



South Coast AQMD Plug-in Hybrid Electric Vehicle Program



June 22, 2006

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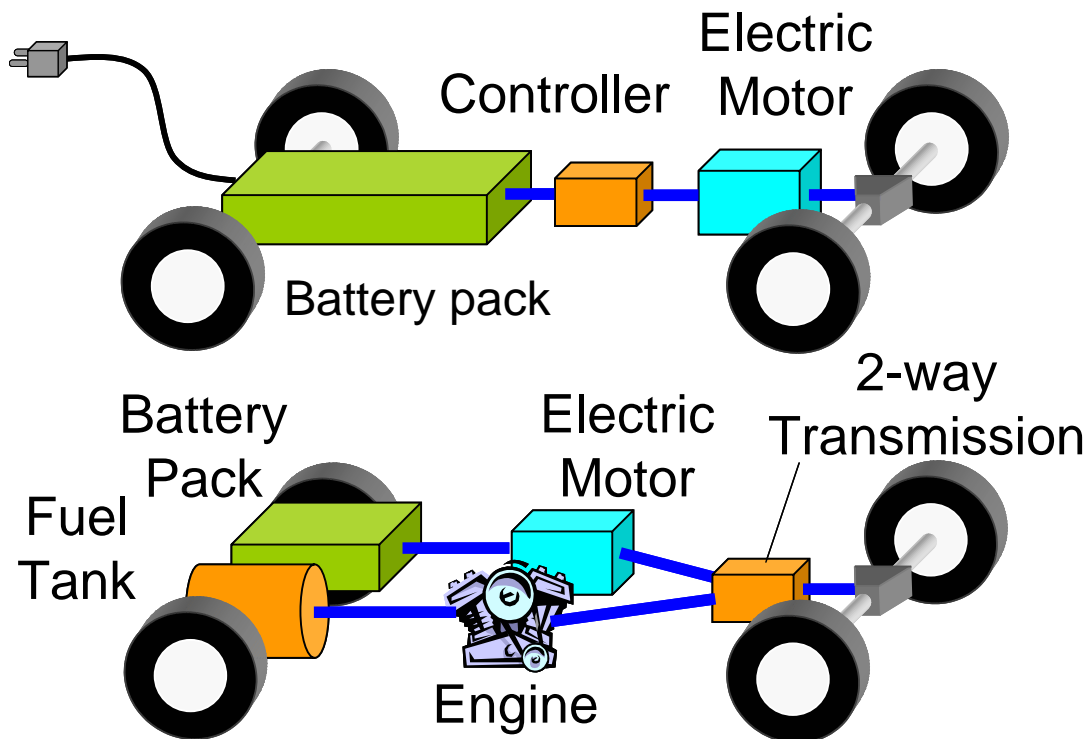
Technology Demonstrations Manager
Science & Technology Advancement

Outline

- *What* are Plug-in Hybrid Electric Vehicles?
- *Why* is the AQMD interested?
- *How* is the AQMD proceeding?

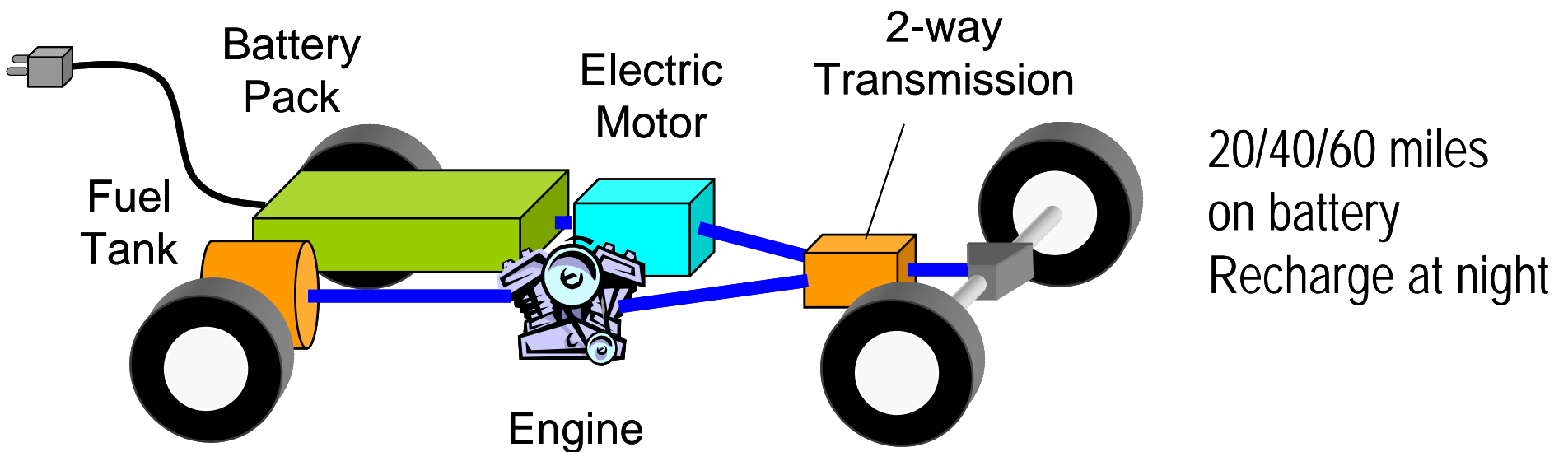
Conventional Vehicles

- All battery electric vehicle +
- Hybrid electric vehicle with ICE



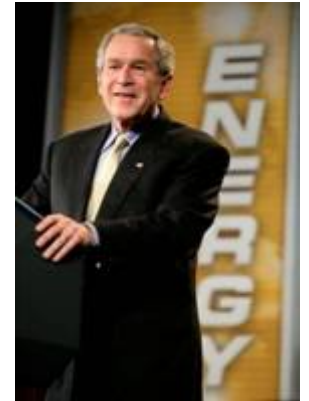
Plug-in Hybrid Electric Vehicle (PHEV)

- All battery electric vehicle +
- Hybrid electric vehicle with ICE



Recent News

- President at Johnson-Controls (Feb 06)
- Saab Hybrid Concept (Mar 06)
- *Scientific American* (Apr 06)
- Toyota in LA Times (Jun 06)



FRANK ROBIKOW, European Pressphoto Agency
MPG: Toyota's Katsuaki Watanabe tells reporters in Tokyo that the automaker plans to lift its fleet's overall fuel economy.

Toyota to Explore Plug-In Hybrids

HYBRID VEHICLES
By Joseph J. Romm and Andrew A. Frank
As car buyers turn to fuel-sipping gasoline-electric hybrid vehicles, a new generation of greener hybrids is just coming over the horizon.

GAIN TRACTION
When gasoline prices climbed to \$3 a gallon last summer, hybrid vehicles — which combine a conventional engine and a battery-powered electric motor to achieve improved fuel economy and performance — began racing out of showrooms. Whereas the average U.S. car gets about 23 miles on a gallon of gas, a full-fledged hybrid car such as a Toyota Prius averages about twice as far on the same amount, depending on how it is driven. Annual U.S. sales of hybrids from 2004 to 2005 doubled to 190,000 and are expected to exceed more than half a million by 2010. By 2015 most new car models ought to offer a hybrid power-train option.

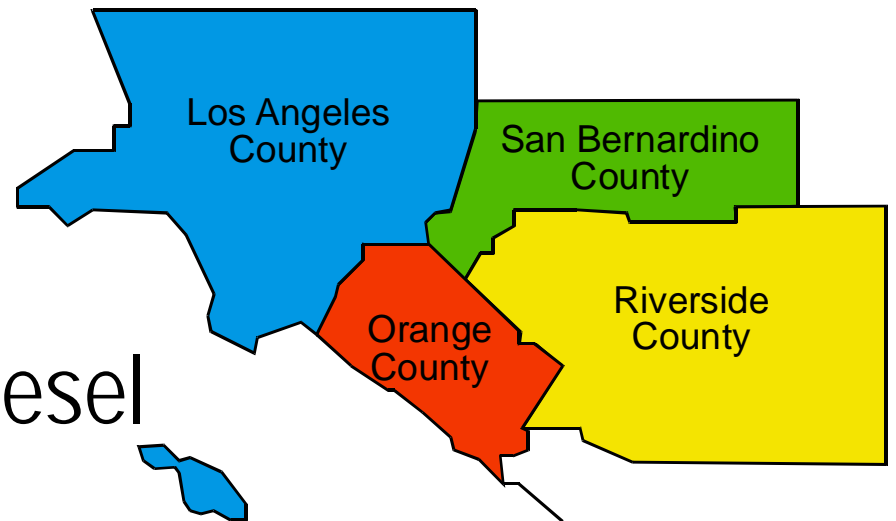
78 WASHINGTON POST OPERATIONS CENTER, BIRMINGHAM, AL APRIL 2006 WWW.WHOP.COM OPERATIONS CENTER, BIRMINGHAM, AL WWW.WHOP.COM

Why is AQMD Interested?

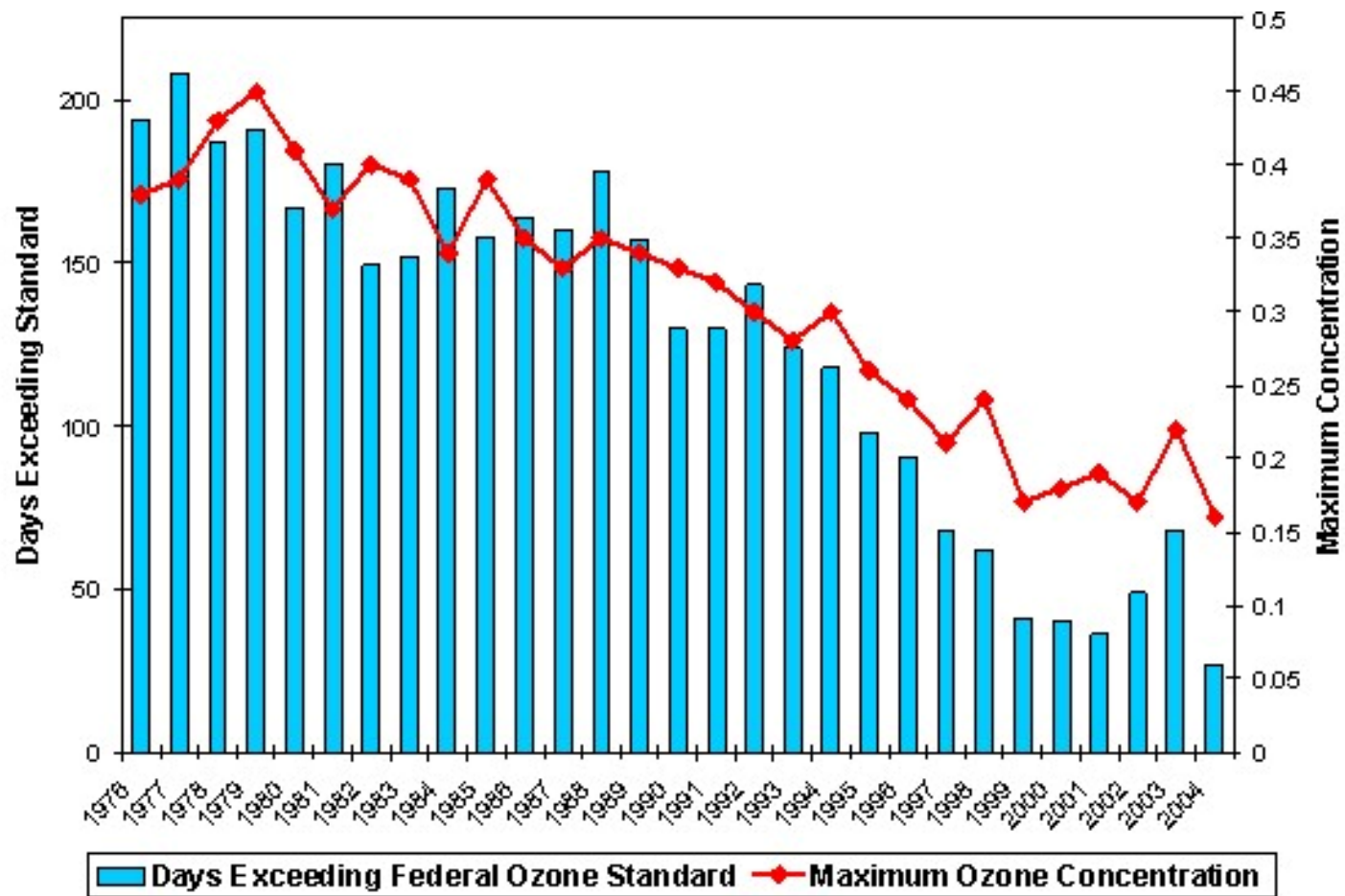
AQMD Background Setting

South Coast Basin:

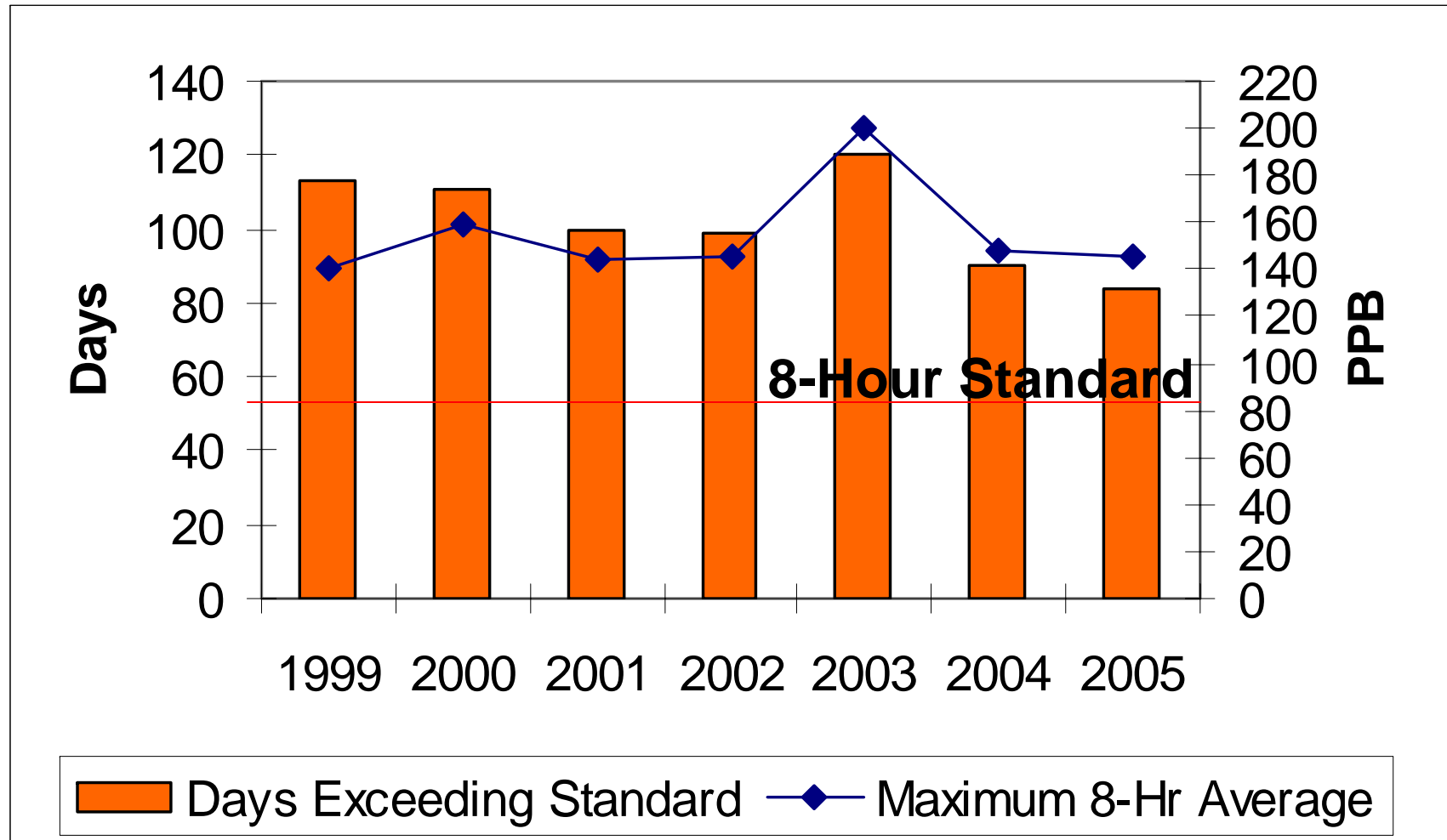
- 4-county region
- 11,000 sq. miles
- 16+ million residents
- Hundreds of thousands diesel vehicles
- Millions of gasoline vehicles
- Combined Ports of Long Beach and Los Angeles are nation's largest cargo gateway



Days Exceeding 1-Hr Ozone Standard



Trends of Basin 8-Hour Ozone



10 Most Particulate-Polluted Counties in US

(annual average PM_{2.5})

1. **Riverside, CA**
2. **San Bernardino, CA**
3. **Los Angeles, CA**
4. Kern, CA
5. Tulare, CA
6. Allegheny, PA
7. Fresno, CA
8. Wayne, MI
9. **Orange, CA**
10. Kings, CA

Public Health Issues



LA Times March 25, 2006

Study Doubles Estimate of Smog Deaths

USC researchers amass measurements of lethal particles that matter from cars and trucks in Los Angeles. The study may double the number of deaths attributed to smog.



State's Air Is Among Nation's Most Toxic

Only New York has a higher risk of cancer caused by airborne chemicals, the EPA says.

By MARLA CONE

LA Times March 22, 2006



A22 WEDNESDAY, MARCH 22, 2006

Cars, Trucks Key Culprits in Toxic Air

[Fumes, from Page A1] side and San Bernardino counties are near the U.S. average.

Although a tiny fraction of all

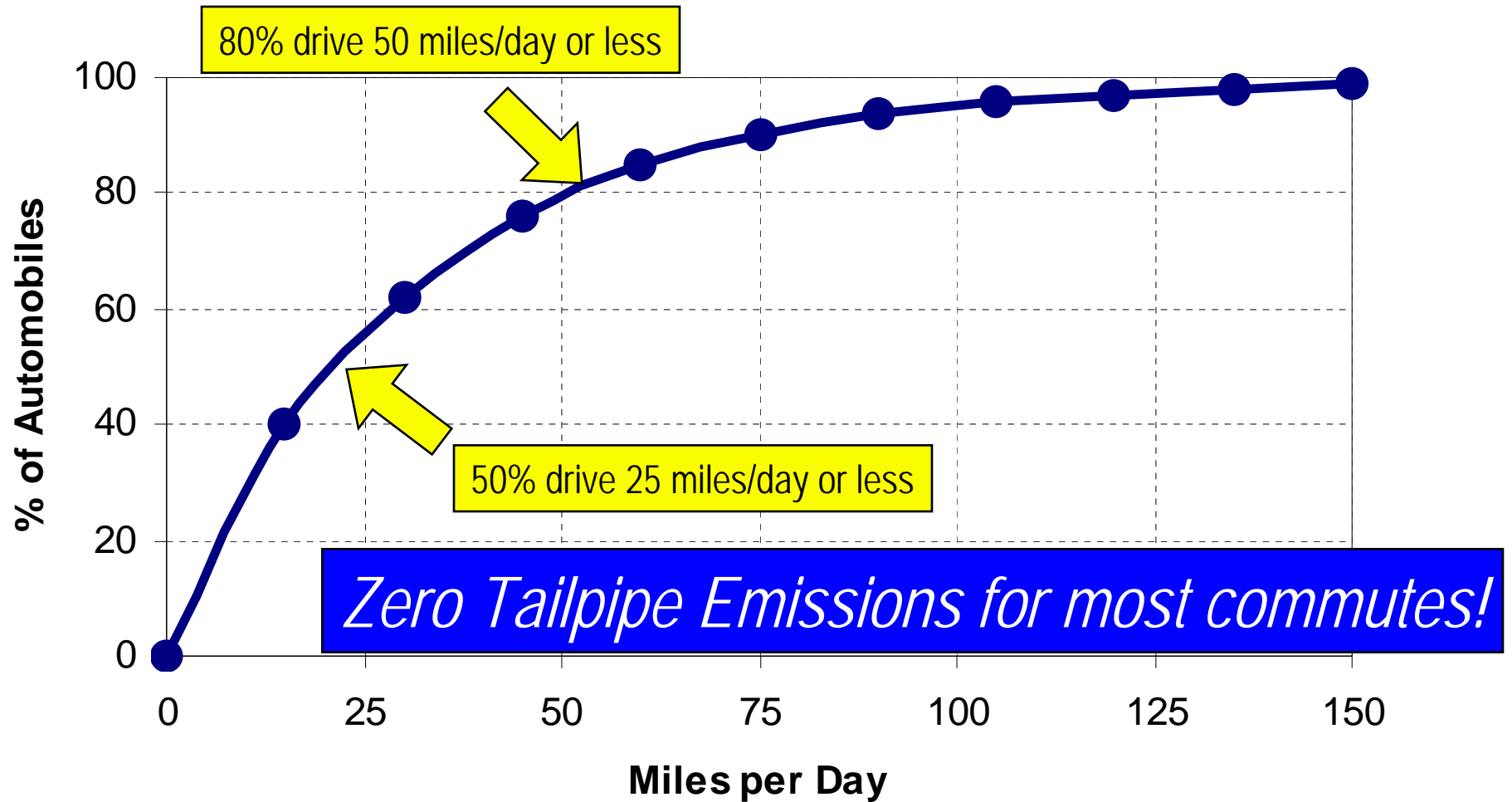
cluded diesel exhaust, which was excluded from the EPA's numbers, and ranked other chemicals as more potent than the

Public Health Issues

- Air pollution linked to asthma, increased cancer risk, and children's health
 - Children's Health Study showed chronic low lung function due to air pollution
 - Mobile sources contribute to 89% of average cancer risk from air toxics in South Coast Air Basin
- Recent findings indicate State has second highest toxic air concentration



Average Commuting Distance



Source: D.O.T. Nationwide Personal Transportation Survey 1990

How is AQMD Proceeding?

Advanced Technologies

Near-Term

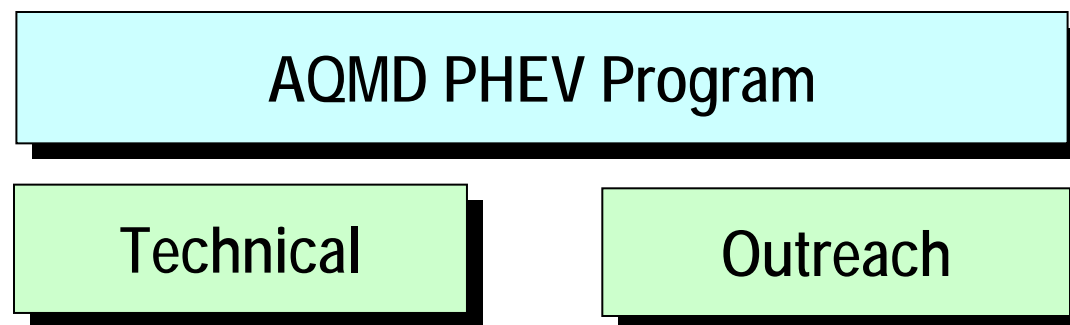
- Aftertreatment
- Emulsified Diesel
- HD Natural Gas Engines
- Natural Gas Fueling Infrastructure
- Advanced Diesel Engines
- Hybrid Vehicles (Plug-in & Hydraulic)
- Gas to Liquid Fuel
- Renewables
- H2 Technologies & Refueling
- Fuel Cell Vehicles



Longer-Term

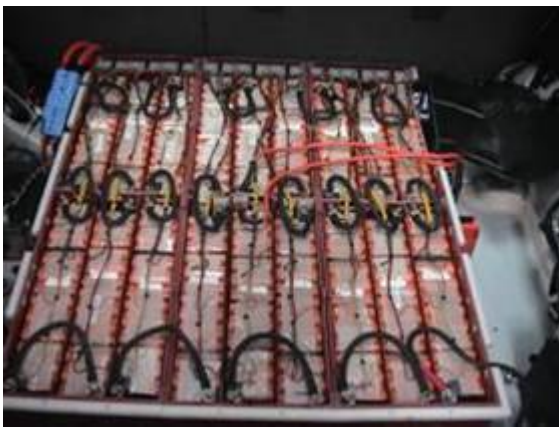
AQMD's Expanded PHEV Program

- 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



Prius Conversion Plug-in HEV

- AQMD “Shakedown” testing underway
- More than 100 mpg under optimum conditions
- Prototype testing and up to 4 additional demonstration vehicles
- Currently using Valence Lithium-ion batteries



Battery pack



DaimlerChrysler PHEV

- Phase I
 - AQMD testing 2 delivery vans this year
 - NiMH and Li-Ion batteries
- Phase 2
 - 30 vehicle fleet worldwide (18 in US)
 - AQMD to test 5 passenger vans in fleet service
 - Water-cooled Saft Li-ion batteries



AQMD Technologies Pathway

- Very expensive
- Limited H2 storage capability
- No commercial product yet



Fuel Cell Vehicles

- Less \$ than FCVs but
- Storage is still an issue
- H2 is expensive
- Low but measurable emissions

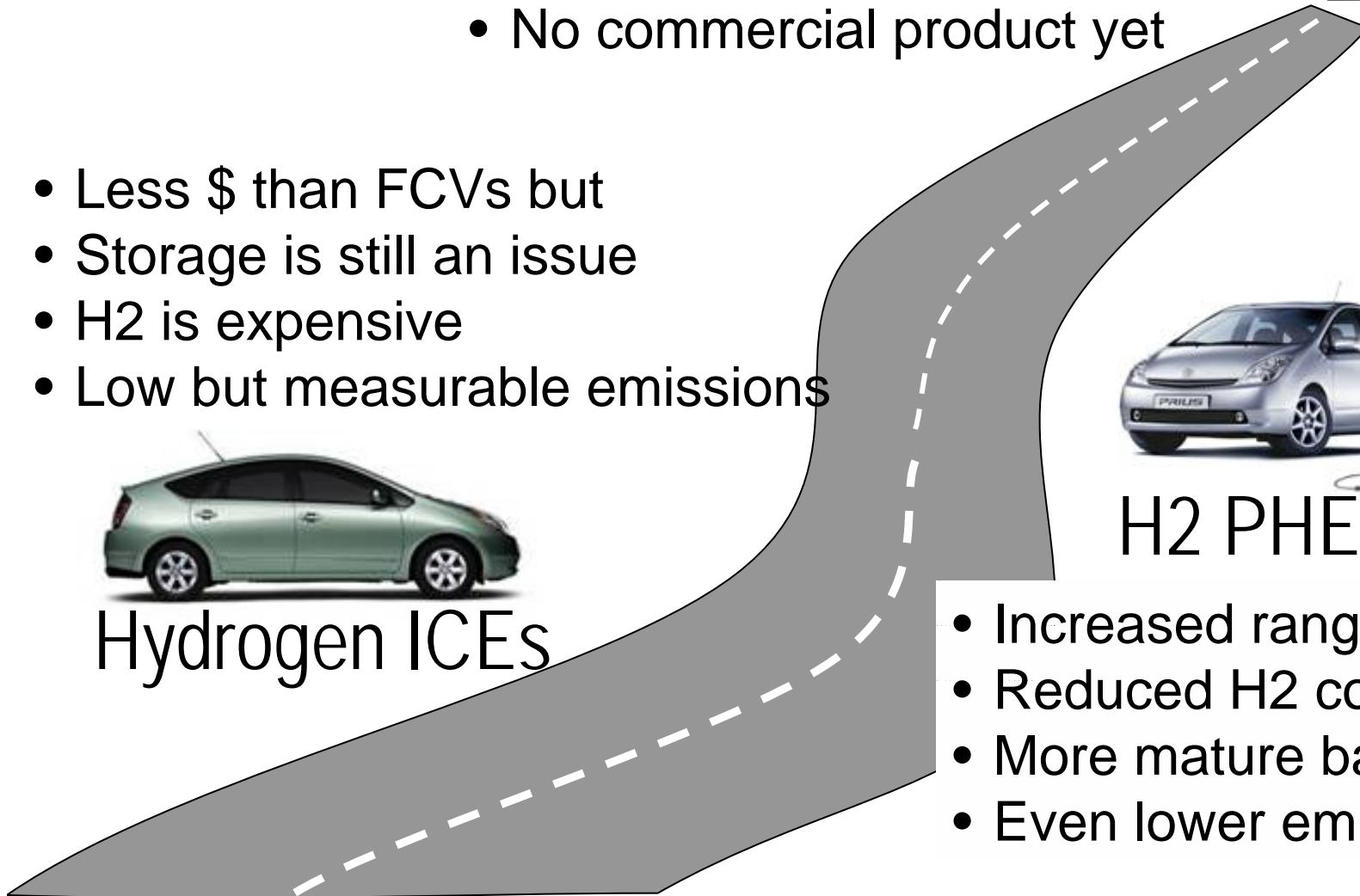


Hydrogen ICEs



H2 PHEVs

- Increased range
- Reduced H2 components
- More mature battery tech
- Even lower emissions



Strategy for Success

- Need for long-term and near-term solutions
- Need to invest now in research-demonstration technologies
- Public-private partnership
- **Need local champions!**



Next Speakers

- Andrew Frank, UC Davis
- Edward Kjaer, SCE
- Roger Duncan, Austin Energy