South Coast Air Quality Management District

Technology Advancement Office
Plug-In Hybrid Vehicle Program
Lisa H. Mirisola

US EPA
State Clean Energy-Environment Technical Forum
Plug-In Hybrid Electric Vehicles (PHEV)
March 15, 2007
AQMD Background

- Greater South Coast Air Basin
  - 4-county region in CA
    - 11,000 sq. miles
    - 16 million people
  - 261 thousand diesel vehicles
  - 9 million gasoline vehicles

- Attainment challenges
  - Further NO\textsubscript{X} and PM reductions needed to meet health standards
Ozone, 1990-2004
3-Year Average Basin-Days Exceeding 1-Hour Standard

Days Over 1-Hour Federal Ozone Standard
Maximum 1-Hour Ozone Concentration (ppm)
Tools for Cleaning up Our Air

- Air Quality Management Plan
- Regulate stationary sources & public fleet activities
- Co fund Technology Demonstrations
- Provide incentives and emission credits to voluntarily use cleaner products
- Rely on state and federal regulations to set emission standards for mobile sources
Advanced Technology Approach

- Technology Advancement Office began in 1988
- Portfolio of possible solutions
- Applications with different “payback” timing
  - Short-term, mid-term, and long-term
    100+ projects on-going
- Leverage federal, state and private efforts
  - Infrastructure and utilization
- Government’s role is to accelerate technologies through demonstrations to overcome status quo
Advanced Technologies

Near-Term

- Aftertreatment
- Emulsified Diesel
- HD Natural Gas Engines
- Natural Gas Fueling Infrastructure
- Advanced Diesel Engines
- Hybrid Vehicles (Plug-in & Hydraulic)
- Gas to Liquid Fuel
- Renewables/Biofuels
- H2 Technologies & Refueling
- Fuel Cell Vehicles

Longer-Term
Plug-In Hybrid Projects 1998-2005

- UC Davis entries – US DOE Future Car & Future Truck “Battery Dominant” Hybrids
- EPRI Attributes & Commercialization HEV studies
- Southern California Edison Plug-in hybrid microturbine utility truck
Develop Research Program to Address Critical Issues

- March 4, 2006, Board directed staff to expand PHEV activities
- April 7, 2006, Board approved staff recommendation for expanded program
  - PHEV Technology Plan
  - PHEV Outreach Plan
Timeline of Recent Efforts

- May 2006 – Board Expanded Efforts
- June 2006 – Informational Briefing
- July 2006 – Forum & Technical Roundtable
- September 2006 – ARB ZEV Symposium
- September 2006 – Plug-In CA Initiative
- November 2006 – Thirty Vehicle RFP
- Draft AQMP Control Measure and ARB ZEV reg
- Ride and Drives & Outreach ongoing
• All-day meeting
• Presentations and discussion by experts
• 2\textsuperscript{nd} in the series of technical roundtables
• Webcast & presentations posted
Different PHEV Modes

All Electric Range

Blended
Emissions Benefits Need to be Measured

- Cold-starts determine emissions for LEV II SULEV passenger vehicles
- Clear benefits
  - Delivery applications
  - Energy diversity
  - GHG
Early Demonstrations Beneficial

- Consensus that early demos desired
- Data input for modeling
- 100 – 200 vehicles
- DOE initiating roadmap in 2007
- AQMD and CARB opportunity

PHEVs Reduce Fuel Consumption By >50%
On Real-World Driving Cycles

227 vehicles from St. Louis each modeled as a conventional, hybrid and PHEV

<table>
<thead>
<tr>
<th>PHEV Type</th>
<th>Average Daily Costs ($/mile)</th>
<th>Gas.</th>
<th>Elec.</th>
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<tbody>
<tr>
<td>CV</td>
<td>$3.45</td>
<td>---</td>
<td>9.1</td>
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<tr>
<td>HEV</td>
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<td>---</td>
<td>6.5</td>
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<td>PHEV40</td>
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<td>$0.72</td>
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</table>

Assumes $2.41/gal and 9¢/kWh

PHEVs:
- >40% reduction in energy costs
- >$500 annual savings

- 8647 total miles driven
- 100% replacement of sample fleet
- 26 mpg
- 3.7 mpg
- 58 mpg & 140 Wh/mi
- 76 mpg & 211 Wh/mi
Roundtable Conclusions

- Lithium Ion battery technology most promising but cost is currently high
- Current hybrid architecture (charge sustaining) will work in “blended” strategy – most likely initial product
- All electric range promises most air quality benefits but requires larger battery
Plug-In Hybrid Projects
2006+ Progress Overview

• PHEV Prius in demo (EnergyCS)
• PHEV Sprinter vans (EPRI-DaimlerChrysler)
• PHEV Jetta w/ Li batteries (AC Propulsion)
• PHEV Utility Boom Truck (EPRI – Eaton, Ford)
• Request Proposals for 30 PHEV
PHEV Prius (EnergyCS)

- AQMD demo 2 PHEV Prius over 14,000 combined miles as PHEVs
- ARB emissions study one PHEV, time limited, but SULEV capable
- Additional demos CalCars, city of Santa Monica, Clean-Tech, SCE, SMUD, PG&E/BAAQMD, Manitoba Hydro
- Up to 5 total for AQMD – current contract
PHEV Sprinter Van (EPRI-DaimlerChrysler)

- 2 prototype PHEV Sprinter vans in test at SCE
- Fleet operation of prototypes at SCE & AQMD
- Next phase – 5 next gen for AQMD 30 van demo in US & Europe
- Amended utility prototypes for passengers
PHEV Jetta w/ Li batteries (AC Propulsion)

- Li battery integration complete
  vehicle ready for demo
- Shares battery strategy with Ebox
  (low cost consumer 18650 cells)
- Series hybrid system
  (increasing US OEM interest)
- In demo this year
PHEV Utility Boom Truck
(EPRI – Eaton, Ford)

- Ford F550 Chassis, Eaton integration
- Add PHEV to Eaton hybrid electric dev
- Demos w/SCE, LADWP, PG&E
30 PHEV Project

- **Timeline**
  - RFP issued November 3, 2006
  - 5 proposals received & evaluated
  - $2.7M approved from AQMD March 2, 2007

- **Demos at up to 15 sites within AQMD**

- **2 passenger vehicle platforms**
  - 20 Quantum Escape PHEVs
  - 10 Hymotion Prius PHEVs
AQMD’s Clean Air Choice Program

• Features the cleanest new retail passenger vehicles LEV II SULEV and cleaner
• Part of the AQMD website http://www.cleanairchoices.org.
• Out of 34 models listed for 2007
  - Nine gasoline hybrids
  - One natural gas
• Outreach Efforts with wrapped vehicles