

Environmentally Friendly Vehicles: Initiatives in the United States

United States



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Consultant

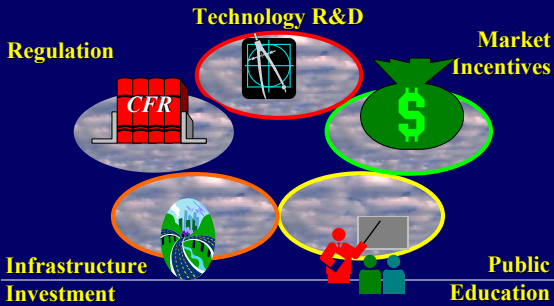
Tokyo, Japan
March 1, 2004



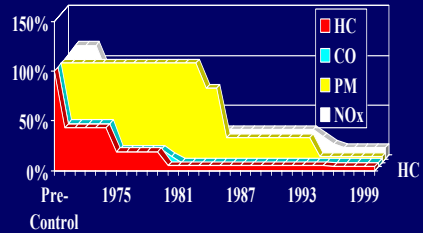
Overview

- United States Program
 - Evolution of Emissions Standards
 - CAFÉ Program
 - Other
- California
 - Emission Reduction Strategy
 - Zero Emission Vehicle (ZEV) Regulation
 - Reducing Climate Change Emissions
 - The California Fuel Cell Partnership

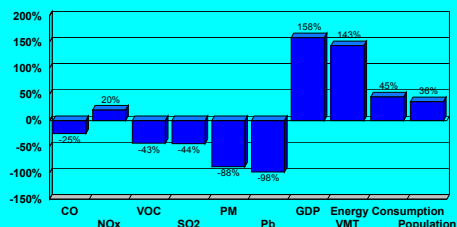
Five Government Strategies to Reach Environmentally Friendly Vehicle Goals



New Car Emissions Standards in the US



Growth Areas and Emissions Trends in the US (1970-2000)

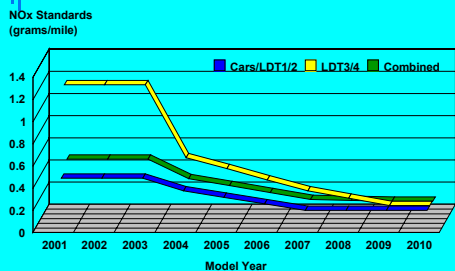


EPA 454/K-01-002
September 2001

Current* 8-hour Ozone and PM2.5 Nonattainment



US Tier 2 Standards



The Same Standards Apply To Light Duty Diesel & Gasoline Fueled Vehicles

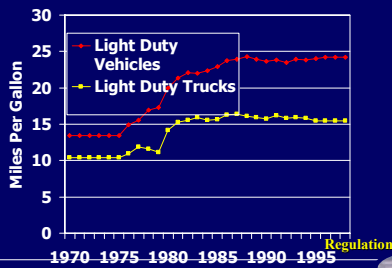
The US Program To Improve Vehicle Fuel Efficiency

- Corporate Average Fuel Economy (CAFE)
 - Standards For New Cars & Light Trucks
 - Labels on New Vehicles
 - Gas Guzzler Taxes
- Partnership For A New Generation of Vehicles (PNGV); Freedom Car
- Tax Incentives

Regulation



Fuel Economy Improvements in the US



National Clean Cities Program

..... A voluntary, locally based government industry partnership program

- Currently 77 Active Cities
- Over 4,400 Stakeholders
- 96 million gallons of petroleum displaced per year
- 19,000 metric tons of emissions reduced per year



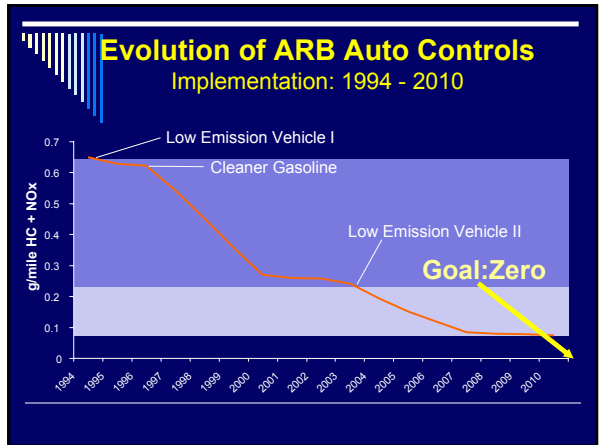
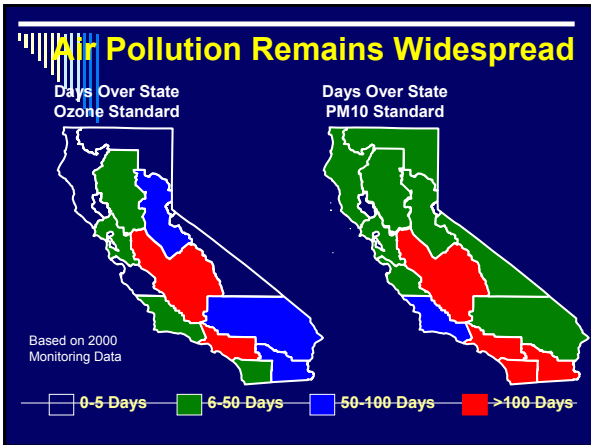
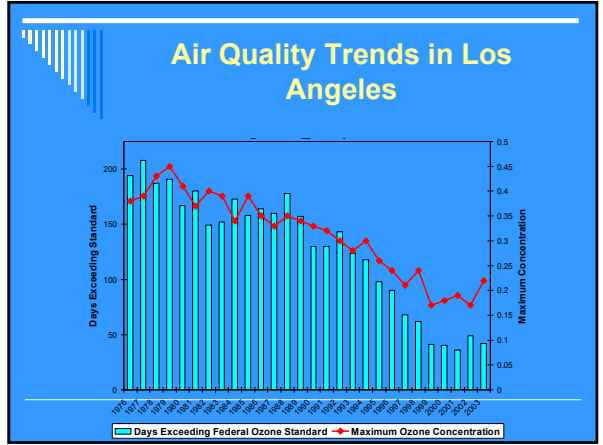
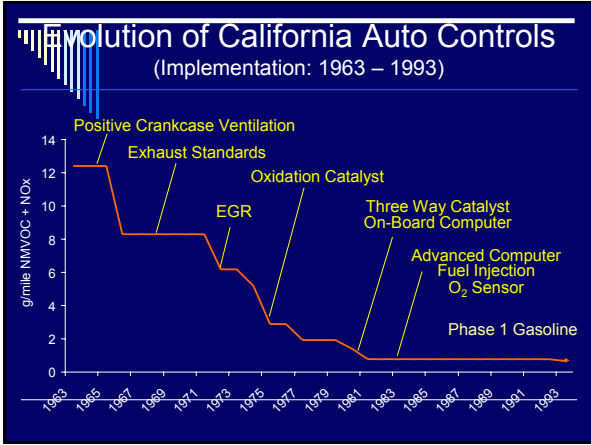
Alternative Fuel Vehicles (AFVs) in the U.S.

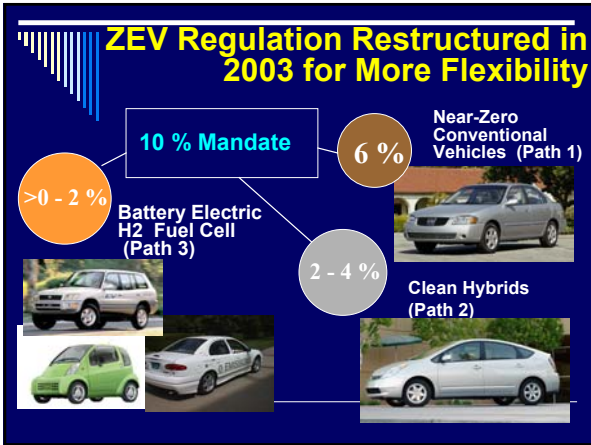
- Alternative Fuel Vehicles
 - 110,000 CNG vehicles
 - 10,400 Electric vehicles
 - 269,000 Propane vehicles
- Alternative Fuel Refueling Stations
 - 1,280 Natural gas stations
 - 592 Electric rechargers
 - 3,353 Propane stations
 - 240 E85 stations
- Approximately 43 light-duty models available
- 100 medium/heavy-duty models available

Los Angeles 1955:

Unbearable air and no solutions.







- ## Path 1: Near-Zero Emission Conventional Vehicles
- Near zero exhaust emissions
 - Zero evaporative emissions
 - 15 year/150,000 mile warranty
 - On-board diagnostics
 - 140,000 sales in 2003
 - 200,000 sales in 2004

Path 2: Hybrid Electric Vehicles

- Three models now available
- More models coming
- ~ 20,000 sales expected in 2005

Toyota Prius Hybrid

Honda Civic Hybrid

Lexus 400 H Hybrid
(coming soon)

Hybrid Electric Vehicles

“ZEV enabling” technology:

- electric drive train
- batteries
- power management

Incentives for Near-Zero Emission Hybrid Electric Vehicles

- Extra regulatory incentives (credits) encourage “strong” hybridization
- Incentives based on:
 - system voltage
 - power output of the electric motor
- Short term incentives for 42-volt systems

Path 3: Battery Electric and Fuel Cell Vehicles

- Full size battery electric
- Neighborhood electric
- Fuel cell

Full-Sized Battery Electric Vehicles



- Over 2,500 sold or leased
- Cost and range issues shifts focus:
 - smaller vehicles
 - fuel cells

Neighborhood Electric Vehicles

25 mph top speed
limited range
2-4 passengers



Over 8,000 sold or leased in response to ZEV regulation

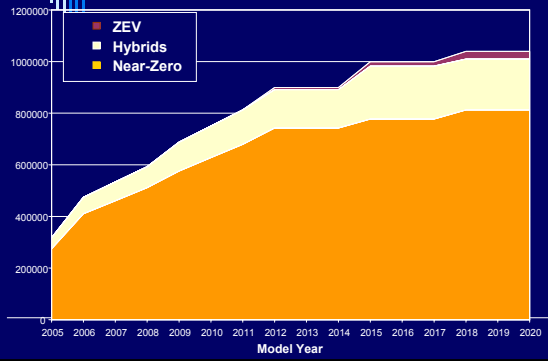


Fuel Cell Vehicles

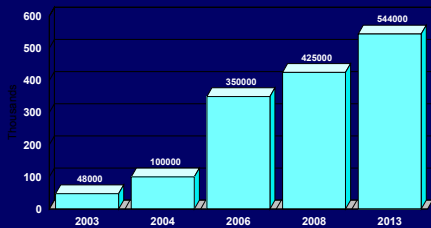
- Promising technology
- Significant cost, manufacturing and performance challenges
- Volume production expected 2010 or later



Vehicle Production Scenario (example)

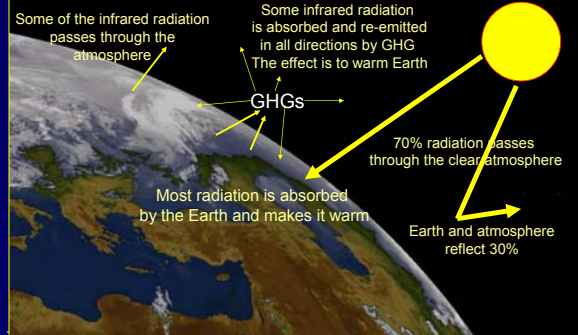


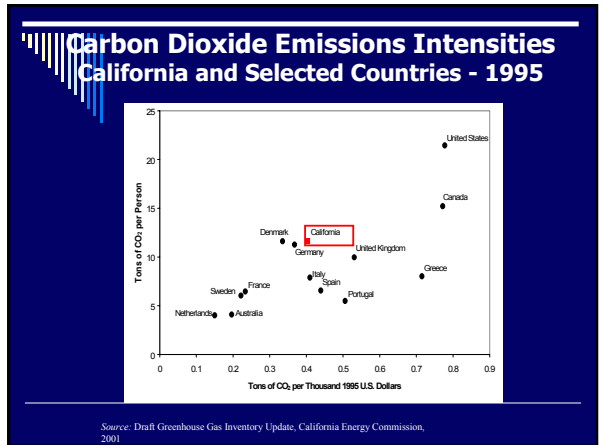
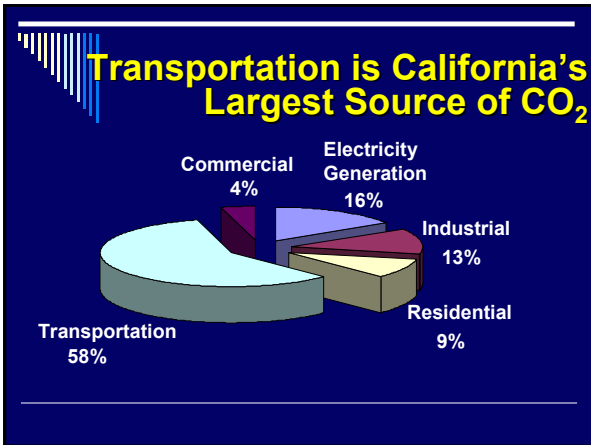
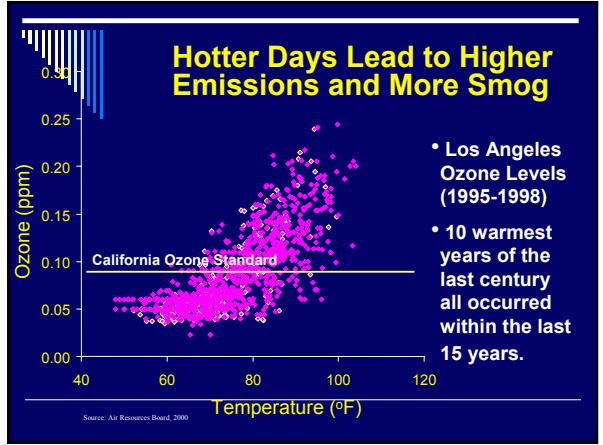
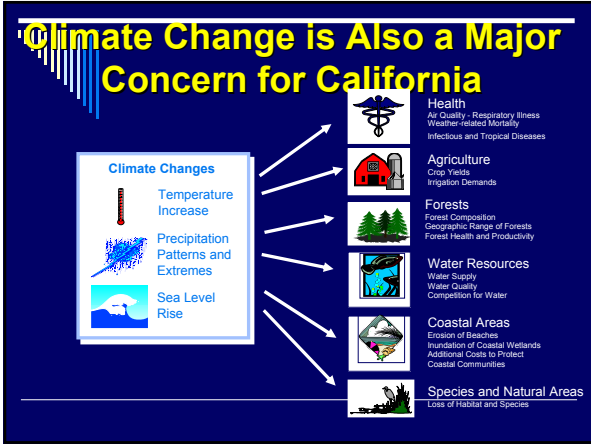
Hybrid Electric Vehicle Forecast For The US



Source: J.D. Powers & Associates

Greenhouse Gas Effect







AB 1493 General Requirements

- By January 1, 2005 Board to adopt regulations that achieve maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles
- Report to Legislature and Governor by January 1, 2005
- Regulations may not take effect prior to January 1, 2006
- Regulations apply only to 2009 and later model years



In Developing Regulations ...

- Consider technical feasibility
- Consider impact on economy of state
- Provide flexibility as to means of compliance
- Conduct public workshops
 - Communities with significant exposure to air contaminants, including communities with minority or low-income populations
- Grant credit for early reductions



Regulations Shall Not Require ...

- Fees or taxes on vehicle, fuel or VMT
- Ban on sale of any vehicle category
- Reduction in vehicle weight
- Limitation on or reduction of speed limit
- Limitation on or reduction of VMT



Climate Change Regulation

- Regulations will provide flexibility, not mandate specific technology
- Hybrid vehicles will compete with other emerging technologies
- Hybrid's role will depend on developments in conventional and fuel cell technology - but increased sales seems certain

Hybrid Electric Drive



Honda Civic
25% CO₂ reduction compared
to non-hybrid model

Toyota Prius
29% CO₂ reduction
compared to comparable
conventional vehicle



Diesel Engines

Diesel engines can provide
substantial CO₂ reductions
compared to their gasoline
counterparts.



Diesels face a significant
challenge in meeting
California's NOx emission
requirements



Long-Term Vision

- The ultimate goal remains - zero-emission technology
- Must be energy-efficient; reduced climate impact
- California is taking the necessary steps now

Advanced Low Emissions Technologies Will Play A Critical Role

- Substantially Reduce Conventional Urban Pollutants
- Reduce Oil Consumption Through High Efficiency
- Major Challenges:
 - Cost
 - Vehicle Availability

Issues Require a Public Policy Response—1

- Large, heavily populated urban areas with a developed or developing motor vehicle population suffer or will suffer from smog, particulate matter and toxic air pollution with serious public health impacts.



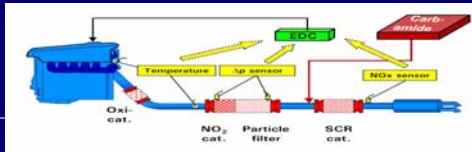
*Global warming is real, and action to reduce warming gases to or below current levels will need to be taken. Motor vehicles are a major source of warming gases.

Issues Requiring a Public Policy Response—2

- Petroleum production will peak and begin to decline, and alternative motor vehicle power sources will need to be developed.
- Advanced motor vehicle technologies can and should play an important role in addressing these issues.

Current Technology: Good But Not Enough—1

- Gasoline cars: 95+% reduction of smog emissions, but so many vehicles in developed countries this is not enough.
- Diesel cars: PM/NOx controls lag gasoline, but efforts to catch up underway.
- Diesel trucks/equipment: 60-80% reduction of NOx/PM.



Current Technology: Good But Not Enough—2

- Motorcycles/three wheelers: 0-50% HC reductions, still many 2-strokes with very high emissions.
- Other gasoline engines (e.g. small engines) 50+% HC reductions = 1970s level of car pollution control technology.
- Big diesels (ships, trains, + jet aircraft) 0 to 50% NOx/PM reductions.

Current Technology: Good But Not Enough—3

- Limited alternative fuel use (some NG buses/medium trucks, a few electric vehicles)
 - Petroleum supply problems viewed as a distant problem.
- Improvements to reduce warming gases modest at best.
 - Improvements mainly go to improve performance, overcome increased weight, or
 - More diesel at the expense of urban smog.

Solutions: Urban Smog

- Cars need to achieve zero and near-zero life cycle emissions. Existing and emerging technologies can achieve this goal.
- All diesels should use NOx /PM after-treatment and cleaner fuel (essential) for 95+% emission reduction. Zero-emission alternatives should be used wherever possible, especially in densely populated areas.

Solutions: Greenhouse Gases

- Ensure that technology improvements increase efficiency not power (e.g. more stringent fuel economy standards).
- Rapidly expand use of hybrid electric drive-trains (~50% CO₂ reduction).
- Develop small car BEV market and integrate with mass transit (where electricity production is clean, and transit under-developed).
- Accelerate commercialization of fuel cell engines for a variety of vehicle types.

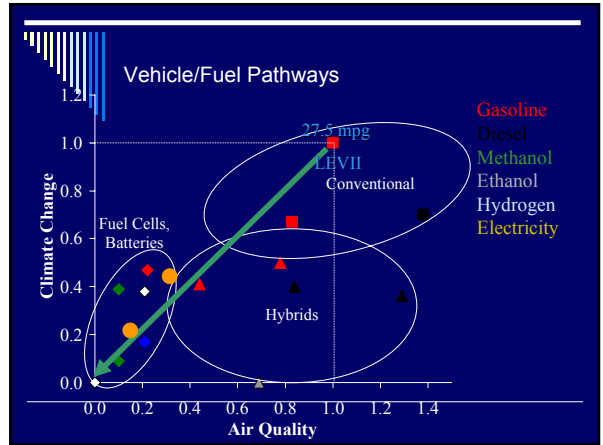
Solutions: Fuel Diversity

- Increase natural gas use in urban fleets.
- Use gas-to-liquids.
- Develop hydrogen infrastructure to support fuel cell commercialization.



Integrating Solutions

- Solutions addressing all three goals (smog, warming, fuel diversity) complement each other and should be implemented in a coordinated manner.



California Fuel Cell Partnership



- Promotes fuel cell vehicle commercialization
- Infrastructure
- Safety
- Public Education



Fuel Infrastructure



- Liquid H₂ storage
- Delivers gaseous hydrogen at two pressures:
 - 3600 psi & 5000 psi
- Fill time ≤ 4 minutes

2400+ fueling events



Fuel Cell Vehicles - Today



41 cars

Over 122,000 miles

5,000+ riders/drivers