



TRB 2004 Annual Meeting

California's Program to Reduce Greenhouse Gas Emissions from Motor Vehicles

Charles M. Shulock
California Air Resources Board
January 12, 2004

California Environmental Protection Agency





Overview

- The California Air Resources Board
- Impacts of Climate Change
- Staff Assessment
- Next Steps
- Other California climate change activities

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- Attain and maintain healthy air quality
- Conduct research into air pollution causes and solutions
- Systematically address motor vehicle pollution

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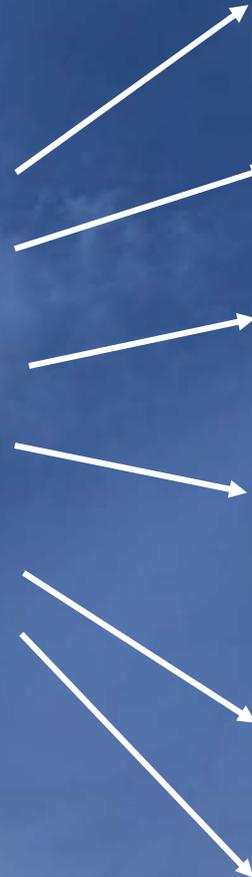


Potential Climate Change Impacts

Climate Changes

-  Temperature Increase
-  Precipitation Patterns and Extremes
-  Sea Level Rise

Source: Anne Grambsch, 1998
U.S. EPA



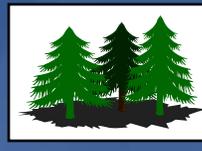
Health

Air Quality - Respiratory Illness
Weather-related Mortality
Infectious and Tropical Diseases



Agriculture

Crop Yields
Irrigation Demands



Forests

Forest Composition
Geographic Range of Forests
Forest Health and Productivity



Water Resources

Water Supply
Water Quality
Competition for Water



Coastal Areas

Erosion of Beaches
Inundation of Coastal Wetlands
Additional Costs to Protect Coastal Communities



Species and Natural Areas

Loss of Habitat and Species

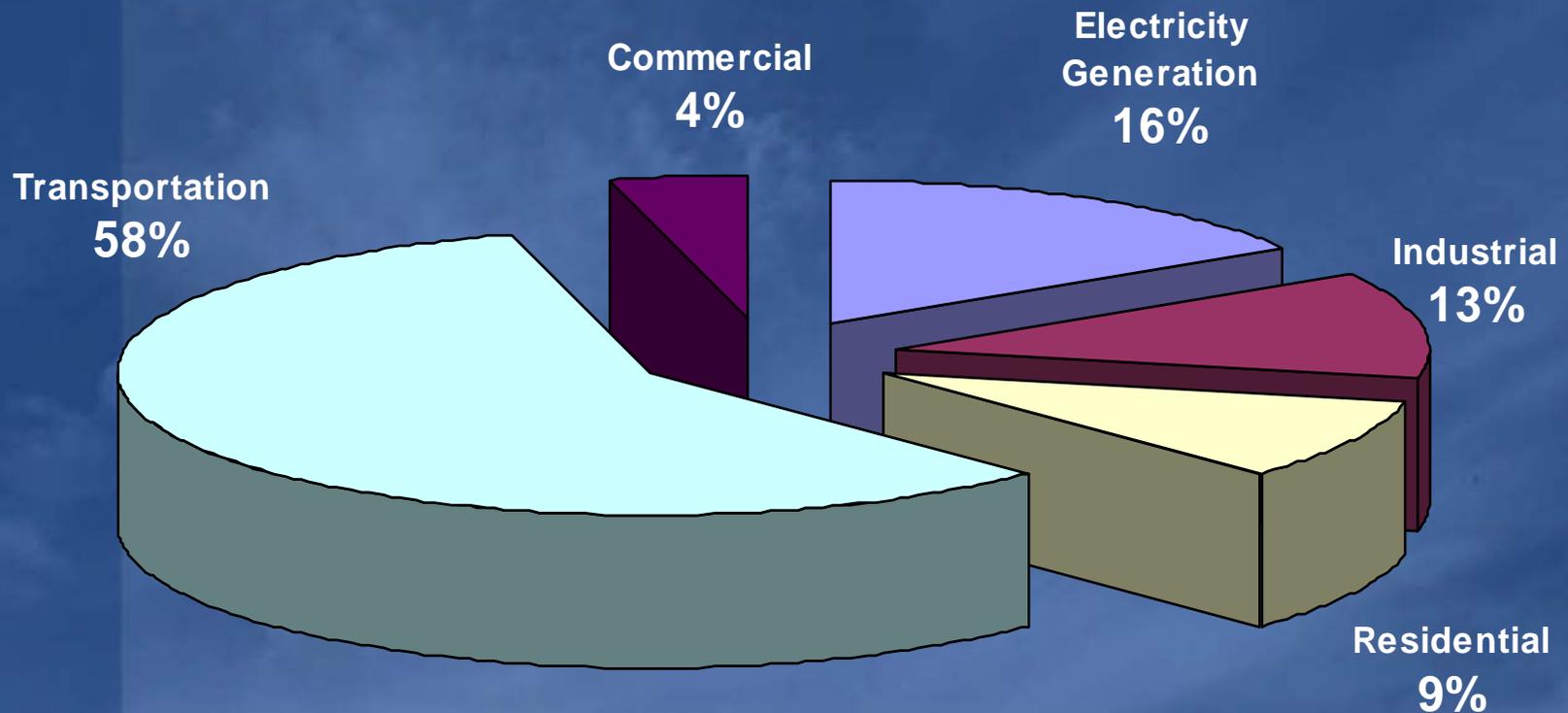
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Transportation

California's Largest Source of Climate Change Emissions



Source: Draft Greenhouse Gas Inventory Update, California Energy Commission, 2001

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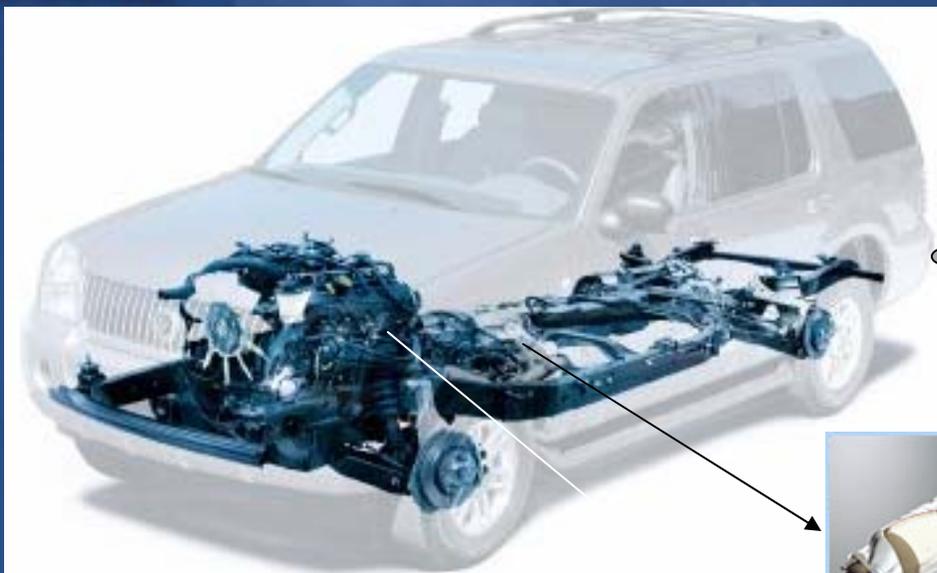
AB 1493 General Requirements

- By January 1, 2005 adopt regulations that achieve the 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

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Vehicle Climate Change Emission Sources



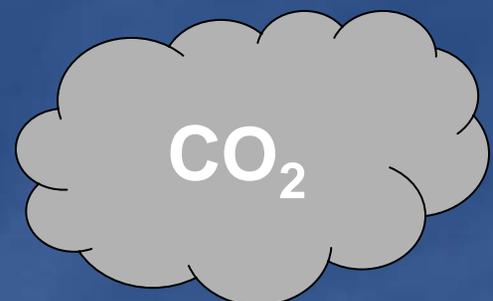
Engine



Transmission



A/C compressor



Engine Technologies



Technology

**GHG
Reduction %**

**Manf. Projected to Use
This Technology by 2009**

Off-the-Shelf

Variable Valve Timing & Lift

3-8

Most manufacturers

Cylinder Deactivation

3-6

GM, Chrysler, Ford, Hyundai

Smaller Engine with supercharger
or turbocharger

5-7

Ford, DC, GM, BMW, Nissan,
Saab, Audi, VW, Jaguar, Mazda,
Subaru

Throttleless Engine

3-6

BMW

Engine friction reduction

1-3

42v Integrated Starter/Generator

13

Hybrid Electric Drive

15-30

Toyota, Honda, GM, DC, Ford,
Nissan, Mitsubishi, Hyundai

Diesel Vehicles

~26

Emerging

Gasoline direct injection

4-17

BMW, VW, Toyota, Mitsubishi,
and others

Camless Engine

15

Variable compression ratio

2-6

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Variable Valve Timing and Lift

Several models currently incorporate variable valve timing.

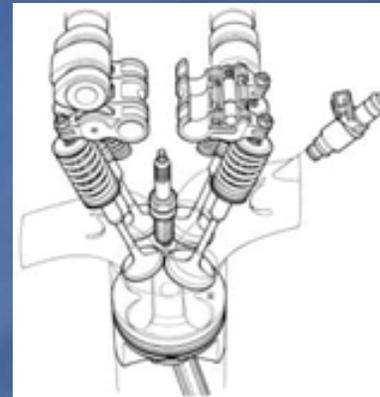


Toyota Celica GT-S

Variable valve lift provides even greater CO₂ reductions



Honda Accord



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Displacement-On-Demand (cylinder de-activation)

Currently offered in Mercedes S-class, Honda Civic Hybrid
Planned in 2004 Chrysler Hemi V-8



GM Displacement on Demand (DOD) to be offered as option in 2005 in V-8s, 2006 in smaller engines

GMC Envoy XUV

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Gasoline Direct Injection



2004 model year BMW 760
Stoichiometric gasoline direct injection
Variable valve timing and lift
Throttleless operation

Lean burn GDI achieves greater CO₂ reductions but requires lean NOx traps and low sulfur gasoline

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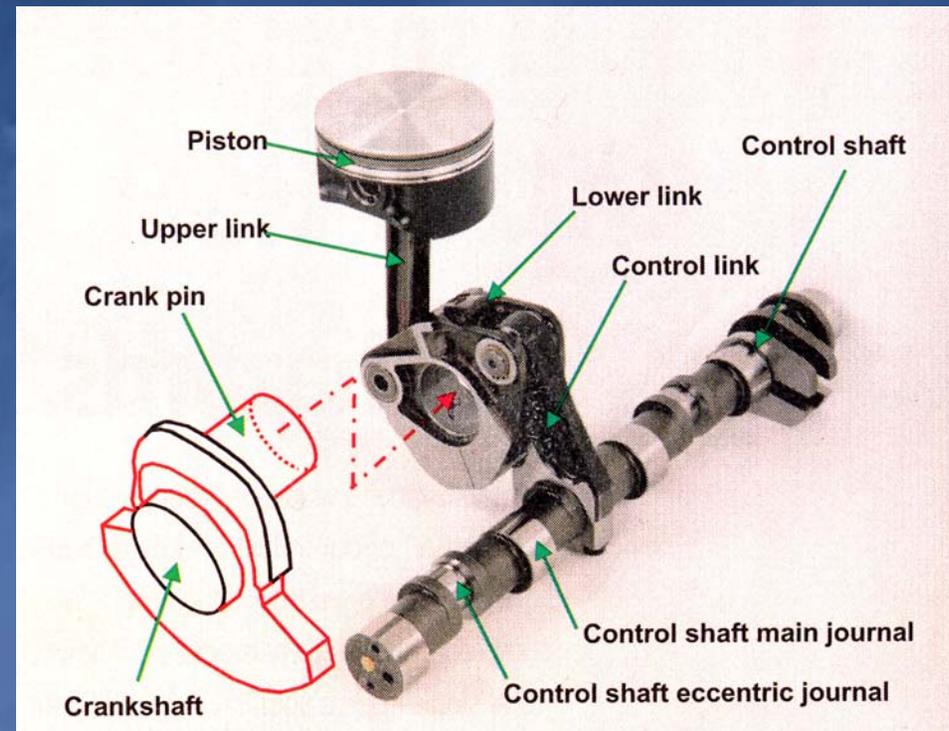




Variable Compression Ratio

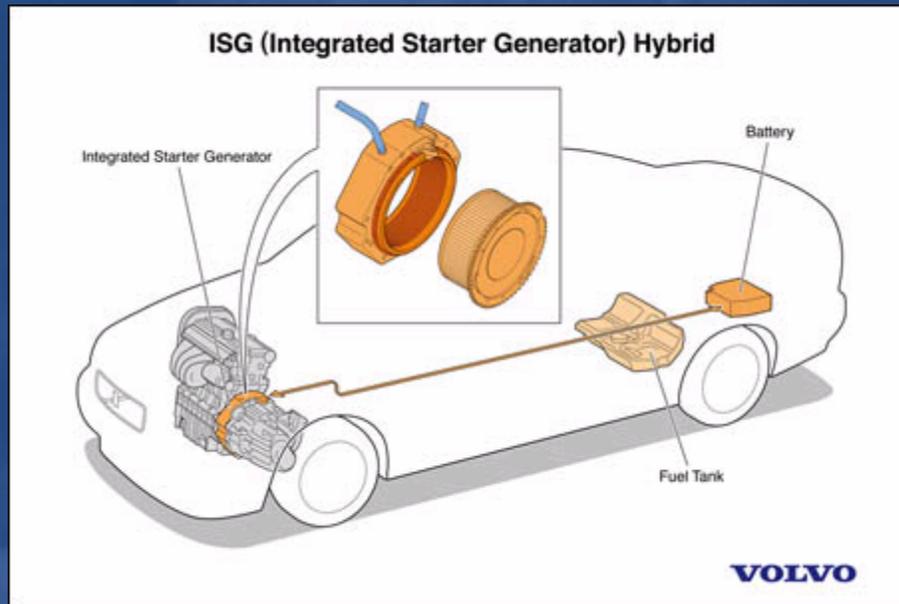
Under development by several manufacturers - Nissan, Saab

When combined with engine downsizing and turbocharging offers significant CO₂ reductions





42v Integrated Starter/Generator



Provides stop/start capability, recovery of braking energy, and some motor assist



CO₂ reductions up to 13% at modest cost

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Hybrid Electric Drive



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

Toyota Prius
29% CO₂ reduction
compared to comparable
conventional vehicle



Coming: 2004 Ford Escape,
2005 Lexus SUV, and others

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Diesel Engines

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

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



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Transmission Technologies

Technology*	GHG Reduction %	Manf. Projected to Use This Technology by 2009
Off-the Shelf 5-speed automatic Continuously variable transmission (CVT)	2-3 4-8	Some manufacturers GM, Nissan, and others
Emerging 6-speed automatic Automatic shifting manual (AMT) Advanced continuously variable transmission	8 15 12	Most manufacturers Select vehicle models Select vehicle models



Other Technologies

Technology	GHG Reduction %	Manf. Projected to Use This Technology by 2009
Vehicle technologies		
Better aerodynamics	1-2	Many
Electric power steering	tbd	
Electric water pump	tbd	
Improved lubricating oils	tbd	
Lower rolling resistance tires	1-1.5	Honda Civic HX, Toyota Prius, others
Mass reduction		
Alternative fuel vehicles	tbd	GM, Ford, DC, Toyota, Honda, BMW and others
Other Emerging Technologies		
Better catalyst to reduce N ₂ O & CH ₄	tbd	
HFC-free air conditioner	tbd	
Variable A/C compressor	tbd	

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Technologies That Reduce Methane or Nitrous Oxide

- Relatively high global warming potential compared to carbon dioxide
- Catalyst modifications have been demonstrated that reduce methane emissions
- Nitrous oxide emissions may also be reduced through catalyst modifications





Technologies That Reduce HFC Emissions

- Better materials and fittings can reduce leakage
- Alternative refrigerants with lower global warming potential
 - R152a, CO₂
- Variable displacement compressors reduce system energy requirements, leading to lower CO₂ emissions





Potential GHG Reductions From Near-Term Measures

- **ACEEE: ~32%**
Low resistance tires, low emission accessories, ISG, CVT
- **NRC Path 2: ~27%**
Variable valve timing and lifting, CVT, multi-valve OHC, electric power steering
- **EEA: ~26%**
Composite aluminum and high strength steel bodies, electric power steering, cylinder deactivation, advanced torque converter





Technology Summary

- Technologies to reduce mobile source GHG emissions available today
- Some already in use or in product plans
- Others under development and available soon
- Vehicle performance and function unaffected or improved
- Significant cost-effective climate change emission reductions possible

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Goals for the 'Form of the Standard'

- Real and significant emission reductions
- No restriction of product offerings
- Do not penalize manufacturers currently using advanced technology
- Minimize opportunities for gaming

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Possible Approaches

- Single fleet average emission standard for all manufacturers
- Separate fleet average emission standards for different vehicle categories:
 - Car vs. truck
 - Size-based
 - Weight-based



Alternative Compliance Strategies

- AB 1493 requires regulations to allow alternative methods of compliance

But...

- Must not dilute the emission benefits, requirements, or technology-forcing nature of regulations
- The goal is to improve the vehicles themselves

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Criteria for Alternative Compliance Strategies

- Real
- Quantifiable
- Surplus
- Enforceable
- Permanent
- No increase in criteria pollutant or toxic air contaminant emissions

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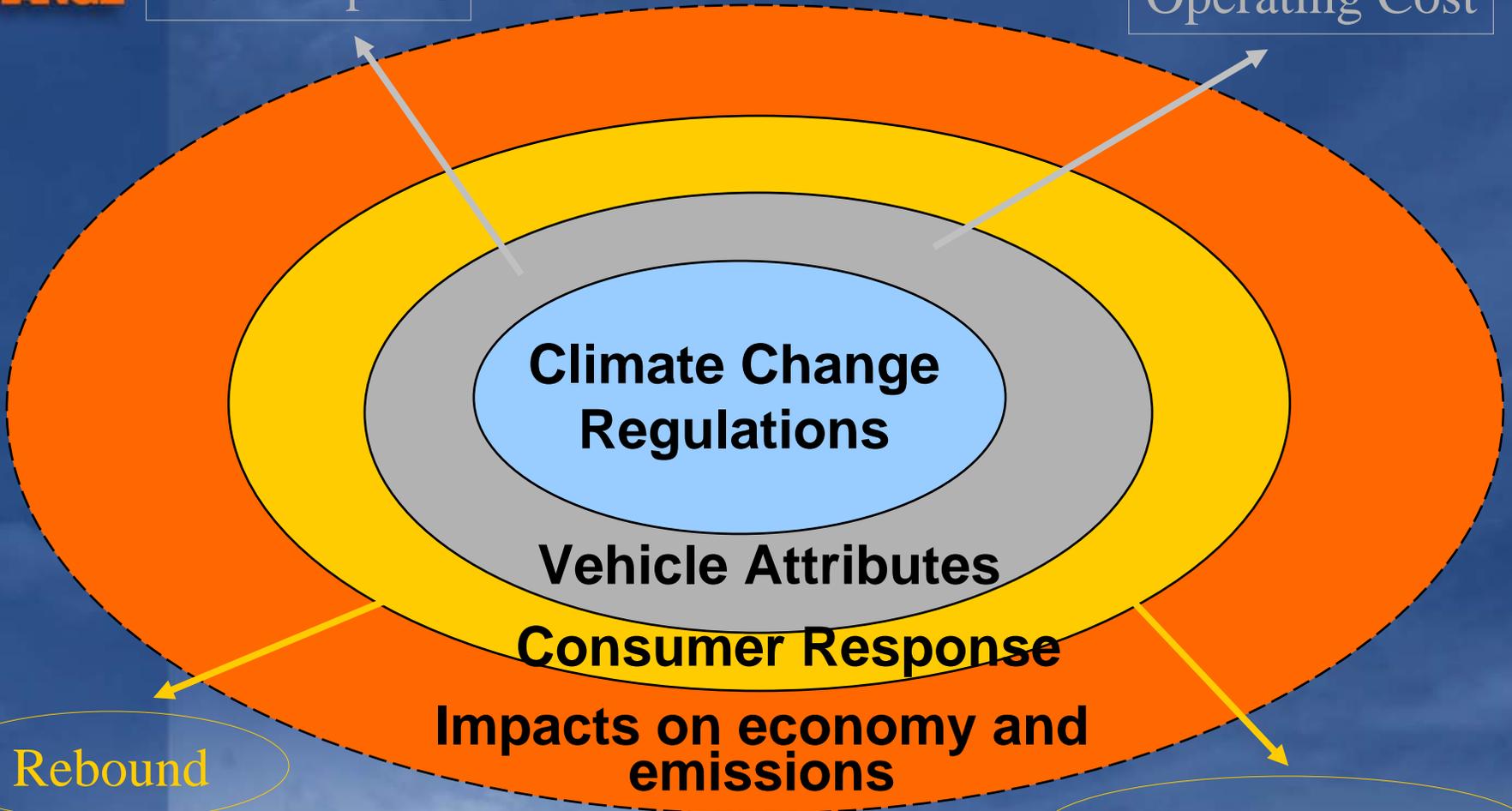


Economic Analysis



Vehicle price

Operating Cost



Rebound

Fleet Turnover

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Community Input

- EJ community may be particularly vulnerable to health consequences and economic effects of climate change
- ARB is committed to a partnership with the EJ community
- Input from the EJ community is essential to a successful partnership

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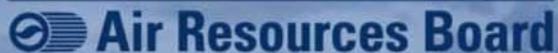
Next Steps

2003	2004				2005
4Q	1Q	2Q	3Q	4Q	1Q-4Q

Staff Assessment
Workshops: Technology, EJ



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Upcoming Milestones

- February 2004--Environmental Justice workshop
- March 2004--Technology Workshop
- May 2004--Draft staff report released
- June 2004--Workshop on draft staff report
- July 2004--Final staff report released
- September 2004--Board hearing

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California Will Continue To Lead the Way

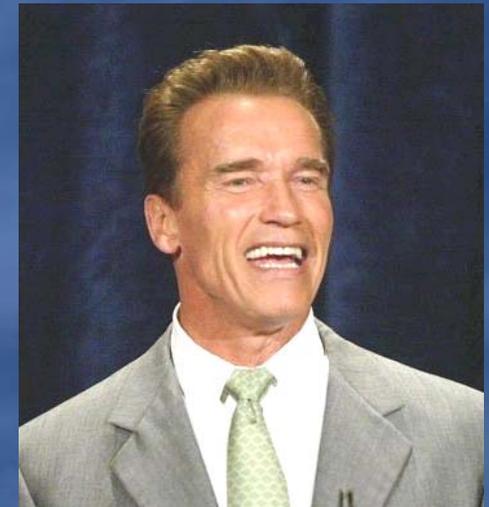


"This is the first law in America to substantively address the greatest environmental challenge of the 21st century. In time, every state - and hopefully every country - will act to protect future generations from the threat of global warming. For California, that time is now."

Governor Gray Davis

"Over 30% of carbon dioxide emissions come from automobiles and as temperatures rise, our air quality worsens. California's landmark legislation to cut greenhouse gases is now law, and I will work to implement it and to win the expected challenges in court along the way."

California Environmental Protection Agency *Governor Arnold Schwarzenegger*



Conclusion



- Climate change threatens public health and the environment
- California is particularly vulnerable
 - Air quality, water supply, coastline, forests
- Technology exists to significantly reduce climate change pollutants from vehicles
- Thorough staff assessment underway
- California's leadership is essential

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AB 1493 List Serve

- Provides subscribers with automatic email notification
 - Notice of workshops and meetings
 - Posting of documents on ARB website
- To subscribe, go to ARB website and follow prompts
 - www.arb.ca.gov/listserv/cc/cc.htm

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