

## **Panel 3 On-Road Light-Duty Vehicle Strategies**

Unless otherwise noted, the following recommendations and comments reflect the views of Panel members and other attendees at the 2007 Air Quality Management Plan Summit meeting.

### Recommended Control Strategies

#### General

- Embrace all technologies and fuels ("silver pellets" versus "silver bullets").
- Expand alternative fuel infrastructure for such fuels as hydrogen, compressed natural gas (CNG), and E-85 (gasoline and ethanol blend that contains at least 85% ethanol)
- Couple criteria pollutant emission reductions with greenhouse gas emission reductions and fuel efficiency.
- Sustained government fleet conversion
- Use the internet to reduce Vehicle Miles Traveled (VMT)
  - Provide incentives to increase telecommuting
- Concerned about a loss of interest in alternative fuels if gasoline prices drop. We need all fuels and all technologies.
- Need sustained effort and motivation

#### Policy

- Improve government efficiency for bringing new technologies on-line and facilitating the commercialization of these technologies.
- Allow Original Equipment Manufacturer (OEM) compliance flexibility for Zero Emission Vehicle (ZEV) levels: Plug-In Hybrid Electric Vehicles (PHEVs) in gold; and Fuel Cell Vehicles (FCVs) at a higher level
- Engage the public. Is it public apathy or just an accepted way of life? Houston encouraged public involvement by working with the business community and having sports stars provide public service announcements.
- Perform "reverse engineering" to identify intermediate steps toward attainment rather than just identifying a shortfall and placing it in a black box.

#### Economic

- Sustained retail tax incentives to offset cost of technology
- Increase incentives for component suppliers
- Sustained tax incentives for fleet conversions

## Emission Measurements and Inventory

- Improve emission inventories, such as the California Air Resources Board's (CARB's) EMFAC model
- Control measure accountability
- Focus on high-emitting vehicles by using remote sensing strategies
- Eliminate the current smog check program and rely instead on expanded remote sensing (IDRV – Inspect, Diagnosis, Repair, Verify)
- Key findings of on-road emission testing versus modeling
  - Replace all light-duty vehicles (LDVs) with Partial Zero-Emission Vehicles (PZEVs). This will result in a 90 to 95% emission reduction for LDVs.
  - Full penetration of Advanced Technology PZEVs (ATPZEVs) would result in a 19% reduction in oxides of nitrogen (NO<sub>x</sub>).
  - Accelerate fleet turnover and target high emitters for removal
  - Use renewable fuels and lower emitting technologies

## Improved Energy Efficiency

- Increase fuel efficiency for LDVs
  - Cost-neutral program to incentivize high mile-per-gallon (MPG) vehicles by taxing low-MPG vehicles
- Renewable diesel - increases efficiency
  - Hydrogen/ biodiesel combination
  - New studies using a combination of biodiesel/hydrogen
- Multi-pathway strategy
  - Increase the efficiency of gasoline-fueled and diesel-fueled internal combustion engines (ICEs)
  - Increase hybridization – include plug-ins - niche only
- PHEVs
  - Replace oil with alternative fuels (in this case, electricity)
  - Reduce carbon dioxide emissions
  - Reduce gasoline consumption (when electricity only is used, no gasoline is consumed)
  - Can use renewable electricity from the sun or wind with the car battery as storage
  - Need government fleet support
  - Need to develop standards – Society of Automotive Engineers (SAE), U.S. Environmental Protection Agency (EPA), and CARB.
  - Incorporate plug-in hybrids into the ZEV mandate

## Electricity

- Electricity is coming back as a mobile, alternative fuel
- The energy of batteries is still an issue (cycle life, calendar life)

- Utilities as an alternative fuel provider – 20,000 megawatts of excess power available at 30% the cost of gasoline
- Smart grid and smart home appliances with new metering technology

### Alternative Fuels

- Future hybrids with flex fuels
- A biofuel PHEV would be "nirvana"
- Incorporate hydrogen into the transportation system in order to reduce emissions, but not as a complete replacement
  - Establish lower hurdles for hydrogen introduction
  - Injection of hydrogen into the exhaust for gasoline or diesel ICEs – onboard hydrogen reformer – low hydrogen use
  - Hydrogen and compressed natural gas (HCNG) mixtures – 30% by volume – retrofit diesel trucks & CNG fleets. Focus on captive fleets because infrastructure issues are easier to address for dedicated fleets.
  - Hydrogen ICEs for locomotives and heavy-duty vehicles, especially with hybrid technology
  - Continue working on the hydrogen infrastructure
- Use ethanol (e.g. E10) to reduce ultrafine particulates. Australia uses it.
- E85 has the potential to lower NOx emissions, but the infrastructure is limited. Perform E85 retrofits with certified conversion kits.
- Ethanol – doubts about use for LDVs
  - Remove ethanol from LDV fuel due to permeation concerns

### Barriers to the Introduction of Clean Air Technologies

- Sparse infrastructure for E85 and hydrogen (but not electricity)
- Technology, infrastructure, and market readiness are barriers for hydrogen fuel cell vehicles.
- Infrastructure is an issue for flexible fuel vehicles (FFVs), not vehicle technology
- Accurate accounting of in-use emissions
- Identifying credit for plug-in hybrid electric vehicles (cycle, emissions, Zero Emission Vehicle level)
- Battery technology for plug-in hybrid electric vehicles
- Durability (temperature, cycling, etc.) issues for various types of hybrids
- OEMs need to build the plug-in hybrids
- OEM support for technology concepts
- Codes and standards need to be developed for alternative fuels (e.g. hydrogen)
- The will of elected officials to implement

## Research Priorities for the Next 5 to 10 Years

- Need continued battery development and testing for plug-in hybrid electric vehicles.
- Proton exchange membranes, water transport, and high-pressure storage for fuel cell vehicles.
- Renewable (biofuel) technologies
- Volatile Organic Compound permeation effect on ozone.
- Fleet turnover mechanisms or retrofits to address older vehicles
- In-use emissions.
- Weekend smog effect.

## Question and Answer Period:

- Do FFVs qualify as Super Ultra-Low Emission Vehicles (SULEVs)?
  - Low volatility gasoline – butane?
  - Sufficient emission studies have not been performed on E85
  - Infrastructure limitations
  - FFVs – ongoing research on certification levels
- Plug-In hybrids
  - OEMs still evaluating battery technology and durability
  - The current goal is a 15-year life, but real life testing is needed. Metal hydride batteries have already shown 100,000-mile durability
  - Southern California Edison – accelerated NiMH battery testing – over 100,000 miles with no degradation
  - Anticipates at least one OEM to launch a commercial product within one year
  - Bench testing of plug-in hybrid batteries – already at 80,000-mile testing
  - The District will continue assessing the quantification of emissions from plug-in hybrids.
- High Emitters – rapid transient & cold Starts – highest emissions
- PZEV evaluation study – 100% penetration rate – Will assess AQMD findings with the University of California, Riverside.
- VMT reduction
  - Needs to include a transportation/transit element
  - Bus Rapid Transit programs are starting to have a positive effect
  - Weekend ozone effect
- On-road studies – alternative fuel vehicles – end-use emissions vs. dynamometer testing
- Retiring high emitters – what are the emission reductions (e.g. in tons per day) – State Implementation Plan (SIP) credit calculations
  - One of the key barriers – current SIP credit program – need to re-evaluate modeling
  - High emitters are low-hanging fruit
- Working on fuel efficiency?

- Evaluating numerous parallel tracks to reduce emissions & looking at long-term solutions
- Supports public transportation, but need to evaluate alternative fuels, rather than focus on just one
  - Supports research on E85, natural gas, bio-fuels
  - Need parallel research on all technologies to achieve clean air
- Hydrogen should not be the ultimate end-goal. Plug-ins use renewable energy more efficiently
- Hydrogen is a good energy vector – relationship with electricity is key, natural gas in the interim is the bridge
- There are no silver bullets. Refineries have initiated the hydrogen economy as part of the refining process.
- Cost of renewable diesel? Cost is higher than petroleum-based fuels – supports renewables that can utilize existing infrastructure. NOx reduction – up to 15% reduction
- Electricity as an alternative fuel is more cost-effective and the infrastructure exists. It can be a bridge to E85
- E85 – ethanol production sufficiently increased
- Oil resources are limited. A paradigm shift is needed for VMT reduction
- E85? We should focus on E100 for economic and environmental benefits – (e.g., Brazil)