

ALTERNATIVE ENERGY: On the Fast Track to Clean Air



A Guide for Considering Clean Energy Options in the San Joaquin Valley



February 1, 2011

DRAFT

Table of Contents

The Need for Cleaner Energy Options in the San Joaquin Valley	1
Clean Alternative Energy Choices	2
Renewable Energy	2
Solar Energy	3
Wind Energy	3
Bio-Fuels	4
Renewable Energy Internet Resources	4
Waste-to-Energy Systems	6
Municipal Waste	6
Combined Heat & Power	6
Dairy Digesters	7
Waste-to-Energy Internet Resources	7
Alternative Transportation Fuels & Technologies	8
Transportation Technologies	8
Alternative Fuels – CNG/LNG.....	9
Alternative Fuels – Biodiesel	10
Transportation Efficiencies	10
Transportation & Alternative Fuels Internet Resources	10
Valley Air District Help with Clean Energy Alternatives	11
General Internet Resources:.....	12



HEALTHY AIR LIVING[™] PARTNERS

Pledge for Clean Air!

Healthy Air Living is about making air quality a priority in daily decision-making. By pledging to make some simple changes at your workplace, your company can make a difference in the air we all breathe.

Any pledge card returned to the Valley Air District will be entered into periodic contests for prizes and incentives. Please download the pledge form, check off what you or your organization pledges to do to reduce emissions and return the form to the Air District.

ALTERNATIVE ENERGY

The San Joaquin Valley Air Pollution Control District (District) encourages cleaner ways of generating electricity and mechanical power, and moving vehicles, in addition to overall reductions in energy use. These alternative energy choices include renewable energy, waste-to-energy systems, and alternative fuels and vehicle technologies.

The District also encourages the use of alternative energy sources that are clearly cleaner than current industry standards in terms of criteria pollutants, specifically nitrogen oxides (NO_x), volatile organic compounds (VOC), particulate matter (PM), sulfur oxides (SO_x), and greenhouse gas (GHG) emissions. However, not all new, advanced technologies are cleaner than current industry standards, and some offer reductions in one pollutant at the expense of increases in others.

This guidance shows the District's current recommendations regarding the most advantageous and viable Alternative Energy systems and provides additional information resources.



The Need for Cleaner Energy Options in the San Joaquin Valley

Despite major reductions in emissions that have significantly improved air quality, the San Joaquin Valley continues to face difficult challenges in meeting the federal ambient air quality standards. The District's Fast Track Action Plan, adopted to support the *2007 Ozone Plan*, identifies Alternative Energy as a potential source of NO_x emissions reductions to contribute to the Valley's progress toward health-based air quality standards. NO_x is a precursor to ozone and PM_{2.5}, both of which have serious health consequences. Ozone can inflame the respiratory tract and increase the lungs' susceptibility to infections, allergens, and other air pollutants. Adverse health effects from exposure to PM_{2.5} are especially serious for children, asthma sufferers, and the elderly with illnesses like bronchitis, emphysema, and pneumonia.

In many ways, the Valley's need for emissions reductions through alternative energy aligns with California's implementation of the Global Warming Solutions Act of 2006 (AB 32). This landmark legislation calls for the reduction of climate change-causing greenhouse gas (GHG) emissions in California to 1990 levels by 2020. The use of alternative energy is a cornerstone to the state's goals. The California Air Resources Board (CARB) adopted regulations to help meet this target, including a Renewable Energy Standard (RES) that requires the state's utility companies to procure 33 percent of their energy mix from renewable sources. In April 2009, CARB also adopted the Low Carbon Fuel Standard (LCFS), which requires a 10 percent reduction in GHGs from transportation fuels by 2020. A major component of this regulation will be the use of clean alternative fuel sources.

Local governments are also doing their part to reduce emissions and improve air quality. Many cities and counties have adopted, or are currently developing, Climate Action Plans that include strategies for reducing GHG emissions. The use of alternative energy, energy efficiency measures, and smart land use are central to these strategies. These strategies for reducing GHG emissions also have the collateral benefit of reducing air pollutants.

The need for both GHG and air pollutant emissions reductions through alternative clean energy is applicable in all sectors of the Valley—residential, commercial, agricultural, industrial, and governmental. Economics play a big role in clean alternative energy choices—the viability of an alternative energy choice depends on the cost when compared to traditional energy sources, generally the combustion of fossil fuels. Where clean energy options help to cut overall costs and provide reductions in emissions, “win-win” opportunities are created for the user and the Valley. Federal, state, and local incentives are helping to make using alternative energy more cost-effective.

Clean Alternative Energy Choices

The District looks to cleaner alternative energy options that balance the need for reduced air pollutant emissions, reduced GHG emissions, waste-stream minimization, and cost-effective options for Valley residents, businesses, and local governments. Included in these options are:

- Renewable energy, such as solar, wind, hydro-electric, and bio-fuels, (e.g. ethanol from energy crops);
- Waste-to-energy systems, such as biomass (woody material from orchards and forests), landfill gas, wastewater treatment gas, dairy digester gas, bio-solids and compost effluent gas, and municipal solid waste combustion; and
- Alternative transportation fuels and technologies, such as vehicles using electric motors, compressed natural gas (CNG), liquefied natural gas (LNG), hybrid (electric or hydraulic) systems, and fuel cells.

With all forms of alternative energy, it is important to consider both the short- and long-term viability and potential of each option. While the complete transition to renewable alternative energy resources may be a long-term goal for optimal GHG emissions reductions and a secure and local energy supply, in the short-term there are viable and cost-effective non-renewable alternatives. Given the immediate need for air pollutant emissions reductions in the Valley, short-term alternatives are not only viable, but can accelerate attainment of health-based air quality standards. Development of infrastructure that allows the use of short-term alternatives will make long-term alternatives viable when the technology has advanced and critical emission reductions are maximized.

Alternative Energy choices for Valley Residents

- Electric Cars
- Hybrid Cars
- CNG-fueled Vehicles
- Solar Panels
- Solar Hot Water Heaters
- Residential-scale wind turbines

Renewable Energy

Solar, wind, and geothermal energy have no direct GHG or criteria pollutant emissions. The energy gained from these resources is limited primarily by the cost and installation of the technology to capture it. Passive and active solar systems and wind turbines are available at all levels, from residential to utility-scale, and creative financing and purchase options are making this technology even more accessible at smaller scales. Natural geothermal energy is essentially limited to northern California, but geothermal or

ground source heat pumps that use the constant temperature of the ground as an energy source are becoming viable options, especially in suburban and rural areas.

Like natural geothermal systems, hydro-electric power is geographically limited. Almost 15 percent of California's energy comes from hydro-electric power facilities, either in the Sierra Nevada or in Oregon or Washington.

Solar Energy

Anyone can take advantage of free energy from the sun simply by letting the sun shine into a cold room in the winter. Passive solar design of homes and buildings can create more calculated savings for homeowners by including windows, walls, and floors that collect, store, and distribute solar energy to warm in the winter and cool in the summer. Passive solar heating can also be used to heat water for use in the home or swimming pool. Active solar water heating systems are also available depending on the climate conditions and specific needs of the home.



Small solar electric systems are also available to homeowners. The increased availability of these systems, in addition to rebates and financing options, are making small photovoltaic systems a viable alternative for creating onsite electricity. The California Solar Initiative (CSI) and the Million Solar Roofs bill (SB1), established in 2006, set up a statewide program to build a million solar roofs within ten years with a goal of making solar power in California cost-effective as an alternative to fossil fuel-generated electricity.

Within the Valley, there are fairly large municipal and institutional projects that are providing significant amounts of energy to the existing grid. California State University Fresno partnered with Chevron to build a 1.5 megawatt PV system on their campus that also serves as the campus's only covered parking structure. Recently, a power company in the northern San Joaquin Valley has proposed a solar farm that will use property purchased and leased from the City of Tracy to expand its existing electricity generation plant to include an additional 130 megawatts of renewable power. The City sees this as an opportunity to expand its "green footprint," hopefully inviting other green energy opportunities (Rodriguez, 2010).

Solar power systems, and sometimes wind systems, can provide enough electricity to offset the need for utility electricity, especially during peak hours. Power purchase agreements for solar power can provide electricity at a more stable pricing, thus avoiding the necessity for peak pricing. Similarly, wind turbines can provide electricity for buildings and power for water pumping.

Wind Energy

Wind energy is another option for rural residents of the Valley in areas with enough wind supply. Today's wind turbines can efficiently generate onsite electricity or be used

Alternative Energy choices for Farms & Ranches

- Solar
- Wind
- Dairy Digester Bio-Gas
- Bio-Fuel
- CNG/LNG
- Electric Water Pumps

for pumping water. Small wind turbines appropriate for residential use range from 400 watts to 20 kilowatts. A 1.5-kilowatt wind turbine can contribute as much as 300 kilowatt-hours per month given a location with sufficient wind resource.



Wind turbines among the golden hills of Altamont Pass. Photo courtesy of NREL.

Granted, many areas of the Valley do not have a consistent strong wind resource, there are certain regions that could benefit, at least seasonally, from the addition of a wind turbine, especially when combined with a small solar PV system.

Upfront purchase costs of solar PV and wind turbine systems are relatively high compared to energy efficiency measures, however, once the system is paid off, the energy that it produces is essentially

free, given minimal maintenance. A growing option for residential solar energy systems is solar panel leasing programs, also called solar power purchase agreements. Such programs allow homeowners to take advantage of clean energy without paying a large upfront purchase cost. Several companies offer these programs in the Valley and each can customize system and payment options that allow for easier entry into the solar energy community.

Bio-Fuels

Energy crops, such as soybeans, corn, sugar cane, and perennial grasses, are part a growing renewable market for renewable bio-fuels, especially ethanol and bio-diesel. NOx emissions vary with the type of crop used as feedstock when producing these bio-fuels. Energy crops that require nitrogen fertilizer, such as corn and soybeans, produce bio-fuels with higher NOx emissions. Depending on the application, these emissions may be removed with emission reduction devices. Research and testing are also underway to develop algae as a source of bio-fuel, which produces no NOx emissions.



Renewable Energy Internet Resources

Solar Power Information

U.S. Department of Energy – Energy Savers – solar general

http://www.energysavers.gov/renewable_energy/solar/index.cfm/mytopic=50011

U.S. Department of Energy – Energy Savers – solar water heaters

http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12850

Solar Power Authority – Web-based clearing house for residential and commercial solar & Cost Calculator

<http://solarpowerauthority.com/>

<http://solarpowerauthority.com/calculator/>

Go Solar California -

<http://www.gosolarcalifornia.org/>

Rebates & Tax Incentives for Solar

The Database of State Incentives for Renewables and Efficiency (DSIRE) is an excellent resource of federal, state, and local funding for solar projects. The database is kept up-to-date on new and existing programs, as well as the rebate/grant requirements and funding available. This site also has direct links to Utility information, rebate, and program web pages

<http://www.dsireusa.org/>

Department of Energy – Energy STAR Program

http://www.energystar.gov/index.cfm?c=tax_credits.tx_index

Affordable Solar

Single-Family Affordable Solar Housing (SASH) Program offers fully subsidized PV systems to low-income home owners.

<http://www.gridalternatives.org/sash>

Solar leasing and purchasing options

<http://solarpowerauthority.com/how-do-solar-panel-leasing-programs-work/>

DOE – Energy Efficiency & Renewable Energy – Solar America Communities

<http://solaramericacommunities.energy.gov/>

Wind Energy

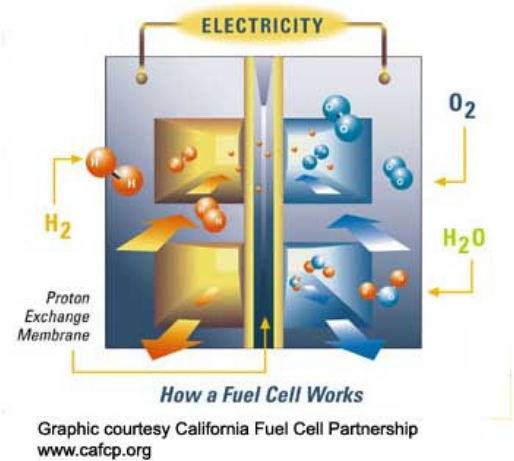
National Renewable Energy Laboratory – Learning about Renewable Energy, Wind Energy

http://www.nrel.gov/learning/re_wind.html

Waste-to-Energy Systems

Waste-to-energy systems are efficient and effective ways to use and reduce waste from agricultural, municipal, and forestry activities. Once the waste is collected, it can be used to generate energy either for on-site use or for sale to utilities to help meet their Renewable Energy Standard requirement. The clean treatment and combustion of biomass waste keeps this material out of landfills and reduces the need for open burning in the Valley. The capture of biogas from local government waste facilities, dairies, and farms provides a locally-produced clean energy alternative for these operations. The on-site use of this energy reduces overall operating costs and reliance on utility power, especially at peak use times when electricity is more expensive.

Waste-to-energy systems are not emission free. Combustion of any carbon-based material, fossil-based or bio-based, uses oxidation to breakup the carbon structure of the source material to produce heat. This process also produces carbon dioxide (CO_2), carbon monoxide (CO), NO_x , PM, and VOCs, but generally in lower amounts. The amount of NO_x emissions produced in waste-to-energy systems depends on the original material, the combustion technology, and the use of appropriate emission reduction technology. While waste-to-energy systems provide significant benefits to the system operators, continued evaluation and mitigation of air pollutants is required.



Municipal Waste

Many municipalities and municipal utilities already use biogas capture to generate electricity at waste water treatment facilities and landfills. In most cases, the gas collected from the treatment processes is used to run generators and turbines to produce energy for onsite operations. The Turlock Irrigation District, a municipal utility, currently uses methane produced from its wastewater treatment plant to power the largest fuel cell plant in California. The plant has the capability of generating 1.2 megawatts of power. Plant operators use any waste heat from the fuel cell reaction to heat water for various processes at the wastewater treatment plant. Because fuel cells involve no combustion, instead converting the gas into electricity electrochemically, the fuel cell operates cleaner than conventional power generators. The fuel used to operate the fuel cell is 100 percent renewable and is the only unit of this size that does so.

Combined Heat & Power

Many industrial processes generate a significant amount of excess heat while burning fuel in engines or electrical generators. This excess heat can be recovered to produce steam, hot water, or space heating, thus reducing system needs for additional power. Although not truly an alternative energy source, in that it is an efficiency measure, co-generation reduces the need for energy purchased from the utility or produced on site,

thus less is required of the primary fuel source. Recent technology innovations have made such combined heat and power systems (CHP) more appropriate for use in areas such as the Valley that have air quality concerns in that they produce fewer NO_x, VOC and CO emissions (DOE, 2010).

Dairy Digesters

Of growing importance to Valley dairy operators is the use of dairy digesters. The anaerobic process used to break down organic residuals produces methane, which in turn can be used to generate electricity, be used to produce CNG for fuel, or be sold to the gas company, if appropriately cleaned of impurities. Using the methane to generate electricity has implications for NO_x emissions, as with any combustion of carbon-based fuel, and requires emission reduction technology to ensure a clean air process.

Waste-to-Energy Internet Resources

National Sustainable Agriculture Information Service – Farm Energy Alternatives

http://attra.ncat.org/attra-pub/farm_energy/

Advanced BioFuels USA

<http://advancedbiofuelsusa.info/>

<http://advancedbiofuelsusa.info/biofuels-basics/biofuels-basics>

Environmental Protection Agency – Combined Heat and Power Partnership; includes a Project Development Handbook

<http://www.epa.gov/chp/index.html>



Photo Source: <http://www.suscon.org/>

Alternative Transportation Fuels & Technologies

Cleaner transportation fuels and technologies are very important to the District's overall strategy for reducing air pollutant emissions. Currently, over 80 percent of the Valley's NOx emissions inventory comes from mobile sources. Already, the use of ultra-low-sulfur-diesel and improved emissions control technology have lowered emissions in the Valley and improved air quality. New fuels consistent with the Low Carbon Fuel Standard will further the progress already made. However, more progress is needed. The District supports strong non-regulatory strategies to incentivize and encourage cleaner energy options for transportation.

Transportation Technologies

Alternative transportation options will play a major role in reducing GHG emissions and air pollutants in the Valley. As a first step, driving fewer miles and combining trips will go a long way in reducing costs and emissions. Beyond that, there are cleaner alternatives for personal, business, and public transportation. Electric vehicles and alternative fuels are becoming more readily available and cost effective, especially as fossil fuel costs rise and the country seeks to reduce its dependence on foreign oil.

Electric vehicles offer the biggest opportunity for reducing emissions in the Valley, but at this time their widespread use is limited by the initial cost and charging infrastructure. As automobile manufacturers continue to "test the waters" with the American population, prices will decrease and accessibility to charging stations will increase. Personal and commercial electric vehicles can take advantage of off-peak electricity rates to charge batteries. Hybrid-electric, hybrid-hydraulic, and fuel-cell vehicles offer similar benefits, but are further away from mass production. Use of these vehicle technologies do not rely on grid electricity and thus have lower life-cycle emissions.

The success of the gasoline-electric hybrid engines used by the Toyota Prius has opened the door for plug-in hybrid electric vehicles (PHEV), full electric vehicles (EVs), and hybrid-hydraulic vehicles. When running on full electric power, these vehicles produce no tailpipe emissions. For the most part, PHEVs and EVs can be charged at night when off-peak electricity rates are lower, thus reducing operation costs. By 2011, EVs will be available for purchase in the Valley from Nissan and General Motors. At this time, charging stations are not widely available, but home charging is an option, given the right home electrical service configuration. Valley utility companies are available to assist homeowners interested in EVs and PHEVs. In



Alternative Energy choices for Business & Local Government

- Solar
- Wind
- Municipal Waste
- Bio-Gas
- Bio-Fuel
- CNG/LNG
- Electric Vehicles
- Hybrid Vehicles

some cases electrical upgrades will be necessary, and eventually, public charging stations will be available for on-the-road options.



Photo courtesy City of Fresno

Valley businesses and governmental agencies can also take advantage of alternative energy sources when powering their vehicle fleets. As an example, the City of Fresno, as part of its Fresno Green program, has deployed the largest fleet of natural gas powered vehicles in the San Joaquin Valley. The City also received a Federal Transportation Administration (FTA) grant to purchase two electric buses to

help reduce air pollutants in the downtown area. Similarly, the City of Visalia received an FTA grant to purchase hybrid electric and CNG buses.

Capitol costs for fleet upgrades and onsite alternative energy systems is no small hurdle to overcome for companies and municipalities, but long term considerations of rising fuel costs, energy independence, and public demands for cleaner, sustainable services and products are pushing such entities to consider such options. In the long run, the Valley benefits through reduced air pollutants and healthier air.

Alternative Fuels – CNG/LNG

Alternative fuels include fossil-based fuels that are cleaner than current standards and biofuels that reduce air pollutants. Compressed natural gas (CNG) and liquefied natural gas (LNG) are being used by many Valley local government and institutional fleets, including cities and school districts. The use of CNG reduces CO emissions by 90 to 97 percent, CO₂ emissions by 25 percent, and NO_x emissions by 30 to 60 percent over light-duty vehicles using gasoline. While use is somewhat limited at this time to fleets, expansion of CNG fueling infrastructure will greatly expand CNG use for personal use. CNG is produced from pipeline natural gas, which is mostly fossil-based. However, the same CNG engines can use biogas-based CNG with equal efficiencies.

The use of alternative fuels is another option for personal use vehicles. Compressed natural gas (CNG) vehicles for personal use are available, and currently there are 15 public CNG fueling stations in the Valley. Flexible Fuel Vehicles can use ethanol-gasoline mixtures of up to 85 percent ethanol (E85), but like CNG, special fueling stations and transport are required. Tailpipe emissions of NO_x decrease by as much as 54 percent with the use of E85 compared to gasoline, as well as decreases in other emissions (Yanowitz & McCormick, 2009). As ethanol distillation moves to lower nitrogen feedstocks, the NO_x emissions reductions associated with this fuel alternative will also decrease. The District offers financial incentives to Valley residents for alternative fuel and electric vehicles (see Internet Resources at the end of this section).



Alternative Fuels – Biodiesel

Biodiesel, which offers additional emissions reductions for PM, CO, and hydrocarbons, has had mixed results in reducing NOx emissions (DOE, 2006; EPA, 2002). For that reason, the wide-scale commercial use of biodiesel has yet to be realized. However, because of its potential as a major GHG emission reduction option for the ever-growing goods movement sector, research continues in an effort to reduce NOx emissions from biodiesel. These research areas include the evaluation of different feedstocks used to distill biodiesel (Cardone et al., 2002) and fuel injection timing modifications to lower internal combustion temperatures (Fang et al., 2008).



Transportation Efficiencies

In addition to cleaner technologies and fuels, efficiencies in goods movement and land use improvements will reduce the overall use of fuels and vehicle miles traveled. Regional land use and transportation planning systems can greatly affect the emissions associated with vehicles. Progress is being made in larger Valley jurisdictions by planning for Bus Rapid Transit systems and encouragement of smart development. Idling restrictions also reduce the use of fuel and reduce significant emissions.

Transportation & Alternative Fuels Internet Resources

California Drive Clean – a buying guide for clean and efficient vehicles
<http://www.driveclean.ca.gov/>

California Energy Commission – Consumer Energy Center
<http://www.consumerenergycenter.org/transportation/index.html>

California Air Resources Board – Alternative Fuels Program
<http://www.arb.ca.gov/fuels/altfuels/altfuels.htm>

Air District Incentive Program – REMOVE II Program for light-duty alternative vehicles
<http://www.valleyair.org/transportation/removell/LMD.htm>

Internet Resources:

California Energy Commission – California’s Renewable Energy Programs, including incentives
<http://www.energy.ca.gov/renewables/index.html>

California Air Resources Board – Incentive Programs for Alternative Fuels & Vehicles
<http://www.arb.ca.gov/fuels/altfuels/incentives/incentives.htm>

California Air Resources Board – Alternative Fuels Program
<http://www.arb.ca.gov/fuels/altfuels/altfuels.htm>

Valley Air District Help with Clean Energy Alternatives

The District has developed resources to promote alternative sources of energy, supported efforts promoting alternative energy, and aligned the District programs with initiatives that promote alternative energy, including the use of District incentive funding for alternative fuel vehicles. Additionally, as part of its 2010 Legislative Platform, the District committed to supporting legislation that provides additional biomass capacity using agricultural materials and expanding net-metering and feed-in tariffs for solar and other renewable energy sources.

In the Valley, one of the most significant switches to cleaner alternative sources of energy has been the replacement of thousands of old, high-emitting diesel irrigation engines with cleaner, more efficient engines and electric motors. In 2008, with financial assistance from the District and the U.S. Department of Agriculture, this effort reduced NOx emissions by over 14 tons per day.



Recent changes to the electric utility rate structure in California may have significant impact on the Valley's agricultural industry. To provide incentives for off-peak electricity usage, utility companies charge more for electricity during peak energy use periods, such as during the heat of the day in the summer. While this dynamic pricing schedule works well for users that can easily adjust their time of use, most farms and dairies run around the clock or follow natural growing cycle. Because of this, it is difficult to limit watering or other activities on very hot days when electricity is in high demand state-wide. One way to help offset the effects of dynamic pricing is by using on-site clean alternative energy. While there may be upfront costs to install alternative energy systems, those costs may balance out in the end given higher rates for peak energy use.

The District recognizes that clean energy alternatives can cost more to implement than traditional energy sources, especially for early adopters. For this reason, the District provides incentives for many existing clean energy options and will look for opportunities to fund new technology or maintenance of existing technology.

The District developed the Technology Advancement Program (TAP) as a strategic approach to encourage innovation and development of new emission reduction technologies, including alternative energy sources and technologies. Through the TAP, the District tracks new technology concepts, refines interagency partnerships, and aggressively seek additional funding for technology advancement that benefits the Valley, while focusing on three areas tailored for Valley businesses and emissions sources:

- Renewable Energy – projects that overcome the barriers to using renewable energy, such as remote solar energy storage, vehicle-to-grid, wind energy, or peak shaving systems;
- Waste-to-Energy – systems or technologies to minimize or eliminate air pollutants and greenhouse gas emissions from existing waste-to-energy systems, including waste-to-fuel systems, such as dairy digesters and other biofuel applications; and
- Mobile Sources – including those retrofit and new equipment technologies that will facilitate the use of alternative fuel sources, allow for vehicle hybridization, or provide efficiency improvements for on- and off-road equipment.

Cleaner alternative energy generation and transportation options are vital to the future air quality and sustainability of the Valley. To help reach these goals, the District will commit its resources to ensure residents, businesses, farmers, ranchers, and local governments are able to get the most out of alternative energy options, especially when those options are the right choice for Valley air quality.

Internet Resources:

Valley Air District – Grants & Incentives Programs
http://www.valleyair.org/Grant_Programs/GrantPrograms.htm

Valley Air District – Technology Advancement Program
http://www.valleyair.org/Grant_Programs/TAP/tap_idx.htm

Contact the Valley Air District
for more information



NORTH
Modesto Office – (209) 557-6400

CENTRAL
Fresno Office – (559) 230-6000

SOUTH
Bakersfield Office – (661) 392-5500

General Internet Resources:

State

California Energy Commission – California’s Renewable Energy Programs, including incentives
<http://www.energy.ca.gov/renewables/index.html>

California Air Resources Board – Energy Activities
<http://www.arb.ca.gov/energy/energy.htm>

California Energy Commission – Consumer Energy Center
<http://www.consumerenergycenter.org/renewables/index.html>

Federal

U.S. Department of Energy – Energy Savers
http://www.energysavers.gov/renewable_energy/solar/index.cfm/mytopic=50011

U.S. Department of Energy – Alternative Fuels & Advanced Vehicles Data Center, EMISSIONS data
<http://www.afdc.energy.gov/afdc/vehicles/emissions.html>

National Renewable Energy Laboratory – Learning about Renewable Energy
<http://www.nrel.gov/learning/>

Environmental Protection Agency – Energy Conservation Action Plan, including Energy Conservation, Alternative Fuels, Alternative Energy Strategies, Green Buildings
http://www.epa.gov/greenkit/q5_energ.htm

Environmental Protection Agency – Combined Heat and Power Partnership; includes a Project Development Handbook
<http://www.epa.gov/chp/index.html>

The Database of State Incentives for Renewables and Efficiency (DSIRE) is an excellent resource of federal, state, and local funding for renewable energy and efficiency projects. The database is kept up-to-date on new and existing programs, as well as the rebate/grant requirements and funding available.
<http://www.dsireusa.org/>

Valley Utilities

Lodi Electric Utility
<http://www.lodielectric.com>

Turlock Irrigation District
<http://www.tid.org/>

Merced Irrigation District
<http://www.mercedid.org/>

Pacific Gas & Electric
<http://www.pge.com/>

Modesto Irrigation District
<http://www.mid.org/>

Southern California Edison
<http://www.sce.com/>

References

- Cardone M, Prati MV, Rocco V, Seggiani M, Senatore A, & Vitoloi S., (2002) Brassica carinata as an alternative oil crop for the production of biodiesel in Italy: engine performance and regulated and unregulated exhaust emissions. *Environmental Science Technology*, 36(21), 4656-62.
- Fang T, Lin Y, Foong T, & Lee C. (2008). Reducing NOx Emissions from a Biodiesel-Fueled Engine by Use of Low-Temperature Combustion. *Environmental Science Technology*, 42(23), 8865-8870.
- Rodriguez, J. (2010, November 22) Green project closer to green light in Tracy. *Stockton Record*.
- U.S. Department of Energy (DOE), Office of Energy Efficiency & Renewable Energy, National Renewable Energy Laboratory. (2006). Effects of Biodiesel Blends on Vehicle Emissions (NREL/MP-540-40554). Retrieved from <http://www.nrel.gov/vehiclesandfuels/nprf/pdfs/40554.pdf>
- U.S. Department of Energy (DOE), Energy Efficiency & Renewable Energy Division, Industrial Technologies Program. (2010). *Flexible CHP System with Low NOx, CO, and VOC Emissions*. Retrieved from http://www1.eere.energy.gov/industry/distributedenergy/pdfs/flexible_chp_sys.pdf
- U.S. Environmental Protection Agency (EPA), Office of Air and Radiation. (2002). A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions, Draft Technical Report (EPA420-P-02-001). Retrieved from www.epa.gov/oms/models/analysis/biodsl/p02001.pdf
- Yanowitz, J. & McCormick, R. (2009). *Effect of E85 on Tailpipe Emissions from Light-Duty Vehicles*. *Journal of the Air & Waste Management Association*, 59, 172-182. doi:10.3155/1047-3289.59.2.172