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Michael Hiltzik:

Golden State

'Hydrogen Highway' Plans Riding on Misconceptions

Technologies with supposedly world-saving attributes tend to trace the same life cycle as the cover subjects of People magazine: stupendous popular adoration, rapidly followed by disillusionment and resentment, then finally ... oblivion.

It remains to be seen whether hydrogen's current moment in the sun as the car owner's answer to dependence on foreign oil will end with dashed hopes, like such once-exalted alternatives as synfuels, MTBE, compressed natural gas and the electric car. But the bear hug administered to the so-called Hydrogen Highway by Gov. Arnold Schwarzenegger in a public ceremony last month is surely a sign that hype is outpacing reality.

Although the governor's proposal to establish 200 hydrogen fueling stations along major highways by the end of this decade suits his taste for high-profile action-hero pageantry, it skates blithely over the enormous scientific doubts that exist over how - or even whether - hydrogen might become America's fuel of choice. And those doubts make it very likely that much of the \$100-million investment in a fueling network that Schwarzenegger is proposing as a public-private partnership will be squandered.

This is not to say that the concept of hydrogen as a vehicular fuel is necessarily a fantasy. "The promise of hydrogen is tremendous," says William Reinert, who supervises hydrogen research at Toyota Motor Corp.'s operation in Torrance.

But that's only true if it can be economically produced from renewable sources and then safely exploited, either onboard or as an intermediate energy source, for consumer vehicles. And while this nirvana beckons, it's not achievable with existing technology. "The problem in going forward," Reinert says, "is that promises get oversold and people tend to ignore the tremendous difficulties we face."

The Schwarzenegger administration seems to have bought heavily into hydrogen razzmatazz. It's not simply that the governor and Terry Tamminen, his environmental secretary, glossed over the existing obstacles to commercial use of hydrogen fuel during their Hydrogen Highways fete; they also misrepresented the current state of the technology.

Schwarzenegger, for example, praised hydrogen-fueled vehicles for producing "no emissions and no smog," adding that they will "clean the air and get rid of the smog that is hanging over our cities."

Well, not exactly. Although the vehicles themselves might not produce harmful emissions, the existing methods of making hydrogen fuel have a host of drawbacks.

Hydrogen is produced commercially today largely by extracting it from natural gas, which yields its own pollutants and in which America is not self-sufficient. The most accessible option for larger-scale production would be to extract it from coal, which releases vast quantities of carbon dioxide, a greenhouse gas - exactly the output we are trying to avoid. As measured by the useful energy generated, the production of hydrogen is more polluting than burning gasoline.

The source of environmental damage might be transferred from the tailpipe to the smokestack, but where's the net gain for society?

"The single biggest misconception is that there's an abundance of pollution-free hydrogen waiting to be tapped," says Joseph Romm, a former Energy Department research official whose recent book is titled "The Hype About Hydrogen."

Tamminen, for his part, proclaimed at the governor's event that "experts agree that, while there is much work still to do, there are no 'show stoppers' to hydrogen power."

If the environmental secretary really thinks so, he has either misheard his experts or chosen them very selectively. Several experts I spoke to used exactly the term "show stopper" to describe the current state of hydrogen storage technology - that is, how to keep the fuel aboard your vehicle while you're tooling down the Hydrogen Highway.

In a study released this year, a panel of the American Physical Society pointed out that "no material exists today that can be used to construct a hydrogen fuel tank" meeting retail consumer standards. These include holding enough fuel for 300 miles of travel, a refueling time of three to five minutes and a safe, useful life of 15 years.

"If we don't solve the storage issue, we won't have a hydrogen economy," Toyota's Reinert told me.

None of this means that the state government shouldn't play a role in developing a new technology. But the risk of betting on the wrong technology is great, which means that Sacramento should be very cautious about how it spends its scarce resources.

"In the long run, over 20 years, there's a wide number of alternative fuel options," says Alex Farrell of the energy and resources interdisciplinary group at UC Berkeley. "People who think they know the single fuel that's the answer have almost no chance of being right. No one can make a claim that hydrogen is the answer and know they're right."

With that in mind, what's the sense of designing and paying for fueling stations now, when no one can be confident of how hydrogen fuel will be generated, transported and stored - or even whether it will be carried in elemental form aboard cars and trucks?

California should put its money not into infrastructure, much as that lends itself to fancy press events and television news spots, but into basic science - say by investing in university research.

Indeed, it's interesting that for all Schwarzenegger has talked about California's role in developing pioneering technologies such as the information superhighway, he doesn't seem to recognize that its success emerged largely from the top-rank research undertaken at state institutions such as Berkeley and UCLA.

What if, rather than starving UC for resources and students, the governor announced a program aimed at promoting university efforts into developing alternative energy?

Meanwhile, California might well be better off promoting a near-term energy solution with a much greater chance of success than hydrogen.

This is, of course, the hybrid car engine, which can get double the gas mileage of a conventional machine.

If the governor really wants to "get rid of the smog that is hanging over our cities," as he claims, even the most dyed-in-the-wool hydrogen maven will tell him that hybrids are the fastest way there.

But not a single statewide incentive program exists to encourage Californians to drive hybrids. (A federal tax deduction starts phasing out this year and expires in 2006.)

If Schwarzenegger really wanted to come off as a public policy innovator, he could have taken the \$4-billion car-tax rebate he gave to all automobile owners and instead applied it only to buyers of fuel-efficient hybrids. Imagine the resulting effect on California's gasoline consumption, fuel prices and air quality: It might even compensate for the grousing at auto-registration time.

Or think of this: What if the governor stopped talking about converting his Hummer to hydrogen fuel and took to driving around town in a hybrid Toyota Prius, like Larry David in "Curb Your Enthusiasm"?

Yet taking such near-term action is always harder than casting one's lot with the distant future. It's so very exciting for any politician to be called a "visionary" and so very dull to be labeled "pragmatic," even if that's the right thing to do.

Attacking daytime smog at night

Study of air quality in New England may have far-reaching effects.

BY ROBERT C. COWEN

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The battle for smog-free air seems to be entering a new phase. As standards tighten, air-quality scientists are working for a deeper understanding of what is involved. And, quixotic as it may sound, there's hope that some aspects of our man-made environment might help give us cleaner air.

Scientists are looking into processes atmospheric chemists have neglected. What's going on at night, for example, can surprise them, as a National Oceanic and Atmospheric Administration research team has discovered.

The recipe for an ozone "event" seems simple. Mix nitrogen oxides and hydrocarbons that cars, factories and some natural processes emit. Add sunshine. Voilà! Ozone smog. Apparent simplicity hides underlying complexity. It takes a lot of preparation to set things up so the ingredients mix to make major smog.

While smog-making stops when the sun goes down, the atmospheric cauldron keeps on bubbling. Its action helps determine what happens after sunrise the next day. Steven Brown at NOAA's Aeronomy Laboratory in Boulder, Colo., and his colleagues have discovered an effect that makes this point. They find that the atmosphere in the marine environment of coastal New England can do a trick that "will short-circuit some of the ozone production that would have occurred the next day," Brown says.

During the night, ozone-forming nitrogen oxides undergo chemical reactions that transform them into nitric acid gas. This gas rapidly deposits on the surface, partially cleansing the air of key smog-making ingredients.

This research is part of a comprehensive study of New England air quality. Some of the results will be specific to this region. Other findings may have wider relevance. It is already clear that scientists everywhere need to understand what is going on in the atmosphere 24 hours a day.

They may need new tools. The discovery Brown and his colleagues published in Geophysical Research Letters was made possible by new instruments that measured concentrations of key chemicals that had been nearly impossible to assess before.

Meanwhile, some air-quality engineers are experimenting with ways to clean air. The European Union is funding tests of a paint that contains tiny particles of titanium dioxide and calcium carbonate. That combination transforms polluting nitrogen oxides, or NOX, into calcium nitrate with water and carbon dioxide as harmless byproducts. The air quality agency for the Los Angeles basin, which includes Orange County, provides funds and conducts research on ways to

cut ground- level ozone, considered a significant health threat. The basin is home to the nation's worst air.