandum of understanding to accelerate the introduction of cleaner locomotives since 2005. The recently adopted In-Use Locomotive Regulation accelerates the adoption of advanced, cleaner technologies for locomotive operations, including zero-emission technologies.

STEP 2(A): CALIFORNIA'S OFF-ROAD CONTROL MEASURES

Emission reductions from ongoing implementation of the current control program are projected to reduce emissions of NOx and direct PM from the off-road sector by over 54 percent between today and 2030. Achieving reductions in the off-road sectors remains a greater challenge than in the on-road sector due to the diverse nature of these sources, regulatory authority that rests outside of CARB in many cases, and the length of time sources remain in the fleet.

Figure D-5 Off-Road Control Measures



The major regulatory and programmatic control measures that provide these emissions reductions are described below.

NEW VEHICLE, EQUIPMENT, AND ENGINE STANDARDS

Internal Combustion Off-Road Equipment (General)

To control emissions from off-road equipment, CARB adopted in 2004 a fourth tier of increasingly stringent PM and NOx standards based on the use of advanced aftertreatment emission controls. U.S. EPA also adopted the Tier 4 standards in 2004. California's current standards are equal in stringency to current federal standards. These ***"Tier 4" standards*** apply to new off-road compression-ignition engines, and were phased-in across product lines from 2008 through 2015 and reduced exhaust emission levels by up to 95 percent compared to previous control strategies. New engine standard requirements vary according to the power rating of engines. Table D-19 shows the schedule for phasing in tiered requirements for new off-road engines with a power rating between 175 and 300 hp. Beginning in 2014, new Tier 4 construction equipment must emit about 96 percent less NOx and PM than new Tier 1 equipment sold in the year 2000.

Table D-19 Phase-in of Off-Road Engine Standards

Model year	Level of Control	Applicable Emission Standard for New Off-road Engines 175<hp<300 g/bhp-hr	
		NOx	PM
1996-2002	Tier 1	6.9	0.4
2003-2005	Tier 2	4.9*	0.15
2006-2010	Tier 3	3.0*	0.15
2011-2013	Tier 4 interim	1.5	0.015
2014+	Tier 4 final	0.3	0.015
Under development	Tier 5 Standards	TBD	TBD

*Reflects combined limit for non-methane hydrocarbons and NOx

Moving beyond the stringency of emission controls required in the current control program, in the 2022 State SIP Strategy, CARB committed to ***Tier 5 Off-Road New Compression-Ignition Engine Standards***, which would go beyond MSM and establish more stringent standards and test procedures for new, off-road compression-ignition (CI) engines to reduce NOx, PM, and carbon (CO2) emissions (referred to as Tier 5) for all off-road engine power categories, including those that do not currently utilize exhaust aftertreatment such as diesel particulate filters (DPF) and selective catalytic reduction (SCR). CI engines are used in a wide range of off-road equipment including tractors, excavators, bulldozers, graders, and backhoes. As of model year 2020, more than half of all new off-road CI engine families continue to be certified to California's most stringent (Tier 4 final) emission standards without the need for DPFs. This means that most new off-road CI engines are not reducing toxic diesel PM to the greatest extent feasible using the best available technology. The proposed new Tier 5 standards and test procedures would be more stringent than required by current U.S. EPA and European Stage V nonroad regulations and would require the use of best available technologies for both PM and NOx. Lower NOx standards – up to 90 percent below the current Tier 4 final emission standard levels – coupled with lower PM standards, would force engine manufacturers to incorporate DPFs, which many currently do not have. DPFs would also ensure greater reductions in ultrafine PM, which may pose a health concern separate from PM emissions as a whole.

CARB has also engaged in a number of feasibility studies and technological demonstrations of the requisite technologies for this measure:

- CARB funded a research effort demonstrating the feasibility of advanced aftertreatment on 79 small off-road CI engines, which was completed by the Center for Environmental Research and Technology (CE-CERT) in 2019. Small off-road CI engines (less than 56-kilowatt [kW] or 75 hp) are not currently required to comply with advanced NOx aftertreatment-based standards, and a subset of these engines that are less than 19 kW (25 hp) are not required to comply with advanced PM aftertreatment--based standards. Small off-road CI engines account for between 20 to 40 percent of the off-road diesel PM and NOx emissions inventories in California.[92]
- A recent research effort performed for CARB by CE-CERT concluded that current reporting and recordkeeping requirements are insufficient for determining the number of engines and equipment sold in California with less-stringent emission levels under both the federal Average, Banking, and Trading program and the federal Transition Program for Equipment Manufacturers.[93] Hence, it would be helpful to revise and improve the reporting and recordkeeping requirements.

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[92] "Evaluation of the feasibility, cost-effectiveness, and necessity of equipping small off-road diesel engines with advanced PM and/or NOx aftertreatment" – CARB Contract No. 14-300, March 2019, https://ww2.arb.ca.gov/sites/default/files/2020-10/14-300.pdf

[93] "Evaluation of the Impacts of Emissions Averaging and Flexibility Programs for all Tier 4 Final Off-road Diesel Engines," CARB Contract No. 14-301, February 2018, https://ww2.arb.ca.gov/sites/default/files/classic//research/apr/past/14-301.pdf?_ga=2.127732621.1682659074.1620315165-1165705998.1587147934

- Recent CARB funded demonstrations of ultra-low NOx on-road engines conducted at the Southwest Research Institute (SWRI) show that much lower NOx standards are feasible for on-road engines. Because off-road diesel engines are similar in technology to on-road heavy-duty diesel engines, this work suggests that lower NOx standards are likely feasible for off-road engines as well. Additionally, CARB is currently funding an off-road demonstration project with SWRI to support determining the feasibility of more stringent off-road standards for NOx, PM, and CO2.
- Recent CARB test data, consistent with test data presented by reputable diesel publications, indicate that up to 40 percent of a typical off-road CI engine's in-use operation occur at idle,[94] and that the frequency of in-use low-load- operation[95] is insufficient to keep exhaust emission aftertreatment temperature above 250 degrees Celsius, that enables efficient SCR operation to control NOx emissions. Establishing new idle emission reduction strategies and a low-load test cycle are also being investigated as part of this Tier 5 measure.

Under this measure, CARB would develop and propose standards and test procedures for new off-road CI engines including the following: aftertreatment-based PM standards for engines less than 19 kW (25 hp), aftertreatment-based NOx standards for engines greater than or equal to 19 kW (25 hp) and less than 56 kW (75 hp), and more stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp) and first time CO2 tailpipe standards targeting a 5 to 8.6 percent reduction. Other possible elements include enhancing in-use compliance, proposing more representative useful life periods, idle requirements and developing a low load test cycle. It is expected that Tier 5 requirements would rely heavily on technologies manufacturers are developing to meet the recently approved low-NOx standards and enhanced in-use requirements for on-road- heavy-duty engines.

Zero-Emission Off-Road Equipment (General)

CARB anticipates increasing the stringency of Off-Road engine requirements through a rule requiring Zero-Emission manufacturer requirement. With the ***Off-Road Zero-Emission Targeted Manufacturer Rule*** measure, a commitment in the 2022 State SIP Strategy, CARB would accelerate the development and production of zero-emission off-road equipment and powertrains into more sectors (including wheel loaders, excavators, and bulldozers) as technology advancements occur due to existing CARB zero-emission regulations and regulations in the forklifts, cargo handling equipment, off-road fleets, and small off-road engines sectors. For this measure, CARB would propose to develop a regulatory measure that would require manufacturers of off-road equipment and/or engines to produce for sale zero-emission equipment and/or powertrains as a percentage of their annual statewide sales volume to ensure these globally emerging zero-emissions products and related innovations come to California.

[94] https://www.constructionequipment.com/home/blog/10727772/thinking-through-fuel-burn-rates
[95] Measurement of PM and Gaseous Emissions from Cargo Handling Equipment (CHE) during Real-World Operation – David Quiros, 29th CRC Real World Emissions Workshop, March 2019

REDUCING IN-USE EMISSIONS

Fleet Rules: Off-Road Equipment (General)

Large diesel off-road equipment typically remains in use for long periods of time. As with heavy-duty trucks, this long life means that newer, lower-emitting engines would be introduced into fleets relatively slowly. To address this, the ***Cleaner In-use Off-Road Equipment Regulation (Off-Road Regulation)*** was adopted in 2007, and amended in 2009 and 2010. The regulation covers all self-propelled off-road diesel vehicles 25 horsepower or greater used in California and most two-engine vehicles (except on--road two-engine sweepers). The Off-Road Regulation requires off-road fleets to reduce their emission by retiring, replacing, or repowering older engines. This Regulation expanded the penetration of existing clean technology to ensure that the engines and vehicles used today are as clean as possible. U.S. EPA approved this regulation in 2013. The types of off-road equipment controlled by this regulation are used in construction, manufacturing, the rental industry, road maintenance, airport ground support, and landscaping. In December 2011, the Off-Road Regulation was modified to include on-road trucks with two diesel engines.

The Off-Road Regulation is an extensive program designed to accelerate the penetration of the cleanest equipment into California's fleets. This regulation significantly reduces emissions of diesel PM and NOx from the over 150,000 in-use off-road diesel vehicles that operate in California by requiring their owners to modernize their fleets and install exhaust retrofits. The regulation requires that fleets meet an increasingly stringent set of fleet average targets, culminating in 2023 for large and medium fleets (large fleets represent about 54 percent of vehicle ownership) and in 2028 for small fleets. The most stringent fleet average target generally corresponds to roughly a 2012 model year, or a Tier 3 average standard. In 2015, the program reduced emissions from 10,447 vehicles used in 838 fleets by requiring owners to modernize their fleets by replacing older engines or vehicles with newer, cleaner models, retiring older vehicles or using them less often, or by applying retrofit exhaust controls. The Off-Road Regulation imposes idling limits on off-road diesel vehicles, requires a written idling policy, and requires a disclosure when selling vehicles. The Regulation also requires that all vehicles be reported to CARB and labeled, restricts the addition of older vehicles into fleets, and requires fleets to reduce their emissions by retiring, replacing, or repowering older engines, or installing verified exhaust retrofits. The requirements and compliance dates of the Off-Road Regulation vary by fleet size.

With the ***2022 Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation***, CARB further reduced emissions from the in-use off-road diesel equipment sector by increasing the stringency of the regulation's requirements. These amendments create additional requirements to the currently regulated fleets by targeting the oldest and dirtiest equipment that is allowed to operate indefinitely under the current regulation's structure. The amendments will require fleets to phase-out use of the oldest and highest polluting off-road diesel vehicles in California and prohibit the addition of high-emitting vehicles to a fleet. The amendments phase-in starting in 2024 through the end of 2036, and include changes to enhance enforceability and encourage the adoption of zero-emission technologies. The In-Use Off Road Diesel Fleets Regulation also requires the use of R99 or R100 renewable diesel in off-road diesel vehicles starting in January 2024 for all fleets.

CARB anticipates further emission reductions from the off-road equipment fleets through the ***Clean Off-Road Fleet Recognition Program measure***. This measure would create a non-monetary incentive to encourage off-road fleets to go above and beyond existing regulatory fleet rule compliance and adopt advanced technology equipment with a strong emphasis on zero-emission technology. This measure would provide a standardized methodology for contracting entities, policymakers, state and local government, and other interested parties to establish guidelines for contracting criteria or require participation in the program to achieve their individual policy goals. For this voluntary program, CARB would establish a framework that would encourage fleets to incorporate advanced technology and ZEVs into their fleets, prior to or above and beyond regulatory mandates. The program would provide standardized criteria or a rating system for fleet participation at various levels to reflect the penetration of advanced technology and ZEVs into a fleet. Levels could be scaled over time as zero-emission equipment becomes more readily available. CARB anticipates the next several years of technology advancements and demonstrations to drive the stringency of the rating system. Participation in the program would be voluntary for fleets; however, designed in a manner that provides them motivation to go beyond business as usual. The program would offer value for fleets to participate by providing them access to jobs/contracts, public awareness, and marketing opportunities.
Beyond the general fleet rules controlling emissions from off-road equipment, CARB has also developed and implemented control measures that target specific to categories of sources within the off-road sector, which are described below.

SOURCE-SPECIFIC RULES

Given the diversity of types of engines, vehicles, and equipment used in the off-road sector, CARB's control strategy includes multiple requirements that are specific to categories of sources within the off-road sector. This includes:

Agricultural Equipment

Emission Standards for Agricultural Equipment

In 2004, U.S. EPA and California adopted equivalent standards that require additional reductions from off-road engines, including engines used in mobile agricultural equipment. These ***Tier 4 Engine Standards*** continue to achieve substantial reductions in PM2.5 and NOx as new farm equipment is introduced into the fleet.

In-Use Controls: Agricultural Equipment

New engines used in agricultural equipment, primarily tractors, must meet the same standards as other off-road engines ensuring that new equipment becomes progressively cleaner. Just as in other off-road applications, diesel agricultural equipment can remain in use for long periods of time. This long life means that equipment with new, lower emitting engines are introduced into the fleet at a relatively slower pace than what is needed to meet air quality standards. The cleanup of agricultural in-use equipment is primarily an issue in the San Joaquin Valley with their large agricultural economy.

The 2007 SIP included the ***2007 Cleaner In-Use Agricultural Equipment Measure*** (Ag Measure) to achieve 5 to 10 tpd of NOx reductions in 2017 by modernizing agricultural equipment in the Valley. The Valley agricultural industry immediately began working on implementing this SIP measure by leveraging federal and local incentives to provide farmers assistance to replace their older, higher polluting equipment with the cleanest available technology. Specifically, new incentive funds were secured through the federal Farm Bill to be used alongside funds from existing programs.

To push beyond the 2007 Ag Measure, CARB staff included in the San Joaquin Valley Supplement to the 2016 State Strategy for the State Implementation Plan (Valley SIP Strategy)[96] the ***Accelerated Turnover of Agricultural Equipment*** measure to achieve 11 tpd NOx reductions in 2024 through the accelerated turnover of approximately 12,000 tier 0, tier 1, and tier 2 agricultural equipment to the cleanest equipment available. This measure lead to the appropriation of significant funding and development of CARB's Funding Agricultural Replacement Measures for Emissions Reductions (FARMER) Program. In addition, eligible projects under the SIP measure and through the FARMER program include electrifying agricultural equipment such as utility quads and small yard tractors that are used on farms and ranches. To fulfill the State commitment under the Accelerated Turnover of Agricultural Equipment Measure, CARB developed in 2019 and submitted to U.S. EPA a SIP-creditable incentive measure for a subset of the total emissions reductions that has since been made federally-enforceable upon approval by U.S. EPA into the California SIP.

Incentives are cost-effective in replacing old high-polluting tractors on most farms. However, there are many of these high-polluting tractors still in service on small farms in which the cost of the new tractor is not feasible even with incentives. To provide cleaner tractors to small farms, CARB staff along with the District and the agricultural industry are working to implement a new tractor trade up program through funding provided by a CARB grant. The trade-up program is designed to assist small farmers overcome potential financial barriers to accessing cleaner mobile agricultural technologies, and is intended to accelerate emission reductions by replacing the oldest tractors with cleaner used models. This is accomplished through a multi-step transaction in which an owner of an older, high-emitting piece of mobile agricultural equipment agrees to scrap that

[96] San Joaquin Valley Supplement to the 2016 State Strategy for the State Implementation Plan https://ww2.arb.ca.gov/sites/default/files/classic/planning/sip/2016sip/valleystrategy.pdf

equipment in exchange for a previously used and reconditioned piece of equipment with a cleaner diesel engine at little or no out-of-pocket cost. The owner of the used equipment is provided incentive funding to assist in the purchase of new equipment that employs the cleanest, commercially available technology.

CARB also included in the Valley SIP Strategy the ***Cleaner In-Use Agricultural Equipment*** measure to serve as a backstop to accelerate the turnover of large tier 0, tier 1, and tier 2 agriculture tractors to tier 4 through existing projects and new projects. While identifying and securing incentive funding will be an important element going forward, the Cleaner In-Use Agricultural Equipment measure is designed to act as a catalyst for attracting early replacement of agricultural equipment using incentives. The backstop rule could require that by 2030 all agricultural equipment operating in the Valley be Tier 2 or cleaner. In combination, the backstop rule, incentives and significant lead time, ensures cleaner agricultural equipment will be used in the Valley through 2030.

Airport Ground Support Equipment (GSE)

Emission Standards for Airport GSE

Engines used in newly manufactured GSE operating on gasoline, LPG, and CNG are required to meet California's new engine emission standards for LSI. The ***LSI engine standard*** for engines greater than 1.0 liter (typical for GSE) is 0.6 g/bhp-hr of hydrocarbons (HC) and NOx. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recent as 2009. Diesel engines in newly manufactured GSE must meet the Tier 4 emission standards applicable to off-road compression-ignition engines under the ***In-Use Off Road Diesel-Fueled Fleets Regulation***. These standards vary by horsepower and are more than 90 percent cleaner than the emissions levels of engines produced twenty years ago.

CARB is also anticipated to further increase the stringency of emission controls with the Zero-Emission Airport Ground Support Equipment measure, which will act as a catalyst to further adoption of zero-emission equipment in the off-road sector, facilitate the transfer of technology to suitable heavier duty-cycle applications, and expand use of zero-emission infrastructure.

In-Use Controls: Airport GSE

In addition to adopting regulations limiting emissions from new engines used in GSE, California has adopted regulations to reduce emissions from existing, in-use GSE. In 2007, California adopted the ***In-Use Off-Road Diesel-Fueled Fleets Regulation,*** which requires fleets operating in-use diesel equipment to meet an annual fleet average emissions target that decreases over time. For example, for equipment over 175 and under 750 HP, the final 2023 NOx fleet average target is 1.5 g/bhp hr, which is equivalent to the interim Tier 4 NOx standard for newly produced engines. Fleets that do not meet the required annual fleet average must meet the BACT requirements that require turnover, repower or retrofit of a specific percent of a fleet's total HP. These requirements are currently being phased in. Additionally, fleets operating LSI GSE must meet the ***In-Use LSI Engine Fleet Requirements***. Adopted in 2006, the LSI fleet rule requires GSE fleets to maintain an average emission level of no more than 2.5 g/bhp hr HC+NOx, starting January 1, 2013. Non-mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the ***Portable Diesel-Engines Air Toxic Control Measure*** (ATCM). The ATCM reduces PM emissions by requiring engine replacement in a schedule based on a fleet's weighted PM emission average.

CARB is also anticipated to further increase the stringency of emission controls with the ***Zero-Emission Airport Ground Support Equipment measure***, a measure committed to in the 2016 State SIP Strategy, which will act as a catalyst to further adoption of zero-emission equipment in the off-road sector, facilitate the transfer of technology to suitable heavier duty-cycle applications, and expand use of zero-emission infrastructure.

Cargo Handling Equipment (CHE)

Emission Standards for Airport CHE

California's ***Cargo Handling Equipment Regulation*** set performance standards for engines in newly acquired, as well as in-use, mobile CHE at ports or intermodal rail yards in California. Mobile CHE is used to transfer goods or perform maintenance and repair activities and includes equipment such as yard trucks (hostlers), top handlers, side handlers, reach stackers, forklifts, rubber-tired gantry cranes, dozers, excavators, loaders, and railcar movers used in maintenance operations at ports and intermodal rail yards. CARB's CHE Regulation was originally adopted in 2005 to establish BACT requirements for new and in-use cargo handling equipment that operate at California's ports and intermodal rail yards, and was amended in 2011 to include opacity monitoring requirements. CARB obtained authorization for the 2005 version of the regulation in 2012. Under the CHE Regulation, all newly purchased yard truck and non-yard truck equipment brought onto a port or intermodal rail yard must have either a Tier 4 Final off-road engine or an on-road engine meeting the 2010 or newer on-road emission standards. CHE Regulations set performance standards for engines in newly acquired, as well as in-use, mobile CHE at ports or intermodal rail yards in California.

CARB staff anticipates increasing the stringency of emission standards for CHE beyond MSM with the ***Amendments to CHE Regulation***. In March 2018, CARB staff presented to the Board a plan to begin development of a regulation to transition CHE to zero-emission technologies, and to minimize emissions and community health impacts from cargo handling equipment. The CHE amendments would set in-use requirements for diesel cargo handling equipment at ports and rail yards, including but not limited to yard trucks (hostlers), rubber-tired gantry cranes, container handlers, and forklifts. The regulatory amendments would propose to start transitioning CHE to zero-emission with an implementation schedule for new equipment and facility infrastructure requirements, with effective dates beginning in 2030. Staff would assess the availability and performance of zero-emission technology as an alternative to all combustion-powered cargo equipment and evaluate additional solutions that may include efficiency improvements. Based on the current state of zero-emission CHE technological developments, the transition to zero-emission would most likely be achieved largely through the electrification of CHE. In this potential action, all mobile equipment at ports and rail yards, including but not limited to diesel, gasoline, natural gas, and propane-fueled equipment, would be subject to new requirements. Staff anticipates that yard trucks and forklifts would transition to zero-emission earliest, followed by rubber-tired gantry cranes, and 90 percent of other CHE will be zero-emission by 2036. These assumptions are supported by the fact that currently some electric rubber tire gantry cranes, electric forklifts, and electric yard tractors are already commercially available. Other technologies are in early production or demonstration phases. CARB staff would also consider opportunities to prioritize the earliest implementation in or adjacent to the communities most impacted by air pollution. Board consideration for adoption of these amendments is anticipated in 2024.

In-Use Controls: CHE

As described earlier, the ***Cargo Handling Equipment Regulation*** (adopted in 2005, amended in 2011) includes performance standards for in-use, mobile CHE at ports or intermodal rail yards in California. CARB's CHE Regulation was originally adopted in 2005 to establish BACT requirements for new and in-use cargo handling equipment that operate at California's ports and intermodal rail yards, and was amended in 2011 to include opacity monitoring requirements. CARB obtained authorization for the 2005 version of the regulation in 2012. Under the CHE Regulation, all legacy in-use non-yard truck engines that are still in service (Tier 0 – Tier 3) must have a Verified Diesel Emission Control Strategy (VDECS) installed.

CARB anticipates increasing the stringency of in-use requirements beyond MSM with the CHE measure committed to in the 2022 State SIP Strategy. CARB's proposed ***Amendments to the Cargo Handling Equipment Regulation*** would set in-use requirements for diesel cargo handling equipment at ports and rail yards, including but not limited to yard trucks (hostlers), rubber-tired gantry cranes, container handlers, and forklifts. Staff would assess the availability and performance of zero-emission technology as an alternative to all combustion-powered cargo equipment and evaluate additional solutions that may include efficiency improvements. The regulatory amendments would propose an implementation schedule for new equipment and facility infrastructure requirements, with effective dates beginning in 2030.

Commercial Harbor Craft (CHC)

Emission Standards and in-use controls for CHC

The ***Commercial Harbor Craft Regulation*** reduces diesel PM and NOx emissions from a number of types of CHC operating in California. CARB's 2008 and 2011 CHC

Regulations required NOx and diesel PM emission controls on crew and supply boats, ferries, excursion vessels, towboats, push boats, tug boats, barges, and dredges.

CARB adopted the ***Amended CHC Regulation in 2022***, establishing expanded and more stringent in-use requirements to cover more vessel categories, including all tank barges, pilot vessels, research vessels, workboats, commercial passenger fishing, and commercial fishing vessels. The amendments also mandate accelerated deployment of zero-emission and advanced technologies in vessel categories where technological feasibility has been demonstrated. Starting in 2023 and phasing in through 2031, most CHC (except for commercial fishing vessels and categories listed below) are required to meet the cleanest possible standard (Tier 3 or 4) and retrofit with DPF based on a compliance schedule. The current regulated CHC categories are ferries, excursion, crew and supply, tug/tow boats, barges, and dredges. The amendments impose in-use requirements on the rest of vessel categories except for commercial fishing vessels, including workboats, pilot vessels, commercial passenger fishing, and all barges over 400 feet in length or otherwise meeting the definition of an ocean-going vessel. The amendments also remove the current exemption for engines less than 50 horsepower. Starting in 2025, all new excursion vessels are required to be plug-in hybrid vessels that are capable of deriving 30 percent or more of combined propulsion and auxiliary power from a zero-emission tailpipe emission source. Starting in 2026, all new and in-use short run ferries are required to be zero-emission; and starting in 2030 and 2032, all commercial fishing vessels need to meet a Tier 2 standard at minimum. The 2022 Amendments to the Commercial Harbor Craft (CHC) Regulation also require the use of at least 99 percent Renewable Diesel (“R100” or “R99”). The use of renewable diesel in CHC will achieve additional emission reductions to the already reduced emissions from Tier 3 or Tier 4 engines plus diesel particulate filters (DPF). Renewable diesel has been required to be used by all CHC operating in the State as of January 1, 2023.

Forklifts

Emission Standards for Forklifts

Forklifts operate in many different industry sectors but are most prevalent in manufacturing and at locations such as warehouses, distribution centers, and ports. Diesel-fueled forklifts were first subject to engine standards and durability requirements in 1996. The most recent ***Tier 4 Final emission standards*** were phased in starting in 2013. Tier 4 emission standards are based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction. Forklifts powered by LSI engines (gasoline and natural gas) have been subject to new engine standards that include both criteria pollutant and durability requirements since 2001, with the cleanest requirements phased-in starting in 2010.

CARB staff anticipates further increases to the stringency of emission controls with the ***Zero-Emission Off-Road Forklift Regulation Phase I measure***, a commitment from the 2016 State SIP Strategy, which would go beyond MSM and accelerate the deployment of zero-emission forklift technologies. The regulatory amendments would propose requirements that prohibit the new purchases of LSI forklifts, with an implementation schedule beginning in 2026. Forklifts are also subject to further controls under the ***Off-Road Zero-Emission Targeted Manufacturer Rule measure***, which CARB committed to in the 2022 State SIP Strategy. This measure would accelerate the deployment of zero-emission forklifts through a measure requiring manufacturers to produce zero-emission equipment and/or powertrains as a percentage of their sales volume.

<u>In-Use Controls: Forklifts</u>

Forklift fleets are subject to both the ***LSI Fleet Regulation*** (if powered by gasoline or propane), and the ***Off-Road Diesel Fleet Regulation*** (if powered by diesel) are required to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. The ***Off-Road Diesel Regulation*** was adopted by the Board in 2007 with implementation beginning in 2010. It is applicable to all diesel-fueled, self-propelled off-road equipment with at least 25 HP. Forklifts are included in the fleet average along with other equipment. Additionally, the ***LSI fleet Regulation*** (which was originally adopted with requirements beginning in 2009) requires fleets with four or more LSI forklifts to meet fleet average emission standards. While the LSI fleet Regulation applies to forklifts, tow tractors, sweeper/scrubbers, and airport ground support equipment, it maintains a separate fleet average requirement specifically for forklifts.

With the recent adoption of the ***2022 Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation,*** forklifts are also subject to begin transitioning to zero-emission technologies. Beginning in 2024, requirements begin to transition fleets from the oldest and highest-emitting off-road engines in operation in California by phasing out Tier 0 – Tier 2 equipment. Also beginning in 2024, the regulation includes requirements to restrict the addition of new vehicles and/or engines with Tier 3 and 4i engines, which is an expansion of the provisions of the current regulation, which restrict the vehicle-engine tiers that can be added to a fleet. The regulation also includes elements that require contracting entities to obtain and retain a fleet's valid Certificate of Reported Compliance prior to awarding a contract or hiring a fleet, mandate the use of R99 or R100 Renewable Diesel for all fleets, with some limited exceptions; provide voluntary compliance flexibility options for fleets that adopt zero-emission technology; and include additional requirements to increase enforceability, provide clarity, and provide additional flexibility for permanent low-use vehicles.

CARB is anticipated to further increase the stringency of in-use emission controls for forklifts beyond MSM with the ***Zero-Emission Off-Road Forklift Regulation Phase I measure,*** a measure committed to in the 2016 State SIP Strategy, which would be designed to accelerate the deployment of zero-emission forklift technologies. The regulatory amendments would propose requirements for fleets to retire existing LSI forklifts that are 13 years and older, and would propose an implementation schedule beginning in 2026. Under the ***Amendments to the Cargo Handling Equipment Regulation measure***, which CARB committed to in the 2022 State SIP Strategy, forklifts operating at ports and intermodal rail yards would also be subject to begin transitioning to zero-emission technologies. Staff anticipates that all forklifts operating at ports and intermodal rail yards would be zero-emission in the coming years, which is supported by the fact that currently some electric forklifts are already commercially available, with other technologies are in early production or demonstration phases.

Marine Engines

Emission Standards for Marine Engines

U.S. EPA first promulgated exhaust emission standards to reduce emissions of HC and NOx from new outboard and personal watercraft engines in 1996, which were to begin in 2006. In 1998, CARB adopted the ***Exhaust Emission Regulations for Spark-Ignition Marine Engines***, which accelerated the federal standard's 2006 implementation date to 2001 in California, and also set more stringent California standards for outboard and personal watercraft engines that took effect in 2004 and 2008. In 2001, CARB amended the ***Spark-Ignition (SI) Marine Regulations*** to include HC+NOx emission standards for new sterndrive and inboard marine engines. These standards adopted Tier I and ***Tier II emission standards for inboard and stern-drive marine engines***. In 2007, U.S. EPA harmonized with CARB's accelerated implementation schedule and more stringent exhaust standards for outboard and personal watercraft engines, and also granted California authorization to enforce CARB's regulations for Outboard Engines and Personal Watercraft engines and Tier I of the California inboard and stern-drive marine engine emissions standards. In 2011, U.S. EPA granted California authorization to enforce CARB's Tier II exhaust emission standards for spark ignited inboard and stern-drive marine engines. The Tier II Emission Standards for Inboard and Stern-Drive Marine Engines (2001) controls emissions at the same level of stringency as national regulations. While CARB has the same exhaust emission standards as the federal standard, the California standard applies to engines sooner, starting in 2008 rather than 2010 under the federal requirement.
In February 2015, CARB Board approved more stringent ***Evaporative Emission Control Standards*** than those set forth by the U.S. EPA's 2008 rule for gasoline-fueled spark-ignition marine watercraft configured with engines greater than 30 kilowatts. The Evaporative Emission Control Standards (2015) exceeds the stringency of applicable national regulations set by U.S. EPA in 2008 for gasoline-fueled spark-ignition marine watercraft >30 kilowatts.

CARB anticipates proposing further increases in stringency for Spark-Ignition Marine Engine Standards. The ***Spark-Ignition Marine Engine Standards measure*** from the 2022 State SIP Strategy would go beyond MSM and reduce emissions from new spark-ignition (SI) marine engines by adopting more stringent exhaust standards for outboard and personal watercraft, which currently do not use catalyst control technologies. Staff estimates that stricter standards could reduce combined HC or ROG and NOx emissions by approximately 70 percent below the current HC+NOx standard (≈16.5 grams per kilowatt-hour (g/kW-hr)) for engines greater than or equal to 40 kilowatts (kW) in power, and by approximately 40 percent for engines less than 40 kW in power. CARB staff is also evaluating whether some outboard and personal watercraft vessels could be propelled by zero-emission technologies in certain applications. For example, zero-emission powertrains have the potential to gradually replace most outboard engines less than 19 kW, as well as many new personal watercraft engines.

Off-Highway Recreational Vehicles (OHRV)

Emission Standards for OHRV

Off-road recreation vehicles, also known as off-highway recreational vehicles (OHRV), primarily include off-highway motorcycles, all-terrain vehicles (ATVs), and utility-terrain vehicles, off-road sport and utility vehicles, sand cars, and golf carts. In 1994, CARB adopted its first OHRV regulation, which established ***exhaust emission standards for OHRVs***. At that time, there were no equivalent federal standards regulating exhaust emissions from the vehicles and engines covered by California's OHRV regulations (U.S. EPA first set exhaust emission limits for OHRVs in 2002). U.S. EPA granted authorization for CARB's 1994 OHRV regulations in 1996. CARB subsequently amended the regulations to increase the stringency of controls and expand the categories of OHRVs controlled under the program; first in 1999, subsequently in 2003, and again in 2006. All three OHRV Engine Emission Standard amendments were granted authorization concurrently by U.S. EPA in 2014.[97]

The 2006 amendments to CARB's OHRV program also set ***evaporative emission standards***, establishing a fuel tank permeation limit of 1.5 grams per square meter per day (g/m^2/day) of total organic gas (TOG) for a 3-day diurnal period, and a fuel hose permeation limit of 15 g/m^2/day. At the time, these limits were identical to the national limits set by U.S. EPA. In July 2013, CARB adopted more stringent evaporative emission control standards for OHRVs that established a new test procedure and reduced evaporative emission limits to 1.0 g/m^2/day. Authorization was granted by U.S. EPA in 2017.[98]

In 2019 the Board approved more stringent exhaust regulations for OHRVs, which set more stringent exhaust emission control standards for ATVs, off-road sport vehicles, and off-road utility vehicles for MY 2022 – 2027, and more stringent evaporative regulations for OHRVs, which harmonize with U.S. EPA evaporative emissions standards for OHMC for MY 2020 – 2026. The 2019 Amendments also included provisions to accelerate the development of zero-emission OHRVs, and set more stringent California-specific emissions standards for all new OHRV beginning with MY 2027 for evaporative emission standards, and with MY 2028 for exhaust emission standards.

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[97] U.S. EPA, 2014. "California State Nonroad Engine Pollution Control Standards; Off-Highway Recreational Vehicles and Engines; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2014-02-04/pdf/2014-02297.pdf Federal Register, Vol. 79, No. 23

[98] U.S. EPA, 2017. "California State Nonroad Engine Pollution Control Standards; Evaporative Emission Standards and Test Procedures for Off-Highway Recreational Vehicles (OHRVs); Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2017-01-19/pdf/2017-01259.pdf Federal Register, Vol. 82, No. 12

In-Use Controls: OHRV

In 1994, CARB set exhaust standards for all OHRV that were to go into effect starting in 1998. The exhaust standards were technology forcing, and additional time was needed for manufacturers to produce a full range of compliant vehicles. Dealers expressed concern that certified models would not be available and that California OHRV dealerships would go out of business. In 1998, CARB met with affected stakeholders and developed a temporary compromise that allowed for the certification of vehicles that do not meet emissions standards. CARB adopted this compromise into regulation in 1999, which have become known as the ***Red Sticker Program***. It allows for certification and sale of OHRV that have no emissions control systems.

In order to reduce excess emissions, the 1999 Amendments established a new compliance category beginning with the 2003 model year, and designates OHRVs as either “green sticker” or “red sticker”, depending on whether the engine meets or exceeds the applicable emission standard. Non-emission compliant OHRVs are identified with a red registration sticker issued from the Department of Motor Vehicles (DMV), while emission compliant OHRVs are identified with a green sticker. Red sticker OHRVs are subject to in-use restrictions that do not apply to green sticker OHRVs; namely, the red sticker limits operation at certain off-highway recreational vehicle parks located in ozone nonattainment areas during the summer months (i.e. peak ozone season).

The red sticker program was envisioned as a temporary measure to provide market stability while manufacturers developed a full range of OHRV that complied with California’s emissions standards. This temporary measure has now been in effect for more than twenty years, and the majority of off-highway motorcycles sold in California are red sticker vehicles with no emissions controls. The 2019 Amendments to the OHRV program instituted actions to begin sunsetting the Red Sticker Program, including:

- Ending red sticker certification of new OHRV with no emissions controls beginning in model year 2022;
- Establishing transitional standards from 2020 through 2026; and
- Lifting the seasonal riding restrictions on existing red sticker vehicles starting on January 1, 2025.

Currently, this program is being phased-out to allow for more stringent emission control measures. In the meantime, however, the red-sticker program continues to control emissions from the in-use OHRV fleet.

Small Off-Road Equipment (SORE)

Emission Standards for SORE

Small Off-Road Engines (SORE) are spark-ignited engines rated at or below 19 kilowatts. This category includes handheld and non-handheld lawn and garden and industrial equipment such as string trimmers, leaf blowers, walk-behind lawn mowers, generators, and lawn tractors. They are used in applications such as lawn and garden, industrial, construction and mining, logging, airport ground support, commercial utility, and farm equipment, golf carts, and specialty vehicles. Staff estimates that there are approximately 16.5 million pieces of SORE equipment in California, the majority of which are spark-ignition (SI) engines used in residential and commercial lawn and garden applications, together with other utility and small industrial applications.

CARB first adopted ***SORE Exhaust Emission Standards and Test Procedures*** in 1990, with amendments in 1998 that increased the stringency and extended the types of engines and equipment applicable to the standard. In September 2003, CARB adopted more stringent exhaust emission standards, and set the first ***Evaporative Emission Standards*** for SORE. Prior to the adoption of these standards, evaporative emissions were uncontrolled. U.S. EPA granted full authorization for this suite of regulations in 2006, and these more stringent standards were phased-in for model years 2006 through 2013.[99]

In 2010, CARB set ***Standards for Zero-Emission SORE Equipment***.[100] In 2011, CARB again amended the regulation, modifying CARB's existing test procedures and aligned California procedures to be consistent with U.S. EPA's amendments to the federal certification and exhaust emission testing requirements (see Title 40 CFR Parts 1054 and 1065.11). The 2011 Amendments also set ***Exhaust Emission Certification Test Fuel Amendments*** for using ethanol blends of up to 10 percent (E10) in Off-Road SI SORE Engines, if it is certified by U.S. EPA. U.S. EPA approved the full suite of 2011 Amendments in 2015.[101] In 2016, CARB amended its ***evaporative emission standards*** for the entire category of SORE to increase stringency.[102]

In 2021, CARB adopted amendments to the Small Off-Road Engine Regulations ***(2021 Amendments to the SORE Regulation)***. These amendments set SORE emission standards to zero in two phases:

- First, SORE emission standards are lowered to zero for model year (MY) 2024 and all subsequent model years by setting exhaust emission standards to zero

[99] U.S. EPA, 2006. "California State Non-road Engine and Vehicle Pollution Control Standards; Decision of the Administrator" https://www.gpo.gov/fdsys/pkg/FR-2006-12-15/pdf/E6-21378.pdf Federal Register / Vol. 71, No. 241
[100] CARB 2010. "Final Regulations Order" accessed June 2018 https://www.arb.ca.gov/regact/2008/sore2008/soreresubfro.pdf?_ga=2.218709145.1039751104.1528225837-29497060.1519676686
[101] U.S. EPA 2015. "California State Non-road Engine Pollution Control Standards; Small Off-Road Engines Regulations; Notice of Decision
[102] CARB 2016. "Final Regulations Order" accessed June 2018 https://www.arb.ca.gov/regact/2016/sore2016/finalreg.pdf?_ga=2.102358145.1039751104.1528225837-29497060.1519676686

(0.00 grams per kilowatt-hour or g·kWh-1). Evaporative emission standards are also set to zero (0.00 grams per test or g·test-1). The evaporative emission standards include “hot soak” emissions (representing emissions that occur when placing a hot engine in storage after use on a hot summer day) to better evaluate emissions from real-world use of SORE equipment. These emission standards of zero apply for engines used in all equipment types produced for sale or lease for operation in California, except pressure washers with engine displacement greater than or equal to 225 cubic centimeters and generators. Generator emission standards are more stringent than the existing emission standards starting in MY 2024, but would not be zero; and

- The second phase would be implemented starting in MY 2028, when the phase-in for zero-emission pressure washers and generators would begin.

In analyzing the feasibility of this regulation, CARB staff found that zero-emission equipment (ZEE) are available for most small off-road equipment categories, including lawn and garden equipment and utility equipment, for both residential and professional use. The level of performance, number of brands, and number of equipment options have increased greatly and continue to do so today. At present, there are at least 35 brands of zero-emission lawn mowers available, with several brands directed at professional users. While adoption rates for ZEE among professional landscapers are lower than for residential users, there is substantial evidence that all new small off-road equipment can be zero-emission. Using ZEE is technologically feasible and can offer significant cost-savings to professional users. There are at least 12 brands of zero-emission lawn and garden equipment designed for professional users available for sale.

Transport Refrigeration Units (TRU)

Emission Standards for TRU

TRUs are refrigeration systems powered by an internal combustion engine (inside the unit housing), designed to control the environment of temperature sensitive products that are transported in refrigerated trucks, trailers, railcars, and shipping containers. TRUs operate in large numbers at distribution centers, food manufacturing facilities, packing houses, truck stops, and intermodal facilities, and are used to haul perishable products including food, beverages, pharmaceuticals, flowers, medical products, industrial chemicals, and explosives. TRUs may be capable of both cooling and heating. They deliver perishable goods to retail outlets, such as grocery stores, restaurants, cafeterias, convenience stores, etc. Although TRU engines are relatively small (ranging from 9 to 36 hp) significant numbers of these engines congregate at distribution centers, truck stops, and other facilities, exacerbating air quality challenges and resulting in potential for health risks to those that live and work nearby. The growth rate of TRUs is tied to population, since food is the main product type that is hauled.

In 2022, CARB adopted amendments to the ***Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled TRUs and TRU Generator Sets (TRU ATCM)***, which include requirements that MY 2023 and newer trailer TRU, DSC TRU, railcar TRU, and TRU generator set engines shall meet a PM emission standard of 0.02 grams per brake horsepower-hour or lower (aligns with the U.S. EPA Tier 4 final off-road PM emission standard for 25-50 horsepower engines).

In the 2022 State SIP Strategy, CARB committed to developing a subsequent ***Transport Refrigeration Unit Regulation Part 2***, which would go beyond MSM and require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets for future Board consideration. The new requirements would achieve additional emission and health risk reductions, increase the use of zero-emission technology in the off-road sector, and meet the directive of Governor Newsom's Executive Order N-79-20, which set a goal for 100 percent zero-emission off-road vehicles and equipment in the State by 2035 where feasible. For this measure, CARB would propose the Part 2 rulemaking to require trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets to use zero-emission technology. CARB is currently assessing zero-emission technologies for trailer TRUs and the remaining TRU categories.

In-Use Controls: TRU

CARB adopted the ***Airborne Toxic Control Measure*** (***ATCM) for In-Use Diesel-Fueled TRUs and TRU Generator Sets (TRU ATCM)*** in 2004 (and amended it in 2010 and 2011) to reduce diesel PM emissions and resulting health risk from diesel-powered TRUs. The TRU regulations establish in-use performance standards for diesel-fueled TRUs and TRU generator sets which operate in California, and facilities where TRUs operate. The regulation is designed to reduce the diesel PM emissions from in-use TRU and TRU generator set engines that operate in California, using a phased-in implementation approach over about 12 years by requiring engines to meet in-use emission standards by the end of the seventh year after manufacture. Implementation of the TRU ATCM began in 2009, and applies to in-use diesel-fueled TRUs and TRU generator sets that operate in California, whether they are registered in or outside the State. U.S. EPA issued an authorization for the TRU regulation in 2009.[103] CARB subsequently amended the TRU ATCM in 2010 and again in 2011 to provide owners of TRU engines with certain flexibilities to facilitate compliance, clarify recordkeeping requirements, and establish requirements for businesses that arrange, hire, contract, or dispatch the transport of goods in TRU-equipped trucks, trailers, or containers. U.S. EPA authorized the 2010 Amendments in 2013 and the 2011 Amendments in 2017, respectively.[104, 105]

[103] U.S. EPA, 2009. "California State Nonroad Engine and Vehicle Pollution Control Standards; Authorization of Transport Refrigeration Unit Engine Standards; Notice of Decision" Federal Register Volume 74, Number 11, pp. 3030-3033

[104] U.S. EPA, 2013. "California State Nonroad Engine Pollution Control Standards; Within-the-Scope Determination for Amendments to California's ''Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets and Facilities Where TRUs Operate''; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2013-06-28/pdf/2013-15437.pdf Federal Register Vol. 78, No. 125

[105] U.S. EPA, 2017. "California State Nonroad Engine Pollution Control Standards; In-Use Diesel-Fueled Transport Refrigeration Units (TRUs) and TRU Generator Sets and Facilities Where TRUs Operate; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2017-01-19/pdf/2017-01225.pdf Federal Register Vol. 82, No. 12

On February 24, 2022, CARB adopted amendments to the TRU ATCM (2022 Amendments) to achieve additional emission and health risk reductions from diesel-powered TRUs and increase the use of zero-emission (ZE) technology in the off-road sector. Key elements of the 2022 Amendments include:

- **Zero-emission truck TRU requirement –** Beginning December 31, 2023, TRU owners shall turnover at least 15 percent of their truck TRU fleet (defined as truck TRUs operating in California) to ZE technology each year (for seven years). All truck TRUs operating in California shall be ZE by December 31, 2029.
- **Applicable facility requirements –** Beginning December 31, 2023, owners of refrigerated warehouses or distribution centers with a building size of 20,000 square feet or greater, grocery stores with a building size of 15,000 square feet or greater, seaport facilities, and intermodal railyards (applicable facilities) shall register the facility with CARB, pay fees every three years, and report all TRUs that operate at their facility to CARB quarterly, or alternatively attest that only compliant TRUs operate at their facility.
- **Expanded TRU reporting –** Beginning December 31, 2023, TRU owners shall report all TRUs (including out-of-state based) that operate in California to CARB.
- **TRU operating fees and compliance labels –** Beginning December 31, 2023, TRU owners shall pay TRU operating fees and affix CARB compliance labels to their TRU every three years, for each TRU operated in California. Collected fees will be used to cover CARB's reasonable costs associated with the certification, audit, and compliance of TRUs.
- **Zero-emission truck TRU assurances –** Manufacturers of zero-emission truck TRUs shall be required to provide a comprehensive warranty for zero-emission truck TRUs and have an authorized service-and-repair facility located in California to perform warranty repairs.

In the 2022 State SIP Strategy, CARB committed to developing a subsequent ***Transport Refrigeration Unit Regulation Part 2***, which would go beyond MSM and require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets for future Board consideration. The new requirements would achieve additional emission and health risk reductions, increase the use of zero-emission technology in the off-road sector, and meet the directive of Governor Newsom's Executive Order N-79-20, which set a goal for 100 percent zero-emission off-road vehicles and equipment in the State by 2035 where feasible. For this measure, CARB would propose the Part 2 rulemaking to require trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets to use zero-emission technology. CARB is currently assessing zero-emission technologies for trailer TRUs and the remaining TRU categories.

PRIMARILY FEDERALLY AND INTERNATIONALLY REGULATED SOURCES

Locomotives

Emission Standards for Locomotives

Under the Act, U.S. EPA has the sole authority to establish emissions standards for new locomotives.[106] Locomotives are self-propelled vehicles used to push or pull trains, including both freight and passenger operations. Union Pacific Railroad (UP) and BNSF Railway (BSNF) are the two Class I, or major, freight railroads operating in California. There are also seven intrastate passenger commuter operators and up to 26 freight shortline railroads currently operating in California. UP and BNSF, however, generate the vast majority (90 percent) of locomotive emissions within the State, with most attributable to interstate line haul locomotives. UP and BNSF operate three major categories of freight locomotives, both nationally and in California. The first category is interstate line haul locomotives, which are primarily ~4,400 horsepower (HP). The second category is made up of medium-horsepower (MHP) locomotives, as defined by CARB as typically between 2,301 and 3,999 HP. MHP locomotives are typically older line haul locomotives that have been cascaded down from interstate service. And lastly, there are switch (yard) locomotives, specifically defined by U.S. EPA as between 1,006 and 2,300 HP. Locomotives operating at railyards and traveling throughout the nation are a significant source of emissions of diesel PM (which CARB has identified as a toxic air contaminant), NOx, and GHGs. These emissions often occur in or near densely populated areas and neighborhoods, exposing residents to unhealthy levels of toxic diesel PM, plus regional ozone and secondary PM2.5.

U.S. EPA has previously promulgated two sets of national locomotive emission regulations (1998 and 2008). In 1998, U.S. EPA approved national regulations that primarily emphasized NOx reductions through Tier 0, 1, and 2 emission standards. Tier 2 NOx emission standards reduced older uncontrolled locomotive NOx emissions by up to 60 percent, from 13.2 to 5.5 g/bhp-hr.

In 2008, U.S. EPA approved a second set of national locomotive regulations. Older locomotives, upon remanufacture, are required to meet more stringent particulate matter (PM) emission standards, which are about 50 percent cleaner than Tier 0-2 PM emission standards. U.S. EPA refers to the PM locomotive remanufacture emission standards as Tier 0+, Tier 1+, and Tier 2+. The new Tier 3 PM emission standard (0.1 g/bhp-hr), for model years 2012-2014, is the same as the Tier 2+ remanufacture PM emission standard. The 2008 regulations also included new ***Tier 4 locomotive NOx and PM emission standards*** (2015 and later model years). U.S. EPA Tier 4 NOx and PM emission standards further reduced emissions by approximately 90 percent from uncontrolled levels.

[106] 42 United States Code (U.S.C.) §7547, (a)(5)

Beyond the currently adopted levels of controls, CARB staff petitioned U.S. EPA in 2017[107] to promulgate by 2020 both Tier 5 national emission standards for newly manufactured locomotives, and more stringent national requirements for remanufactured locomotives, as committed to in the 2016 State SIP Strategy's ***More Stringent National Locomotive Emission Standards*** measure. This would reduce emissions of criteria and toxic pollutants, fuel consumption, and GHG emissions. CARB staff estimates that U.S. EPA could require manufacturers to implement the new locomotive emission regulations by as early as 2023 for remanufactures and 2025 for newly manufactured locomotives. As documented in the Final Technology Assessment for Freight Locomotives,[108] CARB staff believes the most technologically feasible advanced technology for near-term deployment is the installation of a compact aftertreatment system (e.g., combination of selective catalytic reduction (SCR) and diesel oxidation catalyst (DOC)) onto new and remanufactured diesel-electric freight interstate line haul locomotives. Newly manufactured locomotives can also be augmented with on-board batteries to provide an additional 10-25 percent reduction in diesel fuel consumption and GHG emissions to achieve the Tier 5 emission levels. On board batteries could also provide zero emission track mile capabilities in and around railyards to further reduce diesel PM and the associated health risks.

A new federal standard could also facilitate development and deployment of zero-emission track mile locomotives and zero-emission locomotives by building incentives for those technologies into the regulatory structure. The compact SCR and DOC aftertreatment system could also be retrofitted to existing Tier 4 locomotives to be able to achieve a Tier 4+ emissions standard, when Tier 4 locomotives are scheduled for remanufacture (every 7 to 10 years). Based on the typical remanufacture schedule, all Tier 4 locomotives could potentially be retrofitted with aftertreatment between 2025 and 2037. Existing locomotives originally manufactured to meet Tier 2 or Tier 3 standards could also be upgraded with the same compact aftertreatment system upon remanufacture to achieve emissions equal to Tier 4 levels.

In-Use Controls: Locomotives

CARB has worked closely with the major railroads in California, together with other stakeholders, to develop innovative measures to reduce in-use emissions from locomotives, a major source of NOx and PM emissions in the Valley, but a source category over which CARB has limited regulatory authority.

While emission standards for locomotives are set by U.S. EPA, CARB has accelerated reductions from these sources through efforts that have focused on cleaner fuel requirements, and increasing use of cleaner locomotives. CARB staff and the Class I railroads have also been implementing through the ***2005 Statewide Rail Yard Agreement for California Rail Yards,*** a Memorandum of Understanding (MOU) to

[107] https://ww2.arb.ca.gov/resources/documents/us-epa-responds-carbs-petition-strengthen-locomotive-emission-standards
[108] Final Technology Assessment for Freight Locomotives available at: https://www.arb.ca.gov/msprog/tech/report.htm

accelerate the introduction of cleaner locomotives since 2010.[109] This agreement obligated the railroads to increase the use of idle control devices, lowered locomotive idle times to 15 minutes, and opened a collaboration to produce Health Risk Assessments on 18 major railyards in the State, which was completed in 2015.

CARB will also increase the stringency of controls on locomotive operations with the recently adopted ***In-Use Locomotive Regulation***, which the Board adopted in April 2023. This regulation will accelerate the adoption of advanced, cleaner technologies for locomotive operations, including zero-emission technologies, and includes:

- Starting in 2024: Spending Account
  Locomotive operators will be required to fund their own trust account based on the emissions created by their locomotive operations in California. The dirtier the locomotive, the more funds must be set aside. Spending Account funds would be used in the following manner:
    - Until 2030: to purchase, lease, or rent Tier 4 or cleaner locomotives, or for the remanufacture or repower to Tier 4 or cleaner locomotive(s).
    - At any time: to purchase, lease, or rent ZE locomotive(s), ZE capable locomotive(s), ZE rail equipment, or to repower to ZE locomotive(s) or ZE capable locomotive(s).
    - At any time: for ZE infrastructure associated with ZE locomotive(s), ZE capable locomotive(s), ZE rail equipment.
    - At any time: to pilot or demonstrate ZE locomotives or ZE rail equipment technologies.
- Starting in 2030: In-Use Operational Requirements
  Only locomotives less than 23 years old will be able to be used in California. Switchers, industrial and passenger locomotives with original engine build dates of 2030 or newer would be required to operate in a ZE configuration in California. Freight line haul locomotives with original engine build dates of 2035 and newer will be required to operate in a ZE configuration in California.
- Starting in 2024: Idling Limit
  All locomotives with automatic shutoff devices (AESS) will not be permitted to idle longer than 30 minutes, unless for an exempt reason. Exemptions closely align with those described by U.S. EPA, and would be granted for reasons like maintaining air brake pressure to perform maintenance.
- Starting in 2024: Registration and Reporting
  Locomotives operating in the State will be required to register with CARB. Reporting includes and annual administrative payment. Locomotive activity, emission levels and idling data will be required to be reported annually.

Local air districts may also pursue indirect source rules for freight facilities that could result in reductions from this category. CARB staff is considering an indirect source rule suggested control measure to assist air districts.

[109] CARB 2005 “ARB/Railroad Statewide Agreement: Particulate Emissions Reduction Program at California Rail Yards” https://ww2.arb.ca.gov/sites/default/files/2020-06/2005%20MOU%20Remediated%2003102020.pdf

Aircraft

In-Use Controls: Aircraft

NOx emissions from aircraft are projected to grow significantly. In California, aircraft are projected to make up 9.5 percent of mobile source NOx emissions in 2035, increasing from 5.4 percent in 2020.[110] According to CARB's emissions inventory, five different aircraft categories contribute significantly to NOx emissions: civilian piston aircraft, agricultural crop-dusting aircraft, military jet aircraft, commercial jet aircraft, and civilian jet aircraft. Commercial jet aircraft contribute about 90 percent of NOx emissions from all aircraft in California, whereas military jet aircraft and civilian jet aircraft each contribute about 4.5 percent of NOx. Together, civilian piston aircraft and agricultural crop-dusting aircraft produce less than 1 percent of NOx emissions.

The International Civil Aviation Organization (ICAO) is the United Nations body that sets and adopts civil aviation standards and practices for its 193 national government members. The Committee on Aviation Environmental Protection (CAEP) is a technical committee of ICAO. CAEP assists ICAO with formulating new policies and adopting new standards and recommended practices. The most recent standards adopted by ICAO are:[111]

- CAEP/8: latest NOx standard adopted in 2011;
- CAEP/10: first CO2 standard adopted in 2017; and
- CAEP/11: first non-volatile PM mass and number standard adopted in 2019.

U.S. EPA is required to set emission standards for any air pollutant emitted by aircraft that may reasonably be anticipated to endanger public health or welfare.[112] U.S. EPA is not bound by ICAO standards and can adopt standards that are stricter than those set by ICAO. U.S. EPA has historically adopted ICAO standards and has most recently adopted a GHG emission standard and has proposed a PM emission standard for aircraft that are both equivalent to the ICAO standards.

The Federal Aviation Administration's (FAA) Continuous Low Energy, Emissions, and NOISE (CLEEN) Program is a cost-sharing program aimed at accelerating the development and commercialization of new certifiable aircraft technologies and sustainable aviation fuels. The program has been successful in developing technologies relating to composite airframe technologies, advanced wing technologies, advanced fan systems, and many other technologies.[113] There are certified aircraft engines available that achieve NOx emissions below the CAEP/8 standard and PM emissions below the latest CAEP/11 standard. Engine manufacturers are also currently developing engines

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[110] CARB 2022 State SIP Strategy https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf
[111] Committee on Aviation Environmental Protection (CAEP) (icao.int) https://www.icao.int/ENVIRONMENTAL-PROTECTION/Pages/CAEP.aspx
[112] Clean Air Act sec. 231, 42 U.S.C. § 7571.
[113] FAA, CLEEN Phase I and II Projects, Feb. 27, 2020, available at https://www.faa.gov/about/office_org/headquarters_offices/apl/eee/technology_saf_operations/cleen

that achieve significant reductions beyond the current standards. These new technology advances enable reductions in both NOx and PM emissions and provide a pathway for achieving effective ways to reduce harmful emissions.

Included in the 2022 State SIP Strategy was the ***Future Measures for Aviation Emission Reductions***, which committed CARB to strongly advocating for stricter emission regulations from U.S. EPA, while also exploring other opportunities under State authority to set reporting and/or operational requirements that can contribute to emissions reductions from aircraft. The Future Measures for Aviation Emissions Reductions measure was committed to in the 2022 State SIP Strategy. It would go beyond MSM and reduce emissions from airport and aircraft related activities, including main aircraft engines, auxiliary power units (APU), and airport ground transportation. As a part of this measure, CARB would explore requiring all larger airports to perform a comprehensive and standardized emission inventory. An accurate emission inventory that reflects all on-ground and near-ground emissions would establish a baseline and enable verifiable and quantifiable future emissions reductions. CARB would continue to assess technology development for the aviation sector. The purpose is to help inform and support CARB planning, regulatory, and voluntary incentive efforts. Concurrently, CARB would support, track, and explore current, in-development, and future emission reduction technology advancements. CARB would further evaluate federal, State, and local authority in setting operational efficiency practices to achieve emissions reductions. Operational practices include landing, takeoff, taxi, and running the APU, and contribute to on-ground and near-ground emissions. CARB would similarly work with U.S. EPA, air districts, airports, and industry stakeholders in a collaborative effort to develop regulations, voluntary measures, and incentive programs.

FUELS

In addition to new engines and in-use standards, cleaner burning fuels represent an important component in reducing emissions from the off-road mobile fleet. Cleaner fuel has an immediate impact in reducing emissions from the mobile source, and thus represent an important component in reducing NOx and PM emissions from off-road engines. California's stringent air quality programs treat mobile sources and their fuels holistically (as a system, rather than as separate components). As a result, CARB's fuels programs achieve significant reductions in criteria emissions from vehicles and mobile engines used in California.

CARB Diesel Fuel Regulations

The California diesel fuel program sets stringent standards for diesel fuel sold in California and produces cost-effective emission reductions from diesel-powered vehicles. More stringent fuel requirements further ensure that diesel engines are operating as cleanly as possible. ***CARB Diesel Fuel Regulations*** have, over time, phased in more stringent requirements for fuel mixture specifications for aromatic hydrocarbons and sulfur, and have establish a lubricity standard. The program applies to sales of fuel used in on-road vehicles and off-road vehicles and locomotives in California. ***"CARB diesel" Specifications*** adopted in 1988 limited the allowable sulfur content of diesel fuel 500 parts per million by weight (ppmw), and the aromatic hydrocarbon content to 10 percent, and became effective in 1993.

U.S. EPA began regulating sulfur content in diesel in 1993. At that time, uncontrolled fuels (i.e. non-CARB diesel) contained approximately 5,000 parts per million (ppm) of sulfur. In 2006, U.S. EPA began to phase-in more stringent requirements under the federal Ultra-Low Sulfur Diesel (ULSD) regulations, which lowered the amount of sulfur in on-road diesel fuel to 15 ppm. U.S. EPA's Nonroad Diesel Fuel Standards were phased in from 2007 to 2014, and require that all off-road engines, including those used in locomotives and off-road equipment, use ULSD fuel (with some exemptions for older locomotives and marine engines). The Nonroad Standards also require that diesel fuel sold into the market for off-road use must be ULSD. It is important to note that while U.S. EPA defines ULSD as ≤ 15 ppm for on-road applications, the definition of off-road ULSD is significantly less stringent, defined as ≤ 500 ppm standard.

In 2003, ***CARB's Ultra Low Sulfur Diesel (ULSD) Regulation*** increased the stringency of the sulfur content limits in to 15 ppm, which began implementation in 2006. CARB's ULSD Regulation had an immediate impact in reducing emissions from the in-use fleet, while also enabling the use of advanced emissions control technologies, including the use of catalyzed diesel particulate filters, NOx after-treatment, and other advanced after-treatment based emission control technologies that higher sulfur levels would have inhibit the performance of (at the time of CARB's ULSD rulemaking, the average sulfur content of California diesel was approximately 140 ppmw). The original applicability of the regulations was to vehicular diesel fuel; however, the applicability of the regulations has been extended by the adoption of ATCMs to non-vehicular diesel fuel, such as fuel for stationary engines, locomotives, and marine harbor craft.

Beyond the current fuels control program, CARB committed to develop a ***Low Emission Diesel*** Measure in the 2016 State SIP Strategy that will require diesel fuel providers to steadily decrease criteria pollutant emissions from their diesel products. The use of low-emission diesel in on-road vehicles and off-road equipment will reduce tailpipe NOx and PM emissions, in addition to other criteria pollutants. Some studies carried out to date on hydrotreated vegetable oil have reported NOx emission reductions of 6 percent to 25 percent and PM emission reductions of 28 percent to 46 percent, depending on the types of fuels, drive cycles tested, and diesel engines used. This standard is anticipated to both increase consumption of low-emission diesel fuels, and to reduce emissions from conventional fuels. This measure is anticipated to provide NOx benefits predominately from legacy (pre-2010) on-road heavy-duty vehicles, off-road engines, stationary engines, portable engines, marine vessels and locomotives, as well as NOx and diesel PM benefits in potentially all model year off-road engines, stationary engines, portable engines, marine vessels and locomotives. Interstate vehicles, even those registered out-of-State but operating on CARB diesel blended with low-emission diesel, are also anticipated to provide emission reduction benefits.

Controlling Criteria Emissions from Renewable Fuels

The ***Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF) Regulations*** work together to reduce the carbon intensity of the California fuel supply. The regulations also limit criteria emissions from alternative fuels and/or alternative fuel mix blends (a mix of fuels made from renewable feedstocks, which are then blended with conventional gasoline or diesel). The regulations were amended in 2018 to extend the carbon intensity target of 20 percent to 2030. Due to regulatory constraints, the LCFS and ADF do not apply to fossil jet fuel, aviation gasoline, fuels used in interstate locomotives, or fuels used for the propulsion of ocean-going vessels – regulatory control over these fuels lies at the national and international level.

STEP 2(B): OTHER STATES' AND NONATTAINMENT AREAS' OFF-ROAD CONTROL MEASURES

Table D-20 summarizes the most stringent control measures currently in use in any state or nonattainment that have been identified and discussed for off-road equipment. Each of the measures identified in this table are discussed in more detail in this section, below.

Table D-20 Comparison of Stringency – Off-Road Measures

CARB Control Programs Compared to Federal Standards and Control Programs in Other States and Nonattainment Areas

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
New Engine Standards			
New Engine Standards: Off-Road Diesel Engine Emission Standards (general)	Tier 4 Off-Road Engine Standards (CARB and U.S. EPA) Future Measure: *Tier 5 Off-Road Vehicles and Equipment measure (CARB)*	California's emission standards for off-road diesel engines are consistent with those of U.S. EPA and the most stringent in the nation. CARB's current emission standards for new off-road engines with a power rating between 175 and 300 hp are set at the same level of stringency as federal standards, and requires Tier 4 emission standards (which use advanced after treatment technologies such as diesel particulate filters and selective catalytic reduction). This regulation is applicable to all diesel-fueled, self-propelled off-road equipment with at least 25 HP. With the Tier 5 Off-Road Vehicles and Equipment Measure, CARB has committed to develop and propose standards and test procedures for new off-road CI engines More stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp), including the following: • Aftertreatment-based PM standards for engines less than 19 kW (25 hp), • Aftertreatment-based NOx standards for engines greater than or equal to 19 kW (25 hp) and less than 56 kW (75 hp), and • First-time CO2 tailpipe standards targeting a 5 to 8.6 percent reduction. • Other possible elements include enhancing in-use compliance, proposing more representative useful life periods, idle requirements and developing a low load test cycle. It is expected that Tier 5 requirements would rely heavily on technologies manufacturers are developing to meet the recently approved low-NOx standards and enhanced in-use requirements for on-road- heavy-duty engines. *(Note: CARB has committed to pursue the Tier 5 Off-Road Vehicles and Equipment measure, but this measure has not yet been proposed to the Board for approval/adoption)*	No other state has more stringent exhaust emission standards for off-road equipment than California. Currently CARB and U.S. EPA limit exhaust emissions to same "Tier 4" levels: • NOx: 0.3 g/bhp-hr • PM: 0.015 g/bhp-hr
New Engine Standards: Off-Road Zero-Emission Engine Standards (general)	Future Measure: *Off-Road Zero-Emission Targeted Manufacturer Rule measure (CARB)*	The Off-Road Zero-Emission Targeted Manufacturer Rule would accelerate the development and production of zero-emission off-road equipment and powertrains into more sectors (including wheel loaders, excavators, and bulldozers) as technology advancements occur due to existing CARB zero-emission regulations and regulations in the forklifts, cargo handling equipment, off-road fleets, and small off-road engines sectors. For this measure, CARB would propose to develop a regulatory measure that would require manufacturers of off-road equipment and/or engines to produce for sale zero-emission equipment and/or powertrains as a percentage of their annual statewide	No other state requires zero-emission off-road engine standards.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
		sales volume to ensure these globally emerging zero-emissions products and related innovations come to California. *(Note: CARB has committed to pursue the Off-Road Zero-Emission Targeted Manufacturer Rule measure, but this measure has not yet been proposed to the Board for approval/adoption)*	
In-Use Emission Controls			
In-Use Emissions Controls: Fleet Rules (Off-Road Equipment – General)	In-Use Off-Road Diesel-Fueled Fleets Regulation (Off-Road Regulation) (CARB) Future Measure: *Clean Off-Road Fleet Recognition Program (CARB)*	California's in-use emission controls for off-road equipment are the most stringent in the nation. CARB's off-road regulation controls diesel PM and NOx emissions from >150,000 in-use off-road engines by requiring their owners to retire, replace, or repower older engines, and/or installing verified exhaust retrofit control technologies. Additionally, all vehicles are reported and labeled, and older, dirtier vehicles are restricted from entering fleets. With the 2022 Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation, CARB further reduced emissions from the in-use off-road diesel equipment sector by increasing the stringency of the regulation's requirements. These amendments create additional requirements to the currently regulated fleets by targeting the oldest and dirtiest equipment that is allowed to operate indefinitely under the current regulation's structure. The amendments will require fleets to phase-out use of the oldest and highest polluting off-road diesel vehicles in California; prohibit the addition of high-emitting vehicles to a fleet; and require the use of R99 or R100 renewable diesel in off-road diesel vehicles. The amendments phase-in starting in 2024 through the end of 2036 and include changes to enhance enforceability and encourage the adoption of zero-emission technologies. CARB anticipates further emission reductions from the off-road equipment fleets through the Clean Off-Road Fleet Recognition Program measure, which would create a non-monetary incentive to encourage off-road fleets to go above and beyond existing regulatory fleet rule compliance and adopt advanced technology equipment with a strong emphasis on zero-emission technology. This measure would provide a standardized methodology for contracting entities, policymakers, state and local government, and other interested parties to establish guidelines for contracting criteria or require participation in the program to achieve their individual policy goals. *(Note: CARB has committed to develop the Clean Off-Road Fleet Recognition Program measure, but this measure has not yet been proposed to the Board for approval/adoption)*	While Chicago (IL) and New York City (NY) have in-use fleet controls for construction equipment, no other state or nonattainment area controls in-use off-road equipment fleets more stringently than CARB.
Source-Specific Rules			
New Engine Standards: Agricultural equipment	Tier 4 Off-Road Engine Standards (CARB and U.S. EPA)	U.S. EPA and California adopted equivalent Tier 4 standards in 2004 that require additional emission reductions from off-road engines, including those used in mobile agricultural equipment.	No state has more stringent requirements for new emission performance standards for agricultural equipment engines than California.
In-Use Emissions Controls: Agricultural Equipment	Cleaner In-Use Agricultural Equipment (CARB) Accelerated Turnover of Agricultural Equipment Measures (CARB)	California's in-use emission control program for agricultural equipment is among the most stringent in the nation. CARB's *2007 State SIP Strategy* included the Cleaner In-Use Agricultural Equipment measure, to achieve 5 to 10 tpd of NOx reductions in 2017 by modernizing agricultural equipment in the Valley. To push beyond this, CARB included in the Valley SIP Strategy the ***Accelerated Turnover of Agricultural Equipment*** measure to achieve 11 tpd NOx reductions in 2024, by accelerating	CARB's agricultural equipment fleet controls are among the most stringent in the nation.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
	Future Measure: *Cleaner In-Use Agricultural Equipment measure (CARB)*	turnover of approximately 12,000 tier 0, tier 1, and tier 2 agricultural equipment to the cleanest equipment available. To fulfill the State commitment under the Accelerated Turnover of Agricultural Equipment Measure, CARB developed and submitted to U.S. EPA a SIP-creditable incentive measure for a subset of the total projects that has since been made federally-enforceable upon approval by U.S. EPA into the California SIP. CARB is anticipated to further increase the stringency of in-use emission controls a measure designed to accelerate emission reductions from the in-use ag equipment fleet. CARB included the Cleaner In-Use Agricultural Equipment measure in the Valley SIP Strategy to serve as a backstop to accelerate the turnover of large tier 0, tier 1, and tier 2 agriculture tractors to tier 4 through existing projects and new projects. *(NOTE: CARB committed to pursue the Cleaner In-Use Agricultural Equipment measure, but this measure has yet to be proposed to the Board for approval/adoption.)*	
New Engine Standards: Airport Ground Support Equipment (GSE)	Large Spark Ignition (LSI) Fleet Regulation (CARB) Tier 4 Off-Road Engine Standards (CARB and U.S. EPA) Future measure: *Zero-Emission Airport Ground Support Equipment measure (CARB)*	California's emission controls for Airport Ground Support Equipment (GSE) are the most stringent in the nation. NOx limits for the LSI Engine Standard for engines > 1.0 liter (the typical engine size for GSE) is 0.6 g/bhp-hr. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recent as 2009. Additionally, diesel engines in newly manufactured GSE must meet the Tier 4 emission standards applicable to off-road compression ignition engines. CARB is anticipated to further increase the stringency of emission controls with the Zero-Emission Airport Ground Support Equipment measure, which will act as a catalyst to further adoption of zero-emission equipment in the off-road sector, facilitate the transfer of technology to suitable heavier duty-cycle applications, and expand use of zero-emission infrastructure. *(NOTE: CARB has committed to pursue the Zero-Emission Airport Ground Support Equipment measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other state has more stringent exhaust emission standards for airport ground support equipment than California.
In-Use Emissions Controls: Fleet Rules (Airport Ground Support Equipment)	In-Use Off Road Diesel-Fueled Fleets Regulation (CARB) Large Spark-Ignition (LSI) Engine Fleet Requirements Regulation (CARB) Portable Diesel-Engines Air Toxic Control Measure (CARB) Future Measure: *Zero-Emission Airport Ground Support Equipment measure (CARB)*	California's in-use emission controls for airport ground support equipment (GSE) are the most stringent in the nation. The In-Use Off-Road Diesel-Fueled Fleets Regulation requires GSE fleets operating in-use diesel equipment to meet an annual fleet average emissions target that decreases over time. For example, for equipment over 175 and under 750 HP, the final 2023 NOx fleet average target is 1.5 g/bhp hr, which is equivalent to the interim Tier 4 NOx standard for newly produced engines. Fleets that do not meet the required annual fleet average must meet the BACT requirements that require turnover, repower or retrofit of a specific percent of a fleet's total HP. These requirements are currently being phased in. Airport GSE fleets operating LSI GSE must meet the in-use LSI engine fleet requirements. Adopted in 2006, the LSI Engine Fleet Requirements Regulation requires GSE fleets to maintain an average emission level of no more than 2.5 g/bhp hr HC+NOx, starting January 1, 2013. Non-mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the Portable Diesel-Engines Air Toxic Control Measure (ATCM).	No other state or nonattainment area controls airport GSE more stringently than CARB.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
		CARB is anticipated to further increase the stringency of emission controls with the Zero-Emission Airport Ground Support Equipment measure. *(NOTE: CARB has committed to develop the Zero-Emission Airport Ground Support Equipment measure, but it has not yet been proposed to the Board for approval/adoption.)*	
New Engine Standards: Cargo Handling Equipment (CHE)	Cargo Handling Equipment Regulation (CARB) Future Measure: *Cargo Handling Equipment Amendments measure (CARB)*	California's emission controls for Cargo Handling Equipment (CHE) are the most stringent in the nation. CARB's Cargo Handling Equipment regulation sets performance standards for newly acquired engines, as well as in-use mobile CHE at ports or intermodal rail yards. CARB is anticipated to further increase the stringency of the CHE Regulation by transitioning CHE to zero-emission beginning in 2026. Based on the current state of zero-emission CHE technological developments, the transition to zero-emission would most likely be achieved largely through the electrification of CHE. Staff anticipates that all yard trucks and forklifts would be zero-emission by 2030, rubber-tired gantry cranes would be zero-emission by 2032, and 90 percent of other CHE will be zero-emission by 2036. *(Note: CARB has committed to pursue the Cargo Handling Equipment Amendments measure, but this measure has not yet been proposed to the Board for approval/adoption)*	No other state has more stringent exhaust emission standards for cargo handling equipment than California.
In-Use Emissions Controls: Fleet Rules (Cargo Handling Equipment)	Cargo Handling Equipment Regulation (CARB) Future measure: *Amendments to the Cargo Handling Equipment measure (CARB)*	California's in-use emission controls for cargo handling equipment (CHE) are the most stringent in the nation. The Cargo Handling Equipment regulation was adopted in 2005 to establish BACT requirements for in-use and newly purchased CHE, and amended in 2011 to include opacity monitoring requirements. The CHE regulation includes performance standards for in-use, mobile CHE at ports or intermodal rail yards in California, and requires that all newly purchased yard truck and non-yard truck equipment brought onto a port or intermodal rail yard must have either a Tier 4 Final off road engine or an on-road engine meeting the 2010 or newer on-road emission standards, and that all legacy in-use non-yard truck engines that are still in service (Tier 0 – Tier 3) must have a Verified Diesel Emission Control Strategy (VDECS) installed. CARB is anticipated to further increase the stringency with the Amendments to the Cargo Handling Equipment Regulation would set in-use requirements for diesel cargo handling equipment at ports and rail yards, including but not limited to: yard trucks (hostlers), rubber-tired gantry cranes, container handlers, and forklifts. Staff would assess the availability and performance of zero-emission technology as an alternative to all combustion-powered cargo equipment. The regulatory amendments would propose an implementation schedule for new equipment with effective dates beginning in 2026. *(Note: CARB has committed to pursue the Amendments to the Cargo Handling Equipment measure, but this measure has not yet been proposed to the Board for approval/adoption)*	No other state or nonattainment area has more stringent in-use fleet requirements for CHE than California.
New Engine Standards: Commercial Harbor Craft (CHC)	Commercial Harbor Craft Regulation (CARB)	California's emission controls for commercial harbor craft (CHC) are the most stringent in the nation. CARB's 2008 and 2011 CHC Regulations reduced NOx and diesel PM emissions from crew and supply boats, ferries, excursion vessels, towboats, push boats, tug boats, barges and dredges. CARB amended the CHC regulation in 2022, establishing expanded and more stringent in-use requirements to cover more vessel categories, including all tank barges, pilot	No other state has more stringent exhaust emission standards for commercial harbor craft than California.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
		vessels, research vessels, workboats, commercial passenger fishing, and commercial fishing vessels. The amendments also mandate accelerated deployment of zero-emission and advanced technologies in vessel categories where technological feasibility has been demonstrated.	
In-Use Emissions Controls: Fleet Rules (Commercial Harbor Craft)	Commercial Harbor Craft Regulation (CARB)	California's in-use emission controls for commercial harbor craft (CHC) are the most stringent in the nation. The Commercial Harbor Craft regulation (adopted in 2008 and amended in 2010) included in-use limits that required diesel PM and NOx emission controls on ferries, excursion vessels, and tugboats, towboats, and push boats. The 2011 amendments extended the types of CHC for which in-use engine requirements apply to include crew and supply, barges and dredges. CARB amended the CHC regulation in 2022, establishing expanded and more stringent in-use requirements to cover more vessel categories including all tank barges, pilot vessels, research vessels, workboats, commercial passenger fishing, and commercial fishing vessels. The amendments also mandate accelerated deployment of zero-emission and advanced technologies in vessel categories where technology feasibility has been demonstrated.	No other state or nonattainment area controls in-use CHC emissions more stringently than CARB.
New Engine Standards: Forklifts	Tier 4 Off-Road Engine Standards (CARB and U.S. EPA) Future Measures: *Zero-Emission Off-Road Forklift Regulation Phase 1 measure (CARB)* *Off-Road Zero-Emission Targeted Manufacturer Rule measure (CARB)*	California's emission controls for forklifts are the most stringent in the nation. Forklifts powered by LSI engines (gasoline and natural gas) are subject to new engine standards that include both criteria pollutant and durability requirements since 2001, with the cleanest requirements phased-in starting in 2010. Diesel Forklifts > 25 HP are subject to Tier 4 Final emission standards (based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction) starting in 2013. CARB is anticipated to further increase the stringency of emission controls with the Zero-Emission Off-Road Forklift Regulation Phase I measure, which would be designed to accelerate the deployment of zero-emission forklift technologies. The regulatory amendments would propose requirements that prohibit the new purchases of LSI forklifts, with an implementation schedule beginning in 2026. *(NOTE: CARB has committed to pursue the Zero-Emission Off-Road Forklift Regulation Phase 1 measure, but it has not yet been proposed to the Board for approval/adoption.)* CARB is anticipated to further increase the stringency of in-use emission controls for forklifts through the Off-Road Zero-Emission Targeted Manufacturer Rule measure. *(NOTE: CARB has committed to pursue the Off-Road Zero-Emission Targeted Manufacturer Rule measure, but it has not yet been proposed to the Board for approval/adoption.)*	No state has more stringent requirements for new emission performance standards for forklifts engines than California.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
In-Use Emissions Controls: Fleet Rules (Forklifts)	Off-road Diesel Regulation (CARB) LSI Fleet Regulation (CARB) 2022 Amendments to the In-Use Off-Road Diesel Fueled Fleets Regulation (CARB) Future Measure: *Zero-Emission Off-Road Forklift Regulation Phase 1 (CARB)* Future Measure: *Amendments to the Cargo Handling Equipment measure (CARB)*	California's in-use emission controls for forklifts are the most stringent in the nation. Forklift fleets subject to both the LSI fleet regulation (if powered by gasoline or propane), and the off-road diesel fleet regulation (if powered by diesel) are required to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. Diesel Forklifts > 25 HP are subject to fleet average emission requirements under the Off-Road Diesel Regulation starting in 2010. Under the 2022 Amendments to the In-Use Off-Road Diesel Fueled Fleets Regulation, forklifts are also subject to requirements begin to transition fleets from the oldest and highest-emitting off-road engines in operation in California by phasing out Tier 0 – Tier 2 equipment beginning in 2024. Also beginning in 2024, the regulation includes requirements to restrict the addition of new vehicles and/or engines with Tier 3 and 4i engines. CARB is anticipated to further increase the stringency of in-use emission controls with the Zero-Emission Off-Road Forklift Regulation Phase I measure, which would be designed to accelerate the deployment of zero-emission forklift technologies. The regulatory amendments would propose requirements for fleets to retire existing LSI forklifts that are 13 years and older, and would propose an implementation schedule beginning in 2026. *(NOTE: CARB has committed to develop the Zero-Emission Off-Road Forklift Regulation Phase 1 measure, but it has not yet been proposed to the Board for approval/adoption.)* CARB is also anticipated to further reduce the emissions from forklifts operating at ports and intermodal rail yards through the Amendments to the Cargo Handling Equipment Regulation measure. Under the CHE measure, forklifts would begin transitioning to zero-emission technologies. Staff anticipates that all forklifts operating at ports and intermodal rail yards would be zero-emission by 2030. *(NOTE: CARB committed to pursue the Amendments to the Cargo Handling Equipment measure, but this measure has yet to be proposed to the Board for approval/adoption.)*	No other state or nonattainment area has more stringent fleet requirements for in-use forklifts than CARB.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
New Engine Standards: Marine Engines	Exhaust Emission Regulations for Spark-Ignition Marine Engines (CARB) Tier II Emission Standards for Inboard and Stern-Drive Marine Engines (CARB) Evaporative Emission Control Standards (CARB) Future Measure: *Spark-Ignition Marine Engine Standards measure (CARB)*	CARB's recreational boats and marine engine program exceeds the stringency of U.S. EPA's federal standards and are the most stringent in the nation: • The Exhaust Emission Regulations for Spark-Ignition Marine Engines (1998) controls emissions at the same level of stringency as national regulations; • The Tier II Emission Standards for Inboard and Stern-Drive Marine Engines (2001) controls emissions at the same level of stringency as national regulations; and • The Evaporative Emission Control Standards (2015) exceeds the stringency of applicable national regulations set by U.S. EPA in 2008 for gasoline-fueled spark-ignition marine watercraft >30 kilowatts. The Spark-Ignition Marine Engine Standards measure would reduce emissions from new spark-ignition (SI) marine engines by adopting more stringent exhaust standards for outboard and personal watercraft, which currently do not use catalyst control technologies. Staff estimates that stricter standards could reduce combined HC or ROG and NOx emissions by approximately 70 percent below the current HC+NOx standard (≈16.5 grams per kilowatt-hour (g/kW-hr)) for engines greater than or equal to 40 kilowatts (kW) in power, and by approximately 40 percent for engines less than 40 kW in power. CARB staff is also evaluating whether some outboard and personal watercraft vessels could be propelled by zero-emission technologies in certain applications. For example, zero-emission powertrains have the potential to gradually replace most outboard engines less than 19 kW, as well as many new personal watercraft engines. *(Note: CARB has committed to pursue the Spark-Ignition Marine Engine Standards measure, but this measure has not yet been proposed to the Board for approval/adoption)*	No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.
New Engine Standards: Off-Highway Recreational Vehicles (OHRVs)	Exhaust Emission Standards for OHRVs (CARB) Evaporative Emission Standards for OHRVs (CARB)	California's emission controls for Off-Highway Recreational Vehicles (OHRVs) are the most stringent in the nation. CARB's exhaust emission standards control emissions from off-highway motorcycles, all-terrain vehicles, and utility terrain vehicles at more stringent levels than applicable national standards set by U.S. EPA for MY 2022 – 2027+. CARB evaporative emission standards harmonize with federal limits for MY 2020 – 2026. California's evaporative emission standards will exceed the stringency of federal requirements for MY 2027+.	No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.
In-Use Emissions Controls: Fleet Rules (Off-Highway Recreational Vehicles)	OHRV "Red Sticker" program (CARB)	California's in-use emission controls for Off-Highway Recreational Vehicles (OHRVs) are the most stringent in the nation. CARB's "Red Sticker" program requires in-use OHRVs that do not meet the applicable exhaust emission standards display a red registration sticker that limits operation at certain off highway recreational vehicle parks located in nonattainment areas during peak ozone season.	No other state or nonattainment area controls in-use emissions from OHRV more stringently than CARB.
New Engine Standards: Small Off-Road Engines (SORE)	Exhaust and Evaporative Standards for Small Off-Road Engines (CARB)	California's emission controls for small off-road engines (SORE) are the most stringent in the nation. CARB's current SORE program (through MY 2023) aligns the exhaust and evaporative standards for SORE with federal standards, and sets requirements for Zero-Emission SORE equipment. CARB further increased the stringency of emission controls with the 2021 Amendments to the SORE Regulations, which will accelerate the deployment of zero-emission technologies, set tighter exhaust and evaporative emission standards (MY 2024+), and enhance enforcement of current emission standards for SORE. Beginning in MY 2024,	No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
		exhaust and evaporative emission standards were lowered to zero, except for pressure washers with engine displacement greater than or equal to 225 cubic centimeters and generators (phase-in for ZE pressure washers and generators begins in MY 2028 and 2024, respectively). For MY 2024 and subsequent years, CARB's emission control requirements for SORE will exceed federal requirements.	
New Engine Standards: Transport Refrigeration Units (TRU)	Airborne Toxic Control Measure for In-Use Diesel-Fueled TRUs and TRU Generator Sets (TRU ATCM) (CARB) Future Measure: *Transport Refrigeration Units (TRU) Regulation Part 2 measure (CARB)*	California's emission controls for Transport Refrigeration Units (TRU) are the most stringent in the nation. CARB adopted the Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled TRUs and TRU Generator Sets, and Facilities Where TRUs Operate (TRU ATCM) in 2004 and amended it in 2010 and 2011 to reduce diesel particulate matter (PM) emissions and resulting health risk from diesel-powered TRUs used to control the environment of temperature-sensitive products. In 2022, CARB further amended the TRU ATCM (2022 Amendments), which included requirements that MY 2023 and newer trailer TRU, DSC TRU, railcar TRU, and TRU generator set engines shall meet a PM emission standard of 0.02 grams per brake horsepower-hour or lower (aligns with the United States Environmental Protection Agency Tier 4 final off-road PM emission standard for 25-50 horsepower engines). CARB is anticipated to further increase the stringency of in-use emission controls on TRUs via the Transport Refrigeration Units Regulation Part 2 measure, which would be designed to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets. *(Note: CARB has committed to pursue the Transport Refrigeration Unit Regulation Part 2 measure, but this measure has not yet been proposed to the Board for approval/adoption)*	No other state or nonattainment area requires as stringent of emission standards for TRUs
In-Use Emission Controls (Fleet Standard): Transport Refrigeration Units (TRU)	Air Toxic Control Measure for Transport Refrigeration Units and TRU Generator Sets (CARB) Future measure: *Transport Refrigeration Units (TRU) Regulation Part 2 measure (CARB)*	California's in-use emission controls for Transport Refrigeration Units (TRUs) are the most stringent in the nation. CARB adopted the Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled TRUs and TRU Generator Sets, and Facilities Where TRUs Operate (TRU ATCM) in 2004 and amended it in 2010 and 2011 to reduce diesel particulate matter (PM) emissions and resulting health risk from diesel-powered TRUs used to control the environment of temperature-sensitive products. In 2022, CARB further amended the TRU ATCM (2022 Amendments), which included Zero-emission truck TRU fleet requirements. Beginning December 31, 2023, TRU owners shall turnover at least 15 percent of their truck TRU fleet (defined as truck TRUs operating in California) to ZE technology each year (for seven years). All truck TRUs operating in California shall be ZE by December 31, 2029. CARB is anticipated to further increase the stringency of in-use emission controls on TRUs via the TRU Regulation Part 2 measure, which would be designed to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets. *(Note: CARB has committed to pursue the Transport Refrigeration Unit Regulation Part 2 measure, but this measure has not yet been proposed to the Board for approval/adoption)*	No other state or nonattainment area controls in-use emissions from TRUs more stringently than CARB.
Primarily Federally and Internationally Regulated Sources			
New Engine Standards: Locomotives	Tier 4 NOx and PM Locomotive emission standards (U.S. EPA)	U.S. EPA has the sole authority to establish emissions standards for locomotives. CARB petitioned U.S. EPA in 2017 to increase stringency by developing Tier 5 national emission standards for newly manufactured locomotives, and more stringent national	No state has emission standards for locomotives that differ from U.S. EPA's.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
	CARB has petitioned U.S. EPA to further increase stringency. *(2016 State SIP Strategy's More Stringent National Locomotive Emission Standards measure)*	requirements for remanufactured locomotives (by ~2020) *(NOTE: CARB has petitioned U.S. EPA for more stringent locomotive standards given the needs in California's nonattainment areas, but approval/adoption of this MSM rests exclusively with U.S. EPA and is thus beyond the purview of CA.)*	
In-Use Emission Controls (Locomotives): In-Use Locomotive Regulation	Statewide Rail Yard Agreement for California Rail Yards (Locomotive Memorandum of Understanding) (CARB) In-Use Locomotive Regulation (CARB)	California's in-use emission reduction measures for locomotives are the most stringent in the nation. The 2005 Statewide Rail Yard Agreement for California Rail Yards, a Memorandum of Understanding (MOU) with the Class I Railroads to increase the use of idle control devices, lowered locomotive idle times to 15 minutes, and opened a collaboration to produce Health Risk Assessments on 18 major railyards in the State, which was completed in 2015. Adopted in April 2023, the In-Use Locomotive Regulation accelerates the adoption of advanced, cleaner technologies for locomotive operations, including zero-emission technologies. The regulatory elements include: • Starting in 2024: Spending Account Locomotive operators would be required to fund their own trust account based on the emissions created by their locomotive operations in California. The dirtier the locomotive, the more funds must be set aside. Spending Account funds would be used to fund turnover to cleaner locomotives, rail equipment, and/or related infrastructure. • Starting in 2030: In-Use Operational Requirements Only locomotives less than 23 years old would be able to be used in California. Switchers industrial and passenger locomotives with original engine build dates of 2030 or newer would be required to operate in a ZE configuration in California. Freight line haul locomotives with original engine build dates of 2035 and newer would be required to operate in a ZE configuration in California. • Starting in 2024: Idling Limit All locomotives with automatic shutoff devices (AESS) would not be permitted to idle longer than 30 minutes, unless for an exempt reason. Exemptions closely align with those described by U.S. EPA, and would be granted for reasons like maintaining air brake pressure or to perform maintenance. • Starting in 2024: Registration and Reporting Locomotives operating in the State would be required to register with CARB. Reporting includes and annual administrative payment. Locomotive activity, emission levels and idling data would be required to be reported annually. Local air districts may also pursue indirect source rules for freight facilities that could result in reductions from this category.	No other state has a regulation to accelerate the adoption of advanced, cleaner locomotive operations technologies, including zero-emission.
In-Use Emission Controls (Aircraft): Future Measures for Aviation Emission Reductions	Future Measure: *Future Measures for Aviation Emission Reductions (CARB)*	Future Measures for Aviation Emissions Reductions would reduce emissions from airport and aircraft related activities, including main aircraft engines, auxiliary power units (APU), and airport ground transportation. Due to U.S. EPA's authority on setting emission standards, for this measure, CARB would strongly advocate for stricter emission regulations and highlight the need to reduce pollution to protect public health.	No state has emission standards for aircraft that differ from U.S. EPA's and FAA's.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
		CARB would also explore requiring all larger airports to perform a comprehensive and standardized emission inventory. An accurate emission inventory that reflects all on-ground and near-ground emissions would establish a baseline and enable verifiable and quantifiable future emissions reductions. CARB would continue to assess technology development for the aviation sector. The purpose is to help inform and support CARB planning, regulatory, and voluntary incentive efforts. Concurrently, CARB would support, track, and explore current, in-development, and future emission reduction technology advancements. CARB would evaluate federal, State, and local authority in setting operational efficiency practices to achieve emissions reductions. Operational practices include landing, takeoff, taxi, and running the APU, and contribute to on-ground and near-ground emissions. CARB would similarly work with U.S. EPA, air districts, airports, and industry stakeholders in a collaborative effort to develop regulations, voluntary measures and incentive programs. *(Note: CARB has committed to pursue the Future Measures for Aviation Emission Reductions, but this measure has not yet been proposed to the Board for approval/adoption)*	
Fuels			
Fuels Standards: Diesel Standards	CARB Diesel Fuel Regulations and Ultra Low Sulfur Diesel (CARB) Future measure: *Low Emission Diesel measure (CARB)*	California's fuel standards for diesel are the most stringent in the nation. CARB Diesel Fuel Regulations include stringent requirements for fuel mixture specifications for aromatic hydrocarbons and sulfur, and have establish a lubricity standard and applies to sales of fuel used in on-road vehicles and off-road vehicles and locomotives in California. CARB's ULSD program reduces NOx and PM emissions significantly relative to U.S. EPA requirements, providing approximately 7 percent more NOx reductions and 25 percent more PM reductions than federal diesel. CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products. *(NOTE: CARB has committed to pursue the Low Emission Diesel measure, but it has not yet been proposed to the Board for approval/adoption.)*	No state requires cleaner burning diesel than California. The California diesel fuel regulations exceed federal requirements in stringency. CARB staff are aware of only one other state, Texas, who has a boutique diesel fuel program that is approved into the SIP. An independent analysis of The Texas Low Emission Diesel program (TxLED) showed that the TxLED fuel emissions performance does not provide as significant of emission reduction benefits as the California specifications.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
Fuels Standards: Alternative Fuel Standards (Diesel substitutes)	Low Carbon Fuel Standard (LCFS) (CARB) Alternative Diesel Fuel Regulation (ADF) (CARB)	California's fuel standards for diesel substitutes are the most stringent in the nation. The LCFS and ADF regulations work together to reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends. The LCFS regulation supports alternative fuels used in several off-road applications. However, the program does not apply to fossil jet fuel, aviation gasoline, fuels used in interstate locomotives or fuels used for propulsion of ocean-going vessels.	No other state has set criteria emission requirements on alternative fuels and alternative fuel blends. The Federal Renewable Fuel Standard (RFS II) does not specify criteria requirements for alternative fuels. Other states with low carbon fuel and/or clean fuel programs: • Oregon, Washington, and British Columbia have low carbon fuel standard programs, California participates in the Pacific Coast Collaborative with these states/provinces. • Other states that are considering a clean fuel regulation include: NY, MI, MN, NM, VT, IL, MA.

<u>*EMISSION STANDARDS FOR NEW ENGINES AND EQUIPMENT*</u>

Off-Road Equipment (General)

CARB ***Tier 4 Off-Road Equipment Standards are*** nearly identical to those finalized by U.S. EPA in its Clean Air Nonroad Diesel Rule. These regulations require engine manufacturers to meet aftertreatment-based exhaust standards for PM and NOx starting in 2011 that are over 90 percent lower than the previous engine generation's emission levels. CARB's new engine standards for off-road equipment is thus aligned with most stringent control program of any in the nation.

Due to constraints in the Act, California is the only state that can set new engine standards (including control measures such as emission standards, sales mandates, warranty provisions, and OBD requirements) that are more stringent than U.S. EPA's national standards. Other states can adopt California programs for which U.S. EPA has provided California with authorizations. While the Act allows other states to adopt CARB's regulations for off-road engine or off-road vehicles (provided that such standards are identical to the CARB standards for which an authorization has been obtained), other states have not yet adopted off-road engine emission standards equivalent to the California off-road regulation, although there are some states currently considering doing so.

CARB has also committed to increase the stringency of off-road equipment emission standards with the ***Tier 5 Off-Road Vehicles and Equipment measure*** and the ***Off-Road Zero-Emission Targeted Manufacturer Rule measure***. Under the Tier 5 Off-Road Vehicles and Equipment measure, CARB would develop and propose standards and test procedures for new off-road CI engines More stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp). The Off-Road Zero-Emission Targeted Manufacturer Rule would accelerate the development and production of zero-emission off-road equipment and powertrains into more sectors.

<u>*IN-USE EMISSION CONTROLS FOR OFF-ROAD ENGINES AND EQUIPMENT*</u>

Fleet Rules: Off-Road Equipment (General)

In aggregate, CARB's fleet requirements for off-road equipment are the most stringent in the nation. CARB's ***Cleaner In-Use Off-Road Equipment Regulation (Off-Road Regulation)*** controls diesel PM and NOx emissions from >150,000 in-use offroad engines by requiring their owners to retire, replace, or repower older engines, and/or installing verified exhaust retrofit control technologies to BACT-equivalent engines. Additionally, all vehicles are reported and labeled, and older, dirtier vehicles are restricted from entering fleets.

CARB's Off-Road Regulation controls emissions from aerial lifts, aircraft tugs, backhoes, baggage tugs, belt loaders, cargo loaders, crawler tractors (such as bulldozers), excavators, forklifts, graders, loaders, mowers, rollers, rough terrain forklifts, rubber tired loaders, scrapers, skid steer loaders, snow blowers, tractors, trenchers, as well as several types of on-road vehicles, such as two-engine vehicles, and workover rigs. Furthermore, CARB has also committed to further emission reductions from the off-road equipment fleets through the ***Clean Off-Road Fleet Recognition Program*** measure, which would create a non-monetary incentive to encourage off-road fleets to go above and beyond existing regulatory fleet rule compliance and adopt advanced technology equipment with a strong emphasis on zero-emission technology.

Some nonattainment areas have fleet requirements that also require BACT-equivalent levels of controls for some off-road equipment (i.e. construction equipment), which are described below.

- New York City's Local Law 77 requires use of ultra-low sulfur diesel fuel and BACT for reducing emissions from non-road equipment above 37 kW used on city construction projects.
- Chicago (IL) Clean Diesel Construction Ordinance bans high-polluting diesel equipment from City construction sites. While the California program requires fleets to turnover to Tier 4 or equivalent control levels, the Chicago ordinance only requires fleets to turnover to Tier 2 or equivalent control levels (on-road vehicles MY 1998 and earlier and pre-US Environmental Protection Agency Tier 1 equipment will be banned under the Chicago ordinance.)

No other state or nonattainment area controls in-use off-road equipment fleets more stringently than CARB. Neither of the New York or Chicago programs cover the full suite of off-road equipment engine types and applications that are regulated under CARB's program. Additionally, they do not have as stringent of labeling and reporting requirements as CARB. Finally, the use of ULSD in off-road equipment in New York provides significantly less emission reductions than the use of ULSD inside of California (as is required – see fuels section for more information), as federal USLD specifications allow significantly less stringent caps on sulfur and aromatic hydrocarbon content in fuels than CARB diesel specifications.

OFF-ROAD ENGINES AND EQUIPMENT: SOURCE-SPECIFIC RULES

Beyond the regulations that apply to the majority of the off-road category, CARB also controls sub-categories of off-road equipment through source-specific emission standards and fleet requirements, as described below.

Agricultural Equipment

Emission Standards for Agricultural Equipment

CARB's new engine standards for off-road agricultural equipment (ag equipment) is consistent with the most stringent of any in the nation. In 2004, U.S. EPA and California adopted equivalent ***Tier 4 Off-Road Engine Emission Standards***, which includes requirements for agricultural equipment engines. Beyond the Off-Road Regulation, CARB also controls sub-categories of off-road equipment through specific fleet requirements, as described below.

In-Use Controls: Agricultural Equipment

CARB's agricultural equipment fleet controls are among the most stringent in the nation. The 2007 ***Cleaner In-Use Agricultural Equipment Measure*** modernizes agricultural equipment in the Valley. Since approval of the measure and development of SJVAPCD and CARB incentive programs, the District has replaced over 5,000 tier 0 and tier 1 tractors since 2009 to meet the targeted NOx emission reductions of 5 to 10 tpd by 2017. This program was further reinforced and strengthened with CARB's ***Accelerated Turnover of Agricultural Equipment*** measure in the Valley SIP Strategy[114] to achieve 11 tpd NOx reductions in 2024 through accelerated turnover of approximately 12,000 tier 0, tier 1, and tier 2 agricultural equipment to the cleanest equipment available. To fulfill the State commitment under the Accelerated Turnover of Agricultural Equipment Measure, CARB developed and submitted to U.S. EPA a SIP-creditable incentive measure for a subset of the total projects that has since been made federally-enforceable upon approval by U.S. EPA into the California SIP. CARB also included the ***Cleaner In-Use Agricultural Equipment measure*** in the Valley SIP Strategy to serve as a backstop to accelerate the turnover of large tier 0, tier 1, and tier 2 agriculture tractors to tier 4 through existing projects and new projects. This measure could be designed to accelerate emission reductions from the in-use ag equipment fleet by incorporating a phase-in approach to support the use of tier 2 or cleaner engines in agricultural tractors in the Valley by 2030. CARB's agricultural equipment fleet controls are among the most stringent in the nation.

Airport Ground Support Equipment (GSE)

Emission Standards for Airport GSE

CARB's new engine standards for airport GSE is the most stringent in the nation. New airport GSE is subject to emission standards under CARB's ***Large Spark Ignition (LSI) Fleet Regulation*** (natural gas and gasoline engines), and under CARB's ***Tier 4 Off-Road Engine Standards*** (diesel engines). NOx limits for the LSI Engine Standard for engines > 1.0 liter (the typical engine size for GSE) is 0.6 g/bhp-hr. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recent as 2009. Additionally, diesel engines in newly manufactured GSE must meet the Tier 4 emission standards applicable to off-road compression ignition engines. Non-mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the ***Portable Diesel-Engines Air Toxic Control Measure (ATCM)***. The ATCM reduces PM emissions by requiring engine replacement in a schedule based on a fleet's weighted PM emission average. No other state has more stringent exhaust emission standards for airport GSE than CARB. Furthermore, CARB is anticipated to further increase the stringency of emission controls beyond MSM under the ***Zero-Emission***

[114] San Joaquin Valley Supplement to the 2016 State Strategy for the State Implementation Plan https://ww2.arb.ca.gov/sites/default/files/classic/planning/sip/2016sip/valleystrategy.pdf

Airport Ground Support Equipment measure committed to in the 2016 State SIP Strategy.

In-Use Controls: Airport GSE

CARB's new engine standards for airport GSE is the most stringent in the nation. New airport GSE is subject to emission standards under CARB's ***Large Spark Ignition (LSI) Fleet Regulation*** (natural gas and gasoline engines), and under CARB's ***Tier 4 Off-Road Engine Standards*** (diesel engines). NOx limits for the LSI Engine Standard for engines > 1.0 liter (the typical engine size for GSE) is 0.6 g/bhp-hr. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recent as 2009. Additionally, diesel engines in newly manufactured GSE must meet the Tier 4 emission standards applicable to off-road compression ignition engines. Non-mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the ***Portable Diesel-Engines Air Toxic Control Measure (ATCM)***. The ATCM reduces PM emissions by requiring engine replacement in a schedule based on a fleet's weighted PM emission average. No other state has more stringent exhaust emission standards for airport GSE than CARB. Furthermore, CARB is anticipated to further increase the stringency of emission controls beyond MSM under the ***Zero-Emission Airport Ground Support Equipment measure*** committed to in the 2016 State SIP Strategy.

CARB's airport GSE fleet requirements are the most stringent in the nation. CARB's ***In-Use Off-Road Diesel-Fueled Fleets Regulation*** requires fleets operating in-use diesel equipment to meet an annual fleet average emissions target that decreases over time to become equivalent to the interim Tier 4 NOx standard for newly produced engines. Airport GSE fleets operating Large Spark-Ignition (LSI) GSE must meet the in-use LSI engine fleet requirements. Adopted in 2006, ***the LSI Engine Fleet Requirements Regulation*** requires GSE fleets to maintain an average emission level of no more than 2.5 g/bhp hr HC+NOx, starting January 1, 2013. Non-mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the ***Portable Diesel-Engines Air Toxic Control Measure (ATCM)***. The ATCM reduces PM emissions by requiring engine replacement in a schedule based on a fleet's weighted PM emission average. CARB is anticipated to further increase the stringency of emission controls beyond MSM with the ***Zero-Emission Airport Ground Support Equipment measure***. No other state or nonattainment area controls airport GSE more stringently than CARB.

Cargo Handling Equipment (CHE)

Emission Standards for CHE

CARB's ***Cargo Handling Regulation*** established engine performance standards for new CHE used to transfer goods or perform maintenance and repair activities and includes equipment such as yard trucks (hostlers), rubber-tired gantry cranes, top handlers, side handlers, forklifts, and loaders at ports and intermodal rail yards. CARB

CHE emission standards are the most stringent of any in the nation, with further increases in stringency anticipated through the ***Cargo Handling Equipment Amendments measure*** committed to in the 2022 State SIP Strategy, which will go beyond MSM and transition CHE to zero-emission equipment. CARB obtained U.S. EPA authorization in 2012. No other state or nonattainment area has more stringent exhaust emission standards for CHE than California.

In-Use Controls: CHE

CARB's ***Cargo Handling Equipment Regulation*** includes in-use limits that require diesel PM and NOx emission controls for mobile CHE at ports or intermodal rail yards. The CHE Regulation requires that all newly purchased yard truck and non-yard truck equipment brought onto a port or intermodal rail yard must have either a Tier 4 Final off road engine or an on-road engine meeting the 2010 or newer on-road emission standards, and that all legacy in-use non-yard truck engines that are still in service (Tier 0 – Tier 3) must have a Verified Diesel Emission Control Strategy (VDECS) installed. CARB is anticipated to further increase the stringency with the ***Amendments to the Cargo Handling Equipment Regulation***, which would go beyond MSM and set in-use requirements for diesel cargo handling equipment at ports and rail yards. No other state or nonattainment area has more stringent in-use fleet requirements for CHE than California.

Commercial Harbor Craft (CHC)

Emission Standards for CHC

CARB's new engine standards for CHC is the most stringent of any in the nation. The ***Commercial Harbor Craft Regulation*** controls NOx and PM emissions from crew and supply boats, ferries / excursion vessels, towboats, push boats, tugboats, barges, and dredges. CARB amended the CHC regulation in 2022, establishing expanded and more stringent in-use requirements to cover more vessel categories, and to accelerate the deployment of zero-emission and advanced technologies in vessel categories where technological feasibility has been demonstrated. No other state has more stringent exhaust emission standards for commercial harbor craft than California.

In-Use Controls: CHC

CARB's ***Commercial Harbor Craft Regulation*** (adopted in 2007) includes in-use limits that require diesel PM and NOx emission controls, which was amended in 2010 and 2022 to extend the types of CHC for which in-use engine requirements apply. The regulation includes in-use limits that required diesel PM and NOx emission controls on ferries, excursion vessels, tugboats, towboats, push boats, crew and supply boats, barges, dredges, tank barges, pilot vessels, research vessels, workboats, commercial passenger fishing, and commercial fishing vessels. The 2022 amendments also mandate accelerated deployment of zero-emission and advanced technologies in vessel categories where technology feasibility has been demonstrated. No other state or nonattainment area controls in-use CHC emissions more stringently than CARB.

Forklifts

Emission Standards for Forklifts

CARB's new engine standards for forklifts are the most stringent of any in the nation. Forklifts powered by LSI engines (gasoline and natural gas) are subject to new engine standards that include both criteria pollutant and durability requirements since 2001 with the cleanest requirements phased-in starting in 2010. Diesel Forklifts > 25 HP are subject to fleet average emission requirements under the Off-Road Diesel Regulation starting in 2010 and ***Tier 4 Off-Road Engine Standards*** (based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction) starting in 2013. Furthermore, the stringency of these requirements is anticipated to increase under the ***Zero-Emission Off-Road Forklift Regulation Phase 1 measure*** committed to in the 2016 State SIP Strategy and the ***Off-Road Zero-Emission Targeted Manufacturer Rule measure***, committed to in the 2022 State SIP Strategy. Both of these measures would increase the deployment of zero-emission forklifts. No other state has more stringent forklift emission standards than CARB.

In-Use Controls: Forklifts

California forklifts are subject to either the ***LSI Fleet Regulation*** (if powered by gasoline or propane), and the ***Off-Road Diesel Fleet Regulation*** (if powered by diesel). Under both regulations, forklift fleets are required to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. Under the 2022 Amendments to the ***In-Use Off-Road Diesel Fueled Fleets Regulation***, forklifts are also subject to requirements begin to transition fleets from the oldest and highest-emitting off-road engines in operation in California by phasing out Tier 0 – Tier 2 equipment beginning in 2024. Also beginning in 2024, the regulation includes requirements to restrict the addition of new vehicles and/or engines with Tier 3 and 4i engines. CARB is anticipated to further increase the stringency of emission controls the emissions for from forklifts operating at ports and intermodal rail yards beyond MSM through the ***Zero-Emission Cargo Handling Equipment Regulation*** measure, which begin transitioning to zero-emission technologies. Staff anticipates that all forklifts operating at ports and intermodal rail yards would be zero-emission by 2030. No other state or nonattainment area has more stringent fleet requirements for in-use forklifts than CARB.

Marine Engines

Emission Standards for Marine Engines

CARB's new engine standards for recreational boats are the most stringent of any in the nation, and exceed the stringency of U.S. EPA federal standards:

- The ***Exhaust Emission Regulations for Spark-Ignition Marine Engines*** (1998) controls emissions at the same level of stringency as national regulations;
- The ***Tier II Emission Standards for Inboard and Stern Drive Marine Engines*** (2001) controls emissions at the same level of stringency as national regulations; and
- The ***Evaporative Emission Control Standards*** (2015) exceeds the stringency of applicable national regulations set by U.S. EPA in 2008 for gasoline-fueled spark-ignition marine watercraft >30 kilowatts.

Furthermore, CARB is anticipated to increase the stringency of marine engine controls beyond MSM with the ***Spark-Ignition Marine Engine Standards measure,*** which would reduce emissions from new spark-ignition marine engines by adopting more stringent exhaust standards for outboard and personal watercraft, which currently do not use catalyst control technologies. No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.

Off-Highway Recreational Vehicles (OHRV)

Emission Standards for OHRV

CARB's new engine standards for OHRV are the most stringent of any in the nation. CARB's program sets ***Exhaust Emissions Standards and Evaporative Emission Standards for OHRVs,*** together with amendments to the testing procedures to ensure the most stringent level of emission reductions are achieved. CARB's exhaust emission standards control emissions from off-highway motorcycles, all-terrain vehicles, and utility-terrain vehicles at more stringent levels than applicable national standards set by U.S. EPA for MY 2022 – 2027+. CARB evaporative emission standards harmonize with federal limits for MY 2020 – 2026. California's evaporative emission standards will exceed the stringency of federal requirements for MY 2027 and subsequent years. U.S. EPA has issued authorization for CARB's OHRV regulations. No other state or nonattainment area controls emissions from new OHRV more stringently than CARB.

In-Use Controls: OHRV

CARB's In-Use controls for OHRV under the ***"Red Sticker" program*** controls in-use emissions from OHRV more stringently than any other state or nonattainment area in the nation. Under this program, engines that do not meet the applicable emission standard for new engines are subject to in-use restrictions that limits operation at certain off-highway recreational vehicle parks located in ozone nonattainment areas during the summer peak ozone season. CARB is currently in the process of phasing out the Red Sticker program in favor of more stringent emission controls, and has ended Red Sticker certification of new OHRVs with no emission controls beginning in Model Year 2022. The seasonal riding restrictions on existing red sticker vehicles, however, continues through December 2024, providing for ongoing in-use emission controls for the legacy vehicle fleet. No other state or nonattainment area controls in-use emissions from OHRV more stringently than CARB.

Small Off-Road Engines (SORE)

Emission Standards for SORE

California's emission controls for SORE are the most stringent in the nation. CARB's current SORE program (through MY 2023) aligns the exhaust and evaporative standards for SORE with federal standards. CARB further increased the stringency of emission controls with the 2021 Amendments to the SORE Regulations, which will accelerate the deployment of zero-emission technologies, set tighter exhaust and evaporative emission standards, and enhance enforcement of current emission standards for SORE. Beginning in MY 2024, exhaust and evaporative emission standards were lowered to zero, except for pressure washers with engine displacement greater than or equal to 225 cubic centimeters, and generators (phase-in for ZE pressure washers and generators begins in MY 2028 and 2024, respectively). For MY 2024 and subsequent years, CARB's emission control requirements for SORE will exceed federal requirements. No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.

Transport Refrigeration Units (TRU)

Emission Standards for TRU

California's emission controls for Transport Refrigeration Units (TRU) are the most stringent in the nation. CARB adopted the ***Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled TRUs and TRU Generator Sets, and Facilities Where TRUs Operate (TRU ATCM)*** in 2004 and amended it in 2010 and 2011 to reduce diesel particulate matter (PM) emissions and resulting health risk from diesel-powered TRUs used to control the environment of temperature-sensitive products. In 2022, CARB further amended the TRU ATCM (2022 Amendments), which included requirements that MY 2023 and newer trailer TRU, DSC TRU, railcar TRU, and TRU generator set engines shall meet a PM emission standard of 0.02 grams per brake horsepower-hour or lower (aligns with the United States Environmental Protection Agency Tier 4 final off-road PM emission standard for 25-50 horsepower engines). Furthermore, CARB is anticipated to further increase the stringency of in-use emission controls on TRUs beyond MSM via the ***Transport Refrigeration Units Regulation Part 2 measure***, which would be designed to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets. No other state or nonattainment area requires as stringent of emission standards for TRUs.

In-Use Controls: TRU

CARB's ATCM for TRUs and TRU Generator Sets (***ATCM for In-Use Diesel-Fueled TRUs***) requires engines to meet in-use diesel PM emission standards by the end of the seventh year after manufacture, and applies to TRUs that operate in California, regardless of whether they are registered in or outside of the State. CARB's program is the most stringent of its type in the nation. Furthermore, CARB is anticipated to further increase the stringency of emission controls beyond MSM under the ***TRU Regulation Part 2 measure*** committed to in the 2022 State SIP Strategy, which is anticipated to increase NOx and PM emission reductions by reducing the amount of time TRUs operate while stationary. No other state or nonattainment area controls in-use emissions from TRUs more stringently than CARB.

Primarily Federally and Internationally Controlled Sources

Emission Standards for Locomotives

U.S. EPA sets nationwide emission standards for locomotives, the most recent of which is the Tier 4 NOx and PM Locomotive Emission Standards. No state, including California, has the authority to regulate emission standards for locomotives. Thus, CARB's locomotive controls are equivalent to the controls used in all other nonattainment areas in the nation. Nonetheless, further increases in stringency of locomotive emission controls are needed for California nonattainment areas, including the Valley, to attain federal ambient air quality standards. For this reason, CARB has petitioned U.S. EPA to set more stringent emission controls for locomotives.

In-Use Emission Controls for Locomotives

While emission standards for locomotives are set by U.S. EPA, CARB has accelerated reductions from this source through efforts that have focused on increasing the use of cleaner locomotives. The ***2005 Statewide Rail Yard Agreement for California Rail Yards,*** a MOU obligated the railroads to increase the use of idle control devices, lowered locomotive idle times to 15 minutes, and opened a collaboration to produce Health Risk Assessments on 18 major railyards in the State which was completed in 2015. CARB also recently adopted more stringent in-use locomotive emission controls with the ***In-Use Locomotive Regulation***, which accelerates the adoption of advanced, cleaner technologies for locomotive operations, including zero-emission technologies. No other state or nonattainment area has an agreement with Class I railroads to accelerate the introduction of cleaner locomotive engines, or has achieved similarly significant levels of emission reductions from in-use locomotives than CARB.

In-Use Emission Controls for Aircraft

No state has emission standards for aircraft that differ from U.S. EPA's and FAA's. To control emissions from airport and aircraft related activities, including main aircraft engines, auxiliary power units (APU), and airport ground transportation, CARB has committed to the ***Future Measures for Aviation Emissions Reductions.*** Due to U.S. EPA's authority on setting emission standards, for this measure, CARB has identified opportunities for EPA to adopt cleaner emission standards for aircraft. Toward that end, CARB would strongly advocate U.S. EPA for stricter emission regulations and highlight the need to reduce pollution to protect public health.

FUELS

CARB Diesel Fuel Regulations

U.S. EPA began regulating sulfur content in diesel in 1993. At that time, uncontrolled fuels (i.e. non-CARB diesel) contained approximately 5,000 ppm of sulfur. In 2006, U.S. EPA began to phase-in more stringent requirements under the federal ULSD regulations, which lowered the amount of sulfur allowed in federal diesel fuels. U.S. EPA's Nonroad Diesel Fuel Standards were phased in from 2007 to 2014, and require that all off-road engines, including those used in locomotives and off-road equipment, use ULSD fuel (with some exemptions for older locomotives and marine engines). The Nonroad Standards also require that diesel fuel sold into the market for off-road use must be ULSD. It is important to note that while U.S. EPA defines ULSD as ≤ 15 ppm for on-road applications, the definition of off-road ULSD is significantly less stringent, defined as ≤ 500 ppm standard.

For the off-road fleet, CARB's current ULSD regulation is significantly more stringent than the applicable current federal ULSD standards (Phase III):

- Whereas the federal ULSD program differs in requirements for on- and off-road fuels, CARB's ultra-low sulfur diesel program sets the same requirements for fuels burned in on- and off-road applications. CARB limits sulfur content at 15 ppm rather than the federal limit of 500 ppm for off-road ULSD. Compared with CARB ULSD standards, federal off-road ULSD allows 33 times the sulfur content.
- CARB's ULSD significantly reduces emissions relative to federal on-road ULSD, which is much cleaner than federal off-road ULSD. Both federal on-road ULSD and CARB ULSD limit sulfur content (a precursor to secondary atmospheric formation of PM2.5) to 15 ppm, yet CARB's fuel emits ~25 percent less PM. Given that federal off-road ULSD sulfur content is capped at levels 3,000 percent higher than CARB's ULSD, the California program is significantly more stringent in terms of its ability to control emissions of sulfur oxide emissions.
- In addition, CARB controls hydrocarbons and aromatics, unlike U.S. EPA requirements.
- Furthermore, CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products under the Low Emission Diesel measure committed to in the State SIP Strategy.

As was discussed in the on-road diesel fuel section, only one other state has a boutique fuel program with requirements that differ from federal specifications, the Low Emission Diesel Program in Texas (TxLED). An independent analysis of TxLED, CARB ULSD and federal ULSD shows that the TxLED fuel emissions performance does not provide as significant of emission reduction benefits as the California specifications.[115] Furthermore, the stringency of Texas' testing requirements are based on the federal Complex Model, which is less stringent and nuanced than the California Predictive Model that is used to determine compliance with California fuel requirements. CARB diesel specifications are more stringent than federal and other states' programs. CARB's ULSD program reduces NOx and PM emissions significantly relative to U.S. EPA requirements, providing approximately 7 percent more NOx reductions and 25 percent more diesel PM reductions than federal diesel. Furthermore, CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products under ***the Low Emission Diesel measure***. No other state or nonattainment area controls criteria emissions from off-road diesel fuels more stringently than CARB.

Controlling Criteria Emissions from Renewable Fuels

The ***Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF) regulations*** work together to reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends. While other states have adopted or are considering adopting similar programs to the California LCFS, no other state has set criteria emission requirements on alternative fuels and alternative fuel blends. The Federal Renewable Fuel Standard (RFS II), which is the most equivalent program type at the federal level, increases the renewable content of the fuel mix nationally (as the LCFS does in California), however it does not specify criteria requirements for alternative fuels. No other state or nonattainment area controls criteria emissions from renewable fuels more stringently than CARB.

STEP 3(A): EVALUATION OF STRINGENCY: OFF-ROAD CONTROL MEASURES

Step 3(a) calls for an evaluation of each of the potential MSM control measures identified in Step 2, in order to evaluate their stringency and determine whether they meet all applicable requirements to satisfy the definitions of MSM as discussed in Section 1 and Section 2.

As shown in the Table D-20 in Step 2(b), CARB's programs are the most stringent in the nation. This comparison between CARB's control measures and the measures currently in place at the Federal level and/or within other States and jurisdictions illustrates the stringency of the current CARB off-road control program, which meets the stringency requirements of MSM.

Furthermore, CARB staff have conducted an analysis of the timing of the new measures included in the 2022 State SIP Strategy, which go beyond the stringency of the current control program as it is now being implemented. Many of these measures are still in

[115] American Transportation Research Institute (ATRI) 2008 "Energy and Other Fuel Property Changes with On-Road Ultra-Low Sulfur Diesel Fuel" http://www.atri-online.org/research/results/environmentalfactors/2008ATRIDiesel.pdf

their development phases and are not yet being implemented and thus beyond MSM; the development timeline, however, is critical to allowing industry and technological advancements to progress sufficiently such that the newly emerging technologies called for in these regulatory actions (most of which are technology-inducing regulations) have sufficient time to attain market readiness. Table D-21 summarizes the timeframe considerations for each of the applicable off-road control measures, and indicates why a more expedited timeframe is neither technologically nor economically feasible. For these reasons, the measures meet the MSM requirement of being phased in as “expeditiously as practicable” and go beyond MSM requirements in terms of stringency.

Table D-21 Off-Road Control Measures – Stringency and Timeline for Implementation

Measures	Implementation Begins	12 µg/m³ Annual (2012)
Off-Road Control Standards (General)		
Off-Road New Vehicle, Equipment and Engine Standards (General)		
Tier 4 Off-Road Engine Emission Standards	ongoing	MSM
Tier 5 Off-Road Vehicles and Equipment (2022 State SIP Strategy measure with commitment)	2029	Beyond MSM
California's emission standards for off-road diesel engines are consistent with those of U.S. EPA and the most stringent in the nation, with NOx limits at 0.3 g/bhp-hr, and PM limits at 0.015 g/bhp-hr. With the Tier 5 Off-Road Vehicles and Equipment Measure, CARB has committed to develop and propose standards and test procedures for new off-road CI engines More stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp). It is expected that Tier 5 requirements would rely heavily on technologies manufacturers are developing to meet the recently approved low-NOx standards and enhanced in-use requirements for on-road- heavy-duty engines. With the commitment to adopt Tier 5 emission standards, California's control program for new off-road engines will be further lowered to a nation-leading level; these levels will be technology-forcing, and will take years of lead time to enable manufacturers sufficient time to develop, test, certify, and manufacture the necessary low-emission engines and components. Further increases in stringency are not feasible. New off-road emission standards for new vehicles and engines are dependent on technological developments, and require years of lead time to be developed, certified, manufactured, and implemented; a more accelerated timeline is infeasible.		
Zero-Emission Off-Road New Equipment and Engine Standards (General)		
Off-Road Zero-Emission Targeted Manufacturer Rule (2022 State SIP Strategy measure with commitment)	2031	Beyond MSM
The Off-Road Zero-Emission Targeted Manufacturer Rule would accelerate the development and production of zero-emission off-road equipment and powertrains into more sectors (including wheel loaders, excavators, and bulldozers) as technology advancements occur due to existing CARB zero-emission regulations and regulations in the forklifts, cargo handling equipment, off-road fleets, and small off-road engines sectors. As a technology-forcing regulation, the Off-Road Zero-Emission Targeted Manufacturer Rule will accelerate the development and deployment of Zero-Emission off-road engines and powertrains; further increases in stringency are not feasible. Manufacturer sales requirements need years of lead time to be implemented; it would be infeasible to implement on a more accelerated timeframe.		
In-Use Control Measures – Off-Road Fleets (General)		
In-Use Off-Road Diesel-Fueled Fleets Regulation (Off-Road Regulation)	ongoing	MSM
2022 Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation (2022 State SIP Strategy measure, adopted November 2022)	2024	MSM
Clean Off-Road Fleet Recognition Program (2022 State SIP Strategy measure with commitment)	2027	Beyond MSM
California's in-use emission controls for off-road equipment are the most stringent in the nation. CARB's off-road regulation controls diesel PM and NOx emissions from >150,000 in-use off road engines by requiring their owners to retire, replace, or repower older engines, and/or installing verified exhaust retrofit control technologies. Additionally, all vehicles are reported and labeled, and older, dirtier vehicles are restricted from entering fleets. The 2022 Amendments to the Off-Road Regulation create additional requirements to the currently regulated fleets by targeting the oldest and dirtiest equipment that is allowed to operate indefinitely under the current regulation's structure. The amendments will require fleets to phase-out use of the oldest and highest polluting off-road diesel vehicles in California, starting in 2024, and include changes to enhance enforceability and encourage the adoption of zero-emission technologies. CARB anticipates further emission reductions from the off-road equipment fleets through the Clean Off-Road Fleet Recognition Program measure, which would create a non-monetary incentive to encourage off-road fleets to go above and beyond existing regulatory fleet rule compliance and adopt advanced technology equipment with a strong emphasis on zero-emission technology. Fleet requirements need years of lead time to be implemented for reasons of technological and economic feasibility. As purchasing requirements and fleet turnover cannot happen immediately, it would be infeasible to accelerate the implementation schedule for new purchasing requirements. California's currently committed to off-road fleet requirements are technology-forcing and are the most stringent in the nation, requiring the lowest-emitting internal combustion engine and equipment technology, with zero-emission elements; further increases in stringency are not feasible.		

Measures	Implementation Begins	12 µg/m³ Annual (2012)
Off-Road Control Measures - Source Category Specific		
Agricultural Equipment		
Tier 4 Off-Road Engine Emission Standards	ongoing	MSM
U.S. EPA and California adopted equivalent Tier 4 standards in 2004 that require additional emission reductions from off-road engines, including those used in mobile agricultural equipment. No State has more stringent requirements for new emission performance standards for agricultural equipment engines than California. Further increases in stringency, or an accelerated timeline for implementation are not feasible.		
Accelerated Turnover of Agricultural Equipment Measures	ongoing	MSM
Cleaner In-Use Agricultural Equipment Measure (2016 Valley SIP Strategy measure, not yet adopted)	2030	Beyond MSM
California's in-use emission control program for agricultural equipment is among the most stringent in the nation. The 2007 Cleaner In-Use Agricultural Equipment Measure modernizes agricultural equipment in the Valley. This program was further reinforced and strengthened with CARB's Accelerated Turnover of Agricultural Equipment measure in the San Joaquin Valley Supplement to the 2016 State Strategy for the State Implementation Plan (Valley SIP Strategy). Since approval of the measures and development of SJVAPCD and CARB incentive programs, the District has replaced over 5,000 tier 0 and tier 1 tractors since 2009 to meet the targeted NOx emission reductions of 5 to 10 tpd by 2017. To fulfill the State commitment under the Accelerated Turnover of Agricultural Equipment Measure, CARB developed and submitted to U.S. EPA a SIP creditable incentive measure for a subset of the total projects that has since been made federally-enforceable upon approval by U.S. EPA into the California SIP. CARB is anticipated to further increase the stringency of in use emission controls with the Cleaner In-Use Ag Equipment measure, committed to in the Valley SIP Strategy, which would be designed to accelerate emission reductions from the in use ag equipment fleet by incorporating a phase-in approach to support the use of tier 2 or cleaner engines in agricultural tractors in the Valley by 2030 which was committed to in the Valley SIP Strategy. California's agricultural equipment fleet rules are among the most stringent in the nation. Fleet turnover programs need years of lead time to be implemented for reasons of technological and economic feasibility; because fleet turnover cannot happen immediately, it would be infeasible to accelerate the implementation schedule for new purchasing requirements. California's currently committed to in-use agricultural equipment control measures are the most stringent in the nation, further increases in stringency are not feasible.		
Airport Ground Support Equipment (GSE)		
Tier 4 Off-Road Engine Emission Standards	ongoing	MSM
LSI Engine Fleet Requirements Regulation	ongoing	MSM
In-Use Off-Road Diesel-Fueled Fleets Regulation (Off-Road Regulation)	ongoing	MSM
Portable Diesel-Engine ATCM	ongoing	MSM
Zero-Emission Airport Ground Support Equipment (GSE) (2016 State SIP Strategy measure, not yet adopted)	TBD	Beyond MSM

California's emission controls for Airport Ground Support Equipment (GSE) are the most stringent in the nation:

- Diesel engines in newly manufactured GSE must meet the Tier 4 Emission Standards applicable to off-road compression ignition engines;
- NOx limits for the LSI Engine Standard for engines > 1.0 liter (the typical engine size for GSE) is 0.6 g/bhp-hr. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recently as 2009;
- Airport GSE fleets operating LSI GSE must meet the In-Use LSI Engine Fleet Requirements. Adopted in 2006, the LSI fleet rule requires GSE fleets to maintain an average emission level of no more than 2.5 g/bhp hr HC+NOx;
- The In-Use Off-Road Diesel-Fueled Fleets Regulation requires GSE fleets operating in-use diesel equipment to meet an annual fleet average emissions target that decreases over time, which are currently being phased in;
- Non mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the Portable Diesel-Engines ATCM;
- CARB is anticipated to further increase the stringency of emission controls with the Zero-Emission Airport Ground Support Equipment measure, which will act as a catalyst to further adoption of zero-emission equipment.

The stringency of California's control program for Airport GSE leads the nation, and will be further lowered with the Zero-Emission Airport GSE measure; these levels will be technology-forcing, and will take years of lead time to enable manufacturers sufficient time to develop, test, certify, and manufacture the necessary low-emission engines and components. Further increases in stringency are not feasible. New emission standards and fleet requirements for GSE are dependent on technological developments, and require years of lead time to be developed, certified, manufactured, and implemented; a more accelerated timeline is infeasible.

Measures	Implementation Begins	12 µg/m³ Annual (2012)
Cargo Handling Equipment (CHE)		
Cargo Handling Equipment (CHE) Regulation	ongoing	MSM
Amendments to CHE Regulation (2022 State SIP Strategy measure with commitment)	2026	Beyond MSM
California's emission controls for Cargo Handling Equipment (CHE) are the most stringent in the nation. CARB's Cargo Handling Equipment regulation sets performance standards for newly acquired engines, as well as in-use mobile CHE at ports or intermodal rail yards. The CHE regulation also includes performance standards for in-use, mobile CHE at ports or intermodal rail yards in California. CARB is anticipated to further increase the stringency of the CHE Regulation by transitioning CHE to zero-emission beginning in 2026. As committed to in the 2022 State SIP Strategy, CARB's amendments to the Cargo Handling Equipment Regulation would set in-use requirements for diesel cargo handling equipment at ports and rail yards, including but not limited to: yard trucks (hostlers), rubber-tired gantry cranes, container handlers, and forklifts. CARB's control measures are the most stringent in the nation, and the requirements committed will be technology-forcing and the most stringent feasible, including zero-emission requirement; further increases in stringency are not feasible. New standards for CHE are dependent on technological developments, and require years of lead time to be developed, certified, manufactured, and implemented; a more accelerated timeline is infeasible.		
Commercial Harbor Craft (CHC)		
Commercial Harbor Craft (CHC) Regulation	ongoing	MSM
2022 Amendments to CHC Regulation 2022 State SIP Strategy measure, adopted May 2022)	ongoing	MSM
California's emission controls for commercial harbor craft (CHC) are the most stringent in the nation. As amended in 2011, CARB's CHC Regulations reduce NOx and diesel PM emissions from crew and supply boats, ferries, excursion vessels, towboats, push boats, tugboats, barges, and dredges, and included in-use limits that required diesel PM and NOx emission controls. CARB amended the CHC regulation in 2022, establishing expanded and more stringent in-use requirements to cover more vessel categories including all tank barges, pilot vessels, research vessels, workboats, commercial passenger fishing, and commercial fishing vessels. The amendments also mandate accelerated deployment of zero-emission and advanced technologies in vessel categories where technology feasibility has been demonstrated. CARB's CHC control measures are technology forcing and the most stringent in the nation; further increases in stringency are infeasible. The requisite technology developments need years of lead time for development, certification, and implementation; it is not technologically feasible to accelerate the implementation timeline.		
Forklifts		
Tier 4 Off-Road Engine Emission Standards	ongoing	MSM
In-Use LSI Engine Fleet Requirements	ongoing	MSM
In-Use Off-Road Diesel-Fueled Fleets Regulation (Off-Road Regulation)	ongoing	MSM
Zero-Emission Off-Road Forklift Regulation Phase 1 (2016 State SIP Strategy measure with commitment)	2026	Beyond MSM
Amendments to the CHE Regulation (2022 State SIP Strategy measure with commitment)	2026	Beyond MSM
Off-Road Zero-Emission Targeted Manufacturer Rule (2022 State SIP Strategy measure with commitment)	2031	Beyond MSM
California's emission controls for forklifts are the most stringent in the nation. Forklifts powered by LSI engines (gasoline and natural gas) are subject to new engine standards that include both criteria pollutant and durability requirements. Diesel Forklifts > 25 HP are subject to Tier 4 Final emission standards (based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction). Under the 2022 Amendments to the In-Use Off-Road Diesel Fueled Fleets Regulation, forklifts are also subject to requirements begin to transition fleets from the oldest and highest-emitting off-road engines in operation in California by phasing out Tier 0 – Tier 2 equipment beginning in 2024. Also beginning in 2024, the regulation includes requirements to restrict the addition of new vehicles and/or engines with Tier 3 and 4i engines. CARB is anticipated to further increase the stringency of emission controls: • The Zero-Emission Off-Road Forklift Regulation Phase I measure would be designed to accelerate the deployment of zero-emission forklift technologies, with an implementation schedule beginning in 2026; • For forklifts operating at ports and intermodal rail yards, the Amendments to the Cargo Handling Equipment Regulation measure that CARB committed to in the 2022 State SIP Strategy measure would also require transitioning to zero-emission technologies. Staff anticipates that all forklifts operating at ports and intermodal rail yards would be zero-emission by 2030;		

Measures	Implementation Begins	12 µg/m³ Annual (2012)
• The Off-Road Zero-Emission Targeted Manufacturer Rule measure would further increase the stringency of emission controls for forklifts, transitioning more fully to zero-emission powertrains. The stringency of California's forklift control program leads the nation, and will be further lowered with the Zero-Emission Off-Road Forklift Regulation Phase 1, the Amendments to CHE Regulation, and the Off-Road Zero-Emission Targeted Manufacturer Rule measures; the levels committed to with these measures will be technology-forcing, and will take years of lead time to enable manufacturers sufficient time to develop, test, certify, and manufacture the necessary low-emission engines and components. Further increases in stringency are not feasible. New emission standards and fleet requirements for forklifts are dependent on technological developments, and require years of lead time to be developed, certified, manufactured, and implemented; a more accelerated timeline is infeasible		
Marine Engines		
Exhaust Emission Regulation for Spark-Ignition Marine Engines	ongoing	MSM
Tier II Emission Standards for Inboard and Stern-Drive Marine Engines	ongoing	MSM
Marine Engine Evaporative Emission Control Standards	ongoing	MSM
Amendments to Spark-Ignition Marine Engine Standards (2022 State SIP Strategy measure with commitment)	2031	Beyond MSM
CARB's recreational boats and marine engine program exceeds the stringency of U.S. EPA's federal standards and are the most stringent in the nation: • The Exhaust Emission Regulations for Spark-Ignition Marine Engines (1998) controls emissions at the same level of stringency as national regulations; • The Tier II Emission Standards for Inboard and Stern Drive Marine Engines (2001) controls emissions at the same level of stringency as national regulations; and • The Evaporative Emission Control Standards (2015) exceeds the stringency of applicable federal regulations set by U.S. EPA in 2008 for gasoline-fueled SI marine watercraft >30 kilowatts. The Spark-Ignition Marine Engine Standards measure would reduce emissions from new spark-ignition (SI) marine engines by adopting more stringent exhaust standards for outboard and personal watercraft, which currently do not use catalyst control technologies. Staff estimates that stricter standards could reduce combined HC or ROG and NOx emissions by approximately 70 percent below the current HC+NOx standard. CARB staff is also evaluating whether some outboard and personal watercraft vessels could be propelled by zero-emission technologies in certain applications. California's control program for marine engines is currently the most stringent in the nation, and will be further lowered with the Spark-Ignition Marine Engine Standards measure; these levels will be technology-forcing, and will take years of lead time to enable manufacturers sufficient time to develop, test, certify, and manufacture the necessary low-emission engines and components. Further increases in stringency are not feasible. New marine engine emission standards are dependent on technological developments, and require years of lead time to be developed, certified, manufactured, and implemented; a more accelerated timeline is infeasible.		
Off-Highway Recreational Vehicles (OHRV)		
Exhaust and Evaporative Emission Standards for OHRVs	ongoing	MSM
California's emission controls for Off-Highway Recreational Vehicles (OHRVs) are the most stringent in the nation. CARB's exhaust emission standards and evaporative emission standards control emissions from motorcycles, all-terrain vehicles, and utility-terrain vehicles at more stringent levels than applicable national standards set by U.S. EPA for MY 2022 – 2027+. CARB evaporative emission standards harmonize with federal limits for MY 2020 – 2026, and will exceed the stringency of federal requirements for MY 2027+. CARB's "Red Sticker" program requires in-use OHRVs that do not meet the applicable exhaust emission standards display a red registration sticker that limits operation at certain off highway recreational vehicle parks located in nonattainment areas during peak ozone season. CARB's OHRV program is the most stringent in the nation; further increases in stringency or an accelerated implementation timeframe are not feasible.		
Small Off-Road Engines		
SORE Exhaust Emission Standards and Test Procedures	ongoing	MSM
Evaporative Emission Standards for SORE	ongoing	MSM
2021 Amendments to the Small Off-Road Engines (SORE) Regulation	2024	MSM
California's emission controls for small off-road engines (SORE) are the most stringent in the nation. CARB's current SORE program (through MY 2023) aligns the exhaust and evaporative standards for SORE with federal standards, and sets requirements for Zero-Emission SORE equipment. CARB further increased the stringency of emission controls with the 2021 Amendments to the SORE Regulations, which will accelerate the deployment of zero-emission technologies, set tighter exhaust and evaporative emission standards (MY 2024+), and enhance enforcement of current emission standards for SORE. Beginning in MY 2024, exhaust and evaporative emission standards were lowered to zero, except for pressure washers with engine displacement greater than or equal to 225 cubic centimeters and generators (phase-in for ZE pressure washers and generators begins in MY 2028 and 2024, respectively). As a technology-forcing regulation, the SORE Regulation will accelerate the development and deployment of zero-emission SORE; further increases		

Measures	Implementation Begins	12 µg/m³ Annual (2012)
in stringency are not feasible. New exhaust and evaporative emission standards need years of lead time to be implemented; it would be infeasible to implement on a more accelerated timeframe.		
Transport Refrigeration Units (TRUs)		
ATCM for In-Use Diesel-Fueled Transport Refrigeration Units (TRUs) and TRU Generator Sets	ongoing	MSM
Transport Refrigeration Unit Regulation Part 2 (2022 State SIP Strategy measure with commitment)	2028	Beyond MSM
California's emission controls for Transport Refrigeration Units (TRU) are the most stringent in the nation. Amended in 2022, the TRU ATCM requires that MY 2023 and newer trailer TRU, DSC TRU, railcar TRU, and TRU generator set engines meet a PM emission standard of 0.02 grams per brake horsepower-hour or lower (aligns with the United States Environmental Protection Agency Tier 4 final off-road PM emission standard for 25-50 horsepower engines). Beginning December 31, 2023, TRU owners shall turnover at least 15 percent of their truck TRU fleet (defined as truck TRUs operating in California) to ZE technology each year (for seven years). All truck TRUs operating in California shall be ZE by December 31, 2029. CARB has committed to increasing the stringency of TRU controls with the TRU Regulation Phase 2, which would establish zero-emission options for non-truck TRUs. These levels will be technology-forcing, and will take years of lead time to enable manufacturers sufficient time to develop, test, certify, and manufacture the necessary low-emission engines and components. Further increases in stringency are not feasible. New emission standards and zero-emission requirements for TRUs are dependent on technological developments, and require years of lead time to be developed, certified, manufactured, and implemented; a more accelerated timeline is infeasible.		
In-Use Emission Control Measures for Primarily Federally and Internationally Regulated Sources		
In-Use Railroad Control Measures		
Statewide Rail Yard Agreement for California Rail Yards (Railroad MOU)	ongoing	MSM
In-Use Locomotive Regulation (2022 State SIP Strategy measure, adopted April 2023)	2024	MSM
U.S. EPA has the sole authority to establish emissions standards for locomotives. California's in-use emission reduction measures for locomotives are the most stringent in the nation. The 2005, Statewide Rail Yard Agreement for California Rail Yards, a Memorandum of Understanding (MOU) with the Class I Railroads to increase the use of idle control devices, lowered locomotive idle times to 15 minutes, and opened a collaboration to produce Health Risk Assessments on 18 major railyards in the state was completed in 2015. Adopted in April 2023, the In-Use Locomotive Regulation accelerates the adoption of advanced, cleaner technologies for locomotive operations, including zero-emission technologies. The regulatory elements include: • Starting in 2024: Spending Account Locomotive operators would be required to fund their own trust account based on the emissions created by their locomotive operations in California. The dirtier the locomotive, the more funds must be set aside. Spending Account funds would be used to fund turnover to cleaner locomotives, rail equipment, and/or related infrastructure. • Starting in 2024: Idling Limit All locomotives with automatic shutoff devices (AESS) would not be permitted to idle longer than 30 minutes, unless for an exempt reason. Exemptions closely align with those described by U.S. EPA., and would be granted for reasons like maintaining air brake pressure or to perform maintenance. • Starting in 2030: In-Use Operational Requirements Only locomotives less than 23 years old would be able to be used in California. Switchers, industrial, and passenger locomotives with original engine build dates of 2030 or newer would be required to operate in a ZE configuration in California. Freight line haul locomotives with original engine build dates of 2035 and newer would be required to operate in a ZE configuration in California. CARB's in-use emission controls for locomotives are the most stringent in the country, and with the In-Use Locomotive Regulation, which includes zero-emission elements, stringency will be increased further; these requirements are technology-forcing and additional increases in stringency are not feasible. Fleet requirements need years of lead time to be implemented; it would be infeasible to accelerate the implementation timeframe.		
In-Use Aviation Control Measures		
Future Measures for Aviation Emission Reductions (2022 State SIP Strategy measure with commitment)	2029	Beyond MSM
The authority to establish emissions standards for aircraft lies at the federal level; no state has emission standards for aircraft that differ from those set by U.S. EPA and the FAA. CARB's Future Measures for Aviation Emissions Reductions would reduce in-use emissions from airport and aircraft related activities, including main aircraft engines, auxiliary		

Measures	Implementation Begins	12 µg/m³ Annual (2012)
power units (APU), and airport ground transportation. These emission control strategies would be nation-leading in terms of stringency; further increases in stringency are not feasible. These strategies are also dependent on technological and operational developments, and require sufficient lead time for regulated parties to comply; an accelerated implementation timeline would not be feasible.		
Fuels Control Measures		
Conventional Diesel Fuel Standards		
CARB Ultra Low Sulfur Diesel (ULSD)	ongoing	MSM
Low-Emission Diesel Requirement (2016 State SIP Strategy measure, not yet adopted)	TBD	Beyond MSM
CARB's Ultra Low Sulfur Diesel regulation was last amended 2003 to establish more stringent standards for diesel fuel, lowering the sulfur limit to 15 ppmw. The California Diesel Fuel Regulations apply to essentially all diesel fuel supplied, sold, or offered for sale in California. The original applicability of the regulations was to vehicular diesel fuel; however, the applicability of the regulations has been extended by the adoption of ATCMs to non-vehicular diesel fuel, such as fuel for stationary engines, locomotives, and marine harbor craft. The Low Emission Diesel measure would require diesel fuel providers to steadily decrease criteria pollutant emissions from their fuels, which will reduce NOx and PM tailpipe emissions. CARB fuel regulations reduce emissions from even those vehicles registered out of state and therefore not subject to CARB's other mobile source control measures. CARB's diesel standards and requirements are the most stringent in the nation, and some of the most stringent in the world; it is not feasible to require further stringency of fuel specifications.		
Alternative Fuel Standards		
Low Carbon Fuel Standard (LCFS)	ongoing	MSM
Alternative Diesel Fuel (ADF)	ongoing	MSM
California's fuel standards for diesel substitutes are the most stringent in the nation. The LCFS and ADF regulations work together to reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends (due to regulatory constraints, the LCFS and ADF do not apply to aviation gasoline, nor fuels used in interstate locomotives and ocean-going vessels – regulatory control over these fuels lies at the national and international level). The regulations were amended in 2018 to extend the carbon intensity target of 20 percent to 2030. No other state or federal requirements have set as stringent of criteria emission requirements on alternative fuels and alternative fuel blends than California. The LCFS and ADF are technology-forcing regulations, and are the most stringent in the nation; further stringency would not be feasible. As it takes fuel producers years to develop, certify, and manufacture new alternative fuel types to meet the increasingly stringent requirements of the LCFS and ADF, an accelerated implementation timeframe would not be feasible.		

STEP 3(B): EVALUATION OF FEASIBILITY: OFF-ROAD CONTROL MEASURES

Step 3(b) calls for an assessment of the feasibility of implementing any measure that is not included in the Valley's proposed SIP, but which is identified as a potential MSM control measure in Step 2. During the public process for the 2022 State SIP Strategy, CARB staff received a public measure suggestion for an additional potential control measure, as described below:

- Indirect Source Rule
  This measure could involve CARB writing a Suggested Control Measure which acts as a model rule to assist the air districts in the rule development process. An indirect source can be any facility, building, structure, or installation, or combination thereof, which attracts or generates mobile source activity that results in emissions – these include warehouses, railyards, ports, airports, and mobile sources attracted to those warehouses, railyards, ports, and airports. Only a few air districts in California have indirect source rules to limit emissions of this nature on a facility basis.

  CARB staff has been investigating the feasibility and potential benefits of this suggested measure, and is continuing to explore this suggested measure and how it can meet the Clean Air Act requirements for SIP measure approvability. CARB staff has also been exploring its feasibility, given the current limitations of State law and the nature of how emission control authority is designated amongst CARB and local air districts. (How do we want to phrase this limit to our statutory authority?) Nonetheless, CARB staff have included an Indirect Source Rule as one potential element of the ***Zero-Emission Trucks measure*** committed to in the 2022 State SIP Strategy. In addition, CARB staff will explore opportunities to expand existing State law to provide partnership opportunities for CARB and air districts to work together to develop, adopt, and implement indirect source rules.

CARB staff continue to investigate the feasibility of this public measure suggestion, as well as whether it would meet the U.S. EPA's approvability criteria for SIP measures, and legal questions around statutory authority as designated to CARB and the air districts. While CARB staff have included an Indirect Source Rule as one potential element of the Zero-Emission Trucks measure, due to feasibility and approvability issues, this suggestion has not yet been formally organized into a SIP control measure.

D.4.4 Commercial and Residential Building Appliances

STEP 2(A): CALIFORNIA'S COMMERCIAL AND RESIDENTIAL BUILDING APPLIANCES CONTROL MEASURE

In the 2022 State SIP Strategy, CARB committed to achieving emissions reductions for combustion sources used in buildings through the ***Zero Emission Standard for Space and Water Heaters measure***. The primary goal of this measure is to reduce emissions from new residential and commercial space and water heaters sold in California. CARB would set a zero-emission standard for space and water heaters to go into effect in 2030. This measure would be the first time CARB would be regulating these sources of emissions which are also subject to various other requirements at the State and local levels. As such, CARB would design any such standard in collaboration with energy and building code regulators, and with air districts, to ensure it was consistent with all state and local efforts.

The San Joaquin Valley controls emissions from commercial and residential building appliances through two rules, Rule 4902: Residential Water Heaters, and Rule 4905: Natural Gas-Fired, Fan-Type Central Furnaces. Both of these rules limit the types of residential water heaters and furnaces that may be sold in the Valley. Rule 4902 applies to natural gas-fired, residential water heaters with heat input rates less than or equal to 75,000 Btu/hr. The District amended the rule in 2009 to tighten NOx emission limits. Rule 4905 applies to natural gas-fired, fan-type central furnaces with heat input rates less than 175,000 Btu/hr, and combination heating and cooling units with a rated cooling capacity of less than 65,000 Btu/hr. The District amended Rule 4905 in 2015 to tighten the NO_X emission limits for residential units, and to expand the types of appliances covered by the rule to include commercial units and manufactured homes.

As previously mentioned, CARB committed in the 2022 State SIP Strategy to achieving additional emissions reductions for combustion sources used in buildings through the ***Zero Emission Standard for Space and Water Heaters measure***. This would be the first Statewide measure of its kind, as no other state has enacted such a requirement. Through meaningful engagement with communities and the process outlined below, CARB would adopt a statewide zero-emission standard which would have criteria pollutant benefits as a key result along with GHG reductions. Beginning in 2030, 100 percent of sales of new space heaters and water heaters would need to comply with the emission standard. CARB would design any such standard in collaboration with energy and building code regulators, and with air districts, to ensure it was consistent with all state and local efforts, and would work carefully with communities to consider any housing cost or affordability impacts, recognizing that reducing emissions from space and water heaters can generate health benefits and cost-savings with properly designed standards.

CARB understands that this measure needs to be part of a suite of equity-promoting and complementary building decarbonization policies deeply informed by public process that include scaling back natural gas infrastructure, expanding construction of zero-emission buildings, and building a sustainable market by increasing affordability and accessibility through expanding incentive programs, ensuring utility rates are supportive of electrification, developing the workforce, and increasing consumer education. Although this measure is the only component appropriate for including in the SIP, before setting an emission standard, CARB will work in collaboration with other agencies, industry, environmental stakeholders, and community representatives to ensure that the measure is developed and implemented in an equitable manner to benefit low-income and disadvantaged communities. As such, community engagement will be a critical aspect of the entire process. Furthermore, as this proposal is developed, this measure may be expanded to include other end-uses.

For this measure, CARB would develop and propose zero-emission standards for space and water heaters sold in California using its regulatory authority for GHGs (which includes consideration of related criteria pollutant reduction benefits). CARB would collaborate with the U.S. Department of Energy and the California Energy Commission which are responsible for establishing appliance standards focused on maximizing energy efficiency at the federal and state level. CARB would consult with the California Building Standards Commission, Housing and Community Development and the California Energy Commission which have authority to develop building standards for new construction, additions, and alterations of residential and commercial buildings to ensure this measure is complementary. At the regional level, CARB would work with air districts in the development of a statewide zero-emission standard and to support further tightening district rules to drive increased adoption of zero-emission technologies. Finally, CARB would engage with community-based organizations and other key stakeholders to incorporate equitable considerations for low-income and environmental justice communities where feasible. This proposed measure is a key component of a broader portfolio of strategies to advance equitable building decarbonization in California. This measure would not mandate retrofits in existing buildings, but some buildings would require retrofits to be able to use the new technology that this measure would require. Beginning in 2030, 100 percent of new space and water heaters (for either new construction or replacement of burned-out equipment in existing buildings) sold in California would need to meet the zero-emission standard.

This measure has the potential to significantly accelerate the transition away from pollution associated with combustion in these sources, while creating economic opportunities for building retrofits. CARB staff has been analyzing the feasibility and potential benefits of this measure and expect that this regulation would rely heavily on currently-available heat pump technologies, which are now being sold to electrify new and existing homes. CARB staff have included in the Zero Emission Standard for Space and Water Heaters measure the potential to expand beyond space and water heaters to include additional end-uses as suggested via a public measure suggestion.

In addition to the proposed standard for space and water heaters, California has in place programs to ensure weatherization and energy efficiency of new buildings. The State of California's Building Energy Efficiency Standards for Residential and

Nonresidential Buildings (California Energy Code, Title 24, Part 6) are in effect Statewide and affect both new builds and alterations of existing buildings. The Building Energy Efficiency Standards were last updated in 2022 (effective as of January 1, 2023); the 2022 updates set in place new standards to encourage building decarbonization, emphasizing in particular on heat pumps for space heating and water heating, and extended the benefits of photovoltaic and battery storage systems and other demand flexible technology to work in combinations with heat pumps.

California also has a number of funding programs, including the California Department of Community Services and Development's (CSD) Low Income Weatherization Program to provides low-income households with solar photovoltaic systems and energy efficiency upgrades at no cost to residents, including specific components to support low-income farmworkers and multi-family properties. The California CSD also provides additional resources and administers certain federal weatherization programs including the U.S. Department of Energy's Weatherization Assistance Program, and the U.S. Department of Health and Human Services' Low Income Home Energy Assistance Program; California CSD works with local energy services providers throughout the state installing weatherization and energy efficiency measures for low-income homeowners and renters to facilitate these programs. Further, the California Public Utilities Commission has an Energy Savings Assistance Program which provides no-cost weatherization services to consumers who meet the income limits under the California Alternate Rates for Energy program.

STEP 2(B): OTHER STATES' AND NONATTAINMENT AREAS' COMMERCIAL AND RESIDENTIAL BUILDING APPLIANCES CONTROL MEASURES

Table D-22 summarizes the most stringent control measures currently in use in any state that have been identified and discussed for commercial and residential building appliances.

Table D-22 Comparison of Stringency – Commercial and Residential Building Appliances

CARB Control Program Compared to Federal Standards and Control Programs in Other States

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Commercial and Residential Building Appliances			
Space and Water Heaters			
Emission standard (new sales): Zero-Emission Standard for Space and Water Heaters	Future measure: Zero-emission Standard for Space and Water Heaters (CARB)	CARB's Zero-Emission Standard for Space and Water Heaters measure is the most stringent standard of its type at the state level. This measure would reduce emissions from new residential and commercial space and water heaters sold in California. CARB would set an emission standard for space and water heaters to go into effect in 2030. CARB would adopt a statewide zero-emission standard which would have criteria pollutant benefits as a key result along with GHG reductions. Beginning in 2030, 100 percent of sales of new space heaters and water heaters would need to comply with the emission standard. *(Note: CARB has committed to pursue the Zero-Emission Standard for Space and Water Heaters measure, but this measure has not yet been proposed to the Board for approval/adoption)*	No other state has emission standards that require space and water heaters sales to be exclusively zero-emission by 2030. Maryland passed the Climate Solutions Now Act, establishing Building Energy Performance Standards for buildings 35,000 square feet and larger to achieve a 20 percent reduction in net direct greenhouse gas (GHG) emissions by 2030 and net-zero emissions by 2040. The regulation also requires holistic retrofits of low-income households, including weatherization and heat pump installations.[116] New York supports statewide building decarbonization in new construction and existing buildings through a combination of building codes and appliance efficiency standards, among other strategies.[117]

While there may be certain local jurisdictions with requirements for zero-emission space and water heaters that establish earlier implementation dates, CARB has analyzed other State-level requirements and must evaluate feasibility for implementation on a statewide level. As shown in Table D-22 above, CARB's Zero-Emission Standard for Space and

[116] Maryland Department of Environment. "Building Energy Performance Standards: Summary of Authorizing Law for the Development of Regulations." Accessed on April 13, 2023 at: https://mde.maryland.gov/programs/air/ClimateChange/Pages/BEPS.aspx.
[117] New York State Energy Research and Development Authority. 2022. "New York's Carbon Neutral Buildings Roadmap." Available at: https://www.nyserda.ny.gov/All-Programs/Carbon-Neutral-Buildings.

Water Heaters measure is the most stringent State-level requirement of its type within the U.S. and thus goes beyond MSM requirements.

STEP 3(A): EVALUATION OF STRINGENCY: COMMERCIAL AND RESIDENTIAL BUILDING APPLIANCES CONTROL MEASURES

CARB has committed to bringing to the Board by 2025 a measure for zero-emission commercial and residential building appliances, which would propose to require, beginning in 2030, that 100 percent of new space and water heaters sold in California meet the zero-emission standard. No other state is engaged in more stringent efforts to require zero-emission space and water heaters.

Furthermore, CARB staff have conducted an analysis of the timing of the new space and water heater measure included in the 2022 State SIP Strategy. This measure is still in its development phase and is not yet being implemented; the development timeline, however, is critical to allow industry sufficient time to implement the requisite changes in their business models to transition to exclusively selling the required zero-emission technologies called for in this proposed regulatory action, and for manufacturers to scale up production to levels sufficient to meet the demand stimulated by a statewide requirement: A more expedited timeframe would be neither technologically nor economically feasible.

The public process to undertake a rulemaking of this scope would be at least two years. Additionally, manufacturers need time to ramp up production of zero-emission technologies to meet the expected demand. For example, despite the fact that appliance saturation studies in California show residential electric use for space heating has quadrupled over the last 10 years, manufacturing and deployment would need to continue to accelerate to meet the demand under a new zero-emission space and water heater standard.[118] Further, CARB would need to design any such standard in collaboration with energy regulators (U.S. Department of Energy and California Energy Commission), and building code regulators (California Building Standards Commission, California Department of Housing and Community Development, and California Energy Commission), and with air districts, ensure it was consistent with all State and local efforts, and would work carefully with communities to consider any housing cost or affordability impacts, recognizing that reducing emissions from space and water heaters can generate health benefits and cost-savings with properly designed standards. CARB understands that this measure needs to be part of a suite of equity-promoting and complementary building decarbonization policies deeply informed by public process that include scaling back natural gas infrastructure, expanding construction of zero-emission buildings, and building a sustainable market by increasing affordability and accessibility through expanding incentive programs, ensuring utility rates are supportive of electrification, developing the workforce, and increasing consumer education. As part of the public process for equity promoting building decarbonization, CARB is reviewing and considering reports like Building Energy, Energy and Power (BEEP) Coalition's

[118] Opinion Dynamics, *California Heat Pump Residential Market Characterization and Baseline Study*, Figure 18. May 17, 2022. Retrieved from: https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf

Community Priorities for Equitable Building Decarbonization Equitable.[119] Community engagement will be a critical aspect of the entire public process. CARB needs to engage with community-based organizations and other key stakeholders to incorporate equitable considerations for low-income and environmental justice communities where feasible.

For these reasons, the Zero Emission Standard for Space and Water Heaters measure meets the MSM requirement of being phased in as "expeditiously as practicable" and goes beyond MSM requirements in terms of stringency.

[119] Building Energy, Equity and Power Coalition, *Community Priorities for Equitable Building Decarbonization.* March 1, 2022. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2022-03/BEEP%20Letter%20and%20Report_Equitable%20Decarb%20March%202022.pdf

Table D-23 Commercial and Residential Building Appliances Control Measures – Stringency and Timeline for Implementation

Measures	Implementation Begins	12 µg/m^3 Annual (2012)
State SIP Strategy Residential and Commercial Building Appliance Measures (with Commitment)		
Zero Emission Standard for Space and Water Heaters measure	2030	Beyond MSM
With the Zero-Emission Standard for Space and Water Heaters measure, CARB would set a statewide zero-emission standard for space and water heaters. Beginning in 2030, 100 percent of the sales of new space heaters and water heaters would need to comply with the emission standard. This standard would be the most stringent of any state in the U.S., and would exceed the stringency of Federal requirements; further increases in stringency are not feasible. New zero-emission standards take years of lead time to ensure manufacturers have sufficient time to implement the necessary changes in their business models and to scale up production to a sufficient level to meet the demand produced by a Statewide standard; a more accelerated timeline is not feasible		

STEP 3(B): EVALUATION OF FEASIBILITY: COMMERCIAL AND RESIDENTIAL BUILDING APPLIANCES CONTROL MEASURES

Step 3(b) calls for an assessment of the feasibility of implementing any measure that is not included in the Valley's proposed SIP, but which is identified as a potential MSM control measure in Step 2. Staff developed the Zero-Emission Standard for Space and Water Heaters measure in response to a public measure suggestion received during the public process for the 2022 State SIP Strategy, which is described below:

- Additional Building Emission Standards
  CARB could propose additional emissions standards for combustion sources used in buildings by working with air districts to set such standards and, with building and energy code agencies on standards for new construction, or by taking other actions (including potentially incentive programs) to accelerate the removal of fossil fuels from the building stock in both new and existing buildings.

  CARB staff has been investigating the feasibility and potential benefits of this suggested measure and have included in the 2022 State SIP Strategy the Zero-Emission Standard for Space and Water Heaters measure, which also includes the potential to include other end-uses.

CARB staff do not recommend eliminating any of the potential commercial and residential building appliance control measures identified on the basis of technical or economic infeasibility.

D.4.5 Summary of Steps 2 and 3

STEP 2: POTENTIAL MOBILE SOURCE CONTROL MEASURES IDENTIFIED

The purpose of Step 2 is to identify all potential MSM control measures for the emission sources identified Step 1. Per U.S. EPA guidance, staff began to identify the list of all potential MSM control measures by starting with California's control program (Step 2(a)), which includes:

- Control measures adopted in the SIP for the Valley (i.e. the current control program); and
- Additional control measures committed to in the 2022 State SIP Strategy.

In Step 2(b), staff expanded the scope of focus beyond California's controls to identify any additional potential MSM control measures that are in use in other nonattainment areas and states, and which exceed the stringency of California's controls identified in Step 2(a). The analysis undertaken for Step 2(b) found that, while there are some measures in other jurisdictions that have emission controls which are individually more stringent than an individual CARB control program, the comprehensive stringency of similar control measures committed to in the 2022 State SIP Strategy and proposed in the Valley State SIP Strategy meets and/or exceeds the stringency of the controls in use in other jurisdictions. Thus, Step 2(b) did not identify any additional potential MSM control measures in use in other jurisdictions that are more stringent than the California control measures previously identified in Step 2(a).

To meet statutory requirements for the MSM plans, staff also reviewed all previous Valley PM2.5 SIPs in Step 2(c), and found no mobile source control measures that were proposed in previous Moderate or Serious attainment plan control strategies for the Valley that were not subsequently adopted.

As there are no applicable control measures previously rejected as infeasible for the Valley's MSM demonstration process, Step 2(c) did not identify any additional potential MSM control measures beyond the control measures identified in Steps 2(a) and 2(b).

STEP 3: ANALYSIS OF STRINGENCY AND FEASIBILITY

The analysis of stringency and feasibility for each possible MSM control measure identified in Step 2 has shown that California's control program is at least consistent with the most stringent of any nonattainment area or state in the nation, with the majority of California control measures exceeding the stringency of controls in use in the rest of the nation.

The control measures included in the Valley's plan represent the full suite of emission control approaches that aligns with the most stringent levels of control feasible, given the current status of technology and its potential in the near future. Furthermore, CARB staff has not received any public comments to date indicating that more stringent control technologies than those included in the proposed Valley's SIP would be commercially available and/or technologically and economically feasible to implement in the Valley in the timeframe required for the area's PM2.5 SIPs. CARB current control measures analyzed in this document therefore meet the requirements of Most Stringent Measures (MSM), and all 2022 State SIP Strategy measure commitments go beyond MSM requirements.

D.5 SECTION V. STEP 4: ADOPTION OF CONTROL MEASURES

The final step required by the Act's step-wise process is to adopt and implement feasible control measures identified in Step 3 to satisfy MSM requirements.

The CARB control program for the Valley's 12 µg/m^3 annual PM2.5 SIP includes all of the measures identified as MSM in Step 3. The control measures included in this analysis have been shown to meet or go beyond the MSM requirements. The control measures described in this chapter are in varying stages of the adoption and implementation process at CARB:

- Most of the measures identified as MSM have already been adopted by the Board, submitted into the SIP, and are currently being implemented as part of CARB's current control program.
- Additional control measures which go beyond MSM have been committed to in the 2022 State SIP Strategy, which the Board adopted in September 2022, yet many of these control measures themselves have not yet been adopted by the Board. The Board's adoption of the 2022 State SIP Strategy created a commitment to adopt measures according to a defined schedule, and a commitment to achieve specified emission reductions in the Valley.

Board adoption of the proposed Valley SIP for the 12 µg/m^3 annual PM2.5 standard – including the control measures described in the 2022 State SIP Strategy – will satisfy the requirements of Step 4.

D.6 Section VI. Conclusion: Findings of MSM Analysis

California's long history of comprehensive and innovative emissions control has resulted in the strongest mobile source control program in the nation. U.S. EPA has acknowledged the strength of these programs in their approval of CARB's regulations and through the waiver and authorization process. In addition, U.S. EPA has provided past determinations that CARB's mobile source control programs meet BACM and MSM requirements as part of their 2004 approval of the Valley's 2003 PM10 Plan:

> "We believe that the State's control programs constitute BACM at this time for the mobile source and fuels categories, since the State's measures reflect the most stringent emission control programs currently available, taking into account economic and technological feasibility."

Additionally, in their 2020 proposed approval of the San Joaquin Valley's PM2.5 Serious Area 2018 Plan,[120] U.S. EPA further found that CARB's mobile source control program met the more stringent level of MSM. In their 2020 proposal for that plan, U.S. EPA found that,

> "CARB's programs constitute the most stringent emission control programs currently available for the mobile source and fuels categories, taking into account economic and technological feasibility."[121]

Since then, CARB has continued to enhance and accelerate reductions from our mobile source control programs through the implementation of more stringent engine emissions standards, in-use requirements, incentive funding, and other policies and initiatives as described in the preceding sections. These efforts not only ensure that all source sectors continue to achieve maximum emission reductions through implementation of the cleanest current technologies, but also promote the ongoing development of more advanced zero and near-zero technologies. As a result, California's current mobile source control programs reflect the most stringent and feasible level of emissions control in the nation and fully meet the requirements for MSM.

Additionally, this analysis shows that CARB's control measures committed to in the 2022 State SIP Strategy for mobile sources and commercial and residential building appliances go beyond the requirements of MSM.

As the requirements for MSM are inclusive of the requirements for BACM – and indeed, are more stringent than BACM requirements – this analysis shows that CARB's control

[120] 85 FR 44192 https://www.federalregister.gov/documents/2020/07/22/2020-14471/clean-air-plans-2006-fine-particulate-matter-nonattainment-area-requirements-san-joaquin-valley While elements of this plan were later disapproved and remanded due to a 9th Circuit Court of Appeals decision, the Court's findings nonetheless upheld EPA's approval of mobile source control measure finding of MSM.

[121] 85 FR 17382 https://www.federalregister.gov/documents/2020/03/27/2020-05914/clean-air-plans-2006-fine-particulate-matter-nonattainment-area-requirements-san-joaquin-valley

measures for mobile sources and for commercial and residential building appliances also meet the requirements of BACM, in addition to MSM.

In conclusion, CARB followed the procedures outlined by U.S. EPA for determining MSM, and have found that California's control programs for mobile sources and commercial and residential building appliances satisfy and, in certain cases, go beyond the applicable requirements for the PM2.5 standard in this analysis.

D.7 TRANSPORTATION CONFORMITY

D.7.1 Introduction

The California Air Resources Board (CARB) has prepared the motor vehicle emissions budget (MVEB)[122] for the San Joaquin Valley 2024 Plan for the 2012 PM2.5 National Ambient Air Quality Standard (NAAQS). The MVEB is the maximum allowable emissions from motor vehicles within a nonattainment area and is used for determining whether transportation plans and projects conform to the applicable State Implementation Plan (SIP).

Transportation conformity is the federal regulatory procedure for linking and coordinating the transportation and air quality planning processes through the MVEB established in the SIP. Under section 176(c) of the Clean Air Act (Act), federal agencies may not approve or fund transportation plans and projects unless they are consistent with the regional SIP. In addition, conformity with the SIP requires that transportation activities do not (1) cause or contribute to new air quality violations, (2) increase the frequency or severity of any existing violation, or (3) delay the timely attainment of NAAQS. Therefore, quantifying on-road motor vehicle emissions and comparing those emissions with a budget established in the SIP determine transportation conformity between air quality and transportation planning.

The MVEBs are set for each criteria pollutant or its precursors for each milestone year and the attainment year of the SIP. Subsequent transportation plans and programs produced by transportation planning agencies must demonstrate that the emissions from the proposed plan, program, or project do not exceed the MVEBs established in the applicable SIP. The MVEBs established in this SIP apply as a "ceiling" or limit on transportation emissions for the eight San Joaquin Valley metropolitan planning organizations (MPOs)[123] for the years in which they are defined and for all subsequent years until another year for which a different budget is specified, or until a SIP revision modifies the budget. For the San Joaquin Valley Air Pollution Control District's (District)

[122] Federal transportation conformity regulations are found in 40 CFR Part 51, subpart T – Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 U.S.C. of the Federal Transit Laws. Part 93, subpart A of this chapter was revised by the EPA in the August 15, 1997 Federal Register.

[123] This includes the Fresno Council of Governments (FCOG), Kern Council of Governments (KCOG) [SJV portion of KCOG], Kings County Association of Governments (KCAG), Madera County Transportation Commission (MCTC), Merced County Association of Governments (MCAG), San Joaquin Council of Governments (SJCOG), Stanislaus Council of Governments (StanCOG), and Tulare County Association of Governments (TCAG).

PM2.5 Attainment Plan, the interim, attainment and post-attainment years of the SIP (also referred to as the plan analysis years) are 2025, 2028, 2030, and 2031.

D.7.2 Methodology

The MVEB for the San Joaquin Valley PM2.5 attainment plan is established based on guidance from the U.S. EPA on the motor vehicle emission categories and precursors that must be considered in transportation conformity determinations as found in the transportation conformity regulation and final rules as described below.

The MVEB must be clearly identified, precisely quantified, and consistent with applicable Act requirements. Further, it should be consistent with the San Joaquin Valley PM2.5 attainment plan's emission inventory and control measures.

The San Joaquin Valley PM2.5 attainment plan establishes the MVEB only for primary emissions of PM2.5 from motor vehicle exhaust, tire and brake wear, and paved, unpaved, and construction road dust, as well as for NOx. This section discusses budgets that have been set for annual average daily emissions in the analysis years 2025, 2028, 2030, and 2031. The MVEB presented below uses emission rates from California's motor vehicle emission model, EMFAC2021 (V.1.0.2),[124] with San Joaquin Valley activity data (Vehicle Miles Traveled, i.e., VMT and speed distributions), along with California Emissions Projection Analysis Model (CEPAM) 2022v1.01. The activity data are from the San Joaquin Valley MPO's 2023 Federal Statewide Transportation Improvement Program (FSTIP).[125] Thus, the MVEB is consistent with the PM2.5 attainment plan inventory.

On November 15, 2022, the U.S. EPA approved EMFAC2021 for use in SIPs and for demonstrating transportation conformity.[126] The EMFAC model estimates emissions from two combustion processes (running and start exhaust) and four evaporative processes (hot soak, running losses, diurnal, and resting losses). Further, the estimated emissions were adjusted for the Heavy-Duty Inspection and Maintenance (HD I/M) Program[127], the Clean Mile Standard (CMS)[128], Advanced Clean Fleets (ACF) program[129], Advanced Clean Cars II (ACCII)[130], and Clean Trucks Plan (CTP).[131]

The MVEB for San Joaquin Valley PM2.5 Attainment Plan was developed to be consistent with the on-road emissions inventory[132] and attainment demonstration using the following method:

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[124] More information on data sources can be found in the EMFAC technical support documentation at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation
[125] 2023 Federal Statewide Transportation Improvement Program (FSTIP) (ca.gov)
[126] U.S. EPA approval of EMFAC2021 can be found at 87 FR 68483: federalregister.gov
[127] Heavy-Duty Engine and Vehicle Omnibus Regulations, https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox
[128] Clean Mile Standard, https://ww2.arb.ca.gov/our-work/programs/clean-miles-standard
[129] Advanced Clean Fleet, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets
[130] Advanced Clean Cars II, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii
[131] Clean Trucks Plan, https://www.epa.gov/regulations-emissions-vehicles-and-engines/clean-trucks-plan
[132] More information about the on-road motor vehicle emission budgets can be found in Appendix B of the plan.

1) Used the EMFAC2021 model to produce the on-road motor vehicle emissions (average annual day) for the appropriate pollutants (NOx and PM2.5) using 2023 FSTIP activity data;
2) Applied the off-model adjustments to account for recently adopted regulations;
3) Used the CEPAM2022 model to produce on-road construction dust, paved road dust, and unpaved road dust emissions for PM2.5; and
4) Rounded the totals for NOx and PM2.5 to the nearest tenth ton.

D.7.3 Motor Vehicle Emissions Budget

The MVEB in Table D-24 was established according to the methodology outlined above and in consultation with the eight San Joaquin Valley MPOs, the District, U.S. EPA, Federal Highway Administration (FHWA), and Federal Transit Administration (FTA). The MVEB is consistent with the emission inventories and control measures in the PM2.5 attainment plan. These budgets will be effective once U.S. EPA determines it is adequate or approved.

Table D-24 contains the summary MVEB for the eight San Joaquin Valley MPO regions. It includes precursor pollutants of NOx and PM2.5 emissions for milestone and attainment years using the EMFAC2021 model with 2023 FSTIP activity data and CEPAM. Tables D-25 through D-28 contain detailed MVEB for each milestone and attainment year for the eight San Joaquin Valley MPO regions. In addition, it provides emissions from the EMFAC2021 model, and recently adopted regulations using off-model adjustments for NOx and PM2.5 emissions. In addition, it includes on-road construction dust, paved road dust, and unpaved road dust. The final MVEB is rounded upwards to the nearest tenth.

Table D-24 Summary MVEB for the 2024 San Joaquin Valley Plan for each MPO within the San Joaquin Valley Region (tons per day)

MVEB (tons per day)	2025		2028		2030		2031	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Fresno (FCOG)	6.8	2.2	5.0	2.3	4.1	2.5	3.9	2.2
Kern (KCOG)	7.7	1.4	5.8	1.4	5.0	1.8	4.8	1.6
Kings (KCAG)	1.5	0.3	1.2	0.3	1.0	0.4	1.0	0.3
Madera (MCTC)	1.5	0.4	1.1	0.5	0.9	0.6	0.8	0.4
Merced (MCAG)	3.3	0.6	2.4	0.6	2.0	0.6	1.9	0.6
San Joaquin (SJCOG)	5.1	1.0	3.7	1.0	3.1	1.3	2.9	1.0
Stanislaus (StanCOG)	3.4	0.7	2.5	0.7	2.1	0.7	1.9	0.7
Tulare (TCAG)	3.2	1.0	2.4	1.0	1.9	1.0	1.8	1.0

Table D-25 MVEB for the 2024 San Joaquin Valley Plan (Annual Season) for 2025

SJV Totals (Tons per day)	Fresno		Kern		Kings		Madera	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Vehicular Exhaust (including brake/tire wear for PM2.5)	9.0	0.3	11.2	0.4	2.2	0.1	1.9	0.1
Construction Road Dust	-	0.0	-	0.1	-	0.0	-	0.0
Paved Road Dust	-	1.8	-	0.8	-	0.2	-	0.3
Unpaved Road Dust	-	0.1	-	0.1	-	0.1	-	0.1
Reductions from HD I/M	2.22	0.02	3.52	0.04	0.67	0.01	0.48	0.00
Reductions from CMS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reductions from Advanced Clean Fleets	0.10	0.00	0.09	0.00	0.02	0.00	0.02	0.00
Reductions from ACCII	-	-	-	-	-	-	-	-
Reductions from Clean Trucks Plan	-	-	-	-	-	-	-	-
Total[a]	6.71	2.16	7.63	1.35	1.48	0.29	1.41	0.39
Motor Vehicle Emission Budget[b]	6.8	2.2	7.7	1.4	1.5	0.3	1.5	0.4

[a] Values may not add up due to rounding
[b] Motor Vehicle Emission Budgets calculated are rounded up to the nearest tenth of a tpd.
Source: EMFAC2021 v1.02 and CEPAM2022 v1.01

Table D-25 MVEB for the 2024 San Joaquin Valley Plan (Annual Season) for 2025 (continued)

SJV Totals (Tons per day)	Merced		San Joaquin		Stanislaus		Tulare	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Vehicular Exhaust (including brake/tire wear for PM2.5)	4.7	0.1	6.5	0.3	4.1	0.2	3.9	0.1
Construction Road Dust	-	0.0	-	0.1	-	0.1	-	0.0
Paved Road Dust	-	0.4	-	0.7	-	0.4	-	0.7
Unpaved Road Dust	-	0.0	-	0.0	-	0.0	-	0.1
Reductions from HD I/M	1.44	0.02	1.40	0.01	0.78	0.01	0.71	0.01
Reductions from CMS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reductions from Advanced Clean Fleets	0.03	0.00	0.08	0.00	0.05	0.00	0.05	0.00
Reductions from ACCII	-	-	-	-	-	-	-	-
Reductions from Clean Trucks Plan	-	-	-	-	-	-	-	-
Total[a]	3.21	0.57	5.03	0.99	3.32	0.69	3.18	0.93
Motor Vehicle Emission Budget[b]	3.3	0.6	5.1	1.0	3.4	0.7	3.2	1.0

[a] Values may not add up due to rounding
[b] Motor Vehicle Emission Budgets calculated are rounded up to the nearest tenth of a tpd.
Source: EMFAC2021 v1.02 and CEPAM2022 v1.01

Table D-26 MVEB the 2024 San Joaquin Valley Plan (Annual Season) for 2028

SJV Totals (Tons per day)	Fresno		Kern		Kings		Madera	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Vehicular Exhaust (including brake/tire wear for PM2.5)	8.0	0.3	10.4	0.4	2.0	0.1	1.6	0.1
Construction Road Dust	-	0.0	-	0.0	-	0.0	-	0.0
Paved Road Dust	-	1.8	-	0.9	-	0.2	-	0.3
Unpaved Road Dust	-	0.1	-	0.1	-	0.1	-	0.1
Reductions from HD I/M	2.71	0.03	4.31	0.04	0.83	0.01	0.56	0.01
Reductions from CMS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reductions from Advanced Clean Fleets	0.29	0.00	0.26	0.00	0.05	0.00	0.05	0.00
Reductions from ACCII	0.04	0.00	0.04	0.00	0.01	0.00	0.01	0.00
Reductions from Clean Trucks Plan	0.05	0.00	0.05	0.00	0.01	0.00	0.01	0.00
Total[a]	4.93	2.20	5.76	1.37	1.14	0.29	1.01	0.41
Motor Vehicle Emission Budget[b]	5.0	2.3	5.8	1.4	1.2	0.3	1.1	0.5

[a] Values may not add up due to rounding
[b] Motor Vehicle Emission Budgets calculated are rounded up to the nearest tenth of a tpd.
Source: EMFAC2021 v1.02 and CEPAM2022 v1.01

Table D-26 MVEB for the 2024 San Joaquin Valley Plan (Annual Season) for 2028 (continued)

SJV Totals (Tons per day)	Merced		San Joaquin		Stanislaus		Tulare	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Vehicular Exhaust (including brake/tire wear for PM2.5)	4.2	0.1	5.7	0.2	3.6	0.2	3.3	0.1
Construction Road Dust	-	0.0	-	0.0	-	0.0	-	0.0
Paved Road Dust	-	0.4	-	0.7	-	0.5	-	0.7
Unpaved Road Dust	-	0.0	-	0.0	-	0.0	-	0.1
Reductions from HD I/M	1.73	0.02	1.72	0.02	0.96	0.01	0.86	0.01
Reductions from CMS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reductions from Advanced Clean Fleets	0.10	0.00	0.24	0.00	0.14	0.00	0.13	0.00
Reductions from ACCII	0.01	0.00	0.03	0.00	0.02	0.00	0.02	0.00
Reductions from Clean Trucks Plan	0.02	0.00	0.04	0.00	0.03	0.00	0.02	0.00
Total[a]	2.37	0.57	3.68	0.96	2.44	0.65	2.31	0.93
Motor Vehicle Emission Budget[b]	2.4	0.6	3.7	1.0	2.5	0.7	2.4	1.0

[a] Values may not add up due to rounding
[b] Motor Vehicle Emission Budgets calculated are rounded up to the nearest tenth of a tpd.
Source: EMFAC2021 v1.02 and CEPAM2022 v1.01

Table D-27 MVEB for the 2024 San Joaquin Valley Plan (Annual Season) for 2030

SJV Totals (Tons per day)	Fresno		Kern		Kings		Madera	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Vehicular Exhaust (including brake/tire wear for PM2.5)	7.5	0.3	10.0	0.4	2.0	0.1	1.5	0.1
Construction Road Dust	-	0.3	-	0.4	-	0.0	-	0.2
Paved Road Dust	-	1.8	-	0.9	-	0.2	-	0.3
Unpaved Road Dust	-	0.1	-	0.1	-	0.1	-	0.1
Reductions from HD I/M	2.81	0.03	4.50	0.04	0.88	0.01	0.56	0.01
Reductions from CMS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reductions from Advanced Clean Fleets	0.38	0.01	0.34	0.01	0.07	0.00	0.07	0.00
Reductions from ACCII	0.08	0.02	0.07	0.02	0.02	0.00	0.01	0.00
Reductions from Clean Trucks Plan	0.14	0.00	0.12	0.00	0.03	0.00	0.02	0.00
Total[a]	4.10	2.45	4.94	1.70	0.99	0.30	0.83	0.59
Motor Vehicle Emission Budget[b]	4.1	2.5	5.0	1.8	1.0	0.4	0.9	0.6

[a] Values may not add up due to rounding
[b] Motor Vehicle Emission Budgets calculated are rounded up to the nearest tenth of a tpd.
Source: EMFAC2021 v1.02 and CEPAM2022 v1.01

Table D-27 MVEB for the San Joaquin Valley Plan (Annual Season) for 2030 (continued)

SJV Totals (Tons per day)	Merced		San Joaquin		Stanislaus		Tulare	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Vehicular Exhaust (including brake/tire wear for PM2.5)	4.0	0.1	5.3	0.2	3.3	0.2	3.0	0.1
Construction Road Dust	-	0.0	-	0.3	-	0.0	-	0.1
Paved Road Dust	-	0.4	-	0.7	-	0.5	-	0.7
Unpaved Road Dust	-	0.0	-	0.0	-	0.0	-	0.1
Reductions from HD I/M	1.77	0.02	1.80	0.02	1.00	0.01	0.89	0.01
Reductions from CMS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reductions from Advanced Clean Fleets	0.13	0.00	0.32	0.01	0.19	0.00	0.18	0.00
Reductions from ACCII	0.03	0.01	0.07	0.02	0.04	0.01	0.04	0.01
Reductions from Clean Trucks Plan	0.05	0.00	0.12	0.00	0.07	0.00	0.06	0.00
Total[a]	2.00	0.56	3.04	1.29	2.00	0.64	1.88	0.97
Motor Vehicle Emission Budget[b]	2.0	0.6	3.1	1.3	2.1	0.7	1.9	1.0

[a] Values may not add up due to rounding
[b] Motor Vehicle Emission Budgets calculated are rounded up to the nearest tenth of a tpd.
Source: EMFAC2021 v1.02 and CEPAM2022 v1.01

Table D-28 MVEB for the San Joaquin Valley Plan (Annual Season) for 2031

SJV Totals (Tons per day)	Fresno		Kern		Kings		Madera	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Vehicular Exhaust (including brake/tire wear for PM2.5)	7.3	0.3	9.9	0.4	2.0	0.1	1.5	0.1
Construction Road Dust	-	0.0	-	0.2	-	0.0	-	0.0
Paved Road Dust	-	1.9	-	0.9	-	0.2	-	0.3
Unpaved Road Dust	-	0.1	-	0.1	-	0.1	-	0.1
Reductions from HD I/M	2.85	0.03	4.59	0.04	0.90	0.01	0.57	0.01
Reductions from CMS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reductions from Advanced Clean Fleets	0.38	0.01	0.34	0.01	0.07	0.00	0.07	0.00
Reductions from ACCII	0.08	0.02	0.07	0.02	0.02	0.00	0.01	0.00
Reductions from Clean Trucks Plan	0.14	0.00	0.12	0.00	0.03	0.00	0.02	0.00
Total[a]	3.86	2.19	4.72	1.54	0.95	0.30	0.78	0.39
Motor Vehicle Emission Budget[b]	3.9	2.2	4.8	1.6	1.0	0.3	0.8	0.4

[a] Values may not add up due to rounding
[b] Motor Vehicle Emission Budgets calculated are rounded up to the nearest tenth of a tpd.
Source: EMFAC2021 v1.02 and CEPAM2022 v1.01

Table D-28 MVEB for the San Joaquin Valley Plan (Annual Season) for 2031 (continued)

SJV Totals (Tons per day)	Merced		San Joaquin		Stanislaus		Tulare	
	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5
Vehicular Exhaust (including brake/tire wear for PM2.5)	3.9	0.1	5.2	0.2	3.2	0.1	2.9	0.1
Construction Road Dust	-	0.0	-	0.0	-	0.0	-	0.0
Paved Road Dust	-	0.4	-	0.7	-	0.5	-	0.7
Unpaved Road Dust	-	0.0	-	0.0	-	0.0	-	0.1
Reductions from HD I/M	1.79	0.02	1.83	0.02	1.03	0.01	0.90	0.01
Reductions from CMS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reductions from Advanced Clean Fleets	0.13	0.00	0.32	0.01	0.19	0.00	0.18	0.00
Reductions from ACCII	0.03	0.01	0.07	0.02	0.04	0.01	0.04	0.01
Reductions from Clean Trucks Plan	0.05	0.00	0.12	0.00	0.07	0.00	0.06	0.00
Total[a]	1.89	0.56	2.87	0.98	1.87	0.64	1.74	0.92
Motor Vehicle Emission Budget[b]	1.9	0.6	2.9	1.0	1.9	0.7	1.8	1.0

[a] Values may not add up due to rounding
[b] Motor Vehicle Emission Budgets calculated are rounded up to the nearest tenth of a tpd.
Source: EMFAC2021 v1.02 and CEPAM2022 v1.01

Appendix E
INCENTIVE-BASED STRATEGY

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Appendix E: Incentive-Based Strategy

The San Joaquin Valley Air Pollution Control District (District) has increasingly relied on its advocacy efforts to secure state and federal funding sources, and locally generated funding to implement incentive programs that have become a crucial component of the District's overall strategy for achieving the emissions reductions necessary to bring the Valley into attainment. These programs provide an effective way to accelerate emissions reductions and encourage technology advancement, particularly from mobile sources, a sector not directly under the District's regulatory jurisdiction. Given that over 80% of Nitrogen Oxide (NOx) emissions in the San Joaquin Valley (Valley) come from mobile sources, these successful voluntary incentive grant programs help the Valley achieve highly cost-effective emissions reductions that are surplus of the regulatory emissions reductions.

This Appendix will review the District's existing longstanding and successful incentive programs.

Over the past 15 years,[1] the District has provided incentive funding to purchase, replace, or retrofit thousands of pieces of equipment, including:[2]

- 1,660 agricultural irrigation pump engines
- 12,800 agricultural equipment replacements
- 4,680 alternatives to agricultural burning projects
- 350 off-road equipment repowers
- 6,500 heavy-duty trucks
- 1,800 school bus retrofits
- 600 school bus replacements
- 10,400 lawnmower replacements
- 30,300 fireplace change-outs
- 525 electric vehicle charging station projects
- 52 locomotive replacements/retrofits
- 36,500 new alternative fuel light duty vehicles, public & private
- 6,250 vehicle retirements (car crushing)
- 96,080 vehicle emissions repairs
- 15 bicycle infrastructure projects (bike paths)

The District's incentive programs continue to be a model for other agencies throughout the state. Recent audits noted the District's efficient and effective use of incentive grant funds in reducing air pollution.

[1] Significant additional pieces of equipment funded over last several decades.
[2] Data covers projects executed May 13, 2009, through May 13, 2024

E.1 OVERVIEW OF DISTRICT'S INCENTIVE PROGRAM

The District operates one of the largest and most well-respected voluntary incentive programs. Through strong advocacy at the state and federal levels, the District has increased its funding levels over the past decade and has appropriated $650 million in incentive funding in the 2023-2024 District Budget. Since the District's inception in 1992, considerable funding has been invested into thousands of clean-air projects throughout the Valley. These projects have achieved significant emissions reductions with corresponding air quality and health benefits.

The District typically requires match funding of 30% to 70% from grant recipients. To date, grant recipients have provided over $3.8 billion in matching funds, with a combined District and grant recipient funding investment of more than $6.5 billion.

Table E-1 Summary of Grant Expenditures and Results

District Incentive Funding ($)	Grant Recipient Match Funding ($)	Emissions Reductions (tons)	Cost-Effectiveness ($/ton)
$2,698,818,000	$3,894,980,000	280,730	$9,613

E.2 SIP CREDITABILITY FOR INCENTIVE-BASED EMISSIONS REDUCTIONS

Historically, states and local air agencies have not been able to obtain credit in state implementation plans (SIPs) for incentive-based emissions reductions. When provided SIP credit, incentive-based emissions reductions can be used alongside regulatory-based emissions reductions to meet federal Clean Air Act (CAA) requirements, such as demonstrating attainment with federal air quality standards at a future date. Given the substantial investment from the public and private sectors in replacing equipment under these voluntary incentives, establishing a general framework to receive SIP credit for these emissions reductions was critical. Recognizing the importance of this issue, the U.S. Environmental Protection Agency (EPA), California Air Resources Board (CARB), and the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) worked together with the District to create a Statement of Principles (Memorandum of Understanding, or MOU). Signed in December 2010, this MOU established a general framework for ensuring that reductions in air emissions resulting from voluntary incentives to replace off-road agricultural equipment received credit in the SIP. The MOU states that the District, USDA-NRCS, CARB and EPA would work collaboratively to develop a mechanism to provide SIP credit for emissions from incentive programs that are surplus, quantifiable, enforceable, and permanent. Continuing these efforts, in July 2012, EPA and USDA agreed to implement this concept to ensure that emissions reductions from incentive programs were given proper credit in the SIP context.

As a result of these collaborative efforts, the District adopted Rule 9610 (State Implementation Plan Credit for Emission Reductions Generated through Incentive Programs) on June 20, 2013. District Rule 9610 establishes the administrative mechanism through which SIP credit may be quantified for emissions reduced in the Valley through incentives. EPA approved District Rule 9610 on April 9, 2015.

As with prohibitory rules, EPA guidance requires that emissions reductions achieved through voluntary incentive programs be surplus, quantifiable, permanent, and enforceable in order for those reductions to receive SIP credit. Additionally, EPA guidance requires extensive documentation of emissions reductions proposed for SIP credit with ongoing follow-up and tracking of the emissions reductions.

The District designs incentive programs to meet the SIP-creditability criteria. In order to be surplus, emissions reductions from voluntary incentive programs must provide emission reductions ahead or beyond any local, state, or federal regulations. Quantifiable emissions reductions are calculated using publicly developed methodologies. To ensure enforceable and permanent emissions reductions, programs require mechanisms such as legally binding agreements with program participants and physical inspections to verify the completion of projects. Furthermore, all criteria and reporting mechanisms are transparent to the public.

E.3 INCENTIVE FUNDING SOURCES

The District is engaged at every level of state and federal government to craft policy and funding targets that account for the Valley's unique challenges and need to accelerate emissions reductions, particularly from sources not under the District's regulatory authority. Therefore, the District works closely with the Valley's legislative delegation to ensure representation of the Valley's needs in discussions of where to focus funding throughout the state and the region as a whole. In addition, the District focuses on how to allocate the limited funding received for its incentive programs effectively.

In addition to aggressively pursuing funding from state funding sources such as the Carl Moyer Program, the District has been very successful in securing grants from the highly-competitive federal Diesel Emissions Reductions Act (DERA) and the state Assembly Bill (AB) 118 Air Quality Improvement Program (AQIP). Currently, the District actively engages with CARB, the California Energy Commission (CEC) and other state agencies to ensure representation of the Valley in project selections from the Greenhouse Gas (GHG) Reduction Fund.

Recent state and federal budget and funding actions have created unprecedented opportunities for the San Joaquin Valley to receive much needed investments to reduce emissions from mobile sources. At the state level, the 2023-2024 budget, building on prior years, allocates a total of approximately $52.3 billion for climate related investments over six years. At the federal level, recent authorizations under the Infrastructure Investment Jobs Act (IIJA) and Inflation Reduction Act (IRA) provide wide-ranging funding for a variety of important clean technology and infrastructure programs. Notably, IRA includes an estimated $369 billion in funding for climate and energy-related programs, and many billions of additional funding for sustainable agriculture and programs of importance to the Valley. Given the Valley's air quality challenges and significant number of disadvantaged communities, it will be imperative that the state, EPA, and other federal agencies prioritize and integrate new funding opportunities with SIPs for Extreme ozone nonattainment and Serious PM2.5 nonattainment areas.

E.4 INCENTIVE STRATEGY

Each of the funding sources administered by the District includes different guidelines and statutory requirements for using the funds. Beyond the specific guidelines of each funding source, the District considers the following common factors when deciding how and where to spend incentive funds:

- **Cost Effectiveness:** An important factor when considering where to invest District funds is determining which types of projects and programs will give the District the greatest return on its investment. This is typically represented in dollars per ton of emissions reduced. While cost-effectiveness is a primary factor, the District also considers projects that may not have the highest cost-effectiveness, but that provide other benefits, such as the advancement of new technology or community involvement.

- **Inventory of Available Projects:** This factor is critical in all District incentive programs. To date, the District has been extremely successful in designing incentive programs that have broad appeal and applicability across multiple industries. Over the past 10 years, this level of interest has resulted in a substantial number of projects waiting for funding. The District will continue to work with applicants to ensure expeditious funding of eligible projects.

- **Required Expenditure Timeframes:** Each funding source that the District administers generally requires obligation and expenditure by certain deadlines. These deadlines greatly impact funding priorities and choice of projects. The District may prioritize a funding category over others because of the timeframe associated with a particular funding source. For instance, priority may be given to certain projects that can reasonably be expected to finish prior to the deadline for that specific fund over other projects of equal relevance or cost-effectiveness, but with longer expected completion times. Again, the flexibility of this option works in concert with the dynamic nature of the incentive programs, projects, expenditure deadlines.

- **Upcoming Regulatory Deadlines:** To ensure that incentive programs obtain the maximum SIP-creditable emissions reductions, the District performs a thorough analysis of all local, state, and federal regulations relating to the target categories. In addition, the District works proactively with the regulating agencies during the rule development process to understand the potential impacts of that rule on incentive projects and to ensure that opportunities for early incentive funding are maximized. These analyses determine which types of projects can be funded, for how long projects can be funded, which also impacts the potential cost-effectiveness of certain projects.

- **Health Benefits:** In addition to emissions reductions needed to attain air quality standards, the District also seeks incentive projects that provide direct health benefits to Valley residents. For instance, the District’s Lower-Emission School

Bus Program focuses primarily on the localized toxic risk involved in children's exposure to diesel particulates. While not the largest source of regional particulate pollution, replacing or retrofitting aging school buses has an enormous impact on the toxic risk of school transportation.

- **Environmental Justice:** The District places a strong emphasis in providing funding in a manner that benefits environmental justice communities. The District has worked cooperatively with the Environmental Justice Advisory Group to understand the Valley's environmental justice issues and to craft programs that reduce emissions in these areas.

- **Community Involvement and Benefits:** The District develops and administers programs with an emphasis on community involvement. Some examples of these are the Clean-Green-Yard-Machine program, Drive Clean! Rebate program, Burn Cleaner program, Transit Pass Subsidy program, and the Polluting-Automobile Scrap and Salvage program.

E.5 CURRENT INCENTIVE PROGRAMS

E.5.1 Heavy Duty Trucks

The heavy-duty trucks category is composed of light-heavy-duty to heavy-heavy-duty diesel trucks with a gross vehicle weight rating (GVWR) of 14,001 pounds and greater. Light-heavy-duty trucks have a GVWR of 14,001 to 19,500 pounds, medium-heavy-duty trucks have a GVWR of 19,501 to 33,000 pounds, and heavy-heavy-duty trucks have a GVWR greater than 33,001 pounds. Emission reductions in the heavy-duty truck fleet must be achieved through accelerated fleet turnover to the cleanest engines meeting ultra-low NOx emissions levels, which are 90% cleaner than engines currently required.

While CARB rulemaking efforts like CARB's Truck and Bus Regulation, and past funding programs like Prop 1B, are helping transition California fleets to clean engines meeting the 2010 0.2 grams per brake horsepower-hour (bhp-hr) NOx standard, these efforts are not enough to bring the Valley into attainment with the federal PM2.5 standards by the mandated deadlines. In an effort to encourage the transition to near-zero technologies and achieve reductions faster, CARB established optional ultra-low NOx standards of 0.1, 0.05, and 0.02 g/bhp-hr, which are up to 90% lower than the current heavy-duty truck standard. These optional standards have pushed progressive engine manufacturers to explore and develop new engine technologies. As such, engines that meet the optional ultra-low NOx standards for various classes of heavy-duty trucks are already available.

The zero-emission technologies for heavy-duty trucks, such as battery electric vehicles, have limited range and are only currently available for short-range duty cycles, such as refuse, last-mile delivery trucks, and drayage. However, development and demonstration are ongoing for longer-range zero-emission options, including hydrogen fuel cells as range-extenders for battery electric vehicles.

Aside from battery electric or fuel cell electric vehicles, natural gas and propane engines are currently the only fuel-type certified to meet the 0.02 g/bhp-hr ultra-low NOx emissions standards and is currently the only available option for long-range heavy-duty applications. As such, the District must continue to work with EPA, CARB, and industry to establish the appropriate natural gas fueling network to support the proposed fleet turnover.

Despite lack of direct regulatory authority, the District has helped increase the effectiveness of state and federal heavy-duty on-road emissions regulations through the administration of established state incentives programs and the adoption of local programs. Continuing to transition the heavy-duty truck fleet over to zero and near-zero emissions technologies is a critical component of District's control strategy. The District aims to accelerate the turnover of trucks to newer, cleaner vehicles, primarily focusing on the ultra-low NOx engines certified to 0.02 g/bhp-hr.

The District has administered numerous incentive programs over the years, using federal, state, and locally generated funds to replace older on-road heavy-duty trucks with the cleanest available technologies.

Proposition 1B (Prop 1B): The Prop 1B Goods Movement Emission Reduction Program was the single largest source of funding for the District's heavy-duty on-road incentive program. Prop 1B used bond funds for a variety of state transportation priorities, including the replacement of heavy-duty trucks, transportation refrigeration units, and locomotives used in the goods movement corridors. The District aggressively pursued its share of Proposition 1B funding, and the Valley has received over $250 million over the life of the program, replacing 2,900 trucks.

Truck Replacement Program (TRP): The Governing Board authorized the creation of the District's Truck Voucher Program in 2012. This program was created to ensure that Valley truck fleets had opportunities to replace their older, high-polluting trucks well in advance of the Statewide Truck and Bus Regulation deadlines. The program is primarily focused on providing funding for truck replacements for small businesses that do not generally qualify for funding under the Proposition 1B or other programs. District verification of all information submitted, as well as physical inspections of new and old vehicles, help ensure that the integrity of the program is maintained throughout the process.

In March of 2018, the Governing Board approved enhancements to the Truck Voucher Program to incorporate requirements of new state funding and ensure cost-effectiveness and SIP creditability of the resulting emission reductions. In addition, the District added new funding options to encourage Valley fleets to adopt zero and near-zero emission truck technology. The enhancements approved by the Board included rebranding the program under one name, simply the Truck Replacement Program, in order to be more intuitive and inclusive of all District truck programs.

In April of 2022, in response to the regulatory compliance requirement deadline, the District adopted additional enhancements to the program to fully align with the State's recently updated Carl Moyer Program Guidelines. These updates included necessary flexibility to fund truck replacement projects moving forward including enhanced incentives for near-zero and zero emission new trucks as well as the following model year eligibility and funding cap increases:

- Updated existing vehicle engine model year eligibility requirements:
  - Engine model year must be six or more years of age (for example, replace a 2017 model year engine in 2023)
- Increased state funding caps:
  - Up to $160,000 for near-zero low NOx standard (0.02 g/bhp-hr)
  - Up to $410,000 for zero-emission technology
  - Funding amounts vary based on fleet size (small fleets receive higher percentage), cost-effectiveness, and use
- Increased Cost Effectiveness limits:
  - Up to $209,000 for near-zero low NOx standard (0.02 g/bhp-hr)
  - Up to $522,000 for zero emission technology

The District has funded the replacement of over 5,200 heavy-duty trucks, with more applications coming in every day. The program is very popular with Valley based heavy-duty truck dealers because the program operates very efficiently.

E.5.2 Passenger Cars, Light-Duty Vehicles, Medium-Duty Vehicles

This category includes classes of vehicles used primarily for personal transportation. When the light-duty truck and medium-duty vehicle categories were first established, the majority of vehicles in the medium-duty vehicle category were primarily used for work purposes. The popularity and high sales volumes of full size pick-up trucks and SUVs have altered the light- and medium-duty truck use patterns. It is now common for trucks and SUVs to be used primarily for personal transportation.[3]

Passenger cars are vehicles designed primarily for transportation of persons and having a capacity of twelve or less. Light-duty trucks are trucks with a GVWR less than 5,750 lbs. Medium-duty vehicles have a GVWR between 5,751 lbs. and 8,500 lbs.

California has the Nation's longest history of passenger car emissions standards and an accompanying inspection and maintenance program. Continued reductions in emissions from this category while the overall size of the fleet is increasing relies on vehicle turn-over, proper maintenance of legacy vehicles, and continual improvement of new vehicle emissions. The District has operated programs to address each of these needs.

Despite lack of direct regulatory authority, the District has helped increase the effectiveness of state and federal light-duty on-road vehicle regulations through the

[3] CARB. (1999). *"Lev II" And "Cap 2000" Amendments To The California Exhaust And Evaporative Emission Standards And Test Procedures For Passenger Cars, Light-Duty Trucks And Medium-Duty Vehicles, And To The Evaporative Emission Requirements For Heavy-Duty Vehicles: Final Statement Of Reasons.* Retrieved from: http://www.arb.ca.gov/msprog/levprog/levii/pstfrpt.pdf

administration of established state incentives programs and state leading innovation in the adoption of local programs.

Tune In Tune Up: Since 2010, the District has partnered with Valley Clean Air Now (Valley CAN) to administer the Tune In Tune Up vehicle repair program. Initial funding for Tune In Tune Up came from the state's Reformulated Gasoline Settlement Fund and resulted in the repair of more than 2,900 vehicles. Because of the success of this initial effort and benefits to the residents of the Valley, the District has budgeted additional funding for the program hosting a total of 326 events consisting of in-person and virtual events, repairing over 96,080 vehicles, using $53,544,000 of locally generated incentive funds.

With a focus on outreach to low income communities, this award-winning program provides Valley residents with the opportunity and necessary funding to make emissions-related repairs to their vehicles, significantly reducing emissions throughout the Valley, particularly in disadvantaged communities. In partnership with Valley CAN, this program has grown to become the most effective, targeted vehicle repair program in the state. In addition to the significant emissions benefits of the program, the Tune In Tune Up program has produced extremely valuable data regarding the true nature and extent of high-polluting, largely unregistered vehicles in the Valley, particularly amongst the Valley's low income population.

Through this partnership with Valley CAN, the District has provided much-needed funding for vehicle repairs with the vast majority of these vehicles operating within the Valley's disadvantaged communities. An additional benefit of this program is follow-up with owners of vehicles that are unregistered due to smog-related issues to help ensure that their vehicles are re-registered after repair.

Enhanced Fleet Modernization Program (EFMP) and Clean Cars 4 All (CC4A): In recognition that not all vehicles that participate in the Tune In Tune Up weekend events are good candidates for repair, the District developed a first-of-its-kind vehicle replacement pilot program, implemented in partnership with Valley CAN. This program identified vehicles at weekend events which were not good candidates for repair and provided additional funding to retire and replace those vehicles with cleaner, more efficient vehicles. Based on the initial success, this pilot program served as a model for developing the statewide EFMP and CC4A programs.

Since 2015, the District has incorporated a vehicle replacement component into the Tune In Tune Up weekend events. The EFMP and CC4A programs currently provide between $7,000 to a maximum of $12,000 per vehicle to replace older, high emitting vehicles. The incentive is limited to low-income participants and the amount is based on the type of replacement vehicle purchased and the participant's home address. The highest incentive is given to participants who reside within disadvantaged community census tracts that choose the cleanest available vehicles (generally battery-electric).

These programs are funded through CARB's AB 118 program and Greenhouse Gas Reduction Fund (GGRF), more commonly referred to as the Cap and Trade Program.

To date, the District and Valley CAN have replaced more than 6,400 vehicles with newer, cleaner vehicles with approximately 90% of the participants meeting the program's definition of low income and 76% of the vehicles residing within the Valley's disadvantaged communities.

Drive Clean! Rebate Program: Today's market provides consumers with a wide variety of clean-air vehicle options. This program provides rebates to Valley residents and businesses for the purchase or lease of new, clean-air vehicles. The Valley has traditionally lagged other areas of the state in electric vehicle use and ownership. This is evidenced by the low participation of Valley residents in statewide incentive programs for electric and other advanced passenger vehicle technology. Only about 3% of participants in the statewide Clean Vehicle Rebate Program have been from the San Joaquin Valley. This program has further encouraged Valley residents to drive these cleaner alternatives. Since the launch of the Drive Clean! Rebate Program in March 2012, the District has issued over 33,640 rebates, totaling more than $95.4 million in grant funding.

Public Benefits Grants Program, New Alternative Fuel Vehicle Purchase component: The Public Benefit Grants Program was developed to help address the needs and challenges faced by Valley public agencies in their efforts to secure funding for clean-air projects. The program was designed to provide necessary flexibility and leveraging to ensure the success of these projects. The New Alternative Fuel Vehicle Purchase component provides funding for the purchase of new, light-duty alternative fuel vehicles including, electric and plug-in hybrids. Since the launch of the program in 2011, over $56 million has been awarded for the purchase of clean alternative fuel vehicles such as zero-emission motorcycles, full battery-electric and plug-in hybrid electric vehicles.

E.5.3 Mobile Agricultural Equipment

This category includes off-road agricultural equipment such as tractors, backhoes, wheel loaders, and other off-road farming vehicles that are widely used in the Valley. Off-road agricultural equipment replacements and repowers play a crucial role in reducing emissions, and significant emission reductions have already been achieved through accelerated fleet turnover to the cleanest available Tier 4 technologies.

Although the increasingly stringent new engine standards for off-road equipment will reduce emissions from mobile agricultural equipment over time, most existing off-road agricultural equipment operates for several decades before being retired due to their durability and relatively low cost to maintain. Furthermore, the useful life of a tractor in the Valley is much longer than other parts of the country due to the Valley's hot, dry summers and mild, wet winters.

While most of the equipment in this category are tractors, a significant portion consists of harvesters, loaders, sprayers, conditioners, balers, cotton pickers and other specialized equipment types. Some types of non-tractor mobile agricultural equipment have unique and specific roles within an operation based on the commodity produced and usually require specialized functions of the equipment. Non-tractors often have specialized roles that are specific to certain functions and limit their usefulness for multiple operations, causing non-tractors to be significantly more expensive than tractors. The large cost deters operators from replacing and purchasing specialized equipment which leads to less turnover of older, more polluting equipment within the specialized mobile agricultural equipment population.

In 2012, CARB staff began to develop the framework for mobile agricultural equipment to become eligible to receive SIP credit. That process included in-depth research of the unique economical and operational characteristics of mobile agricultural equipment in the agricultural industry, which included reviewing and analyzing the cost and availability of Tier 4 technologies for mobile agricultural equipment. It was determined that a two-step regulatory process that ensures SIP credit for voluntary incentive program mobile agricultural projects in the near-term and a longer-term effort to accelerate use of Tier 4 equipment would better serve to maximize the air quality benefits over time while also meeting SIP goals. As a result, in October 2013, CARB adopted their Regulation for State Implementation Plan Credit from Mobile Agricultural Equipment that relies on voluntary incentive measures to achieve reductions from this essential category.

Despite lack of direct regulatory authority over mobile agricultural equipment, the District has helped accelerate emission reductions from this category ahead of state regulation through the administration of established state incentives programs and the adoption of local programs. The District's successes in its partnerships with Valley growers, USDA-NRCS and CARB to replace tractors through voluntary incentives is a great example of how effective incentive-based strategies can lead to more emission reductions in an expeditious fashion.

Tractor Replacement Program: Since 2009, the District and the USDA-NRCS have implemented and provided funding for a voluntary incentive program that has replaced more than 13,150 agricultural tractors for Valley farmers. Funding for this program includes Federal AQIP, Federal Targeted Airshed Grants, Diesel Emissions Reduction Act, motor vehicle fees, ISR fees, Voluntary Emission Reduction Agreements, the Carl Moyer Program, the FARMER program, and the Community Air Protection program.

Small Farmer Certified Pre-Owned Agricultural Equipment Pilot Program: There are still many old, high polluting tractors used in the San Joaquin Valley by small farmers for whom the cost of the new tractor is not feasible even with the District's current incentive program. The District launched the first-of-its-kind Small Farmer Certified Pre-Owned Agricultural Equipment Pilot Program in the summer of 2022. When coupled with an expanded agricultural equipment replacement program, this program has the potential to achieve significant additional cost-effective emissions reductions.

Electrified Dairy Feed Mixing Program: The District completed a highly successful demonstration of an electrified feed mixing system as a part of the Technology Advancement Program. Informed by that project's success, the District developed this new pilot incentive program to target the installation of electric feed mixing equipment and further reduce diesel emissions from tractors and other mobile equipment and vehicles at Valley dairies and other confined animal feeding operations (CAFOs). The primary emission reductions from this program derive from the elimination of existing agricultural tractors that mix and deliver feed, the elimination or reduction in usage of on-road trucks used to deliver feed, and reduction in usage of any remaining off-road equipment used in the feeding process. Further emission reductions and cost-savings to Valley dairies and CAFO's will be achieved through increased efficiencies of the new systems that result in an overall reduction in feed mixing equipment usage. Since launching the program in January 2018, the program has funded over $23.8 million for the transition to electrified feed systems and has received an additional $17 million in incentive funding application requests from Valley dairies pursuing transition to electrification and much cleaner feed systems.

E.5.4 Locomotives

The emissions from goods movement are a significant source of diesel particulate matter (PM) in the Valley and the state, and many of the larger cities in the Valley are home to locomotive rail yards. Locomotives, in particular, present a considerable health risk from diesel PM emissions. Residential areas located near rail yards have shown a significant increase in cancer risk and can equal or exceed the regional background or regional health risk levels.

Locomotives are divided into three groups: interstate line-haul locomotives, medium-horsepower locomotives that are used primarily in California or regional service, and switcher locomotives. This component also includes emissions from other off-road equipment used at rail yards, including cranes, yard tractors, and material handling equipment such as forklifts.

Interstate line-haul locomotives are generally newer (built 1995 and later), higher horsepower (greater than 4,000 hp) locomotives that operate over long distances and in many states. Medium Horsepower (MHP) Locomotives are typically older locomotives that may have once served in interstate line haul service but are now used in regional service. Switcher (Yard) Locomotives are typically used to push railcars together to form trains within rail yards, but can also be used to power local and regional service trains.[4]

Heavy-Duty Engine Program, Locomotive Component: This program component awards up to 85% grant funding for newer, cleaner diesel locomotive engines and locomotive replacements. The locomotive component of the Proposition 1B Program funded up to 80% for the replacement of an uncontrolled, Tier 0 through Tier 2 locomotive with a new locomotive that meets or exceeds Tier 4 standards (1.30 g/b-bhp-hr NOx and 0.03 g/bhp-hr PM). Eligible projects are funded with local, state, and federal sources, including but not limited to the Carl Moyer Program, the Federal Diesel

[4] California Air Resources Board [CARB]. (2009). Recommendations to Implement Further Locomotive and Railyard Emission Reductions. Retrieved from http://www.arb.ca.gov/railyard/ted/drftrec090909.pdf

Air Shed Grant, and DERA funding. Over the past 15 years, the District has funded idle reduction technology, repower and replacement of 52 locomotives, with more projects currently in the queue.

The District funds locomotive repower or replacement projects by entering into an agreement with the applicant to replace the old, dirty locomotive with newer, cleaner technology. During the pre-inspections, all necessary locomotive engine information is verified by District inspectors and documented in digital photographs. Upon verification of all information, the District enters into an agreement with the recipient for the project. Once the replacement switcher locomotive engine has been purchased and the original engine has been dismantled, the recipient will complete and return the claim-for-payment packet, and a post-inspection is performed, prior to payment, to verify the new information. Monitoring and reporting continue for the duration of the agreement to ensure the emissions reductions from the project are real and quantifiable.

Proposition 1B Locomotive: The District has funded the replacement of 22 locomotives totaling $37.8 million in funding through the Proposition 1B program. These projects achieve 136.5 tons of PM and 3,009 tons of NOx emissions over the life of the projects.

E.5.5 School Bus Replacement and Retrofit

This category includes diesel-fueled buses, including those from public school districts and other qualifying agencies that service public schools, with a GVWR over 14,000 pounds. The number of buses that are in this source category is relatively small compared to the number of heavy-duty trucks also meeting the 14,001 or more GVWR catagory and covered by the State Truck and Bus Regulation. School bus replacements and retrofits play a vital role in reducing school children's exposure to both cancer-causing and smog-forming pollution.

The School Bus Replacement and Retrofit programs provide grant funding for new, safer school buses and air pollution control equipment (retrofit devices) on buses that are already on the road. Public school districts in California that own their buses are eligible to receive funding. Eligible projects are funded with local, state, and federal funds including DERA funding and state and local mitigation fees.

Over the life of the program, the District has provided funding to retrofit 784 school buses and replace 619 school buses. New buses purchased to replace older buses may be fueled with diesel or an alternative fuel, such as compressed natural gas (CNG) or electricity, provided that the required emissions standards specified in the current guidelines for the Lower-Emission School Bus Program are met. Funds are also available for replacing on-board CNG tanks on older school buses and for updating deteriorating natural gas fueling infrastructure. Commercially available zero-emission electric school buses are eligible for additional funding through the state’s Hybrid Voucher Incentive Program (HVIP).

Eligible school buses are selected based on specific program requirements, including replacing the oldest models first. After determining eligibility, school districts are awarded contracts that provide a reasonable time period for project completion. A claim must also be submitted before funds can be reimbursed.

E.5.6 Alternative Fuel Infrastructure

The impact of emissions generated from cars and trucks on the Valley's air quality is significant. More than 80% of the NOx emissions inventory in the Valley is attributed to mobile sources. The Valley's topography, climate, geography and the presence of two major transportation corridors connecting northern and southern California all contribute to the region's problem. Due to the significant source of vehicle emissions, the District has developed and implemented a broad, multi-faceted portfolio of innovative strategies and policies to reduce emissions from cars, trucks, buses and other heavy-duty vehicles. As part of its strategy, the District has created several successful programs incentivizing clean vehicles. However, the District also recognizes that clean vehicle technology cannot be viable without the necessary fueling infrastructure that would not only allow such technology to be accepted by Valley residents and businesses, but also thrive in the region. For this reason, the District has developed incentive programs for the purchase and installation of alternative fueling infrastructure to support clean vehicle technology.

Charge Up! Program: This program provides funding for the purchase and installation of electric vehicle (EV) chargers. Although EV charging infrastructure has steadily improved in the San Joaquin Valley, the continued deployment of such infrastructure is still needed as an increasing number of residents have adopted EV technology. The Charge Up program was recently enhanced to adapt to ever changing trends in the market and needs of current and potential EV owners. Workplace charging was incorporated as many consumers considered purchasing an EV because of the ability to charge at their place of employment. In addition, changing the program to a voucher-based system has helped streamline the process for Valley agencies and businesses to leverage additional funding provided by the state and utility companies. With the ability to stack incentive funds from multiple sources, many program participants have significantly reduced out-of-pocket costs and found the investment of installing EV chargers worthwhile. Since the launch of the program in June 2015, the District has awarded more than $8.6 million in incentives for the siting and installation of 460 level 2 and level 3 electric vehicle chargers.

Clean Vehicle Fueling Infrastructure Program: Through the Clean Vehicle Fueling Infrastructure Program, public or private entities can receive funding for the installation of new alternative fueling infrastructure, conversion of an existing station, or expansion of existing infrastructure to support their vehicle deployment goals. This program originally provided funding to construct natural gas stations, hydrogen fuel stations and battery charging stations for heavy-duty vehicles. Under this program, the District has awarded nearly $50 million in incentives for the siting and installation of hydrogen fueling stations and battery charging stations. In January 2023, the District updated the program to only allow for hydrogen fueling and battery charging stations.

Zero-Emission School Bus Infrastructure Program: The Zero-Emission School Bus Infrastructure Program provides funding for the construction of new private use battery charging stations for zero-emission school buses. Under this program, school districts and private transportation providers serving school districts within designated disadvantaged or low-income communities can receive funding for up to 100% of eligible costs for the purchase and installation of charging infrastructure. Applicants may also receive funding to accommodate future electric school bus deployment. The District has awarded over $4.9 million towards these projects. The Zero-Emission school bus program was recently combined with the Clean Vehicle Fueling Infrastructure program and school bus infrastructure projects can now receive funding from that program.

E.5.7 Community-Based Incentive Programs

The District offers several programs that provide incentives for specific projects that focus getting the community involved in achieving emissions reductions through clean air projects and practices. These programs fall into two major categories: programs that reduce local vehicle miles traveled (VMT) and programs that reduce residential-generated emissions. For programs that reduce vehicle emissions, funds are allocated to support cost-effective projects that have the greatest motor vehicle emissions reductions, resulting in long-term impacts on air pollution problems in the Valley. In addition to vehicle emissions, the District recognizes that focus should also be placed on reducing emissions that are generated from sources at the residential level that directly affect neighborhoods as much as vehicles. All projects under these programs must have a direct air quality benefit in the Valley.

These programs provide funding to help reduce emissions generated at the community level. The importance of these community-based programs cannot be underestimated as they help change the nature of how individuals within each community commutes, conducts business, and resides in the Valley. These programs succeed in incentivizing and supporting changes in individual behavior in ways that help reduce air pollution with the prospects that shifting behavior and habits will transform the community at-large.

Clean Air Rooms: To help mitigate the effects of wildfire smoke on Valley residents, and in particular the District's most vulnerable populations, the District launched the Clean Air Rooms Pilot Program in June of 2022 and in June of 2023 transitioned to a standard program. This program provided residential air filtration units to residents of the Valley's disadvantaged communities. The goal of this program was to partner with local Valley businesses and organizations to distribute in-home air filtration units to residents of disadvantaged communities free of charge. To date, the program has funded 15,700 clean air filtration devices to residents in designated disadvantaged communities throughout the San Joaquin Valley.

AB836 Wildfire Smoke Clean Air Centers: In an effort to address the growing concern of wildfire and other smoke events and the severe impacts these events have on the most vulnerable populations, AB 836 (Wicks, Chapter 393, Statutes of 2019) was adopted. This bill established the foundation for CARB to develop The Wildfire Smoke Clean Air Centers for Vulnerable Populations Incentive Pilot Program (Clean Air Centers Pilot Program) guidelines which provides funding to upgrade ventilation systems and to provide portable air cleaners to create a network of clean air centers to provide vulnerable populations a respite from wildfires and other smoke events. The guidelines established by CARB provide the District with the discretion and flexibility to create clean air centers at schools, community centers, senior centers, sport centers, libraries and other publically accessible buildings that would most effectively protect our vulnerable populations during wildfire smoke events. In April of 2022, the District launched the Clean Air Centers Pilot Program. To date, $699,000 has been awarded to private businesses and public agencies to purchase and deploy air filtration devices at their facility to create clean air centers during times of extreme smoke events.

Bicycle Infrastructure: This program provides funding for bicycle infrastructure projects, including Class I (Bicycle Path Construction), Class II (Bicycle Lane Striping), and Class III (Bicycle Route) projects. The program provides funding to assist with the development or expansion of a comprehensive bicycle-transportation network which will provide a viable transportation option for travel to school, work and commercial sites. Since the start of the program, almost 1.5 million dollars has been awarded for bicycle infrastructure projects throughout the Valley.

Alternative-Fuel Mechanics Training: This program provides funding to develop and advance the education of personnel from qualifying agencies that are using alternative fuel or are transitioning to alternative fuels on the mechanics, safe operation and maintenance of alternative fuel vehicles and infrastructure. As clean new vehicle technology adoption has been dramatically increasing, there has been a reciprocal need for personnel training. The District has awarded over $150,000 towards these projects.

E-Mobility: This program provides funding for the development or expansion of telecommunications services and electronic technology applications to directly replace vehicle travel by the general public. Funding is available for eligible projects such as video teleconferencing, internet business transactions, and telework sites. The District has awarded over $1 million towards these projects.

Public Transportation Subsidy and Park & Ride: This program provides funding for the construction of Park & Ride lots to promote ridesharing and public transportation subsidies to encourage new ridership. Over $1.4 million dollars has been awarded to subsidize and encourage the growth of these ridesharing activities.

Clean Green Yard Machines Residential: The Clean Green Yard Machines Residential Program (Residential CGYM) provides Valley residents with two options to participate and receive a rebate. One option is to replace participants' old gas- or diesel-powered lawn mowers with new eligible electric lawn mowers. Under this option, the participant is required to submit their old lawn mower to a participating dismantling/recycling facility for permanent destruction. The second option is for the purchase of new electric lawn care equipment without having to replace old equipment. This option has an expanded eligible equipment list including edgers, string and hedge trimmers, chainsaws and pole saws. Under this Program, the District has awarded over $2.7 million for over 15,000 pieces of lawn and garden equipment (as of March 31, 2024).

Zero-Emission Landscaping Equipment Voucher Program. In May 2023, the Clean Green Yard Machines Commercial Voucher Program (Commercial CGYM) was redesigned and enhanced to become the District's new Zero-Emission Landscaping Equipment (ZELE) Voucher Program. This Program provides incentives for San Joaquin Valley landscapers, public agencies, and businesses that perform their own landscape maintenance, to replace their old gas- or diesel-powered landscape equipment with new electric options. Incentive levels vary depending on the type of eligible landscaping equipment that will be purchased by the applicant. To achieve emissions reductions, this Program requires existing old gas- or diesel-powered equipment be destroyed at a participating dismantling facility. Since the launch of the ZELE Voucher Program, the District has awarded 924 vouchers for a total of over $2.3 million in funding (as of March 31, 2024).

Public Benefits Grants Program, Community Improvement Projects that Reduce Vehicle Use and Emissions Component: This component provides funding for specific land use and community development projects that are eligible under the Cap and Trade funded Affordable Housing and Sustainable Communities Program and other state and federal funding opportunities. Projects awarded from this program promote a reduction in VMT and associated emissions through enhanced walkability and increased use of zero emission transportation alternatives. The funding provided under this component is intended to be used as match to give Valley projects a competitive advantage, especially in statewide and national solicitations. Projects submitted through this program are awarded on a first-come, first-serve basis pending eligibility. Under the program, 5 projects have been awarded for over $4.8 million.

The District continuously reviews areas where emission reductions can be achieved, especially on the community level where poor air quality has a direct impact on the residents of the San Joaquin Valley.

E.5.8 Agricultural Irrigation Pump Engine Replacement Incentive Measure

Substantial emission reductions from internal combustion (IC) agricultural irrigation pump engines in the Valley have been achieved through a combination of regulatory efforts and incentive actions. District Rule 4702 has effectively reduced emissions from agricultural irrigation pump engines by 84% since the 2005 amendments to the rule, with substantial investments being made by the affected sources to comply. Rule 4702 applies to any IC engine rated at 25 brake horsepower (bhp) or greater. The purpose of this rule is to limit NOx, carbon monoxide (CO), volatile organic compounds (VOC), and oxides of sulfur (SOx) emissions from units rated at or greater than 50 bhp that are subject to this rule. In the continuous effort to improve air quality in the Valley, the District has adopted numerous amendments to Rule 4702 that have resulted in significant reductions of NOx and PM emissions. The rule was further strengthened in August 2011 when rule amendments implemented more stringent NOx limits, as low as

11 parts per million (ppm), for non-agricultural operation spark-ignited engines. Despite the significant reductions to date, attainment of the 2012 PM2.5 standard requires further emissions reductions in the Valley.

The District currently provides 85% of eligible costs in funding for farmers looking to replace older, dirtier diesel engines with low-emission Tier 4 engines or zero-emission electric motors. Agriculture accounts for a majority of the local economy, and this program not only provides for significant emissions reductions from agricultural operations, but provides economic relief to Valley farmers, ranchers, and dairy operators. Eligible projects are funded with local, state, and federal sources, including but not limited to District Indirect Source Review mitigation fees, Carl Moyer Program funding, AB 923 funding, Federal Designated Funding, and Federal Diesel Air Shed Grant funding. In the past, collaboration with the California Public Utilities Commission (CPUC) and local utilities has allowed for additional incentives on electric line extensions and special rate schedules, enhancing participation in the District's replacement program.

Over the past 15 years, the District has funded the replacement of over 1,660 agricultural pump engines, with more projects currently in the queue. Over 1,300 of these replacements involved replacing older diesel engines with electric motors.

E.5.9 Ag Burn Alternatives Grant Program

To support the Valley's ongoing phase-out of agricultural open burning, in 2018, the District's Governing Board authorized the creation of the Ag Burn Alternatives Grant Program.[5] This program provides financial incentives to commercial agricultural operations located within the District boundaries to utilize an alternative practice for the disposition of agricultural material from orchard and vineyard removals as an alternative to open burning. Alternative measures include, but are not limited to, soil incorporation of chipped material, on-site land application on agricultural land, off-site beneficial re-use (mulch, composting, land application near roadways for dust suppression, and other District approved beneficial re-use of the chipped material). Since 2018, the District Governing Board has allocated over $65,000,000 in local and State funding to this program.

On August 19, 2021, the District accepted $178,200,000 in additional state funding to be used in the District's Ag Burn Alternatives Grant Program.[6] To ensure adequate capacity to accommodate the increase in agricultural chipping throughout the Valley in the coming years, particularly for smaller agricultural operations, the District allocated $30,000,000 of the new state funding to expand the Ag Burn Alternatives Grant Program to include a new program option that provides incentives for the purchase of new chipping/grinding equipment. This funding is the result of significant advocacy from

[5] District Ag Burn Alternatives Grant Program. Retrieved from: https://ww2.valleyair.org/grants/ag-burn-alternatives-grant-program/

[6] SJVAPCD. *Accept and Appropriate $178,200,000 in State Funding and Approve Enhancements to Alternatives to Agricultural Open Burning Incentive Program*. (August 19, 2021). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2021/August/final/10.pdf

the District and Valley agricultural stakeholders and is designated to assist the District in developing new alternative practices, increase fleet capacity for chipping in the Valley, and offset the significant incremental cost of implementing new alternatives to open burning.

The District's agricultural open burning phase-out strategy, along with the Ag Burn Alternatives Grant Program are working effectively to reduce emissions from agricultural open burning. New alternatives to open burning have emerged and are being implemented and Valley growers are utilizing the incentive program at a high rate. As a result, the current funding expenditure rate continues to increase. The initial allocation of State funding was expected to last until the end of 2024, however, it was exhausted approximately 11 months ahead of schedule. The early exhaustion of funds resulted in the District allocating additional local and state funds to the program.

Overall, the program has resulted in the deployment of alternative practices at over 251,500 acres, for over 6,800,000 tons of agricultural materials, resulting in the reduction of 13,299 tons of NOx, 24,705 tons of PM, and 21,013 tons of reactive organic gases (ROG) emissions.

E.5.10 Residential Wood Combustion

The District currently operates the Fireplace & Woodstove Change-Out Program (formerly known as the Burn Cleaner Program) to reduce emissions from residential wood burning. The Program helps Valley residents replace their current high-polluting wood-burning devices and open hearth fireplaces with cleaner alternatives such as natural gas or EPA certified wood/pellet devices, and electric heat pumps. Through this Program, residents reduce directly emitted PM2.5 emissions in areas and times where those reductions are needed most. Given the potentially high cost of these new devices, this Program provides a reduced upfront cost to low-income qualified applicants to encourage their participation by applying the incentive at point of purchase. The Program is part of the multi-faceted approach to reduce residential wood smoke emissions through the District's Residential Wood Smoke Reduction Program, which is implemented each winter season from November 1 to the end of February. In 2022, the District Governing Board approved the latest enhancements to the Program, which includes increased incentives for the installation of natural gas or electric devices to offset rising prices of device and labor costs due to inflation. In addition to increased incentives, a new component for fireplace decommissioning only was incorporated into the Program.

The Program has replaced over 30,000 wood burning devices with EPA-certified devices, clean-burning natural gas or electric heat pumps to date.[7] The District encourages Valley residents to transition from older, higher polluting, wood burning fireplaces to cleaner alternatives by decreasing the number of allowable burn days for these types of devices while also increasing the number of burn days allowed for

[7] As of March 20, 2024

registered clean wood burning devices through the District Rule 4901 tiered episodic wood burning curtailment program.

E.5.11 Commercial Charbroiling

In addition to regulatory requirements of District Rule 4692 (Commercial Charbroiling), the District created the Restaurant Charbroiler Technology Partnership (RCTP) program with the goal of reducing PM2.5 emissions from underfired commercial charbroilers. The program was initially allocated with $750,000 of incentive funding to fully cover all emissions control device installation costs as well as two years of device maintenance. RCTP initially struggled to find restaurants interested in participating in the program despite the program's willingness to cover all associated costs. Despite the District's efforts in promoting available funding under the RCTP program, the District has faced difficulty in finding restaurants willing to partner with the District to demonstrate new technologies. To date, only one restaurant, the Habit Burger Grill, has successfully completed two years of demonstration of a Molitron wet scrubber in their Stockton restaurant. Initially, the project experienced hood fan sizing issues, resulting in the restaurant being smoked out and forced to close temporarily. The Habit Burger Grill has subsequently installed these control devices on additional new restaurants, with some of these installations in the Valley.

In 2019, the District made an even larger concerted effort to conduct outreach to restaurants in the San Joaquin Valley regarding incentives available through RCTP. Through this outreach effort, the District received only 15 RCTP interest cards out of the over 4,200 restaurants that were contacted to comply with the 2018 Rule 4692 reporting and registration requirements. After discussing RCTP with these restaurants in more detail, none of these restaurants considered moving forward after this additional outreach.

In addition, the District tailored its approach and made direct contact with five prominent Valley restaurants, which resulted in a great deal of interest to evaluate the feasibility of installing the underfired emission control technology on their existing operations, with the understanding that all costs of the technology and two year maintenance would be covered through the RCTP program. District staff conducted multiple site visits to these operations, working with the restaurant owner/operator, engineering consultants, and technology vendors. Initial control system designs, quotes from vendors, and installation quotes from contractors were obtained and the feasibility of the technologies were fully assessed for each of the restaurants. However, after conducting a lengthy detailed analysis, none of the restaurants moved forward with the demonstration due to feasibility issues related to the installation of the control devices and local permitting challenges, and concerns about the cost of maintenance after the funded two-year demonstration period concluded under RCTP.

In recognition of the costs and technological challenges of pollution control devices for commercial charbroilers, the District Governing Board adopted a multipronged strategy to promote emission reductions from this category, while minimizing the impact on restaurants during the COVID-19 pandemic. This strategy, approved by the Governing

Board in December 2020, will require significant effort by the District through creating enhancements to the RCTP program, developing and providing guidance to local agencies for the development of ordinances, providing education to local agencies on the health impact of commercial cooking emissions, working with CARB as they consider developing a statewide Suggested Control Measure, working with CARB/EPA in making improvements to the emissions inventory for commercial underfired charbroiling, and formalizing the restaurant workgroup to stay in touch with current industry conditions and to continue to develop and deploy underfired charbroiler technology. In addition to this strategy, the District recently formed a Charbroiler Collaborative Workgroup with Bay Area Air Quality Management District, South Coast Air Quality Management District, San Diego County Air Pollution Control District, and CARB, aimed at conducting additional research and overcoming barriers for charbroiling control technology. Work through the collaborative is ongoing.

E.5.12 Low-Dust Nut Harvester Grant Program

The Valley is one of the largest agriculture producing regions in the nation and the sole producer of 99% of the U.S. almond and walnut supply. In 2022, almonds were California's #1 crop by acreage with 7,600 farms containing 1,342,920 bearing acres, resulting in many Valley residents being exposed to PM emissions from harvesting operations. In an effort to reduce exposure to localized sources of PM, the District developed the Low-Dust Nut Harvester Replacement Program as a way to advance the deployment of low-dust nut harvesting equipment in the Valley and to reduce localized community impacts from this source category.

Studies, conducted in partnership with the District, USDA-NRCS, and agricultural stakeholders and overseen by the San Joaquin Valleywide Air Pollution Study Agency have demonstrated that low-dust harvesting technology can be effective at reducing localized PM emissions associated with harvesting activities. Studies indicate that low-dust harvesting technology can reduce localized PM emissions by more than 40%, and in some cases up to nearly 80%. Additionally, working with agricultural stakeholders, a scientific survey was conducted that concluded that a significant portion of nut crop growers and custom harvesters were interested in demonstrating new lower-emitting harvest technologies if provided with meaningful financial incentives.

These findings were used to develop the District's Low-Dust Nut Harvester Replacement Program. Since 2018, the District has been operating this first-of-its-kind voluntary incentive program to replace conventional nut harvesting equipment with new, low-dust equipment. The Low-Dust Nut Harvester Replacement Program initially started as a pilot program, however; due to its success, was converted to a full program in late 2020. The program builds upon more than a decade of significant investment made in the San Joaquin Valley to develop low-dust nut harvesting technologies and to understand the potential benefits in reducing PM emissions from the use of these new technologies. To date, the program has successfully obligated over $20.7 million to replace 241 pieces of nut-harvesting equipment with low-dust nut harvesting equipment, which has resulted in the reduction of more than 1,400 tons of PM2.5.

E.6 TECHNOLOGY ADVANCEMENT

Despite major reductions in emissions and corresponding improvements in air quality, the Valley continues to face difficult challenges in meeting the federal ambient air quality standards. Achieving attainment of EPA's increasingly stringent ambient air quality standards will require the development and implementation of transformative zero/near-zero emissions technology over the coming decades.

On March 18, 2010, the District's Governing Board approved the District's Technology Advancement Program (TAP), a strategic and comprehensive program to identify, solicit, and support technology advancement opportunities. The program's primary goal has been to advance technology and accelerate the deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable. To date, the District has undergone four rounds of Request for Proposals (RFPs) resulting in the successful demonstration of numerous innovative technologies.

To encourage the development of technologies in source categories critical to the Valley's attainment goals, the District's Governing Board established technology focus areas on alternatives to open burning, renewable energy, waste solutions, and mobile sources. To date, the District has completed four TAP competitive funding RFPs, receiving over 135 proposals for clean technology demonstration projects through these RFPs. In total, the District's Governing Board has approved 35 of the proposed projects for total funding of over $12 million, with successful demonstrations of zero-emissions yard trucks, electric composting, ultra-low NOx biogas engines, and other technologies.

E.7 PILOT PROJECTS

The District has long advocated for developing, demonstrating, and deploying the cleanest feasible technologies to assist in meeting the region's air quality, including supporting battery electric, hydrogen, and other technologies that have developed rapidly in recent years. In keeping with the District Governing Board's priority to bring federal and state funding resources to the Valley to support the District's clean air goals, the District has submitted multiple applications to various state and federal funding opportunities. Provided below are summaries of projects that have been awarded to the District in pursuit of important advance clean air technologies for deployment in the Valley.

E.7.1 OK Produce Zero-Emission Heavy-Duty Truck Demonstration Project

Through a competitive joint solicitation with CEC and CARB, the District was awarded $24,874,197 to support large-scale deployments of on-road, zero-emission Class 8 regional haul trucks as well as the necessary zero-emission vehicle fueling infrastructure needed for service operation. The District has partnered with OK Produce, a local delivery goods company, to demonstrate the ability of their fleet to transition from fossil-fuel to zero-emission goods delivery at their facility in Fresno, CA by deploying 50 Class 8 Volvo battery electric, zero-emission vehicles (ZEVs); deploy at least 24 dual-port direct current fast chargers (DCFC), on-site renewable energy generation, and a battery energy storage solution (BESS) to support the ZEVs. This Project will have a transformative impact environmentally on historically disadvantaged regions throughout the Valley, specifically the AB 617 designated community of South Central Fresno, California. The large-scale transition of OK Produce’s fleet to zero-emission vehicles in this region will set an important precedent for other fleets throughout the nation could emulate. This project will help further reduce emissions within the community through the commercialization and deployment of electric trucks with supporting charging infrastructure. The project is further supported through the District’s Truck Replacement Program, which will contribute additional match funding in the amount of $7,764,097.27 towards the cost of each Volvo electric truck and ensure permanent dismantling of the old diesel trucks.

E.7.2 South-Central Fresno Pepsi Delivery Truck Electrification Project

The South-Central Fresno Pepsi Delivery Truck Electrification Project is another awarded project to the District in response to a joint solicitation with CEC and CARB. The District partnered with PepsiCo, Inc. with the goal to advance the zero-emission Class 8 on-road technology and understanding of fleet dynamics when deploying many zero-emission trucks and supporting infrastructure. The project will support the deployment of 50 Class 8 Tesla battery electric semi-trucks, 8 DCFCs, electric vehicle supply equipment (EVSE) charging stations, and 2 BESSs. The CEC agreement, which totals to $9,103,710 including match, will fund the installation of the EVSE and BESS at the PepsiCo, Inc. Bottling Group, LLC (BGLLC) faculty in Fresno, CA. The deployment of the 50 Class 8 BET by New Bern Transport Corporation will be funded by the CARB agreement which totals to $17,200,000 including match. This project will be the largest collaborative deployment for PepsiCo, Inc. to date and will have a transformative environmental impact which includes an improvement to the localized air quality as well as the reduction of greenhouse gases to the AB 617 designated community of South Central Fresno.

E.7.3 Frito-Lay Zero-Emission and Near Zero-Emission Freight Facility Project

The Frito-Lay Zero-Emission and Near Zero-Emission Freight Facility Project was a partnership between the District and Frito-Lay, a division of PepsiCo, Inc., in solicitation with CARB, to implement an industry leading showcase for environmentally sustainable manufacturing, warehousing, and distribution which transformed the 500,000 square-foot manufacturing site located in Modesto, CA. The awarded $30,832,500 investment saw the Frito-Lay Facility replace all diesel-powered freight vehicles and equipment with zero-emission and near zero-emission technologies. The transformative changes to the Frito-Lay Facility included the deployment of 15 Tesla battery electric semi-trucks (BET), 6 Peterbilt battery electric box trucks, 3 Build Your Dreams battery electric yard trucks, 12 Crown battery electric forklifts, 38 Volvo compressed natural gas (CNG) trucks, as well as a CNG refueling system, 1 megawatt solar carport with energy storage, and the Tesla and ChargePoint charging infrastructure and energy storage system. This project resulted in a reduction of over 400,000 kg CO2 emissions annually, directly impacting the local community of Modesto. This project is nearing its completion with all the vehicles, equipment, and infrastructure currently being in use at the Frito-Lay Facility and serves as an example to showcase that environmentally sustainable manufacturing, warehousing, and distribution is attainable.

E.7.4 San Joaquin Valley I-5 Electric Freight Corridor (Valley EFC) Project

The District was awarded $56,008,096 in funding from the Federal Highway Administration (FHWA) to develop charging infrastructure at two critical locations for medium and heavy-duty electric vehicle (MHDEV) charging along the I-5 corridor in need of refueling infrastructure for passenger and MHDEVs. The District is partnering with WattEV, a charging infrastructure developer and pioneer of the innovative Truck-as-a-Service (TaaS) model to provide a comprehensive solution to convert fleets from diesel to zero-emission battery-electric vehicles. WattEV will provide $19,222,620 for match share towards the project cost. The two sites that make up the Valley EFC project, Taft in Kern County and Gustine in Merced County, will become the future destination to a combined 90 passenger vehicle CCS 240kW chargers, 85 commercial vehicle CCS 240kW chargers, and 17 commercial vehicle MCS 1200kW chargers. These CCS and MCS chargers, at full capacity, can provide charging to up to 42,768 trucks annually, enabling an ecosystem for consistent and reliable charging in the pursuit of a zero-emission (ZE) transportation future. This project is expected to reduce nearly 32,000 tons of greenhouse gasses (GHGs) and 55 tons of smog-forming oxides of nitrogen (NOx).

E.7.5 Flexible Solutions for Freight Facilities Project

The District was awarded $24,874,197 for the CARB funded Flexible Solutions for Freight Facilities is a project to demonstrate zero and near-zero emission technologies on locomotives and around rail yards. Wabtec designed, manufactured, and commissioned a single Battery Electric Locomotive (BEL) that was used within a diesel consist [multiple locomotives providing tractive effort] running between Stockton to Barstow, California in commercial operations. The BEL improved the fuel efficiency of the entire consist an average of 12% while simultaneously reducing the consist’s criteria pollutant and greenhouse gas emissions when compared to a conventional diesel consist. The project gave BNSF and Wabtec the opportunity to evaluate operational options for maximizing the utility of the BEL.

In addition, zero and near-zero emission equipment was demonstrated at BNSF's intermodal yards in Stockton and San Bernardino. The Stockton and San Bernardino facilities each demonstrated a Mi-Jack hybrid-electric rubber-tire gantry (RTG) crane that features an advanced battery system that achieved a greater than 70% fuel efficiency improvement. The San Bernardino facility also deployed a full-electric side loader built by Taylor Machine Works, Inc. and distributed by Mi-Jack. The project finished with an on-road zero-emission demonstration featuring BYD's Class 8 drayage truck solution, which was used for short-haul drayage operations in San Bernardino. The project also included electrical infrastructure upgrades and electric vehicle supply equipment (EVSE) to charge the series of zero and near-zero pieces of equipment and vehicles.

E.7.6 San Joaquin Valley Transit Electrification Project

The District was awarded $13,414,215 for the CARB funded The San Joaquin Valley Transit Electrification Project which provided zero-emission transit buses and supporting charging infrastructure to four Valley transit agencies. The upfront cost of battery electric buses has been a deterrent to greater deployment here in the Valley as well with many of the region's transit agencies having very little capital to make the investment to new technologies. The Project deployed with a substantial number of buses to help bring down upfront cost, to demonstrate Proterra's bus technology's ability to satisfy the range anxiety Valley transit agencies may have, and validate that with our different challenges the Valley could also be a region where zero-emission vehicles flourish.

As validation for this forecast, the City of Modesto Transit (Modesto Transit), City of Visalia Transit (Visalia Transit), Fresno County Rural Transit Agency (FCRTA), Proterra, San Joaquin Regional Transit District (San Joaquin RTD), using funding from CARB and in collaboration with the District, has led the San Joaquin Valley Transit Electrification Project to deploy fifteen (15) 40 foot Proterra electric transit buses operating in the cities of Modesto, Stockton, Visalia and in multiple communities throughout Fresno County with each transit agency providing a non-electric, existing transit bus to compare as a baseline vehicle.

E.7.7 San Joaquin Valley Zero-Emission Cargo Handling Demonstration Project

The District was awarded $772,555 for the CARB funded The San Joaquin Valley Zero-Emission Cargo Handling Demonstration Project was designed to assist with the acceleration of commercialized off-road zero-emission technologies by demonstrating two prototype state-of-the-art battery electric heavy-duty forklifts at the Port of Stockton. This demonstration benefited an AB 617 identified community and adjacent disadvantaged communities by significantly reducing greenhouse gas emissions, criteria pollutants, and toxic diesel emissions. The San Joaquin Valley Zero-Emission Cargo Handling Demonstration Project consists of the District as the grant administrator, DANNAR as the technology provider, ChargePoint as a project partner providing electric charging infrastructure, and carbonBLU as the third-party designated data collector. The Port demonstrated the two DANNAR units at their facility. Both units have forklift capabilities, but each unit also carries one additional feature. One of the units had a scissor lift attachment and the other unit has a cargo truck bed.

E.7.8 The Green On-Road Linen Delivery Project

The Green On-Road Linen Delivery Project was a collaborative effort between AmeriPride Linen Delivery Services (later acquired by Aramark), the District, Motiv Power Systems (Motiv), and CALSTART to deploy twenty-one (21) zero emission Class 6 battery electric (BEV) walk-in vans along with supporting infrastructure at four locations in the San Joaquin Valley to provide linen delivery services. The commercial pilot project involved AmeriPride locations in Stockton, Merced, Fresno and Bakersfield; all within disadvantaged communities in those cities. The vehicle powertrains were built by Motiv with the body work completed by Utilimaster with funding from a $7,125,515 grant from the California Climate Investments initiative through CARB. Additional cash match was provided by AmeriPride Linen services.

E.7.9 USPS Zero-Emission Delivery Truck Pilot Commercial Deployment Project

The District was awarded $4,555,670 from CARB funding for a pilot project in Fresno and Stockton led by the USPS, in partnership with CALSTART, Efficient Drivetrains, Inc. (EDI), which was acquired by Cummins Inc. in July 2018, Motiv Power Systems (Motiv), Morgan Olson, and Black and Veatch (B&V), to demonstrate the commercial viability of electric- powered parcel delivery trucks to replace the diesel-powered units in the USPS fleet. The project involved deployment of fifteen (15) zero-emissions parcel delivery trucks and fifteen (15) charging stations at USPS locations in Stockton (5) and Fresno (10). The project was designed to prove the efficacy of electric-powered delivery vans for mail and parcel delivery duty cycles.

The project plan called for the all-electric vans to be used in the same way as their diesel-powered counterparts, covering distances of up to 70 miles per day. The goal was to demonstrate that these vehicles are just as reliable and easy to operate as the vehicles they were replacing. The project also considered other potential costs unique to electric vehicles, such as any electrical upgrades needed to support the installation of electric vehicle charging equipment. The project scope included an evaluation of how charging the trucks affects utility demand charges, the potential benefit of on-site solar and energy storage, and examined ways to reduce electricity costs by optimizing charging schedules.

E.7.10 Valley Air ZEV Mobility Pilot Project

CARB awarded the District a total of $749,800 for the transformative implementation of advanced clean car sharing and mobility options in census tracts that are within the top 19% of disadvantaged communities. The project includes a match funding of over 60% of the total project cost for $1,160,300. This project is in partnership with Green

Commuter, as the primary subcontractor and technology provider, and CALSTART, as the evaluation coordinator.

With funding from CARB, the Valley Air ZEV Mobility Pilot Project deployed nine electric vehicles, consisting of six Chevrolet Bolts and three Tesla Model Xs, and installed 26 Level two and four level three charging stations. The charging stations are located in three areas throughout Merced and Fresno Counties, specifically in Delhi, Atwater, and Cantua Creek. The charging stations and electric vehicles provided the Cantua Creek and Delhi communities with much needed access to car sharing and vanpooling services and addressed the need for equitable access to electric vehicles and charging infrastructure within the geographic area.

E.7.11 Ecosystem of Shared Mobility Services in the San Joaquin Valley

The District was funded $3,119,000 by CARB for the implementation of the Ecosystems project by partnering and/or subcontracting with several local entities including, but not limited to: Sigala Inc.; UC Davis, Institute of Transportation Studies; Shared-Use Mobility Center (SUMC); Self-Help Enterprises, and MOVE. Funding for the Ecosystem pilot project provided by a grant from the California Air Resources Board (CARB) through the Car Sharing and Mobility Option Pilot Project solicitation. Research for the project was also supported by funding through the University of California via the Public Transportation Account and the Road Repair and Accountability Act of 2017 (Senate Bill 1) and the National Center for Sustainable Transportation, supported by the U.S. Department of Transportation (USDOT) and the California Department of Transportation (Caltrans) through the University Transportation Centers program. MioCar deployed 27 vehicles with supporting electric vehicle charging infrastructure in multiple areas of the Valley providing disadvantaged communities the opportunity to utilize a new clean air program.

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Appendix F
PRECURSOR DEMONSTRATION

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Appendix F: Precursor Demonstration for Ammonia, SOx, and ROG

[This section provided by the California Air Resources Board]

F.1 INTRODUCTION

Fine particulate matter (PM2.5) is made up of many constituent particles that are either directly emitted, such as soot and dust, or formed through complex reactions of gases in the atmosphere. Oxides of nitrogen (NOx), sulfur dioxide (SO2), volatile organic compounds (VOCs), and ammonia (NH3) are gases that are precursors to PM2.5, transforming into particles through physical and chemical atmospheric processes.

The United States Environmental Protection Agency (U.S. EPA) finalized a PM2.5 State Implementation Plan (SIP) Requirements Rule[1] (PM2.5 Rule) that identifies the four PM2.5 precursor pollutants—NOx, SO2, VOCs, and ammonia—that must be evaluated for potential control measures in any PM2.5 attainment plan. As described in the PM2.5 Precursor Demonstration Guidance[2] (Guidance) finalized by U.S. EPA in May 2019, the PM2.5 Rule permits air agencies to "submit an optional precursor demonstration designed to show that for a specific PM2.5 nonattainment area, emissions of a particular precursor from sources within the nonattainment area do not or would not contribute significantly to PM2.5 levels that exceed" the national ambient air quality standards (NAAQS). If the agency's demonstration is approved by U.S. EPA, the attainment plan "may exclude that precursor from certain control requirements under the Clean Air Act."

This document includes precursor demonstrations that the California Air Resources Board (CARB) is requesting to be excluded from certain control requirements specified in the Clean Air Act (Act) for three PM2.5 precursors: ammonia (NH3), oxides of sulfur (SOx), and reactive organic gases (ROG). The CARB inventory tracks SOx rather than SO2 specifically, but SOx consists mostly of SO2. ROG is similar, although not identical, to U.S. EPA's term "VOC."[3] CARB's inventory tracks ROG as a subset of total organic gases (TOG). NOx is an important and significant precursor to PM2.5 and is controlled extensively in the SIP. NOx emissions are essential to the attainment strategy for the San Joaquin Valley (Valley).

Following the Guidance, the three precursor demonstrations analyze "the relationship between precursor emissions and the formation of secondary PM2.5 components" using an air quality model, and take into consideration additional relevant factors.

[1] 81 FR 58010 (August 24, 2016)
[2] U.S. EPA. PM2.5 Precursor Demonstration Guidance. 30 May 2019. https://www.epa.gov/sites/default/files/2019-05/documents/transmittal_memo_and_pm25_precursor_demo_guidance_5_30_19.pdf
[3] See: California Air Resources Board. "FACT SHEET #1: Development of Organic Emission Estimates For California's Emission Inventory and Air Quality Models." Aug. 2000. Web. 24 May 2018. www.arb.ca.gov/ei/speciate/factsheetsmodeleispeciationtog082000.pdf

F.2 U.S. EPA PM2.5 PRECURSOR DEMONSTRATION GUIDANCE

U.S. EPA finalized the Guidance in May 2019 to “assist air agencies who may wish to submit PM2.5 precursor demonstrations.” The Guidance provides recommendations or guidelines, as authorized under the Act, “that will be useful to air agencies in developing the precursor demonstrations by which the U.S. EPA can ultimately determine whether sources of a particular precursor contribute significantly to PM2.5 levels that exceed the standard in a particular nonattainment area.” Recommendations include modeling procedures for conducting the required analysis and contribution thresholds to determine the impact of a precursor on PM2.5 levels. The Guidance also describes an analytical process to perform the precursor demonstration, involving a concentration-based analysis followed by a sensitivity-based analysis and consideration of additional information.

F.2.1 Concentration-Based Analysis

The evaluation of precursors begins with a concentration-based analysis using ambient data to determine whether precursor emissions contribute to total PM2.5 concentrations. Each precursor’s impact on total PM2.5 mass is compared to contribution thresholds. U.S. EPA recommends values for these thresholds, or air quality concentrations below which air quality impacts are not statistically significantly different from “the inherent variability in the measured atmospheric conditions,” and thus do not contribute to PM2.5 concentrations that exceed the NAAQS. These thresholds are ≥0.2 micrograms per cubic meter ($\mu g/m^3$) for the annual PM2.5 standard and ≥1.5 $\mu g/m^3$ for the 24-hour PM2.5 standard.

As shown below in Table F-1, based on this metric, ammonia, SO2, and VOCs contribute to total PM2.5 mass in the Valley in amounts that exceed U.S. EPA’s recommended thresholds.

Table F-1 Contribution of Ammonia, SO2, and VOCs to Total PM2.5

Species	Relevant Precursor	Species Contribution ($\mu g/m^3$) to PM2.5 Mass*	Over Threshold?
Ammonium nitrate	Ammonia	4.6	Yes
Ammonium sulfate	SO2 (SOx)	1.1	Yes
Carbonaceous aerosols	VOCs (ROG)	6.5	Yes

* 2017 annual average for Bakersfield-California

This concentration-based analysis, however, does not accurately capture the impact of reductions of precursor emissions on PM2.5 levels. Since the concentration-based analysis shows the precursors contribute to total PM2.5 mass in amounts over U.S. EPA’s recommended thresholds, CARB proceeded to conduct an optional sensitivity-based analysis to demonstrate that reductions of ammonia, SOx, and ROG will have negligible impact on PM2.5 air quality and be excluded from certain control requirements.

F.2.2 Sensitivity-Based Analysis

The PM2.5 Rule allows for a sensitivity-based analysis to examine the degree to which PM2.5 levels are sensitive to precursor reductions. According to the Guidance:

> This modeling analysis examines the sensitivity of ambient PM2.5 concentrations in the nonattainment area to decreases in precursor emissions in the area…. Where decreases in emissions of the precursor result in insignificant air quality impacts (i.e., the area is “not sensitive” to decreases), such a small degree of impact can be considered to not “contribute” to PM2.5 concentrations for the purposes of determining whether control requirements should apply.

U.S. EPA notes in the Guidance that, “where air agencies have both base year and future year modeling in support of an attainment demonstration…, precursor demonstration modeling to demonstrate that precursor emissions do not contribute significantly to PM2.5 concentrations in the nonattainment area could be done in either a base year or a future year.”

For each existing PM2.5 monitor location in the area, the first step for estimating PM2.5 impacts from ammonia, SOx, or ROG in the base year is to estimate the average PM2.5 concentration on an annual basis. The second step is to calculate the annual average PM2.5 concentration at each monitor with a specified percent reduction in precursor emissions, still in the base year. The difference between these two calculated PM2.5 values is the impact on PM2.5 levels from precursor emissions reductions. Note that “precursor demonstrations do not examine changes in emissions between a base year and a future year. Instead, the calculation of changes in PM2.5 concentrations occur between a modeled case with all emissions and a modeled case with reduced precursor emissions.” In addition, U.S. EPA recommends in the Guidance modeling reductions of between 30 and 70 percent of precursor emissions since emission reductions need to be large enough to test the interaction of the precursor. In general, the recommended range is reasonable for SO2 and NOx; however, this range is not reasonable for ammonia. As indicated in the Guidance, between 2011 and 2017, the median changes in SO2 and NOx emissions nationally were decreases of 63.6 and 31.8 percent respectively, while, in contrast, the median change in ammonia was a 0.8 percent increase in emissions. The large reductions in SO2 and NOx emissions are in response to reasonable controls that are available and in practice at sources. The slight increase nationally of ammonia is indicative of the lack of controls on ammonia sources across the nation.

The third step in the sensitivity-based analysis is to compare the modeled impact on PM2.5 levels from a decrease in ammonia, SOx, or ROG emissions to contribution thresholds for annual PM2.5. If the calculated PM2.5 impact is greater than 0.2 $\mu g/m^3$ for the 12 $\mu g/m^3$ annual standard, then PM2.5 levels are sensitive to the modeled percent reduction in ammonia, SOx, or ROG emissions.

F.2.3 Consideration of Additional Information

To supplement modeling analysis, U.S. EPA Guidance also allows an air agency to consider additional information, assessing the significance of a precursor "'based on the facts and circumstances of the area.'" The Guidance states:

> If the estimated air quality impact is greater than or equal to the recommended contribution threshold, this fact does not necessarily preclude approval of the precursor demonstration. There may be cases where it could be determined that precursor emissions have an impact above the recommended contribution thresholds, yet "do not contribute significantly" to levels that exceed the standard in the area.

In these cases, an air agency may provide U.S. EPA with "information related to other factors they believe should be considered in determining whether the contribution of emissions of a particular precursor to levels that exceed the NAAQS is 'significant' or not." Such factors may include trends in emissions of other precursors such as NOx, anticipated growth or loss of emissions sources, and impacts of modeled precursor reductions in a future year rather than the base year. U.S. EPA may also require an evaluation of available emissions controls in support of a precursor demonstration. These factors are discussed in the context of the precursor analyses for the Valley in the subsequent sections.

The following sections contain sensitivity-based analyses and supplemental information demonstrating that ammonia, SOx, and ROG are not significant precursors to PM2.5 in the Valley.

F.3 AMMONIA ANALYSIS

Ammonium nitrate (NH4NO3) is a constituent of PM2.5, making up about 19 percent of fine particulate matter mass in the Valley in 2017. Ammonium nitrate forms when nitrogen dioxide (NO2) reacts with highly oxidizing species in the atmosphere to form nitric acid (HNO3). Nitric acid then reacts with ammonia (NH3) to yield ammonium nitrate as a particle. Since ammonia reacts chemically in this way to form a particle, ammonia is a precursor to PM2.5.

Lowering PM2.5 concentrations to levels that meet the NAAQS will rely upon an effective control strategy for ammonium nitrate. The amount of ammonium nitrate that can form in the atmosphere is limited by whichever precursor, either NOx or ammonia, is in least supply, and research studies confirm that there are relatively fewer NOx molecules in the air in the Valley than ammonia. This implies that reducing NOx, the limiting precursor in this case, is more effective for reducing ammonium nitrate concentrations and thus improving PM2.5 air quality.

Following the analytical process outlined in the Guidance and summarized above, CARB has evaluated ammonia in the Valley. The results of the sensitivity-based analysis and consideration of additional information are presented below.

F.3.1 Sensitivity-Based Analysis

CARB staff used an air quality model to estimate the PM2.5 design value for the annual standard in the base year of 2017 at each Valley monitor. Then, CARB staff applied the recommended lower bound of a 30 percent reduction to ammonia emissions and used the air quality model to estimate the PM2.5 design values, as shown in Table F-2. The difference between the two design values represents the modeled impact on PM2.5 levels of a 30 percent reduction in ammonia emissions in 2017. This is the value that is compared to U.S. EPA's recommended contribution threshold for the 12 $\mu g/m^3$ annual standard of 0.2 $\mu g/m^3$ to establish if PM2.5 levels are sensitive to this level of ammonia reduction.

Table F-2 Base Year 2017 PM2.5 – 30 Percent Ammonia Reduction

Site	2017 Baseline DV	2017 DV with 30% Ammonia Reduction	Difference
Bakersfield-Planz	16.97	16.69	0.28
Hanford	15.73	15.52	0.21
Bakersfield-Golden	15.52	15.24	0.28
Visalia	15.43	15.23	0.20
Bakersfield-California	15.12	14.87	0.25
Corcoran	14.95	14.65	0.30
Fresno-Hamilton	13.99	13.85	0.14
Fresno-Garland	13.69	13.58	0.11
Turlock	12.7	12.64	0.06
Clovis	12.69	12.47	0.22
Merced-SCoffee	12.28	12.17	0.11
Stockton	12.21	12.27	-0.06
Madera	12.11	11.94	0.17
Merced-MStreet	11.73	11.63	0.10
Modesto	11.16	11.17	-0.01
Manteca	10.37	10.42	-0.05
Tranquility	8.19	8.08	0.11

For completeness, CARB staff repeated this analysis, applying the U.S. EPA-recommended upper bound of a 70 percent reduction to ammonia emissions in the 2017 base year, as shown in Table F-3.

Table F-3 Base Year 2017 PM2.5 – 70 Percent Ammonia Reduction

Site	2017 Baseline DV	2017 DV with 70% Ammonia Reduction	Difference
Bakersfield-Planz	16.97	15.93	1.04
Hanford	15.73	14.53	1.2

Site	2017 Baseline DV	2017 DV with 70% Ammonia Reduction	Difference
Bakersfield-Golden	15.52	14.4	1.12
Visalia	15.43	14.6	0.83
Bakersfield-California	15.12	14.15	0.97
Corcoran	14.95	13.49	1.46
Fresno-Hamilton	13.99	13.34	0.65
Fresno-Garland	13.69	13.1	0.59
Turlock	12.7	12.0	0.7
Clovis	12.69	11.65	1.04
Merced-SCoffee	12.28	11.37	0.91
Stockton	12.21	11.71	0.5
Madera	12.11	11.1	1.01
Merced-MStreet	11.73	11.21	0.52
Modesto	11.16	10.59	0.57
Manteca	10.37	9.94	0.43
Tranquility	8.19	7.57	0.62

From this analysis, the estimated air quality impact of reducing ammonia emissions by the lower bound of 30 percent in the base year equals or exceeds U.S. EPA's recommended annual threshold of 0.2 μg/m^3 at seven Valley monitors. Reducing emissions by the upper bound of 70 percent shows impacts above the threshold at all sites. It is not possible, however, at this point to conclude from this analysis that emissions of ammonia "significantly contribute."

In this case, ammonia emissions have an impact above the recommended contribution thresholds even at the lower bound, but, as the Guidance indicates, this does not necessarily mean the precursor contributes significantly to PM2.5 levels that exceed the NAAQS. Making the appropriate determination about the ammonia emission reduction impact requires further analysis of additional factors.

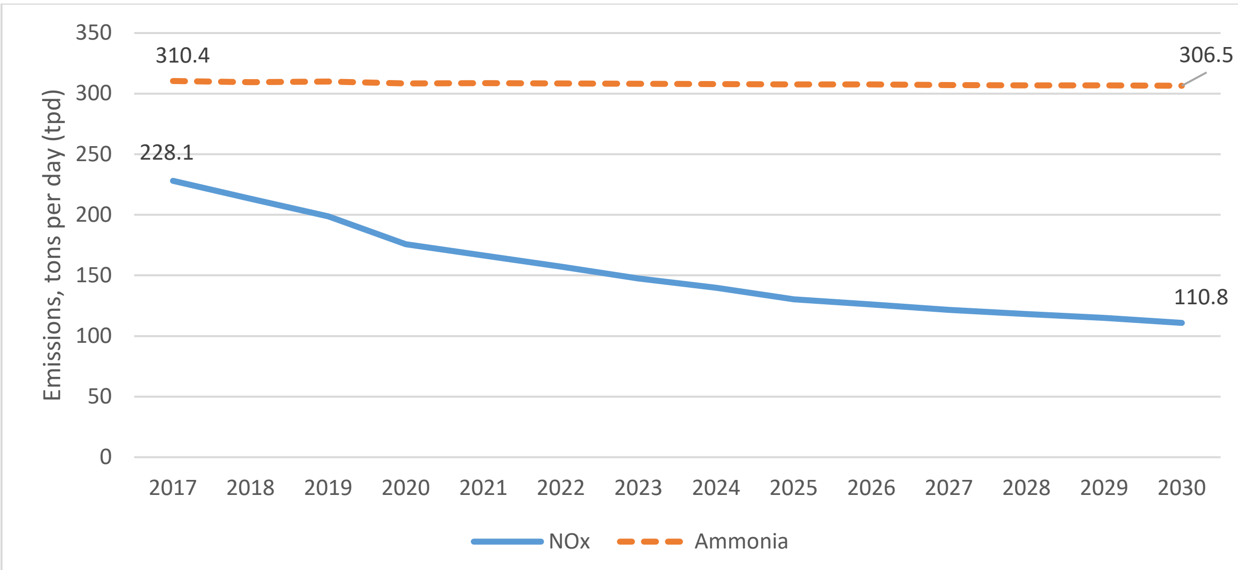
F.3.2 Consideration of Additional Information

To supplement modeling analysis, the Guidance also allows an air agency to consider additional information, assessing the significance of a precursor "'based on the facts and circumstances of the area.'" CARB staff believes that there are several critical factors that must be considered in determining whether ammonia is a significant precursor to PM2.5 in the Valley.

F.3.2.1 Emissions Trends and Studies

CARB has an extensive suite of measures in place to reduce NOx emissions from mobile sources that reduce ammonium nitrate. Between 2017 and 2030, total NOx emissions are expected to decline 117 tons per day (tpd) or 51 percent. Meanwhile, total ammonia emissions are expected to remain flat, declining 3.9 tpd or 1 percent, as shown in Figure F-1. The San Joaquin Valley Air Pollution Control District (District) adopted four rules[4] between 2004 and 2011 with measures that provided ammonia emissions reductions in the Valley; however, reductions from these existing control measures are already accounted for in the inventory, prior to the base year of 2017. In the future, emissions from the main sources of ammonia—dairies, fertilizer, and non-dairy livestock operations—are not anticipated to either increase or decrease substantially.

Figure F-1 NOx and ammonia emission trends in the San Joaquin Valley between 2017 and 2030



Source: CEPAM 2022 v 1.00

The steep downward trend of NOx emissions and the stability of ammonia emissions between 2017 and 2030 lead CARB staff to conclude that modeling the impact of ammonia emissions reductions in the future, rather than the base year, is appropriate and more representative of the Valley's emissions conditions. The Guidance states that, in some situations, it may be "more appropriate to model future conditions that provide a more representative sensitivity analysis." This approach is applicable in the Valley. After a 30 percent reduction in ammonia emissions, NOx and ammonia are of roughly similar magnitude in the base year, thereby leading to some modeled sensitivity of PM2.5 levels to a 30 percent reduction in ammonia emissions, these conditions do not persist and are not representative in the future.

As early as the 1995 Integrated Modeling Study (IMS95), in situ measurements in the San Joaquin Valley indicated the region was ammonia-saturated, which supports NOx being the controlling precursor to ammonium nitrate formation (Kumar et al., 1998[5];

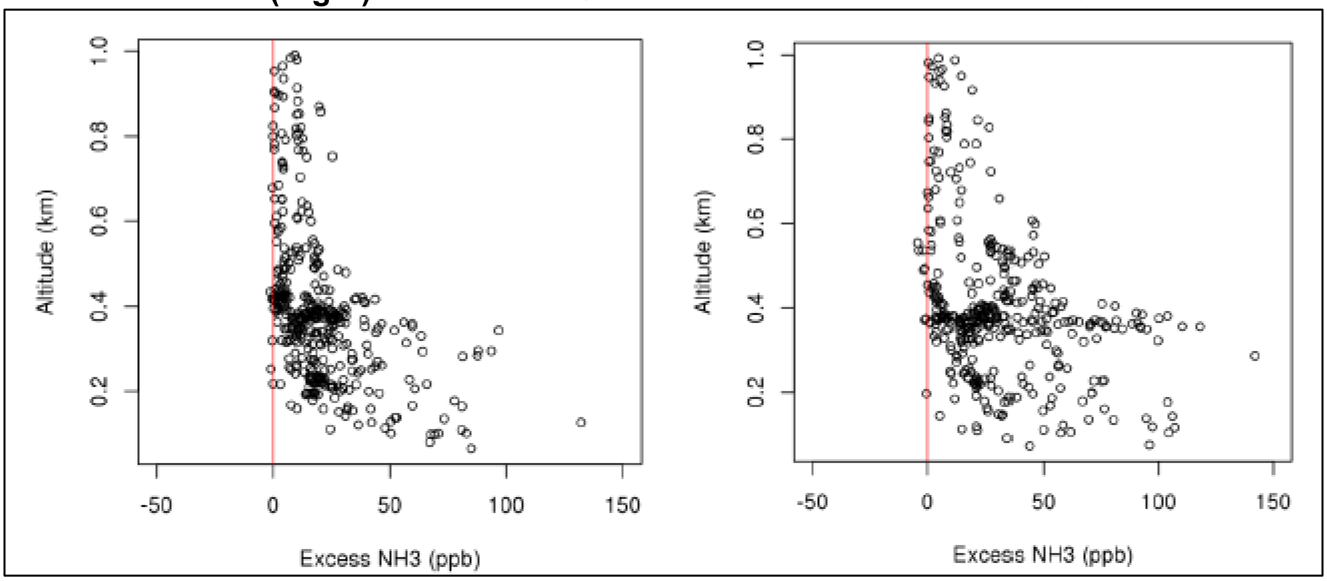
[4] District Rule 4550: Conservation Management Practices (adopted 2004); Rule 4565: Biosolids, Animal Manure, and Poultry Litter Operations (adopted 2007); Rule 4566: Organic Material Composting Operations (adopted 2011); and Rule 4570: Confined Animal Facilities (adopted 2006, amended 2010)

[5] Kumar, N.; Lurmann, F.W.; Pandis, S.; Ansari, A. *Analysis of Atmospheric Chemistry during 1995 Integrated Monitoring Study*; STI-997214-1791-FR; Report prepared for the San Joaquin Valleywide Air Pollution Study Agency, c/o the California Air Resources Board, Sacramento, CA, by Sonoma Technology, Inc.: Petaluma, CA, 1998.

Blanchard et al., 2000[6]). Wintertime measurements five years later during the CRPAQS field study (December 1999 through February 2001) were consistent with the IMS95 findings, where nearly all of the measurements were ammonia-saturated (Lurmann et al., 2006[7]). Lurmann et al. (2006) note that "[t]he consistent excess of NH3 over nitric acid levels indisputably shows that secondary ammonium nitrate formation is more limited by nitric acid availability than NH3 within the SJV and in the foothills."[8]

More recent measurements during the DISCOVER-AQ field campaign in January and February 2013 (Parworth et al., 2017[9]; and Figure F-2), support previous findings of an ammonia-saturated environment, where a small to moderate reduction in ammonia emissions is likely to have little to no effect on ammonium nitrate concentrations.

Figure F-2 Excess ammonia (NH3) in the San Joaquin Valley on Jan 18 (Left) and Jan 20 (Right) based on NASA aircraft measurements in 2013



Since ammonium nitrate formation is limited by NOx, reducing NOx emissions is the more effective strategy for reducing ammonium nitrate and PM2.5.

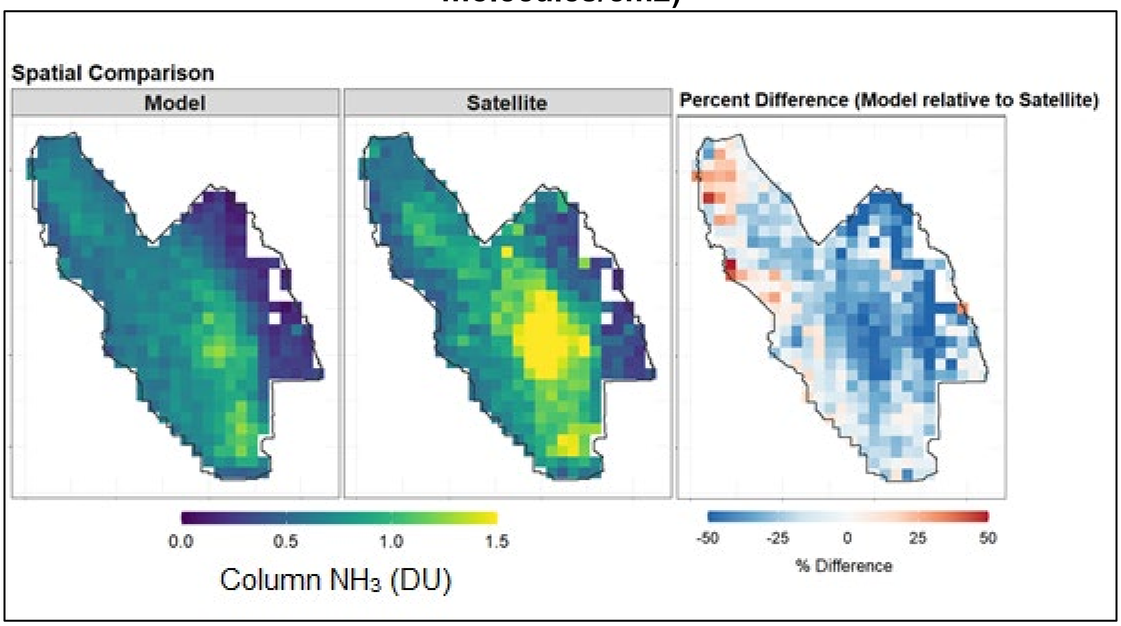
Other research has found that ammonia emission concentrations in the San Joaquin Valley are higher than currently estimated, further confirming that NOx reductions are the most effective path to reducing PM2.5. A 2017 study using satellite data also aligns

[6] Blanchard, C.L.; Roth, P.M.; Tenenbaum, S.J.; Ziman, S.D.; Seinfeld, J.H. The Use of Ambient Measurements to Identify Which Precursor Species Limit Aerosol Nitrate Formation; *J. Air & Waste Manage. Assoc.* 2000, 50, 2073-2084.
[7] Lurmann, F.W.; Brown, S.G.; McCarthy, M.C.; Roberts, P.T. Processes Influencing Secondary Aerosol Formation in the San Joaquin Valley during Winter; J. Air & Waste Manage. Assoc. 2006, 56, 1679-1693, https://doi.org/10.1080/10473289.2006.10464573
[8] Ibid. Page 1688
[9] Parworth, C.L.; Young, D.E.; Kim, H.; Zhang, X.; Cappa, C.D.; Collier, S.; Zhang, Q. Wintertime water-soluble aerosol composition and particle water content in Fresno, California, J. Geophys. Res., 122, 3155-3170, doi:10.1002/2016JD026173

with this previous research. Measurements of column-integrated ammonia[10] taken from the Infrared Atmospheric Sounding Interferometer (IASI), an instrument housed aboard the European Space Agency's MetOP-A satellite which passes over California daily, suggest that CARB's emissions inventory currently underestimates ammonia emissions in the Valley. These results suggest the modeled sensitivity to ammonia reductions is overstated and further reinforces the efforts to develop and deploy ammonia controls would not move the Valley forward on the path to reducing PM2.5 concentrations, and that NOx emissions reductions are the most effective strategy to reduce ammonium nitrate. CARB is continuing to evaluate ammonia emissions and for any updates that are made to the emissions inventory for ammonia in connection with development of future SIPs, CARB staff will hold a public process to solicit public input.

Figure F-3 shows the annual average of column ammonia in 2017 from IASI (Satellite) and Community Multiscale Air Quality (CMAQ) (Model). The model is biased low for column ammonia in the Valley. This bias is most noticeable in Tulare County, where both the model and satellite show an ammonia hotspot, but the model shows about half as much ammonia as the satellite.

Figure F-3 Maps of annual average ammonia from CMAQ (Model; left), IASI (Satellite; middle), and the percentage difference (DU, 1 DU = 2.69e16 molecules/cm2)



With these new findings from the 2017 study aligning with previous findings from IMS95, CRPAQS, and DISCOVER-AQ, CARB staff's conclusion based on the scientific analysis available continues to be that focusing on NOx emission reductions is key to improving the health of Valley residents and actions to reduce ammonia will not provide significant PM2.5 air quality improvements.

[10] Column-integrated ammonia is total ammonia in the atmosphere above a specific location, including both surface (ground-level) and aloft. Most column-integrated ammonia is found at the surface.

F.3.2.2 Future Year Modeling

Analysis of NOx and ammonia emissions trends, discussed above, indicated that modeling the impact of ammonia emissions reductions in the future, rather than the base year, is appropriate and more representative of the Valley's emissions conditions. In accordance with the Guidance, CARB staff repeated the sensitivity-based analysis of ammonia for the future attainment year of 2030. Staff used an air quality model to estimate the PM2.5 design value for the annual standard in 2030 at each Valley monitor. Then, CARB staff applied a 30 percent reduction to ammonia emissions and used the air quality model to estimate the PM2.5 design values in 2030, shown in Table F-4. The difference between the two design values represents the modeled impact on PM2.5 levels of a 30 percent reduction in ammonia emissions in the attainment year. The future-year modeling includes emission reductions from measures in the CARB-adopted 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy).[11]

Table F-4 Future Year 2030 PM2.5 – 30 Percent Ammonia Reduction

Site	2030 Baseline DV	2030 DV with 30% Ammonia Reduction	Difference
Bakersfield-Planz	14.05	13.96	0.09
Hanford	11.17	11.01	0.16
Bakersfield-Golden	12.48	12.38	0.1
Visalia	12.41	12.33	0.08
Bakersfield-California	12.39	12.3	0.09
Corcoran	10.71	10.54	0.17
Fresno-Hamilton	11.77	11.7	0.07
Fresno-Garland	11.55	11.49	0.06
Turlock	10.33	10.21	0.12
Clovis	9.91	9.8	0.11
Merced-SCoffee	9.61	9.49	0.12
Stockton	10.7	10.59	0.11
Madera	9.17	9.06	0.11
Merced-MStreet	9.96	9.9	0.06
Modesto	9.3	9.19	0.11
Manteca	8.85	8.75	0.1
Tranquility	6.37	6.29	0.08

For completeness, CARB staff repeated this analysis, applying instead the U.S. EPA-recommended upper bound of a 70 percent reduction to ammonia emissions in 2030, as shown in Table F-5.

[11] CARB. 2022 State Strategy for the State Implementation Plan. 22 Sept. 2022. https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf

Table F-5 Future Year 2030 PM2.5 – 70 Percent Ammonia Reduction

Site	2030 Baseline DV	2030 DV with 70% Ammonia Reduction	Difference
Bakersfield-Planz	14.05	13.75	0.30
Hanford	11.17	10.66	0.51
Bakersfield-Golden	12.48	12.17	0.31
Visalia	12.41	12.15	0.26
Bakersfield-California	12.39	12.1	0.29
Corcoran	10.71	10.11	0.60
Fresno-Hamilton	11.77	11.53	0.24
Fresno-Garland	11.55	11.34	0.21
Turlock	10.33	9.96	0.37
Clovis	9.91	9.58	0.33
Merced-SCoffee	9.61	9.23	0.38
Stockton	10.7	10.36	0.34
Madera	9.17	8.78	0.39
Merced-MStreet	9.96	9.76	0.20
Modesto	9.3	8.96	0.34
Manteca	8.85	8.54	0.31
Tranquility	6.37	6.12	0.25

From this analysis, in 2030, the modeled air quality impact of reducing ammonia emissions by 30 percent falls under U.S. EPA's recommended threshold of 0.2 μg/m^3 at all Valley monitor sites. The estimated air quality impact of reducing ammonia emissions by the upper bound of 70 percent in 2030 exceeds U.S. EPA's recommended threshold at all sites.

F.3.2.3 Available Emissions Controls

Another factor that may be considered as additional information for this analysis is available emissions controls on ammonia. The availability of ammonia emissions controls is relevant to the decision-making process, influencing the extent of reasonable modeled reductions. While U.S. EPA recommends modeling emissions reductions of between 30 and 70 percent to estimate PM2.5 impacts, these percentage were based on the change seen nationally in NOx and SO2 reductions between 2011 and 2017. During that same time, ammonia emissions increased slightly, indicating limited control opportunities. CARB staff, District staff, and the public process also have not identified specific controls that are technologically and economically feasible to achieve reductions at the low end of the recommended sensitivity range (i.e., 30 percent), much less at the upper end of the range.

At U.S. EPA staff's request, CARB and the District developed a supplemental document on ammonia as a PM2.5 precursor to support the Attainment Plan Revision for the 1997 Annual PM2.5 Standard (15 μg/m^3 SIP Revision) which CARB submitted in 2021. The supplemental document—Ammonia: Supplemental Information for EPA in Support of 15 μg/m^3 Annual PM2.5 Standard (Ammonia Supplemental Information for the 15 μg/m^3

SIP Revision)[12]—expanded on earlier analyses, assessing potential controls on ammonia sources identified by U.S. EPA to analyze the appropriateness of the 30 percent reduction threshold for the precursor analysis, relevant to the 15 µg/m^3 annual PM2.5 standard. CARB submitted the Ammonia Supplemental Information for the 15 µg/m^3 SIP Revision to U.S. EPA in March 2023. U.S. EPA proposed approval of the 15 µg/m^3 SIP Revision, including the precursor demonstration for ammonia, on July 14, 2023.[13] The information in this section of the Precursor Demonstration builds on the analysis and conclusions presented in the Ammonia Supplemental Information for the 15 µg/m^3 SIP Revision, relevant here to the 12 µg/m^3 annual PM2.5 standard.

It is important to note that not all control measure concepts are appropriate to be submitted into the SIP as rules. Any rules that are submitted into the SIP must meet U.S. EPA requirements, and must:

- Include enforceable emission limitations and other control measures, means, or techniques, as well as schedules and timetables for compliance, as may be necessary to meet the requirements of the Clean Air Act [Act section 110(a)(2)(A)];
- Provide necessary assurances that the State will have adequate personnel, funding, and authority under State law to carry out such SIP (and is not prohibited by any provision of federal or state law from carrying out such SIP) [Act section 110(a)(2)(E)];
- Be adopted by a State after reasonable notice and public hearing [Act section 110(l)]; and
- Not interfere with any applicable requirement concerning attainment and reasonable further progress, or any other applicable requirement of the Act [Act section 110(l)].

The supplemental evaluation of potential controls on ammonia sources identified by U.S. EPA is found below.

F.3.2.3.1 Evaluation of Potential Controls on Ammonia Emissions Sources

The District and CARB analyzed potential control measures to reduce ammonia emissions in order to evaluate whether a 30 percent reduction in ammonia emissions is feasible. For an effective control measure evaluation, it is necessary to characterize and understand the key sources of ammonia in the Valley.

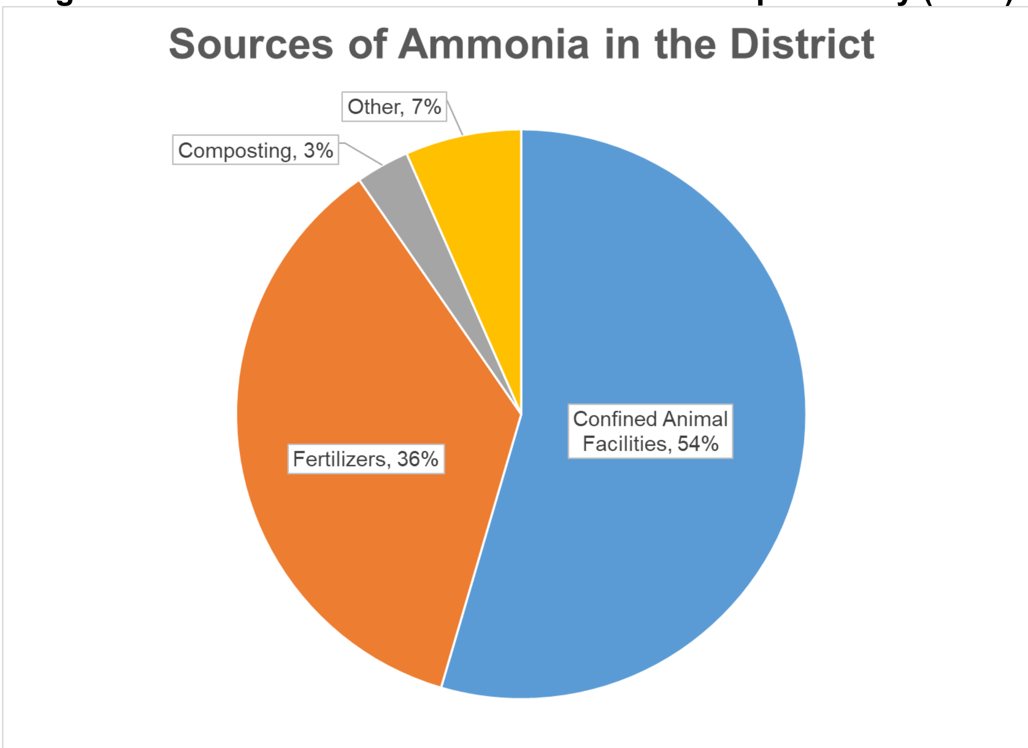
The three main sources of ammonia emissions in the Valley from stationary and area sources, which account for 93 percent of the Valley's ammonia emissions[14], are the focus of the evaluation. Since the attainment year for this SIP is 2030, data and figures below reflect the projected ammonia inventory for that year. The increased level of

[12] CARB. Ammonia: Supplemental Information for EPA in Support of 15 µg/m3 Annual PM2.5 Standard. March 2023. https://ww2.arb.ca.gov/sites/default/files/2023-04/AmmoniaSupplementalInformation.pdf
[13] See 88 FR 45276. (July 14, 2023). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2023-07-14/pdf/2023-14687.pdf
[14] Based on CEPAM 2022 v 1.00 Annual Average Emissions Inventory for 2030

control due to the implementation of District rules and regulations is already incorporated into the projected emission inventory.

- Confined Animal Facilities (CAFs) with 167.2 tons per day (tpd);
- Agricultural Fertilizers at 109.9 tpd; and
- Composting Solid Waste Operations at 9.3 tpd.

Figure F-4 Sources of Ammonia in the San Joaquin Valley (2030)



Since the primary source of ammonia emissions in the Valley are from CAFs, the District focused its evaluation on the different types of animal operations, specifically dairies, which account for the majority of ammonia emissions.

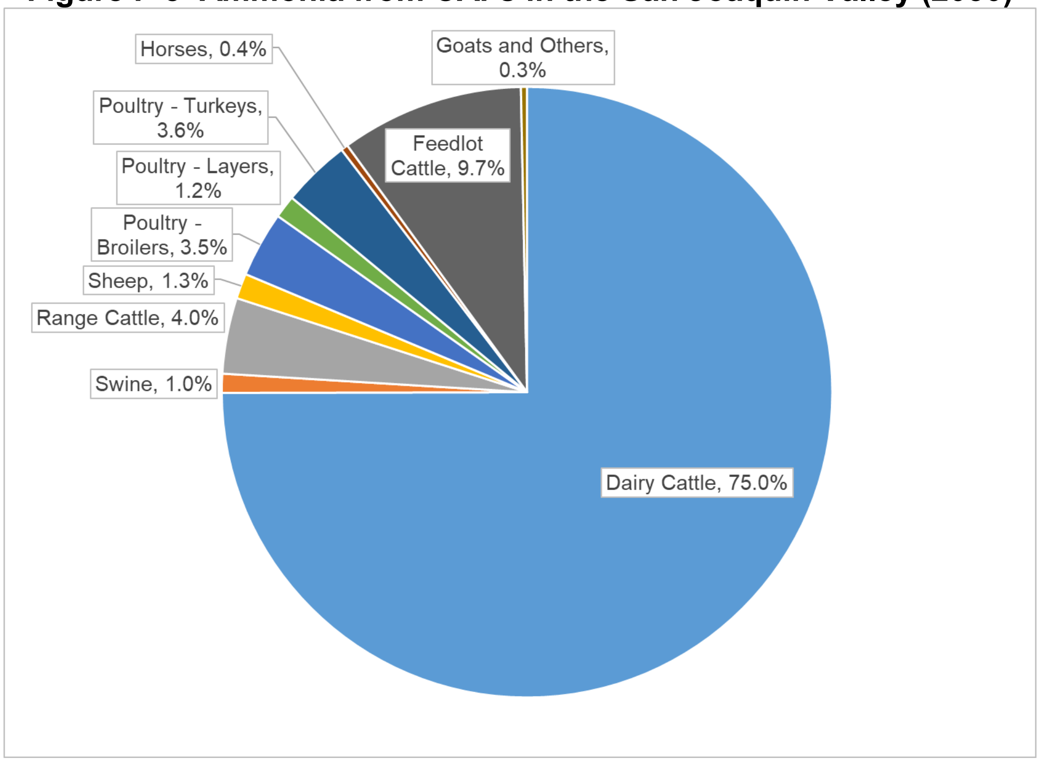
The total ammonia emissions in the Valley in 2030 are 306.5 tons per day. As shown in Table F-6 below, to reduce the total ammonia emissions by 30 percent, 50 percent, and 70 percent, emissions from CAFs would need to be further reduced by 55 percent, 92 percent, and 128 percent respectively. As shown in the evaluation below, the District has only identified a few measures that have the theoretical potential to reduce additional ammonia emissions, which may achieve a total of up to 2 percent reduction in emissions notwithstanding technological and economic feasibility considerations. These reductions are not capable of achieving the lower bound level of 30 percent reductions, and the 50 percent and 70 percent reduction levels are infeasible.

Table F-6 CAF Emission Reduction Analysis

	30% Reduction	50% Reduction	70% Reduction
Theoretical Ammonia Reductions (tpd)	91.9	153.2	214.5
% reduction required from CAFs	55%	92%	128%

As shown below in Figure F-5, dairy cattle emissions account for 75.0 percent of ammonia emissions from CAFs.

Figure F-5 Ammonia from CAFs in the San Joaquin Valley (2030)



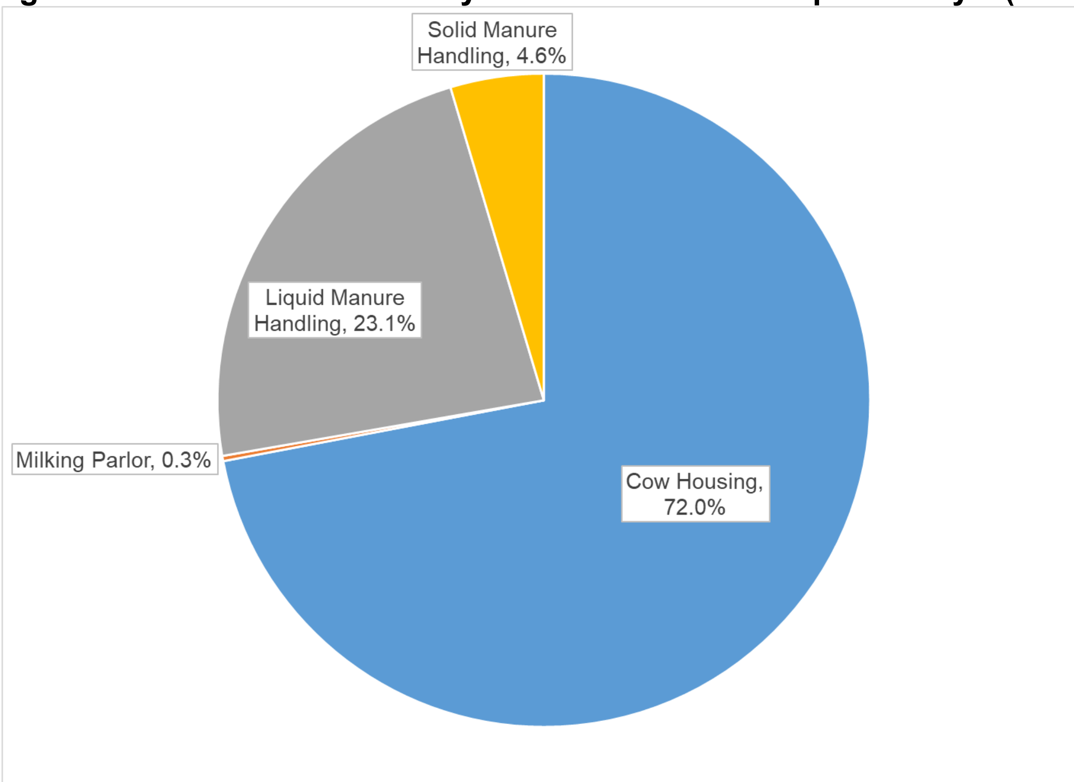
The total ammonia emissions in the Valley in 2030 are 306.5 tons per day. As shown in Table F-7 below, to reduce the total ammonia emissions by 30 percent, 50 percent, and 70 percent, emissions from dairy cattle would need to be reduced by 73 percent, 122 percent, and 171 percent, respectively.

Table F-7 Dairy Cattle Emission Reductions Analysis

	30% Reduction	50% Reduction	70% Reduction
Theoretical Ammonia Reductions (tpd)	91.95	153.24	214.54
% reduction required of dairy cattle	73%	122%	171%

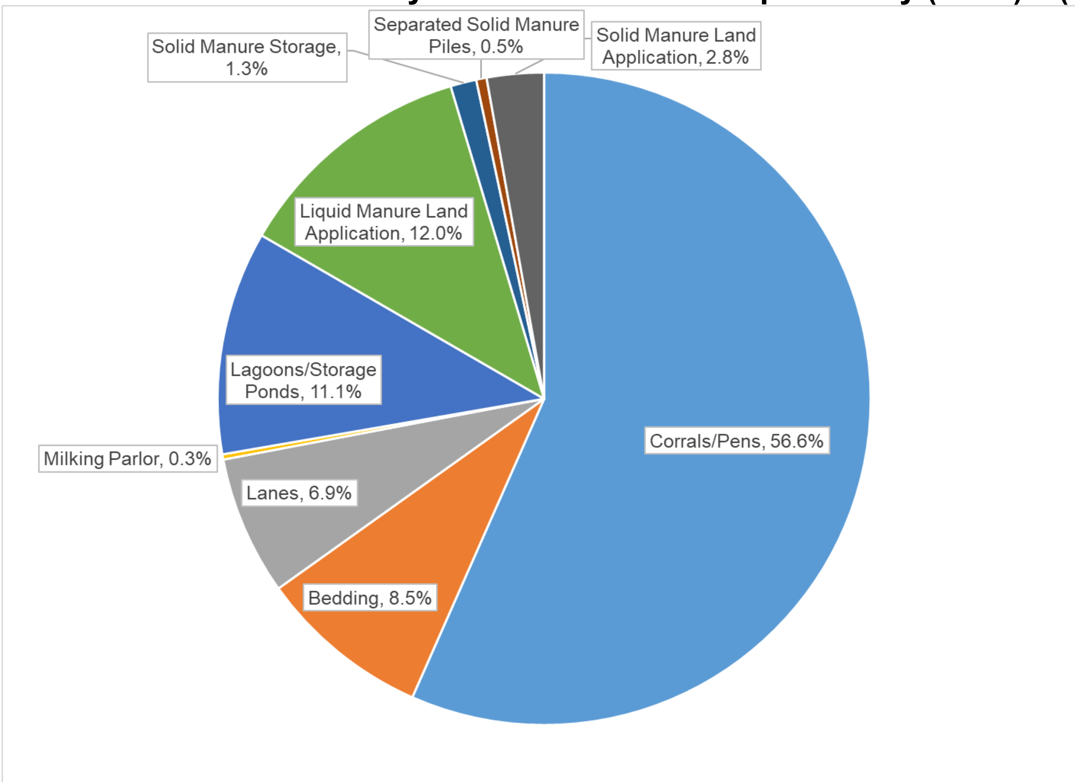
As shown in Figure F-6, the primary source of ammonia emissions from dairy cattle is cow housing (72 percent). Figure F-7 further evaluates ammonia emissions from dairy cattle by illustrating the different categories such as corrals/pens (56.6 percent), liquid manure land application (12 percent), and lagoons/storage ponds (11.1 percent), etc. Accordingly, the District has provided an evaluation of mitigation measures for dairy cattle focusing on housing, land application techniques, and solid and liquid manure handling.

Figure F-6 Ammonia from Dairy Cattle in the San Joaquin Valley[15] (2030)



[15] Based on District ammonia emission factors for dairy cattle.

Figure F-7 Ammonia from Dairy Cattle in the San Joaquin Valley (cont.)[16] (2030)



Based on the emission inventory analysis above, reducing ammonia emissions by the lower bound precursor demonstration threshold of 30 percent would require eliminating over 50 percent of ammonia emissions from CAFs, or over 70 percent of emissions from only dairy cattle, beyond the ammonia emission reductions already achieved by the requirements of District Rule 4570 (Confined Animal Facilities). A 70 percent reduction of ammonia emissions in the District would require the elimination of all CAFs in the District in addition to other categories that have already achieved significant ammonia reductions.

F.3.2.3.2 Inventory of Confined Animal Facilities in the Valley

The District reviewed current permitted facilities in the Valley. Demonstrated below in Table F-8 is the count of permitted facilities by type that are subject to Rule 4570, and the controlled ammonia emissions from each type of facility.

[16] Ibid.

Table F-8 Inventory of Confined Animal Facilities in the Valley (2030)

Facility Type	# of Facilities Subject to Rule 4570[17]	Ammonia Emissions from Facility Type (tpd)
Dairies	859	125.3
Beef Feedlots	6	16.2
Other Cattle	17	6.7
Chicken – Broilers	47	5.8
Chicken – Layers	12	2.0
Turkeys	19	6.0
Swine	1	1.7

F.3.2.3.3 District Rule 4570 (Confined Animal Facilities)

Background

The largest source of ammonia in the Valley is CAFs. The District has implemented Rule 4570 to reduce emissions from this source category, and requires the most stringent requirements for reducing emissions from CAFs in the nation. Rule 4570 was originally adopted on June 15, 2006, and was again amended on October 21, 2010. District Rule 4570 applies to facilities where animals are corralled, penned, or otherwise caused to remain in restricted areas and primarily fed by a means other than grazing for at least 45 days in any twelve-month period. In addition to limiting volatile organic compound (VOC) emissions, District Rule 4570 includes measures that limit ammonia emissions from these operations.

Evaluation of District Rule 4570

District Rule 4570 includes multiple mitigation measures that control ammonia emissions from CAFs. Since these facilities generally cover a large area and have different processes, a single mitigation measure or technology is generally not sufficient to control overall emissions from the facility. Due to the varying types of operations and emissions sources at these facilities, each CAF requires a site-specific constellation of measures to achieve overall emission reductions.

District Rule 4570 includes a large number of measures that must be implemented by each CAF and also requires additional measures to be selected from a menu of mitigation measures options to achieve additional emission reductions. The menu approach gives the facilities the flexibility to achieve the required emission reductions by selecting mitigation measures that are most practical and effective for their operation. As discussed in the District staff report for the 2010 amendments to District Rule 4570,[18] the design and operation of each CAF differs depending on animal type, regional climatic conditions, business practices, and the preferences of the owners/operators. Because of this, no two CAFs are identical. In addition to air quality

[17] Review of District permits database (May 2023)
[18] SJVAPCD. *Staff Report for 2010 Amendments Rule 4570 (Confined Animal Facilities).* Available at: http://valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2010/October/Agenda_Item_7_Oct_21_2010.pdf

regulations, CAFs are subject to other regulations to protect water quality and the environment. These additional regulations often restrict how CAFs can operate.

It is not feasible for all CAFs to implement the same measures due to various factors, such as infrastructure, conditional use permits, water quality regulations, production contracts, and other limitations. The options included in District Rule 4570 provide the owners and operators of CAFs much-needed flexibility to choose the mitigation measures that make the best environmental and economic sense for their facility, while maximizing the amount of emission reductions.

F.3.2.3.4 Other Air District Rules

The District provided an in-depth review of Rule 4570 in Appendix C of the *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (*2018 PM2.5 Plan*), [19] including a comprehensive analysis of Rule 4570, in which the District compared emissions limits, optional control requirements, and work practices in Rule 4570 to comparable requirements in rules from the following areas:

- South Coast Air Quality Management District (SCAQMD) Rule 223 (Emission Reduction Permits for Large Confined Animal Facilities);
- SCAQMD Rule 1127 (Emission Reductions from Livestock Waste);
- Bay Area Air Quality Management District (BAAQMD) Regulation 2, Rule 10 (Large Confined Animal Facilities);
- Ventura County Air Pollution Control District (VCAPCD) Rule 23 (Exemptions from Permit);
- Sacramento Metropolitan Air Quality Management District (SMAQMD) Rule 496 (Large Confined Animal Facilities);
- Imperial County Air Pollution Control District (ICAPCD) Rule 217 (Large Confined Animal Facilities Permits Required) and Policy Number 38 (Recommended Mitigation Measures for Large Confined Animal Facilities); and
- Idaho Administrative Procedure Act 58.01.01 Sections 760-764 (Rules for the Control of Ammonia from Dairy Farms);

In addition to these rules, the District's *2016 Plan for the 2008 8-hour Ozone Standard* (*2016 Ozone Plan*)[20] included a comparison of District Rule 4570 to requirements from the following:

- Butte County Air Pollution Control District (BCAQMD) Rule 450 (Large Confined Animal Facilities); and
- Yakima Regional Clean Air Agency (Air Quality Management Policy and Best Management Practices for Dairy Operations).

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[19] SJVAPCD. *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards*. Appendix C, pages C-311 – C-339. Available at: https://www.valleyair.org/pmplans/documents/2018/pm-plan-adopted/2018-Plan-for-the-1997-2006-and-2012-PM2.5-Standards.pdf

[20] SJVAPCD. *2016 Plan for the 2008 8-hour Ozone Standard*. Available at: http://valleyair.org/Air_Quality_Plans/Ozone-Plan-2016/Adopted-Plan.pdf

Through the rule comparisons included in the *2022 Ozone Plan*, *2018 PM2.5 Plan*, and the *2016 Ozone Plan*, the District demonstrated that Rule 4570 was more stringent than the above rules in other areas, at the time of each plan's adoption. The areas mentioned above have not changed or amended their respective rules since the District's previous evaluations, except for the Yakima Regional Clean Air Agency, which rescinded their policy for dairies in 2018. The District has found no new requirements in other areas, but has reevaluated the rules above and found that Rule 4570 continues to implement the most stringent requirements for CAFs.

F.3.2.3.5 Federal Actions and Guidance

The evaluation of appropriate practices and measures to reduce emissions from confined animal facilities requires accurate methodologies to estimate emissions. The National Academy of Sciences identified the lack of methodologies to estimate emissions from animal feeding operations (AFOs) in 2002. In response, U.S. EPA announced an opportunity for AFOs to sign a voluntary consent agreement and final order known as the Air Compliance Agreement (2005).[21] The goal of the agreement was to develop scientifically credible methodologies for estimating emission models produced by AFOs. AFOs that chose to participate in the agreement provided the funding for the National Air Emissions Monitoring Study (NAEMS). As part of the agreement, U.S. EPA agreed not to sue participating AFOs for certain violations of the Act, Compensation, and Liability Act (CERCLA), and Emergency Planning and Community Right-to-Know Act (EPCRA), provided that the AFOs comply with the agreement's conditions.

The NAEMS monitored 25 AFOs in various regions of the country to have equipment installed for ammonia, hydrogen sulfide, particulate matter, and VOC emissions monitoring. Separate draft models of swine, poultry, and dairy AFOs emissions were created using the monitoring data and input from the U.S. EPA Science Advisory Board.[22]

While data collection took place from 2007 to 2010, these draft models only became publicly available in August 2020, August 2021, and June 2022 for swine, poultry, and dairy AFOs respectively. U.S. EPA's final models to estimate emissions from AFOs are not yet available. Currently, U.S. EPA projects that finalization of all draft models will occur in late 2023.[23] Though U.S. EPA has not provided final guidance on emission estimation methodologies for CAFs, the District has reviewed information from U.S. EPA and many other sources in order to use the best information available to calculate emissions from CAFs.

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[21] See 70 FR 4958. (January 31, 2005). Retrieved from: https://www.epa.gov/sites/default/files/2016-06/documents/afolagooneemreport2012draftappe.pdf
[22] Livestock and Poultry Environmental Learning Community. *NAEMS: How It Was Done and Lessons Learned*. April 20, 2022. Retrieved from: https://lpelc.org/naems/
[23] EPA. *National Air Emissions Monitoring Study*. Retrieved from: https://www.epa.gov/afos-air/national-air-emissions-monitoring-study#naems-status

F.3.2.3.6 District Efforts

The District first began permitting agricultural sources in 2004, and since that time District staff members have gained a great deal of experience in the evaluation of emissions from agricultural sources through collaborative efforts with other institutions, agencies, and interested stakeholders. The District has also been thoroughly involved in collaborative scientific research efforts to evaluate emissions from agricultural sources. This is particularly true of the agricultural emissions research efforts in California. The District has played an important role in coordination of these efforts through the San Joaquin Valleywide Air Pollution Study Agency (Study Agency) and the Study Agency's Agricultural Air Quality Research Committee (AgTech). The District has also been at the forefront of developing and implementing regulations to reduce emissions from CAFs.

The District will continue to track the development of rules, regulations, research/studies, and practices for CAFs to ensure the best available control measures and most stringent measures are in place in the Valley, in coordination with industry stakeholders, researchers, CARB, and other agencies.

F.3.2.3.7 Evaluation of Mitigation Measures for Confined Animal Facilities

In the Federal Register posting for the proposed partial approval and partial disapproval of portions of the state implementation plan revisions for the 1997 annual PM2.5 standard,[24] U.S. EPA indicates that further evaluation of potential control measures for ammonia sources is needed. In U.S. EPA's proposed disapproval of portions of the *2018 PM2.5 Plan* for the 2012 annual PM2.5 standard,[25] U.S. EPA refers to several studies that were cited in a Public Justice comment letter[26] that evaluate CAF mitigation measures that have the potential to achieve additional ammonia reductions. In the same proposal, U.S.EPA noted that the United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) has collaborated to develop a "Reference Guide for Poultry and Livestock Production Systems" (NRCS Reference Guide) [27] that lists 12 measures that may reduce ammonia emissions by more than 30 percent. U.S. EPA also cited a 2011 inventory of mitigation methods by Price et al. prepared for the UK government (UK User Guide) that identifies several ammonia mitigation methods for UK farms.[28]

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[24] See 86 FR 38662. (July 22, 2021). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2021-07-22/pdf/2021-15551.pdf

[25] See 87 FR 60494. (October 5, 2022). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2022-10-05/pdf/2022-21492.pdf

[26] Public Justice, et al. (January 28, 2022). Group Comment Letter *Re: Clean Air Plans; 2012 Fine Particulate Matter Serious Nonattainment Area Requirements; San Joaquin Valley, California*; EPA-R09-OAR-2021-0884. Retrieved from: https://www.regulations.gov/comment/EPA-R09-OAR-2021-0884-0136

[27] EPA-USDA NRCS. "Reference Guide for Poultry and Livestock Production Systems." September 2017. Retrieved from: https://www.epa.gov/sites/default/files/2017-01/documents/web_placeholder.pdf

[28] Price et al., "An Inventory of Mitigation Methods and Guide to their Effects on Diffuse Water Pollution, Greenhouse Gas Emissions and Ammonia Emissions from Agriculture, User Guide," December 2011. Retrieved from: https://repository.rothamsted.ac.uk/download/942687eab7ec4b83751c7e241d62f0fa8472d72adcd25a149bb891b7c30d55d0/1595300/MitigationMethods-UserGuideDecember2011FINAL.pdf

Following the proposed disapprovals and several meetings with U.S. EPA Region 9 staff, the District was provided with a list of mitigation measures generated by EPA Region 9 staff for evaluation, many of which the District has already evaluated over the years. As discussed earlier, it is also important to note that U.S. EPA has been committed to addressing emission from livestock operations under a voluntary “safe harbor” consent agreement put into place by U.S. EPA in 2005. While the San Joaquin Valley has regulated emissions from livestock operations since 2005, U.S. EPA is still in the process of evaluating emissions and establishing the regulatory framework under this consent agreement, and the District will continue supporting the national effort to address emissions from these operations. This list encompassed publications that evaluated potential ammonia emission reductions for either individual mitigation measures or compilations of mitigation measures. The publications provided to the District included a wide variety of mitigation measures such as reducing crude protein content in feed, litter amendments, injection/incorporation of manure, changing land use from arable to woodland, and reducing human consumption of meat and eggs.

Though some of the suggested measures have related studies that appear to demonstrate potential feasibility, it is imperative to consider the conditions under which the studies were performed and how those conditions compare to the Valley. Several of the studies evaluated were conducted in areas outside of California, and many outside of the nation. Notably, CAFs in the Valley face unique challenges, including hot, dry summers, drought conditions, and strict water regulations, which may not have been considered in some of the publications and studies that evaluated these methods. Valley dairies in particular are typically much larger than dairies in other areas. Based on information from the USDA National Agricultural Statistics Service, the average dairy in the Valley has almost 1,600 cows compared to a national average of less than 300 cows per dairy outside of California.[29, 30] The UK User Guide, which contains many of the measures evaluated in this document, indicated that the average UK dairy has 170 cows. The differences in climate, typical management practices, size of operations, and regulatory environment affect the types of mitigation measures that can be applied to each operation.

Many of the mitigation measures for consideration by U.S. EPA were not applicable to the Valley, were unreasonable or unenforceable, or were based on limited applicability in California (e.g., research conducted in other countries with drastically different operating and natural characteristics). The complete list of potential mitigation measures provided by U.S. EPA Region 9 staff can be found in Appendix A of the Ammonia Supplemental Information for the 15 µg/m^3 SIP Revision.[31] The District’s evaluation of all potential mitigation measures provided by U.S. EPA is included in the following sections.

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[29] Hanson, M. (2021) U.S. Dairy Herd Hits 27-year High. *Dairy Herd Management.* Retrieved from: https://www.dairyherd.com/news/dairy-production/us-dairy-herd-hits-27-year-high

[30] Latest USDA Statistics for average size of dairies excluding California, retrieved from: https://downloads.usda.library.cornell.edu/usda-esmis/files/h989r321c/7d279w693/f7624g40c/mkpr0222.pdf (about 270 cows per dairy outside California)

[31] CARB. Ammonia: Supplemental Information for EPA in Support of 15 µg/m3 Annual PM2.5 Standard. March 2023. https://ww2.arb.ca.gov/sites/default/files/2023-04/AmmoniaSupplementalInformation.pdf

Nutrition and Feed Management (Feeding)

Table F-9 Nutrition and Feed Management Measures Evaluated

Method	Measure	CAF Type	Reference
Reducing Crude Protein (Beef)	Influence of Dietary Crude Protein Concentration and Source on Potential Ammonia Emissions from Beef Cattle Manure	Beef	Preece[32]
	Reducing Crude Protein in Beef Cattle Diet Reduces Ammonia Emissions from Artificial Feedyard Surfaces	Beef	Todd[33]
	Reduce Dietary Crude Protein in Beef Cattle	Beef	Cole (2005)[34]
Reducing Crude Protein (Dairy)	Reducing Dietary Protein Decreased the Ammonia Emitting Potential of Manure from Commercial Dairy Farms	Dairy	Hristov[35]
Reducing Crude Protein (Swine)	Reduce Crude Protein Content from Finishing Pig Houses	Swine	Hayes[36]
Feed Timing	Phase, Group, and Split Sex-Feeding	Beef	Cole (2006)[37]
	Group and Phase Feeding	All	NRCS[38]
	Phase Feeding	All	Guthrie[39]

[32] Preece, Sharon L.M. et al., ''Ammonia Emissions from Cattle Feeding Operations,'' Texas A&M AgriLife Extension Service, referring to Cole, N.A., R.N. Clark, R.W. Todd, C.R. Richardson, A. Gueye, L.W. Greene, and K. McBride, ''Influence of Dietary Crude Protein Concentration and Source on Potential Ammonia Emissions from Beef Cattle Manure,'' Journal of Animal Science 83:(3), 722 (2005)

[33] Todd, R.W., N.A. Cole, and R.N. Clark, ''Reducing Crude Protein in Beef Cattle Diet Reduces Ammonia Emissions from Artificial Feedyard Surfaces.'' Journal of Environmental Quality. 35:(2), 404–411 (2006).

[34] Cole, N., et al., Influence of dietary crude protein concentration and source on potential ammonia emissions from beef cattle manure. J. Anim. Sci. 83, 722 (2005).

[35] Hristov, A. N., Heyler, K., Schurman, E., Griswold, K., Topper, P., Hile, M., ... & Dinh, S. (2015). CASE STUDY: Reducing dietary protein decreased the ammonia emitting potential of manure from commercial dairy farms. The Professional Animal Scientist, 31(1), 68-79

[36] Hayes ET, Leek AB, Curran TP, et al. The influence of diet crude protein level on odour and ammonia emissions from finishing pig houses. Bioresource Technology, 2004

[37] Cole NA, Defoor PJ, Galyean ML, Duff GC, Gleghorn JF. "Effects of phase-feeding of crude protein on performance, carcass characteristics, serum urea nitrogen concentrations, and manure nitrogen of finishing beef steers", Journal of Animal Science, 2006

[38] EPA-USDA NRCS. "Reference Guide for Poultry and Livestock Production Systems." September 2017. Retrieved from: https://www.epa.gov/sites/default/files/2017-01/documents/web_placeholder.pdf

[39] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

Method	Measure	CAF Type	Reference
Wet Distillers Grain	Reduce Feeding of Wet Distillers Grain	Beef	Todd[40]
Grazing	Increase Grazing Time for Dairy Cattle	Dairy	Guthrie
Feed Additives	Feed Additives for Poultry	Poultry	NRCS

Reducing Crude Protein Content for Beef Cattle - ***(applies to beef cattle only)***

U.S. EPA noted that studies in 2005 and 2006 found that "*decreasing the crude protein concentration of beef cattle finishing diets based upon steam-flaked corn from 13 to 11.5 percent decreased ammonia emissions by 30 to 44 percent.*"

In the 2005 study, steers were randomly assigned to one of nine dietary treatments (three formulated dietary crude protein (CP) concentrations and three supplemental urea: cottonseed meal ratios). Steers were confined to tie stalls, and feces and urine excreted were collected and frozen after approximately 30, 75, and 120 days on feed. As protein concentration in diet increased from 11.5 to 13 percent, in vitro daily ammonia emissions increased 60 to 200 percent, due primarily to increased urinary nitrogen excretion. As days on feed increased, in vitro ammonia emissions also increased.

This study had a small sample size with 54 cattle used for nine dietary treatments (six cattle per treatment). These results are only applicable to the finishing cycle of beef cattle lives (four to six months of age), and not applicable to milk cows and support stock at dairies. There are very few finishing cycle feeder beef cattle in the Valley. Most beef cattle in California are beef calves and stockers, fed through grazing. Most of these cattle are sent outside of California for the finishing cycle.[41, 42]

Notably, beef finishing cattle make up a small part of the overall inventory of cattle in the Valley. The current feedlot cattle inventory includes all feedlot cattle; however, the lives of beef cattle are divided into different phases of production. Cow and calf pairs are raised on rangeland. Weaned yearlings/stockers may continue to be raised on rangeland or be sent to yearling/stocker feedlots until a weight of approximately 800 to 900 pounds. Finally, beef cattle are sent to other feedlots out of California for the finishing phase, in which the cattle are fed for four to six months until they reach the desired finished weight. Because of the higher cost of feeding cattle in California and

[40] Todd, R.W., N.A. Cole, D.B. Parker, M. Rhoades, and K. Casey. 2009. "Effect of Feeding Distillers Grains on Dietary Crude Protein and Ammonia Emissions from Beef Cattle Feedyards." In Proceedings of the Texas Animal Manure Management Issues Conference, 83–90.
[41] Andersen, M.A., Blank, S.C., LaMendola, T, Sexton, R.J., "California's Cattle and Beef Industry at the Crossroads", California Agriculture 56(5),152-156. Retrieved from: https://doi.org/10.3733/ca.v056n05p152
[42] Saitone, T.L., "Livestock and Rangeland in California", Livestock and Rangeland in California. Retrieved from: https://s.giannini.ucop.edu/uploads/giannini_public/94/c1/94c100fd-9626-47d4-8b82-0bfdb1081a57/livestock_and_rangeland.pdf

the lack of sufficient beef processing capacity, most of feedlot cattle in California are yearlings/stockers for which this measure does not apply.[43]

If dietary protein concentrations are decreased to the point that animal performance is adversely affected, then total ammonia emissions could be increased because animals require more days on feed to reach market weight and condition. There was also little change in ammonia between the 13 percent and 14.5 percent CP groups.

In the 2006 study, two groups of steers were fed diets with either 11.5 or 13 percent CP and all urine and feces were collected. Manure from steers fed 11.5 percent CP diet had less urine, less urinary nitrogen, and a lesser fraction of total nitrogen in urine, compared with the 13 percent crude protein diet. Decreasing CP in beef cattle diets from 13 to 11.5 percent significantly decreased ammonia emission by 44 percent in closed chamber experiment, and decreased mean daily ammonia flux by 29 percent, 30 percent, and 52 percent in spring, summer, and autumn field trials, respectively. No difference was observed in winter.

Additionally, National Research Council (NRC) Nutrient Requirements of Beef Cattle states that decreasing the CP concentration in the diet can potentially reduce animal performance, prolonging the time necessary to reach market weight and potentially increasing ammonia emissions over the life of the cattle. Because adequate protein levels are required for optimal growth, decreasing CP levels hinder the ability to meet daily weight gain goals.

The overall effectiveness of this measure is unclear because of the small sample size and short period of the study. NRC Nutrient Requirements of Beef cattle states that decreasing the CP concentration in the diet can potentially reduce animal performance. Higher CP levels may be needed to meet daily weight gain goals.

If decreasing the CP content of the diet adversely affects performance, any short-term ammonia reductions can be negated by the longer time on feed required for animals to reach their target market weight and condition.[44] While there may be ammonia reductions in the short term, longer time on feed will result in additional ammonia emissions for the additional amount of time it takes for the animals to reach the appropriate weight. Thus, overall emissions may ultimately be the same, or possibly even increase. Due to the limited pool of data and only studying emissions for 21 days, more research is needed to show a full-cycle of emissions and full impact to the animals.

[43] Forero, L., Barry, S., Larson, S. (2021). Beef Cattle on California Annual Grasslands: Production Cycle and Economics. *University of California Agriculture and Natural Resources*. Retrieved from: https://anrcatalog.ucanr.edu/pdf/8687.pdf

[44] Cole NA, Defoor PJ, Galyean ML, Duff GC, Gleghorn JF. "Effects of phase-feeding of crude protein on performance, carcass characteristics, serum urea nitrogen concentrations, and manure nitrogen of finishing beef steers", Journal of Animal Science, 2006.

Despite the uncertainties discussed above, the District further evaluated the potential emission reductions of implementing this measure in the Valley. This analysis is provided below.

The feedlot cattle inventory in the Valley includes calves, beef stockers, yearlings, and finishing cattle. This measure is only applicable to beef finishing cattle. It will be conservatively assumed that 50 percent of the feedlot cattle in the Valley are beef finishing cattle. The ammonia emissions from young beef cattle compared to beef finishing cattle will be assumed to be proportional to their nitrogen excretion. Based on information from the American Society of Agricultural and Biological Engineers (ASABE),[45] it is estimated that the average daily nitrogen excretion for beef finishing cattle is 25.7 percent higher than young beef cattle. Therefore, the overall control efficiency for this measure can be estimated as follows:

30% x 50% x 1.257 = 18.9%

No costs for implementation of this measure in the United States could be located. Notably, feed costs are a significant part of the overall costs of raising livestock, often representing as much as 60-70 percent of production costs,[46] and protein is often the most expensive component in livestock feed.[47] As a result, beef cattle producers will generally avoid overfeeding protein to minimize productions costs. Therefore, the actual emission reductions from this measure may be significantly lower to nothing since most beef cattle producers will already try to minimize feeding excess protein whenever feasible.

The District has concluded that the measure requires further research on both the effect on production and overall costs, and therefore is not a viable mitigation option to include in Rule 4570 at this time. The District will continue to evaluate the feasibility of this option as practices evolve and further research is conducted.

Reducing Crude Protein Content for Dairy Cattle - ***(applies to dairy cattle only)***

In a compilation by Bittman[48] it was recommended that the average CP content of diets for dairy cattle should not exceed 15-16 percent of the dry matter (DM). Phase feeding can be applied in such a way that the CP content of dairy diets is gradually decreased from 16 percent of DM just before calving and in early lactation to below 14 percent in late lactation and the main part of the dry period.

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[45] American Society of Agricultural and Biological Engineers. (March 2005). ASABE D384.2 Manure Production and Characteristics. Retrieved from: https://elibrary.asabe.org/abstract.asp?aid=32018
[46] Strauch, B.A., Stockton, M.C. (Sep 2013). Feed Cost Cow-Q-Lator. NebGuide. University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources (G2214). Retrieved from: https://extensionpublications.unl.edu/assets/pdf/g2214.pdf
[47] North Dakota State University (NDSU). (Dec 2019). Comparing Value of Feedstuffs (AS1742). Retrieved from: https://www.ag.ndsu.edu/publications/livestock/comparing-value-of-feedstuffs
[48] Bittman, S., Dedina, M., Howard C.M., Oenema, O., Sutton, M.A., (eds). (2014). “Options for Ammonia Mitigation: Guidance from the UNECE Task Force on Reactive Nitrogen,” Centre for Ecology and Hydrology, Edinburgh, UK. Retrieved from: http://www.vuzt.cz/svt/vuzt/publ/P2014/037.pdf

A study[49] measured the effect of reducing the CP content of ammonia emitting potential of dairy manure in a controlled environment. Eleven Pennsylvania dairies with gutter-scrape, gravity-flow, or flush manure-management systems participated in the study. In the study, the CP concentration of the feed for cows that were identified as high-producing cows was decreased from an average of 16.5 to 15.4 percent for the dairies included in the study. Fecal and urine samples were collected from the dairies in the fall of 2009, spring of 2010, fall of 2010, and spring of 2011. The study indicated that laboratory ammonia emissions from reconstituted manure was on average 23 percent lower for the low CP diet versus the high CP diet. No difference was seen in milk yield and milk composition during the low CP and the high CP diet, with average milk yields of 32.2 kg/day and 32.5 kg/day. The researchers that conducted the study concluded that the ammonia emitting potential of dairy manure can be reduced by moderately decreasing dietary CP content.

Although effects of reducing the CP content of the feed for dairy cows may merit further research, there are questions related to the applicability of this study to dairy cattle in the Valley. One important question is if the milk production of the cows in the study is comparable to the milk production of cows in the Valley. The average milk production of the high-producing cows included in the study was only 32.2-32.5 kg/day. In comparison, according to information from USDA National Agricultural Statistics Service, on average, milk cows in California produced approximately 36.2 kg/day of milk in 2021, [50] with high-producing cows in the Valley producing at a rate of 44 to over 50 kg/day of milk per dairy cow.[51] Therefore, although the cows in the study were identified as high-producing cows that were expected to produce greater amounts of milk, the average milk cow in California produces more milk than the cows in this study. Higher levels of milk production require higher levels of protein, so it is likely that reducing the CP content of feed will reduce milk yields of cows that produce milk.

In communications with the District, Dr. Peter Robinson, UC Davis Extension Specialist, Dairy Cattle Nutritional Management Department of Animal Science, stated that the optimal CP level for high-producing dairy cows in the Valley is around 16.8 percent, which is the level that dairy typically feed their high-producing cows. He also states that when CP levels are decreased to levels that are a little lower than required, milk production tends to be negatively impacted immediately. Dr. Robinson's recommended CP content is based on 14 large on-farm studies that he has completed in the Valley from 2005 to the present. [52] Based on the data he provided from these studies, feed with a CP content of approximately 16.9 percent resulted in maximum milk production for high-producing cows in the Valley, which was about 48.5 kg/day of milk, 50 percent

[49] Hristov, A. N., Heyler, K., Schurman, E., Griswold, K., Topper, P., Hile, M., ... & Dinh, S. (2015). CASE STUDY: Reducing dietary protein decreased the ammonia emitting potential of manure from commercial dairy farms. The Professional Animal Scientist, 31(1), 68-79

[50] USDA, National Agricultural Statistics Service. Milk Production (February 2022). https://downloads.usda.library.cornell.edu/usda-esmis/files/h989r321c/7d279w693/f7624g40c/mkpr0222.pdf

[51] Data from studies of dairy cows in the San Joaquin Valley provided by Dr. Peter Robinson, UC Davis Extension Specialist, Dairy Cattle Nutritional Management Department of Animal Science. https://animalbiology.ucdavis.edu/people/peter-robinson

[52] A list of selected scientific publications by Peter Robinson, PhD is available on the UC Davis website at: https://animalscience.ucdavis.edu/people/faculty/peter-robinson/Articles/Scientific-Publications

more than the milk production of the high-producing cows in this study. Therefore, 50 percent more high-producing cows would be needed to produce the same amount of milk, which would negate the ammonia reductions from this measure. Another potential issue with the study is that manure samples of a specific size were used to compare the ammonia emitting potential of the manure, but it is unclear if the changes in feed composition affected manure production, which could also affect ammonia emissions.

As discussed above, California dairy operators typically feed their high-producing cows a diet that has CP content near the optimum level of 16.8 percent, and decreasing the CP content of the diet can have an adverse effect on milk production in dairy cattle. Thus, CP reductions for dairy cattle must be closely managed to avoid impacting productivity (e.g., milk yield, fat corrected yield, milk protein yield). Additionally, Dr. Robinson stated that most cows need to recoup body weight during later lactation and that lowering the CP percentage in the diet during this period could have very negative impacts on both milk yield and body weight recovery.

Because nutrient concentrations in feed and feed ingredients vary considerably, reducing CP in diets will require additional lab analyses of feed to ensure that animals receive sufficient nutrients, which will result in increased costs. Dairy operators have no incentive to overfeed protein since high protein feeds are usually the most expensive ingredients. The percent of CP in the diets fed that California dairy operators feed to dairy cattle has been significantly reduced from previous levels. According to Dr. Robinson, CP in the diets of dairy cows was frequently in excess of 20 percent in the 1980s and 1990s, but that has decreased to the current level of 16.8 percent today. In communication with District staff, Dr. Robert Hagevoort, Extension Dairy Specialist and Topliff Dairy Chair, New Mexico State University, [53] also confirmed similar reductions in the CP content of dairy feed for dairies in the western U.S. compared to previous levels.

In addition, reducing the CP content to the recommended levels is difficult for cattle that graze or are fed a large amount of grass because grass has higher amounts of protein. The NRCS Reference Guide indicates that reduction of CP can also cause deficiency in certain amino acids that can adversely affect animal performance, such as weight gain.

California dairies are expected to continue to try to improve feed efficiency and minimize environmental impacts. However, it is not feasible to require this measure at this time because of questions that remain about the impact on milk production, animal health, and costs on California dairies. Therefore, the District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Reducing Protein Content for Swine - ***(applies to swine only)***

Research indicates that low-protein diets may result in poorer performance in finishing pigs than conventional diets.[54] The NRCS Reference Guide indicates that changes to

[53] https://dairy.nmsu.edu/faculty-staff/robert-hagevoort.html (accessed March 15, 2023)
[54] Hayes ET, Leek AB, Curran TP, et al. The Influence of Diet Crude Protein Level on Odour and Ammonia Emissions from Finishing Pig Houses. Bioresource Technology, 2004

animal diets generally increase costs because of the time and expense of diet formulation and acquisition of new ingredients, and that the availability of additives and feedstuff fluctuates. Additionally, there are increased costs for low-protein feed due to the need to supplement with amino acids found in protein like crystalline lysine, threonine, tryptophan, methionine and valine. As previously shown, emissions from swine are a small part of the District's ammonia inventory, as there is only one permitted swine facility in the District. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Reduce Feeding of Wet Distillers Grain - ***(applies to beef cattle only)***

In another study, U.S. EPA noted that "one feedyard feeding distillers grains averaged 149 grams of ammonia-N per head per day (ammonia–N/head/day) over nine months, compared with 82 g ammonia–N/head/day at another feedyard feeding lower protein steamflaked, corn-based diets." Nominally, this would represent a 45 percent reduction in ammonia emissions from manure by going to a lower protein diet. However, the net ammonia emission reduction either from reducing crude protein levels in feed, or by providing a lower protein steam-flaked, corn-based diet rather than a distiller grain diet is unclear given the role of protein intake on the time for beef cattle to reach market weight or on milk production for dairy cows.[55]

This study involved two years of near-continuous ammonia emission data collections at two feedyards. Cattle were fed either conventional feed or wet distillers grains (WDG). Ammonia emissions were 36 percent higher for cattle that were fed WDG.

This study is only applicable to WDG, a feed byproduct of ethanol production. The study notes that WDG typically contains 20 percent or more of protein. That is higher than the ideal diet protein content of 11.5-13.5 percent for beef cattle. This feed is not common in California, because WDG is sold primarily to dairies or cattle feedlots within the immediate vicinity of an ethanol plant, and California only grows 0.07 percent of the nation's corn[56], and produces 0.8 percent[57] of the nation's ethanol. Since dairies in the Valley do not feed WDG, and there is almost no means for WDG feed to be acquired by Valley dairies, this measure is already being implemented and no further emission reductions can be achieved.

Phase, Group, and Split Sex-Feeding - ***(applies to all CAFs)***

The NRCS Reference Guide and a compilation by Guthrie, Giles, etc.[58] focus on mitigation measures for feed management including group and phase feeding, dietary

[55] Todd, R.W., N.A. Cole, D.B. Parker, M. Rhoades, and K. Casey. (2009). "Effect of Feeding Distillers Grains on Dietary Crude Protein and Ammonia Emissions from Beef Cattle Feedyards." In Proceedings of the Texas Animal Manure Management Issues Conference, 83–90.
[56] United States Department of Agriculture - National Agricultural Statistics Service, 2017 Census of Agriculture
[57] U.S. Energy Information Administration, State Energy Data 2020: Production
[58] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

formulation changes, and feed additives. Controlling the protein content of feed is a key element to lowering nitrogen content of manure. Protein naturally contains nitrogen compounds that are often broken down into simple compounds such as ammonia. Group and phase feeding allows the animal to receive the proper nutrition intake by separating animals by age or sex. This allows for a specific diet tailored to each group in order to reduce manure excretion and nitrogen content. Split sex feeding programs are already included as a mitigation option in District Rule 4570 for swine facilities.

The Reference Guide states that dietary formulation changes involve changes in feed ingredients or ration formulations to provide essential available nutrients to meet animal requirements while minimizing excess amounts of nutrients.

Because feed is one of the most significant costs for confined animal facilities, producers work with nutritionists to design diets to maximize feed efficiency and minimize excess nutrients to reduce overall costs. Confined animal facilities work to continually improve feed formulations to deliver nutrients in the amounts required to meet production goals. Overfeeding is undesirable because it will increase costs and farming operations have overall small margins of profit. Operations that overfeed would not be able to compete and would not remain in business because they would not be able to compete with operations that formulate rations for greater efficiency.

As a result of genetic selection and improved diets, milk production per cow has increased and feed usage has decreased by 77 percent.[59] For poultry, it is estimated that genetic selection and the current feed practices have reduced nitrogen excretion by poultry by up to 55 percent.[60]

Rule 4570 includes mitigation options for feeding animals in accordance with NRC Guidelines. The NRC Guidelines establish different nutrition requirements for animals at different ages and stages of production. Nutritionists formulate diets to meet the requirements at these different ages and stages of production.

As stated above, farms already formulate diets to maximize feed efficiency and minimize excess nutrients. There are many challenges to further dietary changes[61], including:

- Nutrient concentrations in feed and feed ingredients vary considerably; therefore, changing feed formulations of diets will require additional lab analyses of feed resulting in increased costs;

[59] McCabe, C. (2021). How Dairy Milk Has Improved its Environmental and Climate Impact. Clarity and Leadership for Environmental Awareness and Research at UC Davis. Retrieved from: https://clear.ucdavis.edu/explainers/how-dairy-milk-has-improved-its-environmental-and-climate-impact

[60] United States Department of Agriculture - Natural Resources Conservation Service. (2020). Feed and Animal Management for Poultry. Nutrient Management Technical Note No. 190-NM-4. Retrieved from: https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=45569.wba

[61] EPA-USDA NRCS. “Reference Guide for Poultry and Livestock Production Systems”, pp. 12-13. September 2017. Retrieved from: https://www.epa.gov/sites/default/files/2017-01/documents/web_placeholder.pdf

- Changes in dietary formulations increase feed costs due to the time and expense of diet formulation and acquisition of new ingredients;
- Reduction of crude protein nitrogen can cause deficiency in certain amino acids, such as lysine, threonine, and methionine, that can adversely affect animal performance, including growth and milk production; and
- Crude protein reductions for dairy cattle must be closely managed to avoid impacting productivity.

As discussed above, confined animal facilities already formulate diets to maximize feed efficiency and minimize excess nutrients to reduce overall costs and remain competitive. Rule 4570 includes mitigation options for feeding animals in accordance with NRC Guidelines, which includes specific nutrient requirements for different animals. Therefore, this measure is already implemented by the confined animal facilities in the Valley and any ammonia reductions from this measure are already being attained.

Phase feeding and split-sex feeding have been commonly used at confined animal facilities throughout the nation for many years, particularly on larger operations,[62, 63, 64, 65] and are a standard practice for the relatively larger confined animal facilities subject to District permitting requirements in the Valley. Because of the higher cost of production in California, confined animal facilities are larger operations compared to other states to take advantage of economies of scale. The standard practice at these operations is to separate animals by phases, ages, or groups that are fed specific diets. At dairies, calves, young heifers, bred heifers, dry cows, milk cows in different stages of lactation, and sick cattle are placed in separate groups and fed rations that are specifically formulated. Beef cattle are separated into cows and calf pairs raised on rangeland, bulls, yearlings/stockers, and finishing cattle, which are fed a separate diet. Broiler chickens are typically fed three to four different diets during their grow-out period and turkeys may be fed up to six diets during their grow-out period to match the specific age or stage of production.[66] It is estimated that genetic selection and the current feed practices have reduced ammonia reduced nitrogen excretion by poultry by up to 55 percent.

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[62] Carter, S., Sutton, A., Stenglein, R. (2012). Diet and Feed Management to Mitigate Airborne Emissions – Air Quality Education In Animal Agriculture. *USDA National Institute of Food and Agriculture.* Retrieved from: https://lpelc.org/wp-content/uploads/2019/03/Dietand-Feed-FINAL.pdf

[63] Van Heutgen, E. (2010) Growing-Finishing Swine Nutrient Recommendations and Feeding Management. Pork Information Gateway Factsheets Number PIG 07-01-09. https://porkgateway.org/resource/growing-finishing-swine-nutrient-recommendations-and-feeding-management/

[64] USDA Animal and Plant Health Inspection Service (APHIS). Iowa State University (2022) US Poultry Industry Manual - Broilers: brooding. Poultry FAD Preparedness & Response Series. https://www.thepoultrysite.com/articles/fad-broilers-brooding

[65] Miles, R.D., Jacob, J.P. (2000) Feeding the Commercial Egg-Type Laying Hen. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. https://ucanr.edu/sites/placernevadasmallfarms/files/102990.pdf

[66] Moss A, Chrystal P, Cadogan D, Wilkinson S, Crowley T, Choct M. (2021). “Precision feeding and precision nutrition: a paradigm shift in broiler feed formulation?”
Animal Bioscience, 2021;34(3):354-362. Retrieved from: https://www.animbiosci.org/journal/view.php?doi=10.5713/ab.21.0034

Phase feeding is the standard practice in the Valley which also allows for reduction in feed costs and meet production goals. In addition, Rule 4570 includes feeding animals in accordance with NRC Guidelines. The NRC Guidelines establish different nutrition requirements for animals at different ages and stages of production. Nutritionists formulate diets to meet the requirements at these different ages and stages of production. Because phase feeding is in practice at the majority if not all of confined animal facilities in the Valley, any ammonia reductions of this practice are currently being achieved. No additional ammonia reductions are expected from the suggested mitigation measure.

Increase Grazing Time for Dairy Cattle - ***(applies to dairy cattle only)***

A compilation by Guthrie[67] states that increased grazing time could reduce ammonia from dairy operations by up to 50 percent as distributed urine can be absorbed into soil and broken down before ammonia is released. However, this practice is not feasible in the Valley, as there is not sufficient land to graze cattle and the arid climate generally requires irrigation to grow crops.

The University of California Agricultural and Natural Resources (UC ANR) publication[68] estimates that the long-term carry capacity of rangeland for grazing in Madera County is 15 or 16 acres per 1,000 lb animal unit; therefore, based on the information in this publication approximately 21-22 acres of unirrigated rangeland would be required to allow a typical 1,400 lb mature dairy cow to graze. The University of California Cooperative Extension (UCCE) publication[69] indicates that 15-18 acres of unirrigated rangeland are required to support a 1,200 lb cow in the Sierra Foothills for one year, and that one acre of irrigated pasture would produce enough forage to feed a 1,200 lb cow for six months. Based on the information in these publications, it is estimated that in the San Joaquin Valley 1522 acres of unirrigated land would be required for each mature cow to graze for a year, one acre of irrigated pasture would be required for a mature cow to graze for six months, and two acres of irrigated pasture would be required for a mature cow to graze for one year. The enormous amount of land required to graze cattle on non-irrigated land clearly makes this infeasible. Based on information from the USDA National Agricultural Statistics Service, the average dairy in the Valley has approximately 1,600 milk and dry cows, not including heifers and calves. Therefore, it is estimated the average dairy in the Valley would require 1,600 acres of land to graze its mature cows for 6 months and 3,200 acres of land to graze its mature cows for one year. Because of the often arid conditions in the Valley, this land would need to be regularly irrigated to sustain sufficient forage for grazing. Additionally, this measure

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67 Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

68 George, M., Frost, W., and McDougald, N. (December 2020). Ecology and Management of Annual Rangelands Series Part 8: Grazing Management. University of California Agricultural and Natural Resources Publication 8547. https://anrcatalog.ucanr.edu/pdf/8547.pdf

69 Macon, D., and Meyer, H. (June 2018). How Many Cows Can My Property Support? - Basics of Carrying Capacity, Stocking Rate, and Pasture Irrigation. University of California Cooperative Extension. *UCCE Placer/Nevada Publication 31 1005.* Retrieved from: https://projects.sare.org/wp-content/uploads/Pub-31-1005-Carrying-Capacity-and-Stocking-Rate.pdf

would be impossible to implement as a result of the ongoing severe drought, the Sustainable Groundwater Management Act (SGMA), and limitations on water usage pose severe challenges to the Valley.

The study Survey of Dairy Housing and Manure Management Practices in California[70] reported that in 2007, the average number of milk and dry cows of dairies that responded to the survey in Tulare County was 1,800 cows and that these dairies had 524 acres on which manure was applied to grow feed. Assuming that the acreage for feed production on a dairy in the Valley is proportional to the number of mature cows, the average dairy in Valley with 1,600 mature cows is estimated to have approximately 466 acres of land used for feed production. If half of this land is maintained for feed production and the mature cows at the dairy are grazed on irrigated pasture for six months, the average dairy would require approximately 1,367 additional acres (1,600 acres – 233 acres). For grazing of mature cows on irrigated pasture for the entire year, the average dairy in the Valley with 1,600 mature cows would require approximately 2,734 additional acres (3,200 acres – 467 acres). Information from the USDA National Agricultural Statistics Service indicates that there are currently 965 dairies and 1.5 million milk and dry cows in the Valley. Therefore, 1.5 million acres of irrigated pasture would need to be available for grazing if dairy cows in the Valley graze for just six months and 3 million acres of irrigated pasture would need to be available for dairy cows in the Valley to graze for the entire year.

Because the amount of land needed is not available, this mitigation measure is not feasible in the Valley. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Feed Additives for Poultry - ***(applies to poultry only)***

Feed additives such as minerals, antibiotics, and digestive aids are another option to mitigate emissions. These additives can allow for improved nutrient absorption and minimize nitrogen excretion. Feed additives are a mitigation option included in District Rule 4570 for poultry.

Feed additives are more commonly used with poultry than with ruminants, such as cattle, because of the differences in how the digestive system works in ruminants compared to poultry. Additives in the feed of poultry operations can be absorbed by these animals. However, feed and feed additives are pre-digested by rumen bacteria prior to being absorbed in the digestive system of ruminants, which may alter the composition of many feed additives. The use of the rumen bacteria in the digestive system of ruminants that pre-digest feed allows cattle, and other ruminants to utilize various feeds that cannot be digested by non-ruminants.

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[70] Meyer, D., Price, P.L., Rossow, H.A., Silva-del-Rio, N., Karle, B., Robinson, P.H., DePeters, E.J., and Fadel, J. (2011) Survey of dairy housing and manure management practices in California. Journal Dairy Sci. 94:4744-4750. https://doi.org/10.3168/jds.2010-3761

Rule 4570 requires owners/operators of a layer CAF to implement at least one of the following feed mitigation measures:

- Feed according to NRC guidelines; or
- Feed animals probiotics designed to improve digestion according to manufacturer recommendations; or
- Feed animals an amino acid supplemented diet to meet their nutrient requirements; or
- Feed animals feed additives such as amylase, xylanase, and protease, designed to maximize digestive efficiency according to manufacturer recommendations.

Feed is one of the most significant costs for confined animal facilities, therefore producers work with nutritionists to design diets that maximize feed efficiency, increase feed adsorption, and reduce costs. For poultry, it is estimated that genetic selection and the current feed practices have reduced nitrogen excretion by poultry by up to 55 percent.

There are challenges to increase usage of feed additives. Feed is one of the most significant costs of production and feed additives will increase feed costs due to the time and expense of diet formulation and feed additive acquisition. Some additives have negative effects and may increase emissions of some pollutants. The use of antibiotics as feed additives has also been subject to greater restrictions because of efforts to combat increasing bacterial resistance to antibiotics.

The Reference Guide states that many feed additives are already “regularly used to improve nutrient absorption from feed ingredients.” Although the Reference Guide suggests that feed additives may improve nutrient absorption and decrease emissions of some pollutants, it does not specify which additives reduce which pollutants for different animals or the amount of each additive required.

Although the suggested measure lacks the specificity needed for a regulation, confined animal facilities already formulate diets to maximize nutrient adsorption, including the use of various feed additives. In addition, Rule 4570 includes feeding animals in accordance with NRC Guidelines, which includes specific nutrient requirements for different animals, and the option to utilize various feed additives. Therefore, because this measure is already used by the confined animal facilities in the Valley and included in Rule 4570, any ammonia reductions from this measure are already being achieved in the District.

It is critical for farmers to have the flexibility to decide the kind of mitigation measures that will work best for their specific operation by taking into consideration animal health and welfare, productivity, food safety and overall bio-security issues. The District’s menu of feeding options in Rule 4570 provides farmers with this flexibility, while also requiring the most stringent measures for controlling emissions from confined animal facilities.

Animal Confinement (Housing)

Table F-10 Animal Confinement Measures Evaluated

Method	Measure	CAF Type	Reference
Biofilters and Wet Scrubbers	Enclosed Barns with Biofiltration Systems	Dairy	Kresge[71]
	Biofilters	All	NRCS[72]
	Install Air-Scrubbers or Biotrickling Filters to Mechanically Ventilated Pig Housing	Swine	Price[73]
	Air Scrubbing Techniques	All	Guthrie[74]
	Wet Scrubbers	All	NRCS
Washing Floors/Lanes	Clean Lanes at Dairies	Dairy	Beene[75]
	Washing Floors and Other Soiled Areas in Livestock Facilities	All	Guthrie
	Scrape/Flush Freestall Lanes	Dairy	Mendes[76]
	Washing Down Dairy Cow Collecting Yards	Dairy	Price
Corral Management	Constantly Manage Corrals	Dairy	Card[77]
	Frequency of Corral Manure Management	Dairy	Schmidt[78]
Floor Design	Floor Design Including Slates, Grooves, V-Shaped Gutters and Sloping Floors to Collect and Contain Slurry Faster	Dairy, Swine	Guthrie
	Part-slatted Floor Design for Pig Housing	Swine	Price
	Adapt Dairy Housing	Dairy	Pinder[79]

[71] Kresge, L., Strochlic, R. (2007). Clearing the Air: Mitigating the Impact of Dairies on Fresno County's Air Quality and Public Health. California Institute for Rural Studies.
[72] EPA-USDA NRCS. "Reference Guide for Poultry and Livestock Production Systems." September 2017. Retrieved from: https://www.epa.gov/sites/default/files/2017-01/documents/web_placeholder.pdf
[73] Price et al., "An Inventory of Mitigation Methods and Guide to their Effects on Diffuse Water Pollution, Greenhouse Gas Emissions and Ammonia Emissions from Agriculture, User Guide," December 2011. Retrieved from: https://repository.rothamsted.ac.uk/download/942687eab7ec4b83751c7e241d62f0fa8472d72adcd25a149bb891b7c30d55d0/1595300/MitigationMethods-UserGuideDecember2011FINAL.pdf
[74] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html
[75] Beene, M., Krauter, C., Goorahoo, D. (2005). Ammonia Fluxes from Animal Housing at a California Free Stall Dairy. California State University, Fresno. Center for Irrigation Technology and Plant Science Department. Retrieved from: https://www3.epa.gov/ttnchie1/conference/ei15/session6/beene.pdf
[76] Mendes, L.B., Pieters, J.G., Snoek, D., Ogink N.W.M., Brusselman, E., Demeyer, P. (2017). Reduction of Ammonia Emissions from Dairy Cattle Cubicle Houses via Improved Management or Design-Based Strategies: A Modeling Approach, In *Science of The Total Environment*, Volume 574, 2017, Pages 520-531, ISSN 0048-9697. Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S0048969716319970?via%3Dihub
[77] Card, T. and Schmidt, C. (May 2006). Dairy Air Emissions Report: Summary of Dairy Emission Estimation Procedures. Final Report to CARB.
[78] Schmidt, C.E., T. Card, P. Gaffney, and S. Hoyt. (2005). Assessment of Reactive Organic Gases and Amines from a Northern California Dairy Using the EPA Surface Emissions Isolation Flux Chamber. Presented at the 14th Annual Emission Inventory Conference of the U.S. Environmental Protection Agency, Las Vegas, NV.
[79] Pinder, R., Adams, P., Pandis, S. (2007). Ammonia Emission Controls as a Cost-Effective Strategy for Reducing Atmospheric Particulate Matter in the Eastern United States. *Environmental Science and Technology*, Volume 41, Pages 380-386. Retrieved from: https://pubs.acs.org/doi/pdf/10.1021/es060379a

Method	Measure	CAF Type	Reference
	Separate Urine/Manure with 3% Floor Slope	Dairy	Braam[80]
Additional Straw Bedding	Additional Targeted Straw-bedding for Cattle Housing	All cattle	Price
	Straw Bedding for Cattle Housing	All cattle	Guthrie
Other Housing	Optimal Barn Acclimatization with Roof Insulation and/or Automatically Controlled Natural Ventilation	All	Guthrie
	Oil Spray/Sprinkling	Swine	NRCS
	Convert Caged Laying Hen Housing from Deep-Pit Storage to Belt Manure Removal	Poultry	Price
	More Frequent Manure Removal from Laying Hen Housing with Belt Clean Systems	Poultry	Price
	In-House Poultry Manure Drying	Poultry	Price

Biofilters - ***(applies to all CAFs)***

A biofilter is an air filtration and odor mitigation system that channels building exhaust through a mixture of organic materials that support microbial growth. Biofilters have been identified in several publications as a potential ammonia mitigation method, including the NRCS Reference Guide. The NRCS Reference Guide notes many considerations that must be taken into account when implementing these systems, including that they require careful design, monitoring, and maintenance, and have very high associated costs.

Initial costs and challenges include the replacement of existing ventilation fans in order to provide the necessary airflow and the energy to overcome the added pressure drop caused by the biofilter. Biofilters require increased retention time; however increasing the retention time usually increases the system static pressure, which can compromise the ventilation system performance. It is typically not practical to treat all of the exhaust air during the summer when a large amount of ventilation flow is required to remove excessive heat from the production house. Lower ventilation airflow may also lead to heat stress in the animals.

Different types of biofilters have their own disadvantages. Flat open biofilter beds are easier to construct and generally cost less; however, they require very large footprints. Vertical biofilters are more difficult to construct and are more expensive, and biological material can settle, causing air leaks, which will reduce the performance of the system. In addition, biofilter media will need to be replaced periodically.

[80] Braam, C., Ketelaars, J., Smits, M. (1997). Effects of floor design and floor cleaning on ammonia emission from cubicle houses for dairy cows, *Wageningen Journal of Life Sciences*. Retrieved from: https://library.wur.nl/ojs/index.php/njas/article/view/525

Biofilters require ongoing maintenance to prevent air leakage, dust accumulation, and air constriction in the media to ensure effectiveness of the system performance. Monitoring and maintenance of the filter media moisture is essential to operation of the biofilter, and sprinklers or other wetting systems may be required. Rodents and weeds have also been a problem for some biofilters.

Included in Appendix B of the Ammonia Supplemental Information for the 15 µg/m^3 SIP Revision, is a cost-effectiveness analysis that demonstrates the economic infeasibility of biofilters. District Rule 4570 does provide options for facilities to use emissions control devices such as biofilters; however, it is not feasible to require all facilities subject to Rule 4570 to install biofilters as they are not cost-effective or practical for livestock facilities in the Valley. The District has concluded that the measure discussed is not a viable mitigation measure to require in Rule 4570.

Air-Scrubbers/Wet Scrubbers - *(applies to all CAFs)*

Several compilations of mitigation measures, including the NRCS Reference Guide and UK User Guide, list air scrubbing as a potential method of capturing ammonia from animal housing; however, there are considerable costs and challenges associated with the implementation of scrubbers at animal facilities. One such challenge is that off-the-shelf industrial scrubbers are typically not applicable to animal production systems, due to the variation and dynamic changes of such biological systems (e.g., housing structure variation, changes in ventilation airflow rate/pattern in response to the changes of air temperature, manure management practices, unique PM characteristics).

The practicality of scrubbers is limited due to their potential to compromise the ventilation airflow rate needed to control temperature in production houses to ensure animal health. There are added costs for the replacement of existing ventilation fans in order to provide the necessary airflow and the energy to overcome the added pressure drop because of the scrubber. Additionally, it is typically not practical to treat all of the exhaust air during the summer when a large amount of ventilation flow is required to remove excess heat from the production house and prevent heat stress in the animals.

Additional costs and challenges to scrubbers include the ongoing maintenance required to prevent dust accumulation and air constriction in the media to ensure effectiveness of the system performance. There are also potential dangers in transporting and handling materials such as acid used in the scrubber. Furthermore, wet scrubbers require large supplies of water and special wastewater handling systems that are not typical at animal production operations. This increased water usage is not practical in the Valley because of limited availability of water due to drought and increasing restrictions on the amount of usable groundwater, due to SGMA.

The UK User Guide identifies installing air-scrubbers as a mitigation method specifically for pig housing, however, concludes that the practical application of this method is only to new purpose-built buildings. Included in Appendix B of the Ammonia Supplemental Information for the 15 µg/m^3 SIP Revision is a cost-effectiveness analysis of scrubbers for swine facilities. The District found that scrubbers are not cost effective, and are therefore not technologically or economically feasible to require in the Valley. District Rule 4570 does provide options for facilities to use emissions control devices such as scrubbers; however, it is not feasible to require all facilities subject to Rule 4570 to install scrubbers. The District has concluded that the measure discussed is not a viable mitigation measure to require in Rule 4570.

Washing Floors/Lanes - ***(applies to all CAFs)***

Several publications include the washing of floors and other soiled areas in livestock facilities as a potential mitigation method to reduce ammonia emissions. The UK User Guide includes a more specific measure involving washing down the concrete areas where dairy cows are collected prior to and after each milking even, through pressure washing or by hosing and brushing.

District Rule 4570 includes the requirement to clean the manure from the lanes, where the majority of manure is excreted, at dairies and other cattle facilities. The majority of cow holding areas at Valley dairies are equipped with sprinkler pens for washing the cows, and are periodically washed throughout the day, rather than scraped once per day.[81] Additionally, Rule 4570 requires constant washing of milking parlor floors to remove manure, which is also standard practice for California dairies. It is essential for all areas of milking parlors, including the milking parlor floors, to be the one of the cleanest parts of the dairy to ensure that the milk from the cows is clean and uncontaminated. There is a constant need for flushing and cleaning of the milking parlor because milk that is contaminated cannot be sold. Therefore, whenever practical, Rule 4570 requires cleaning of areas where the majority of manure accumulates.

Operators of dairy CAFs are required to implement several mitigation measures related to the cleaning of floors/lanes to comply with District Rule 4570, including the following:

Required Measures:

- Flush or hose milking parlor immediately prior to, immediately after, or during each milking;
- Pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers; and
- Flush, scrap, or vacuum freestall flush lanes immediately prior to, immediately after, or during each milking; or flush or scrape freestall flush lanes at least 3 times per day.

[81] Chang, A., T. Harter, J. Letey, D. Meyer, R. D. Meyer, M. Campbell-Mathews, F. Mitloehner, S. Pettygrove, P. Robinson, R. Zhang (2006) Managing Dairy Manure in the Central Valley of California; University of California Committee of Experts on Dairy Manure Management Final Report to the Regional Water Quality Control Board, Region 5, Sacramento, June 2005. https://ucanr.edu/sites/groundwater/files/136450.pdf

Additional Measures (must select at least one of the following):

- Use non-manure-based bedding and non-separated solids based bedding for at least 90 percent of the bedding material, by weight, for freestalls;
- For a large dairy CAF, remove manure that is not dry from individual cow freestall beds or rake, harrow, scrape, or grade freestall bedding at least once every 7 days; or
- For a medium dairy CAF, remove manure that is not dry from individual cow freestall beds or rake, harrow, scrape, or grade freestall bedding at least once every 14 days.

Operators of other cattle CAFs are required to implement the following mitigation measures to comply with District Rule 4570:

- Vacuum, scrape, or flush freestalls at least once every 7 days;
- Pave feedlanes, where present, for a width of at least 6 feet along the corral side of the feedlane; and
- Either use non-manure-based bedding and non-separated solids based bedding for at least 90 percent of the bedding material, by weight, for freestalls; or remove manure that is not dry from individual cow freestall beds or rake, harrow, scrape, or grade bedding in freestalls at least once every seven days.

In conclusion, the District already requires mitigation measures that require CAFs to wash floors and/or lanes inside of cow housing areas. No additional ammonia reductions are expected from the suggested mitigation measure.

Corral Management - ***(applies to all cattle)***

Proper management of manure in animal housing areas will stabilize the nitrogen compounds, which will reduce the rate that these compounds are converted to ammonia that can be lost to the atmosphere. Research by Card and Schmidt (2005) supports that management of manure in corrals reduces ammonia emissions from the corrals and points out that of two dairies tested, the ammonia emissions from the dairy with constantly managed corrals had “exceptionally low ammonia emissions.” Follow-up research by Card and Schmidt (2009) at one of the dairies studied indicated that ammonia emissions were significantly reduced (>80 percent reduction comparing 2008 to 2005 reported ammonia emissions) when the frequency of management of the manure in the corrals was increased.

Rule 4570 includes requirements for management of corrals to prevent excessive buildup of manure, designing or managing corrals to prevent excessive moisture, and periodic scraping and removal of manure from corrals. Under Rule 4570, dairy, beef feedlot, and other cattle facilities are required to implement four to six measures for corral management depending on facility type, as well as select one additional mitigation measure as detailed below:

Required Measures

- Pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers (*dairy and other cattle*);
- Clean manure from corrals at least 4 times per year with at least 60 days between cleaning; or clean corrals at least once between April and July and at least once between September and December (*dairy*);
- Scrape corrals twice a year with at least 90 days between cleanings, excluding the removal of in-corral mounds (*beef feedlot and other cattle*);
- Scrape, vacuum or flush concrete lanes in corrals at least once every day for mature cows and every 7 days for support stock; or clean concreted lanes such that the depth of manure does not exceed 12 inches at any point or time (*dairy and other cattle*);
- Inspect water pipes and troughs and repair leaks at least once every 7 days;
- Choose one of the following:
    - Slope the surface of the corrals at least 3 percent where the available space for each animal is 400 square feet or less. Slope the surface of the corrals at least 1.5 percent where the available space for each animal is more than 400 square feet per animal;
    - Maintain corrals to ensure proper drainage preventing water from standing more than 48 hours; or
    - Harrow, rake, or scrape corrals sufficiently to maintain a dry surface; and
- If the CAF has shade structures, they must choose one of the following:
    - Install shade structures such that they are constructed with a light permeable roofing material;
    - Install all shade structures uphill of any slope in the corral;
    - Clean manure from under corral shades at least once every 14 days, when weather permits access into the corral (*dairy*); or
    - Install shade structure so that the structure has a North/South orientation.

Additional Measures

- Manage corrals such that the manure depth in the corral does not exceed 12 inches at any time or point, except for in-corral mounding. Manure depth may exceed 12 inches when corrals become inaccessible due to rain events. The facility must resume management of the manure depth of 12 inches or lower immediately upon the corral becoming accessible.
- Knockdown fence line manure build-up prior to it exceeding a height of 12 inches at any time or point. Manure depth may exceed 12 inches when corrals become inaccessible due to rain events. The facility must resume management of the manure depth of 12 inches or lower immediately upon the corral becoming accessible.
- Use lime or a similar absorbent material in the corral according to the manufacturer's recommendation to minimize moisture in the corrals; or apply

thymol to the corral soil in accordance with the manufacturer's recommendation (*dairy and other cattle*).

In conclusion, the District already requires mitigation measures that minimize emissions from corral housing areas. No additional ammonia reductions are expected from the suggested mitigation measure.

Floor Design - ***(applies to dairy cattle and swine only)***

Several publications list different floor design types for collecting and containing slurry that may reduce ammonia emissions that include slats, grooves, v-shaped gutters, and sloping floors. The measures included in these documents are applicable to small dairies in which cows are kept in stables or cubicle-type housing that is common on small European dairies in which manure was allowed to accumulate. These measures are also applicable to manure handled as a slurry, and does not apply to the larger dairies in the Valley that are subject to District permitting, which handle very little manure as a slurry.[82] It should also be noted that most physical changes to existing dairy barns must be incorporated at the design stage, and are not practical for existing structures, resulting in significantly higher capital costs.

Valley dairies have paved lanes to facilitate manure removal, as required by Rule 4570. The lanes on the dairies are sloped to allow manure to be sent to a lagoon system. In addition, Rule 4570 requires that manure must be periodically removed from the lanes where the cattle spend the majority of their time. Therefore, Rule 4570 already incorporates control measures for specialized floor design and this is already being implemented by dairies in the Valley.

Rule 4570 requirements for dairy and other cattle facilities are as follows:

- Pave feedlanes, where present, for a width of at least 8 feet along the corral side of the feedlane fence for milk and dry cows and at least 6 feet along the corral side of the feedlane for heifers and other cattle; and
- For corrals, choose one of the following:
  - Slope the surface of the corrals at least 3 percent where the available space for each animal is 400 square feet or less. Slope the surface of the corrals at least 1.5 percent where the available space for each animal is more than 400 square feet per animal;
  - Maintain corrals to ensure proper drainage preventing water from standing more than 48 hours;
  - Harrow, rake, or scrape corrals sufficiently to maintain a dry surface.

The UK User Guide includes a floor design measure specifically for swine that aims to reduce the overall emitting surface area of slurry by replacing fully slatted floors with

[82] Marklein, A. R., Meyer, D., Fischer, M. L., Jeong, S., Rafiq, T., Carr, M., and Hopkins, F. M. (2021) Facility-scale inventory of dairy methane emissions in California: implications for mitigation, Earth Syst. Sci. Data, 13, 1151–1166, https://doi.org/10.5194/essd-13-1151-2021, 2021.

part-slatted floors. This type of floor design is already a requirement at the only swine facility in the District. The facility has a specific permit condition that states "Permittee shall use a slatted floor system (slatted floors over deep pits or shallow flush alleys), with daily manure removal for shallow flush alleys and weekly removal from deep pits." Under Rule 4570, swine CAFs are required to implement measures for animal housing that includes the use of a similar slatted floor system, as follows:

- Use a slatted floor system (slatted floors over deep pits or shallow flush alleys), with daily manure removal for shallow flush alleys and weekly removal from deep pits.

In conclusion, the District already requires a mitigation measure for swine CAFs to minimize emissions from animal housing areas through the use of a slatted floor system. No additional ammonia reductions are expected from the suggested mitigation measure.

Separate Urine/Manure with 3 Percent Floor Slope - ***(applies to dairy cattle only)***

In one study[83] completed in the Netherlands, ammonia emissions from cubicle housing with a slatted floor, used on small dairies in Europe, were compared with two different solid floor systems: a non-sloped and a 3 percent one-sided sloped floor, combined with a highly frequent or normal removal of manure by a scraper. The study results indicated that the slope of the floor had more impact on reducing ammonia emissions than increasing the scraping frequency. Solid floors with a slope decreased ammonia emissions compared to slatted floors. However, the study indicated that solid floors without a slope may not decrease ammonia emission compared with slatted floors.

Cubicle housing with slatted floors and manure pits under the housing areas are not used for dairy cattle in the Valley. The typical practice is to house cattle in barns or corrals with flushed or scraped lanes. These lanes are sloped to facilitate flushing of the manure to the lagoon system. Additionally, Rule 4570 includes requirements that corrals be sloped, which allows urine to drain away, which reduces the conversion of urea in urine to ammonia since it will have less contact with enzymes in feces that promote this transformation.

District Rule 4570 requires dairy, beef feedlot, and other cattle facilities to implement the following mitigation measure, or an equivalent measure:

- Slope the surface of the corrals at least 3 percent where the available space for each animal is 400 square feet or less. Slope the surface of the corrals at least 1.5 percent where the available space for each animal is more than 400 square feet per animal.

[83] Braam, C., Ketelaars, J., Smits, M. (1997). Effects of floor design and floor cleaning on ammonia emission from cubicle houses for dairy cows, *Wageningen Journal of Life Sciences*. Retrieved from: https://library.wur.nl/ojs/index.php/njas/article/view/525

In conclusion, the District Rule 4570 already includes mitigation measures involving sloped floors for cattle facilities. No additional ammonia reductions are expected from the suggested mitigation measure.

Additional Targeted Straw-Bedding for Cattle Housing - *(applies to dairy and other cattle only)*

This method involves adding extra straw bedding to cattle houses, targeting the wetter and dirtier areas of the house. This measure is applicable to small dairy farms that house cattle indoors and use a solid manure handling system, such as small dairy farms in Europe; however, most dairies in the Valley handle the majority of the manure as a liquid and do not use straw bedding. One study[84] indicated that storage or treatment ponds were found on 95.9 percent of dairies, and another report prepared for CARB states that, "*California dairy effluent often runs 1 percent total solids*."[85] These dairies also use frequent flushing to remove the manure instead of absorbing with straw, thereby reducing emissions through flushing. Beef cattle in the Valley are not housed indoors; therefore, this measure would not apply to beef cattle in the Valley.

For areas of the dairy that would benefit from this method, the use of straw, or other non-manure based bedding for cow housing is included as a menu option for cattle housed in barns, as shown below:

- Use non-manure-based bedding and non-separated solids based bedding for at least 90 percent of the bedding material, by weight, for freestalls (e.g. rubber mats, almond shells, sand, or waterbeds).

In conclusion, the District already has a mitigation measure option to minimize emissions from cow bedding. No additional ammonia reductions are expected from the suggested mitigation measure.

Optimal Barn Acclimatization with Roof Insulation and/or Automatically Controlled Natural Ventilation - *(applies to all CAFs)*

The compilation by Guthrie, et al.[86] includes ammonia mitigation measures that involve specific building design to provide optimal barn acclimatization. This measure was based on information from the United Nations Economic Commission for Europe (UNECE) compilation Framework Code for Good Agricultural Practice for Reducing

[84] Meyer, D., Price, P.L., Rossow, H.A., Silva-del-Rio, N., Karle, B., Robinson, P.H., DePeters, E.J., and Fadel, J. (2011) Survey of dairy housing and manure management practices in California. Journal Dairy Sci. 94:4744-4750. https://doi.org/10.3168/jds.2010-3761
[85] Meyer, D, Heguy, J., Karle, B. and Robinson, P. (2019) Characterize Physical and Chemical Properties of Manure in California Dairy Systems to Improve Greenhouse Gas Emission Estimates. California Environmental Protection Agency, Air Resources Board. https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/16rd002.pdf
[86] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

Ammonia Emissions.[87] The UNECE publication stated that for cattle cubicle housing was considered the reference and that for cattle housed in cubicles with traditional slats, and claimed that this measure can moderately reduce ammonia by 20 percent compared to conventional cubicle housing.

Cubicle housing with traditional slats is not typically used to house cattle in the Valley; therefore, this measure is not applicable to cattle in the Valley. In cubicle housing with traditional slats, the manure that cattle excrete seeps through the slats and falls to an alley or a storage pit below the housing area. In the Valley, dairy cattle are typically housed in barns or corrals with lanes that are flushed or scraped to remove manure to a separate area for storage. In cubicle housing with traditional slats, a large amount of the ammonia emissions are from the manure stored in an alley or pit below the housing area. Therefore, this measure would not reduce ammonia emissions from cattle housing in the Valley because manure is stored in a different area.

In addition, these measures are not feasible for many existing buildings and must be incorporated in the initial design stage of a new build. For poultry, new houses generally incorporate insulation and controlled ventilation. However, this measure is generally not feasible for implementation at Valley dairies or other cattle facilities. Due to the warm climate in the Valley, barns used for cattle consist of a roof with open sides to allow for adequate airflow and cooling. These structures would need to be completely redesigned and reconstructed to implement this mitigation measure, and there would be substantial cost to enclose the cattle and equip the barns with ventilation systems to supply sufficient airflow for the cattle. Furthermore, the increased airflow from the fans required for ventilation may promote increased emissions from the barns rather than reduce ammonia.

In conclusion, the suggested measure is not applicable to cattle facilities in the Valley and would not result in any additional ammonia reductions.

Oil Spray/Sprinkling - ***(applies to swine only)***

Sprinkling of vegetable oil in animal production areas has been demonstrated as an effective measure within swine barns for PM mitigation, with observed smaller reductions of ammonia ranging from 0-30 percent. However, results of research on the effect of this practice on ammonia emissions vary greatly.[88] This practice requires daily labor if applied by hand, and requires additional time during room washing to remove oil residue. Additionally, oil residue can cause ventilation fans to become stuck in on or off positions, preventing them from operating correctly to ensure proper ventilation and cooling of animals. As mentioned above, current research shows considerable

[87] UNECE. 2015. United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions. United Nations Economic Commission for Europe Convention on Long-range Transboundary Air Pollution. https://unece.org/environment-policy/publications/framework-code-good-agricultural-practice-reducing-ammonia

[88] Harmon, J., Hoff, S., Rieck-Hinz, A. (2014). Animal Housing – Vegetable Oil Sprinkling Overview. *Air Management Practices Assessment Tool*, Iowa State University. Retrieved from: https://store.extension.iastate.edu/product/Animal-Housing-Vegetable-Oil-Sprinkling-Overview

variability in the potential ammonia emission reductions of this measure; therefore, it is currently uncertain if this measure will reduce ammonia emissions and the magnitude of any potential reductions. Furthermore, the NRCS Reference Guide indicates that this measure is applicable to swine barns, which contribute a very small amount to the District's ammonia inventory with only one permitted facility in the Valley. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Convert Caged Laying Hen Housing from Deep-Pit Storage to Belt Manure Removal - *(applies to poultry only)*

This measure applies to high-rise laying hen housing with deep pit storage. In a deep-pit storage system, laying hens are kept in tiered cages and the manure from laying hens drops into a pit below the cages where it may be stored for months prior to removal. The UK User Guide identifies that replacing this system with a series of belts below each tier of cages, which remove manure from the house, could have the potential to reduce ammonia emissions.

In the United States, the overall trend for farms that produce eggs has been to shift away from high-rise laying hen housing with tiered cages to cage-free housing. In 2018, voters in California approved Proposition 12, also known as the Farm Animal Confinement Initiative.[89] Proposition 12 requires that animals held in buildings, such as laying hens, breeding sows, or veal calves, *"be housed in confinement systems that comply with specific standards for freedom of movement, cage-free design, and minimum floor space."* Implementation of the law began on January 1, 2022, and as a result all eggs produced in California must be procured only from hens in cage-free housing. High-rise hen houses in which egg-laying hens are kept in cages are no longer legal in California. There are significant questions that need to be answered regarding the practicality, cost, and overall ammonia emission reductions of implementing this measure for cage-free hen houses. Therefore, the District has concluded that this measure is not a viable mitigation option to include in Rule 4570 at this time.

More Frequent Manure Removal from Laying Hen Housing with Belt Clean Systems - *(applies to poultry only)*

This method identified in the UK User Guide increases the frequency of manure removal to twice weekly, and relies on the rapid removal of manure from the house prior to the peak rate of ammonia emission. This measure is only applicable to laying hen houses that are already equipped with belt manure removal systems, and is not feasible for the majority of existing laying hen houses in the Valley given the significant facility reconstruction costs and potential space/infrastructure limitations at existing facilities. In addition, as explained above, all eggs produced in California must be procured only from hens in cage-free housing and there are significant questions that need to be answered regarding the practicality, cost, and overall ammonia emission reductions of implementing this measure for cage-free hen houses. Therefore, the District has

[89] California Proposition 12, Animal Care Program. Retrieved from: https://www.cdfa.ca.gov/AHFSS/AnimalCare/

concluded that this measure is not a viable mitigation option to include in Rule 4570 at this time.

In-House Poultry Manure Drying - ***(applies to poultry only)***

In-house poultry manure drying, as identified in the UK User Guide, is applicable to poultry housing, and involves the installation of ventilation/drying systems that reduce the moisture content of poultry litter. The author expects implementation of this method to be low to moderate, due to the practical limitations involved with installing systems in existing buildings. Forced air drying systems are not feasible for houses in which the birds are raised on litter because the litter remains in the houses with the birds until cleaned out to prepare for another flock. Following BACT Guidelines 5.7.1[90] and 5.7.2[91], this practice is evaluated as a potential BACT measure for new or expanding facilities; the required mitigation measure is as follows:

- Completely enclosed mechanically ventilated layer housing with evaporative cooling pads, mixing fans, and a computer control system.

In conclusion, the District already has a mechanism to implement this mitigation measure for expanding or new poultry housing operations. No additional ammonia reductions are expected from the suggested mitigation measure.

Manure Management (Storage)

Table F-11 Manure Management (Storage) Measures Evaluated

Method	Measure	CAF Type	Reference
Lagoon Management	Replace Lagoons with Deep Tanks	Dairy	Guthrie[92]
	Oxygenation of Liquid Manure Lagoons	All	NRCS[93]
Storage Bags	Storage Bags	Dairy	Guthrie
Manure Storage Covers	Liquid Manure Storage Covers	All	NRCS
		All	Marks[94]
	Solid Manure Storage Covers	All	NRCS

[90] https://ww2.arb.ca.gov/sites/default/files/classic/technology-clearinghouse/bact/BACTID773.pdf?:linktarget=_self&:embed=yes
[91] https://ww2.arb.ca.gov/sites/default/files/classic/technology-clearinghouse/bact/BACTID774.pdf?:linktarget=_self&:embed=yes
[92] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html
[93] EPA-USDA NRCS. “Reference Guide for Poultry and Livestock Production Systems.” September 2017. Retrieved from: https://www.epa.gov/sites/default/files/2017-01/documents/web_placeholder.pdf
[94] Marks, R. (2001). Cesspools of Shame: How Factory Farm Lagoons and Sprayfields Threaten Environmental and Public Health. *Natural Resources Defense Council and the Clean Water Network.* Retrieved from: https://www.nrdc.org/sites/default/files/cesspools.pdf

Method	Measure	CAF Type	Reference
		All	Price[95]
		All	Chadwick[96]
	Allow Cattle Slurry Stores to Develop a Natural Crust	Dairy	Price
Solid-Liquid Separation	Solid-Liquid Separation	All	NRCS
Anaerobic Digesters	Anaerobic Digesters	Dairy	NRCS
		Dairy	Marks
		Dairy	Kresge[97]
Amendments/Additives	Litter Amendments and Manure Additives	All	NRCS
	Acidifying Slurry and Shifting Chemical Balance from Ammonia to Ammonium	All	Guthrie
	Acidifying Amendments and Additives for Poultry Litter	Poultry	Price
	Urease Inhibitors	All Cattle	Pinder[98]
		All Cattle	Preece[99]
Surface Cooling	Surface Cooling of Slurry Manure	All	Guthrie
pH of Manure	Lowering pH of Manure	All	Preece
On-farm Composting	Composting	All Cattle	NRCS

Replace Lagoons with Deep Tanks - ***(applies to dairy cattle only)***

A compilation[100] indicated that replacing lagoons with deep tanks can reduce ammonia emissions by 30-60 percent. The information from the compilation indicates that this

[95] Price et al., "An Inventory of Mitigation Methods and Guide to their Effects on Diffuse Water Pollution, Greenhouse Gas Emissions and Ammonia Emissions from Agriculture, User Guide," December 2011. Retrieved from: https://repository.rothamsted.ac.uk/download/942687eab7ec4b83751c7e241d62f0fa8472d72adcd25a149bb891b7c30d55d0/1595300/MitigationMethods-UserGuideDecember2011FINAL.pdf

[96] Chadwick, D.R. (2005). Emissions of Ammonia, Nitrous Oxide and Methane from Cattle Manure Heaps: Effect of Compaction and Covering. *Atmosphere Environment*, Vol. 39, Issue 4: 787-799. Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S135223100400994X

[97] Kresge, L., Strochlic, R. (2007). Clearing the Air: Mitigating the Impact of Dairies on Fresno County's Air Quality and Public Health. *California Institute for Rural Studies.*

[98] Pinder, R., Adams, P., Pandis, S. (2007). Ammonia Emission Controls as a Cost-Effective Strategy for Reducing Atmospheric Particulate Matter in the Eastern United States. *Environmental Science and Technology*, Volume 41, Pages 380-386. Retrieved from: https://pubs.acs.org/doi/pdf/10.1021/es060379a

[99] Preece, S., Cole, N., Todd, R., Auvermann, B. (2017). Ammonia Emissions from Cattle Feeding Operations. *Texas A&M AgriLife Extension Service.* Retrieved from: http://baen.tamu.edu/wp-content/uploads/sites/24/2017/01/E-632.-Ammonia-Emissions-from-Cattle-Feeding-Operations.pdf

[100] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

measure is applicable to manure that is handled as a slurry. The reductions in ammonia emissions are a result of the smaller surface area of the manure in contact with the air from which ammonia may be emitted. Storage of manure in deep tanks is not a feasible measure for the District due to the size of dairies in the Valley and the way that manure is typically handled. As previously mentioned, the average dairy in the Valley has almost 1,600 cows compared to a national average of less than 300 cows per dairy outside of California[101, 102] and are larger than the typical European dairies for which this measure was considered. In addition, dairies in the Valley typically handle liquid manure as a dilute liquid rather than a thick slurry. The dilute dairy manure typically handled in the Valley has a solids content of 2 percent or less while slurry manure has a solids content of about 10 percent. As a result, the volume of manure handled would be approximately 27 times greater than the average dairy outside of California that handles dairy manure as a slurry. It is not practical to construct tanks that would contain such large amounts of manure. Notably, the depth of lagoons and storage ponds is limited to protect groundwater because a minimum distance is required between the bottom of the lagoons and storage ponds and the groundwater.[103,104] Therefore, the tanks would need to be constructed aboveground. However, it is not practical to construct tanks aboveground because of the large amount of liquid manure that must be stored. Pumping the manure into aboveground tanks would require larger amounts of energy. Also, it is possible the release of the ammonia conserved in the manure tanks will be delayed until the manure is sent to a storage pond or applied to land. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Oxygenation of Liquid Manure Lagoons - ***(applies to all CAFs)***

The NRCS Reference Guide states that large land footprint of naturally aerobic lagoons is not practical for many farms. This is particularly applicable to the large farms in the Valley. Naturally aerobic lagoons are not feasible in the Valley because the dairies in the Valley would require an extremely large footprint. The design criteria of naturally aerobic lagoons in the USDA-NRCS Practice Standard Code 359 will be used to illustrate the approximate size that would be required for naturally aerated lagoons for confined animal facilities in the Valley. USDA-NRCS Practice Standard Code 359 requires that naturally aerobic lagoons be designed to have a minimum treatment surface area as determined on the basis of daily BOD_5 loading per unit of lagoon surface. The standard specifies that the maximum loading rate of naturally aerobic lagoons shall not exceed the loading rate indicated by the USDA-NRCS Agricultural

[101] Hanson, M. (2021) U.S. Dairy Herd Hits 27-year High. *Dairy Herd Management.* Retrieved from: https://www.dairyherd.com/news/dairy-production/us-dairy-herd-hits-27-year-high

[102] Latest USDA Statistics for average size of dairies excluding California. Retrieved from: https://downloads.usda.library.cornell.edu/usda-esmis/files/h989r321c/7d279w693/f7624g40c/mkpr0222.pdf (about 270 cows per dairy outside California)

[103] California Regional Water Quality Control Board Central Valley Region Order R5-2013-0122 – Reissued Waste Discharge Requirements General Order for Existing Milk Cow Dairies. Retrieved from: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2013-0122.pdf

[104] California Regional Water Quality Control Board Central Valley Region Order R5-2017-0058 –Waste Discharge Requirements General Order for Confined Bovine feeding Operations. Retrieved from: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2017-0058.pdf

Waste Management Field Handbook (AWMFH)[105] or the maximum loading rate according to state regulatory requirements, whichever is more stringent.

According to Figure 10-30 (August 2009) of the latest version of the AWMFH, the maximum aerobic lagoon lading rate for the Valley is 45 - 55 lb-BOD_5/acre-day. Based on information from the USDA National Agricultural Statistics Service, the average dairy in the Valley has approximately 1,600 milk and dry cows. Based on a typical dairy herd composition, the average dairy in the Valley is estimated to have approximately 1,348 milk cows, 252 dry cows, and 1,153 heifers and calves. According to Table 4-5 (March 2008) of the USDA-NRCS AWMFH, the total daily manure produced by each milk cow, dry cows, and 970 lb heifer will have an average BOD loading of 2.9 lb-BOD_5/day, 1.4 lb-BOD_5/day, and 1.2 lb-BOD_5/day, respectively. The average BOD loading of manure produced by smaller heifers and calves is estimated based on manure volatile solids excretion rates. Assuming that 80 percent of the manure will be flushed to the lagoon system, the minimum lagoon surface area required for a naturally aerobic lagoon treating manure from an average size dairy in the Valley with 1,600 milk and dry cows can be calculated as follows:

<u>BOD_5 loading (lb/day)</u>

1,348 milk cows x 2.9 lb-BOD_5/cow-day x 0.80 = 3,127 lb-BOD_5/day

252 dry cows x 1.4 lb-BOD_5/cow-day x 0.80 = 282 lb-BOD_5/day

457 heifers (15-24 months) x 1.2 lb-BOD_5/heifer-day x 0.80 = 439 lb-BOD5/day

366 heifers (7-14 months) x 0.83 lb-BOD_5/heifer-day x 0.80 = 243 lb-BOD_5/day

182 heifers (4-6 months) x 0.47 lb-BOD_5/heifer-day x 0.80 = 68 lb-BOD_5/day

148 calves (0-3 months) x 0.27 lb-BOD_5/heifer-day x 0.80 = 32 lb-BOD_5/day

Total BOD loading = 3,127 lb-BOD_5/day + 282 lb-BOD_5/day + 439 lb-BOD_5/day + 243 lb-BOD_5/day + = 68 lb-BOD_5/day + 32 lb-BOD_5/day = 4,191 lb-BOD_5/day

<u>Minimum Surface Area Required for a Naturally Aerobic Lagoon for an Average San Joaquin Valley Dairy</u>

Minimum Surface (acres) in areas with a maximum loading rate of 55 lb-BOD_5/acre-day = 4,191 lb-BOD_5/day ÷ 55 lb-BOD_5/acre-day = 76.2 acres

Minimum Surface (acres) in areas with a maximum loading rate of 45 lb-BOD_5/acre-day = 4,191 lb-BOD_5/day ÷ 45 lb-BOD_5/acre-day = 93.1 acres

[105] United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), Agricultural Waste Management Field Handbook (AWMFH). Retrieved from: https://directives.sc.egov.usda.gov/viewerfs.aspx?hid=21430

As shown above the minimum surface area required for a naturally aerobic lagoon treating manure from an average size dairy in the Valley would range from approximately 76.2 – 93.1 acres. This amount of land is not typically available and would require the removal of land that is currently used to produce feed or other crops. Construction of a lagoon over 76 acres in size would be a massive project that would have numerous challenges and high costs for both design and construction. For example, the expense of lining a lagoon of this size would be extremely high. To comply with the requirements of the Central Valley Regional Water Quality Control Board, new lagoons and ponds that store dairy manure in the Valley have generally needed to comply with the Central Valley Regional Water Quality Control Board Tier 1 design standards, which require a lagoon or pond with a double liner constructed of high density polyethylene (HDPE) or material of equivalent durability with a leachate collection and removal system. The Capital Press article[106] indicated that the cost for the installation of double-liner for an existing lagoon at a dairy near Sunnyside, Washington in 2016 was roughly $500,000 for each lagoon and the lagoons averaged 78,000 square feet each. Based on this information, the cost of a double liner for a lagoon storing dairy manure is estimated to be about $7.88 per square foot and $343,253 per acre in 2022. Therefore, the cost for the liner for a lagoon only with an area of 76.2 to 93.1 acres would be $26,555,879 to $31,956,854.

In addition to construction costs, there would also be an increase in expenses for designing and maintaining lagoons of such a large size. To comply with the requirements of Regional Water Quality Control Board and Mosquito Abatement District the lagoon would need to be regularly cleared of any dead algae, vegetation, and floating debris that could create a habitat for mosquitos and other vectors that carry diseases. Therefore, as a result of the large size of the lagoons, the maintenance required to comply with these regulations would be difficult and there would also be increased costs. Finally, ammonia emissions may increase from naturally aerobic lagoons because of the large surface in contact with the atmosphere.

The NRCS Reference Guide states that the energy required at an animal production operation to introduce enough oxygen for complete aerobic treatment using mechanical aeration is very expensive and aeration of the surface of the liquid manure is more common.

The Government of Ontario publication[107] states that there are several disadvantages for on-farm use of mechanical aeration and specifically lists the following:

- High initial costs;
- High energy costs;
- High maintenance costs;

[106] Wheat, D. (2018). Dairy Installs Double Liner in Its Lagoon. Capital Press. Updated December 13, 2018. Retrieved from: https://www.capitalpress.com/state/washington/dairy-installs-double-liner-in-its-lagoon/article_9ded077e-db11-5cc5-adb7-aa7ebee6e5b9.html
[107] Government of Ontario. (2006). "Aeration of Liquid Manure". Retrieved from: https://www.ontario.ca/page/aeration-liquid-manurehttps://www.ontario.ca/page/aeration-liquid-manure

- Effectiveness is reduced in cold weather;
- The introduction of antibiotics and sanitizers can upset or destroy the required aerobic bacteria; and
- Nitrogen loss to the atmosphere is increased with mechanical aeration.

This publication cautions that improperly designed mechanical aeration systems may contribute more odor than what is reduced through the mixing of air into the liquid, which indicates that mechanical aeration of manure can increase emissions.
The very high cost of complete mechanical aeration makes this option infeasible for farms. For complete aerobic treatment of a lagoon, sufficient oxygen must be delivered into the lagoon and the oxygen delivered must be completely mixed throughout the lagoon. A report by the University of California (UC) Davis[108] states, "*Mixing is important to ensure uniformity of temperature and composition throughout the volume, e.g., continuous bulk turnover is needed to eliminate quiescent zones or sludge layers where anaerobic conditions persist. Also, relatively vigorous mixing (high turbulence) prevents clumping of organisms/substrate, and reduces diffusion resistance by thinning the film thickness through which dissolved oxygen must migrate (diffuse) to reach substrate particles and organisms.*" Delivery of oxygen and mixing of the oxygen throughout a lagoon requires substantial amounts of energy. The cost of electricity for complete aeration can be estimated based on the amount of oxygen that needs to be supplied and the energy required for complete mixing of oxygen throughout a lagoon. The Government of Ontario publication indicates that for complete aeration of manure, oxygen must be supplied in an amount equal to twice the BOD in the manure.

A publication[109] indicates that approximately 1.5 to 2.5 pounds of oxygen is required to digest one pound of Biological Oxygen Demand (BOD_5) with additional oxygen required for conversion of ammonia to nitrate (NO3-) (nitrification). In this publication, Dr. Ruihong Zhang of UC Davis estimated that 2.4 lbs (1.1 kg) of oxygen (O_2) per cow must be provided each day for removal of BOD and an additional 3 lbs (1.4 kg) per cow for oxidation of 70 percent of the nitrogen, which is a ratio of approximately 2.25 lb of oxygen per lb of BOD. It will be estimated that 2 lb of oxygen per 1 lb of BOD_5 is required for nitrification of ammonia.

As discussed above, the lagoons for an average size dairy in the Valley with 1,600 mature cows will have a BOD loading rate of approximately 4,191 lb-BOD_5/day. Based on the data gathered in the UC Davis report, aeration efficiencies for mechanical aerators ranged from 0.10 to 0.68 kg of oxygen provided per kW-hr of energy utilized.[110] The most efficient aerator tested installed in dairy lagoons had an aeration efficiency of 0.49 kg-O_2/kW-hr. These efficiency tests were performed in clean water. The efficiency

[108] Williams, R.B., Elmashad, H., Kaffka, S. (2020). Research and Technical Analysis to Support and Improve the Alternative Manure Management Program Quantification Methodology. *University of California, Davis, California Biomass Collaborative*, CARB Agreement No. 17TTD010. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/ucd_ammp_qm_analysis_final_april2020.pdf
[109] San Joaquin Valley Dairy Manure Technology Feasibility Assessment Panel. (2005) An Assessment of Technologies for Management and Treatment of Dairy Manure in California's San Joaquin Valley. California Air Resources Board
[110] Zhang, R., Sun, H., Kamthunzi, W.M., Collar, C.A., Mitloehner, F.M. (2007) Aerator Performance for Wastewater Lagoon Application, ASABE. https://elibrary.asabe.org/abstract.asp?aid=23832

of the aerators will be lower in liquid manure because of the higher amount of solids that it contains compared to clean water. The yearly energy requirement for a mechanically aerated lagoon treating flushed manure an average size dairy in the Valley is calculated as follows:

Oxygen Requirement for Average Size Dairy in the Valley

4,191 lb-BOD_5/day x 1 kg/2.2046 lb = 1,901 kg-BOD_5/day x 2 = 3,802 kg-BOD_5/day

Electricity for High Efficiency Aerator

3,802 kg-BOD_5/day ÷ (0.68 kg-O_2/kW-hr) x (365 day/year) = 2,040,779 kW-hr/year

Electricity for Low Efficiency Aerator

3,802 kg-BOD_5/day ÷ (0.10 kg-O_2/kW-hr) x (365 day/year) = 13,877,300 kW-hr/year

Electricity for Complete Mixing of Air

The UC Davis report estimates that mixing for complete aeration of a dairy lagoon would require 3,300 kW-hr per milk cow per year. The energy required for mixing for complete aeration for an average sized dairy in the Valley is calculated as follows:

1,348 milk cows x 3,300 kW-hr/milk cow-year = 4,448,400 kW-hr/year

Total Electricity Required for Complete Aeration with High Efficiency Aerator

2,040,779 kW-hr/year + 4,448,400 kW-hr/year = 6,489,179 kW-hr/yr

Total Electricity Required for Complete Aeration with Low Efficiency Aerator

13,877,300 kW-hr/year + 4,448,400 kW-hr/year = 18,325,700 kW-hr/yr

Cost of Electricity for Complete Mechanical Aeration of a Lagoon Treating Manure from an Average Size Dairy in the Valley:

The cost for electricity will be based upon the average price for industrial electricity in California for the year December 2021 through November 2022, as taken from the Energy Information Administration (EIA) website:

Average Cost for electricity = $0.1685/kW-hr

The electricity costs for complete aeration are calculated as follows:

<u>Low Cost Estimate (High Efficiency Aerator)</u>

6,489,179 kW-hr/year x $0.1685/kW-hr = $1,093,427/year

<u>High Cost Estimate (Low Efficiency Aerator)</u>

18,325,700 kW-hr/year x $0.1685/kW-hr = $3,087,880/year

As shown above, the estimated cost for only the electricity for a mechanically aeration to reduce ammonia emissions from an average size dairy in the Valley ranges from nearly $1.1 million per year to nearly $3.1 million per year. This cost does not include the design and construction of the mechanical aeration system or any additional operational costs. However, it is clear that the cost of electricity alone would make this system economically infeasible, especially when considering that the price of electricity is expected to continue to increase.

Although the NRCS Reference Guide states that surface aeration of manure is more common because of the difficulty and expense of complete mechanical aeration, the amount of oxygen provided by aeration of the surface of liquid manure would not be sufficient to oxidize ammonia. Any ammonia oxidized would be converted to nitrite and nitrate. Increased concentrations of nitrite and nitrate in the liquid manure may require treatment to protect water quality or increase emissions of NOx or nitrous oxide (N2O). Although surface aeration may sometimes reduce odors of some compounds, surface aeration may actually increase ammonia emissions because it accelerates the release of carbon dioxide (CO2), an acidic gas, which increases the pH of the manure promoting increased ammonia emissions.[111, 112] Additionally, low levels of aeration will not provide sufficient oxygen for treatment, but can increase the transfer of emissions from the manure to the air because of the increased disturbance at the surface of the liquid manure.

Naturally aerated lagoons are not feasible in the Valley because of the large land requirements, fully mechanically aerated lagoons are not practical because of the high energy requirements and costs, and surface aeration is not expected to reduce ammonia emissions; therefore, this is not a feasible measure to reduce ammonia emissions from liquid manure in the Valley.

The District is unaware of any instances in which oxygenation demonstrates to be a practical technology on any farm to decrease ammonia emissions from liquid manure and has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

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[111] Zhao, B., Chen, S. (2003). Ammonia Volatilization from Dairy Manure under Anaerobic and Aerated Conditions at Different Temperature. Paper number 034148, 2003 American Society of Agricultural and Biological Engineers Annual Meeting. Retrieved from: https://elibrary.asabe.org/abstract.asp?aid=13892

[112] Kaffka, S., Barzee, T., El-Mashad, H., Williams, R., Zicari, S., Zhang, R. (2016). Evaluation of Dairy Manure Management Practices for Greenhouse Gas Emissions Mitigation in California. Final Technical Report to the State of California Air Resources Board Contract #14-456. Retrieved from: https://biomass.ucdavis.edu/wp-content/uploads/ARB-Report-Final-Draft-Transmittal-Feb-26-2016.pdf

Storage Bags - ***(applies to dairy cattle only)***

Manure storage bags have primarily been used to store manure from pig farms in Europe and Canada. They have also recently started to be used to store manure on some dairy farms that are relatively small compared to the typical dairies in the Valley. The storage of manure in bags is only suitable for small dairies that handle manure as a slurry. Manure storage bags are not suitable for large dairies that handle dilute liquid manure because of the large volumes of manure that must be stored until it can be applied to cropland. The majority of dairies in the Valley are large flush dairies in which liquid manure mixed with water is stored in large earthen lagoons or ponds until it can be applied to cropland. Dairies that handle manure as a slurry without the addition of water are extremely rare in the Valley. [113] In addition, lagoons and storage ponds that hold manure are required to be lined in order to reduce the chances of manure contaminating the groundwater. Manure storage bags may not be allowed because there is a high possibility that something may puncture the bag causing manure to leak, which could degrade groundwater.

The District is unaware of any dairies in the Valley that are currently using storage bags to store manure. Manure storage bags are not suitable for the typical size dairies in the Valley and there are questions about if these bags would comply with existing California regulations, including water regulations. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Liquid Manure Storage Covers - ***(applies to all CAFs)***

The NRCS Reference Guide includes manure storage covers as a potential measure to reduce emissions from the storage of manure. Manure can be handled and stored in the form of a thick slurry, a dilute liquid, or as a solid. A study[114] notes that placing a cover over a lagoon can reduce emissions, however the different cover types have both benefits and drawbacks. Such covers include, natural or synthetic and they may be flexible or rigid, which vary in cost. The type of cover that is appropriate for each operation depends on the size and type of manure storage, environmental factors, and the goals of the farm. Manure storage covers limit emissions by slowing diffusion of gases and reducing the effects of wind on the surface of the manure. Although manure storage covers may reduce pollutants directly emitted from the manure, they do not destroy or eliminate pollutants such as ammonia. Rather, concentrations of these pollutants increase in the stored manure and additional measures would be required to prevent their release when the manure is removed from storage.

[113] Marklein, A. R., Meyer, D., Fischer, M. L., Jeong, S., Rafiq, T., Carr, M., and Hopkins, F. M. (2021) Facility-Scale Inventory of Dairy Methane Emissions in California: Implications for Mitigation, Earth Syst. Sci. Data, 13, 1151–1166, https://doi.org/10.5194/essd-13-1151-2021, 2021.
[114] Marks, R. (2001). Cesspools of Shame: How Factory Farm Lagoons and Sprayfields Threaten Environmental and Public Health. *Natural Resources Defense Council and the Clean Water Network.* Retrieved from: https://www.nrdc.org/sites/default/files/cesspools.pdf

As previously mentioned, Valley dairies that handle manure as a slurry without the addition of water are extremely rare and therefore certain types of manure covers are generally not applicable. The NRCS Reference Guide notes that concrete covers cannot be used on earthen or steel manure storages and natural covers (e.g. straw, barely, cornstalks) are impractical if the surface area of the storage is very large. Dairies in the Valley primarily store liquid manure with low solids content in large earthen lagoons or ponds,[115] therefore concrete covers and natural covers cannot feasibly be used to cover liquid manure in the Valley. Additionally, the Valley regulations from the Regional Water Quality Control Board[116] and mosquito abatement districts[117] generally require the removal of any materials that would form natural covers in order to decrease the chances for the proliferation of mosquitos and other vectors.

Although covers made of rigid plastic, such as HDPE, may be a potential option to cover lagoons and ponds that store liquid manure in the Valley, they would be very prohibitively expensive because of the large area that would need to be covered. As previously mentioned, the average dairy in the Valley has almost 1,600 cows compared to a national average of less than 300 cows per dairy outside of California. Since the Valley dairies are larger compared to other dairies in the nation, the lagoons and ponds that store liquid manure are also several times larger compared to the national average dairy that stores mostly undiluted slurry manure.

Moreover, manure covers do not destroy ammonia, rather they create a barrier that suppresses emissions of ammonia from the manure and air space above the manure. This leads to increased concentrations of ammonia and other air contaminants in the manure and air space above the manure, which will just delay the release of ammonia until it is sent to a different pond or applied to land. The increase concentration of ammonia in the manure will also increase the pH and subsequently increase the potential for ammonia emissions. Furthermore, because of the warm climate of the Valley, covering a lagoon with a plastic cover would turn the lagoon into an anaerobic digester. The majority of anaerobic digesters operating on dairies in the Valley are already covered lagoon digesters. The NRCS Reference Guide also states that gases will build up under impermeable covers that must be flared or utilized in another way. Flaring or combusting these gases would produce NO_X, which is the primary precursor for PM2.5 in the Valley, as well as direct PM2.5 emissions.

The District has permitted several facilities to construct and operate a covered lagoon. However, in each case, the covered lagoon was part of a digester system to capture biogas/digester-gas, and the cost of the system was funded by grants from the California Department of Food and Agriculture (CDFA) Dairy Digester Research and Development Program.

[115] Meyer, D., Price, P.L., Rossow, H.A., Silva-del-Rio, N., Karle, B., Robinson, P.H., DePeters, E.J., and Fadel, J. (2011) Survey of Dairy Housing and Manure Management Practices in California. Journal Dairy Sci. 94:4744-4750. https://doi.org/10.3168/jds.2010-3761
[116] California Regional Water Quality Control Board Central Valley Region. Order R5-2013-0122. Retrieved from: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2013-0122.pdf
[117] The Fresno County Mosquito Control Districts. Retrieved from: https://fresnocountymosquito.org/

In conclusion, it is not reasonable to require covers to reduce ammonia emissions from liquid manure storage in the Valley given the high expense associated to the practice and the fact that the practice is not expected to result in any overall reductions of ammonia emissions in the Valley, but could increase emissions of other pollutants.

Solid Manure Storage Covers - ***(applies to all CAFs)***

U.S. EPA identified Method 62 (Cover solid manure sources with sheeting) from the UK User Guide, noting that it could result in ammonia emission reductions up to 90 percent. Method 62 involves covering solid manure stores with sheeting, which provides a physical barrier preventing the release of ammonia to the air. U.S. EPA acknowledged that this method "would increase ammonium content of the slurry, potentially leading to higher ammonia emissions during storage and spreading." District Rule 4570, U.S. EPA acknowledges, contains mitigation measure options for the covering of dry manure piles, and in most cases, facilities are required to cover manure and separated solids or else remove them from the facility.[118]

Storage of solid manure/separated solids contributes a very small amount of total ammonia emissions in the Valley, by making up less than 2 percent of the total ammonia emissions from dairies. Nonetheless, covering for solid manure/separated solids during the months of October through May is included in Rule 4570 and required for most dairies during these 8 months of the year, which include the District's PM2.5 season.

Based on District permitting records covering solid manure or separated manure solids during October through May is required by 729 dairies, 84 percent of the dairies are subject to Rule 4570, and a larger percentage of the total dairy cattle since this measure is required for all dairies that are classified as large confined animal facilities under the rule.

Covers for solid manure/separated solids is not required during the summer because solid manure is primarily composed of organic material that is combustible and during the hot summers in the Valley, elevated temperatures increase the chances of spontaneous combustion of manure piles.[119] Therefore, for safety reasons manure covers cannot be required during the hotter summer months. However, through District Rule 4570, the District requires CAFs to cover solid manure/separated solids during the colder winter months, as shown below:

- Cover dry manure outside the housing with a weatherproof covering from October through May, except for times when wind events remove the covering, not to exceed 24 hours per event; and

[118] Chadwick, D.R. (2005). Emissions of Ammonia, Nitrous Oxide and Methane from Cattle Manure Heaps: Effect of Compaction and Covering. *Atmosphere Environment*, Vol. 39, Issue 4: 787-799. Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S135223100400994X

[119] Westendorf, M. L. "Animal Science Update: Spontaneous Combustion". New Jersey Farmer. August 15, 2016. Page 6. https://plant-pest-advisory.rutgers.edu/spontaneous-combustion/

- Cover separated solids outside the housing with a weatherproof covering from October through May, except for times when wind events remove the covering, not to exceed 24 hours per event.

In conclusion, the District already has a mechanism to implement this mitigation measure for solid manure/separated solid stored onsite. No additional ammonia reductions are expected from the suggested mitigation measure.

Allow Cattle Slurry Stores to Develop a Natural Crust - ***(applies to dairy cattle only)***

This measure identified in the UK User Guide involves retaining a surface crust on slurry stores, composed of fiber and bedding material present in cattle slurry, for as long as possible. This practice is applicable to thick slurry manure, which differs from the typical liquid manure stored in the Valley. The dilute liquid manure handled in the Valley is stored in ponds and lagoons much larger than storages used for slurry manure in other regions, and does not contain enough solids to form a natural crust.

Additionally, this practice is more applicable to cooler climates, while in the Valley's warm climate, floating debris on liquid manure create a habitat for mosquitos and other vectors that carry diseases, including West Nile virus, zika, dengue, chikungunya, and St. Louis encephalitis.[120] To reduce the potential for the propagation of mosquitos and other disease carrying vectors, Regional Water Quality Control Board[121] and Mosquito Abatement District regulations require the removal of any dead algae, vegetation, and floating debris, including those that would form a natural crust on the surface of a lagoon or pond.[122] Thus, this practice is not allowed in the Valley. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Solid-Liquid Separation - ***(applies to all CAFs)***

The NRCS Reference Guide states that for manure streams handled as a slurry, separation of the solid and liquid portions prior to storage, additional treatment, and/or land application may reduce odor and other gaseous emissions, particularly for undersized lagoons. Various solid separation technologies are used for these purposes, including screens, rotary drums, centrifugal tanks, earthen pits, weeping walls, settling basins and screw-presses.

Dairies in the Valley primarily handle liquid manure that has been diluted with water, rather than slurry manure, and the effluent from dairies in California often has a total

[120] The Fresno County Mosquito Control Districts. Retrieved from: https://fresnocountymosquito.org/
[121] California Regional Water Quality Control Board Central Valley Region. Order R5-2013-0122. Retrieved from: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2013-0122.pdf
[122] Collar, C. (2005). West Nile Virus – How Dairies Can Help 'Fight the Bite. *University of California, Davis, Cooperative Extension.* Retrieved from: https://cemerced.ucanr.edu/newsletters/September_200523148.pdf

solids content of only 1 percent;[123] therefore this measure is not directly applicable to most dairies in the Valley. The NRCS Reference Guide indicates that solid-liquid separation does not work well for manure streams with very low or very high solids content, unless advanced technologies or multiple separation stages or screen sizes are used to remove large and small solids from the manure stream separately. These technologies will have additional challenges and increased costs. Additionally, some studies indicate that the majority of ammonia nitrogen in dilute manure streams remains in the liquid portion and are not removed by solid-liquid separation. The NRCS Reference Guide indicates that some separator designs may increase emissions of gases or particles during the separation process. Dried separated solids may also increase the potential for PM emissions.

As mentioned above, this control measure is applicable to manure handled as a slurry rather than the dilute liquid manure that is typically handled on dairies in the Valley. Therefore, this practice is not directly applicable to dairies in the Valley. However, for cattle facilities that handle liquid manure, Rule 4570 does allow the facilities to choose the option to remove solids from the waste system with a solid separator system prior to the waste entering the lagoon. This option has been chosen by the vast majority cattle facilities that handle liquid manure, including over 90 percent of dairy cattle facilities subject to Rule 4570.[124] The option in Rule 4570 is as follows:

- Remove solids from the waste system with a solid separator system, prior to the waste entering the lagoon.

In conclusion, the District already has a mitigation measure option to minimize emissions from solid-liquid manure separation. No additional ammonia reductions are expected from the suggested mitigation measure.

Anaerobic Digesters - ***(applies to dairy cattle only)***

Anaerobic digesters are storage or treatment lagoons that are undergoing anaerobic reactions, primarily located at dairies. Digesters are outfitted with roofs and covers that enclose all anaerobic emissions within the system and vent to a gas collection system that eliminates undesired methane emissions. The microbes performing anaerobic reactions in lagoons convert nitrogen to form various new compounds, including ammonia. Through the implementation of its Short-Lived Climate Pollutant Strategy and SB 1383,[125] the State of California has funded the installation of over 120 dairy digester

[123] Meyer, D, Heguy, J., Karle, B. and Robinson, P. (2019) Characterize Physical and Chemical Properties of Manure in California Dairy Systems to Improve Greenhouse Gas Emission Estimates. California Environmental Protection Agency, Air Resources Board. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/16rd002.pdf
[124] EPA-USDA NRCS. "Reference Guide for Poultry and Livestock Production Systems." September 2017. Retrieved from: https://www.epa.gov/sites/default/files/2017-01/documents/web_placeholder.pdf
[125] CARB. Analysis of Progress toward Achieving the 2030 Dairy and Livestock Sector Methane Emissions Target. (March 2022). Retrieved from: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiayMXd4af9AhXWrmoFHYf2BNsQFnoECBAQAQ&url=https%3A%2F%2Fww2.arb.ca.gov%2Fsites%2Fdefault%2Ffiles%2F2022-03%2Ffinal-dairy-livestock-SB1383-analysis.pdf&usg=AOvVaw32GB5_r8-3GsSd57-XTnyo

systems throughout the state to reduce methane emissions, with the majority of installations in the San Joaquin Valley. Through the generation of vehicle renewable natural gas, some dairy digester systems have the potential of reducing vehicle-related NOx, PM2.5, air toxics, and greenhouse gas (GHG) emissions.

Some forms of energy conversion from biogas (e.g., burning biogas in an engine to produce electricity) may increase emissions of NOx, a precursor for PM2.5 and ozone, and direct PM2.5 emissions. These emissions can have a negative impact in the Valley, which is designated as nonattainment for PM2.5 and ozone This technology is very expensive, due to capital costs, operation, and maintenance expenses. It also requires significant addition of water, and may not be feasible in water-limited areas.

The NRCS Reference Guide includes anaerobic digesters as a measure to reduce VOCs and GHG emissions, but does not indicate that it reduces ammonia. Some of the information discussed in the NRCS Reference Guide about anaerobic digestion indicates a potential for increased ammonia emissions. The results of some studies also indicate that there is a potential for increased ammonia emissions following digestion.[126] There is limited information regarding the potential and scale of ammonia emissions impacts associated with digester, and California does not currently attribute any increased ammonia impacts from the implementation of dairy digester systems.

At this time there are significant uncertainties about the overall effect of anaerobic digesters on ammonia emissions from manure and additional research is needed to better understand this, particularly for digesters in the Valley. Because of this and the very high costs associated with installation of anaerobic digesters, they are not a feasible option to implement into Rule 4570 at this time. However, this practice would be evaluated as a potential BACT measure for any new or expanding operations; the required mitigation measure from BACT Guideline 5.8.6[127], is as follows:

- Anaerobic treatment lagoon designed according to NRCS Guideline 359.

In conclusion, the District already has a mechanism to implement this mitigation measure for expanding or new confined animal facilities. No additional ammonia reductions are expected from the suggested mitigation measure.

<u>Manure Additives</u> - *(applies to all CAFs)*

Manure amendments are not practical for manure handled as a dilute liquid, which is typical for Valley dairies, because the large volume of water mixed with the manure greatly increases the amount of an amendment required to change the properties of liquid manure, such as pH. The addition of certain amendments also increases the risk

[126] Koirala, K., Ndegwa, P.M., Joo, H.S., Frear, C., Stockle, C.O., Harrison, J.H. (2013). Impact of Anaerobic Digestion of Liquid Dairy Manure on Ammonia Volatilization Process. *American Society of Agricultural and Biological Engineers,* Vol. 56(5): 1959-1966. Retrieved from: https://labs.wsu.edu/ndegwa/documents/2016/09/Article-57.pdf/

[127] CARB BACT Guidelines Tool. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/classic/technology-clearinghouse/bact/BACTID781.pdf?:linktarget=_self&:embed=yes

of foaming in liquid manure, which can damage pumps.[128] For slurry and liquid manure, it is difficult and costly to apply a sufficient amount of amendments to change the pH of the manure because of its natural buffering capacity, or resistance to changes in pH due to its chemical properties.

The NRCS Reference Guide states, *"It is often difficult to establish microbiological additives due to competition from naturally-occurring bacteria in manure.*" The microbes in microbial additives are often out-competed by the naturally occurring microorganisms, because of the abundance of diverse microorganisms that are naturally present in manure that can multiply rapidly when favorable conditions are present. As a result, microbial additives are often ineffective or must be continually added to the manure. A study[129] conducted by Iowa State University, clearly demonstrates that many questions remain unanswered about the general effectiveness of microbial additives used to reduce emissions. The study evaluated 12 commercial microbial additives that were marketed for their ability to reduce emissions of odorous VOCs, H2S, ammonia, GHG, and odors. The results indicated that emissions from the treated manure were not statistically significant to the untreated manure for any of the 12 products tested. Thus, the ability of microbial additives to reduce emissions from manure remains unproven. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Acidifying Slurry and Shifting Chemical Balance from Ammonia to Ammonium - *(applies to all CAFs)*

This mitigation method mentioned in the compilation by Guthrie, et al.[130] involves the use of manure amendments to minimize ammonia emissions. Manure amendments are not practical for manure handled as a dilute liquid, which is typical for Valley dairies, because the large volume of water mixed with the manure greatly increases the amount of an amendment required to change the properties of liquid manure, such as pH. The addition of certain amendments also increases the risk of foaming in liquid manure, which can damage pumps. For slurry and liquid manure, it is difficult and costly to apply a sufficient amount of amendments to change the pH of the manure because of natural buffering capacity. Notably, some additives can even increase emissions of certain pollutants and can be toxic to handle.

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[128] USDA NRCS/EPA (2017) Agricultural Air Quality Conservation Measures Reference Guide for Poultry and Livestock Production Systems. https://www.nrcs.usda.gov/sites/default/files/2022-06/Ag_AQ_Conservation_Measures_Poultry_and_Livestock_September_2017.pdf

[129] Koziel, J., Chen, B., Andersen, D., Parker, D., Bialowiec, A., Banik, C., Lee, M., O'Brien, S., Ma, H., Meiirkhanuly, Z., Wi, J., Li, P., Iowa State University. (2021). Evaluating Manure Additives for Odor Mitigation. *National Hog Farmer.* Retrieved from: https://www.nationalhogfarmer.com/agenda/evaluating-manure-additives-odor-mitigation

[130] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

Moreover, any additives to the manure require approval of the Regional Water Quality Control Board.[131] The Regional Water Quality Control Board has determined that increased salinity is a threat to water quality in the Valley.[132] As a result, in many cases the application of amendments and additives that use salts to change pH will not be allowed.

For reasons discussed above, manure amendments are not practical for most operations in the Valley. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Acidifying Amendments and Additives for Poultry Litter - ***(applies to poultry only)***

This method involves the application of aluminum to poultry litter to reduce the pH of the litter. However, poultry operations have already reduced nitrogen excretion by 55 percent and are not a significant source of ammonia in the Valley. Use of acidifying litter amendments is more common for poultry litter however, any additives to the manure require approval of the Regional Water Quality Control Board. The Regional Water Quality Control Board has determined that increased salinity is a threat to water quality in the Valley.[133, 134] As a result, in many cases the application of amendments and additives that use salts to change pH will not be allowed.

Notably, some additives can increase emissions of certain pollutants and can be toxic to handle. For example, the litter in poultry houses in the Valley are drier than many other parts of the country and therefore aluminum would need to be applied as a liquid. Nevertheless, liquid aluminum is an acid that is dangerous to handle and requires a certified applicator to be hired which results in higher costs.

Despite the uncertainties above, the District further evaluated the potential emission reductions of implementing this measure in the Valley. This analysis is provided below.

Ammonia is a weak base and reducing the pH of litter binds ammonia and reduces its volatilization. Aluminum sulfate, also known as alum, is a common compound used to treat poultry litter to reduce ammonia emissions and bind phosphorous to prevent runoff. The typical recommended application rate for aluminum sulfate is 0.1 to 0.2 lb of

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[131] California Regional Water Quality Control Board Central Valley Region. (March 2017). Resolution R5-2017-0031 (Accepting the Salt and Nitrate Management Plan). Retrieved from: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/resolutions/r5-2017-0031_res.pdf

[132] California Regional Water Quality Control Board Central Valley Region. (May 2006). Salinity in the Central Valley. Retrieved from: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/CDWA%20et%20al/SDWA_206.pdf

[133] California Regional Water Quality Control Board Central Valley Region. (May 2006). Salinity in the Central Valley. Retrieved from: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/CDWA%20et%20al/SDWA_206.pdf

[134] California Regional Water Quality Control Board Central Valley Region. (March 2017). Resolution R5-2017-0031 (Accepting the Salt and Nitrate Management Plan). Retrieved from: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/resolutions/r5-2017-0031_res.pdf

aluminum sulfate per broiler placed.[135] The higher the aluminum sulfate application rate, the higher the ammonia control and phosphorus binding ability of aluminum sulfate. The lower recommended application rate will control ammonia emissions for about half the time as the higher recommended application rate.[136, 137] Young chicks are more vulnerable to higher ammonia concentrations in the houses; however, ammonia emissions are lower because of the lower amount of manure produced by the smaller birds. These recommended application rates are based on broilers with a finished weight of approximately four pounds. Larger birds will require correspondingly larger application rates to achieve the same control of ammonia.[138]

A study published in 2020 found that an application rate of 98 kg of aluminum sulfate per 100 square meters incorporated into litter reduced overall ammonia emissions from broilers by 35 percent.[139] In the study, the birds were placed in 2.1 m by 1.8 m pens with 50 birds per pen to evaluate different treatments. Therefore, the application rate of alum on a per bird basis was calculated as follows:

98 kg/100 m^2 x 2.1 m × 1.8 m ÷ 50 bird = 0.074 kg/bird

The application rate of 0.074 kg/bird is equivalent to an application rate 0.16 lb-aluminum sulfate per bird. Therefore, it will be assumed that this is the application rate required to reduce ammonia emissions by 35 percent. The District's current ammonia emission factor for broiler chickens is 0.0958 lb-NH3/bird-year. Thus, the ammonia emission reductions for this practice can be calculated as follows:

0.0958 lb-NH3/bird-year x 35% = 0.0335 lb-NH3/bird/year

The cost of the emission reductions is based on the cost of the purchase and application of aluminum sulfate. Because of the typically dry conditions in the Valley, liquid aluminum sulfate is preferred because moisture is required for aluminum sulfate to react with ammonia. A USDA-ARS publication[140] indicates that one ton of aluminum sulfate is equivalent to 370 gallons of liquid aluminum sulfate. Based on a web search, the price of aluminum sulfate is estimated to be $1,155 per 55 gallon drum.[141] The customer applicator rate is assumed to be $100 for each broiler house housing 20,000

[135] See Moore, P. Treating Poultry Litter with Aluminum Sulfate. USDA ARS. Developed by Livestock GRACEnet. https://www.ars.usda.gov/ARSUserFiles/np212/LivestockGRACEnet/AlumPoultryLitter.pdf
[136] Moore, P., Watkins, S. Treating Poultry Litter with Alum. University of Arkansas (U of A) Division of Agriculture Cooperative Extension Service. https://www.uaex.uada.edu/publications/PDF/FSA-8003.pdf
[137] Moore, P., Miles, D., Burns, R. (March 2019). Reducing Ammonia Emissions from Poultry Litter with Alum. Livestock and Poultry Environmental Learning Community (LPELC). https://lpelc.org/reducing-ammonia-emissions-from-poultry-litter-with-alum/
[138] Anderson, K.; Moore, P.A., Jr.; Martin, J.; Ashworth, A.J. (2020) Effect of a New Manure Amendment on Ammonia Emissions from Poultry Litter. *Atmosphere*, *11*, 257. https://doi.org/10.3390/atmos11030257
[139] Penn, C., Zhang, H (April 2017) Alum-Treated Poultry Litter as a Fertilizer Source. Oklahoma State University Extension. https://extension.okstate.edu/fact-sheets/alum-treated-poultry-litter-as-a-fertilizer-source.html#nitrogen-content-of-alum-treated-litter
[140] See Moore, P. Treating Poultry Litter with Aluminum Sulfate. USDA ARS. Developed by Livestock GRACEnet. https://www.ars.usda.gov/ARSUserFiles/np212/LivestockGRACEnet/AlumPoultryLitter.pdf
[141] Alliance Chemical, Price of Aluminum Sulfate 50%. Retrieved from: https://alliancechemical.com/product/aluminum-sulfate-50/?attribute_pa_size=55-gallon&attribute_pa_packaging-type=drum&gclid=EAIaIQobChMIurHTv9WT_QIVMRPUAR1c5QvKEAQYASABEgJ5__D_BwE

birds. Therefore, the total cost for each application of aluminum sulfate on a per bird basis is calculated as follows:

0.16 lb-aluminum sulfate/bird x 1 ton/2,000 lb x 370 gal-aluminum sulfate/ton-aluminum sulfate x $1,155/55 gal-aluminum sulfate + $100/20,000 bird = $0.63/bird

Approximately 6.7 broiler flocks are produced each year and aluminum sulfate must be applied prior to placing each flock; therefore, the annual cost of this measure on a bird capacity basis is 6.7/year x $0.63/bird = $4.22/bird capacity-year.

The cost effectiveness of the ammonia reductions from this measure are calculated as follows:

$4.22/bird-year ÷ 0.0335 lb-NH3/bird-year x 2,000 lb/ton = $251,940/ton-NH3 reduced

As demonstrated above, the potential reductions from this measure are not cost effective, with a cost effectiveness of $251,940 per ton of ammonia reduced. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

<u>Urease Inhibitors</u> - *(applies to all cattle)*

A study[142] indicates that the information for this control measure was taken from AirControlNet, a software tool previously used by EPA to estimate the cost of emission reductions. The AirControlNET v.4.1 Documentation Report[143] indicates that the specific chemical additive that this measure refers to was N-(n-butyl) thiophosphoric triamide (NBPT), which was being sold under the trade name Conserve-Nr. NBPT is a type of urease inhibitor. The cost information was provided by a supplier of the chemical and appears to be an underestimate.

Urease inhibitors inhibit the action of the enzyme urease. Urease, which is present in feces and produced by soil microorganisms, converts urea into ammonia, which can then volatilize. Although there are many compounds that can inhibit urease, only a few are non-toxic, effective at low concentrations, and chemically stable. Urease inhibitors have shown promising results for reducing nitrogen emissions from urea-based fertilizers, but some studies indicate that there remain questions about their effectiveness in reducing ammonia from manure.[144]

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[142] Pinder, R., Adams, P., Pandis, S. (2007). Ammonia Emission Controls as a Cost-Effective Strategy for Reducing Atmospheric Particulate Matter in the Eastern United States. *Environmental Science and Technology*, Volume 41, Pages 380-386. Retrieved from: https://pubs.acs.org/doi/pdf/10.1021/es060379a

[143] E.H. Pechan & Associates, Inc. (September 2005). AirControlNET v.4.1 Documentation Report. Retrieved from: https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1012ZYW.TXT

[144] Lasisi, A.A., Akinremi, O.O., and Kumaragamage, D. "Ammonia emission from manures treated with different rates of urease and nitrification inhibitors," Canadian Journal of Soil Science 100(3), 198-205, (25 February 2020). Retrieved from: https://doi.org/10.1139/cjss-2019-0128

Urease inhibitors appear to reduce ammonia emissions for relatively short periods of time and must be reapplied, and the buildup of urea in the pen surface may require that the NBPT additions increase with time to continue to control ammonia. Because of the need to re-apply increasing amounts of urease inhibitors as manure and urea accumulate, there will be increased costs.

Additionally, there is evidence that urease inhibitors may alter plant metabolism and lead to accumulation of urea in plant tissue,[145] which can have negative effects on crops. Urea inhibitors will also increase the amount of nitrogen in the manure, and to comply with Regional Water Quality Control Board Regulations, some farms would need to acquire additional cropland to apply the manure or identify ways to export the manure to ensure that nitrogen is not over-applied.

It appears that the treatment of animal manure with urease inhibitors has not yet been commercialized. This is likely because of the limited chemical stability of the inhibitors, the need for reapplication, the lack of efficient and automated application systems, and a subsequent increase in the cost for the farmer. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Surface Cooling of Slurry Manure - ***(applies to all CAFs)***

The publication by Guthrie, et al.[146] suggests this measure for CAFs with a slurry manure handling system. The measure involves lowering the temperature of the slurry in the channels by pumping a coolant (e.g., groundwater) through a series of fins floating on the slurry. This measure appears to be largely theoretical, and the District is not aware of any instances in which cooling of liquid or slurry manure has been used to reduce emissions from animal production operations. Furthermore, there are high costs for installation of piping and pumping coolant and circulation of coolant through manure, and recycling groundwater may not be permitted in some regions. For these reasons, this measure is unproven and not feasible to implement in the Valley.

Feeding Strategies to Lower the pH of Manure - ***(applies to all CAFs)***

Livestock feeding strategies can influence the pH of manure and urine. The pH of manure can be lowered by increasing the fermentation in the large intestine. This increases the volatile fatty acids (VFA) content of the manure and causes a lower pH. The pH of urine can be lowered by lowering the electrolyte balance of the diet. Furthermore, the pH of urine can be lowered by adding acidifying components to the diet. A low pH of the manure and urine excreted also results in a low pH of the slurry/manure during storage even after a certain storage period. This pH effect can

[145] Zanin L, Venuti S, Tomasi N, Zamboni A, De Brito Francisco RM, Varanini Z, Pinton R. (2016) Short-Term Treatment with the Urease Inhibitor N-(n-Butyl) Thiophosphoric Triamide (NBPT) Alters Urea Assimilation and Modulates Transcriptional Profiles of Genes Involved in Primary and Secondary Metabolism in Maize Seedlings. Front Plant Sci. 2016 Jun 22;7:845. doi: 10.3389/fpls.2016.00845. PMID: 27446099; PMCID: PMC4916206.
[146] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

reduce ammonia emissions from slurries during storage and also following application. This measure is primarily for non-ruminants, such as poultry and pigs and is not recommended for cattle.

The pH of freshly excreted urine mainly depends on the electrolyte content of the diet. The pH of urine will eventually rise towards alkaline values due to the hydrolysis of urea irrespective of initial pH; however, the initial pH and the pH buffering capacity of urine affect the rate of ammonia volatilization from urine immediately following urination. Lowering the pH of urine of ruminants is theoretical possible. However, it has not been demonstrated to be feasible on actual farms. Lowering the pH of cattle manure is also theoretically possible, but this might easily coincide with disturbed rumen fermentation and is therefore not recommended. Since this measure has not been demonstrated for cattle and remains theoretical, it is premature to consider it as part of any regulatory efforts.

The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Land Application of Manure

Table F-12 Land Application of Manure Measures Evaluated

Method	Measure	CAF Type	Reference
Timing of Land Application	Timing of Land Application	All Cattle	NRCS[147]
	Optimal Weather Conditions for Spreading	All Cattle	Guthrie[148]
Injection	Injection	All Cattle	NRCS
	Use Slurry Injection Application Techniques	All Cattle	Price[149]
	Injector	All Cattle	Guthrie
	Open-slot Injection	All Cattle	Webb[150]
	Injector	All Cattle	Eory[151]

[147] EPA-USDA NRCS. "Reference Guide for Poultry and Livestock Production Systems." September 2017. Retrieved from: https://www.epa.gov/sites/default/files/2017-01/documents/web_placeholder.pdf

[148] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

[149] Price et al., "An Inventory of Mitigation Methods and Guide to their Effects on Diffuse Water Pollution, Greenhouse Gas Emissions and Ammonia Emissions from Agriculture, User Guide," December 2011. Retrieved from: https://repository.rothamsted.ac.uk/download/942687eab7ec4b83751c7e241d62f0fa8472d72adcd25a149bb891b7c30d55d0/1595300/MitigationMethods-UserGuideDecember2011FINAL.pdf

[150] Webb, J., Pain B., Bittman, S., Morgan J. The impacts of manure application methods on emissions of ammonia, nitrous oxide and on crop response—a review. Agric. Ecosyst. Environ. 137, 39–46 (2010). Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S0167880910000046?via%3Dihub

[151] Eory, V., Rees, B., Topp, K., Dewhurst, R., et al. ClimateXChange, "On-farm technologies for the reduction of greenhouse gas emissions in Scotland," March 2016. Retrieved from: https://www.climatexchange.org.uk/media/1927/on-farm_technology_report.pdf

Method	Measure	CAF Type	Reference
	Injection Techniques	All Cattle	Bittman[152]
	Injection into the Soil	All Cattle	Preece[153]
Incorporation of Liquid and Solid Manure	Incorporation	All Cattle	NRCS
	Incorporate Manure into the Soil	All Cattle	Price
	Incorporation of Manure	All Cattle	Guthrie
	Incorporation of Surface-Applied Solid Manure and Slurry into Soil	All Cattle	Bittman
	Incorporation into the Soil	All Cattle	Preece
	Incorporate Manure into the Soil	All Cattle	Atia[154]
	Immediate Incorporation of Applied Manure	All Cattle	Pinder[155]
Band Spreading	Banding	All Cattle	NRCS
	Slurry Band Spreading Application Techniques	All Cattle	Price
	Band Spreading	All Cattle	Guthrie
	Band Spreading Slurry	All Cattle	Bittman
Other Land Application	Slurry Dilution	All Cattle	Bittman
	Transport Manure to Neighboring Farms	All Cattle	Price

<u>Timing of Land Application</u> - *(applies to all cattle)*

This measure requires operators to apply the correct amount of necessary nutrients to crops when they are most in demand and in locations where they can be accessed by specific plants. Applying nutrients in spring prior to planting, when crops are ready to utilize the nitrogen, can reduce ammonia emissions compared to applying in fall. Applying at lower soil temperatures can also help to reduce near-term ammonia emissions due to reduced microbial activity in cooler soils. Split application to better time the nutrient application to crop needs can also be beneficial.

Although not specifically included in Rule 4570, the measure is already required for confined animal facilities in the Valley that apply manure to land. Regional Water Quality Control Board Regulations[156] require that manure may only be applied to land at

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[152] Bittman, S., Dedina, M., Howard C.M., Oenema, O., Sutton, M.A., (eds), 2014, "Options for Ammonia Mitigation: Guidance from the UNECE Task Force on Reactive Nitrogen," Centre for Ecology and Hydrology, Edinburgh, UK. Retrieved from: http://www.vuzt.cz/svt/vuzt/publ/P2014/037.pdf

[153] Preece, Sharon L.M. et al., ''Ammonia Emissions from Cattle Feeding Operations,'' Texas A&M AgriLife Extension Service, referring to Cole, N.A., R.N. Clark, R.W. Todd, C.R. Richardson, A. Gueye, L.W. Greene, and K. McBride, ''Influence of Dietary Crude Protein Concentration and Source on Potential Ammonia Emissions from Beef Cattle Manure,'' Journal of Animal Science 83:(3), 722 (2005)

[154] Atia, A. (2008). Ammonia volatilization from manure application. Alberta Agriculture, Food and Rural Development. Retrieved from: https://open.alberta.ca/dataset/b115d4b8-982d-43d5-97a6-1d987bf8ba01/resource/863253f1-22f1-4a7b-950a-c424ef5cc9e5/download/2008-538-3.pdf

[155] Pinder, R., Adams, P., Pandis, S. (2007). Ammonia Emission Controls as a Cost-Effective Strategy for Reducing Atmospheric Particulate Matter in the Eastern United States. *Environmental Science and Technology*, Volume 41, Pages 380-386. Retrieved from: https://pubs.acs.org/doi/pdf/10.1021/es060379a

[156] California Regional Water Quality Control Board Central Valley Region. Order R5-2013-0122. Retrieved from: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2013-0122.pdf

agronomic rates in accordance with an approved nutrient management plan, and that nutrients, including nitrogen, may only be applied at times when plants can utilize these nutrients. The rate of application of manure and process wastewater for each crop in each land application area (also considering sources of nutrients other than manure or process wastewater) to meet each crop's needs without exceeding the application rates is specified in the Regional Water Quality Control Board Technical Standard.

The NRCS Reference Guide estimates that this measure will reduce ammonia emissions from land application by 65-70 percent. Because this measure is already required, as an industry standard, these reductions have already been achieved in the Valley.

Injection - ***(applies to all cattle)***

Applying manure to the soil surface without incorporation can lead to significant emissions of ammonia and other odorous gases. Several of the mitigation measure compilations evaluated by the District included injection of liquid or slurry manure as an option to reduce ammonia emissions from land application. However, this method is more applicable to slurry manure than the dilute liquid manure applied to land in the Valley. Additionally, the equipment needed to transport and inject the dilute liquid manure, which is not typically used in the Valley, would have high costs for fuel and would increase emissions of NOx and PM2.5.

Estimated ammonia emissions reductions from the injection of liquid manure are based on the assumption that surface broadcasting of liquid manure is the typical practice. Broadcasting of liquid manure results in higher emissions because of the larger amount of surface area of the liquid manure that will be in direct contact with the atmosphere. However, nearly all liquid manure in the Valley is diluted and applied via surface gravity irrigation systems, such as flood and furrow irrigation. Because of the much lower concentration of ammonia in the diluted liquid manure typically applied in the Valley, and the reduced surface area of liquid manure in furrow and flood irrigation systems compared to broadcasting, ammonia emissions from the application of liquid manure in the Valley is already much lower than traditional surface broadcasting. A report prepared by the University of California Division of Agricultural and Natural Resources Committee of Experts on Dairy Manure Management[157] indicates that in California, "nearly all" manure from lagoons is diluted with irrigation water and applied via surface gravity irrigation systems and that "during irrigations, farmers commonly dilute lagoon water with 5 to 10 parts of fresh source water." The report goes on to state that "in systems with frequent, but well diluted manure water applications, ammonia losses from the ground surface will commonly be minimal during the irrigation (10 percent or less)."

[157] Chang, A., T. Harter, J. Letey, D. Meyer, R. D. Meyer, M. Campbell-Mathews, F. Mitloehner, S. Pettygrove, P. Robinson, R. Zhang (2006) Managing Dairy Manure in the Central Valley of California; University of California Committee of Experts on Dairy Manure Management Final Report to the Regional Water Quality Control Board, Region 5, Sacramento, June 2005. https://ucanr.edu/sites/groundwater/files/136450.pdf

The Ammonia Volatilization from Manure Application fact sheet,[158] estimates that ammonia losses from unincorporated manure to be 66 percent in the spring and early fall; this the standard practice in the Valley of applying manure by gravity flow irrigation is already estimated to reduce ammonia emissions by at least 85 percent compared to broadcasting of manure.

Furthermore, to avoid damaging growing crops, injection of liquid manure can only be performed prior to planting the crop, typically a maximum of two times per year. Additionally, the amount of nitrogen that can be applied to cropland is limited to protect water quality. Many agricultural areas in the Valley already have nitrate levels in the groundwater that are above acceptable limits, and many dairies are required to reduce the amount of nitrogen applied to land. Injection of manure reduces the amount of nitrogen emitted to the air, but the retained nitrogen is placed in the soil. Thus, injection of manure into the soil will increase the amount of nitrogen in the cropland and may not be feasible for some dairies, or will require additional land in order to comply with their nutrient management plans.

District Rule 4570 includes the requirement to minimize the amount of emissions from applying liquid manure to the soil. These mitigation measures include an option to inject liquid manure, as shown below:

- Apply liquid/slurry manure via injection with drag hose or similar apparatus.

In conclusion, the District already has mitigation measures for liquid manure injection. No additional ammonia reductions are expected from the suggested mitigation measures.

<u>Incorporation of Liquid Manure</u> - *(applies to all cattle)*

Many mitigation measure compilations included incorporation of slurry and liquid manure into soil as an option to reduce ammonia emissions.[159] However, as discussed above, nearly all liquid manure in the Valley is diluted and applied via surface gravity irrigation systems, such as flood and furrow irrigation. Because of the of the much lower concentration of ammonia in the diluted liquid manure typically applied in the Valley, ammonia emissions from the application of liquid manure in the Valley is already much lower than the emissions from broadcasting slurry manure.

Slurry manure is not typically applied in the Valley and liquid manure in the Valley is diluted prior to application. However, District Rule 4570 includes a mitigation option to minimize the amount of emissions from incorporating liquid manure to the soil, as shown below:

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[158] Atia, A. (2008). Ammonia volatilization from manure application. Alberta Agriculture, Food and Rural Development. Retrieved from: https://open.alberta.ca/dataset/b115d4b8-982d-43d5-97a6-1d987bf8ba01/resource/863253f1-22f1-4a7b-950a-c424ef5cc9e5/download/2008-538-3.pdf

[159] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

- Allow liquid manure to stand in the fields for no more than 24 hours after irrigation.

In conclusion, the District already has mitigation measures for the incorporation of liquid manure. No additional ammonia reductions are expected from the suggested mitigation measures.

Incorporation of Solid Manure - ***(applies to all cattle)***

The NRCS Reference Guide and UK User Guide include methods for incorporation of solid manure that involve mixing manure with surface soil to reduce the exposed surface area of the manure. The NRCS Reference Guide advises that incorporation should occur as soon as possible after the manure is applied, or at least within 24 hours, to reduce ammonia emissions. In the Valley, solid manure land application accounts for less than 3 percent of total ammonia emissions from dairies and incorporation of solid manure within 72 hours is already required for over 80 percent of cattle facilities that apply manure to land.

To avoid damaging growing crops, incorporation of solid manure can only be performed prior to planting the crop, typically a maximum of two times per year. Almost all dairies in the Valley use a double-crop farming system for their cropland to maximize the amount of manure that can be applied and increase the amount of feed produced for the cattle, with some dairies using a triple-crop system. In the typical double-crop system used on Valley dairies, corn for silage is planted in late April through June to be harvested in September, and winter forage (e.g. wheat, oats, barley, etc.) is planted in late September to be harvested in April or May.[160,161] Because of the very short time frame available between crops, the standard practice in the Valley is to incorporate applied solid manure as soon as practical so the land can be prepared for the next crop.

Solid manure applied to cropland is often incorporated immediately after application; however, additional time may sometimes be required due to unforeseen circumstances, such as difficult weather conditions, equipment breakdowns, or the unavailability of the contractors that perform the work since they may be busy at other farms that are also preparing to plant the next crop. With this under consideration, Rule 4570 gives additional time to account for the unforeseen circumstances that may unexpectedly delay incorporation of manure into cropland within 24 hours, as shown below:

- Incorporate all solid manure within 72 hours of land application.

[160] University of California, Davis. UC Drought Management – Corn. Retrieved from: https://ucmanagedrought.ucdavis.edu/Agriculture/Crop_Irrigation_Strategies/Corn/
[161] Ag Proud – Progressive Dairy. 12-Month Forage Pays. Retrieved from: https://www.agproud.com/articles/30676-12-month-forage-pays

The District is further evaluating requiring solid manure applied to cropland to be incorporated within 24 hours. An analysis of this measure, including the control efficiency and estimated costs, is below.

The control efficiency for incorporation is estimated based on information from the Chesapeake Bay Program Watershed Model report.[162] This report includes estimations of ammonia emission reductions for low-disturbance incorporation and high-disturbance incorporation of manure. The report gives vertical tillage as an example of low-disturbance incorporation and states that for high-disturbance incorporation, chisel plowing followed by secondary tillage with a disk harrow or field cultivator is expected to be the most common practice. Information in the report indicates that with low-disturbance incorporation, ammonia emissions are reduced 34 percent when manure is incorporated within 72 hours and 50 percent when manure is incorporated within 24 hours. The report also indicates that with high-disturbance incorporation, ammonia emissions are reduced 50 percent when manure is incorporated within 72 hours and 75 percent when manure is incorporated within 24 hours. Based on this information, the ammonia (NH3) emissions from incorporation of solid manure within 72 hours and 24 hours are estimated as follows:

<u>Low-Disturbance Incorporation of Solid Manure within 72 Hours</u>

Control Efficiency: 34%

Percent NH3 emissions of manure that is not incorporated: 66%

<u>Low-Disturbance Incorporation of Solid Manure within 24 Hours</u>

Control Efficiency: 50%

Percent NH3 emissions of manure that is not incorporated: 50%

<u>High-Disturbance Incorporation of Solid Manure within 72 Hours</u>

Control Efficiency: 50%

Percent NH3 emissions of manure that is not incorporated: 50%

<u>High-Disturbance Incorporation of Solid Manure within 24 Hours</u>

Control Efficiency: 75%

Percent NH3 emissions of manure that is not incorporated: 25%

[162] Chesapeake Bay Phase 6.0 Manure Incorporation And Injection Expert Review Panel: Dell, C., Allen, A., Dostie, D., Meinen, R., Maguire, R (December 2016) Manure Incorporation and Injection Practices for Use in Phase 6.0 of the Chesapeake Bay Program Watershed Model. Prepared for Chesapeake Bay Program, Annapolis, MD 21403. CBP/TRS-309-16. EPA Contract No. EP-C-12-055. https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/phase_6_final_mii_final_report.pdf

The ammonia control efficiency for incorporation of solid manure within 24 hours rather than 72 hours, compared to the ammonia emissions from solid manure that is not incorporated is estimated as follows:

Low-Disturbance Incorporation of Solid Manure within 24 Hours

66% - 50% = 16%

High-Disturbance Incorporation of Solid Manure within 24 Hours

75% - 50% = 25%

The ammonia emissions from solid manure land application are approximately 2.8 percent of the ammonia emissions from dairies and other cattle facilities; therefore, the overall control efficiency of this measure is estimated to be:

Low-Disturbance Incorporation of Solid Manure within 24 Hours

17% x 2.8% = 0.48% of total NH3 emissions from cattle

High-Disturbance Incorporation of Solid Manure within 24 Hours

25% x 2.8% = 0.7% of total NH3 emissions from cattle

The incremental ammonia control efficiency for incorporation of solid manure within 24 hours compared to incorporation of solid manure within 72 hours is calculated as follows.

Low-Disturbance Incorporation of Solid Manure within 24 Hours

1 – (50%/66%) = 24.2%

High-Disturbance Incorporation of Solid Manure within 24 Hours

1 – (50%/75%) = 33.3%

This control efficiency is just for the application of solid manure to cropland, which is a very small portion of the total emissions from cattle facilities.

The cost of more rapid incorporation varies greatly, depending whether a farm already has the required equipment available or if the farm requires an additional tractor and must contract with a custom farm service to implement this practice. For farms for which the required equipment for more rapid incorporation is available, it will be assumed that the primary cost of this measure will be the additional labor required to operate the equipment, to ensure that the manure is incorporated within the required timeframe. For other farms for which the required equipment is not available, it will be assumed that they must hire a custom farm service to ensure that manure is incorporated within the required timeframe. The labor costs for incorporation of solid manure and the costs for hiring a custom farm service will be estimated based on information from the University of California Cooperative Extension.[163, 164] The costs for labor and hiring a custom farm service for low-disturbance incorporation of solid manure are assumed to be similar to finish discing of a field, and the costs for labor and hiring a custom farm service for high-disturbance incorporation of manure are assumed to be similar to chiseling a field followed by discing.

Based on the University of California Cooperative Extension publications, the incremental cost for low-disturbance incorporation of solid manure is estimated to be approximately $2.64 per acre if only additional labor is required, and $15.37 per acre if a custom farm service must be used. At dairies in the Valley, solid manure is typically applied to land twice per year so the overall cost for low-disturbance incorporation of solid manure is as follows:

<u>Incremental Labor Cost for Low-Disturbance Incorporation of Solid Manure within 24 Hours</u>

$2.64/acre x 2 time/year = $5.28/acre-year.

<u>Incremental Cost for Custom Farm Service for Low-Disturbance Incorporation of Solid Manure within 24 Hours</u>

$15.37/acre x 2 time/year = $30.74/acre-year.

Based on the University of California Cooperative Extension publications, the incremental cost for high-disturbance incorporation of solid manure is estimated to be approximately $6.60 per acre if only additional labor is required, and $64.21 per acre if a custom farm service must be used. As mentioned above, at dairies in the Valley solid manure is typically applied to land twice per year so the overall cost for high-disturbance incorporation of solid manure is as follows:

<u>Incremental Labor Cost for High-Disturbance Incorporation of Solid Manure within 24 Hours</u>

$6.60/acre x 2 time/year = $13.20/acre-year.

[163] University of California Cooperative Extension, Agriculture and Natural Resources, Agricultural Issues Center (2016) 2016 Sample Costs to Establish and Produce Alfalfa, Tulare County, Southern San Joaquin Valley, 300 Acre Planting. https://coststudyfiles.ucdavis.edu/uploads/cs_public/1c/e2/1ce256d0-957e-4bd4-b17e-18fef4efcedd/16alfalfasjv300acfinal_41916.pdf
[164] University of California Cooperative Extension, Agriculture and Natural Resources, Agricultural Issues Center (2016) 2016 Sample Costs to Establish and Produce Alfalfa, Tulare County, Southern San Joaquin Valley, 50 Acre Planting. https://coststudyfiles.ucdavis.edu/uploads/cs_public/24/b6/24b68b4a-4c04-4853-b127-d3461e1a248f/16alfalfasjv50ac_final_4192016.pdf

Incremental Cost for Custom Farm Service for High-Disturbance Incorporation of Solid Manure within 24 Hours

$64.21/acre x 2 time/year = $128.42/acre-year.

Estimated ammonia emissions from unincorporated manure will be based on measurements included in the 2008 Dairy Emission Study report by Schmidt.[165] Based on measurements in this study, ammonia emissions from unincorporated solid manure are estimated to be approximately 4 lb-NH3/acre-year.

The cost effectiveness of the potential ammonia reductions for low-disturbance incorporation of solid manure with 24 hours compared to incorporation with 72 hours are estimated as follows:

NH3 Emissions for Low-Disturbance Incorporation of Solid Manure within 72 hours:

4 lb-NH3/acre-year x 66% = 2.64 lb-NH3/acre-year

NH3 Emissions for Low-Disturbance Incorporation of Solid Manure within 24 hours:

4 lb-NH3/acre-year x 50% = 2.0 lb-NH3/acre-year

Potential NH3 Emission Reductions for Low-Disturbance Incorporation within 24 hours

= 2.64 lb-NH3/acre-year - 2.0 lb-NH3/acre-year = 0.64 lb-NH3/acre-year

Cost Effectiveness if Only Additional Labor is Required

Cost of NH3 reductions: $5.28/acre-year ÷ 0.64 lb-NH3/acre-year x 2,000 lb/ton = $16,500/ton-NH3

Cost Effectiveness if Custom Farm Service is Required

Cost of NH3 reductions: $30.74/acre-year ÷ 0.64 lb-NH3/acre-year x 2,000 lb/ton = $96,063/ton-NH3

The cost effectiveness of the potential ammonia reductions for high-disturbance incorporation of solid manure with 24 hours compared to incorporation with 72 hours are estimated as follows:

NH3 Emissions for High-Disturbance Incorporation of Solid Manure within 72 hours:

4 lb-NH3/acre-year x 50% = 2.0 lb-NH3/acre-year

[165] Schmidt, C., Card, T. (August 2009) 2008 Dairy Air Emissions Report: Summary of Dairy Emission Estimation Procedures. Prepared for the San Joaquin Valleywide Air Pollution Study Agency

NH3 Emissions for High-Disturbance Incorporation of Solid Manure within 24 hours:

4 lb-NH3/acre-year x 25% = 1.0 lb-NH3/acre-year

Potential NH3 Emission Reductions for High-Disturbance Incorporation within 24 hours

= 2.0 lb-NH3/acre-year - 1.0 lb-NH3/acre-year = 1.0 lb-NH3/acre-year

Cost Effectiveness if Only Additional Labor is Required

Cost of NH3 reductions: $13.20/acre-year ÷ 1.0 lb-NH3/acre-year x 2,000 lb/ton = $26,400/ton-NH3

Cost Effectiveness if Custom Farm Service is Required

Cost of NH3 reductions: $128.42/acre-year ÷ 1.0 lb-NH3/acre-year x 2,000 lb/ton = $256,840/ton-NH3

As explained above, cattle facilities that apply solid manure to cropland incorporate the manure as quickly as possible in order to prepare for planting of the next crop; so this is already an industry standard, therefore, many cattle facilities are already attaining the potential ammonia emission reductions of this practice, except when conditions make this impractical.

In conclusion, the District already has mitigation measures for incorporation of solid manure. No additional ammonia reductions are expected from the suggested mitigation measures.

Band Spreading - ***(applies to all cattle)***

This practice[166] reduces volatilization of ammonia by using low-pressure application near the ground. Band spreading of manure can only be done during very limited periods immediately prior to planting of a crop, a maximum of two times per year. This practice is primarily applicable to slurry manure rather than flush manure, and has limited applicability to the Valley in which most manure is applied as a liquid or a solid. Band spreading is generally a slower operation (with lower application rates), so there may be some issues with labor availability. Additionally, there are high costs due to the initial investment of new machines, as well as the costs of ongoing maintenance and fuel.

As previously discussed, nearly all liquid manure in the Valley is diluted and applied via surface gravity irrigation systems, such as flood and furrow irrigation, which allows

[166] Chang, A., T. Harter, J. Letey, D. Meyer, R. D. Meyer, M. Campbell-Mathews, F. Mitloehner, S. Pettygrove, P. Robinson, R. Zhang (2006) Managing Dairy Manure in the Central Valley of California; University of California Committee of Experts on Dairy Manure Management Final Report to the Regional Water Quality Control Board, Region 5, Sacramento, June 2005. https://ucanr.edu/sites/groundwater/files/136450.pdf

manure to flow on the ground without using pressure to apply liquid manure. Due to the much lower concentration of ammonia in the diluted liquid manure typically applied in the Valley, and the reduced surface area of liquid manure in furrow and flood irrigation systems compared to broadcasting, ammonia emissions from the application of liquid manure in the Valley is already much lower than traditional surface broadcasting and also expected to be lower than emissions from liquid manure applied with band spreading. Moreover, trucks used for these methods would damage growing crops and directly emit NOx and PM, hindering the District's efforts to attain the PM2.5 and ozone NAAQS. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Slurry Dilution - ***(applies to all cattle)***

This method involves the dilution of slurry with water to decrease the ammonium-N concentration, as well as increase the rate of infiltration into the soil following spreading on land. For undiluted slurry, dilution must be at least 1:1 (one part slurry to one part water) to reduce emissions by at least 30 percent.

This practice is applicable to manure handled as a slurry. The slurry manure would be diluted by 50 percent so it can be infiltrated into soil more quickly. The ammonia reductions for this measure are proportional to the extent of dilution. The majority of dairies in the Valley are large flush dairies in which liquid manure mixed with water is stored in large earthen lagoons or ponds until it can be applied to cropland. The typical practice in the Valley is to dilute manure with irrigation water when it is applied to cropland. The liquid handled on Valley dairies typically has a DM content of 2 percent or less. This manure is then commonly further diluted with 5 to 10 parts of fresh source water during irrigation. Because of this, ammonia emissions from the typical application of liquid manure can be estimated to be more than 90 percent lower than the ammonia emissions from this practice (4.5 percent DM applied, compared to 0.2 percent DM applied). The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Transport Manure to Neighboring Farms - ***(applies to all cattle)***

This mitigation measure does not result in overall decreases in ammonia emissions. Although ammonia emissions are reduced from the exporting farm, these emissions are transferred to the receiving farm.

Regional Water Quality Control Board Regulations prohibit the over-application of nutrients from manure in the Valley and already only allow manure to be applied at agronomic rates in accordance with an approved nutrient or waste management plan. Nutrient management plans require that farms transport excess manure to other fields or identify other uses for excess manure. Transporting manure would increase emissions of NOx and PM2.5 from fuel use, and these emissions would hinder the District's efforts to attain the PM2.5 and ozone NAAQS. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Other Mitigation Measures

Table F-13 Other Mitigation Measures Evaluated

Method	Measure	CAF Type	Reference
Other	Pasture and Range Management: Stocking Density	Other Cattle	NRCS[167]
	Improved Livestock Genetics	All	Price[168]
	Planting a Tree Shelter Belt	All	Guthrie[169]
	Using Plants with Improved Nitrogen Use Efficiency	All Cattle	Guthrie
	Changing Land from Arable to Woodland	All	Guthrie
	Reduced Consumption of Meat and Eggs by Humans	All	Guthrie

Pasture and Range Management: Stocking Density - ***(applies to grazing cattle only)***

The NRCS Reference Guide lists managing animal stocking density at grazing-based livestock operations as a mitigation method for ammonia emissions. However, the District does not have authority to regulate animals on pasture or rangeland, as they are not confined. This measure also does not recommend a specific stocking density; however, cattle that graze on pastureland and rangeland in California generally require low stocking densities to provide sufficient forage for cattle. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Improved Genetics - ***(applies to all CAFs)***

A publication prepared for use in the United Kingdom includes genetic selection of useful traits to improve animal health and fertility as a potential mitigation measure to increase the efficiency of animals and reduce environmental impacts. Farmers select animal breeds that have improved genetics that increase efficiency as feasible to reduce overall costs and increase yield. The publication notes that use of animals with improved genetics "*is generally good in the poultry, dairy and pig industries*." Improvements in genetics and management practices to increase efficiency have already significantly reduced the environmental footprint of production from animal agriculture compared to previous years. As a result of genetic selection and improved

[167] EPA-USDA NRCS. "Reference Guide for Poultry and Livestock Production Systems." September 2017. Retrieved from: https://www.epa.gov/sites/default/files/2017-01/documents/web_placeholder.pdf
[168] Price et al., "An Inventory of Mitigation Methods and Guide to their Effects on Diffuse Water Pollution, Greenhouse Gas Emissions and Ammonia Emissions from Agriculture, User Guide," December 2011. Retrieved from: https://repository.rothamsted.ac.uk/download/942687eab7ec4b83751c7e241d62f0fa8472d72adcd25a149bb891b7c30d55d0/1595300/MitigationMethods-UserGuideDecember2011FINAL.pdf
[169] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

diets, milk production per cow has increased and feed usage has decreased by 77 percent and water use has decreased by 65 percent.[170] GHG emissions from California dairy cattle per amount of milk produced have also decreased by over 45 percent in the 50 years from 1964 to 2014.[171] For poultry, it is estimated that genetic selection and the current feed practices have reduced nitrogen excretion by poultry by up to 55 percent, primarily due to the reduced time from egg to market age.[172]

Farmers are expected to continue to use animals with improved genetics that will increase efficiency and reduce production costs. However, there are several issues that cause this measure to be unsuitable as a requirement in a regulation. The study does not specify the genetic traits that need to be improved. The measure is largely theoretical and requires extensive research and funding to develop new breeds with the desired traits. It would take generations of each breed to evaluate the effectiveness of the breeds as it pertains to reducing ammonia emissions and any potential adverse impacts on the environment. There are also potential ethical concerns regarding if animals were to be genetically modified to accelerate selection of specific traits. Therefore, the District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Planting a Tree Shelter Belt - ***(applies to all CAFs)***

This measure involves planting tree shelterbelts around livestock housing and manure slurry storage facilities to disrupt airflow around these sites. The effectiveness of tree shelterbelts as a measure to reduce particulate matter from facilities depends on the shelterbelt height, canopy density, and the prevailing environmental conditions. While some evidence demonstrates effectiveness for PM2.5 emissions reductions, there is little to no evidence for ammonia emissions reductions. Effective tree shelterbelts are expensive and difficult to establish due to the large size of the facilities, severe water limitations, soil conditions, and the number of trees needed to protect these areas.

Irrespective of the lack of available data on the potential ammonia emissions reductions, implementation of this measure requires additional consideration with respect to animal health. Cattle facilities in the Valley depend on natural airflow to cool cattle and provide them with fresh air. Disrupting natural airflow can adversely affect cattle that depend on the natural flow of air, particularly during summer months where large numbers of heat-related animal mortalities occur in the San Joaquin Valley. Tree shelterbelts also require sufficient space to be effective, thus, dairies would need either to remove crops or acquire additional land for a shelterbelt. Furthermore, a shelterbelt of sufficient height to

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[170] McCabe, C. (2021). How Dairy Milk Has Improved its Environmental and Climate Impact. Clarity and Leadership for Environmental Awareness and Research at UC Davis. Retrieved from: https://clear.ucdavis.edu/explainers/how-dairy-milk-has-improved-its-environmental-and-climate-impact

[171] Naranjo A., Johnson A., Rossow H., Kebreab E. (2020) Greenhouse Gas, Water, and Land Footprint per Unit of Production of the California Dairy Industry Over 50 years. J Dairy Sci. 2020 Apr;103(4):3760-3773. doi: 10.3168/jds.2019-16576. Epub 2020 Feb 7. PMID: 32037166.

[172] United States Department of Agriculture - Natural Resources Conservation Service. (2020). Feed and Animal Management for Poultry. Nutrient Management Technical Note No. 190-NM-4. Retrieved from: https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=45569.wba

be effective would take a number of years to establish. In many cases in the Valley, where the soil has high salinity, conditions are unsuitable for planting tree shelterbelts.

In several cases, permitted CAFs proposed to grow shelterbelts to satisfy District BACT requirements, however, the shelterbelts were not sustainable. Agronomic land surveys of the facilities confirmed the poor soil quality would not sustain the tree shelterbelts. As a result, the District eliminated this option as a BACT requirement for these specific CAFs and allowed an alternative mitigation measure to be implemented.

For the reasons listed above, it is infeasible to require planting tree shelterbelts at animal facilities; however, the trees and plants in the agricultural fields and orchards that surround Valley animal facilities already capture a portion of emissions from these facilities and remove some of the ammonia by deposition. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Using Plants with Improved Nitrogen Use Efficiency - ***(applies to all cattle)***

This measure involves developing new plant varieties with improved genetic traits for the capture of soil nitrogen, which would allow reduced fertilizer application. New plant varieties could also be developed with improved nutritional characteristics. This measure is theoretical and requires extensive research and funding to develop new plant varieties with the desired traits. Years of testing would be required to evaluate the effectiveness of new plant varieties for reducing ammonia emissions and any adverse impacts of the new plant varieties. Furthermore, capturing additional soil nitrogen would primarily benefit water quality rather than reducing ammonia emissions. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Changing Land Use from Arable to Woodland - ***(applies to all CAFs)***

This measure involves changing land use from agricultural land to permanent woodland. However, many areas in the Valley are dry and often affected by droughts, and thus not suitable for the establishment of permanent woodlands. The District does not have authority to require that agricultural land be converted to forests. Moreover, conversion of agricultural land to farmland would result in total loss of income for the farmers and an associated loss in tax revenue. The District has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Reduced consumption of meat and eggs by humans by 63 percent - ***(applies to all CAFs)***

The District does not have authority to regulate what people eat and has concluded that the measure discussed is not a viable mitigation option to include in Rule 4570.

Evaluation of Potential Emissions Reductions from CAFs

As demonstrated in the evaluation above, the District has only identified a few measures that have the theoretical potential to reduce additional ammonia emissions beyond the practices currently enforced through Rule 4570. These measures are reducing CP content in feed for beef finishing cattle, incorporation of solid manure within 24 hours, and acidifying amendments for poultry litter and manure. Despite the technological and economic feasibility issues of these mitigation measures, the District evaluated the potential emission reductions and the impact they might have on the Valley's total ammonia emissions inventory if these measures were to be implemented. This was calculated as follows.

- Control efficiency of reducing CP content in feed for beef finishing cattle, applied to beef cattle emissions inventory:

  18.9% x 16.2 tpd = 3.1 tpd

- Control efficiency of incorporation of solid manure within 24 hours, applied to beef and dairy cattle emissions inventory:

  0.48% x 141.5 tpd = 0.7 tpd

- Control efficiency of acidifying amendments for poultry litter and manure, applied to broiler and layer emissions inventory:

  35% x 7.8 tpd = 2.7 tpd

The emissions reductions from the measures above total 6.5 tpd, which would be reduced from the total ammonia emissions inventory of 306.5 tpd:

6.5 tpd ÷ 306.5 tpd = 2.1%

Overall, ammonia emissions from CAFs in the Valley can only be reduced by 2 percent by implementing the mitigation measures above. This demonstrates that additional reductions in the EPA-recommended range of 30-70 percent are infeasible.

Fertilizers

Ammonia emissions from agricultural fertilizers are 109.9 in 2030. Emissions growth from agricultural fertilizers are estimated by farmland acreage projection data developed by the Farmland Mapping & Monitoring Program (FMMP) of the California Department of Conservation.

The California Department of Food and Agriculture (CDFA) Feed, Fertilizer and Livestock Drugs Regulatory Services (FFLDRS) Branch primary focus is to ensure in every way possible a clean and wholesome supply of meat and milk, and to promote environmentally safe and agronomically sound use and handling of fertilizer materials. This is performed through regulating manufacturing, labeling, and use of fertilizing materials, feed and livestock drugs.

The CDFA Fertilizer Research and Education Program (FREP) funds and facilitates research to advance the environmentally safe and agronomically sound use and handling of fertilizing materials. FREP is voluntary and serves growers, agricultural supply and service professionals, extension personnel, public agencies, consultants, and other interested parties.

The Fertilizer Inspection Advisory Board (FIAB) is a statutory body that is advisory to the CDFA secretary on matters pertaining to fertilizer issues, including FREP activities. The Board consists of nine persons appointed by the secretary of agriculture, one of whom shall be a public member and eight of whom shall be licensed with CDFA to manufacture or distribute fertilizing materials, including organic inputs. The FIAB established the Technical Advisory Subcommittee (TASC) to advise the FIAB on matters related to the funding of FREP projects. The TASC serves as an expert scientific panel on matters concerning plant nutrition and on environmental effects related to fertilizing materials use. TASC assists in setting research priorities, reviews research proposals, and makes recommendations on projects for funding.

The composition of the TASC is determined by the FIAB. There should be at least nine members representing the major segments of the fertilizer industry, certified crop advisors, technical experts, farming community, public, and governmental agencies. Members have to demonstrate knowledge, technical and scientific expertise in the fields of fertilizing materials, agronomy, plant physiology, principles of experimental research, production agriculture, and environmental issues related to fertilizing materials use. One member can satisfy more than one of the criteria stated above. At minimum, one member shall be appointed from the membership of the FIAB, and one member on the TASC shall be from CDFA.

The TASC meets at least two times per year-once in spring to evaluate concept proposals and once in summer to evaluate full proposals. Additional meetings are necessary for special initiatives. Meetings typically last all day and alternate between Sacramento and other locations throughout the State. Serving on the TASC requires a time commitment in addition to participating in meetings. Members must read and critically evaluate all concept proposals (typically around 35 two-page proposals) and full proposals (typically at least ten 15-page proposals). In addition, TASC members are responsible for reviewing final research reports for FREP funded projects and may be asked to participate in conferences and special initiatives.

CARB has not found an ammonia emission reduction measure for fertilizers that meets U.S. EPA requirements for SIP submittal. CARB staff reached out to the National Association of Clean Air Agencies (NACAA) to ascertain whether other air pollution control agencies across the United States had any experience or regulations reducing ammonia emissions from fertilizers. NACAA reached out to all of their members and CARB staff did not receive any existing rules or regulations controlling ammonia emissions from fertilizers. CARB staff also reached out to EPA Region 9 staff whether they were aware of any rules or regulations controlling ammonia emissions from fertilizers and they were not aware of any. EPA Region 9 staff did ask CARB to review some practices per Table F-14.

Mitigation Measures

Table F-14 Fertilizer Mitigation Measures Evaluated

Method	Measure	Reference
Fertilizer	Optimizing or minimizing use of fertilizer	Guthrie
	Adding a Urease Inhibitor	Guthrie
	Mixing and injecting fertilizer into the soil quickly	Guthrie and Eory
	Applying fertilizer during optimal weather conditions	Guthrie and Eory

<u>Optimize or minimize use of fertilizer</u>

The San Joaquin Valley is a part of Central Valley Water Board of the California Water Board, which is an expansive region extending south from the Oregon border to the northernmost portion of Los Angeles County. The California Legislature passed Senate Bill 390 in 1999, which required Water Boards to develop programs that regulate agricultural lands in accordance with the Porter-Cologne Water Quality Control Act (California Water Code Division 7). In 2003, the Central Valley Irrigated Lands Regulatory Program (ILRP) was established, regulating agricultural discharges to surface waters. The Central Valley Water Board extended the regulations in 2012 to include discharges to ground waters. With the exclusion of lands that are never-irrigated or are covered under a separate Central Valley Water Board program, all commercial irrigated lands are required to obtain regulatory coverage under the ILRP.[173] In accordance with the ILRP, growers are required to prepare farm management plans – which includes an Irrigation Nitrogen Management Plan Summary Report – that comply with the approved upon Waste Discharge Requirements (WDR). Using information from the Reports, inferences can be made about nitrogen management based on estimates that compare nitrogen applied (A) to the nitrogen removed (R) from a field: A/R ratio and A-R difference. Included in the nitrogen fraction is any nitrogen proactively added to a field such as organic amendments, synthetic fertilizers, manure, and irrigation water, whereas nitrogen removed refers to the nitrogen in the materials removed from the field.[174]

Though growers do not have an immediate requirement under ILRP to use nitrogen efficient strategies, growers that are deemed outliers in A/R ratio and A-R difference would be required to employ enhanced strategies to lower these estimates. CDFA

[173] Central Valley Water Board. *Irrigated Lands Regulatory Program (ILRP) FAQs*. Available at: https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/ilrp_faq.pdf
[174] California State Water Resources Control Board. *State of California State Water Resources Control Board, Order WQ 2018-0002.* Available at: https://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2018/wqo2018_0002_with_data_fig1_2_appendix_a.pdf

FREP offers an Irrigation and Nitrogen Management training program[175] for this purpose among others. A subset of the Irrigation and Nitrogen Management training program is dedicated to nitrogen efficiency, including overviews of the “4 R’s” of nitrogen management, and of efficient nitrogen practices.[176] The 4 R’s principles are founded on applying the “Right source” of nitrogen at the “Right rate”, “Right time”, and “Right place”. The right rate principle is with the identified measure, as it promotes strategies for providing nitrogen in rates that do not go beyond the crop demand for nitrogen. Examples of how this can be accomplished include adjusting the rate of application based on expected crop yield and adjusting season application rates based on soil and plant-tissue testing.

Guthrie et al. (2018) describe how minimizing the amount of fertilizer applied to an level that is optimal for crop can reduce ammonia emissions.[177] This measure and associated findings were not well described by both Guthrie et al. (2018) and the publications they referenced, nor were any specific regulations identified.[178,179,180,181] Additionally, the viewpoints of Guthrie et al. (2018) were prepared in the context of Europe and United Kingdom. There is therefore a probability that the conditions and farming practices described by Guthrie et al. (2018) are consistent with those present and employed in California. This, combined with the lack in strong evidence demonstrating the emission reduction potentials, demonstrates the need for additional research be completed under conditions consistent with those of the San Joaquin valley before this measure can be considered.

Urease Inhibitor

When combined with urease enzyme present in plants, urea present in urea-based fertilizers can be converted into ammonia, which can then volatilize. Urease inhibitors are a class of nitrogen stabilizer designed to minimize volatilization from applied nitrogen sources by inhibiting the action of the urease, thereby reducing the formation of ammonia.

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[175] CDFA. *Fertilizer Research and Education Program*. Available at: https://www.cdfa.ca.gov/is/ffldrs/frep/

[176] CDFA. *Irrigation and Nitrogen Management Training for Grower Self-Certification*. Available at: https://www.cdfa.ca.gov/is/ffldrs/frep/pdfs/training/inmtp_workbook.pdf

[177] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). Impact of ammonia emissions from agriculture on biodiversity: An evidence synthesis. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

[178] UNECE. 2015. United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions. United Nations Economic Commission for Europe Convention on Long-range Transboundary Air Pollution. https://unece.org/environment-policy/publications/framework-code-good-agricultural-practice-reducing-ammonia

[179] Zhang, Y., A.L. Collins, J.I. Jones, P.J. Johnes, A. Inman, J.E. Freer. (2017). The potential benefits of on-farm mitigation scenarios for reducing multiple pollutant loadings in prioritised agri-environment areas across England. Environmental Science & Policy 73, 100-114. https://doi.org/10.1016/j.envsci.2017.04.004

[180] Collins, A.L., Y.S. Zhang, M. Winter, A. Inman, J.I. Jones, P.J. Johnes, W. Cleasby, E. Vrain, A. Lovett, L. Noble. (2016). Tackling agricultural diffuse pollution: What might uptake of farmer-preferred measures deliver for emissions to water and air? Science of The Total Environment 547, 269-281. https://doi.org/10.1016/j.scitotenv.2015.12.130

[181] Dalgaard, T., J. F. Bienkowski, A. Bleeker, U. Dragosits, J. L. Drouet, P. Durand, A. Frumau, N. J. Hutchings, A. Kedziora, V. Magliulo, J. E. Olesen, M. R. Theobald, O. Maury, N. Akkal, P. Cellier. (2012). Farm nitrogen balances in six European landscapes as an indicator for nitrogen losses and basis for improved management. Biogeosciences 9, 5303–5321. https://doi.org/10.5194/bg-9-5303-2012

Nitrogen stabilizers are regulated by federal and State regulatory agencies. At the federal level, The Federal Insecticide, Fungicide, and Rodenticide Act requires that nitrogen stabilizers sold and distributed in the United States be registered with U.S. EPA.[182] At the state level, both the California Department of Pesticide Regulations (DPR) and CDFA maintain regulatory authorities over nitrogen stabilizers. While DPR requires all nitrogen stabilizers to be registered,[183] CDFA regulates licensing, registration, labeling, tonnage reporting, and inspection of only a subset of commercial nitrogen stabilizers.[184] In coordination with 4R Nutrient Stewardship and UC Davis Land and Water Resources, CDFA FREP also encourage growers to use enhanced-efficiency sources such as Urease Inhibitors, identifying these sources as possible "Right Source" through their 4 R's principles.[185]

Although urease inhibitors have shown tremendous promise in reducing ammonia emissions, some studies indicate potential occurrences of pollution swapping through increasing of NOx emissions which must be critically considered and explored prior to further considering the measure.[186,187] Additionally, although there are numerous identified benefits associated with the use urease inhibitors, there is little existing knowledge about their potential to enter the food chain and impact food safety.[188] Further research is needed which demonstrates that there are no food safety-related issues prior to this measure being viable for consideration.

According to Guthrie et al. (2018), the addition of a urease inhibitor has the potential to reduce ammonia emissions by 40-70 percent.[189] Though this has the potential to hold remarkable mitigation potential, their estimates along with those of the original experiments, were prepared under European and United Kingdom conditions. As these findings were based outside of California where environmental and climatic conditions may differ, further research is needed that explores the reduction potentials of urease inhibitors in conditions consistent with those of the San Joaquin Valley. In addition to

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182 US EPA. *Nitrogen Stabilizer Products that Must Be Registered under FIFRA*. Available at: https://www.epa.gov/pesticide-registration/nitrogen-stabilizer-products-must-be-registered-under-fifra
183 CDPR. *A Guide to Pesticide Regulation in California 2017 Update*. Available at: https://www.cdpr.ca.gov/docs/pressrls/dprguide/dprguide.pdf
184 CDFA. *California Fertilizer Laws and Regulations*. Available at: https://www.cdfa.ca.gov/is/docs/Fertilizer_Law_and_Regs.pdf
185 CDFA FREP. *California Crop Fertilization Guidelines.* Available at: https://www.cdfa.ca.gov/is/ffldrs/frep/FertilizationGuidelines/Adjustments.html#h11
186 Drury, C.F., X. Yang, W.D. Reynolds, W. Calder, T.O. Oloya, A.L. Woodley. (2017). Combining Urease and Nitrification Inhibitors with Incorporation Reduces Ammonia and Nitrous Oxide Emissions and Increases Corn Yields. Journal of Environmental Quality 46:5, 939-949. https://doi.org/10.2134/jeq2017.03.0106
187 Mirkhani, R., C. Resch, G. Weltin, L. K. Heng, J. Mitchell, R. Clare Hood-Nowotny, G. Dercon. (2023). Effect of urease inhibitor and biofertilizer on nitrous oxide emission, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-11242, https://doi.org/10.5194/egusphere-egu23-11242
188 Byrne M.P., J.T. Tobin, P.J. Forrestal, M. Danaher, C.G. Nkwonta, K. Richards, E. Cummins, S.A. Hogan, T.F. O'Callaghan. (2020). Urease and Nitrification Inhibitors—As Mitigation Tools for Greenhouse Gas Emissions in Sustainable Dairy Systems: A Review. Sustainability 12:15, 6018. https://doi.org/10.3390/su12156018
189 Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). Impact of ammonia emissions from agriculture on biodiversity: An evidence synthesis. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

this, Guthrie et al. (2018) merely identified the measures but did not reference or identify any specific regulations.

Quick mixing and injecting into soil

The identified measure would involve rapid incorporation of fertilizers into soils after the fertilizers have been applied. As previously described, with the implementation of ILRP and WDRs by the Central Valley Water Board growers are required to prepare and management plans. The 4 R's of nitrogen management serve as guiding nitrogen efficiencies principles that growers are recommended to follow when developing their management plans. The identified measure is addressed through two of the four principles. The "Right time" principle refers to timed application of nitrogen to ensure availability to the plant during periods of greatest demand. The measure is also addressed through the "Right place" principle, which considers targeted application of fertilizer in the crop's effective rootzones to facilitate and enhance the uptake of nitrogen by the crop.

As described by Guthrie et al. (2018), ammonia emissions can be reduced by 50-90 percent through this measure, should the fertilizer be mixed in or injected into the soil within 4-6 hours of their application.[190] Though they do not touch on the speed of the process, Eory et al. (2016) likewise identified fertilizer injection as a candidate ammonia emission mitigation measure.[191] However, the publications referenced in Guthrie et al. (2018) and Eory et al. (2016) focus solely on manure application methods and do not provide estimates for commercial fertilizers. [192,193] We cannot assume the mitigation potential of fertilizers to be consistent with that of manure sources. We therefore proceed with caution with the identified measure and will not be considering it at this moment. In addition to this, research from a California-context is profoundly limited,[194] resulting in uncertainty regarding the ammonia reduction potentials under California-specific conditions. Consistent with the previously mentioned fertilizer measures, Guthrie et al. (2018) and Eory et al. (2016) merely identify the measure, and do not reference any specific regulations.

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[190] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). Impact of ammonia emissions from agriculture on biodiversity: An evidence synthesis. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

[191] Eory, V., Rees, B., Topp, K., Dewhurst, R., et al. ClimateXChange, "On-farm technologies for the reduction of greenhouse gas emissions in Scotland," March 2016. Retrieved from: https://www.climatexchange.org.uk/media/1927/on-farm_technology_report.pdf

[192] Loyon, L., C.H. Burton, T. Misselbrook, J. Webb, F.X. Philippe, M. Aguilar, M. Doreau, M. Hassouna, T. Veldkamp, J.Y. Dourmad, A. Bonmati, E. Grimm, S.G. Sommer. (2016). Best available technology for European livestock farms: Availability, effectiveness and uptake. Journal of Environmental Management 166, 1-11. https://doi.org/10.1016/j.jenvman.2015.09.046

[193] Webb, J., B. Pain, S. Bittman, J. Morgan. (2010). he impacts of manure application methods on emissions of ammonia, nitrous oxide and on crop response—A review. Agriculture, Ecosystems & Environment 137:1-2, 39-46. https://doi.org/10.1016/j.agee.2010.01.001

[194] Krauter, C., D. Goorahoo, C. Potter, S. Klooster. (2014). *Ammonia Emissions and Fertilizer Applications in California's Central Valley*. Available at: https://www.cdfa.ca.gov/is/ffldrs/frep/pdfs/completedprojects/00-0515Krauter2006.pdf

Application during optimal weather conditions

Weather conditions (i.e., air temperature, precipitation, and wind speed) have a demonstrated effect on ammonia fluxes.[195] The identified measure would involve rapid incorporation of fertilizers into soils after the fertilizers have been applied. The 4 R's "Right time" principle covers the issue that this measure aims to address. The principle is based on timed nitrogen application in order to ensure the availability of nitrogen to the plant during the more nutrient demanding periods. This period is during vegetative growth in annual crops, and during early fruit and nut development in mature trees and vines.[196]

While describing the fertilizer injection measure, Eory et al. (2016) convey that additional work is needed to determine the emission benefits related to fertilizer application with respect to weather.[197] They however do not provide any additional or specific information regarding a measure or identify the reduction potential of its application. Guthrie et al. (2018) identified weather as affecting ammonia emissions by up to 5 percent and provided the recommendation that growers refrain from using urea-based fertilizers during warm, dry, and windy conditions.[198] After reviewing the two publications referenced in Guthrie et al. (2018) for this measure, Zhang et al. (2017)[199] and Newell et al. (2011)[200], no information regarding concerning weather-related conditions was found. Other publications have demonstrated a link between weather conditions and ammonia emissions, though it is unclear which environmental factors are most appropriate for the various fertilizer types.[201,202] It is particularly important for further research to address the impact of weather and fertilizer application timing under conditions specific to the San Joaquin Valley. Lastly, as has been described previously,

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[195] Li, Q., X. Cui, X. Liu, M. Roelcke, G. Pasda, W. Zerulla, A.H. Wissemeier, X. Chen, K. Goulding, F. Zhang. (2017). A new urease-inhibiting formulation decreases ammonia volatilization and improves maize nitrogen utilization in North China Plain. Scientific Reports 7, 43853. https://doi.org/10.1038/srep43853, https://doi.org/10.1038/srep43853

[196] CDFA. *Irrigation and Nitrogen Management Training for Grower Self-Certification*. Available at: https://www.cdfa.ca.gov/is/ffldrs/frep/pdfs/training/inmtp_workbook.pdf

[197] Eory, V., Rees, B., Topp, K., Dewhurst, R., et al. ClimateXChange, "On-farm technologies for the reduction of greenhouse gas emissions in Scotland," March 2016. Retrieved from: https://www.climatexchange.org.uk/media/1927/on-farm_technology_report.pdf

[198] Guthrie, S., Giles, S., Dunkerley, F., Tabaqchali, H., Harshfield, A., Ioppolo, B., Manville, C. (2018). The Impact of Ammonia Emissions from Agriculture on Biodiversity. *Rand Europe, The Royal Society.* Retrieved from: https://www.rand.org/pubs/research_reports/RR2695.html

[199] Zhang, Y., A.L. Collins, J.I. Jones, P.J. Johnes, A. Inman, J.E. Freer. (2017). The potential benefits of on-farm mitigation scenarios for reducing multiple pollutant loadings in prioritised agri-environment areas across England. Environmental Science & Policy 73, 100-114. https://doi.org/10.1016/j.envsci.2017.04.004

[200] Newell Price, J.P., D. Harris, M. Taylor, J.R. Williams, S.G. Anthony, D. Duethmann, R.D. Gooday, E.I. Lord, B.J. Chambers, D.R. Chadwick, T.H. Misselbrook. "An Inventory of Mitigation Methods and Guide to their Effects on Diffuse Water Pollution, Greenhouse Gas Emissions and Ammonia Emissions from Agriculture," December 2011. Retrieved from: https://repository.rothamsted.ac.uk/download/942687eab7ec4b83751c7e241d62f0fa8472d72adcd25a149bb891b7c30d55d0/1595300/MitigationMethods-UserGuideDecember2011FINAL.pdf

[201] V Venterea, R.T., A.D. Halvorson, N. Kitchen, M.A. Liebig, M.A. Cavigelli, S.J. Del Grosso, P.P. Motavalli, K.A. Nelson, K.A. Spokas, B. Pal Singh, C.E. Stewart, A. Ranaivoson, J. Strock, H. Collins. (2012). Challenges and opportunities for mitigating nitrous oxide emissions from fertilized cropping systems. Frontiers in Ecology and the Environment 10:10, 562-570. https://doi.org/10.1890/120062

[202] Grahmann, K., N. Verhulst, A. Buerkert, I. Ortiz-Monasterio, B. Govaerts. (2013). Nitrogen use efficiency and optimization of nitrogen fertilization in conservation agriculture. Cabi Reviews 8:053. https://doi.org/10.1079/PAVSNNR20138053

Guthrie et al. (2018) and Eory et al. (2016) do not refer to any specific regulations when identifying the measure.

CARB has not identified effective mechanisms within its authority to regulate air emissions of ammonia from livestock, which overwhelmingly come from the decomposition of manure, or from fertilizers, the second largest category of emissions in the Valley. CARB's main source of authority is the California Health and Safety Code. CARB's authority is primarily over mobile sources, consumer products, and air toxics, as well as methane from livestock (see Cal. Health & Saf. Code §§ 43013, 39666, 39730.7, 41712).

Estimated feasible reductions in ammonia from this emissions source in the Valley are zero tons.

Composting and Other Sources

The District already regulates ammonia emissions from composting operations through District Rules 4565 and 4566. Based on the mitigation measures in practice at facilities subject to Rule 4565 and 4566, ammonia emissions are already being reduced by 44 percent. With these controls in place, composting accounts for only 3 percent of the District's ammonia emissions; therefore, the District will not be further evaluating this source category at this time.

The other source category consists of ammonia emissions primarily from mobile sources and fuel combustion, which are heavily controlled. Therefore, the District will not be further evaluating this source at this time.
Estimated feasible reductions in ammonia from these emissions sources in the Valley are zero tons.

Research

CARB is working to fill knowledge gaps on feasible and effective ammonia controls. Development of effective air pollution mitigation strategies for ammonia requires additional spatiotemporal understanding of atmospheric ammonia emissions that are currently lacking as a result of limited data. CARB is conducting research, both in-house and with external partners, to characterize gaseous ammonia emissions from agricultural activities in the San Joaquin Valley. The results of these studies will help future development of CARB's ammonia emission inventory, SIP, Short-Lived Climate Pollutant Reduction Strategy, and community air protection program (AB 617). Findings from these research projects will help CARB better characterize ammonia emissions in the Valley, as a necessary prerequisite to identifying potential effective measures to achieve additional emissions reductions.

Ammonia emissions in general are not well quantified Statewide and further focused study is needed to facilitate quantification and potential further control strategies that are effective and cost-effective. As an example of the agency's work in this area, CARB's

Research Division has developed a new mobile measurement platform equipped with a state-of-the-science ammonia analyzer and other advanced analytical instruments to improve the understanding of various ammonia sources in California. In September and October 2018, CARB staff collaborated with researchers from the University of California, Davis, to quantify emissions from several dairies in the Valley as part of the ongoing projects funded by the California Department of Food and Agriculture, CARB, and industry. Methane, oxides of nitrogen, and other air pollutants and meteorological parameters were measured at or near dairies in addition to ammonia. The major objective is to evaluate the effectiveness of various alternative manure management practices (AMMP) with respect to emission reductions as CARB staff will revisit these dairies after they implement the selected AMMP technologies. This effort is a direct response to Senate Bill 1383 requirements and goals. The AMMP is designed to identify air pollution sources and estimate their emission rates. Its mobility makes it ideal for field measurements that require large spatial coverage, such as mapping ammonia mixing ratios with an emphasis on determining the magnitude of emissions, characterizing spatial variability of emissions, and identifying dominant sources of emissions.

In addition, CARB is undertaking a suite of projects that address research needs. Many projects focus on emissions from dairies, while others, including those with a satellite or remote sensing component, can offer insight into ammonia emissions in the Valley from all source categories. CARB staff is also working with academic researchers and industry representatives to explore potential opportunities to reduce the emissions of ammonia and other air pollutants from dairy manure lagoons which are one of the largest contributors to ammonia in California. Preliminary experiments have been conducted, and further investigation is underway at some Valley dairies with the support from farmers. Additionally, CARB staff is planning to analyze existing satellite data to refine the spatial resolution and allocation of ammonia in California. This may also help evaluate the impact of major wildfires on surface ammonia levels in recent years, and can be used to compare with the estimation methodology in the current ammonia emission inventory associated with wildfires.

Due to research which indicates California is underestimating ammonia emissions in the air, CARB is reviewing and will reassess ammonia estimates in recognition of this research. This effort will help us update our understanding about modeled sensitivity of PM2.5 formation to changes in ammonia emissions.

F.3.3 Conclusion

CARB has followed the Guidance to evaluate whether ammonia contributes significantly to PM2.5 levels that exceed the 12 $\mu g/m^3$ annual PM2.5 NAAQS. Considering relevant contextualizing information such as emissions, research, and available controls, along with performing sensitivity-based analysis for the future attainment year, CARB determined that emissions of ammonia do not contribute significantly to PM2.5 levels that exceed the 12 $\mu g/m^3$ annual NAAQS in the area. Therefore, CARB has excluded ammonia from control requirements in the SIP.

While the Guidance recommends modeling emissions reductions of PM2.5 precursors of between 30 and 70 percent to evaluate if precursor emissions reductions have a significant impact on PM2.5 levels, CARB and the District have determined that the 30 percent reduction in ammonia emissions is not achievable. Moreover, CARB and the District have not identified methods within its authority to control air emissions of ammonia that achieve an overall 30 percent reduction in ammonia emissions. In practice, the District has implemented the best available control measures on livestock operations that have already achieved approximately 25 percent reduction from this source. CARB is not aware of controls that would achieve greater reductions on the order needed to achieve an overall 30 percent reduction of ammonia emissions in the Valley; nevertheless, CARB is pursuing further research specific to California and the Valley to improve our understanding of ammonia emissions from various sources as a necessary prerequisite to identifying potential effective measures to achieve additional emissions reductions.

The District and CARB analyzed potential control measures to reduce ammonia emissions from key source categories in order to evaluate whether a 30 percent reduction in emissions is feasible. Specific to the confined animal facility category, the District conducted a new, extensive evaluation of potential measures to control sources of ammonia emissions. EPA provided the list of measures to CARB and the District and requested that the measures and studies referenced be addressed specifically for the Valley. In this evaluation, the District has identified only a few measures that have the theoretical potential to reduce additional ammonia emissions beyond the practices currently enforced through District Rule 4570. These measures are reducing crude protein content in feed for beef finishing cattle, incorporation of solid manure within 24 hours, and acidifying amendments for poultry litter and manure. Despite the technological and economic feasibility issues of these mitigation measures, the District evaluated the potential emission reductions and the impact they might have on the Valley's total ammonia emissions inventory if these measures were to be implemented. Overall, ammonia emissions in the Valley can only be reduced from the confined animal facilities source category by 2 percent by implementing these mitigation measures. For the fertilizer category, CARB has not identified effective mechanisms within its authority to regulate air emissions of ammonia from livestock, which overwhelmingly come from the decomposition of manure, or from fertilizers. Furthermore, CARB and the District are unaware of any other jurisdictions with rules for the source. In addition, CARB and the District did not identify feasible control measures for composting or other emissions sources.

Based on the extensive evaluation which identified feasible reductions of only approximately 2 percent, as summarized below in Table F-15, CARB and the District conclude that a 30 percent reduction in ammonia emissions is not achievable.

Table F-15 Estimated Feasible Emission Reductions

Emissions Category	Emissions (tpd, 2030)	Identified Controls	Feasible Ammonia Reductions
Confined Animal Feeding	167.2	• Reducing crude protein content in feed for beef finishing cattle • Incorporation of solid manure within 24 hours • Acidifying amendments for poultry litter and manure	6.5 tpd
Fertilizers	109.9	No authority or feasible controls identified	0
Composting	9.3	No feasible controls identified	0
Other sources	20.2	No feasible controls identified	0
Total Ammonia	306.5		6.5 tpd

Numbers may not add up due to rounding.

A 2 percent reduction is consistent with the national trend identified in U.S. EPA guidance which stated that ammonia changes ranged nationally from an increase of six percent to a decrease of nine percent.[203] Moving forward, updated national guidance on ammonia emission reductions achievable in practice is needed, as well as guidance on available and feasible control measures.

[203] EPA. *PM2.5 Precursor Demonstration Guidance*. May 2019. https://www.epa.gov/sites/production/files/2019-05/documents/transmittal_memo_and_pm25_precursor_demo_guidance_5_30_19.pdf

F.4 SULFUR DIOXIDE ANALYSIS

Ammonium sulfate ([NH4]2SO4) is a constituent of PM2.5, making up about 12 percent of fine particulate matter mass in the Valley in 2017. Sulfur oxides (SOx) emitted from stationary and mobile combustion sources, mostly as sulfur dioxide (SO2), are oxidized in the atmosphere to ultimately form sulfuric acid (H2SO4). Sulfuric acid then combines with ammonia to form ammonium sulfate. Since SOx reacts chemically in this way to form a particle, SOx is a precursor to PM2.5.

Following the analytical process outlined in the Guidance and summarized above, CARB has evaluated SOx in the Valley. The results of the sensitivity-based analysis and consideration of additional information are presented below.

F.4.1 Sensitivity-Based Analysis

CARB staff used an air quality model to estimate the PM2.5 design value for the annual standard in the base year of 2017 at each Valley monitor. Then, CARB staff applied the recommended lower bound of a 30 percent reduction to SOx emissions and used the air quality model to estimate the PM2.5 design values, as shown in Table F-16. The difference between the two design values represents the modeled impact on PM2.5 levels of a 30 percent reduction in SOx emissions in 2017. This is the value that is compared to U.S. EPA's recommended contribution threshold of 0.2 $\mu g/m^3$ for the 12 $\mu g/m^3$ annual standard to establish if PM2.5 levels are sensitive to this level of SOx reduction.

Table F-16 Base Year 2017 PM2.5 – 30 Percent SOx Reduction

Site	2017 Baseline DV	2017 DV with 30% SOx Reduction	Difference
Bakersfield-Planz	16.97	16.94	0.03
Hanford	15.73	15.91	-0.18
Bakersfield-Golden	15.52	15.51	0.01
Visalia	15.43	15.39	0.04
Bakersfield-California	15.12	15.11	0.01
Corcoran	14.95	15.10	-0.15
Fresno-Hamilton	13.99	13.99	0
Fresno-Garland	13.69	13.72	-0.03
Turlock	12.7	12.88	-0.18
Clovis	12.69	12.88	-0.19
Merced-SCoffee	12.28	12.50	-0.22
Stockton	12.21	12.48	-0.27
Madera	12.11	12.30	-0.19
Merced-MStreet	11.73	11.75	-0.02
Modesto	11.16	11.39	-0.23
Manteca	10.37	10.60	-0.23
Tranquility	8.19	8.33	-0.14

For completeness, CARB staff repeated this analysis, applying instead the recommended upper bound of a 70 percent reduction to the SOx emissions in the base year, as shown in Table F-17.

Table F-17 Base Year 2017 PM2.5 – 70 Percent SOx Reduction

Site	2017 Baseline DV	2017 DV with 70% SOx Reduction	Difference
Bakersfield-Planz	16.97	16.92	0.05
Hanford	15.73	15.90	-0.17
Bakersfield-Golden	15.52	15.49	0.03
Visalia	15.43	15.32	0.11
Bakersfield-California	15.12	15.10	0.02
Corcoran	14.95	15.12	-0.17
Fresno-Hamilton	13.99	13.93	0.06
Fresno-Garland	13.69	13.66	0.03
Turlock	12.7	12.87	-0.17
Clovis	12.69	12.97	-0.28
Merced-SCoffee	12.28	12.49	-0.21
Stockton	12.21	12.46	-0.25
Madera	12.11	12.31	-0.20
Merced-MStreet	11.73	11.72	0.01
Modesto	11.16	11.37	-0.21
Manteca	10.37	10.58	-0.21
Tranquility	8.19	8.35	-0.16

From this analysis, the estimated air quality impact of reducing SOx emissions in the base year by the lower bound of 30 percent is well under U.S. EPA's recommended threshold at all Valley monitors. In fact, in some cases, the estimated air quality impact is negative, implying that a reduction in SOx emissions would in fact increase PM2.5 levels at certain sites. Reducing emissions by the upper bound of 70 percent also shows impacts below the recommended threshold at all Valley sites.

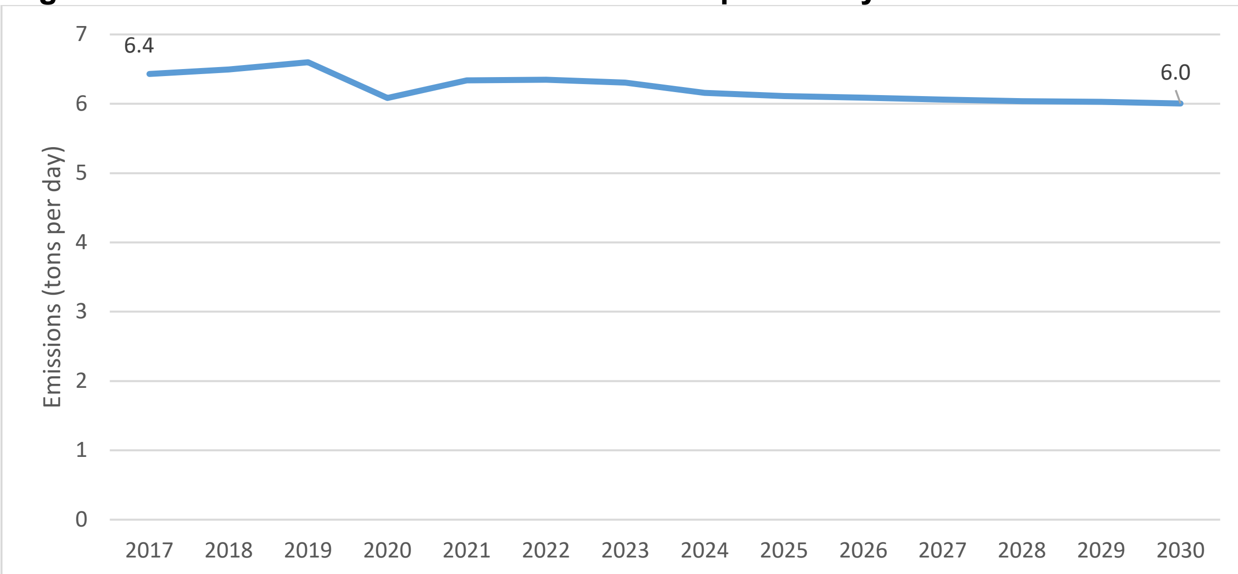
F.4.2 Consideration of Additional Information

To supplement modeling analysis, the Guidance also allows an air agency to consider additional information. Accordingly, CARB evaluated the trend of SOx emissions in the Valley to support the sensitivity-based analysis.

F.4.2.1 Emissions Trend

CARB's SOx inventory indicates that emissions remain roughly constant between 2017 and 2030, dropping 0.4 tpd or 6.7 percent, as shown in Figure F-8. Ammonia emissions also remain flat over the same time frame, as shown above in Figure F-1. Thus, conditions for ammonium sulfate formation are similar in the base and future years, with relative levels of ammonia and SOx remaining the same.

Figure F-8 SOx emission trend in the San Joaquin Valley between 2017 and 2030



Source: CEPAM 2022 v 1.00

F.4.2.2 Future Year Modeling

Analysis of SOx and ammonia emissions trends, discussed above, indicates that the sensitivity-based analysis performed for 2017 in Table F-16 and Table F-17 above is representative into the future with the Valley's emissions conditions remaining similar to the base year.

For completeness, however, CARB staff repeated the sensitivity-based analysis of SOx for the future attainment year of 2030 in accordance with the Guidance. Staff used an air quality model to estimate the PM2.5 design value for the annual standard in 2030 at each Valley monitor. Then, CARB staff applied a 30 percent reduction to SOx emissions and used the air quality model to estimate the PM2.5 design values in 2030, shown in Table F-18. The difference between the two design values represents the modeled impact on PM2.5 levels of a 30 percent reduction in ammonia emissions in the attainment year. The future-year modeling includes emission reductions from measures in the CARB-adopted 2022 State SIP Strategy.

Table F-18 Future Year 2030 PM2.5 – 30 Percent SOx Reduction

Site	2030 Baseline DV	2030 DV with 30% SOx Reduction	Difference
Bakersfield-Planz	14.05	13.99	0.06
Hanford	11.17	11.11	0.06
Bakersfield-Golden	12.48	12.42	0.06
Visalia	12.41	12.32	0.09
Bakersfield-California	12.39	12.33	0.06
Corcoran	10.71	10.68	0.03
Fresno-Hamilton	11.77	11.7	0.07
Fresno-Garland	11.55	11.49	0.06
Turlock	10.33	10.3	0.03
Clovis	9.91	9.88	0.03
Merced-SCoffee	9.61	9.59	0.02
Stockton	10.7	10.68	0.02
Madera	9.17	9.14	0.03
Merced-MStreet	9.96	9.92	0.04
Modesto	9.3	9.27	0.03
Manteca	8.85	8.82	0.03
Tranquility	6.37	6.37	0

For completeness, CARB staff repeated this analysis, applying instead the recommended upper bound of a 70 percent reduction to the SOx emissions in 2030, as shown in Table F-19.

Table F-19 Future Year 2030 PM2.5 – 70 Percent SOx Reduction

Site	2030 Baseline DV	2030 DV with 70% SOx Reduction	Difference
Bakersfield-Planz	14.05	13.94	0.11
Hanford	11.17	11.05	0.12
Bakersfield-Golden	12.48	12.38	0.10
Visalia	12.41	12.23	0.18
Bakersfield-California	12.39	12.28	0.11
Corcoran	10.71	10.66	0.05
Fresno-Hamilton	11.77	11.62	0.15
Fresno-Garland	11.55	11.42	0.13
Turlock	10.33	10.27	0.06
Clovis	9.91	9.88	0.03
Merced-SCoffee	9.61	9.56	0.05
Stockton	10.7	10.66	0.04
Madera	9.17	9.11	0.06
Merced-MStreet	9.96	9.88	0.08
Modesto	9.3	9.24	0.06
Manteca	8.85	8.79	0.06
Tranquility	6.37	6.38	-0.01

From this analysis, the estimated air quality impact of reducing SOx emissions by 30 percent and by 70 percent in 2030 continues to fall under U.S. EPA's recommended threshold of 0.2 μg/m^3 for the 12 μg/m^3 annual PM2.5 standard at all sites.

F.4.3 Conclusion

CARB has followed the Guidance to evaluate whether SOx contributes significantly to PM2.5 levels that exceed the NAAQS. Using sensitivity-based analysis in the base year and future year, CARB determined that emissions of SOx do not contribute significantly to PM2.5 levels that exceed the 2012 NAAQS in the area. Therefore, CARB has excluded SOx from control requirements in the SIP.

F.5 REACTIVE ORGANIC GAS ANALYSIS

Following the analytical process outlined in the Guidance and summarized above, CARB has evaluated Reactive Organic Gas (ROG) in the San Joaquin Valley. The results of the sensitivity-based analysis and consideration of additional information are presented below.

F.5.1 Sensitivity-Based Analysis

CARB staff used an air quality model to estimate the PM2.5 design value for the annual standard in the base year of 2017 at each Valley monitor. Then, CARB staff applied the recommended lower bound of a 30 percent reduction to ROG emissions and used the air quality model to estimate the PM2.5 design values, as shown in Table F-20. The difference between the two design values represents the modeled impact on PM2.5 levels of a 30 percent reduction in ROG emissions in 2017. This is the value that is compared to U.S. EPA's recommended contribution threshold of 0.2 $\mu g/m^3$ for the 12 $\mu g/m^3$ annual standard to establish if PM2.5 levels are sensitive to this level of ROG reduction.

Table F-20 Base Year 2017 PM2.5 – 30 Percent ROG Reduction

Site	2017 Baseline DV	2017 DV with 30% ROG Reduction	Difference
Bakersfield-Planz	16.97	16.89	0.08
Hanford	15.73	15.89	-0.16
Bakersfield-Golden	15.52	15.49	0.03
Visalia	15.43	15.35	0.08
Bakersfield-California	15.12	15.08	0.04
Corcoran	14.95	15.09	-0.14
Fresno-Hamilton	13.99	13.94	0.05
Fresno-Garland	13.69	13.68	0.01
Turlock	12.7	12.82	-0.12
Clovis	12.69	12.8	-0.11
Merced-SCoffee	12.28	12.46	-0.18
Stockton	12.21	12.44	-0.23
Madera	12.11	12.24	-0.13
Merced-MStreet	11.73	11.72	0.01
Modesto	11.16	11.35	-0.19
Manteca	10.37	10.56	-0.19
Tranquility	8.19	8.3	-0.11

For completeness, CARB staff repeated this analysis, applying instead the U.S. EPA-recommended upper bound of a 70 percent reduction to ROG emissions in the base year, as shown in Table F-21.

Table F-21 Base Year 2017 PM2.5 – 70 Percent ROG Reduction

Site	2017 Baseline DV	2017 DV with 70% ROG Reduction	Difference
Bakersfield-Planz	16.97	16.74	0.23
Hanford	15.73	15.82	-0.09
Bakersfield-Golden	15.52	15.38	0.14
Visalia	15.43	15.19	0.24
Bakersfield-California	15.12	14.97	0.15
Corcoran	14.95	15.04	-0.09
Fresno-Hamilton	13.99	13.8	0.19
Fresno-Garland	13.69	13.55	0.14
Turlock	12.7	12.71	-0.01
Clovis	12.69	12.7	-0.01
Merced-SCoffee	12.28	12.39	-0.11
Stockton	12.21	12.34	-0.13
Madera	12.11	12.14	-0.03
Merced-MStreet	11.73	11.64	0.09
Modesto	11.16	11.25	-0.09
Manteca	10.37	10.47	-0.10
Tranquility	8.19	8.29	-0.10

From this analysis, the estimated air quality impact of reducing ROG emissions in the base year by the lower bound of 30 percent is below U.S. EPA's recommended annual threshold of 0.2 µg/m^3 at all sites. Reducing emissions by the upper bound of 70 percent shows impacts above the threshold at two of the sites.

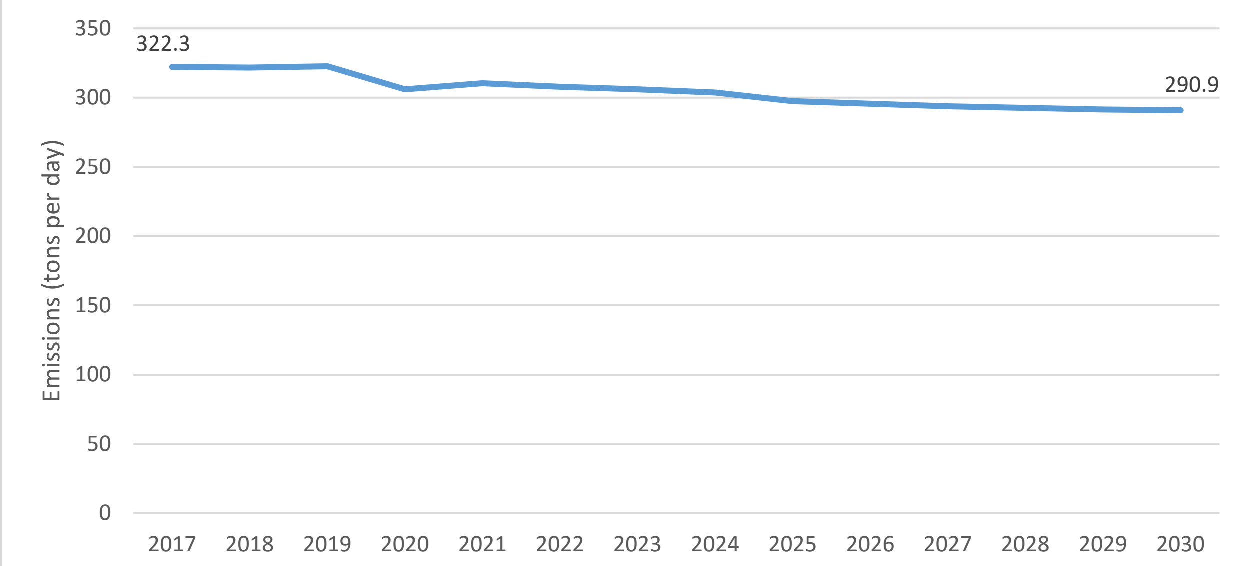
F.5.2 Consideration of Additional Information

To supplement modeling analysis, the Guidance also allows an air agency to consider additional information. Accordingly, CARB evaluated the trend of ROG emissions in the Valley to support the sensitivity-based analysis and conducted future year sensitivity modeling.

F.5.2.1 Emissions Trend

CARB has an extensive suite of measures in place to reduce ROG emissions, particularly in the area of regulating consumer products. In addition, the District has numerous rules that provide ROG emissions reductions in the Valley. CARB's ROG inventory indicates that these existing controls reduce emissions by 18.4 tpd, or 5.7 percent, between 2017 and 2030, as shown in Figure F-9. Considering the change and that CARB's 2022 State SIP Strategy provides additional ROG reductions beyond the base year, it is important to evaluate the role ROG plays in PM2.5 formation and whether it may differ in the base and future years, as the sensitivity-based analysis performed for 2017 may not be representative into the future.

Figure F-9 ROG emission trend in the San Joaquin Valley between 2017 and 2030



Source: CEPAM 2022 v.1.00

F.5.2.2 Future Year Modeling

Analysis of ROG emission trends, discussed above, indicates that the sensitivity-based analysis performed for 2017 in Table 20 and Table 21 above is representative into the future with the Valley's emissions conditions remaining similar to the base year.
For completeness, however, CARB staff repeated the sensitivity-based analysis of ROG for the future attainment year of 2030 in accordance with the Guidance. Staff used an air quality model to estimate the PM2.5 design value for the annual standard in 2030 at each Valley monitor. Then, CARB staff applied a 30 percent reduction to ROG emissions and used the air quality model to estimate the PM2.5 design values in 2030, shown in Table F-22. The difference between the two design values represents the modeled impact on PM2.5 levels of a 30 percent reduction in ROG emissions in the attainment year. The future-year modeling includes NOx and PM2.5 emission reductions from measures in the CARB-adopted 2022 State SIP Strategy.

Table F-22 Future Year 2030 PM2.5 – 30 Percent ROG Reduction

Site	2030 Baseline DV	2030 DV with 30% ROG Reduction	Difference
Bakersfield-Planz	14.05	14.01	0.04
Hanford	11.17	11.19	-0.02
Bakersfield-Golden	12.48	12.45	0.03
Visalia	12.41	12.38	0.03
Bakersfield-California	12.39	12.36	0.03
Corcoran	10.71	10.73	-0.02
Fresno-Hamilton	11.77	11.71	0.06
Fresno-Garland	11.55	11.50	0.05
Turlock	10.33	10.32	0.01

Site	2030 Baseline DV	2030 DV with 30% ROG Reduction	Difference
Clovis	9.91	9.89	0.02
Merced-SCoffee	9.61	9.61	0
Stockton	10.7	10.69	0.01
Madera	9.17	9.16	0.01
Merced-MStreet	9.96	9.94	0.02
Modesto	9.3	9.28	0.02
Manteca	8.85	8.83	0.02
Tranquility	6.37	6.38	-0.01

For completeness, CARB staff repeated this analysis, applying instead the recommended upper bound of a 70 percent reduction to ROG emissions in 2030, as shown in Table F-23.

Table F-23 Future Year 2030 PM2.5 – 70 Percent ROG Reduction

Site	2030 Baseline DV	2030 DV with 70% ROG Reduction	Difference
Bakersfield-Planz	14.05	13.96	0.09
Hanford	11.17	11.23	-0.06
Bakersfield-Golden	12.48	12.42	0.06
Visalia	12.41	12.34	0.07
Bakersfield-California	12.39	12.32	0.07
Corcoran	10.71	10.77	-0.06
Fresno-Hamilton	11.77	11.63	0.14
Fresno-Garland	11.55	11.44	0.11
Turlock	10.33	10.3	0.03
Clovis	9.91	9.88	0.03
Merced-SCoffee	9.61	9.62	-0.01
Stockton	10.7	10.67	0.03
Madera	9.17	9.15	0.02
Merced-MStreet	9.96	9.9	0.06
Modesto	9.3	9.26	0.04
Manteca	8.85	8.81	0.04
Tranquility	6.37	6.38	-0.01

From this analysis, in 2030, the modeled air quality impact of reducing ROG emissions by 30 percent and 70 percent falls under U.S. EPA's recommended threshold at all sites.

F.5.3 Conclusion

CARB has followed the Guidance to evaluate whether ROG contributes significantly to PM2.5 levels that exceed the 12 µg/m^3 annual NAAQS. Using sensitivity-based analysis in the base and future years, CARB determined that emissions of ROG do not contribute significantly to PM2.5 levels that exceed the 2012 NAAQS in the area. Therefore, CARB has excluded ROG from control requirements in the SIP.

Appendix G

RFP, QUANTITATIVE MILESTONES, AND CONTINGENCY

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Appendix G: RFP, Quantitative Milestones, and Contingency

Pursuant to federal Clean Air Act (CAA) requirements, states are required to submit a state implementation plan (SIP) to U.S. Environmental Protection Agency (EPA) for areas designated nonattainment of National Ambient Air Quality Standards (NAAQS, or standards) for PM2.5.[1] This appendix fulfills the following federal CAA requirements for PM2.5 nonattainment areas as identified in the CAA, codified in the code of federal regulations,[2] and clarified in the 2016 PM2.5 Implementation Rule:[3]

1. Reasonable Further Progress [CAA Section (§) 172(c)(2)]
2. Quantitative Milestones [CAA §189(c)]
3. Contingency [CAA §172(c)(9)]

G.1 REASONABLE FURTHER PROGRESS (RFP)

The term "reasonable further progress" (RFP) means such annual incremental reductions in emissions of the relevant air pollutant as are required for the purpose of ensuring attainment of the applicable NAAQS by the applicable date.[4] Each attainment plan for a PM2.5 nonattainment area shall include an RFP plan that demonstrates that sources in the area will achieve such annual incremental reductions in emissions of PM2.5 and PM2.5 plan precursors as are necessary to ensure attainment of the applicable PM2.5 NAAQS as expeditiously as practicable. As demonstrated in this Plan (Appendices F and J), California Air Resources Board (CARB) modeling determined ammonia, volatile organic compounds (VOCs), and oxides of sulfur (SOx) do not contribute significantly to PM2.5 levels that exceed the 2012 NAAQS in the Valley. As such, the demonstrations in this appendix appropriately address direct PM2.5 emissions and oxides of nitrogen (NOx).

G.1.1 RFP Plan Requirements

The RFP plan shall include the following:[5]

1. A schedule describing the implementation of control measures during each year of the applicable attainment Plan.
2. RFP projected emissions for direct PM2.5 and NOx for each applicable milestone year, based on the anticipated implementation schedule for control measures.
3. An analysis that presents the schedule of control measures and estimated emissions changes to be achieved by each milestone year, and that demonstrates that the control strategy will achieve RFP toward attainment between the base year and the attainment year. The analysis shall rely on

[1] Clean Air Act, Title 1, Part D Subpart 1 and CAA Title 1, Part D Subpart 4
[2] CFR part 51 – Requirements for preparation, adoption, and submittal of implementation Plans
[3] EPA. *Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements; Final Rule*. 81 Fed. Reg. 164, pp. 58010-58162. (2016, August 24). (to be codified at 40 CFR Parts 50, 51, and 93). https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf
[4] Clean Air Act §171(1)
[5] 40 CFR §51.1012

information from the base year inventory and the attainment projected inventory for the nonattainment area, in addition to the RFP projected emissions required.

4. An analysis that demonstrates that by the end of the calendar year for each milestone date for the area, pollutant emissions will be at levels that reflect either generally linear progress or stepwise progress in reducing emissions on an annual basis between the base year and the attainment year. A demonstration of stepwise progress must be accompanied by appropriate justification for the selected implementation schedule.
5. At the state's election, an analysis that identifies air quality targets associated with the RFP projected emissions identified for the milestone years at the design value monitor locations.

G.1.2 Determination of RFP Years

The baseline year for this Plan is 2017. Analyses and modeling performed for this Plan demonstrate that the District will attain the 2012 PM2.5 standard as expeditiously as practicable, by 2030. RFP years for an attainment Plan for a particulate matter air quality standard shall be determined by the quantitative milestone deadlines.[6] Refer to the Quantitative Milestone Requirements section below to see how milestone years were determined.

Table G-1 Summary of Significant RFP and Quantitative Milestone Dates

Base Year	Attainment Year	RFP and Quantitative Milestone Years
2017	2030	2025, 2028, 2031*

* 2031 is a Quantitative Milestone year only, not an RFP milestone year. All other dates are both RFP and Quantitative Milestone years.

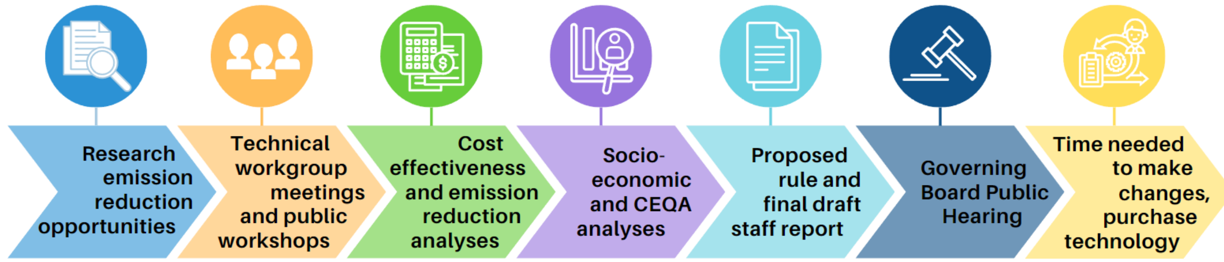
G.1.3 RFP Milestone Requirement Targets and Attainment Demonstrations

As previously stated, RFP means such annual incremental reductions in emissions of the relevant air pollutant as are required or may reasonably be required by EPA for the purpose of ensuring attainment of the applicable national ambient air quality standard by the applicable date. This section of this Plan demonstrates satisfaction of CAA RFP requirements. In concurrence with CAA requirements, the following analysis demonstrates linear RFP for the 2012 PM2.5 standard, concluding at the attainment year of 2030.

The regulatory measures need time to undergo a robust public rulemaking process and implementation after the Plan adoption. In these efforts, the District and CARB is committed to a transparent public process that includes stakeholder, industry, and other-agency input at every step possible. As illustrated in Figure G-1, the rule amendment process is a robust process that can take significant time, sometimes years, to complete and implement.

[6] 40 CFR 51.1012(a)(4)

Figure G-1 Public Process of Rule Development and Implementation



For the incentive-based measures, the total emission reductions can only be achieved over multiple years due to availability of willing participants and significant funding required. Modeling demonstrates attainment occurs in the Valley as expeditiously as practicable.

G.1.4 RFP Calculation Methodology and Generally Linear RFP Targets

Emissions data is presented as an annual average in tons per day (tpd).

1. Determine the emissions inventory of the Valley for the baseline year, the RFP years that have not yet passed, the attainment year, and the post-attainment RFP year (see Appendix B).

Table G-2 Annual Average Emission Inventory (tpd)

Pollutant	2017	2025	2028	2030	2031
Direct PM2.5	65.7	55.3	54.7	55.6	54.4
NOx	226.7	121.1	106.2	98.2	95.2

2. Identify additional annual average emission reductions between the Plan base year and the attainment year from adopted measures not yet in the Plan baseline and the Plan control measure commitments (see Chapter 4).

Table G-3 Annual Average Emissions Reductions from Measures Not Yet Included in the Baseline and Control Measure Commitments (tpd)

Pollutant	2017	2025	2028*	2030^{+}	2031
Direct PM2.5	0	0	0	0.72	0.72
NOx	0	0	4.84	20.2	20.2

* 2028 reductions reflect emission reductions from measures in CARB's 2016 and 2022 State SIP Strategies that have been adopted but are not yet in the baseline inventory (see Table G-3a).

Table G-3a Annual Average Emission Reductions in 2028 from Measures in CARB 2016 and 2022 State SIP Strategies Adopted but Not Yet in Baseline

Measure	2028 NOx (tpd)	2028 PM2.5 (tpd)
Advanced Clean Cars II	0.18	Not quantified
Advanced Clean Fleets Regulation	1.26	Not quantified
Clean Miles Standard	0.01	Not quantified
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	0.74	Not quantified
In-Use Locomotive Regulation	2.42	Not quantified
Clean Trucks Plan	0.23	Not quantified
Total	4.84	0

+ 2030 reductions reflect emission reductions from measures in CARB's 2016 and 2022 State SIP Strategies that have been adopted but are not yet in the baseline inventory, plus CARB's aggregate emission reduction commitment (see Table 4-6) and the District's aggregate emission reduction commitment (see Table 4-3).

3. Subtract the emission reductions from measures not included in the baseline and control measure commitments (Table G-3) from the emission inventory (Table G-2) to determine the Plan inventory.

Table G-4 Projected Attainment Emissions Inventory after Control Measures (tpd)

Pollutant	2017	2025	2028	2030	2031
Direct PM2.5	65.7	55.3	54.7	54.88	53.71
NOx	226.7	121.1	101.36	78.0	75.0

4. Determine the total reductions from the 2017 baseline emission inventory that must be achieved to reach attainment by subtracting attainment year emissions after controls (Table G-4) from Plan base year emissions (Table G-2).

Table G-5 Total Reductions Necessary to Reach Attainment (tpd)

	A	B	C
Pollutant	Plan Base Year Emissions (2017)	Attainment Emissions (2030)	Reductions Needed for Attainment
	(Table G-2)	(Table G-4)	(A – B)
Direct PM2.5	65.7	54.88	10.82
NOx	226.7	78.0	148.7

5. Determine the fraction of reductions that are achieved in each RFP milestone year.

   Where (milestone year – base year) / (attainment year – base year)

Table G-6 Milestone Year Fractions Achieved in Each Milestone Year

	2025	2028	2030	2031
% of Reductions Needed for Attainment	62%	85%	100%	100%

6. Calculate the linear RFP levels using reduction fractions.

Table G-7 Linear RFP Levels (tpd)

	A	B	C	D	E	F	G	H	I	J
			2025		2028		2030		2031	
Pollutant	2017 Base Year Emission Inventory	Reductions Needed to Attain NAAQS	Tons to be Reduced	Linear RFP Level	Tons to be Reduced	Linear RFP Level	Tons to be Reduced	Linear RFP Level	Tons to be Reduced	Linear RFP Level
	(Table G-2)	(Table G-5)	(B x Table G-6)	(A – C)	(B x Table G-6)	(A – E)	(B x Table G-6)	(A – G)	(B x Table G-6)	(A –I)
Direct PM2.5	65.7	10.82	6.66	59.04	9.16	56.54	10.82	54.88	10.82	54.88
NOx	226.7	148.7	91.51	135.19	125.82	100.88	148.7	78.0	148.7	78.0

7. Compare the linear RFP levels (Table G-7) to the projected attainment emissions inventory (Table G-4).

Table G-8 Comparison of Linear RFP Levels to Projected Attainment Emissions Inventory

	2025		2028		2030		2031	
Pollutant	Linear RFP Level	Attainment Emissions Inventory	Linear RFP Level	Attainment Emissions Inventory	Linear RFP Level	Attainment Emissions Inventory	Linear RFP Level	Attainment Emissions Inventory
	(Table G-7)	(Table G-4)	(Table G-7)	(Table G-4)	(Table G-7)	(Table G-4)	(Table G-7)	(Table G-4)
Direct PM2.5	59.04	55.3	56.54	54.7	54.88	54.88	54.88	53.71
NOx	135.19	121.1	100.88	101.36	78.0	78.0	78.0	75.0

8. Establish generally linear RFP target emission levels.

Table G-9 Generally Linear RFP Targets

Pollutant	2025	2028	2030	2031
Direct PM2.5	59.04	56.54	54.88	54.88
NOx	135.19	101.36	78.0	78.0

G.2 QUANTITATIVE MILESTONES

Consistent with CAA §189(c)(1), the state must submit in each attainment Plan for a PM2.5 nonattainment area specific quantitative milestones that demonstrate reasonable further progress toward attainment of the applicable PM2.5 NAAQS in the area.

G.2.1 Quantitative Milestone Requirements

Quantitative milestones in a SIP for an area reclassified as Serious nonattainment shall meet the following requirements:[7]

1. For areas that can attain the NAAQS by the end of the tenth calendar year following the effective date of designation, milestone dates of 7.5 years and 10.5 years respectively, from the date of designation of the area.
2. For areas that cannot attain the NAAQS by the end of the tenth calendar year following the effective date of designation, milestone dates of 7.5 years, 10.5 years, and 13.5 years from the date of designation. If the attainment date is beyond 13.5 years from the date of designation, such Plan shall also contain a quantitative milestone to be achieved no later than milestones dates of 16.5 years, respectively from the date of designation of the area.
3. Milestones that provide for objective evaluation of RFP toward timely attainment of the NAAQS in the area. At a minimum each quantitative milestone Plan must include a milestone for tracking progress achieved in implementing SIP control measures, including Best Available Control Measure (BACM) and Best Available Control Technology (BACT) by each milestone date.

The Valley was designated Nonattainment for the 2012 PM2.5 NAAQS effective on April 15, 2015, and was reclassified as Serious on December 27, 2021. The Valley will attain the 2012 NAAQS in 2030. Based on these dates and pursuant to the requirements above, quantitative milestone years are as follows in Table G-10.

Table G-10 Quantitative Milestone Dates and Deadlines

Quantitative Milestone Dates	Milestone Report Due Dates
2025, 2028, 2031	2026, 2029, 2032

G.2.2 Stationary Sources Quantitative Milestone Commitments

The District will report on milestones for implementation of stationary source reductions set forth in previous District adopted attainment Plans as well as this *Plan for the 2012 Annual PM2.5 Standard*. The 2012 NAAQS has quantitative milestone years in 2025, 2028, and 2031. Notably, previous required quantitative milestone reports for the moderate nonattainment plan have already been submitted to the EPA per the *2016 Moderate Area Plan for the 2012 PM2.5 Standard*.

[7] 40 CFR §51.1013 Quantitative milestone requirements.

2025
For the 2025 milestone year, the District is reporting on the following milestones:
- The status of amendments to District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters);

2028
For the 2028 milestone year, the District is reporting on the following milestones:
- Implementation of amendments to District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters);
- Implementation of amendments to District Rule 4550 (Conservation Management Practices);
- Implementation of incentive-based commitments for the *Fireplace and Woodstove Change-Out Program*, and *Low-Dust Nut Harvester Replacement Program*.

2031
For the 2031 milestone year, the District is reporting on the following milestones:
- Implementation of amendments to District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters);
- Implementation of amendments to District Rule 4550 (Conservation Management Practices);
- Implementation of incentive-based commitments for the *Fireplace and Woodstove Change-Out Program*, and *Low-Dust Nut Harvester Replacement Program*.

G.2.3 Mobile Sources Quantitative Milestone Commitments

[This section provided by the California Air Resources Board]

CARB will report on milestones for implementation of mobile source measures that contribute significant emissions reductions included in the reasonable further progress demonstration through the 2031 milestone year. These regulations were originally set forth as measure commitments in the 2016 State Strategy for the State Implementation Plan (2016 State SIP Strategy) and the 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy).

The applicable quantitative milestone years for the 2012 12 μg/m^3 annual PM2.5 standard are 2025, 2028, and 2031.

2025
For the 2025 milestone year, CARB is reporting on the following three milestones:
- Implementation from 2022 through 2025 of the *Clean Truck Check Program*, previously known as the *Heavy-Duty Vehicle Inspection and Maintenance Program*, which ensures that vehicles' emissions control systems are properly functioning when traveling on California's roadways;
- Implementation from 2022 through 2025 of the *Advanced Clean Fleets Regulation* which focuses on strategies to ensure that the cleanest vehicles are

deployed by government, business, and other entities in California to meet their transportation needs; and

- Implementation from 2022 through 2025 of the *In-Use Off-Road Diesel-Fueled Fleets Regulation* which requires fleets operating in-use off-road diesel equipment to meet an annual fleet average emissions target that decreases over time.

2028

For the 2028 milestone year, CARB is reporting on the following three milestones:

- Implementation from 2026 through 2028 of the *Heavy-Duty Vehicle Inspection and Maintenance Program*, also known as Clean Truck Check, which ensures that vehicles' emissions control systems are properly functioning when traveling on California's roadways;
- Implementation from 2026 through 2028 of the *Advanced Clean Fleets Regulation* which focuses on strategies to ensure that the cleanest vehicles are deployed by government, business, and other entities in California to meet their transportation needs; and
- Implementation from 2026 through 2028 of the *In-Use Off-Road Diesel-Fueled Fleets Regulation* which requires fleets operating in-use off-road diesel equipment to meet an annual fleet average emissions target that decreases over time.

2031

For the 2031 milestone year, CARB is reporting on the following milestone:

- The status of new CARB SIP measures adopted between 2024 and 2030 per the schedule included in the adopted San Joaquin Valley 12 ug/m^3 annual PM2.5 Plan that provide for attainment of the 12 ug/m^3 PM2.5 annual standard in 2030.

G.3 CONTINGENCY MEASURES

Through an attainment plan, a region puts forth strategies to achieve air quality improvements by federal CAA mandated deadlines. Agencies strive to be thorough and scientific in air quality planning to ensure an area meets attainment of federal standards by the attainment date. However, given the large number of variables inherent in planning and air quality more generally, there is a possibility that the air quality benefits will not occur as quickly as expected. In air quality planning, a contingency measure is a measure that would reduce direct PM2.5 emissions or PM2.5 precursors in the event the region does not reach attainment by the applicable attainment date, fails to make RFP towards the standard, fails to submit a quantitative milestone report, or fails to meet a quantitative milestone. The purpose of contingency measures is to achieve additional air quality benefits while the region and state formally revise the attainment plan pursuant to CAA requirements for plan revisions and attainment date extensions.[8]

[8] EPA. *Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements; Final Rule*. 81 Fed. Reg. 164, pp. 58010-58162. (August 24, 2016). https://www.govinfo.gov/content/pkg/FR-2016-08-24/pdf/2016-18768.pdf

Contingency measures "must be fully adopted rules or measures that can take effect without further action by the state or the EPA upon failure to meet milestones or attain by the attainment deadline." Legal interpretations of what qualifies as approvable contingency measures under the CAA have changed over the years.

Prior to 2016, agencies could use "surplus" emissions reductions from fully adopted rules to satisfy the contingency requirement. These rules achieved continuing and new emissions reductions past the attainment deadline through phased-in implementation and ongoing technology deployment. However, in *Bahr v. EPA*, 836 F.3d 1218 (9th Cir. 2016)("*Bahr*"), the court rejected EPA's interpretation allowing for early implementation of contingency measures that provided additional emission reductions, and held instead that contingency measures may only consist of new measures that do not take effect until triggered by an applicable CAA failure.

For many years, air basins outside the Ninth Circuit were able to continue relying on emissions reductions from already-implemented measures to fulfill the contingency measure requirement (*Louisiana Environmental Action Network v. EPA*, 283 F.3d 575 (5th Cir. 2004) ("*LEAN*"). However, in *Sierra Club v. EPA*, 21 F.4th 185 (D.C. Cir. 2021) the court cited and agreed with the *Bahr* case, superseding *LEAN* and now prohibiting all regions in the nation from relying on surplus emissions reductions from early implemented measures to satisfy contingency measure requirements. This 2021 *Sierra Club* decision (published after EPA's implementation rule for the 2012 PM2.5 NAAQS in 2016), coupled with increased nonattainment areas under increasingly stringent NAAQS, elevates the contingency measure problem to one of nation-wide significance.

In response to *Bahr* and as part of the 75 parts per billion (ppb) 8-hour ozone SIP due in 2016, CARB developed the statewide Enhanced Enforcement Contingency Measure (Enforcement Contingency Measure) as a part of the *2018 Updates to the California State Implementation Plan* to address the need for a triggered action as a part of the contingency measure requirement. Additionally, the District developed a new contingency measure achieving additional reductions from architectural coatings if required by an applicable CAA failure. CARB and the District worked closely with EPA regional staff in developing the contingency measure package that included the Enforcement Contingency Measure, the District architectural coatings measure and emission reductions from implementation of CARB's mobile source emissions program. As part of the *San Joaquin Valley 2016 Ozone Plan for 2008 8-hour Ozone Standard* SIP action, EPA approved CARB's enforcement as a "SIP strengthening" measure. In this action, EPA also approved the District's architectural coatings measure and the implementation of the mobile source reductions along with a CARB emission reduction commitment as meeting the contingency measure requirement for this SIP.

Subsequently, the Association of Irritated Residents filed a lawsuit against EPA for its approval of various elements within the *San Joaquin Valley 2016 Ozone Plan for 2008 8-hour Ozone Standard*, including the contingency measure. The Ninth Circuit Court of Appeals issued its decision in *Association of Irritated Residents v. EPA*[9] (*AIR*) that

[9] *Association of Irritated Residents v. U.S. Environmental Protection Agency*, 10 F.4th 937 (9th Cir. 2021).

EPA's approval of the contingency element was arbitrary and capricious because EPA departed from its long-standing policy of requiring a SIP's contingency measure element to provide for emissions reductions equating to at least one year's RFP without providing a reasoned explanation for its change in policy. The Ninth Circuit Court of Appeals held that, in line with EPA's longstanding interpretation of what is required of a contingency measure and the purpose it serves, together with *Bahr*, all reductions needed to satisfy the CAA's contingency measure requirements must come from the contingency measure itself, and that the amount of reductions needed for contingency cannot be reduced based upon surplus emission reductions from ongoing programs.

G.3.1 EPA Draft Guidance for Contingency Measures

In light of the recent court decisions described above, EPA developed the *Draft Guidance on the Preparation of State Implementation Plan Provisions that Address the Nonattainment Area Contingency Measure Requirements for Ozone and Particulate Matter* (*Draft Guidance*) on March 16, 2023.[10] The District, CARB, and other local/state air quality management agencies engaged with EPA in the development of this *Draft Guidance* to provide technical input and recommendations through workgroup meetings and ongoing staff discussions. The purpose of the *Draft Guidance* is to identify solutions and flexibility related to key issues that regions face in developing approvable contingency measures, including the scarcity of available measures, implementation timelines following a contingency trigger, and the amount of reductions needed, among other issues.

The *Draft Guidance* contains three main concepts: (1) revising the quantity of emissions reductions that contingency measures should provide to account for declining emissions inventories over time; (2) allowing for an infeasibility justification if an area is unable to identify feasible contingency measures in sufficient quantities due to a scarcity of available, qualifying measures and/or (3) revising the time period within which emissions reductions from contingency measures should occur.

G.3.2 Contingency Measure Emission Reduction Targets

In its *Draft Guidance*, EPA has recognized that the longstanding policy of requiring emission reductions of one year's worth of RFP for contingency measures is extremely challenging and infeasible for areas such as the Valley. EPA's *Draft Guidance* therefore puts forth a new approach to calculate the recommended quantity of emission reductions, which EPA has named One Year's Worth of Progress (OYW_P). Based on this *Draft Guidance*, Table G-11 summarizes the NOx and PM2.5 emission reductions needed to demonstrate that OYW_P is being achieved through the contingency measure. In EPA's *Draft Guidance*, the OYW_P value is calculated as the average emission reductions expected per year over the planning time line, expressed as a percentage of the base year emission inventory, and then applying this percentage to the attainment

[10] EPA. *Guidance on the Preparation of State Implementation Plan Provisions that Address the Nonattainment Area Contingency Measure Requirements for Ozone and Particulate Matter*. March 16, 2023. Retrieved from: https://www.epa.gov/system/files/documents/2023-03/CMTF%202022%20guidance%203-17-23.pdf

year inventory to result in an emission reduction target for contingency. In mathematical form, this would be expressed as:

$$OYW_P = \frac{\frac{(base\ year\ EI - attainment\ year\ EI)}{(attainment\ year - base\ year)}}{base\ year\ EI} * (attainment\ year\ EI)$$

The steps for the calculations for the 2012 PM2.5 standard are detailed below, consistent with EPA's *Draft Guidance*.

Step 1: Calculate the annual average reductions needed to attain for each relevant precursor.

	2012 Standard
PM2.5 Step 1a	$65.7\ tpd - 54.88\ tpd = 10.8\ tpd$
PM2.5 Step 1b	$10.8\ tpd \div 13\ years = 0.83\ tpd$
NOx Step 1a	$226.7\ tpd - 78.00\ tpd = 148.7\ tpd$
NOx Step 1b	$148.7\ tpd \div 13\ years = 11.4\ tpd$

Step 2: Calculate the annual percentage reduction needed to attain.

	2012 Standard
PM2.5	$0.83\ tpd \div 65.7 = 0.013\ (or\ 1.3\%)$
NOx	$11.4\ tpd \div 226.7 = 0.050\ (or\ 5.0\%)$

Step 3: Calculate the amount of reductions needed for OYW of progress.

	2012 Standard
PM2.5	$54.88\ tpd \times 1.3\ \% = \mathbf{0.70\ tpd}$
NOx	$78.00\ tpd \times 5.0\ \% = \mathbf{3.94\ tpd}$

The following table summarizes the amount of emissions reductions needed to achieve the target, for the 2012 PM2.5 NAAQS, based on the OYW_P approach outlined in the Draft Guidance.[11]

Table G-11 Contingency Measure Reductions Needed under OYW_P Approach

Base Year	Attainment Year	Contingency Annual Average Emission Reduction Targets (tpd)	
		NOx	PM2.5
2017	2030	3.94	0.70

[11] EPA. *Guidance on the Preparation of State Implementation Plan Provisions that Address the Nonattainment Area Contingency Measure Requirements for Ozone and Particulate Matter*. March 16, 2023. Retrieved from: https://www.epa.gov/system/files/documents/2023-03/CMTF%202022%20guidance%203-17-23.pdf

Under the prior EPA contingency policy, the contingency reductions would need to be achieved in the year after which the contingency provision was triggered.[12] However, EPA's *Draft Guidance* on contingency measures allows emission reductions to be achieved within two years of the contingency triggering event.[13]

Additionally, EPA's *Draft Guidance* explains that, where areas are unable to identify and adopt feasible contingency measures that would reduce emissions by an amount sufficient to meet the OYW of progress, then it would be appropriate to submit contingency measures that result in less than that amount, using a reasoned justification approach demonstrating the lack of sufficient feasible measures to meet the recommended quantity of contingency measures. EPA's *Draft Guidance* also notes "a state may use the ratio to substitute contingency measure reductions of one precursor for a shortfall in contingency measure reductions of another precursor."

Areas like the Valley that have significant nonattainment challenges have developed several generations of aggressive and far-reaching emission reduction measures to meet various CAA requirements. When viable emission reductions are identified, they are implemented to contribute to expeditious attainment. Reductions are not held in reserve and to be used only if an area fails to meet a milestone. As a result, developing contingency measures for District attainment plans is a significant challenge. From extensive analyses and discussions, the District and CARB developed the following contingency commitments for the *2024 Plan for the 2012 Annual PM2.5 Standard*.

G.3.3 Adopted Contingency Measures for the 2012 Annual PM2.5 Standard

On May 18, 2023, the District's Governing Board adopted the *PM2.5 Contingency Measure State Implementation Plan Revision* (*PM2.5 Contingency Measure SIP Revision*).[14] The *Contingency SIP Revision* included a contingency measure feasibility analysis of all emission sources under District and CARB control, an amendment to Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) to add a contingency measure provision, and a commitment to evaluating District Rule 8051 (Open Areas) for a potential second contingency measure. On September 21, 2023, the District's Governing Board adopted revisions to Rule 8051 to add a contingency provision.

On December 20, 2023, EPA proposed approval of the District and CARB's *PM2.5 Contingency Measure SIP Revision*,[15] which closely followed EPA's recommendations in the *Draft Guidance*. EPA found that the District and CARB implemented all feasible

[12] "Guidance on Issues Related to 15 Percent Rate-of-Progress Plans," Memorandum from Michael H. Shapiro to Regional Air Directors (August 23, 1993), available at: https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19930823_shapiro_15pct_rop_guidance.pdf

[13] EPA. *Guidance on the Preparation of State Implementation Plan Provisions that Address the Nonattainment Area Contingency Measure Requirements for Ozone and Particulate Matter*. March 16, 2023. Retrieved from: https://www.epa.gov/system/files/documents/2023-03/CMTF%202022%20guidance%203-17-23.pdf

[14] SJVAPCD. *PM2.5 Contingency Measure State Implementation Plan Revision.* (May 18, 2023). Retrieved from: https://ww2.valleyair.org/media/jkhaefnp/06-pm25-contingency-measure-sip-revision.pdf

[15] EPA. *Clean Air Plans; Contingency Measures for the Fine Particulate Matter Standards; San Joaquin Valley; Proposed Rule.* 88 Fed. Reg. 243, pp. 87988-88012. (December 20, 2023). https://www.govinfo.gov/content/pkg/FR-2023-12-20/pdf/2023-27686.pdf

contingency measure opportunities and that no other opportunities for contingency measures exist in the Valley, which demonstrates the stringency of the District and CARB's regulations. EPA's proposed approval of the *PM2.5 Contingency Measure SIP Revision* sets the foundation for this section. Contingency measures for the District are included in District Rules 4901 and 8051, and CARB has incorporated a contingency measure within their smog check measure for mobile sources.

G.3.3.1 Wood Burning Fireplaces and Wood Burning Heaters

Background

The District's residential wood burning emission reduction strategy includes wood burning curtailments implemented through District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters), in conjunction with the District's incentive grant program for fireplace and woodstove change-outs, and robust public education and outreach efforts. This approach is designed to improve public health by reducing toxic wood smoke emissions in Valley neighborhoods during the peak PM2.5 winter season (November through February), and has proven to be extremely effective in advancing the District's objectives to attain the PM2.5 federal standards and protect public health. Commitments in the District's *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (*2018 PM2.5 Plan*) included rulemaking for Rule 4901 to further lower wood burning curtailment levels, as well as enhancements to the District's incentive grant funding levels, public outreach and education, enforcement, and air quality forecasting programs.

Through the District's Residential Wood Smoke Reduction Program, which is based on Rule 4901, the District has declared and enforced episodic wood burning curtailments, also called "No Burn" days, since 2003. The District's Residential Wood Smoke Reduction Program and District Rule 4901 reduce harmful species of PM2.5 when and where those reductions are most needed, in impacted urbanized areas when the local weather is forecast to hamper particulate matter dispersion.

Rule 4901 was first adopted in 1993, and has been subsequently amended five times. The 1993 adoption of Rule 4901 established a public education program on techniques to reduce wood burning emissions. It also enforced EPA Phase II requirements for new wood burning heaters, prohibited the sale of used wood burning heaters, established a list of prohibited fuel types, and required the District to request voluntary curtailment of wood burning on days when the ambient air quality was unhealthy.

In 2003, the rule was amended to add episodic wood burning curtailments when air quality was forecast to be at 150 or higher on the air quality index (AQI), which was equivalent to a PM2.5 concentration of 65 $\mu g/m^3$ at the time; restrictions on the installation of wood burning devices in new residential developments, based on housing density; and a requirement that during the transfer of a residential property, sellers provide a statement of compliance to the District and buyer for residential real properties with non-compliant wood burning devices.

In 2008, the rule was amended, lowering the mandatory curtailment level to a PM2.5 concentration of 30 µg/m^3, and adding an attainment plan contingency measure that would lower the wood burning curtailment level to 20 µg/m^3 if EPA were to find that the Valley did not attain the 1997 PM2.5 NAAQS in 2014.

In 2014, Rule 4901 was amended again to lower the No Burn threshold for high polluting wood burning heaters and fireplaces from 30 µg/m^3 to 20 µg/m^3 and establish a separate No Burn threshold for cleaner certified wood burning devices. The amendment doubled the number of No Burn days for high polluting units that were the source of over 95% of the wintertime residential wood smoke emissions.

In 2019, the District amended Rule 4901 to lower the curtailment threshold from 20 to 12 µg/m^3 for older, higher-polluting wood burning heaters, open hearth fireplaces, and non-registered wood burning heaters in the Hot Spot counties of Madera, Fresno, and Kern. Within these same Hot Spot counties, the cleaner, registered wood burning heaters are allowed to burn when air quality is forecast to be between 12 and 35 µg/m^3. In these counties, no wood burning is allowed when air quality is forecast to be above 35 µg/m^3. In the remaining Valley counties, the previous curtailment thresholds remain in place.

Following these amendments, EPA recognized in their February 2020 evaluation of BACM and most stringent measures (MSM) for the 2006 PM2.5 NAAQS, that Rule 4901 implements BACM and MSM levels of control.[16] In July 2020, EPA took final action to approve the 2019 amendments to Rule 4901 and provide SIP credit for emissions reductions achieved through the strategy.[17]

<u>Contingency Measure</u>

On May 18, 2023, as part of the *PM2.5 Contingency Measure State Implementation Plan Revision* (*Contingency SIP Revision*),[18] the District amended District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) to include a contingency measure trigger that would be activated should EPA issue a final rulemaking that the Valley failed to:

1. Meet any RFP requirement;
2. Meet any quantitative milestone in an approved attainment plan;
3. Submit a quantitative milestone report; or
4. Attain the applicable PM2.5 NAAQS by the applicable attainment date.

Effective 60 days after EPA final action, the trigger would impose the following District-wide lower residential wood burning curtailment levels:

[16] EPA. Technical Support Document, Evaluation of BACM/MSM, San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS. (February 2020). Retrieved from: https://www.regulations.gov/document/EPA-R09-OAR-2019-0318-0005

[17] EPA. *Air Plan Approval; California; San Joaquin Valley Unified Air Pollution Control District*. 85 Fed. Reg. 141, pp. 44206-44209. (July 22, 2020). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2020-07-22/pdf/2020-14298.pdf

[18] SJVAPCD. *PM2.5 Contingency Measure State Implementation Plan Revision.* (May 18, 2023). Retrieved from: https://ww2.valleyair.org/media/jkhaefnp/06-pm25-contingency-measure-sip-revision.pdf

- No burning for non-registered units (Level One) when PM2.5 concentrations are forecast to equal or exceed 12 μg/m^3
- No burning for all devices (Level Two) when PM2.5 concentrations are forecast to exceed 35 μg/m^3

Further, should EPA subsequently find that the Valley failed to meet another of the aforementioned regulatory requirements, stricter curtailment levels would apply District-wide:

- No burning for non-registered units (Level One) when PM2.5 concentrations are forecast to equal or exceed 11 μg/m^3
- No burning for all devices (Level Two) when PM2.5 concentrations are forecast to exceed 35 μg/m^3

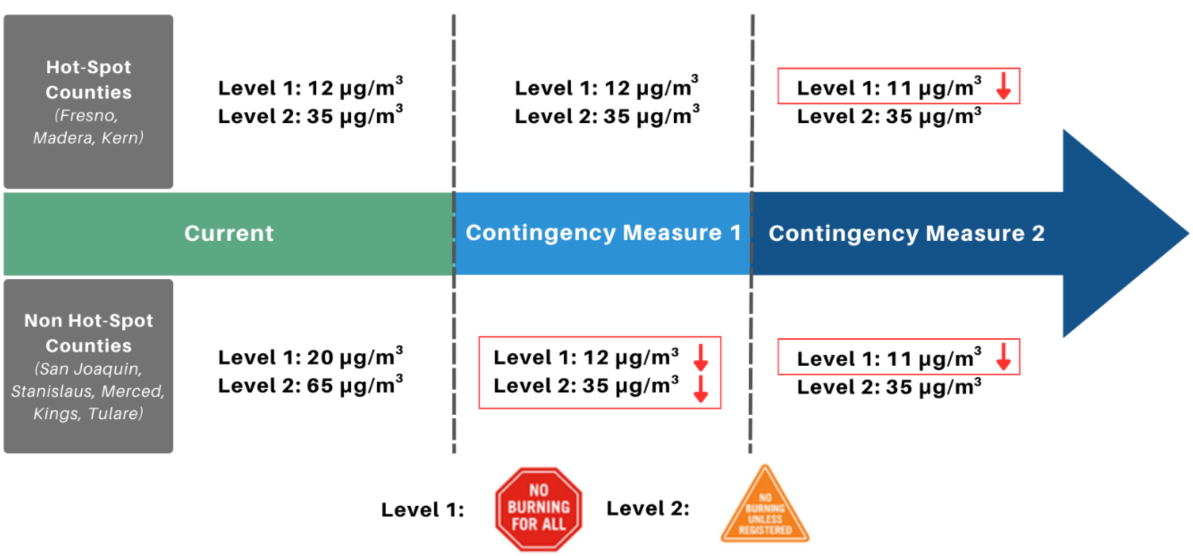
Table G-12 and Figure G-2 depict the sequence of increasingly stringent contingency curtailment thresholds to be enforced following each contingency trigger.

Table G-12 District Contingency Curtailment Thresholds

Contingency Concept	Hot Spot County (μg/m^3)		Non Hot Spot County (μg/m^3)	
	Level 1	Level 2	Level 1	Level 2
Current Requirements	12	35	20	65
Contingency Measure 1	12	35	12	35
Contingency Measure 2	11	35	11	35

Hot Spot counties: Madera, Fresno, Kern
Non Hot Spot counties: San Joaquin, Stanislaus, Merced, Kings, Tulare

Figure G-2 Adopted Contingency Measure – Residential Wood Burning



Estimated Contingency Emission Reductions

Rule 4901 already includes the most stringent residential wood combustion control strategy in the nation, and this contingency measure further enhances the stringency of this rule. Table G-13 estimates the expected increase in curtailment days that would occur if the contingency thresholds are triggered. The values represent the collective increase in Level One and Level Two curtailment days.

Table G-13 Additional Curtailments by Contingency Trigger (Days)

County	First Trigger		Second Trigger	
	Level One (12 μg/m^3)	Level Two (35 μg/m^3)	Level One (11 μg/m^3)	Level Two (35 μg/m^3)
Fresno	0.00	0.00	3.66	-
Kern (SJV)	0.00	0.00	3.35	-
Kings	5.65	22.60	3.32	-
Madera	0.00	0.00	4.71	-
Merced	37.77	2.34	4.68	-
San Joaquin	29.91	5.65	2.66	-
Stanislaus	25.93	8.31	3.32	-
Tulare	22.52	14.79	5.38	-

*The expected additional curtailment is calculated using a 3-year average of District air quality data from 2019-2022

The District performed an analysis of recent ambient air quality data and estimates these amendments would achieve the emission reductions found in the following table. The analysis and emissions reduction estimates are largely based on the methodology that was used in the analysis for 2019 amendments to Rule 4901,[19] which was approved by EPA.[20] See Appendix C of the *PM2.5 Contingency Measure SIP Revision*[21] for additional details on the District's emission reduction analysis.

[19] SJVAPCD. *Appendix B Emission Reduction Analysis for Proposed Amendments Residential Wood Burning Emission Reduction Strategy, pp. B-1 – B-14*. (June 20, 2019). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2019/June/final/13.pdf

[20] EPA. *Air Plan Approval; California; San Joaquin Valley Unified Air Pollution Control District; Final Rule*. 85 Fed Reg. 141, pp. 44206-44209. (July 22, 2020). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2020-07-22/pdf/2020-14298.pdf

[21] SJVAPCD. *PM2.5 Contingency Measure State Implementation Plan Revision.* (May 18, 2023). Retrieved from: https://ww2.valleyair.org/media/jkhaefnp/06-pm25-contingency-measure-sip-revision.pdf

Table G-14 Annual Average Emission Reductions by Proposed Contingency Trigger (tpd)

County	First Trigger (12/35 µg/m³)		Second Trigger (11/35 µg/m³)	
	PM2.5	NOx	PM2.5	NOx
Fresno	0.0000	0.0000	0.0297	0.0039
Kern (SJV)	0.0000	0.0000	0.0161	0.0023
Kings	0.0258	0.0040	0.0030	0.0004
Madera	0.0000	0.0000	0.0021	0.0003
Merced	0.0895	0.0109	0.0104	0.0013
San Joaquin	0.1786	0.0264	0.0133	0.0020
Stanislaus	0.1619	0.0229	0.0156	0.0022
Tulare	0.1235	0.0175	0.0176	0.0025
Total	**0.5793**	**0.0817**	**0.1078**	**0.0148**

In total, the emission reductions achievable from these amendments to Rule 4901 for purposes of qualifying contingency measures are 0.69 tpd of PM2.5 and 0.10 tpd NOx on an annual average basis. These amendments, once approved by EPA into the SIP, will contribute towards satisfying the contingency measure requirements for NOx and PM2.5 for the PM2.5 NAAQS. As mentioned above, on December 20, 2023, EPA proposed approval of this measure.[22]

G.3.3.2 Dust from Open Areas

Background

The District's Regulation VIII suite of rules limit fugitive PM10 emissions from numerous activities associated with significant dust emissions. These rules reduce fugitive dust from construction sites, earthmoving activities, parking and staging areas, open areas, agricultural operations, carryout and trackout, paved and unpaved roads, and material storage sites. The Regulation VIII rules were adopted in November 2001, and subsequently amended in 2004 to incorporate more stringent requirements.

The 2004 rule amendment to District Rule 8051 (Open Areas) implemented BACM to control fugitive dust emissions from open areas. Amendments to the rule included limiting visible dust emissions (VDE) to 20% opacity and maintaining stabilized surface conditions in urban open areas 0.5 acres and greater and rural open areas 3.0 acres and greater that have at least 1,000 square feet of disturbed surface area.

Rule 8051 allows for a variety of control options to maintain a stabilized surface and limit VDE to less than 20% opacity. Rule 8051 allows control of fugitive dust by applying water, chemical dust suppressant, or organic dust suppressant to areas

[22] EPA. *Clean Air Plans; Contingency Measures for the Fine Particulate Matter Standards; San Joaquin Valley; Proposed Rule.* 88 Fed. Reg. 243, pp. 87988-88012. (December 20, 2023). https://www.govinfo.gov/content/pkg/FR-2023-12-20/pdf/2023-27686.pdf

without vegetation; establishing vegetation on all previously disturbed surfaces; or paving, applying and maintaining gravel, or applying and maintaining chemical/organic dust stabilizers/suppressants. To prevent unauthorized vehicle access to open areas, property owners must also post "No Trespassing" signs or install physical barriers to prevent vehicle access to the area. District Rule 8051 has continued to be an integral part of the District's fugitive windblown dust control strategy.

Contingency Measure

Consistent with commitments outlined in the *Contingency SIP Revision*, the District proposed amendments to Rule 8051 to incorporate a contingency measure that would lower the rural acreage applicability threshold within the rule. The District's Governing Board adopted the amendments to Rule 8051 on September 21, 2023.[23]

The adopted amendments to Rule 8051 added a contingency measure that would lower the rural open area applicability level to include rural parcels between 1 to 3 acres. The amendments also modified the exemptions section of the rule to incorporate considerations for fire prevention activities. EPA proposed approval of this contingency measure on December 20, 2023, which would be activated upon issuance of final determination by EPA that the Valley failed to meet one of the contingency elements as outlined in the CAA.

Estimated Contingency Emission Reductions

The total PM2.5 emission reductions achieved from the proposed contingency measure is estimated at 0.008 tpd, on an annual average basis. For further analysis of the emission reductions, see Appendix B of the Final Staff Report for Rule 8051.[24]

G.3.3.3 Smog Check Contingency Measure

On October 26, 2023, CARB unanimously adopted the *California Smog Check Contingency Measure State Implementation Plan Revision*,[25] and transmitted the revision to EPA on November 13, 2023. The EPA proposed approval on December 20, 2023. The *California Smog Check Contingency Measure State Implementation Plan Revision* addresses SIP contingency measure requirements of the federal CAA for certain areas designated as nonattainment of the NAAQS within the State, including the San Joaquin Valley.

The Motor Vehicle Inspection and Maintenance Program (Smog Check Program) is a vehicle inspection and maintenance program administered by the California Bureau of Automotive Repair (BAR) that identifies vehicles with faulty emission control

[23] SJVAPCD. *Adopt Amendments to Rule 8051 (Open Areas)*. (September 21, 2023). Retrieved from: https://ww2.valleyair.org/media/04efhheh/item-9_-adopt-proposed-ammendments-to-rule-8051.pdf
[24] SJVAPCD. *Adopt Amendments to Rule 8051 (Open Areas)*. (September 21, 2023). Retrieved from: https://ww2.valleyair.org/media/04efhheh/item-9_-adopt-proposed-ammendments-to-rule-8051.pdf
[25] CARB. *California Smog Check Contingency Measure State Implementation Plan Revision. September 15, 2023.* Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2023-09/Smog_Check_CM_SIP_Revision_Final.pdf

components. Smog Check Program inspections are required biennially as a part of the vehicle registration process and/or when a vehicle changes ownership or is registered for the first time in California. In 2017, Assembly Bill (AB) 1274 added Health and Safety Code (H&SC) § 44011(a)(4)(B)(ii), which allowed vehicles eight or less model-years old to be exempt from requirements for Smog Check Program inspections. In lieu of an inspection, this law requires seven and eight model-year old vehicles owners to pay an annual Smog Abatement Fee of $25, $21 of which goes to the Air Pollution Control Fund for use to incentivize clean vehicles and equipment through the Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program). This law also specifies that this exemption is allowed unless CARB determines that exempting these vehicles prohibits the State from meeting SIP commitments.

To address contingency measure requirements, CARB's Smog Check Contingency Measure would remove exemptions within the current Smog Check Program. Should any air district within the state fail one of the four triggering events under the CAA, the measure would:

- Change the existing smog check inspection exemptions in the California Smog Check Program in the applicable nonattainment area(s);
- Apply to the California nonattainment area(s) and standard(s) for which the Triggering Event occurs, which includes the 1997, 2008, and 2015 8-hour ozone standards, and 1997, 2006, and 2012 PM2.5 standards for the San Joaquin Valley; and
- Be implemented within 30 days of the effective date of a U.S. EPA finding that a Triggering Event occurred.

If triggered, these additional vehicles would then be subject to Smog Check Program inspections based on the area in which the vehicle is registered (i.e., enhanced, basic, and change of ownership), resulting in additional emissions control equipment failures being identified and corrected, thereby reducing emissions that typically result when emissions control equipment is not performing as designed. CARB expects to achieve 0.086 tpd NOx emission reductions in the Valley upon triggering this contingency measure for the 2012 PM2.5 standard.

For further analysis, please see CARB's analysis in the *California Smog Check Contingency Measure State Implementation Plan Revision*.

G.3.4 Reasoned Justification Approach

Section 4 of EPA's *Draft Guidance* outlines the procedures for preparation of a reasoned justification for providing contingency measures achieving less than OYW_P. These procedures involve the identification of existing and potential controls not already included in the applicable attainment plan and evaluation of the feasibility of such controls.

The following sections evaluate potential contingency measure opportunities for PM2.5 and NOx, consistent with EPA's guidance for a reasoned justification approach in their

Draft Guidance. Table G-15 below lists all source categories in the San Joaquin Valley emissions inventory, as output by CEPAM v1.00. PM2.5 and NOx emissions inventory data for each category is included for the year 2030 (representing the attainment year for the 2012 PM2.5 standard), reported in tpd and as percentages of the total.

Table G-15 District CEPAM v1.00 Annual Average Inventories for 2030

2030 Annual Average					
MSC	SUB CATEGORY	PM2.5 Emissions (tpd)	% of PM2.5 Inventory	NOx Emissions (tpd)	% of NOx Inventory
10	ELECTRIC UTILITIES	0.72	1.29%	2.23	2.27%
20	COGENERATION	0.33	0.60%	0.72	0.73%
30	OIL AND GAS PRODUCTION (COMBUSTION)	1.30	2.33%	1.45	1.47%
40	PETROLEUM REFINING (COMBUSTION)	0.06	0.11%	0.16	0.16%
50	MANUFACTURING AND INDUSTRIAL	0.27	0.48%	1.30	1.33%
52	FOOD AND AGRICULTURAL PROCESSING	0.50	0.89%	3.02	3.07%
60	SERVICE AND COMMERCIAL	0.45	0.80%	4.08	4.16%
99	OTHER (FUEL COMBUSTION)	0.01	0.01%	0.51	0.52%
110	SEWAGE TREATMENT	0.01	0.02%	0.04	0.04%
120	LANDFILLS	0.10	0.17%	0.16	0.16%
130	INCINERATORS	0.01	0.02%	0.04	0.04%
140	SOIL REMEDIATION	0.00	0.00%	0.00	0.00%
199	OTHER (WASTE DISPOSAL)	0.04	0.08%	0.01	0.01%
210	LAUNDERING	0.01	0.01%	0.00	0.00%
220	DEGREASING	0.05	0.10%	0.00	0.00%
230	COATINGS AND RELATED PROCESS SOLVENTS	0.32	0.57%	0.00	0.00%
240	PRINTING	0.00	0.00%	0.00	0.00%
250	ADHESIVES AND SEALANTS	0.00	0.00%	0.00	0.00%
299	OTHER (CLEANING AND SURFACE COATINGS)	0.00	0.00%	0.00	0.00%
310	OIL AND GAS PRODUCTION	0.02	0.04%	0.09	0.09%
320	PETROLEUM REFINING	0.02	0.04%	0.01	0.01%
330	PETROLEUM MARKETING	0.02	0.03%	0.05	0.05%
399	OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.00	0.00%	0.00	0.00%
410	CHEMICAL	0.33	0.59%	0.34	0.34%
420	FOOD AND AGRICULTURE	0.77	1.38%	0.00	0.00%
430	MINERAL PROCESSES	1.08	1.95%	0.21	0.21%
440	METAL PROCESSES	0.02	0.04%	0.00	0.00%
450	WOOD AND PAPER	0.20	0.36%	0.00	0.00%
460	GLASS AND RELATED PRODUCTS	0.07	0.12%	1.75	1.78%
470	ELECTRONICS	0.00	0.00%	0.00	0.00%
499	OTHER (INDUSTRIAL PROCESSES)	0.07	0.13%	0.01	0.01%
510	CONSUMER PRODUCTS	0.00	0.00%	0.00	0.00%
520	ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.00	0.00%	0.00	0.00%

2030 Annual Average					
MSC	SUB CATEGORY	PM2.5 Emissions (tpd)	% of PM2.5 Inventory	NOx Emissions (tpd)	% of NOx Inventory
530	PESTICIDES/FERTILIZERS	0.00	0.00%	0.00	0.00%
540	ASPHALT PAVING / ROOFING	0.00	0.00%	0.00	0.00%
610	RESIDENTIAL FUEL COMBUSTION	3.01	5.41%	4.47	4.56%
620	FARMING OPERATIONS	12.72	22.89%	0.00	0.00%
630	CONSTRUCTION AND DEMOLITION	2.84	5.12%	0.00	0.00%
640	PAVED ROAD DUST	5.55	9.98%	0.00	0.00%
645	UNPAVED ROAD DUST	3.67	6.60%	0.00	0.00%
650	FUGITIVE WINDBLOWN DUST	7.08	12.74%	0.00	0.00%
660	FIRES	0.21	0.38%	0.04	0.04%
670	MANAGED BURNING AND DISPOSAL	5.95	10.70%	1.79	1.82%
690	COOKING	2.59	4.66%	0.00	0.00%
699	OTHER (MISCELLANEOUS PROCESSES)	0.00	0.00%	0.00	0.00%
710	LIGHT DUTY PASSENGER (LDA)	0.27	0.48%	2.24	2.29%
722	LIGHT DUTY TRUCKS - 1 (LDT1)	0.02	0.04%	0.43	0.44%
723	LIGHT DUTY TRUCKS - 2 (LDT2)	0.14	0.24%	1.72	1.76%
724	MEDIUM DUTY TRUCKS (MDV)	0.10	0.18%	1.77	1.80%
725	LIGHT HEAVY DUTY TRUCKS - 1 (LHDT1)	0.15	0.27%	2.68	2.72%
726	LIGHT HEAVY DUTY TRUCKS - 2 (LHDT2)	0.05	0.09%	0.82	0.83%
727	MEDIUM HEAVY DUTY TRUCKS (MHDT)	0.04	0.07%	1.46	1.49%
728	HEAVY HEAVY DUTY TRUCKS (HHDT)	0.54	0.97%	10.16	10.35%
750	MOTORCYCLES (MCY)	0.00	0.00%	0.20	0.20%
775	BUSES	0.01	0.02%	0.42	0.43%
780	MOTOR HOMES (MH)	0.00	0.01%	0.13	0.13%
810	AIRCRAFT	1.69	3.04%	4.54	4.63%
820	TRAINS	0.33	0.59%	16.50	16.80%
833	OCEAN GOING VESSELS	0.00	0.00%	0.05	0.05%
835	COMMERCIAL HARBOR CRAFT	0.00	0.00%	0.03	0.03%
840	RECREATIONAL BOATS	0.37	0.67%	2.36	2.40%
850	OFF-ROAD RECREATIONAL VEHICLES	0.02	0.04%	0.14	0.15%
860	OFF-ROAD EQUIPMENT	0.46	0.83%	10.61	10.81%
861	OFF-ROAD EQUIPMENT (PERP)	0.05	0.09%	2.17	2.21%
870	FARM EQUIPMENT	0.94	1.69%	17.27	17.59%
890	FUEL STORAGE AND HANDLING	0.00	0.00%	0.00	0.00%

As part of this evaluation, the District and CARB analyzed contingency measure opportunities for each source category. Notably, as demonstrated in Section G.3.5, the District and CARB's contingency measures achieve the necessary reductions to achieve OYW_P for PM2.5 sources. However, the District is still including an analysis for PM2.5 source categories below.

This evaluation included analysis of technological and economic feasibility of potential measures. Each measure was evaluated on whether it could be implemented within 60 days of being triggered and achieve the necessary reductions within 1-2 years of being triggered. Additionally, the technological feasibility of each option was considered to assess whether the measure would be technologically feasible to implement. More stringent requirements may be unavailable or economically infeasible to implement, especially in the time frame required for contingency measure implementation. Notably, as part of the District's rule analyses conducted for this plan, in addition to the recent *2018 PM2.5 Plan*, *2022 Ozone Plan*, and *2023 Initial SIP Requirements for the 2012 Annual PM2.5 Standard*,[26] comparisons to analogous rules from other regions were completed, demonstrating the stringency of the District's rules. The District is referring to these comparisons as a part of the below analyses, as allowed under the *Draft Guidance*.

[26] SJVAPCD. *Initial SIP Requirements for the 2012 Annual PM2.5 Standard.* October 19, 2023. Retrieved from: https://ww2.valleyair.org/media/vzbbnhkg/00-final-adopted-initial-sip-requirements-for-the-2012-annual-pm25-standard.pdf

G.3.4.1 Fuel Combustion

Table G-16 Fuel Combustion Inventory Contributions

MSC	SUB CATEGORY	PM2.5 (tpd)	NOx (tpd)
10	ELECTRIC UTILITIES	0.72	2.23
20	COGENERATION	0.33	0.72
30	OIL AND GAS PRODUCTION (COMBUSTION)	1.30	1.45
40	PETROLEUM REFINING (COMBUSTION)	0.06	0.16
50	MANUFACTURING AND INDUSTRIAL	0.27	1.30
52	FOOD AND AGRICULTURAL PROCESSING	0.50	3.02
60	SERVICE AND COMMERCIAL	0.45	4.08
99	OTHER (FUEL COMBUSTION)	0.01	0.51
610	RESIDENTIAL FUEL COMBUSTION	3.01	4.47
	Total	***6.65***	***17.94***

This category includes turbines, boilers, steam generators, process heaters, one large solid waste combustor, internal combustion engines, central fan-type furnaces primarily fueled by Public Utility Commission (PUC) quality natural gas; liquid fuel e.g., diesel, is used in the internal combustion engines, but for other units it is rare and predominately held in reserve for emergency use. These units are used to generate electricity, produce hot water, produce steam, transfer heat from combustion gases to liquid or process streams, and condition living and office spaces. These units emit PM2.5 and NOx and can be found at facilities representing a wide range of industries including, but not limited, to electrical utilities, cogeneration operations, oil and gas production, petroleum refining, manufacturing and industrial processes, food and agricultural processing, hospitals, hotels, service and commercial facilities, residential housing and commercial office spaces. These units have significant variability in technology, size, use, and age of equipment, as well as variability in potential controls for various pollutants.

The District has evaluated opportunities for contingency measures within the fuel combustion category and did not identify a feasible measure. The District has recently amended a number of fuel combustion rules to incorporate more stringent regulations that go beyond state and federal regulations. Notably, CARB plans to implement a zero-NOx regulation for both residential space heating and residential water heating, thus leaving no opportunities for a contingency measure. The District's analysis is provided below:

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
Rule 4306 and 4320 (Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters >5 MMBtu/hr)	Refer to the District's analysis in the *PM2.5 Contingency Measure SIP Revision* for Emissions from Oil and Gas Production Combustion Equipment.	The District concludes that this source category is not an appropriate contingency measure due to the following reasons: • Analyses provided by the District shows that further controls are either technologically infeasible, or not cost effective • District is already requiring the most stringent feasible controls, exceeding MSM requirements • Significant time is needed to plan and prepare for the installation of equipment including budgeting appropriate funds for large projects (2-3 years), which is incompatible with a contingency trigger • Operations are in the process of investing in and installing technologies to meet recently amended rule limits • A contingency trigger is incompatible with the technologies involved in reducing emissions from this category, as operations would need time to plan and install technology and reductions would not be achieved within one to two years of a contingency trigger Rules 4306 and 4320 meet or exceed BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.
Rule 4307 (Boilers, Steam Generators and Process Heaters 2 – 5 MMBtu/hr)	Require use of technologies such as SCRs, ultra-low NOx burners, and EMx.	No; As stated in Appendix C of the *2024 PM2.5 Plan*, the potential emission reduction opportunities are not cost effective. Various control technologies that were further evaluated for their potential to reduce emissions as a contingency measure include SCRs, ultra-low NOx burners, and EMx. • Retrofitting a range of SCR options has annualized costs ranging from \$225,378 to \$19,532,760. These options range from \$140,726 to \$912,868 per ton of emissions reduced • Retrofitting a range of ultra-low NOx burner options has annualized costs ranging from \$64,977 to \$5,631,340, which	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		would have a cost effectiveness ranging from $48,296 to $371,297 per ton of emissions reduced • Replacement of an older unit with a new boiler meeting the 9 ppmv NOx unit has annualized costs ranging from $147, 816 to $12,810,720, with a cost effectiveness ranging from $109,869 to $844,633 per ton of emissions reduced • The District researched post-combustion controls such as EMx, the second generation of the SCONOx technology that reduces NOx, SOx, CO, and VOC emissions. Per EmeraChem, manufacturer/vendor of the technology, this technology has not been achieved in practice (AIP) for natural gas fired boilers. SCONOx and EMx systems have only been used by power plants for the control of turbine emissions. The cost of an EMx system would be anywhere from $3 to $5 million, or even up to $8 million in some cases for large power plant installations. Moreover, an EMx system is ideal for a new installation, but becomes extremely challenging and sometimes nearly impossible to retrofit to an existing unit. In fact, cost-effectiveness analyses conducted by the District for the installation of SCONOx/EMx units on large power plant turbine installations within the Valley have shown that this technology is not cost-effective. Given the high cost-effectiveness demonstrated for turbines and lack of demonstrated practice with boilers, this technology is not feasible or cost-effective for reducing emissions from this category. While cost-effectiveness was further reviewed, there are a number of additional feasibility considerations and complexities that potentially render the utilization of the above technologies as infeasible, including physical constraints, control effectiveness for the wide variety of potential applications, and other considerations. Rule 4307 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with	

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		the technologies involved in reducing emissions from this category.	
Rule 4308 (Boilers, Steam Generators and Process Heaters 0.075 to less than 2.0 MMBtu/hr)	Require use of technologies such as SCRs, ultra-low NOx burners, and EMx.	No; As stated in Appendix C of the *2024 PM2.5 Plan*, the technologies involved with reducing emissions from this source category are not cost effective and this source category is not suitable for a contingency measure. These potential controls are also not cost effective as implementation of: • Selective Catalytic Reduction (SCR) systems reduce NOx emissions from 20 ppmv @ 3% O_2 to 5 ppmv @ 3% O_2 has a cost effectiveness of at least $484,684/ton of emissions reduced • Ultra-low NOx burner system reduces NOx emissions from 20 ppmv @ 3% O2 to 9 ppmv @ 3% O2 at a cost effectiveness of $91,746/ton of emissions reduced • EMx systems, as explained under Rule 4307, are not cost effective and most likely not technologically feasible for these small units While cost-effectiveness was further reviewed, there are a number of additional feasibility considerations and complexities that potentially render the utilization of the above technologies as infeasible, including physical constraints, control effectiveness for the wide variety of potential applications, and other considerations. Rule 4308 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. All units subject to 4308 have to be certified by the manufacturer prior to sale. Manufacturers would need long lead time to design new units and have them tested by independent third party laboratories, and finally certified by the Air District. Manufacturers would also need time to produce the amount of units needed Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
Rule 4309 (Dryers, Dehydrators, and Ovens)	Require use of technologies such as low NOx burners.	No; As stated in Appendix C of the *2024 PM2.5 Plan*, alternative control technology such as low NOx burners would reduce NOx emissions, however, more stringent requirements have not been implemented for many categories. For example, the 2022 Ozone Plan concluded that District Rule 4309 is at least as stringent as or more stringent than analogous rules from other California air districts. The only analogous rule identified to be more stringent than Rule 4309 was South Coast Air Quality Management District (SCAQMD) Rule 1147.1, which the District concluded that this rule exceeds RACT requirements and the NOx requirement has not been widely adopted in other SIP rules. In addition, requiring the use of these burners has proven to have a negative impact on product quality such as drying onions and changing onion color due to higher carbon monoxide emissions. The District does not see implementing low NOx burners as feasible due to affecting the facilities ability to carry out normal business until the technologies are further improved. Rule 4309 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.
Rule 4352 (Solid Fuel Fired Boilers, Steam Generators, and Process Heaters)	Require use of additional or alternative control technologies beyond existing stringent controls.	No; The District recently adopted amendments to Rule 4352 in December 2021 after going through a robust public process of a year and a half. Appendix C of the 2021 Rule 4352 Staff Report evaluated alternative control technologies applicable to sources subject to Rule 4352.[27] District analysis found that all alternative control technology that could reduce emissions further require technology that has prohibitively high capital costs and is not cost effective. In addition, many of these technologies have not been	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required

[27] SJVAPCD. *Adopt Proposed Amendments to Rule 4352 (Solid Fuel Fired Boilers, Steam Generators, and Process Heaters).* (December 16, 2021). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2021/December/final/12.pdf

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		implemented at facilities subject to Rule 4352; therefore, these control technologies are not commercially tested and proven. Rule 4352 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years. Additionally, operations are currently investing in control technologies to meet recently amended rule limits.
Rule 4702 (Internal Combustion Engines)	Require use of additional or alternative control technologies beyond existing stringent controls.	No; The District recently adopted amendments to Rule 4702 per commitments in the *2018 PM2.5 Plan* in August 2021 after going through a robust public process. The 2021 Rule 4702 staff report included evaluations of additional control technology including SCRs, electrification and solar power, and other control technologies.[28] • SCR systems require significant capital, up to $300,000 to purchase a single unit and up to $60,000 of annual operation and maintenance costs • Introducing an electric engine/solar system has a cost effectiveness ranging from $150,000 to $260,000 per ton of emissions reduced In addition to cost effectiveness, there are a number of additional feasibility considerations and complexities that potentially render the utilization of the above technologies as infeasible, including physical constraints, control effectiveness variation for the wide range of potential applications, and other considerations. Rule 4702 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years. Additionally, operations are currently investing in control technologies to meet recently amended rule limits.

[28] SJVAPCD. *Proposed Amendments to Rule 4702 (Internal Combustion Engine)*. (July 20, 2021). Retrieved from: http://www.valleyair.org/workshops/postings/2021/08-19-21-r4702/DraftStaffReport.pdf

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	
Rule 4703 (Stationary Gas Turbines)	Require use of additional or alternative control technologies beyond existing stringent controls.	No; As stated in Appendix C of the *2024 PM2.5 Plan,* the District has found that further control from sources subject to Rule 4703 is not currently feasible or cost effective. • Retrofitting a SCR system on units producing less than 3 megawatts (to comply with 2 ppmvd NOx @ 15% O_2) incurs an estimated $439,278 of annual costs, which costs $348,633 per ton of emissions reduced. • Retrofitting a SCR system on units producing between 3 to 10 megawatts (to comply with 2 ppmvd NOx @ 15% O_2) incurs an estimated $716,998 of annual costs, which costs $770,965 per ton of emissions reduced. • Retrofitting a SCR system on units producing greater than 10 megawatts (simple cycle unit to comply with 2.5 ppmvd NOx @ 15% O_2) incurs an estimated $1,737,092 of annual costs, which costs $232,231 per ton of emissions reduced. • Retrofitting SCRs on units producing greater than 10 megawatts (combined cycle to comply with 2 ppmvd NOx @ 15% O_2) incurs an estimated $2,785,635 of annual costs, which costs $141,116 per ton of emissions reduced. While cost-effectiveness was further reviewed, there are a number of additional feasibility considerations and complexities that potentially render the utilization of the above technologies as infeasible, including physical constraints, control effectiveness for the wide variety of potential applications, and other considerations. Rule 4703 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters)	Refer to the District's analysis above in Section G.3.3.1 for Wood Burning Fireplaces and Wood Burning Heaters.	-	-
Rule 4902 (Residential Water Heaters)	Adopt zero-NOx requirements earlier than CARB measure.	No; CARB currently has an existing commitment that will require zero-NOx water heaters and achieve emission reductions statewide starting in 2030. The District evaluated opportunities to advance the implementation timeframe of zero-NOx requirements in the Valley. Manufacturers need time to ramp up production of zero-emission technologies to meet the expected demand. Further, any such standard would have to be developed in collaboration with energy and building code regulators and the District would need to ensure it was consistent with all State and local efforts. The District would need to work carefully with communities to consider any housing cost or affordability impacts. The District would need to engage with community-based organizations and other key stakeholders to incorporate equity considerations for low-income and environmental justice communities where feasible. Given the need for triggerable and potentially short-term reductions, the long lead time associated with this potential measure, the attrition-based nature of implementation, and the existing CARB measure in place that would conflict with a local contingency measure, this measure is deemed infeasible. In an effort to identify potential emission reduction opportunities, the District's *2022 Ozone Plan* includes a further study commitment to evaluate current and upcoming work from CARB and other agencies related to reducing emissions from residential and commercial combustion sources, and evaluate the feasibility of implementing zero-emission or low-NOx requirements for these sources in the Valley. Through this effort, the District will also evaluate opportunities to advocate for funding under the Inflation Reduction Act, Bipartisan Infrastructure Law, and other funding sources, which are prioritizing funding opportunities for electrification of appliances to reduce greenhouse gas emissions.	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		The District continues to support CARB in the development and implementation of a statewide zero-NOx appliances measure, as it will result in direct air quality and public health benefits for the Valley. Additionally, as part of this *2024 PM2.5 Plan*, the District commits to further evaluating potential opportunities to reduce NOx emissions from natural gas building appliances in the Valley. As part of this evaluation, the District will consider the implementation of zero-NOx requirements earlier than CARB's statewide measure, to the extent that measures are technologically and economically feasible in the Valley. The District will collaborate with utilities, agencies, and organizations to help leverage funding and coordinate incentives with existing programs.	
Rule 4905 (Natural Gas – Fired, Fan Type Residential Central Furnace)	Adopt zero-NOx requirements earlier than CARB measure.	No; CARB currently has an existing commitment that will require zero-NOx furnaces and achieve emission reductions statewide starting in 2030. The District evaluated opportunities to advance the implementation timeframe of zero-NOx requirements in the Valley. Manufacturers need time to ramp up production of zero-emission technologies to meet the expected demand. Further, any such standard would have to be developed in collaboration with energy and building code regulators and the District would need to ensure it was consistent with all State and local efforts. The District would need to work carefully with communities to consider any housing cost or affordability impacts. The District would need to engage with community-based organizations and other key stakeholders to incorporate equity considerations for low-income and environmental justice communities where feasible. Given the need for triggerable and potentially short-term reductions, the long lead time associated with this potential measure, the attrition-based nature of implementation, and the existing CARB measure in place that would conflict with a local contingency measure, this measure is deemed infeasible. In an effort to identify potential emission reduction opportunities, the District's 2022 Ozone Plan includes a further study commitment to evaluate current and upcoming work from CARB and other agencies related to reducing emissions from residential and commercial combustion sources, and evaluate the feasibility of implementing zero-emission or low-NOx requirements for these	No; This measure would require a very robust public process that would take at least two years (or more). Manufacturers would require long lead time to design and produce the amount of units needed. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		sources in the Valley. Through this effort, the District will also evaluate opportunities to advocate for funding under the Inflation Reduction Act, Bipartisan Infrastructure Law, and other funding sources, which are prioritizing funding opportunities for electrification of appliances to reduce greenhouse gas emissions. The District continues to support CARB in the development and implementation of a statewide zero-NOx appliances measure, as it will result in direct air quality and public health benefits for the Valley. Additionally, as part of this *2024 PM2.5 Plan*, the District commits to further evaluating potential opportunities to reduce NOx emissions from natural gas building appliances in the Valley. As part of this evaluation, the District will consider the implementation of zero-NOx requirements earlier than CARB's statewide measure, to the extent that measures are technologically and economically feasible in the Valley. The District will collaborate with utilities, agencies, and organizations to help leverage funding and coordinate incentives with existing programs. Rule 4905 meets or exceeds federal BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	

G.3.4.2 Waste Disposal

Table G-17 Waste Disposal Inventory Contributions

MSC	SUB CATEGORY	PM2.5 (tpd)	NOx (tpd)
110	SEWAGE TREATMENT	0.01	0.04
120	LANDFILLS	0.10	0.16
130	INCINERATORS	0.01	0.04
140	SOIL REMEDIATION	0.00	0.00
199	OTHER (WASTE DISPOSAL)	0.04	0.01
	Total	***0.16***	***0.25***

This category includes sewage treatment, landfills, incinerators, flares, soil remediation, composting, and other miscellaneous categories. These units emit NOx and PM2.5 and are primarily found at landfills, public owned treatment works, locations with contaminated soils, oil and gas operations, refineries, and agricultural operations. Flare emissions under the waste disposal source categories are predominately generated by landfill flares. Smaller quantities of emissions are generated by sewage treatment and incineration flares combusting digester gas, process gas, waste gas, and natural gas. Composting emissions are generated by the decomposition of organic materials. Incinerator emissions are primarily generated by waste disposal activities in the industrial sector and involve combustion of distilled oil, liquefied petroleum gas, natural gas, pathological waste and waste gas. These units have significant variability in technology, size, use and age of equipment, as well as variability in potential controls for various pollutants. Collectively, this category contributes to 0.17 tpd of PM2.5 emissions and 0.33 tpd of NOx.

The District has evaluated opportunities for contingency measures within the waste disposal category and did not identify a feasible measure. The District's analysis is provided below:

Landfills

The evaluation for Rule 4311 (Flares) is provided in Section G.3.4.4 below. The District did not identify any other PM2.5 or NOx controls for this category for consideration as contingency measures. District rules that are applicable to landfill operations, such as Rule 4642 (Solid Waste Disposal Sites), control VOC emissions and do not include PM2.5 or NOx control measures.

Composting

Composting is a VOC emissions source category, and the District did not identify any PM2.5 or NOx controls for consideration as contingency measures.

Incinerators

The District did not identify any incinerator control measures for further consideration as a potential contingency measure. The District reviewed the comparable requirements to other states for Rule 4203 (Particulate Matter Emissions from Incineration of Combustible Refuse) and Rule 4302 (Incinerator Burning), and did not identify requirements for control of incinerator emissions beyond those of Rules 4203 and 4302. For example, neither BAAQMD nor SCAQMD implement rules with similar particulate matter emissions requirements.

G.3.4.3 Cleaning and Surface Coating

This category includes inks, solvents, coatings, adhesives, surface preparation products, and sealants. The primary pollutant emitted from these source categories are VOCs and the products are primarily used at dry cleaners, automotive assembly and repair operations, cardboard box and container manufacturing operations, printing operations, and a variety of coatings operations including; automotive, paper, plastics, metal parts, pleasure craft, aerospace, and wood.

These source categories contribute 0.35 tpd of PM2.5 emissions and less than 0.01 tpd of NOx emissions to the 2017 Femissions inventory. The small quantity of PM2.5 emissions is associated with spraying, material handling, and mixing processes. Additionally, in EPA's *Technical Supplement Document for the Proposed Contingency Measures Federal Implementation Plan for the Fine Particulate Matter Standards for San Joaquin Valley, California* (*PM2.5 Contingency TSD*),[29] EPA did not identify any control measure for further consideration in the Cleaning and Surface Coating Category. Upon further review, the District has not identified any Cleaning and Surface Coating control measures for further consideration as contingency measures.

[29] EPA. *Technical Support Document (TSD) for the Proposed Contingency Measures Federal Implementation Plan for the Fine Particulate Matter Standards for San Joaquin Valley, California.* (July 2023). Retrieved from: https://www.regulations.gov/document/EPA-R09-OAR-2023-0352-0034

G.3.4.4 Petroleum Production and Marketing

Table G-18 Petroleum Production and Marketing Inventory Contributions

MSC	SUB CATEGORY	PM2.5 (tpd)	NOx (tpd)
310	OIL AND GAS PRODUCTION	0.02	0.09
320	PETROLEUM REFINING	0.02	0.01
330	PETROLEUM MARKETING	0.02	0.05
399	OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.00	0.00
	Total	***0.06***	***0.15***

This category includes oil and natural gas wells, storage tanks, vapor recovery units, flares, sumps, wastewater separators, and other petroleum processes. These units emit NOx and PM2.5 and are primarily located at oil and natural gas fields, refineries, fuel terminals, gasoline dispensing facilities, natural gas processing plants, and pipelines. These units have significant variability in technology, size, use and age of equipment, as well as variability in potential controls for various pollutants.

The District has evaluated opportunities for contingency measures within the petroleum production and marketing category and did not identify a feasible measure. The District's analysis is provided below:

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
Rule 4311 (Flares)	None; no technologies currently available to achieve lower limits.	No; The District recently adopted amendments to Rule 4311 in December 2020 after going through a robust public process of over 3 years. As stated in the Appendix B of the 2020 Rule 4311 staff report, the control level implemented in the recent rule amendment (December 2020) required substantial costs and the emission levels selected are the most stringent levels.[30] The District did not identify any new level of control more stringent than what is currently required under Rule 4311. The 2020 amendments require operators to install the cleanest ultra-low NOx flaring technology available. Further reductions from this source category would require control technologies with greater complexity and costs, which have yet to be identified and	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

[30] SJVAPCD. *Adopt Proposed Amendments to Rule 4311 (Flares).* (December 17, 2020). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2020/December/final/12.pdf

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		would be less cost effective than the previous rule amendment. Notably, the most recent amendments to these rules required over 3 years of analysis and public engagement. Additionally, operations are still in the process of complying with the recent rule amendments, and imposing more stringent requirements on these facilities at this time would be infeasible. Rule 4311 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	

G.3.4.5 Industrial Processes

Table G-19 Industrial Processes Inventory Contributions

MSC	SUB CATEGORY	PM2.5 (tpd)	NOx (tpd)
410	CHEMICAL	0.33	0.34
420	FOOD AND AGRICULTURE	0.77	0.00
430	MINERAL PROCESSES	1.08	0.21
440	METAL PROCESSES	0.02	0.00
450	WOOD AND PAPER	0.20	0.00
460	GLASS AND RELATED PRODUCTS	0.07	1.75
470	ELECTRONICS	0.00	0.00
499	OTHER (INDUSTRIAL PROCESSES)	0.07	0.01
	Total	***2.54***	***2.30***

This category includes dryers, dehydrators, ovens, glass melting furnaces, chemical storage tanks, wine fermentation tanks, resin, polypropylene, polystyrene, polyethylene manufacturing, inks and coatings manufacturing. These processes and units emit NOx and PM2.5 and are located at glass plants, agricultural and chemical distributors, operations that use fiberglass to manufacture products, hot mix asphalt batch plants, food manufacturing operations, agricultural drying operations, container manufacturing operations, and wine and brandy aging operations. These processes and units have significant variability in technology, size, use and age of equipment, as well as variability in potential controls for various pollutants.

The District has evaluated opportunities for contingency measures within the industrial processes category and did not identify a feasible measure. Notably, the District has recently amended a number of rules within this category to incorporate more stringent regulations that go beyond state and federal regulations. The District's analysis is provided below:

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
Rule 4204 (Cotton Gins)	Require use of additional or alternative control technologies beyond existing stringent controls.	No; As stated in Appendix C of the District's *2024 PM2.5 Plan*, the District did not find additional feasible emission reduction opportunities from baghouse filters and 1D-3D cyclones with expansion chambers. Baghouse filters are unable to effectively control cotton fibers at the high air velocities and potentially high humidity needed at these facilities. 1D-3D cyclones with expansion chambers were found to be ineffective against the small particle sizes of PM2.5. Therefore, the most effective controls are currently in place. Additionally, the District considered mechanical conveyance for the main trash handling system as a potential opportunity to reduce emissions, however it has only been demonstrated as feasible for newly constructed or rebuilt cotton gins. Operators that have installed a mechanical conveyance system for their cotton gin have had to build a lower floor, below the main level containing the major cotton gin equipment, to house the mechanical conveyors. Therefore, as confirmed by equipment manufacturers, it is not technologically feasible to retrofit existing cotton gins with mechanical conveyance systems to replace existing trash handling equipment. Rule 4204 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		the technologies involved in reducing emissions from this category.	
Rule 4354 (Glass Melting Furnaces)	Require use of additional or alternative control technologies beyond existing stringent controls.	No; As stated in Appendix C of the 2021 Rule 4354 Staff Report, the District reviewed alternative control technologies, including, but not limited to, oxy-fuel fired furnaces and natural gas furnaces equipped with a SCR, and found no additional feasible control technologies for this source category.[31] Alternative control technologies, require substantial capital, operation, and maintenance costs associated with implementation. In addition, significant amount of space is also required for certain types of controls, making implementation of these technologies infeasible. Capital costs are estimated to range from $2,123,053 to $28,307,370 while annual operation and maintenance costs range from $595,088 to $3,676,829. Additionally, as a comparison, EPA recently finalized their interstate transport FIP which included new national emissions limits that are significantly higher (less stringent) than the District's rule limits. Rule 4354 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years. Additionally, operations are currently investing in control technologies to meet recently amended rule limits.
Rule 8021 (Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities)	This Rule is part of the Regulation VIII (Fugitive PM10 Prohibitions) series of Rules. The District identified one opportunity for Open Areas in Rule 8051, as	The District has evaluated all potential requirements achieved in practice in other areas or included in other state implementation plans. As demonstrated in Appendix C of the *2024 PM2.5 Plan*, Regulation VIII currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds RACM, BACM, and MSM requirements for this source category.	-

[31] SJVAPCD. *Adopt Proposed Amendments to Rule 4354 (Glass Melting Furnaces)*. (December 16, 2021). Retrieved from: https://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2021/December/final/11.pdf

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
	discussed in Section G.3.3.2 above.		
Rule 8031 (Bulk Materials)	This Rule is part of the Regulation VIII (Fugitive PM10 Prohibitions) series of Rules. The District identified one opportunity for Open Areas in Rule 8051, as discussed in Section G.3.3.2 above.	The District has evaluated all potential requirements achieved in practice in other areas or included in other state implementation plans. As demonstrated in Appendix C of the *2024 PM2.5 Plan*, Regulation VIII currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds RACM, BACM, and MSM requirements for this source category.	-
Almond Harvesting	Refer to the District's analysis in the *PM2.5 Contingency Measure SIP Revision* for Dust Emissions from Almond Harvesting.	The District concludes that this source category is not an appropriate contingency measure due to the following reasons: • There is a significant amount of time manufacturers need to build low-dust nut harvesters, with a minimum 1 year required lead time, to deliver one low-dust nut harvester • Supply chain issues within the industry • Manufacturers will not be able to manufacture a sufficient amount of harvesters within the implementation time period required under the contingency guidance by EPA • More work is needed to better understand the emissions profile and more research and collaboration must be undertaken with USDA-NRCS and agricultural stakeholders	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

G.3.4.6 Solvent Evaporation

This category includes consumer products, architectural coatings and related process solvents, pesticides/fertilizers, asphalt paving and roofing. Most rules in this category apply to products that emit VOCs and can be found in a multitude of consumer products that are packaged in aerosol containers, asphalt paving operations, residential and commercial developments and remodeling locations. CEPAM reports zero PM2.5 and NOx emissions in this category and therefore, a contingency measure is not applicable for this source category. Additionally, in EPA's *PM2.5 Contingency TSD*, EPA did not identify any control measure for further consideration in the Solvent Evaporation Category for the San Joaquin Valley.

G.3.4.7 Miscellaneous Processes

Table G-20 Miscellaneous Processes Inventory Contributions

MSC	SUB CATEGORY	PM2.5 (tpd)	NOx (tpd)
610	RESIDENTIAL FUEL COMBUSTION	3.01	4.47
620	FARMING OPERATIONS	12.72	0.00
630	CONSTRUCTION AND DEMOLITION	2.84	0.00
640	PAVED ROAD DUST	5.55	0.00
645	UNPAVED ROAD DUST	3.67	0.00
650	FUGITIVE WINDBLOWN DUST	7.08	0.00
660	FIRES	0.21	0.04
670	MANAGED BURNING AND DISPOSAL	5.95	1.79
690	COOKING	2.59	0.00
699	OTHER (MISCELLANEOUS PROCESSES)	0.00	0.00
	Total	***43.62***	***6.30***

This category includes a number of subcategories, such as residential fuel combustion (space heating, water heating, cooking, and other appliances, such as clothes dryers, barbecues, and water heaters used for pools, spas and hot tubs). Residential fuel combustion also includes wood-burning heaters (e.g., woodstoves, pellet stoves, and wood-burning fireplace inserts). Farming Operations includes various animal specific feedlot operations. Fires includes emissions from automobile fires and structure fires. Managed burning and disposal includes various agricultural burning, forest management, and non-agricultural open burning. Cooking mostly includes emissions from commercial charbroiling, deep fat frying, and general cooking.

The District analyzed contingency measure opportunities for rules within the miscellaneous processes category and did not identify a feasible measure. Notably, CARB plans to implement a zero-NOx regulation for both residential space heating and residential water heating, thus leaving no opportunities for a contingency measure. In addition, the District has committed to phase out ag burning which also eliminates open burning as a contingency option. All other emission sources were found to be infeasible and the analysis is provided below:

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
Rule 4103 (Open Burning)	None; The District has already committed to phase out ag burning by January 1, 2025.[32]	-	-
Rule 4106 (Prescribed Burns)	Require mechanical removal, air curtain burners, and forest-specific biomass projects.	No; As stated in Appendix C of the *2024 PM2.5 Plan*, alternative control methods are not feasible. The District reanalyzed various alternative control methods such as mechanical removal, air curtain burners, and forest-specific biomass projects, which are infeasible due to the vast number of acres that require management and lack of access to remote areas in the forest. Due to recent increase in wildfires, the District continues to support reductions of forest fire fuel through prescribed burns. Therefore, this source category is not suitable for a contingency measure. Rule 4106 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Agencies would need long lead time to design, plan, and deploy technologies. In addition, land agencies also need to ensure that they have appropriate budgets in place, which could take significant time. The lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.
Rule 4550 (Conservation Management Practices)	None; this measure is an "on-the-way" measure. The District has committed to evaluate emission reduction opportunities for this source category in the *2024 PM2.5 Plan*, including opportunities to reduce emissions from fallowed land and promote the selection of	-	-

[32] SJVAPCD. *Final Supplemental Report and Recommendations on Agricultural Burning.* June 17, 2021. Retrieved from: https://ww2.valleyair.org/media/aldmsd0b/final-supplemental-report-and-recommendations-on-agricultural-burning.pdf

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
	conservation tillage as a CMP, in coordination with agricultural stakeholders, NRCS, and the District's AgTech committee. The District is currently conducting a robust rule development process and there is a significant amount of work needed to ensure that impacts of the Sustainable Groundwater Management Act (SGMA) are understood along with ensuring that measures are technologically feasible and cost-effective; therefore, this source category is not suitable for a contingency measure.		
Rule 4692 (Commercial Charbroiling)	Refer to the District's analysis in the *PM2.5 Contingency Measure SIP Revision* for Commercial Charbroiling.	The District concludes that this source category is not an appropriate contingency measure due to the following reasons: • Installation cost of controls can be prohibitively expensive • Retrofitting controls on existing restaurants can be prohibitively expensive and technologically infeasible • Maintenance of controls can be prohibitively expensive • Maintenance requires specially trained staff that may not be accessible to all restaurants • Regenerative filters lack UL 8782 certification • Limited areas that have regulations in place do not enforce their rules or include exemptions Rule 4692 meets or exceeds BACM requirements for this source category based upon evaluation of applicable federal regulations, state standards, and other air districts' rules. Therefore, the	No; Any new regulation would need approximately two years (or more) of rule development to allow for a robust public process with all affected industries, stakeholders, and public. Operations would need long lead time to design, plan, obtain operating permits, and install control technology. Lead time required would not conform with the required trigger timeline. It also would be infeasible to implement new requirements within 60 days and achieve reductions within one to two years.

District Rule	Contingency Options	Technological and Economic Feasibility	Trigger Feasibility
		District concludes that this control measure is not an appropriate contingency measure because the most stringent feasible controls are already in place, and a contingency trigger is incompatible with the technologies involved in reducing emissions from this category.	
Rule 4902 (Residential Water Heaters)	Refer to the District's analysis above in Section G.3.4.1 for Fuel Combustion.		-
Rule 4905 (Natural Gas – Fired, Fan Type Residential Central Furnace)	Refer to the District's analysis above in Section G.3.4.1 for Fuel Combustion.		-
Rule 8071 (Unpaved Vehicle Traffic)	This Rule is part of the Regulation VIII (Fugitive PM10 Prohibitions) series of Rules. The District identified one opportunity for Open Areas in Rule 8051, as discussed in Section G.3.3.2 above.	The District has evaluated all potential requirements achieved in practice in other areas or included in other state implementation plans. As demonstrated in Appendix C of the *2024 PM2.5 Plan*, Regulation VIII currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds RACM, BACM, and MSM requirements for this source category.	-
Rule 8081 (Ag Sources)	This Rule is part of the Regulation VIII (Fugitive PM10 Prohibitions) series of Rules. The District identified one opportunity for Open Areas in Rule 8051, as discussed in Section G.3.3.2 above.	The District has evaluated all potential requirements achieved in practice in other areas or included in other state implementation plans. As demonstrated in Appendix C of the *2024 PM2.5 Plan*, Regulation VIII currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds RACM, BACM, and MSM requirements for this source category.	-

G.3.4.8 On-Road Mobile Vehicles

Table G-21 On-Road Mobile Vehicles Inventory Contributions

MSC	SUB CATEGORY	PM2.5 (tpd)	NOx (tpd)
710	LIGHT DUTY PASSENGER (LDA)	0.27	2.24
722	LIGHT DUTY TRUCKS - 1 (LDT1)	0.02	0.44
723	LIGHT DUTY TRUCKS - 2 (LDT2)	0.14	1.72
724	MEDIUM DUTY TRUCKS (MDV)	0.10	1.77
725	LIGHT HEAVY DUTY TRUCKS - 1 (LHDT1)	0.15	2.68
726	LIGHT HEAVY DUTY TRUCKS - 2 (LHDT2)	0.05	0.82
727	MEDIUM HEAVY DUTY TRUCKS (MHDT)	0.04	1.46
728	HEAVY HEAVY DUTY TRUCKS (HHDT)	0.54	10.16
750	MOTORCYCLES (MCY)	0.00	0.20
775	BUSES	0.01	0.42
780	MOTOR HOMES (MH)	0.00	0.13
	Total	***1.32***	***22.04***

CARB analyzed opportunities to implement a contingency measure for on-road motor vehicles and identified the California Smog Check Contingency Measure. CARB did not identify any other feasible contingency measures. Please see CARB's discussion in their *California Smog Check Contingency Measure* document.

G.3.4.9 Other Mobile Sources

Table G-22 Other Mobile Sources Inventory Contributions

MSC	SUB CATEGORY	PM2.5 (tpd)	NOx (tpd)
810	AIRCRAFT	1.69	4.54
820	TRAINS	0.33	16.50
833	OCEAN GOING VESSELS	0.00	0.05
835	COMMERCIAL HARBOR CRAFT	0.00	0.03
840	RECREATIONAL BOATS	0.37	2.36
850	OFF-ROAD RECREATIONAL VEHICLES	0.02	0.14
860	OFF-ROAD EQUIPMENT	0.46	10.62
861	OFF-ROAD EQUIPMENT (PERP)	0.05	2.18
870	FARM EQUIPMENT	0.94	17.27
890	FUEL STORAGE AND HANDLING	0.00	0.00
	Total	***3.87***	***53.69***

CARB analyzed opportunities to implement a contingency measure for on-road motor vehicles and identified the California Smog Check Contingency Measure. CARB did not identify any other feasible contingency measures. Please see CARB's discussion in their *California Smog Check Contingency Measure* document.

G.3.4.10 Opportunities for Transportation Control Measures

In addition to CARB's mobile source control measures, vehicular emissions can be reduced through implementation of Transportation Control Measures (TCMs), which are strategies that reduce transportation-related air pollution and fuel use by reducing vehicle miles traveled and improving roadway operations.[33] Vehicle use can be reduced through less-polluting transportation alternatives, such as public transit, strategies that decrease the need for vehicle trips, such as telecommuting, and through strategies to increase efficiency through management of the transportation system. CAA section 108(f) lists 16 types of TCMs, including:

- Programs for improved public transit;
- Restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high occupancy vehicles;
- Employer-based transportation management plans, including incentives;
- Trip-reduction ordinances;
- Traffic flow improvement projects that achieve emission reductions;
- Fringe and transportation corridor parking facilities serving multiple occupancy vehicle programs or transit service;
- Programs to limit or restrict vehicle use in downtown areas or other areas of emission concentration particularly during period of peak use;
- Programs for the provision of all forms of high-occupancy, shared-ride services;
- Programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;
- Programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;
- Programs to control extended idling of vehicles;
- Programs to reduce motor vehicle emissions, consistent with title II of the CAA, which are caused by extreme cold start conditions;
- Employer-sponsored programs to permit flexible work schedules;
- Programs and ordinances to facilities non-automotive travel, provision and utilization of mass transit, and to generally reduce the need for single-occupant vehicle travel, as part of the transportation planning and development efforts of a locality, including programs and ordinances applicable to new shopping centers, special events, and other centers of vehicle activity;
- Programs for new construction and major reconstructions of paths, tracks or areas solely for the use by pedestrian or other non-motorized means of transportation when economically feasible and in the public interest; and
- Program to encourage the voluntary removal from use and the marketplace of pre-1980 mode year light duty vehicles and pre-1980 model light duty trucks.

In the San Joaquin Valley, county planning and transportation agencies, transit districts, and local jurisdictions are responsible for identifying, adopting and implementing most types of TCMs. There are eight county-based planning and transportation agencies in the San Joaquin Valley, which include the metropolitan planning organizations (MPOs)

[33] EPA, "*Transportation Control Measures - Information Document for Developing and Implementing Emissions Reductions Programs*," EPA-430-R-09-040, March 2011.

for federal transportation planning purposes for their respective counties. The EPA's transportation conformity regulations require that the MPOs show timely implementation of all TCMs committed to in the applicable SIP, and the San Joaquin Valley MPOs are responsible for making the necessary demonstration of timely implementation when they determine conformity.

The Valley MPOs have identified and adopted a number of TCMs over the years through the District's attainment plans, including ongoing work with local transit agencies and local jurisdictions. The District's *2016 Ozone Plan* includes a list of TCMs implemented in the Valley to meet CAA requirements and to reduce vehicular emissions in support of the Valley's attainment plans for ozone and PM2.5.[34] Through this effort, essentially all of the types of TCMs listed in CAA section 108(f) have been implemented in part or parts of the San Joaquin Valley. More recently, the District's *2022 Ozone Plan* identifies and includes new TCMs for implementation in the coming years. The new TCMs include new projects that facilitate and encourage bicycle and pedestrian travel modes in support of transit-oriented development, that provide for eco-driving educational programs, that promote transit service, and that promote rideshare and carpool programs.

In addition, in 2009, the District adopted District Rule 9410 (Employer Based Trip Reduction) to reduce VMT from private vehicles used by employees to commute to and from their worksites to reduce emissions of NOx, VOC and PM. EPA approved District Rule 9410 on February 9, 2016.[35] The eTRIP Rule requires the Valley's larger employers, representing a wide range of locales and sectors, to select and implement workplace measures that make it easier for their employees to choose ridesharing and alternative transportation. Because of the diversity of employers covered by the eTRIP Rule, the rule was built with a flexible, menu-based approach. Employers choose from a list of measures, each contributing to a workplace that encourages employees to reduce their dependence on single-occupancy vehicles. Each eTRIP measure has a point value, and employer eTRIPs must reach specified point targets for each strategy over a phased-in compliance schedule (2010 – 2015). The District has continually provided employer assistance through training, guidance materials, promotional information, and online reporting options.

TCMs are not feasible contingency measures because TCMs have to be developed through the area's transportation planning process, which can take a significant amount of time and are funded to large degree by the Federal Highway Administration and Federal Transit Administration based on transportation improvement programs developed by the MPOs in the area. Therefore, given the time it would take to advance these projects through the planning and funding processes, TCMs are not feasible for a contingency measure.

[34] 2016 Ozone Plan, Attachment D ("Adopted Transportation Control Measures") to Appendix D ("Mobile Source Control Strategy"), Tables D-10 - D17. The EPA approved different portions of the 2016 Ozone Plan at different times - see 83 FR 41006 (August 17, 2018), 84 FR 3302 (February 12, 2019), and 84 FR 11198 (March 25, 2019).
[35] EPA. *Approval and Promulgation of Implementation Plans; California; San Joaquin Valley Unified Air Pollution Control District; Employer Based Trip Reduction Programs; Final Rule*. 81 Fed. Reg. 26. Pp. 6761-6763. (2016, February 9). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2016-02-09/pdf/2016-02411.pdf

G.3.5 Contingency Emission Reductions

The total emission reductions achieved from both the District's adopted contingency measures within Rule 4901, Rule 8051, and CARB's Smog Check Measure are estimated at 0.70 tpd of PM2.5 and 0.19 tpd of NOx. The District and CARB's contingency strategy meets the OYW_P threshold for PM2.5.

Table G-23 Reduction Targets and Selected Measures Emission Reductions

PM2.5 Standard	PM2.5 (tpd)		NOx (tpd)	
	OYW_P Approach	Selected Measures	OYW_P Approach	Selected Measures
2012 Annual	0.70	0.70	3.94	0.19

The District examined the emissions that are under either District or CARB jurisdictional control, and found that federally regulated sources make up a significant portion of the Valley's emissions inventory. The District's proposed contingency commitments achieve significant emission reductions that fully address the direct PM2.5 OYW_P targets, highlighting the need to achieve continued fair-share emissions reductions from mobile sources, particularly with respect to federally-regulated mobile sources.

Table G-24 Reduction Targets and Selected Measures Emission Reductions for Sources under District and CARB Regulatory Jurisdiction

PM2.5 Standard	PM2.5 (tpd)			NOx (tpd)				
	OYW_P Approach (A)	Selected Measures (B)	Balance (C: B-A)	OYW_P Approach (D)	Selected Measures (E)	Initial Balance (F: E-D)	PM2.5 Surplus to NOx (6:1 Plan ratio) (G: C*6)	Remaining Balance (F+G)
2012 Annual	0.65	0.70	0.05	3.44	0.19	(3.25)	0.30	(2.95)

G.3.6 Federal Contingency Measure Opportunities

The District has previously submitted petitions to the federal government requesting that they reduce their fair share of emissions in an equitable manner through more stringent national standards for light-duty trucks, medium-duty trucks, heavy-duty trucks and locomotives.[36] Similarly, in April 2017, CARB petitioned EPA to adopt more stringent emission standards for locomotives, in order to provide critical NOx and PM2.5 reductions specifically for disadvantaged communities surrounding railyards.[37] CARB asked EPA to update standards, to take effect for remanufactured locomotives in 2023 and for newly built locomotives in 2025. In response to the District and similar petitions submitted by CARB and SCAQMD, on January 24, 2023, EPA finalized a rule to reduce

[36] SJVAPCD. *Petition Requesting that EPA Adopt New National Standards for On-Road Heavy-Duty Trucks and Locomotives under Federal Jurisdiction.* Retrieved from: https://www.epa.gov/sites/default/files/2016-11/documents/san_joaquin_valley_petition_for_hd_and_locomotive.pdf

[37] CARB. *Petition for Rulemaking: Seeking the Amendment of the Locomotive Emission Standards.* April 13, 2017. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_locomotive_petition_and_cover_letter_4_3_17.pdf

emissions from new heavy-duty trucks nationwide.[38] Additionally on November 9, 2022, EPA committed to evaluating and identifying potential regulatory actions to address emissions from locomotives.[39]

On November 8, 2023, EPA finalized changes to locomotive preemption regulations,[40] preserving the ability of California to adopt and enforce certain emission standards regulating non-new locomotives and engines if EPA has authorized such standards, and allowing other states to adopt those same California standards. EPA must continue to work towards addressing harmful emissions from new locomotives and new locomotive engines, which remain exclusively under federal authority. Most recently, on March 20, 2024, EPA announced a final rule for multi-pollutant emission standards for light-duty and medium-duty vehicles, to be phased in over model years 2027 through 2032.[41] Soon after, on March 29, 2024, EPA announced a final rule for greenhouse gas emissions standards for heavy-duty vehicles, also phased in over model years 2027 through 2032.[42] The District closely followed and participated in these rulemaking processes to advocate for the Valley's need for emissions reductions from this sector, and will continue to do so for future actions.

The District continues to participate in EPA's regulatory processes to communicate the Valley's need for emissions reductions from these sectors. While the above strategies would reduce emissions in the long-term, they do not assist the District and CARB in addressing needed contingency measures for the following reasons:

- Emissions reductions from these measures will be realized in the long-term over an extended period, and not in the rapid, trigger-based, and short-term fashion required for contingency measures.
- EPA's recently finalized mobile source emissions standards are not designed to serve as contingency measures. Without meeting all of the requirements for contingency measures (held in reserve, triggered upon various CAA findings, etc.), federal mobile source regulatory measures recently adopted and currently under development will not assist in addressing contingency measure requirements.

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[38] EPA. *Control of Air Pollution from New Motor Vehicles: Heavy Duty Engine and Vehicle Standards*; Final Rule. 88 Fed. Reg. 15, pp. 4296–4718. (Jan. 24, 2023). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2023-01-24/pdf/2022-27957.pdf

[39] EPA. *Regulations for Emissions from Vehicles and Engines – Petitions to Address Harmful Emissions from Locomotives*. Retrieved from: https://www.epa.gov/regulations-emissions-vehicles-and-engines/petitions-address-harmful-emissions-locomotives

[40] EPA. *Locomotives and Locomotive Engines; Preemption of State and Local Regulations*. 88 Fed. Reg. 215, pp. 77004-77009. (Nov. 8, 2023). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2023-11-08/pdf/2023-24513.pdf

[41] EPA. *Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles; Final Rule.* 89 Fed. Reg. 76, pp. 27842-28215. (April 18, 2024). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2024-04-18/pdf/2024-06214.pdf

[42] EPA. *Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3; Final Rule.* 89 Fed. Reg. 78, pp. 29440-29831. (April 22, 2024). Retrieved from: https://www.govinfo.gov/content/pkg/FR-2024-04-22/pdf/2024-06809.pdf

Significant State and Federal Funding Opportunities

Through strong collaboration with state agencies and residents, businesses, public agencies, community-based organizations, and other stakeholders, the San Joaquin Valley has served as a center of innovation for many of the state's recent transformative clean air, low carbon strategies. As a related important opportunity that could play a major role in assisting the San Joaquin Valley and other Extreme ozone and Serious PM2.5 nonattainment areas, recent state and federal budget and funding actions have created unprecedented opportunities for investing in transformational clean technology changes across the mobile source sector. At the federal level, recent authorizations under the Infrastructure Investment Jobs Act and Inflation Reduction Act (IRA) provide wide-ranging funding for a variety of important clean technology and infrastructure programs. Notably, IRA includes an estimated $369 billion in funding for climate and energy-related programs, and over $20 billion in new funding for sustainable agriculture and programs of importance to the San Joaquin Valley. Given the Valley's air quality challenges, EPA and other federal agencies must prioritize these new funding opportunities for Serious and Extreme nonattainment areas, and provide opportunities for incentive-based contingency measures, taking into consideration that areas such as the Valley have limited additional opportunities for regulatory strategies given the level of stringency of District rules.

G.3.7 Conclusion

As demonstrated above, the District and CARB are currently implementing the most stringent measures feasible for all PM2.5 and NOx rules, and no opportunities exist for additional contingency measures beyond the adopted measure in District Rule 4901, Rule 8051, and CARB's Smog Check Measure. This supports a reasoned justification for achieving less than OYW_P of NOx.

Both the District and CARB have decades of experience developing stringent regulations and, as a result, have robust control programs which limit the ability to identify potential contingency measures that achieve surplus reductions. At this time, CARB and the District are including zero-emission and near-zero emission components in most of their regulations, both those already adopted and those that are in development. Beyond the wide array of sources the District and CARB have been regulating over the last few decades, and especially considering those they are driving to zero-emission, there are few sources of emissions left for the District and CARB to implement additional controls upon under its authorities. The few source categories that do not have control measures are primarily-federally and internationally regulated.

To fulfill contingency measure requirements, the District has amended Rule 4901 and Rule 8051 as part of the *PM2.5 Contingency Measure SIP Revision,* and CARB has included contingency provisions as part of the *California Smog Check Contingency Measure State Implementation Plan Revision.* EPA recently proposed approval and found that the District and CARB implemented all feasible contingency measure opportunities. As shown above, the District and CARB are implementing the most stringent measures available and have analyzed all emission sources able to satisfy contingency requirements as outlined in EPA's *Draft Guidance*.

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Appendix H

NEW SOURCE REVIEW AND EMISSIONS REDUCTION CREDITS

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Appendix H: New Source Review and Emission Reduction Credits

H.1 INTRODUCTION

The San Joaquin Valley Air Pollution Control Air District (District) requires most new and modified stationary sources that increase emissions in amounts in excess of specific emission offset thresholds to obtain emission reduction credits (ERCs) to offset the growth in emissions. District Rule 2201 (New and Modified Stationary Source Review, or NSR, Rule) contains the offset requirements. Offsets represent either on-site reductions or the use of banked ERCs. The District expects that some pre-baseline credits (pre-2017 for the modeling used in this PM2.5 Plan) will be used to mitigate growth from permitted stationary sources during the period of this plan. This Appendix discusses the use of such ERCs in the San Joaquin Valley (Valley).

H.2 PRE-BASELINE EMISSION REDUCTION CREDITS

The General Preamble to the Federal Clean Air Act (57 FR 13498) states that the pre-baseline ERCs must be reflected as growth and included in the attainment demonstration "*to the extent that the State expects that such credits will be used as offsets or netting prior to attainment of the ambient standards.*" The August 26, 1994 memorandum from John Seitz, EPA's Director of Office of Air Quality Planning and Standards, to David Howekamp of EPA Region IX, provides two ways for inclusion of these ERCs as growth by stating that "*A state may choose to show that the magnitude of the pre-1990* (pre-baseline) *ERCs (in absolute tonnage) was included in the growth factor, or the state may choose to show that it was not included in the growth factor, but in addition to anticipated general growth.*" In either case, the purpose is to ensure that the forecasted use of pre-baseline ERCs is reflected as growth to the baseline emissions inventories; and therefore, is factored into the attainment demonstration modeling and any application rate of progress demonstrations for the plan.

Growth Estimates: The emissions trends and growth estimates in this plan were generated using the reports from the California Emissions Projection Analysis Model (CEPAM). The emissions inventory and associated emissions projections are based on ARB's latest PM 2.5 Plan Projections (California Emissions Projection Analysis Model: 2022 PM2.5 Nonattainment Area External Adjustment Reporting Tool version 1.00- Annual Average). CEPAM's computer tools were used to develop projections and emission estimates based on the most current available growth and control data available at the time of the forecast runs. CEPAM was first developed in the 1990s (called CEFS at the time) to assist in developing air quality plans, determining how and where air pollution can be reduced, tracking progress towards meeting plans goals and mandates, and constructing emission trends, and has been updated regularly since then.

A key component of CEPAM is the growth data. The growth estimates generated by CEPAM are based on actual emissions from a baseline year and the forecasted actual emissions growth to a specified year. For this this plan, the baseline year and grown to year are 2017 and 2030, respectively. Table H-2 through Table H-5 show total projected growth from stationary sources of 0.26 tons per day (tpd) of directly emitted PM2.5, and, for PM2.5 precursors, growth of 0.74 tpd of NOx, 0.25 tpd of SOx, and 8.25 tpd of VOC, for the period of 2017 through 2030. Ammonia is not included in the analysis. Although a PM2.5 precursor, modeling has demonstrated that ammonia is not a significant precursor in the Valley and ERCs are not issued for ammonia, so no accounting for ammonia ERCs is necessary or appropriate. The CEPAM inventory shows negative growth for some segments of the economy, representing a shrinking emissions inventory even before considering reductions required by District plans. However, for the purposes of this ERC-use analysis, the District did not include these negative growth numbers (by setting negative growth to zero), as only positive growth requires offsetting with ERCs.

While the growth estimates in CEPAM include growth in emissions requiring offsets under the New Source Review Rule as well as that which can be accommodated without triggering offsets, in some cases, the growth estimate (tpd) determined by CEPAM does not fully characterize the actual offset usage during a plan. This is due to factors which are not included in CEPAM, such as the fact that the amount of offsets required for a project is based on potential emissions, as opposed to actual emissions. This results in some cases where due to District or federal NSR calculation methodologies, offsets are required for projects that do not result in any increase in actual emissions. In these cases, the CEPAM growth is not a complete representation of offset usage.

Emissions Offset Requirements: Under District's New Source Review Rule 2201, new sources with emissions exceeding the following level must offset their emissions:

NOx …………………………….. 20,000 lbs/year
VOC…………………………….. 20,000 lbs/year
PM10……………………………. 29,200 lbs/year
SOx……………………………… 54,750 lbs/year

Additionally, for existing facilities with emissions meeting or exceeding the above levels, any increase in emissions that is not due solely to increased utilization allowed by their current permits must be offset.

Also, PM2.5 offsets would be required for any new major PM2.5 source (exceeding 70 tons per year of direct PM2.5 emissions), or for major modifications at existing major PM2.5 sources (emissions increases of 20,000 lbs PM2.5 per year at an existing major PM2.5 source).

Use of Interpollutant Offsets: Rule 2201 allows the use of interpollutant trading amongst criteria pollutants and their precursors upon the appropriate scientific demonstration of an adequate trading ratio. At this time, EPA has not approved an interpollutant trading ratio for PM2.5 precursors. Until EPA approves such ratios in response to the submittal from the District of a future PM2.5 precursor trading analysis, the District will not allow the use of precursor ERCs to offset PM2.5 emissions increases.

Pre-Baseline Offset Usage Estimate: The amount of offsets expected to be consumed during a plan's period has historically been estimated by establishing the percentage of permitting actions for each source category that would be subject to offset requirements under Rule 2201 and then applying an offset ratio to the actual emissions associated with these actions. For each source category, this percentage was established based on past permitting history, the fraction of sources in the category with emissions at or above the offset trigger levels, and any expected changes in permitting activity for the source category. The following factors were used in estimating the potential need for offsets:

- All increases from modifications to existing sources with potential emissions at or above the above offset thresholds would require offsets (District Rule 2201).

- New sources with emissions exceeding the above offset thresholds would require offsets (District Rule 2201).

- The percentage of sources that meet any of the above criteria was estimated by examining past permitting history and by projecting future permitting based on the estimated growth. For instance, the majority of permitting actions with increases in emissions from oil production facilities come from sources with potential emissions in excess of the above offset thresholds. Therefore, for that source category, it was assumed that 80-100% of increases in overall emissions due to facility modifications would require offsets.

District Rule 2201 establishes offset ratios ranging from 1.0:1 to 1.5:1 based on the distance from the source of ERCs to the source with increase in emissions. An offset ratio of 1.5:1 applies to all transactions where the distance is greater than 15 miles, and to all federal major modifications or new major sources for NOx or VOC (since the District is classified as Extreme Non-Attainment for Ozone). For the period of January 2017 through March 6, 2023, the average offset ratio for all permitting actions were 1.50:1 for NOx, to 1.37:1 for SOx, to 1.34:1 for PM10, to 1.50:1 for VOC. Table H-2 through Table H-5 contain the expected growth, percentage of activities subject to offset requirements, and the expected quantity of offsets for each pollutant.

The general NOx and SOx growth included in CEPAM is not sufficient to account for the magnitude of pre-baseline NOx and SOx ERC usage that is expected to be used after 2017 and through 2030. The low growth estimate for NOx and SOx emissions from CEPAM is not unexpected, as the District has taken actions to reduce NOx and SOx emissions through the District's past Ozone and PM attainment plans. However, as discussed in the Growth Estimate section above, the growth estimate in CEPAM is not always indicative of the offset usage during a plan period. Therefore, to ensure the total expected pre-baseline NOx and SOx ERC usage is sufficiently reflected as growth in the plan, additional pre-baseline NOx and SOx ERC tonnage was added to the plan beyond the anticipated general growth in CEPAM. This additional tonnage was factored into the attainment demonstration modeling and application rate of progress demonstrations for the plan.

The general VOC and PM2.5 growth included in CEPAM is sufficient to account for the magnitude of pre-baseline ERC usage for VOC and PM, respectively, that is forecasted to be used after 2017 and through 2030. Therefore, it was not necessary to add additional pre-baseline VOC or PM ERC tonnage to the anticipated general growth in CEPAM.

Although some offsets are expected to come from post-baseline reductions, this plan conservatively assumes that all offsets will be pre-baseline. See Table H-6 for a current list of District-issued ERCs, as of March 2023. These ERCs and future ERCs (and any ERCs generated from them) are available to be used in the District's NSR program.

The expected ERC usage after 2017 and through 2030, as shown in Table H-2 through Table H-5, has been estimated in this plan as follows:

Table H-1 Total Expected ERC Usage, 2017-2030

Pollutant	Expected ERC Use (tons/day)	General Growth (tons/day)	Tonnage Added to General Growth (tons/day)	Total Growth (tons/day)
PM2.5	0.13	0.26	0	0.26
NOx	3.04	0.74	2.43	3.17
SOx	0.52	0.25	0.40	0.65
VOC	4.91	8.25	0	8.25

As shown above, the plan's estimated growth in emissions for each pollutant and the additional ERC tonnage added to the anticipated general growth, where necessary, is sufficient to account for the quantity of pre-baseline offsets (conservatively considering all ERCs used to be pre-baseline ERCs) that are expected to be used between 2017 and 2030.

Therefore, if growth in new and modified sources occurs at the rate estimated in this plan, the use of offsets as required in Rule 2201 will ensure that permitted increases in emissions will not interfere with progress toward attainment of federal PM2.5 standards. As discussed in Appendix G, the District also satisfies the requirement for reasonable further progress with the above-mentioned projected inventories and without taking credit for the ERCs required of and provided by new and modified stationary sources permitted during this period.

<u>Safeguards to assure plan integrity despite the use of pre-baseline credits</u>: In order to assure that the use of pre-baseline ERCs does not interfere with attainment effort and the applicable rate of progress, this plan incorporates the following safeguards:

- The District will place a cap on the amount of pre-baseline credits that can be used. Although the District has relied on a number of conservative assumptions in estimating the usage quantity of pre-baseline credits, some degree of uncertainty exists. For instance, unexpected growth or irregular permitting activity may occur for one or more source categories. The cap on the use of pre-baseline ERCs will be enforced by tracking the use of such credits and disallowing the use of pre-baseline credits in permitting actions when the above-specified growth levels are reached. The second column of the table above lists expected ERC use for stationary source growth, for each pollutant. The third column is the general growth that is included in CEPAM, for each pollutant. The fourth column is the added growth tonnage to the anticipated general growth, to account for excepted pre-baseline ERC usage, for each pollutant. The fifth column of the table above lists the cap on pre-baseline ERC usage, for each pollutant.

- Although some ERCs will come from post-baseline reductions, this plan conservatively assumes that all offsets will come from pre-baseline reductions. As discussed earlier, federal law only requires the pre-baseline ERCs to be included in the growth and the attainment demonstration. This plan assumes that all ERCs used to offset emission increases will be pre-baseline ERCs and, therefore, includes them all within the projected inventory as growth. Using this higher projected inventory leads to conservative conclusions relating to the attainment and rate of progress demonstrations.

Table H-2 Estimated PM2.5 Growth, Control, and Estimated Offset Use

SUMMARY CATEGORY NAME	2017 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2030 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets* (tons/day)
FUEL COMBUSTION								
ELECTRIC UTILITIES	1.12	-32.42%	0.00	-3.40%	-0.04	0.72	50%	0.00
COGENERATION	0.34	-2.16%	0.00	0.04%	0.00	0.33	50%	0.00
OIL AND GAS PRODUCTION (COMBUSTION)	1.90	-31.79%	0.00	0.02%	0.00	1.30	80%	0.00
PETROLEUM REFINING (COMBUSTION)	0.06	0.00%	0.00	0.00%	0.00	0.06	80%	0.00
MANUFACTURING AND INDUSTRIAL	0.26	1.39%	0.00	0.00%	0.00	0.27	25%	0.00
FOOD AND AGRICULTURAL PROCESSING	0.56	6.69%	0.04	-18.59%	-0.10	0.50	20%	0.01
SERVICE AND COMMERCIAL	0.43	5.52%	0.02	-2.36%	-0.01	0.45	25%	0.01
OTHER (FUEL COMBUSTION)	0.01	-0.24%	0.00	-29.74%	0.00	0.01	25%	0.00
TOTAL PM2.5: FUEL COMBUSTION	**4.69**		**0.07**		**-0.16**	**3.62**		**0.02**
WASTE DISPOSAL								
SEWAGE TREATMENT	0.01	12.06%	0.00	-0.02%	0.00	0.01	25%	0.00
LANDFILLS	0.11	16.40%	0.02	-26.41%	-0.03	0.10	50%	0.01
INCINERATORS	0.01	6.47%	0.00	-0.01%	0.00	0.01	25%	0.00
SOIL REMEDIATION	0.00	-1.95%	0.00	-0.01%	0.00	0.00	25%	0.00
OTHER (WASTE DISPOSAL)	0.04	7.98%	0.00	0.01%	0.00	0.04	25%	0.00
TOTAL PM2.5: WASTE DISPOSAL	**0.17**		**0.02**		**-0.03**	**0.16**		**0.01**
CLEANING AND SURFACE COATINGS								
LAUNDERING	0.01	14.14%	0.00	0.04%	0.00	0.01	25%	0.00
DEGREASING	0.06	-5.53%	0.00	0.02%	0.00	0.05	50%	0.00
COATINGS AND RELATED PROCESS SOLVENTS	0.28	13.02%	0.04	0.00%	0.00	0.32	25%	0.01
PRINTING	0.00	0.27%	0.00	0.00%	0.00	0.00	10%	0.00
ADHESIVES AND SEALANTS	0.00	18.70%	0.00	0.00%	0.00	0.00	10%	0.00
OTHER (CLEANING AND SURFACE COATINGS)	0.00	15.30%	0.00	0.00%	0.00	0.00	50%	0.00

SUMMARY CATEGORY NAME	2017 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2030 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets* (tons/day)
TOTAL PM2.5: CLEANING AND SURFACE COATINGS	**0.35**		**0.04**		**0.00**	**0.38**		**0.01**
PETROLEUM PRODUCTION AND MARKETING								
OIL AND GAS PRODUCTION	0.04	-31.79%	0.00	-15.44%	-0.01	0.02	80%	0.00
PETROLEUM REFINING	0.02	0.00%	0.00	0.00%	0.00	0.02	80%	0.00
PETROLEUM MARKETING	0.02	-20.51%	0.00	0.01%	0.00	0.02	80%	0.00
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.00	0.00%	0.00	0.00%	0.00	0.00	80%	0.00
TOTAL PM2.5: PETROLEUM PRODUCTION AND MARKETING	**0.08**		**0.00**		**-0.01**	**0.06**		**0.00**
INDUSTRIAL PROCESSES								
CHEMICAL	0.31	4.05%	0.01	-0.05%	0.00	0.33	25%	0.00
FOOD AND AGRICULTURE	0.67	13.88%	0.09	0.01%	0.00	0.77	50%	0.06
MINERAL PROCESSES	1.15	-6.06%	0.00	0.01%	0.00	1.08	50%	0.00
METAL PROCESSES	0.02	19.30%	0.00	0.03%	0.00	0.02	80%	0.00
WOOD AND PAPER	0.21	-3.90%	0.00	0.00%	0.00	0.20	50%	0.00
GLASS AND RELATED PRODUCTS	0.16	8.24%	0.01	-59.48%	-0.09	0.07	50%	0.01
ELECTRONICS	0.00	1.77%	0.00	-0.03%	0.00	0.00	25%	0.00
OTHER (INDUSTRIAL PROCESSES)	0.06	12.43%	0.01	0.02%	0.00	0.07	25%	0.00
TOTAL PM2.5: INDUSTRIAL PROCESSES	**2.59**		**0.13**		**-0.09**	**2.54**		**0.08**
TOTAL PM2.5: STATIONARY SOURCES	**7.88**		**0.26**		**-0.28**	**6.76**		**0.13**
ADDITIONAL PRE-BASELINE ERC TONNAGE ADDED TO GENERAL GROWTH								
ADDITONAL PRE-BASELINE ERC TONNAGE			0.00					0.00
TOTAL PM2.5: STATIONARY SOURCES AND ADDITONAL ERC TONNAGE			**0.26**					**0.13**

*Offset distance ratio of 1.34:1 used.

California Emissions Projection Analysis Model: 2022 PM2.5 Plan External Adjustment Reporting Tool version 1.00- Annual Average

Table H-3 Estimated NOx Growth, Control, and Estimated Offset Use

SUMMARY CATEGORY NAME	2017 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2030 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets* (tons/day)
FUEL COMBUSTION								
ELECTRIC UTILITIES	2.80	-20.12%	0.00	-0.49%	-0.01	2.23	100%	0.00
COGENERATION	0.74	-2.16%	0.00	-0.02%	0.00	0.72	100%	0.00
OIL AND GAS PRODUCTION (COMBUSTION)	2.75	-31.82%	0.00	-22.96%	-0.63	1.45	100%	0.00
PETROLEUM REFINING (COMBUSTION)	0.24	-0.06%	0.00	-32.53%	-0.08	0.16	100%	0.00
MANUFACTURING AND INDUSTRIAL	1.42	1.56%	0.02	-9.70%	-0.14	1.30	40%	0.01
FOOD AND AGRICULTURAL PROCESSING	5.49	1.85%	0.10	-46.33%	-2.54	3.02	25%	0.04
SERVICE AND COMMERCIAL	4.69	5.84%	0.27	-17.11%	-0.80	4.08	25%	0.10
OTHER (FUEL COMBUSTION)	0.61	0.04%	0.00	-17.08%	-0.10	0.51	25%	0.00
TOTAL NOx: FUEL COMBUSTION	**18.74**		**0.40**		**-4.31**	**13.46**		**0.15**
WASTE DISPOSAL								
SEWAGE TREATMENT	0.05	12.75%	0.01	-28.69%	-0.01	0.04	0%	0.00
LANDFILLS	0.23	15.52%	0.04	-39.41%	-0.09	0.16	30%	0.02
INCINERATORS	0.04	-0.29%	0.00	-0.01%	0.00	0.04	90%	0.00
SOIL REMEDIATION	0.00	13.35%	0.00	-0.02%	0.00	0.00	0%	0.00
OTHER (WASTE DISPOSAL)	0.01	6.85%	0.00	-0.03%	0.00	0.01	0%	0.00
TOTAL NOx: WASTE DISPOSAL	**0.32**		**0.04**		**-0.10**	**0.24**		**0.02**
CLEANING AND SURFACE COATINGS								
LAUNDERING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
DEGREASING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
COATINGS AND RELATED PROCESS SOLVENTS	0.00	26.83%	0.00	0.03%	0.00	0.00	0%	0.00
PRINTING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
ADHESIVES AND SEALANTS	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
OTHER (CLEANING AND SURFACE COATINGS)	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00

SUMMARY CATEGORY NAME	2017 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2030 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets* (tons/day)
TOTAL NOx: CLEANING AND SURFACE COATINGS	**0.00**		**0.00**		**0.00**	**0.00**		**0.00**
PETROLEUM PRODUCTION AND MARKETING								
OIL AND GAS PRODUCTION	0.23	-31.79%	0.00	-43.03%	-0.10	0.09	100%	0.00
PETROLEUM REFINING	0.01	0.00%	0.00	0.00%	0.00	0.01	100%	0.00
PETROLEUM MARKETING	0.06	-19.33%	0.00	-0.01%	0.00	0.05	20%	0.00
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
TOTAL NOx: PETROLEUM PRODUCTION AND MARKETING	**0.30**		**0.00**		**-0.10**	**0.15**		**0.00**
INDUSTRIAL PROCESSES								
CHEMICAL	0.32	4.05%	0.01	-0.05%	0.00	0.34	50%	0.01
FOOD AND AGRICULTURE	0.00	0.00%	0.00	0.00%	0.00	0.00	10%	0.00
MINERAL PROCESSES	0.22	-6.39%	0.00	0.01%	0.00	0.21	25%	0.00
METAL PROCESSES	0.00	0.00%	0.00	0.00%	0.00	0.00	10%	0.00
WOOD AND PAPER	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
GLASS AND RELATED PRODUCTS	3.08	9.37%	0.29	-47.98%	-1.48	1.75	100%	0.43
ELECTRONICS	0.00	4.08%	0.00	-0.02%	0.00	0.00	0%	0.00
OTHER (INDUSTRIAL PROCESSES)	0.01	12.43%	0.00	0.02%	0.00	0.01	25%	0.00
TOTAL NOx: INDUSTRIAL PROCESSES	**3.64**		**0.30**		**-1.48**	**2.30**		**0.44**
TOTAL NOx: STATIONARY SOURCES	**23.00**		**0.74**		**-5.99**	**16.16**		**0.61**
ADDITIONAL PRE-BASELINE ERC TONNAGE ADDED TO GENERAL GROWTH								
ADDITONAL PRE-BASELINE ERC TONNAGE			2.43					2.43
TOTAL NOx: STATIONARY SOURCES AND ADDITONAL ERC TONNAGE			**3.17**					**3.04**

*Offset distance ratio of 1.50:1 used.

California Emissions Projection Analysis Model: 2022 PM2.5 Plan External Adjustment Reporting Tool version 1.00- Annual Average

Table H-4 Estimated SOx Growth, Control, and Estimated Offset Use

SUMMARY CATEGORY NAME	2017 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2030 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets* (tons/day)
FUEL COMBUSTION								
ELECTRIC UTILITIES	0.25	-25.02%	0.00	-7.76%	-0.02	0.17	50%	0.00
COGENERATION	0.03	-2.16%	0.00	0.04%	0.00	0.03	50%	0.00
OIL AND GAS PRODUCTION (COMBUSTION)	0.67	-31.79%	0.00	0.02%	0.00	0.45	80%	0.00
PETROLEUM REFINING (COMBUSTION)	0.02	0.00%	0.00	0.00%	0.00	0.02	100%	0.00
MANUFACTURING AND INDUSTRIAL	0.11	5.12%	0.01	-0.05%	0.00	0.12	25%	0.00
FOOD AND AGRICULTURAL PROCESSING	0.26	7.55%	0.02	-4.01%	-0.01	0.27	10%	0.00
SERVICE AND COMMERCIAL	0.30	4.68%	0.01	-7.67%	-0.02	0.29	25%	0.00
OTHER (FUEL COMBUSTION)	0.00	-2.17%	0.00	0.00%	0.00	0.00	0%	0.00
TOTAL SOx: FUEL COMBUSTION	**1.64**		**0.04**		**-0.05**	**1.35**		**0.01**
WASTE DISPOSAL								
SEWAGE TREATMENT	0.08	14.67%	0.01	-0.03%	0.00	0.09	0%	0.00
LANDFILLS	0.10	16.41%	0.02	-0.02%	0.00	0.11	0%	0.00
INCINERATORS	0.01	7.12%	0.00	-0.02%	0.00	0.01	25%	0.00
SOIL REMEDIATION	0.00	13.11%	0.00	-0.22%	0.00	0.00	0%	0.00
OTHER (WASTE DISPOSAL)	0.00	7.28%	0.00	-0.03%	0.00	0.00	0%	0.00
TOTAL SOx: WASTE DISPOSAL	**0.19**		**0.03**		**0.00**	**0.22**		**0.00**
CLEANING AND SURFACE COATINGS								
LAUNDERING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
DEGREASING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
COATINGS AND RELATED PROCESS SOLVENTS	0.00	26.93%	0.00	0.00%	0.00	0.00	0%	0.00
PRINTING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
ADHESIVES AND SEALANTS	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
OTHER (CLEANING AND SURFACE COATINGS)	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
TOTAL SOx: CLEANING AND SURFACE COATINGS	**0.00**		**0.00**		**0.00**	**0.00**		**0.00**

SUMMARY CATEGORY NAME	2017 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2030 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets* (tons/day)
PETROLEUM PRODUCTION AND MARKETING								
OIL AND GAS PRODUCTION	0.47	-31.79%	0.00	0.02%	0.00	0.32	90%	0.00
PETROLEUM REFINING	0.01	0.00%	0.00	0.00%	0.00	0.01	100%	0.00
PETROLEUM MARKETING	0.00	-21.45%	0.00	0.01%	0.00	0.00	0%	0.00
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.00	0.00%	0.00	0.00%	0.00	0.00	80%	0.00
TOTAL SOx: PETROLEUM PRODUCTION AND MARKETING	**0.48**		**0.00**		**0.00**	**0.33**		**0.00**
INDUSTRIAL PROCESSES								
CHEMICAL	0.38	4.05%	0.02	-0.05%	0.00	0.40	25%	0.01
FOOD AND AGRICULTURE	0.45	12.93%	0.06	0.02%	0.00	0.51	50%	0.04
MINERAL PROCESSES	0.41	-6.39%	0.00	0.01%	0.00	0.38	25%	0.00
METAL PROCESSES	0.00	25.75%	0.00	0.04%	0.00	0.00	25%	0.00
WOOD AND PAPER	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
GLASS AND RELATED PRODUCTS	1.49	6.42%	0.10	-4.30%	-0.06	1.52	50%	0.07
ELECTRONICS	0.00	3.13%	0.00	0.00%	0.00	0.00	0%	0.00
OTHER (INDUSTRIAL PROCESSES)	0.05	12.43%	0.01	0.02%	0.00	0.06	25%	0.00
TOTAL SOx: INDUSTRIAL PROCESSES	**2.78**		**0.18**		**-0.06**	**2.87**		**0.11**
TOTAL SOx: STATIONARY SOURCES	**5.10**		**0.25**		**-0.12**	**4.77**		**0.12**
ADDITIONAL PRE-BASELINE ERC TONNAGE ADDED TO GENERAL GROWTH								
ADDITONAL PRE-BASELINE ERC TONNAGE			0.40					0.40
TOTAL SOx: STATIONARY SOURCES AND ADDITONAL ERC TONNAGE			**0.65**					**0.52**

*Offset distance ratio of 1.37:1 used.
California Emissions Projection Analysis Model: 2022 PM2.5 External Adjustment Reporting Tool version 1.00- Annual Average

Table H-5 Estimated VOC Growth, Control, and Estimated Offset Use

SUMMARY CATEGORY NAME	2017 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2030 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets* (tons/day)
FUEL COMBUSTION								
ELECTRIC UTILITIES	0.18	-36.07%	0.00	-0.91%	0.00	0.11	100%	0.00
COGENERATION	0.43	-2.16%	0.00	-0.26%	0.00	0.42	90%	0.00
OIL AND GAS PRODUCTION (COMBUSTION)	1.15	-31.79%	0.00	-0.05%	0.00	0.78	95%	0.00
PETROLEUM REFINING (COMBUSTION)	0.04	0.00%	0.00	0.00%	0.00	0.04	100%	0.00
MANUFACTURING AND INDUSTRIAL	0.21	1.21%	0.00	-18.15%	-0.04	0.17	25%	0.00
FOOD AND AGRICULTURAL PROCESSING	0.68	4.83%	0.03	-25.54%	-0.17	0.54	10%	0.00
SERVICE AND COMMERCIAL	0.59	4.14%	0.02	-2.40%	-0.01	0.60	25%	0.01
OTHER (FUEL COMBUSTION)	0.04	-0.03%	0.00	-22.84%	-0.01	0.03	10%	0.00
TOTAL VOC: FUEL COMBUSTION	**3.31**		**0.06**		**-0.24**	**2.69**		**0.01**
WASTE DISPOSAL								
SEWAGE TREATMENT	0.05	13.73%	0.01	-7.46%	0.00	0.05	25%	0.00
LANDFILLS	1.50	12.83%	0.19	-1.15%	-0.02	1.67	50%	0.14
INCINERATORS	0.01	7.10%	0.00	-0.01%	0.00	0.01	0%	0.00
SOIL REMEDIATION	0.09	15.37%	0.01	-0.03%	0.00	0.10	10%	0.00
OTHER (WASTE DISPOSAL)	21.55	12.25%	2.64	0.03%	0.01	24.19	25%	0.99
TOTAL VOC: WASTE DISPOSAL	**23.20**		**2.85**		**-0.02**	**26.02**		**1.14**
CLEANING AND SURFACE COATINGS								
LAUNDERING	0.08	11.06%	0.01	-0.02%	0.00	0.09	0%	0.00
DEGREASING	1.79	14.23%	0.26	0.01%	0.00	2.05	10%	0.04
COATINGS AND RELATED PROCESS SOLVENTS	8.84	19.52%	1.73	-0.72%	-0.06	10.49	50%	1.29
PRINTING	5.61	-4.24%	0.00	0.02%	0.00	5.38	25%	0.00
ADHESIVES AND SEALANTS	0.62	1.59%	0.01	0.03%	0.00	0.63	25%	0.00
OTHER (CLEANING AND SURFACE COATINGS)	7.03	15.30%	1.08	0.01%	0.00	8.10	50%	0.81
TOTAL VOC: CLEANING AND SURFACE COATINGS	**23.97**		**3.07**		**-0.06**	**26.73**		**2.14**

SUMMARY CATEGORY NAME	2017 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2030 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets* (tons/day)
PETROLEUM PRODUCTION AND MARKETING								
OIL AND GAS PRODUCTION	11.46	-31.79%	0.00	-0.52%	-0.06	7.78	80%	0.00
PETROLEUM REFINING	0.44	0.00%	0.00	0.00%	0.00	0.44	90%	0.00
PETROLEUM MARKETING	5.08	-14.20%	0.00	-13.20%	-0.67	3.84	40%	0.00
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.01	2.11%	0.00	-0.01%	0.00	0.01	80%	0.00
TOTAL VOC: PETROLEUM PRODUCTION AND MARKETING	**17.00**		**0.00**		**-0.73**	**12.07**		**0.00**
INDUSTRIAL PROCESSES								
CHEMICAL	2.61	4.05%	0.11	-0.05%	0.00	2.71	25%	0.04
FOOD AND AGRICULTURE	12.36	16.47%	2.04	0.00%	0.00	14.39	50%	1.53
MINERAL PROCESSES	0.19	-6.39%	0.00	0.01%	0.00	0.18	25%	0.00
METAL PROCESSES	0.17	23.53%	0.04	0.04%	0.00	0.21	25%	0.01
WOOD AND PAPER	0.01	-3.90%	0.00	0.00%	0.00	0.01	25%	0.00
GLASS AND RELATED PRODUCTS	0.01	4.16%	0.00	-0.01%	0.00	0.01	100%	0.00
ELECTRONICS	0.00	4.14%	0.00	0.34%	0.00	0.00	0%	0.00
OTHER (INDUSTRIAL PROCESSES)	0.64	12.43%	0.08	0.02%	0.00	0.72	25%	0.03
TOTAL VOC: INDUSTRIAL PROCESSES	**15.98**		**2.26**		**0.00**	**18.23**		**1.61**
TOTAL VOC: STATIONARY SOURCES	**83.46**		**8.25**		**-1.05**	**85.75**		**4.91**
ADDITIONAL PRE-BASELINE ERC TONNAGE ADDED TO GENERAL GROWTH								
ADDITONAL PRE-BASELINE ERC TONNAGE			0.00					0.00
TOTAL VOC: STATIONARY SOURCES AND ADDITONAL ERC TONNAGE			**8.25**					**4.91**

*Offset distance ratio of 1.50:1 used.
California Emissions Projection Analysis Model: 2022 PM2.5 Plan External Adjustment Reporting Tool version 1.00- Annual Average

Table H-6 List of Emission Reduction Credits PM10 and PM2.5 Precursors

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
ACMII CA 6, LLC DBA COLUMBINE VINEYARDS	S	2516	4	PM10	0	0	14	3
AERA ENERGY LLC	S	32	4	PM10	0	0	69	120
AERA ENERGY LLC	S	202	4	PM10	123	100	70	88
AERA ENERGY LLC	S	215	4	PM10	403	362	361	406
AERA ENERGY LLC	S	254	4	PM10	1093	1174	0	913
AERA ENERGY LLC	S	255	4	PM10	4184	1519	0	1074
AERA ENERGY LLC	S	256	4	PM10	10145	5624	0	0
AERA ENERGY LLC	S	259	4	PM10	1483	1747	0	705
AERA ENERGY LLC	S	260	4	PM10	1858	1946	286	633
AERA ENERGY LLC	S	272	4	PM10	806	760	721	693
AERA ENERGY LLC	S	319	4	PM10	449	650	497	499
AERA ENERGY LLC	S	790	4	PM10	153	102	117	167
AERA ENERGY LLC	S	802	4	PM10	734	1218	47	623
AERA ENERGY LLC	S	862	4	PM10	1257	1129	1090	1193
AERA ENERGY LLC	S	863	4	PM10	5	5	10	9
AERA ENERGY LLC	S	913	4	PM10	846	548	530	785
AERA ENERGY LLC	S	983	4	PM10	503	106	151	756
AERA ENERGY LLC	S	1006	4	PM10	991	1085	445	696
AERA ENERGY LLC	S	1008	4	PM10	80	100	30	21
AERA ENERGY LLC	S	1010	4	PM10	1975	2028	0	2074
AERA ENERGY LLC	S	1012	4	PM10	350	748	479	91
AERA ENERGY LLC	S	1013	4	PM10	269	2280	694	170
AERA ENERGY LLC	S	1026	4	PM10	278	579	252	201
AERA ENERGY LLC	S	1040	4	PM10	0	961	467	0
AERA ENERGY LLC	S	1057	4	PM10	72	81	66	65

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
AERA ENERGY LLC	S	1091	4	PM10	97	119	120	121
AERA ENERGY LLC	S	1424	4	PM10	787	1901	1476	380
AERA ENERGY LLC	S	1476	4	PM10	262	0	0	74
AERA ENERGY LLC	S	1477	4	PM10	455	0	0	128
AERA ENERGY LLC	S	1927	4	PM10	1854	2703	2734	2332
AERA ENERGY LLC	S	2025	4	PM10	1028	714	726	684
AERA ENERGY LLC	S	2361	4	PM10	4	1	0	2
AERA ENERGY LLC	S	2575	4	PM10	2301	1770	0	548
AERA ENERGY LLC	S	2774	4	PM10	443	368	369	489
AERA ENERGY LLC	S	2782	4	PM10	61	60	58	63
AERA ENERGY LLC	S	3265	4	PM10	1591	0	0	0
AGRI-CEL INC	S	3631	4	PM10	31	38	35	4
ALON BAKERSFIELD REFINING	S	5180	4	PM10	1426	1689	1612	1777
ALON BAKERSFIELD REFINING	S	5184	4	PM10	2500	2500	2500	2500
ALON BAKERSFIELD REFINING	S	5185	4	PM10	2445	2476	2506	2506
ALTA VISTA GIN/MURRIETA FARM	C	1445	4	PM10	0	0	0	7858
AMERICAN MOULDING & MILLWORK	N	63	4	PM10	1106	701	809	471
ANDERSON CLAYTON CORP	C	959	4	PM10	0	0	0	26896
ANDERSON CLAYTON CORPORATION	N	737	4	PM10	979	0	0	19767
ANEW ENVIRONMENTAL, LLC	S	5310	4	PM10	2044	1935	1726	1724
ARDAGH GLASS INC	C	1345	4	PM10	18	18	18	18
AZTECA MILLING LP	C	1042	4	PM10	0	0	0	2847
BAR VP DAIRY	C	797	4	PM10	0	0	0	2180
BAR VP DAIRY	C	798	4	PM10	0	0	0	3204
BAR VP DAIRY	C	799	4	PM10	0	0	0	4111
BASF CORPORATION	S	5214	4	PM10	883	28	2	509
BENTA ENERGY LLC	C	1435	4	PM10	6374	0	0	9215
BENTA ENERGY LLC	C	1490	4	PM10	384	0	0	8778

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
BERRY PETROLEUM COMPANY, LLC	N	1441	4	PM10	896	896	896	896
BERRY PETROLEUM COMPANY, LLC	N	1534	4	PM10	1285	1284	1284	1284
BERRY SEED & FEED COMPANY	N	1406	4	PM10	17448	15153	16686	18791
BRIAN ANDERSON	C	1374	4	PM10	0	0	0	20729
BRITZ AG FINANCE CO., INC.	C	558	4	PM10	0	0	0	5780
BRITZ AG FINANCE CO., INC.	C	559	4	PM10	0	0	0	35897
BRITZ GIN PARTNERSHIP	S	475	4	PM10	0	0	0	4259
BRITZ GIN PARTNERSHIP II	C	871	4	PM10	0	0	0	10903
BRITZ INCORPORATED	C	159	4	PM10	0	0	0	715
BRITZ INCORPORATED	C	586	4	PM10	0	0	0	19720
BROWN SAND INC	N	46	4	PM10	1107	1474	840	1099
BRUCE R. CARTER	S	5239	4	PM10	14	18	16	2
BUTTONWILLOW GINNING CO	S	2937	4	PM10	0	0	0	28460
BUTTONWILLOW GINNING CO	S	4634	4	PM10	0	0	0	13495
CALAVERAS MATERIALS INC.	C	233	4	PM10	243	652	759	479
CALIFORNIA DAIRIES	N	498	4	PM10	273	313	128	186
CALIFORNIA DAIRIES INC	N	1343	4	PM10	4	4	4	4
CALIFORNIA DAIRIES INC	S	2152	4	PM10	0	0	0	99
CALIFORNIA DAIRIES INC	S	2204	4	PM10	0	0	0	405
CALIFORNIA RESOURCES ELK HILLS LLC	S	826	4	PM10	71	67	60	68
CALIFORNIA RESOURCES ELK HILLS LLC	S	829	4	PM10	68	72	85	69
CALIFORNIA RESOURCES ELK HILLS LLC	S	4906	4	PM10	300	172	839	958
CALIFORNIA RESOURCES ELK HILLS, LLC	C	1439	4	PM10	80	80	80	80
CALIFORNIA RESOURCES ELK HILLS, LLC.	N	1460	4	PM10	0	0	985	0
CALIFORNIA RESOURCES ELK HILLS, LLC.	N	1461	4	PM10	0	0	3215	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1115	4	PM10	51	40	67	47

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA RESOURCES PRODUCTION CORP	N	1116	4	PM10	136	113	42	96
CALIFORNIA RESOURCES PRODUCTION CORP	N	1169	4	PM10	398	398	225	398
CALIFORNIA RESOURCES PRODUCTION CORP	N	1171	4	PM10	0	0	173	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1200	4	PM10	5	5	10	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	3996	4	PM10	76	26	48	52
CALIFORNIA RESOURCES PRODUCTION CORP	S	4647	4	PM10	204	204	203	203
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1227	4	PM10	23	69	108	96
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1288	4	PM10	0	0	0	1409
CALMAT CO.	C	50	4	PM10	15	16	23	24
CALPINE CORP	S	1577	4	PM10	489	0	0	23085
CALPINE CORP	S	1683	4	PM10	0	0	0	1462
CALPINE CORP	S	1689	4	PM10	0	0	0	2604
CALPINE CORP	S	1693	4	PM10	1091	1103	1115	1115
CALPINE CORP	S	2877	4	PM10	421	0	176	0
CALPINE CORP	S	3198	4	PM10	0	0	0	8699
CALPINE CORP	S	3288	4	PM10	0	0	987	8059
CALPINE CORPORATION	C	448	4	PM10	1067	1067	1067	1067
CALPINE CORPORATION	C	449	4	PM10	82	28	373	674
CALPINE CORPORATION	C	942	4	PM10	50845	67976	8408	841
CALPINE CORPORATION	N	208	4	PM10	715	8177	6581	715

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALPINE CORPORATION	N	297	4	PM10	0	0	101	66394
CALPINE ENERGY SERVICES LP	S	3090	4	PM10	751	812	634	694
CALPINE ENERGY SERVICES LP	S	3091	4	PM10	0	0	0	7210
CALPINE ENERGY SERVICES, LP	C	1010	4	PM10	1029	0	0	13916
CAMPBELL SOUP CO	N	127	4	PM10	416	289	261	308
CAMPBELL SOUP SUPPLY CO	N	31	4	PM10	0	434	1064	0
CANANDAIGUA WINE COMPANY INC	C	702	4	PM10	423	422	449	411
CANDLEWICK YARNS	C	507	4	PM10	11	9	7	7
CENTRAL CA ALMOND GROWERS ASSC	C	1551	4	PM10	0	0	0	20000
CENTRAL VALLEY MEAT CO	C	1528	4	PM10	0	0	0	20211
CENTRAL VALLEY MEAT CO	N	1588	4	PM10	7573	6404	6659	8182
CERTAINTEED LLC	C	1503	4	PM10	600	600	600	600
CHEVRON PIPE LINE-MIDDWAY	S	77	4	PM10	3067	2768	2607	3422
CHEVRON USA	C	966	4	PM10	144	144	144	144
CHEVRON USA INC	C	331	4	PM10	3766	3767	3767	3767
CHEVRON USA INC	C	339	4	PM10	11300	11300	11301	11301
CHEVRON USA INC	S	357	4	PM10	137	116	114	153
CHEVRON USA INC	S	629	4	PM10	24	21	21	21
CHEVRON USA INC	S	702	4	PM10	1861	1881	1902	1902
CHEVRON USA INC	S	1485	4	PM10	1890	1911	1932	1932
CHEVRON USA INC	S	3544	4	PM10	1086	1185	913	966
CHEVRON USA INC	S	3604	4	PM10	699	1081	1219	805
CHEVRON USA INC	S	3679	4	PM10	5317	2839	3598	5227
CHEVRON USA INC	S	4202	4	PM10	1144	1194	1244	1244
CHEVRON USA INC	S	4304	4	PM10	711	831	839	1007
CHEVRON USA INC	S	4377	4	PM10	297	912	1284	1251
CHEVRON USA INC	S	4659	4	PM10	328	306	337	324
CHEVRON USA INC	S	4668	4	PM10	23064	17442	24065	20486

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CHEVRON USA INC	S	5059	4	PM10	233	236	281	247
CHEVRON USA INC REFINERY	S	2275	4	PM10	490	1911	1932	532
CHEVRON USA PRODUCTION INC	S	147	4	PM10	50	57	46	46
CHEVRON USA PRODUCTION INC	S	3228	4	PM10	74	85	147	56
CHEVRON USA PRODUCTION INC	S	3533	4	PM10	101	106	124	122
CHEVRON USA, INC.	C	1147	4	PM10	136	140	95	131
CHEVRON USA, INC.	C	1372	4	PM10	26	61	29	9
CHRISTOPHER RANCH LLC	C	1430	4	PM10	0	0	0	16009
CLEAN HARBORS BUTTONWILLOW LLC	S	49	4	PM10	567	573	580	580
CONAGRA FROZEN FOODS	N	672	4	PM10	135	48	91	137
CORCORAN IRRIGATION DISTRICT	C	560	4	PM10	75	77	74	44
COUNTY LINE GIN	C	997	4	PM10	0	0	0	8549
COUNTY OF SAN JOAQUIN SOLID WASTE DIV	S	2264	4	PM10	0	0	0	471
COUNTY OF SAN JOAQUIN SOLID WASTE DIV	S	2266	4	PM10	0	0	0	1000
COUNTY OF SAN JOAQUIN SOLID WASTE DIV	S	2267	4	PM10	0	0	0	8813
CRAYCROFT BRICK COMPANY	C	71	4	PM10	50	40	39	40
CRIMSON RESOURCE MANAGEMENT	S	2161	4	PM10	20	17	12	24
CRIMSON RESOURCE MANAGEMENT	S	3392	4	PM10	1745	1292	1258	941
CXA LA PALOMA, LLC	N	1456	4	PM10	11695	16203	9929	8254
DARLING INGREDIENTS INC	C	1482	4	PM10	221	0	0	1779
DARLING INGREDIENTS INC	C	1485	4	PM10	204	297	219	173
DARLING INGREDIENTS INC	C	1487	4	PM10	205	297	220	172
DARLING INTERNATIONAL INC	N	1503	4	PM10	254	228	279	271
DARLING INTERNATIONAL INC	S	5113	4	PM10	428	1056	502	50
DARLING INTERNATIONAL INC	S	5115	4	PM10	1852	1286	1945	719

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
DEL MONTE FOODS MODESTO PLANT 1	N	58	4	PM10	0	0	8410	0
DEL MONTE FOODS MODESTO PLANT 1	N	1238	4	PM10	221	189	388	83
DIAMOND FOODS, LLC	N	645	4	PM10	49	0	4	0
DIAMOND PET FOOD PROCESSROS OF RIPON LLC	S	4977	4	PM10	0	0	0	8225
DIAMOND PET FOODS - RIPON	N	1136	4	PM10	5198	5320	5320	5442
DOLE PACKAGED FOODS LLC	N	520	4	PM10	5	20	72	14
E & J GALLO WINERY	C	1071	4	PM10	32	32	31	29
E&B NATURAL RESOURCES MGMT	S	4774	4	PM10	135	145	150	148
E&B NATURAL RESOURCES MGMT	S	4878	4	PM10	0	0	0	58
E&B NATURAL RESOURCES MGMT	S	4959	4	PM10	46	46	46	44
EAGLE VALLEY GINNING LLC	N	847	4	PM10	0	0	0	29098
ECKERT COLD STORAGE CO.	N	133	4	PM10	5	20	72	14
ELBOW ENTERPRISES INC	S	3071	4	PM10	0	0	0	19406
ELEMENT MARKETS EMISSIONS LLC	C	1486	4	PM10	311	452	333	262
ELEMENT MARKETS EMISSIONS LLC	C	1512	4	PM10	985	0	0	4942
ELEMENT MARKETS EMISSIONS LLC	C	1531	4	PM10	248	388	270	199
ELEMENT MARKETS LLC	S	5233	4	PM10	614	1426	2766	1778
ELEMENT MARKETS LLC	S	5237	4	PM10	1363	946	1432	2760
EVOLUTION MARKETS LLC	C	941	4	PM10	0	0	0	41215
EVOLUTION MARKETS LLC	S	2878	4	PM10	0	0	0	11831
F & T FARMS	C	1533	4	PM10	0	0	0	16647
FJ MANAGEMENT INC.	N	1334	4	PM10	0	0	320	0
FJ MANAGEMENT INC.	N	1335	4	PM10	0	0	1322	0
FOSTER FARMS- PORTERVILLE PLANT	S	2337	4	PM10	40	40	40	40
FRESNO/CLOVIS REGIONAL WWTP	C	1211	4	PM10	5	5	4	4
FRITO-LAY INC	N	888	4	PM10	0	0	2339	0
FRITO-LAY INC	S	3412	4	PM10	7136	7320	7507	7506

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
FRITO-LAY INC	S	3414	4	PM10	0	0	0	6935
FRITO-LAY INC	S	3416	4	PM10	0	8	306	310
FRITO-LAY INC	S	3417	4	PM10	0	0	0	2531
FRITO-LAY INC	S	3419	4	PM10	132	132	133	134
FRITO-LAY INC	S	3453	4	PM10	17	68	208	207
FRITO-LAY INC	S	5255	4	PM10	1862	1800	1800	1800
FRITO-LAY, INC	C	1068	4	PM10	69	70	67	63
FRITO-LAY, INC	C	1069	4	PM10	286	280	268	259
FRITO-LAY, INC	C	1136	4	PM10	0	0	0	699
FRITO-LAY, INC.	S	3437	4	PM10	210	288	195	174
FUTURE ENERGY, LLC	C	1489	4	PM10	444	0	0	445
GALLO GLASS COMPANY	N	1583	4	PM10	14480	14202	15530	13820
GENERAL CABLE INDUSTRIES, LLC	C	524	4	PM10	2	1	2	1
GENERAL MILLS INC	N	608	4	PM10	178	0	385	298
GENERAL MILLS INC	S	3218	4	PM10	0	0	0	4525
GRADE 6 OIL LLC-KRH	C	1481	4	PM10	0	0	0	5298
GRANITE CONSTRUCTION COMPANY	C	1065	4	PM10	0	0	0	2
H J HEINZ COMPANY	N	60	4	PM10	0	42	226	4
H J HEINZ COMPANY	N	694	4	PM10	0	0	1372	0
H J HEINZ COMPANY	N	1085	4	PM10	72	73	63	31
H&H COTTON GINNING COMPANY	C	105	4	PM10	0	0	0	9954
H. J. HEINZ COMPANY, L.P.	N	21	4	PM10	0	60	180	60
HANNIBAL INDUSTRIES, INC.	N	950	4	PM10	300	303	306	306
HERSHEY CHOCOLATE & CONF CORP	N	952	4	PM10	254	230	240	228
HOGAN MANUFACTURING INC	N	34	4	PM10	1972	4031	2344	2712
HURON ASSETS, LLC	C	521	4	PM10	8	373	186	631
INGREDION INCORPORATED	N	1086	4	PM10	1392	853	1662	1400
J D HEISKELL & CO LLC	C	1538	4	PM10	63	63	63	63

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
J G BOSWELL CO	S	5079	4	PM10	0	0	0	35587
J G BOSWELL CO	S	5080	4	PM10	46	43	0	152
J G BOSWELL COMPANY	C	92	4	PM10	670	460	648	916
J G BOSWELL COMPANY	C	93	4	PM10	2810	2418	2082	4097
J R SIMPLOT COMPANY	C	1039	4	PM10	988	1900	877	1470
KERN DELTA CO LLC	S	4317	4	PM10	0	0	0	26563
KERN OIL & REFINING CO	S	4976	4	PM10	92	159	154	200
KERN OIL & REFINING CO	S	5142	4	PM10	2397	2892	2637	4158
KOCH SUPPLY & TRADING LP	C	1311	4	PM10	0	0	0	2881
KOCH SUPPLY & TRADING LP	N	1154	4	PM10	165	308	333	5030
KOCH SUPPLY & TRADING LP	N	1156	4	PM10	0	4710	4761	4191
KOCH SUPPLY & TRADING LP	N	1161	4	PM10	0	0	0	8300
KOCH SUPPLY & TRADING LP	S	4148	4	PM10	0	0	0	18971
KOCH SUPPLY & TRADING LP	S	4149	4	PM10	0	0	0	3789
KOCH SUPPLY & TRADING LP	S	4150	4	PM10	0	0	0	1956
KODA FARMS	C	856	4	PM10	0	0	0	1396
KODA FARMS INC	N	1042	4	PM10	0	0	0	5180
KODA FARMS MILLING INC	S	3196	4	PM10	0	0	0	856
KODA FARMS MILLING INC	S	3197	4	PM10	0	0	0	3144
KODA FARMS MILLING INC	S	3796	4	PM10	0	0	0	4820
LA PALOMA GENERATING CO, LLC	C	1055	4	PM10	0	0	0	360
LACTALIS HERITAGE DAIRY, INC.	S	5278	4	PM10	8	70	112	71
LAND O' LAKES INC	S	4924	4	PM10	15	15	15	15
LAWRENCE LIVERMORE NATL SECURITY, LLC	N	464	4	PM10	8	3	0	6
LEHIGH HANSON WEST REGION	C	89	4	PM10	45	41	47	38
LIDESTRI FOODS, INC	N	391	4	PM10	0	0	1056	0
LOS BANOS ASPHALT COMPANY	N	125	4	PM10	85	162	376	168

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
LOS GATOS TOMATO PRODUCTS	C	1021	4	PM10	0	24	0	0
MACPHERSON OIL COMPANY	C	1321	4	PM10	0	0	0	8
MACPHERSON OIL COMPANY	C	1361	4	PM10	0	0	0	1843
MALAGA POWER, LLC	C	1354	4	PM10	0	0	0	138
MARTIN ANDERSON	C	1051	4	PM10	32	48	28	2
MERCED CO COMMUNITY & ECONOMIC DEV DEPT	N	109	4	PM10	6262	6332	6402	6402
MESA VERDE TRADING CO INC	S	4309	4	PM10	4439	67	0	1328
MID-SET COGENERATION COMPANY	S	4860	4	PM10	3847	3914	3899	3885
MIDSTREAM ENERGY PARTNERS (USA) LLC	S	5077	4	PM10	16	48	30	8
MID-VALLEY COTTON GROWERS INC	S	3803	4	PM10	0	0	0	2128
MOLYCORP MINERALS LLC	S	3539	4	PM10	373	329	313	238
MONTEREY RESOURCES, INC.	S	432	4	PM10	906	918	753	837
MT VERNON RECYCLING & COMPOSTING FAC	S	2969	4	PM10	18	24	26	22
NAS LEMOORE	C	330	4	PM10	17	17	17	17
NAS LEMOORE	C	1559	4	PM10	7655	3054	5493	1481
NESTLE PURINA PETCARE CO	S	4764	4	PM10	150	150	150	150
NESTLE PURINA PETCARE COMPANY	C	1543	4	PM10	0	0	0	1194
OAKWOOD LAKE RESORT	N	601	4	PM10	0	9	15	0
OLAM SVI	N	1428	4	PM10	500	1387	1737	15
OLAM SVI	N	1431	4	PM10	231	598	1264	789
OLDUVAI GORGE LLC	N	1410	4	PM10	0	0	3362	512
OLDUVAI GORGE LLC	S	4978	4	PM10	0	0	0	38729
OLDUVAI GORGE, LLC	C	1376	4	PM10	0	0	0	779
OLDUVAI GORGE, LLC	C	1380	4	PM10	0	0	0	702
OLDUVAI GORGE, LLC	C	1424	4	PM10	0	0	0	1574
OLDUVAI GORGE, LLC	C	1529	4	PM10	0	0	0	5680

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
OLDUVAI GORGE, LLC	C	1552	4	PM10	0	0	0	8000
OWENS-BROCKWAY GLASS CONTAINER	N	517	4	PM10	0	0	0	490
PACIFIC PIPELINE SYSTEM LLC	S	575	4	PM10	0	0	108	0
PACIFIC PIPELINE SYSTEM LLC	S	576	4	PM10	0	203	181	0
PACIFIC PIPELINE SYSTEM LLC	S	577	4	PM10	710	860	899	899
PACTIV, LLC	S	3865	4	PM10	33	29	7	15
PARAMOUNT FARMS	N	1321	4	PM10	0	0	65	0
PARAMOUNT FARMS INC	N	1084	4	PM10	27	1770	275	275
PARAMOUNT FARMS, INC.	C	1207	4	PM10	0	0	188	20
PARAMOUNT FARMS, INC.	C	1357	4	PM10	0	1000	16305	0
PILKINGTON NORTH AMERICA INC	N	1320	4	PM10	0	0	0	52685
PILKINGTON NORTH AMERICA INC	S	4562	4	PM10	0	0	0	6679
PILKINGTON NORTH AMERICA INC	S	4584	4	PM10	0	0	0	23321
PILKINGTON NORTH AMERICA, INC	C	1356	4	PM10	1000	0	19695	12000
POHL ALMOND HULLING	N	212	4	PM10	0	0	4279	8511
PONDEROSA PAINT CO	C	1463	4	PM10	888	888	1193	1193
P-R FARMS, INC.	C	126	4	PM10	0	0	357	180
R M WADE & COMPANY	C	152	4	PM10	14	17	17	16
RANCHERS COTTON OIL	C	817	4	PM10	1327	1325	1323	1323
RIO BRAVO FRESNO	C	244	4	PM10	1000	0	0	0
RIVERSIDE DAIRY	C	819	4	PM10	1225	409	0	3469
RIVERSIDE DAIRY	C	820	4	PM10	4335	0	0	6111
SAINT-GOBAIN	S	4496	4	PM10	0	0	0	118
SAINT-GOBAIN CONTAINERS, INC	N	1293	4	PM10	0	0	0	167
SALIDA HULLING ASSOCIATION	N	44	4	PM10	0	0	12246	0
SAN JOAQUIN FACILITIES MGMT	S	1253	4	PM10	27	30	32	30
SAN JOAQUIN FACILITIES MGMT	S	1509	4	PM10	7	9	9	9
SAN JOAQUIN FACILITIES MGMT	S	1735	4	PM10	23	20	15	12

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
SAPUTO CHEESE USA INC/LEGAL DEPT	S	4655	4	PM10	0	0	0	7
SC JOHNSON HOME STORAGE INC	C	107	4	PM10	326	315	281	269
SC JOHNSON HOME STORAGE INC	C	1173	4	PM10	271	360	355	366
SENECA RESOURCES	C	1410	4	PM10	0	0	0	589
SENECA RESOURCES	C	1428	4	PM10	0	0	0	200
SENECA RESOURCES	N	1495	4	PM10	0	0	0	951
SENECA RESOURCES COMPANY, LLC	C	1408	4	PM10	0	0	0	22
SENTINEL PEAK RESOURCES CA LLC	C	1415	4	PM10	0	0	0	2
SENTINEL PEAK RESOURCES CA LLC	C	1421	4	PM10	85	0	375	329
SENTINEL PEAK RESOURCES CA LLC	C	1422	4	PM10	0	0	0	2180
SENTINEL PEAK RESOURCES CA LLC	C	1456	4	PM10	0	0	0	12000
SENTINEL PEAK RESOURCES CA LLC	N	1419	4	PM10	0	0	0	510
SENTINEL PEAK RESOURCES CA LLC	N	1484	4	PM10	3269	3660	3947	2974
SENTINEL PEAK RESOURCES CA LLC	N	1551	4	PM10	1929	2915	2695	2493
SENTINEL PEAK RESOURCES CA LLC	S	4841	4	PM10	0	0	0	10572
SENTINEL PEAK RESOURCES CA LLC	S	5046	4	PM10	643	322	356	1039
SENTINEL PEAK RESOURCES CA LLC	S	5128	4	PM10	0	0	0	5626
SENTINEL PEAK RESOURCES CA LLC	S	5207	4	PM10	3015	2048	1883	2433
SHAFTER HAY & CUBE LLC	S	3804	4	PM10	0	691	1099	154
SHAFTER-WASCO GINNING CO	S	3268	4	PM10	0	0	0	4695
SOC RESOURCES INC	S	3089	4	PM10	5	4	4	4
SOUTH VALLEY GINS INC	S	3554	4	PM10	0	0	0	8671
SOUTH VALLEY GINS INC	S	4635	4	PM10	1223	0	0	12164
SPRECKELS SUGAR COMPANY INC.	C	1464	4	PM10	0	6074	7699	3185
STOCKTON EAST WATER DISTRICT	N	763	4	PM10	214	299	301	271
SWANSON HULLING	N	10	4	PM10	0	0	2984	0
TAFT PRODUCTION CO	S	2670	4	PM10	1914	1959	2000	2000
TAUBER OIL COMPANY	C	1284	4	PM10	0	0	0	1

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
TEXACO EXPLOR. & PROD. INC.	S	202503	4	PM10	41	43	37	40
THE DOW CHEMICAL COMPANY	N	799	4	PM10	73	82	83	72
THE ENVIRONMENTAL RESOURCES TRUST,	C	1013	4	PM10	418	418	418	418
THE NESTLE COMPANY INC	N	93	4	PM10	5602	5688	4414	7118
TKV CONTAINERS, INC.	C	1015	4	PM10	0	349	349	0
TRI-CITY GROWERS INC	S	4392	4	PM10	1694	0	0	7175
TULE RIVER CO-OP GIN INC	S	2913	4	PM10	0	0	0	484
TURLOCK IRRIGATION DISTRICT	C	510	4	PM10	0	0	0	6430
TURLOCK IRRIGATION DISTRICT	N	433	4	PM10	0	0	0	4720
UNITED STATES GYPSUM CO	S	2543	4	PM10	0	0	0	8032
UNITED STATES GYPSUM CO	S	2576	4	PM10	0	0	0	5078
UNITED STATES GYPSUM CO	S	2577	4	PM10	0	0	350	17130
UNITED STATES GYPSUM CO	S	2578	4	PM10	0	0	0	14051
UNITED STATES GYPSUM CO	S	2580	4	PM10	1340	0	0	0
UNITED STATES GYPSUM CO	S	2581	4	PM10	2953	0	0	8168
UNITED STATES GYPSUM CO	S	2582	4	PM10	0	0	0	2736
UNITED STATES GYPSUM CO	S	2583	4	PM10	87	0	721	10072
UNITED STATES GYPSUM CO	S	2584	4	PM10	0	0	0	6407
UNITED STATES GYPSUM COMPANY	C	818	4	PM10	0	0	0	18935
UNITED STATES GYPSUM COMPANY	C	827	4	PM10	0	0	0	4000
UNITED STATES GYPSUM COMPANY	C	828	4	PM10	0	0	0	2848
UNITED STATES GYPSUM COMPANY	C	829	4	PM10	0	0	0	1649
UNITED STATES GYPSUM COMPANY	C	830	4	PM10	0	0	0	5824
UNITED STATES GYPSUM COMPANY	C	831	4	PM10	0	0	0	5395
UNITED STATES GYPSUM COMPANY	C	832	4	PM10	0	0	0	5112
UNITED STATES GYPSUM COMPANY	C	833	4	PM10	1006	44	0	943
UNITED STATES GYPSUM COMPANY	C	834	4	PM10	0	0	0	6788
UNITED STATES GYPSUM COMPANY	C	835	4	PM10	0	0	0	5357

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
UNITED STATES GYPSUM COMPANY	C	836	4	PM10	0	0	0	6688
UNITED STATES GYPSUM COMPANY	C	837	4	PM10	0	0	0	18959
UNITED STATES GYPSUM COMPANY	C	838	4	PM10	0	0	0	5098
UNITED STATES GYPSUM COMPANY	C	839	4	PM10	0	0	0	5476
UNITED STATES GYPSUM COMPANY	C	840	4	PM10	0	0	0	3470
UNITED STATES GYPSUM COMPANY	C	841	4	PM10	0	0	0	2642
UNITED STATES GYPSUM COMPANY	C	842	4	PM10	0	0	0	3471
UNITED STATES GYPSUM COMPANY	C	843	4	PM10	0	0	0	7953
UNITED STATES GYPSUM COMPANY	C	845	4	PM10	0	0	0	10655
UNITED STATES GYPSUM COMPANY	C	846	4	PM10	0	0	0	11928
UNITED STATES GYPSUM COMPANY	C	847	4	PM10	0	0	0	26284
UNITED STATES GYPSUM COMPANY	N	659	4	PM10	0	0	0	23209
UNITED STATES GYPSUM COMPANY	N	660	4	PM10	0	0	0	23515
VAN GRONINGEN ORCHARDS	N	894	4	PM10	0	0	2306	1327
VANDERHAM WEST	S	2410	4	PM10	0	0	0	5765
VANDERHAM WEST	S	2411	4	PM10	0	0	0	7592
VANDERHAM WEST	S	2412	4	PM10	0	0	7	3945
VANDERHAM WEST	S	2413	4	PM10	9	0	0	4701
VARCO PRUDEN BUILDINGS, INC.	N	898	4	PM10	3827	4258	7700	6665
VECTOR ENVIRONMENTAL INC	S	4039	4	PM10	58	70	66	8
VINTAGE PRODUCTION CALIFORNIA LLC	S	3036	4	PM10	29	29	29	29
VULCAN MATERIALS	C	40	4	PM10	75	359	165	553
WEST ISLAND COTTON GROWERS INC	C	55	4	PM10	0	0	0	4365
WEST ISLAND COTTON GROWERS INC	C	1017	4	PM10	607	0	1193	1800
WESTERN MILLING LLC	S	2634	4	PM10	0	0	0	579
WESTERN MILLING LLC	S	4220	4	PM10	0	0	0	3065
WESTERN MILLING, LLC	C	621	4	PM10	152	152	152	152
WESTERN MILLING, LLC	C	670	4	PM10	0	0	0	10844

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
WESTERN STONE PRODUCTS INC	N	17	4	PM10	513	513	558	558
WESTSIDE FARMERS COOP #2 AND #3	C	1038	4	PM10	3311	0	0	37809
WESTSIDE FARMERS COOP GIN	C	352	4	PM10	0	0	0	33444
WONDERFUL PISTACHIOS & ALMONDS	S	1446	4	PM10	0	0	1088	18586
ACMII CA 6, LLC DBA COLUMBINE VINEYARDS	S	2516	2	NOx	0	0	189	46
AERA ENERGY LLC	C	219	2	NOx	1,738	1,923	2,100	1,931
AERA ENERGY LLC	C	1401	2	NOx	22,209	22,209	22,209	22,208
AERA ENERGY LLC	S	135	2	NOx	5,032	1,152	0	0
AERA ENERGY LLC	S	137	2	NOx	5,115	6,792	5,437	9,206
AERA ENERGY LLC	S	139	2	NOx	11,686	11,816	11,946	11,946
AERA ENERGY LLC	S	140	2	NOx	36,695	46,397	47,292	36,806
AERA ENERGY LLC	S	158	2	NOx	38,057	29,690	32,405	43,791
AERA ENERGY LLC	S	162	2	NOx	128,454	152,970	128,743	130,786
AERA ENERGY LLC	S	163	2	NOx	96,698	107,197	101,158	78,678
AERA ENERGY LLC	S	470	2	NOx	3,478	4,930	5,390	5,212
AERA ENERGY LLC	S	662	2	NOx	9,433	18,919	3,766	817
AERA ENERGY LLC	S	784	2	NOx	7,140	3,993	228	0
AERA ENERGY LLC	S	838	2	NOx	442	218	338	338
AERA ENERGY LLC	S	865	2	NOx	6,713	6,788	6,863	6,863
AERA ENERGY LLC	S	883	2	NOx	632	160	2,073	2,061
AERA ENERGY LLC	S	1061	2	NOx	8,071	8,777	10,695	9,555
AERA ENERGY LLC	S	1062	2	NOx	8,530	9,784	10,046	9,903
AERA ENERGY LLC	S	1063	2	NOx	9,423	10,057	12,159	9,776
AERA ENERGY LLC	S	1064	2	NOx	5,126	5,705	5,881	6,709
AERA ENERGY LLC	S	1065	2	NOx	10,366	10,483	11,017	8,841
AERA ENERGY LLC	S	1066	2	NOx	5,542	7,367	5,038	6,117

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
AERA ENERGY LLC	S	1067	2	NOx	1,255	893	2,650	4,592
AERA ENERGY LLC	S	1068	2	NOx	7,648	9,620	6,968	8,415
AERA ENERGY LLC	S	1069	2	NOx	4,713	5,029	4,352	2,082
AERA ENERGY LLC	S	1070	2	NOx	495	4,228	2,744	99
AERA ENERGY LLC	S	1092	2	NOx	348	242	246	236
AERA ENERGY LLC	S	1270	2	NOx	4,586	4,637	4,688	4,688
AERA ENERGY LLC	S	1437	2	NOx	42,372	49,588	46,800	43,954
AERA ENERGY LLC	S	1476	2	NOx	1,242	0	0	350
AERA ENERGY LLC	S	1477	2	NOx	2,153	0	0	607
AERA ENERGY LLC	S	1821	2	NOx	5,974	7,291	7,466	4,158
AERA ENERGY LLC	S	1851	2	NOx	914	455	0	1,154
AERA ENERGY LLC	S	1935	2	NOx	474	508	543	543
AERA ENERGY LLC	S	2023	2	NOx	1,108	636	737	993
AERA ENERGY LLC	S	2361	2	NOx	30	4	0	12
AERA ENERGY LLC	S	2774	2	NOx	5,817	4,899	4,757	8,181
AERA ENERGY LLC	S	2782	2	NOx	329	323	318	341
AERA ENERGY LLC	S	3267	2	NOx	5,519	3,439	0	2,156
AERA ENERGY LLC	S	3312	2	NOx	2,432	4,568	1,346	162
AERA ENERGY LLC	S	3689	2	NOx	76,465	88,497	87,135	83,102
AERA ENERGY LLC	S	3831	2	NOx	8,498	5,583	30	1,326
AERA ENERGY LLC	S	4063	2	NOx	573	515	438	663
AERA ENERGY LLC	S	4064	2	NOx	359	564	674	586
AERA ENERGY LLC	S	4422	2	NOx	6,370	2,050	2,897	6,316
AERA ENERGY LLC	S	4932	2	NOx	90,546	80,916	29,850	74,333
AERA ENERGY LLC	S	5109	2	NOx	7	9	7	6
AGRI-CEL INC	S	3631	2	NOx	54	67	63	8
ALON BAKERSFIELD REFINING	S	5176	2	NOx	90,450	92,839	95,280	95,280
ALON BAKERSFIELD REFINING	S	5183	2	NOx	1,080	1,344	1,267	1,431

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
ALON BAKERSFIELD REFINING	S	5186	2	NOx	4,645	5,658	5,190	4,325
ALTA VISTA GIN/MURRIETA FARM	C	1445	2	NOx	0	0	0	171
ANDERSON CLAYTON CORP	C	1279	2	NOx	0	0	0	754
ANEW ENVIRONMENTAL, LLC	S	5310	2	NOx	801	757	688	705
AVENAL POWER CENTER, LLC	C	899	2	NOx	2,243	2,243	2,243	2,243
AVENAL POWER CENTER, LLC	C	902	2	NOx	13,879	6,131	1,086	8,539
BAKER COMMODITIES INC	N	482	2	NOx	1,194	1,194	1,196	1,194
BASF CORPORATION	S	5214	2	NOx	41	11	25	61
BENTA ENERGY LLC	C	1490	2	NOx	0	0	0	873
BENTA ENERGY LLC ERC PLACEHOLDER	N	1586	2	NOx	750	750	750	750
BENTA ENERGY LLC ERC PLACEHOLDER	N	1592	2	NOx	4,963	786	9,140	4,963
BENTA ENERGY LLC ERC PLACEHOLDER	N	1601	2	NOx	82	82	82	81
BERRY PETROLEUM COMPANY LLC	S	4888	2	NOx	0	0	77	278
BERRY PETROLEUM COMPANY LLC	S	4889	2	NOx	8,556	0	0	0
BERRY PETROLEUM COMPANY, LLC	N	1443	2	NOx	112	112	112	112
BERRY PETROLEUM COMPANY, LLC	N	1538	2	NOx	503	503	503	502
BRITZ AG FINANCE CO., INC.	C	557	2	NOx	0	0	0	232
BRITZ GIN PARTNERSHIP II	C	871	2	NOx	0	0	0	585
BRITZ INCORPORATED	C	586	2	NOx	0	0	0	381
BROWN SAND INC	N	46	2	NOx	90	98	46	83
BRUCE R. CARTER	S	5239	2	NOx	25	31	29	4
BUILDING MATERIALS MANUF CORP	S	1662	2	NOx	5,832	5,840	5,848	5,848
BUTTONWILLOW GINNING CO	S	4634	2	NOx	0	0	0	520
CALAVERAS MATERIALS INC.	C	233	2	NOx	1,265	3,371	3,913	2,469
CALIFORNIA DAIRIES	N	1341	2	NOx	1,486	265	264	264
CALIFORNIA DAIRIES	N	1604	2	NOx	916	916	915	915
CALIFORNIA DAIRIES INC	N	707	2	NOx	0	1,270	1,363	226
CALIFORNIA DAIRIES INC	S	2293	2	NOx	32	33	32	32

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA DAIRIES INC	S	2731	2	NOx	50	0	24	1,282
CALIFORNIA DAIRIES, INC.	C	635	2	NOx	22	22	22	22
CALIFORNIA DAIRIES, INC.	C	658	2	NOx	0	0	102	75
CALIFORNIA DAIRIES, INC.	C	1364	2	NOx	450	126	356	79
CALIFORNIA HEAVY OIL, INC.	N	1554	2	NOx	0	162	162	0
CALIFORNIA HEAVY OIL, INC.	N	1555	2	NOx	0	87	131	0
CALIFORNIA NATURAL COLOR	C	1209	2	NOx	13	13	12	15
CALIFORNIA RESOURCES ELK HILLS LLC	S	3249	2	NOx	89	208	73	157
CALIFORNIA RESOURCES ELK HILLS LLC	S	4196	2	NOx	109	69	138	148
CALIFORNIA RESOURCES ELK HILLS LLC	S	4436	2	NOx	1,735	332	662	1,082
CALIFORNIA RESOURCES ELK HILLS LLC	S	4701	2	NOx	0	0	0	543
CALIFORNIA RESOURCES ELK HILLS LLC	S	4707	2	NOx	10,221	11,071	14,626	14,976
CALIFORNIA RESOURCES ELK HILLS LLC	S	4945	2	NOx	1,500	1,500	1,500	1,500
CALIFORNIA RESOURCES ELK HILLS LLC	S	4998	2	NOx	15,781	15,781	15,781	15,781
CALIFORNIA RESOURCES ELK HILLS LLC	S	5153	2	NOx	6,160	6,160	6,160	6,159
CALIFORNIA RESOURCES PRODUCTION CORP	N	1165	2	NOx	456	465	456	456
CALIFORNIA RESOURCES PRODUCTION CORP	N	1235	2	NOx	3,614	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1245	2	NOx	1,219	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1517	2	NOx	750	750	750	750
CALIFORNIA RESOURCES PRODUCTION CORP	N	1529	2	NOx	2,500	2,500	2,500	2,500
CALIFORNIA RESOURCES PRODUCTION CORP	S	3586	2	NOx	0	1,512	6,228	0

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA RESOURCES PRODUCTION CORP	S	3588	2	NOx	1,847	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4093	2	NOx	159	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4434	2	NOx	0	5,255	2,832	6,776
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1335	2	NOx	456	456	456	456
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1343	2	NOx	4,973	4,972	4,973	4,738
CALIFORNIA RESOURCES PRODUCTION CORP.	N	346	2	NOx	0	165	1,432	14
CALIFORNIA RESOURCES PRODUCTION CORP.	N	1481	2	NOx	107	107	107	99
CALIFORNIA STATE PRISON - CORCORAN	S	3112	2	NOx	135	137	137	138
CALMAT CO.	C	50	2	NOx	104	111	154	159
CALNEV PIPE LINE LLC	S	2553	2	NOx	1,886	1,886	1,886	1,886
CALPINE CORP	S	3298	2	NOx	2,103	9,681	19,140	9,076
CALPINE CORP	S	3541	2	NOx	0	242	0	0
CALPINE ENERGY SERVICES LP	S	3138	2	NOx	0	0	0	760
CALPINE ENERGY SERVICES LP	S	3277	2	NOx	6,400	0	3,870	1,876
CALPINE ENERGY SERVICES, L.P.	N	845	2	NOx	4,089	4,089	4,089	3,093
CALPINE ENERGY SERVICES, L.P.	N	846	2	NOx	4,429	4,429	4,429	3,353
CALPINE ENERGY SERVICES, L.P.	N	903	2	NOx	5,833	5,834	5,834	5,833
CALPINE ENERGY SERVICES, LP	C	1014	2	NOx	302	0	0	852
CALPINE ENERGY SERVICES, LP	C	1040	2	NOx	0	0	0	684
CAMPBELL SOUP CO	N	127	2	NOx	1,515	454	409	924
CANANDAIGUA WINE COMPANY INC	C	1203	2	NOx	354	358	380	334

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CANDLEWICK YARNS	C	507	2	NOx	90	77	63	58
CHEMICAL WASTE MANAGEMENT, INC	N	687	2	NOx	7	7	6	6
CHEVRON PIPE LINE COMPANY	S	404104		NOx	20,385	20,612	20,838	20,838
CHEVRON PIPE LINE-MIDDWAY	S	77	2	NOx	2,038	1,840	1,733	2,274
CHEVRON U S A INC	S	1428	2	NOx	1,968	1,990	2,011	2,011
CHEVRON U.S.A. INC.	N	1051	2	NOx	15,566	8,173	19,366	19,259
CHEVRON U.S.A. INC.	N	1052	2	NOx	0	0	8,139	0
CHEVRON U.S.A. INC.	N	1053	2	NOx	0	0	9,120	180
CHEVRON U.S.A. INC.	N	1054	2	NOx	500	500	500	500
CHEVRON USA INC	C	221	2	NOx	2,311	2,557	2,792	2,567
CHEVRON USA INC	C	331	2	NOx	23,739	23,739	23,740	23,740
CHEVRON USA INC	C	364	2	NOx	30,130	29,673	29,217	29,217
CHEVRON USA INC	C	1158	2	NOx	0	0	0	132
CHEVRON USA INC	C	1159	2	NOx	0	0	0	137
CHEVRON USA INC	C	1160	2	NOx	175	0	0	1,230
CHEVRON USA INC	C	1161	2	NOx	0	0	0	846
CHEVRON USA INC	S	629	2	NOx	2,316	2,041	2,088	1,975
CHEVRON USA INC	S	704	2	NOx	5,564	5,626	5,687	5,687
CHEVRON USA INC	S	909	2	NOx	3,990	3,412	3,474	3,072
CHEVRON USA INC	S	1100	2	NOx	62,167	62,857	63,548	63,548
CHEVRON USA INC	S	1102	2	NOx	57,160	57,795	58,430	58,430
CHEVRON USA INC	S	1106	2	NOx	11,814	11,942	12,075	12,075
CHEVRON USA INC	S	1256	2	NOx	45,238	45,741	46,244	46,244
CHEVRON USA INC	S	1419	2	NOx	4,875	4,928	4,983	4,983
CHEVRON USA INC	S	1445	2	NOx	17,602	20,114	20,328	15,867
CHEVRON USA INC	S	1470	2	NOx	780	789	797	797
CHEVRON USA INC	S	1487	2	NOx	11,663	11,793	11,923	11,923
CHEVRON USA INC	S	1605	2	NOx	5,672	7,143	7,028	6,447

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CHEVRON USA INC	S	1967	2	NOx	973	955	855	984
CHEVRON USA INC	S	2031	2	NOx	5,694	4,723	4,406	0
CHEVRON USA INC	S	2111	2	NOx	7,823	15,506	21,032	12,182
CHEVRON USA INC	S	2456	2	NOx	32,003	32,799	31,884	32,561
CHEVRON USA INC	S	3156	2	NOx	12,415	12,563	12,710	12,710
CHEVRON USA INC	S	3544	2	NOx	3,027	3,303	2,542	2,691
CHEVRON USA INC	S	3604	2	NOx	1,948	3,037	3,398	2,243
CHEVRON USA INC	S	3784	2	NOx	47,002	47,880	48,758	48,758
CHEVRON USA INC	S	3817	2	NOx	0	0	9,568	154
CHEVRON USA INC	S	3818	2	NOx	0	6,312	0	5,064
CHEVRON USA INC	S	4304	2	NOx	1,983	2,317	2,340	2,807
CHEVRON USA INC	S	4551	2	NOx	132,708	132,708	132,708	132,708
CHEVRON USA INC	S	4652	2	NOx	19,428	12,602	13,035	11,552
CHEVRON USA INC	S	4659	2	NOx	72	68	74	72
CHEVRON USA INC	S	4666	2	NOx	39,135	39,676	40,218	40,218
CHEVRON USA INC	S	4857	2	NOx	5,065	39	1,663	4,084
CHEVRON USA INC	S	5059	2	NOx	258	261	310	274
CHEVRON USA INC	S	204102		NOx	3,806	3,765	3,765	3,848
CHEVRON USA INC REFINERY	S	4573	2	NOx	24,199	24,787	25,374	25,374
CHEVRON USA PRODUCTION INC	S	674	2	NOx	507	781	226	485
CHEVRON USA PRODUCTION INC	S	3228	2	NOx	139	161	275	104
CHEVRON USA PRODUCTION INC	S	3533	2	NOx	181	188	224	219
CHEVRON USA, INC	S	436	2	NOx	12,891	9,861	9,530	10,101
CHEVRON USA, INC	S	3819	2	NOx	6,000	6,000	6,000	6,000
CHRISTOPHER RANCH LLC	C	1430	2	NOx	0	0	0	484
CITY OF FRESNO	S	4867	2	NOx	1,696	3,526	1,536	1,221
CITY OF FRESNO	S	4868	2	NOx	1,313	1,378	1,443	1,443
CITY OF FRESNO	S	5313	2	NOx	3,220	3,221	3,221	3,220

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CITY OF FRESNO	S	5317	2	NOx	1,077	304	1,854	1,077
CITY OF TULARE	N	902	2	NOx	0	436	436	471
CITY OF TULARE	S	3398	2	NOx	501	0	0	0
CITY OF VISALIA	N	317	2	NOx	0	0	7,160	0
CITY OF VISALIA	N	1465	2	NOx	403	0	0	0
CITY OF VISALIA	N	1467	2	NOx	1,085	1,097	0	807
CLARK BROTHERS-DERRICK GIN	C	511	2	NOx	0	0	0	43
CON AGRA FOOD INGREDIENTS CO	S	2201	2	NOx	6	6	5	5
CONAGRA FROZEN FOODS	N	487	2	NOx	356	163	243	300
CONAGRA FROZEN FOODS	N	856	2	NOx	0	0	1,749	0
CORCORAN IRRIGATION DISTRICT	C	560	2	NOx	352	356	321	209
COTTON ASSOCIATES, INC.	S	25	2	NOx	0	0	0	157
CRAYCROFT BRICK COMPANY	C	71	2	NOx	417	336	328	332
CRIMSON RESOURCE MANAGEMENT	S	2251	2	NOx	316	272	186	375
CRIMSON RESOURCE MANAGEMENT	S	3388	2	NOx	4,704	3,393	3,449	2,696
CRIMSON RESOURCE MANAGEMENT	S	3389	2	NOx	95	299	319	166
CRIMSON RESOURCE MANAGEMENT	S	3441	2	NOx	5	4	4	5
CXA LA PALOMA, LLC	N	1457	2	NOx	0	9,612	22,455	0
DAIRY FARMERS OF AMERICA, INC.	C	689	2	NOx	0	0	253	0
DARLING INGREDIENTS INC	C	1298	2	NOx	0	0	0	270
DARLING INTERNATIONAL INC	N	1225	2	NOx	0	51	107	0
DARLING INTERNATIONAL INC	S	4346	2	NOx	911	860	804	641
DIAMOND FOODS, LLC	N	573	2	NOx	1	1	0	0
DIAMOND FOODS, LLC	N	826	2	NOx	4,443	2,607	2,618	0
DIAMOND PET FOODS - RIPON	N	1525	2	NOx	7,000	7,000	7,000	7,000
E & J GALLO WINERY	N	1512	2	NOx	9,542	9,179	10,501	9,541
E & J GALLO WINERY	N	1568	2	NOx	5,000	5,000	5,000	5,000
E&B NATURAL RESOURCES MGMT	S	4774	2	NOx	91	93	100	102

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
E&B NATURAL RESOURCES MGMT	S	4880	2	NOx	0	0	0	83
E&B NATURAL RESOURCES MGMT	S	4957	2	NOx	38	38	36	36
E&B NATURAL RESOURCES MGMT	S	5029	2	NOx	57	57	54	54
E&B NATURAL RESOURCES MGMT	S	5052	2	NOx	244	244	239	239
E&B NATURAL RESOURCES MGMT	S	5088	2	NOx	245	245	240	240
E&B NATURAL RESOURCES MGMT	S	5131	2	NOx	850	850	850	750
E&B NATURAL RESOURCES MGMT	S	5168	2	NOx	304	327	351	351
E&B NATURAL RESOURCES MGMT	S	5223	2	NOx	1,811	1,811	1,811	1,811
E&B NATURAL RESOURCES MGMT	S	5224	2	NOx	2,165	2,165	2,166	2,165
EAGLE VALLEY GINNING LLC	N	847	2	NOx	0	0	0	427
ECKERT COLD STORAGE CO.	N	133	2	NOx	146	545	2,047	395
ELBOW ENTERPRISES INC	S	2535	2	NOx	0	0	0	1,168
ELEMENT MARKETS EMISSIONS LLC	C	1472	2	NOx	10	0	0	85
ELEMENT MARKETS EMISSIONS LLC	C	1508	2	NOx	52	77	45	3
ELEMENT MARKETS EMISSIONS LLC	C	1510	2	NOx	0	13	14	0
ELEMENT MARKETS LLC	S	5245	2	NOx	31,826	19,875	32,547	33,460
ELEMENT MARKETS LLC	S	5314	2	NOx	1,597	17,282	29,381	10,860
ELEMENT MARKETS, LLC	N	1327	2	NOx	364	328	400	391
ELK HILLS POWER, LLC	S	1994	2	NOx	12,485	12,624	12,762	12,762
ELK HILLS POWER, LLC	S	5045	2	NOx	439	455	470	469
EXXONMOBIL CORP	S	4544	2	NOx	5,175	5,197	5,494	4,871
EXXONMOBIL CORP	S	4545	2	NOx	3,010	2,818	2,052	3,565
EXXONMOBIL CORP	S	4546	2	NOx	1,648	1,666	1,685	1,685
FARMERS COOPERATIVE GIN INC	S	2533	2	NOx	0	0	0	598
FEDERAL POWER AVENAL LLC	N	720	2	NOx	0	9	1,255	437
FEDERAL POWER AVENAL LLC	N	722	2	NOx	0	1,166	88,317	1,422
FEDERAL POWER AVENAL LLC	N	726	2	NOx	0	0	4,728	0
FEDERAL POWER AVENAL LLC	N	728	2	NOx	10,542	3,731	2,487	5,171

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
FEDERAL POWER AVENAL LLC	S	2814	2	NOx	6,121	13,869	18,914	11,461
FEDERAL POWER AVENAL LLC	S	4946	2	NOx	49,500	49,500	49,500	49,500
FRESNO/CLOVIS REGIONAL WWTP	C	1211	2	NOx	65	65	65	65
FRESNO/CLOVIS REGIONAL WWTP	N	1493	2	NOx	2,558	2,559	2,557	2,557
FRESNO/CLOVIS REGIONAL WWTP	N	1595	2	NOx	525	525	525	525
FRESNO/CLOVIS REGIONAL WWTP	N	1598	2	NOx	311	287	335	311
FRITO-LAY INC	S	5253	2	NOx	6,427	6,614	6,784	6,783
FRITO-LAY, INC.	S	3763	2	NOx	287	442	182	53
FUTURE ENERGY, LLC	C	1489	2	NOx	107	0	0	322
FUTURE ENERGY, LLC	S	5117	2	NOx	215	321	321	0
GALLO GLASS COMPANY	N	966	2	NOx	63,525	46,849	57,176	61,929
GALLO GLASS COMPANY	N	1563	2	NOx	58,657	56,881	63,053	52,691
GENERAL MILLS INC	N	610	2	NOx	52	3	0	100
GENERAL MILLS INC	S	3217	2	NOx	0	0	0	30
GLOBAL AMPERSAND LLC	S	2976	2	NOx	239	239	239	239
GRADE 6 OIL LLC-KRH	C	1480	2	NOx	1,038	1,037	1,037	1,037
GROWERS COOP	S	88	2	NOx	0	0	22	406
GUARDIAN INDUSTRIES HOLDINGS, LLC	C	1514	2	NOx	19,830	19,688	19,996	19,903
GUARDIAN INDUSTRIES, LLC	C	1433	2	NOx	11,746	11,746	11,745	11,744
H J HEINZ COMPANY	N	534	2	NOx	0	360	3,207	0
H J HEINZ COMPANY	N	694	2	NOx	0	43	2,570	0
H J HEINZ COMPANY	N	1085	2	NOx	69	70	60	30
H. J. HEINZ COMPANY, L.P.	N	21	2	NOx	0	1,026	3,112	1,060
HANSEN BROTHERS	C	249	2	NOx	0	0	0	256
HERSHEY CHOCOLATE & CONF CORP	N	952	2	NOx	114	106	125	125
HILMAR CHEESE CO	S	2138	2	NOx	0	0	0	1,070
HOLMES WESTERN OIL CORP	S	3377	2	NOx	1,633	1,632	1,632	1,632
HYDROGEN ENERGY CA LLC	C	1058	2	NOx	10,100	10,100	10,100	10,100

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
HYDROGEN ENERGY CALIFORNIA LLC	S	3273	2	NOx	120,500	120,500	120,500	120,500
INGREDION INCORPORATED	N	1593	2	NOx	8,448	0	0	7,391
J G BOSWELL CO	S	5079	2	NOx	0	0	0	1,035
J.G. BOSWELL COMPANY	C	135	2	NOx	14	4	0	40
JOHN T HOPPER	C	712	2	NOx	0	55	295	56
KAWEAH DELTA DISTRICT HOSPITAL	S	2657	2	NOx	100	441	536	667
KERN DELTA CO LLC	S	4315	2	NOx	0	0	0	622
KERN LAKE COOP GIN	S	2074	2	NOx	0	0	0	309
KERN OIL & REFINING CO	S	4976	2	NOx	129	223	215	279
KERN OIL & REFINING CO	S	5102	2	NOx	94	277	91	1
KERN OIL & REFINING COMPANY	C	1500	2	NOx	2,061	3,081	1,613	0
KERN OIL & REFINING COMPANY	N	1470	2	NOx	48	74	123	93
KRAFT FOODS INC	C	149	2	NOx	284	284	284	284
KRAFT FOODS INC	C	386	2	NOx	9,774	9,883	9,992	9,992
KRAFT FOODS INC	C	387	2	NOx	5	5	4	4
KRAFT FOODS INC	C	1138	2	NOx	0	0	0	1,632
LACTALIS HERITAGE DAIRY, INC.	S	5273	2	NOx	0	0	3,425	1,107
LACTALIS HERITAGE DAIRY, INC.	S	5274	2	NOx	2,070	0	0	94
LACTALIS HERITAGE DAIRY, INC.	S	5275	2	NOx	0	0	0	24
LACTALIS HERITAGE DAIRY, INC.	S	5276	2	NOx	1,227	3,443	0	733
LACTALIS HERITAGE DAIRY, INC.	S	5279	2	NOx	0	0	165	0
LAWRENCE LIVERMORE NATL SECURITY, LLC	N	464	2	NOx	83	31	0	61
LEHIGH HANSON WEST REGION	C	89	2	NOx	284	257	294	236
LEPRINO FOODS	N	108	2	NOx	2,335	2,529	2,412	2,143
LEPRINO FOODS COMPANY	C	60	2	NOx	7,878	7,985	7,810	7,898
LIDESTRI FOODS, INC	N	391	2	NOx	0	0	1,527	0

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
LOCKHEED MARTIN AERONAUTICS COMPANY	N	1437	2	NOx	500	500	500	500
LOCKHEED MARTIN AERONAUTICS COMPANY	N	1471	2	NOx	500	500	500	500
LOCKHEED MARTIN AERONAUTICS COMPANY	N	1485	2	NOx	500	500	500	500
LOS BANOS ASPHALT COMPANY	N	125	2	NOx	23	113	359	120
LOS GATOS TOMATO PRODUCTS	C	1021	2	NOx	0	4	0	0
LOVELACE & SONS FARMING	C	807	2	NOx	0	0	0	257
MACPHERSON OIL CO	S	4132	2	NOx	145	145	145	145
MACPHERSON OIL COMPANY	C	1195	2	NOx	73	73	73	73
MACPHERSON OIL COMPANY	N	1339	2	NOx	1,368	1,367	1,368	1,368
MADERA DP 2, LLC	S	4989	2	NOx	2,100	2,100	2,100	2,100
MALAGA POWER, LLC	C	1355	2	NOx	0	0	1,029	0
MEMORIAL MEDICAL CENTER	S	2268	2	NOx	2,550	2,550	2,550	2,550
MERCED CO COMMUNITY & ECONOMIC DEV DEPT	N	109	2	NOx	38,954	39,386	39,819	39,819
MID - GENERATION MANAGER	N	430	2	NOx	0	0	273	0
MID-SET COGENERATION COMPANY	S	4860	2	NOx	9,685	9,949	10,041	10,012
MIDSTREAM ENERGY PARTNERS (USA) LLC	S	5070	2	NOx	14	14	14	14
MIDSTREAM ENERGY PARTNERS (USA) LLC	S	5074	2	NOx	47	137	86	23
MIDSTREAM ENERGY PARTNERS (USA) LLC	S	5075	2	NOx	125	125	125	125
MIDWAY PEAKING LLC	S	4234	2	NOx	283	283	496	354
MODESTO IRRIGATION DISTRICT	C	1111	2	NOx	0	0	74	5,923
MONTEREY RESOURCES, INC.	S	432	2	NOx	2,053	2,081	1,707	1,898
MT VERNON RECYCLING & COMPOSTING FAC	S	2969	2	NOx	1,564	2,135	2,265	1,857
NAS LEMOORE	C	1048	2	NOx	26	26	25	25

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
NORTHERN CALIFORNIA POWER AGENCY	C	1132	2	NOx	0	137	122	117
NORTHERN CALIFORNIA POWER AGENCY	C	1268	2	NOx	0	0	2,196	1,831
NORTHERN CALIFORNIA POWER AGENCY	N	751	2	NOx	0	0	10,015	0
NORTHERN CALIFORNIA POWER AGENCY	N	752	2	NOx	0	791	835	0
NORTHERN CALIFORNIA POWER AGENCY	N	1028	2	NOx	0	274	790	147
NORTHERN CALIFORNIA POWER AGENCY	S	2854	2	NOx	0	1,437	0	0
NORTHERN CALIFORNIA POWER AGENCY	S	2857	2	NOx	0	0	0	1,031
NORTHERN CALIFORNIA POWER AGENCY	S	2895	2	NOx	0	0	0	3,406
NORTHERN CALIFORNIA POWER AGENCY	S	4180	2	NOx	0	0	0	1,865
NORTHROP GRUMMAN CORPORATION	N	992	2	NOx	2,000	2,000	2,000	2,000
OAKWOOD LAKE RESORT	N	601	2	NOx	0	117	188	0
OLAM SVI	N	1426	2	NOx	0	0	1,641	329
OLDUVAI GORGE LLC	N	1528	2	NOx	42,815	40,928	40,766	45,002
OLDUVAI GORGE LLC	N	1572	2	NOx	875	927	771	876
OLDUVAI GORGE LLC	N	1599	2	NOx	1,843	0	0	1,040
OLDUVAI GORGE LLC	S	5281	2	NOx	0	17,553	0	0
OLDUVAI GORGE LLC	S	5318	2	NOx	12,861	0	0	2,609
OLDUVAI GORGE, LLC	C	998	2	NOx	0	0	0	815
OLDUVAI GORGE, LLC	C	1540	2	NOx	0	298	1,590	300
OLDUVAI GORGE, LLC	C	1541	2	NOx	0	286	1,530	289
OXY USA, INC	N	1196	2	NOx	0	396	665	0
PACIFIC COAST PRODUCERS	N	753	2	NOx	195	605	3,088	312
PACIFIC GAS & ELECTRIC CO	S	4404	2	NOx	30	16	55	63
PACIFIC PIPELINE SYSTEM LLC	S	575	2	NOx	0	4,693	10,418	3,569
PACIFIC PIPELINE SYSTEM LLC	S	1099	2	NOx	0	13,703	12,649	0
PACIFIC PIPELINE SYSTEM LLC	S	2286	2	NOx	1,278	2,194	2,438	2,438
PACTIV, LLC	S	3863	2	NOx	233	199	51	109
PARAMOUNT FARMS	N	1325	2	NOx	14,475	14,475	14,475	14,475

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
PARAMOUNT FARMS INC	N	284	2	NOx	3,670	3,580	3,488	3,488
PARAMOUNT FARMS, INC.	C	1462	2	NOx	480	550	515	514
PASTORIA ENERGY FACILITY LLC	S	1543	2	NOx	10,354	8,381	11,018	11,467
PASTORIA ENERGY FACILITY LLC	S	4163	2	NOx	164,079	166,154	168,230	169,711
PASTORIA ENERGY LLC	C	755	2	NOx	2,525	1,011	0	2,038
PHILLIPS 66 PIPELINE LLC	C	1163	2	NOx	0	0	17	0
PILKINGTON NORTH AMERICA INC	N	410	2	NOx	272	4	43	275
PLAINS LPG SERVICES, L.P.	C	717	2	NOx	1,024	1,024	1,023	1,023
PONDEROSA PAINT CO	C	1463	2	NOx	502	502	423	423
R F MACDONALD	C	579	2	NOx	0	8	0	0
R M WADE & COMPANY	C	152	2	NOx	326	373	379	370
SAN JOAQUIN REFINING CO	S	4452	2	NOx	0	1	1	0
SAN JOAQUIN REFINING COMPANY	C	1341	2	NOx	616	8	41	283
SAPUTO CHEESE USA, INC.	N	834	2	NOx	1,810	1,810	1,810	1,810
SENECA RESOURCES	N	906	2	NOx	183	517	517	517
SENECA RESOURCES	N	1416	2	NOx	226	227	225	225
SENECA RESOURCES COMPANY, LLC	S	1427	2	NOx	88	57	76	98
SENECA RESOURCES COMPANY, LLC	S	3718	2	NOx	0	118	0	0
SENECA RESOURCES COMPANY, LLC	S	4578	2	NOx	18	18	18	18
SENECA RESOURCES COMPANY, LLC	S	4829	2	NOx	18	18	18	18
SENECA RESOURCES COMPANY, LLC	S	4864	2	NOx	27	27	27	26
SENECA RESOURCES COMPANY, LLC	S	5086	2	NOx	374	374	372	373
SENTINEL PEAK RESOURCES CA LLC	N	1484	2	NOx	899	877	794	502
SENTINEL PEAK RESOURCES CA LLC	S	4835	2	NOx	13,229	10,050	6,765	15,163
SENTINEL PEAK RESOURCES CA LLC	S	4836	2	NOx	10,010	10,691	10,155	6,716
SENTINEL PEAK RESOURCES CA LLC	S	4838	2	NOx	1,411	73	1,449	2,071
SENTINEL PEAK RESOURCES CA LLC	S	4839	2	NOx	148	148	148	148
SENTINEL PEAK RESOURCES CA LLC	S	5203	2	NOx	14,422	11,783	11,330	12,832

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
SETTON PISTACHIO OF TERRA BELLA	S	5307	2	NOx	0	5,000	0	0
SHAFTER-WASCO GINNING CO	S	3268	2	NOx	0	0	0	232
SOUTH VALLEY GINS INC	S	3554	2	NOx	0	0	0	192
SOUTH VALLEY GINS INC	S	4635	2	NOx	77	0	0	752
SOUTHERN CALIF GAS CO	S	1016	2	NOx	283	288	289	289
SOUTHERN CALIFORNIA GAS	N	299	2	NOx	0	1,311	1,415	0
SPRECKELS SUGAR COMPANY INC.	C	1464	2	NOx	0	3,701	5,023	2,200
STOCKTON EAST WATER DISTRICT	N	763	2	NOx	2,654	3,705	3,750	3,359
STOCKTON MUNICIPAL UTIL DEPT	N	1600	2	NOx	418	418	418	419
STRATAS FOODS LLC	C	1020	2	NOx	0	0	0	108
SUN GARDEN-GANGI CANNING CO., LLC	N	222	2	NOx	0	0	12,886	540
SYNAGRO WWT, INC.	S	3855	2	NOx	925	925	925	925
TAUBER OIL CO	S	5118	2	NOx	14	825	130	195
TESLA INC	N	1527	2	NOx	3,750	3,750	3,750	3,750
TESLA, INC	S	5295	2	NOx	12,500	12,500	12,500	12,500
TEXACO EXPLOR. & PROD. INC.	S	202503		NOx	7,037	7,356	6,314	6,778
THE BEVERAGE SOURCE	N	92	2	NOx	220	800	520	900
THE NESTLE COMPANY INC	N	508	2	NOx	2,975	2,444	1,853	3,352
TRIANGLE PACIFIC CORPORATION	N	18	2	NOx	187	54	54	161
TRI-CITY GROWERS INC	S	4392	2	NOx	54	0	0	229
TULE RIVER TRIBE GAMING AUTHORITY	S	5244	2	NOx	17,800	17,800	17,800	17,800
TURLOCK IRRIGATION DISTRICT	S	3707	2	NOx	3,442	2,862	2,277	2,277
UNITED STATES GYPSUM CO	S	2543	2	NOx	0	0	0	311
UNITED STATES GYPSUM CO	S	2815	2	NOx	39,560	6,703	27,282	33,352
UNITED STATES GYPSUM COMPANY	C	818	2	NOx	0	0	0	734
UNITED STATES GYPSUM COMPANY	N	662	2	NOx	308	36,838	15,649	308
VALLEY AIR CONDITIONING & REPAIR INC	C	693	2	NOx	0	0	108	0
VECTOR ENVIRONMENTAL INC	S	4039	2	NOx	102	125	117	15

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
VINTAGE PRODUCTION CALIFORNIA LLC	S	4088	2	NOx	80	80	80	80
VINTAGE PRODUCTION CALIFORNIA LLC	S	4484	2	NOx	860	860	860	861
VINTAGE PRODUCTION CALIFORNIA LLC	S	5096	2	NOx	783	782	781	781
VULCAN MATERIALS	C	40	2	NOx	74	355	163	547
WELLHEAD POWER LLC	C	874	2	NOx	0	3	3	0
WESTERN STONE PRODUCTS INC	N	17	2	NOx	543	543	619	619
WESTLAKE FARMS INC	C	645	2	NOx	0	0	0	498
WESTSIDE FARMERS COOP #2 AND #3	C	1038	2	NOx	109	0	0	1,122
WILTON RANCHERIA	N	1395	2	NOx	26,875	26,875	26,875	26,875
WONDERFUL PISTACHIOS & ALMOND LLC	N	1571	2	NOx	39,357	38,222	45,797	42,147
WONDERFUL PISTACHIOS & ALMOND LLC	N	1590	2	NOx	8,000	8,000	8,000	8,000
WONDERFUL PISTACHIOS & ALMONDS	C	1453	2	NOx	10,770	10,770	4,237	2,485
WONDERFUL PISTACHIOS & ALMONDS	C	1471	2	NOx	113	113	112	112
3H CATTLE CO	S	3672	5	SOx	0	14	0	0
ACMII CA 6, LLC DBA COLUMBINE VINEYARDS	S	2516	5	SOx	0	0	2	0
AERA ENERGY LLC	S	272	5	SOx	1735	2907	1810	2494
AERA ENERGY LLC	S	284	5	SOx	19831	12103	6514	16106
AERA ENERGY LLC	S	395	5	SOx	4836	5200	5928	5651
AERA ENERGY LLC	S	548	5	SOx	2803	26	0	0
AERA ENERGY LLC	S	556	5	SOx	1379	869	781	989
AERA ENERGY LLC	S	790	5	SOx	2	1	1	2
AERA ENERGY LLC	S	841	5	SOx	26339	26631	26924	26924
AERA ENERGY LLC	S	847	5	SOx	153	227	173	72
AERA ENERGY LLC	S	863	5	SOx	6	7	13	12
AERA ENERGY LLC	S	989	5	SOx	0	2808	0	0
AERA ENERGY LLC	S	998	5	SOx	735	0	0	0

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
AERA ENERGY LLC	S	1000	5	SOx	138	2811	489	10
AERA ENERGY LLC	S	1001	5	SOx	275	583	0	0
AERA ENERGY LLC	S	1032	5	SOx	28371	72172	48856	9900
AERA ENERGY LLC	S	1057	5	SOx	4	5	4	3
AERA ENERGY LLC	S	1071	5	SOx	10682	10682	10682	10682
AERA ENERGY LLC	S	1072	5	SOx	5	4	4	4
AERA ENERGY LLC	S	1073	5	SOx	2	2	2	2
AERA ENERGY LLC	S	1075	5	SOx	0	1	0	0
AERA ENERGY LLC	S	1076	5	SOx	12	11	13	11
AERA ENERGY LLC	S	1077	5	SOx	79	176	164	173
AERA ENERGY LLC	S	1091	5	SOx	57	70	71	71
AERA ENERGY LLC	S	1133	5	SOx	436	877	687	281
AERA ENERGY LLC	S	1295	5	SOx	1289	2983	696	488
AERA ENERGY LLC	S	1339	5	SOx	102863	63756	0	10468
AERA ENERGY LLC	S	1476	5	SOx	21	0	0	6
AERA ENERGY LLC	S	1477	5	SOx	36	0	0	10
AERA ENERGY LLC	S	1865	5	SOx	5592	4295	5749	5942
AERA ENERGY LLC	S	2010	5	SOx	0	3320	0	0
AERA ENERGY LLC	S	2019	5	SOx	582	589	597	597
AERA ENERGY LLC	S	2361	5	SOx	542	71	2	215
AERA ENERGY LLC	S	3310	5	SOx	281	227	223	281
AERA ENERGY LLC	S	3363	5	SOx	21065	27266	29310	28564
AERA ENERGY LLC	S	3525	5	SOx	1902	1902	1902	1902
AERA ENERGY LLC	S	3685	5	SOx	52466	53256	54044	54044
AERA ENERGY LLC	S	3833	5	SOx	16508	18345	2147	8994
AERA ENERGY LLC	S	4286	5	SOx	16674	26211	11387	5910
AERA ENERGY LLC	S	4934	5	SOx	85022	40042	56575	91420
AERA ENERGY LLC	S	5110	5	SOx	16	20	16	13

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
AERA ENERGY LLC	S	5219	5	SOx	100791	66432	0	24770
AGRI-CEL INC	S	3631	5	SOx	12	14	13	1
ALON BAKERSFIELD REFINING	S	5177	5	SOx	4577	4354	5173	4134
ALON BAKERSFIELD REFINING	S	5181	5	SOx	5174	5397	4576	5615
ALON BAKERSFIELD REFINING	S	5182	5	SOx	2802	13301	9451	16907
ALTA VISTA GIN/MURRIETA FARM	C	1445	5	SOx	0	0	0	19
ANDERSON CLAYTION-MARICOPA GIN	S	697	5	SOx	0	0	0	3
ANDERSON CLAYTON CORP	C	75	5	SOx	0	0	0	28
ANDERSON CLAYTON CORP	C	76	5	SOx	0	0	0	3
ANDERSON CLAYTON CORP	C	78	5	SOx	0	0	0	31
ANDERSON CLAYTON CORP	C	79	5	SOx	0	0	0	22
ANDERSON CLAYTON CORP	C	80	5	SOx	0	0	0	2
ANDERSON CLAYTON CORP	C	81	5	SOx	0	0	0	2
ANDERSON CLAYTON CORP	C	250	5	SOx	0	0	0	42
ANDERSON CLAYTON CORP	C	326	5	SOx	0	0	0	22
ANDERSON CLAYTON CORP	C	333	5	SOx	0	0	0	6
ANDERSON CLAYTON CORP	C	334	5	SOx	0	0	0	9
ANDERSON CLAYTON CORP	C	335	5	SOx	0	0	0	6
ANDERSON CLAYTON CORP	C	336	5	SOx	0	0	0	9
ANDERSON CLAYTON CORP	C	427	5	SOx	0	0	0	3
ANDERSON CLAYTON CORP	C	472	5	SOx	0	0	0	21
ANDERSON CLAYTON CORP	C	959	5	SOx	0	0	0	53
ANDERSON CLAYTON CORP	S	314	5	SOx	0	0	0	2
ANDERSON CLAYTON CORP	S	471	5	SOx	0	0	0	1
ANDERSON CLAYTON CORP	S	1045	5	SOx	0	0	0	3
ANDERSON CLAYTON CORP	S	1171	5	SOx	0	0	0	3
ANDERSON CLAYTON CORP	S	1262	5	SOx	0	0	0	2
ANDERSON CLAYTON CORP	S	1263	5	SOx	1	0	0	3

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
ANDERSON CLAYTON CORP.	C	234	5	SOx	0	0	0	6
ANDERSON CLAYTON CORP.	C	460	5	SOx	0	0	0	4
ANDERSON CLAYTON CORP.	C	863	5	SOx	0	0	0	4
ANDERSON CLAYTON CORP.	N	181	5	SOx	0	0	0	1
ANDERSON CLAYTON CORP.	N	499	5	SOx	0	0	0	24
ANDERSON CLAYTON CORP/BURREL	C	806	5	SOx	3	0	0	7
ANDERSON CLAYTON CORP/BUTTE	C	699	5	SOx	0	0	0	31
ANDERSON CLAYTON CORP/DAIRYLAN	C	332	5	SOx	0	0	0	9
ANDERSON CLAYTON CORP/KERMAN	C	428	5	SOx	0	0	0	48
ANDERSON CLAYTON CORPORATION	N	135	5	SOx	0	0	0	1
ANDERSON CLAYTON CORPORATION	N	737	5	SOx	0	0	0	3
ATTN: COMPLIANCE OFFICER	C	21	5	SOx	10	10	10	10
BAR 20 PARTNERS LTD	N	612	5	SOx	0	0	79	0
BAR 20 PARTNERS LTD	N	617	5	SOx	0	0	304	0
BAR 20 PARTNERS LTD	N	778	5	SOx	0	0	1	0
BAR VP DAIRY	C	810	5	SOx	250	1096	0	682
BAR VP DAIRY	C	811	5	SOx	919	0	117	80
BAR VP DAIRY	N	638	5	SOx	0	0	0	32
BAR VP DAIRY	N	639	5	SOx	10	10	0	7
BAR VP DAIRY	N	640	5	SOx	0	0	16147	0
BAR VP HEIFER RANCH	S	4289	5	SOx	0	1	49	50
BASF CORPORATION	S	5214	5	SOx	1	0	1	1
BENTA ENERGY LLC	C	1557	5	SOx	1090	1090	1090	1090
BENTA ENERGY LLC	S	5292	5	SOx	123	123	124	124
BERRY PETROLEUM COMPANY LLC	S	4893	5	SOx	0	0	833	2467
BERRY PETROLEUM COMPANY, LLC	N	1536	5	SOx	629	628	628	628
BRITZ AG FINANCE CO., INC.	C	557	5	SOx	0	0	0	33
BRITZ GIN PARTNERSHIP II	C	871	5	SOx	0	0	0	4

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
BRITZ INCORPORATED	C	586	5	SOx	0	0	0	11
BROWN SAND INC	N	46	5	SOx	3	3	2	3
BRUCE R. CARTER	S	5239	5	SOx	5	7	6	1
BUILDERS CONCRETE, INC	C	41	5	SOx	8	8	8	8
BUTTONWILLOW GINNING CO	S	2937	5	SOx	0	0	0	4
BUTTONWILLOW GINNING CO	S	4634	5	SOx	0	0	0	20
CALAVERAS MATERIALS INC.	C	233	5	SOx	998	2716	3181	1989
CALIFORNIA DAIRIES INC	S	3058	5	SOx	1401	1401	1399	1399
CALIFORNIA DAIRIES, INC	N	986	5	SOx	9000	9000	9000	9000
CALIFORNIA RESOURCES ELK HILLS LLC	S	826	5	SOx	5	5	4	5
CALIFORNIA RESOURCES ELK HILLS LLC	S	4196	5	SOx	8	5	14	15
CALIFORNIA RESOURCES ELK HILLS LLC	S	4211	5	SOx	13	12	16	16
CALIFORNIA RESOURCES ELK HILLS LLC	S	4709	5	SOx	4691	4683	4680	4680
CALIFORNIA RESOURCES ELK HILLS, LLC.	N	1387	5	SOx	450	456	456	455
CALIFORNIA RESOURCES PRODUCTION CORP	N	1079	5	SOx	0	0	0	936
CALIFORNIA RESOURCES PRODUCTION CORP	N	1080	5	SOx	0	0	9774	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1118	5	SOx	250	250	250	250
CALIFORNIA RESOURCES PRODUCTION CORP	N	1129	5	SOx	212	212	212	212
CALIFORNIA RESOURCES PRODUCTION CORP	N	1150	5	SOx	250	250	250	250
CALIFORNIA RESOURCES PRODUCTION CORP	N	1249	5	SOx	3933	3933	3932	3932
CALIFORNIA RESOURCES PRODUCTION CORP	N	1497	5	SOx	3612	3611	3609	3608

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA RESOURCES PRODUCTION CORP	N	1524	5	SOx	20616	17953	11011	21192
CALIFORNIA RESOURCES PRODUCTION CORP	N	1531	5	SOx	2000	2000	2000	2000
CALIFORNIA RESOURCES PRODUCTION CORP	S	3593	5	SOx	494	494	492	492
CALIFORNIA RESOURCES PRODUCTION CORP	S	4016	5	SOx	325	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4017	5	SOx	5	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1201	5	SOx	1598	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1259	5	SOx	132	132	132	132
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1295	5	SOx	6500	6500	6500	6500
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1325	5	SOx	4493	4493	4493	4493
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1331	5	SOx	76	76	76	76
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1333	5	SOx	280	280	280	280
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1491	5	SOx	1000	1000	1000	1000
CALMAT CO.	C	50	5	SOx	39	41	58	59
CALPINE CORPORATION	N	844	5	SOx	6925	7045	7164	7164
CALPINE ENERGY SERVICES LP	S	3075	5	SOx	5080	12043	7319	15177
CALPINE ENERGY SERVICES LP	S	3279	5	SOx	1625	0	0	1339
CALPINE ENERGY SERVICES LP	S	3281	5	SOx	3875	5500	5500	4161

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALPINE ENERGY SERVICES LP	S	3294	5	SOx	4000	4000	4000	4000
CALPINE ENERGY SERVICES LP	S	3348	5	SOx	9536	6336	6163	6545
CALPINE ENERGY SERVICES LP	S	3356	5	SOx	24000	24000	24000	24000
CALPINE ENERGY SERVICES LP	S	4165	5	SOx	4332	1562	709	3781
CALPINE ENERGY SERVICES, L.P.	N	841	5	SOx	3041	1167	5891	3122
CALPINE ENERGY SERVICES, L.P.	N	893	5	SOx	0	0	0	52748
CAMPBELL SOUP CO	N	127	5	SOx	18	13	11	13
CAMPBELL SOUP SUPPLY CO	N	31	5	SOx	0	52	128	0
CANANDAIGUA WINE COMPANY INC	C	702	5	SOx	33	34	35	32
CANDLEWICK YARNS	C	507	5	SOx	5	5	4	4
CANTUA COOPERATIVE GIN, INC.	C	760	5	SOx	0	0	0	4
CENTRAL VALLEY EGGS LLC	S	4759	5	SOx	5785	5785	5785	5785
CES DELANO BECCS PLANT	S	2721	5	SOx	890	916	941	941
CHEVRON PIPE LINE-MIDDWAY	S	1542	5	SOx	25189	21032	18790	30130
CHEVRON USA INC	C	331	5	SOx	1576	1577	1577	1577
CHEVRON USA INC	C	339	5	SOx	4730	4730	4731	4731
CHEVRON USA INC	S	891	5	SOx	2712	2742	2773	2773
CHEVRON USA INC	S	906	5	SOx	2470	2498	2526	2526
CHEVRON USA INC	S	907	5	SOx	1527	1306	1330	1176
CHEVRON USA INC	S	1485	5	SOx	1890	1911	1931	1931
CHEVRON USA INC	S	2454	5	SOx	9938	15295	38474	24993
CHEVRON USA INC	S	4200	5	SOx	7613	17935	24182	23612
CHEVRON USA INC	S	4570	5	SOx	20808	21063	21319	21319
CHEVRON USA INC	S	4672	5	SOx	13830	11370	8398	3752
CHEVRON USA INC	S	4674	5	SOx	10743	16072	22931	32748
CHEVRON USA INC	S	4882	5	SOx	31253	31717	32161	32144
CHRISTOPHER RANCH LLC	C	1430	5	SOx	0	0	0	52
CITY OF TULARE	S	3396	5	SOx	26	26	26	26

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CLARK BROTHERS-DERRICK GIN	C	511	5	SOx	0	0	0	3
COALINGA FARMERS CO-OP GIN	C	537	5	SOx	0	0	0	14
COIT RANCH	C	532	5	SOx	0	0	0	4
CONAGRA FROZEN FOODS	N	489	5	SOx	7	4	5	6
CORCORAN IRRIGATION DISTRICT	C	560	5	SOx	4	5	4	3
COTTON ASSOCIATES, INC.	S	25	5	SOx	0	0	0	1
COW PALACE	S	2638	5	SOx	300	300	300	300
CRANBROOK ASSOCIATES LLC	N	140	5	SOx	24	24	391	31
CRAYCROFT BRICK COMPANY	C	71	5	SOx	2	2	2	2
DANELL BROTHERS INC	N	682	5	SOx	10000	10000	10000	10000
DEL MONTE FOODS MODESTO PLANT 1	N	1238	5	SOx	17	15	43	8
DIAMOND FOODS, LLC	N	645	5	SOx	2699	2294	2340	1357
DOLE PACKAGED FOODS LLC	N	520	5	SOx	1	3	9	8
DUNAVANT OF CALIFORNIA	C	297	5	SOx	22	29	19	25
DUNCAN ENTERPRISES	C	1550	5	SOx	3	3	3	2
E & J GALLO WINERY	S	5261	5	SOx	339	225	108	107
E&B NATURAL RESOURCES MGMT	S	5031	5	SOx	323	320	320	317
E&B NATURAL RESOURCES MGMT	S	5090	5	SOx	2350	2345	2335	2335
E&B NATURAL RESOURCES MGMT	S	5169	5	SOx	81	80	81	80
E&B NATURAL RESOURCES MGMT	S	5225	5	SOx	126	126	126	126
EAGLE VALLEY GINNING LLC	N	847	5	SOx	0	0	0	3
ECKERT COLD STORAGE CO.	N	133	5	SOx	1	3	9	8
ELBOW ENTERPRISES INC	S	2535	5	SOx	0	0	0	33
ELEMENT MARKETS EMISSIONS LLC	C	1508	5	SOx	18	27	16	1
ELEMENT MARKETS EMISSIONS LLC	C	1510	5	SOx	0	0	1	0
ELEMENT MARKETS LLC	S	5234	5	SOx	0	1081	5277	0
ELEMENT MARKETS, LLC	N	1327	5	SOx	20	18	22	22
ELK HILLS POWER, LLC	S	1950	5	SOx	496	306	118	118

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
EVOLUTION MARKETS LLC	C	882	5	SOx	0	0	0	23
EVOLUTION MARKETS LLC	S	2632	5	SOx	11102	11225	11348	11348
EVOLUTION MARKETS LLC	S	2741	5	SOx	0	0	8706	0
EVOLUTION MARKETS LLC	S	2742	5	SOx	5836	1652	9106	19927
EVOLUTION MARKETS LLC	S	2743	5	SOx	0	0	2666	551
EVOLUTION MARKETS LLC	S	2750	5	SOx	0	0	0	28
FARMERS COOPERATIVE GIN INC	S	2533	5	SOx	0	0	0	4
FARMERS FIREBAUGH GINNING CO.	C	956	5	SOx	2	0	0	6
FEDERAL POWER AVENAL LLC	N	762	5	SOx	21000	21000	21000	21000
FEDERAL POWER AVENAL LLC	S	2788	5	SOx	5	7	3	6
FEDERAL POWER AVENAL LLC	S	2789	5	SOx	6	14	12	8
FEDERAL POWER AVENAL LLC	S	2790	5	SOx	12862	491	0	8499
FEDERAL POWER AVENAL LLC	S	2791	5	SOx	92179	23666	69157	96288
FIBREBOARD CORP	N	209	5	SOx	9	7	4	10
FOSTER FARMS SPERRY RANCH	S	3795	5	SOx	175	175	0	0
FRESNO/CLOVIS REGIONAL WWTP	N	1489	5	SOx	0	0	922	921
FRESNO/CLOVIS REGIONAL WWTP	N	1491	5	SOx	921	922	0	0
FRESNO/CLOVIS REGIONAL WWTP	N	1573	5	SOx	15511	15511	13652	13652
FRITO-LAY INC	S	3767	5	SOx	5203	5000	8796	8796
FRITO-LAY, INC.	S	3423	5	SOx	137	176	113	64
FRITO-LAY, INC.	S	3427	5	SOx	8	8	9	9
FUTURE ENERGY, LLC	N	1513	5	SOx	83	83	83	84
GARY STOWE	C	1441	5	SOx	12	0	0	130
GENERAL MILLS INC	N	139	5	SOx	2	2	2	2
GLOBAL AMPERSAND LLC	S	2978	5	SOx	29	0	0	0
GRIMMIUS CATTLE CO	S	4739	5	SOx	0	0	404	0
GRIMMIUS CATTLE COMPANY	N	636	5	SOx	21307	28000	6627	20577
GROWERS COOP	S	88	5	SOx	0	0	0	3

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
GUARDIAN INDUSTRIES HOLDINGS, LLC	C	1513	5	SOx	70500	70500	70500	70500
GUARDIAN INDUSTRIES, LLC	C	1434	5	SOx	5217	5217	5217	5217
H J HEINZ COMPANY	N	60	5	SOx	0	0	32	0
H J HEINZ COMPANY	N	694	5	SOx	0	0	117	0
H J HEINZ COMPANY	N	1085	5	SOx	6	6	4	3
HANSEN BROTHERS	C	249	5	SOx	0	0	0	2
HARBERT ERC, LLC	C	1386	5	SOx	1694	1889	1916	2778
HERSHEY CHOCOLATE & CONF CORP	N	373	5	SOx	2	2	2	2
HERSHEY CHOCOLATE & CONF CORP	N	952	5	SOx	3	3	3	3
HYDROGEN ENERGY CA LLC	C	1058	5	SOx	24500	24500	24500	24500
HYDROGEN ENERGY CALIFORNIA LLC	S	3275	5	SOx	42000	42000	42000	42000
INGREDION INCORPORATED	N	264	5	SOx	39050	39050	39050	39050
INGREDION INCORPORATED	N	1086	5	SOx	51681	26912	37684	61746
INTERLAKE MATERIAL HANDLING	N	414	5	SOx	8	8	7	8
J G BOSWELL CO	S	5079	5	SOx	0	0	0	82
J R SIMPLOT COMPANY	N	1250	5	SOx	10191	18116	16984	11323
J.G. BOSWELL COMPANY	C	47	5	SOx	2	1	2	2
J.G. BOSWELL COMPANY	C	135	5	SOx	2	1	0	5
KERMAN CO-OP GIN & WAREHOUSE	C	1002	5	SOx	0	0	0	2
KERN DELTA CO LLC	S	4313	5	SOx	0	0	0	15
KERN DELTA CO LLC	S	4318	5	SOx	0	0	0	4
KERN LAKE COOP GIN	S	2074	5	SOx	0	0	0	14
KERN OIL & REFINING CO	S	3106	5	SOx	78598	78599	51520	78598
KERN OIL & REFINING CO	S	4963	5	SOx	7216	7216	7215	7215
KERN OIL & REFINING CO	S	4976	5	SOx	256	447	430	558
LATON CO-OP GIN, INC.	C	746	5	SOx	0	0	0	3
LAWRENCE LIVERMORE NATL SECURITY, LLC	N	464	5	SOx	30	11	0	22

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
LIDESTRI FOODS, INC	N	391	5	SOx	0	0	84	0
LODI GAS STORAGE LLC	N	515	5	SOx	5	5	5	5
LOS BANOS ASPHALT COMPANY	N	125	5	SOx	4	22	72	24
LOS GATOS TOMATO PRODUCTS	C	1021	5	SOx	0	1	0	0
MACPHERSON OIL CO	S	3927	5	SOx	0	3	13	4
MADERA CO-OP GIN, INC.	C	943	5	SOx	0	0	0	2
MERCED CO COMMUNITY & ECONOMIC DEV DEPT	N	109	5	SOx	3179	3214	3249	3249
MID-SET COGENERATION COMPANY	S	4860	5	SOx	92	94	94	93
MIDSTREAM ENERGY PARTNERS (USA) LLC	S	5078	5	SOx	290	290	290	290
MID-VALLEY COTTON GROWERS INC	S	2989	5	SOx	0	0	0	4
MINTURN CO-OP GIN	N	441	5	SOx	0	0	0	31
MODESTO IRRIGATION DISTRICT	C	599	5	SOx	2078	1671	0	0
MODESTO IRRIGATION DISTRICT	N	989	5	SOx	23945	25082	12500	0
MODESTO IRRIGATION DISTRICT	S	2686	5	SOx	25188	2688	78	8578
MOLYCORP MINERALS, LLC	N	938	5	SOx	8250	8250	8250	8250
MOLYCORP MINERALS, LLC	N	939	5	SOx	21899	23000	0	14704
MT VERNON RECYCLING & COMPOSTING FAC	S	2969	5	SOx	3	5	5	4
NAS LEMOORE	C	138	5	SOx	16	6	13	4
NAS LEMOORE	C	330	5	SOx	1	1	1	1
NAVERUS INC	N	526	5	SOx	1	1	1	1
NORTHERN CALIFORNIA POWER AGENCY	N	1022	5	SOx	0	0	5751	0
NORTHERN CALIFORNIA POWER AGENCY	S	4182	5	SOx	1504	0	9485	9940
NRG POWER MARKETING INC	C	426	5	SOx	16	13	5	15
OAKWOOD LAKE RESORT	N	601	5	SOx	0	0	1	0
OLAM SVI	N	1430	5	SOx	7118	18526	23007	910
OLAM SVI	N	1431	5	SOx	50	144	271	166

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
OLDUVAI GORGE LLC	N	769	5	SOx	13	12	12	12
OLDUVAI GORGE LLC	N	786	5	SOx	46	46	40	36
OLDUVAI GORGE LLC	N	1262	5	SOx	762	60023	0	0
OLDUVAI GORGE LLC	N	1264	5	SOx	46372	2294	0	0
OLDUVAI GORGE LLC	N	1458	5	SOx	0	0	399	396
OLDUVAI GORGE LLC	N	1459	5	SOx	15043	19226	0	0
OLDUVAI GORGE LLC	N	1574	5	SOx	48387	48264	0	0
OLDUVAI GORGE LLC	S	2483	5	SOx	0	0	1600	0
OLDUVAI GORGE LLC	S	2604	5	SOx	0	0	0	6
OLDUVAI GORGE LLC	S	2671	5	SOx	1744	1744	1744	1744
OLDUVAI GORGE LLC	S	4825	5	SOx	918	1079	1237	1238
OLDUVAI GORGE LLC	S	5011	5	SOx	19146	27918	5240	19190
PACIFIC PIPELINE SYSTEM LLC	S	575	5	SOx	1	39	115	24
PACIFIC PIPELINE SYSTEM LLC	S	576	5	SOx	0	175	161	0
PACIFIC PIPELINE SYSTEM LLC	S	577	5	SOx	42	57	61	61
PANOCHE ENERGY CENTER LLC	N	1177	5	SOx	2784	0	0	1787
PANOCHE ENERGY CENTER LLC	N	1179	5	SOx	0	0	24703	0
PANOCHE GINNING CO	C	904	5	SOx	0	0	0	5
PARAMOUNT FARMS, INC.	C	291	5	SOx	0	0	8	1
PARAMOUNT FARMS, INC.	C	501	5	SOx	26	81	126	112
PASTORIA ENERGY FACILITY LLC	S	2744	5	SOx	11324	11450	11576	11576
PG & E ENERGY TRADING POWER LP	N	200	5	SOx	8	999	321	8
PILKINGTON NORTH AMERICA INC	N	1542	5	SOx	31318	31005	35123	34851
PONDEROSA PAINT CO	C	1463	5	SOx	5	5	5	5
PSEG GLOBAL LLC	C	1385	5	SOx	1694	1889	1917	2778
R M WADE & COMPANY	C	152	5	SOx	2	2	2	2
R W MARTELLA	S	3108	5	SOx	0	351	351	922
RICHARD OPPEDYK	S	2620	5	SOx	2750	2750	2750	2750

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
RIVER RANCH FARMS	S	2930	5	SOx	4702	0	0	11853
RON VANDER WEERD	S	2751	5	SOx	6250	6200	6134	6249
RON VANDER WEERD/ROSALINDA VANDER WEERD	N	1108	5	SOx	0	0	6702	0
RON/ROSALINDA VANDER WEERD	C	883	5	SOx	0	3800	3800	0
RON/ROSALINDA VANDER WEERD	C	884	5	SOx	3750	0	66	3751
SAN JOAQUIN REFINING CO	S	4450	5	SOx	3	2	2	2
SAN JOAQUIN VALLEY ENERGY	N	129	5	SOx	391	555	565	244
SAN JOAQUIN VALLEY ENERGY PART	C	137	5	SOx	298	263	274	342
SAPUTO CHEESE USA INC - LEGAL DEPT	N	1361	5	SOx	1	0	0	0
SEMI TROPIC COOP GIN	S	426	5	SOx	0	0	0	2
SENECA RESOURCES COMPANY, LLC	S	3720	5	SOx	0	0	0	20
SENECA RESOURCES COMPANY, LLC	S	4580	5	SOx	4	4	4	4
SENECA RESOURCES COMPANY, LLC	S	4827	5	SOx	4	4	4	4
SENECA RESOURCES COMPANY, LLC	S	4831	5	SOx	59	58	59	58
SENECA RESOURCES COMPANY, LLC	S	4866	5	SOx	1	0	0	0
SENECA RESOURCES COMPANY, LLC	S	5084	5	SOx	101	100	100	99
SENTINEL PEAK RESOURCES CA LLC	C	1412	5	SOx	61	55	49	49
SENTINEL PEAK RESOURCES CA LLC	C	1413	5	SOx	6	0	16	17
SENTINEL PEAK RESOURCES CA LLC	C	1414	5	SOx	22	22	22	22
SENTINEL PEAK RESOURCES CA LLC	N	1418	5	SOx	35	35	33	33
SENTINEL PEAK RESOURCES CA LLC	N	1484	5	SOx	171	178	172	93
SENTINEL PEAK RESOURCES CA LLC	S	4842	5	SOx	5	5	3	3
SENTINEL PEAK RESOURCES CA LLC	S	4843	5	SOx	674	350	28	28
SENTINEL PEAK RESOURCES CA LLC	S	5166	5	SOx	7556	7755	10543	9861
SENTINEL PEAK RESOURCES CA LLC	S	5205	5	SOx	1322	1318	1318	1318
SHAFTER-WASCO GINNING CO	S	3268	5	SOx	0	0	0	19
SIERRA POWER CORPORATION	S	5148	5	SOx	4820	4232	4130	4467

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
SIMPLOT AB RETAIL	S	3570	5	SOx	688	715	742	742
SOC RESOURCES INC	S	3089	5	SOx	94	89	87	90
SOUTH VALLEY GINS INC	S	3554	5	SOx	0	0	0	5
SOUTH VALLEY GINS INC	S	4635	5	SOx	2	0	0	240
SPRECKELS SUGAR COMPANY INC.	C	1464	5	SOx	0	26875	37739	16268
STOCKTON EAST WATER DISTRICT	N	763	5	SOx	8	10	11	9
SUN GARDEN-GANGI CANNING CO., LLC	N	100	5	SOx	0	0	23440	4
SUNLAND REFINING CORP	S	698	5	SOx	1293	1123	1211	1241
TAFT PRODUCTION CO	S	2672	5	SOx	1695	1733	1771	1771
TAUBER OIL COMPANY	N	1514	5	SOx	7	7	7	6
THE ENVIRONMENTAL RESOURCES TRUST, INC	C	1013	5	SOx	9823	9823	9823	9823
THE NESTLE COMPANY INC	N	93	5	SOx	2491	39	48	6273
TRACY COMMERCE CENTER, LLC	N	1226	5	SOx	0	2146	1749	1492
TRI-CITY GROWERS INC	S	4392	5	SOx	2	0	0	6
TRICOR REFINING LLC	S	4862	5	SOx	75	74	75	75
TULE RIVER CO-OP GIN INC	S	2682	5	SOx	0	0	0	3
TURLOCK IRRIGATION DISTRICT	S	3709	5	SOx	29865	14110	0	32286
TWIN EAGLE RESOURCE MANAGEMENT LLC	S	4425	5	SOx	13197	17604	0	0
TWIN EAGLE RESOURCE MANAGEMENT, LLC	N	1265	5	SOx	0	12555	0	0
TWIN EAGLE RESOURCE MANAGEMENT, LLC	N	1266	5	SOx	9370	0	0	0
UNITED STATES GYPSUM CO	S	2543	5	SOx	0	0	0	9
UNITED STATES GYPSUM COMPANY	C	818	5	SOx	0	0	0	5
UNIVERSITY ENERGY SERVICES	S	561	5	SOx	63	54	59	61
VALLEY AIR CONDITIONING & REPAIR INC	C	438	5	SOx	41	105	154	162

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
VALLEY AIR CONDITIONING & REPAIR INC	C	502	5	SOx	7	22	36	30
VANDER WOUDE DAIRY	S	4055	5	SOx	3613	0	3800	3160
VANDERHAM WEST	S	3233	5	SOx	1453	1452	1452	1452
VECTOR ENVIRONMENTAL INC	S	4039	5	SOx	22	27	25	3
VINTAGE PRODUCTION CALIFORNIA LLC	S	3035	5	SOx	2	2	4	4
VULCAN MATERIALS	C	40	5	SOx	25	120	55	185
WESTERN COTTON SERVICES	S	98	5	SOx	0	0	0	27
WESTERN STONE PRODUCTS INC	N	17	5	SOx	636	636	725	725
WESTLAKE FARMS INC	C	645	5	SOx	0	0	0	29
WESTSIDE FARMERS COOP #2 AND #3	C	1038	5	SOx	1	0	0	10
WESTSIDE FARMERS COOP GIN	C	164	5	SOx	0	0	0	37
WESTSIDE FARMERS COOP GIN	C	592	5	SOx	10	0	0	71
ACMII CA 6, LLC DBA COLUMBINE VINEYARDS	S	2516	1	VOC	0	0	26	6
ACMII CA 6, LLC DBA COLUMBINE VINEYARDS	S	2516	1	VOC	0	0	26	6
AEMETIS FACILITY KEYES, INC.	S	5302	1	VOC	2978	2979	2979	2978
AEMETIS FACILITY KEYES, INC.	S	5303	1	VOC	9862	13000	13000	13000
AERA ENERGY LLC	C	219	1	VOC	268	297	324	298
AERA ENERGY LLC	C	1399	1	VOC	7943	8397	8437	8139
AERA ENERGY LLC	S	663	1	VOC	544	495	483	454
AERA ENERGY LLC	S	868	1	VOC	724	735	729	672
AERA ENERGY LLC	S	1058	1	VOC	8179	8280	8354	8353
AERA ENERGY LLC	S	1138	1	VOC	162	233	2	25
AERA ENERGY LLC	S	1142	1	VOC	39631	39976	40411	40489
AERA ENERGY LLC	S	1162	1	VOC	713	719	730	730
AERA ENERGY LLC	S	1476	1	VOC	190	0	0	54

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
AERA ENERGY LLC	S	1477	1	VOC	329	0	0	93
AERA ENERGY LLC	S	1587	1	VOC	26	28	26	26
AERA ENERGY LLC	S	1681	1	VOC	10	10	10	10
AERA ENERGY LLC	S	1874	1	VOC	40	10	1	22
AERA ENERGY LLC	S	1880	1	VOC	360	591	251	0
AERA ENERGY LLC	S	2136	1	VOC	3772	3393	3836	3913
AERA ENERGY LLC	S	2237	1	VOC	5394	5463	5539	5539
AERA ENERGY LLC	S	2361	1	VOC	27	4	0	11
AERA ENERGY LLC	S	2725	1	VOC	65082	65830	66578	66578
AERA ENERGY LLC	S	2774	1	VOC	8176	5745	5185	3973
AERA ENERGY LLC	S	2782	1	VOC	44	43	42	46
AERA ENERGY LLC	S	2939	1	VOC	6264	3536	3647	6483
AERA ENERGY LLC	S	3110	1	VOC	21914	22310	22708	22708
AERA ENERGY LLC	S	3223	1	VOC	16	16	16	17
AERA ENERGY LLC	S	3272	1	VOC	2642	2701	2759	2759
AERA ENERGY LLC	S	3308	1	VOC	2266	1066	1090	2320
AERA ENERGY LLC	S	3451	1	VOC	20480	438	2608	1572
AERA ENERGY LLC	S	3687	1	VOC	17245	18573	17870	17768
AERA ENERGY LLC	S	4063	1	VOC	157	140	120	181
AERA ENERGY LLC	S	4064	1	VOC	98	154	184	160
AERA ENERGY LLC	S	4767	1	VOC	6395	7457	9040	6324
AERA ENERGY LLC	S	4783	1	VOC	582	960	904	537
AERA ENERGY LLC	S	5058	1	VOC	172437	175025	177668	177721
AERA ENERGY LLC	S	5082	1	VOC	116467	117918	119371	117522
AERA ENERGY LLC	S	5107	1	VOC	15	19	16	13
AERA ENERGY LLC	S	5122	1	VOC	50080	50508	51652	50770
ALON BAKERSFIELD REFINING	S	5178	1	VOC	29099	29898	30307	30215
ALON BAKERSFIELD REFINING	S	5179	1	VOC	19865	19865	19865	19866

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
ALTA VISTA GIN/MURRIETA FARM	C	1445	1	VOC	0	0	0	6
ANDERSON CLAYTION-MARICOPA GIN	S	697	1	VOC	0	0	0	25
ANDERSON CLAYTON CORP	C	74	1	VOC	0	0	0	5
ANDERSON CLAYTON CORP	C	75	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP	C	76	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP	C	78	1	VOC	0	0	0	8
ANDERSON CLAYTON CORP	C	79	1	VOC	0	0	0	5
ANDERSON CLAYTON CORP	C	80	1	VOC	0	0	0	12
ANDERSON CLAYTON CORP	C	81	1	VOC	0	0	0	15
ANDERSON CLAYTON CORP	C	250	1	VOC	0	0	0	9
ANDERSON CLAYTON CORP	C	326	1	VOC	0	0	0	18
ANDERSON CLAYTON CORP	C	333	1	VOC	0	0	0	5
ANDERSON CLAYTON CORP	C	334	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP	C	335	1	VOC	0	0	0	5
ANDERSON CLAYTON CORP	C	336	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP	C	427	1	VOC	1	0	0	17
ANDERSON CLAYTON CORP	C	472	1	VOC	0	0	0	13
ANDERSON CLAYTON CORP	C	903	1	VOC	0	0	0	4
ANDERSON CLAYTON CORP	C	959	1	VOC	0	0	0	76
ANDERSON CLAYTON CORP	S	314	1	VOC	0	0	1	18
ANDERSON CLAYTON CORP	S	471	1	VOC	0	0	0	9
ANDERSON CLAYTON CORP	S	1045	1	VOC	0	0	0	22
ANDERSON CLAYTON CORP	S	1171	1	VOC	3	0	0	24
ANDERSON CLAYTON CORP	S	1262	1	VOC	1	0	0	19
ANDERSON CLAYTON CORP	S	1263	1	VOC	9	0	0	24
ANDERSON CLAYTON CORP.	C	234	1	VOC	0	0	0	12
ANDERSON CLAYTON CORP.	C	460	1	VOC	2	0	0	31
ANDERSON CLAYTON CORP.	C	863	1	VOC	0	0	0	36

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
ANDERSON CLAYTON CORP.	N	181	1	VOC	0	0	0	6
ANDERSON CLAYTON CORP.	N	499	1	VOC	0	0	0	15
ANDERSON CLAYTON CORP/BURREL	C	806	1	VOC	14	0	0	42
ANDERSON CLAYTON CORP/BUTTE	C	699	1	VOC	0	0	0	19
ANDERSON CLAYTON CORP/DAIRYLAN	C	332	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP/KERMAN	C	428	1	VOC	0	0	0	11
ANDERSON CLAYTON CORP/STRATFOR	C	56	1	VOC	0	0	0	4
ANDERSON CLAYTON CORPORATION	N	135	1	VOC	0	0	0	5
ANDERSON CLAYTON CORPORATION	N	737	1	VOC	1	0	0	16
ANEW ENVIRONMENTAL, LLC	C	1562	1	VOC	0	0	0	40
ANEW ENVIRONMENTAL, LLC	N	1594	1	VOC	15000	16335	16334	12331
ANEW ENVIRONMENTAL, LLC	S	5310	1	VOC	2274	2151	1940	1989
ANEW ENVIRONMENTAL, LLC	S	5311	1	VOC	0	0	0	17
ANEW ENVIRONMENTAL, LLC	S	5312	1	VOC	20000	20000	20000	20000
ANEW ENVIRONMENTAL, LLC	S	5325	1	VOC	1000	1500	1500	0
APTCO LLC	C	663	1	VOC	0	147	788	148
APTCO LLC	C	664	1	VOC	0	149	796	150
APTCO LLC	C	665	1	VOC	0	141	758	143
APTCO LLC	C	684	1	VOC	0	138	241	139
APTCO LLC	N	390	1	VOC	1370	1266	1618	948
APTCO LLC	N	397	1	VOC	12104	11748	9416	0
APTCO LLC	N	540	1	VOC	5000	5000	5000	5000
APTCO LLC	N	854	1	VOC	3141	4397	2894	0
APTCO LLC	S	5201	1	VOC	1126	1528	1648	976
ARCO PIPELINE FACILITY	C	271	1	VOC	419	417	417	417
ARDAGH GLASS INC	C	1344	1	VOC	0	0	0	7
ASV WINES	C	1474	1	VOC	0	0	1	0
BAKERSFIELD CRUDE TERMINAL	S	4189	1	VOC	3821	3819	9800	5042

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
BAKERSFIELD CRUDE TERMINAL	S	4190	1	VOC	877	878	30	0
BAKERSFIELD CRUDE TERMINAL	S	4191	1	VOC	8302	8303	3170	7958
BAR 20 PARTNERS LTD	S	2593	1	VOC	0	9	345	350
BAR 20 PARTNERS LTD	S	2594	1	VOC	7	15	38	38
BAR 20 PARTNERS LTD	S	2595	1	VOC	873	882	892	892
BAR 20 PARTNERS LTD	S	2915	1	VOC	445	419	50	45
BASF CORPORATION	S	5214	1	VOC	3	1	2	5
BEAR CREEK WINERY	S	5262	1	VOC	300	300	300	300
BENTA ENERGY LLC	S	5291	1	VOC	161	161	161	160
BERRY PETROLEUM COMPANY LLC	S	4883	1	VOC	6945	6943	6943	6943
BERRY PETROLEUM COMPANY LLC	S	4884	1	VOC	842	5769	3922	152
BERRY PETROLEUM COMPANY LLC	S	4886	1	VOC	22190	22190	22190	22189
BERRY PETROLEUM COMPANY LLC	S	4887	1	VOC	2415	1551	0	1322
BERRY PETROLEUM COMPANY LLC	S	5175	1	VOC	1	0	0	0
BERRY PETROLEUM COMPANY, LLC	N	1445	1	VOC	0	573	0	0
BREA OIL COMPANY, INC.	S	3355	1	VOC	149	391	193	112
BRITZ AG FINANCE CO., INC.	C	557	1	VOC	0	0	0	8
BRITZ GIN PARTNERSHIP II	C	871	1	VOC	0	0	0	32
BRITZ INCORPORATED	C	586	1	VOC	0	0	0	21
BRONCO WINE CO	S	3732	1	VOC	125	125	125	125
BROWN SAND INC	N	46	1	VOC	2	2	1	2
BRUCE R. CARTER	S	5326	1	VOC	4447	4332	3701	0
BUILDERS CONCRETE, INC	C	41	1	VOC	35	35	35	35
BUTTONWILLOW GINNING CO	S	2937	1	VOC	0	0	0	40
BUTTONWILLOW GINNING CO	S	4634	1	VOC	0	0	0	105
CALAVERAS MATERIALS INC.	C	233	1	VOC	148	410	483	300
CALIFORNIA DAIRIES	N	497	1	VOC	33	33	33	33
CALIFORNIA DAIRIES, INC.	C	683	1	VOC	0	0	454	0

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA RESOURCES ELK HILLS LLC	S	1717	1	VOC	1239	3804	4274	1639
CALIFORNIA RESOURCES ELK HILLS LLC	S	1719	1	VOC	928	1948	2037	1118
CALIFORNIA RESOURCES ELK HILLS LLC	S	1722	1	VOC	1132	2723	3230	1359
CALIFORNIA RESOURCES ELK HILLS LLC	S	1723	1	VOC	1723	4185	4934	2003
CALIFORNIA RESOURCES ELK HILLS LLC	S	1725	1	VOC	1169	2764	3251	1348
CALIFORNIA RESOURCES ELK HILLS LLC	S	1726	1	VOC	1603	3911	4662	1932
CALIFORNIA RESOURCES ELK HILLS LLC	S	1727	1	VOC	1061	2580	3064	1240
CALIFORNIA RESOURCES ELK HILLS LLC	S	1728	1	VOC	1692	4025	4596	2098
CALIFORNIA RESOURCES ELK HILLS LLC	S	2488	1	VOC	9	4650	5387	2519
CALIFORNIA RESOURCES ELK HILLS LLC	S	2627	1	VOC	52	52	52	52
CALIFORNIA RESOURCES ELK HILLS LLC	S	3225	1	VOC	648	1755	1926	805
CALIFORNIA RESOURCES ELK HILLS LLC	S	3627	1	VOC	3730	3448	3015	3510
CALIFORNIA RESOURCES ELK HILLS LLC	S	3947	1	VOC	83	2429	3196	464
CALIFORNIA RESOURCES ELK HILLS LLC	S	3951	1	VOC	75129	76311	77494	77493
CALIFORNIA RESOURCES ELK HILLS LLC	S	4470	1	VOC	55150	63829	66405	61718
CALIFORNIA RESOURCES ELK HILLS LLC	S	4643	1	VOC	435	2800	3881	892
CALIFORNIA RESOURCES ELK HILLS LLC	S	4704	1	VOC	1700	2072	5392	4827
CALIFORNIA RESOURCES ELK HILLS LLC	S	4795	1	VOC	0	1895	2768	0
CALIFORNIA RESOURCES ELK HILLS LLC	S	4947	1	VOC	2500	2500	2500	2500
CALIFORNIA RESOURCES ELK HILLS LLC	S	5037	1	VOC	0	337	1353	392
CALIFORNIA RESOURCES ELK HILLS LLC	S	5043	1	VOC	128	1655	2113	215
CALIFORNIA RESOURCES ELK HILLS LLC	S	5211	1	VOC	958	2706	3195	1140
CALIFORNIA RESOURCES ELK HILLS LLC	S	5251	1	VOC	0	935	2896	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1125	1	VOC	179	179	179	179
CALIFORNIA RESOURCES PRODUCTION CORP	N	1193	1	VOC	1604	1604	1604	1604

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA RESOURCES PRODUCTION CORP	N	1478	1	VOC	0	0	241	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1479	1	VOC	0	0	709	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1487	1	VOC	293	293	293	294
CALIFORNIA RESOURCES PRODUCTION CORP	S	4049	1	VOC	32	796	1783	481
CALIFORNIA RESOURCES PRODUCTION CORP	S	4062	1	VOC	26	178	115	66
CALIFORNIA RESOURCES PRODUCTION CORP	S	4080	1	VOC	0	255	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4256	1	VOC	87	19	0	4
CALIFORNIA RESOURCES PRODUCTION CORP	S	4432	1	VOC	0	116	741	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4482	1	VOC	0	325	774	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4630	1	VOC	70	138	199	152
CALIFORNIA RESOURCES PRODUCTION CORP	S	4785	1	VOC	0	908	1259	7
CALIFORNIA RESOURCES PRODUCTION CORP	S	4849	1	VOC	0	1196	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	5015	1	VOC	0	69	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	5033	1	VOC	0	1065	224	0

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA RESOURCES PRODUCTION CORP	S	5126	1	VOC	500	500	500	500
CALIFORNIA RESOURCES PRODUCTION CORP	S	5155	1	VOC	0	588	1313	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	5157	1	VOC	0	4013	5529	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	5159	1	VOC	48	4119	5670	416
CALIFORNIA RESOURCES PRODUCTION CORP	S	5172	1	VOC	2000	3000	3000	0
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1458	1	VOC	45	45	45	45
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1477	1	VOC	709	397	0	707
CALIFORNIA RESOURCES PRODUCTION CORP.	N	1213	1	VOC	163	163	163	163
CALIFORNIA-WASHINGTON CAN CO	N	77	1	VOC	2664	0	0	1583
CALMAT CO.	C	50	1	VOC	2	2	3	3
CALPINE CORP	S	1666	1	VOC	0	0	0	9
CALPINE CORP	S	3116	1	VOC	1440	1546	1621	1621
CALPINE CORPORATION	C	1080	1	VOC	2235	2037	1988	2251
CALPINE ENERGY SERVICES LP	S	3261	1	VOC	4454	4972	3890	4155
CALPINE ENERGY SERVICES LP	S	3283	1	VOC	0	150	171	0
CALPINE ENERGY SERVICES LP	S	3292	1	VOC	4804	6146	6632	3338
CALPINE ENERGY SERVICES LP	S	3300	1	VOC	4636	4705	4774	4771
CALPINE ENERGY SERVICES LP	S	3368	1	VOC	1500	1500	1500	1500
CALPINE ENERGY SERVICES LP	S	3503	1	VOC	5500	5500	5500	5500
CALPINE ENERGY SERVICES LP	S	3504	1	VOC	1000	1000	1000	1000

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALPINE ENERGY SERVICES LP	S	3555	1	VOC	5000	5000	5000	5000
CALPINE ENERGY SERVICES, L.P.	N	927	1	VOC	10503	10981	11573	11536
CAMPBELL SOUP CO	N	127	1	VOC	84	58	52	61
CANANDAIGUA WINE COMPANY INC	C	1085	1	VOC	21	17	30	15
CANDLEWICK YARNS	C	507	1	VOC	23	20	16	14
CANTUA COOPERATIVE GIN, INC.	C	760	1	VOC	0	0	0	38
CENTRAL CALIFORNIA SHEETS LLC	S	4754	1	VOC	1	0	0	0
CENTRAL VALLEY EGGS LLC	S	4855	1	VOC	7131	7130	7130	7130
CHEMICAL WASTE MANAGEMENT INC	S	2645	1	VOC	1513	2602	2033	2038
CHEMICAL WASTE MANAGEMENT, INC	N	1284	1	VOC	5785	0	0	10355
CHEVRON PIPE LINE-MIDDWAY	S	77	1	VOC	42	38	36	47
CHEVRON PIPE LINE-MIDDWAY	S	647	1	VOC	235	699	540	95
CHEVRON USA INC	C	221	1	VOC	357	395	431	396
CHEVRON USA INC	C	277	1	VOC	2209	2209	2209	2209
CHEVRON USA INC	C	331	1	VOC	1220	1220	1221	1221
CHEVRON USA INC	S	165	1	VOC	2970	3003	3036	3036
CHEVRON USA INC	S	703	1	VOC	2084	2107	2130	2130
CHEVRON USA INC	S	1793	1	VOC	1420	1443	1335	1334
CHEVRON USA INC	S	1847	1	VOC	2764	2793	2825	2825
CHEVRON USA INC	S	2107	1	VOC	651	638	666	666
CHEVRON USA INC	S	2430	1	VOC	2459	2142	1336	1543
CHEVRON USA INC	S	2674	1	VOC	1848	1848	1848	1848
CHEVRON USA INC	S	2675	1	VOC	1835	1835	1835	1835
CHEVRON USA INC	S	2708	1	VOC	1605	1634	1664	1664
CHEVRON USA INC	S	3518	1	VOC	1780	1780	1780	1780
CHEVRON USA INC	S	3701	1	VOC	25142	25559	25976	25976
CHEVRON USA INC	S	3811	1	VOC	3947	4032	4121	4125
CHEVRON USA INC	S	4066	1	VOC	1281	1477	1673	1673

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CHEVRON USA INC	S	4068	1	VOC	522	567	615	615
CHEVRON USA INC	S	4198	1	VOC	37461	38412	39324	39358
CHEVRON USA INC	S	4355	1	VOC	6428	6428	6428	6428
CHEVRON USA INC	S	4576	1	VOC	99488	100764	102130	102151
CHEVRON USA INC	S	4670	1	VOC	116015	117519	119022	119022
CHEVRON USA INC	S	4820	1	VOC	0	44	157	393
CHEVRON USA INC	S	4899	1	VOC	306	306	306	306
CHEVRON USA INC	S	4952	1	VOC	3641	3822	4003	3343
CHEVRON USA INC	S	5059	1	VOC	169	171	203	179
CHEVRON USA INC	S	5061	1	VOC	25835	26760	27684	27679
CHEVRON USA INC REFINERY	S	657	1	VOC	35011	35399	35788	35788
CHEVRON USA PRODUCTION INC	S	674	1	VOC	5779	5851	5903	5902
CHEVRON USA, INC	S	1049	1	VOC	3461	0	0	0
CHEVRON USA, INC	S	2373	1	VOC	11698	11110	8970	9796
CHEVRON USA, INC.	C	1372	1	VOC	14	36	12	9
CHRISTOPHER RANCH LLC	C	1430	1	VOC	0	0	0	18
CITY OF TULARE	C	1063	1	VOC	0	107	678	109
CITY OF VISALIA WATER RECLAMATION FACILI	S	1837	1	VOC	5067	2634	4107	4614
CLARK BROTHERS-DERRICK GIN	C	511	1	VOC	0	0	0	2
CLEAN HARBORS BUTTONWILLOW LLC	S	685	1	VOC	31195	31541	31888	31888
COALINGA FARMERS CO-OP GIN	C	537	1	VOC	0	0	0	8
COIT RANCH	C	532	1	VOC	0	0	0	8
CONAGRA FROZEN FOODS	N	858	1	VOC	5	0	0	8
CONSTELLATION BRANDS U.S. OPS INC.	N	1581	1	VOC	118	338	652	425
CONSTELLATION BRANDS U.S. OPS, INC.	C	1516	1	VOC	1500	3000	1500	0
CONSTELLATION BRANDS U.S. OPS, INC.	C	1546	1	VOC	2043	2982	2085	0
CONSTELLATION BRANDS US OPS, INC	S	5297	1	VOC	339	339	339	340

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CORCORAN IRRIGATION DISTRICT	C	560	1	VOC	154	163	159	90
COTTON ASSOCIATES, INC.	S	25	1	VOC	0	0	0	8
CRAYCROFT BRICK COMPANY	C	71	1	VOC	24	20	19	19
CRIMSON RENEWABLE ENERGY LP	S	4730	1	VOC	131	131	131	132
CRIMSON RESOURCE MANAGEMENT	S	2161	1	VOC	54	49	31	63
CRIMSON RESOURCE MANAGEMENT	S	3386	1	VOC	67	138	142	94
CRIMSON RESOURCE MANAGEMENT	S	3387	1	VOC	23009	20107	19072	13925
CRIMSON RESOURCE MANAGEMENT	S	3441	1	VOC	13	4	13	22
DART CONTAINER CORPORATION	C	555	1	VOC	30481	26626	14213	50680
DEL MONTE FOODS MODESTO PLANT 1	N	1238	1	VOC	82	71	116	28
DELICATO VINEYARDS	C	1521	1	VOC	2500	5000	2500	0
DELTA TRADING L P	S	4735	1	VOC	1844	1941	2034	2037
DIAMOND FOODS, LLC	N	572	1	VOC	126	45	138	120
DIAMOND FOODS, LLC	N	645	1	VOC	1695	1419	1451	783
DIAMOND FOODS, LLC	N	828	1	VOC	1495	671	1063	1914
DOLE PACKAGED FOODS LLC	N	520	1	VOC	3	11	41	8
DUNCAN ENTERPRISES	C	1550	1	VOC	26	26	27	18
E & J GALLO WINERY	C	1404	1	VOC	6369	6365	5752	5631
E & J GALLO WINERY	S	4751	1	VOC	14349	14341	16065	16065
E & J GALLO WINERY	S	4769	1	VOC	2761	2761	1087	1083
E & J GALLO WINERY	S	4773	1	VOC	827	771	56	41
E & J GALLO WINERY	S	5265	1	VOC	6829	6819	6810	6798
E & J GALLO WINERY	S	5267	1	VOC	61511	111502	79311	79291
E & J GALLO WINERY	S	5269	1	VOC	40673	40649	37699	37674
E & J GALLO WINERY	S	5299	1	VOC	15814	15769	15740	15718
E&B NATURAL RESOURCES	S	4408	1	VOC	9	11	11	10
E&B NATURAL RESOURCES MGMT	S	2773	1	VOC	7	12	5	9
E&B NATURAL RESOURCES MGMT	S	3791	1	VOC	7500	7500	7500	7500

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
E&B NATURAL RESOURCES MGMT	S	4774	1	VOC	41	44	47	45
EAGLE VALLEY GINNING LLC	N	847	1	VOC	0	0	0	23
ECKERT COLD STORAGE CO.	N	133	1	VOC	3	11	41	8
ELBOW ENTERPRISES INC	S	2535	1	VOC	0	0	0	70
ELEMENT MARKETS EMISSIONS LLC	C	1472	1	VOC	1	0	0	4
ELEMENT MARKETS EMISSIONS, LLC	N	1566	1	VOC	0	0	3	0
ELEMENT MARKETS LLC	S	3370	1	VOC	5	4	4	4
ELEMENT MARKETS LLC	S	5288	1	VOC	13163	13941	12057	0
ELEMENT MARKETS LLC	S	5305	1	VOC	1720	2720	2438	0
ENRON OIL & GAS CO	S	1044	1	VOC	5516	5576	5638	5638
EQUILON ENTERPRISES LLC	N	1167	1	VOC	23	3	20	19
EVERGREEN BEVERAGE PACKAGING	S	4412	1	VOC	5	6	4	5
EXXONMOBIL CORP	S	4547	1	VOC	128	130	131	131
FARADAY&FUTURE, INC.	S	5012	1	VOC	12500	12500	12500	12500
FARMERS COOPERATIVE GIN INC	S	2533	1	VOC	0	0	0	39
FARMERS FIREBAUGH GINNING CO.	C	956	1	VOC	16	0	0	47
FEDERAL POWER AVENAL LLC	S	4948	1	VOC	10000	10000	10000	10000
FIBREBOARD CORP	N	209	1	VOC	41	34	16	45
FJ MANAGEMENT INC	S	5301	1	VOC	466277	408499	432946	437706
FORWARD, INC COMPOSTING FACILITY	S	5300	1	VOC	7390	7391	7391	7390
FOSTER FOOD PRODUCTS	S	1501	1	VOC	432	437	442	442
FOSTER FOOD PRODUCTS	S	1502	1	VOC	68	63	58	58
FRESNO/CLOVIS REGIONAL WWTP	C	1211	1	VOC	6	6	5	5
FRITO-LAY INC	S	3411	1	VOC	4018	6573	9128	9128
FRITO-LAY, INC.	S	3426	1	VOC	380	474	377	337
FRITO-LAY, INC.	S	3429	1	VOC	55	57	58	58
FRITO-LAY, INC.	S	3430	1	VOC	76	96	74	72
G3 ENTERPRISES	S	4076	1	VOC	183	183	182	182

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
G3 ENTERPRISES	S	4371	1	VOC	137	137	137	136
G3 ENTERPRISES	S	4763	1	VOC	139	139	139	138
G3 ENTERPRISES	S	5100	1	VOC	3	3	3	3
GARY ROGERS	C	72	1	VOC	7	0	1	1
GARY STOWE	C	1441	1	VOC	4	0	0	44
GENERAL MILLS INC	N	139	1	VOC	16	13	13	19
GROWERS COOP	S	88	1	VOC	0	0	1	15
GUARDIAN INDUSTRIES CORP	S	4900	1	VOC	1461	1549	1353	1378
H J HEINZ COMPANY	N	60	1	VOC	0	23	129	0
H J HEINZ COMPANY	N	694	1	VOC	0	0	701	0
H J HEINZ COMPANY	N	1085	1	VOC	52	53	45	23
H. J. HEINZ COMPANY, L.P.	N	21	1	VOC	0	60	180	60
HANSEN BROTHERS	C	249	1	VOC	0	0	0	13
HECK CELLARS	S	4053	1	VOC	9715	9715	9715	9715
HERSHEY CHOCOLATE & CONF CORP	N	42	1	VOC	1	1	1	1
HERSHEY CHOCOLATE & CONF CORP	N	373	1	VOC	9	11	13	11
HERSHEY CHOCOLATE & CONF CORP	N	952	1	VOC	5	5	6	6
HOLMES WESTERN OIL CORP	S	4032	1	VOC	216	562	641	200
HOLMES WESTERN OIL CORPORATION	C	823	1	VOC	0	0	0	10
HOLMES WESTERN OIL CORPORATION	N	652	1	VOC	324	326	311	301
HOLMES WESTERN OIL CORPORATION	N	653	1	VOC	30	30	25	24
HOLMES WESTERN OIL CORPORATION	N	1390	1	VOC	23	22	21	21
HUNTER EDISON OIL DEVELOPMENT	S	3723	1	VOC	2186	2256	2234	2282
HYDROGEN ENERGY CALIFORNIA LLC	S	3305	1	VOC	14625	14625	14625	14625
HYDROGEN ENERGY CALIFORNIA LLC	S	3557	1	VOC	11437	11438	11438	11437
HYDROGEN ENERGY CALIFORNIA LLC	S	3605	1	VOC	7937	7938	7938	7937
INGREDION INCORPORATED	S	4696	1	VOC	416	415	415	414
INTERNATIONAL PAPER CO	S	2995	1	VOC	875	875	875	875

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
J G BOSWELL CO	S	5079	1	VOC	0	0	0	60
J.G. BOSWELL COMPANY	C	135	1	VOC	1	0	0	1
KAWEAH DELTA DISTRICT HOSPITAL	S	2656	1	VOC	460	738	828	938
KERMAN CO-OP GIN & WAREHOUSE	C	1002	1	VOC	0	0	0	13
KERN COUNTY PUBLIC WORKS	C	1553	1	VOC	0	83	83	0
KERN COUNTY PUBLIC WORKS	C	1554	1	VOC	0	767	1032	454
KERN COUNTY PUBLIC WORKS	C	1555	1	VOC	1055	1415	1403	1447
KERN COUNTY PUBLIC WORKS	C	1556	1	VOC	2156	456	0	0
KERN COUNTY PUBLIC WORKS DEPARTMENT	S	5287	1	VOC	3025	5522	5660	0
KERN COUNTY PUBLIC WORKS DEPARTMENT	S	5289	1	VOC	7	165	212	78
KERN COUNTY PUBLIC WORKS DEPARTMENT	S	5290	1	VOC	53	22	40	51
KERN COUNTY PUBLIC WORKS DEPARTMENT	S	5293	1	VOC	20000	32000	28000	0
KERN COUNTY PUBLIC WORKS DEPARTMENT	S	5304	1	VOC	1000	1000	1000	1000
KERN COUNTY PUBLIC WORKS DEPARTMENT	S	5308	1	VOC	1864	2618	2618	354
KERN DELTA CO LLC	S	4311	1	VOC	0	0	0	17
KERN DELTA CO LLC	S	4314	1	VOC	0	0	0	38
KERN LAKE COOP GIN	S	2074	1	VOC	0	0	0	134
KERN OIL & REFINING CO	S	4976	1	VOC	88	153	148	192
KERN OIL & REFINING CO	S	5199	1	VOC	387	386	385	384
KERN OIL & REFINING CO	S	5213	1	VOC	2294	2291	2291	2287
KERN OIL & REFINING CO	S	5258	1	VOC	299	313	298	445
KERN OIL & REFINING COMPANY	C	1523	1	VOC	2000	2000	2000	2000

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
KERN RIVER HOLDINGS INC	S	4598	1	VOC	54	54	54	53
LAND O' LAKES INC	S	4920	1	VOC	0	0	0	19
LAND O' LAKES INC	S	4922	1	VOC	103	167	197	0
LANGETWINS WINERY	S	5320	1	VOC	8	8	8	8
LATON CO-OP GIN, INC.	C	746	1	VOC	0	0	0	8
LAWRENCE LIVERMORE NATL SECURITY, LLC	N	464	1	VOC	2	1	0	1
LEHIGH HANSON WEST REGION	C	89	1	VOC	92	83	95	76
LEPRINO FOODS COMPANY	C	60	1	VOC	137	139	136	138
LIDESTRI FOODS, INC	N	391	1	VOC	0	0	389	0
LIVE OAK LIMITED	S	3	1	VOC	198	200	202	202
LOS ANGELES CNTY SANITATION DIST NO 2	N	472	1	VOC	5953	6019	6086	6086
LOS ANGELES CNTY SANITATION DIST NO 2	N	1068	1	VOC	269	1452	271	426
LOS ANGELES COUNTY SANITATION DISTRICT 2	S	2147	1	VOC	12500	12500	12500	12500
LOS BANOS ASPHALT COMPANY	N	125	1	VOC	16	81	258	86
LOS GATOS TOMATO PRODUCTS	C	1021	1	VOC	0	3	0	0
MACPHERSON OIL CO	S	4419	1	VOC	2	2	2	2
MACPHERSON OIL COMPANY	N	1254	1	VOC	0	0	0	493
MACPHERSON OIL COMPANY	N	1337	1	VOC	1428	1428	1428	935
MADERA CO-OP GIN, INC.	C	943	1	VOC	0	0	0	11
MALIBU BOATS LLC	S	2555	1	VOC	5000	5000	5000	5000
MATTHEW T. BAKKE	S	4938	1	VOC	5000	5000	5000	5000
MCMANIS FAMILY VINEYARDS	S	5316	1	VOC	1443	1443	1541	1337
MCMANIS FAMILY VINEYARDS	N	1597	1	VOC	13753	10010	0	245
MERCED CO COMMUNITY & ECONOMIC DEV DEPT	N	523	1	VOC	31801	32175	32549	32549
MESA VERDE TRADING CO INC	S	4307	1	VOC	4	0	0	1

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
MID VALLEY DISPOSAL INC	S	4969	1	VOC	69	69	69	69
MID VALLEY DISPOSAL INC	S	5330	1	VOC	419	442	577	552
MIDSTREAM ENERGY PARTNERS (USA) LLC	S	5071	1	VOC	7	22	14	4
MIDSTREAM ENERGY PARTNERS (USA) LLC	S	5072	1	VOC	197	24	0	1
MIDSTREAM ENERGY PARTNERS (USA) LLC	S	5073	1	VOC	1079	1108	1139	1137
MID-VALLEY COTTON GROWERS INC	S	317	1	VOC	0	0	0	6
MID-VALLEY COTTON GROWERS INC	S	2989	1	VOC	0	0	0	16
MIDWAY PEAKING LLC	S	4233	1	VOC	0	0	0	10
MINTURN CO-OP GIN	N	441	1	VOC	0	0	0	20
MODESTO IRRIGATION DISTRICT	C	1109	1	VOC	4342	4331	4373	4371
MODESTO IRRIGATION DISTRICT	N	479	1	VOC	0	0	305	0
MODESTO IRRIGATION DISTRICT	N	739	1	VOC	0	0	27	0
MODESTO TALLOW COMPANY	N	1477	1	VOC	184	165	202	196
MONTEREY RESOURCES, INC.	S	4814	1	VOC	368	282	126	148
MT VERNON RECYCLING & COMPOSTING FAC	S	2969	1	VOC	46	59	61	52
NAS LEMOORE	C	1561	1	VOC	1082	0	3	0
NORTHERN CALIFORNIA POWER AGENCY	S	3744	1	VOC	240	103	0	0
NUSTAR ENERGY LP	S	3634	1	VOC	227	226	226	226
NUSTAR TERMINALS OPS PARTNERSHIP LP	C	1519	1	VOC	2728	2572	2291	2977
OAKWOOD LAKE RESORT	N	601	1	VOC	0	72	115	0
OILDALE ENERGY LLC	S	1096	1	VOC	100	100	100	100
OLDUVAI GORGE LLC	N	1366	1	VOC	89	0	0	0
OLDUVAI GORGE LLC	N	1412	1	VOC	8969	0	385	0
O'NEILL VINTNERS & DISTILLERS	S	3886	1	VOC	404	404	404	404
PACIFIC ETHANOL INC	S	4778	1	VOC	991	989	988	982
PACIFIC GAS & ELECTRIC CO	S	4965	1	VOC	8	8	8	7
PACIFIC PIPELINE SYSTEM LLC	S	776	1	VOC	28	67	77	34

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
PACIFIC SOUTHWEST CONTAINER LLC	S	5243	1	VOC	0	0	1	0
PACTIV CORPORATION	N	1062	1	VOC	27192	27192	27192	27192
PACTIV, LLC	C	1182	1	VOC	9986	9206	9494	9041
PACTIV, LLC	C	1183	1	VOC	2001	1688	2462	1110
PACTIV, LLC	C	1184	1	VOC	47518	2227	0	17129
PACTIV, LLC	C	1185	1	VOC	51342	0	0	0
PACTIV, LLC	N	1241	1	VOC	23529	14812	15264	14520
PACTIV, LLC	S	3862	1	VOC	1513	1972	1571	1510
PANOCHE GINNING CO	C	904	1	VOC	0	0	0	49
PARAMOUNT FARMS, INC.	C	291	1	VOC	0	0	63	12
PELCO INC A DELAWARE CORPORATION	C	1121	1	VOC	374	374	349	349
PELCO INC A DELAWARE CORPORATION	C	1122	1	VOC	1842	2601	2219	1756
PG&E ENVIRONMENTAL SERVICES	N	1382	1	VOC	393	5292	4501	81
PHILLIPS 66 PIPELINE LLC	N	1276	1	VOC	1445	766	67	0
PHILLIPS 66 PIPELINE LLC	S	4913	1	VOC	155	174	138	144
PHILLIPS 66 PIPELINE LLC	S	4979	1	VOC	184	165	202	196
PHOENIX BIO INDUSTRIES LLC	C	824	1	VOC	500	500	500	500
PILKINGTON NORTH AMERICA INC	N	1540	1	VOC	67	66	86	80
PLAINS LPG SERVICES LP	S	3793	1	VOC	583	583	583	583
PLAINS LPG SERVICES LP	S	4561	1	VOC	0	972	1020	381
PONDEROSA PAINT CO	C	1463	1	VOC	45	45	40	40
SAINT-GOBAIN	S	4497	1	VOC	0	0	0	34
SAINT-GOBAIN CONTAINERS, INC	N	1292	1	VOC	0	0	0	135
SAN JOAQUIN FACILITIES MGMT	S	3801	1	VOC	228	225	223	223
SAN JOAQUIN FACILITIES MGMT	S	4446	1	VOC	0	0	13	8
SAN JOAQUIN FACILITIES MGMT	S	4448	1	VOC	34	8	34	39
SAN JOAQUIN FACILITIES MGMT	S	4910	1	VOC	33091	27806	31888	37172
SAN PABLO BAY PIPELINE COMPANY LLC	C	1501	1	VOC	500	910	500	90

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
SAN PABLO BAY PIPELINE COMPANY LLC	S	5215	1	VOC	307	615	307	0
SEALED AIR CORPORATION	C	851	1	VOC	19000	19000	19000	19000
SEMI TROPIC COOP GIN	S	426	1	VOC	1	0	1	28
SENECA RESOURCES	N	1411	1	VOC	134	0	401	0
SENECA RESOURCES	N	1414	1	VOC	43	42	42	42
SENECA RESOURCES	N	1433	1	VOC	0	0	1	0
SENECA RESOURCES COMPANY, LLC	S	3440	1	VOC	0	0	0	339
SENTINEL PEAK RESOURCES CA LLC	C	1498	1	VOC	388	0	1736	1024
SENTINEL PEAK RESOURCES CA LLC	N	1484	1	VOC	268	292	209	184
SENTINEL PEAK RESOURCES CA LLC	N	1553	1	VOC	7335	7335	7335	7335
SENTINEL PEAK RESOURCES CA LLC	S	4832	1	VOC	821	821	822	822
SENTINEL PEAK RESOURCES CA LLC	S	4833	1	VOC	840	840	840	840
SENTINEL PEAK RESOURCES CA LLC	S	4834	1	VOC	24	24	24	24
SENTINEL PEAK RESOURCES CA LLC	S	5209	1	VOC	3326	3324	3324	3324
SEQUOIA FOREST INDUSTRIES	C	67	1	VOC	2	9	0	6
SFPP LP	S	4188	1	VOC	2374	2374	2372	2372
SHAFTER-WASCO GINNING CO	S	3268	1	VOC	0	0	0	13
SHELL CALIFORNIA PIPELINE COMPANY LLC	C	467	1	VOC	185	0	0	0
SHELL OIL PRODUCTS US	S	4223	1	VOC	0	20	3	3
SHELL OIL PRODUCTS US	S	4251	1	VOC	431	460	493	492
SHELL OIL PRODUCTS US	S	4336	1	VOC	61	33	0	0
SHELL PIPELINE COMPANY LP	S	2303	1	VOC	0	658	431	0
SILGAN CONTAINERS LODI MFG CORP	N	431	1	VOC	5103	3464	3573	3865
SILGAN CONTAINERS MANUFAC CORP	C	1208	1	VOC	4279	3921	3042	3166
SOUTH KERN INDUSTRIAL CENTER LLC	S	3006	1	VOC	0	190	382	0
SOUTH VALLEY GINS INC	S	3554	1	VOC	0	0	0	10
SOUTH VALLEY GINS INC	S	4635	1	VOC	4	0	0	42

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
SOUTHERN CALIF GAS CO	S	671	1	VOC	570	576	583	583
SOUTHERN CALIF GAS CO	S	1739	1	VOC	1322	1337	1354	1352
STOCKTON EAST WATER DISTRICT	N	763	1	VOC	1627	2271	2299	2059
SYNAGRO WEST, INC DBA CENTRL VLY COMPOST	N	1394	1	VOC	8	0	47	0
TESLA, INC	S	5284	1	VOC	2500	3750	3750	0
TESLA, INC	S	5285	1	VOC	5500	8250	8250	0
TESORO LOGISTICS OPERATIONS LLC	N	1463	1	VOC	1249	1249	1249	1247
TESORO LOGISTICS OPERATIONS LLC	S	4736	1	VOC	4937	4938	4937	4938
THE DOW CHEMICAL COMPANY	N	799	1	VOC	218	212	236	224
THE NESTLE COMPANY INC	N	93	1	VOC	997	1820	1874	1007
THE WINE GROUP INC	C	1525	1	VOC	1000	1000	1000	1000
THE WINE GROUP LLC	S	4761	1	VOC	179	179	179	179
TRC CYPRESS GROUP, LLC	S	2292	1	VOC	1412	1412	1412	1412
TRC OPERATION CO INC	S	767	1	VOC	394	399	403	403
TRI-CITY GROWERS INC	S	4392	1	VOC	3	0	0	14
TULARE CITY WASTEWATER PLANT	S	2697	1	VOC	60	60	60	87
TULE RIVER CO-OP GIN INC	S	2682	1	VOC	0	0	0	13
TURLOCK IRRIGATION DISTRICT	C	607	1	VOC	297	297	297	297
TURLOCK IRRIGATION DISTRICT	C	1116	1	VOC	1080	1080	1079	1079
UNIVERSITY ENERGY SERVICES	S	561	1	VOC	63	54	59	61
VANDERHAM WEST	S	3235	1	VOC	240	240	240	240
VARCO PRUDEN BUILDINGS, INC.	N	898	1	VOC	5404	6473	10921	8632
VECTOR ENVIRONMENTAL INC	S	5294	1	VOC	12127	4678	5027	5416
VINTAGE PRODUCTION CALIFORNIA LLC	S	4440	1	VOC	74	74	74	74
VINTAGE PRODUCTION CALIFORNIA LLC	S	4454	1	VOC	170	170	170	170
VINTAGE PRODUCTION CALIFORNIA LLC	S	4992	1	VOC	8611	8611	8611	8610
VULCAN MATERIALS	C	40	1	VOC	2	11	5	17

Facility Name	Emissions Reduction Certificate (ERC) Number			Pollutant	Emissions Reduction (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
WESTERN COTTON SERVICES	S	606	1	VOC	0	0	0	9
WESTERN STONE PRODUCTS INC	N	17	1	VOC	6	6	7	7
WESTLAKE FARMS INC	C	645	1	VOC	0	0	0	18
WESTSIDE FARMERS COOP #2 AND #3	C	1038	1	VOC	5	0	0	57
WESTSIDE FARMERS COOP GIN	C	164	1	VOC	0	0	0	31
WESTSIDE FARMERS COOP GIN	C	592	1	VOC	6	0	0	44
WONDERFUL PISTACHIOS & ALMONDS	C	1537	1	VOC	1425	2510	1591	2561

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Appendix I
MODELING EMISSION INVENTORY

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Appendix I: Modeling Emission Inventory

[This Appendix provided by the California Air Resources Board]

Modeling Emission Inventory for the PM2.5 State Implementation Plan April 2024

CALIFORNIA
AIR RESOURCES BOARD

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I. Acronyms

AMSS – Atmospheric Modeling and Support Section

APCD – Air Pollution Control District

AQMD – Air Quality Management District

Caltrans – California Department of Transportation

CalVAD – California Vehicle Activity Database

CARB – California Air Resources Board

CCAQS – Central California Air Quality Studies

CCOS – Central California Ozone Study

CEIDARS – California Emission Inventory Development and Reporting System

CEMS – Continuous emissions monitoring system

CEPAM – California Emission Projection Analysis Model

CMAQ – Community Multi-Scale Air Quality (Model)

COG – Council of Government

CRPAQS – California Regional Particulate Air Quality Study

EIC – Emission Inventory Code

EICSUM – EIC Summary category, the first three digits of EIC

ERG – Eastern Research Group

HD – Heavy Duty

I&M – Inspection and Maintenance

MPO – Metropolitan Planning Organization

NetCDF – Network Common Data Form

NLCD – National Land Cover Database

NOx – Oxides of Nitrogen

OGV – Ocean Going Vessel

PM – Particulate Matter

PM10 – Particulate Matter 10 micrometers in diameter and smaller

PM2.5 – Particulate Matter 2.5 micrometers in diameter and smaller

ROG – Reactive Organic Gases

RRF – Relative Response Factor

RTPA – Regional Transportation Planning Agencies

RWC – Residential Wood Combustion

SAPRC – Statewide Air Pollution Research Center

SCC – Source Classification Code

SIP – State Implementation Plan

SIPIWG – State Implementation Plan Inventory Working Group

SJV – San Joaquin Valley

SMOKE – Sparse Matrix Operator Kernel Emissions

SSS – State SIP Strategy

TOG – Total Organic Gases

II. Development of PM2.5 Emissions Inventories

Emission inputs for air quality modeling (commonly and interchangeably referred to as “modeling inventories” or “gridded inventories”) have been developed by the California Air Resources Board (CARB) and staff from multiple air districts. These inventories support multiple State Implementation Plans (SIPs) across California to address nonattainment of the federal criteria pollutant standards. CARB maintains an electronic database of emissions and other useful information to generate aggregate emission estimates at the county, air basin, and district level, *Criteria Pollutant Emission Inventory Data*. This database is called the California Emission Inventory Development and Reporting System (CEIDARS). CEIDARS provides a foundation for the development of a more refined (hourly, grid cell-specific) set of emission inputs that are required by air quality models. The CEIDARS base year inventory is a primary input to the state’s emission forecasting system, known as the California Emission Projection Analysis Model (CEPAM). CEPAM produces the projected emissions that are then processed to serve as the emission inputs for air quality models. The following sections of this document describe the methods used to prepare the base and future year emissions inventory estimates.

A. Inventory Coordination

Most of this inventory was developed in direct coordination with staff at the regional Air Pollution Control Districts across the state. In July of 2019 CARB convened the SIP Inventory Working Group (SIPIWG) to provide an opportunity and means for interested parties (CARB, districts, etc.) to discuss issues pertaining to the development and review of base year, future year, planning and gridded inventories to be used in SIP modeling. The group met every four to six weeks through early 2020. Group participants included staff from Bay Area, Butte, Eastern Kern, El Dorado, Feather River, Imperial, Northern Sierra, Placer, Sacramento, San Diego, San Joaquin Valley, San Luis Obispo, South Coast, Ventura, and Yolo-Solano air districts.

Additionally, CARB established the SIPIWG Spatial Surrogate Sub-committee, which focuses on improving input data to spatially disaggregate emissions at a more refined level needed for air quality modeling. Local air districts that participate include San Joaquin Valley, San Diego, Bay Area, Imperial, South Coast, Ventura, and Sacramento.

A great deal of work preceded this modeling effort through the Central California Air Quality Studies (CCAQS). CCAQS consisted of two studies: 1) the Central California Ozone Study (CCOS); and 2) the California Regional PM10 (particulate matter 10μm in diameter and smaller) /PM2.5 (particulate matter 2.5μm in diameter and smaller) Air Quality Study (CRPAQS) (Reynolds, et al., 2012).

B. Background

California’s emission inventory is an estimate of the amounts and types of pollutants emitted from thousands of industrial facilities, millions of motor vehicles, and myriad emission sources such as consumer products and fireplaces. The development and maintenance of the emission inventory involves several agencies. This multi-agency effort includes: CARB, 35 local air pollution control and air quality management districts (Districts), regional transportation planning agencies (RTPAs), and the California Department of Transportation (Caltrans). CARB is responsible for the compilation of the final statewide emission inventory, and for maintaining this information in CEIDARS. In addition to the statewide emission inventory, emissions from parts of northern Mexico and the western United States (Nevada, Arizona, Oregon, Idaho, and Utah) are also incorporated in the final emission inventory used for modeling. The final emission inventory reflects the best information available at the time.

The basic principle for estimating county-wide regulatory emissions is to multiply an estimated, per-unit emission factor by an estimate of typical usage or activity. For example, on-road motor vehicle emission factors are estimated for a specific vehicle type and applied to all applicable vehicles. The estimates are based on dynamometer tests of a small sample for a vehicle type. The activity for any given vehicle type is based on an estimate of typical driving patterns, number of vehicle starts, and typical miles driven. Assumptions are also made regarding typical usage: it is assumed that all vehicles of a certain vehicle type are driven under similar conditions in each region of the state.

Developing emission estimates for stationary sources involves the use of per unit emission factors and activity levels. Under ideal conditions, facility-specific emission factors are determined from emission tests for a particular process at a facility. A continuous emission monitoring system (CEMS) can also be used to determine a gas or particulate matter concentration or emission rate (USEPA, 2016). More commonly, a generic emission factor is developed by averaging the results of emission tests from similar processes at several different facilities. This generic factor is then used to estimate emissions from similar types of processes when a facility-specific emission factor is not available. Activity levels from stationary sources can be derived from the amount of product produced, solvent used, or fuel used.

The district-reported and CARB-estimated emissions totals are stored in the CEIDARS database for any given pollutant. Both criteria pollutants and their precursors are stored in this complex database. These are typically annual average emissions for each county, air basin, and district. Modeling inventories for reactive organic gases (ROG) are estimated from total organic gases (TOG). Similarly, the modeling inventories for PM10 and PM2.5 are estimated from total particulate matter (PM). Details about chemical and size resolved speciation of emissions for modeling can be found in Section III.E. Additional information on CARB emission inventories can be found on CARB's website (CARB, Emission Inventory Activities, n.d.).

C. Inventory Years

The emission inventory scenarios used for air quality modeling must be consistent with U.S. EPA's Modeling Guidance (USEPA, 2014). Since changes in the emissions inventory can affect the calculation of the relative response factors (RRFs) used to project air quality to future years, the terms used in the preparation of the emission inventory scenarios must be clearly defined. In this document, the following inventory definitions will be used.

1. Base Case Modeling Inventory (2017)

Base case modeling is intended to evaluate model performance and demonstrate confidence in the modeling system used for the modeled attainment test. The base case modeling inventory is not used as part of the modeled attainment test itself. Model performance is assessed relative to how well model-simulated concentrations match actual measured concentrations. The modeling inputs are developed to represent (as best as possible) actual, day-specific conditions. Emissions for certain sectors are based on day-specific activities, meteorology, and emission adjustments. Actual district-reported point source emissions were gathered for the year 2017. The year 2017 was selected to coincide with the year selected for baseline design values (described below). The U.S. EPA modeling guidance states that once the model has been shown to perform adequately, the use of day-specific emissions is no longer needed. In preparation for SIP development, both CARB and the local air districts began a comprehensive review and update of the emission inventory resulting in a comprehensive emissions inventory for 2017.

2. Reference Year Modeling Inventory (2017)

The reference year inventory is intended to be a representation of emission patterns occurring through the baseline design value period and the emission patterns expected in the future year. U.S. EPA modeling guidance describes the reference year modeling inventory as “a common starting point” that represents average or “typical” conditions that are consistent with the baseline design value period. U.S. EPA guidance also states, “using a ‘typical’ or average reference year inventory provides an appropriate platform for comparisons between baseline and future years.” The 2017 reference year inventory represents typical average conditions and emission patterns through the 2017 design value period. This reference emissions inventory is not developed to capture all day-specific emission characteristics; however, this reference inventory does include meteorological effects for 2017 (e.g., temperature, relative humidity, and solar insolation), as well as certain day-specific emission activities, such as agricultural and prescribed burning.

3. Future Year Modeling Inventory (2030)

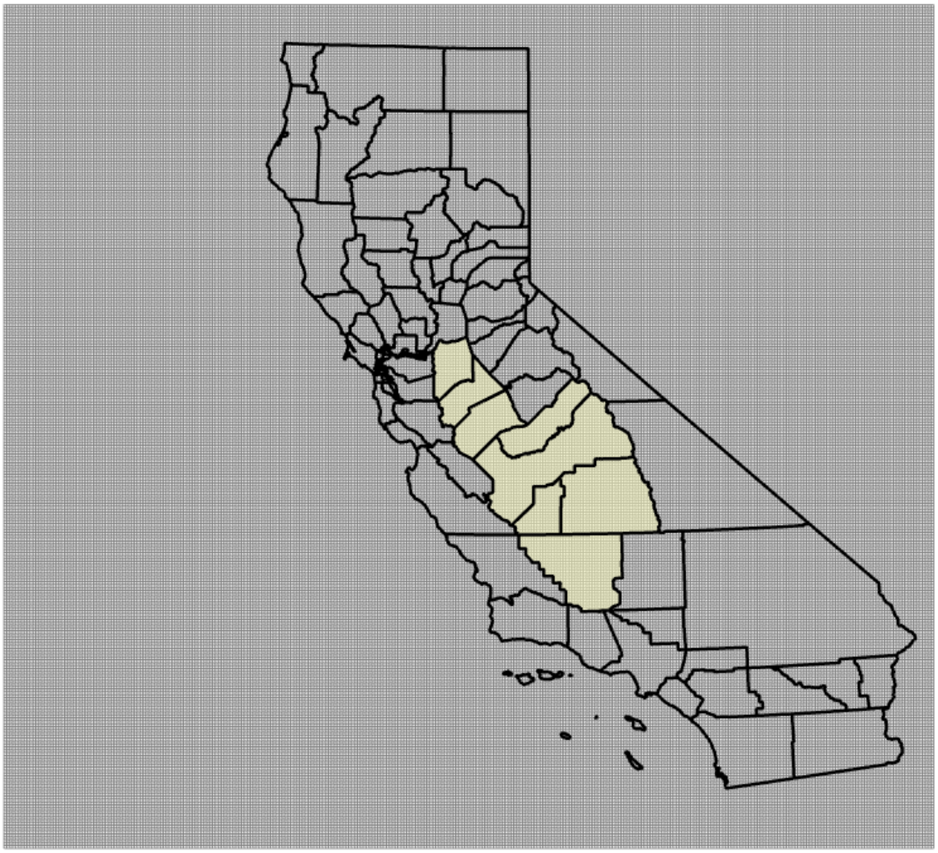
Future year modeling inventories, along with the reference year modeling inventory, are used in the model-derived RRF calculation. Projected inventory year 2030 was chosen to address the modeled attainment year for the annual PM2.5 2012 standard of 12ug/m^3.

These inventories maintain the “typical” average patterns of the 2017 reference year modeling inventory. Some sectors of the 2030 inventory include temporal variations that were driven by temperature, relative humidity, and solar insolation effects from reference year (2017) meteorology. Future year point and area source emissions are projected from the 2017 baseline emissions. Future year on-road emission inventories are projected by EMFAC.

D. Spatial Extent of Emission Inventories

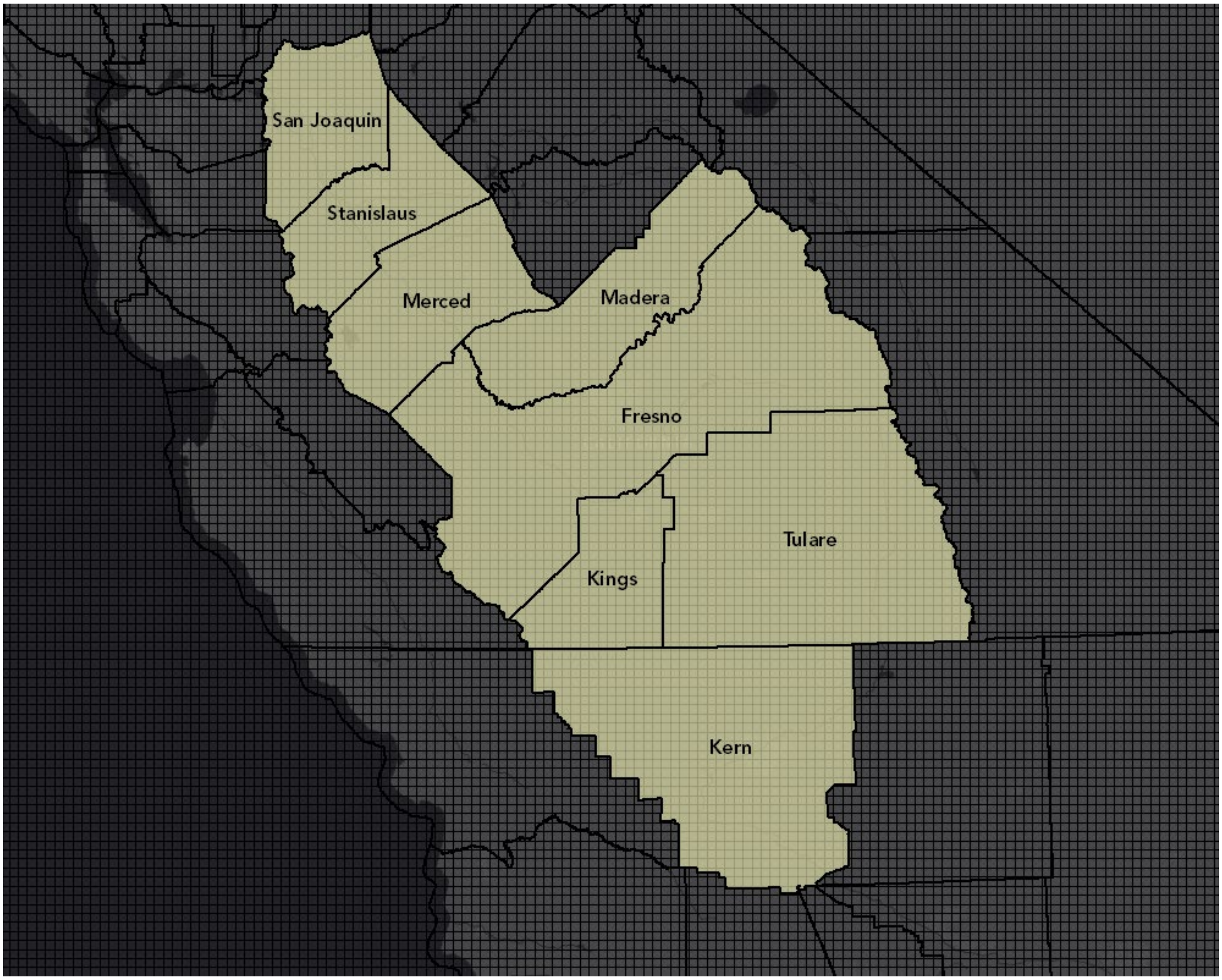
The model-ready emissions files that are prepared for use as an input for the air quality model conform to the definition and extent of the grids shown in Figure 1.

Figure 1. Spatial coverage of emissions grid with nonattainment area highlighted in yellow



An enlarged image of the San Joaquin Valley PM2.5 Nonattainment area in California is highlighted in yellow in Figure 2. This figure illustrates the portion of the statewide 4 km modeling grid around that surrounds the San Joaquin Valley PM2.5 Nonattainment area.

Figure 2: San Joaquin Valley PM2.5 Nonattainment area highlighted in California with statewide 4 km grid overlayed



The domain uses a Lambert projection and assumes a spherical Earth. The emissions inventory grid uses a Lambert Conical Projection with two parallels. The parallels are at 30° and 60° N latitude, with a central meridian at 120.5° W longitude. The coordinate system origin is offset to 37° N latitude. The emissions inventory is developed for the gridded statewide domain at spatial resolution of 4 km x 4 km. The state modeling domain extends entirely over California and 100 nautical miles west over the Pacific Ocean. The specifications for the statewide modeling domain are summarized in Table 1.

Table 1: Modeling domain parameters

Parameter	Statewide Domain
Map Projection	Lambert Conformal Conic
Datum	None (Clarke 1866 spheroid)
1st Standard Parallel	30.0° N
2nd Standard Parallel	60.0° N
Central Meridian	-120.5° W
Latitude of projection origin	37.0° N
Coordinate system Units	Meters
Semi-major axis	6370 km
Semi-minor axis	6370 km
Grid size	4 km x 4 km
Number of cells	I=321, J=291 or 321 x 291
Lambert origin	(-684,000 m, -564,000 m)
Geographic center	-120.5° Lat and 37.0° Lon

III. Estimation of Base Year Modeling Inventory

As mentioned in Section II.C.1, base-case modeling is intended to demonstrate confidence in the modeling system used for the modeled attainment test. The following sections describe the temporal and spatial distribution of emissions and how each of the sectors within the modeling inventories are prepared.

A. Terminology

Table 2 summarizes the terminology and examples used in this document for the different emission source types such as point sources, area sources, on-road motor vehicle sources and biogenic sources. The table shows differences in the terms from modeling and planning perspectives as both these sets of terms are used in this document. The terms “point sources” and “area sources” are often confused. Traditionally, these terms have had different meanings to the developers of planning emissions inventories and the developers of modeling emissions inventories. In modeling terminology, “point sources” traditionally refers to elevated emission sources that exit from a stack and have an associated plume rise. The current inventory includes emissions sources reported by the Air Pollution Control District (APCD). Those sources associated with a facility are treated as either elevated sources or non-elevated. The emissions processor calculates plume rise for elevated sources; non-elevated sources are treated as ground-level sources. Examples of non-elevated emissions sources include landfills and composting facilities. “Area sources” refers collectively to area-wide sources, stationary-aggregated sources, and other mobile sources (including aircraft, trains, ships, and all off-road vehicles and equipment). That is, “area sources” are low-level sources from a modeling perspective. On-road motor vehicle sources are emissions from cars and trucks while biogenic sources are natural sources such as vegetation and soils.

Table 2: Inventory terms for emission source types

Modeling Term	Emission Inventory Term	Examples
Point	Stationary – Point Facilities	Stacks at Individual Facilities
Area	Off-road Mobile	Construction Equipment, Farm Equipment, Trains, Recreational Boats
Area	Area-wide	Residential Fuel Combustion, Livestock Waste, Consumer Products, Architectural Coatings
Area	Stationary - Aggregated	Industrial Fuel Use
On-road Motor Vehicles	On-road Mobile	Cars and Trucks
Biogenic	Biogenic	Vegetation and Soils

The following sections describe in more detail the temporal, spatial, and chemical disaggregation of the emissions inventory for point sources and area sources.

B. Emissions Inventory

Modeling emissions are based on the CEPAM 2019 v1.04 inventories for the base year and future year. Updates to CEPAM were made for pesticide emissions to incorporate the use of the California Department of Pesticide Regulation’s (DPR) latest Pesticide Use Reporting (PUR). Final baseline inventory included a revision from San Joaquin Valley APCD on January 22, 2024 to correct the charbroiling area portion of the cooking inventory. Additionally, the San Joaquin Valley modeling inventory incorporated Emission Reduction Credit (ERC) adjustments to the projected future year (FY) 2030 inventory. The ERC adjustments were applied for the entire San Joaquin Valley air basin to stationary area and point sources. The final ERC adjustment for the annual inventory across the district was 2.43 tons per day of NOx and 0.4 tons per day of SOx.

C. Temporal Distribution of Emissions

The emissions are temporally resolved by month, week, day, and hour to more accurately gauge model performance and, ultimately, better assess the influence of control measures on attainment. This section covers the temporal distributions of the point, area, and off-road mobile sources. The temporal distribution of the emissions from on-road, biogenic, and ocean-going vessel (OGV) sources are discussed in Sections IV.B, IV.C, and IV.E. The temporal distribution of residential wood combustion (RWC) and agricultural ammonia sectors are described in Section IV.F.4 and Section IV.F.5, respectively.

Temporal data are stored in CARB's emission inventory database. Each local air district assigns temporal data for all processes at each facility in their district to represent when emissions at each process occur. For example, emissions from degreasing may have a different temporal distribution than a boiler due to differences in their respective operating hours. CARB or district staff also assign temporal data for each area source category by county/air basin/district.

1. Monthly Variation

Emissions are adjusted temporally to represent variations by month. Some emission sources operate the same throughout a year. For example, a process heater at a refinery or a line-haul locomotive likely operates the same month-to-month. Other emission categories, such as a tomato processing plant or use of recreational boats, vary significantly by season. CARB's emission inventory database stores the relative monthly fractional activity for each process, the sum of which is 100. Using an example of emission sources that typically operate the same over each season, emissions from refinery heaters and line-haul locomotives would have a monthly fraction (throughput) of 8.33 for each month (calculated as 100/12 = 8.33). This is considered a flat monthly profile. To apply monthly variations to create a gridded inventory, the annual average day's emissions (yearly emissions divided by 365) is multiplied by the typical monthly throughput. For example, a typical monthly throughput of 15 in July for recreational boats results in emissions about 1.8 times higher (15 / 8.33 = 1.8) than a day in a month with a flat monthly profile.

2. Weekly Variation

Emissions are adjusted temporally to represent variations by day of the week. Some operations are the same over a week, such as a utility boiler or a landfill. Many businesses operate only 5 days per week. Other emissions sources are similar on weekdays, but may operate differently on weekend days, such as architectural coatings or off-road motorcycles. To accommodate variations in days of the week, each process or emission category is assigned a days-per-week code or DPWK. Table 3 shows the current DPWK codes.

Table 3: Day of week variation factors

Code	Weekly Cycle Code Description	M	T	W	TH	F	S	S
1	One day per week	1	1	1	1	1	0	0

Code	Weekly Cycle Code Description	M	T	W	TH	F	S	S
2	Two days per week	1	1	1	1	1	0	0
3	Three days per week	1	1	1	1	1	0	0
4	Four days per week	1	1	1	1	1	0	0
5	Five days per week - Uniform activity on weekdays, none on Saturday and Sunday	1	1	1	1	1	0	0
6	Six days per week - Uniform activity on weekdays, none on Saturday and Sunday	1	1	1	1	1	1	0
7	Seven days per week – Uniform activity every day of the week	1	1	1	1	1	1	1
20	Uniform activity on Saturday and Sunday, no activity the remainder of the week	0	0	0	0	0	1	1
21	Uniform activity on Saturday and Sunday, half as much activity on weekdays	5	5	5	5	5	10	10
22	Uniform activity on weekdays, reduced activity on weekends	10	10	10	10	10	7	4
23	Uniform activity on weekdays, reduced activity on weekends	10	10	10	10	10	8	8
24	Uniform activity on weekdays; half as much activity on Saturday. Little activity on Sunday	10	10	10	10	10	5	1
25	Uniform activity on weekdays, one third as much on Saturday, little on Sunday	10	10	10	10	10	3	1
26	Uniform activity on weekdays, little activity on Saturday, no activity on Sunday	10	10	10	10	10	3	0
27	Uniform activity on weekdays, half as much activity on weekends	10	10	10	10	10	5	5
28	Uniform activity on weekdays, five times as much activity on weekends	2	2	2	2	2	10	10
29	Uniform activity on Monday through Thursday, increased activity on Friday, Saturday, and Sunday	8	8	8	8	10	10	10

3. Daily Variation

Emissions are adjusted temporally to represent variations by hour of day. Many emission sources occur 24 hours per day, such as livestock waste or a sewage treatment plant whereas many businesses operate 8 hours per day. Other emissions sources vary significantly over a day, such as residential space heating or pesticide application. Each process or emission category is assigned an hours-per-day (HPDY) code. Table 4 displays the daily variation factors or current HPDY codes. Code 33 is no longer used for residential fuel combustion in favor of day specific adjustments see Section IV.F.4. Additional temporal profiles are shown in Appendix C: Additional Temporal Profiles.

Table 4: Daily variation factors

Code	Code Description	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	1 HOUR PER DAY	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	3 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	4 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
5	5 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
6	6 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
7	7 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
8	8 HOURS PER DAY - UNIFORM ACTIVITY FROM 8 A.M. TO 4 P.M. (NORMAL WORKING SHIFT)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
9	9 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
10	10 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
11	11 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
12	12 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
13	13 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
14	14 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
15	15 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Code	Code Description	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
16	16 HOURS PER DAY - UNIFORM ACTIVITY FROM 8 A.M. TO MIDNIGHT (2 WORKING SHIFTS)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	17 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	18 HOURS PER DAY	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	19 HOURS PER DAY	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
20	20 HOURS PER DAY	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
21	21 HOURS PER DAY	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
22	22 HOURS PER DAY	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
23	23 HOURS PER DAY	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	UNIFORM ACTIVITY DURING THE DAY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
31	MAJOR ACTIVITY 5-9 P.M., AVERAGE DURING DAY, MINIMAL IN EARLY A.M.(GAS STATIONS)	3	1	1	1	1	1	1	5	5	5	5	5	5	5	5	5	5	10	10	10	10	7	7	3
33	MAX ACTIVITY 7-9 A.M. & 7-11 P.M.,AVERAGE DURING DAY, LOW AT NIGHT (RESIDENTIAL FUEL COMBUSTION)	2	2	2	2	2	2	2	10	10	6	6	5	5	5	5	5	5	5	5	10	10	10	10	2
34	ACTIVITY 1 TO 9 A.M.; NO ACTIVITY REMAINDER OF DAY (i.e. ORCHARD HEATERS)	0	8	8	8	8	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	MAX ACTIVITY 7 A.M. TO 1 A.M., REMAINDER IS LOW	10	1	1	1	1	1	1	8	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Code	Code Description	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	(i.e. COMMERCIAL AIRCRAFT)																								
37	ACTIVITY DURING DAYLIGHT HOURS; LESS CHANCE IN EARLY MORNING AND LATE EVENING	0	0	0	0	0	1	3	6	9	10	10	10	10	10	10	10	10	9	6	3	1	0	0	0
38	ACTIVITY DURING MEAL TIME HOURS (i.e. RESIDENTIAL COOKING)	0	0	0	0	0	2	6	6	2	2	1	2	4	4	2	1	1	3	10	8	7	6	1	0
50	PEAK ACTIVITY AT 7 A.M. & 4 P.M.; AVERAGE DURING DAY (ON-ROAD MOTOR VEHICLES)	1	1	1	1	1	1	6	10	6	5	5	5	5	5	5	6	10	8	6	4	1	1	1	1
51	ACTIVITY FROM 6 A.M. TO 12 P.M. (PETROLEUM DRY CLEANING)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
52	MAJOR ACTIVITY FROM 6 A.M.-12 P.M., LESS FROM 12-7 P.M. (PESTICIDES)	0	0	0	0	0	1	6	10	10	10	10	10	6	3	3	3	3	4	4	0	0	0	0	0
53	ACTIVITY FROM 7 A.M. TO 12 P.M. (AGRICULTURAL AIRCRAFT)	0	0	0	0	0	0	0	2	2	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0
54	UNIFORM ACTIVITY FROM 7 A.M. TO 9 P.M. (DAYTIME BIOGENICS)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
55	UNIFORM ACTIVITY FROM 9 P.M. TO 7 A.M. (NIGHTIME BIOGENICS)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
56	MAX ACTIVITY 8 A.M. TO 5 P.M, MINIMAL AT NIGHT & EARLY MORNING	0	0	0	0	1	1	2	3	10	10	10	10	10	10	10	10	9	1	1	1	1	1	1	1
57	MAX ACTIVITY 7 A.M. TO 2 P.M., MINIMAL AT EVENING	0	0	0	0	0	1	6	10	10	10	10	10	10	9	8	4	2	1	1	0	0	0	0	0

Code	Code Description	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	AND MORNING HOURS (CONSTRUCTION EQUIPMENT ON HOT DAYS)																								
58	MAX ACTIVITY 7 A.M. TO NOON.;REDUCED ACTIVITY NOON TO 6 P.M. (AUTO REFINISHING)	0	0	0	0	0	0	0	10	10	10	10	10	8	8	8	8	8	8	0	0	0	0	0	0
59	MAXIMUM ACTIVITY FROM 7:00 AM TO 3:00 PM; REDUCED ACTIVITY FROM 3:00 TO 6:00 PM.(CONSTRUCTION EQUIPMENT ON NORMAL DAYS)	0	0	0	0	0	0	2	10	10	10	10	10	10	10	10	7	3	1	1	0	0	0	0	0
60	MAXIMUM ACTIVITY FROM NOON TO 7:00 PM; REDUCED ACTIVITY EVENING AND MORNING HOURS (RECREATIONAL BOAT EXHAUST)	0	0	0	0	0	0	0	2	4	6	7	9	10	10	10	10	10	10	10	7	5	3	1	0
81	MAX ACTIVITY 9 AM TO 3 PM; HALF THE ACTIVITY REMAINING HOURS (WASTE FROM DAIRY CATTLE)	7	6	6	5	4	4	4	5	7	8	9	10	10	10	7	3	3	3	4	4	5	6	7	7
82	ACTIVITY FROM 10 AM TO 9 PM RISING TO PEAK AT 3; NO ACTIVITY REMAINDER OF DAY (WASTE FROM POULTRY)	0	0	0	0	0	0	0	0	0	3	3	7	7	7	10	10	7	3	3	3	3	0	0	0
83	ACTIVITY FROM 9 AM TO 12 AM RISING TO PEAK AT 3; MINIMUM ACTIVITY REMAINDER OF DAY (WASTE FROM SWINE)	0	0	0	0	0	0	0	1	1	2	4	6	8	8	9	10	8	4	3	3	2	1	1	1
84	MAJOR ACTIVITY FROM 11AM TO 6PM; REDUCED	7	7	6	6	6	6	6	7	8	8	9	9	10	10	10	10	9	9	8	8	7	7	7	7

Code	Code Description	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	OTHER HOURS (EVAP-COASTAL COUNTIES)																								
85	MAJOR ACTIVITY FROM 11AM TO 6PM; REDUCED OTHER HOURS (EVAP-NON-COASTAL COUNTIES)	5	5	5	5	4	4	5	5	6	7	8	9	9	10	10	10	9	9	8	7	6	6	6	5

D. Spatial Allocation

Once the base case, reference, or future year inventories are developed, the next step of modeling inventory development is to spatially allocate the emissions. Air quality models attempt to replicate the physical (e.g., transport) and chemical processes that occur in the atmosphere within a modeling domain. Therefore, it is important that the physical location of emissions be specified as accurately as possible. Ideally, the actual location of all emissions would be known exactly. However, some categories of emissions would be virtually impossible to determine—for example, the actual amount and location of consumer products (e.g., deodorant) used every day. To the extent possible, the spatial allocation of emissions in a modeling inventory approximates as closely as possible the actual location of emissions.

Spatial allocation is typically accomplished by using spatial surrogates. These spatial surrogates are processed into spatial allocation factors to geographically distribute county-wide area source emissions to individual grid cells. Spatial surrogates are developed based on demographic, land cover, and other data that exhibit patterns geographically. Sonoma Technology, Inc. (STI) (Funk, Stiefer, & Chinkin, 2001) under CCOS contract, originally developed many of the spatial surrogates by creating a base year (2000) and various future year surrogate inventories. STI updated the underlying spatial data and developed new surrogates (Reid, Penfold, & Pollard, 2008), completing the project in 2008. CARB and districts have since continued to update and improve many of the spatial surrogates, adding new ones as more data become available.

Four basic types of data are used to develop the spatial allocation factors: land use and land cover, satellite imagery, facility location, and demographic and socioeconomic data. Land use and land cover data are associated with specific land uses, such as agricultural harvesting or recreational boats. Facility locations are used for sources such as gas stations and dry cleaners. Demographic and socioeconomic data, such as population and housing, are associated with residential, industrial, and commercial activities (e.g., residential fuel combustion). To develop spatial allocation factors of high quality and resolution, local socioeconomic and demographic data were used when available for developing base case, baseline, and future year inventories. For any given region, data can be available from a local Metropolitan Planning Organization (MPO), a Council of Government (COG) or a Regional Transportation Planning Agency (RTPA). These are used as inputs for travel demand models. In rural regions for which local data is not available, data from California Statewide Travel Demand Model (CSTDM) was used.

The current snapshot used for the San Joaquin Valley PM2.5 SIP emission inventory for BY2017 and FY2030 is defined as snapshot October 1st, 2022 (SNP20221001) patch 1. Detailed methodology for each surrogate can be found in the spatial surrogate methodology document (CARB, Spatial Surrogate Methodology Document SNP20221001, 2022). This snapshot includes all previous updates noted in surrogate snapshot 2021-10-01 (CARB, Spatial Surrogate Methodology Document SNP2021-10-01, 2021) as well as recent improvements outlined below. A summary of the primary spatial surrogates by EICSUM is provided in Appendix D: Spatial Surrogate Assignments.

- Improvements to Construction surrogates
- Improvements to Landfills and Compositing surrogates

- Updates to Distribution Centers
- Creation of new surrogate for Forest Roads
- Updates to Pasture Agriculture Land
- Improvements to the Switch Railyards Surrogate
- Improvements to ocean-going vessel surrogates based on 2018 Automatic Identification System (AIS)

1. Spatial Allocation of Area Sources

Area-wide emissions are modeled using a top-down approach where emission totals are estimated for a large geographic area of interest (GAI). Each area source category is assigned a primary spatial surrogate that is used to allocate emissions to a grid cell in CARB's 4 km statewide modeling domain. Examples of surrogates include population, land use, and other data with known geographic distributions for allocating emissions to grid cells, as described above.

2. Spatial Allocation of Point Sources

Each point source is allocated to grid cells using the latitude and longitude reported for each stack. If there are no stack latitude and longitude, the facility coordinates are used. There are two types of point sources: elevated and non-elevated sources. Stationary point sources with stacks are regarded as elevated sources. Those without physical stacks that provide only latitude/longitude, such as airports or landfills, are considered non-elevated. Emissions are allocated vertically for elevated sources using the SMOKE (Sparse Matrix Operator Kernel Emissions) modeling system's in-line plume rise calculation for the CMAQ (Community Multi-scale Air Quality) photochemical model. SMOKE will select the sources that will receive the CMAQ in-line plume rise treatment, and group together sources with nearly identical stack parameters to reduce the number of calculations performed by the CMAQ in-line plume rise module. SMOKE will then output the emissions by grouped sources and the accompanying stack/facility coordinates and stack parameters for CMAQ's in-line plume rise module to handle the vertical allocation of the elevated sources.

3. Spatial Allocation of Wildfires, Prescribed Burns, and Wildland Fire Use

Emissions from wildfires, prescribed burns, and wildland fires are event- and location-based. A fire event can last a few hours or span multiple days. Where available, data from the Visible Infrared Imaging Radiometer Suite (VIIRS) 375 m thermal anomalies product are used to capture daily growth of the fire. Grid cells from the fire extent are only used for spatial allocation on the days where the VIIRS satellite detect thermal anomalies in these areas. For fires where the VIIRS data is unavailable, the fire is spatially allocated to grid cells using the final extent of each fire event while the temporal distribution also reflects the actual duration of the fire. The spatial information to allocate the fire emissions comes from a statewide interagency fire perimeters geodatabase maintained by the Fire and Resource Assessment Program (FRAP) of the California Department of Forestry and Fire Protection (CALFIRE). More details on the methodology and estimation of the wildfire emissions can be found in Section IV.F.1.

4. Spatial Allocation of Ocean-going Vessels (OGV)

CARB OGV emissions consist of four activity types: hoteling, maneuvering, anchorage and transit. Since hoteling is stationary in port areas, it was treated as a point source. The remaining activity types are regarded as area sources. Individual berths were identified from a combination of AIS telemetry data, satellite and aerial photography, and detailed port maps where available. The centroids of grid cells on the Statewide domain containing berth locations were then associated with hoteling emissions for each GAI. Transit, spatial surrogates were constructed based on the National Waterway Network and AIS data from 2017. Maneuvering spatial surrogates were drawn to connect the transit lanes with the berth locations for each port. Anchorage locations were determined based on raster data from the National Oceanic and Atmospheric Administration (NOAA) which reflects anchorage locations codified in the Federal Register.

5. Spatial Allocation of On-road Motor Vehicles

The spatial allocation of on-road motor vehicles is based on data from the latest travel demand models provided by local MPOs. These model outputs are combined into a statewide transportation network using the Integrated Transportation Network (ITN). For areas without a regional travel demand model, data from CSTDM is used. For more details, see Section IV.B.3.

E. Speciation Profiles

CARB's emission inventory lists the amounts of pollutants discharged into the atmosphere by sources in a certain geographical area during a given time period. It currently contains estimates for CO, NH3, NOx, SOx, total organic gases (TOG) and particulate matter (PM). CO and NH3 each are single species; NOx emissions are composed of NO, NO2 and HONO; and SOx emissions are composed of SO2 and SO3. TOG and PM potentially contain over hundreds of different chemical species, and speciation is the process of disaggregating these inventory pollutants into individual chemical species components or groups of species. CARB maintains and updates such speciation profiles for organic gases (OG) and PM for a variety of source categories.

Photochemical models simulate the physical and chemical processes in the lower atmosphere and include all emissions of the important classes of chemicals involved in photochemistry as well as less reactive compounds that are of concern from a health or visibility standpoint. TOG includes all organic compounds that can become airborne (through evaporation, sublimation, as aerosols, etc.), excluding CO, CO2, carbonic acid, metallic carbides or carbonates, and ammonium carbonate. TOG emissions reported in the CARB's emission inventory are the basis for deriving the reactive organic gas (ROG) emission components, which are also reported in the inventory. ROG is defined as TOG minus CARB's exempt compounds (e.g., methane, ethane, various chlorinated fluorocarbons, acetone, perchloroethylene, volatile methyl siloxanes, etc.). ROG is nearly identical to U.S. EPA's Volatile Organic Compounds (VOC), which is based on EPA's exempt list. For all practical purposes, use of the terms ROG and VOC are interchangeable.

The OG speciation profiles are applied to estimate the amounts of various organic compounds that make up TOG emissions. A speciation profile contains a list of organic compounds and the weight fraction that each compound comprises of the TOG emissions from a particular source type. In addition to the chemical name for each chemical constituent, the file also shows the 5-digit CARB internal identification chemical code. The speciation profiles are applied to TOG to develop both the photochemical model inputs and the emission inventory for ROG. District-reported fractions are not used in developing modeling inventories because the information needed to calculate the amount of each organic compound is not available.

The PM emissions are size-fractionated by using PM size distribution profiles, which contain the total weight fraction for PM2.5 and PM10 out of total PM. The fine and coarse PM chemical compositions are characterized by applying the PM chemical speciation profiles for each source type, which contain the weight fractions of each chemical species for PM2.5, PM10, and total PM. PM chemical speciation profiles may also vary for different PM size fractions even for the same emission source. PM size profiles and speciation profiles are typically generated based on source testing data. In most previous source testing studies aimed at determining PM chemical composition, filter-based sampling techniques were used to collect PM samples for chemical analyses.

The most current OG profiles and PM profiles are available for download from *CARB's speciation profile web page*. Based on these original profiles, a model-ready speciation file, gspro, was generated for a specific chemical mechanism (for example, SAPRC07T) to separate aggregated inventory pollutant emission totals into emissions of model species required by the air quality model.

Each process or product category is keyed to one of the OG profiles and one of the PM profiles. Also available for download from CARB's web site (see link in previous paragraph) is a cross-reference file that indicates which OG profile and PM profile are assigned to each category in the inventory. The inventory source categories are represented by an 8-digit source classification code (SCC) for point sources, or a 14-digit emission inventory code (EIC) for area and mobile sources. Some of the OG profiles and PM profiles related to motor vehicles, ocean going vessels, and fuel evaporative sources vary by the inventory year of interest, due to changes in fuel composition, vehicle fleet composition, and emissions control devices such as diesel particulate filters (DPFs). Details can be found in CARB's references of speciation profile development available on the *Consolidated List for Speciation Profiles site*. Mapping of each category to OG and PM profiles is summarized in rogpm and gsref files.

Research studies are conducted regularly to improve CARB's speciation profiles. These profiles support ozone and PM modeling studies and can also be used for regional toxics modeling. Speciation profiles need to be as complete and accurate as possible. CARB has an ongoing effort to update speciation profiles as data become available through testing of emission sources or surveys of product formulations. New speciation data generally undergo technical and peer review; updates to the profiles are coordinated with end users of the data. The recent additions to CARB's speciation profiles include:

- OG profiles
  - Off-road recreational vehicle exhaust and evaporation
  - Biomass burning
  - Consumer products

  - Architectural coating
  - Gasoline fuel and headspace vapor
  - Gasoline vehicle hot soak and diurnal evaporation
  - Gasoline vehicle start and running exhaust
  - Silage
  - Aircraft exhaust
  - Compressed Natural Gas (CNG) bus running exhaust
- PM profiles
  - Piston-Engine aircraft (aviation gasoline)
  - Tire burning
  - Gasoline vehicle exhaust (start and running)
  - On-road diesel exhaust
  - Off-road diesel exhaust
  - Ocean going vessel exhaust
  - Aircraft exhaust
  - Concrete batching
  - Commercial cooking
  - Residential fuel combustion-natural gas
  - Coating/painting
  - Cotton ginning
  - Stationary combustion
  - OGV auxiliary boiler combustion
  - Compressed Natural Gas (CNG) vehicle running exhaust
  - Off-road diesel military generator exhaust

IV. Methodology for Developing Base Case, Baseline, and Future Projected Emissions Inventories

As mentioned in Section II.C, the base case and reference inventories include temperature, humidity, and solar insolation effects for some emission categories; development of these data is described in Sections IV.F. Sections IV.A through IV.H detail how the base case and reference inventories were created for different sectors of the inventory such as point, area, on-road motor vehicles, biogenic, OGV, other day-specific sources, Northern Mexico, and Western States. Section IV.I briefly describes the control measure reduction factors applied to the future year.

A. Estimation of Gridded Area and Point sources

Emissions inventories that are temporally, chemically, and spatially resolved are needed as inputs for the photochemical air quality model. Point sources and area sources (area-wide, off-road mobile, and aggregated stationary) are processed into emissions inventories for photochemical modeling using the SMOKE modeling system (https://www.cmascenter.org/smoke/). The current SIP modeling uses SMOKE v4.9 (referred as Official SMOKE hereafter) following in-house testing of this version of the software.

1. General Methodology

Inputs for SMOKE are annual emissions totals from CEPAM and information for allocating to temporal, chemical, and spatial resolutions. Temporal inputs for SMOKE are screened for missing or invalid temporal codes as discussed in Section V.A. Temporal allocation of emissions using SMOKE involves the disaggregation of annual emissions totals into monthly, day-of-week, and hour-of-day emissions totals. The temporal codes from Table 3 and Table 4 are reformatted into an input-ready format as explained in the SMOKE user's manual. Chemical speciation profiles, as described in Section III.E, and emissions source cross-reference files used as inputs for SMOKE are developed by CARB staff. SMOKE uses the files for the chemical speciation of NOx, SOx, TOG, and PM to produce the species needed by photochemical air quality models.

Emissions for area sources are allocated to grid cells defined by the modeling grid domain in Section II.D. Emissions are spatially disaggregated using spatial surrogates as described in Section III.D. These spatial surrogates are converted to a SMOKE-ready format as described in the SMOKE user's manual. Emissions for point sources are allocated to grid cells by SMOKE using the latitude and longitude coordinates reported for each stack.

2. Temporal Allocation of Electric Generating Units using U.S. EPA Continuous Emissions Monitoring data

Continuous Emission Monitoring (CEM) data is collected through EPA's clean air markets division in which they monitor continuous CO_2, NOx, SO_2, and mercury emissions from specific electric generating units to check compliance with a variety of federal air quality programs. Electric Generating Units (EGUs) are required to submit operations data such as facility information, monitoring plans, quality assurance (QA) test information as well as hourly heat input and hourly gross electricity generation. This information is helpful when developing a formal emissions inventory that can be used in air quality modeling applications. The emissions from the combustion of fuel by EGU are divided into two classifications: the first is from steam EGUs also known as boilers and non-steam EGUs such as gas turbines and internal combustion engines. The primary fuel type varies across the nation between coal, oil, gas and other waste. But here in California, our primary plant fuel type is natural gas.

Hourly CEM data (USEPA, Clean Air Markets Program Data, 2017) was assessed for each California facility ID (ORIS) and boiler ID that matched to a specific CEIDARS facility ID, stack, segment and process ID. For base year 2017 emissions, facilities in CEIDARS that had matching CEM data used the CEM hourly heat input as the temporal profile to allocate annual reported estimates to each hour for all pollutants. For future year 2030 emissions, facilities in CEIDARS that had matching CEM data used the 2017 hourly heat input as the temporal profile to allocate annual reported estimates of all pollutants. Work is currently being done to generate an average hourly profile using multi-year CEM heat input data that may be more reflective of an average, future year scenario. For a complete review of San Joaquin Valley matching facilities, please review Appendix E: San Joaquin Valley Facilities with CEM data.

B. Estimation of On-road Motor Vehicle Emissions

1. General Methodology

The EMFAC2021 with Metropolitan Planning Organizations specific activity version 11 (MPOv11) emissions are processed into on-road emissions inventories using ESTA developed by CARB. The ESTA model applies spatial and temporal surrogates to emissions to create top-down emission inventory files.

More information on ESTA is available at the following *GitHub repository for Emissions Spatial and Temporal Allocator*.

2. Activity Data Updates

Link-based and Traffic Analysis Zone (TAZ)-based travel activity from travel demand models provided by different MPOs, Caltrans and other California RTPAs. Parameters such as vehicle mix and VMT are compared between the default EMFAC and Caltrans databases prior to spatial allocation to ensure values lie within reasonable limits.

3. Spatial Adjustment

CARB works with local MPOs to obtain the latest available output from regional travel demand models. The output link networks from these models are combined into a statewide link network using the Integrated Transportation Network (ITN) framework (CARB, 2021). For regions where no local travel demand model data are available, data from CSTDM are used (Caltrans, 2020). Data are quality assured by checking network/link volume, vehicle miles traveled (VMT), and spatial rendering. Overlapping networks are checked for duplicate links to avoid overallocation in these regions. Model output years vary between all regional data sources for ITN. The networks are normalized into modeling years used for air quality modeling using county level growth factors from EMFAC. Table 5 contains the data vintages used in the current working version of the statewide ITN.

Spatial allocation of on-road activity surrogates is split into two vehicle groups, light-duty and heavy-duty. Some major MPOs and Caltrans provide vehicle classification splits in their model link outputs. When possible, this information is incorporated into the ITN. However, when no vehicle splits are provided by the regional models the total network volumes must be used for both light-duty and heavy-duty spatial distribution. Travel demand model output provides network volume information organized by peak and off-peak time periods. This peak period volume information is disaggregated to create 24 hourly surrogates for an average modeling day.

The link networks are processed through the spatial allocator tool to create gridded surrogates weighted by VMT.

Table 5: Network information for data sources used in current version of ITN

Network	Counties in Network	Data Vintage
Association of Monterey Bay Area Governments (AMBAG)	Monterey, San Benito, Santa Cruz	2018 RTDM
Butte County Association of Governments (BCAG)	Butte	2019 FSTIP
California Statewide Travel Demand Model (CSTDM)	Statewide	Version 3.0
Fresno Council of Governments (FCOG)	Fresno	2022 RTP/SCS
Kings County Association of Governments (KCAG)	Kings	2022 RTP/SCS
Kern Council of Governments (KCOG)	Kern	2022 RTP/SCS
Merced County Association of Governments (MCAG)	Merced	2022 RTP/SCS
Madera County Transportation Commission (MCTC)	Madera	2022 RTP/SCS
Metropolitan Transportation Commission (MTC)	Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, Sonoma	2017 RTP/SCS
Sacramento Area Council of Governments (SACOG)	El Dorado, Placer, Sacramento, Solano, Sutter, Yolo, Yuba	2020 MTP/SCS
San Diego Association of Governments (SANDAG)	San Diego	2021 RTP/SCS
Santa Barbara County Association of Governments (SBCAG)	Santa Barbara	2017 FSTIP
Southern California Association of Governments (SCAG)	Imperial, Los Angeles, Orange, Riverside, San Bernardino, Ventura	2020 RTP/SCS
San Joaquin Council of Governments (SJCOG)	San Joaquin	2022 RTP/SCS

Network	Counties in Network	Data Vintage
San Luis Obispo Council of Governments (SLOCOG)	San Luis Obispo	2019 RTP/SCS
Shasta Regional Transportation Agency (SRTA)	Shasta	2018 RTP/SCS
Stanislaus Council of Governments (StanCOG)	Stanislaus	2022 RTP/SCS
Tulare County Association of Governments (TCAG)	Tulare	2022 RTP/SCS
Tahoe Metropolitan Planning Organization (TMPO)	El Dorado, Placer	2015 FSTIP

Evaporative surrogates were created using registration data from the California Department of Motor Vehicles (DMV). Vehicle registration was provided by census block group for the entire state. Registration data were split into five vehicle types and two fuel types. Table 6 shows the vehicle type categories used for the evaporative emission surrogates. Registration counts were totaled over a three-year period (2015-2018) and assigned to the corresponding census block group polygons. Data from the NASA Nighttime Lights (Mills, Weiss, & Liang, 2013) dataset was used to clip the census block group into areas with active population.

Table 6: Registration data vehicle type classes.

Vehicle Class Group Name	Description
MC	Motorcycles
MH_BUS	Motorhomes and Buses
P	Passenger Vehicles
T1_T4	Light-Heavy Duty Trucks
T5_T7	Heavy-Heavy Duty Trucks

4. Temporal Adjustment (Day-of-week adjustments for EMFAC daily totals)

EMFAC2021 produces a single average day-of-week (DOW) estimate that represents Tuesday, Wednesday, and Thursday for each county in California. To represent daily emissions more accurately, DOW adjustments are made to all emissions estimated on a Friday, Saturday, Sunday, or Monday. The DOW adjustment factors were developed using CalVAD data. The California Vehicle Activity Database (CalVAD), developed by UC Irvine for CARB, is a system that fuses available data sources to produce a “best estimate” of vehicle activity by class. The latest activity from the CalVAD database was released in 2012. There are no expected upcoming updates. The CalVAD data set includes actual daily measurements of VMT on the road network for 43 of the 58 counties in California. However, there are seven counties that can't be used because the total vehicle miles traveled are less than the sum of the heavy heavy-duty truck vehicle miles traveled and trucks excluding heavy heavy-duty vehicle miles traveled. Furthermore, two more counties that have high vehicle miles traveled on Sunday are also excluded. Therefore, only 34 of these counties had useful data. To fill the missing 24 counties' data to cover all of California, a county which is nearby and similar in geography is selected to represent each of the missing counties. The CalVAD fractions were developed for three categories of vehicles: passenger cars (LD), light- and medium-duty trucks (LM), and heavy-heavy duty trucks (HHDT). Heavy-heavy duty vehicle fractions have recently been updated using 2017 Performance Measurement System (PeMS) data. Truck volumes were pulled for each county. Day of year specific fractions were calculated relative to an average weekday for each county. Fractions were manually reviewed by staff to check data integrity. Counties without data or poor data quality were screened out and replaced with an older version of fractions from CalVAD.

Table 7 shows the corresponding assignment to each vehicle type. Furthermore, the CalVAD fractions are scaled so that a typical workday (Tuesday, Wednesday, or Thursday) gets a scaling factor of 1.0. All other days of the week receive a scaling factor where their VMT is related back to the typical workday. This means there are a total of five weekday scaling factors. Lastly, the CalVAD data were used to create a typical holiday, because the traffic patterns for holidays are quite different than a typical weekday. Thus, in the end, there are six daily fractions for each of the three vehicle classes, for all 58 counties. The DOW factors and vehicle type can be found in Appendix A: Day-of-week Redistribution Factors by Vehicle Type and County.

Table 7: Vehicle classification and type of adjustment

Vehicle Class	Vehicle Type	Type of Adjustment
1	LDA	LD
2	LDT1	LD
3	LDT2	LD
4	MDV	LD
5	LHDT1	LM
6	LHDT2	LM
7	T6	LM
8	T7 HHDT	HHDT

Vehicle Class	Vehicle Type	Type of Adjustment
9	Other Bus	LM
10	School Bus	Unadjusted on weekdays, zeroed on weekends
11	Urban Bus	LD
12	Motorhomes	LD
13	Motorcycles	LD

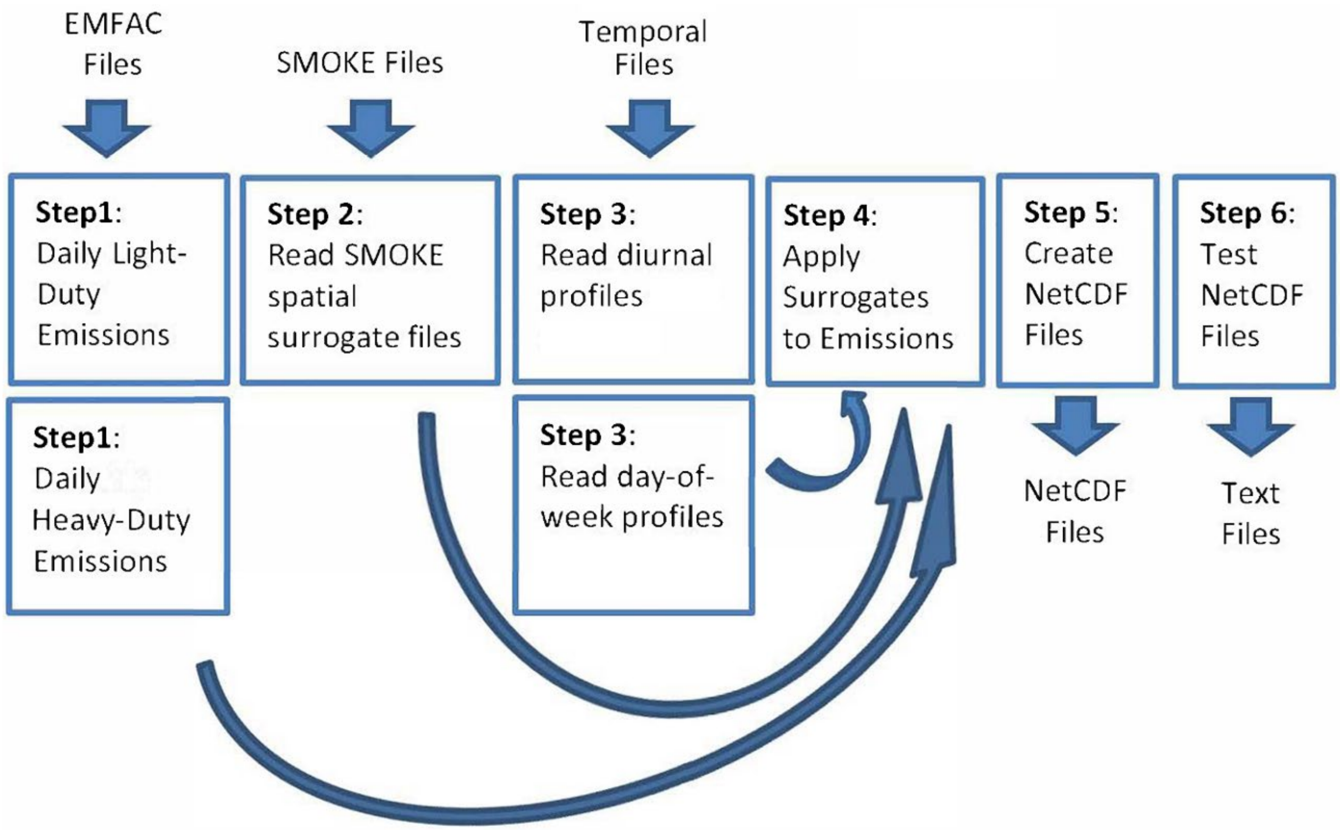
5. Temporal Adjustment (Hour-of-day profiles for EMFAC daily totals)

EMFAC produces emission estimates for an average weekday and lacks the day-of-week hour-of-day temporal variations that are known to occur on specific days of the week. To rectify this, the CalVAD data were used to develop hour-of-day profiles for Friday through Monday, a typical weekday and a typical holiday. Heavy-heavy duty hourly vehicle fractions were updated using 2017 Performance Measurement System (PeMS) data from Caltrans in counties where data were available. The hour-of-day profiles for passenger cars (LD), light- and medium-duty trucks (LM), and heavy heavy-duty trucks (HH) can be found in Appendix B: Hour-of-day Profiles by Vehicle Type and County.

6. Summary of On-road Emissions Processing Steps

The six steps to process on-road emissions for regional air quality modeling with CMAQ are represented below in Figure 3. Step 1 reads daily emissions input data from EMFAC. Step 2 reads SMOKE-ready spatial surrogates files. Step 3 reads day of week and diurnal temporal activity profiles from CalVAD. Step 4 applies both the spatial surrogates and temporal allocations to the daily emissions from EMFAC. Step 5 creates the gridded, hourly Network Common Data Form (NetCDF) files for each day of the year being modeled. Lastly, step 6 produces text files for use in quality assurance and quality checks of the emissions data.

Figure 3: Workflow for spatial and temporal allocation of on-road emissions



7. Adjustment to the Future Year On-road Emissions

The future year on-road mobile source emissions were adjusted to incorporate emission reduction programs for heavy duty vehicles. The reductions applied to the inventory reflect the Low NOx Standard (CARB, Heavy-Duty Low NOx, 2020), Advanced Clean Truck (ACT) (CARB, Advanced Clean Trucks, 2020), Advanced Clean Car II (ACCII), Statewide SIP Strategy (SSS) and Heavy Duty Inspection and Maintenance Regulation (CARB, Heavy-Duty Inspection and Maintenance Regulation, 2021).

C. Estimation of Gridded Biogenic Emissions

Biogenic emissions were generated using the MEGAN3.0 biogenics emissions model (https://bai.ess.uci.edu/megan/versions). MEGAN3.0 incorporates a new pre-processor (MEGAN-EFP) for estimating biogenic emission factors based on available landcover and emissions data. The MEGAN3.0 default datasets for plant growth form, ecotype, and emissions were utilized. Leaf Area Index (LAI) for non-urban grid cells was based on the 8-day 500-m resolution MODIS Terra/Aqua combined product (MCD15A2H) for 2017 (https://earthdata.nasa.gov/). The LAI data was converted to LAIv, which represents the LAI for the vegetated fraction within each grid cell, by dividing the gridded MODIS LAI values by the Maximum Green Vegetation Fraction (MGVF) for each grid cell (DroughtView, 2014). The

MODIS LAI product does not provide information on LAI in urban regions, so urban LAIv was estimated from the US Forest Service's Forest Inventory and Analysis (FIA) urban tree plot data, processed through the i-Tree v6 software (https://www.itreetools.org/tools/i-tree-eco). Hourly meteorology was provided by 4-km WRF simulations for 2017, and all stress factor adjustments were turned off.

D. Aircraft Emissions

Aircraft emissions were generated using the Gridded Aircraft Trajectory Emissions Model (GATE) developed by CARB (CARB, Gridded Aircraft Trajectory Emissions Model Documentation, 2017). The GATE model distributes aircraft emissions in three dimensions. The GATE model takes annual aircraft emissions during landing, taxiing, and take-off, and converts this data into gridded, hourly emissions as follows:

- Read aircraft emissions from an annual inventory
- Split the emissions into hourly components
- Split any county-wide emissions into individual runways and use the point source emissions if they are available
- Geometrically model the 3D flight paths at each runway
- Intersect the above 3D paths with the 3D modeling grid
- Distribute the hourly aircraft emissions into the 3D grid

E. Estimation of Ocean-going Vessel (OGV) Emissions

Annual emissions are provided through CEPAM for commercial and military OGV. The Mobile Source Analysis Branch compiled port activity data for 2016 reported for Long Beach, Port of Los Angeles, Bay Area, and San Diego. The activity data consisted of daily visits by vessel types for the full calendar year. This data was used to derive monthly and weekly temporal profiles for OGV sources. No activity data was available to create temporal profiles for the military sector; default SMOKE temporal profiles were assumed.

Subsequently, emissions were separated by at-berth and everything else. At-berth emissions are processed through SMOKE as inline point sources. Latitude and longitude locations were predetermined as of 22nd October 2021 based on GIS vertices captured by satellites. (Kwok, 2015). The at-berth emissions had been temporally allocated with monthly and weekly profiles derived from the 2016 port activities described in the last paragraph. For transit, maneuvering, and anchorage, emissions are distributed evenly in two vertical layers (2 and 3) (Kwok, 2015).

F. Estimation of Other Day-specific Sources

Day-specific data were used for preparing base case inventories when data were available. CARB and district staff were able to gather hourly/daily emission information for 1) wildfires and prescribed burns, 2) paved and unpaved road dust, and 3) agricultural burns in six districts (more details highlighted below).

For the reference and future year inventories, day-specific emissions for wildfires, prescribed burns, and wildland fires use (WFU) are left out of the inventory. All other day-specific data are included in both reference and future year modeling inventories.

1. Wildfires and Prescribed Burns

Day-specific, base case estimates of emissions from wildfires and prescribed fires were developed in a two-part process. The first part consisted of estimating micro-scale, fire-specific emissions (i.e. at the fire polygon scale, which can be at a smaller spatial scale than the grid cells used in air quality modeling). The second part consisted of several steps of post-processing fire polygon emission estimates into gridded, hourly emission estimates that were formatted for use in air quality modeling.

Fire event-specific emissions were estimated using a combination of geospatial databases and a federal wildland fire emission model (Clinton, Gong, & Scott, 2006). A series of pre-processing steps were performed using GIS to develop fuel loading and fuel moisture inputs to the First Order Fire Effects (FOFEM) fire emission model (Lutes, Keane, & Reinhardt, 2012). Polygons from a statewide interagency fire perimeters geodatabase (Fire17_1.zip, downloaded May 8, 2018) maintained by FRAP, provided georeferenced information on the location, size (area), spatial shape, and timing of wildfires and prescribed burns. Under interagency Memorandums of Understanding, federal, state, and local agencies report California wildfire and prescribed burning activity data to FRAP. Using GIS software, fire polygons were overlaid upon a vegetation fuels raster dataset called the Fuel Characteristic Classification System (FCCS) (Ottmar, Sandberg, & Riccardi, 2007). The FCCS maps vegetation fuels at a 30-meter spatial resolution, and is maintained and distributed by LANDFIRE.GOV, a state and federal consortium of wildland fire and natural resource management agencies. With spatial overlay of fire polygons upon the FCCS raster, fuel model codes were retrieved and component areas within each fire footprint tabulated. For each fuel code, loadings (tons/acre) for fuel categories were retrieved from a FOFEM look-up table. Fuel categories included dead woody fuel size classes, overstory live tree crown, understory trees, shrubs, herbaceous vegetation, litter, and duff. Fuel moisture values for each fire were estimated by overlaying fire polygons on year- and month-specific 1 km spatial resolution fuel moisture raster files generated from the national Wildland Fire Assessment System (WFAS.net) and retrieving moisture values from fire polygon centroids. Fire event-specific fuel loads and fuel moisture values were compiled and formatted to a batch input file and run through FOFEM.

A series of post-processing steps were performed on the FOFEM batch output to include emission estimates (pounds/acre) for three supplemental pollutant species (NH3, TNMHC, and N2O) in addition to the seven species native to FOFEM (CO, CO2, PM2.5, PM10, CH4, NOx, and SO2), and to calculate total emissions (tons) by pollutant species for each fire. Emission estimates for NH3, TNMHC, and N2O were based on mass ratios to emitted CO and CO2 (Gong, Clinton, & Pu, 2003).

Fire polygon emissions were apportioned to CMAQ model grid cells using area fractions, developed using GIS software, by intersecting fire polygons to the grid domain. For fires captured in the VIIRS dataset, a set of automated scripts used the VIIRS data to spatially allocate fire emissions to the gridded modeling domain on days with active thermal anomalies.

Another set of post-processing steps were applied to allocate fire polygon emissions by date and hour of the day. Fire polygon emissions were allocated evenly between fire start and end dates, taken from the fire perimeters geodatabase. For fires captured in the VIIRS dataset, automated scripts determined fire temporal weighting factors based on the total number of satellite detects. Daily emissions were then allocated to hour of day and to the model grid cells by using a script developed by CARB. A stack file and a 2-D hourly emissions file are generated for each day that has fire emissions. The stack file includes the fire locations, stack parameters and the number of acres burned for a fire in one day. The 2-D hourly emissions file includes the emissions for each species and the heat flux (BTU/hr). CMAQ's in-line plume rise module will handle the vertical allocation of the fire emissions.

2. Paved and Unpaved Road Dust

Statewide emissions of total particulate matter from both paved and unpaved road dust are also a part of the CEPAM inventory. However, the sectors that have been embedded in any CEPAM version are already pre-adjusted. The unadjusted emissions are what is required before making any adjustment. Therefore, the unadjusted paved road dust is based upon CEPAM SIP2019v1.02-v1.01, while the unadjusted unpaved road dust uses an older CEPAM version with 20161130 snapshot. To adjust for precipitation, daily precipitation data for 2017 were used, provided by an in-house database maintained by CARB staff that stores meteorological data collected from outside sources. The specific data sources for these data include Remote Automated Weather Stations (RAWS), Atmospheric Infrared Sounder (AIRS), California Irrigation Management Information System (CIMIS) networks, and Federal Aviation Administration (FAA). FAA provides precipitation data collected from airports in California.

When the precipitation reaches or exceeds 0.01 inches (measured anywhere within a county or county/air basin boundary on a particular day), the uncontrolled emissions are reduced on that day only: 25% for paved road dust, and total removal for the unpaved. The reductions are achieved by running SMOKE with control matrices.

3. Agricultural Burning

Agricultural burn 2017 data processed were reported by air districts. The tons burned provided by the air districts were converted to acres using fuel loading data. With date of the burns, the location of the burns (latitude and longitude coordinates), crop type, and burn duration, the agricultural burn data were processed and then projected onto a statewide grid for each hour of a specific day.

4. Residential Wood Combustion Curtailment

Emissions were reduced to reflect residential wood curtailment (RWC) in San Joaquin Valley APCD, Sacramento Metropolitan AQMD and South Coast AQMD.

A pre-SMOKE utility program called GenTpro is used to generate county-specific temporal profiles based on average temperature by grid cell (UNC Chapel Hill - The Institute for the Environment, 2016). Emissions for any given county are only allocated whenever the daily minimum temperature anywhere within a GAI is below 50 °F based on WRF simulated meteorology for year 2017. The subsequent GenTpro county-specific, daily profiles will temporally allocate emissions for both base year 2017 and future year 2030.

San Joaquin Valley APCD provided areas of curtailment where gas utility is accessible. The designated areas are used to mask the spatial surrogates for woodstoves and fireplaces. The masked surrogates were used to apply day-specific curtailment. The corresponding complimentary surrogates were also constructed by subtracting the masked surrogates from the original spatial surrogates. These complimentary surrogates apply to areas without curtailment. For winter months (January, February, November, December) of year 2017; SJVAPCD provided no-burn days by county, from which day-specific CNTLMAT curtailment files were constructed. The no-burn days of the month are determined by thresholds of PM levels for each day and these thresholds are county dependent.

Emissions from residential wood combustion are reduced in curtailment areas by 65% in 2017 and 97% in 2030 on the no burn days to represent compliance with the no burn day status based on ambient aerosol mass spectrometry measurements in Fresno (Ge et al 2012; Young et al, 2016). With these settings, processing of curtailed months using SMOKE is enabled by merging the outputs of two separate runs. The first run is for the portion with masked surrogates with curtailment via CNTLMAT, and the second run is for the portion that includes complimentary surrogates without curtailment.

For non-curtailed months, SMOKE is only run once with the original spatial surrogates without any curtailment of emissions. For the base year, the whole RWC inventory was applied with the assumption of a 65% compliance rate. For the future year, a 97% compliance rate was assumed, and the curtailment days differ depending on two categories of woodstoves: registered and unregistered. The curtailment days also depend on the PM2.5 levels established following the implementation of the hotspots program from the 2018 PM2.5 Plan for the 12 μg/m3 annual PM2.5 standard (SJVAQMD, 2018). Based on surveys conducted by SJVAPCD, portions of registered and unregistered woodstoves are derived to determine the emission shares. Each category is subject to a different set of two-tier PM2.5 thresholds. For Fresno, Kern and Madera that have been deemed as hotspot areas by Valley Air District (SJVAQMD, 2018), no burning is allowed for any devices when PM2.5 is above 35 ug/m3, while registered woodstoves are still allowed to burn when PM2.5 is above 12 ug/m3 but not more than 35 ug/m3. For other SJV counties, no burning is allowed for any devices when PM2.5 is above 65 ug /m3, whereas registered woodstoves are allowed to burn when PM2.5 is above 20 ug/m3 but not more than 65 ug/m3. Fireplaces are subject to the curtailment rules for unregistered woodstoves.

Areas under Sacramento Metropolitan AQMD (SACAQMD) have their RWC emissions reduced by 57% -or 70% depending on the PM level within the county. Curtailment is applied to the entire spatial surrogates without exceptions. Areas under South Coast (SCAQMD) are subject to 75% curtailment whenever no-burn days within the basin are designated. The compliance rates for SACAQMD and SCAQMD apply to both base- and future years.

5. Estimation of Agricultural Ammonia Emissions

Ammonia emissions from fertilizers/pesticides and livestock are separated from the aggregated area source inventory as they are affected by local meteorology. For fertilizers/pesticides, emissions vary by hour based on WRF's two-meter temperature and ten-meter wind speed. For livestock, WRF's ground temperature and aerodynamic resistance drive hourly variations in emissions. Through GenTpro, these meteorological factors are averaged by county before creating year-long hourly profiles for each of the respective sectors. All algorithms are described in the SMOKE Manual 4. (UNC Chapel Hill - The Institute for the Environment, 2016), while the results of CARB in-house tests were summarized in an internal report (Kwok, 2016). In general, higher temperature and/or wind speeds favor ammonia emissions. Monthly surrogates based on the frequency of pesticide applications were also applied to fertilizer NH3. The sector also has emissions reported by a few individual facilities whose latitudes/longitudes are known.

Since the facility-reported livestock sources were represented as point sources, they must be converted to area source format to make use of GenTpro hourly profiles. Another hourly GenTpro file was created for these facility-reported portions of the sector. To preserve the spatial distribution, emissions were apportioned to those individual facilities by GAI. Thus, each area-to-point fraction file was created for each of the pollutants NH3, PM, and TOG. After SMOKE was run for each pollutant, the gridded NetCDF files were merged.

6. Commercial Cooking

Base year 2017 and future year 2030 commercial cooking emissions were updated in accordance with San Joaquin Valley APCD's recent area source methodology (SJVAPCD, 2023). The methodology includes emission estimates for commercial charbroiling, deep fat frying, and other commercial cooking. The methodology uses a study performed for CARB and the number of restaurants listed in each county as surrogates for determining the number of cooking devices and the amount of food (meats and potatoes) cooked in each county. The amount of food cooked on each device type is multiplied by appropriate emission factors to determine the emissions from each food type on each cooking device. These are then summed for county level emissions.

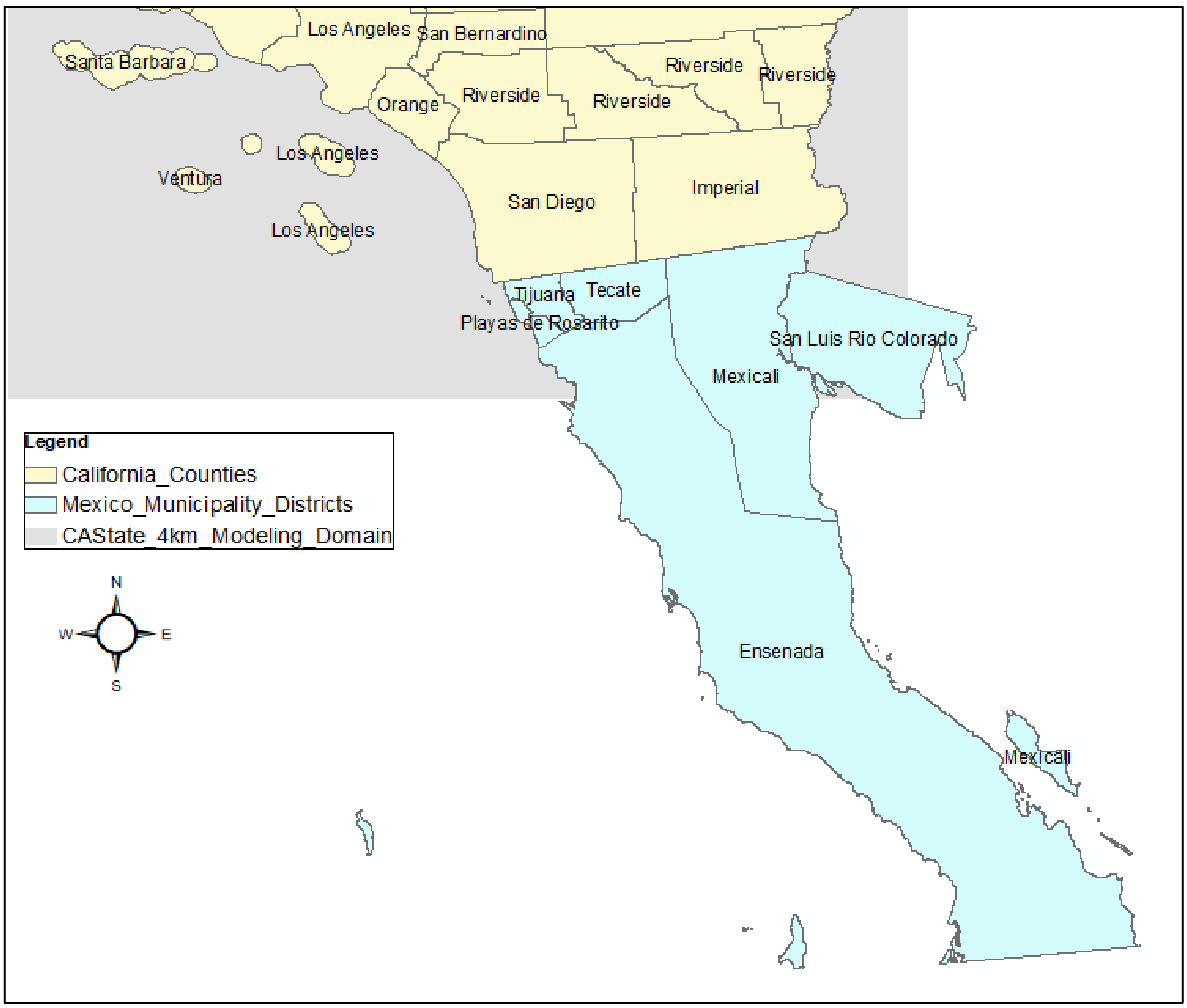
G. Northern Mexico Emissions

Transboundary flow of pollutants between California and Mexico must be considered and accounted for in air quality simulations of Southern California. Affected areas in California include the border regions of San Diego and Imperial counties. Given the right meteorological conditions, more northern counties such as Riverside, Orange, and Los Angeles may also be impacted. As a result, emissions within the five municipalities of Mexico's State of Baja California and one municipality from Sonora must be included when running regional air quality models on the California Statewide Domain. The boundaries of our California 4km modeling domain is shown in grey color in Figure 4.

CARB's Mexico emissions inventory for area, point and non-road emission sources have been processed using an updated inventory developed by Eastern Research Group Inc. (ERG). This inventory is based on the 2014 Mexico National Emissions Inventory (MNEI) with additional improvements made by ground-truthing agricultural burning and brick kilns, and improving methods to calculate idling mobile emissions at the border entries (ERG, 2019). Base year 2017 emission estimates were developed by projecting the 2014 emissions to 2017. Future year 2030 emissions estimates were developed by interpolating 2014, 2020 and 2025 emission estimates to 2030.

For mobile sources, the U.S. EPA on-road emissions model SMOKE-MOVES (Sparse Matrix Operator Kernel Emissions – Motor Vehicle Emission Simulator) Mexico was used to produce an on-road emissions inventory. The on-road sector is reflective of true 2017 emissions. Future year 2030 emission estimates used the U.S. EPA on-road emissions model SMOKE-MOVES Mexico for future year 2028. SMOKE-MOVES is more comprehensive than the data provided for the on-road sector in the 2014 MNEI, and after discussions with U.S. EPA it was suggested to use SMOKE-MOVES over the 2014 MNEI estimates.

Figure 4: Outline of Mexico municipalities included in California air quality simulations



Under contract to CARB, ERG completed an update to the spatial distribution of Mexico's area, non-road and on-road emissions (ERG, 2019). These updates include additional spatial surrogates such as the location of brick kilns, bakeries, ports, airports etc. for the state of Baja California. In addition, the project supports large improvements on emission estimates at two major border crossings (ERG, 2019). These updates have been included in the base and future year inventories and the surrogates used are listed in Table 8.

EPA's National Emission Inventory (NEI) has been used by CARB as a foundation for identifying spatial surrogates that will aid in allocating emissions in the northern part of Mexico. While searching for improved surrogates, different online databases were investigated to find shapefiles relevant to established source sectors. The updated population surrogate was pulled from Instituto Nacional de Estadística y Geografía (INEGI) using information from Mexico's 2010 Population and Housing Census. INEGI provides spatial information about Mexico such as resources, population, and land use. The population surrogate was also used to update the following residential heating sources: wood, distillate oil, coal, and LP gas. The total road miles surrogate that is used to spatially allocate on-road emissions was also updated using data provided by INEGI's dataset containing information on urban and rural roads and highways. Agriculture and forests spatial surrogates were updated using the same dataset from Comisión Nacional Forestal (CONAFOR). Using satellite images taken by the MODIS sensor (Moderate Resolution Imaging Spectroradiometer), the resulting vector data set from CONAFOR was produced to characterize Mexico's land. The border crossings surrogate was updated using statistics from the U.S. Bureau of Transportation, which provided points of entry along California and Mexico's border. Once the shapefiles were collected, they were converted to the standard projection used in CARB's modelling. These EPA-based surrogates are used within the state of Sonora, which was not covered in the ERG contract, and as secondary spatial allocation for the state of Baja CA. Table 9 lists the EPA-based Mexico surrogates with vintage May 2018.

Table 8: List indicating ERG developed spatial surrogates for the state of Baja California

Spatial Surrogate ID	Description	Year
100	Mexicali Agriculture	2014
110	Mexicali Agburn	2014
111	Mexicali Agburn Asparagus	2014
112	Mexicali Agburn Bermuda	2014
113	Mexicali Agburn Wheat	2014
120	Airports	2014
130	Autoshop	2014
140	Bakeries	2014
150	Border Crossing	2014

Spatial Surrogate ID	Description	Year
160	Brick Kilns	2014
170	Charbroiling	2014
180	Feedlots	2014
190	Gas Stations	2014
200	Graphic Arts	2014
210	Hospitals	2014
220	Landfills	2014
230	Total Population	2014
231	Rural Population	2014
232	Urban Population	2014
240	Ports	2014
250	Railroads	2014
260	Wastewater	2014
270	Windblown Dust	2014

Table 9: List of EPA's Mexico surrogates with vintage of May 2018

ID	Surrogate	Year	Shapefile	Weight Field
10	Population	2010	north_mexico_population.shp	population
12	Housing	2010	north_mexico_population.shp	population
14	Residential Heating Wood	2010	north_mexico_population.shp	population
16	Residential Heating Distillate Oil	2010	north_mexico_population.shp	population
18	Residential Heating Coal	2010	north_mexico_population.shp	population

ID	Surrogate	Year	Shapefile	Weight Field
20	Residential Heating LP Gas	2010	north_mexico_population.shp	population
22	Total Road Miles	2011	MEX_roads.shp	WEIGHT
24	Total Railroad Miles	2000	mexico_rr_MM5.shp	LENGTH
26	Total Agriculture	2015	MEX_agriculture.shp	WEIGHT
28	Forest Land	2015	MEX_Forests.shp	WEIGHT
30	Land Area	2000	REPMEX_ES_HEAT1_MM5.shp	P001
32	Commercial Land	1999	com_ind_viv_MM5.shp	A500_2000
34	Industrial Land	1999	com_ind_viv_MM5.shp	A505_2000
36	Commercial Plus Industrial	1999	com_ind_viv_MM5.shp	A510_2000
38	Commercial plus Industrial Land	1999	com_ind_viv_MM5.shp	A515_2000
40	Residential Commercial Industrial Institutional	1999	com_ind_viv_MM5.shp	a535_2000
42	Personal Repair	1999	REP_CRUCES_MM5.shp	a545_1999
44	Airports Area	1999	mexico_air_MM5.shp	WEIGHT
46	Marine Ports	1999	mexico_ports_MM5.shp	VALUE
48	Brick Kilns	1999	BOSQUE_LAD_MM5.shp	LAD_2000
50	Mobile Sources Border Crossing	2014	Border_Crossing_Years_MM5.shp	Y20**

H. Western States Emissions

In addition to transboundary flow from Mexico into California cities, pollutants can travel between various bordering states such as Nevada, Arizona, Oregon, Idaho, and Utah. The current statewide modeling domain includes grid cells that cover these regions and therefore emission estimates from the four major source sectors (area, point, non-road and on-road) need to be included for a complete California State modeling domain inventory. As CARB or California air districts are not responsible for the development of emission estimates in those geographic regions, the national emission inventory developed by the U.S. EPA was used for states outside of California.

CARB's Western US emissions inventory has been developed using the U.S. Environmental Protection Agency (EPA) 2016v2 Modeling Platform for the years 2016, 2023, 2026 and 2032.This platform drew on data from the 2017 National Emissions Inventory with incorporation of 2016-specific state data and adjustments / projections for each sector (USEPA, 2021).

Base year 2017 emissions were developed with the "2016fj_16j" case for year 2016 while future year 2030 emissions were developed with "2032_16j" for year 2032. The "f" represents the base year emissions modeling platform iteration and "j" represents the 10th configuration of emissions modeled for the modeling platform (USEPA, 2021). Spatial and temporal allocations were applied using the U.S. EPA ancillary files, however, all spatial surrogates were processed through the spatial allocator tool with the California statewide map projection applied.

I. Application of Control Measure Reduction Factors

Future year Residential wood combustion was adjusted by extending the curtailment program into March in addition to the winter months (January, February, November and December). This additional month of the curtailment program results in additional PM2.5 reduction benefits. Details on the application of the curtailment program can be found in Section IV.F.4.

Future year onroad vehicle emissions were adjusted to reflect statewide reduction commitments for CARB's Low NOx, ACT, ACCII, SSS, and HD I&M. The onroad adjustments are summarized in Section IV.B.7.

Offroad emissions in the future year were adjusted to account for the SSS reductions in year 2030. Off-road mobile source categories that were adjusted for the SSS were:

- Trains
- Commercial harbor craft
- Recreational boats
- Off-road recreational vehicles
- Off-road equipment
- Portable equipment (PERP)
- Farm equipment.

Farm equipment NOx and PM2.5 emissions in the future year were adjusted to reflect additional reductions resulting from the Funding Agricultural Replacement Measures for Emission Reductions (FARMER) Program.

V. Quality Assurance of Modeling Inventories

As mentioned in Section II.C.1., base case modeling is intended to demonstrate confidence in the modeling system. Quality assurance of the data is necessary to detect outliers and potential problems with emission estimates. The most important quality assurance checks of the modeling emissions inventory are summarized in the following sections.

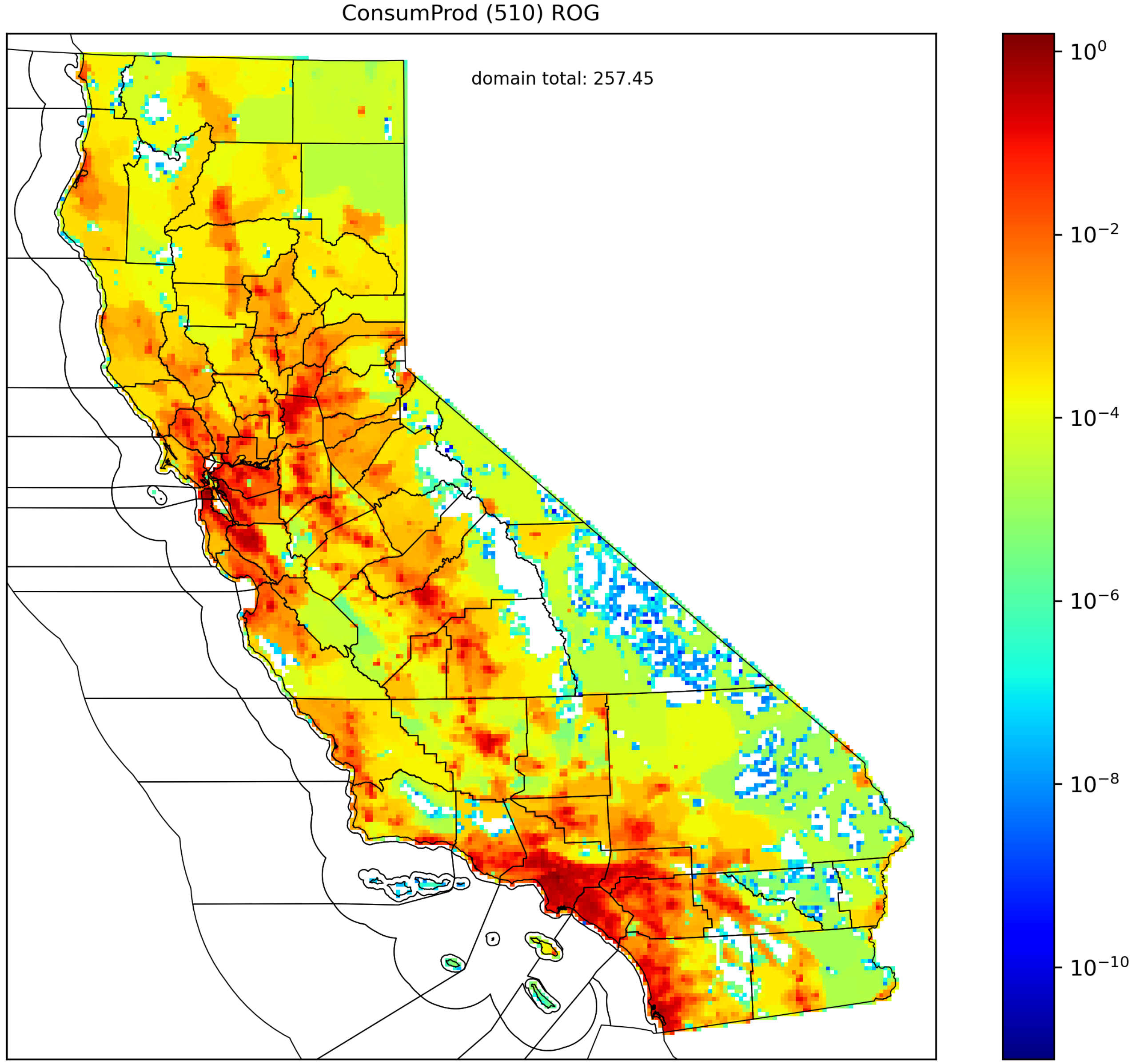
A. Area and Point Sources

All SMOKE inputs are subject to extensive quality assurance procedures performed by CARB staff. Annual and forecasted emissions are carefully reviewed prior to running SMOKE. CARB and district staff review data used to calculate emissions along with other ancillary data, such as temporal profiles and the location of facilities and assignment of SCC to each process. Growth and control information are reviewed and updated as needed.

We also compare annual average emissions from CEPAM with planning inventory totals to ensure data integrity. The planning and modeling inventories start with the same annual average emissions. The planning inventory is developed for an average summer day and an average winter day, whereas the modeling inventory processes daily emissions. Both inventory types use the same temporal data described in Section III.C. The summer planning inventory uses the monthly throughputs from May through October. Similarly, the winter planning inventory uses the monthly throughputs from November through April. The modeling inventory produces emissions for every day of the year.

Annual, gridded emissions totals are plotted on the statewide modeling domain and visually inspected to check the spatial allocation of emissions. Spatial plots by source category like the one shown in Figure 5 are carefully screened for proper spatial distribution of emissions.

Figure 5: Example of an ROG spatial plot by source category (Consumer Products)



Before air quality model-ready emissions files are generated by SMOKE, the run configurations and parameters set within the SMOKE environment are checked for consistency for both the reference and future years.

To aid in the quality assurance process, SMOKE is configured to generate inventory reports of temporally, chemically, and spatially-resolved emissions inventories. CARB staff utilize the SMOKE reports by checking emissions totals by source category and region. Staff also create and analyze time series plots, and compare aggregate emissions totals with the pre-SMOKE emissions totals obtained from CEPAM.

Checks for missing or invalid temporal assignments are conducted to ensure accurate temporal allocation of emissions. Special attention is paid to checking monthly throughputs and appropriate monthly temporal distribution of emissions for each source category. In addition, checks for time-invariant temporal assignments are done for certain source categories and suitable alternate temporal assignments are determined and applied.

Further improvements to temporal profiles used in the allocation of area source emissions are performed using suitable alternate temporal assignments determined by CARB staff. Select sources from manufacturing and industrial, degreasing, petroleum marketing, mineral processes, consumer products, residential fuel combustion, farming operations, aircraft, off-road equipment, and commercial harbor craft sectors are among the source categories included in the application of adjustments to temporal allocation.

B. On-road Emissions

There are several processes to conduct quality assurance of the on-road mobile source modeling inventory at various stages of the inventory processing. The specific steps taken are described below.

- Plot MPO provided data spatially to find any missing or incomplete links.
- Compare spatial distribution of VMT between on and off-peak periods for each MPO.
- Generate time series plots for the on-road emissions files to check the diurnal pattern.
- Compare the daily total emissions for the on-road emissions files and the EMFAC2021 emissions files for each county to ensure that the emissions are the same.
- Generate the spatial plot for the on-road emissions files to check if there were any missing emissions.

C. Aircraft Emissions

There are two steps to conduct quality assurance of the aircraft emissions.

- Compare the daily total emissions for the aircraft emissions files and the raw emissions files for each county to ensure that the emissions are the same.
- Generate the spatial plot for the aircraft emissions files to check if there were any missing emissions.

D. Day-specific Sources

1. Wildfires

GIS records for 607 wildfires, 219 prescribed wildland burn events, and 17 wildland fires use reported for 2017 were downloaded from FRAP and imported to a geodatabase. Data fields included wildfire or burn project name, burned area, and start and end dates. A series of geoprocessing steps were used to map and overlay wildfire and prescribed burn footprint polygons on the statewide vegetation fuels (FCCS) and moisture raster datasets, to retrieve associated fuel loadings and moisture values for use as input to FOFEM. Wildfire and prescribed burn footprint polygons were also overlaid on the statewide 4-km modeling grid to assign grid cell IDs to each wildfire and prescribed burn. Emission estimates for each wildfire and prescribed burn event were generated by FOFEM and summarized in an Access database. To check the location of the fires and the daily total emissions, a script is used to make a NetCDF file from the stack file and the 2-D hourly emissions file for each day. The spatial plot and the daily total emissions from processing the NetCDF file are then compared to the raw fire emissions data to check for accuracy.

2. Agricultural Burning

Checks were done to verify the quality of the agricultural burn data. The day-specific emissions from agricultural burning were compared to the emissions from CEPAM for each county to check for agreement between the planning and modeling inventories. Time series plots were reviewed for each county to confirm that days when burning occurred matched the days provided by the local air district. For each county, a few individual fires were calculated by hand starting from the raw data through all the steps to the final model-ready emissions files to make sure the calculations were done correctly. Spatial plots were made to verify the location of each burn.

E. Additional Quality Assurance

In addition to the quality assurance described above, comparisons are made between annual average inventories from CEPAM and modeling inventories. The modeling inventory shows emissions by month and subsequently calculates the annual average for comparison with CEPAM emissions. Annual average inventories and modeling inventories can be different, but differences should be well understood. For example, modeling inventories are adjusted to reflect different days of the week for on-road motor vehicles as detailed in Section IV.B since weekend travel is generally less than weekday travel, modeling inventory emissions are usually lower when compared to annual average inventories from CEPAM. Figure 6 is an example of a QA report that summarizes PM2.5 emissions by category for EIC3 10 through 499 for the San Joaquin Valley PM2.5 Nonattainment Area. The report compares the monthly and annual processed emissions totals against CEPAM. Please note that this report is only an example since emissions have been updated from what is displayed here.

Figure 6: Comparison of inventories report

2017 SJV PM2.5 SIP, Base Year 2017 -- Based Off Of Gid687 With Updates: Apply District Monthly Temporal Profiles For RWC In SJV (Instead Of Gentpro) BYr:*2017* MYr:*2017*

Spec:*PM25*

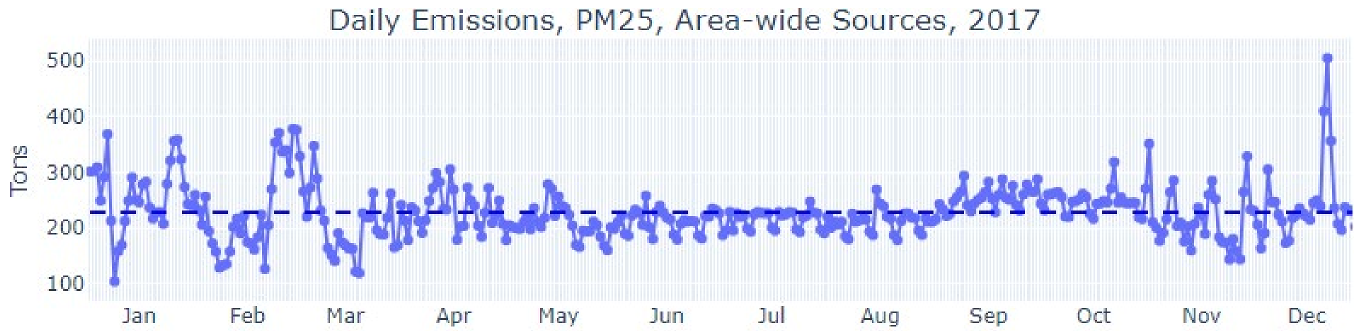
EIC	Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	RF3064_19v1.02	RF3084_19v1.03	RF3108_19v1.04	RF3089_22v1.01
10	Electric Utilities	4.51	4.17	3.68	3.57	3.79	4.89	5.71	6.39	5.55	5.27	4.46	4.40	4.70	4.46	4.46	4.46	4.46
20	Cogeneration	1.45	1.43	1.40	1.43	1.47	1.48	1.49	1.48	1.45	1.47	1.46	1.45	1.45	1.57	1.57	1.57	1.58
30	Oil And Gas Production (Combustion)	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.21	2.22	2.24	2.24	2.24	2.24
40	Petroleum Refining (Combustion)	4.17	4.17	4.27	4.27	4.27	4.24	4.24	4.24	4.19	4.19	4.19	4.17	4.22	4.12	4.14	4.14	4.14
50	Manufacturing And Industrial	3.38	3.49	3.67	3.81	4.01	4.09	4.02	4.13	4.14	4.18	3.86	3.58	3.86	4.01	4.14	4.14	4.35
52	Food And Agricultural Processing	1.42	1.46	0.87	1.16	1.01	1.04	1.26	1.40	1.38	0.84	1.31	1.35	1.21	1.13	1.16	1.16	1.16
60	Service And Commercial	5.10	5.00	4.57	4.09	3.44	3.42	3.35	3.44	3.38	3.62	3.78	4.80	3.99	4.18	4.22	4.01	3.99
99	Other (Fuel Combustion)	2.78	2.79	2.79	2.79	2.82	2.83	2.81	2.84	2.82	2.83	2.79	2.78	2.81	0.23	0.70	0.70	0.71
110	Sewage Treatment	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
120	Landfills	0.99	0.96	0.97	0.97	0.99	1.00	0.97	0.98	0.97	0.97	0.97	0.98	0.98	1.09	1.09	1.09	1.09
130	Incinerators	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
140	Soil Remediation	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.06	0.06	0.06	0.06
199	Other (Waste Disposal)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
210	Laundering	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
220	Degreasing	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
230	Coatings And Related Process Solvents	1.76	1.79	1.82	1.78	1.82	1.84	1.76	1.85	1.78	1.81	1.78	1.76	1.80	1.82	1.82	1.82	1.85
240	Printing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
250	Adhesives And Sealants	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
299	Other (Cleaning And Surface Coatings)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
310	Oil And Gas Production	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
320	Petroleum Refining	2.55	2.55	2.54	2.54	2.54	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.85	2.85	2.85	2.85
330	Petroleum Marketing	0.04	0.04	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
399	Other (Petroleum Production And Marketing)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
410	Chemical	1.54	1.58	1.63	1.61	1.63	1.65	1.59	1.64	1.58	1.59	1.57	1.54	1.60	1.56	1.56	1.56	1.58
420	Food And Agriculture	1.58	1.55	1.52	1.50	1.51	1.53	2.62	3.67	4.89	5.32	4.11	1.85	2.64	3.21	3.21	3.21	3.24
430	Mineral Processes	10.29	10.48	11.02	10.97	11.11	11.60	10.67	11.26	10.65	10.72	10.32	9.95	10.75	12.67	12.67	12.67	12.79
440	Metal Processes	0.75	0.76	0.79	0.77	0.79	0.79	0.75	0.79	0.77	0.78	0.76	0.75	0.77	0.73	0.73	0.73	0.74
450	Wood And Paper	6.70	6.78	6.86	6.79	6.87	6.94	6.74	6.96	6.80	6.88	6.77	6.71	6.82	6.88	6.88	6.88	6.95
460	Glass And Related Products	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
470	Electronics	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
499	Other (Industrial Processes)	11.12	11.32	11.56	11.37	11.55	11.76	11.30	12.07	11.79	11.98	11.49	11.20	11.54	4.00	3.52	3.52	3.52

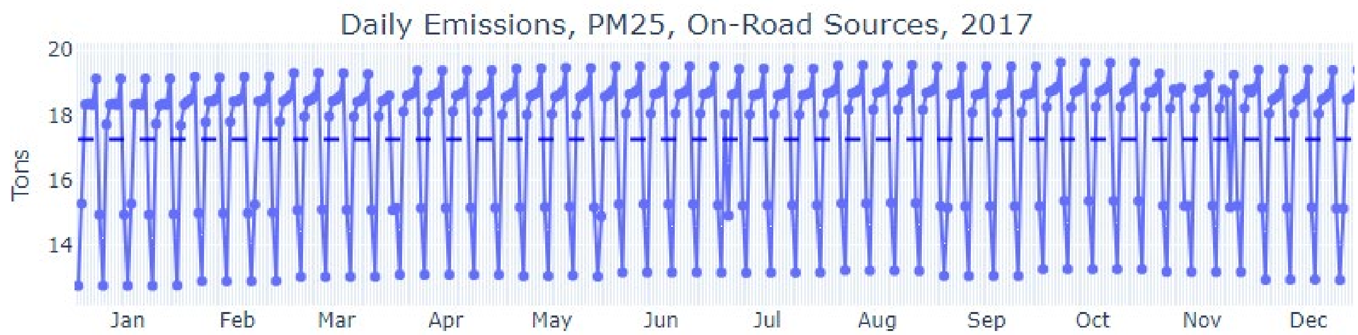
Notes:

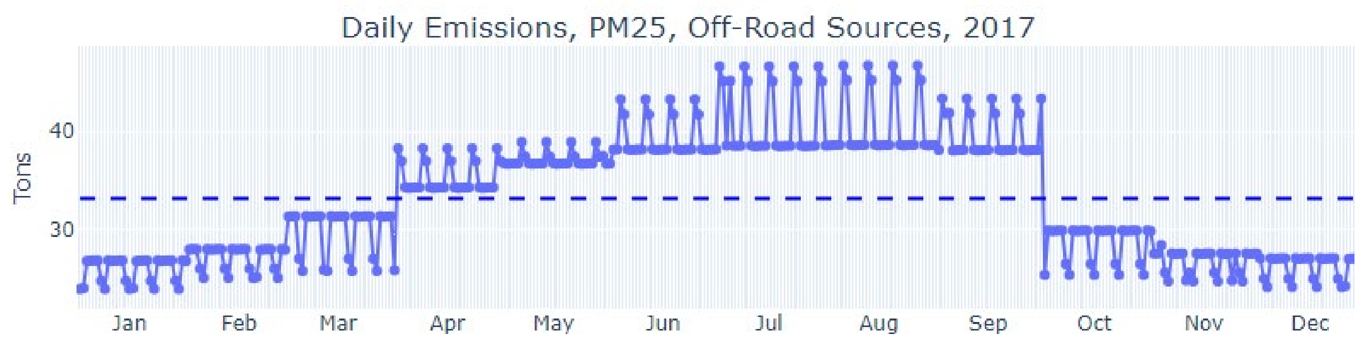
- CEPAM refers to annual average emissions from 2019 SIP Baseline Emission Inventory Tool with external adjustments: *CEPAM External Adjustment Reporting Tool*
- Monthly gridded emissions come from GeoVAST mo-yr/avg tabular summary - gid 703

Staff also review how modeling emissions vary over a year. Figure 7 provides an example of a modeling inventory time series plot for San Joaquin Valley Air Basin for area-wide sources, on-road sources, and off-road sources. Again, this figure is only an example.

Figure 7: Daily variation of NOx emission sources in San Joaquin Valley Air Basin in 2017







F. Model-ready Files Quality Assurance

Prior to developing the modeling inventory emissions files used in the photochemical models, the same model-ready emissions files developed for the individual source categories (e.g., on-road, area, point, day-specific sources) are checked for quality assurance. Extensive quality assurance procedures are already performed by CARB staff on the intermediate emissions files (e.g., SMOKE-generated reports); however, further checks are needed to ensure data integrity is preserved when the model-ready emissions files are generated from those intermediate emissions files. Figure 8 shows the share of area, on-road, cooking, livestock, residential wood combustion, stationary and agricultural day specific burns contribution to annual PM2.5 emissions for the San Joaquin Valley Air Basin in 2017. These same sources are shown as a daily timeseries for the San Joaquin Valley PM2.5 Nonattainment Area in Figure 9. These figures are only examples and do not reflect the inventory totals used for SIP attainment modeling.

Figure 8: Annual processed emissions example for 2017 San Joaquin Valley Air Basin PM 2.5 for selected sectors

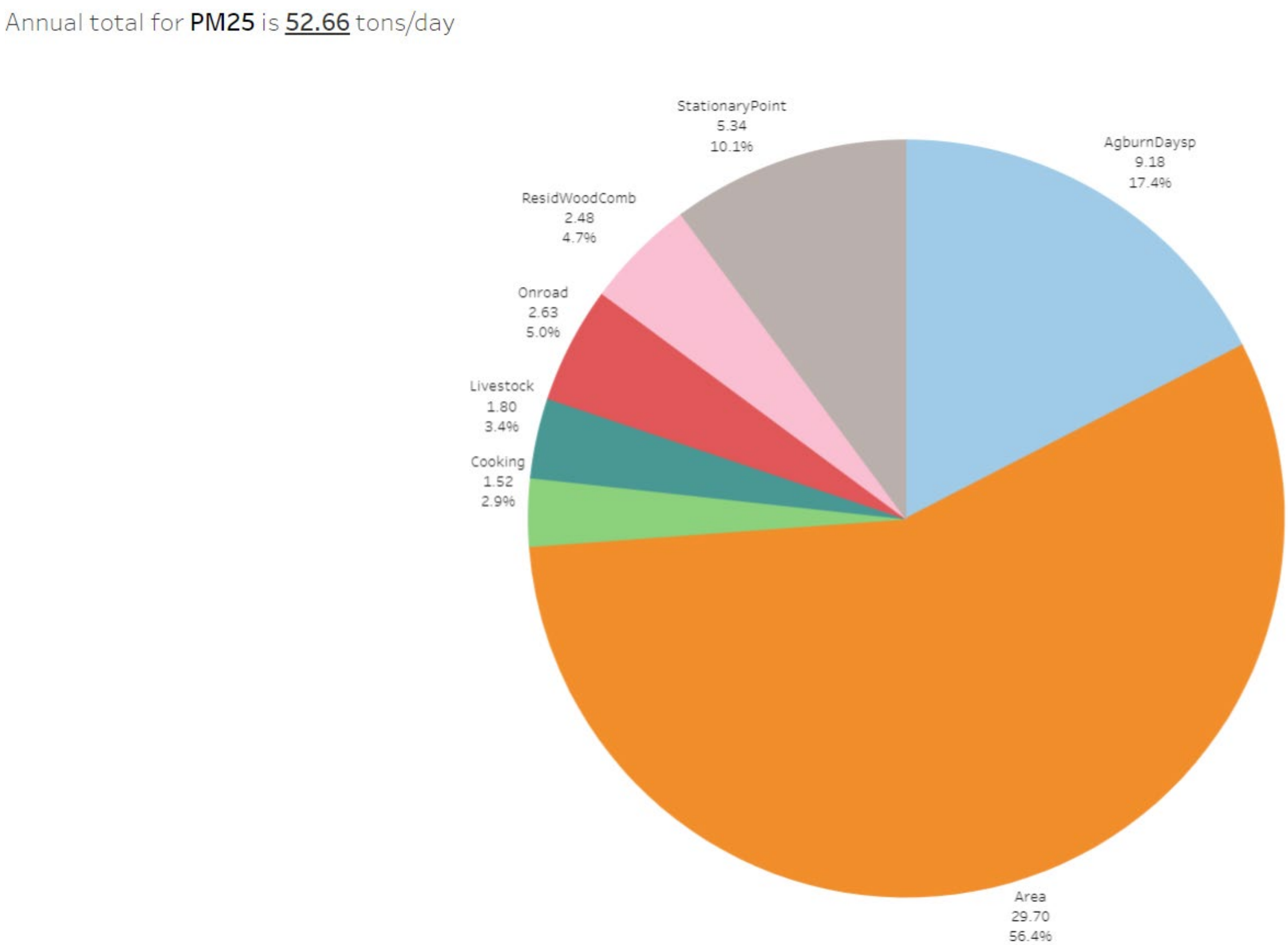
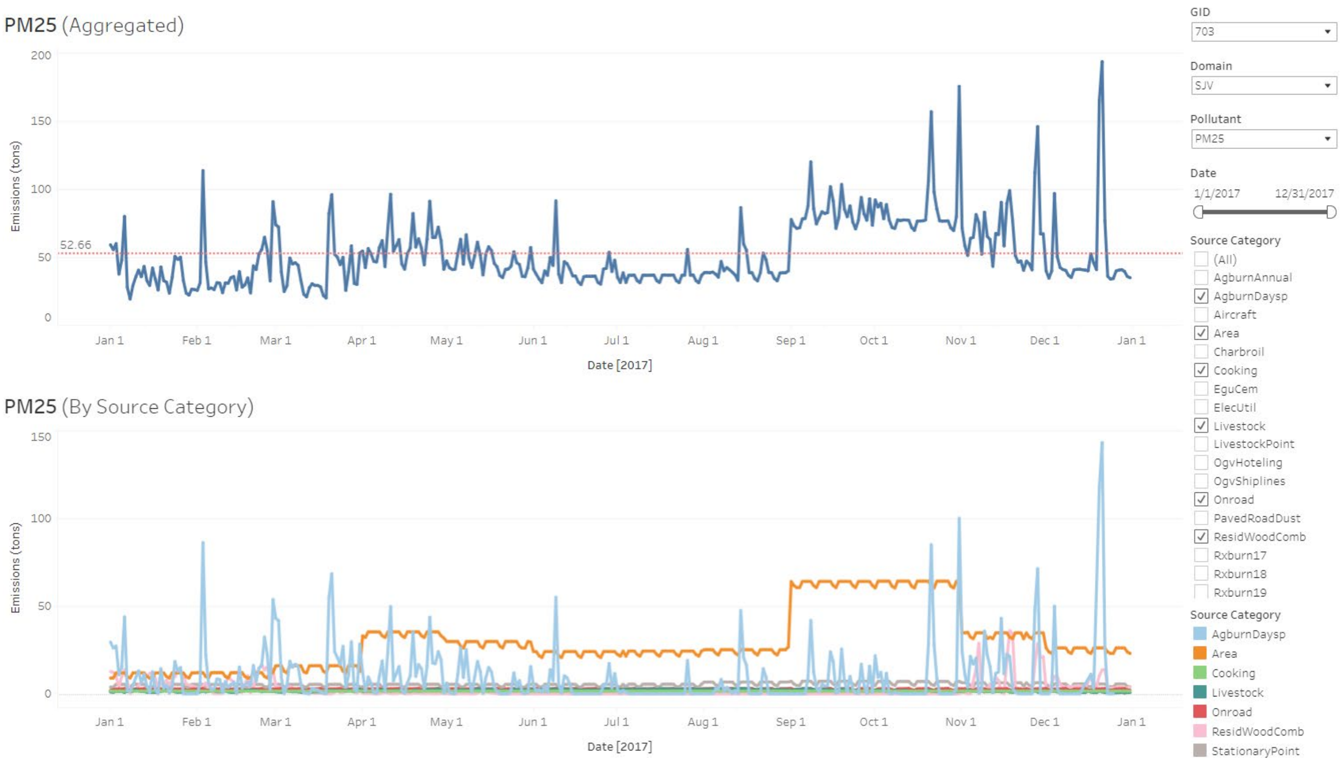


Figure 9: Example timeseries plot for daily 2017 PM 2.5 emissions from selected sectors for San Joaquin Valley Air Basin



Comparisons of the totals for both the intermediate and model-ready emissions files are made. Emissions totals are aggregated spatially, temporally, and chemically to single-layer, statewide, daily values by inventory pollutant. Spatial plots are also generated for both the intermediate and model-ready emissions files using the same graphical utilities and aggregated to the same spatial, temporal, and chemical resolution to allow equal comparison of emissions. Any discrepancies in the emissions totals are reconciled before proceeding with the development of the model-ready inventory emissions files.

Before combining the model-ready emissions files of the individual source category inventories into a single model-ready inventory, they are checked for completeness. Most sources should have emissions for every day in the modeling period. Exceptions to this apply to sources like fires since burning (natural or planned) does not occur every day. It is important that during these checks source inventories with missing files are identified and resolved. Once all constituent source inventories are complete, they are used to develop the model-ready inventory used in photochemical modeling. When the modeling inventory files are generated, log files are also generated documenting the constituents of each daily model-ready emissions file as an additional means of verifying that each daily model-ready inventory is complete.

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VII. Appendix A: Day-of-week Redistribution Factors by Vehicle Type and County

The factors shown in Table 10 shows the “day-of-week” factors for broad vehicle classes: LD is Light-Duty, LM is Light- and Medium-Duty Trucks. The “day-of-week” factors for Heavy Heavy-Duty Trucks or HD are available daily for the entire year. Table 11 shows an excerpt the week of July 1st to 7th.

Table 10: Day-of-week adjustment for LD and LM vehicle class by county

County	Day of Week	LD	LM
Fresno	Sunday	0.85	0.44
Fresno	Monday	1.01	0.93
Fresno	Tues/Wed/Thurs	1.00	1.00
Fresno	Friday	1.15	1.03
Fresno	Saturday	0.95	0.56
Fresno	Holiday	0.80	0.78
Kern	Sunday	1.11	0.63
Kern	Monday	1.06	0.94
Kern	Tues/Wed/Thurs	1.00	1.00
Kern	Friday	1.25	1.04
Kern	Saturday	1.10	0.73
Kern	Holiday	0.99	0.91
Kings	Sunday	0.66	0.36
Kings	Monday	0.96	0.91
Kings	Tues/Wed/Thurs	1.00	1.00
Kings	Friday	1.04	0.98
Kings	Saturday	0.81	0.52

County	Day of Week	LD	LM
Kings	Holiday	0.67	0.67
Madera	Sunday	1.02	0.48
Madera	Monday	1.02	0.94
Madera	Tues/Wed/Thurs	1.00	1.00
Madera	Friday	1.17	1.02
Madera	Saturday	1.10	0.60
Madera	Holiday	0.87	0.83
Merced	Sunday	1.00	0.59
Merced	Monday	1.01	0.96
Merced	Tues/Wed/Thurs	1.00	1.00
Merced	Friday	1.18	1.10
Merced	Saturday	1.06	0.71
Merced	Holiday	0.98	0.90
San Joaquin	Sunday	0.93	0.50
San Joaquin	Monday	0.98	0.92
San Joaquin	Tues/Wed/Thurs	1.00	1.00
San Joaquin	Friday	1.13	1.09
San Joaquin	Saturday	1.04	0.66
San Joaquin	Holiday	0.91	0.77
Stanislaus	Sunday	1.00	0.59
Stanislaus	Monday	1.01	0.96
Stanislaus	Tues/Wed/Thurs	1.00	1.00

County	Day of Week	LD	LM
Stanislaus	Friday	1.18	1.10
Stanislaus	Saturday	1.06	0.71
Stanislaus	Holiday	0.98	0.90
Tulare	Sunday	1.03	0.43
Tulare	Monday	1.05	0.94
Tulare	Tues/Wed/Thurs	1.00	1.00
Tulare	Friday	1.10	1.02
Tulare	Saturday	0.99	0.67
Tulare	Holiday	0.94	0.58

Table 11: Day-of-week adjustment for July 1st to 7th for HH vehicle class by county

Date	Day of Week	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
7/1	Saturday	0.77	0.83	0.76	0.63	0.90	0.74	0.90	0.73
7/2	Sunday	0.71	0.75	0.68	0.55	0.78	0.64	0.78	0.60
7/3	Monday	0.99	1.03	0.96	0.97	1.04	1.04	1.04	0.97
7/4	Holiday	0.70	0.77	0.71	0.62	0.73	0.67	0.73	0.64
7/5	Wednesday	0.99	1.03	1.00	0.93	1.08	1.05	1.08	1.00
7/6	Thursday	0.99	1.06	1.02	0.95	1.02	1.04	1.02	1.01
7/7	Friday	1.01	1.07	1.00	0.95	1.14	1.06	1.14	1.03

VIII. Appendix B: Hour-of-day Profiles by Vehicle Type and County

The factors shown in the table below represent the different hourly profiles for days of the week for each county for a broad vehicle class: LD is Light-Duty, LM is Light- and Medium-Duty Trucks, and HH is Heavy Heavy-Duty Trucks. Hourly profiles for LD, LM, and HH by day of week are shown in Table 12, Table 13, and Table 14. The county names are abbreviated as follows: Fresno is C10, Kern is C15, Kings is C16, Madera is C20, Merced is C24, San Joaquin is C39, Stanislaus is C50 and Tulare is C54.

Table 12: Hour-of-day profiles for LD and LM vehicle classes for Counties C10 – C20

Day of Week	Hour	C10 LD	C10 LM	C15 LD	C15 LM	C16 LD	C16 LM	C20 LD	C20 LM
Sunday	0	0.015	0.033	0.014	0.028	0.016	0.031	0.014	0.037
Sunday	1	0.010	0.030	0.010	0.024	0.010	0.025	0.008	0.032
Sunday	2	0.008	0.027	0.007	0.022	0.007	0.026	0.005	0.028
Sunday	3	0.005	0.025	0.006	0.020	0.005	0.022	0.004	0.026
Sunday	4	0.006	0.024	0.007	0.021	0.004	0.020	0.004	0.026
Sunday	5	0.010	0.026	0.012	0.024	0.008	0.023	0.009	0.027
Sunday	6	0.017	0.029	0.016	0.027	0.018	0.029	0.016	0.030
Sunday	7	0.022	0.032	0.024	0.032	0.023	0.030	0.022	0.033
Sunday	8	0.032	0.038	0.032	0.039	0.034	0.040	0.033	0.039
Sunday	9	0.044	0.046	0.042	0.045	0.048	0.049	0.046	0.047
Sunday	10	0.055	0.052	0.051	0.051	0.059	0.057	0.056	0.052
Sunday	11	0.063	0.057	0.059	0.056	0.071	0.064	0.065	0.057
Sunday	12	0.071	0.062	0.066	0.060	0.084	0.077	0.071	0.059
Sunday	13	0.076	0.064	0.071	0.063	0.083	0.077	0.073	0.059
Sunday	14	0.077	0.063	0.075	0.065	0.080	0.072	0.076	0.059
Sunday	15	0.077	0.061	0.078	0.064	0.076	0.065	0.076	0.058

Day of Week	Hour	C10 LD	C10 LM	C15 LD	C15 LM	C16 LD	C16 LM	C20 LD	C20 LM
Sunday	16	0.075	0.059	0.077	0.063	0.074	0.062	0.077	0.058
Sunday	17	0.073	0.056	0.074	0.060	0.068	0.056	0.074	0.055
Sunday	18	0.066	0.050	0.069	0.055	0.059	0.044	0.068	0.048
Sunday	19	0.057	0.044	0.061	0.049	0.050	0.037	0.060	0.043
Sunday	20	0.050	0.038	0.053	0.042	0.043	0.032	0.052	0.039
Sunday	21	0.040	0.033	0.042	0.035	0.036	0.028	0.042	0.034
Sunday	22	0.030	0.028	0.032	0.030	0.028	0.022	0.030	0.028
Sunday	23	0.020	0.023	0.021	0.025	0.015	0.015	0.018	0.023
Monday	0	0.009	0.019	0.013	0.022	0.005	0.013	0.007	0.021
Monday	1	0.005	0.018	0.009	0.019	0.002	0.012	0.003	0.020
Monday	2	0.004	0.018	0.008	0.019	0.001	0.013	0.002	0.020
Monday	3	0.005	0.020	0.011	0.022	0.001	0.012	0.004	0.023
Monday	4	0.011	0.023	0.021	0.029	0.003	0.015	0.012	0.028
Monday	5	0.024	0.034	0.040	0.041	0.012	0.021	0.029	0.039
Monday	6	0.044	0.047	0.047	0.046	0.034	0.040	0.050	0.051
Monday	7	0.069	0.064	0.056	0.054	0.070	0.071	0.072	0.063
Monday	8	0.063	0.062	0.050	0.052	0.073	0.071	0.063	0.059
Monday	9	0.055	0.056	0.049	0.052	0.061	0.063	0.058	0.056
Monday	10	0.055	0.056	0.052	0.053	0.058	0.062	0.057	0.057
Monday	11	0.057	0.059	0.057	0.056	0.059	0.063	0.059	0.059
Monday	12	0.061	0.061	0.061	0.059	0.062	0.064	0.060	0.062
Monday	13	0.063	0.062	0.064	0.060	0.064	0.067	0.061	0.061

Day of Week	Hour	C10 LD	C10 LM	C15 LD	C15 LM	C16 LD	C16 LM	C20 LD	C20 LM
Monday	14	0.069	0.065	0.068	0.063	0.073	0.071	0.066	0.062
Monday	15	0.074	0.068	0.074	0.067	0.078	0.072	0.071	0.064
Monday	16	0.079	0.068	0.073	0.065	0.086	0.073	0.075	0.062
Monday	17	0.076	0.062	0.067	0.058	0.087	0.070	0.074	0.058
Monday	18	0.053	0.043	0.050	0.044	0.056	0.046	0.052	0.041
Monday	19	0.037	0.030	0.037	0.034	0.037	0.028	0.037	0.030
Monday	20	0.030	0.023	0.032	0.028	0.029	0.021	0.030	0.022
Monday	21	0.024	0.018	0.026	0.023	0.023	0.015	0.025	0.017
Monday	22	0.018	0.013	0.021	0.018	0.016	0.010	0.019	0.014
Monday	23	0.012	0.010	0.014	0.015	0.009	0.007	0.012	0.011
Tues, Wed, Thurs	0	0.007	0.018	0.010	0.021	0.004	0.013	0.005	0.020
Tues, Wed, Thurs	1	0.004	0.017	0.007	0.019	0.002	0.011	0.002	0.019
Tues, Wed, Thurs	2	0.003	0.017	0.006	0.020	0.001	0.011	0.001	0.019
Tues, Wed, Thurs	3	0.004	0.019	0.009	0.022	0.001	0.011	0.003	0.021
Tues, Wed, Thurs	4	0.010	0.023	0.019	0.029	0.003	0.014	0.010	0.027
Tues, Wed, Thurs	5	0.024	0.032	0.039	0.041	0.012	0.021	0.027	0.037
Tues, Wed, Thurs	6	0.044	0.047	0.048	0.046	0.035	0.040	0.050	0.050
Tues, Wed, Thurs	7	0.070	0.064	0.058	0.053	0.069	0.066	0.074	0.063

Day of Week	Hour	C10 LD	C10 LM	C15 LD	C15 LM	C16 LD	C16 LM	C20 LD	C20 LM
Tues, Wed, Thurs	8	0.065	0.063	0.052	0.052	0.073	0.071	0.065	0.059
Tues, Wed, Thurs	9	0.055	0.057	0.049	0.050	0.060	0.062	0.057	0.057
Tues, Wed, Thurs	10	0.054	0.056	0.050	0.051	0.057	0.061	0.055	0.057
Tues, Wed, Thurs	11	0.055	0.058	0.054	0.054	0.058	0.063	0.056	0.058
Tues, Wed, Thurs	12	0.058	0.060	0.059	0.056	0.060	0.064	0.057	0.059
Tues, Wed, Thurs	13	0.061	0.062	0.062	0.058	0.061	0.065	0.059	0.060
Tues, Wed, Thurs	14	0.068	0.065	0.068	0.062	0.071	0.070	0.065	0.063
Tues, Wed, Thurs	15	0.074	0.067	0.075	0.067	0.077	0.072	0.071	0.064
Tues, Wed, Thurs	16	0.080	0.067	0.075	0.066	0.086	0.073	0.078	0.064
Tues, Wed, Thurs	17	0.078	0.063	0.070	0.060	0.087	0.072	0.078	0.061
Tues, Wed, Thurs	18	0.055	0.045	0.052	0.046	0.059	0.051	0.055	0.043
Tues, Wed, Thurs	19	0.039	0.032	0.039	0.036	0.039	0.032	0.039	0.031
Tues, Wed, Thurs	20	0.032	0.024	0.033	0.030	0.032	0.023	0.033	0.024
Tues, Wed, Thurs	21	0.027	0.019	0.029	0.025	0.026	0.017	0.028	0.019
Tues, Wed, Thurs	22	0.020	0.014	0.023	0.020	0.018	0.011	0.021	0.014

Day of Week	Hour	C10 LD	C10 LM	C15 LD	C15 LM	C16 LD	C16 LM	C20 LD	C20 LM
Tues, Wed, Thurs	23	0.013	0.010	0.015	0.017	0.010	0.007	0.013	0.011
Friday	0	0.007	0.019	0.009	0.021	0.006	0.014	0.006	0.020
Friday	1	0.004	0.018	0.007	0.019	0.002	0.012	0.002	0.019
Friday	2	0.003	0.017	0.006	0.019	0.001	0.011	0.002	0.019
Friday	3	0.004	0.019	0.008	0.021	0.001	0.012	0.003	0.021
Friday	4	0.009	0.023	0.015	0.027	0.002	0.015	0.009	0.027
Friday	5	0.020	0.032	0.031	0.037	0.011	0.021	0.022	0.036
Friday	6	0.037	0.044	0.039	0.043	0.031	0.039	0.039	0.047
Friday	7	0.059	0.060	0.048	0.050	0.063	0.064	0.059	0.058
Friday	8	0.057	0.059	0.045	0.050	0.067	0.069	0.054	0.058
Friday	9	0.052	0.056	0.045	0.049	0.057	0.062	0.051	0.056
Friday	10	0.053	0.057	0.049	0.053	0.057	0.063	0.052	0.057
Friday	11	0.056	0.059	0.054	0.055	0.059	0.065	0.054	0.059
Friday	12	0.059	0.061	0.058	0.057	0.061	0.065	0.056	0.060
Friday	13	0.062	0.063	0.063	0.060	0.062	0.066	0.059	0.062
Friday	14	0.068	0.066	0.068	0.063	0.070	0.069	0.065	0.063
Friday	15	0.073	0.067	0.072	0.067	0.073	0.069	0.071	0.064
Friday	16	0.077	0.067	0.073	0.064	0.079	0.073	0.077	0.062
Friday	17	0.074	0.061	0.070	0.059	0.078	0.065	0.076	0.057
Friday	18	0.060	0.047	0.060	0.048	0.061	0.050	0.063	0.046
Friday	19	0.046	0.034	0.049	0.039	0.045	0.034	0.050	0.035

Day of Week	Hour	C10 LD	C10 LM	C15 LD	C15 LM	C16 LD	C16 LM	C20 LD	C20 LM
Friday	20	0.038	0.026	0.042	0.032	0.036	0.023	0.042	0.026
Friday	21	0.034	0.020	0.037	0.027	0.031	0.017	0.037	0.021
Friday	22	0.028	0.015	0.031	0.023	0.028	0.013	0.030	0.015
Friday	23	0.020	0.011	0.021	0.018	0.017	0.008	0.021	0.012
Saturday	0	0.015	0.028	0.016	0.028	0.013	0.022	0.012	0.031
Saturday	1	0.010	0.025	0.011	0.023	0.008	0.019	0.008	0.027
Saturday	2	0.008	0.024	0.009	0.022	0.005	0.017	0.006	0.025
Saturday	3	0.007	0.023	0.009	0.021	0.003	0.016	0.005	0.024
Saturday	4	0.009	0.024	0.014	0.025	0.004	0.016	0.008	0.027
Saturday	5	0.016	0.029	0.027	0.034	0.010	0.022	0.017	0.032
Saturday	6	0.026	0.036	0.034	0.038	0.023	0.031	0.026	0.039
Saturday	7	0.036	0.043	0.042	0.045	0.036	0.041	0.036	0.045
Saturday	8	0.045	0.050	0.050	0.052	0.045	0.049	0.047	0.052
Saturday	9	0.053	0.055	0.056	0.056	0.053	0.054	0.055	0.057
Saturday	10	0.060	0.061	0.060	0.057	0.061	0.063	0.062	0.062
Saturday	11	0.066	0.064	0.063	0.059	0.067	0.072	0.067	0.063
Saturday	12	0.069	0.065	0.065	0.061	0.071	0.072	0.068	0.062
Saturday	13	0.069	0.063	0.066	0.061	0.071	0.069	0.068	0.059
Saturday	14	0.070	0.063	0.067	0.060	0.071	0.070	0.068	0.059
Saturday	15	0.069	0.060	0.067	0.060	0.070	0.067	0.068	0.056
Saturday	16	0.067	0.057	0.064	0.056	0.070	0.061	0.068	0.054
Saturday	17	0.063	0.051	0.058	0.052	0.066	0.056	0.064	0.050

Day of Week	Hour	C10 LD	C10 LM	C15 LD	C15 LM	C16 LD	C16 LM	C20 LD	C20 LM
Saturday	18	0.056	0.044	0.051	0.046	0.059	0.048	0.057	0.042
Saturday	19	0.047	0.036	0.044	0.037	0.049	0.036	0.049	0.034
Saturday	20	0.041	0.031	0.039	0.033	0.043	0.032	0.043	0.030
Saturday	21	0.038	0.027	0.035	0.029	0.040	0.027	0.039	0.027
Saturday	22	0.034	0.024	0.030	0.024	0.037	0.024	0.035	0.024
Saturday	23	0.024	0.019	0.023	0.020	0.024	0.017	0.025	0.020
Holiday	0	0.013	0.023	0.015	0.023	0.011	0.017	0.011	0.023
Holiday	1	0.007	0.022	0.009	0.021	0.006	0.018	0.005	0.024
Holiday	2	0.006	0.022	0.007	0.020	0.002	0.018	0.004	0.022
Holiday	3	0.005	0.022	0.008	0.021	0.001	0.019	0.004	0.024
Holiday	4	0.008	0.025	0.013	0.024	0.003	0.015	0.007	0.026
Holiday	5	0.016	0.030	0.027	0.032	0.010	0.021	0.016	0.033
Holiday	6	0.028	0.039	0.033	0.037	0.026	0.034	0.027	0.040
Holiday	7	0.040	0.046	0.039	0.043	0.043	0.046	0.037	0.045
Holiday	8	0.045	0.049	0.043	0.047	0.050	0.052	0.043	0.051
Holiday	9	0.049	0.052	0.050	0.050	0.051	0.052	0.051	0.053
Holiday	10	0.057	0.058	0.055	0.055	0.060	0.067	0.059	0.060
Holiday	11	0.065	0.062	0.064	0.060	0.067	0.070	0.067	0.064
Holiday	12	0.070	0.067	0.068	0.061	0.073	0.078	0.071	0.066
Holiday	13	0.071	0.067	0.071	0.066	0.075	0.072	0.071	0.067
Holiday	14	0.074	0.066	0.073	0.064	0.076	0.070	0.072	0.064
Holiday	15	0.076	0.067	0.075	0.067	0.072	0.073	0.075	0.062

Day of Week	Hour	C10 LD	C10 LM	C15 LD	C15 LM	C16 LD	C16 LM	C20 LD	C20 LM
Holiday	16	0.076	0.064	0.072	0.064	0.075	0.066	0.076	0.060
Holiday	17	0.072	0.058	0.066	0.059	0.071	0.059	0.072	0.056
Holiday	18	0.058	0.046	0.056	0.046	0.059	0.046	0.060	0.044
Holiday	19	0.047	0.035	0.047	0.042	0.047	0.032	0.050	0.035
Holiday	20	0.039	0.028	0.039	0.033	0.040	0.029	0.043	0.029
Holiday	21	0.032	0.022	0.031	0.027	0.034	0.024	0.035	0.022
Holiday	22	0.026	0.017	0.025	0.021	0.030	0.015	0.028	0.018
Holiday	23	0.018	0.013	0.016	0.018	0.018	0.009	0.017	0.014

Table 13: Hour-of-day profiles for LD and LM vehicle classes for Counties C24 – C50

Day of Week	Hour	C24 LD	C24 LM	C39 LD	C39 LM	C50 LD	C50 LM	C54 LD	C54 LM
Sunday	0	0.014	0.025	0.016	0.024	0.014	0.025	0.022	0.015
Sunday	1	0.009	0.019	0.010	0.017	0.009	0.019	0.024	0.015
Sunday	2	0.007	0.016	0.007	0.015	0.007	0.016	0.023	0.011
Sunday	3	0.005	0.015	0.006	0.014	0.005	0.015	0.023	0.009
Sunday	4	0.006	0.016	0.008	0.015	0.006	0.016	0.024	0.010
Sunday	5	0.010	0.019	0.011	0.018	0.010	0.019	0.026	0.018
Sunday	6	0.015	0.023	0.017	0.022	0.015	0.023	0.030	0.031
Sunday	7	0.021	0.029	0.023	0.027	0.021	0.029	0.034	0.035
Sunday	8	0.031	0.038	0.032	0.036	0.031	0.038	0.035	0.042
Sunday	9	0.043	0.050	0.045	0.048	0.043	0.050	0.040	0.057
Sunday	10	0.055	0.060	0.056	0.059	0.055	0.060	0.044	0.066

Day of Week	Hour	C24 LD	C24 LM	C39 LD	C39 LM	C50 LD	C50 LM	C54 LD	C54 LM
Sunday	11	0.063	0.065	0.063	0.067	0.063	0.065	0.047	0.070
Sunday	12	0.070	0.070	0.068	0.071	0.070	0.070	0.051	0.076
Sunday	13	0.075	0.071	0.071	0.074	0.075	0.071	0.054	0.073
Sunday	14	0.077	0.069	0.073	0.073	0.077	0.069	0.056	0.071
Sunday	15	0.078	0.070	0.073	0.071	0.078	0.070	0.059	0.071
Sunday	16	0.077	0.067	0.073	0.068	0.077	0.067	0.060	0.066
Sunday	17	0.075	0.062	0.072	0.063	0.075	0.062	0.061	0.063
Sunday	18	0.068	0.055	0.067	0.055	0.068	0.055	0.060	0.052
Sunday	19	0.061	0.047	0.061	0.047	0.061	0.047	0.059	0.050
Sunday	20	0.051	0.039	0.054	0.040	0.051	0.039	0.055	0.037
Sunday	21	0.041	0.031	0.044	0.031	0.041	0.031	0.048	0.029
Sunday	22	0.029	0.024	0.031	0.024	0.029	0.024	0.038	0.018
Sunday	23	0.019	0.019	0.019	0.019	0.019	0.019	0.028	0.014
Monday	0	0.011	0.017	0.010	0.012	0.011	0.017	0.022	0.004
Monday	1	0.007	0.015	0.006	0.010	0.007	0.015	0.023	0.004
Monday	2	0.006	0.015	0.006	0.010	0.006	0.015	0.023	0.004
Monday	3	0.009	0.018	0.011	0.015	0.009	0.018	0.024	0.006
Monday	4	0.018	0.027	0.029	0.028	0.018	0.027	0.027	0.015
Monday	5	0.030	0.039	0.043	0.043	0.030	0.039	0.035	0.035
Monday	6	0.044	0.051	0.053	0.052	0.044	0.051	0.040	0.056
Monday	7	0.058	0.058	0.061	0.059	0.058	0.058	0.044	0.063
Monday	8	0.053	0.058	0.055	0.057	0.053	0.058	0.046	0.071

Day of Week	Hour	C24 LD	C24 LM	C39 LD	C39 LM	C50 LD	C50 LM	C54 LD	C54 LM
Monday	9	0.051	0.059	0.051	0.056	0.051	0.059	0.046	0.066
Monday	10	0.054	0.062	0.051	0.058	0.054	0.062	0.049	0.070
Monday	11	0.057	0.064	0.052	0.060	0.057	0.064	0.051	0.070
Monday	12	0.060	0.064	0.054	0.061	0.060	0.064	0.056	0.072
Monday	13	0.061	0.064	0.056	0.063	0.061	0.064	0.055	0.073
Monday	14	0.067	0.066	0.063	0.068	0.067	0.066	0.058	0.073
Monday	15	0.072	0.065	0.069	0.072	0.072	0.065	0.061	0.077
Monday	16	0.075	0.063	0.072	0.071	0.075	0.063	0.061	0.073
Monday	17	0.074	0.055	0.070	0.065	0.074	0.055	0.059	0.059
Monday	18	0.055	0.042	0.055	0.045	0.055	0.042	0.050	0.037
Monday	19	0.042	0.031	0.041	0.031	0.042	0.031	0.045	0.024
Monday	20	0.034	0.023	0.033	0.023	0.034	0.023	0.040	0.017
Monday	21	0.027	0.018	0.027	0.017	0.027	0.018	0.035	0.013
Monday	22	0.020	0.014	0.021	0.013	0.020	0.014	0.029	0.010
Monday	23	0.014	0.011	0.014	0.010	0.014	0.011	0.022	0.006
Tues/Wed/Thurs	0	0.008	0.016	0.009	0.011	0.008	0.016	0.021	0.004
Tues/Wed/Thurs	1	0.005	0.014	0.006	0.010	0.005	0.014	0.021	0.004
Tues/Wed/Thurs	2	0.005	0.014	0.005	0.010	0.005	0.014	0.022	0.004
Tues/Wed/Thurs	3	0.008	0.018	0.010	0.014	0.008	0.018	0.024	0.005
Tues/Wed/Thurs	4	0.017	0.026	0.027	0.026	0.017	0.026	0.028	0.014
Tues/Wed/Thurs	5	0.030	0.039	0.043	0.041	0.030	0.039	0.035	0.033
Tues/Wed/Thurs	6	0.044	0.050	0.054	0.051	0.044	0.050	0.041	0.056

Day of Week	Hour	C24 LD	C24 LM	C39 LD	C39 LM	C50 LD	C50 LM	C54 LD	C54 LM
Tues/Wed/Thurs	7	0.059	0.059	0.062	0.059	0.059	0.059	0.044	0.067
Tues/Wed/Thurs	8	0.055	0.058	0.056	0.057	0.055	0.058	0.046	0.071
Tues/Wed/Thurs	9	0.051	0.059	0.051	0.055	0.051	0.059	0.047	0.067
Tues/Wed/Thurs	10	0.052	0.060	0.049	0.056	0.052	0.060	0.049	0.069
Tues/Wed/Thurs	11	0.054	0.061	0.050	0.058	0.054	0.061	0.052	0.071
Tues/Wed/Thurs	12	0.057	0.062	0.052	0.059	0.057	0.062	0.054	0.069
Tues/Wed/Thurs	13	0.060	0.063	0.055	0.062	0.060	0.063	0.056	0.072
Tues/Wed/Thurs	14	0.066	0.065	0.062	0.068	0.066	0.065	0.059	0.074
Tues/Wed/Thurs	15	0.073	0.066	0.069	0.074	0.073	0.066	0.061	0.080
Tues/Wed/Thurs	16	0.077	0.064	0.072	0.074	0.077	0.064	0.060	0.072
Tues/Wed/Thurs	17	0.076	0.057	0.070	0.067	0.076	0.057	0.057	0.059
Tues/Wed/Thurs	18	0.058	0.044	0.056	0.048	0.058	0.044	0.051	0.037
Tues/Wed/Thurs	19	0.044	0.032	0.043	0.033	0.044	0.032	0.045	0.025
Tues/Wed/Thurs	20	0.036	0.025	0.034	0.025	0.036	0.025	0.041	0.019
Tues/Wed/Thurs	21	0.028	0.019	0.028	0.019	0.028	0.019	0.035	0.014
Tues/Wed/Thurs	22	0.021	0.014	0.021	0.014	0.021	0.014	0.029	0.010
Tues/Wed/Thurs	23	0.015	0.012	0.015	0.010	0.015	0.012	0.022	0.006
Friday	0	0.008	0.016	0.008	0.012	0.008	0.016	0.020	0.004
Friday	1	0.006	0.014	0.006	0.010	0.006	0.014	0.021	0.003
Friday	2	0.005	0.014	0.005	0.010	0.005	0.014	0.023	0.004
Friday	3	0.008	0.017	0.009	0.013	0.008	0.017	0.022	0.005
Friday	4	0.014	0.024	0.022	0.023	0.014	0.024	0.027	0.013

Day of Week	Hour	C24 LD	C24 LM	C39 LD	C39 LM	C50 LD	C50 LM	C54 LD	C54 LM
Friday	5	0.024	0.035	0.036	0.036	0.024	0.035	0.034	0.032
Friday	6	0.036	0.045	0.046	0.045	0.036	0.045	0.038	0.051
Friday	7	0.049	0.053	0.053	0.052	0.049	0.053	0.042	0.062
Friday	8	0.047	0.054	0.049	0.051	0.047	0.054	0.046	0.070
Friday	9	0.047	0.056	0.046	0.052	0.047	0.056	0.047	0.066
Friday	10	0.051	0.060	0.048	0.055	0.051	0.060	0.050	0.070
Friday	11	0.054	0.062	0.050	0.058	0.054	0.062	0.052	0.071
Friday	12	0.057	0.063	0.054	0.061	0.057	0.063	0.054	0.070
Friday	13	0.061	0.065	0.058	0.065	0.061	0.065	0.056	0.072
Friday	14	0.068	0.067	0.065	0.070	0.068	0.067	0.058	0.074
Friday	15	0.074	0.067	0.069	0.075	0.074	0.067	0.059	0.075
Friday	16	0.076	0.064	0.071	0.073	0.076	0.064	0.059	0.070
Friday	17	0.075	0.058	0.069	0.069	0.075	0.058	0.055	0.057
Friday	18	0.064	0.048	0.061	0.052	0.064	0.048	0.053	0.041
Friday	19	0.052	0.037	0.050	0.038	0.052	0.037	0.045	0.027
Friday	20	0.043	0.029	0.042	0.029	0.043	0.029	0.042	0.020
Friday	21	0.035	0.022	0.035	0.022	0.035	0.022	0.039	0.017
Friday	22	0.027	0.016	0.028	0.017	0.027	0.016	0.032	0.014
Friday	23	0.020	0.012	0.020	0.012	0.020	0.012	0.026	0.011
Saturday	0	0.015	0.026	0.014	0.021	0.015	0.026	0.025	0.010
Saturday	1	0.010	0.020	0.009	0.016	0.010	0.020	0.025	0.007
Saturday	2	0.008	0.018	0.007	0.014	0.008	0.018	0.026	0.007

Day of Week	Hour	C24 LD	C24 LM	C39 LD	C39 LM	C50 LD	C50 LM	C54 LD	C54 LM
Saturday	3	0.008	0.019	0.007	0.015	0.008	0.019	0.027	0.009
Saturday	4	0.011	0.021	0.011	0.018	0.011	0.021	0.029	0.014
Saturday	5	0.017	0.028	0.018	0.025	0.017	0.028	0.036	0.033
Saturday	6	0.025	0.036	0.027	0.033	0.025	0.036	0.042	0.056
Saturday	7	0.034	0.044	0.036	0.042	0.034	0.044	0.041	0.055
Saturday	8	0.044	0.053	0.045	0.050	0.044	0.053	0.043	0.057
Saturday	9	0.054	0.061	0.054	0.059	0.054	0.061	0.045	0.061
Saturday	10	0.062	0.068	0.061	0.067	0.062	0.068	0.048	0.066
Saturday	11	0.067	0.071	0.065	0.071	0.067	0.071	0.050	0.067
Saturday	12	0.069	0.070	0.067	0.072	0.069	0.070	0.052	0.068
Saturday	13	0.070	0.067	0.067	0.070	0.070	0.067	0.053	0.067
Saturday	14	0.070	0.064	0.067	0.068	0.070	0.064	0.055	0.070
Saturday	15	0.069	0.061	0.067	0.065	0.069	0.061	0.058	0.077
Saturday	16	0.068	0.057	0.066	0.061	0.068	0.057	0.057	0.066
Saturday	17	0.064	0.051	0.063	0.055	0.064	0.051	0.054	0.053
Saturday	18	0.056	0.042	0.057	0.045	0.056	0.042	0.052	0.040
Saturday	19	0.048	0.034	0.049	0.036	0.048	0.034	0.046	0.034
Saturday	20	0.041	0.029	0.043	0.030	0.041	0.029	0.042	0.027
Saturday	21	0.037	0.024	0.040	0.026	0.037	0.024	0.038	0.023
Saturday	22	0.031	0.020	0.035	0.023	0.031	0.020	0.032	0.019
Saturday	23	0.023	0.016	0.025	0.017	0.023	0.016	0.025	0.014
Holiday	0	0.013	0.020	0.012	0.015	0.013	0.020	0.024	0.008

Day of Week	Hour	C24 LD	C24 LM	C39 LD	C39 LM	C50 LD	C50 LM	C54 LD	C54 LM
Holiday	1	0.009	0.017	0.008	0.013	0.009	0.017	0.024	0.007
Holiday	2	0.007	0.015	0.006	0.012	0.007	0.015	0.023	0.006
Holiday	3	0.007	0.016	0.008	0.014	0.007	0.016	0.023	0.007
Holiday	4	0.011	0.020	0.015	0.020	0.011	0.020	0.027	0.016
Holiday	5	0.019	0.028	0.023	0.028	0.019	0.028	0.033	0.030
Holiday	6	0.027	0.035	0.031	0.035	0.027	0.035	0.035	0.045
Holiday	7	0.035	0.042	0.036	0.040	0.035	0.042	0.040	0.052
Holiday	8	0.040	0.048	0.041	0.045	0.040	0.048	0.043	0.065
Holiday	9	0.048	0.055	0.047	0.051	0.048	0.055	0.045	0.061
Holiday	10	0.059	0.064	0.055	0.061	0.059	0.064	0.050	0.075
Holiday	11	0.065	0.070	0.063	0.069	0.065	0.070	0.049	0.076
Holiday	12	0.069	0.072	0.066	0.072	0.069	0.072	0.058	0.075
Holiday	13	0.071	0.071	0.068	0.074	0.071	0.071	0.052	0.069
Holiday	14	0.072	0.069	0.070	0.073	0.072	0.069	0.055	0.069
Holiday	15	0.073	0.068	0.071	0.072	0.073	0.068	0.062	0.070
Holiday	16	0.073	0.065	0.071	0.068	0.073	0.065	0.065	0.074
Holiday	17	0.070	0.057	0.068	0.061	0.070	0.057	0.053	0.057
Holiday	18	0.060	0.046	0.060	0.050	0.060	0.046	0.051	0.040
Holiday	19	0.050	0.036	0.051	0.040	0.050	0.036	0.047	0.031
Holiday	20	0.042	0.029	0.044	0.031	0.042	0.029	0.046	0.027
Holiday	21	0.034	0.023	0.037	0.025	0.034	0.023	0.040	0.019
Holiday	22	0.027	0.017	0.029	0.019	0.027	0.017	0.034	0.014

Day of Week	Hour	C24 LD	C24 LM	C39 LD	C39 LM	C50 LD	C50 LM	C54 LD	C54 LM
Holiday	23	0.018	0.014	0.020	0.013	0.018	0.014	0.024	0.011

Table 14: Hour-of-day profiles excerpt from July 1st to 7th for HH vehicle class by county

Date	Hour	C10	C15	C16	C20	C24	C39	C50	C54
7/1/2017	0	0.017	0.022	0.021	0.025	0.023	0.021	0.023	0.019
7/1/2017	1	0.020	0.024	0.024	0.021	0.019	0.018	0.019	0.022
7/1/2017	2	0.023	0.028	0.027	0.021	0.017	0.020	0.017	0.021
7/1/2017	3	0.027	0.031	0.031	0.031	0.028	0.028	0.028	0.030
7/1/2017	4	0.031	0.035	0.035	0.035	0.032	0.033	0.032	0.034
7/1/2017	5	0.036	0.038	0.039	0.039	0.037	0.037	0.037	0.039
7/1/2017	6	0.040	0.042	0.043	0.043	0.041	0.042	0.041	0.043
7/1/2017	7	0.044	0.045	0.046	0.046	0.045	0.047	0.045	0.047
7/1/2017	8	0.048	0.048	0.049	0.050	0.049	0.050	0.049	0.051
7/1/2017	9	0.051	0.051	0.052	0.052	0.053	0.054	0.053	0.054
7/1/2017	10	0.054	0.053	0.054	0.054	0.055	0.056	0.055	0.056
7/1/2017	11	0.056	0.054	0.055	0.056	0.057	0.058	0.057	0.057
7/1/2017	12	0.057	0.055	0.056	0.056	0.058	0.059	0.058	0.058
7/1/2017	13	0.057	0.055	0.055	0.056	0.058	0.059	0.058	0.057
7/1/2017	14	0.057	0.054	0.054	0.055	0.057	0.058	0.057	0.056
7/1/2017	15	0.055	0.053	0.053	0.053	0.056	0.056	0.056	0.054
7/1/2017	16	0.053	0.050	0.050	0.051	0.053	0.053	0.053	0.052
7/1/2017	17	0.051	0.048	0.047	0.048	0.050	0.049	0.050	0.048

Date	Hour	C10	C15	C16	C20	C24	C39	C50	C54
7/1/2017	18	0.047	0.045	0.044	0.044	0.046	0.045	0.046	0.044
7/1/2017	19	0.044	0.041	0.040	0.041	0.042	0.041	0.042	0.040
7/1/2017	20	0.039	0.038	0.037	0.037	0.038	0.036	0.038	0.036
7/1/2017	21	0.035	0.034	0.033	0.033	0.033	0.031	0.033	0.031
7/1/2017	22	0.031	0.030	0.029	0.029	0.028	0.027	0.028	0.027
7/1/2017	23	0.027	0.027	0.025	0.025	0.024	0.022	0.024	0.023
7/2/2017	0	0.019	0.023	0.023	0.028	0.026	0.024	0.026	0.024
7/2/2017	1	0.020	0.024	0.023	0.024	0.022	0.021	0.022	0.027
7/2/2017	2	0.021	0.025	0.024	0.024	0.020	0.023	0.020	0.026
7/2/2017	3	0.024	0.026	0.026	0.026	0.022	0.023	0.022	0.023
7/2/2017	4	0.026	0.028	0.028	0.028	0.025	0.027	0.025	0.026
7/2/2017	5	0.030	0.030	0.030	0.031	0.029	0.031	0.029	0.029
7/2/2017	6	0.033	0.033	0.033	0.035	0.033	0.035	0.033	0.033
7/2/2017	7	0.037	0.036	0.036	0.038	0.037	0.039	0.037	0.037
7/2/2017	8	0.041	0.039	0.039	0.041	0.041	0.043	0.041	0.040
7/2/2017	9	0.044	0.042	0.042	0.044	0.045	0.047	0.045	0.044
7/2/2017	10	0.048	0.045	0.045	0.047	0.048	0.050	0.048	0.047
7/2/2017	11	0.051	0.048	0.048	0.050	0.052	0.053	0.052	0.050
7/2/2017	12	0.053	0.050	0.050	0.052	0.054	0.055	0.054	0.052
7/2/2017	13	0.055	0.052	0.052	0.053	0.056	0.057	0.056	0.054
7/2/2017	14	0.056	0.053	0.053	0.054	0.057	0.057	0.057	0.055
7/2/2017	15	0.056	0.054	0.054	0.054	0.057	0.057	0.057	0.055

Date	Hour	C10	C15	C16	C20	C24	C39	C50	C54
7/2/2017	16	0.056	0.054	0.054	0.054	0.056	0.056	0.056	0.055
7/2/2017	17	0.055	0.054	0.054	0.052	0.055	0.054	0.055	0.054
7/2/2017	18	0.053	0.053	0.053	0.051	0.053	0.051	0.053	0.052
7/2/2017	19	0.051	0.051	0.051	0.049	0.050	0.048	0.050	0.050
7/2/2017	20	0.048	0.049	0.049	0.046	0.047	0.044	0.047	0.047
7/2/2017	21	0.045	0.047	0.047	0.043	0.043	0.040	0.043	0.044
7/2/2017	22	0.041	0.044	0.044	0.040	0.039	0.036	0.039	0.040
7/2/2017	23	0.038	0.041	0.041	0.036	0.035	0.031	0.035	0.036
7/3/2017	0	0.012	0.016	0.015	0.016	0.020	0.015	0.020	0.015
7/3/2017	1	0.015	0.018	0.017	0.014	0.016	0.013	0.016	0.017
7/3/2017	2	0.019	0.021	0.021	0.014	0.015	0.014	0.015	0.016
7/3/2017	3	0.024	0.025	0.025	0.025	0.025	0.026	0.025	0.024
7/3/2017	4	0.029	0.029	0.029	0.031	0.030	0.032	0.030	0.029
7/3/2017	5	0.034	0.033	0.033	0.037	0.035	0.038	0.035	0.034
7/3/2017	6	0.039	0.037	0.038	0.043	0.040	0.044	0.040	0.039
7/3/2017	7	0.044	0.041	0.042	0.048	0.045	0.049	0.045	0.044
7/3/2017	8	0.049	0.045	0.046	0.053	0.050	0.054	0.050	0.049
7/3/2017	9	0.053	0.049	0.050	0.057	0.053	0.058	0.053	0.053
7/3/2017	10	0.056	0.052	0.053	0.060	0.057	0.061	0.057	0.057
7/3/2017	11	0.059	0.054	0.056	0.062	0.059	0.063	0.059	0.059
7/3/2017	12	0.060	0.056	0.057	0.063	0.060	0.064	0.060	0.060
7/3/2017	13	0.061	0.057	0.058	0.063	0.060	0.063	0.060	0.061

Date	Hour	C10	C15	C16	C20	C24	C39	C50	C54
7/3/2017	14	0.060	0.057	0.058	0.061	0.060	0.062	0.060	0.060
7/3/2017	15	0.059	0.057	0.057	0.059	0.058	0.059	0.058	0.059
7/3/2017	16	0.056	0.055	0.056	0.055	0.055	0.055	0.055	0.056
7/3/2017	17	0.053	0.053	0.053	0.051	0.052	0.050	0.052	0.053
7/3/2017	18	0.049	0.050	0.050	0.046	0.048	0.045	0.048	0.049
7/3/2017	19	0.044	0.047	0.046	0.040	0.043	0.039	0.043	0.044
7/3/2017	20	0.039	0.043	0.042	0.034	0.038	0.033	0.038	0.039
7/3/2017	21	0.034	0.039	0.037	0.029	0.033	0.027	0.033	0.033
7/3/2017	22	0.029	0.035	0.033	0.023	0.028	0.021	0.028	0.028
7/3/2017	23	0.024	0.030	0.028	0.018	0.023	0.015	0.023	0.023
7/4/2017	0	0.020	0.025	0.024	0.025	0.028	0.023	0.028	0.022
7/4/2017	1	0.023	0.027	0.027	0.021	0.023	0.020	0.023	0.025
7/4/2017	2	0.026	0.030	0.030	0.021	0.021	0.022	0.021	0.024
7/4/2017	3	0.030	0.033	0.033	0.032	0.027	0.030	0.027	0.032
7/4/2017	4	0.033	0.037	0.037	0.036	0.031	0.034	0.031	0.036
7/4/2017	5	0.037	0.040	0.041	0.040	0.034	0.039	0.034	0.039
7/4/2017	6	0.041	0.043	0.044	0.044	0.038	0.043	0.038	0.043
7/4/2017	7	0.044	0.046	0.047	0.047	0.042	0.047	0.042	0.046
7/4/2017	8	0.048	0.048	0.050	0.050	0.045	0.050	0.045	0.049
7/4/2017	9	0.050	0.050	0.052	0.053	0.048	0.053	0.048	0.052
7/4/2017	10	0.053	0.052	0.053	0.055	0.051	0.055	0.051	0.053
7/4/2017	11	0.054	0.053	0.054	0.056	0.053	0.057	0.053	0.055

Date	Hour	C10	C15	C16	C20	C24	C39	C50	C54
7/4/2017	12	0.055	0.053	0.055	0.056	0.054	0.057	0.054	0.055
7/4/2017	13	0.055	0.053	0.054	0.056	0.055	0.057	0.055	0.055
7/4/2017	14	0.055	0.052	0.053	0.055	0.055	0.056	0.055	0.054
7/4/2017	15	0.054	0.051	0.051	0.053	0.054	0.054	0.054	0.052
7/4/2017	16	0.052	0.049	0.049	0.050	0.053	0.051	0.053	0.050
7/4/2017	17	0.049	0.046	0.046	0.047	0.051	0.048	0.051	0.047
7/4/2017	18	0.046	0.043	0.042	0.043	0.048	0.044	0.048	0.044
7/4/2017	19	0.042	0.040	0.039	0.040	0.045	0.040	0.045	0.040
7/4/2017	20	0.039	0.037	0.035	0.036	0.041	0.036	0.041	0.037
7/4/2017	21	0.035	0.034	0.032	0.032	0.038	0.031	0.038	0.033
7/4/2017	22	0.031	0.031	0.028	0.028	0.034	0.027	0.034	0.029
7/4/2017	23	0.028	0.028	0.025	0.024	0.030	0.023	0.030	0.026
7/5/2017	0	0.012	0.017	0.015	0.017	0.019	0.015	0.019	0.014
7/5/2017	1	0.016	0.019	0.018	0.014	0.016	0.013	0.016	0.016
7/5/2017	2	0.020	0.023	0.021	0.014	0.014	0.014	0.014	0.016
7/5/2017	3	0.025	0.027	0.026	0.026	0.024	0.027	0.024	0.025
7/5/2017	4	0.030	0.031	0.030	0.032	0.029	0.033	0.029	0.030
7/5/2017	5	0.035	0.035	0.035	0.037	0.035	0.039	0.035	0.036
7/5/2017	6	0.040	0.039	0.040	0.043	0.040	0.045	0.040	0.041
7/5/2017	7	0.045	0.044	0.045	0.048	0.045	0.050	0.045	0.046
7/5/2017	8	0.050	0.047	0.049	0.053	0.050	0.055	0.050	0.051
7/5/2017	9	0.054	0.051	0.052	0.057	0.054	0.059	0.054	0.055

Date	Hour	C10	C15	C16	C20	C24	C39	C50	C54
7/5/2017	10	0.057	0.054	0.055	0.060	0.057	0.061	0.057	0.058
7/5/2017	11	0.059	0.056	0.057	0.062	0.059	0.063	0.059	0.060
7/5/2017	12	0.060	0.057	0.059	0.062	0.061	0.064	0.061	0.061
7/5/2017	13	0.061	0.058	0.059	0.062	0.061	0.063	0.061	0.061
7/5/2017	14	0.060	0.057	0.058	0.061	0.060	0.061	0.060	0.060
7/5/2017	15	0.058	0.056	0.057	0.058	0.058	0.058	0.058	0.058
7/5/2017	16	0.056	0.054	0.055	0.055	0.056	0.054	0.056	0.055
7/5/2017	17	0.052	0.051	0.051	0.050	0.052	0.050	0.052	0.052
7/5/2017	18	0.048	0.048	0.048	0.045	0.048	0.044	0.048	0.047
7/5/2017	19	0.043	0.044	0.043	0.040	0.043	0.038	0.043	0.042
7/5/2017	20	0.038	0.040	0.039	0.034	0.038	0.032	0.038	0.037
7/5/2017	21	0.033	0.036	0.034	0.029	0.032	0.026	0.032	0.031
7/5/2017	22	0.028	0.031	0.029	0.023	0.027	0.020	0.027	0.026
7/5/2017	23	0.023	0.027	0.025	0.018	0.022	0.015	0.022	0.021
7/6/2017	0	0.012	0.016	0.014	0.016	0.018	0.015	0.018	0.014
7/6/2017	1	0.016	0.019	0.017	0.014	0.015	0.013	0.015	0.016
7/6/2017	2	0.020	0.022	0.021	0.014	0.014	0.014	0.014	0.016
7/6/2017	3	0.024	0.026	0.026	0.026	0.024	0.027	0.024	0.024
7/6/2017	4	0.030	0.030	0.030	0.032	0.029	0.033	0.029	0.029
7/6/2017	5	0.035	0.034	0.035	0.038	0.035	0.039	0.035	0.035
7/6/2017	6	0.040	0.039	0.040	0.043	0.040	0.045	0.040	0.040
7/6/2017	7	0.045	0.043	0.044	0.048	0.045	0.050	0.045	0.045

Date	Hour	C10	C15	C16	C20	C24	C39	C50	C54
7/6/2017	8	0.050	0.047	0.048	0.053	0.050	0.055	0.050	0.050
7/6/2017	9	0.054	0.050	0.052	0.057	0.054	0.059	0.054	0.054
7/6/2017	10	0.057	0.053	0.055	0.060	0.057	0.061	0.057	0.057
7/6/2017	11	0.059	0.056	0.057	0.062	0.060	0.063	0.060	0.060
7/6/2017	12	0.060	0.057	0.059	0.063	0.061	0.064	0.061	0.061
7/6/2017	13	0.061	0.058	0.059	0.062	0.061	0.063	0.061	0.061
7/6/2017	14	0.060	0.057	0.059	0.061	0.060	0.061	0.060	0.061
7/6/2017	15	0.058	0.056	0.057	0.058	0.059	0.058	0.059	0.059
7/6/2017	16	0.056	0.054	0.055	0.055	0.056	0.054	0.056	0.056
7/6/2017	17	0.052	0.052	0.052	0.050	0.052	0.050	0.052	0.052
7/6/2017	18	0.048	0.049	0.048	0.045	0.048	0.044	0.048	0.048
7/6/2017	19	0.043	0.045	0.044	0.040	0.043	0.038	0.043	0.043
7/6/2017	20	0.038	0.041	0.039	0.034	0.038	0.032	0.038	0.038
7/6/2017	21	0.033	0.036	0.034	0.028	0.032	0.026	0.032	0.032
7/6/2017	22	0.028	0.032	0.030	0.023	0.027	0.020	0.027	0.027
7/6/2017	23	0.023	0.028	0.025	0.017	0.022	0.015	0.022	0.022
7/7/2017	0	0.012	0.016	0.015	0.016	0.018	0.015	0.018	0.014
7/7/2017	1	0.015	0.019	0.018	0.014	0.015	0.013	0.015	0.016
7/7/2017	2	0.019	0.022	0.021	0.014	0.014	0.014	0.014	0.015
7/7/2017	3	0.024	0.026	0.026	0.026	0.024	0.027	0.024	0.025
7/7/2017	4	0.029	0.030	0.030	0.032	0.030	0.033	0.030	0.030
7/7/2017	5	0.034	0.035	0.035	0.038	0.035	0.039	0.035	0.035

Date	Hour	C10	C15	C16	C20	C24	C39	C50	C54
7/7/2017	6	0.039	0.039	0.040	0.043	0.040	0.045	0.040	0.041
7/7/2017	7	0.044	0.043	0.044	0.048	0.045	0.050	0.045	0.046
7/7/2017	8	0.049	0.047	0.049	0.053	0.050	0.055	0.050	0.050
7/7/2017	9	0.053	0.051	0.052	0.057	0.054	0.059	0.054	0.054
7/7/2017	10	0.056	0.054	0.055	0.060	0.057	0.062	0.057	0.058
7/7/2017	11	0.059	0.056	0.057	0.062	0.059	0.063	0.059	0.060
7/7/2017	12	0.060	0.057	0.059	0.063	0.061	0.064	0.061	0.061
7/7/2017	13	0.061	0.058	0.059	0.062	0.061	0.063	0.061	0.061
7/7/2017	14	0.060	0.057	0.058	0.061	0.060	0.061	0.060	0.060
7/7/2017	15	0.059	0.056	0.057	0.058	0.058	0.058	0.058	0.059
7/7/2017	16	0.056	0.054	0.055	0.055	0.056	0.054	0.056	0.056
7/7/2017	17	0.053	0.051	0.052	0.050	0.052	0.049	0.052	0.052
7/7/2017	18	0.049	0.048	0.048	0.045	0.048	0.044	0.048	0.048
7/7/2017	19	0.044	0.044	0.044	0.040	0.043	0.038	0.043	0.043
7/7/2017	20	0.039	0.040	0.039	0.034	0.038	0.032	0.038	0.037
7/7/2017	21	0.034	0.036	0.034	0.028	0.033	0.026	0.033	0.032
7/7/2017	22	0.029	0.031	0.029	0.022	0.027	0.020	0.027	0.027
7/7/2017	23	0.024	0.027	0.025	0.017	0.022	0.015	0.022	0.022

IX. Appendix C: Additional Temporal Profiles

OGV temporal profiles were constructed based on 2016 port activities of all vessels, compiled by an in-house section in CARB. Fractions for the ports of Long Beach, Los Angeles, Oakland and San Diego were updated using aggregated AIS data from 2015 through 2019. All vessel types were grouped by port area boundary and divided into day of week and monthly activity fractions (Table 15 and Table 16). Some profiles are either area- or inline specific, others will be used by both area and inline sources. Activity data was not available for all ports; a flat (emissions are spread evenly across the time period) monthly and daily profile was used for those ports. A flat profile was also used to represent the hourly variation for all OGV vessels at every port area/waters. The temporal profiles do not apply to OGV military, which assumes a flat at monthly, days of week, and hours of day intervals (see the profile labeled Elsewhere in the tables below). The areas labeled with a "+" received area source profile updates and "*" received inline only updates.

Hourly temporal profiles were updated for consumer products (Table 17 and Table 18). The new profiles were developed by the Consumer Products and Air Quality Assessment Branch based on research on identifying volatile chemical product tracer compounds in U.S. cities (Gkatzelis, et al., 2021).

Table 15: OGV monthly profiles

Port Areas/Waters	Profile ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eureka	M_EKA	0.000	0.000	0.000	0.000	0.167	0.167	0.167	0.000	0.167	0.167	0.167	0.000
Hueneme	M_NTD	0.065	0.088	0.090	0.093	0.095	0.083	0.083	0.075	0.078	0.080	0.088	0.085
Carquinez	M_CAR	0.068	0.076	0.080	0.076	0.087	0.093	0.090	0.085	0.085	0.090	0.075	0.095
Oakland	M_OAK	0.084	0.088	0.081	0.078	0.081	0.084	0.084	0.090	0.081	0.090	0.080	0.079
Redwood City	M_RWC	0.055	0.018	0.091	0.091	0.127	0.073	0.055	0.127	0.091	0.091	0.036	0.145
Richmond	M_RCH	0.083	0.092	0.086	0.081	0.086	0.095	0.083	0.097	0.075	0.062	0.084	0.076
Sacramento	M_SAC	0.018	0.036	0.018	0.054	0.054	0.089	0.036	0.036	0.054	0.071	0.482	0.054
San Diego	M_SGQ	0.081	0.078	0.077	0.086	0.088	0.093	0.085	0.075	0.088	0.086	0.082	0.082
San Francisco	M_SFO	0.070	0.071	0.074	0.080	0.095	0.093	0.071	0.087	0.080	0.087	0.091	0.100
Stockton	M_SCK	0.083	0.088	0.083	0.074	0.111	0.101	0.060	0.101	0.055	0.083	0.092	0.069
Elsewhere	1	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Waters of LA County+	M_6059	0.093	0.071	0.084	0.088	0.084	0.075	0.080	0.091	0.074	0.087	0.081	0.092
El Segundo*	M_ELS	0.104	0.055	0.084	0.093	0.086	0.066	0.075	0.104	0.066	0.090	0.075	0.104

Port Areas/Waters	Profile ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Port of Los Angeles*	M_LAX	0.087	0.088	0.087	0.087	0.084	0.083	0.081	0.082	0.081	0.079	0.081	0.081
Port of Long Beach*	M_LGB	0.084	0.086	0.082	0.083	0.081	0.087	0.084	0.082	0.086	0.084	0.081	0.080

Table 16: OGV weekly profiles

Port Areas/Waters	Profile ID	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Eureka	W_EKA	0.500	0.000	0.333	0.000	0.000	0.000	0.167
Hueneme	W_NTD	0.113	0.145	0.205	0.160	0.108	0.115	0.155
Carquinez	W_CAR	0.178	0.131	0.146	0.163	0.136	0.126	0.121
Oakland	W_OAK	0.150	0.151	0.161	0.151	0.135	0.121	0.130
Redwood City	W_RWC	0.109	0.127	0.200	0.091	0.218	0.109	0.145
Richmond	W_RCH	0.167	0.153	0.142	0.126	0.161	0.129	0.122
Sacramento	W_SAC	0.179	0.250	0.089	0.143	0.161	0.071	0.107
San Diego	W_SGQ	0.150	0.162	0.169	0.142	0.129	0.117	0.131
San Francisco	W_SFO	0.155	0.138	0.153	0.137	0.127	0.143	0.146
Stockton	W_SCK	0.152	0.147	0.106	0.157	0.161	0.106	0.171
Elsewhere	7	0.143	0.143	0.143	0.143	0.143	0.143	0.143
Waters of LA County+	W_6059	0.143	0.132	0.152	0.150	0.139	0.148	0.135
El Segundo*	W_ELS	0.137	0.137	0.154	0.148	0.137	0.145	0.143
Port of Los Angeles*	W_LAX	0.142	0.145	0.153	0.155	0.150	0.135	0.121
Port of Long Beach*	W_LGB	0.138	0.140	0.148	0.147	0.152	0.144	0.132

Table 17: Consumer products diurnal profile assignment codes and descriptions

Tracer Diurnal Profile Assignment	CEIDARS HPDY	HPDYN
PCBTF	86	INCREASING ACTIVITY FROM 9AM TO 2PM AND DECREASING UNTIL 10PM. PCBTF TRACER (CP)
D-4 Siloxane	87	MINOR PEAK AT 5 AM, PEAK ACTIVITY AT 2PM AND 6PM. D4-SILOXANE TRACER (CP)
Monoterpenes	88	ACTIVITY STARTS AT 6AM, 12PM PEAK, OSCILLATES TO 8PM. MONOTERPENE TRACER (CP)
PDCB	89	PEAK ACTIVITY FROM 6PM TO 9PM. MINOR PEAKS AT 5AM AND 12PM.
D-5 Siloxane	90	PRIMARY PEAK ACTIVITY AT 12PM AND SECONDARY AT 8PM. D5-SILOXANE TRACER (CP)

Table 18: Consumer products hourly temporal profiles

Hour	PCBTF Tracer (CP)	D4-Siloxane Tracer (CP)	Monoterpene Tracer (CP)	PDCB Tracer (CP)	D5-Siloxane Tracer (CP)
0	0.009	0.015	0.015	0.019	0.016
1	0.011	0.017	0.015	0.022	0.018
2	0.012	0.018	0.014	0.023	0.016
3	0.012	0.020	0.012	0.026	0.015
4	0.017	0.032	0.013	0.041	0.022
5	0.020	0.038	0.013	0.046	0.027
6	0.017	0.031	0.016	0.036	0.025
7	0.014	0.024	0.025	0.028	0.026
8	0.016	0.026	0.042	0.027	0.034
9	0.026	0.037	0.061	0.033	0.058

Hour	PCBTF Tracer (CP)	D4-Siloxane Tracer (CP)	Monoterpene Tracer (CP)	PDCB Tracer (CP)	D5-Siloxane Tracer (CP)
10	0.048	0.048	0.074	0.040	0.081
11	0.072	0.055	0.083	0.041	0.088
12	0.097	0.063	0.074	0.038	0.077
13	0.121	0.075	0.069	0.030	0.055
14	0.108	0.070	0.062	0.022	0.039
15	0.079	0.053	0.063	0.024	0.039
16	0.074	0.047	0.064	0.042	0.047
17	0.076	0.073	0.054	0.080	0.050
18	0.061	0.085	0.061	0.097	0.057
19	0.043	0.068	0.063	0.102	0.068
20	0.031	0.049	0.051	0.088	0.063
21	0.016	0.026	0.025	0.049	0.042
22	0.011	0.017	0.014	0.027	0.021
23	0.009	0.015	0.015	0.019	0.016

X. Appendix D: Spatial Surrogate Assignments

The primary spatial surrogate for each EICSUM and the corresponding data source are listed in Table 19 below.

Table 19: Primary surrogate assignment at the EICSUM level, description, and data source

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
10	Electric Utilities	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
20	Cogeneration	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
30	Oil and Gas Production (Combustion)	211	Gas Well	California Department of Conservation, Division of Oil, Gas and Geothermal Resources
30	Oil and Gas Production (Combustion)	431	Oil well	Division of Oil, Gas, And Geothermal Resources
50	Manufacturing and Industrial	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
52	Food and Agricultural Processing	720	Farm Road Vehicle Miles Traveled	Department of Pesticide Regulation
60	Service and Commercial	621	UCD Service, Commercial, Employment	MPO/COG/CSTDM Data
99	Other (Fuel Combustion)	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
110	Sewage Treatment	470	Publicly Owned Treatment Works	State Water Resources Control Board
120	Landfills	341	Landfills	CalRecycle - Solid Waste Information System (SWIS) Dataset
130	Incinerators	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
140	Soil Remediation	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
199	Other (Waste Disposal)	343	Compost	CalRecycle - Solid Waste Information System (SWIS) Dataset
199	Other (Waste Disposal)	390	Non irrigated Pastureland	National Land Cover Database (NLCD)
199	Other (Waste Disposal)	470	Publicly Owned Treatment Works	State Water Resources Control Board
210	Laundering	150	Drycleaners	Dun & Bradstreet’s Market Insight Database
220	Degreasing	120	Autobody Shops	Dun & Bradstreet’s Market Insight Database
220	Degreasing	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
230	Coatings and Related Process Solvents	120	Autobody Shops	Dun & Bradstreet’s Market Insight Database
230	Coatings and Related Process Solvents	743	Wood Furniture	Dun & Bradstreet’s Market Insight Database
230	Coatings and Related Process Solvents	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
240	Printing	731	Print	Dun & Bradstreet’s Market Insight Database
250	Adhesives and Sealants	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
299	Other (Cleaning and Surface Coatings)	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
310	Oil and Gas Production	211	Gas well	California Department of Conservation, Division of Oil, Gas and Geothermal Resources

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
310	Oil and Gas Production	431	Oilwell	California Department of Conservation, Division of Oil, Gas and Geothermal Resources
330	Petroleum Marketing	460	Ports	National Transportation Atlas Database (NTAD)
330	Petroleum Marketing	200	Gas Stations	Dun & Bradstreet’s Market Insight Database
330	Petroleum Marketing	520	Refineries and Tank Farms	FEMA and the ARB CEIDAR Database
330	Petroleum Marketing	214	Gas Distribution	U.S. Energy Information Administration
399	Other (Petroleum Production and Marketing)	200	Gas Stations	Dun & Bradstreet’s Market Insight Database
410	Chemical	741	Plastic	Dun & Bradstreet’s Market Insight Database
420	Food and Agriculture	680	Wineries	Dun & Bradstreet’s Market Insight Database
420	Food and Agriculture	320	Irrigated Cropland	National Land Cover Database (NLCD)
430	Mineral Processes	590	Sand and Gravel Mines	National Atlas
440	Metal Processes	738	Metal Parts	Dun & Bradstreet’s Market Insight Database
450	Wood And Paper	732	Wood	Dun & Bradstreet’s Market Insight Database
499	Other (Industrial Processes)	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
500	Solvent Evaporation Unspecified	441	UCD Population	MPO/COG/CSTDM Data

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
510	Consumer Products	550	Residential and Nonresidential Change Industrial Employment	Council of Government (Cog) Housing and Employment
510	Consumer Products	252	UCD Total Housing	MPO/COG/CSTDM Data
510	Consumer Products	280	Housing and Restaurants	Combo: MPO/COG/CSTDM Data and Dun & Bradstreet Market Insight
510	Consumer Products	260	Housing and Autobody	Combo: MPO/COG/CSTDM Data and Dun & Bradstreet Market Insight
510	Consumer Products	120	Autobody Shops	Dun & Bradstreet's Market Insight Database
510	Consumer Products	739	Other Coatings	Dun & Bradstreet's Market Insight Database
510	Consumer Products	270	Housing and Commercial Employment	MPO/COG/CSTDM Data
510	Consumer Products	651	UCD Single Family Housing	MPO/COG/CSTDM Data
510	Consumer Products	450	Population, Commercial Employment and Hospitals	MPO/COG/CSTDM Data and ESRI
510	Consumer Products	672	Developed Land High Density	National Land Cover Database (NLCD)
520	Architectural Coatings and Related Process Solvents	230	HE Square Feet	Council of Government (COG) Housing and Employment
520	Architectural Coatings and Related Process Solvents	270	Housing and Commercial Employment	MPO/COG/CSTDM Data

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
520	Architectural Coatings and Related Process Solvents	110	All Paved Roads	Tiger Geodatabases from U.S. Census Bureau
530	Pesticides/Fertilizers	230	HE Square Feet	Council of Government (COG) Housing and Employment
530	Pesticides/Fertilizers	512	Pesticides No Methyl Bromide	Department of Pesticide Regulation
530	Pesticides/Fertilizers	514	Pesticides Methyl Bromide	Department of Pesticide Regulation
530	Pesticides/Fertilizers	732	Wood	Dun & Bradstreet’s Market Insight Database
540	Asphalt Paving / Roofing	588	UCD On-road Construction	Caltrans Highway Construction Projects Dataset (Line)
610	Residential Fuel Combustion	573	Fireplaces	Digital Map Products 2017 Parcel Data
610	Residential Fuel Combustion	572	Residential Liquid Petroleum Gas Heating	US Census American Community Survey (ACS)
620	Farming Operations	356	Horse Ranches	CARB Green House Gas Inventory Group
620	Farming Operations	320	Irrigated Cropland	National Land Cover Database (NLCD)
620	Farming Operations	690	Land Prep	Department of Pesticide Regulation
630	Construction and Demolition	588	UCD On-road Construction	Caltrans Highway Construction Projects Dataset (Line)
630	Construction and Demolition	587	UCD Offroad Construction	Storm Notice of Intent (NOI) Dataset
640	Paved Road Dust	590	Sand and Gravel Mines	National Atlas
640	Paved Road Dust	610	Secondary Paved Roads	Tiger Geodatabases from U.S. Census Bureau

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
645	Unpaved Road Dust	384	Military Tactical	Federal Aviation Administration / National Transportation Atlas Database (NTAD) And ESRI
645	Unpaved Road Dust	190	Forestland	National Land Cover Database (NLCD)
645	Unpaved Road Dust	720	Farm Road Vehicle Miles Traveled	Department of Pesticide Regulation
645	Unpaved Road Dust	660	Unpaved Roads	Tiger Geodatabases from U.S. Census Bureau
650	Fugitive Windblown Dust	391	Pasture	National Land Cover Database (NLCD)
650	Fugitive Windblown Dust	660	Unpaved Roads	Tiger Geodatabases from U.S. Census Bureau
650	Fugitive Windblown Dust	160	Dry Lake Beds	U.S. Geological Survey (USGS)
660	Fires	441	UCD Population	MPO/COG/CSTDM Data
660	Fires	480	Primary Roads	Tiger Geodatabases from U.S. Census Bureau
670	Managed Burning and Disposal	674	Developed Land Low Density	National Land Cover Database (NLCD)
670	Managed Burning and Disposal	190	Forestland	National Land Cover Database (NLCD)
670	Managed Burning and Disposal	720	Farm Road Vehicle Miles Traveled	Department of Pesticide Regulation
680	Utility Equipment	651	UCD Single Family Housing	MPO/COG/CSTDM Data
690	Cooking	561	Charbroiling	SJV APCD & Dun and Bradstreet Insight Market

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
699	Other (Miscellaneous Processes)	441	UCD Population	MPO/COG/CSTDM Data
7XX	On-Road	801-824	Light-Duty Vehicle Miles Traveled	MPO/COG/CSTDM Data
7XX	On-Road	825-848	Heavy-Duty Vehicle Miles Traveled	MPO/COG/CSTDM Data
7XX	On-Road	853	30% Idling/70% Distribution	Digital Map Products Parcel Data/California Statewide Travel Demand Model (CSTDM) Data
7XX	On-Road	859	90% Idling/10% Distribution	Digital Map Products Parcel Data/California Statewide Travel Demand Model (CSTDM) Data
7XX	On-Road	860	Diesel Motorcycle Evaporatives	EMFAC California Department of Motor Vehicle (DMV) Registration Data
7XX	On-Road	861	Gas Motorcycle Evaporatives	EMFAC California Department of Motor Vehicle (DMV) Registration Data
7XX	On-Road	862	Diesel Motor Home and Bus Evaporatives	EMFAC California Department of Motor Vehicle (DMV) Registration Data
7XX	On-Road	863	Gas Motor Home and Bus Evaporatives	EMFAC California Department of Motor Vehicle (DMV) Registration Data
7XX	On-Road	864	Diesel Passenger Vehicles	EMFAC California Department of Motor Vehicle (DMV) Registration Data
7XX	On-Road	865	Gas Passenger Vehicles	EMFAC California Department of Motor Vehicle (DMV) Registration Data
7XX	On-Road	866	Diesel Light-Heavy Duty Vehicles	EMFAC California Department of Motor Vehicle (DMV) Registration Data

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
7XX	On-Road	867	Gas Light-Heavy Duty Vehicles	EMFAC California Department of Motor Vehicle (DMV) Registration Data
7XX	On-Road	868	Diesel Heavy-Heavy Duty Vehicles	EMFAC California Department of Motor Vehicle (DMV) Registration Data
7XX	On-Road	869	Gas Heavy-Heavy Duty Vehicles	EMFAC California Department of Motor Vehicle (DMV) Registration Data
810	Aircraft	382	Military Aircraft	Federal Aviation Administration / National Transportation Atlas Database (NTAD) And ESRI
810	Aircraft	100	Airports	Federal Aviation Administration and ESRI
810	Aircraft	140	Commercial Airports	Federal Aviation Administration, National Transportation Atlas Database (NTAD)
810	Aircraft	320	Irrigated Cropland	National Land Cover Database (NLCD)
820	Trains	491	Linehaul	ARB In-House Rail Modeling
820	Trains	360	Metrolink Lines	Federal Railroad Administration / National Transportation Atlas Database (NTAD)
820	Trains	490	Rail Lines	Federal Railroad Administration / National Transportation Atlas Database (NTAD)
820	Trains	361	Passenger Rail	Offroad Diesel Analysis Section, AQPSD
820	Trains	501	Switcher Railyards	Off-Road Diesel Analysis Section, AQPSD: Union Pacific Railroad (Up) And Burlington Northern Santa Fe Railway (BNSF)
830	Ships and Commercial Boats	460	Ports	(US DOT)/Bureau of Transportation Statistics' (BTS's) National

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
				Transportation Atlas Database (NTAD)
830	Ships and Commercial Boats	431	Oilwell	Division of Oil, Gas, And Geothermal Resources
830	Ships and Commercial Boats	640	Ship Lanes	Marine Cadastre Automatic Identification System
833	Ocean Going Vessels	460	Ports	National Transportation Atlas Database (NTAD)
833	Ocean Going Vessels	383	Military Ships	Marine Cadastre - Military Vessel
833	Ocean Going Vessels	640	Ship Lanes	Marine Cadastre Automatic Identification System
833	Ocean Going Vessels	642	Tanker	Marine Cadastre Automatic Identification System
833	Ocean Going Vessels	643	Passenger	Marine Cadastre Automatic Identification System
835	Commercial Harbor Craft	460	Ports	National Transportation Atlas Database (NTAD)
835	Commercial Harbor Craft	332	Ferries	Ferry Company Websites and Google Maps
835	Commercial Harbor Craft	383	Military Ships	Marine Cadastre - Military Vessel
835	Commercial Harbor Craft	641	Crew Supply	Marine Cadastre Automatic Identification System
835	Commercial Harbor Craft	339	Dredge	Marine Cadastre Coastal Maintained Channels
840	Recreational Boats	338	Ocean Recreation Boats	Marine Cadastre Automatic Identification System - Pleasure Craft
840	Recreational Boats	651	UCD Single Family Housing	MPO/COG/CSTDM Data

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
840	Recreational Boats	336	Ocean, Lakes and Recreation Boats	U.S. Geological Survey (USGS)
840	Recreational Boats	335	Lakes, Rivers, Recreation Boats	U.S. Geological Survey (USGS)
850	Off-Road Recreational Vehicles	220	Golf Courses	ESRI
850	Off-Road Recreational Vehicles	651	UCD Single Family Housing	MPO/COG/CSTDM Data
850	Off-Road Recreational Vehicles	660	Unpaved Roads	Tiger Geodatabases from U.S. Census Bureau
850	Off-Road Recreational Vehicles	170	Elevation over 1500 m	U.S. Geological Survey (USGS)
860	Off-Road Equipment	580	Residential Nonresidential Change	Council of Government (COG) Housing and Employment
860	Off-Road Equipment	630	Service and Commercial Employment, Schools, Golf Courses and Cemeteries	Council of Government (COG) Service and Commercial Employment & Esri
860	Off-Road Equipment	460	Ports	National Transportation Atlas Database (NTAD)
860	Off-Road Equipment	431	Oilwell	Division of Oil, Gas, And Geothermal Resources
860	Off-Road Equipment	384	Military Tactical	Federal Aviation Administration / National Transportation Atlas Database (NTAD) and ESRI
860	Off-Road Equipment	100	Airports	Federal Aviation Administration and Esri
860	Off-Road Equipment	500	Railyards	Federal Railroad Administration / National Transportation Atlas Database (NTAD)

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
860	Off-Road Equipment	485	TRU	Integrated Transportation Network and Caltrans Truck Network and Digital Map Products 2017 Parcel Data
860	Off-Road Equipment	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
860	Off-Road Equipment	339	Dredge	Marine Cadastre Coastal Maintained Channels
860	Off-Road Equipment	651	UCD Single Family Housing	MPO/COG/CSTDM Data
860	Off-Road Equipment	190	Forestland	National Land Cover Database (NLCD)
860	Off-Road Equipment	191	Forestland Roads	NLCD in conjunction with TIGER road network
860	Off-Road Equipment	587	UCD Offroad Construction	Storm Notice of Intent (NOI) Dataset
870	Farm Equipment	720	Farm Road Vehicle Miles Traveled	Department of Pesticide Regulation
890	Fuel Storage and Handling	651	UCD Single Family Housing	MPO/COG/CSTDM Data
890	Fuel Storage and Handling	335	Lakes, Rivers, Recreation boats	U.S. Geological Survey (USGS)
910	Biogenic Sources	672	Developed Land High Density	National Land Cover Database (NLCD)
910	Biogenic Sources	190	Forestland	National Land Cover Database (NLCD)
920	Geogenic Sources	190	Forestland	National Land Cover Database (NLCD)
920	Geogenic Sources	212	Gas Seep	U.S. Geological Survey (USGS)

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
920	Geogenic Sources	432	Oil Seep	U.S. Geological Survey (USGS) – Pacific Coastal & Marine Science
930	Wildfires	190	Forestland	National Land Cover Database (NLCD)
930	Wildfires	391	Pasture	Sierra Research Agtool Contract
940	Windblown Dust	412	Fugitive Dust	National Land Cover Database (NLCD)

XI. Appendix E: San Joaquin Valley Facilities with CEM data

Table 20 below, summarizes the facilities from San Joaquin Valley that have Continuous Emissions Monitoring hourly data.

Table 20: San Joaquin Valley facilities with Continuous Emissions Monitoring.

State	CEM Facility Name	ORIS ID	Unit ID	AB	FACID	POINT ID	STACK ID	SEGMENT ID
CA	Woodland Generation Station	7266	1	SJV	3233	1	1	1
CA	Woodland Generation Station	7266	2	SJV	3233	4	4	1
CA	Almond Power Plant	7315	1	SJV	3299	1	1	1
CA	NCPA Combustion Turbine Project #2	7449	NA1	SJV	583	1	1	1
CA	Fresno Cogeneration Partners, LP	10156	GEN1	SJV	14	10	10	1
CA	Kingsburg Cogen Facility	10405	1	SJV	722	2	2	1
CA	Bear Mountain Limited	10649	GT1	SJV	2049	1	1	1

CA	Badger Creek Limited	10650	GT1	SJV	1250	1	1	1
CA	DTE Stockton	54238	BIOMS1	SJV	645	36	36	2
CA	Live Oak Limited	54768	GT1	SJV	172	1	1	1
CA	La Paloma Generating Plant	55151	CTG-1	SJV	3412	1	1	1
CA	La Paloma Generating Plant	55151	CTG-2	SJV	3412	2	2	1
CA	La Paloma Generating Plant	55151	CTG-3	SJV	3412	3	3	1
CA	La Paloma Generating Plant	55151	CTG-4	SJV	3412	4	4	1
CA	Sunrise Power Company	55182	CTG1	SJV	3746	1	1	1
CA	Sunrise Power Company	55182	CTG2	SJV	3746	2	2	1
CA	Elk Hills Power	55400	CTG-1	SJV	3523	1	1	1
CA	Elk Hills Power	55400	CTG-2	SJV	3523	2	2	1
CA	CalPeak Power - Panoche	55508	GT-1	SJV	3811	1	1	1
CA	Pastoria Energy Facility	55656	CT001	SJV	3636	1	1	1
CA	Pastoria Energy Facility	55656	CT002	SJV	3636	2	2	1
CA	Pastoria Energy Facility	55656	CT004	SJV	3636	3	3	1
CA	Hanford Energy Park Peaker	55698	HEP1	SJV	4140	1	1	1
CA	Hanford Energy Park Peaker	55698	HEP2	SJV	4140	2	2	1

CA	Henrietta Peaker Plant	55807	HPP1	SJV	3929	1	1	1
CA	Henrietta Peaker Plant	55807	HPP2	SJV	3929	2	2	1
CA	Tracy Combined Cycle Power Plant	55933	TPP1	SJV	4597	1	1	1
CA	Tracy Combined Cycle Power Plant	55933	TPP2	SJV	4597	2	2	1
CA	Walnut Energy Center	56078	1	SJV	7172	1	1	1
CA	Walnut Energy Center	56078	2	SJV	7172	2	2	1
CA	Ripon Generation Station	56135	1	SJV	4940	1	1	1
CA	Ripon Generation Station	56135	2	SJV	4940	2	2	1
CA	Malaga Power	56239	GT-1	SJV	4305	1	1	1
CA	Malaga Power	56239	GT-2	SJV	4305	2	2	1
CA	Midway Peaking	56639	1	SJV	7286	1	1	1
CA	Midway Peaking	56639	2	SJV	7286	2	2	1
CA	Panoche Energy Center	56803	1	SJV	7220	1	1	1
CA	Panoche Energy Center	56803	2	SJV	7220	2	2	1
CA	Panoche Energy Center	56803	3	SJV	7220	3	3	1
CA	Panoche Energy Center	56803	4	SJV	7220	4	4	1
CA	Algonquin Power Sanger	57564	8	SJV	4071	8	8	1

CA	Lodi Energy Center	57978	CT1	SJV	2697	5	5	1
CA	Delano Energy Center, LLC	58122	GEN1	SJV	6662	2	2	1

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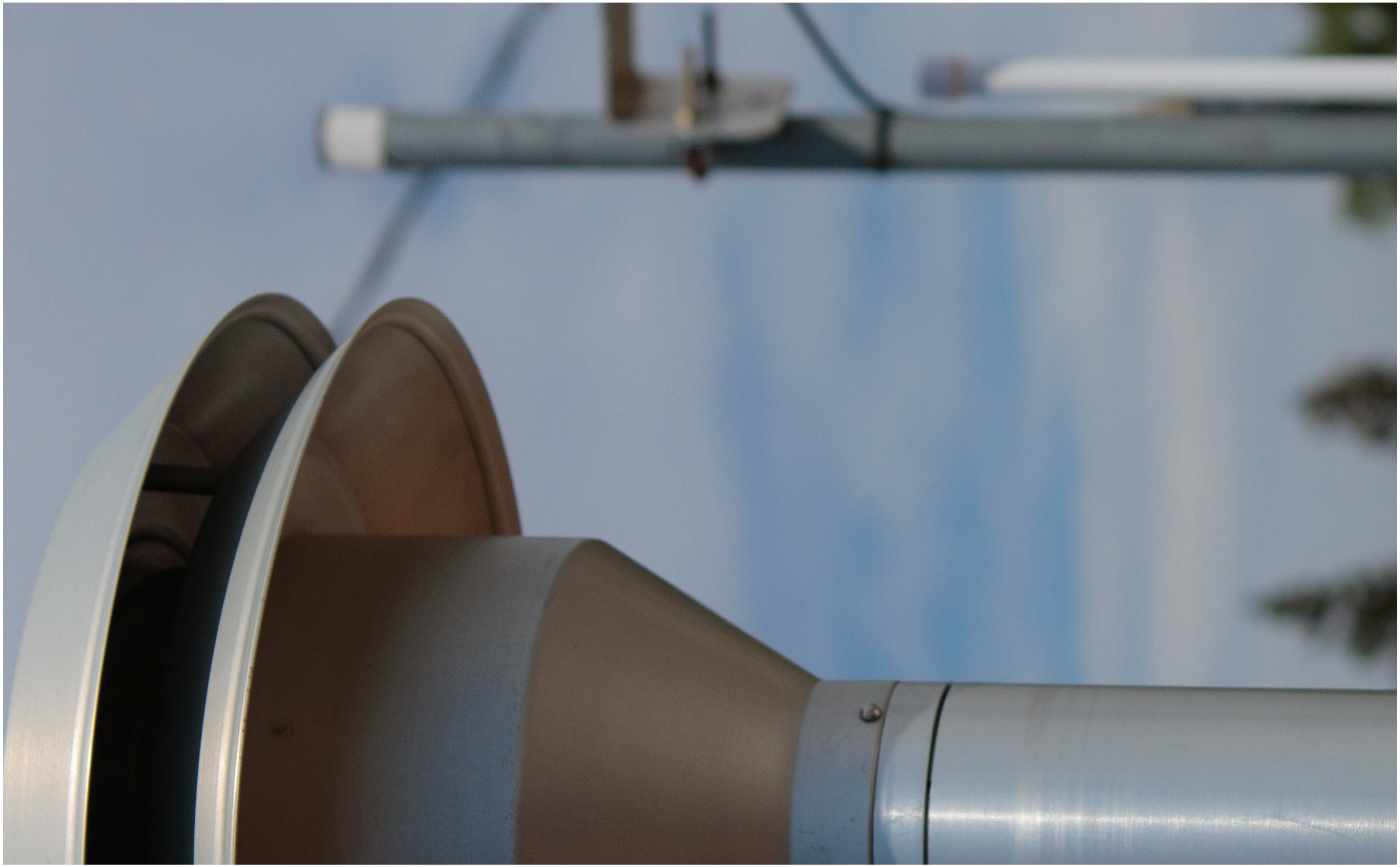
Appendix J

MODELING PROTOCOL AND ATTAINMENT DEMONSTRATION



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Appendix J: Modeling Protocol and Attainment Demonstration

[This Appendix provided by the California Air Resources Board]

Modeling Protocol and Attainment Demonstration for the San Joaquin Valley Annual $PM_{2.5}$ State Implementation Plan

Prepared by

California Air Resources Board

San Joaquin Valley Air Pollution Control District

Prepared for

United States Environmental Protection Agency Region IX

May 2024

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Acronyms

BCs – Boundary Conditions

BDSNP – Berkeley-Dalhousie Soil NOx Parameterization

CAPP – Community Air Protection Program

CARB – California Air Resources Board

CMAQ Model – Community Multi-scale Air Quality Model

CRPAQS – California Regional Particulate Air Quality Study

CSN – Chemical Speciation Network

DISCOVER-AQ – Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality

DV – Design Value

EC – Elemental Carbon

FEM – Federal Equivalent Method

FDDA – Four Dimensional Data Assimilation

FRM – Federal Reference Method

GEOS-5 – Goddard Earth Observing System Model, Version 5

ICs – Initial Conditions

IMPROVE - Interagency Monitoring of Protected Visual Environments

IOA – Index Of Agreement

MATS – Model Attainment Test Software

MB – Mean Bias

MCIP – Meteorology-Chemistry Interface Processor

ME – Mean Error

MEGAN – Model of Emissions of Gases and Aerosols from Nature

MFB – Mean Fractional Bias

MFE – Mean Fractional Error

MOZART – Model for Ozone and Related chemical Tracers

NAAQS – National Ambient Air Quality Standard

NARR – North American Regional Reanalysis

NASA – National Aeronautics and Space Administration

NCR – National Center for Atmospheric Research

NMB – Normalized Mean Bias

NME – Normalized Mean Error

NO_x – Nitrogen Oxides

OC – Organic Carbon

OM – Organic Matter

PBL – Planetary Boundary Layer

$PM_{2.5}$ – Particulate Matter of Aerodynamic Diameter less than 2.5 micrometers

RH – Relative Humidity

RMSE – Root Mean Square Error

ROG – Reactive Organic Gases

RRF – Relative Response Factors

RWC – Residential Wood Combustion

SANDWICH – Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbon Hybrid material balance

SAPRC – Statewide Air Pollution Research Center

SASS - Spiral Aerosol Speciation Sampler

SIP – State Implementation Plan

SJV – San Joaquin Valley

SJVAPCD – San Joaquin Valley Air Pollution Control District

SLAMS – State and Local Air Monitoring Stations

SOA – Secondary Organic Aerosol

SO_x – Sulfur oxides

U.S. EPA – United States Environmental Protection Agency

WRF – Weather and Research Forecasting

I. Introduction

The purpose of this document is to demonstrate the attainment of the 2012 National Ambient Air Quality Standard (NAAQS) for annual $PM_{2.5}$ (12 µg/m^3) in the San Joaquin Valley nonattainment area (SJV or the Valley) with an attainment deadline of 2030. It forms the scientific basis for the 2024 SJV $PM_{2.5}$ State Implementation Plan (SIP).

The model demonstration shows that in 2030, the highest projected annual $PM_{2.5}$ design value (DV) in the Valley under the future attainment emission scenario is 12.0 µg/m^3, which demonstrates that SJV will attain the 2012 annual $PM_{2.5}$ standard by 2030.

This document is organized as follows: Section 1 provides background and context to the $PM_{2.5}$ pollution in the SJV. Section 2 describes the general approach for projecting DVs to the future year. Section 3 discusses the meteorological modeling and evaluation. Section 4 describes the emissions inventory used in the modeling. Section 5 shows $PM_{2.5}$ model performance, projected 2030 DVs, $PM_{2.5}$ precursor sensitivities for 2030, and the un-monitored area analysis.

A. Ambient $PM_{2.5}$ Monitors in the SJV

SJV covers an area of 23,490 square miles and is home to approximately 4 million residents. The Valley is bordered on the west by the coastal mountain ranges and on the east by the Sierra Nevada range. These ranges converge at the southern end of the basin at the Tehachapi Mountains. The majority of the population is centered in the urban areas of Bakersfield, Fresno, Modesto, and Stockton. The nonattainment area includes seven full counties (San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, and Tulare) and one partial county (only the western portion of Kern County, which lies in the jurisdiction of the SJV Air Pollution Control District (SJVAPCD or the District)).

The Valley can be divided into three regions that are characterized by distinct geography, meteorology, and air quality: 1) northern SJV (San Joaquin, Stanislaus, and Merced counties), 2) central SJV (Madera, Fresno, and King counties), and 3) southern SJV (Tulare and Western Kern counties). A third of the Valley's population lives in the northern SJV. This lowland area is bordered by the Sacramento Valley and Delta lowland to the north, the central portion of the SJV to the south, and mountain ranges to the east and west. Because of the marine influence, which extends into this area through gaps in the coastal mountains to the west, the northern SJV experiences a more temperate climate than the rest of the Basin. These more moderate temperatures (cooler in the summer and warmer in the winter) and the predominant air flow patterns generally favor better air quality. Similar to the northern SJV, the central and southern SJV are also low-lying areas, flanked by mountains on their west and east sides. Pollutant concentrations usually reach peak levels in the Valley within these two regions, where the population is primarily clustered around the Fresno and Bakersfield urban areas. In these regions the interaction between geography, climate, and a mix of natural (biogenic) and anthropogenic emissions pose significant challenges to air quality progress. The southern SJV represents the terminus of the Valley and is flanked by mountains on the south. The surrounding mountains in both areas act as barriers to air flow, combined with recirculation patterns and stable air to trap pollutants near the valley floor. The more extreme temperatures and stagnant conditions in these two regions lead to poorer atmospheric dispersion and a build-up of $PM_{2.5}$. In addition to the urban air quality problems, emissions and pollutants from these areas are transported downwind, resulting in higher pollutant concentrations in downwind areas.

As discussed above, the Valley's regional diversity includes several major metropolitan areas, vast expanses of agricultural land, industrial sources, and major highways, all of which contribute to poor air quality. SJVAPCD and the California Air Resources Board (CARB) work together and operate an extensive network of air quality monitors throughout the Valley to help monitor and protect public health. The data collected from the Valley air monitoring network is used to generate daily air quality forecasts, issue health advisories, support compliance with various ambient air quality standards and serves as the basis for developing long-term attainment strategies and tracking progress towards meeting health-based air quality standards.

Figure 1 shows the spatial distribution of the $PM_{2.5}$ mass and speciation monitors in the Valley (see Table 1 for longitude/latitude information for each monitor). The monitors are located throughout the Valley floor and within the higher population density urban areas. A detailed discussion about the monitoring network and its adequacy can be found in the Valley's 2023 Air Monitoring Network Plan (https://ww2.valleyair.org/media/berdud2a/sjvapcd-2023-air-monitoring-network-plan.pdf).

Figure 1. Map of the ambient $PM_{2.5}$ monitoring network (including monitors for $PM_{2.5}$ mass only or $PM_{2.5}$ mass and speciation) in the San Joaquin Valley.

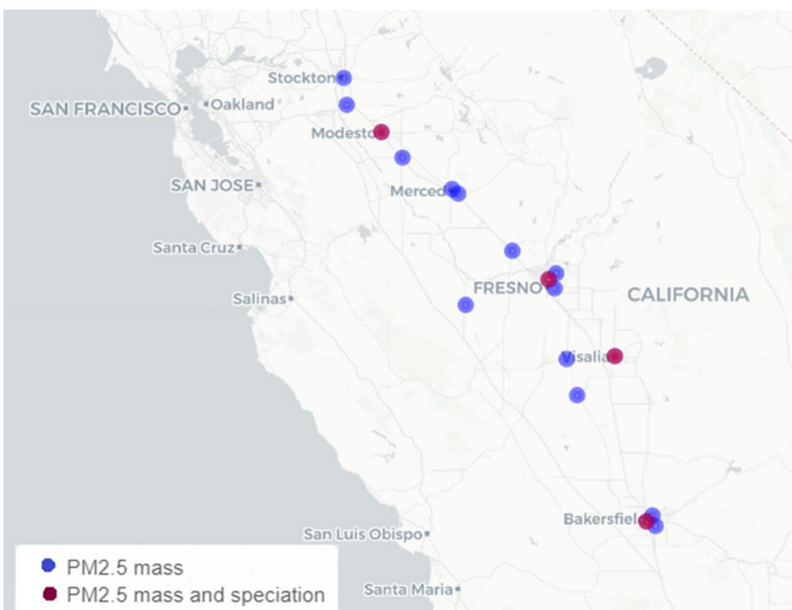


Table 1. 2015-2019 San Joaquin Valley $PM_{2.5}$ Monitoring Sites.*

Site AQS ID	County	Site	FRM $PM_{2.5}$*	FEM $PM_{2.5}$*	Speciation	Latitude	Longitude
060190011	Fresno	Fresno – Garland	X	X	X	36.7854	-119.7732
060195025	Fresno	Fresno - Hamilton & Winery (Pacific)	X			36.7264	-119.7330
060195001	Fresno	Clovis	X	X		36.8194	-119.7164
060192009	Fresno	Tranquillity		X		36.6342	-120.3823
060290016	Kern	Bakersfield - Planz	X			35.3246	-118.9976
060290014	Kern	Bakersfield - California Avenue	X		X	35.3566	-119.0626
060290010	Kern	Bakersfield - Golden	X			35.3856	-119.0150
060311004	Kings	Hanford		X		36.3157	-119.6434
060310004	Kings	Corcoran	X	X		36.1022	-119.5657
061072002	Tulare	Visalia	X		X	36.3322	-119.2912
060392010	Madera	Madera		X		36.9533	-120.0342
060472510	Merced	Merced - M Street	X			37.3083	-120.4805
060470003	Merced	Merced - S. Coffee		X		37.2819	-120.4337

Site AQS ID	County	Site	FRM $PM_{2.5}$*	FEM $PM_{2.5}$*	Speciation	Latitude	Longitude
060990006	Stanislaus	Turlock		X		37.4883	-120.8360
060990005	Stanislaus	Modesto		X	X	37.6422	-120.9942
060772010	San Joaquin	Manteca		X		37.7934	-121.2479
060771002	San Joaquin	Stockton		X		37.9507	-121.2685

*: FRM: Federal Reference Method for $PM_{2.5}$ mass; FEM: Federal Equivalent Method for $PM_{2.5}$ mass.

B. $PM_{2.5}$ Air Quality Trends

Tables 2 and 3 show the annual average $PM_{2.5}$ concentrations and the annual $PM_{2.5}$ design values (i.e., 3-year average), from 1999 to 2019, for sites in the SJV, respectively. Correspondingly, Tables 4 and 5 show the annual 98th percentile and annual 24-hour design values (i.e., 3-year average) over the same time period, respectively. In the most recent years, Bakersfield generally has the highest annual and 24-hour design values in the valley. Figure 2 shows the trend in peak valley-wide annual average $PM_{2.5}$ concentrations and 98th percentile of the 24-hour $PM_{2.5}$ concentrations, as well as the approximate number of days above the 24-hour standard in the valley from 1999 to 2019. While SJV $PM_{2.5}$ concentrations can vary strongly depending on yearly patterns of precipitation or drought conditions, in general, SJV has seen significant improvement in $PM_{2.5}$ concentrations over the last 20 years, with steady decreases in both annual average $PM_{2.5}$ levels and in the number of days above the 24-hour standard, which align with the substantial emission reductions of $PM_{2.5}$, Nitrogen Oxides (NOx) and Reactive Organic Gases (ROG) experienced in the valley (Figure 3).

Table 2. Annual Average $PM_{2.5}$ ($\mu g/m^3$).

SJV Monitoring Site	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Stockton	19.7	15.5	13.9	16.7	13.6	13.2	12.5	13.1	12.9	14.4	11.3	11.0	11.3	12.4	17.7	12.1	12.8	11.8	12.0	14.1	9.3
Manteca													10.8	8.3	11.7	9.9	12.6	9.8	10.9	10.3	8.1
Modesto	24.9	18.7	15.6	18.7	14.5	13.6	13.9	14.8	15.0	16.0	13.0	12.3	14.7	11.9	14.3	11.4		11.2	12.6	11.8	7.7
Turlock											16.1	12.7	17.1	14.8	15.1	12.3	14.2	12.7	12.4	13.6	10.6
Merced-Coffee												16.3	15.6	11.0	13.3	10.8	12.8	12.0	13.0	12.9	9.1
Merced-M		16.7	14.5	18.7	15.7	15.2	14.1	14.8	15.2		13.6	11.2	10.4	9.5	13.5	11.2	12.6	11.2	12.4	11.9	9.6
Madera-City													20.4	16.0	17.8	13.5	13.8	12.0	12.3	12.3	9.7
Fresno-First	27.6		19.8	21.5	17.8	16.3	16.7	16.8	18.8	17.4	15.1	13.0	15.5								
Fresno-Garland														14.1	16.8	15.1	14.4	12.7	14.7	14.1	11.1
Fresno-Winery		18.4	18.6	21.3	17.8	17.0	16.9	17.6	16.8	16.5	14.6	13.4	15.4	12.7	15.9	13.8	14.1	13.0	15.0	14.8	11.2
Clovis	19.8	16.3	18.0	16.2	18.5	16.4	16.3	16.4	16.4	16.2	18.3	14.7	17.9	15.4	15.9	16.6	15.0	12.6	13.0	12.6	10.2
Tranquility												7.0	8.2	7.1	8.4	7.7	10.0	7.9	8.1	9.0	5.8
Corcoran		16.4	19.2	21.5	16.2	17.4	17.5	16.9	18.4	15.8	17.7	17.9			15.6	15.4		14.8	15.9	14.9	12.1
Hanford												14.5	18.0	14.8	18.2	17.5	16.5	15.5	17.0	15.4	12.2
Visalia	27.6	23.9	22.5	23.2	18.2	17.0	18.8	18.8	20.4	19.8	16.0	13.6	16.1	14.8	18.9	17.9	16.1	14.7	16.3	16.2	12.9
Bakersfield-California	27.4	22.5	21.2	22.7	17.1	18.9	18.0	18.7	22.0	21.9	19.0	14.2	16.2	13.0	20.0	18.6	16.3	14.8	15.7	15.9	11.8
Bakersfield-Planz		20.3	20.8	23.5	17.8	17.4	19.8	19.3	21.8	23.5	22.5	16.8	14.4	14.7	21.7	21.6	17.9	15.9	18.2	18.0	13.0

Table 3. Annual $PM_{2.5}$ Design Value (three-year average, µg/m^3).

SJV Monitoring Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Stockton	16.4	15.3	14.7	14.5	13.1	12.9	12.8	13.5	12.9.	12.2	11.2	11.6	13.8	14.1	14.2	12.2	12.1	12.7	11.8
Manteca													10.2	9.9	11.4	10.8	11.0	10.3	9.8
Modesto	19.7	17.7	16.2	15.6	14.0	14.1	14.6	15.3	14.7	13.8	13.3	12.9	13.6	12.5			10.9	11.8	10.7
Turlock											15.3	14.9	15.7	14.1	13.9	13.1	13.0	12.9	12.2
Merced-Coffee												14.3	13.3	11.7	12.3	11.9	12.5	12.6	11.7
Merced-M		16.6	16.3	16.5	15.0	14.7	14.7				11.7	10.4	11.1	11.4	12.5	11.7	12.1	11.8	11.3
Madera-City													18.1	15.8	15.0	13.1	12.7	12.2	11.4
Fresno -First			19.7	18.6	16.9	16.6	17.4	17.7	17.1	15.2	14.5								
Fresno -Garland													15.4	15.3	15.4	14.1	13.9	13.9	13.3
Fresno -Winery		19.4	19.2	18.7	17.2	17.2	17.1	17.0	16.0	14.9	14.5	13.9	14.7	14.1	14.6	13.6	14.0	14.3	13.7
Clovis	18.0	16.8	17.6	17.0	17.1	16.4	16.4	16.4	17.0	16.4	17.0	16.0	16.4	16.0	15.8	14.7	13.4	12.7	11.9
Tranquility												7.5	7.9	7.7	8.7	8.5	8.6	8.3	7.7
Corcoran		19.0	19.0	18.4	17.0	17.2	17.6	17.0	17.3	17.1								15.2	14.3
Hanford												15.8	17.0	16.8	17.4	16.5	16.3	16.0	14.9
Visalia	24.7	23.2	21.3	19.5	18.0	18.2	19.3	19.7	18.8	16.5	15.2	14.8	16.6	17.2	17.6	16.2	15.5	15.7	15.1
Bakersfield-California	23.7	22.1	20.3	19.6	18.0	18.5	19.6	20.9	21.0	18.4	16.5	14.5	16.4	17.2	18.3	16.6	15.5	15.4	14.5
Bakersfield-Planz		21.5	20.7	19.6	18.4	18.9	20.3	21.5	22.6	20.9	17.9	15.3	16.9	19.3	20.4	18.5	17.2	17.3	16.4

Table 4. Annual 98th percentile of the 24-hour $PM_{2.5}$ ($\mu g/m^3$).

SJV Monitoring Site	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Stockton	79.0	55.0	58.0	50.0	41.0	36.0	44.0	42.0	48.0	61.6	40.4	29.7	44.8	33.9	56.3	44.5	39.1	32.4	44.2	42.1	32.9
Manteca													38.9	30.9	40.2	40.0	42.7	29.3	34.5	32.9	26.8
Modesto	100	71.0	69.0	69.0	47.0	45.0	55.0	52.0	57.4	53.9	54.5	37.3	54.7	40.8	56.4	49.5	30.8	36.2	51.1	36	28.4
Turlock										67.4	53.1	43.5	57.4	45.4	55.4	51.2	47.3	38.5	48	37.7	36
Merced-Coffee											41.4	39.9	47.4	35.6	42.3	43.8	40.3	32.8	43.7	34.5	23.4
Merced-M	91.9	60.0	49.3	55.1	44.2	43.0	48.3	43.8	52.7	54.0	45.2	39.1	38.5	41.8	67.3	45.9	39.0	34.6	40.3	35.6	29.5
Madera-City												50.6	59.1	43.2	54.6	51.0	43.7	35.7	45.8	36.5	23.9
Fresno-First	120	90.0	75.0	75.0	56.0	52.0	71.0	51.0	67.0	57.4	55.8	48.8	69.5								
Fresno-Garland														52.6	63.8	66.7	52.0	43.7	68	43.8	36.9
Fresno-Winery		64.8	61.5	71.9	49.7	49.4	71.2	55.0	57.4	44.5	48.2	40.2	67.5	51.3	71.6	61.8	42.0	40.0	73.2	54.5	37.1
Clovis	59.2	72.5	71.5	53.2	48.1	52.4	63.0	51.3	60.9	49.0	49.0	44.3	68.5	48.0	56.2	64.6	45.7	36.1	50	38.4	28
Tranquility											35.8	27.0	27.5	26.9	35.7	31.2	35.8	27.0	34.4	29.5	17.1
Corcoran	53.0	55.1	89.5	65.1	42.2	49.4	74.5	50.1	57.9	47.9	53.4	47.2			66.0	71.0		45.9	69.7	42.3	45.1
Hanford												48.5	64.6	48.3	67.6	81.9	51.4	43.3	68.7	45.1	41.1
Visalia	114	103.0	96.0	70.0	47.0	54.0	65.0	50.0	59.7	62.1	53.9	36.3	50.7	53.8	62.5	75.4	45.8	40.7	74.6	46.8	45.5
Bakersfield-California	98.0	92.7	94.9	73.0	48.3	61.5	63.2	60.5	73.0	64.5	66.7	53.3	65.5	56.4	71.8	79.9	57.2	47.0	71.8	56.7	43.4
Bakersfield-Planz		76.5	90.6	66.8	47.5	47.6	66.4	64.7	72.2	72.3	65.5	47.2	43.2	40.6	83.6	76.7	56.5	50.7	69.7	56.6	46.7

Table 5. 24-hour $PM_{2.5}$ Design Values (three-year average, µg/m^3).

SJV Monitoring site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Stockton	64	54	50	42	40	41	45	51	50	44	38	36	45	45	47	39	38	40	40
Manteca													37	37	41	37	36	32	31
Modesto	80	70	62	54	49	51	55	54	55	49	49	44	51	49	46	39	39	41	39
Turlock										55	51	49	53	51	51	46	45	41	41
Merced-Coffee											43	41	42	41	42	39	38	37	34
Merced-M	67	55	50	47	45	45	48	50	51	46	41	40	49	52	47	40	38	37	35
Madera-City												51	52	50	50	43	42	39	35
Fresno-First	95	80	69	61	60	58	63	58	60	54	58								
Fresno-Garland														61	61	54	54	52	50
Fresno-Winery		66	61	57	57	59	61	52	50	44	52	53	64	62	54	48	52	56	55
Clovis	68	66	58	51	55	56	58	54	53	47	54	54	58	56	56	49	44	42	39
Tranquility												27	30	31			32	30	27
Corcoran	66	70	66	52	55	58	61	52	53	49	47				75		72	53	52
Hanford												54	60	66	67	59	54	52	52
Visalia	104	90	71	57	55	56	58	57	59	51	47	47	56	64	61	54	54	54	56
Bakersfield-California	95	87	72	61	58	62	66	66	68	62	62	58	65	69	70	61	59	59	57
Bakersfield-Planz		78	68	54	54	60	68	70	70	62	52	44	56	67	72	61	59	59	58

Figure 2. Trends in valley-wide annual average, 24-hour 98th percentile $PM_{2.5}$, and approximate number of days above the 24-hour standard.

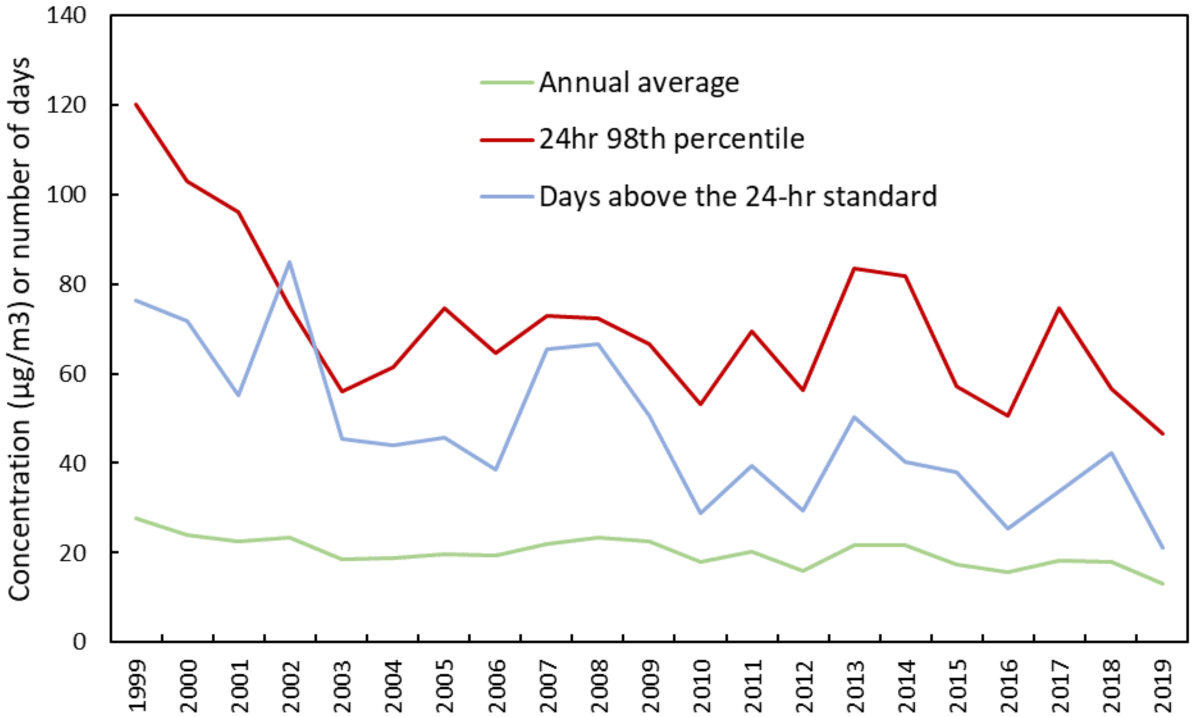
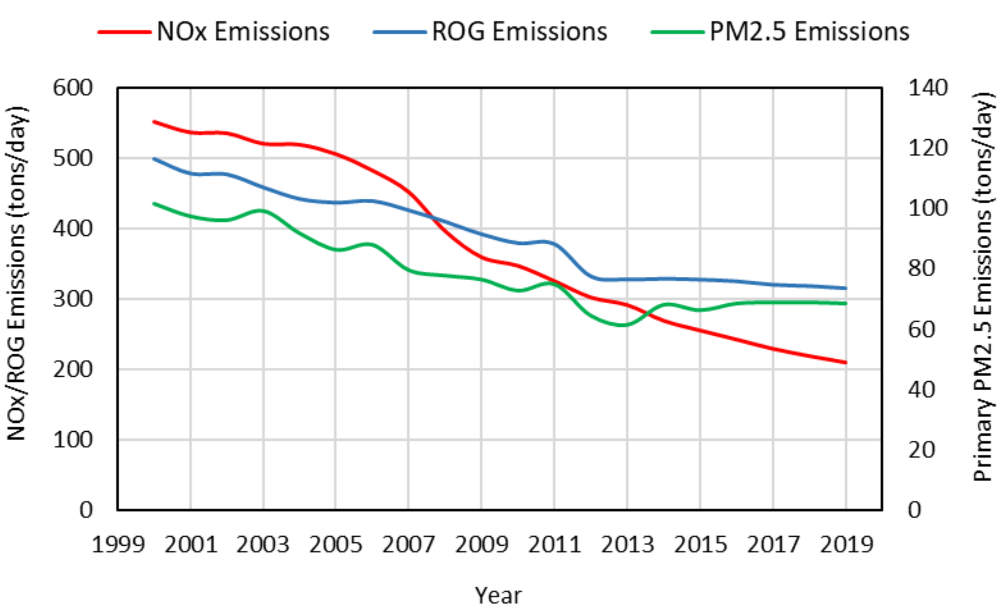


Figure 3. San Joaquin Valley trends in $PM_{2.5}$, NOx, and ROG emissions.

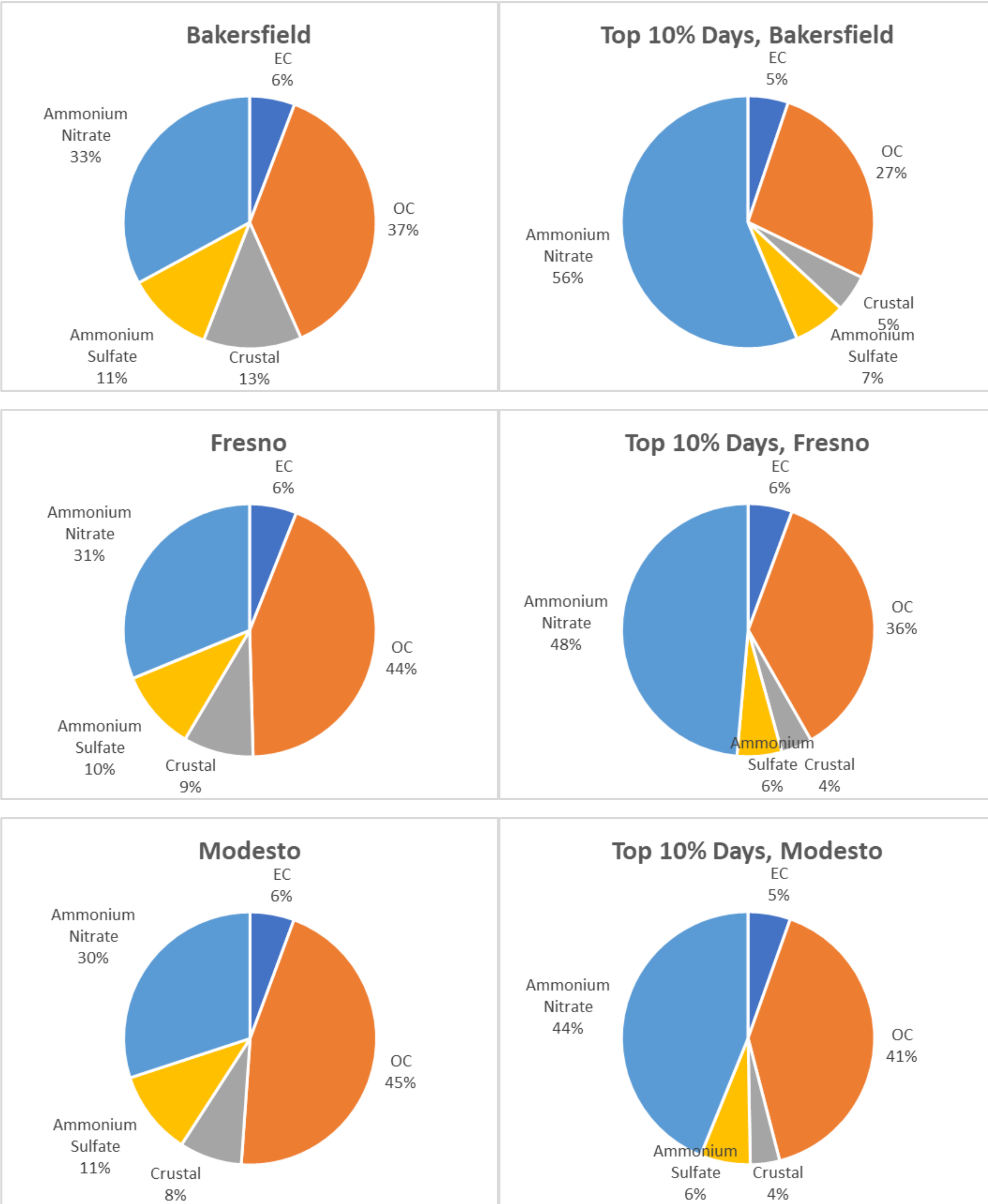


C. Major $PM_{2.5}$ Chemical Components

Four monitoring sites collect $PM_{2.5}$ chemical composition data in the San Joaquin Valley: Bakersfield-California, Fresno-Garland, Modesto, and Visalia. The Bakersfield and Fresno speciation monitors are part of the national Chemical Speciation Network (CSN) while Modesto and Visalia are part of the State and Local Air Monitoring Stations (SLAMS) network. All four sites use Spiral Aerosol Speciation Sampler (SASS) samplers from Met One Instruments for data collection. Since deployment of the speciation sampling, changes were made to the carbon sampling and analysis method. The collection method changed from the Met One SASS to the URG3000N sampler, which is very similar to the Interagency Monitoring of Protected Visual Environments (IMPROVE) module C sampler. The analytical method was changed from the National Institute of Occupational Safety and Health (NIOSH)-like thermal optical transmittance method to IMPROVE_A thermal optical reflectance. At Bakersfield, Modesto, and Visalia these changes were implemented in May 2007, while the Fresno site switched to the new carbon system in April 2009.

Figure 4 illustrates the average of the 2015-2019 annual average $PM_{2.5}$ compositions, as well as the average of the top 10 percent of days at Bakersfield, Fresno, and Modesto over the same period. (Note that this composition can be somewhat different from those used in the DV calculation since there is difference between FRM and CSN filter measurement and analysis methods. More detail can be found in the U.S. EPA modeling guidance (U.S. EPA 2018)). Organic matter (OM) was calculated by multiplying measured OC by 1.5 according to the OM/OC ratio measured at Fresno (Ge et al., 2012). Ammonium nitrate and OM are the largest contributors to $PM_{2.5}$ on an annual basis, accounting for approximately 70-75% of the $PM_{2.5}$ mass. Their contributions are even higher on peak $PM_{2.5}$ days, accounting for 80-85% of $PM_{2.5}$ mass. Formation mechanisms for ammonium nitrate are discussed in Section D. OM sources typically include residential wood combustion, cooking, biomass burning, and mobile sources. In addition, OM can also be formed in the atmosphere from oxidation of ROG. Ammonium sulfate contributes approximately 10% of the $PM_{2.5}$ on an annual basis. Its contribution is half that on peak days, at approximately 6%. Elemental carbon and crustal materials typically contribute less than 10% to $PM_{2.5}$ levels in these cities, except at Bakersfield, where crustal materials contributed more than 10% on an annual basis.

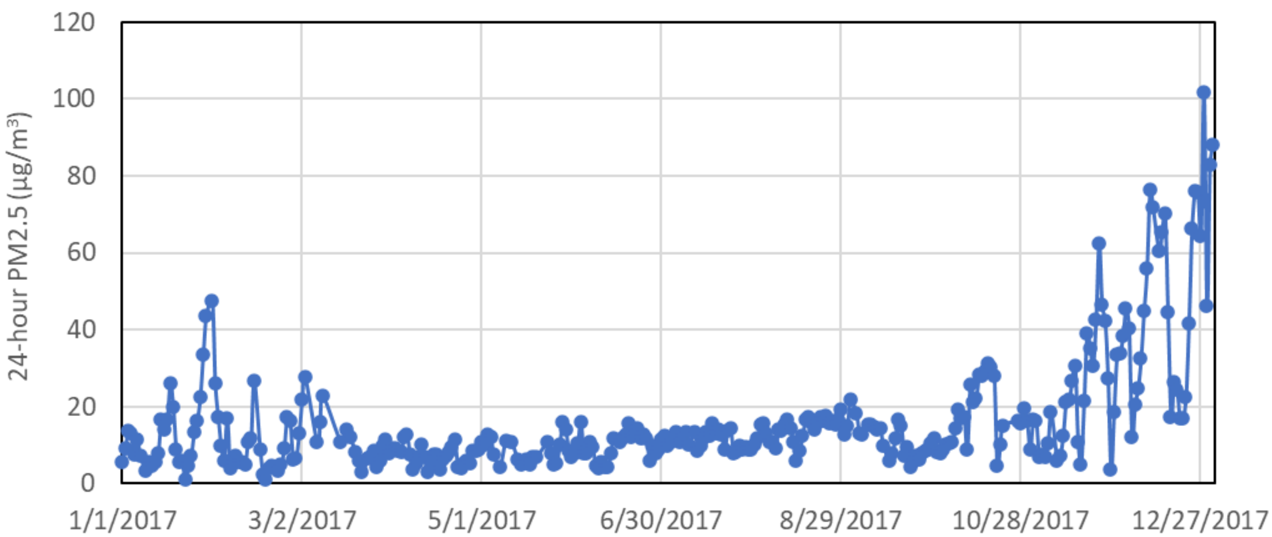
Figure 4. Five-year average (2015-2019) and average peak day (top 10 percent over the same five years) $PM_{2.5}$ compositions at Bakersfield, Fresno, and Modesto.



D. Seasonality of $PM_{2.5}$ and Meteorological Conditions Leading to Elevated $PM_{2.5}$

$PM_{2.5}$ concentrations in the SJV exhibit a strong seasonal variability, with the highest concentrations occurring during the months of November through February. For example, Figure 5 represents the time series of 24-hour $PM_{2.5}$ concentrations at Bakersfield - California Avenue in 2017, which shows elevated $PM_{2.5}$ episodes occurred in the first few and last few months of the year. The predominance of elevated $PM_{2.5}$ episodes during winter months results from a confluence of meteorological conditions conducive to the formation and buildup of $PM_{2.5}$, as well as wintertime sources of directly emitted $PM_{2.5}$.

Figure 5. 24-hour $PM_{2.5}$ concentrations at Bakersfield-California Avenue in 2017.



High $PM_{2.5}$ concentrations typically build up during multiday episodes under stagnant winter weather when a high-pressure system (the Great Basin High) reduces the ventilation in the Valley (Ferreria et al., 2005). These stagnation events, sandwiched between two weather systems, are characterized by low wind speeds, moderate temperatures, vertical atmospheric stability, and high relative humidity. This stable atmosphere prevents precursor gases and primary (or directly emitted) $PM_{2.5}$ released at the surface in the Valley from rapidly dispersing. The moderate temperatures and high relative humidity also enhance the formation of secondary particulate matter, especially ammonium nitrate and sulfate. In contrast, hotter and drier weather conditions in summer favor the evaporation of semi-volatile species from particles. Greater mixing heights in the summer can also help the ventilation of air pollutants. As a result, summertime $PM_{2.5}$ concentrations in the SJV are typically much lower compared to wintertime.

Wintertime $PM_{2.5}$ episodes can last for many days. At the beginning of an episode, concentrations are low but increase daily because of both the accumulation of primary pollutants and formation of secondary pollutants (Watson et al, 2002). Concentrations continue to build until there is a change in the weather significant enough to wash out particles through rainfall or increased ventilation of the Valley. For example, the two main episodes captured during the CRPAQS (i.e., California Regional Particulate Matter Air Quality Study) field study (starting in late 1999) had up to 18 days with $PM_{2.5}$ concentrations exceeding 65 μg/m^3 (Turkiewicz et al., 2006). In December 2017, Bakersfield experienced 20 days with $PM_{2.5}$ concentrations greater than 35 μg/m^3. During such episodes, urban sites typically record elevated concentrations earlier than rural sites, and consequently, have a greater number of days with high concentrations. However, due to the buildup of $PM_{2.5}$ concentrations, rural sites can achieve concentrations with similar magnitude as urban sites by the end of an episode.

The elevated wintertime $PM_{2.5}$ concentrations observed during pollution episodes are the result of both directly emitted particulates (known as primary particulate matter) and particulate matter formed via chemical and physical processes in the atmosphere (known as secondary particulate matter). Ammonium nitrate, the dominant $PM_{2.5}$ component throughout the Valley in winter, is formed in the atmosphere from chemical reactions between precursor pollutants such as NO_x, ROG, and ammonia. Carbonaceous aerosol, the second most abundant component, is primarily directly emitted, and is the result of contributions from wood combustion (e.g., wood burning for heating), charbroiling, and mobile sources (Ge et al., 2012; Young et al., 2016).

Ammonium nitrate can be formed both at the surface and aloft and can be fairly uniform across urban and rural sites. The spatial homogeneity of ammonium nitrate is influenced by higher wind speeds aloft (which allow for more efficient transport), and the diurnal variation in mixing heights (which allow entrainment of ammonium nitrate down to the surface). Ammonium nitrate is also formed via both daytime and nighttime chemistry pathways. The amount of ammonium nitrate produced will be limited by the relative abundance of its precursors in the atmosphere. In the San Joaquin Valley, nighttime formation is considered to be the most important pathway (Lurmann et al., 2006; Prabhakar et al., 2017). The nighttime pathway involves oxidation of NO_2, followed by reaction with ammonia to form ammonium nitrate. Since ammonia is abundant in the Valley in the winter, NO_x is considered to be the limiting precursor (Chen, et al., 2014, 2020; Kleeman, et al., 2005; Parworth, et al., 2017; Prabhakar et al., 2017). In contrast, the daytime pathway also involves ROG. Modeling studies that investigated winter episodes in the Valley estimated that reductions in ROG emissions have a small impact on nitrate concentrations only at very high $PM_{2.5}$ concentrations (Pun, et al., 2009). However, at current $PM_{2.5}$ levels the impact is very limited, and in some cases ROG reductions can lead to an increase in $PM_{2.5}$ concentrations (Chen et al., 2014; Kleeman, et al., 2005).

II. Approaches

This section briefly describes CARB's procedures, based on U.S. EPA guidance (U.S. EPA, 2018), for projecting future year annual and 24-hour $PM_{2.5}$ Design Values (DVs) using model output and a Relative Response Factor (RRF) approach.

A. Methodology

The U.S. EPA modeling guidance (U.S. EPA, 2018) outlines the approach for using models to predict future year annual $PM_{2.5}$ DVs. The guidance recommends using model predictions in a “relative” rather than “absolute” sense. In this relative approach, the fractional change (or ratio) in $PM_{2.5}$ concentration between the model future year and model baseline year are calculated for all valid monitors. These ratios are called relative response factors (RRFs). Since $PM_{2.5}$ is comprised of different chemical species, which respond differently to changes in emissions of various pollutants, separate RRFs are calculated for the individual $PM_{2.5}$ species. Baseline DVs are then projected to the future on a species-by-species basis, where the DV is separated into individual $PM_{2.5}$ species and each species is multiplied by its corresponding RRF. The individual species are then summed to obtain the future year $PM_{2.5}$ DV.

A brief summary of the modeling procedures utilized in this attainment analysis, as prescribed by the U.S. EPA modeling guidance (U.S. EPA, 2018), is provided below.

B. Modeling Period

Based on analysis of recent years’ ambient $PM_{2.5}$ levels and meteorological conditions leading to elevated $PM_{2.5}$ concentrations, the year 2017 was selected for baseline modeling calculations.

C. Baseline Design Values

Specifying the baseline DV is a key consideration in the model attainment test because this value is projected forward to the future and used to test for future attainment of the standard at each monitor. U.S. EPA guidance (2018) defines the annual $PM_{2.5}$ DV for a given year as the 3-year average (ending in that year) of the annual average $PM_{2.5}$ concentrations, where the annual average is calculated as the average of the quarterly averages for each calendar quarter (e.g., January-March, April-June, July-September, October-December). For example, the 2017 $PM_{2.5}$ DV is the average of the annual $PM_{2.5}$ concentrations from 2015, 2016, and 2017.

To minimize the influence of year-to-year variability in demonstrating attainment, the U.S. EPA (2018) allows the averaging of three DVs, where one of the years is the baseline emissions inventory and modeling year. This average DV is referred to as the baseline DV. Since each DV represents an average over three years, observational data from 2015, 2016, 2017, 2018, and 2019 will influence the average DV, with each year receiving a different weighting. Table 6 illustrates the observational data from each year that goes into the baseline DV.

Table 6. Illustrates the data from each year that is utilized in the baseline DV calculation.

DV Year	Years averaged for the DV				
2017	2015	2016	2017		
2018		2016	2017	2018	
2019			2017	2018	2019

Yearly weighting for the baseline DV calculation is calculated as:

$$\mathbf{2017-2019}\ \boldsymbol{Average} = \frac{PM2.5_{2015}+2\times PM2.5_{2016}+3\times PM2.5_{2017}+2\times PM2.5_{2018}+PM2.5_{2019}}{9} \quad (1)$$

Table 7 shows the 2017-2019 average annual DVs (or annual baseline DVs) for each Federal Reference Method (FRM) and Federal Equivalent Method (FEM) site in the SJV, which had sufficient data to calculate a DV. For one site with incomplete data, assumptions were made to calculate the baseline DV and the assumptions were annotated following Table 7. The highest DV occurred at the Bakersfield - Planz site with a baseline DV of 16.97 μg/m^3.

Table 7. Average baseline DV for each monitoring site in the SJV, as well as the yearly annual DVs from 2017-2019 utilized in calculating the baseline DVs.*

AQS site ID	Monitoring Site Name	2017	2018	2019	2017-2019 Average Baseline
060290016	Bakersfield - Planz	17.18	17.32	16.41	16.97
060311004	Hanford	16.33	15.99	14.87	15.73
060290010	Bakersfield - Golden	15.83	15.77	14.95	15.52
061072002	Visalia	15.49	15.69	15.12	15.43
060290014	Bakersfield - California Ave.	15.47	15.42	14.48	15.12
060310004	Corcoran *	15.35	15.20	14.31	14.95
060195025	Fresno - Hamilton & Winery	14.05	14.26	13.68	13.99
060190011	Fresno - Garland	13.92	13.86	13.30	13.69
060990006	Turlock	13.00	12.89	12.23	12.70
060195001	Clovis	13.42	12.69	11.94	12.69
060470003	Merced - S Coffee	12.52	12.61	11.69	12.28
060771002	Stockton	12.14	12.65	11.83	12.21
060392010	Madera	12.71	12.19	11.41	12.11
060472510	Merced-M Street	12.07	11.83	11.31	11.73
060990005	Modesto	10.90	11.85	10.71	11.16
060772010	Manteca	11.03	10.31	9.76	10.37
060192009	Tranquillity	8.62	8.29	7.66	8.19

*: Because of incomplete data at Corcoran in 2015, annual 2015 $PM_{2.5}$ concentration was assumed to be average of annual 2016 and 2017 $PM_{2.5}$ concentrations.

D. Base, Reference, and Future Years

The modeling assessment consists of the following three primary model simulations, which all utilized the same model inputs for meteorology, chemical boundary conditions, and biogenic emissions. The only difference between the simulations was the year represented by the anthropogenic emissions (2017 versus 2030) and certain day-specific emissions.

1. *Base Year (or Base Case) Simulation*

   The base year simulation for 2017 was used to assess model performance and includes as much day-specific detail as possible in the emissions inventory such as hourly adjustments to the motor vehicle and biogenic inventories based on observed local meteorological conditions, as well as known wildfire and agricultural burning events.

2. *Reference (or Baseline) Year Simulation*

   The reference year simulation was identical to the base year simulation, except that certain emissions events which are either random and/or cannot be projected to the future were removed from the emissions inventory, such as wildfires.

3. *Future Year Simulations*

   The future year simulations are identical to the reference year simulation, except that projected future year 2030 anthropogenic emission levels were used rather than 2017 emission levels. All other model inputs (e.g., meteorology, chemical boundary conditions, biogenic emissions, and calendar for day-of-week specifications in the inventory) were the same as those used in the reference year simulation.

To summarize (Table 8), the base year 2017 simulation was used for evaluating model performance, while the reference (or baseline) 2017 and future year 2030 simulations were used to project the average DVs to the future year.

Table 8. Description of CMAQ model simulations used to evaluate model performance and project baseline design values to the future years.

Simulation	Anthropogenic Emissions	Biogenic Emissions	Meteorology	Chemical Boundary Conditions
Base year (2017)	2017 w/ wildfires	2017 MEGAN	2017 WRF	2017 Geos-Chem
Reference year (2017)	2017 w/o wildfires	2017 MEGAN	2017 WRF	2017 Geos-Chem
Future year (2030)	2030 w/o wildfires	2017 MEGAN	2017 WRF	2017 Geos-Chem

E. $PM_{2.5}$ Species Calculations

Since $PM_{2.5}$ consists of different chemical components, it is necessary to assess how each individual component will respond to emission reductions. As a first step in this process, the measured total $PM_{2.5}$ must be separated into its various components. In the SJV, the primary components on the filter based $PM_{2.5}$ measurements include sulfates, nitrates, ammonium, organic carbon (OC), elemental carbon (EC), particle-bound water, other primary inorganic particulate matter, and passively collected mass (blank mass). Species concentrations were obtained from the four chemical speciation sites in the SJV. These four sites are located at: Bakersfield - California Avenue, Fresno - Garland, Visalia - North Church, and Modesto - 14th Street. Chemical species were measured once every three or six days at those sites. Since not all of the 17 FRM/FEM $PM_{2.5}$ sites in the Valley have collocated speciation monitors, it was necessary to utilize the speciated $PM_{2.5}$ measurements at one of the four speciation sites to represent the speciation profile at each of the FRM/FEM sites. The choice of which speciation site to represent the speciation profile at a given FRM monitor (Table 9) was determined based on geographic proximity, analysis of local emission sources, and measurements from previous field studies (e.g., CRPAQS, DISCOVER-AQ), and is consistent with previous $PM_{2.5}$ SIPs in the Valley.

Table 9. $PM_{2.5}$ speciation data used for each $PM_{2.5}$ design site.

AQS Site ID	$PM_{2.5}$ Design Site (FRM/FEM Monitor)	$PM_{2.5}$ Speciation Site
060290016	Bakersfield - Planz	Bakersfield - California
060311004	Hanford	Visalia - Church
060290010	Bakersfield - Golden	Bakersfield - California
061072002	Visalia	Visalia - Church
060290014	Bakersfield - California Ave.	Bakersfield - California
060310004	Corcoran	Visalia - Church
060195025	Fresno - Hamilton & Winery	Fresno - Garland
060190011	Fresno - Garland	Fresno - Garland
060990006	Turlock	Modesto - 14th
060195001	Clovis	Fresno - Garland
060470003	Merced - S Coffee	Modesto - 14th
060771002	Stockton	Modesto - 14th
060392010	Madera	Fresno - Garland
060472510	Merced - M Street	Modesto - 14th
060990005	Modesto	Modesto - 14th

AQS Site ID	$PM_{2.5}$ Design Site (FRM/FEM Monitor)	$PM_{2.5}$ Speciation Site
060772010	Manteca	Modesto - 14th
060192009	Tranquillity	Fresno - Garland

The FRM $PM_{2.5}$ monitors and speciation samplers utilize different filter media (Teflon vs. nylon, respectively), which can lead to differences in the amount of $PM_{2.5}$ nitrate retained on the filters. When direct measurements of the retained nitrate on the FRM filter are not available, the U.S. EPA (2018) recommends using the SANDWICH approach (Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbon Hybrid material balance) described by Frank (2006) to apportion the FRM $PM_{2.5}$ mass to individual $PM_{2.5}$ species based on nearby CSN speciation data. A key component of the SANDWICH method is to estimate the amount of nitrate evaporated from the FRM filters. Frank (2006) followed Hering and Cass (1999) to estimate the volatized nitrate from the FRM filter which is described below. To estimate volatized nitrate, necessary inputs include 24-hour average nitrate measurements and hourly temperature and relative humidity data. For each hour *i* of the day, calculate the dissociation constant, K_i from ambient temperature and relative humidity (RH).

For RH < 61%:

$$\ln(K_i) = 118.87 - (24084/T_i) - 6.025 \times \ln(T_i) \qquad (2)$$

where T_i is the hourly temperature in Kelvins and K_i is in nanobars.

For RH ≥ 61%, K_i is replaced by:

$$K_i' = [P_1 - P_2(1 - a_i) + P_3(1 - a_i)^2] \times (1 - a_i)^{1.75} \times K_i, \qquad (3)$$

where, $a_i$is “fractional” relative humidity and

$$\ln(P_1) = -135.94 + 8763/T_i + 19.12 \times \ln(T_i),$$

$$\ln(P_2) = -122.65 + 9969/T_i + 16.22 \times \ln(T_i),$$

$$\ln(P_3) = -182.61 + 13875/T_i + 24.46 \times \ln(T_i).$$

Using this information, calculate the nitrate retained on the filter as:

$$\text{Retained Nitrate} = \text{STN nitrate} - 745.7/T_R \times (\kappa - \gamma) \times \frac{1}{24}\sum_{i=1}^{24} \sqrt{K_i} \qquad (4)$$

where T_R is the daily average temperature for the sampled air volume in Kelvin, K_i is the dissociation constant for NH_4NO_3 at ambient temperature for hour *i*, and $(\kappa - \gamma)$ relates to the temperature rise of the filter and vapor depletion from the inlet surface and is assumed to have a value equal to one (Hering and Cass, 1999).

During the CRPAQS field study in the SJV, Chow et al. (2005) performed a series of experimental studies to study loss of $PM_{2.5}$ nitrate from FRM samples and found that the Hering and Cass (1999) methodology overestimated nitrate loss from the FRM filter for every sample during warm months and most of samples during cold months. The possible reasons for these differences include the presence of ammonia in the sampling system, which suppresses volatilization of ammonium nitrate from the filter, or the presence of non-volatilized nitrate associated with sea salt and mineral dust. Chow et al. (2005) reported that the amount of nitrate lost to evaporation during sampling at the Angiola, Fresno, and Bakersfield sites ranged from 3.5 to 6.5% during cold months and from 61 to 84%, during warm months. Based on the nitrate evaporation range in Chow et al. (2005), we assume that 20% of nitrate is evaporated from the FRM filter (or 80% nitrate is retained on FRM filter) during the colder months (quarters 1 and 4) and 90% of nitrate is evaporated from the FRM filter (or 10% nitrate is retained on FRM filter) during the warmer months (quarters 2 and 3). It is important to note that the calculation of nitrate loss from FRM filters only impacts the relative percentage of nitrate and OM in the filter, but it does not change the baseline DVs.

Once the retained nitrate is calculated along with sulfate, ammonium, elemental carbon, and sea salt, particle bound water is calculated using the Aerosol Inorganics Model (AIM, or http://www.aim.env.uea.ac.uk/aim/aim.php). Organic Matter (OM) mass is calculated as the difference between FRM $PM_{2.5}$ mass and all other species (i.e., retained nitrate, sulfate, ammonium, elemental carbon, crustal material, and blank mass which is 0.2 µg/m^3) as suggested in U.S. EPA's SANDWICH approach (U.S. EPA 2018).

To apportion the FRM $PM_{2.5}$ mass to specific species, $PM_{2.5}$ speciation data from 2015-2019 were utilized. For the annual DV calculation, for each quarter, percent contributions from individual chemical species to FRM $PM_{2.5}$ mass were calculated as the average of the corresponding quarters from 2015-2019.

F. Future Year Design Values

The approach taken for projecting future year annual $PM_{2.5}$ DVs is described briefly below. See U.S. EPA (2018) for additional details. Projecting baseline annual $PM_{2.5}$ DVs to the future involves the following steps:

Step 1: Compute observed quarterly weighted average concentrations (consistent with the weighted average DV calculation) at each monitor for the following species: ammonium, nitrate, sulfate, organic carbon, elemental carbon, sea salt, and other primary PM. This is done by multiplying quarterly weighted average FRM $PM_{2.5}$ concentrations by the fractional composition of $PM_{2.5}$ species for each quarter.

Step 2: Compute the component-specific RRF for each quarter and each species at each monitor based on the reference and future year modeling. The RRF for a specific component *j* is calculated using the following expression:

$$\text{RRF}_j = \frac{[C]_{j,\text{ future}}}{[C]_{j,\text{ reference}}} \quad (5)$$

Where $[C]_{j,\text{ future}}$ is the modeled quarterly mean concentration for component *j* predicted for the future year averaged over the 3x3 array of grid cells surrounding the monitor, and $[C]_{j,\text{reference}}$ is the same, but for the reference year simulation. An RRF was calculated for each species in Step 1 and at each monitor and for each quarter.

Step 3: Apply the component specific RRF from Step 2 to the observed quarterly weighted average concentrations from Step 1 to obtain projected quarterly species concentrations.

Step 4: Use the online E-AIM model (http://www.aim.env.uea.ac.uk/aim/aim.php) to calculate future year particle-bound water for each quarter at each monitor based on projected ammonium sulfate and ammonium nitrate concentrations.

Step 5: The projected concentration for each quarter is summed over all species, including particle bound water from Step 4, as well as a blank mass of 0.2 µg/m^3 to obtain the future quarterly average $PM_{2.5}$ concentration. Finally, the future annual $PM_{2.5}$ DVs are calculated as the average of the projected $PM_{2.5}$ concentrations from the four quarters. If the projected annual DV is ≤ NAAQS, then the attainment test is passed.

III. Meteorological Modeling

California's proximity to the ocean, complex terrain, and diverse climate pose unique challenges for developing meteorological fields. These fields must adequately represent the synoptic and mesoscale features of the regional meteorology. In summertime, the majority of the storm tracks are far to the north of the state and a semi-permanent Pacific high typically sits off the California coast. Interactions between this eastern Pacific subtropical high pressure system and the thermal low pressure further inland over the Central Valley or South Coast lead to conditions conducive to pollution buildup (Fosberg and Schroeder, 1966; Bao et al., 2008). In wintertime, periods of high atmospheric pressure bring light winds and, sometimes, low solar insolation (Daly et al. 2009) to the Central Valley. Because of the topographical features surrounding San Joaquin Valley, under such conditions, a layer of cold and wet air can be overlaid by warm air aloft creating strong and long-lasting stagnation in the area (Whiteman et al. 2001). It is under such conditions that high surface particulate matter concentrations typically occur (Gillies et al. 2010; Baker et al. 2011).

In the past, CARB has utilized both prognostic and diagnostic meteorological models, as well as hybrid approaches in an effort to develop meteorological fields for use in air quality modeling that most accurately represent the meteorological processes which are important to air quality (e.g., Jackson et al., 2006). In this work, the state-of-the-science Weather Research and Forecasting (WRF) prognostic model (Skamarock, et al. 2021)

4.2.1 was utilized to develop the meteorological fields used in the subsequent photochemical model simulations.

A. WRF Model Setup

The WRF modeling domain consisted of three nested Lambert projection grids of 36 km (D01), 12 km (D02), and 4 km (D03) uniform horizontal grid spacing as shown in Figure 6. The 4 km innermost domain has 427x427 grid points and spans 1748 km in the east-west and the north-south directions. All three domains utilized 30 vertical sigma layers with the lowest layer extending to 30 m above the surface (Table 10). The North America Regional Reanalysis (NARR) fields, enhanced with surface and upper-air observations, were used for initial and boundary conditions as well as Four Dimension Data Assimilation (FDDA) on the outermost (36 km) domain. The horizontal spatial resolution of the NARR data is 32 km. The major physics options for each domain are listed in Table 11, which include the Yon-Sei University (YSU) planetary boundary layer (PBL) scheme, Kain-Fritsch cumulus parameterization for the outer two domains, and 5-layer thermal diffusion land-surface option.

Figure 6. WRF modeling domains (D01 36 km; D02 12 km; and D03 4 km).

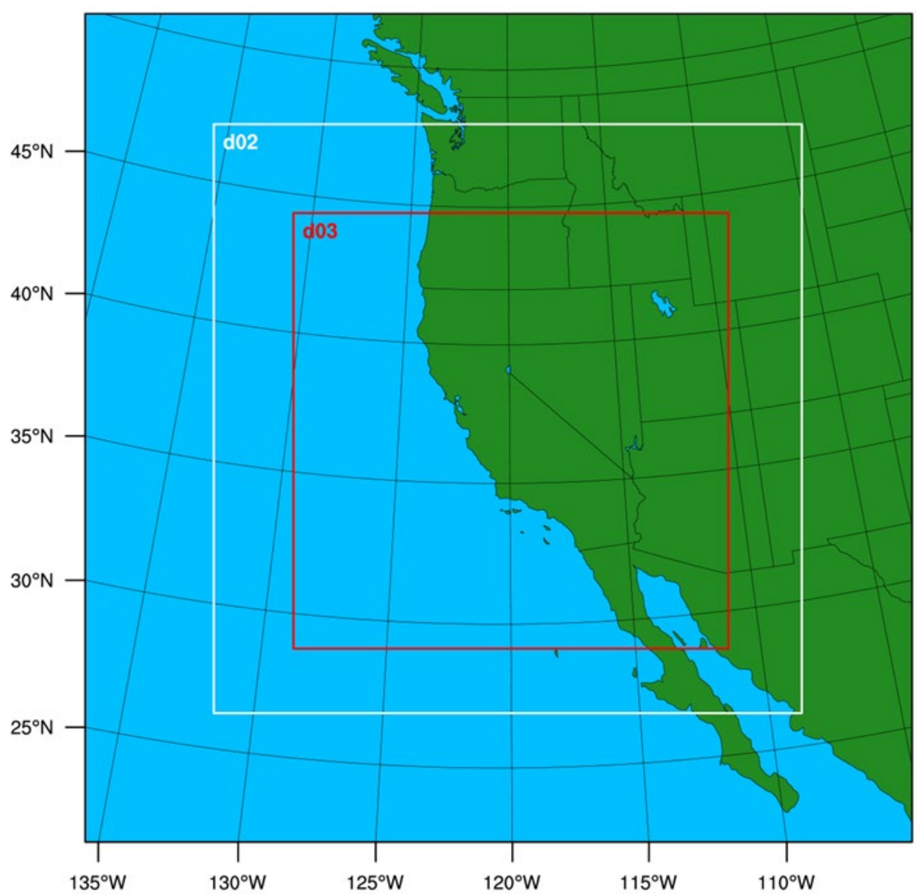


Table 10. WRF vertical layer structure.

Layer Number	Height (m)	Layer Thickness (m)	Layer Number	Height (m)	Layer Thickness (m)
30	16082	1192	15	2262	403
29	14890	1134	14	1859	334
28	13756	1081	13	1525	279
27	12675	1032	12	1246	233
26	11643	996	11	1013	194
25	10647	970	10	819	162
24	9677	959	9	657	135
23	8719	961	8	522	113
22	7757	978	7	409	94
21	6779	993	6	315	79
20	5786	967	5	236	66
19	4819	815	4	170	55
18	4004	685	3	115	46
17	3319	575	2	69	38
16	2744	482	1	31	31

To prevent any large deviations from the reanalysis data, analysis nudging was applied to the outermost domain (D01) above the planetary boundary layer (PBL) for moisture and above 2 km for wind and temperature. No nudging was used on the two inner domains to allow the model physics to work fully without externally imposed forcing. Boundary conditions on the outermost domain were updated every 6 hours, while WRF was reinitialized every 6 days with one day overlap, where the first day after being reinitialized was discarded as model spin-up. The Meteorology-Chemistry Interface

Processor (MCIP) version 5.3.3 was used to process the 4 km (D03) WRF output for use in the CTM simulations.

Table 11. WRF Physics options.

Physics Option	D01 (36 km)	D02 (12 km)	D03 (4 km)
Microphysics	WSM 6-class	WSM 6-class	WSM 6-class
Longwave Radiation	RRTM	RRTM	RRTM
Shortwave Radiation	Dudhia	Dudhia	Dudhia
Surface Layer	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov
Land Surface	5-layer Thermal Diffusion	5-layer Thermal Diffusion	5-layer Thermal Diffusion
Planetary Boundary Layer	YSU	YSU	YSU
Cumulus Parameterization	Kain-Fritsch Scheme	Kain-Fritsch Scheme	No

B. WRF Model Results and Evaluation

WRF simulated surface wind speed, temperature, and relative humidity from the 4 km domain were validated against hourly observations at 78 surface stations in the SJV. Observational data for the surface stations were obtained from CARB's archived meteorological database http://www.arb.ca.gov/aqmis2/aqmis2.php). Table 12 lists the observational stations and the parameters measured at each station, including wind speed and direction (wind), temperature (T) and relative humidity (RH). The location of each of these sites is shown in Figure 7. Quarterly and annual quantitative performance metrics for 2017 were used to compare hourly surface observations and modeled estimates: mean bias (MB), mean error (ME) and index of agreement (IOA) based on recommendations from Simon et al. (2012). A summary of these statistics by performance region is shown in Table 13 through Table 17. The performance regions cover roughly the Modesto, Fresno, Visalia, and Bakersfield regions, as well as one for the entire San Joaquin Valley (SJV), respectively. The region around Modesto includes sites 5737, 2833, and 2080. The region surrounding Fresno encompasses sites 5741, 2449, 2013, and 2844. The region around Visalia includes sites 2032, 5386, and 3250, while the region covering Bakersfield includes sites 5287 and 3146 (note that no wind data available at these two sites for the 4th quarter in 2017). Model performance statistical metrics were calculated using all available data. All the sites in the valley are included in the SJV performance region (in addition to the sites mentioned above). The distribution of daily mean bias and mean error are shown in Figure 8 and Figure 9. Figure 10 and Figure 11 show observed vs. modeled scatter plots.

The wind speed biases were positive in each quarter of 2017 from a valley-wide perspective, as well as over the four performance regions. The wind speed mean biases are mostly less than 0.7 m/s in all performance regions. The annual temperature biases are within -1.5 K over the entire SJV and in three of the four performance regions (i.e., Modesto, Fresno and Visalia); whereas the annual temperature bias is -2.09 K in Bakersfield. Temperature biases show seasonal patterns in all performance regions, with higher biases during the second and third quarter of 2017 and lower biases during the first and fourth quarter. The higher temperature biases during spring and summer are likely related to the difficulty in accurately representing irrigation in the WRF model. Irrigation in SJV is most likely to occur during the spring and summer (i.e. the growing season) due to the fact that the maximum precipitation occurs in winter and the minimum precipitation occurs in summer. Simulated temperature is generally in good agreement with the observations in almost all regions with the index of agreement (IOA) above 0.90 (1.0 represents perfect agreement). Relative humidity biases are positive in all performance regions. The annual bias values range from 8.19% to 19.63%, with the largest bias occurring in Bakersfield. These results are comparable to other recent WRF modeling efforts in California investigating ozone formation in Central California (e.g., Hu et al., 2012) and modeling analysis for the CalNex and CARES field studies (e.g., Fast et al., 2012; Baker et al., 2013; Kelly et al., 2014; Angevine et al., 2012). Detailed hourly time-series of surface temperature, relative humidity, wind speed, and wind direction for SJV for each month of 2017 can be found in the supplementary material. Spatial distribution of 2017 quarterly mean bias and mean error of these parameters are also shown in the supplementary material. In addition, model simulated hourly precipitation are compared to observations. Stations with precipitation data are limited during this period, therefore, comparison results at Modesto, Fresno and Belridge are shown here to represent northern, central and southern part of SJV, respectively. Time series plots at these three sites for wetter months (i.e., January to March and November to December) are shown in the supplementary material. Model comparison to observations suggests that both the timing and amount of precipitation are simulated reasonably well by WRF over SJV.

Figure 7. Meteorological observation sites in San Joaquin Valley. The numbers correspond to the sites listed in Table 12.

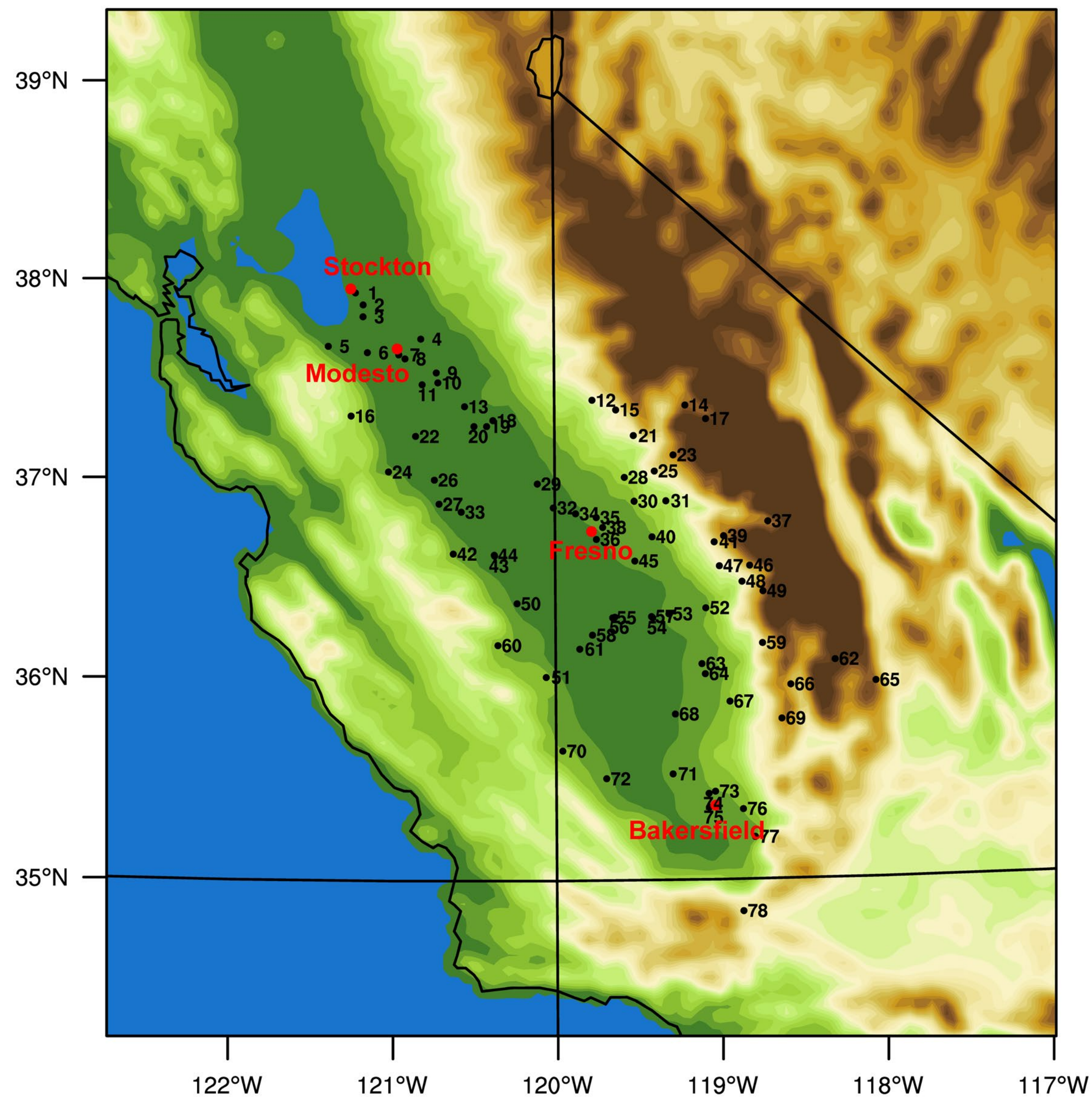


Table 12. Meteorological monitor location and parameter(s) measured. Sites are shown in Figure 7.

Site Number	Site ID	Site Name	Parameter(s) Measured
1	2094	Stockton-Hazelton Street	Wind, T, RH
2	5362	Stockton Metropolitan Airport	T, RH
3	5736	Manteca	Wind, T, RH
4	5831	Oakdale #2	Wind, T, RH
5	3696	Tracy-Airport	Wind, T
6	5737	Modesto #3	Wind, T, RH
7	2833	Modesto-14th Street	Wind, T, RH
8	2080	Modesto City - County Airport-Sham Field	T, RH
9	7233	Denair II	Wind, T, RH
10	3303	Rose Peak	Wind, T, RH
11	2996	Turlock-S Minaret Street	Wind, T
12	3344	Metcalf Gap	Wind, T, RH
13	2814	Merced-Castle Air Force Base	T, RH
14	3570	Mount Tom (FTS)	Wind, T, RH
15	3582	Batterson	Wind, T, RH
16	3526	Diablo Grande	Wind, T, RH
17	3510	High Sierra	Wind, T, RH
18	5793	Merced	Wind, T, RH
19	3022	Merced-S Coffee Avenue	Wind, T

Site Number	Site ID	Site Name	Parameter(s) Measured
20	5318	Merced Municipal Airport	T, RH
21	3455	North Fork	Wind, T, RH
22	5752	Kesterson	Wind, T, RH
23	3649	Shaver #2	Wind, T, RH
24	3307	Los Banos	Wind, T, RH
25	3638	Mountain Rest (FTS)	Wind, T, RH
26	5730	Los Banos #2	Wind, T, RH
27	5770	Panoche	Wind, T, RH
28	3522	Hurley 1	Wind, T, RH
29	5317	Madera Municipal Airport	T, RH
30	3346	Fancher Creek	Wind, T, RH
31	3535	Trimmer (FTS)	Wind, T, RH
32	3211	Madera-Pump Yard	Wind, T, RH
33	5711	Firebaugh - Telles	Wind, T, RH
34	2844	Fresno-Sierra Skypark #2	Wind, T
35	5741	Fresno State #2	Wind, T, RH
36	2013	Fresno-Drummond Street	Wind, T
37	3550	Cedar Grove	Wind, T, RH
38	2449	Fresno-Fresno Air Terminal	T, RH
39	3534	Park Ridge	Wind, T, RH
40	5787	Orange Cove	Wind, T, RH

Site Number	Site ID	Site Name	Parameter(s) Measured
41	3523	Pinehurst	Wind, T, RH
42	3309	Panoche Road	Wind, T, RH
43	3759	Tranquillity-32650 West Adams Avenue	Wind, T
44	5757	Westlands	Wind, T, RH
45	5723	Parlier #2	Wind, T, RH
46	3036	Sequoia Natl Park-Lower Kaweah	Wind, T, RH
47	3349	Shadequarter	Wind, T, RH
48	3484	Sequoia and Kings Canyon Natl Park	Wind, T, RH
49	3533	Wolverton	Wind, T, RH
50	5828	Five Points SW	Wind, T, RH
51	3330	Kettleman Hills	Wind, T, RH
52	5746	Lindcove	Wind, T, RH
53	2032	Visalia-N Church Street	Wind, T, RH
54	3250	Visalia-Airport	Wind, T, RH
55	3129	Hanford-S Irwin Street	Wind, T
56	5308	Hanford Municipal Airport	T, RH
57	5386	Visalia Municipal Airport	T, RH
58	3712	Santa Rosa Rancheria-17225 Jersey	Wind, T
59	3457	Oak Opening	Wind, T, RH
60	6028	Coalinga-CIMIS	Wind, T, RH

Site Number	Site ID	Site Name	Parameter(s) Measured
61	5715	Stratford #2	Wind, T, RH
62	3519	Blackrock	Wind, T, RH
63	5812	Porterville #3	Wind, T, RH
64	5351	Porterville Municipal Airport	T, RH
65	3543	Whittier Hills	Wind, T, RH
66	3554	Johnsondale	Wind, T, RH
67	3350	Fountain Springs	Wind, T, RH
68	5823	Delano #2	Wind, T, RH
69	3476	UHL	Wind, T, RH
70	5729	Blackwells Corner	Wind, T, RH
71	5709	Shafter - USDA	Wind, T, RH
72	5791	Belridge	Wind, T, RH
73	2772	Oildale-3311 Manor Street	Wind, T, RH
74	5287	Meadows Field Airport	T, RH
75	3146	Bakersfield-5558 California Avenue	Wind, T, RH
76	2312	Edison	Wind, T, RH
77	5771	Arvin-Edison	Wind, T, RH
78	5414	Lebec	Wind, T

Table 13. Hourly surface wind speed (m/s), temperature (K) and relative humidity statistics (%) in Modesto.

Variable	Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
Wind Speed	Q1	2.32	3.06	0.74	1.08	0.82
Wind Speed	Q2	2.64	3.33	0.68	1.17	1.00
Wind Speed	Q3	2.07	2.51	0.44	0.89	0.77
Wind Speed	Q4	1.91	2.41	0.50	0.97	1.00
Wind Speed	Annual	2.23	2.82	0.59	1.02	1.00
Temperature	Q1	284.79	283.87	-0.92	1.55	0.95
Temperature	Q2	293.28	291.51	-1.77	2.22	0.96
Temperature	Q3	298.08	296.70	-1.38	2.34	0.94
Temperature	Q4	285.48	286.21	0.74	2.43	1.00
Temperature	Annual	290.43	289.60	-0.83	2.14	0.99
Relative Humidity	Q1	76.84	79.45	2.62	7.85	0.91
Relative Humidity	Q2	55.15	63.64	8.49	12.10	0.85
Relative Humidity	Q3	50.07	63.91	13.85	14.37	0.79
Relative Humidity	Q4	68.87	76.56	7.69	9.98	0.89
Relative Humidity	Annual	62.67	70.86	8.19	11.09	0.88

Table 14. Hourly surface wind speed (m/s), temperature (K) and relative humidity (%) statistics in Fresno.

Variable	Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
Wind Speed	Q1	1.60	2.24	0.64	0.92	0.74
Wind Speed	Q2	1.92	2.67	0.75	0.98	0.70
Wind Speed	Q3	1.85	2.02	0.16	0.82	0.99
Wind Speed	Q4	1.36	1.56	0.20	0.73	0.99
Wind Speed	Annual	1.68	2.12	0.44	0.86	0.99
Temperature	Q1	284.95	284.17	-0.79	1.52	0.96
Temperature	Q2	294.42	292.55	-1.86	2.11	0.97
Temperature	Q3	300.64	298.55	-2.1	2.53	0.93
Temperature	Q4	286.26	286.42	0.15	1.74	0.97
Temperature	Annual	291.60	290.45	-1.15	1.98	0.98
Relative Humidity	Q1	75.53	78.28	2.75	9.36	0.88
Relative Humidity	Q2	50.14	64.42	14.27	16.27	0.79
Relative Humidity	Q3	41.72	63.42	21.70	21.90	0.68
Relative Humidity	Q4	64.44	77.08	12.63	14.40	0.92
Relative Humidity	Annual	57.88	70.77	12.89	15.52	0.86

Table 15. Hourly surface wind speed (m/s), temperature (K) and relative humidity (%) statistics in Visalia.

Variable	Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
Wind Speed	Q1	1.38	2.03	0.65	0.91	0.65
Wind Speed	Q2	1.45	2.23	0.79	0.98	0.60
Wind Speed	Q3	1.23	1.85	0.62	0.89	0.47
Wind Speed	Q4	1.35	1.64	0.29	0.84	0.99
Wind Speed	Annual	1.35	2.00	0.64	0.92	0.99
Temperature	Q1	285.07	284.23	-0.84	1.62	0.95
Temperature	Q2	294.76	292.23	-2.52	2.68	0.95
Temperature	Q3	300.34	298.23	-2.10	2.73	0.90
Temperature	Q4	285.93	286.23	0.29	2.50	0.99
Temperature	Annual	291.58	290.28	-1.30	2.39	0.99
Relative Humidity	Q1	77.74	81.43	3.69	9.90	0.82
Relative Humidity	Q2	53.07	72.79	19.71	20.33	0.71
Relative Humidity	Q3	49.73	73.41	23.68	23.69	0.64
Relative Humidity	Q4	65.92	82.94	17.02	17.52	0.73
Relative Humidity	Annual	61.55	77.64	16.09	17.90	0.74

Table 16. Hourly surface wind speed (m/s), temperature (K) and relative humidity (%) statistics in Bakersfield (No wind data available for the 4th quarter).

Variable	Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
Wind Speed	Q1	1.17	1.70	0.53	0.89	0.99
Wind Speed	Q2	1.55	2.04	0.49	0.88	0.71
Wind Speed	Q3	1.29	1.58	0.29	0.67	0.78
Wind Speed	Q4	--	--	--	--	--
Wind Speed	Annual	1.34	1.80	0.45	0.83	0.99
Temperature	Q1	286.07	285.07	-1.00	1.88	0.94
Temperature	Q2	296.23	293.31	-2.91	3.07	0.94
Temperature	Q3	302.75	299.28	-3.47	3.58	0.86
Temperature	Q4	288.22	287.27	-0.95	1.97	0.96
Temperature	Annual	293.35	291.26	-2.09	2.63	0.96
Relative Humidity	Q1	68.86	74.76	5.90	11.81	0.79
Relative Humidity	Q2	42.06	64.45	22.39	22.83	0.62
Relative Humidity	Q3	36.02	65.70	29.68	29.72	0.74
Relative Humidity	Q4	54.58	74.85	20.27	21.21	0.68
Relative Humidity	Annual	50.30	69.93	19.63	21.44	0.75

Table 17. Hourly surface wind speed (m/s), temperature (K) and relative humidity (%) statistics in the San Joaquin Valley.

Variable	Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
Wind Speed	Q1	1.98	2.60	0.61	0.66	0.84
Wind Speed	Q2	2.15	2.77	0.62	0.66	0.79
Wind Speed	Q3	1.84	2.29	0.44	0.47	0.80
Wind Speed	Q4	1.53	1.97	0.45	0.50	0.81
Wind Speed	Annual	1.87	2.40	0.53	0.57	0.83
Temperature	Q1	283.16	282.63	-0.53	1.12	0.98
Temperature	Q2	292.39	290.37	-2.02	2.16	0.96
Temperature	Q3	298.35	296.01	-2.34	2.78	0.91
Temperature	Q4	285.33	285.35	0.02	1.91	0.96
Temperature	Annual	289.84	288.62	-1.22	2.00	0.97
Relative Humidity	Q1	76.57	73.82	-2.74	6.67	0.91
Relative Humidity	Q2	53.70	64.07	10.37	12.01	0.82
Relative Humidity	Q3	44.20	64.44	20.23	20.27	0.64
Relative Humidity	Q4	56.88	66.97	10.09	11.32	0.80
Relative Humidity	Annual	57.75	67.30	9.55	12.6	0.81

Figure 8. Distribution of model daily mean bias for Modesto, Fresno, Visalia, Bakersfield and SJV. Results are shown for wind speed (top), temperature (middle), and Relative Humidity (bottom).

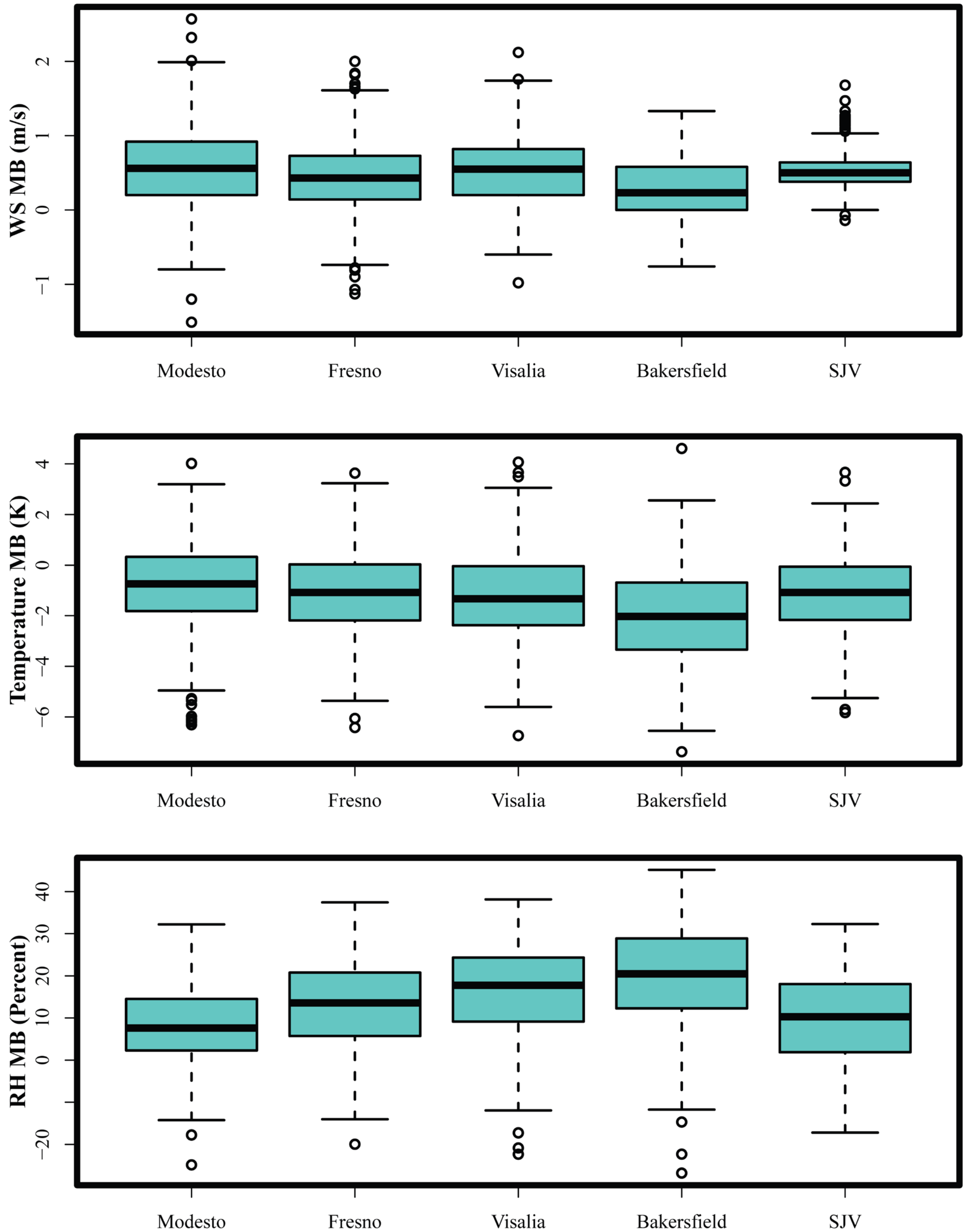


Figure 9. Distribution of model daily mean error for Modesto, Fresno, Visalia, Bakersfield and SJV. Results are shown for wind speed (top), temperature (middle), and Relative Humidity (bottom)

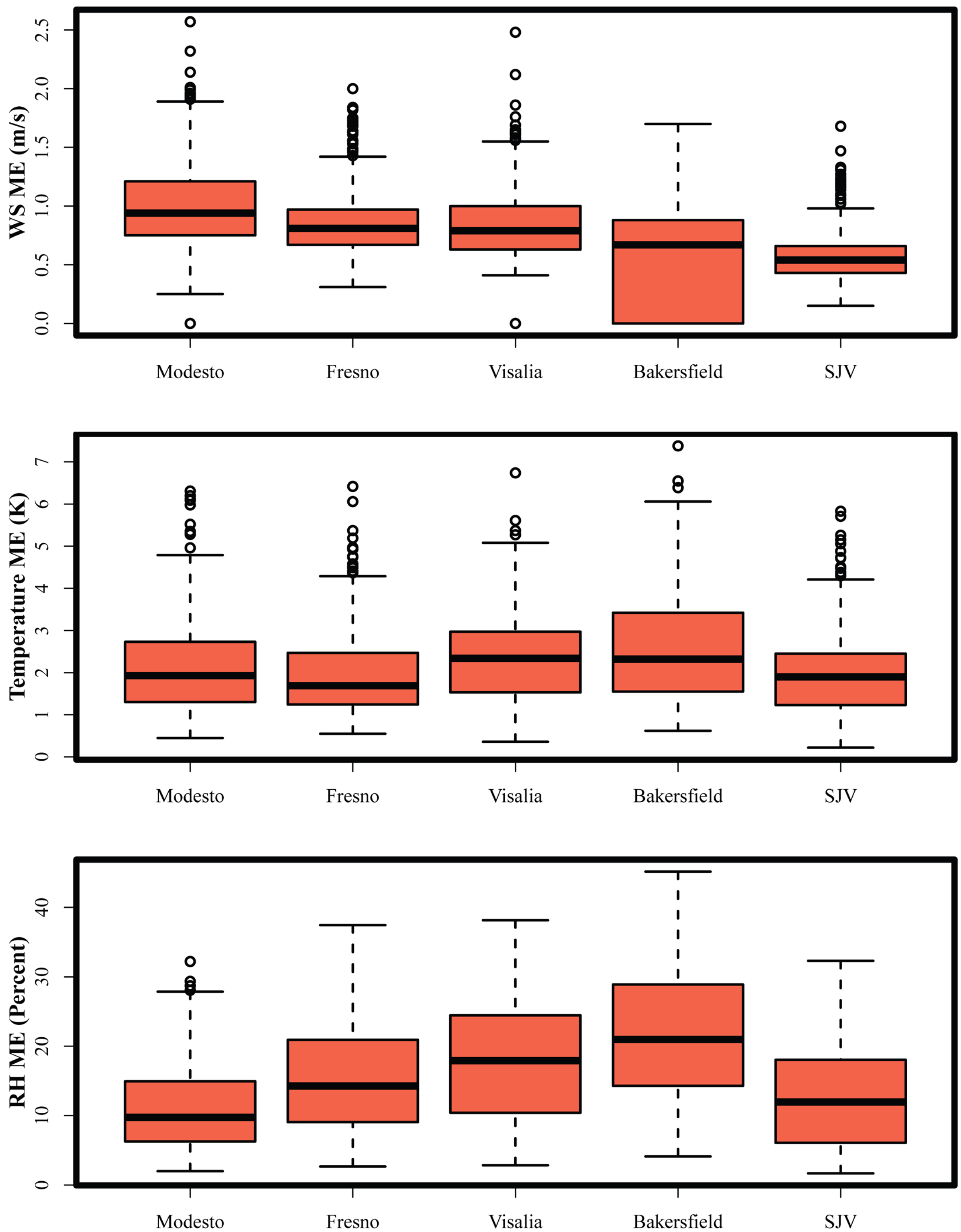


Figure 10. Comparison of modeled and observed hourly wind speed (left column), 2-meter temperature (middle column), and relative humidity (right column). Results for Modesto are shown in the top row, Fresno in the middle row, and Visalia in the bottom row.

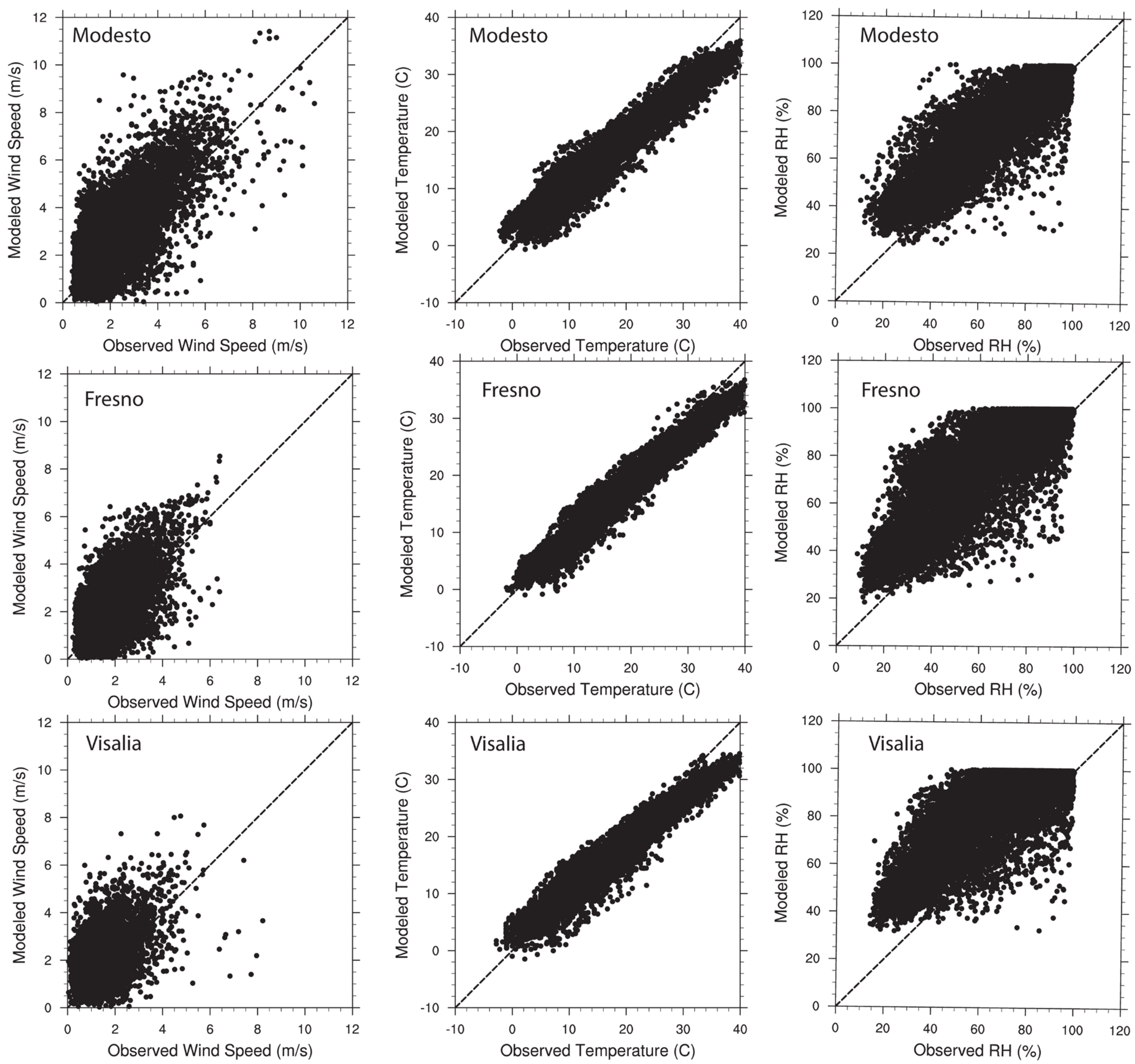
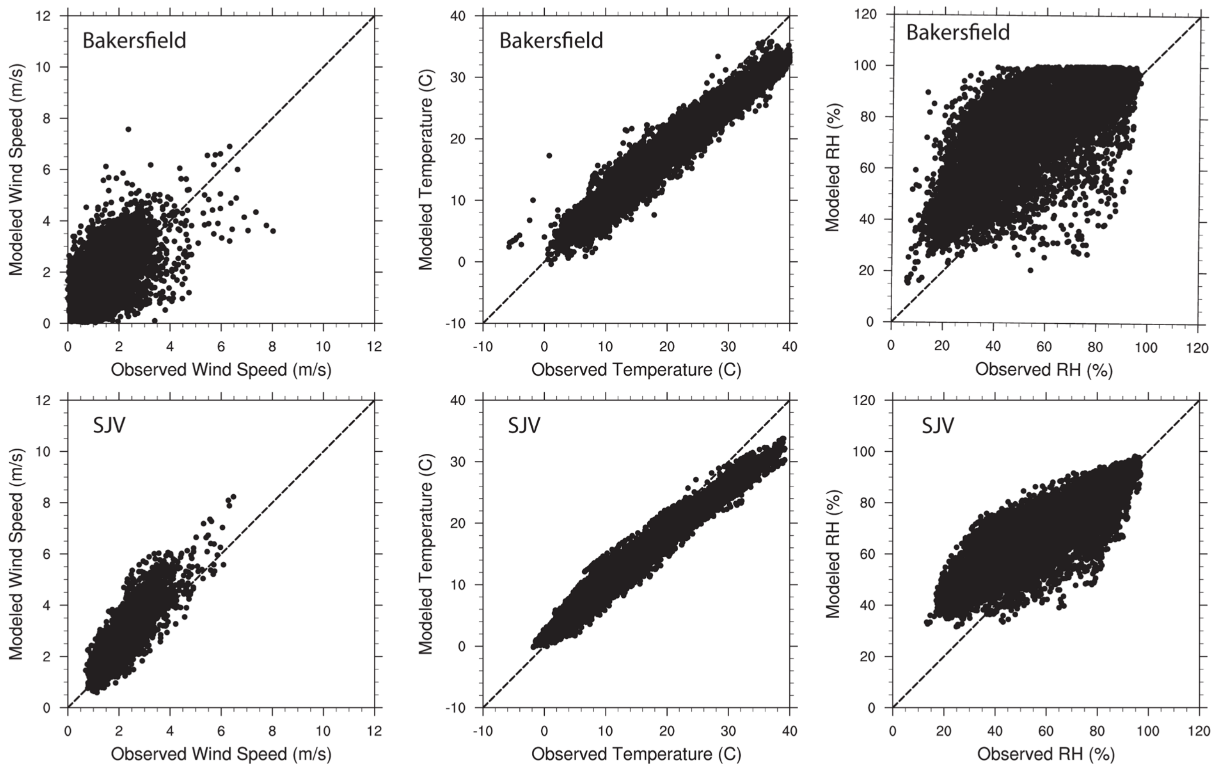


Figure 11. Comparison of modeled and observed hourly wind speed (left column), 2-meter temperature (middle column), and relative humidity (right column). Results for Bakersfield are shown in the top row and SJV in the bottom row.



C. Phenomenological Evaluation

Conducting a detailed phenomenological evaluation for all modeled days can be resource intensive given that the entire year was modeled. However, some insight and confidence that the model is able to reproduce the meteorological conditions leading to elevated particulate matter can be gained by investigating the meteorological conditions during a period of peak PM within the Valley in more detail. The highest $PM_{2.5}$-conducive meteorological conditions in the Valley occurred around December 28, 2017. Surface weather analysis shows that on December 28, the western US was under a typical Great Basin high pressure system. In the 500 hPa map (not shown), a strong high pressure system centered over the Pacific off the coast of California. The ridge associated with this high pressure system extends from Northern California along the west Pacific coast all the way to Alaska. As shown in Figure 12 through Figure 14, the winds are mainly offshore along the northern California coast. Under this type of weather system, conditions in SJV are driven by diurnal cycles of the local winds. Figure 12 and Figure 13 show that at 13:00 PST and 14:00 PST, December 28, the upslope flows along the eastern side of the Coastal Ranges and the western side of the Sierras, lead to a weak northwesterly flow on the floor of the valley. The downslope winds form at nighttime (Figure 14), which converge towards the valley and the winds in the center of the valley floor turn southeasterly. At the southern end of the valley, an eddy-like pattern occurs during nighttime due to the interaction of the katabatic flows. The surface wind distributions of the modeled and observed winds indicate the model was able to capture many of the important features of the meteorological fields in the SJV.

Figure 12. Surface wind field at 13:00 PST December 28, 2017.

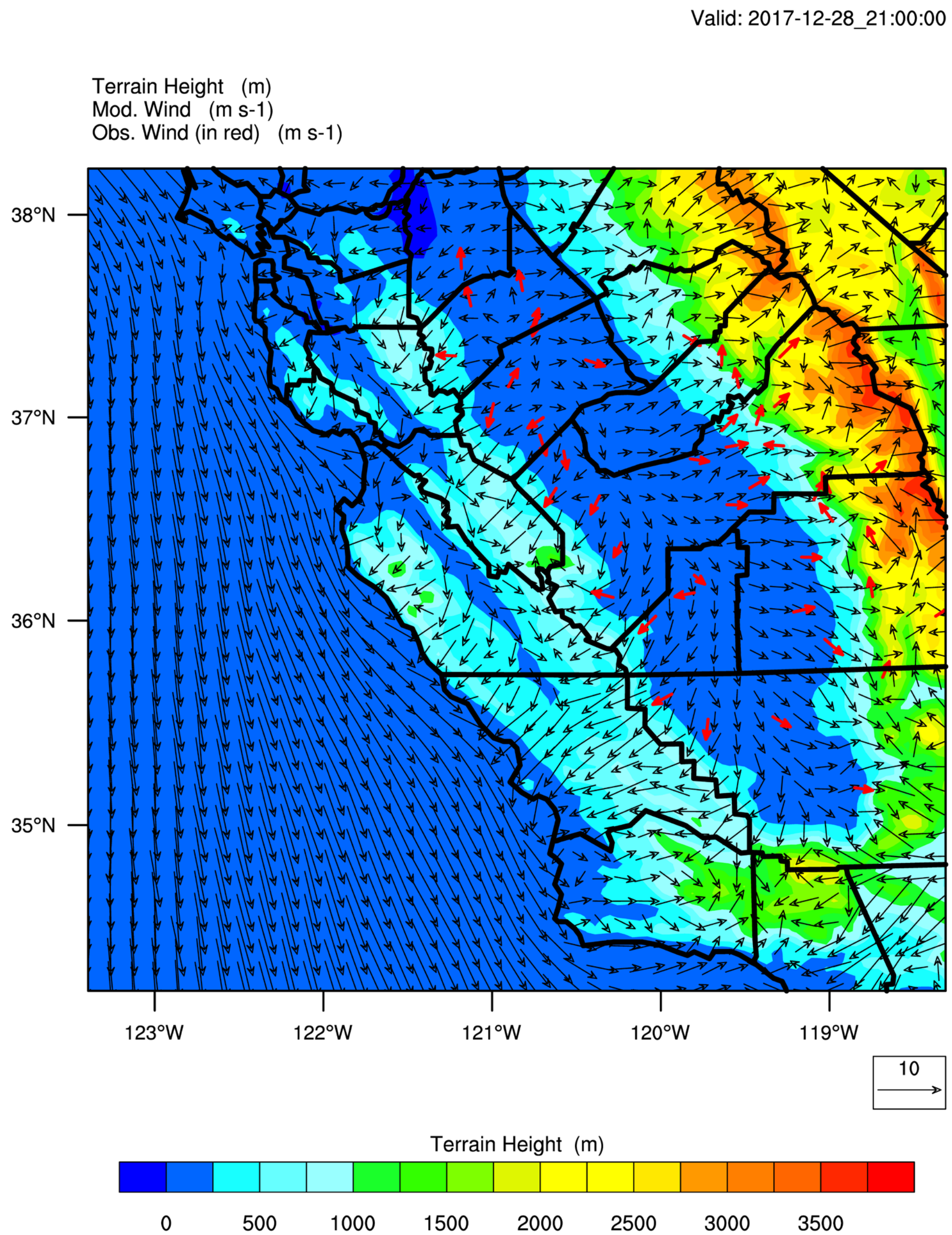


Figure 13. Surface wind field at 14:00 PST December 28, 2017.

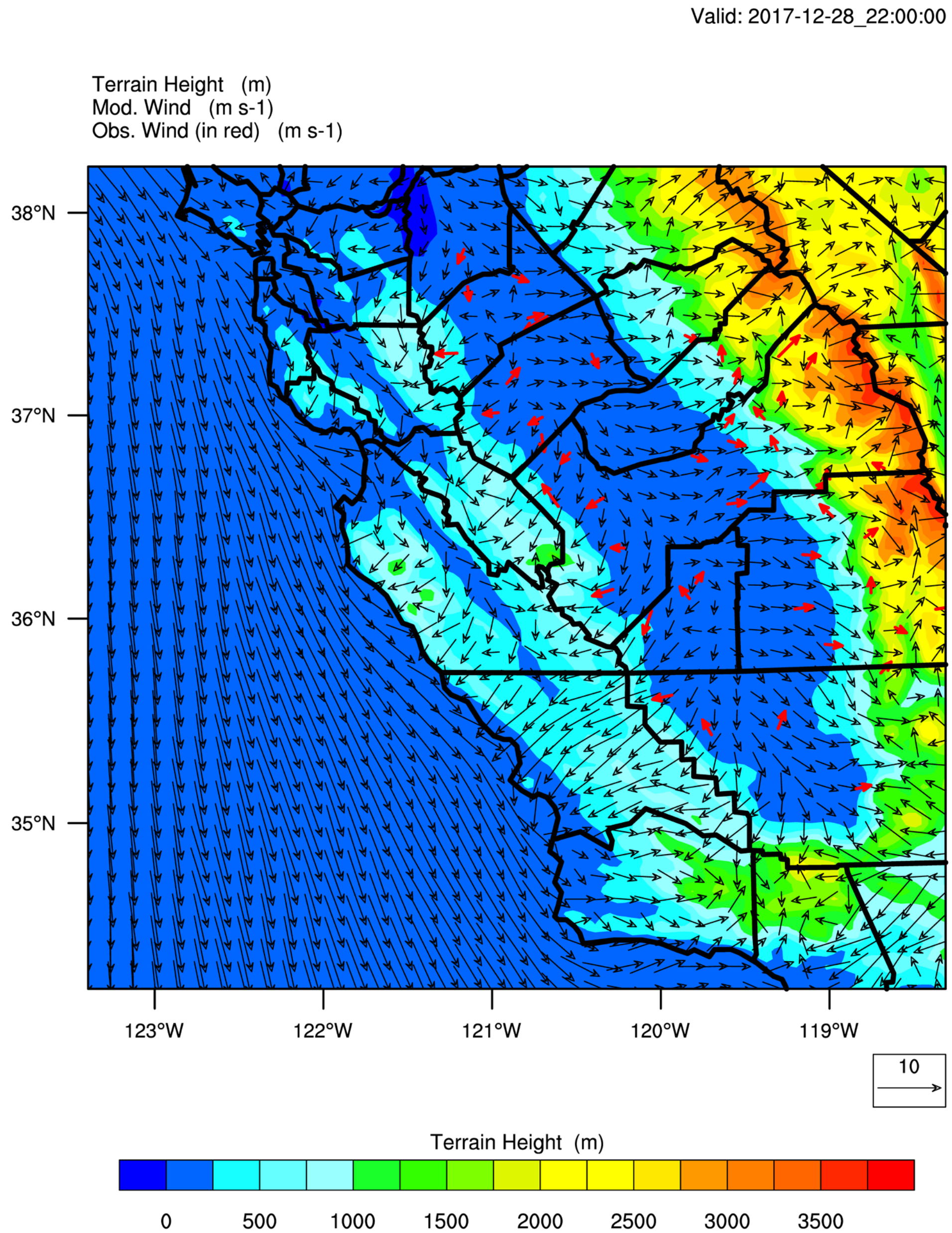
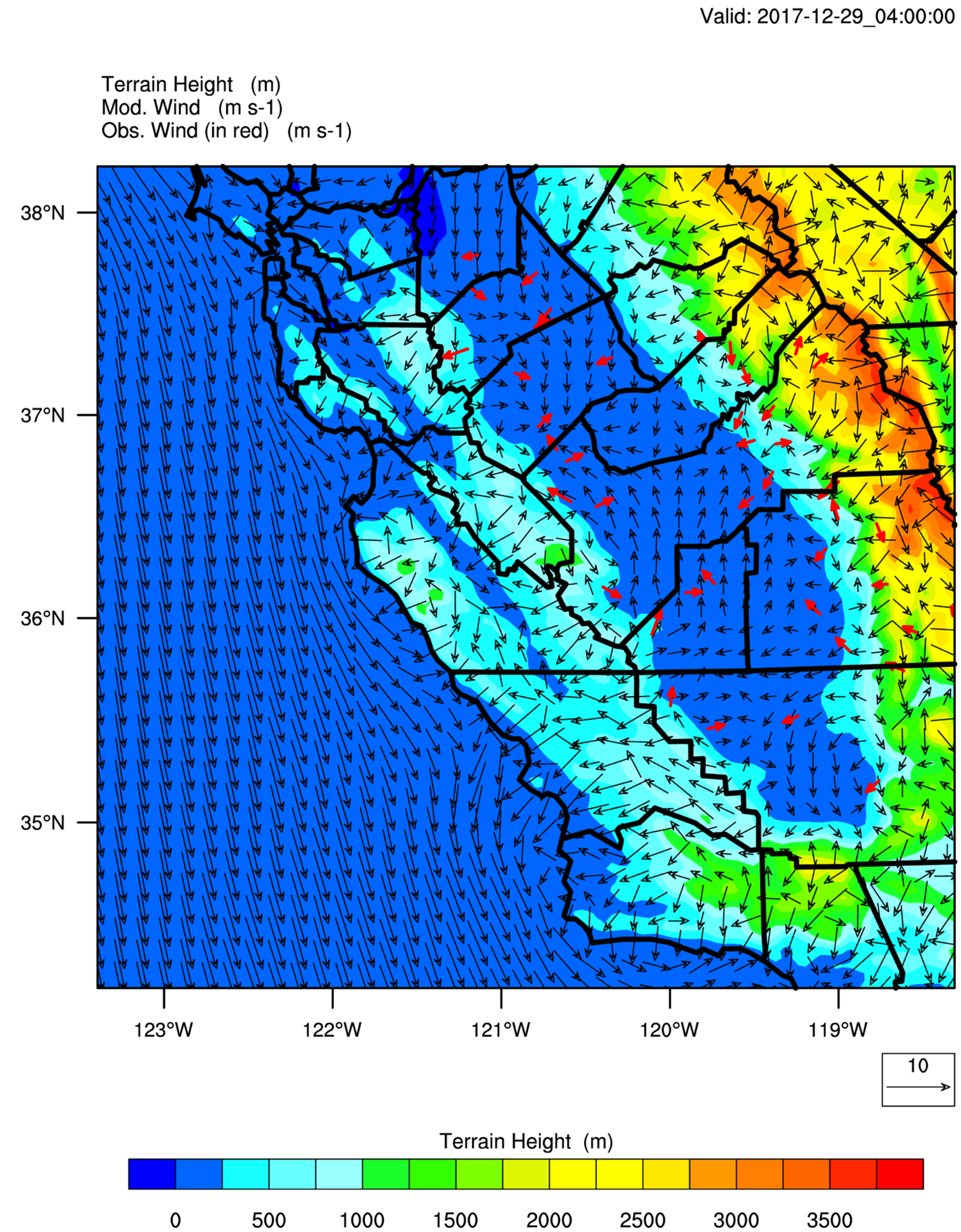


Figure 14. Surface wind field at 20:00 PST December 28, 2017.



IV. Emissions

The anthropogenic emissions inventory used in this modeling was based on the California Emissions Projection Analysis Model (CEPAM2019 v1.04). For a detailed description of the emissions inventory, updates to the inventory, and how it was processed from the planning totals to a gridded inventory for modeling, see the Modeling Emissions Inventory Appendix.

Table 18 summarizes the 2017, 2030 baseline and 2030 attainment anthropogenic emissions inventories for primary $PM_{2.5}$ and the four $PM_{2.5}$ precursors in the SJV, respectively. These emission totals are based on the model-ready emission inventory and are inherently different from the planning emission inventory because the model-ready inventory considers additional factors such as weekday/weekend differences in on-road mobile emissions, day-to-day changes in residential wood burning activity, and the effects of meteorology on ammonia emissions.

From 2017 to the 2030 attainment inventory, anthropogenic emissions in the SJV will drop approximately 64%, 12%, 19%, 2%, and 2% for NO_x, ROG, primary $PM_{2.5}$, sulfur oxides (SO_x), and ammonia (NH_3), respectively. Among these five precursors, anthropogenic NO_x emissions show the largest relative reduction, dropping from 216 tons/day in 2017 to 77 tons/day in 2030. Anthropogenic $PM_{2.5}$ emissions will drop from 62 tons/day to 50 tons/day, reflecting a 19% reduction from 2017 to 2030.

Additional emission reductions to achieve attainment in 2030 compared to 2030 baseline emissions are summarized in Table 19 for both NO_x and $PM_{2.5}$. As previously stated, the amount of reductions in Table 19 are based on the modeling inventory and therefore can appear different from the reductions based on the planning inventory. A description of these emission control measures (i.e., state SIP strategy for on-road and off-road mobile sources, extending RWC curtailment program through the end of March, and agricultural incentives) can be found in the SIP.

Table 18. SJV Model-Ready Annual Emissions for 2017, 2030 (baseline), and 2030 (attainment).*

	Source Category	Stationary	Area	On-road Mobile	Other Mobile	Total	Change from 2017 to 2030
2017 (ton/day)	NOx	22.9	12.0	95.3	86.0	216.2	
	ROG	89.0	159.9	27.7	42.4	319	
	PM2.5	7.9	44.9	2.6	6.1	61.5	
	SOx	5.1	0.3	0.6	0.2	6.2	
	NH_3	13.0	292.9	4.6	0.	310.5	
2030 baseline (ton/day)	NOx	18.5	6.0	20.3	53.3	98.1	-55%
	ROG	91.6	153.3	12.9	26.9	284.7	-11%
	PM2.5	6.8	38.2	1.4	4.1	50.5	-18%
	SOx	5.1	0.3	0.5	0.3	6.1	-2%
	NH_3	14.2	284.3	6.7	0.1	305.2	-2%
2030 attainment (ton/day)	NOx	18.1	5.3	16.8	37.2	77.4	-64%
	ROG	91.6	153.1	12.7	23.6	281.0	-12%
	PM2.5	6.8	38.0	1.3	3.5	49.6	-19%
	SOx	5.1	0.3	0.5	0.3	6.1	-2%
	NH_3	14.2	284.3	6.3	0.1	304.8	-2%

*: Note: emissions here are based on the model-ready inventory, which considers additional factors such as weekday/weekend difference in on-road mobile emissions. Therefore, emission values here may appear different from the planning inventory.

Table 19. Additional NOx and $PM_{2.5}$ emission reductions (tons/day) implemented in the 2030 attainment inventories.*

Emission control measures	NOx (tpd)	$PM_{2.5}$ (tpd)
State SIP strategy	17.83	0.66
Agricultural incentives (FARMER Program)	3.00	0.18
Extending district's RWC curtailment program through March 31	0.02	0.14

*: Note: emission reductions here are based on the model-ready inventory and can be different from reductions based on planning inventory presented in other documents.

Biogenic emissions were generated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN3.0) biogenics emissions model (https://bai.ess.uci.edu/megan). MEGAN3.0 incorporates a new pre-processor (MEGAN-EFP) for estimating biogenic emission factors based on available landcover and emissions data. The MEGAN3.0 default datasets for plant growth form, ecotype, and emissions were utilized. Leaf Area Index (LAI) for non-urban grid cells was based on the 8-day 500 m resolution MODIS Terra/AQUA combined product (MCD15A2H) for 2018 (https://earthdata.nasa.gov/). The LAI data was converted to LAIv, which represents the LAI for the vegetated fraction within each grid cell, by dividing the gridded MODIS LAI values by the Maximum Green Vegetation Fraction for each grid cell (https://climate.arizona.edu/data/LandCover/MGVF/Average.tif.zip). The MODIS LAI product does not provide information on LAI in urban regions, so urban LAIv was estimated from the US Forest Service's Forest Inventory and Analysis urban tree plot data, processed through the i-Tree v6 software (https://www.itreetools.org/tools/i-tree-eco). Peak summertime urban LAIv for SJV was estimated to be 5.0, and this peak value was adjusted for each 8-day MODIS period based on the relative change in non-urban MODIS LAI across the state. Hourly meteorology was provided by the 4 km WRF simulation described above, and all stress factor adjustments were turned off.

Monthly biogenic ROG totals for 2017 within the Valley are shown in Figure 15 (note that the same biogenic emissions were used in 2017 and 2030 modeling). Biogenic ROG emissions are highest in the summer at over 800 tons/day in July when temperature, insolation, and leaf area are generally at their peak. In addition to biogenic ROG emissions, the MEGAN model also estimates NOx emissions from soils using the Yienger and Levy scheme (Yienger and Levy, 1995), which accounts for natural emissions from soils as well as enhanced emissions from managed crop lands. Figure 16 shows the monthly average soil NOx emissions for 2017 from MEGAN. Soil NOx emissions are highest during summer months, where the emissions peaked at 33 tpd in July.

Figure 15. Monthly average biogenic ROG emissions for 2017.

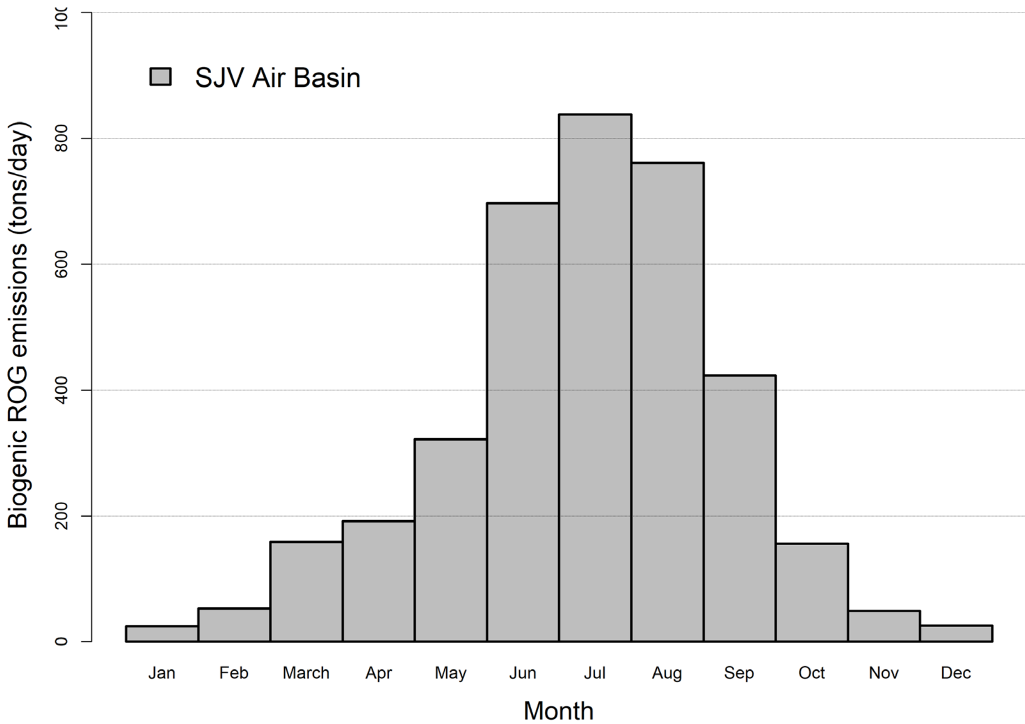
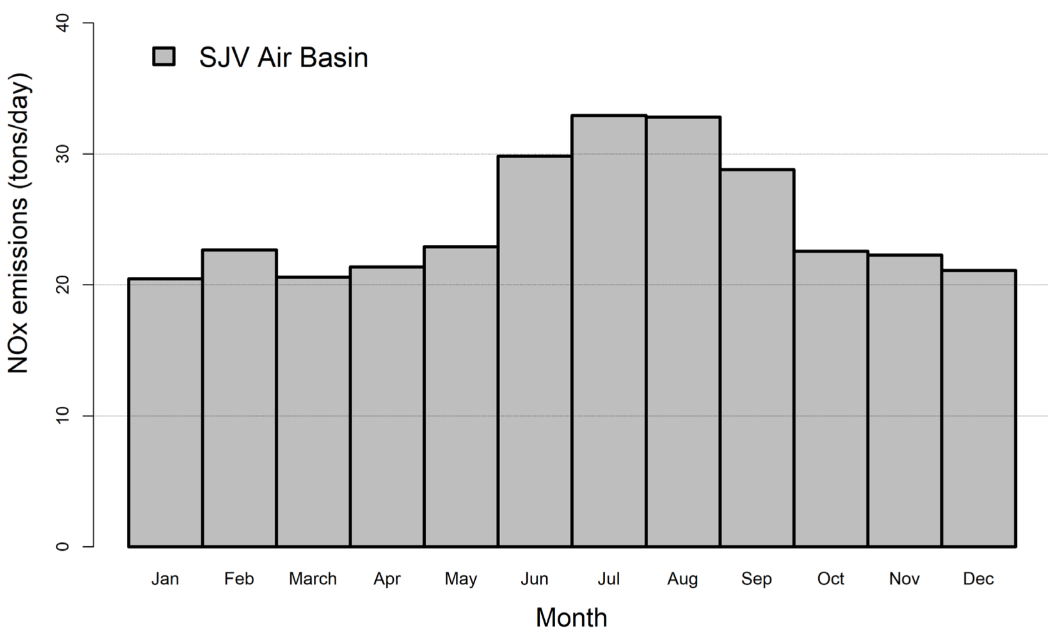


Figure 16. Monthly average soil NOx emissions for 2017.



V. $PM_{2.5}$ Modeling

A. CMAQ Model Setup

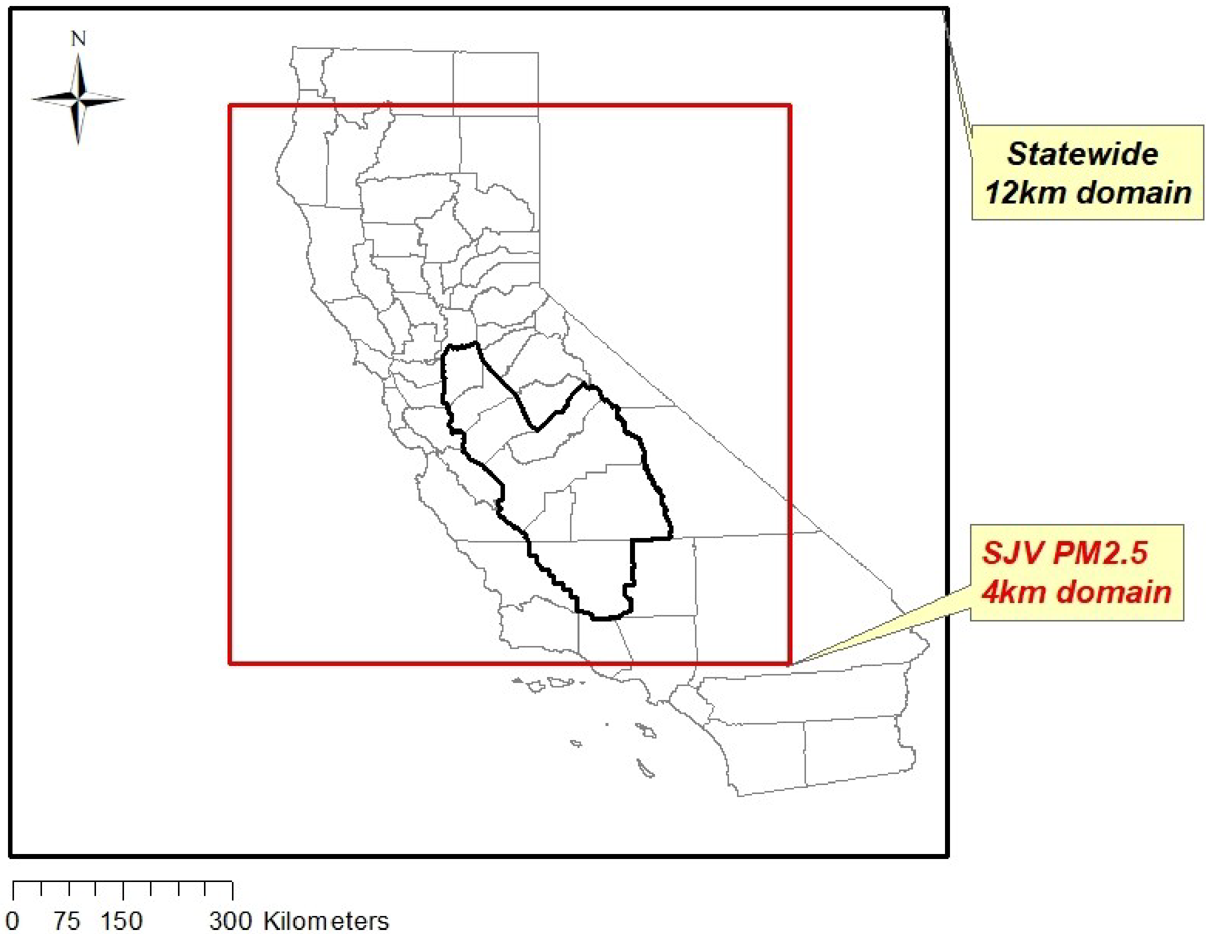
Figure 17 shows the CMAQ modeling domains used in this work. The larger domain covering all of California has a horizontal grid resolution of 12 km with 107 x 97 lateral grid cells for each vertical layer and extends from the Pacific Ocean in the west to Eastern Nevada in the east and runs from the U.S.-Mexico border in the south to the California-Oregon border in the north. The nested domain covering the SJV region has a finer scale 4 km grid resolution and includes 192 x 192 lateral grid cells. Both the 12 km and 4 km domains are based on a Lambert Conformal Conic projection with reference longitude at – 120.5ºN and 60ºN, which is consistent with the WRF domain settings. In addition, there are 30 vertical layers for CMAQ, consistent with the WRF model, which extends from the surface to 100 mb such that a majority of the vertical layers fall within the planetary boundary layer.

The CMAQ model version 5.3.3 (https://github.com/USEPA/CMAQ/releases/tag/CMAQv5.3.3_17Aug2021) was used for all air quality model simulations. CMAQ is the U.S. EPA's open-source regional air quality model, which is widely used in the regulatory and scientific communities and represents the current state-of-the-science. CMAQ has been utilized for studying ozone and $PM_{2.5}$ formation in California for over a decade (e.g., Cai et al., 2016, 2019; Jin et al., 2008, 2010; Kelly et al., 2010, 2014; Livingstone et al., 2009; Pun et al., 2009; Tonse et al., 2008; Vijayaraghavan et al., 2006; Zhang et al., 2010), and has been the primary CTM used in California SIPs since 2008 (SJV, 2008), having been used in over a dozen ozone and $PM_{2.5}$ SIPs (Eastern Kern, 2017, 2023; Imperial, 2017, 2018; Sacramento, 2017, 2023; SJV, 2012, 2013, 2016a,b, 2018, 2022; South Coast, 2012, 2016; Ventura, 2016; Western Mojave, 2016; Western Nevada, 2018).

The SAPRC07tic chemical mechanism (Carter, 2010a,b) was chosen to represent the gas-phase photochemistry in the atmosphere, along with the aero6 aerosol module for simulating aerosol dynamics and chemistry. Photolysis rates were calculated in-line to better represent changes in photolysis rates due to meteorological conditions and gaseous and particulate pollutant levels in the atmosphere. Other configurations are shown in Table 20. The same configuration was used for all simulations.

Annual simulations were conducted on a simultaneous month-by-month basis, rather than one single continuous simulation. For each month, the CMAQ simulations included a seven-day spin-up period (i.e., the last seven days of the previous month) for the outer 12 km domain, where initial conditions were set to the default CMAQ initial conditions. These outer domain simulations were used to provide lateral boundary conditions for the inner 4 km simulation, which also utilized a seven-day spin-up period.

Figure 17. CMAQ modeling domains utilized in the modeling assessment.



Chemical boundary conditions for the outer 12 km domain were extracted from the Goddard Earth Observing System (GEOS)-Chem model (https://geoschem.github.io/overview.html). The GEOS-Chem model was run internally for the year 2017 and output from GEOS-Chem was mapped to CMAQ model species using U.S. EPA's air quality model boundary condition tool available at https://github.com/barronh/aqmbc/. The same GEOS-Chem derived BCs for the 12 km outer domain were used in all simulations.

Table 20. CMAQ configuration and settings.

Process	Scheme
Horizontal advection	WRF-based scheme for mass-conserving advection
Vertical advection	WRF-based scheme for mass-conserving advection
Horizontal diffusion	Multi-scale
Vertical diffusion	ACM2 (Asymmetric Convective Model version 2)
Gas-phase chemical mechanism	SAPRC-07 gas-phase mechanism version "tic" with extended isoprene chemistry
Chemical solver	EBI (Euler Backward Iterative solver)
Aerosol module	Aero7 (the seventh-generation CMAQ aerosol mechanism)
Cloud module	ACM_AE7 (ACM cloud processor that uses the ACM methodology to compute convective mixing with heterogeneous chemistry for AERO7)
Photolysis rate	phot_inline (calculate photolysis rates in-line using simulated aerosols and ozone concentrations)

B. CMAQ Model Evaluation

CMAQ model performance was evaluated for $PM_{2.5}$ mass, individual $PM_{2.5}$ chemical species, as well as a number of gas-phase species based on observations from an extensive network of monitors in the SJV.

Time series of observed and modeled $PM_{2.5}$ chemical species based on $PM_{2.5}$ speciation measurements are shown in the supplemental material (Figures S24-27 of the supplemental materials for Bakersfield, Fresno, Modesto, and Visalia, respectively). $PM_{2.5}$ species are measured every 3 or 6 days at these sites. Observed $PM_{2.5}$ concentrations are higher in winter months and are much lower in summer months. During winter months, $PM_{2.5}$ in the SJV is dominated by ammonium nitrate and directly emitted OC. The CMAQ model was able to reasonably reproduce these key characteristics of $PM_{2.5}$ pollution in the SJV, including successfully capturing many elevated wintertime ammonium nitrate events, which is key for accurately simulating both peak wintertime $PM_{2.5}$ as well as annual average $PM_{2.5}$ in the SJV.

Table 21 to Table 24 summarize the key model performance metrics for major $PM_{2.5}$ chemical species at the four speciation sites. Model performance was evaluated on a quarterly basis for each species at each monitor. Average observations and modeled values, mean bias, mean error, mean fractional bias (MFB), and mean fractional error (MFE) are given for individual $PM_{2.5}$ species at these four sites. In general, model performance was similar at different monitors. Modeling somewhat over predicted $PM_{2.5}$ concentrations for quarter one, but slightly under predicted $PM_{2.5}$ concentrations for other quarters. Boylan and Russell (2006) proposed two criteria for model performance evaluation: Model performance goals are considered as the level of accuracy that is close to the best a model can be expected to achieve, while model performance criteria are considered as the level of accuracy that is acceptable for modeling applications. For more abundant species (e.g., concentrations ≥ 3 μg/m^3), model performance criteria are met when MFE ≤ 75% and MFB ≤ ±60%; model performance goals are met when MFE ≤ 50% and MFB ≤ ± 30%. For less abundant species, the performance criteria and goals are less stringent. A graphical representation of the quarterly MFB and MFE values in Tables 21-24 is shown in Figure 18 for each site, along with suggested model performance goals and criteria (green and red lines, respectively) from Boylan and Russell (2006). Based on these metrics, the current CMAQ modelling system met the model performance criteria and in many instances exceeded model performance goals.

Table 21. Quarterly $PM_{2.5}$ model performance based on $PM_{2.5}$ speciation measurement at Fresno - Garland.

Quarter	Species	# of Obs.	Avg. Obs. (μg/m^3)	Avg. Mod. (μg/m^3)	Mean bias (μg/m^3)	Mean error (μg/m^3)	MFB	MFE
1	$PM_{2.5}$	28	9.6	17.0	7.4	8.3	0.55	0.67
1	Ammonium	24	0.6	1.2	0.6	0.7	0.95	1.03
1	Nitrate	28	2.0	3.5	1.5	1.9	0.35	0.62
1	Sulfate	28	0.6	0.7	0.1	0.4	0.38	0.64
1	OC	28	2.7	5.4	2.8	3.0	0.58	0.70
1	EC	28	0.5	1.7	1.2	1.2	1.05	1.05
2	$PM_{2.5}$	31	7.2	7.2	0.0	2.2	-0.06	0.30
2	Ammonium	29	0.2	0.2	0.0	0.2	0.08	0.82
2	Nitrate	30	0.7	0.9	0.2	0.4	0.09	0.46
2	Sulfate	30	1.0	0.6	-0.4	0.4	-0.38	0.50

Quarter	Species	# of Obs.	Avg. Obs. (µg/m^3)	Avg. Mod. (µg/m^3)	Mean bias (µg/m^3)	Mean error (µg/m^3)	MFB	MFE
2	OC	30	2.1	1.7	-0.3	0.9	-0.28	0.46
2	EC	30	0.3	0.5	0.2	0.3	0.51	0.60
3	$PM_{2.5}$	30	12.1	10.7	-1.4	4.1	-0.20	0.37
3	Ammonium	30	0.3	0.2	-0.1	0.2	-0.39	0.97
3	Nitrate	30	0.6	0.8	0.1	0.5	-0.07	0.62
3	Sulfate	30	1.1	0.8	-0.3	0.4	-0.31	0.45
3	OC	30	3.9	3.1	-0.7	1.5	-0.35	0.52
3	EC	30	0.5	0.5	0.1	0.2	0.06	0.27
4	$PM_{2.5}$	31	29.3	27.0	-2.3	8.9	-0.01	0.36
4	Ammonium	30	2.6	2.3	-0.2	1.1	0.41	0.75
4	Nitrate	30	8.3	8.1	-0.2	2.9	0.21	0.52
4	Sulfate	30	0.9	1.1	0.1	0.4	0.16	0.44
4	OC	30	6.2	5.7	-0.5	2.1	-0.15	0.39
4	EC	30	1.6	1.8	0.2	0.6	0.04	0.39

Table 22. Quarterly $PM_{2.5}$ model performance based on $PM_{2.5}$ speciation measurement at Visalia.

Quarter	Species	# of Obs.	Avg. Obs. (µg/m^3)	Avg. Mod. (µg/m^3)	Mean bias (µg/m^3)	Mean error (µg/m^3)	MFB	MFE
1	$PM_{2.5}$	9	11.3	17.0	5.7	6.8	0.31	0.47
1	Ammonium	15	1.1	1.4	0.3	0.6	0.30	0.63

Quarter	Species	# of Obs.	Avg. Obs. (µg/m^3)	Avg. Mod. (µg/m^3)	Mean bias (µg/m^3)	Mean error (µg/m^3)	MFB	MFE
1	Nitrate	15	3.6	4.9	1.2	2.3	0.06	0.67
1	Sulfate	15	0.9	0.5	-0.5	0.5	-0.55	0.63
1	OC	15	3.3	3.5	0.1	1.2	-0.11	0.41
1	EC	15	0.5	1.1	0.6	0.7	0.59	0.74
2	$PM_{2.5}$	14	7.7	6.8	-1.0	1.7	-0.13	0.25
2	Ammonium	16	0.6	0.3	-0.3	0.3	-0.71	0.77
2	Nitrate	16	1.4	1.2	-0.2	0.5	-0.24	0.48
2	Sulfate	16	1.3	0.5	-0.8	0.8	-0.73	0.77
2	OC	16	2.3	1.1	-1.2	1.2	-0.70	0.70
2	EC	16	0.3	0.3	0.0	0.1	0.18	0.30
3	$PM_{2.5}$	14	15.2	13.5	-1.7	5.0	-0.19	0.37
3	Ammonium	16	0.8	0.4	-0.3	0.5	-0.74	0.92
3	Nitrate	16	1.6	1.6	0.0	1.1	-0.25	0.62
3	Sulfate	16	1.5	0.7	-0.8	0.8	-0.67	0.70
3	OC	16	4.8	3.2	-1.5	1.7	-0.46	0.51
3	EC	16	0.5	0.6	0.0	0.2	-0.02	0.30
4	$PM_{2.5}$	15	24.5	23.8	-0.7	7.1	0.04	0.37
4	Ammonium	14	3.1	2.7	-0.4	0.9	0.06	0.52
4	Nitrate	14	9.8	9.6	-0.2	2.3	0.14	0.52
4	Sulfate	14	1.1	0.7	-0.4	0.5	-0.34	0.45

Quarter	Species	# of Obs.	Avg. Obs. (μg/m^3)	Avg. Mod. (μg/m^3)	Mean bias (μg/m^3)	Mean error (μg/m^3)	MFB	MFE
4	OC	15	5.9	3.8	-2.2	2.2	-0.43	0.46
4	EC	15	1.1	1.2	0.1	0.3	0.06	0.34

Table 23. Quarterly $PM_{2.5}$ model performance based on $PM_{2.5}$ speciation measurement at Bakersfield.

Quarter	Species	# of Obs.	Avg. Obs. (μg/m^3)	Avg. Mod. (μg/m^3)	Mean bias (μg/m^3)	Mean error (μg/m^3)	MFB	MFE
1	$PM_{2.5}$	22	11.8	16.5	4.7	5.8	0.48	0.53
1	Ammonium	24	1.2	1.2	0.0	0.4	0.46	0.73
1	Nitrate	27	3.7	3.7	0.0	0.9	-0.05	0.33
1	Sulfate	27	0.9	0.6	-0.2	0.5	0.02	0.62
1	OC	24	3.0	5.4	2.5	2.5	0.59	0.61
1	EC	24	0.7	1.7	1.0	1.0	0.91	0.91
2	$PM_{2.5}$	29	8.6	7.0	-1.6	2.6	-0.22	0.36
2	Ammonium	28	0.4	0.2	-0.2	0.2	-0.32	0.80
2	Nitrate	29	0.9	0.8	-0.1	0.4	-0.13	0.58
2	Sulfate	29	1.1	0.6	-0.5	0.6	-0.50	0.64
2	OC	27	2.4	1.7	-0.7	0.7	-0.42	0.43
2	EC	27	0.4	0.5	0.1	0.2	0.36	0.52
3	$PM_{2.5}$	29	12.2	10.8	-1.4	4.1	-0.19	0.37
3	Ammonium	29	0.3	0.2	-0.1	0.2	-0.32	0.90

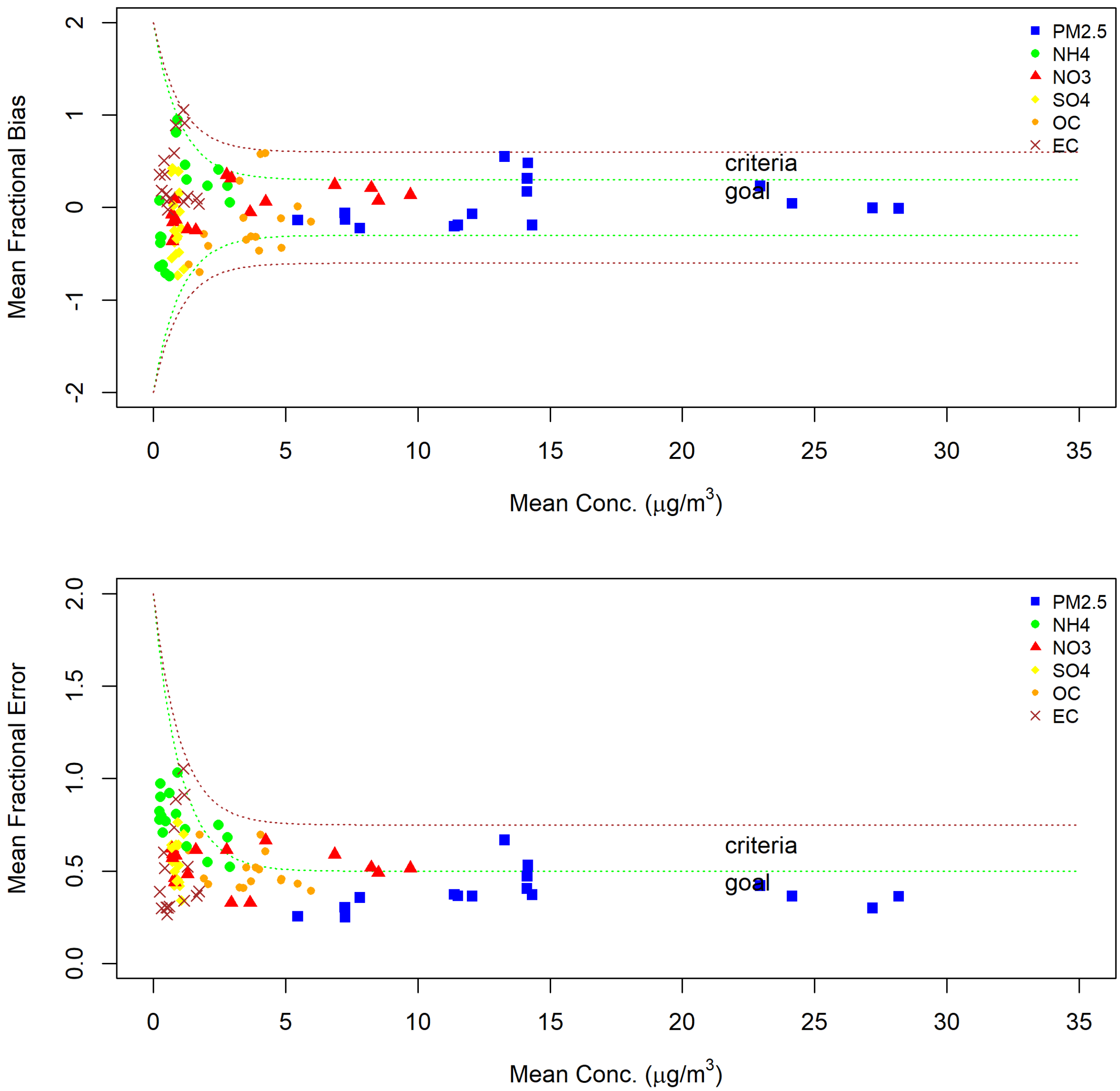
Quarter	Species	# of Obs.	Avg. Obs. ($\mu g/m^3$)	Avg. Mod. ($\mu g/m^3$)	Mean bias ($\mu g/m^3$)	Mean error ($\mu g/m^3$)	MFB	MFE
3	Nitrate	30	0.7	0.8	0.1	0.5	-0.16	0.59
3	Sulfate	30	1.2	0.7	-0.5	0.5	-0.48	0.53
3	OC	28	4.1	3.3	-0.8	1.5	-0.31	0.45
3	EC	28	0.6	0.6	0.1	0.2	0.10	0.31
4	$PM_{2.5}$	29	28.5	25.9	-2.6	7.9	0.00	0.30
4	Ammonium	25	3.1	2.6	-0.5	1.3	0.24	0.68
4	Nitrate	28	9.0	8.0	-1.0	3.2	0.08	0.49
4	Sulfate	28	1.1	0.9	-0.2	0.4	-0.04	0.42
4	OC	29	5.2	5.7	0.5	2.5	0.01	0.43
4	EC	29	1.5	1.8	0.3	0.6	0.10	0.37

Table 24. Quarterly $PM_{2.5}$ model performance based on $PM_{2.5}$ speciation measurement at Modesto.

Quarter	Species	# of Obs.	Avg. Obs. ($\mu g/m^3$)	Avg. Mod. ($\mu g/m^3$)	Mean bias ($\mu g/m^3$)	Mean error ($\mu g/m^3$)	MFB	MFE
1	$PM_{2.5}$	16	11.7	16.6	5.0	6.1	0.17	0.41
1	Ammonium	7	0.6	1.1	0.6	0.6	0.81	0.81
1	Nitrate	7	2.4	3.5	1.2	1.2	0.31	0.33
1	Sulfate	7	0.6	0.9	0.3	0.4	0.42	0.55
1	OC	7	2.7	3.8	1.1	1.5	0.29	0.41
1	EC	7	0.5	1.2	0.7	0.7	0.89	0.89

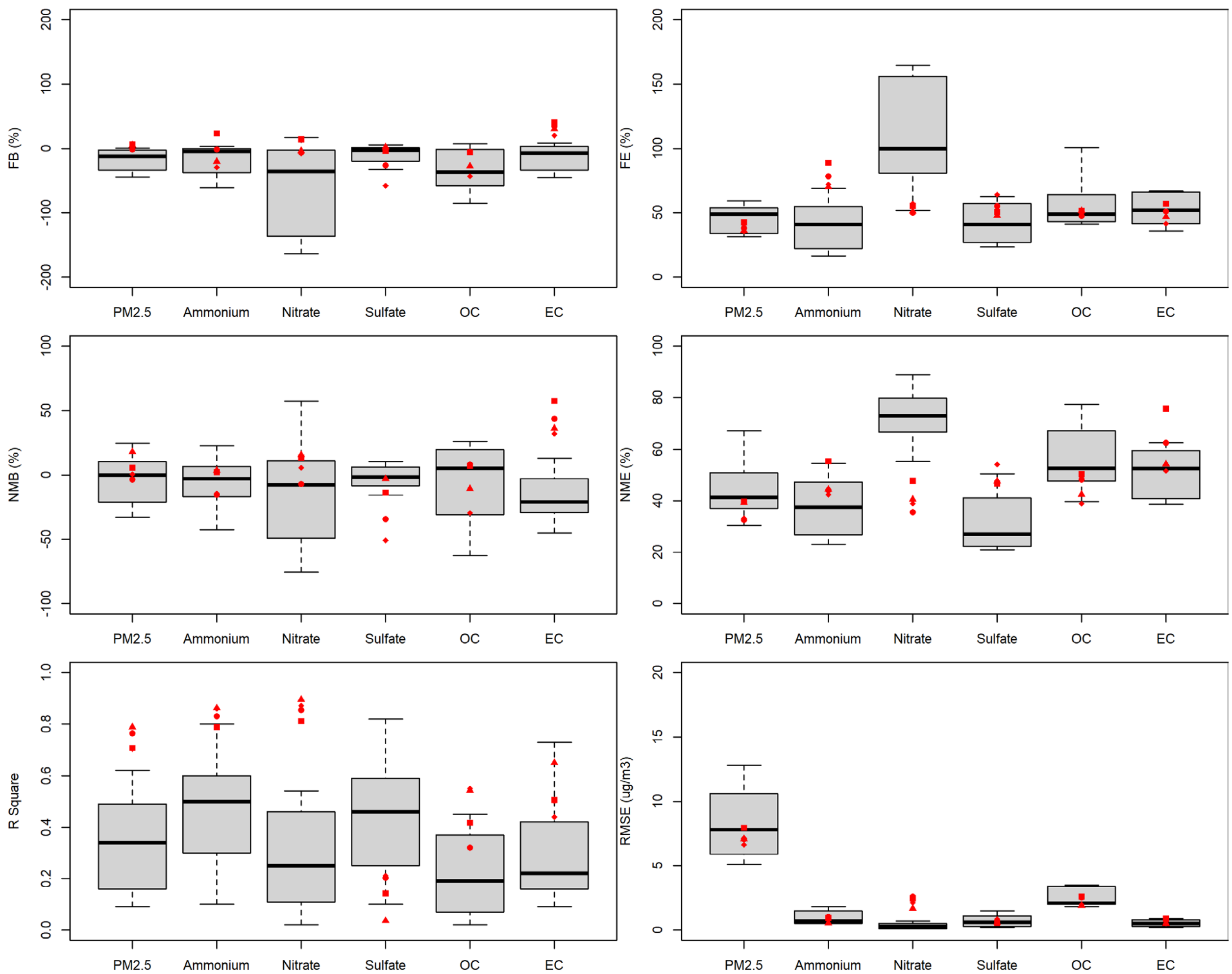
Quarter	Species	# of Obs.	Avg. Obs. (μg/m^3)	Avg. Mod. (μg/m^3)	Mean bias (μg/m^3)	Mean error (μg/m^3)	MFB	MFE
2	$PM_{2.5}$	17	5.9	5.0	-0.9	1.5	-0.14	0.26
2	Ammonium	17	0.3	0.2	-0.1	0.2	-0.64	0.78
2	Nitrate	17	0.8	0.6	-0.3	0.4	-0.36	0.57
2	Sulfate	17	0.9	0.7	-0.2	0.3	-0.25	0.42
2	OC	17	1.7	1.0	-0.8	0.8	-0.61	0.61
2	EC	17	0.2	0.3	0.1	0.1	0.35	0.39
3	$PM_{2.5}$	15	12.1	12.0	-0.1	4.7	-0.07	0.37
3	Ammonium	15	0.5	0.3	-0.2	0.2	-0.62	0.71
3	Nitrate	15	0.8	0.8	0.0	0.4	-0.12	0.44
3	Sulfate	15	1.2	0.9	-0.3	0.4	-0.23	0.34
3	OC	15	4.3	3.4	-0.9	1.8	-0.32	0.52
3	EC	15	0.5	0.5	0.1	0.1	0.15	0.30
4	$PM_{2.5}$	16	20.4	25.5	5.0	7.3	0.23	0.42
4	Ammonium	15	1.9	2.1	0.2	0.6	0.23	0.55
4	Nitrate	15	6.3	7.4	1.2	2.3	0.24	0.59
4	Sulfate	15	0.8	1.1	0.3	0.6	0.39	0.64
4	OC	15	4.8	4.8	0.0	1.9	-0.12	0.45
4	EC	15	1.2	1.4	0.3	0.6	0.12	0.52

Figure 18. Bugle plot of quarterly $PM_{2.5}$ model performance in terms of MFB and MFE at the four $PM_{2.5}$ speciation sites in the SJV (i.e., Bakersfield, Fresno, Modesto, and Visalia).



In addition to evaluating the standard statistical performance metrics, it is also informative to put these performance statistics in the context of other studies published in the scientific literature. Figure 19 compares key performance statistics from the modeling platform presented in this document to the range of published performance statistics from 2006 to 2012 and summarized in Simon et al. (2012). In Figure 19, the black centerline shows the median value (i.e., median model performance) from those studies, the boxes outline the 25th and 75th percentile values, and the whiskers show the 10th and 90th percentile values.

Figure 19. Comparison of annual $PM_{2.5}$ model performance to other modeling studies in Simon et al. (2012). Red symbols represent performance at the four $PM_{2.5}$ speciation sites in the SJV.



The model performance for each of the four speciation sites in the SJV is shown in red. Performance metrics including MFB, MFE, normalized mean bias (NMB), normalized mean error (NME), R squared, and root mean square error (RMSE) are compared. Model performance metrics in the SJV are typically equal to or better than the corresponding statistics from other studies. One exception is the higher RMSE for nitrate in the SJV, which is simply a reflection of the higher nitrate concentrations in the SJV compared to other regions. In fact, MFB, MFE, NME, and R squared for nitrate in the SJV are on par with the majority of the model studies summarized in Simon et al. (2012). Finally, the model performance is also comparable to that of the 2012 SJV $PM_{2.5}$ SIP and 2018 SJV $PM_{2.5}$ SIP.

Since speciation monitors do not measure $PM_{2.5}$ on a daily basis, it is also advantageous to compare modeled 24-hour average $PM_{2.5}$ concentrations to observations from continuous $PM_{2.5}$ samplers, which typically report 24-hour average $PM_{2.5}$ concentrations on a daily basis. Figures S28 to S38 in the supplemental materials show the time series of modeled and observed 24-hour average $PM_{2.5}$ concentrations at these sites located throughout the SJV. Distinct seasonal variations in $PM_{2.5}$ concentrations are observed throughout the Valley, and they are also reasonably captured by the model. Of particular importance, the modeling system was able to capture the elevated $PM_{2.5}$ events during the winter months and the lower $PM_{2.5}$ which is common in the summer months. In addition, Table 25 summarizes the corresponding model performance statistics at these sites. All the sites met or exceeded the $PM_{2.5}$ model performance criteria defined in Boyland and Russell (2006).

In addition to the $PM_{2.5}$ performance evaluation, gas phase model performance was also evaluated for NO_2, ozone (O_3) and NH_3, which are key products of the photochemical processes in the atmosphere. Scatter plots of observed and modeled one-hour NO_2 mixing ratios at 15 sites are shown in Figures S39 to S53 in the supplemental materials. On average, there is good agreement between observed and modeled NO_2 mixing ratios. The slope of the regression line between the observed and modeled hourly NO_2 mixing ratios is within ±30% of the 1:1 correlation line at most of the sites. Scatter plots of observed and modeled hourly O_3 mixing ratios at 25 sites are shown in Figures S54 to S78 in the supplemental materials. Modeled O_3 mixing ratios show excellent agreement with observed mixing ratios and the slopes of the regression lines between observed and modeled O_3 are within ±15% of the 1:1 correlation line for most of the sites.

The IASI instrument, which is housed aboard the European Space Agency's MetOP-A satellite, passes over California each day around 10:00 am local time, providing measurements of column-integrated NH_3. The IASI measurement data processed by CARB are recorded in 12 x 12 km grid cells. In order for IASI data to be directly compared against NH_3 column densities predicted by CMAQ, CMAQ outputs were computed into vertical-column integrals in the same 12 km grid used for IASI data, then filtered to only select grid cells that overlap in space-time with a valid IASI pixel. Figure S79 shows the annual average of column NH_3 in 2017 from IASI and CMAQ, which indicates a low bias of ~18% in the modeled column NH_3 in the SJV. Since NH_3 is already in excess with respect to ammonium nitrate formation, this underprediction in column NH_3 will have little impact on simulated ammonium nitrate but does mean the modeled sensitivity to changes in NH_3 is likely overestimated and real world ammonium nitrate will be even less sensitive to changes in NH_3 emissions.

Table 25. Model performance for 24-hour $PM_{2.5}$ concentrations measured from continuous beta-attention $PM_{2.5}$ monitors.

Sites	# of Obs.	Avg. Obs. (µg/m³)	Avg. Mod. (µg/m³)	Mean bias (µg/m³)	Mean error (µg/m³)	MFB	MFE
Fresno - Garland	358	14.5	15.8	1.3	5.3	0.06	0.40
Tranquillity	357	8.4	8.1	-0.3	4.0	-0.15	0.43
Clovis	365	13.2	14.6	1.4	5.1	0.03	0.41
Corcoran	359	15.7	12.4	-3.3	5.8	-0.29	0.45
Hanford	362	17.2	13.7	-3.6	6.3	-0.29	0.45
Madera	359	12.5	12.5	0.0	4.7	-0.07	0.42
Merced	362	13.3	12.2	-1.1	5.4	-0.21	0.45
Stockton	352	12.3	13.1	0.8	5.2	-0.06	0.42
Manteca	362	11.2	11.7	0.5	5.1	-0.14	0.44
Modesto	362	12.9	14.6	1.6	5.0	0.04	0.36
Turlock	362	12.8	14.5	1.7	5.2	0.14	0.45

C. Future Year 2030 Design Values

Projected future year 2030 annual $PM_{2.5}$ DVs for each site are shown in Table 26. The Bakersfield-Planz site has the highest projected DV at 12.0 µg/m^3, rounded to the nearest tenths digit following the U.S. EPA's guidance (U.S. EPA 2018). This DV meets the 12 µg/m^3 annual $PM_{2.5}$ standard established by the U.S. EPA in 2012.

The corresponding Relative Response Factors (RRFs) for annual $PM_{2.5}$ are given in Table 27 (Note, RRF is calculated on a quarterly basis in the actual DV calculation, so the annual RRF is shown for illustrative purposes only). From 2017 to 2030, there are substantial reductions projected for ammonium nitrate, EC, and organic matter (OM), a slight decrease in sulfate, but a slight increase in crustal material (i.e., other primary $PM_{2.5}$ such as fugitive dust emissions). The reduction in ammonium nitrate is a direct result of NO_x emission reductions in 2030 compared to 2017, while EC and OM reductions are primarily tied to the reduction in primary $PM_{2.5}$ emissions. Because future year projection is performed for each individual $PM_{2.5}$ species, the base year annual $PM_{2.5}$ compositions are given in Table 28. In addition, the projected 2030 annual $PM_{2.5}$ compositions are shown in Table 29. In 2030, for the annual $PM_{2.5}$ standard, OM is the dominant $PM_{2.5}$ component.

Table 26. Projected future year 2030 annual $PM_{2.5}$ DVs at each monitor.

Site AQS ID	Name	Base DV (µg/m³)	2030 Annual DV (µg/m³)	2030 Annual DV (µg/m³, rounded to the tenths digit)
060290016	Bakersfield - Planz	16.97	11.98	12.0
060311004	Hanford	15.73	11.04	11.0
060290010	Bakersfield - Golden	15.52	10.82	10.8
061072002	Visalia	15.43	10.50	10.5
060290014	Bakersfield - California Ave.	15.12	10.52	10.5
060310004	Corcoran	14.95	10.90	10.9
060195025	Fresno – Hamilton	13.99	9.81	9.8
060190011	Fresno – Garland	13.69	9.49	9.5
060990006	Turlock	12.7	9.69	9.7
060195001	Clovis	12.69	8.99	9.0
060470003	Merced - S. Coffee	12.28	9.31	9.3
060771002	Stockton	12.21	10.16	10.2
060392010	Madera	12.11	8.75	8.8
060472510	Merced - M. Street	11.73	8.73	8.7
060990005	Modesto	11.16	8.54	8.5
060772010	Manteca	10.37	8.38	8.4
060192009	Tranquillity	8.19	6.37	6.4

Table 27. 2030 Annual RRFs for $PM_{2.5}$ components.

Site	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal	RRF for salt
Bakersfield-Planz	0.71	0.57	0.39	0.88	0.76	0.38	1.12	1.00
Hanford	0.70	0.61	0.38	0.99	0.75	0.47	0.99	1.00
Bakersfield-Golden	0.70	0.54	0.35	0.87	0.77	0.39	1.12	1.00
Visalia	0.68	0.57	0.34	0.96	0.73	0.45	1.06	1.00
Bakersfield-California Ave	0.70	0.56	0.38	0.88	0.75	0.38	1.12	1.00
Corcoran	0.73	0.63	0.39	1.02	0.79	0.54	0.98	1.00
Fresno-Hamilton	0.70	0.63	0.44	0.94	0.71	0.42	1.12	1.00
Fresno-Garland	0.69	0.61	0.42	0.94	0.71	0.44	1.08	1.00
Turlock	0.76	0.68	0.50	0.98	0.80	0.50	1.07	1.00
Clovis	0.71	0.62	0.39	0.96	0.73	0.49	1.08	1.00
Merced-S. Coffee	0.76	0.65	0.42	0.98	0.81	0.50	1.05	1.00
Stockton	0.83	0.74	0.55	1.01	0.87	0.57	1.21	1.00
Madera	0.72	0.63	0.41	0.97	0.76	0.46	1.06	1.00
Merced-M. Street	0.74	0.63	0.42	0.98	0.80	0.50	1.05	1.00
Modesto	0.77	0.69	0.51	0.98	0.79	0.50	1.08	1.00
Manteca	0.81	0.74	0.55	1.01	0.84	0.53	1.08	1.00
Tranquillity	0.78	0.66	0.40	1.00	0.83	0.53	1.03	1.00

Table 28. 2017 Base year annual $PM_{2.5}$ compositions (µg/m^3).*

Name	$PM_{2.5}$	NH_4	NO_3	SO_4	OM	EC	Crustal	Salt
Bakersfield-Planz	16.97	1.31	2.83	1.30	7.69	0.90	1.87	0.05
Hanford	15.73	1.31	2.83	1.30	7.30	0.61	1.29	0.08
Bakersfield-Golden	15.52	1.21	2.68	1.16	6.97	0.83	1.67	0.05
Visalia	15.43	1.28	2.75	1.28	7.17	0.60	1.28	0.08
Bakersfield-Cal. Ave	15.12	1.19	2.64	1.12	6.78	0.81	1.61	0.05
Corcoran	14.95	1.24	2.66	1.24	6.95	0.58	1.25	0.08
Fresno-Hamilton	13.99	0.96	2.06	0.95	7.37	0.74	1.06	0.05
Fresno-Garland	13.69	0.94	2.04	0.92	7.20	0.73	1.03	0.05
Turlock	12.70	0.94	2.01	0.96	6.20	0.68	0.95	0.18
Clovis	12.69	0.84	1.74	0.90	6.74	0.66	1.02	0.05
Merced-S. Coffee	12.28	0.89	1.77	0.99	6.08	0.65	0.96	0.19
Stockton	12.21	0.90	1.83	0.97	5.99	0.64	0.93	0.18
Madera	12.11	0.82	1.71	0.85	6.40	0.63	0.95	0.04
Merced-M. Street	11.73	0.87	1.84	0.89	5.72	0.62	0.88	0.17
Modesto	11.16	0.82	1.72	0.86	5.45	0.59	0.84	0.16
Manteca	10.37	0.75	1.50	0.84	5.11	0.54	0.80	0.16
Tranquillity	8.19	0.52	1.01	0.61	4.36	0.41	0.70	0.03

*: Particle-bound water and blank mass are not shown.

Table 29. Projected 2030 Annual $PM_{2.5}$ compositions (µg/m^3).*

Name	Future $PM_{2.5}$	Future NH_4	Future NO_3	Future SO_4	Future OM	Future EC	Future Crustal	Future Salt	Future Water
Bakersfield-Planz	11.98	0.75	1.11	1.14	5.82	0.34	2.09	0.05	0.48
Hanford	11.04	0.80	1.08	1.29	5.50	0.29	1.28	0.08	0.51
Bakersfield-Golden	10.82	0.65	0.93	1.01	5.37	0.32	1.87	0.05	0.41
Visalia	10.5	0.73	0.94	1.23	5.22	0.27	1.36	0.08	0.47
Bakersfield-Cal. Ave	10.52	0.66	1.01	0.98	5.09	0.31	1.81	0.05	0.42
Corcoran	10.9	0.78	1.05	1.26	5.52	0.31	1.22	0.08	0.49
Fresno-Hamilton	9.81	0.60	0.92	0.90	5.27	0.31	1.19	0.05	0.38
Fresno-Garland	9.49	0.57	0.86	0.86	5.13	0.32	1.12	0.05	0.36
Turlock	9.69	0.64	1.00	0.94	4.97	0.34	1.01	0.18	0.41
Clovis	8.99	0.52	0.67	0.87	4.92	0.32	1.10	0.05	0.34
Merced-S. Coffee	9.31	0.58	0.74	0.97	4.92	0.32	1.00	0.19	0.38
Stockton	10.16	0.66	1.01	0.98	5.20	0.37	1.13	0.18	0.42
Madera	8.75	0.51	0.69	0.83	4.84	0.29	1.01	0.04	0.33
Merced-M. Street	8.73	0.55	0.77	0.88	4.58	0.31	0.92	0.17	0.35
Modesto	8.54	0.57	0.88	0.84	4.33	0.30	0.91	0.16	0.36
Manteca	8.38	0.56	0.82	0.85	4.28	0.29	0.87	0.16	0.36
Tranquillity	6.37	0.35	0.41	0.61	3.60	0.22	0.71	0.03	0.23

*: For each site, blank filter mass equal to 0.2 µg/m^3 is not shown in this table.

D. $PM_{2.5}$ Precursor Sensitivity Analysis

To evaluate the impact of reducing emissions of different $PM_{2.5}$ precursors on $PM_{2.5}$ DVs, a series of model sensitivity simulations were performed. In these simulations anthropogenic emissions of the precursor species were reduced by a specific percentage from the baseline emissions. The U.S. EPA (USEPA, 2016) recommends a range of 30-70% reduction in precursor emissions in the nonattainment area, and that recommendation is followed here.

Comparing the difference in $PM_{2.5}$ DVs from the precursor reduction simulations and the baseline modeling shows the sensitivity of the $PM_{2.5}$ DVs to changes in baseline precursor emissions. Given the nature of $PM_{2.5}$ formation, the effect of reductions in the following $PM_{2.5}$ precursors were investigated: primary $PM_{2.5}$, NOx, SOx, NH_3, and ROG. For each precursor sensitivity, only anthropogenic emissions in the San Joaquin Valley were reduced. Natural emissions and emissions outside of the SJV were kept constant. Since it is known that NOx and direct $PM_{2.5}$ contribute significantly to $PM_{2.5}$ formation in the SJV (Pusede et al., 2016) and these species already meet U.S. EPA's criteria for significant precursors, sensitivity runs for NOx and direct $PM_{2.5}$ were only performed with a 30% emission reduction. Given the lower contribution of other precursor species to total $PM_{2.5}$ (i.e., ammonia, ROG, and SOx), both 30% and 70% emission reductions were performed for those species.

The precursor sensitivity modeling was performed for both the 2017 base year and 2030 future year. Table 30 shows the impact from precursor reductions on annual $PM_{2.5}$ DVs for 2017. 30% $PM_{2.5}$ and 30% NOx reductions clearly show significant impact on $PM_{2.5}$ DVs. Direct PM reduction is more effective than NOx for the annual standard. Although both NOx and ammonia contribute to ammonium nitrate formation, the impact on $PM_{2.5}$ DVs from ammonia reduction is much less than that from NOx reductions, because ammonium nitrate formation in the SJV is limited by the availability of nitric acid instead of by ammonia (Lurmann et al., 2006; Markovic, 2014; Parworth, et al., 2017; Prabhakar et al., 2017). This is consistent with previous modeling studies (Chen et al., 2014; Kleeman et al., 2005; Pun et al., 2009). Reducing SOx emissions has a very small impact on annual DVs, and may even have a dis-benefit for annual DVs at many sites. The negative impact on DVs from SOx emission reductions is due to the non-linearity in inorganic thermodynamics that governs the partitioning of nitrate onto particles (e.g., West et al., 1999). Reducing ROG emissions has a small positive impact on annual DVs. In 2017, reducing ROG emissions reduced secondary organic aerosol (SOA) formation as well as slightly lowering ammonium nitrate formation, as demonstrated in Kleeman et al. (2005) and Pun et al. (2009).

Table 31 shows the impact on annual DVs from precursor reductions in 2030. Similar to 2017, 30% PM and 30% NOx reductions lead to substantial reductions in annual $PM_{2.5}$ DVs in 2030. While ammonia reduction also leads to reductions in annual $PM_{2.5}$ DVs, an equivalent percentage of ammonia reduction is typically less effective than NOx reductions, due to the excess of ammonia in the SJV (Parworth et al., 2017; Prabhaker et al., 2017). While NOx emissions in 2030 exhibit substantial reductions from 2017 levels, ammonia emission trends are relatively flat, meaning ammonia is even more in excess in 2030 (i.e., NH_3 reductions will be even less effective at reducing $PM_{2.5}$ in 2030). Reducing SOx emissions has a very small impact on annual DVs and reducing ROG emissions has essentially no effect on the annual DVs. However, under 2030 emission levels, reducing ROG emissions can slightly increase ammonium nitrate formation in the wintertime. This is different from the reference year 2017, because modeled ammonium nitrate concentration is much smaller in 2030 than in 2017, such that the response in ammonium nitrate formation to ROG emission reductions is reversed. A previous modeling study by CARB (2016) utilizing the Integrated Reaction Rate (IRR) technique in the CMAQ model shows that reduced ROG emissions can lead to less peroxyacetyle nitrate (PAN) formation (Meng et al., 1997), increased availability of nitrogen dioxide and more nighttime nitric acid formation. However, since lower ROG levels also reduce daytime hydroxyl radical concentrations and result in less daytime nitric acid formation, these processes compete with each other and lead to a different net impact on ammonium nitrate formation depending on the NOx and ROG emission levels.

Table 30. Difference in Annual $PM_{2.5}$ DVs between the 2017 baseline run and precursor emission reduction runs.*

Sites	Baseline DV	30% PM*	30% NOx	30% NH_3	70% NH_3	30% ROG	70% ROG	30% SOx	70% SOx
Bakersfield-Planz	16.97	-2.63	-0.7	-0.35	-1.3	-0.07	-0.21	-0.02	-0.01
Hanford	15.73	-1.86	-0.77	-0.19	-0.85	-0.01	-0.13	0.01	-0.05
Bakersfield-Golden	15.52	-2.38	-0.8	-0.36	-1.41	-0.01	-0.11	0.01	0.01
Visalia	15.43	-1.95	-0.85	-0.27	-1.09	-0.06	-0.2	-0.02	-0.07
Bakersfield-Cal. Ave	15.12	-2.32	-0.68	-0.32	-1.22	-0.02	-0.14	0.01	0.01
Corcoran	14.95	-1.64	-0.86	-0.24	-1	-0.04	-0.14	0	-0.01
Fresno-Hamilton	13.99	-2.11	-0.33	-0.2	-0.86	-0.04	-0.2	0.02	-0.03
Fresno-Garland	13.69	-2.04	-0.34	-0.17	-0.79	-0.01	-0.14	0.04	0.02
Turlock	12.7	-1.44	-0.12	-0.08	-0.5	0	-0.11	0.05	0.02
Clovis	12.69	-1.8	-0.37	-0.19	-0.76	0	-0.11	0.06	0.08
Merced-S Coffee	12.28	-1.3	-0.27	-0.15	-0.68	0.01	-0.07	0.04	0.01
Stockton	12.21	-1.12	-0.02	-0.02	-0.38	0.06	-0.02	0.09	0.06
Madera	12.11	-1.45	-0.25	-0.14	-0.75	0.03	-0.08	0.08	0.05
Merced-M Street	11.73	-1.25	-0.28	-0.15	-0.72	0.01	-0.07	0.04	0.01

Sites	Baseline DV	30% PM*	30% NOx	30% NH_3	70% NH_3	30% ROG	70% ROG	30% SOx	70% SOx
Modesto	11.16	-1.27	-0.06	-0.04	-0.42	0.04	-0.05	0.07	0.04
Manteca	10.37	-0.82	0.01	-0.02	-0.31	0.04	-0.05	0.07	0.04
Tranquillity	8.19	-0.73	-0.29	-0.14	-0.51	0	-0.03	0.03	0.04

*: 30% PM means that anthropogenic PM emissions within SJV are reduced by 30% from the baseline emissions inventory. Same meaning applies to other precursor reduction runs.

Table 31. Difference in Annual $PM_{2.5}$ DVs between the 2030 baseline run and precursor emission reduction runs.*

Sites	Baseline DV	30% PM*	30% NOx	30% NH_3	70% NH_3	30% ROG	70% ROG	30% SOx	70% SOx
Bakersfield-Planz	16.97	-2.4	-0.47	-0.12	-0.37	-0.02	-0.05	-0.06	-0.1
Hanford	15.73	-1.53	-0.39	-0.1	-0.35	0	0	-0.07	-0.14
Bakersfield-Golden	15.52	-2.15	-0.4	-0.12	-0.39	-0.01	-0.01	-0.05	-0.08
Visalia	15.43	-1.71	-0.43	-0.1	-0.34	-0.01	-0.01	-0.08	-0.16
Bakersfield-Cal. Ave	15.12	-2.12	-0.41	-0.11	-0.35	-0.01	-0.03	-0.05	-0.09
Corcoran	14.95	-1.34	-0.41	-0.11	-0.39	-0.02	-0.03	-0.04	-0.09
Fresno-Hamilton	13.99	-1.86	-0.3	-0.09	-0.31	-0.05	-0.12	-0.07	-0.14
Fresno-Garland	13.69	-1.84	-0.28	-0.09	-0.28	-0.04	-0.09	-0.06	-0.11

Sites	Baseline DV	30% PM*	30% NOx	30% NH_3	70% NH_3	30% ROG	70% ROG	30% SOx	70% SOx
Turlock	12.7	-1.35	-0.25	-0.07	-0.25	-0.03	-0.07	-0.04	-0.08
Clovis	12.69	-1.61	-0.25	-0.07	-0.24	-0.02	-0.06	-0.03	-0.06
Merced-S Coffee	12.28	-1.15	-0.21	-0.08	-0.26	-0.02	-0.04	-0.03	-0.07
Stockton	12.21	-1.19	-0.14	-0.06	-0.21	-0.02	-0.05	-0.02	-0.05
Madera	12.11	-1.2	-0.24	-0.09	-0.29	-0.02	-0.05	-0.04	-0.09
Merced-M Street	11.73	-1.1	-0.21	-0.08	-0.27	-0.01	-0.03	-0.03	-0.07
Modesto	11.16	-1.26	-0.19	-0.07	-0.22	-0.03	-0.07	-0.04	-0.08
Manteca	10.37	-0.81	-0.15	-0.05	-0.18	-0.02	-0.06	-0.03	-0.06
Tranquillity	8.19	-0.52	-0.13	-0.06	-0.19	-0.01	-0.01	0	0

*: 30% PM means that anthropogenic PM emissions within SJV are reduced by 30% from the baseline emissions inventory. Same meaning applies to other precursor reduction runs.

E. Unmonitored Area Analysis

The unmonitored area analysis is performed to ensure that there are no regions outside of the existing monitoring network that could exceed the NAAQS if a monitor was present at that location (U.S. EPA, 2018). The U.S. EPA recommends combining spatially interpolated design value fields with modeled gradients for the pollutant of interest and grid-specific RRFs in order to generate gridded future year gradient adjusted design values. The spatial Interpolation of the observed design values is done only within the geographic region constrained by the monitoring network, since extrapolating to outside of the monitoring network is inherently uncertain.

This analysis can be done using SMAT-CE (Software for the Modeled Attainment Test – Community Edition, *https://www.epa.gov/scram/photochemical-modeling-tools*). However, this software is not open source and comes as a precompiled software package. To maintain transparency and flexibility in the analysis, in-house R codes (https://www.r-project.org/) developed at CARB are utilized in this analysis.

For annual $PM_{2.5}$ standards, the unmonitored area analysis involves the following steps:

Step 1: At each grid cell, the quarterly RRFs of each species are calculated based on the reference- and future-year modeling results following the same approach outlined in the Methodology section of this document.

Step 2: At each grid cell, the quarterly average of the modeled $PM_{2.5}$ species is calculated from the reference year simulation, and the gradients in these quarterly speciated averages between each grid cell and grid cells which contain a monitor is calculated.

Step 3: The quarterly reference year speciated $PM_{2.5}$ design values are obtained for each monitoring site from the attainment test. For each grid cell, the monitors within its Voronoi Region are identified, and the quarterly speciated $PM_{2.5}$ values are then interpolated using normalized inverse distance squared weightings for all monitors within a grid cell's Voronoi Region. The quarterly interpolated speciated $PM_{2.5}$ fields are further adjusted based on the appropriate gradients from Step 2.

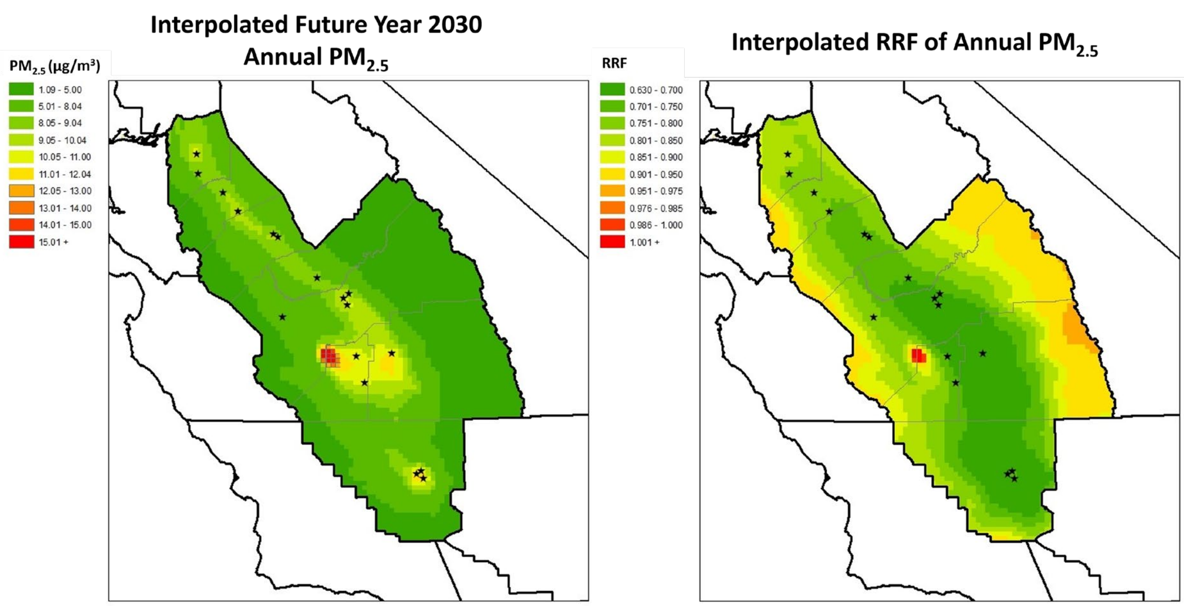
Step 4: The quarterly future year speciated $PM_{2.5}$ value for each grid cell is obtained by multiplying reference year speciated $PM_{2.5}$ value with the quarterly RRF for that grid from step 1. The future year annual $PM_{2.5}$ design value for each grid cell is thus calculated by averaging the quarterly speciated $PM_{2.5}$ values.

Step 5: The future year gridded annual average $PM_{2.5}$ estimates are then compared to the annual $PM_{2.5}$ NAAQS to determine compliance.

Under the Voronoi diagram method, each monitoring site was assigned to a Voronoi region based on location and the distance to each grid cell (Sen 2016), and the interpolations were done between each grid cell and all the monitors in surrounding Voronoi regions. Voronoi diagram with inverse distance weighting method has been used in various 2-D data analysis areas, including air quality measurements interpolations (Atsuyuki, et al., 2009; Deligiorgi and Philippopoulos 2011).

Figure 20 shows the spatial distribution of projected 2030 annual $PM_{2.5}$ DVs (left) and RRFs (right) in the SJV nonattainment area. Projected 2030 annual $PM_{2.5}$ DVs at every grid cell are below the threshold needed for attainment (12.04 μg/m^3), except for a few cells surrounding the Lemoore military facility (grids borders are marked in the plot), where the greater $PM_{2.5}$ levels are due to localized emissions associated with that facility. A similar $PM_{2.5}$ hotspot associated with the Lemoore military facility was observed in past SJV $PM_{2.5}$ SIPs as well. This demonstrates that all unmonitored areas within the SJV will attain the 12 μg/m^3 annual $PM_{2.5}$ standard (technically, DVs not greater than 12.04 μg/m^3 are considered as attainment) established by the USEPA in 2012, except for a small area surrounding the Lemoore military facility (the areas with marked grid cells in Figure 20) which will need further evaluation given the uncertainties associated with emissions from military facilities**.**

Figure 20. Spatial distribution of projected 2030 annual $PM_{2.5}$ DVs (left) and RRFs based on the unmonitored area analysis within the SJV nonattainment area.



F. Discussions on the Impact from Different Soil NOx Parameterizations and Increasing Prescribed Burn Emissions

Soils can be a source of atmospheric nitrogen oxides (NOx), especially in regions with significant cropland where nitrogen fertilizers are widely used. However, the magnitude of soil NOx emissions can vary substantially, depending on local land use, management activities, and meteorological/irrigation conditions (Guo et al., 2020). Various parameterizations and models have been proposed to simulate soil NOx emissions, and these various approaches have a wide range of soil NOx emission estimates for the SJV (e.g., Almaraz et al., 2018; Guo et al., 2020; Sha et al., 2021; Zhu et al., 2023). While the attainment demonstration simulations used soil NOx emission estimates from the default YL95 scheme (Yienger and Levy, 1995) in the MEGAN model, to assess the response of future DVs to changes in the soil NOx inventory, a sensitivity analysis was conducted using the Berkeley-Dalhousie soil NOx parameterization or BDSNP (Hudman et al., 2012) in the MEGAN model. The BDSNP model has been referenced in recent air quality studies over the SJV (e.g., Sha et al., 2021; Zhu et al., 2023). On an annual basis, the BDSNP algorithm estimated much higher soil NOx emissions than the default scheme in MEGAN3.0. However, on a monthly basis, the BDSNP algorithm estimated soil NOx emissions can be smaller than the default scheme for winter months. Figure 21 shows monthly soil NOx emissions estimates for the SJV from the default YL95 scheme as well as the BDSNP algorithm.

Table 32 shows the future year annual DV difference between the default soil NOx emissions and the BDSNP algorithm. For the annual DVs, using BDSNP slightly reduced annual DVs. This is likely because the BDSNP estimated soil NOx emissions are actually lower than the default YL95 scheme for winter months, leading to smaller ammonium nitrate prediction when ambient ammonium nitrate concentrations are highest. Since ammonium nitrate levels are low in the summer months when BDSNP predicts the highest soil NOx emissions, there is very little impact on the overall DVs.

In addition, we also performed the 2017 model performance simulation based on the BDSNP scheme and compared it to the observations as well as the model prediction based on the default YL95 scheme in MEGAN3.0. Figures S80-S83 in the supplemental material show these comparisons for $PM_{2.5}$ species at Fresno, Bakersfield, Visalia, and Modesto, respectively. The BDSNP scheme only modestly increased nitrate prediction in warmer months. Despite much higher NOx emissions from the BDSNP in warmer months, meteorological conditions do not favor ammonium nitrate formation in warmer months in the SJV, leading to only modest increase in nitrate prediction in warmer months. The BDSNP scheme has minimal impact on the predictions of other species such as OC, EC, and sulfate. Overall, $PM_{2.5}$ model performance based on BDSNP scheme is close to those based on the default YL95 soil NOx scheme in MEGAN.

Figure 21. Daily soil NOx emissions for each month of 2017 estimated from the MEGAN3.0 default soil NOx scheme and the MEGAN BDSNP soil NOx scheme.

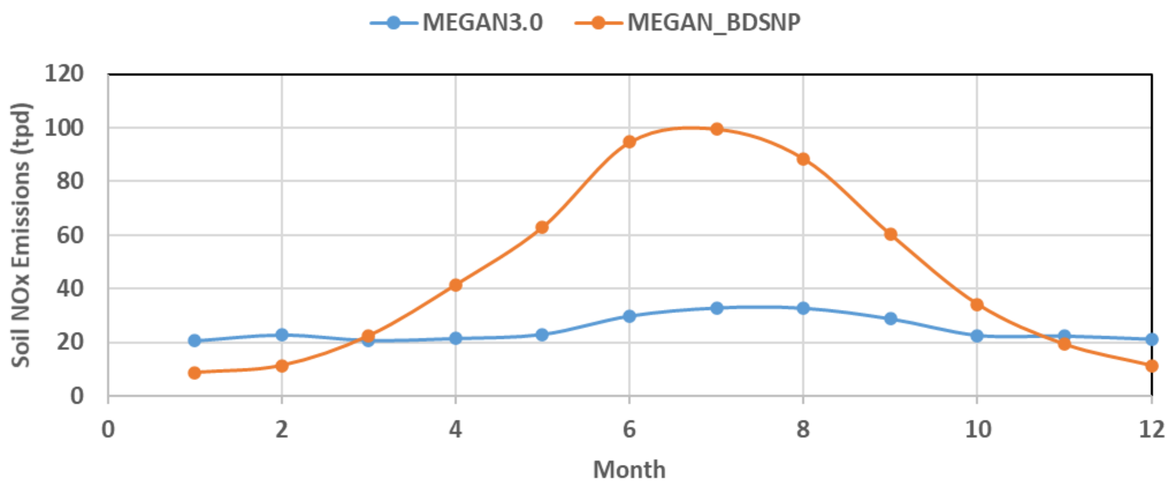


Table 32. 2030 annual DVs difference calculated using the BDSNP soil NOx algorithm compared to the default soil NOx algorithm in MEGAN3.0.

AQ site	Site name	Base year annual $PM_{2.5}$ DVs (µg/m^3)	Difference in 2030 annual $PM_{2.5}$ DVs (µg/m^3)
60290016	Bakersfield - Planz	16.97	-0.13
60311004	Hanford	15.73	-0.18
60290010	Bakersfield - Golden	15.52	-0.11
61072002	Visalia	15.43	-0.14
60290014	Bakersfield - California Ave.	15.12	-0.11
60310004	Corcoran	14.95	-0.18
60195025	Fresno - Hamilton	13.99	-0.07
60190011	Fresno - Garland	13.69	-0.05
60990006	Turlock	12.7	-0.04
60195001	Clovis	12.69	-0.02
60470003	Merced - S. Coffee	12.28	-0.03
60771002	Stockton	12.21	-0.04

AQ site	Site name	Base year annual $PM_{2.5}$ DVs ($\mu g/m^3$)	Difference in 2030 annual $PM_{2.5}$ DVs ($\mu g/m^3$)
60392010	Madera	12.11	-0.04
60472510	Merced - M. Street	11.73	-0.03
60990005	Modesto	11.16	-0.04
60772010	Manteca	10.37	-0.04
60192009	Tranquillity	8.19	-0.07

To evaluate the potential impact increased prescribed burning may have on future DVs and attainment of the NAAQS, an additional sensitivity analysis was conducted. For this sensitivity analysis, the base year 2017 utilized the actual 2017 prescribed burning emissions, while for the future year 2030, aggregated prescribed burning emissions from four years (2017, 2018, 2019, and 2021) were utilized. Since future prescribed burn scenarios are not available, those four years were chosen as a conservative representation of prescribed burn activity under a scenario where prescribed burning increased by a factor of four, consistent with the near-term state goals. Table 33 shows the annual average prescribed burn emissions from 2017 and the aggregated emissions from four years. The aggregated four-year emissions are approximately 10 times higher than the 2017 emissions. Figure 22 shows the locations of prescribed burns for 2017, 2018, 2019, and 2021. As can be seen, the typical locations of prescribed burns are generally away from the populated regions of the valley and so are expected to have only a minor impact on air quality in the valley.

Table 34 shows the difference in annual DVs from the sensitivity run compared to the default run. With the aggregated prescribed burn emissions, the annual DVs can increase slightly (less than a tenth of a $\mu g/m^3$) and only 0.04 $\mu g/m^3$ in Bakersfield, which is not sufficient to jeopardize attainment of the NAAQS.

Table 33. Annual average prescribed burning $PM_{2.5}$ emissions in the SJV.

Year	Annual $PM_{2.5}$ emissions (tons/day)
2017	4.5

Year	Annual $PM_{2.5}$ emissions (tons/day)
2018	7.0
2019	7.0
2021	28.6

Figure 22. Locations of prescribed burning events for 2017, 2018, 2019, and 2021.

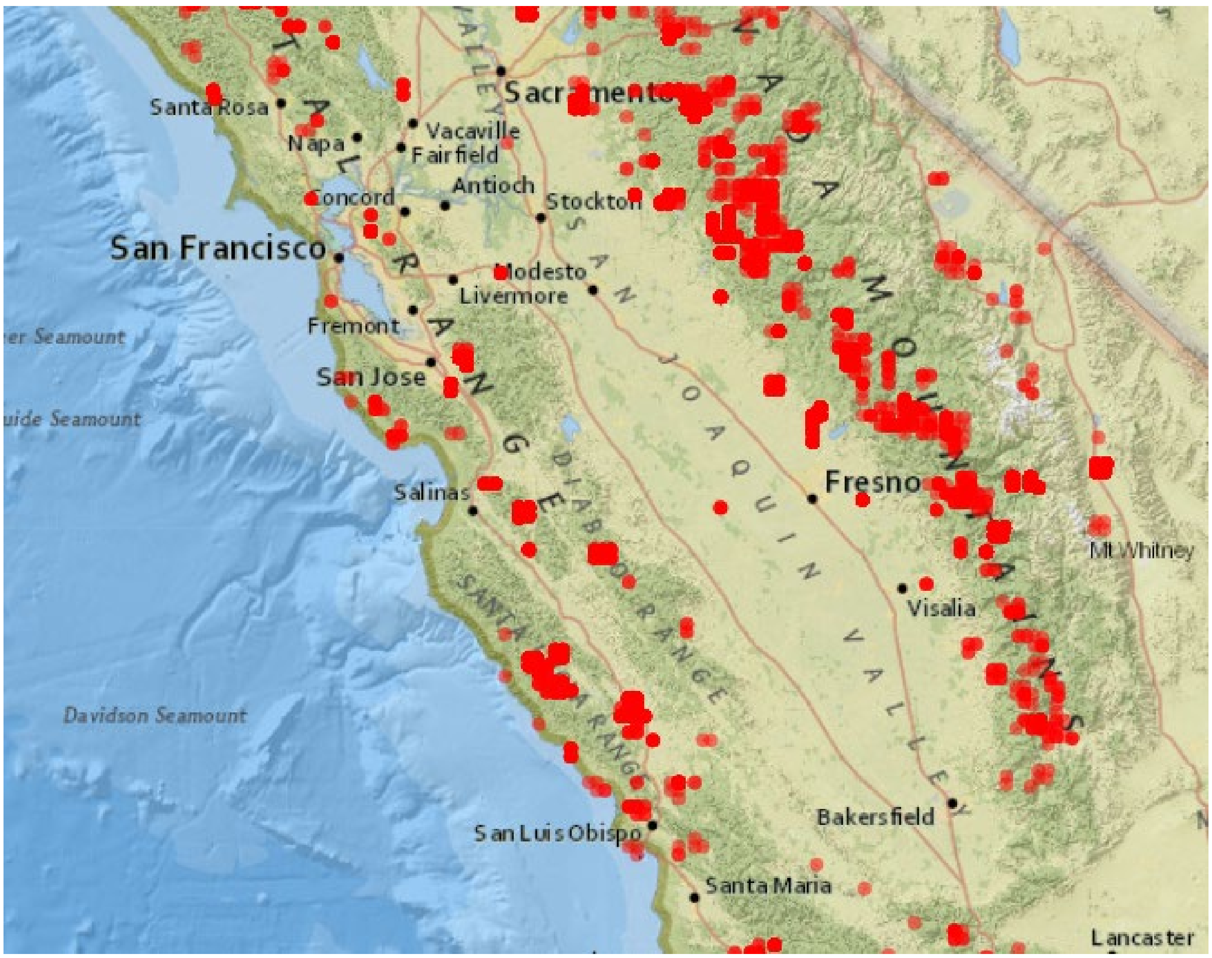


Table 34. 2030 annual DVs difference calculated using the aggregated four year prescribed burning emissions for future year.

AQ site	Site name	Base year annual $PM_{2.5}$ DVs (µg/m^3)	Difference in 2030 $PM_{2.5}$ DVs (µg/m^3)
060290016	Bakersfield - Planz	16.97	0.05
060311004	Hanford	15.73	0.08
060290010	Bakersfield - Golden	15.52	0.05
061072002	Visalia	15.43	0.07
060290014	Bakersfield - California Ave	15.12	0.04
060310004	Corcoran	14.95	0.09
060195025	Fresno - Hamilton	13.99	0.05
060190011	Fresno - Garland	13.69	0.05
060990006	Turlock	12.7	0.04
060195001	Clovis	12.69	0.07
060470003	Merced - S. Coffee	12.28	0.06
060771002	Stockton	12.21	0.04
060392010	Madera	12.11	0.07
060472510	Merced - M. Street	11.73	0.06
060990005	Modesto	11.16	0.03
060772010	Manteca	10.37	0.04
060192009	Tranquillity	8.19	0.08

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VII. Supplemental Materials

Supplemental Materials List of Figures

Figure S 1. Time series of temperature, relative humidity, wind speed, and wind direction for San Joaquin Valley in January 2017.

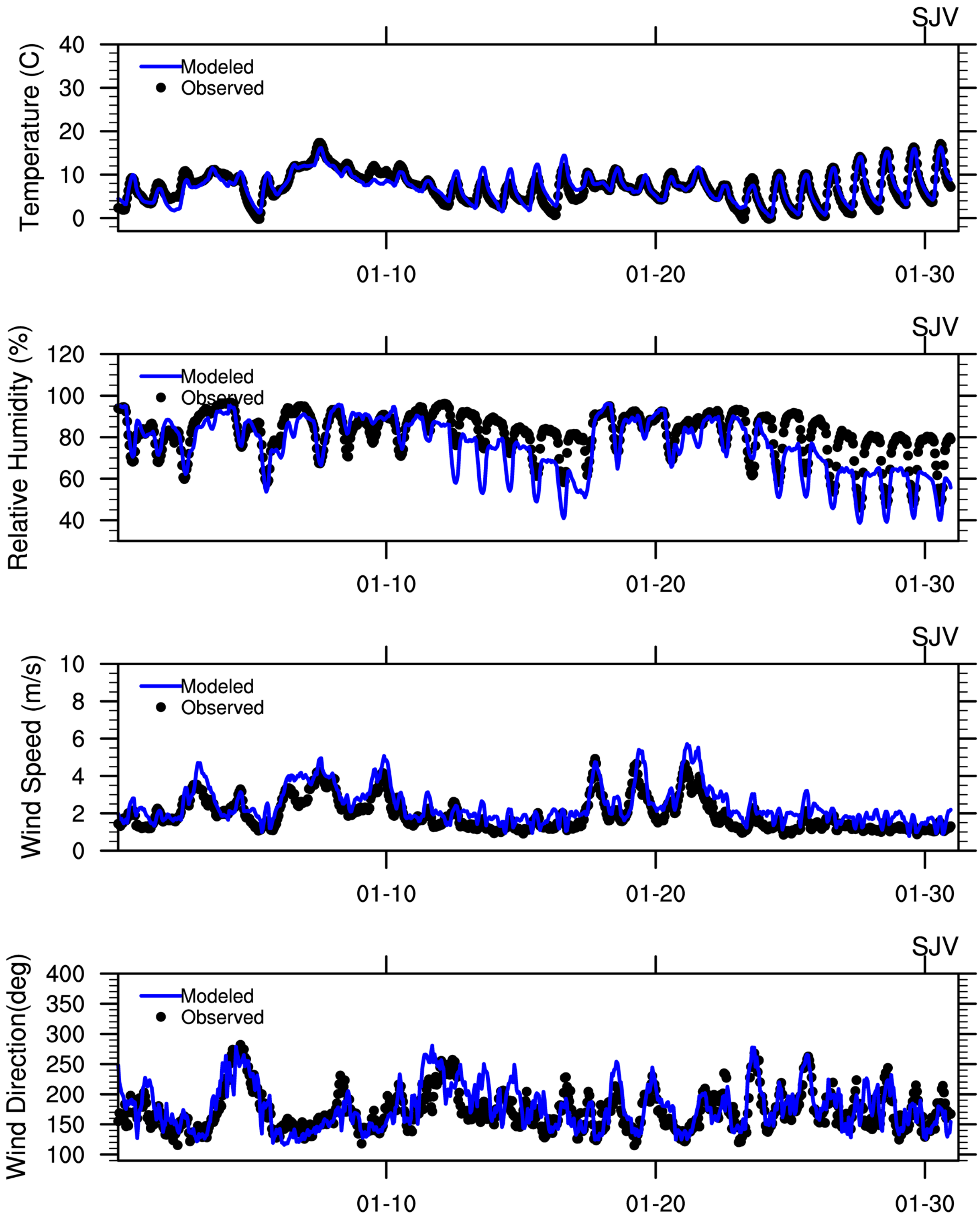


Figure S 2. Time series of temperature, relative humidity, wind speed, and wind direction for San Joaquin Valley in February 2017.

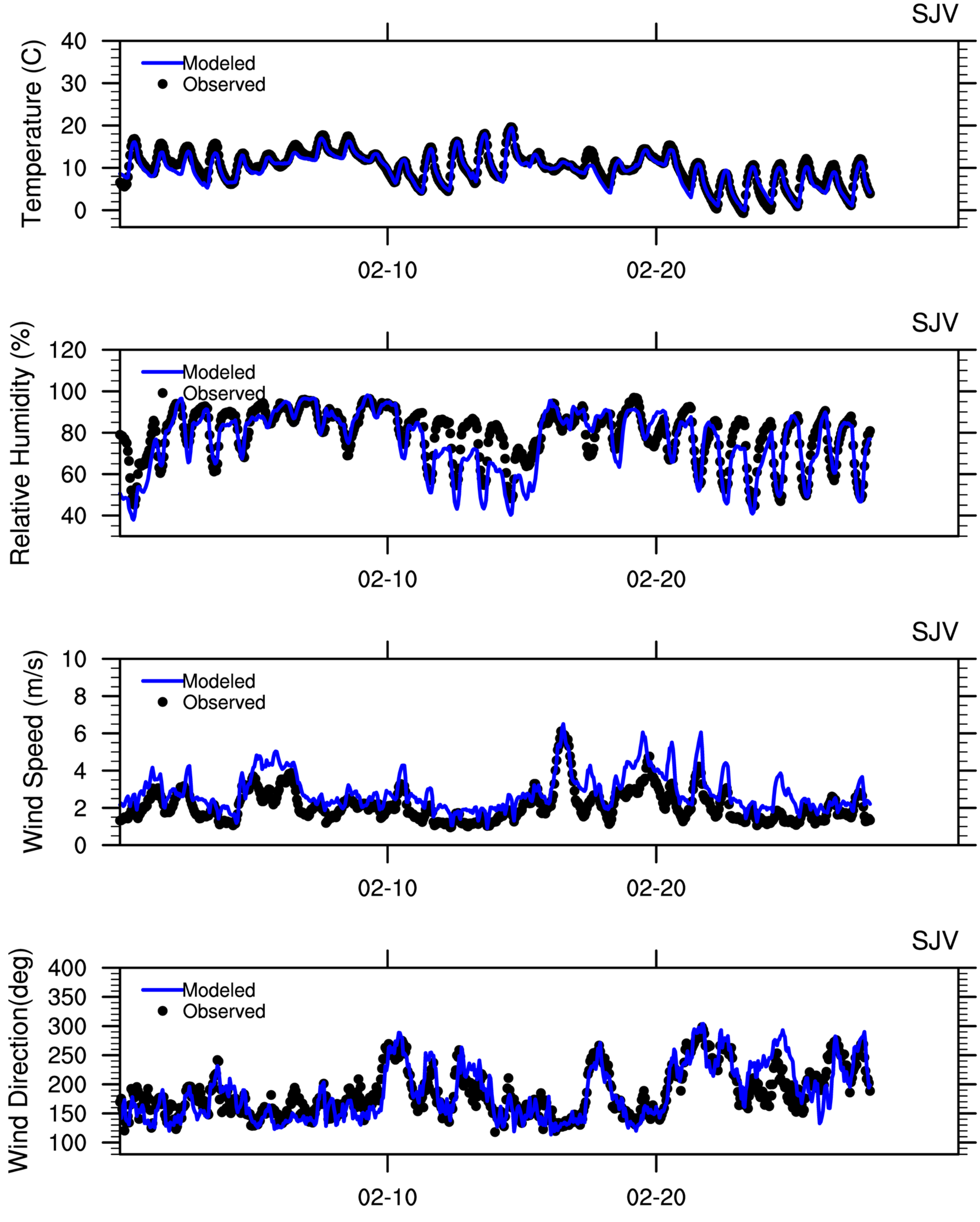


Figure S 3. Time series of temperature, relative humidity, wind speed, and wind direction for San Joaquin Valley in March 2017.

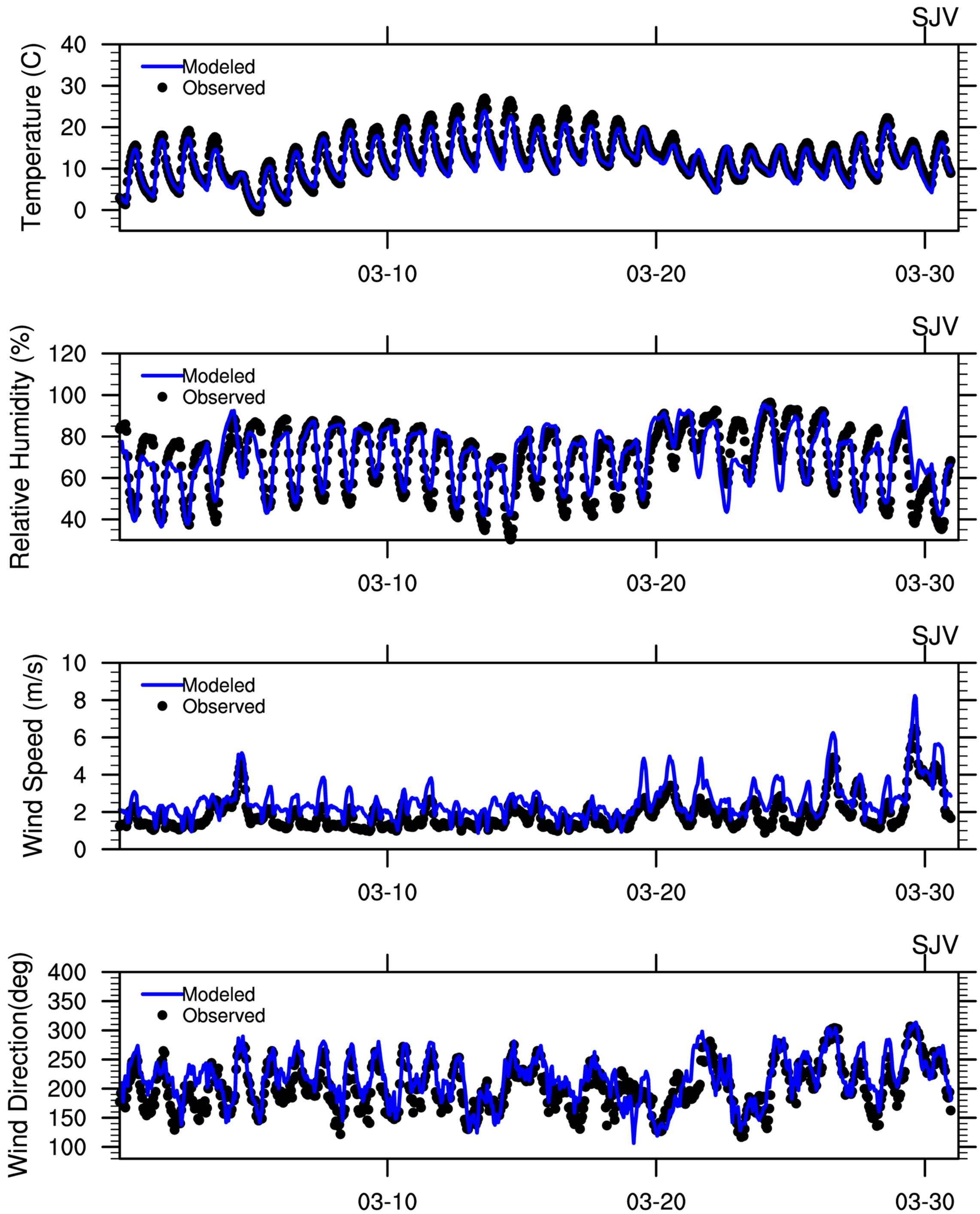


Figure S 4. Time series of temperature, relative humidity, wind speed and wind direction for San Joaquin Valley in April 2017.

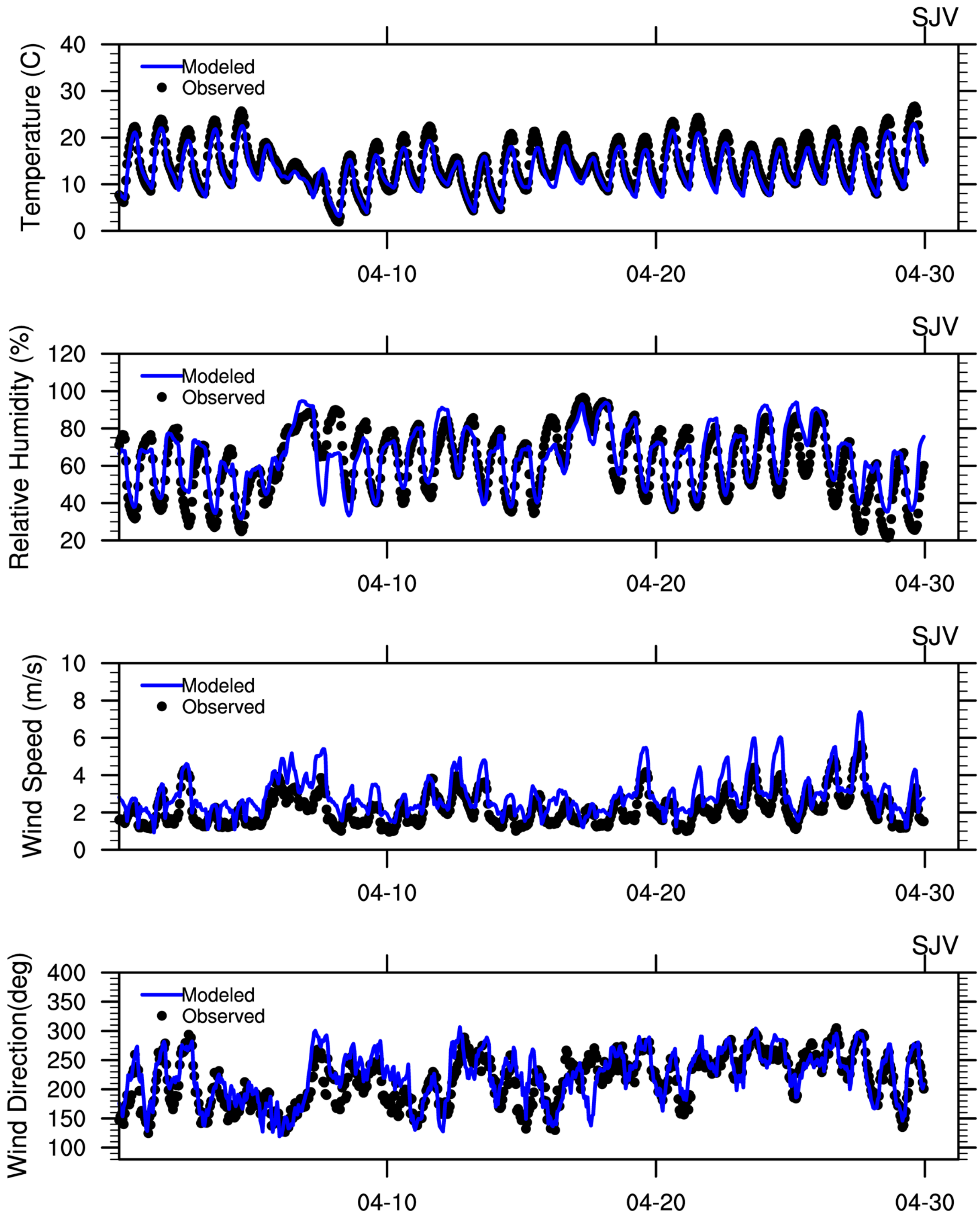


Figure S 5. Time series of temperature, relative humidity, wind speed and wind direction for San Joaquin Valley in May 2017.

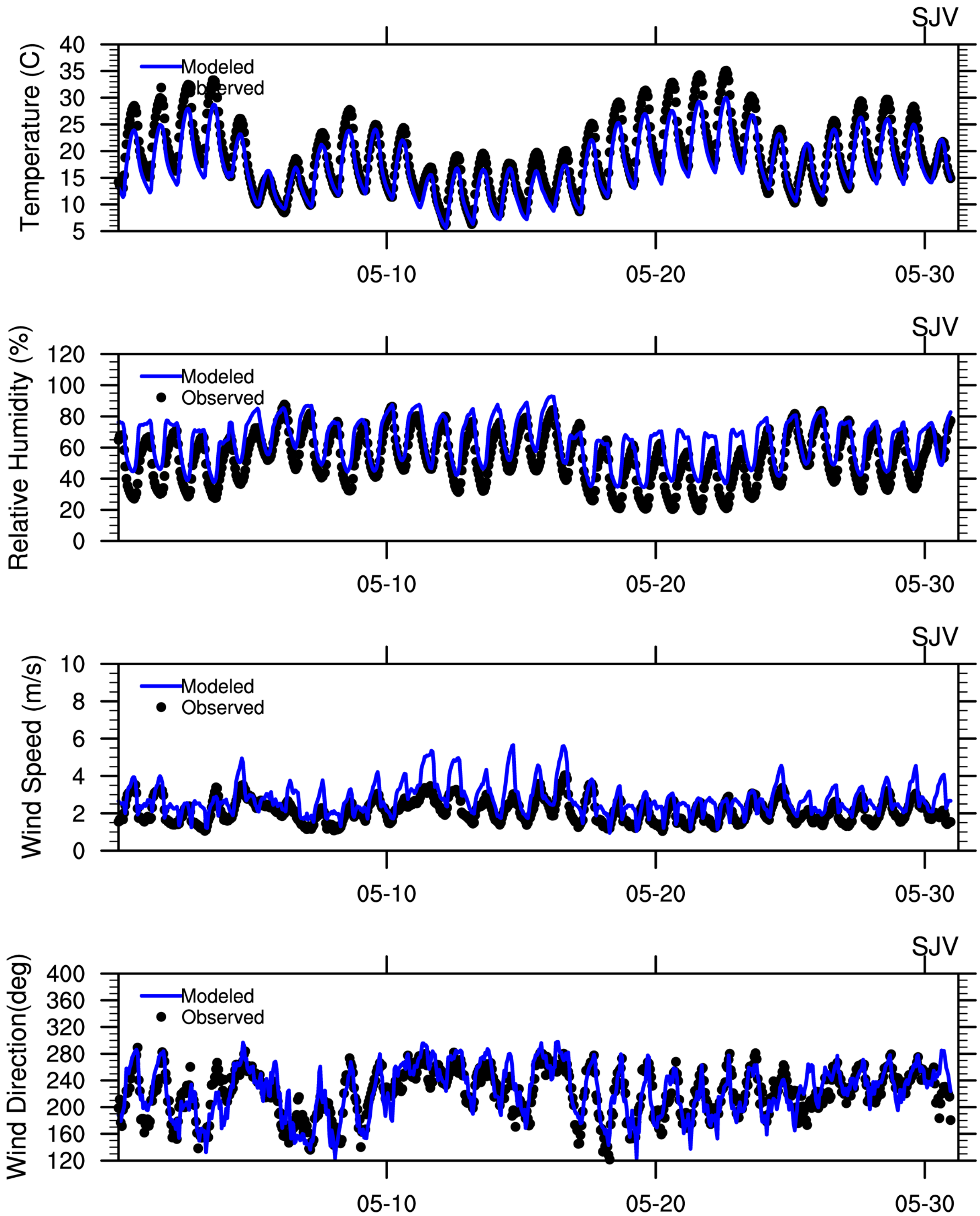


Figure S 6. Time series of temperature, relative humidity, wind speed, and wind direction, for San Joaquin Valley in June 2017.

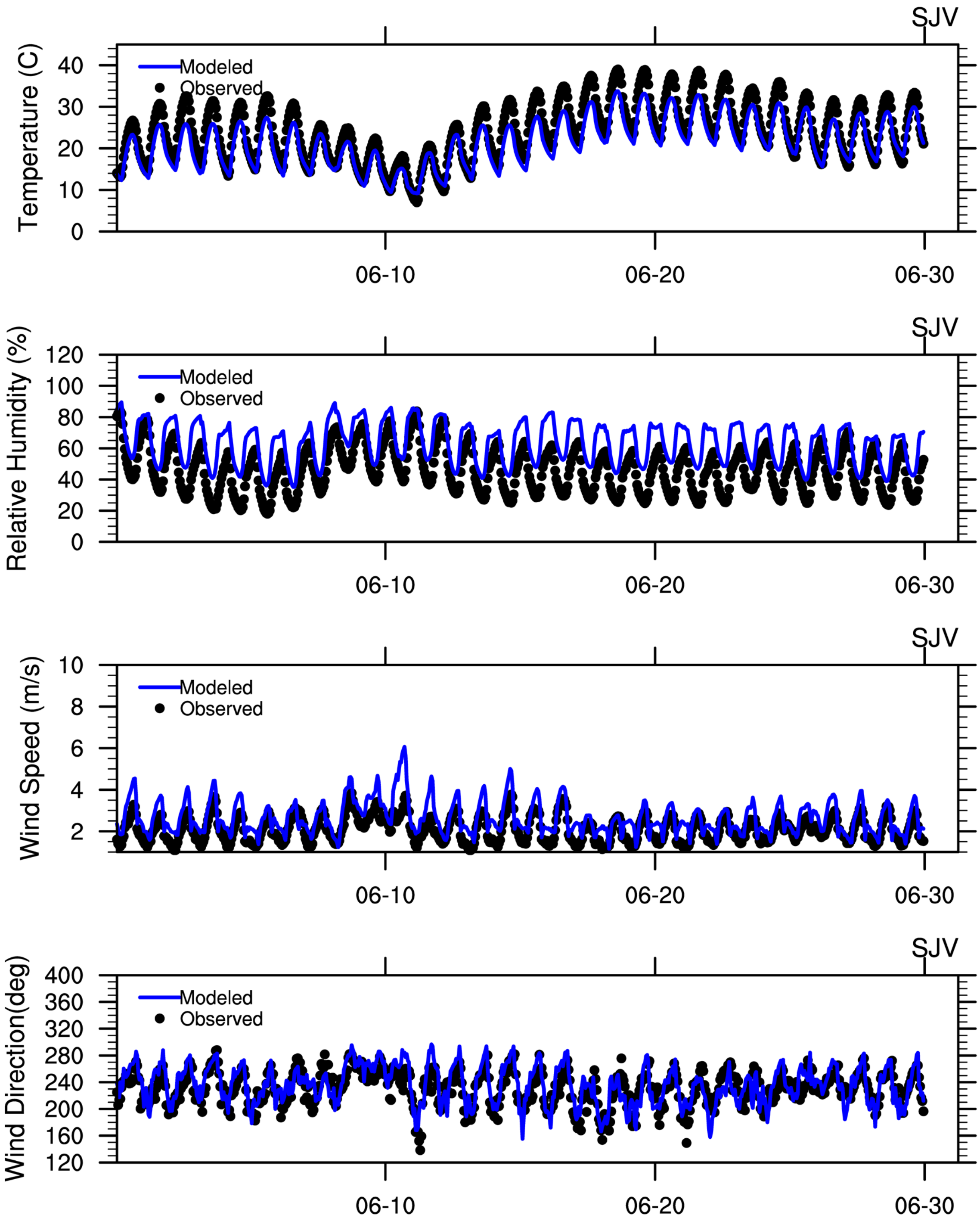


Figure S 7. Time series of temperature, relative humidity, wind speed, and wind direction for San Joaquin Valley in July 2017.

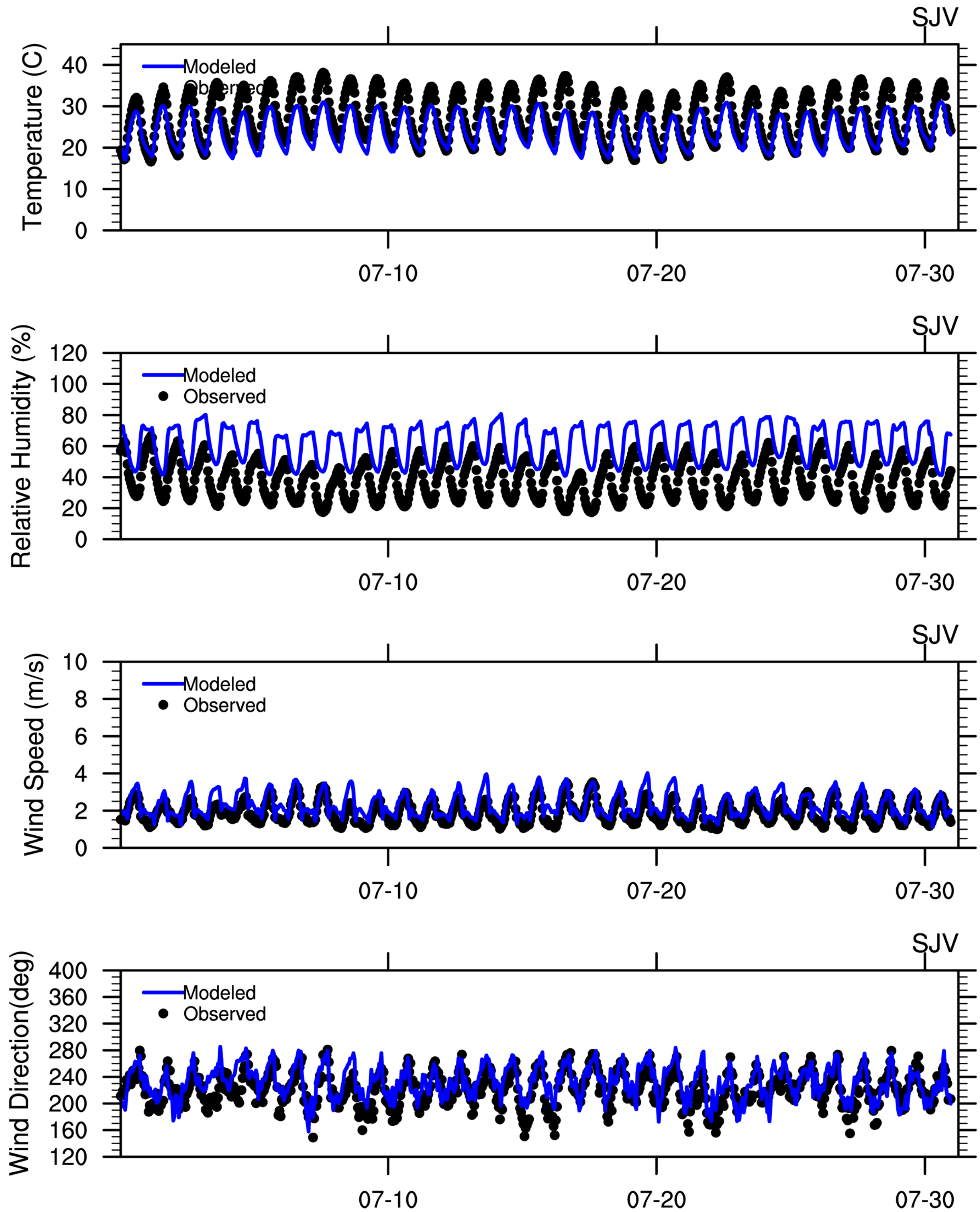


Figure S 8. Time series of temperature, relative humidity, wind speed, and wind direction for San Joaquin Valley in August 2017.

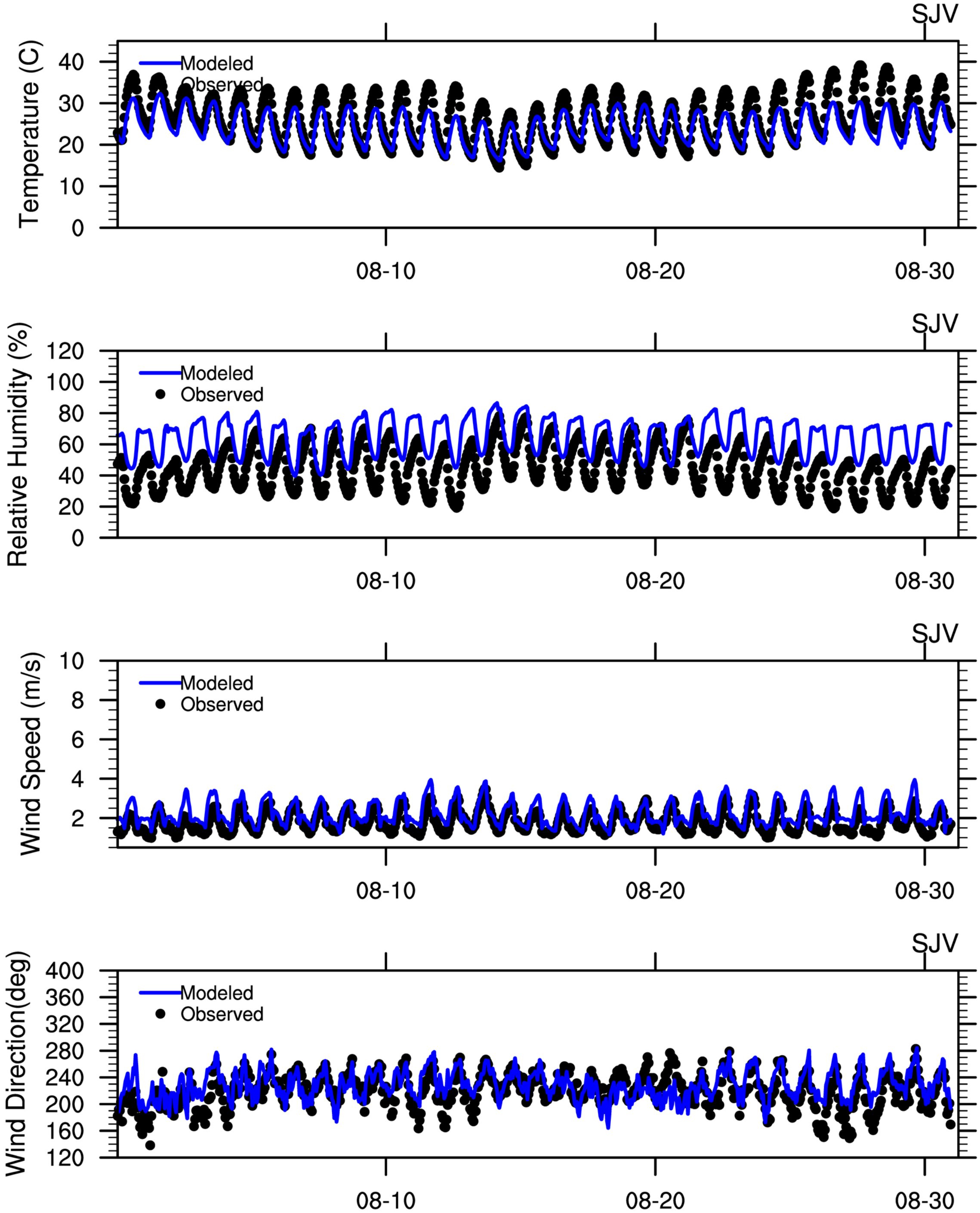


Figure S 9. Time series of temperature, relative humidity, wind speed, and wind direction for San Joaquin Valley in September 2017.

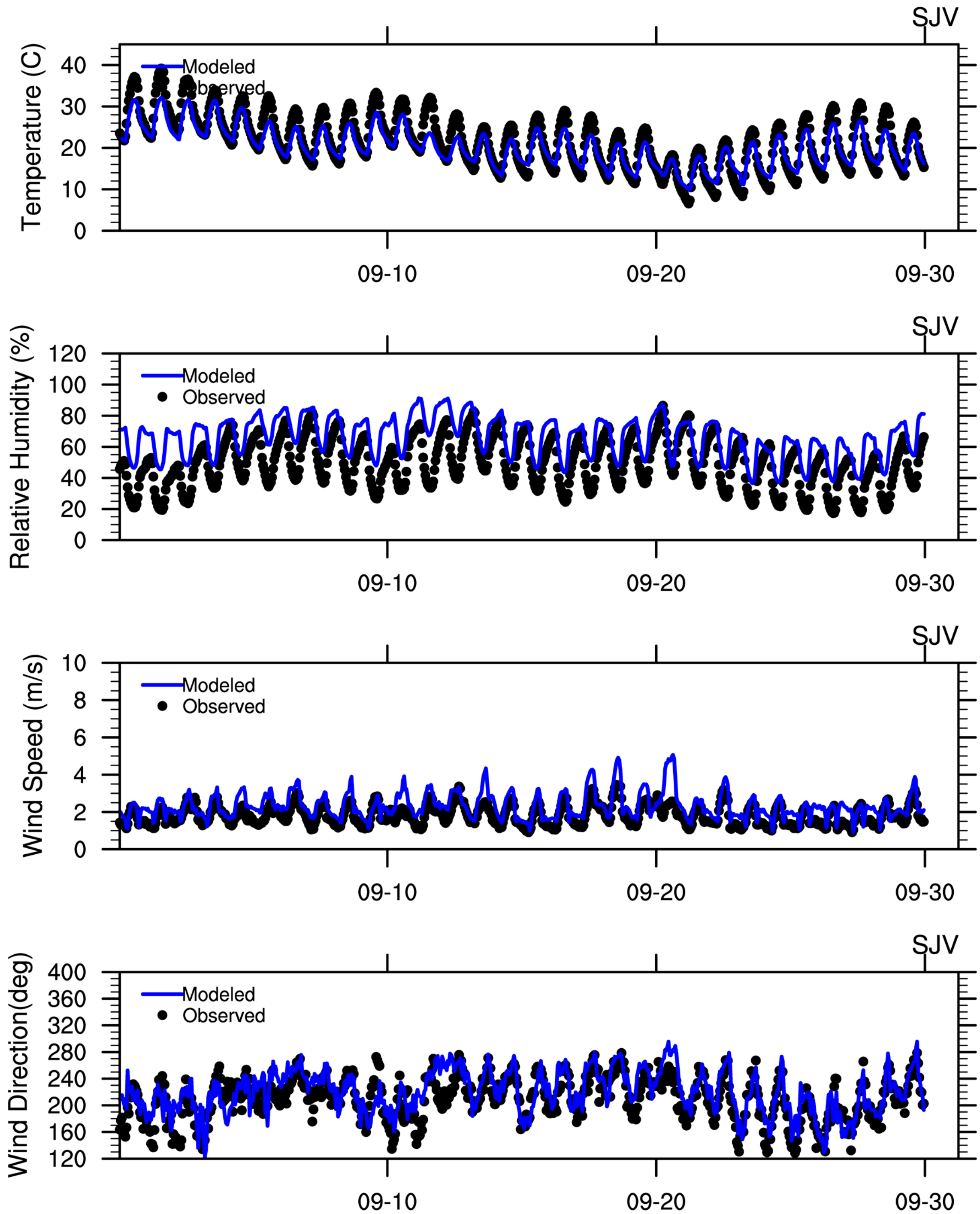


Figure S 10. Time series of temperature, relative humidity, wind speed, and wind direction for San Joaquin Valley in October 2017.

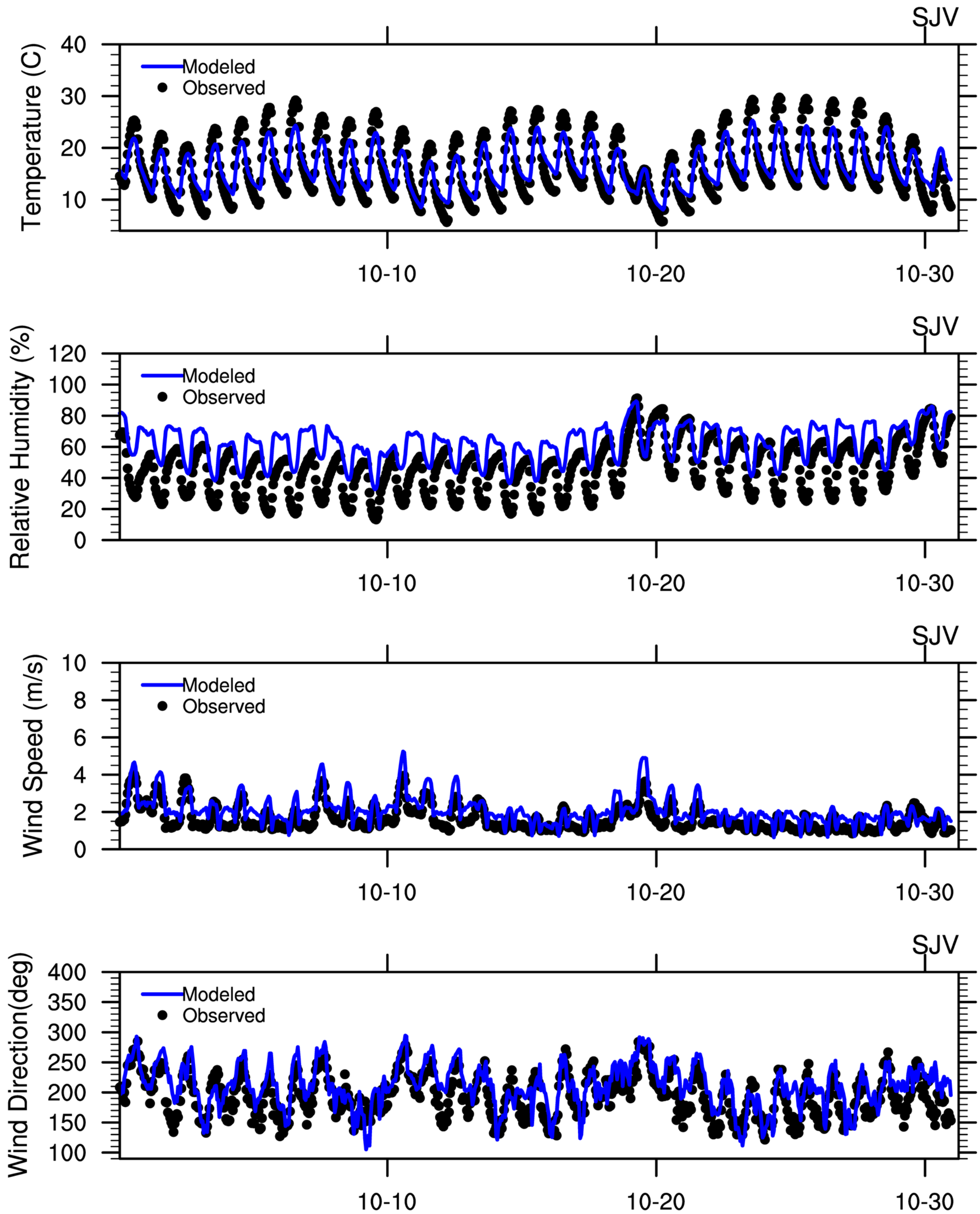


Figure S 11. Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in November 2017.

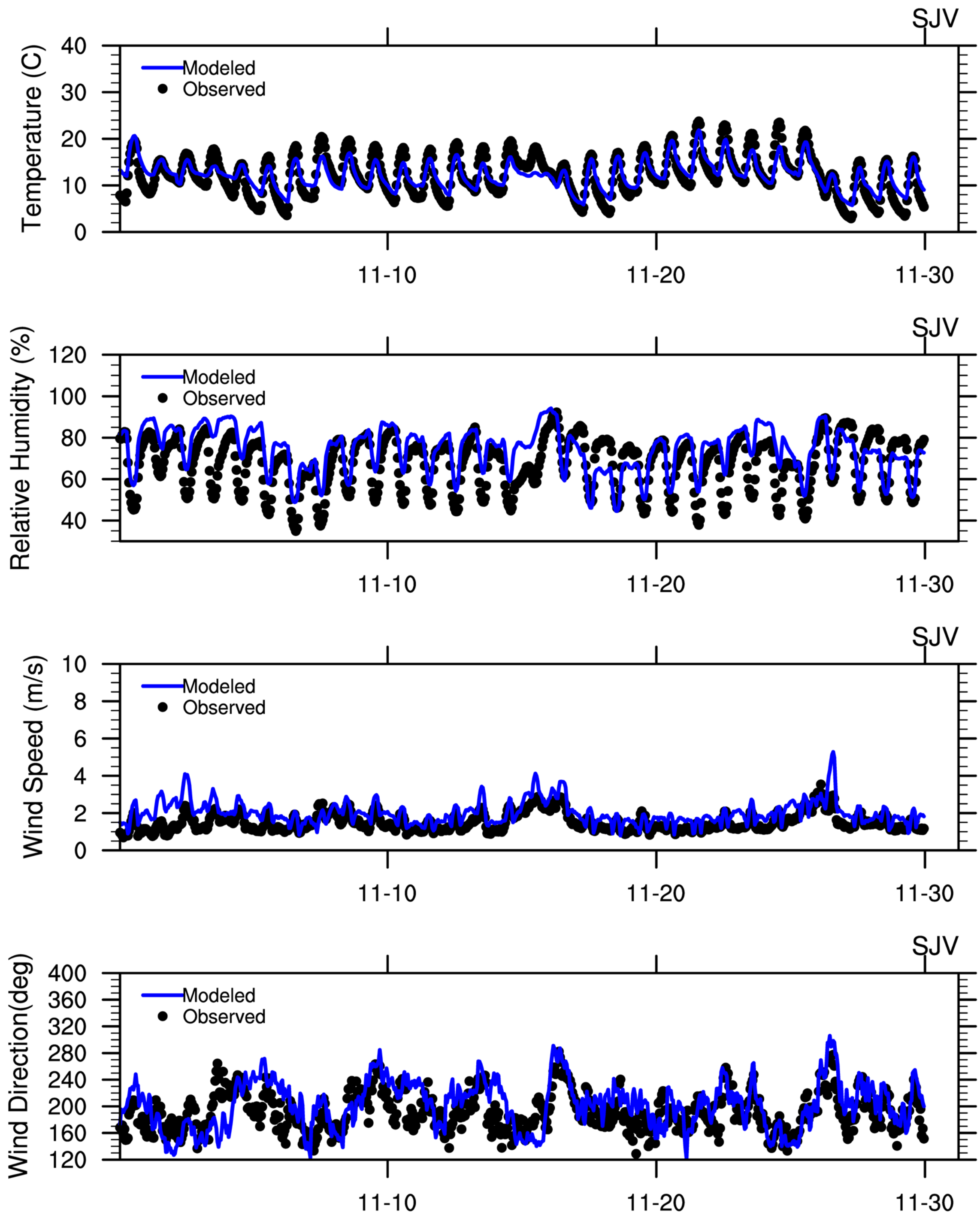


Figure S 12. Time series of temperature, relative humidity, wind speed and wind direction for San Joaquin Valley in December 2017.

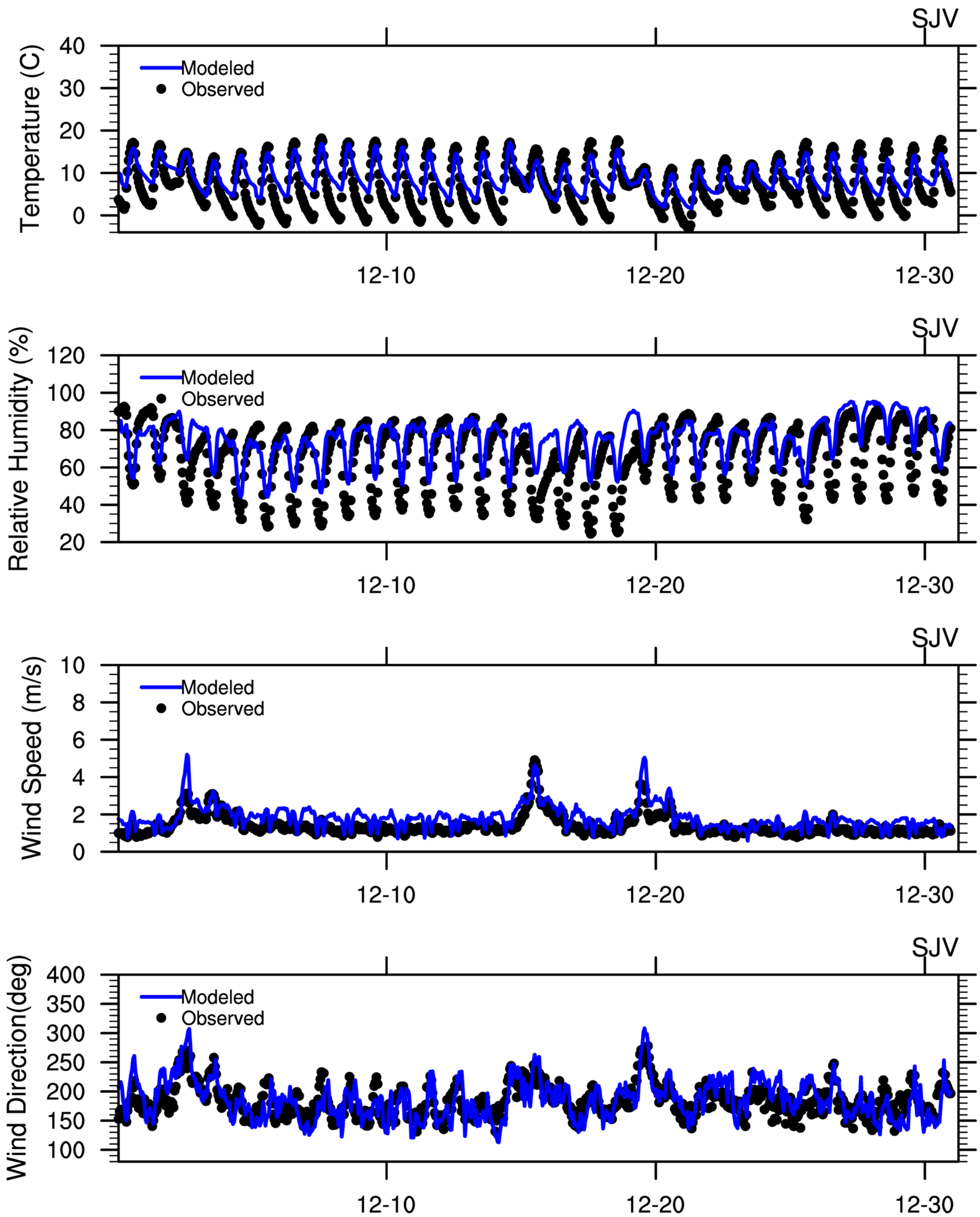


Figure S 13. Hourly surface temperature mean bias in each quarter of 2017.

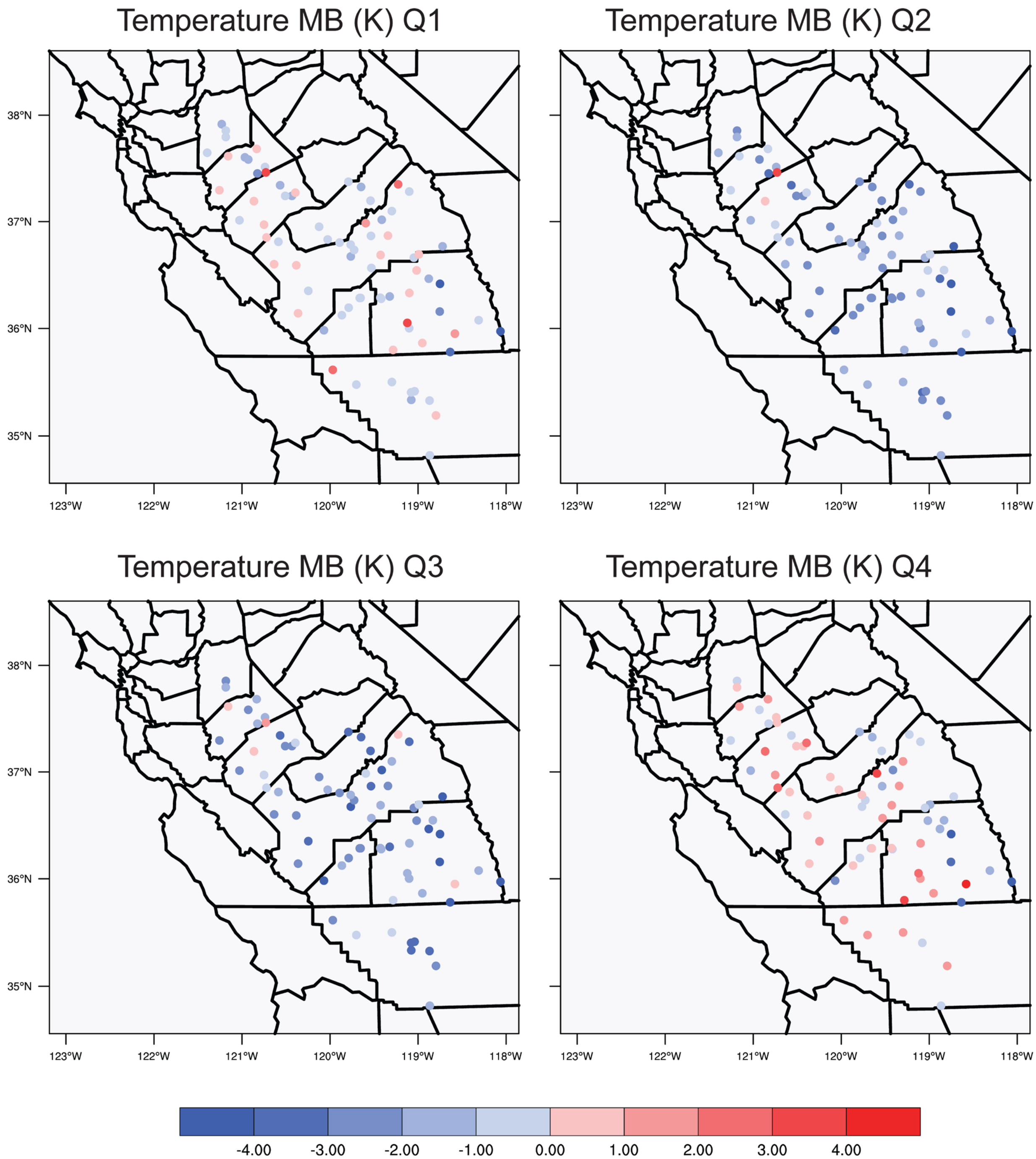


Figure S 14. Hourly surface temperature mean error in each quarter of 2017.

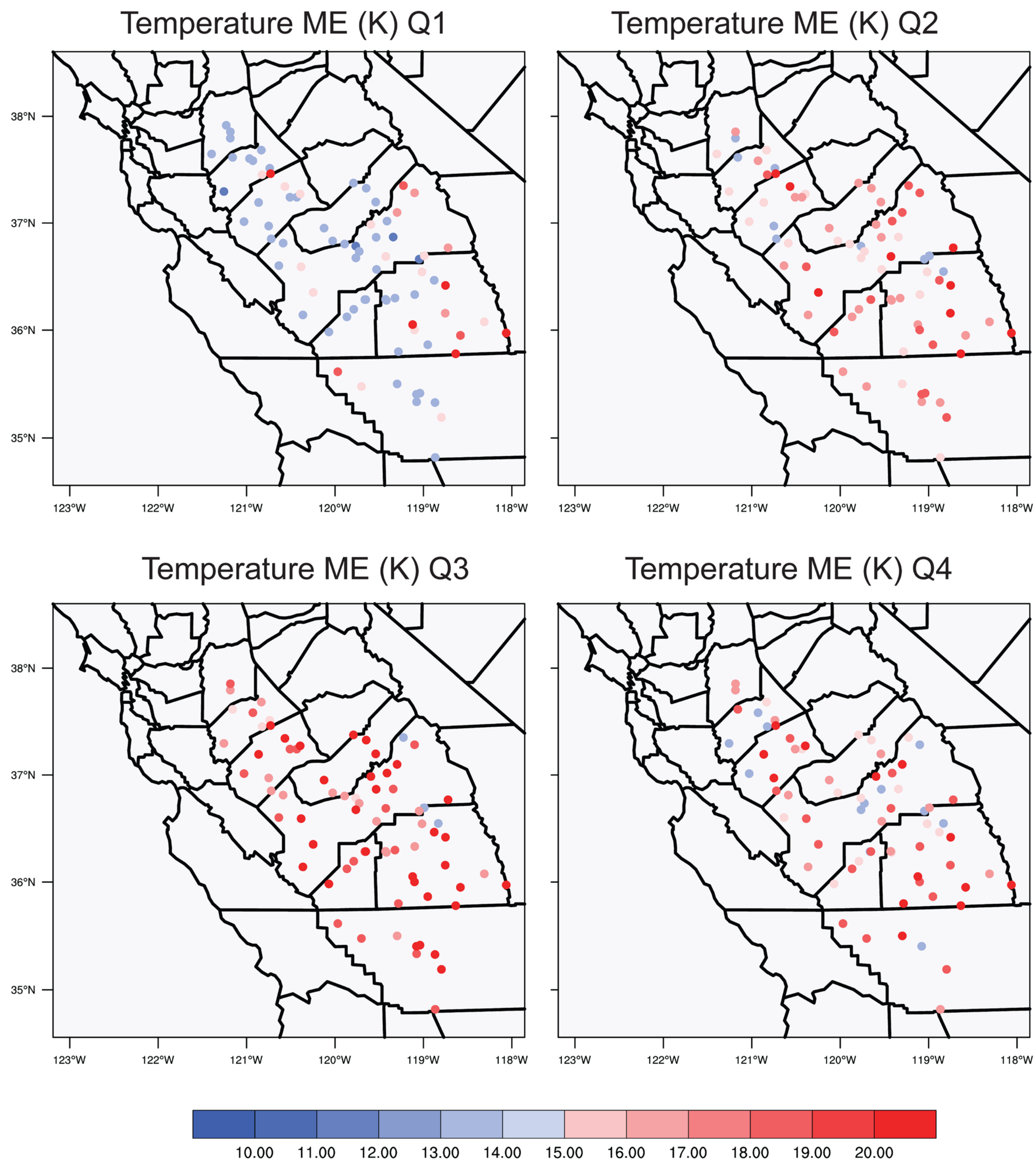


Figure S 15. Hourly surface wind speed mean bias in each quarter of 2017.

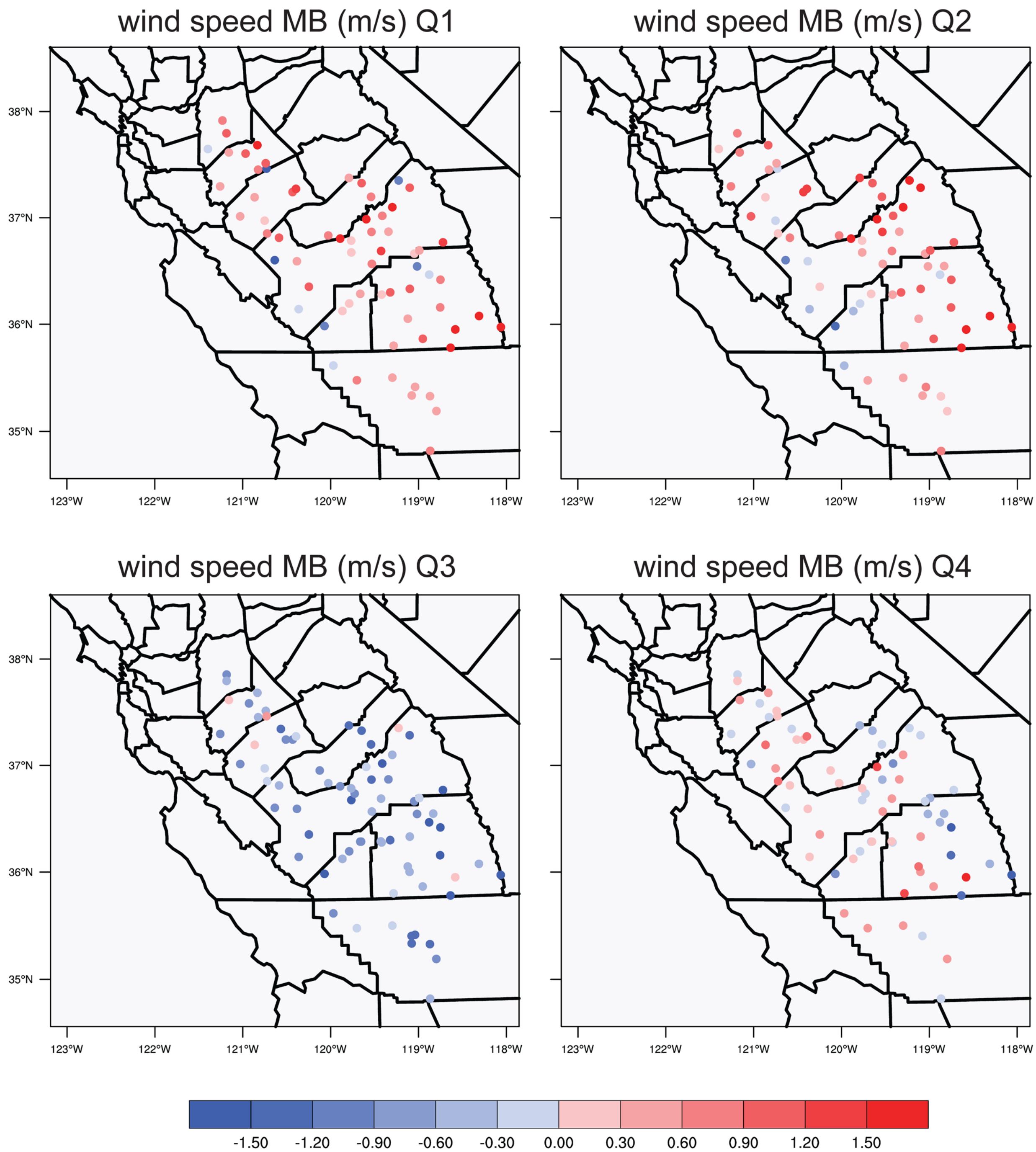


Figure S 16. Hourly surface wind speed mean error in each quarter of 2017.

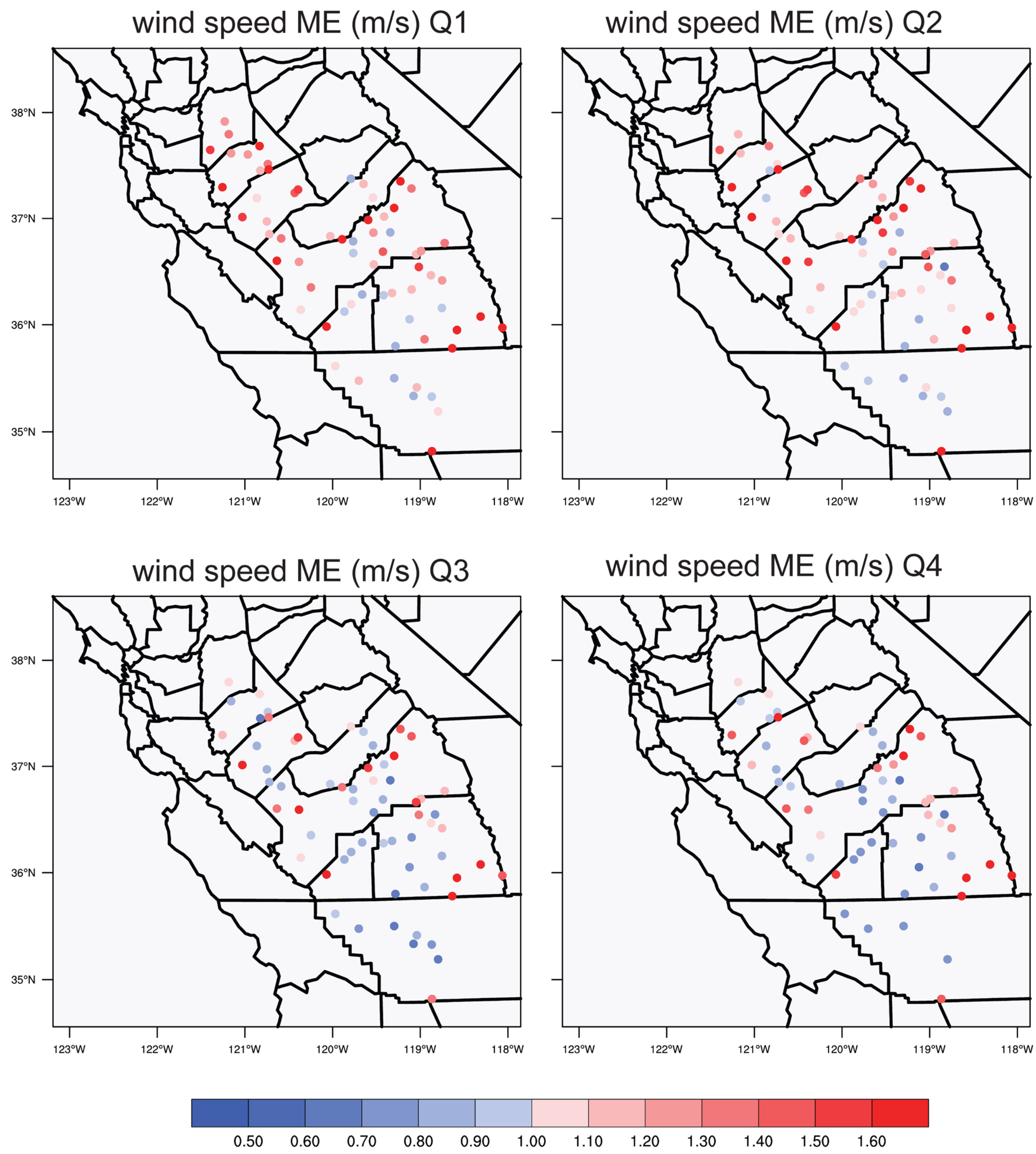


Figure S 17. Hourly surface relative humidity mean bias in each quarter of 2017.

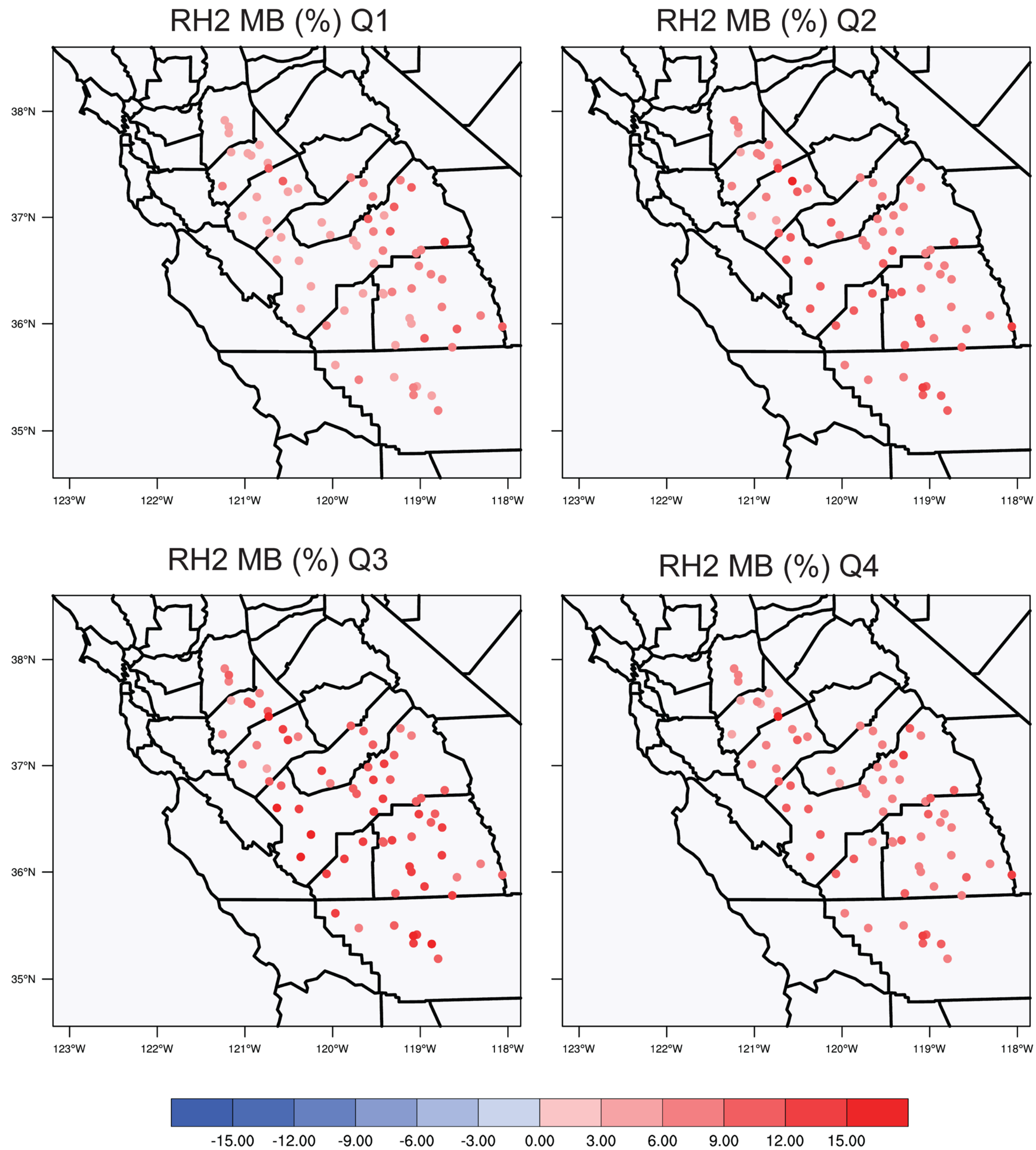


Figure S 18. Hourly surface relative humidity mean error in each quarter of 2017.

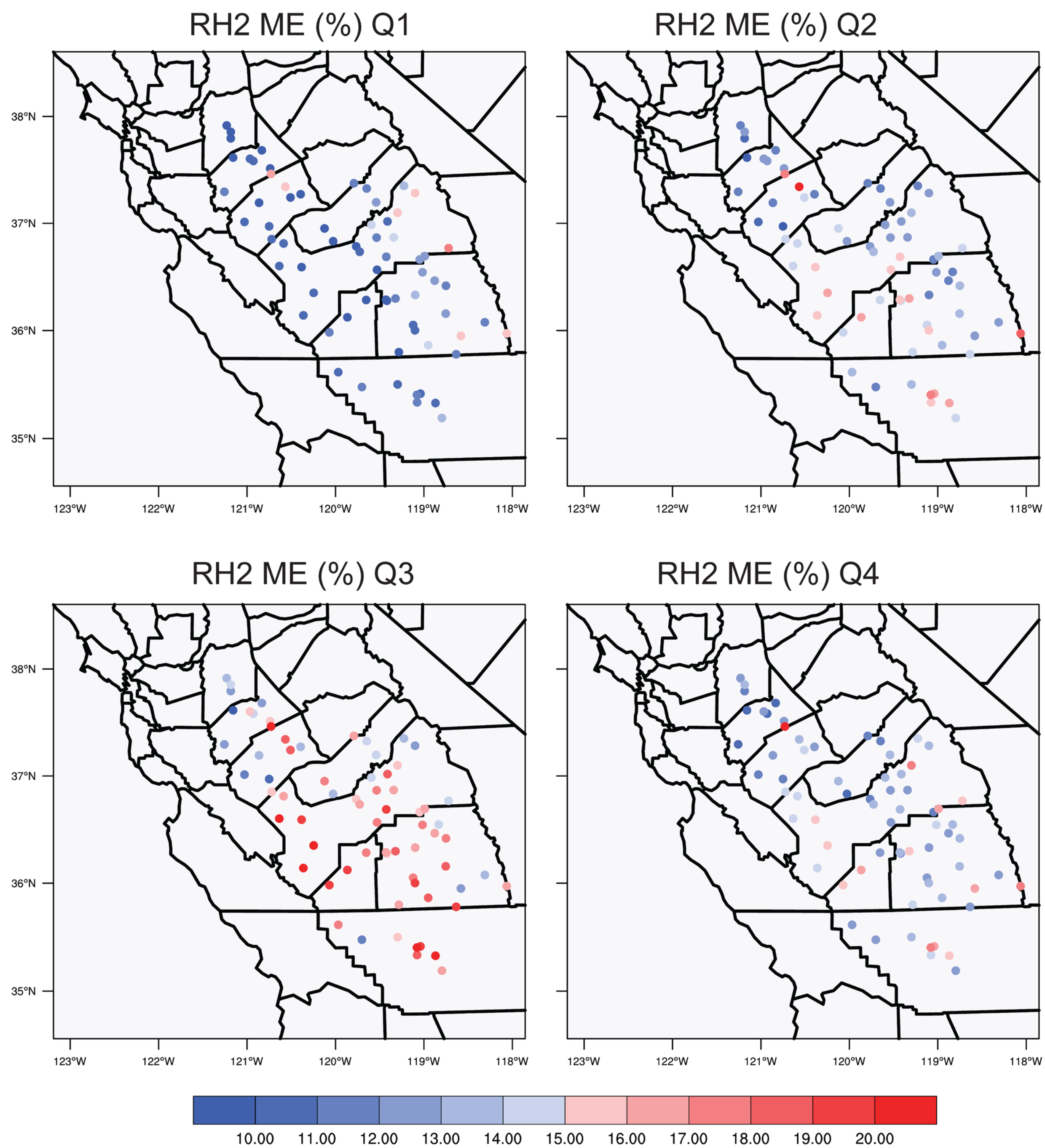


Figure S 19. Hourly precipitation for sites Modesto #3, Fresno State #2, and Belridge for January 2017.

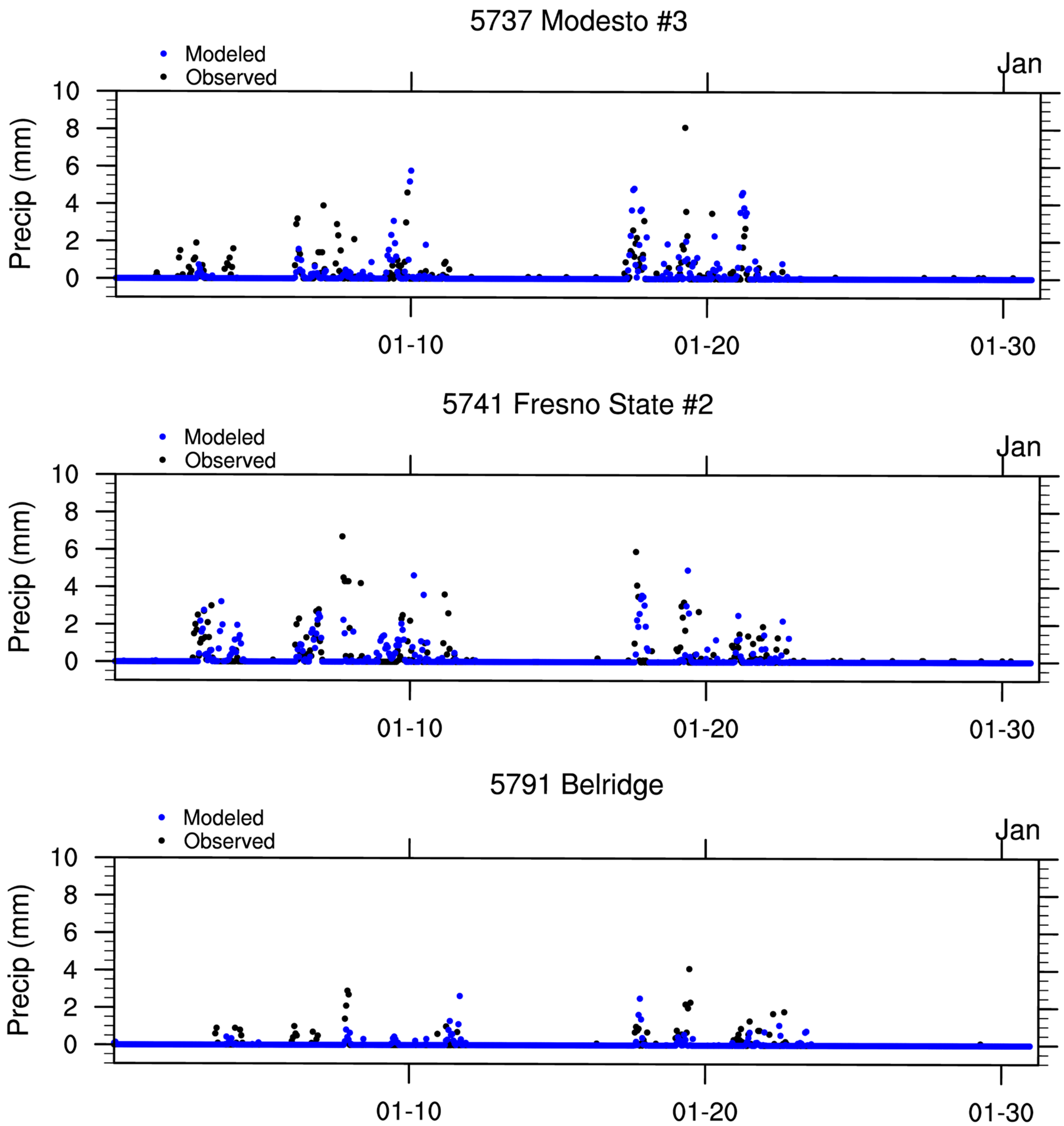


Figure S 20. Same as Figure S 19, but for February 2017.

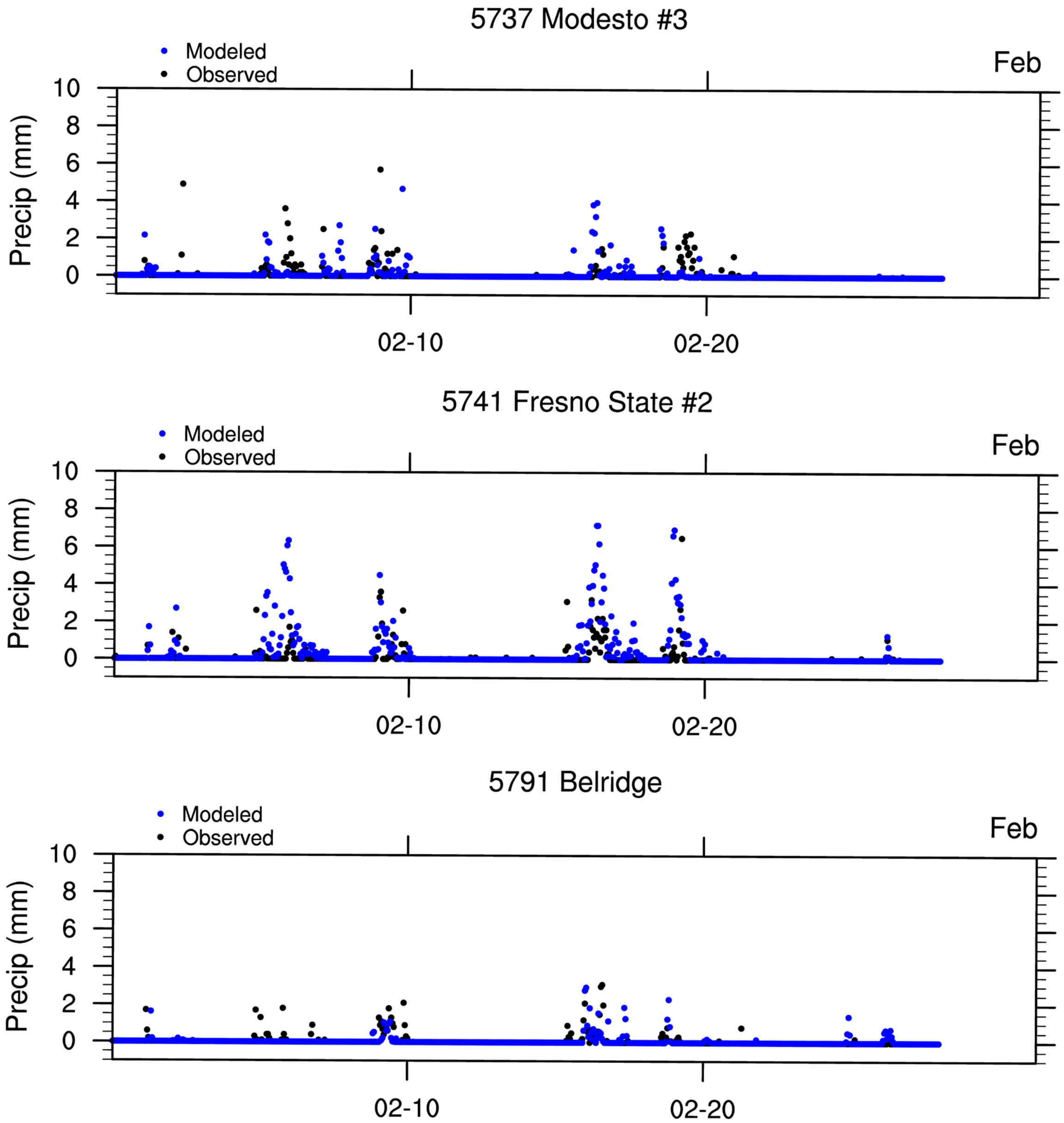


Figure S 21. Same as Figure S 19, but for March 2017.

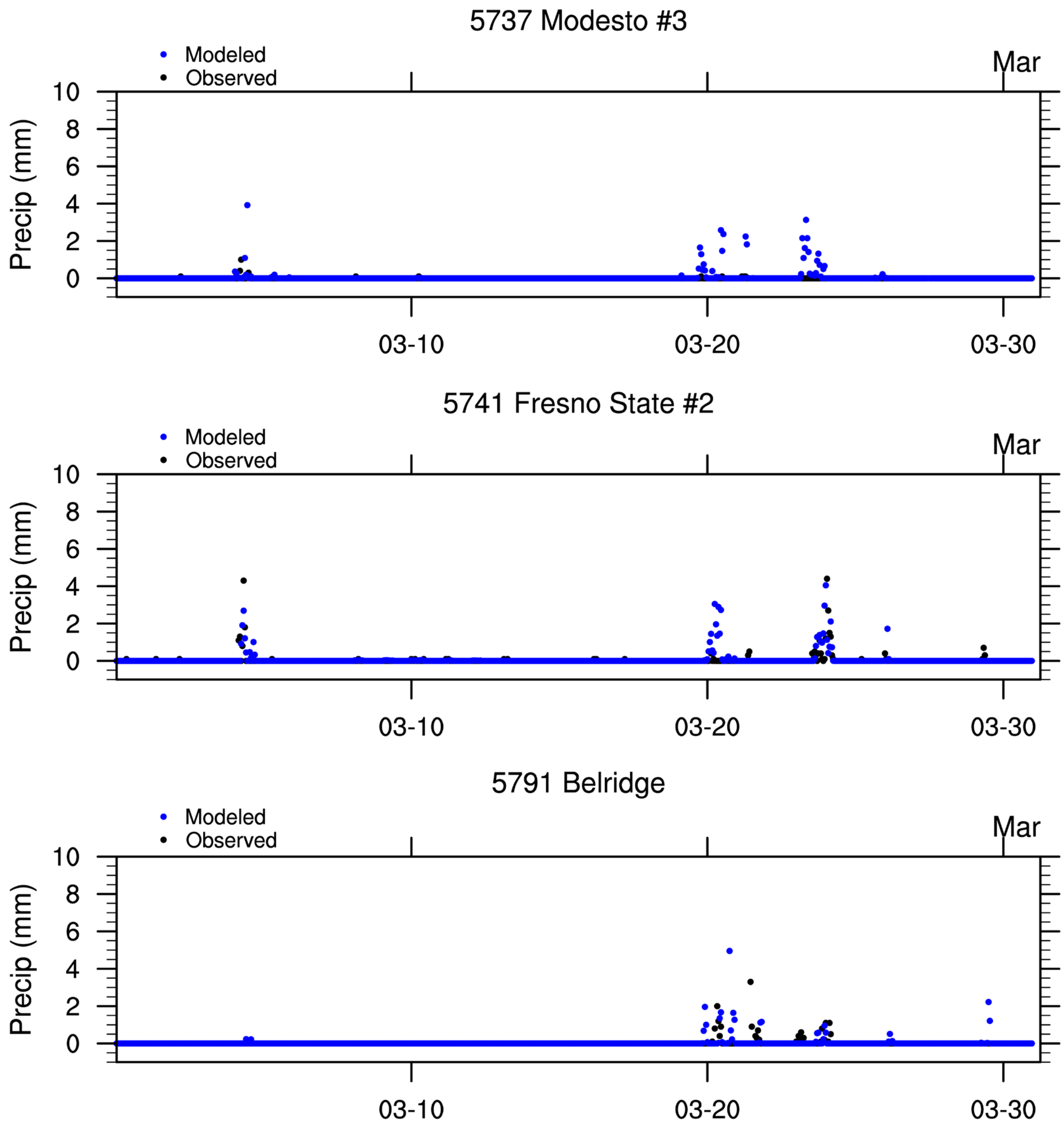


Figure S 22. Same as Figure S 19, but for November 2017.

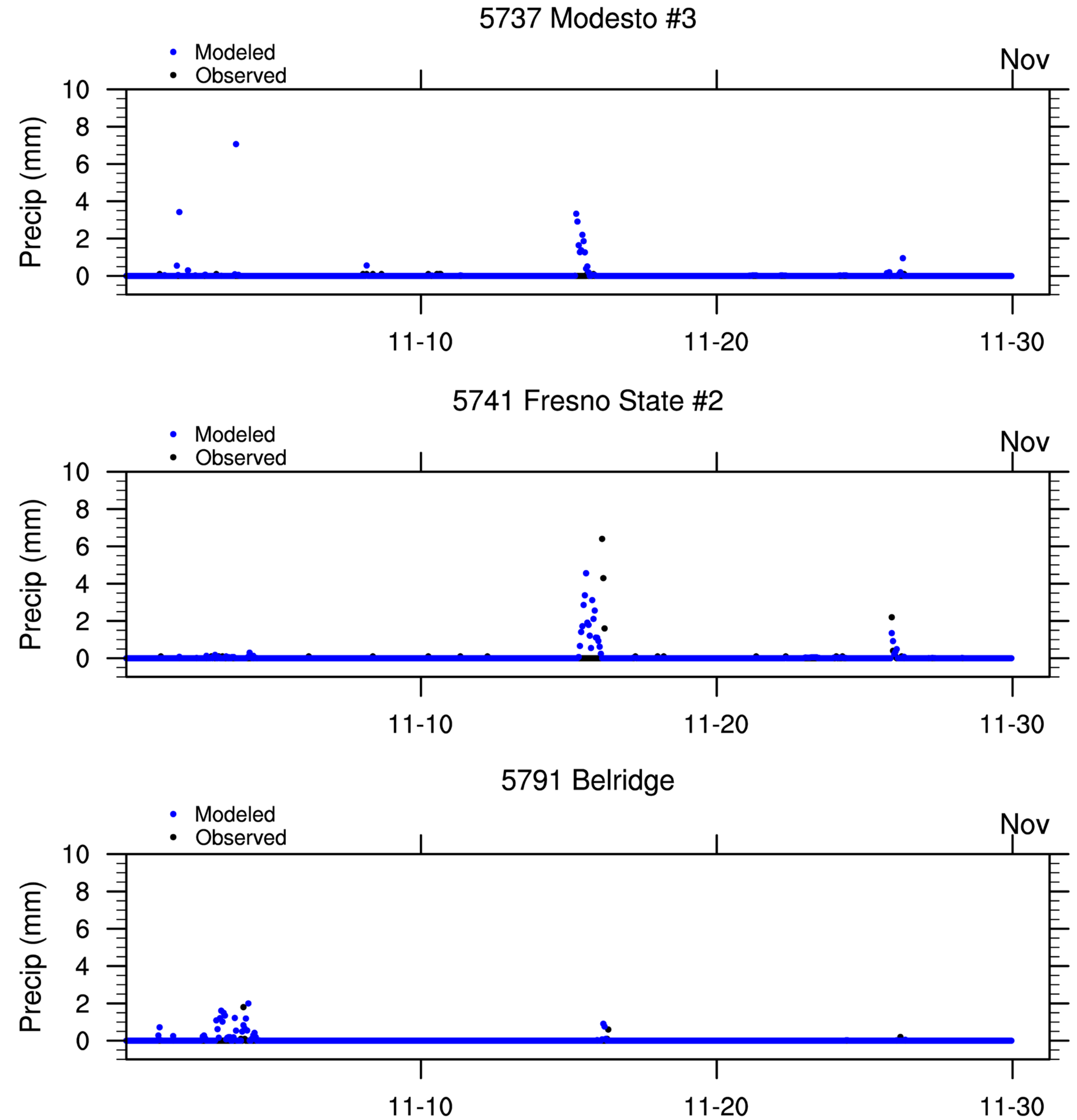


Figure S 23. Same as Figure S 19, but for December 2017.

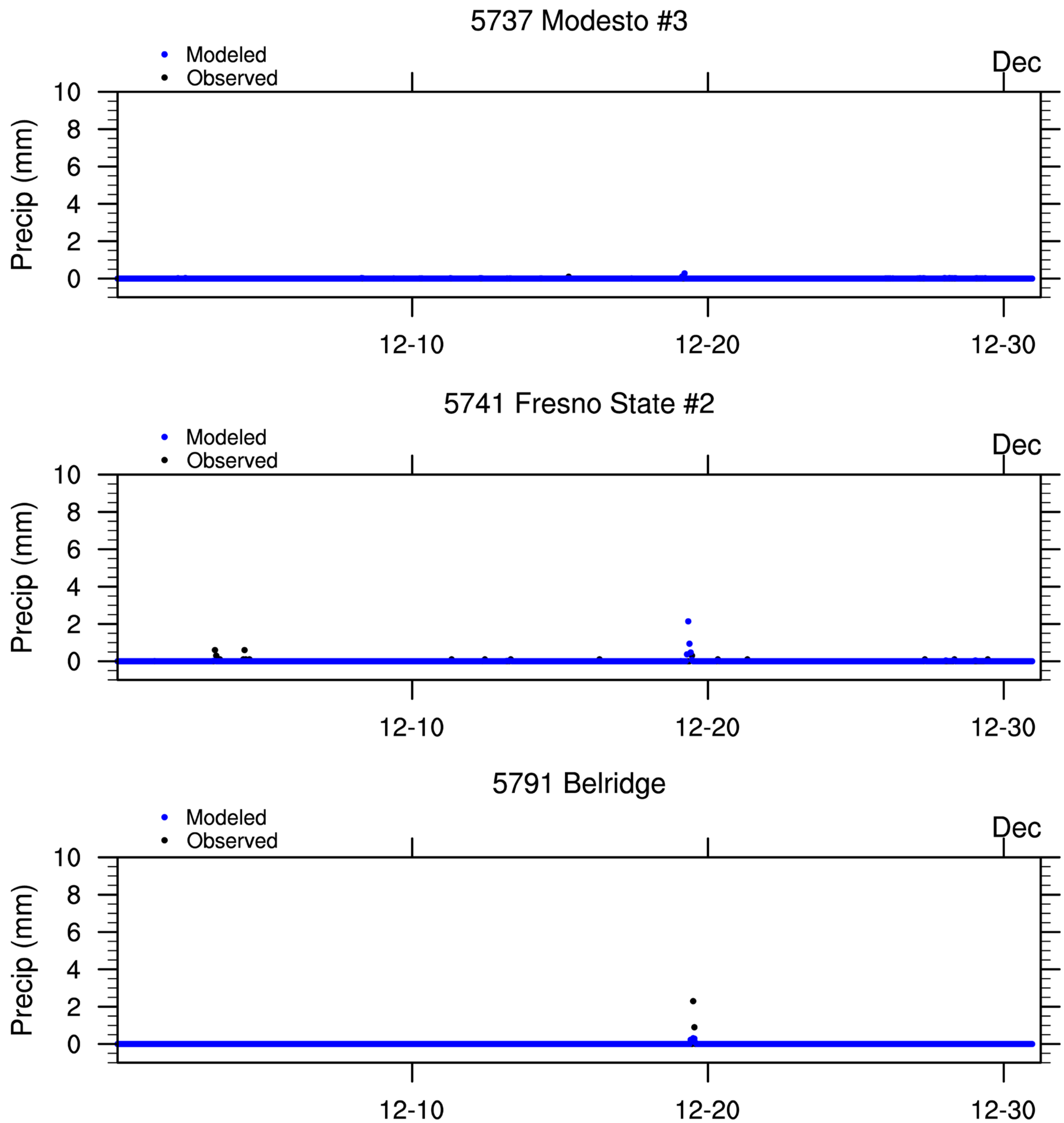


Figure S 24. Comparison of time series of observed (from CSN measurement) and modeled $PM_{2.5}$ species at Bakersfield.

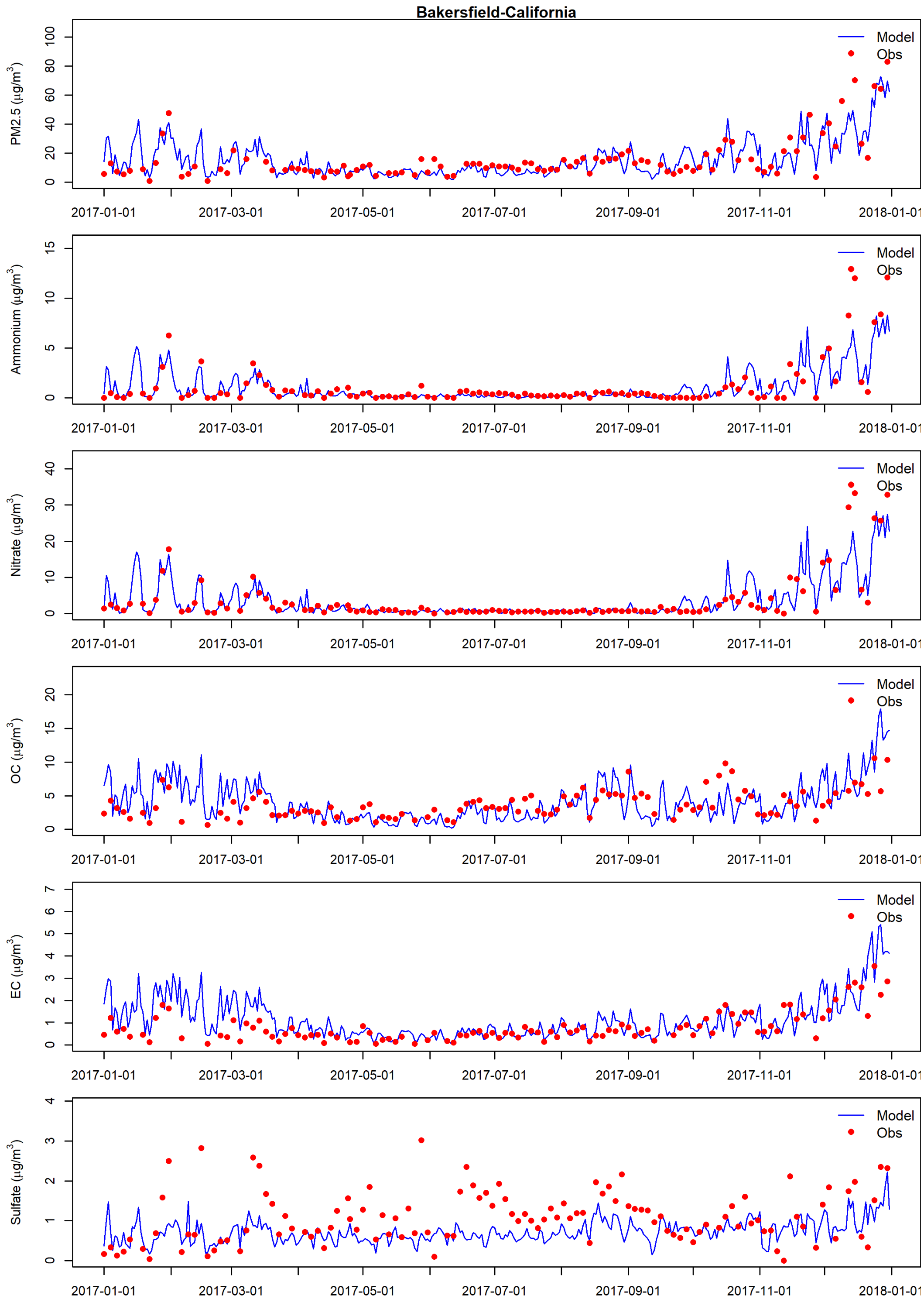


Figure S 25. Comparison of time series of observed (from CSN measurement) and modeled PM2.5 species at Fresno.

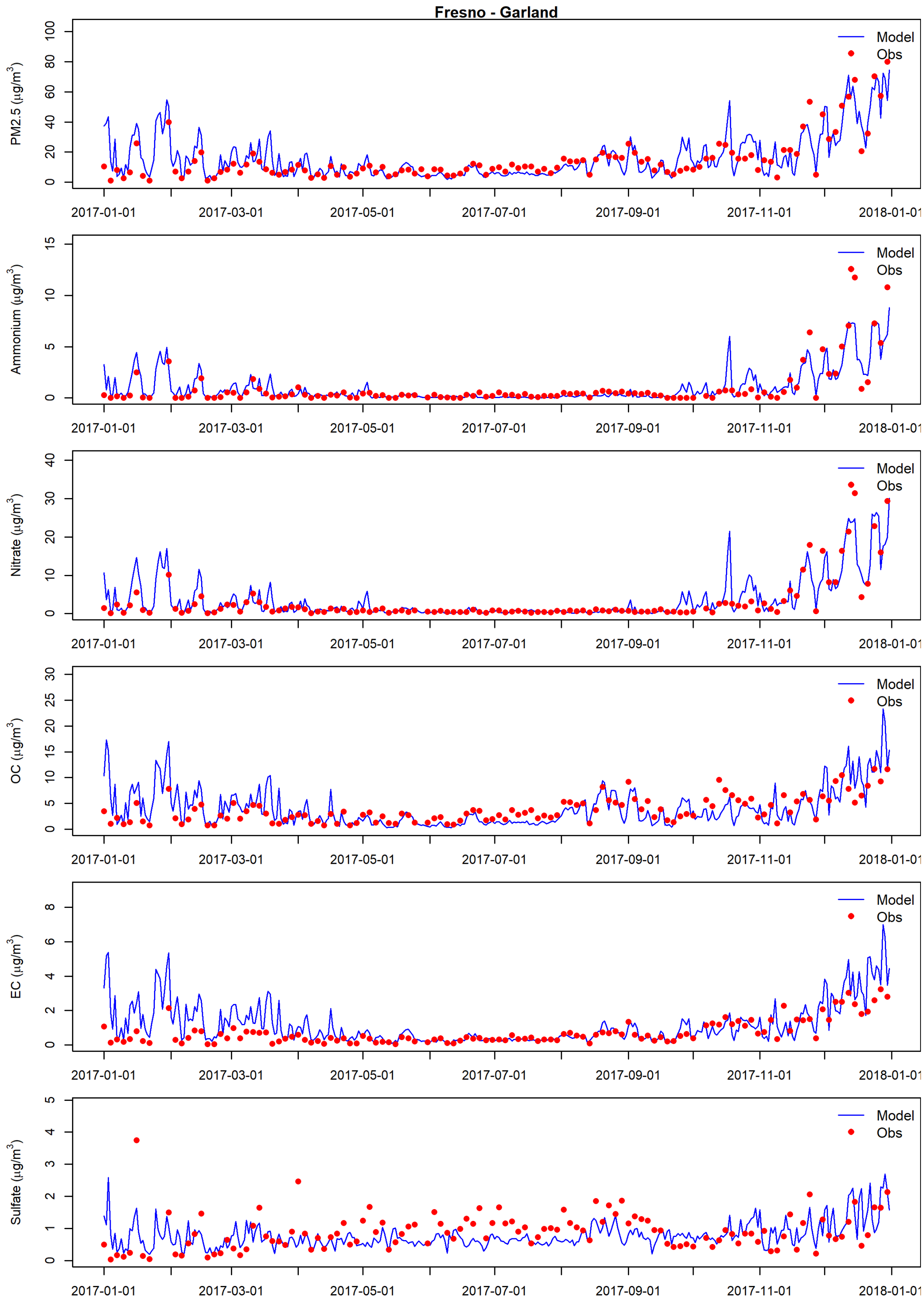
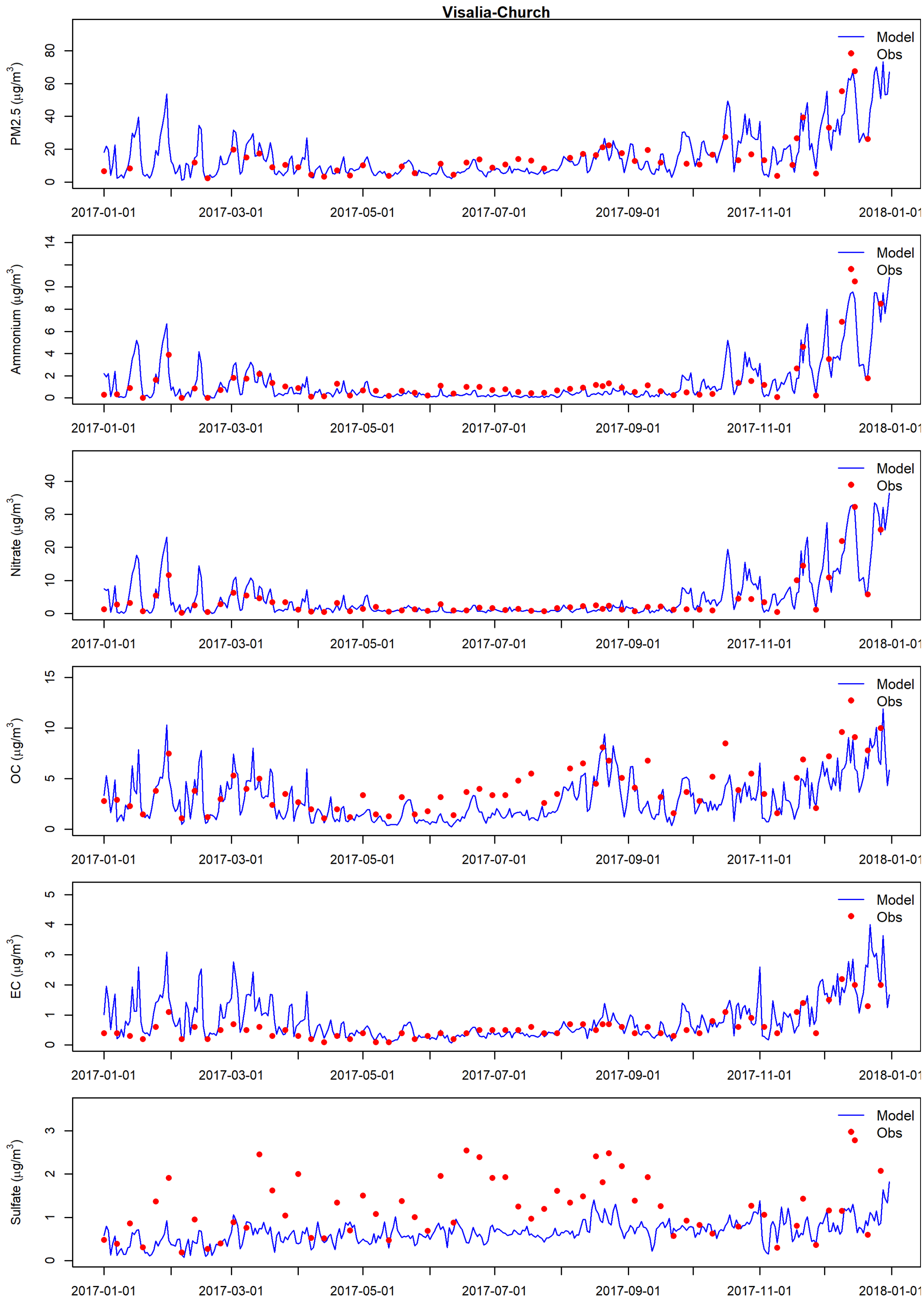


Figure S 26. Comparison of time series of observed (from CSN measurement) and modeled $PM_{2.5}$ species at Visalia.



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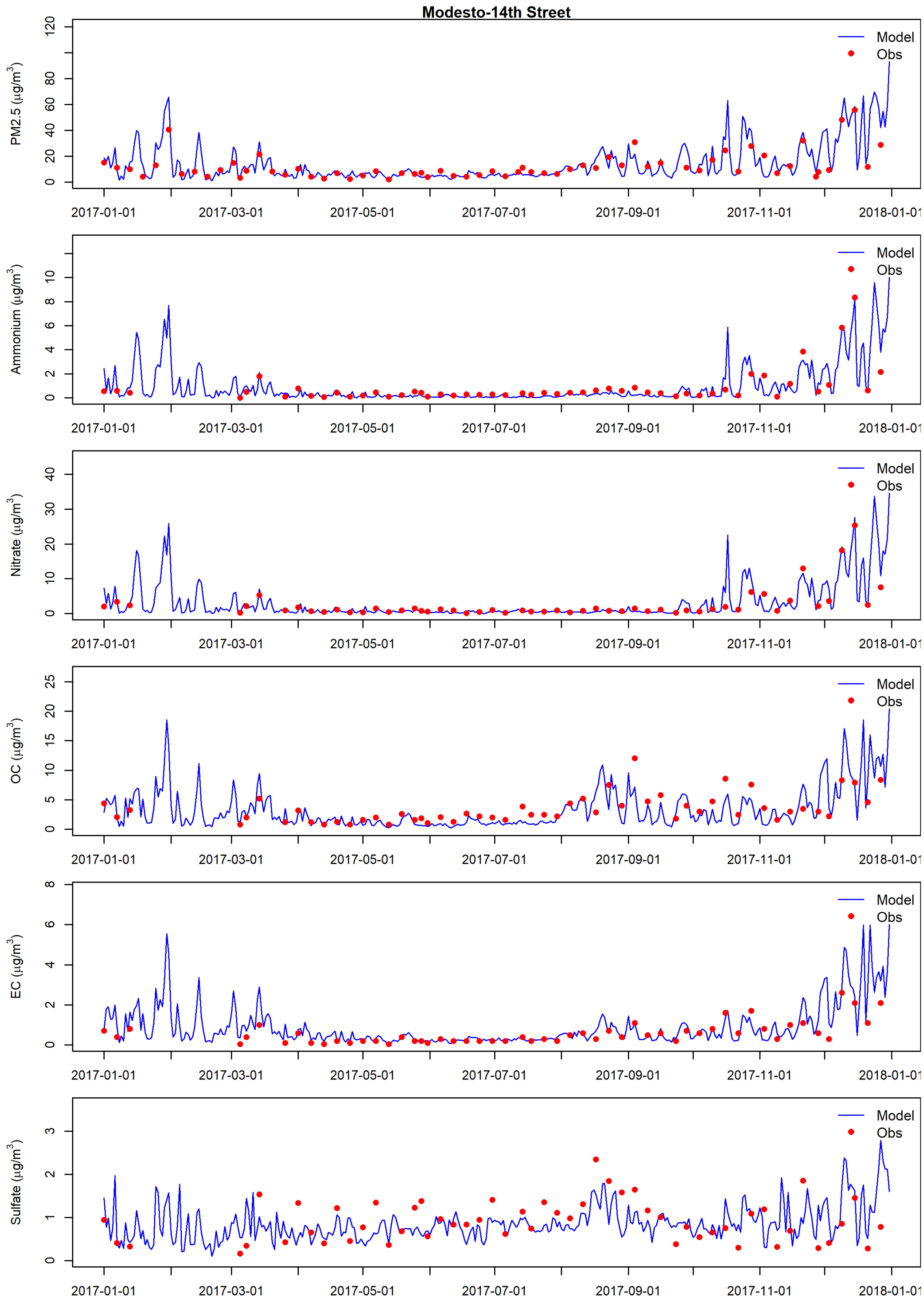
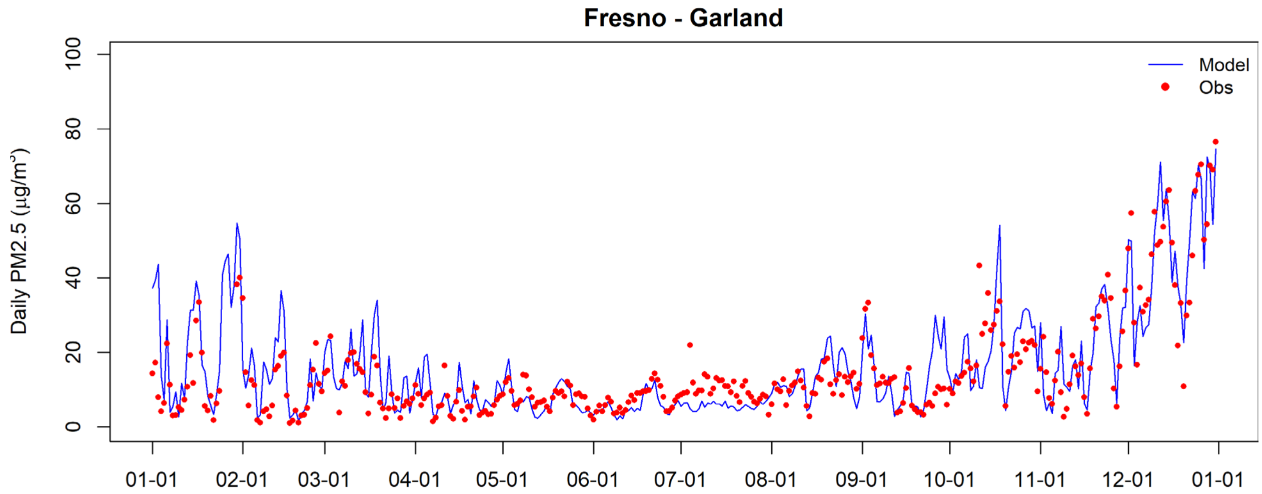


Figure S 28. Observed and modeled 24-hour average $PM_{2.5}$ at Fresno – Garland.



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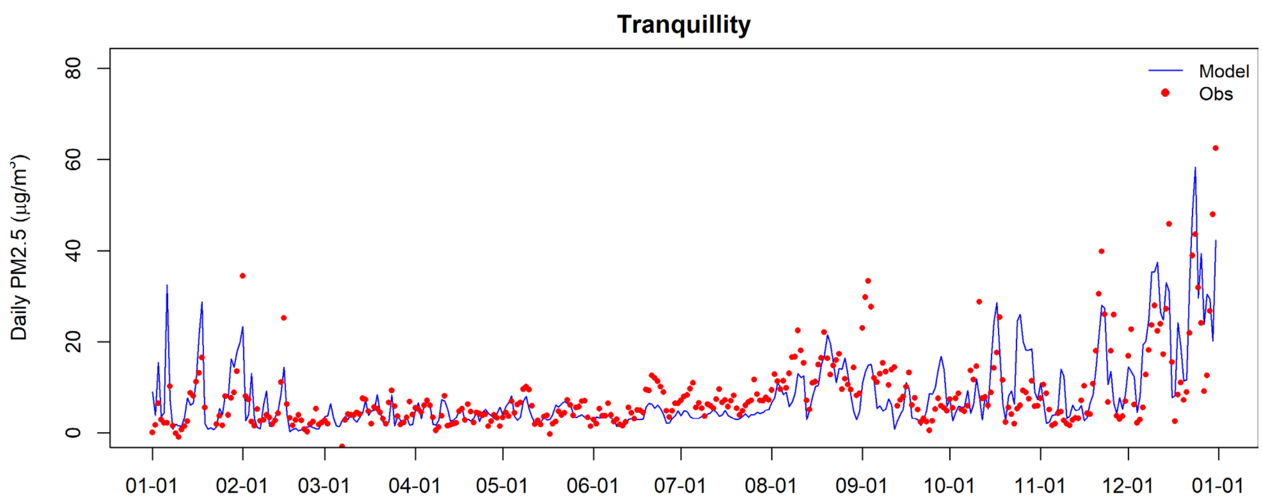
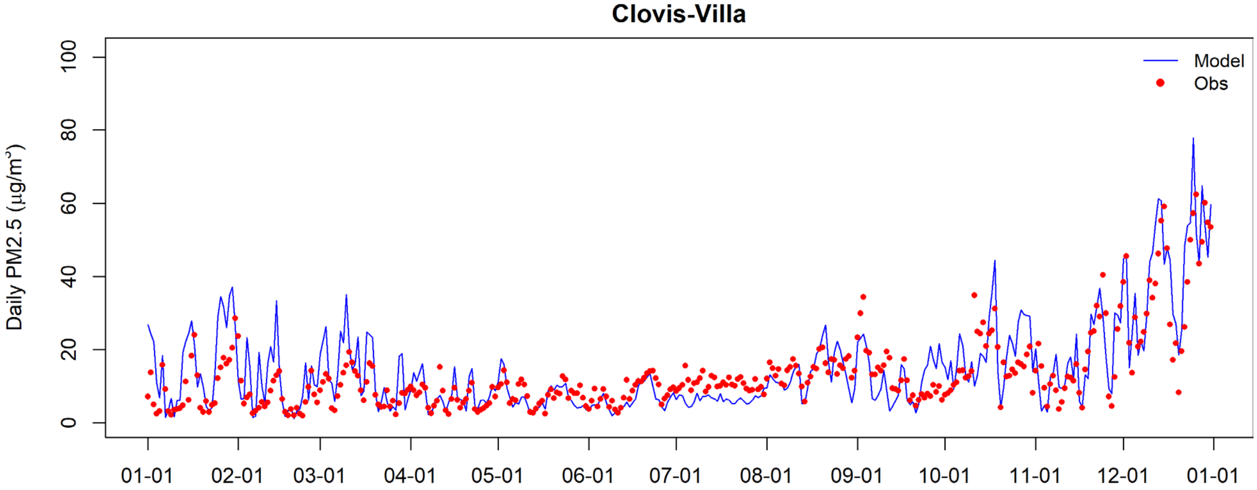


Figure S 30. Observed and modeled 24-hour average $PM_{2.5}$ at Clovis.



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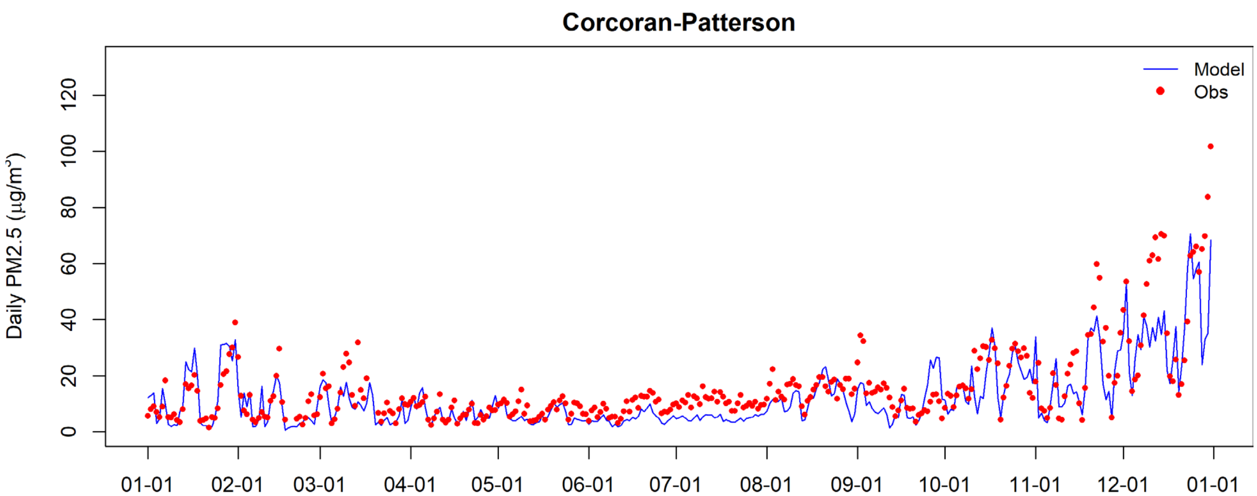
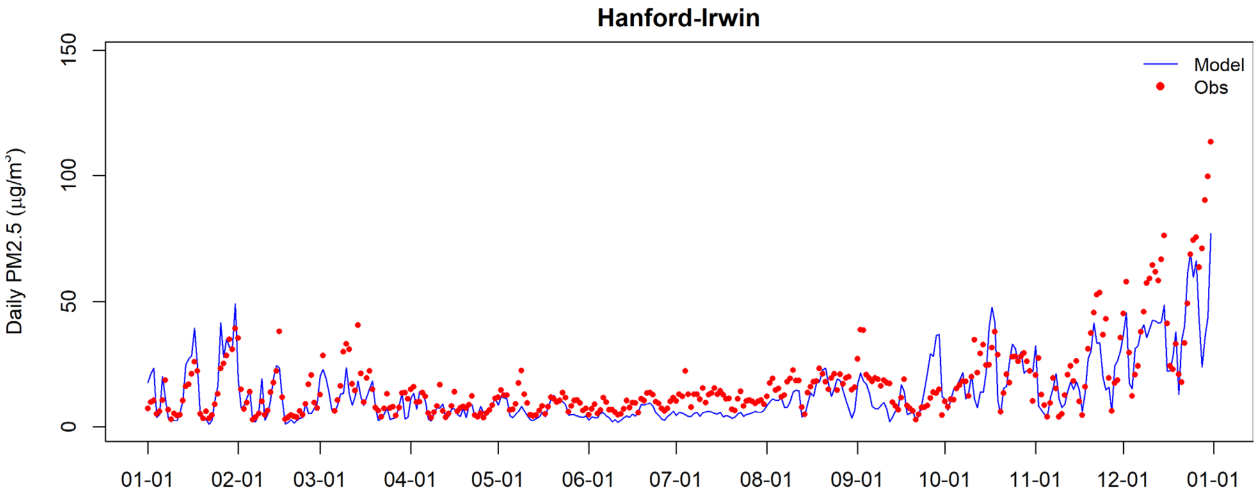


Figure S 32. Observed and modeled 24-hour average $PM_{2.5}$ at Hanford.



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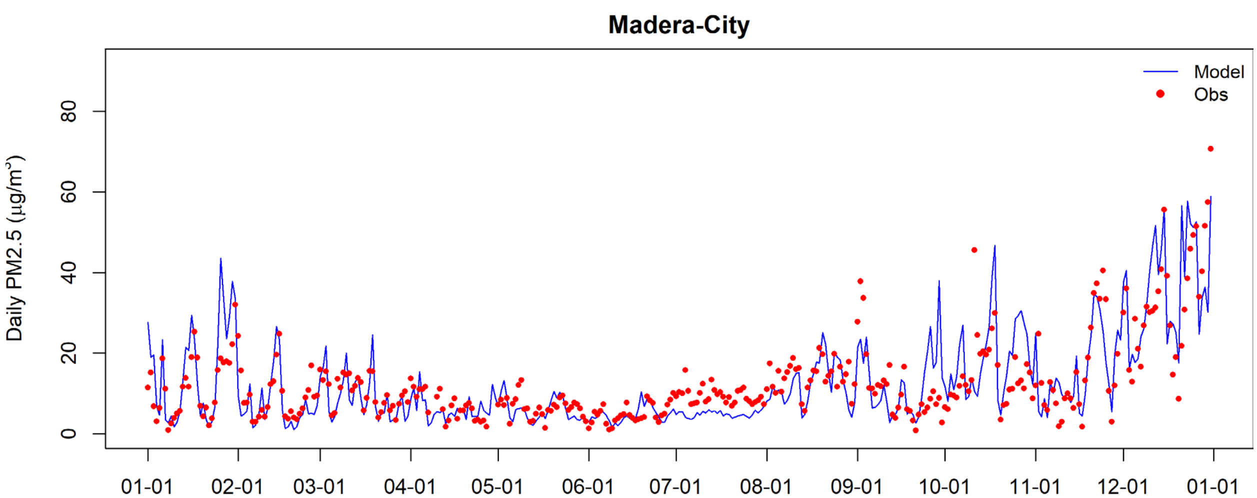

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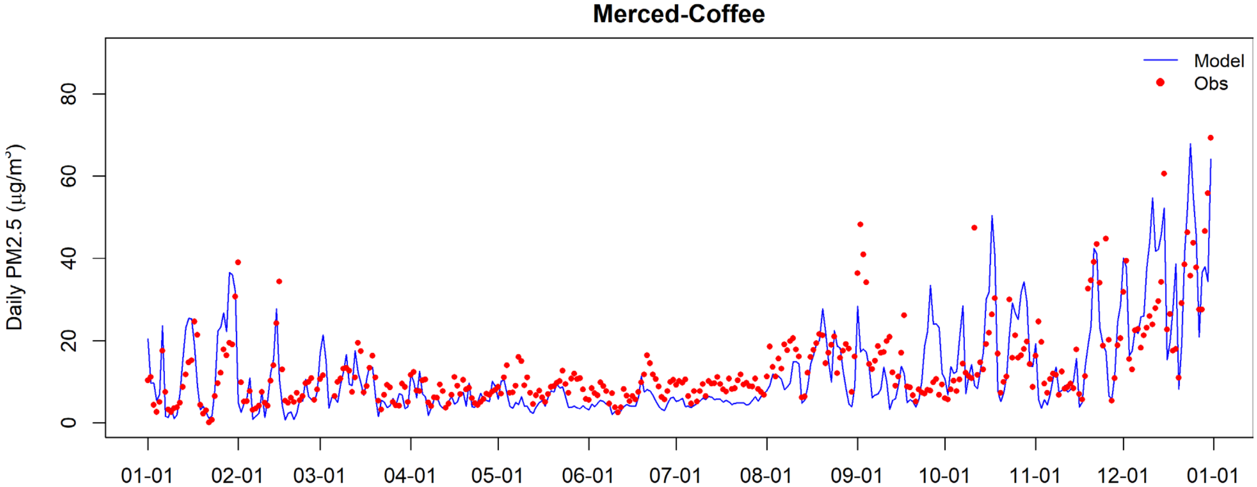

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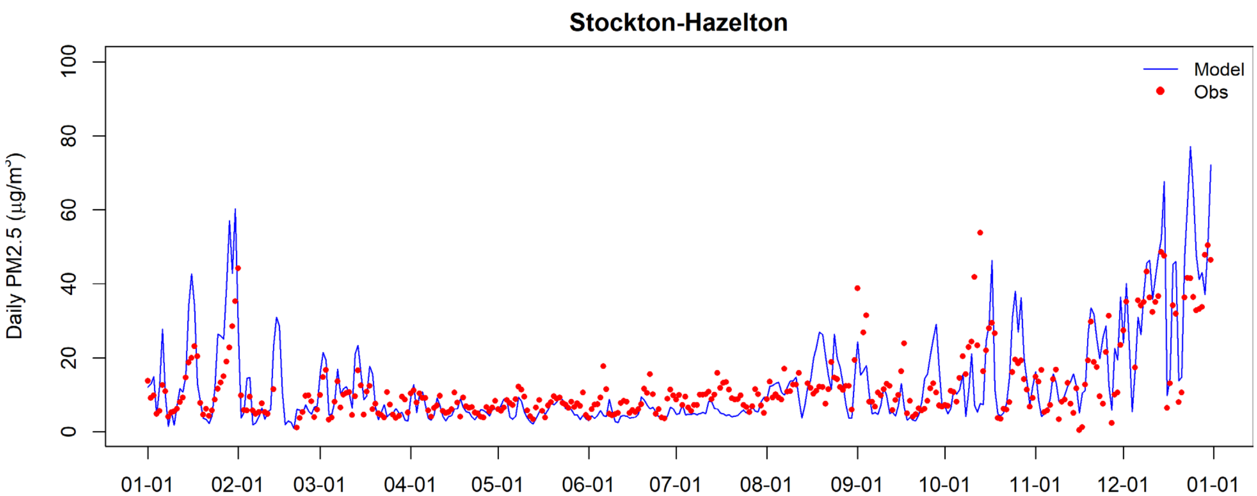


Figure S 36. Observed and modeled 24-hour average $PM_{2.5}$ at Manteca.

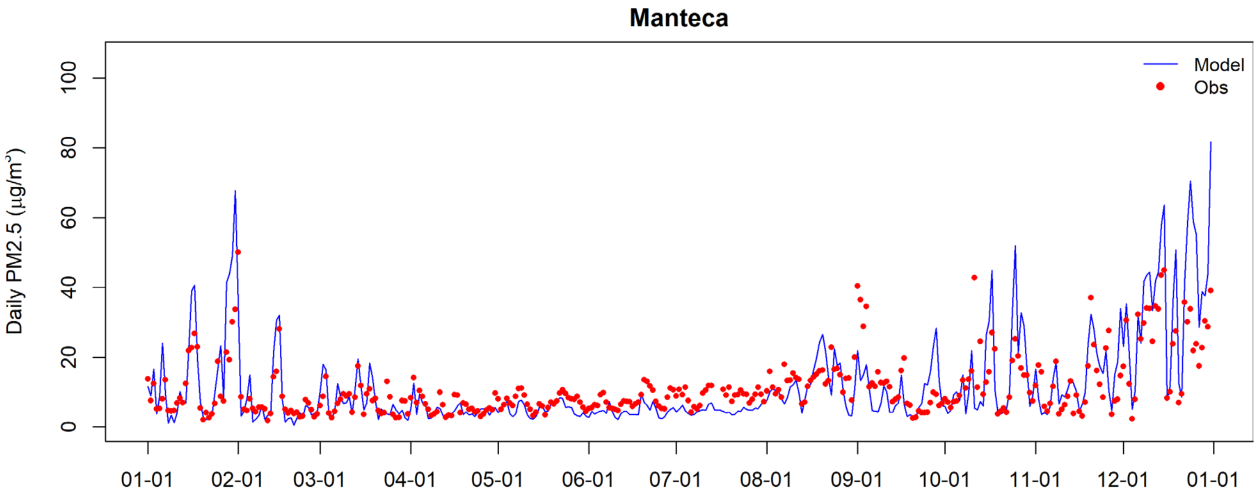


Figure S 37. Observed and modeled 24-hour average $PM_{2.5}$ at Modesto.

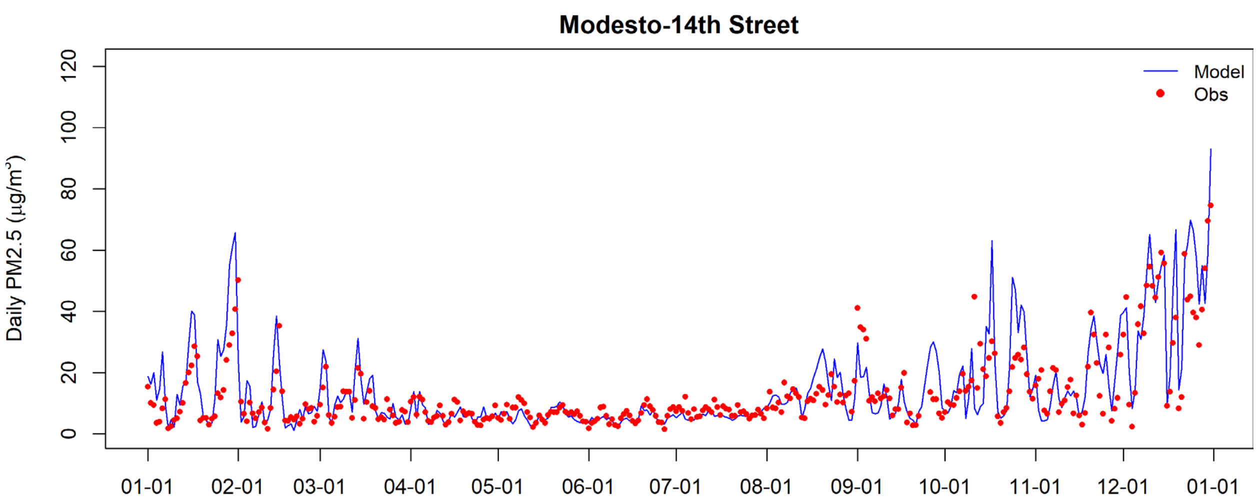


Figure S 38. Observed and modeled 24-hour average $PM_{2.5}$ at Turlock.

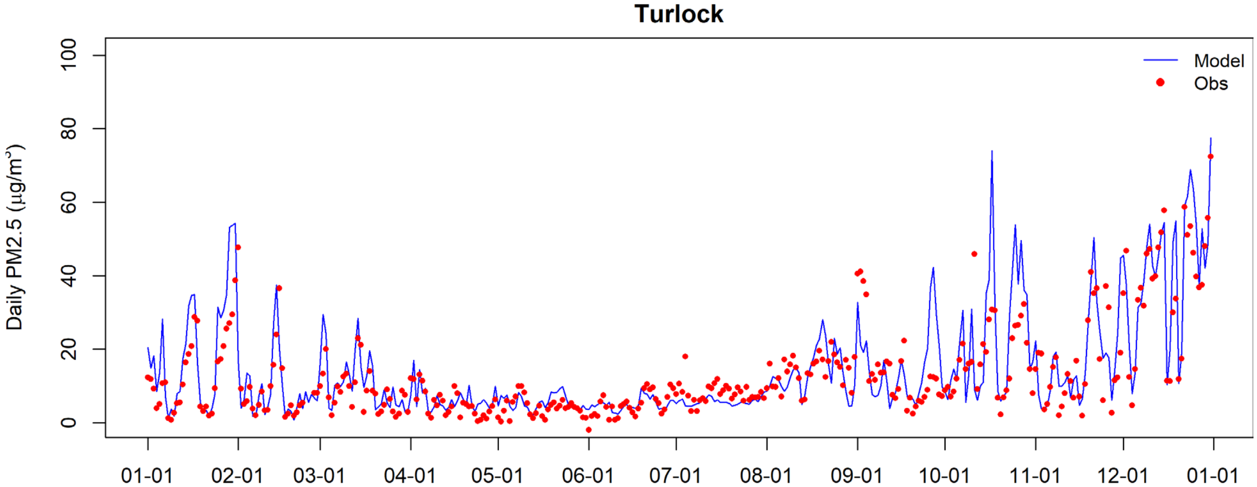


Figure S 39. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Fresno – Drummond Street.

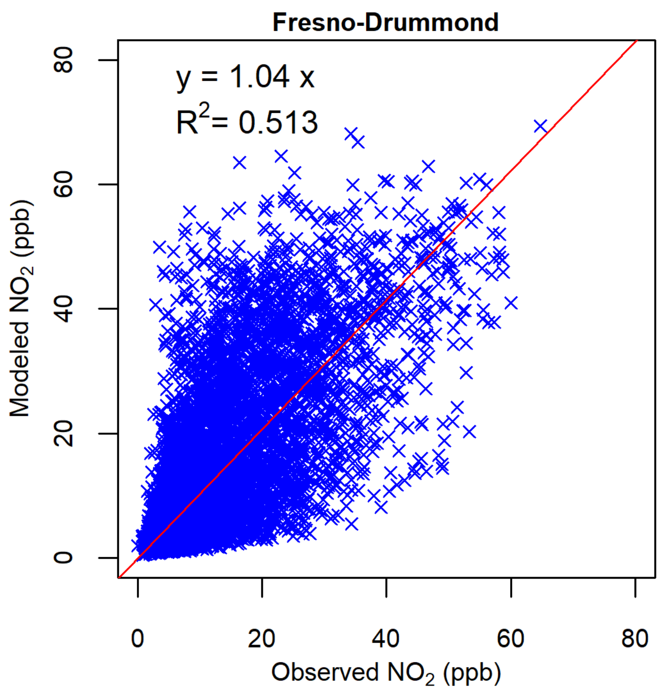


Figure S 40. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Visalia.

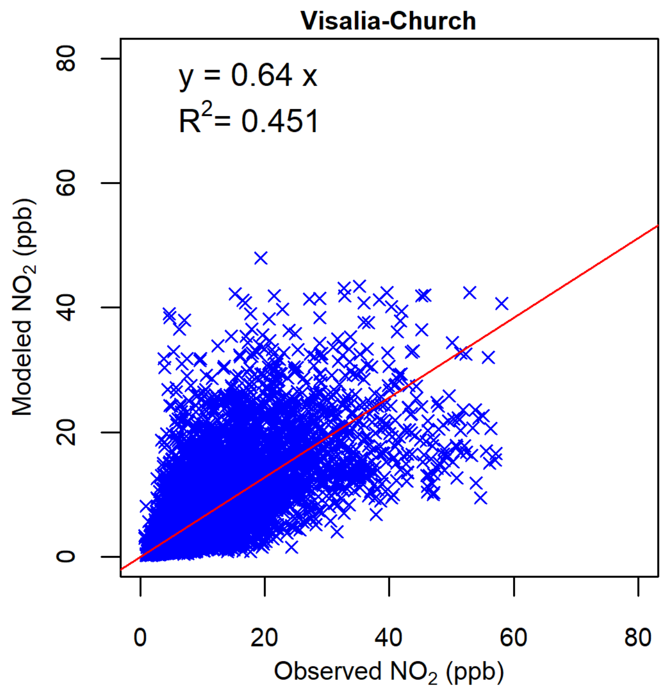


Figure S 41. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Stockton.

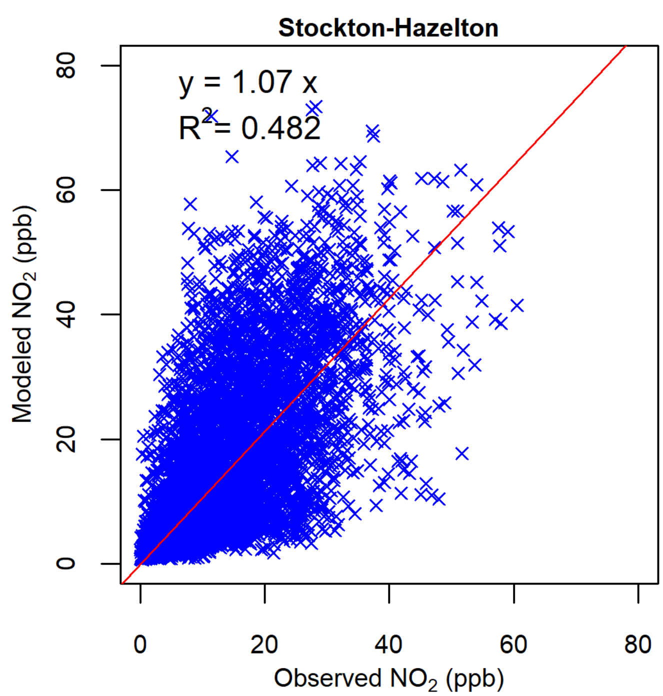


Figure S 42. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Parlier.

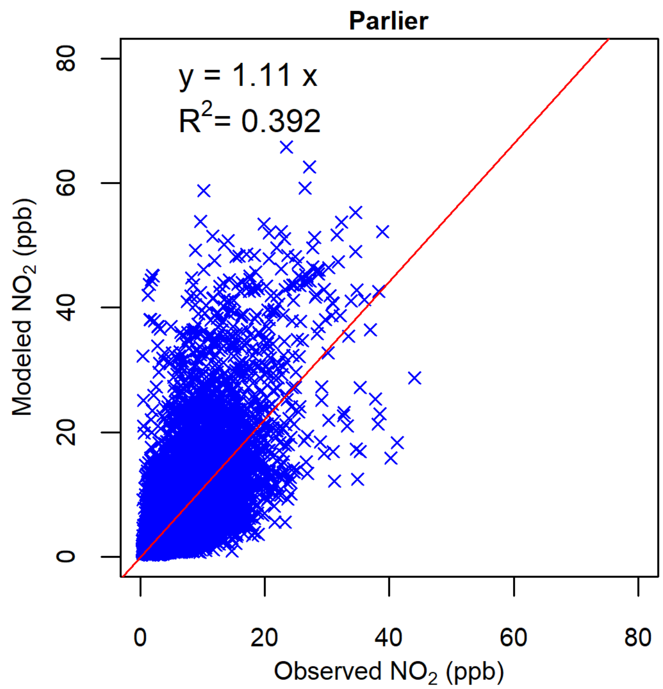


Figure S 43. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Edison.

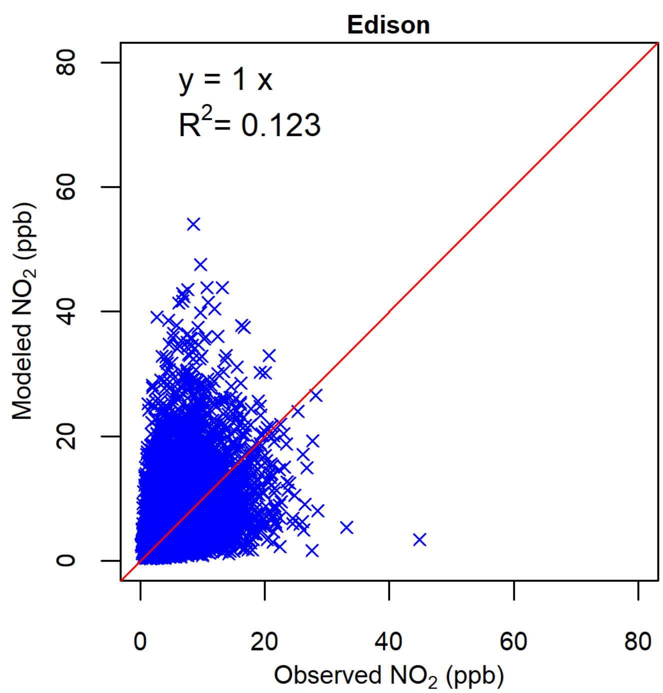


Figure S 44. Scattering plot of observed and modeled 1-hour NO2 mixing ratio at Fresno – Sierra Sky Park.

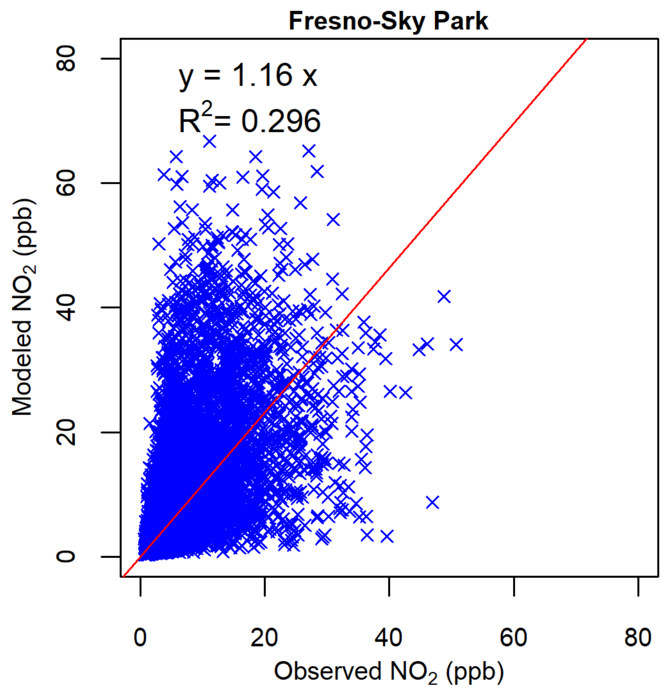


Figure S 45. Scattering plot of observed and modeled 1-hour NO2 mixing ratio at Shafter.

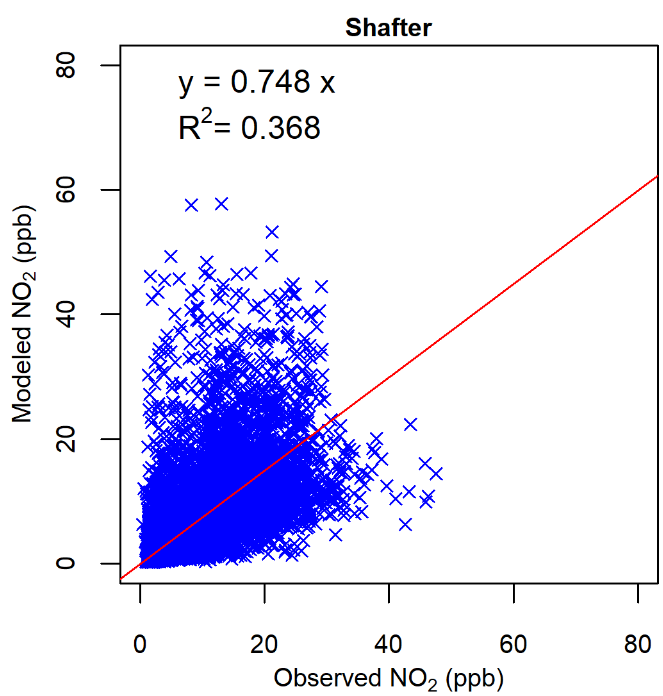


Figure S 46. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Turlock

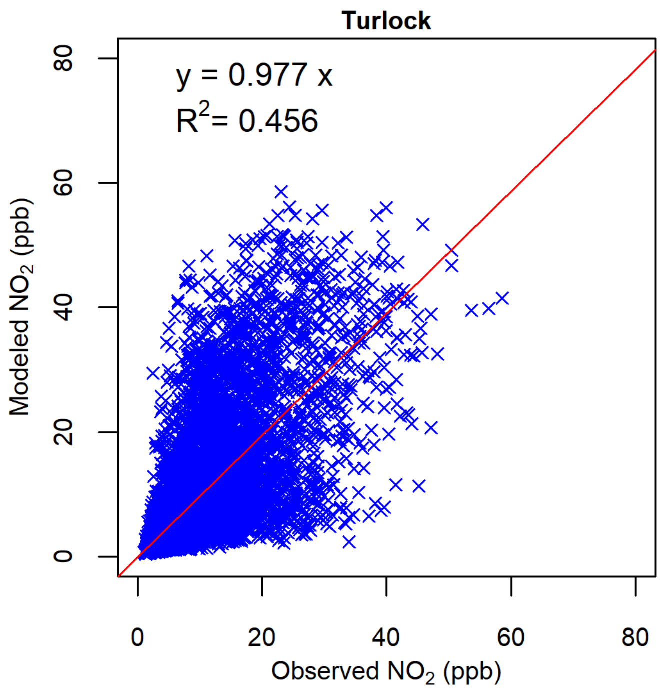


Figure S 47. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Merced

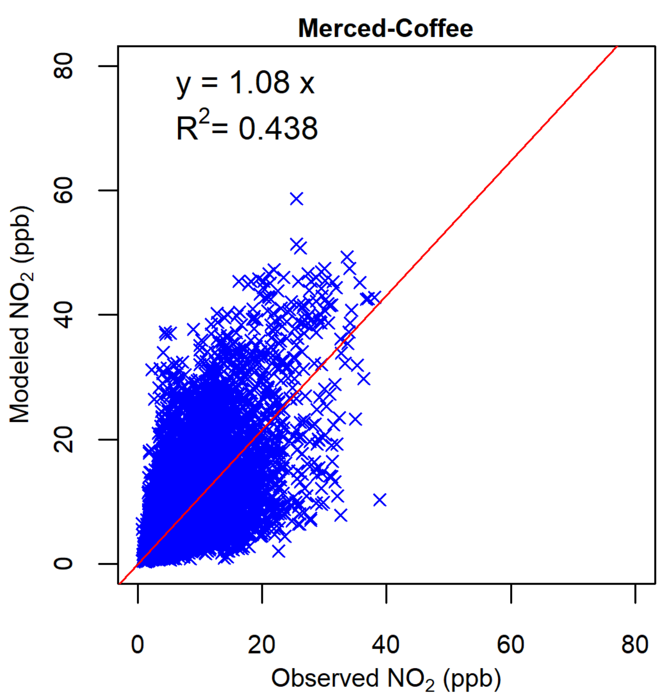


Figure S 48. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Clovis.

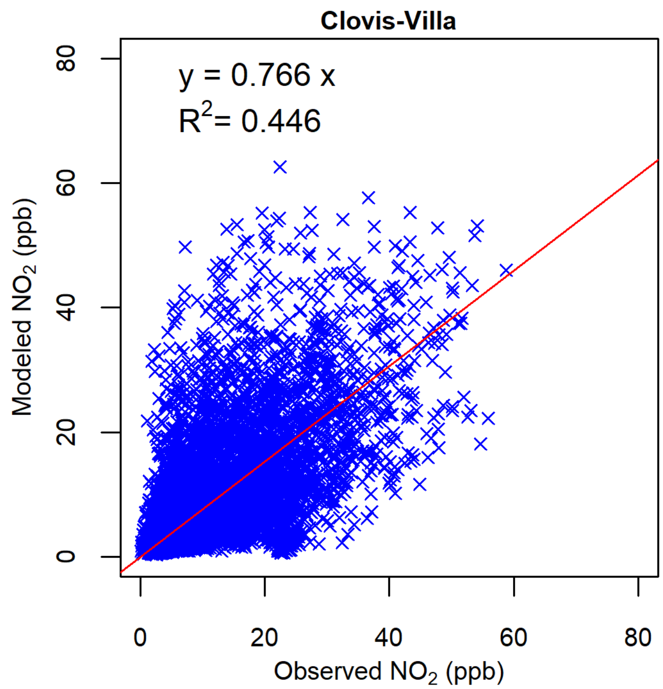


Figure S 49. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Bakersfield – California Avenue.

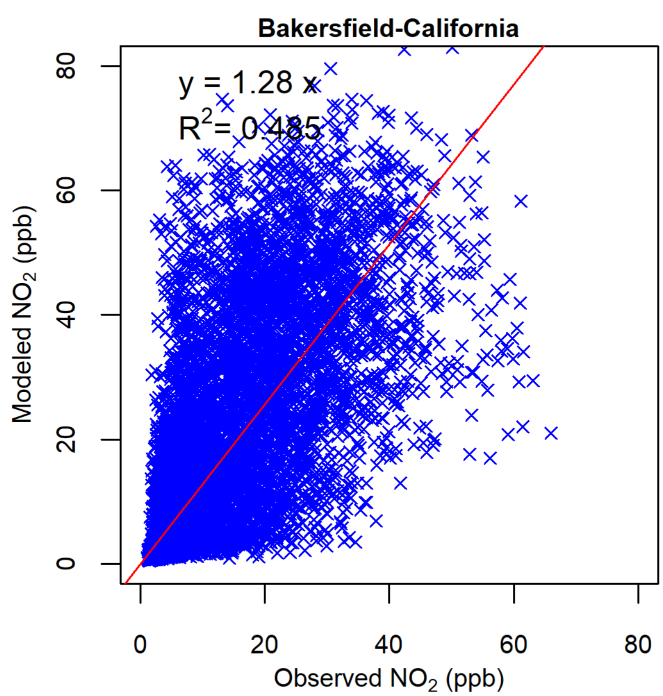


Figure S 50. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Madera.

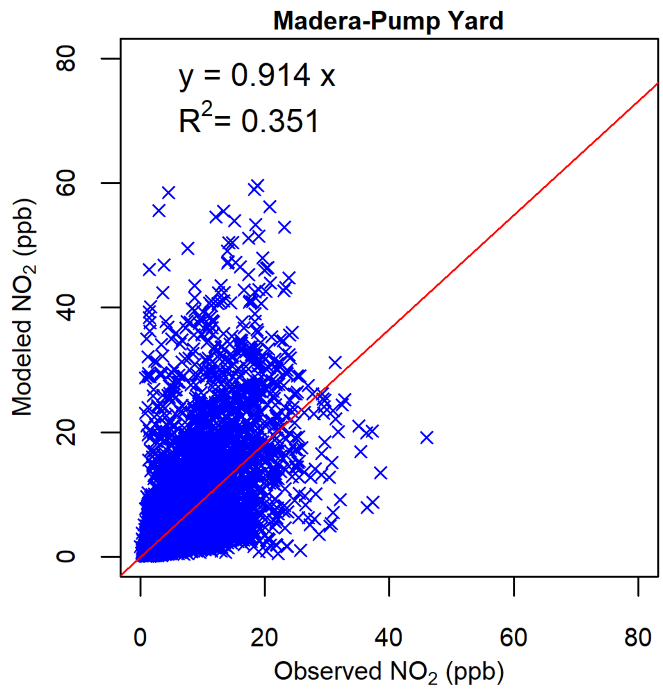


Figure S 51. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Tracy.

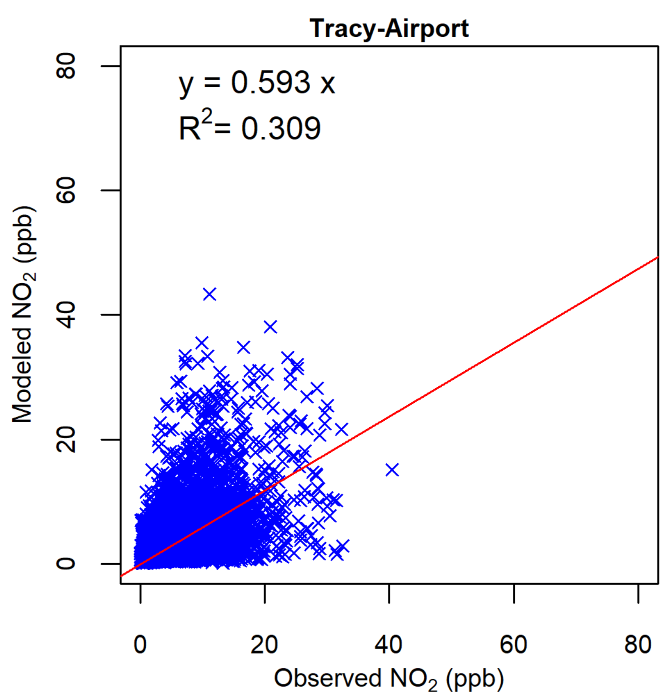


Figure S 52. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Fresno – Garland.

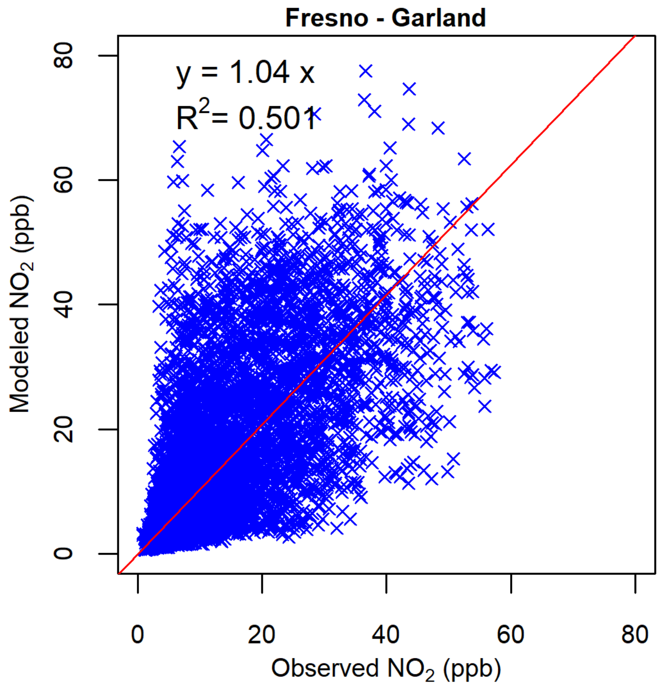


Figure S 53. Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Bakersfield – Municipal Airport

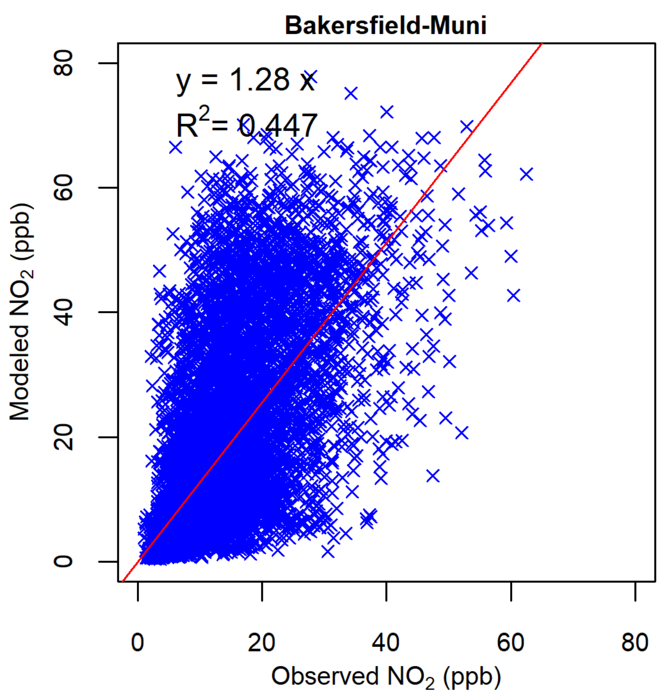


Figure S 54. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Fresno – Drummond Street.

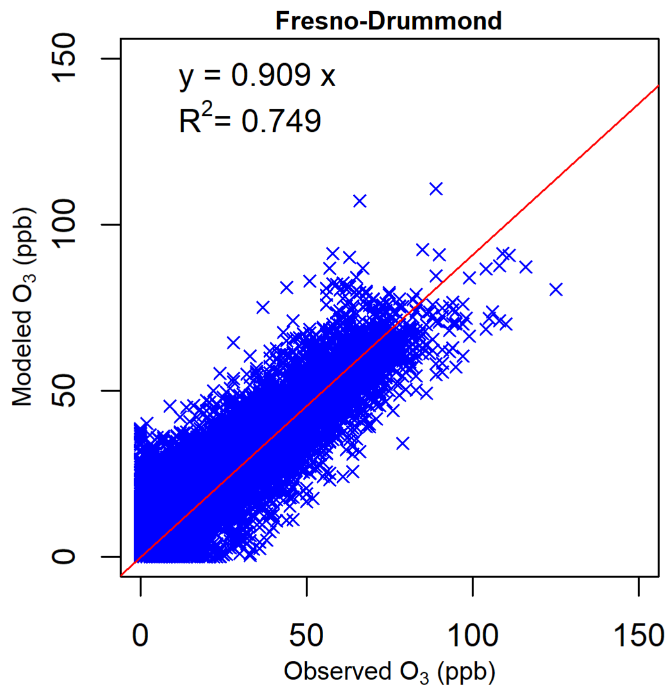


Figure S 55. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Visalia

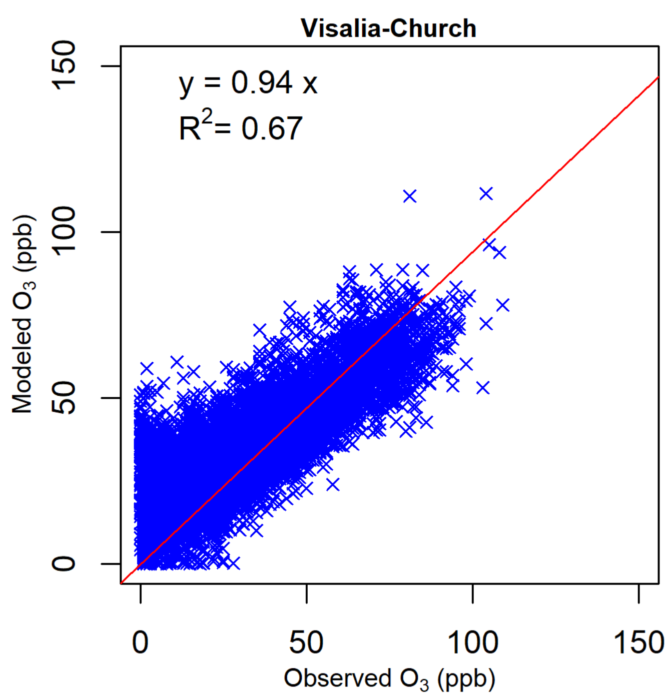


Figure S 56. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Stockton

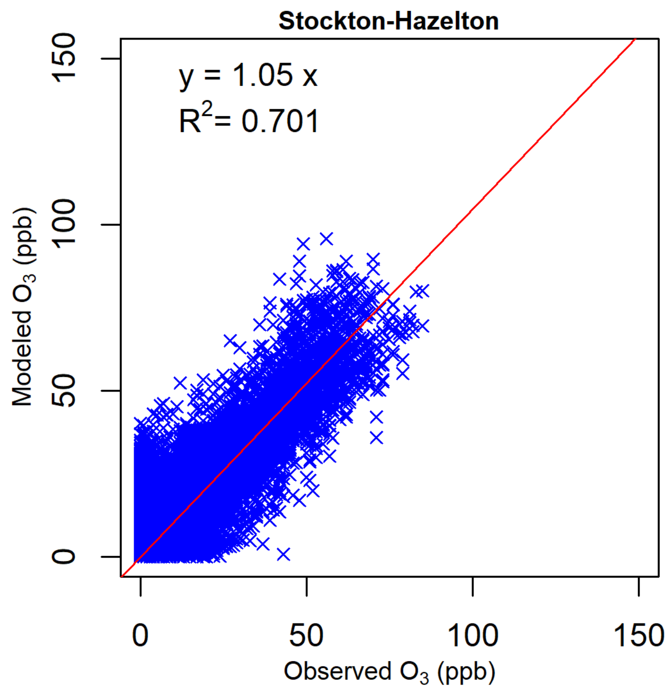


Figure S 57. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Parlier

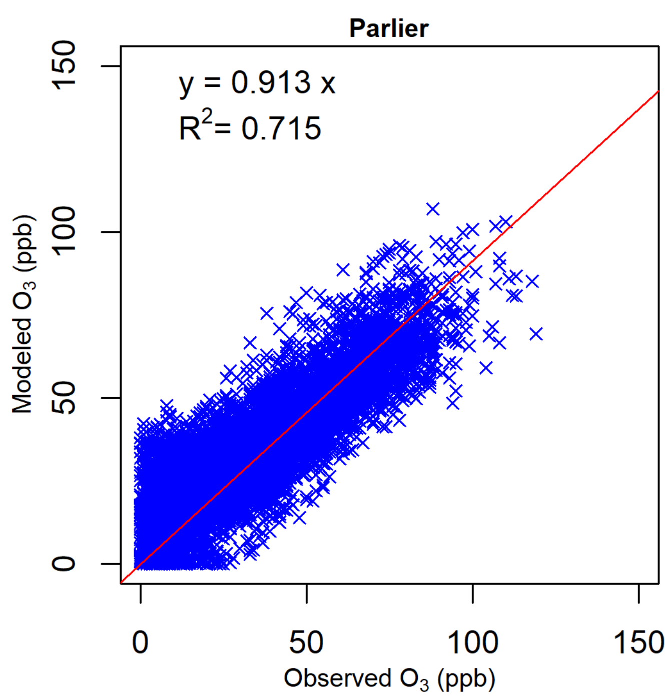


Figure S 58. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Edison

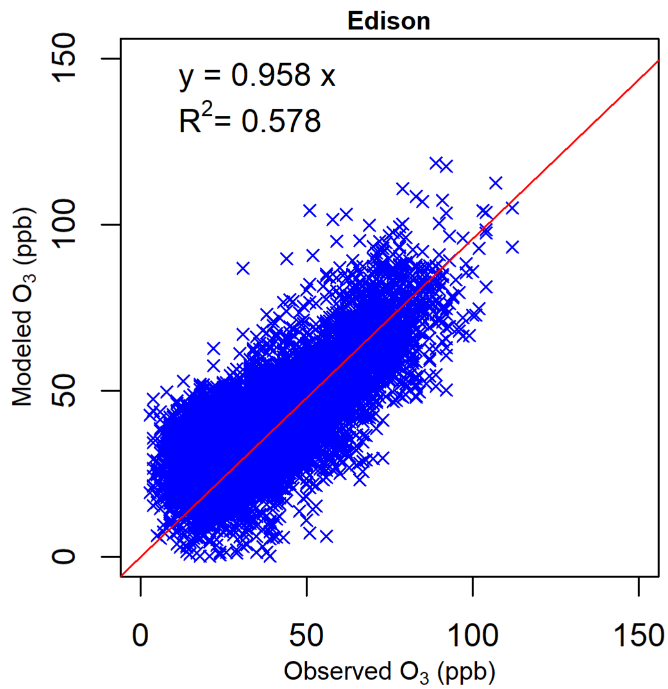


Figure S 59. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Oildale

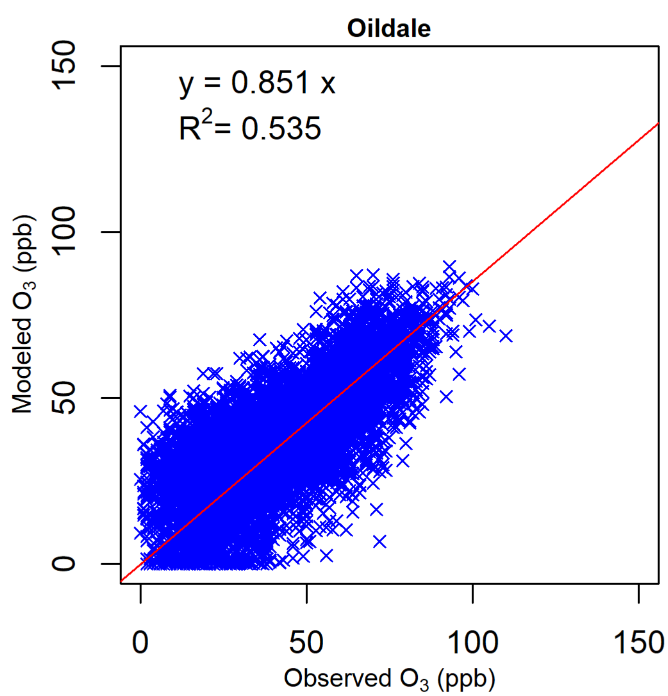


Figure S 60. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Modesto -14th Street

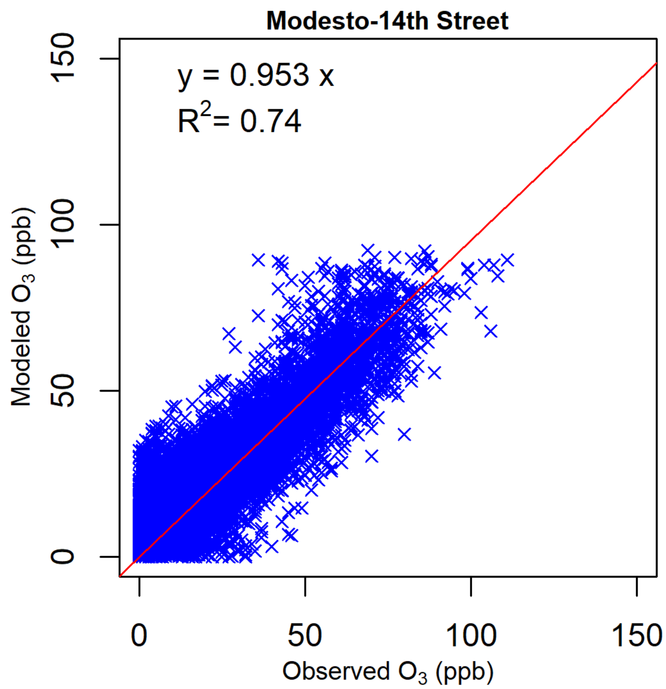


Figure S 61. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Fresno –Sierra Sky Park

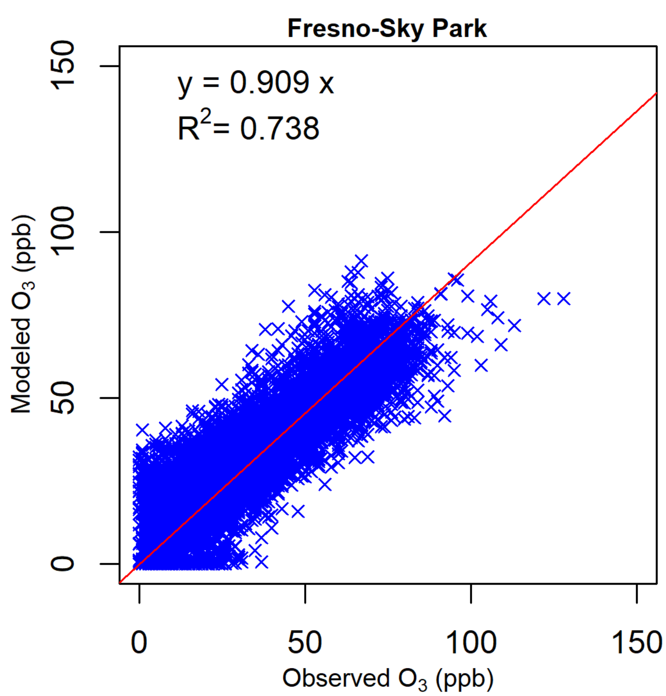


Figure S 62. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Maricopa

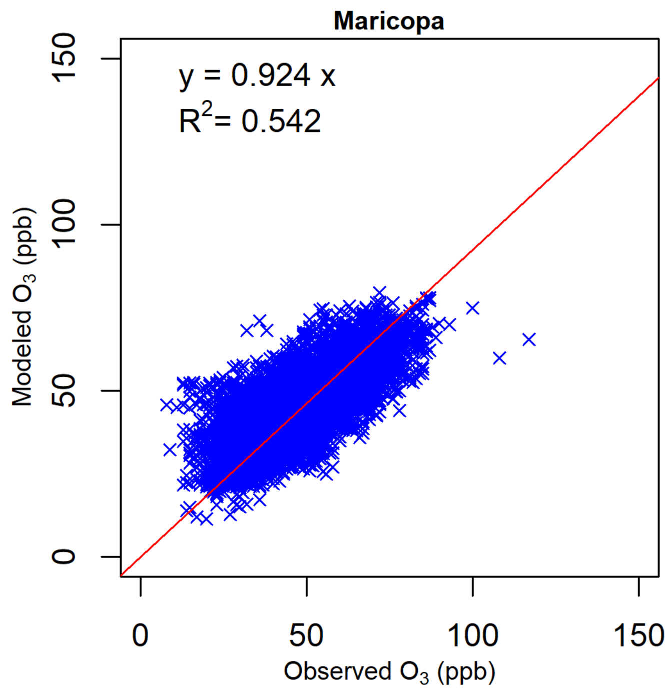


Figure S 63. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Shafter

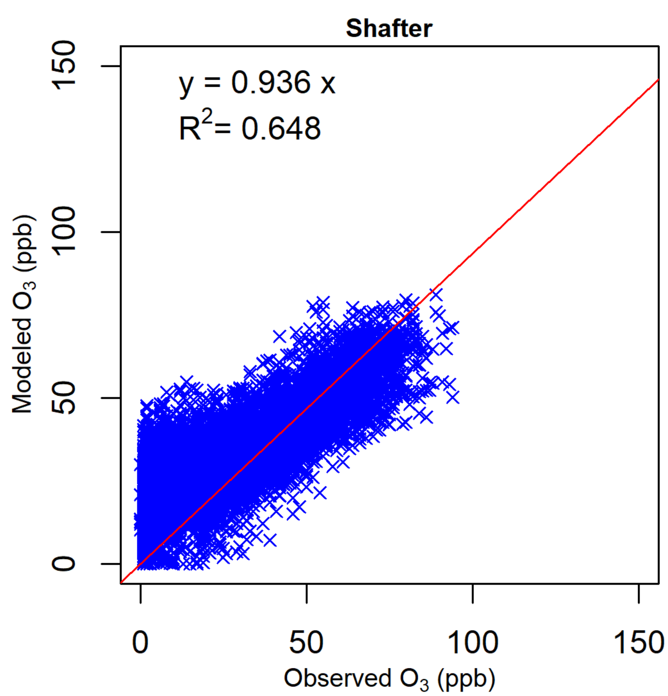


Figure S 64. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Turlock

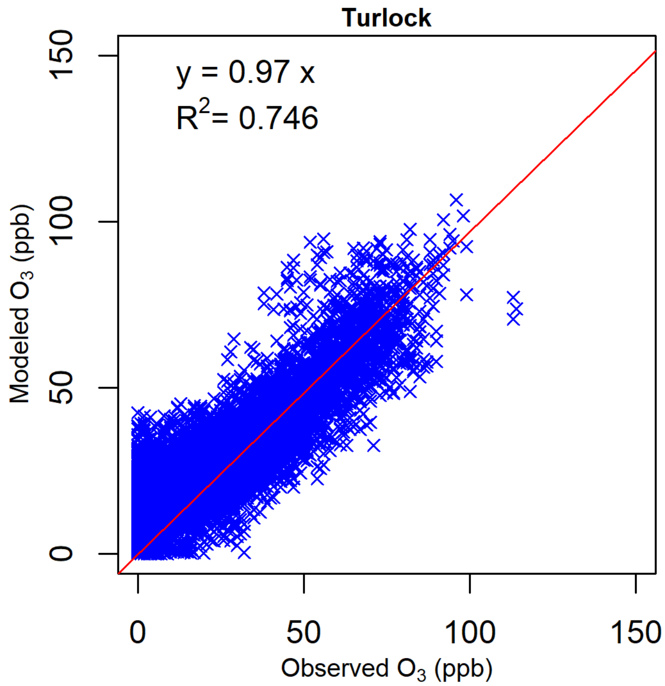


Figure S 65. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Merced – S Coffee Avenue

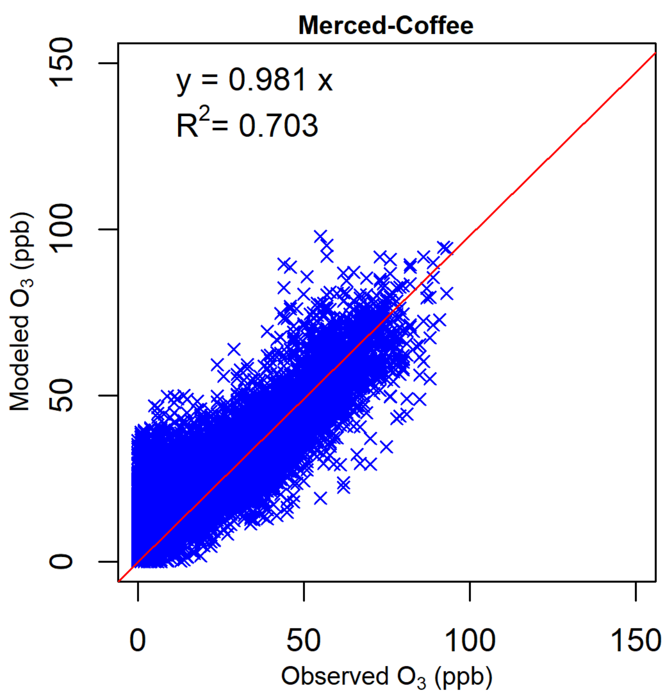


Figure S 66. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Clovis

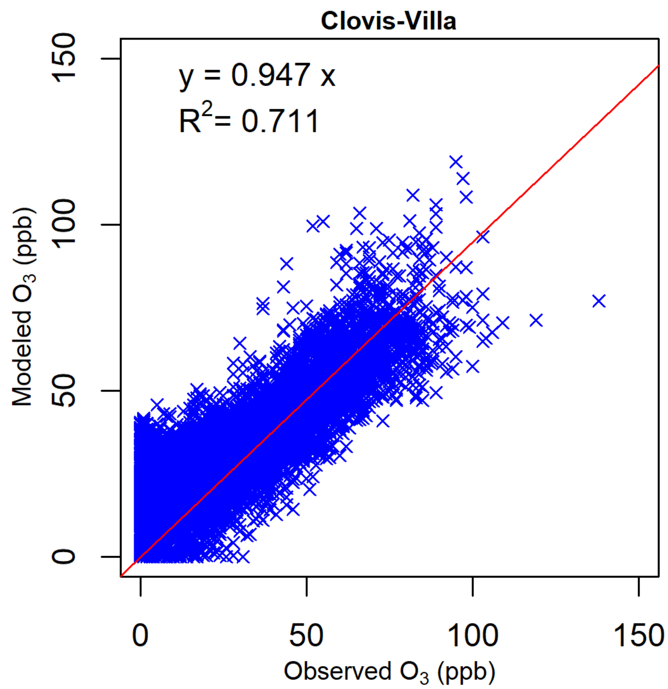


Figure S 67. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Sequoia National Park

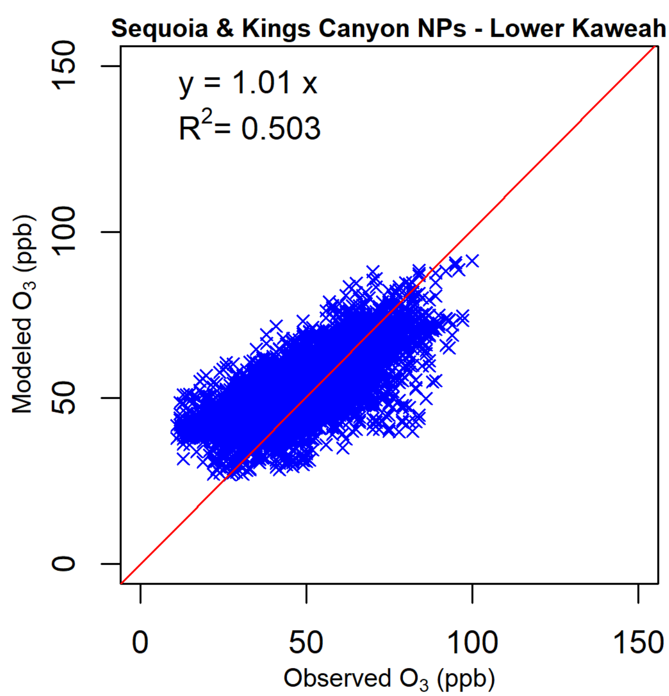


Figure S 68. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Hanford

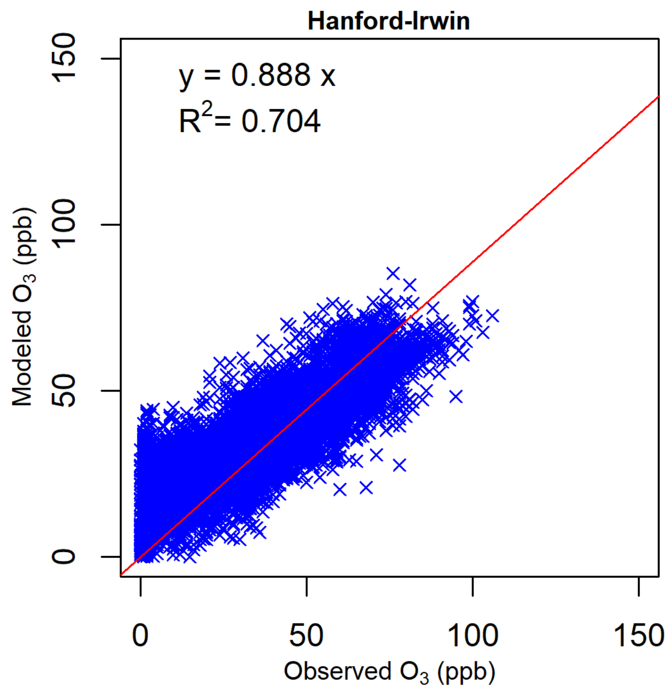


Figure S 69. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Bakersfield – California Avenue

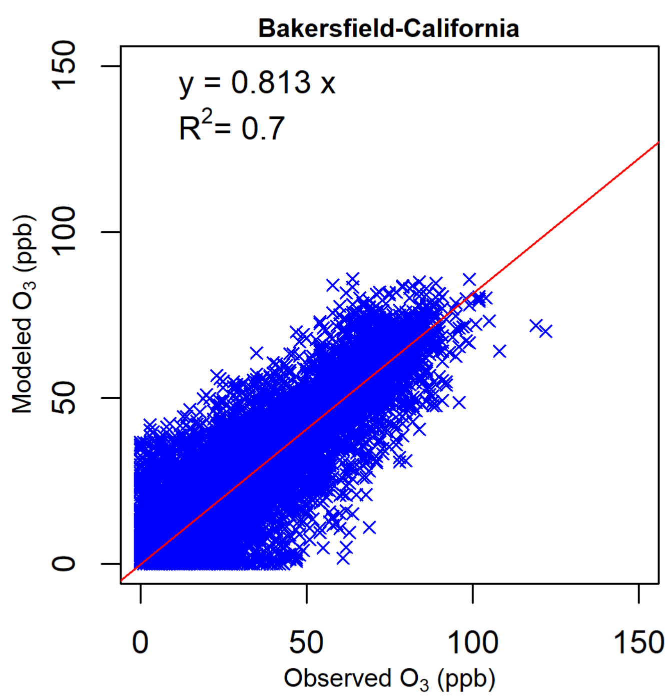


Figure S 70. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Madera – Pump Yard

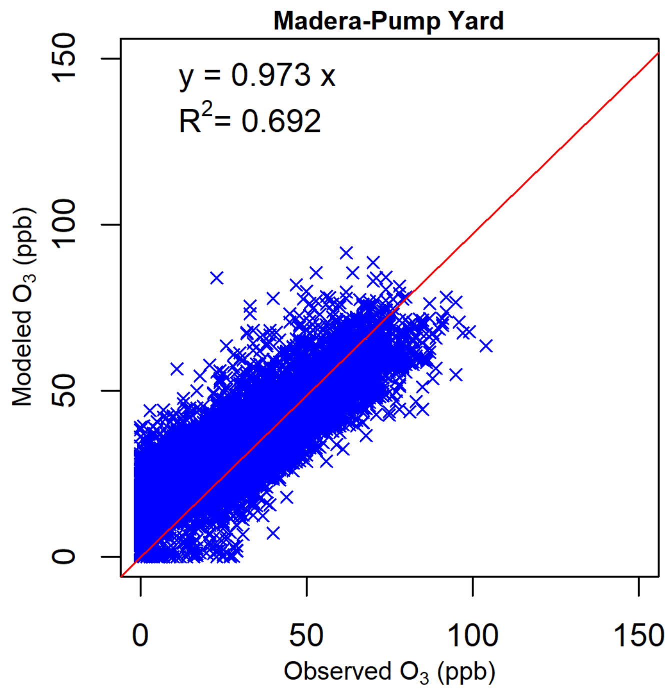


Figure S 71. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Sequoia and Kings Canyon National Park

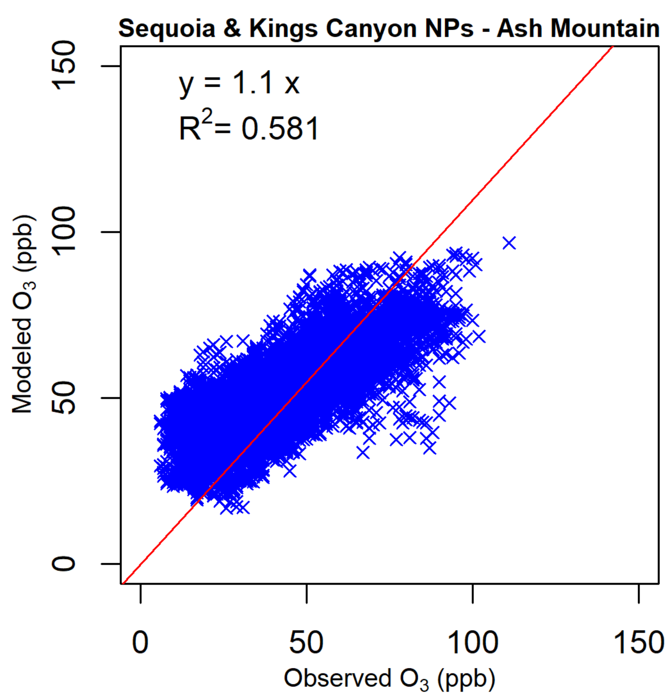


Figure S 72. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Tracy

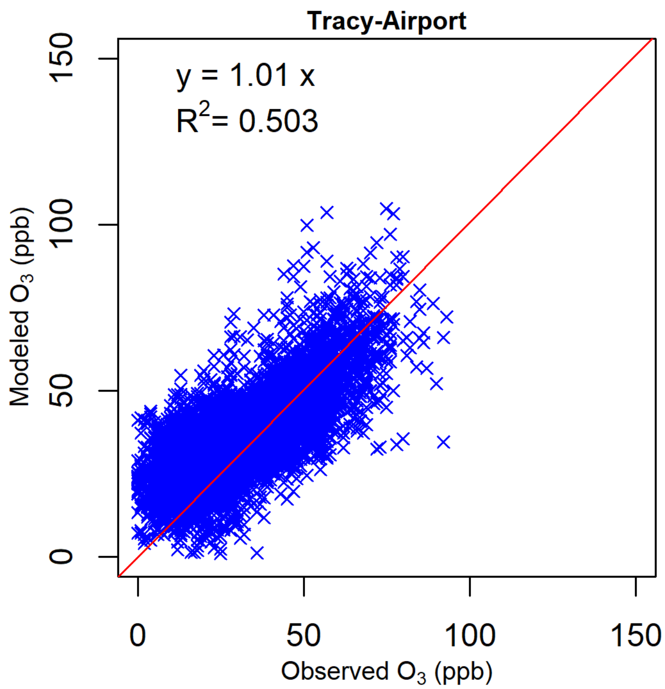


Figure S 73. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Arvin

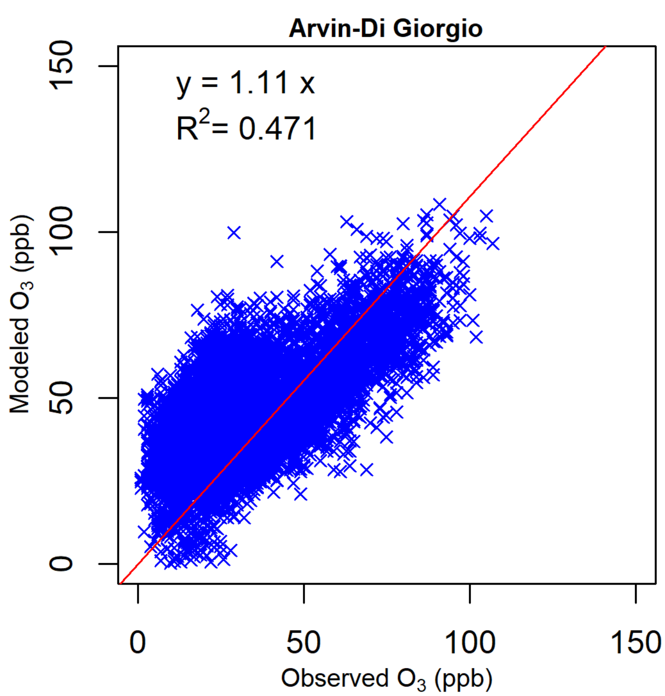


Figure S 74. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Tranquillity

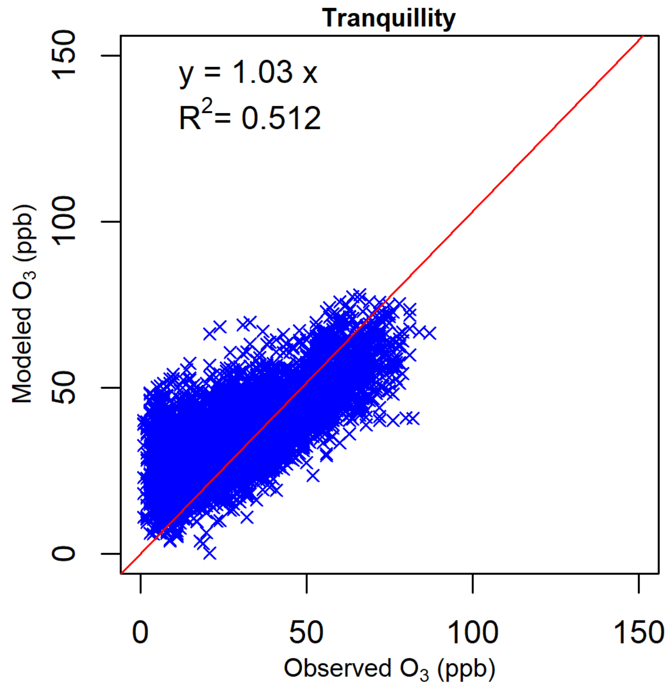


Figure S 75. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Porterville

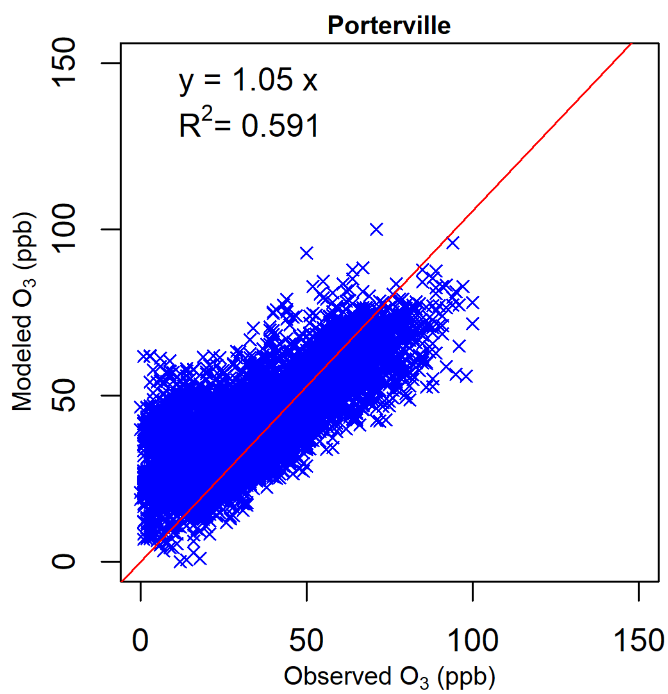


Figure S 76. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Madera – 28261 Avenue

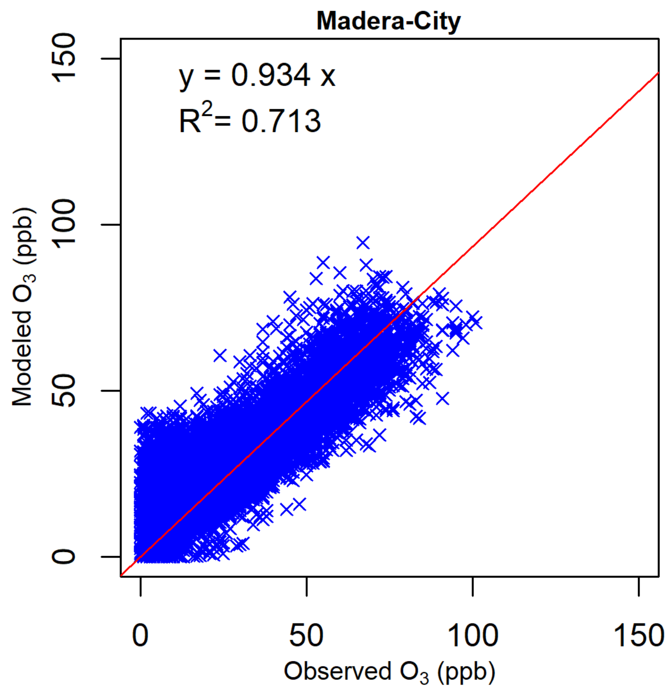


Figure S 77. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Fresno-Garland

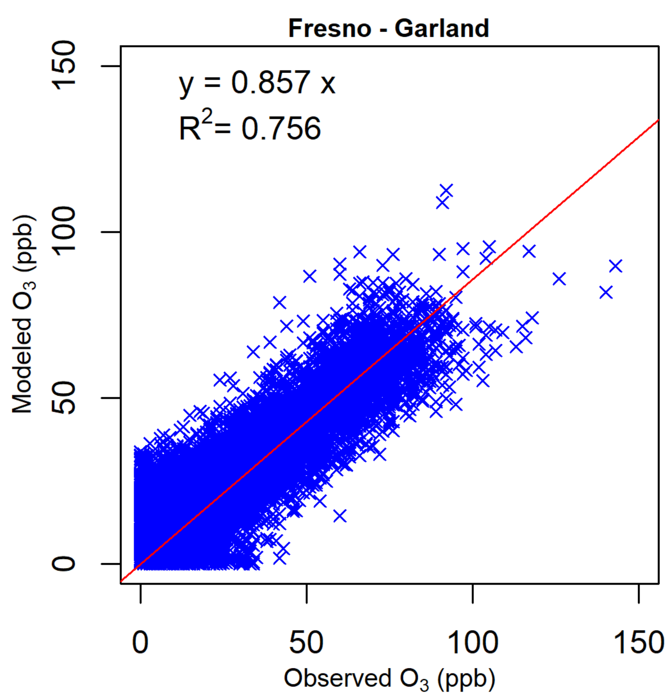


Figure S 78. Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Bakersfield – Municipal airport.

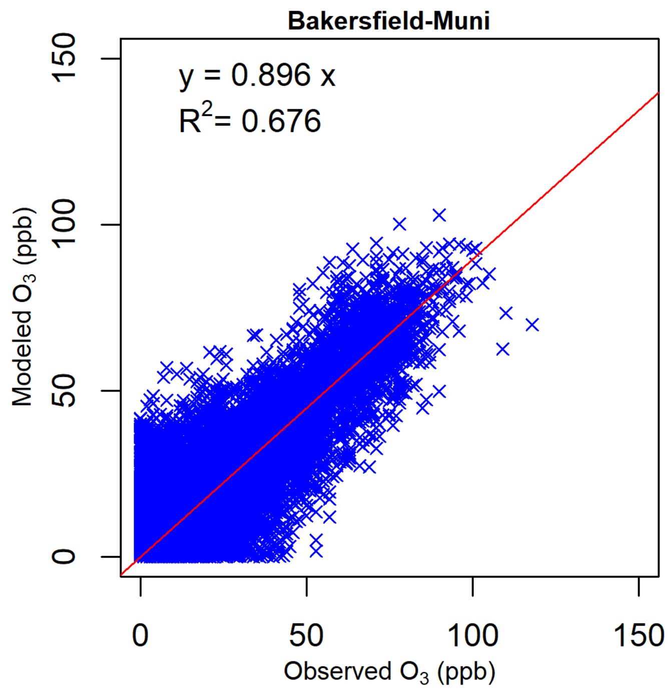


Figure S 79. Comparison of annual average NH3 column from IASI satellite measurements and model simulations.

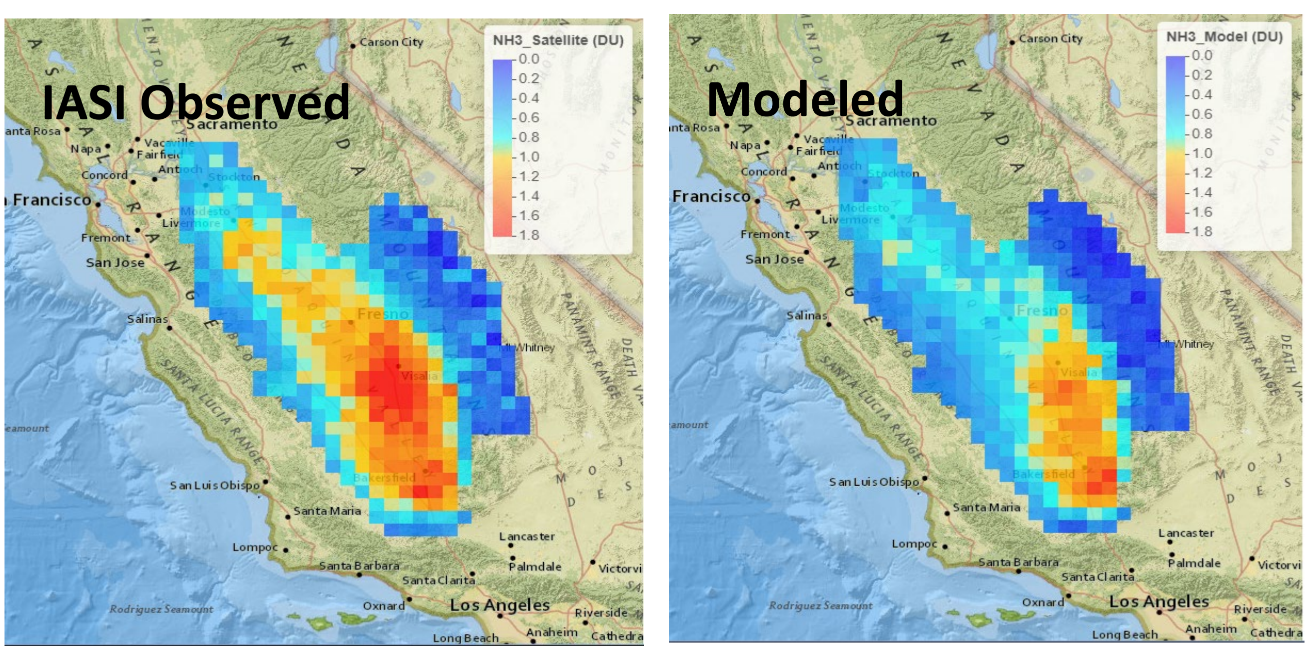


Figure S 80. Observed and modeled (regular: using the default MEGAN soil NOx scheme; BDSNP: using the MEGAN Berkeley Dalhousie soil NOx scheme) $PM_{2.5}$ species at Fresno.

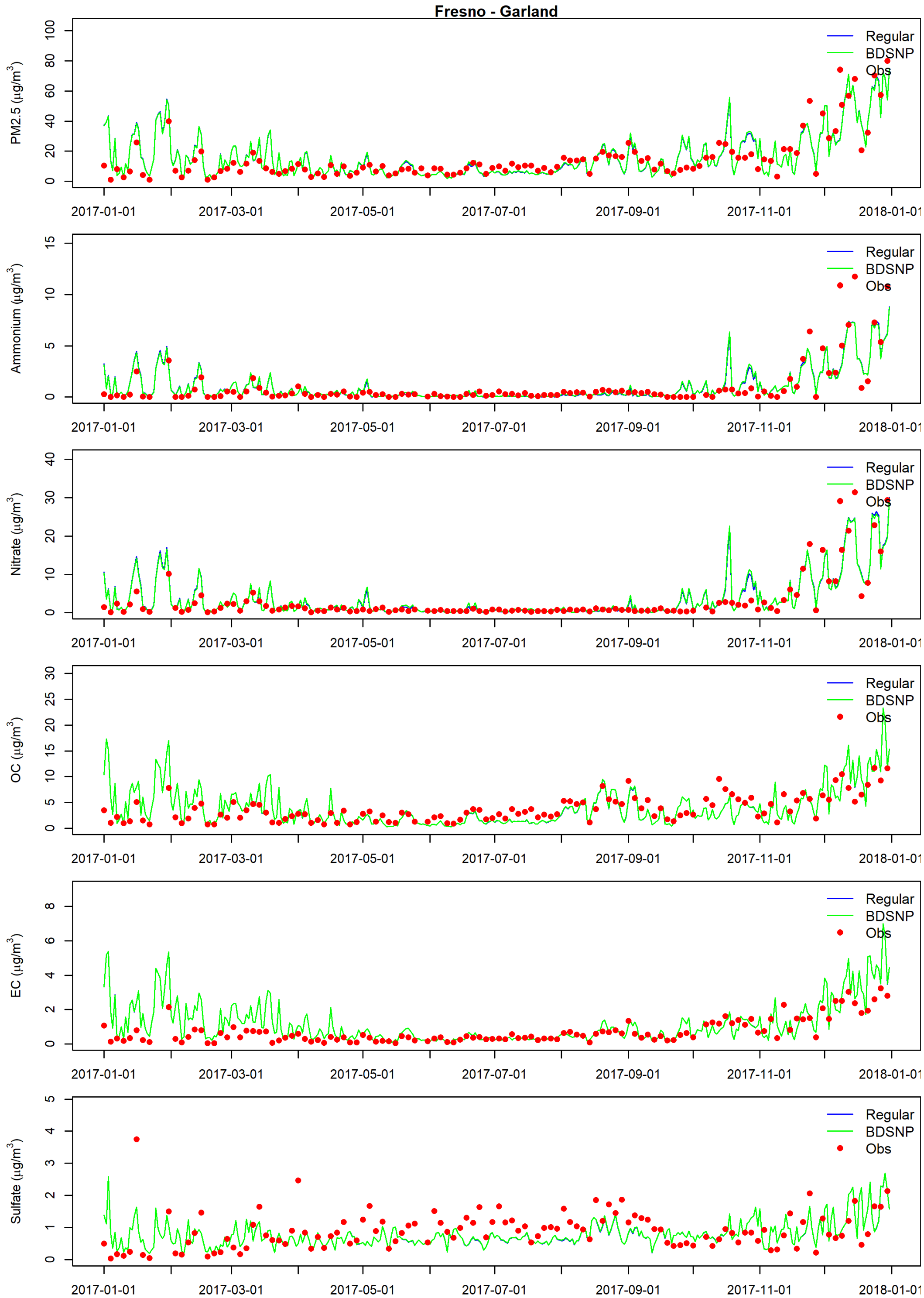


Figure S 81. Observed and modeled (regular: using the default MEGAN soil NOx scheme; BDSNP: using the MEGAN Berkeley Dalhousie soil NOx scheme) $PM_{2.5}$ species at Bakersfield.

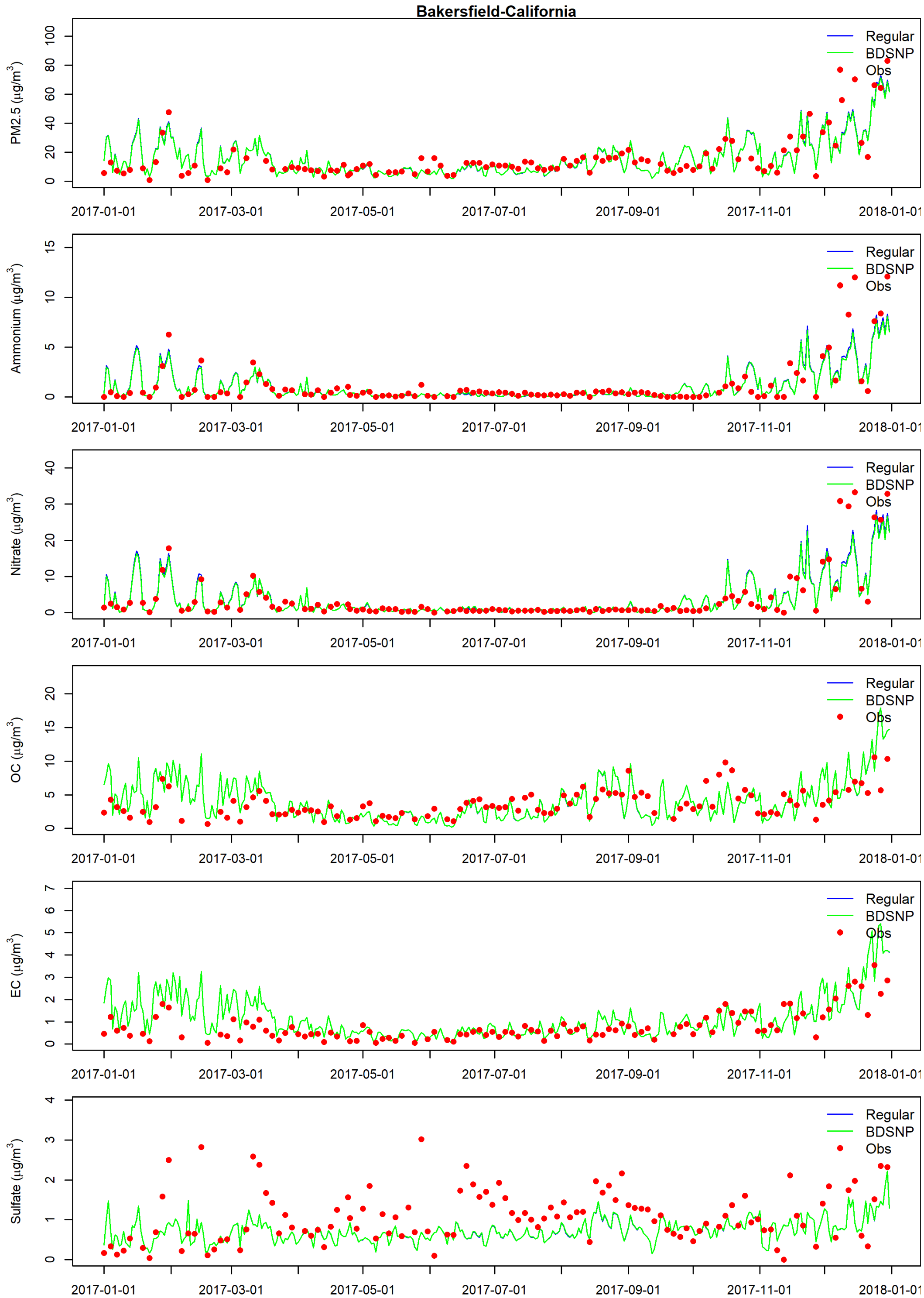


Figure S 82. Observed and modeled (regular: using the default MEGAN soil NOx scheme; BDSNP: using the MEGAN Berkeley Dalhousie soil NOx scheme) $PM_{2.5}$ species at Visalia.

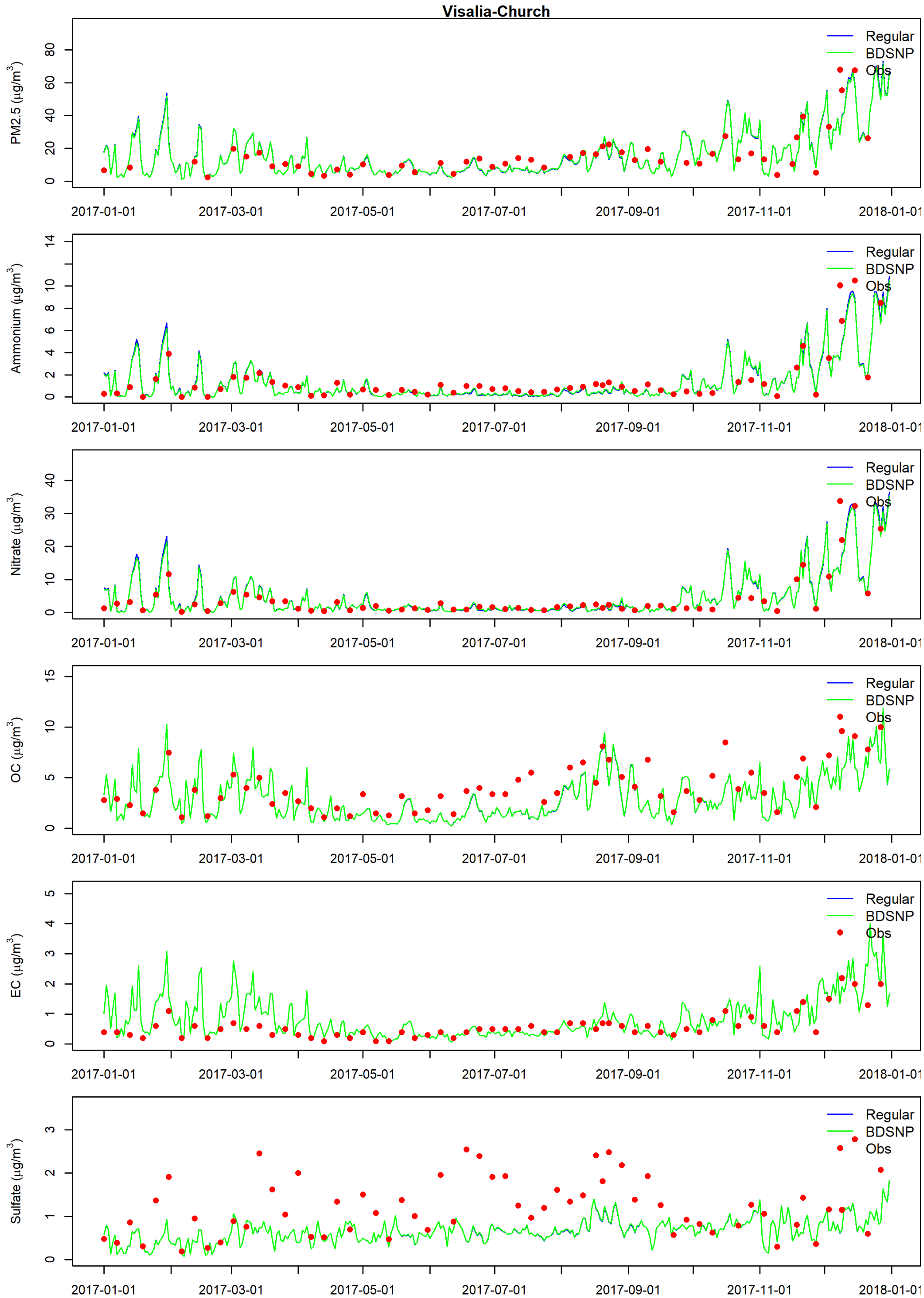
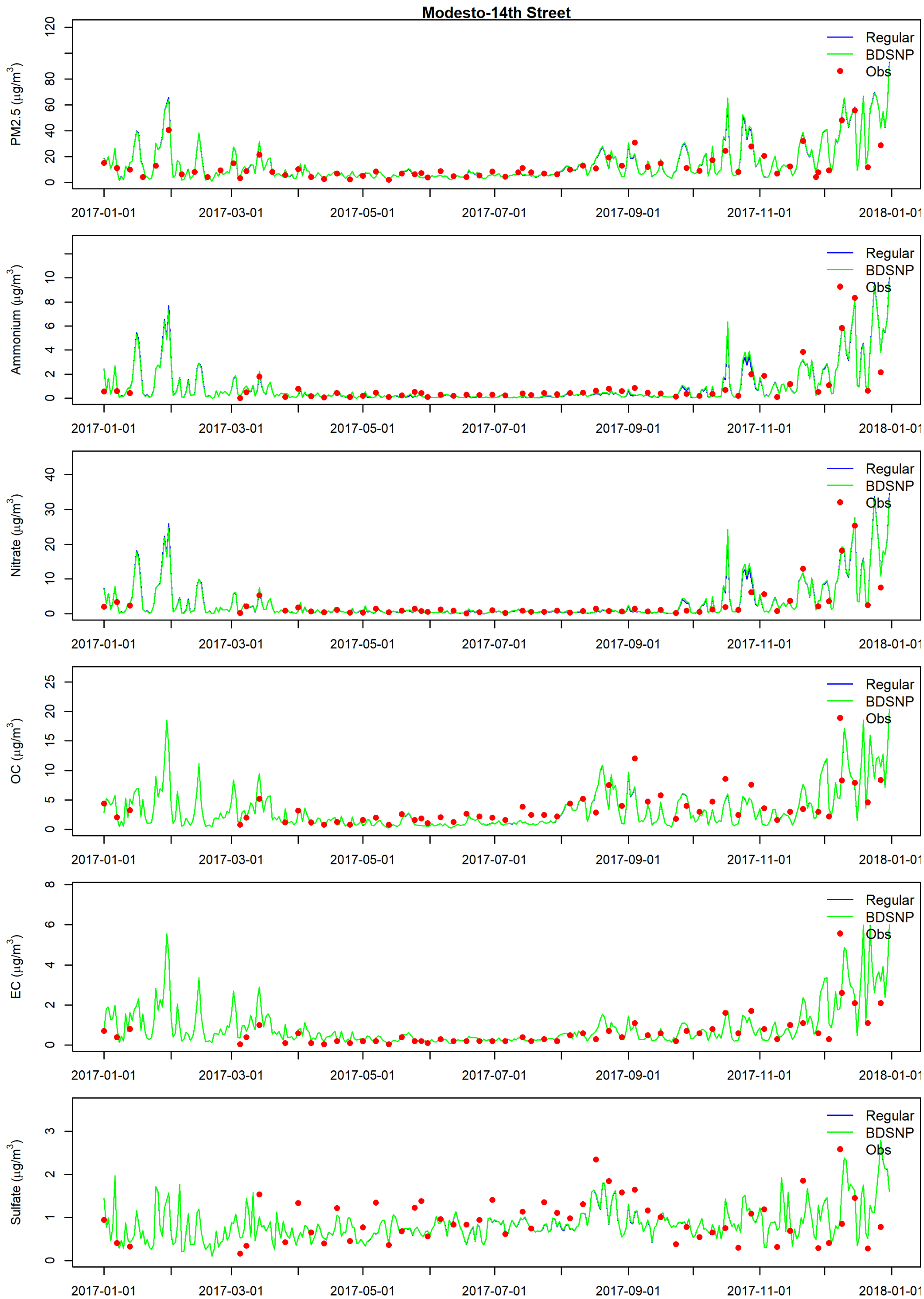


Figure S 83. Observed and modeled (regular: using the default MEGAN soil NOx scheme; BDSNP: using the MEGAN Berkeley Dalhousie soil NOx scheme) $PM_{2.5}$ species at Modesto.



Appendix K

COMMENTS AND RESPONSES

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SUMMARY OF COMMENTS AND RESPONSES
2024 Plan for the 2012 Annual PM2.5 Standard

This *2024 PM2.5 Plan* was prepared through an involved public process that provided multiple opportunities for the public and interested stakeholders to offer suggestions and comments for improving and strengthening the Plan. The District presented regular updates on the development of this Plan at public meetings, including meetings of District Governing Board, Citizens Advisory Committee (CAC), and Environmental Justice Advisory Group (EJAG), and each update was followed by an opportunity for the public to ask questions or request additional information. The District and CARB also hosted 5 public workshops to discuss, present, and receive feedback on the development of this Plan. See Table K-1 below for a summary of this public process.

Table K-1 *2024 PM2.5 Plan* Public Process

Date	Meeting Summary
Throughout 2023-2024	Ongoing updates to the District's Governing Board, Citizen's Advisory Committee, and Environmental Justice Advisory Committee meetings.
3/23/2023	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard, and solicit suggestions for more robust public engagement and suggestions for discussion topics for future workshops.
5/11/2023	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard, and solicit suggestions for sources of interest, and potential emission reduction opportunities to be included in BACM/MSM analysis.
8/28/2023	Publication of the *Draft Initial SIP Requirements* on the District website.
9/7/2023	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard, including results of the precursor and BACM/MSM analyses, and solicit feedback on the *Draft Initial SIP Requirements*.
9/19/2023	Publication of the Proposed Initial SIP Requirements on the District website, with paper copies available upon request for public review and comment.
10/19/2023	District Governing Board adoption of the *Proposed Initial SIP Requirements* at a public hearing with opportunities for public comment.
2/15/2024	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard.
4/26/2024	Publication of draft chapters of the *2024 PM2.5 Plan* on the District website, with paper copies available upon request for public review and comment.
4/29/2024	Public workshop to present, discuss, and receive feedback on the development of the Plan for the 2012 annual PM2.5 standard.
5/21/2024	Publication of the Proposed *2024 PM2.5 Plan* on the District website, with paper copies available upon request for public review and comment.
6/20/2024	Public hearing for the adoption of the Proposed *2024 PM2.5 Plan* with opportunities for public comment.

The public was notified in advance of public workshops via the District's email lists and website. To promote an equitable public process, workshop materials were made available in English and Spanish, and the District provided simultaneous Spanish interpretation during all plan development workshops. Simultaneous interpretation in other languages was made available upon request. In addition, the District conducted the workshops through a hybrid approach, where members of the public are welcome to attend either in person, or join virtually through a real-time webinar environment. This allows for access and engagement opportunities for members of the public who may not be able to attend in person.

Throughout the public process, the District and CARB received verbal comments and questions related to the following topics. The District and CARB provided verbal responses during public workshops as these topics were discussed.

- Low-dust nut harvesters
- Incentives for agricultural equipment
- Receiving credit for reductions achieved through incentive programs
- Building decarbonization and incentives for heat pumps
- Residential wood burning strategy
- Industrial sources
- Ammonia precursor demonstration and control measures
- Commercial charbroiling
- Impact of mobile source measures on goods movement and industry
- Incentives for mobile sources
- Soil NOx
- Title VI
- Health benefits

The District received one written comment during the entirety of the public process, as summarized and responded to below:

COMMENTER:
Rocky Mountain Institute (RMI)

> **COMMENT:** As the Air District builds out its pollution control strategies for the *2023 PM2.5 Plan*, the agency should pursue both near-term and long-term emission reductions through regional zero-NOx appliance standards for space and water heating. (RMI)
>
> **RESPONSE:** CARB began the public process for the development of zero-emission appliance standards in May 2023. CARB has committed to conduct an extensive investigation into this measure, develop a proposed rule through meaningful public engagement, and bring the proposed rule before their Board by 2025. The District continues to support CARB in the development and implementation of this measure, as it will result in emission reductions and associated health benefits in the San Joaquin Valley.

As part of this Plan, the District is committing to further evaluate potential opportunities to reduce NOx emissions from space and water heating appliances, including implementation of zero-emission requirements earlier than CARB's statewide measure, to the extent that measures are economically and technologically feasible in the Valley. This will require extensive analyses and collaboration across all levels of government, utilities, appliance manufacturers, developers, contractors, households, and businesses to achieve this goal successfully and equitably. In addition to evaluating the feasibility of a regulatory measure, the District will collaborate with utilities, air districts, agencies, and organizations to help leverage funding and coordinate incentives with existing programs that help accelerate the transition to zero-emission space and water heating appliances.

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Attachment A

LOCAL TRANSPORTATION CONTROL MEASURE REVIEW AND MOST STRINGENT MEASURE ANALYSIS

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Trinity Consultants

MEMORANDUM

To: San Joaquin Valley Metropolitan Planning Organization (MPO) Staff

From: Suriya Vallamsundar and Alex Marcucci, Trinity Consultants

Date: April 8, 2024

RE: Local Transportation Control Measure Review and Most Stringent Measure (MSM) Analysis for the San Joaquin Valley 2024 Plan for the 2012 Annual Particulate Matter ($PM_{2.5}$) Standard

This memorandum presents the results and methodology for conducting the Most Stringent Measure (MSM) analysis in support of the 2024 Plan for the 2012 Annual $PM_{2.5}$ Standard, as well as attainment extension request. The California Air Resources Board (CARB) and the San Joaquin Valley Air Pollution Control District (District) are currently developing a SIP to meet serious area requirements under the Clean Air Act (CAA) for the 2012 annual $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS). Due to the serious nonattainment designation, a Best Available Control Measure (BACM) analysis is required including transportation control measure (TCM) review for the control of direct $PM_{2.5}$ and $PM_{2.5}$ precursors from on-road mobile sources. In April 2023, Trinity Consultants (Trinity) conducted a BACM analysis for the Initial SIP Requirements for the 2012 Annual $PM_{2.5}$ Standard and concluded that the TCMs being implemented in the SJV meet all the BACM requirements with no additional measures identified since the latest comprehensive TCM review was conducted in July 2022 for the Valley's 2022 Ozone Plan[1].

As the SJVAPCD is making progress on the remaining elements for the $PM_{2.5}$ SIP, the District is planning on requesting an attainment deadline extension. According to CAA Section 188(e)[2] and the 2016 $PM_{2.5}$ Final Rule[3], if a state(s) submits a request for a serious area attainment date extension simultaneous with the serious area attainment plan, such a plan shall meet the most stringent measure (MSM) requirements in addition to the BACM/BACT analysis. The MSM analysis for the 2024 $PM_{2.5}$ Plan included the review of MSMs contained in other nonattainment area SIPs and conducting a comparison to TCMs implemented in the Valley, as well as identifying new candidate TCMs for MSM by applying a more stringent criteria for determining the feasibility of the measure than previously done for the BACM analysis. In addition, this MSM analysis consisted of reevaluating measures previously rejected as BACM to assess their feasibility as MSM. As a result of this review, no additional TCMs were identified as MSMs beyond those already being implemented in the SJV.

Background

The EPA defines an MSM in 40 CFR 51.1010 (b) as any permanent and enforceable control measure that achieves the most stringent emissions reductions in direct $PM_{2.5}$ emissions and/or emissions of $PM_{2.5}$ plan precursors from among those control measures which are either included in the SIP for any other NAAQS, or have been achieved in practice in any state, and that can feasibly be implemented in the relevant $PM_{2.5}$ NAAQS nonattainment area. A measure could also be considered an MSM if the measure cannot be

---

[1] *San Joaquin Valley Air Pollution Control District. 2022 Ozone Plan for the San Joaquin Valley. Appendix D Mobile Source Control Strategy. Accessed at https://ww2.valleyair.org/media/rtrjnlxo/13-appendix-d-mobile-source-control-strategy.pdf.*

[2] Clear Air Act, 188. Accessed at https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart4-sec7513.htm.

[3] 81 Federal Register 58009. Accessed at https://www.federalregister.gov/documents/2016/08/24/2016-18768/fine-particulate-matter-national-ambient-air-quality-standards-state-implementation-plan.

implemented within the four-year window after an area is reclassified as serious nonattainment. Furthermore, an MSM could be a control measure that has not been implemented anywhere else. The 2016 $PM_{2.5}$ Final Rule recommends starting the process of identifying MSMs with the work already undertaken for the nonattainment area's BACM determinations and evaluating if any of these measures qualify for implementation as an MSM. EPA notes that more stringent criteria should be applied for determining the feasibility of potential MSM than that is prescribed for BACM.

In April 2023, during SIP development for the 2012 annual PM2.5 standard, Trinity was tasked with conducting a BACM analysis for TCMs in line with the 2016 Final $PM_{2.5}$ Rule[4]. Based on that review, Trinity identified no additional measures for implementation given that all TCMs that are currently being implemented in the Valley constitute BACM. In addition to these TCMs, there are statewide and district-wide programs and regulations implemented by CARB that focus on reducing transportation emissions by controlling the extended idling of vehicles, encouraging vehicle turnover, and employer-based trip reduction measures, etc. The MSM analysis started with reassessing these TCMs from previous BACM analysis to identify if any additional TCMs would qualify as MSMs, as described herein.

MSM Analysis Methodology

The 2016 $PM_{2.5}$ Final Rule describes the following process for determining MSMs: (a) update emission inventories for nonattainment area; (b) identify potential MSMs; (c) compare MSMs to control measures already adopted in the SIP for the nonattainment area; and (d) adopt and implement any MSM that is more stringent than any measures that are already included in the SIP. Each of these steps is explained below:

Step 1: Update the Emissions Inventories

Updating emission inventories is not necessary given that the state will meet this inventory requirement as part of its serious area attainment plan submission and the attainment deadline extension request will be submitted as part of the plan itself.

Step 2: Identify Potential MSM

The second step in MSM analysis involves identifying potential MSMs from other SIPs, or measures that are implemented in other states for controlling emissions from sources similar to those listed in the emissions inventory. A review of TCMs from other $PM_{2.5}$ nonattainment areas was conducted as part of the BACM analysis in April 2023. SIPs reviewed as part of the BACM analysis were revisited and are shown in Table 1.

[4] San Joaquin Valley Air Pollution Control District. 2023. Initial SIP Requirements for the 2012 Annual PM2.5 Standard, Attachment A: Local Transportation Control Measure Review and Best Available Control Measure (BACM) Analysis for the San Joaquin Valley 2023 Particulate Matter (PM2.5) State Implementation Plan. Trinity Consultants.

Table 1. $PM_{2.5}$ Nonattainment Areas Reviewed for Candidate TCMs

Region	Designation	Applicable SIP
South Coast Air Quality Management District (SCAQMD)	Serious for 2012 and 2006 PM2.5 Standards and Moderate for 1997 PM2.5 Standards	2022 Air Quality Management Plan, South Coast Air Quality Management District
Alaska Department of Environmental Conservation (Fairbanks)	Serious for 2006 PM2.5 Standards	2020 Amendments to the Serious SIP
Northern Sierra Air Quality Management District (Plumas County)	Serious for 2012 PM2.5 Standards	2017 Portola Fine Particulate Matter (PM2.5) Attainment Plan 2020 Contingency Measure SIP Submittal
Allegheny County Health Department Air Quality Program (Allegheny)	Moderate for 2012 PM2.5 Standards	2019 Attainment Demonstration for the Allegheny County, PA PM2.5 Nonattainment Area, 2012 NAAQS
Imperial County Air Pollution Control District	Moderate for 2012 and 2006 PM2.5 Standards	2018 Imperial County Annual Particulate Matter less than 2.5 microns in diameter State Implementation Plan
Utah Air Quality Board (Salt Lake City)	Serious for 2006 PM2.5 Standards	2019 Control Measures for Area and Point Sources, Fine Particulate Matter, Serious Area PM2.5 SIP for the Salt Lake City, UT Nonattainment Area 2020 Technical Support Documentation for Utah's Salt Lake City and Provo 2006 24-Hour PM2.5 State Implementation Plans
Utah Air Quality Board (Provo)	Serious for 2006 PM2.5 Standards	2018 Provisions to Ensure BACM/BACT for the Provo, UT Serious PM2.5 Nonattainment Area 2020 Technical Support Documentation for Utah's Salt Lake City and Provo 2006 24-Hour PM2.5 State Implementation Plans
Oregon Department of Environmental Quality (Klamath Falls)	Moderate for 2006 PM2.5 Standards	2012 Klamath Falls Fine Particulate Matter (PM2.5) Attainment Plan
Allegheny County Health Department Air Quality Program (Liberty-Clairton)	Moderate for 2006 and 1997 PM2.5 Standards	2011 Attainment Demonstration for the Liberty-Clairton PM2.5 Nonattainment Area
Sacramento Metropolitan Air Quality Management District (Sacramento)	Moderate for 2006 PM2.5 Standards	2013 PM2.5 Implementation/Maintenance Plan and Re-designation Request for Sacramento PM2.5 Nonattainment Area
Bay Area Air Quality Management District (San Francisco Bay Area)	Moderate for 2006 PM2.5 Standards	Spare the Air: 2017 Clean Air Plan
Montana Department of Environmental Quality (Libby)	Moderate for 1997 PM2.5 Standards	2020 Request for Redesignation of the Libby PM2.5 Nonattainment Area and Approval of an Attainment Area Limited Maintenance Plan

Based on the SIP review, Trinity determined that none of the plans listed above include TCMs implemented as MSMs. In general, the TCMs being implemented in other jurisdictions are those that were already reviewed during the 2023 $PM_{2.5}$ SIP BACM analysis and constitute either BACM or RACM TCMs. Only SCAQMD added new TCMs as part of their 2022 Air Quality Management Plan and those are listed in Table 2 below. These TCMs are either already being implemented in the SJV or cannot be implemented due to lack of implementation authority.

Table 2. Additional TCMs Identified through SIP Review

TCM #	TCM	Description	Analysis	Comments
	i. Improved Public Transit			
1.17	Public transit facility improvements and operating assistance	Construct and/or improve bus and rail terminals, stations, and maintenance facilities	Existing	RTP/SCS
1.18	Paratransit Service	Self-explanatory	Existing	RTP/SCS
1.19	Express Busways/Dedicated Bus Lanes	Construct bus-only lanes	No Implementation Authority	Would require state agency authority and funds
	iii. Bicycle Facilities			
3.14	Bike to Workday/Month	Encourage biking to work during bike awareness month. Provide outreach activities, education on the bike-to-work option, and provide assistance in trying to bike to work.	Existing	RTP/SCS
	v. Reduce Extreme Cold-Start Emissions			
5.26	Roundabouts at low-traffic intersections	Construct roundabouts and remove stop signs as appropriate	Existing	RTP/SCS
	Vii. Planning and Development Efforts to Reduce SOV Travel			
7.19	Programs to encourage goods movement by rail	Self-explanatory	Existing	CARB
7.20	Buy parking lots and convert to other land use	Limit parking by converting available parking to other land uses to discourage driving	No Implementation Authority	Would require local agency authority and funds
	ix. Pre-1980 Model-Year Vehicle Scrappage			
9.10	Safe Routes to School programs	Encourage educational and encouragement programs with families and schools and support policies to improve pedestrian and bicycle safety.	Existing	RTP/SCS
	xi. Employer-Based Plans and Incentives			
11.9	Reduced Idling at Schools	Self-Explanatory	Existing	CARB

In addition to identifying new candidate measures, any measures that were rejected during the BACM process must be re-evaluated to determine if they may be feasible given the longer attainment timeframe or due to changes that have occurred in the interim that improve the feasibility of previously rejected measures. Accordingly, TCMs that were rejected as part of the 2023 $PM_{2.5}$ BACM analysis were re-evaluated to see if these measures would constitute MSMs. As shown in Table 3, TCMs related to reducing extreme cold start emissions continue not to apply in the SJV, and TCMs related to express lanes, parking fee regulations, and pricing policies continue not to be feasible since there were no changes to regional authority associated with measure implementation.

Table 3. Re-evaluation of TCMs rejected as part of $PM_{2.5}$ BACM Analysis

TCM #	TCM	Description	Re-Evaluation	Comments
	v. Reduce Extreme Cold-Start Emissions			
5.1	Use of plug-ins	Expanded availability of plug-ins to facilitate cold weather starting of vehicles and reduce engine idling time	Not Applicable	Due to warmer temperatures compared to Alaska
5.2	Electrification of parking lot outlets	Electrification of parking lot outlets at temps < 21° F	Not Applicable	
5.3	Outreach Programs	Public education focused on the benefits of plugging-in	Not Applicable	
	x. Transit-Only or High Occupancy Vehicle Lanes			
10.3	Express Lanes	Price travel demand on highways by developing an express lane network for vehicles	No implementation authority	Would require state agency authority and funds.
	xv. Limit or Restrict Vehicle Use in Downtown Areas			
15.2	Parking Fee Regulations	Parking fees can be increased in different forms such as the highest charges for parking in central business districts, increase fees for parking garages to deter vehicle use during high ozone level days, and charging city-owned parking garage pass holders a fee for more than one entrance and exit each day, etc.	No implementation authority	Parking fees are set by each jurisdiction
15.11	Pricing Policies	Transportation Pricing (such as tolling and cordon pricing) to reduce the vehicle miles traveled	No implementation authority	Pricing policies are set by each jurisdiction and/or the State

Step 3. Compare MSM SIP Control Measures

The next step is to compare potential MSMs against measures already adopted in serious area SIPs for each source category to determine whether these measures would provide any additional emission reductions. According to the analysis discussed in Step 2, TCMs that are currently implemented in the Valley already represent MSMs with no new MSMs identified.

Step 4. Adopt and Implement Any MSM That are More Stringent Than Any Measures That Are Already Approved Into the SIP

The fourth step requires the adoption of any MSMs that are more stringent than existing measures. For measures identified as infeasible, a justification for rejecting a potential MSM must be provided. Based on re-evaluating TCMs rejected as part of the BACM analysis, no new measures were determined to meet the MSM criteria.

MSM Analysis Results

Based on MSM review, no additional TCMs were selected for implementation because it was determined that BACM conducted for the 2023 $PM_{2.5}$ SIP already represents the best level of local controls feasible in the SJV. Thus, TCMs being implemented in the Valley meet the MSM requirement with no new TCMs identified.

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