Observations on Improving the Environmental Sustainability of the Transportation System

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What I will Cover Today

- Overall assessment of mobile sources and pollution
  - Health impact and quality of life concerns
- Global Warming and Transportation
- State Policy Options to address problems
  - Promising Technology Innovations
  - VMT Reduction Options

Trends in Massachusetts

- From 1950-1990, Massachusetts' population grew 28% while the amount of developed land increased by 188%, *more than six times the rate of population growth.*
- Between 1990 - 2020, Boston metro-region will see a 24% increase in vehicle miles traveled,
- a 35% increase in total vehicle hours, and
- and a decrease in operating speeds of 5%.

Opportunity to Develop Integrated Policies

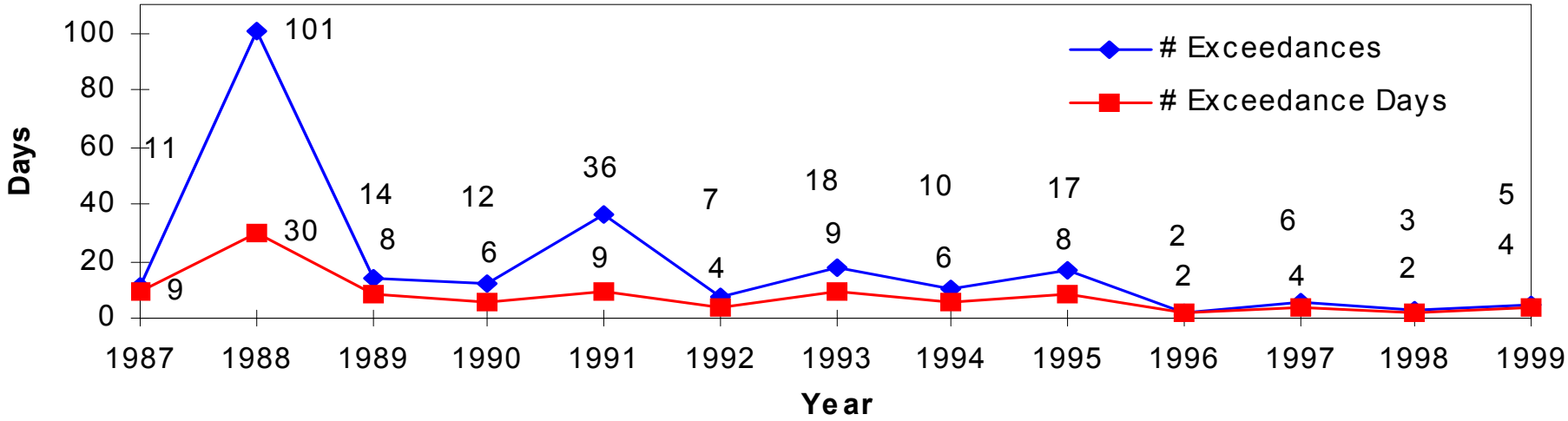
- Climate Change
  - Principally CO_2 but also N_2O
  - Methane
  - Black Soot/Carbon
- Air Quality Issues

Smog	VOCs and NOx
Particulates	Regional Haze
Acid Rain	Mercury

- Land Use
- Forestry

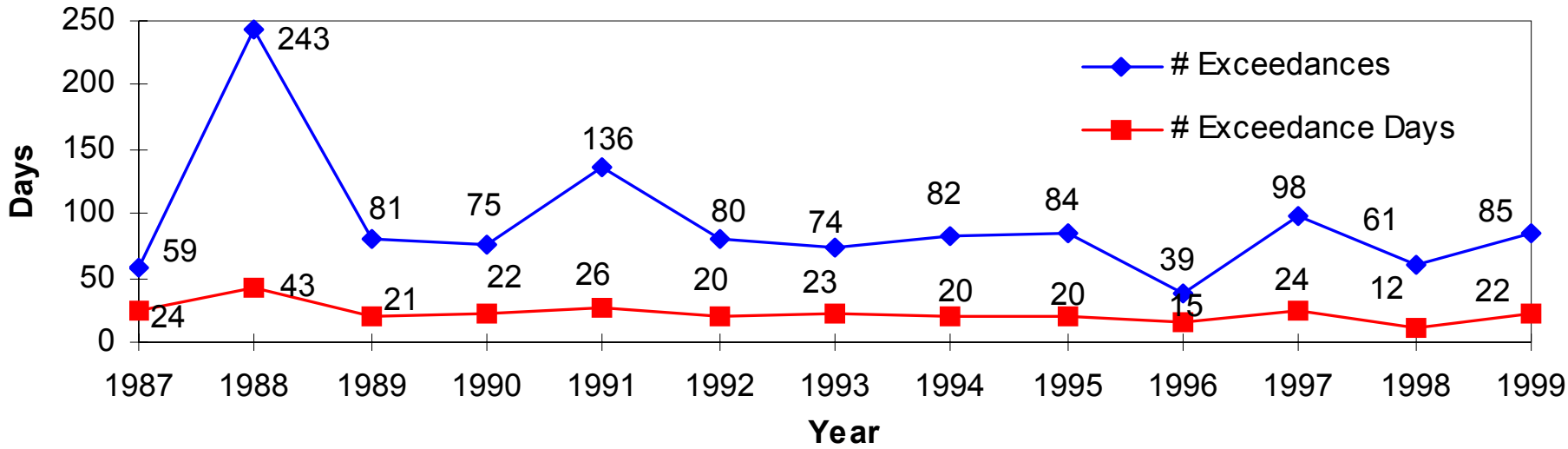
1-hr O3 Exceedance Days & Total Exceedances 1987-1999

Ozone exceeded the 1-hour standard(0.125 ppm)

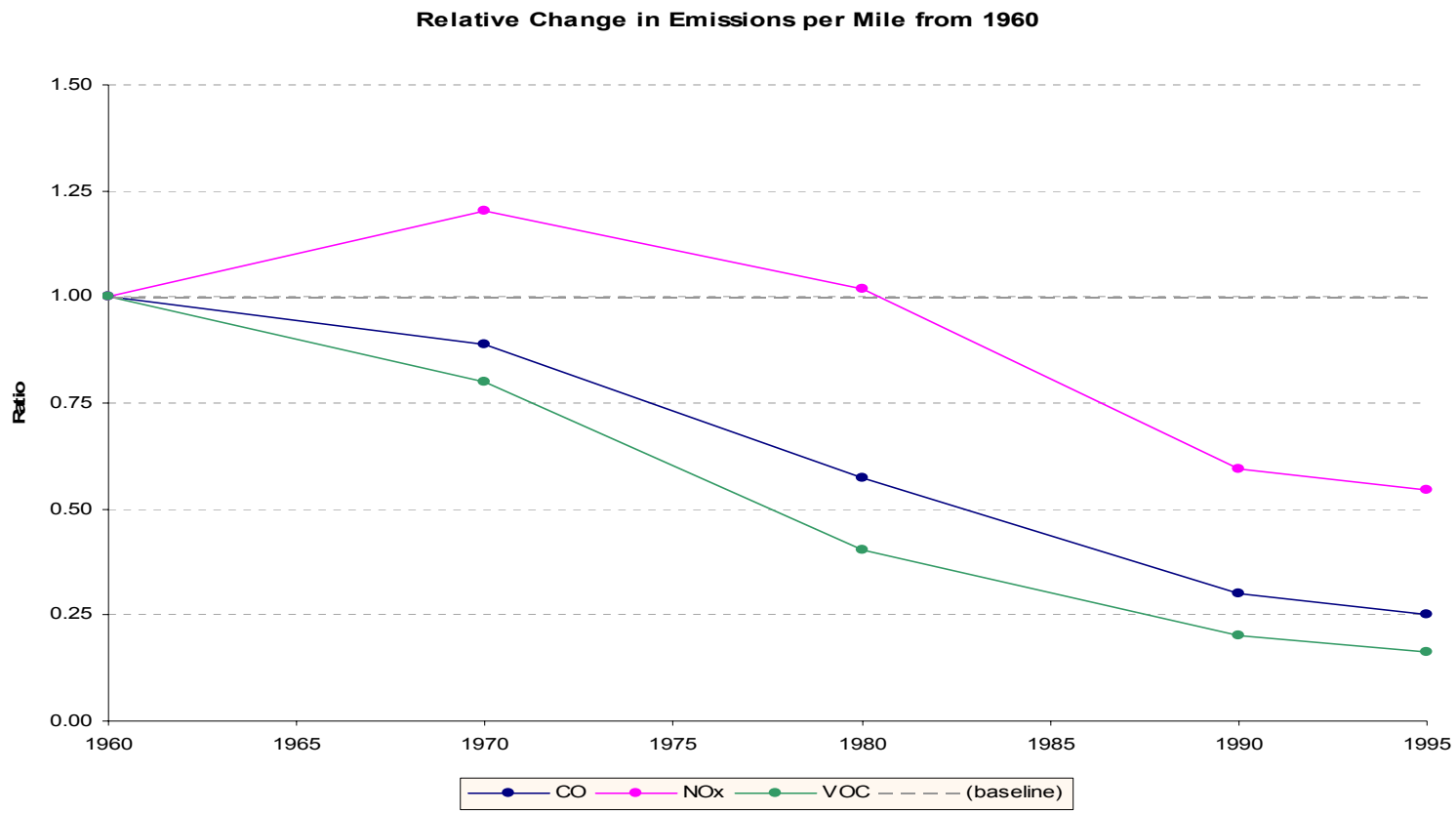


8-hr O3 Exceedance Days & Total Exceedances 1987-1999

Ozone exceeded the 8-hour standard (0.085 ppm)

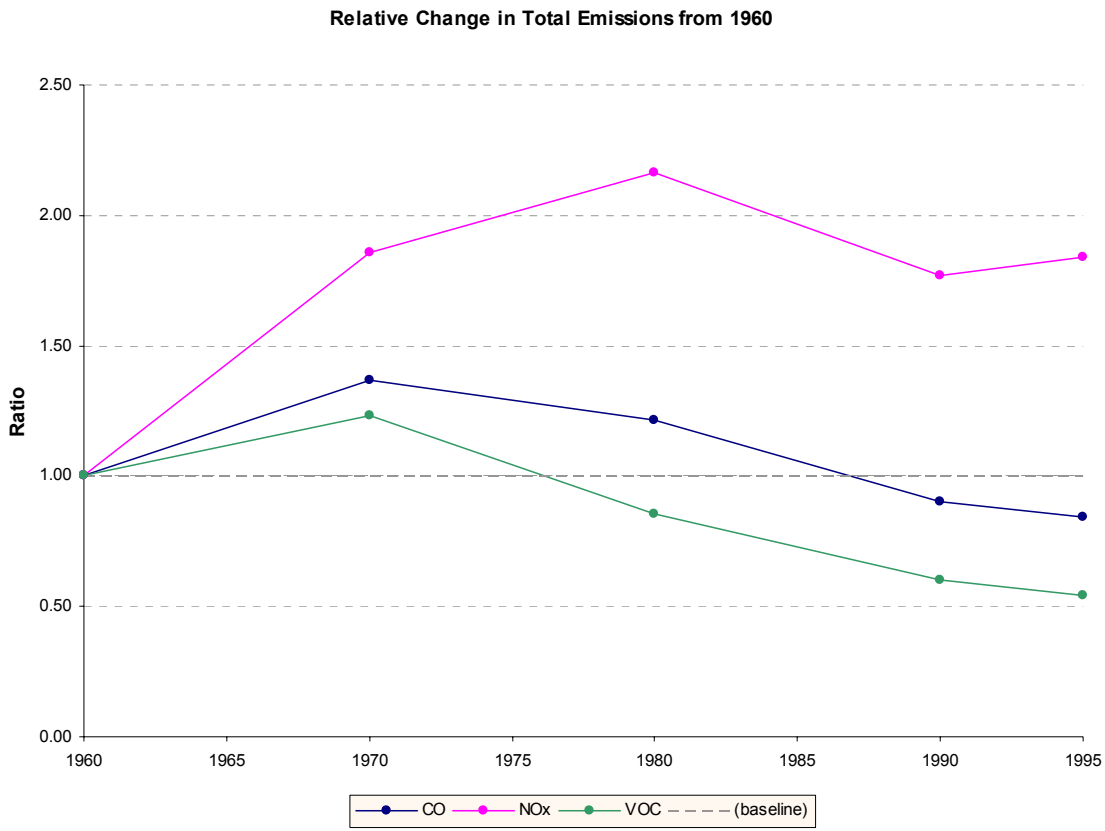


CO, NOx and VOC Emissions *per Vehicle Mile of Travel* have Declined



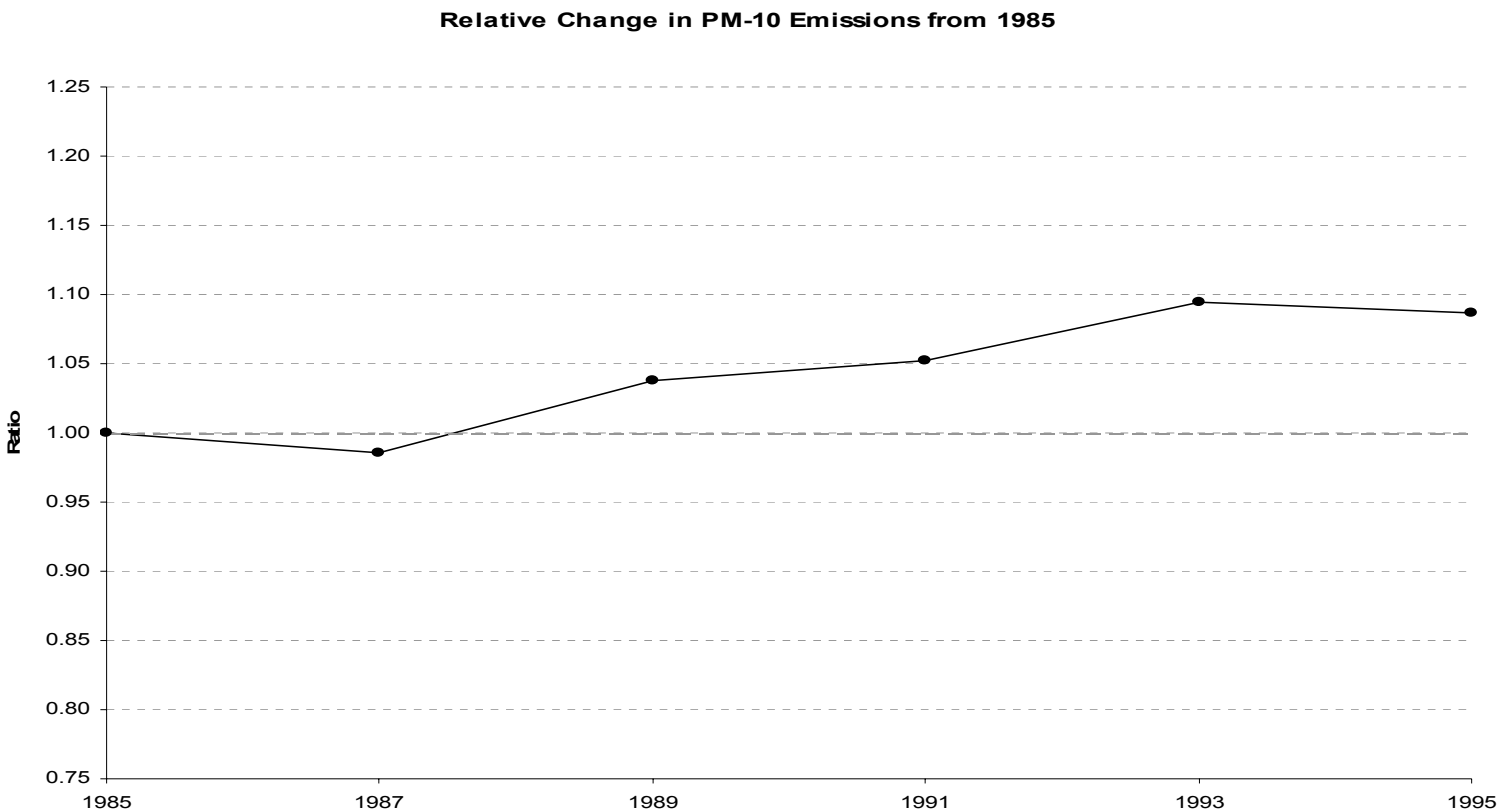
Source: US EPA

Less Progress in Reducing *Total* Criteria Pollutant Emissions



Source: US EPA

Particulate Matter Emissions (which affect health the most) have Increased

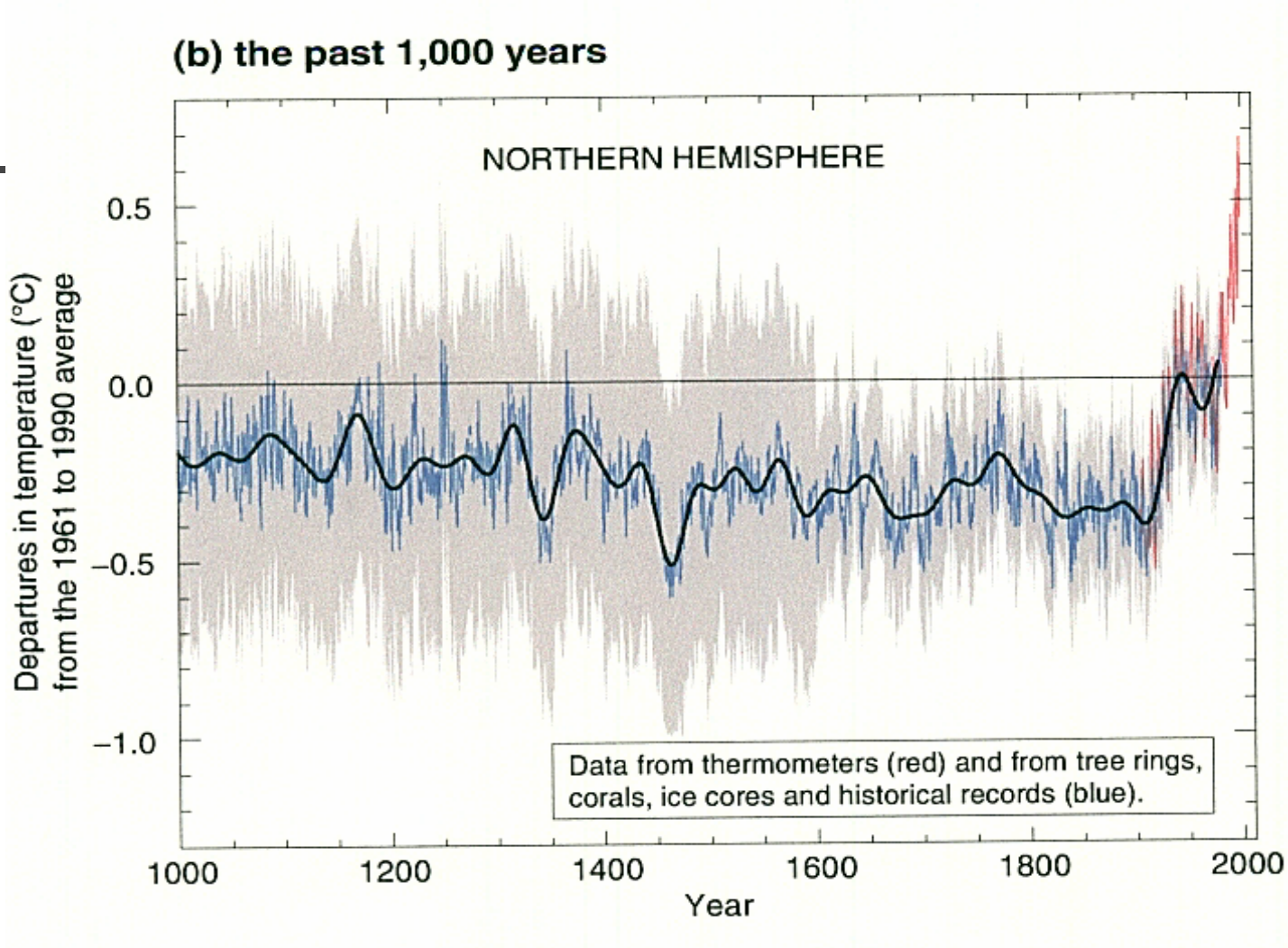


Source: US EPA

The Transportation Sector has been Difficult to Regulate

- Large Corporations with clout
- Once sold, many small emitters
- Complex: multiple entities affect emissions
  - Vehicle makers, fuel suppliers, drivers
  - Public sector: infrastructure and planning
  - Private sector: developers, employers
- Analytical challenges
  - Long time frame for change to occur
  - Multiple costs, benefits, reasons for projects/decisions

Variations of the Earth's surface temperature for:



Source: IPCC Working Group I, Summary for Policymakers, 2001.

Latest Findings on Climate Change

- **Global average surface temperature has increased over the 20th century by about 1°F.**
- **1990s warmest decade on record, 1998 warmest year.**
- **Snow cover decreased 10% since the late 1960s.**
- **Global average sea level rose 4-8” in 20th century.**
- **Precipitation up 0.5 to 1% per decade in the 20th century and 2 to 4% increase in the frequency of heavy precipitation events over mid- and high latitudes of the Northern Hemisphere continents.**

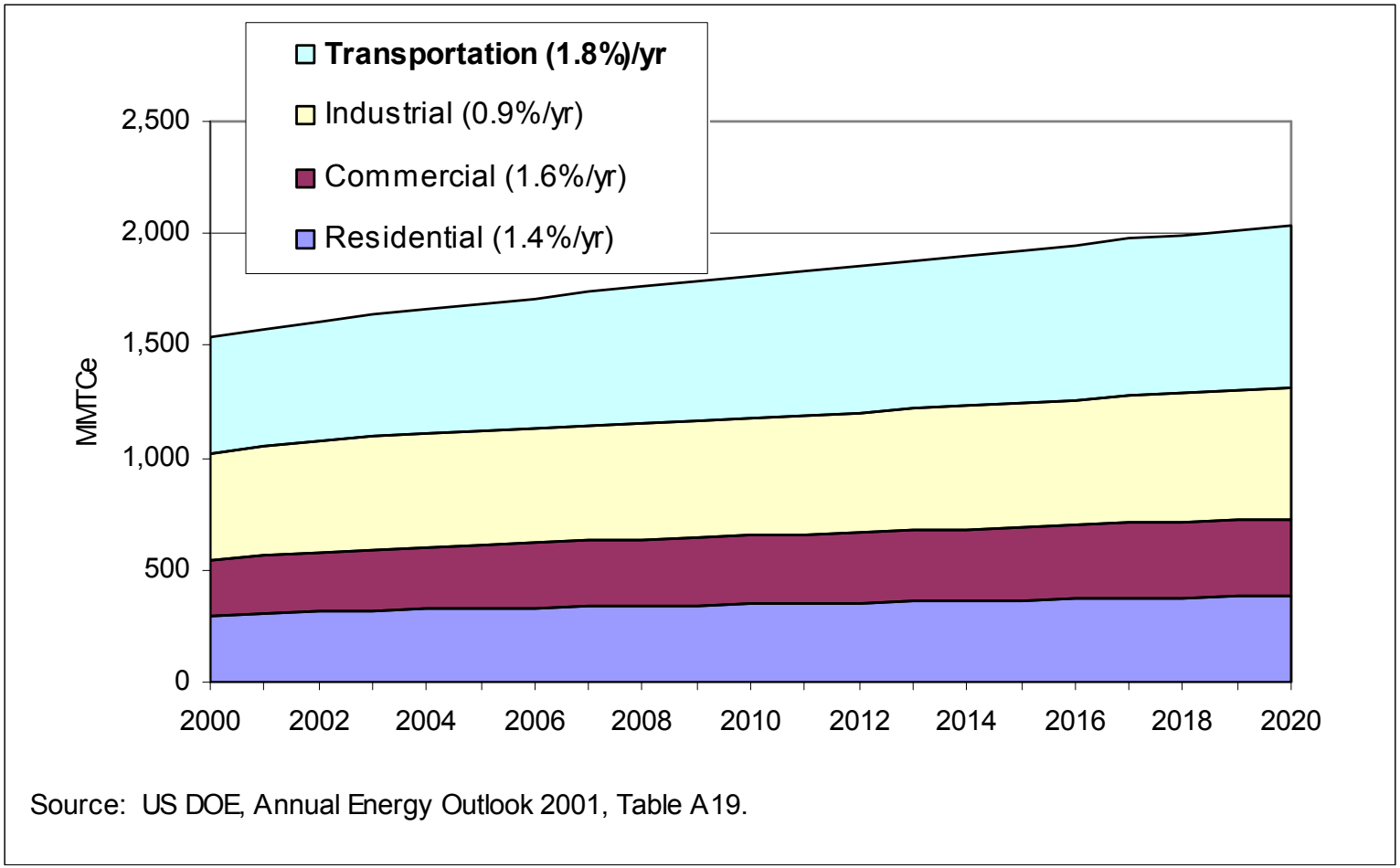
Latest Findings on Climate (cont.)

- The present CO_2 concentration highest in 20 million years. The current rate of increase is unprecedented during at least the past 20,000 years.
- About three-quarters of the anthropogenic emissions of CO_2 to the atmosphere during the past 20 years is due to fossil fuel burning.
- "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."
- Emissions put up in the atmosphere today will stay there warming for about 100 years. Do you really want to go for a drive in the country to enjoy nature?

Latest IPCC Predictions (to 2100)

- Average surface temperature is predicted to increase by 2.5 °F to 10.4 °F
- The projected warming rate is the highest in at least 10,000 years
- Sea-level is predicted to rise 3 inches to almost 3 feet

US CO_2 Emissions 2000-2020



Source: US DOE, Annual Energy Outlook 2001, Table A19.

Massachusetts and Regional Emissions in Perspective

- Annual emissions = 19.2 tons per person in MA compared to 26.3 tons per capita in the US and 3.3 tons globally.
- MA emits 1.9% of the total U.S. inventory including all upstream fuel-cycle emissions with 2.4% of the population. *Nevertheless, MA state-wide emissions are comparable to the total emissions of whole countries (i.e. Egypt, Austria, and Greece).*
- If the Eastern Canada/New England Region was classified as a country, that country would be the 12th largest emitter of GHG in the world.

The GHG *Regional* Emission Reduction Goals

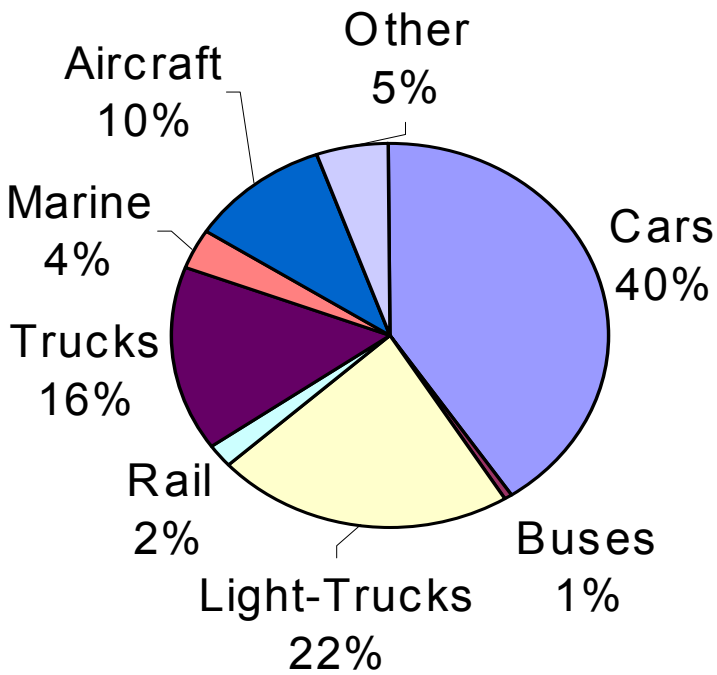
- **Short-term Goa**l: Reduce regional GHG emissions to 1990 emissions by 2010.
- **Mid-term Goal:** Reduce regional GHG emissions by at least 10% below 1990 emissions by 2020.
- **Long-term Goal:** Reduce regional GHG emissions sufficiently to eliminate any dangerous threat to climate; current science suggests this will require reductions of 75%-85% below current levels.

Transportation & Climate Change

- 1/3 of US CO_2 -- fastest growing source
- Key factors
  - Fuel Efficiency
  - Fuel Carbon Content
  - Travel Demand
- No silver bullets

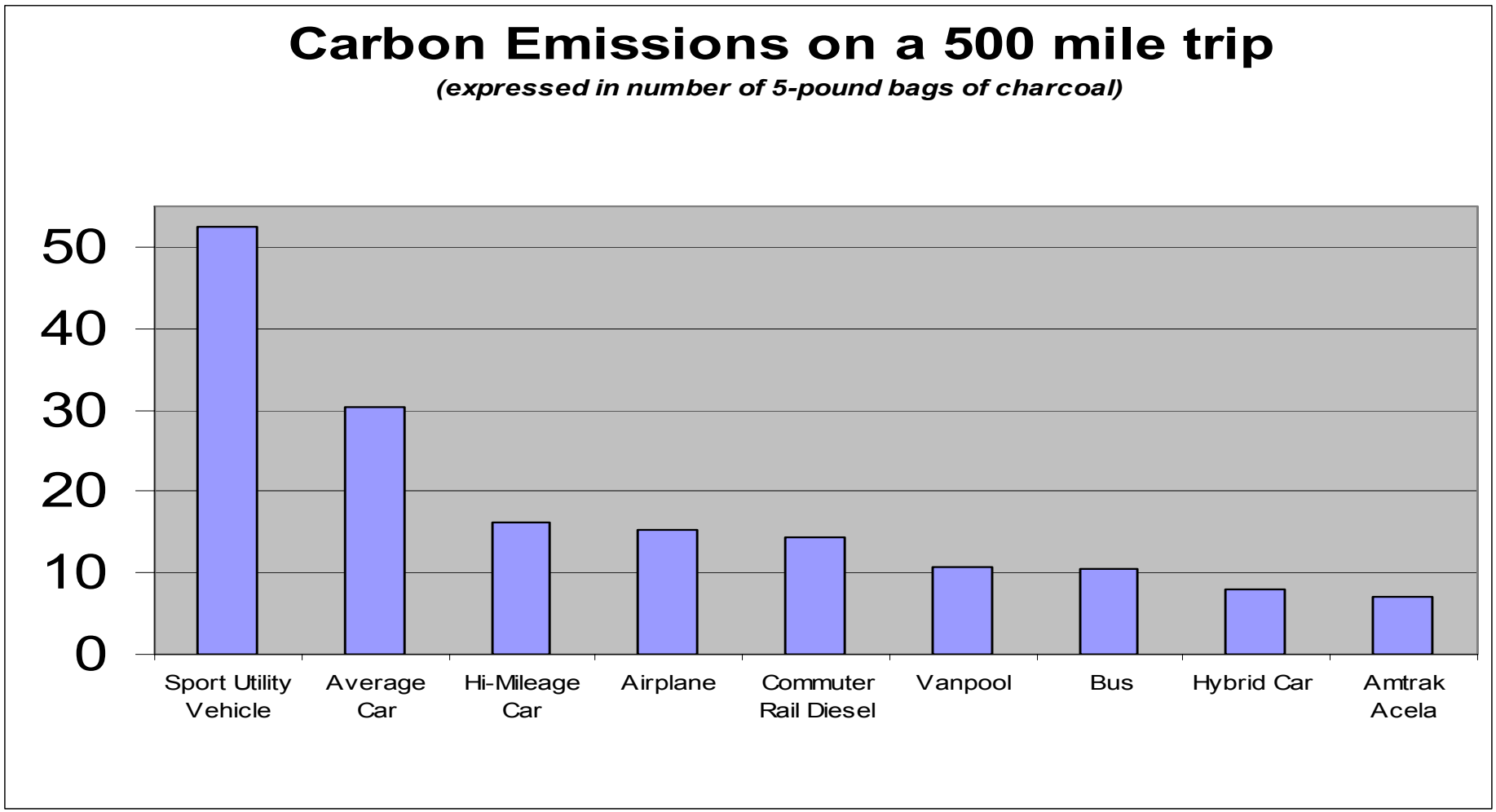
Transportation GHG by Mode

US Transportation GHG Emissions by Mode (1999)



Source: US EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-1999 , Table ES-4 (Draft, Jan., 2001)

Comparative CO_2 Emissions by Mode



US Motor Vehicle Fuel Use (2000)

Gasoline	79.8%
Diesel	17.9%
MTBE	1.5%
Ethanol in Gasahol	0.6%
LPG	0.2%
CNG	0.02%

Source: US DOE, EIA: http://www.eia.doe.gov/cneaf/alternate/page/datatables/table10.html

CO_2 Emissions by Fuel Type (cars)

Fuel	Tailpipe Emissions		Well-to-Wheel Emissions
Gasoline	**100**		**100**
Diesel	**77**		**52-74**
LPG	**79-89**	Field	**71-82**
		Refinery	**78-93**
Natural Gas	**68-83**		**65-78**
Methanol	**82-95**	Natural Gas	**80**
		Cellulose	**30-100**
Ethanol	**100**	Cellulose	**10-16**
		Sugar/starch	**24-55**
Biodiesel	**78**		**13-32**
Hydrogen	**0**		**5-362**

Source: Internation Energy Agency, *Automotie Fuels for the Future* , Table 3, 2000.

Note: Current E10 from corn: 1% reduction in GHG, E95 20% reduction (ANL 1999)

Travel Demand & Environmental Impact

- 'Toughest nut to crack'
- VMT growth offsets technology & fuel improvements
- Reducing VMT yields multiple benefits
  - Energy, GHG, AQ, open space, congestion, 'livability'
- Important trade-offs (e.g., density and CO hot spots)
- Increased research and growing knowledge on land use and travel

Energy Efficient Transportation Choices

- Work with Regional Planning Agencies to disclose CO_2 impacts of transportation decision-making.
- Examine Programs that Send a Clearer Price Signal about the Environmental Costs of Driving
- Boost Public Transit Services
- Expand Commuter Choice for State Employees
- Introduce a Demonstration Project to Reduce Household Travel Needs

Energy Efficient Transportation Choices

- Seek Opportunities to Improve Energy Efficiency at Logan Airport
- Support Opportunities for Improving Aircraft Movement Efficiency
- Evaluate the Benefits of Expanded Rail and Water Opportunities

Efficient Clean Vehicle Technologies

- Continue to Require and Provide Incentives for Cleaner and More Fuel Efficient Vehicles
- Cleaner Vehicles/Fuels in Public Transit Fleets
- Advocate for Public Incentives for Purchase of Fuel Efficient/Clean Alternate Fuel Vehicles
- Advocate for Aircraft Efficiency at a Regional and National Level
- Support the Clean up of Marine Engines through Retrofits, Accelerated Engine Turnover and the Use of Alternative Fuels

Three ways to save energy:

- Reducing the carbon intensity of the fuel used (Fuel Switching)
- Improving conversion efficiency. (Hybrid Vehicles)
- Reducing the need for the energy in the first place (Conservation)

Opportunities for Reducing Environmental Impacts

- More Efficient Vehicles: Toyota Prius hybrid; saves 50% of fuel or more, huge potential market share.
- Displacing carbon and increasing energy efficiency are not costly but profitable because *saving fuel costs less than buying fuel* (without including the environmental value of pollution reduction).
- Information systems to help avoid trips, virtual mobility systems.

Massachusetts LEV Program

- Adopted in 1990: Section 177 CAAA
- Includes a progressively improved average for Non-methane Organic Gases (NMOG)
- Going through updates as needed to reflect CA
- Includes a requirement for ZEVs in 2003 and credits for energy efficiency
- Now Pavley Amendment to address CO2 and other warming gases

Low Emission Vehicle Program

NY, MA, ME and VT adopted CA LEV in lieu of federal EPA emission standards

NJ just adopted and CT to follow

Fleet-wide emissions standards become more protective over time

Good choice because it is effective, efficient and easy to implement

2003 Milestone: 10% electric vehicles

Most cost effective reduction strategy for MA

LEV Program

- Working with automakers and CA to ensure successful implementation
- Allow limited flexibility to ensure success here in the northeast
- Goal: Reach same level of stringency as California within 3 years

LEV Stimulates the Market for Clean Vehicles

- electric
- Hybrid electric with gasoline
- CNG
- Hybrid, battery first vehicles
- Fuel Cells
- Other advanced technology
- Long-term: Hydrogen Fuel Cells most promising

Improving VMT Efficiency

- Transit Improvements: technology and funding
- Roadway Efficiency and Pricing
- Car Sharing
- Telecommuting Demonstrations
- Travel Blending

Moving Forward on Transportation Improvements

- Continued Implementation of Clean Air Act and Aggressive Low Emission Vehicle Program
- Strong support for accelerating use of new, cost-effective technologies
- Compliance with more protective ozone standard
- Continue to drive demand for hybrid and electric vehicle technology