Global Warming and Greenhouse Gas Emissions from Motor Vehicles

Overview

1. Evidence for global warming
2. Potential climate change impacts
3. Human activities
4. Summary
The Greenhouse Effect

Industrial Era Has Changed the Atmosphere

- Carbon dioxide, methane, nitrous oxide, particulate matter, and other pollutants cause global warming

- IPCC concludes increases in these gases are a result of human activities

Temperature and Carbon Dioxide Are Related

- Ice core records show the current rate of increase and levels are unprecedented.

Potential Climate Change Impacts

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

- Health
  - Air Quality - Respiratory Illnesses
  - 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

Source: Adapted from Office of Science and Technology Policy, Climate Change State of Knowledge, October 1997
Our Principal Reservoir - The Sierra Snow Pack - is Shrinking

Warmer Winters Have:
- Reduced snow pack
- Led to earlier snow melt
- Decreased spring runoff by 10%
- Affected water supply

Sacramento River Runoff (1910-2000) - April to July as a Percent of Total Runoff

San Francisco Yearly Mean Sea Level (1855-2000)

Sea Level is Rising Along California’s Coast

- Sea level has already risen 7” in 150 years
- Levee stability and salt water intrusion concerns
- IPCC projects 4-12” sea level rise by 2050
- Present Delta system may not be viable with 8-12” sea level rise

Source: California Environmental Protection Agency, Environmental Protection Indicators for California, 2001
Hotter Days Lead to Higher Emissions and More Smog

- 10 warmest years of the last century all occurred within the last 15 years.

California Ozone Standard

Source: California Environmental Protection Agency

Human Activities Can Intensify the Greenhouse Effect

Transportation

Utilities

Industry

Source: U.S. EPA State and Local Climate Change Outreach Kit, March 2000
California Greenhouse Gas Emissions 1999 (In CO₂ Equivalents)

Sources
- Carbon Dioxide (CO₂)
  - Fossil fuel combustion
- Methane
  - Fossil fuels
  - Landfills, agriculture
- Nitrous Oxide
  - Agriculture, cars
- Hydrofluorocarbons
  - Refrigerants, solvents

Aerosols Affect Global Warming

- Some aerosols reflect incoming radiation (global cooling)
- Black carbon (soot) absorb radiation (global warming)
  - Enhanced warming when mixed with other particles
Carbon Dioxide Emissions Intensities
California and Selected Countries - 1995

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

Transportation is California’s Largest Source of CO₂

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

• Global climate change is a concern
• Need more progress towards reducing greenhouse gas emissions
• AB 1493 requires the Board to set emission standards for greenhouse gases from light-duty mobile sources

AB 1493
Implementation
AB 1493 Implementation

• Requirements of the Bill
• Staff implementation activities
  ‣ Approach
  ‣ Process overview
  ‣ Milestones
  ‣ Tasks
• AB 1493 List Serve and Internet resources

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
What Is Left?

<table>
<thead>
<tr>
<th>Technology</th>
<th>GHG Reduction, %</th>
<th>Current Models Using This Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off-the-Shelf Engine Technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Variable Valve Timing</td>
<td>3-8</td>
<td>BMW, Honda</td>
</tr>
<tr>
<td>2 Cylinder Deactivation</td>
<td>3-6</td>
<td>Cadillac</td>
</tr>
<tr>
<td>3 Smaller engine with supercharger</td>
<td>5-7</td>
<td>Mercedes</td>
</tr>
<tr>
<td>4 Throttleless engine</td>
<td>3-6</td>
<td>BMW</td>
</tr>
<tr>
<td>5 Hybrid electric drive</td>
<td>15-30</td>
<td>Toyota Prius</td>
</tr>
<tr>
<td>Off-the-Shelf Transmission Technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 9-speed automatic</td>
<td>2-3</td>
<td>Ford Explorer (SUV)</td>
</tr>
<tr>
<td>2 Continuously variable transmission</td>
<td>4-8</td>
<td>Saturn VUE (SUV)</td>
</tr>
<tr>
<td>Emerging Engine Technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Camless engine</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2 Variable compression ratio</td>
<td>2-6</td>
<td></td>
</tr>
<tr>
<td>Emerging Transmission Technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Automatic shifting manual</td>
<td>3-5 (vs 4 speed automatic)</td>
<td></td>
</tr>
<tr>
<td>2 Advanced continuous variable transmission</td>
<td>4-8 (vs 1st generation CVT)</td>
<td></td>
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<tr>
<td>Vehicle Technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Better aerodynamics, 10%</td>
<td>1-2</td>
<td>Mercedes C25</td>
</tr>
<tr>
<td>2 42 volt electronics</td>
<td>1-3</td>
<td>Toyota Crown (Japan)</td>
</tr>
<tr>
<td>3 Integrated starter/generator, with regeneration (engine off at idle)</td>
<td>5-10</td>
<td>Toyota Prius</td>
</tr>
<tr>
<td>4 Lower rolling resistant tires/wheels</td>
<td>1-1.5</td>
<td>Honda Civic HX</td>
</tr>
<tr>
<td>Other emerging technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Better catalyst to reduce N2O &amp; CH4</td>
<td>tbd</td>
<td></td>
</tr>
<tr>
<td>2 HFC-free air conditioner</td>
<td>tbd</td>
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Data extracted from a 2001 report of the National Academy of Sciences. Greenhouse gas (GHG) emission reductions are based on CO2.

Reductions may not be additive.

Staff Implementation Activities

- Approach
- Process overview
- Milestones
- Tasks
Approach

• Follow standard regulatory model
  ‣ Sound technical evaluation
  ‣ Open public process

• Assign high priority
  ‣ Fast start, experienced technical team
  ‣ Regular briefings for senior management

• Partner with other agencies
  ‣ California Energy Commission
  ‣ California Climate Change Registry
  ‣ Others as appropriate

Process Overview

<table>
<thead>
<tr>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<tr>
<td>4Q</td>
<td>1Q</td>
<td>2Q</td>
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Technical Assessment
(Individual tasks)
Staff findings/Workshops/Board update

Staff Proposal
Draft report
Workshop

Board Adoption
Staff report
Board hearing
Milestones

Detailed technical work
- Initial workshop (GHG inventory) December 02
- Symposium on vehicle technology March 03
- Additional workshops Various
- Summary workshop October 03
- Board update November 03

Draft staff proposal
- Release staff draft May 04
- Workshop June 04

Final staff proposal July 04

Board adoption September 04

Report to Legislature/Governor January 05

Tasks

• Public and stakeholder outreach
• Baseline inventory
• Technology assessment
• Environmental, social, economic impacts
• Early reduction credits (MY 2000-2008)
• Alternative compliance measures (MY 2009+)
• Staff proposal
Public and Stakeholder Outreach

- Work closely with interested parties
- Public workshops
- Communication tools
  - Presentations/speakers
  - Web site
  - List serve

Baseline Inventory

- Establish MY 2000 baseline (used for calculation of credits for early compliance)
  - CO₂, CH₄, N₂O, HFCs
  - Black carbon, tropospheric ozone precursors
- More information needed for some pollutants
Technology Assessment

• Technology Symposium
• In-depth staff review
  ‣ Engine, transmission, catalyst
  ‣ Air conditioning
  ‣ Tires
  ‣ Hybridization
  ‣ Aerodynamics
  ‣ Vehicle integration
• External expert assessment

Other Tasks

• Environmental and social impacts
• Effect on California economy
• Methodology for calculation of early reduction credits
• Criteria for consideration of alternative compliance measures
Staff Proposal

- Integration of findings
  - Technology review
  - Benefits and costs
  - Social and economic impacts
  - Early credits and alternative compliance
- Staff report
- Proposed regulatory language

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 climate change website (www.arb.ca.gov/gcc/gcc.htm) and follow prompts
**Internet Resources**

- Air Resources Board
  - www.arb.ca.gov/gcc/gcc.htm
- California Energy Commission
  - www.energy.ca.gov/global_climate_change/index.html
- California Climate Change Registry
  - www.climateregistry.org
- United States Environmental Protection Agency
  - www.epa.gov/globalclimatechange/index.html
- Intergovernmental Panel on Climate Change
  - www.ipcc-nggip.iges.or.jp