

## Global Warming and Greenhouse Gas Emissions from Motor Vehicles



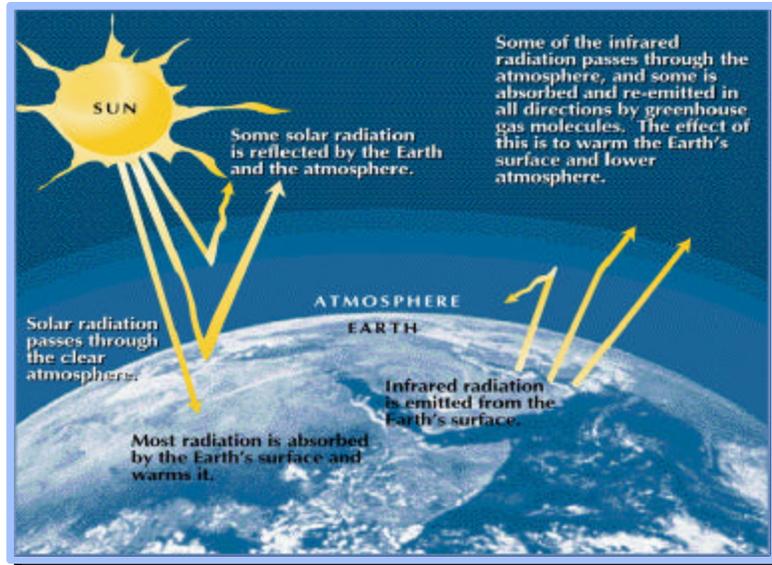
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## Overview



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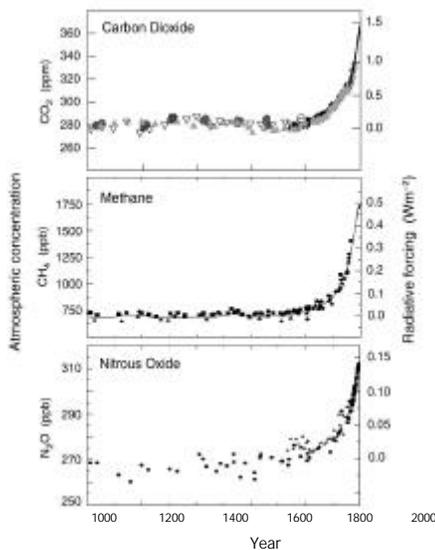
# The Greenhouse Effect



Source: U.S. EPA State and Local Climate Change Outreach Kit, March 2000

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# Industrial Era Has Changed the Atmosphere

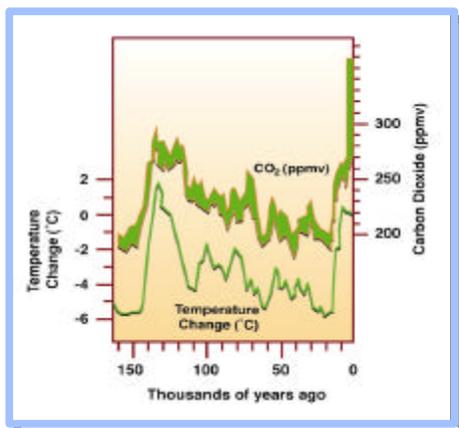


- Carbon dioxide, methane, nitrous oxide, particulate matter, and other pollutants cause global warming
- IPCC concludes increases in these gases are a result of human activities

Source: IPCC Report: Summary for Policy Makers, Climate Change 2001: The Scientific Basis

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## Temperature and Carbon Dioxide Are Related

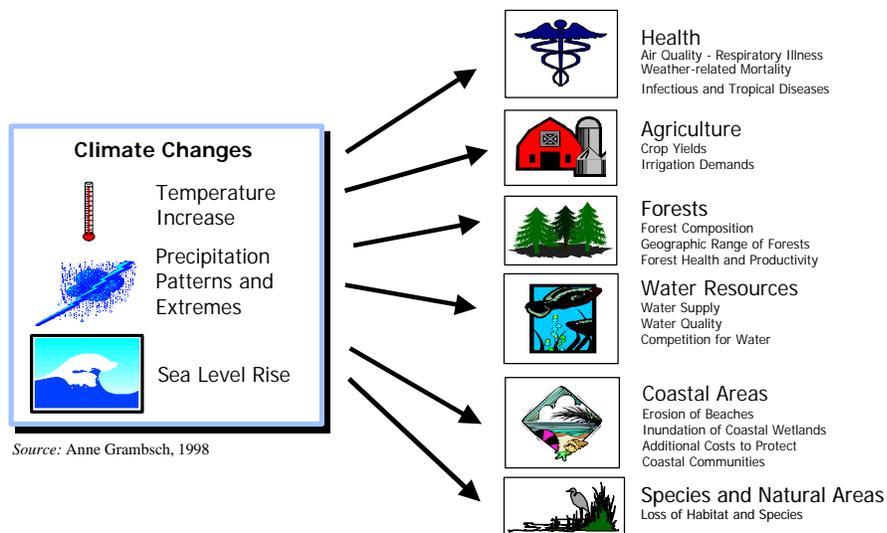


- Ice core records show the current rate of increase and levels are unprecedented

Source: Adapted from Office of Science and Technology Policy, Climate Change State of Knowledge, October 1997

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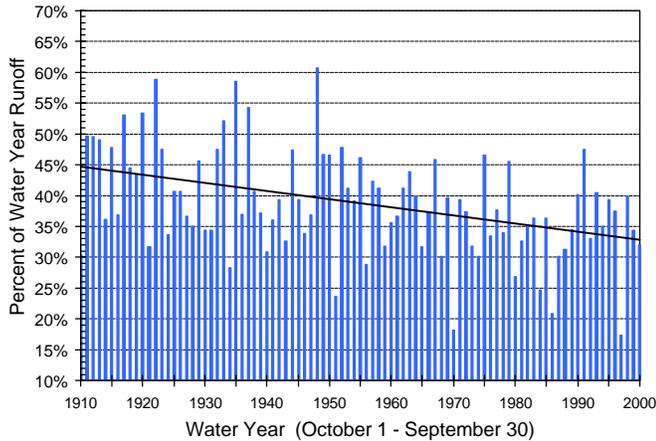
## Potential Climate Change Impacts



Source: Anne Grambsch, 1998

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## Our Principal Reservoir - The Sierra Snow Pack - is Shrinking



Warmer Winters Have:

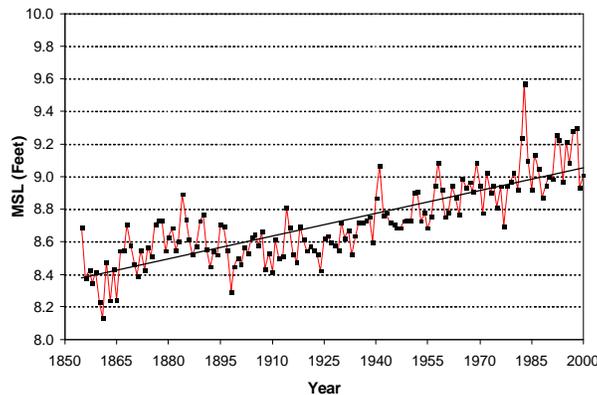
- Reduced snow pack
- Led to earlier snow melt
- Decreased spring runoff by 10%
- Affected water supply

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

Source: California Environmental Protection Agency, Environmental Protection Indicators for California, 2001

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## Sea Level is Rising Along California's Coast



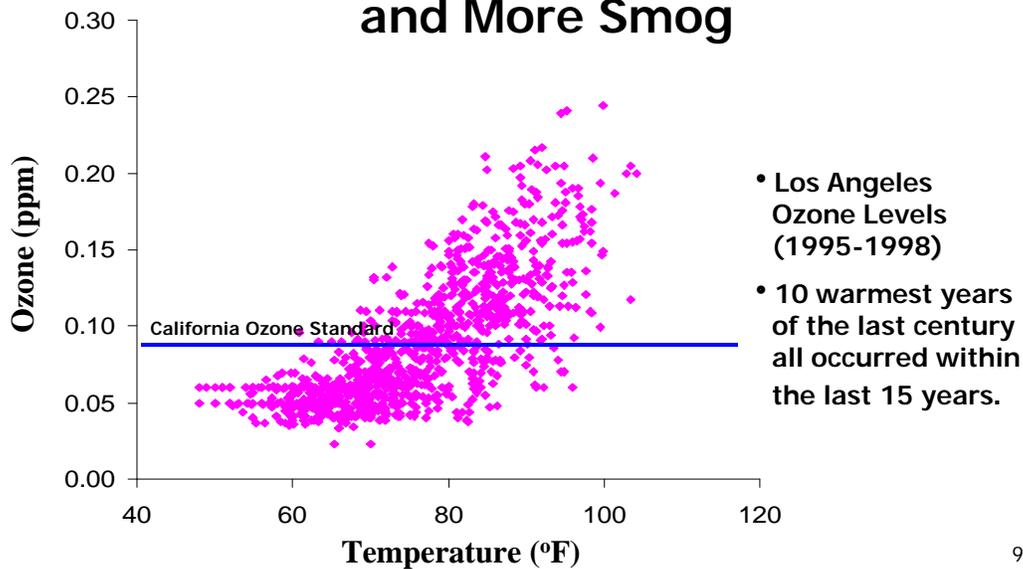
- Sea level has already risen 7" in 150 years
- Levee stability and salt water intrusion concerns
- IPCC projects 4-12" sea level rise by 2050
- Present Delta system may not be viable with 8-12" sea level rise

San Francisco Yearly Mean Sea Level (1855-2000)

Source: California Environmental Protection Agency, Environmental Protection Indicators for California, 2001

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## Hotter Days Lead to Higher Emissions and More Smog



Source: California Environmental Protection Agency

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## Human Activities Can Intensify the Greenhouse Effect



Transportation



Industry

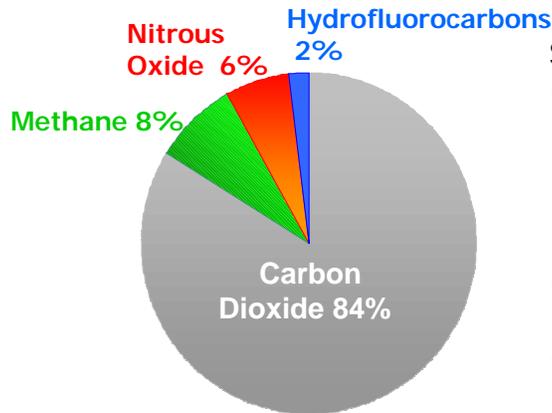


Utilities

Source: U.S. EPA State and Local Climate Change Outreach Kit, March 2000

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# California Greenhouse Gas Emissions 1999 (In CO<sub>2</sub> Equivalents)



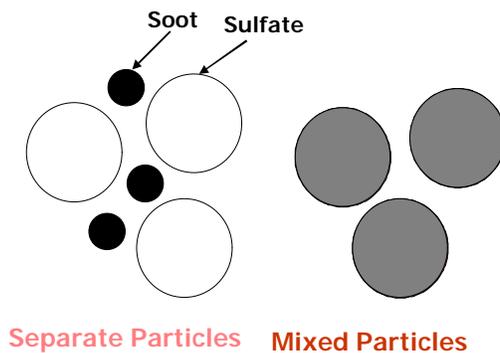
## Sources

- Carbon Dioxide (CO<sub>2</sub>)
  - Fossil fuel combustion
- Methane
  - Fossil fuels
  - Landfills, agriculture
- Nitrous Oxide
  - Agriculture, cars
- Hydrofluorocarbons
  - Refrigerants, solvents

Source: Draft Greenhouse Gas Inventory Update, California Energy Commission, 2001  
In CO<sub>2</sub> equivalents

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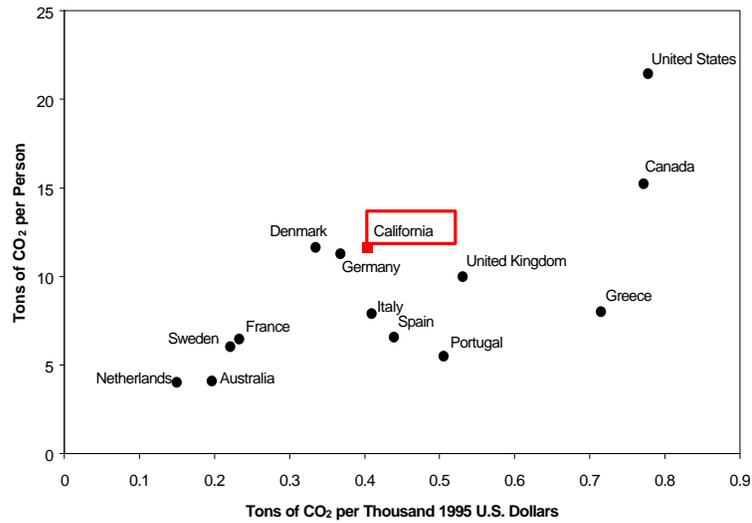
## Aerosols Affect Global Warming



- Some aerosols reflect incoming radiation (global cooling)
- Black carbon (soot) absorb radiation (global warming)
  - Enhanced warming when mixed with other particles

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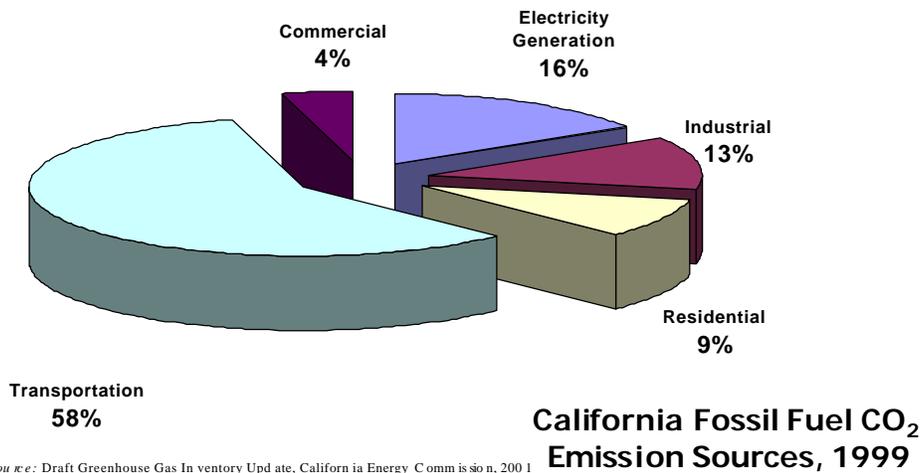
## Carbon Dioxide Emissions Intensities California and Selected Countries - 1995



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

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## Transportation is California's Largest Source of CO<sub>2</sub>



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

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## 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

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## AB 1493 Implementation

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## **AB 1493 Implementation**

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

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## **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

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## **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

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## **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

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## What Is Left?

Technology	GHG Reduction, %	Current Models Using This Technology
<b>Off-the-Shelf Engine Technology</b>		
1 Variable Valve Timing	3-8	BMW, Honda
2 Cylinder Deactivation	3-6	Cadillac
3 Smaller engine with supercharger	5-7	Mercedes
4 Throttleless engine	3-6	BMW
5 Hybrid electric drive	15-30	Toyota Prius
<b>Off-the-Shelf Transmission Technology</b>		
1 5-speed automatic	2-3	Ford Explorer (SUV)
2 Continuously variable transmission	4-8	Saturn VUE (SUV)
<b>Emerging Engine Technology</b>		
1 Camless engine	15	
2 Variable compression ratio	2-6	
<b>Emerging Transmission Technology</b>		
1 Automatic shifting manual	3-5	(vs 4 speed automatic)
2 Advanced continous variable transmission	4-8	(vs 1st generation CVT)
<b>Vehicle technologies</b>		
1 Better aerodynamics, 10%	1-2	Mercedes E
2 42 volt electronics	1-3	Toyota Crown (Japan)
3 Integrated starter/generator, with regeneration (engine off at idle)	5-10	Toyota Prius
4 Lower rolling resistant tires/wheels	1-1.5	Honda Civic HX
<b>Other emerging technologies</b>		
1 Better catalyst to reduce N2O & CH4	tbd	
2 HFC-free air conditioner	tbd	

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

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## Staff Implementation Activities

- Approach
- Process overview
- Milestones
- Tasks

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# 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

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# Process Overview

2002	2003				2004			
4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q

**Technical Assessment**  
 (Individual tasks)  
 Staff findings/Workshops/Board update



**Staff Proposal**  
 Draft report  
 Workshop



**Board Adoption**  
 Staff report  
 Board hearing

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## 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

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## 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

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## Public and Stakeholder Outreach

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

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## Baseline Inventory

- Establish MY 2000 baseline (used for calculation of credits for early compliance)
  - ▶ CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs
  - ▶ Black carbon, tropospheric ozone precursors
- More information needed for some pollutants

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## **Technology Assessment**

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

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## **Other Tasks**

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

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## **Staff Proposal**

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

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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 climate change website ([www.arb.ca.gov/gcc/gcc.htm](http://www.arb.ca.gov/gcc/gcc.htm)) and follow prompts

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## Internet Resources

- Air Resources Board
  - ▶ [www.arb.ca.gov/gcc/gcc.htm](http://www.arb.ca.gov/gcc/gcc.htm)
- California Energy Commission
  - ▶ [www.energy.ca.gov/global\\_climate\\_change/index.html](http://www.energy.ca.gov/global_climate_change/index.html)
- California Climate Change Registry
  - ▶ [www.climateregistry.org](http://www.climateregistry.org)
- United States Environmental Protection Agency
  - ▶ [www.epa.gov/global\\_warming/index.html](http://www.epa.gov/global_warming/index.html)
- Intergovernmental Panel on Climate Change
  - ▶ [www.ipcc-nggip.iges.or.jp](http://www.ipcc-nggip.iges.or.jp)