Transportation Greenhouse Gas Emissions 1990 – 2003: Trends, Uncertainties and Methodological Improvements

John Davies
Transportation and Climate Division
Office of Transportation and Air Quality
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Overview

- **Characterize the magnitude of growth in transportation GHG emissions, based on data from EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks***
- **Discuss factors affecting the rise in transportation GHGs**
- **Sources of uncertainty in the *Inventory* transportation estimates**
- **Recent methodological improvements**

Inventory of U.S. GHG Emissions and Sinks – Institutional Responsibilities

- **Prepared annually by EPA under United Nations Framework Convention on Climate Change (UNFCCC)**
- **Coordinated by EPA Office of Atmospheric Programs (OAP)**
- **Includes transportation estimates developed by EPA Office of Transportation and Air Quality (OTAQ)**
- **Relies extensively on data provided by the Energy Information Administration (EIA) of the U.S. Department of Energy**

Inventory of GHG Emissions and Sinks – Document Organization

- **GHG data are oriented around specific gases (CO_2, CH_4 N_2O HFCs)**
  - **UNFCCC guidelines also require presentation of GHG data by broad categories (fossil fuel combustion, non-energy use of fuel, etc.)**
  - **Primary value to climate specialists**
- **EPA disaggregates estimates by economic sector, relying heavily on EIA estimates for CO2 emissions**
- **OTAQ further disaggregates transportation GHG estimates by mode (passenger cars, light-duty trucks, heavy-duty trucks, aircraft, rail, ships/boats)**
- **OTAQ also generates bottom-up estimates of CH_4 and N_2O**

Inventory estimates of Transportation GHGs

Includes

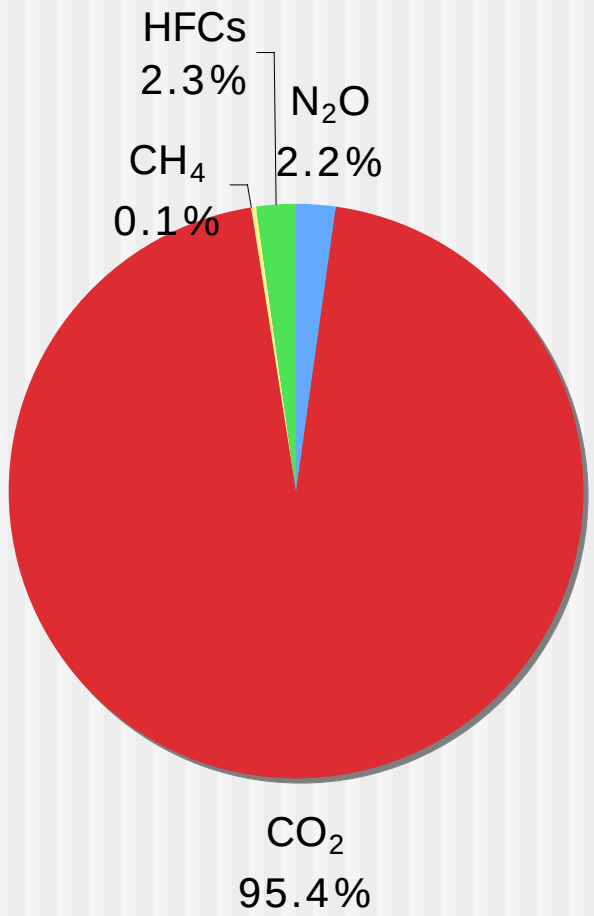
- Tailpipe emissions (from use of energy to power vehicles)
- HFCs from mobile air conditioners

Does not include

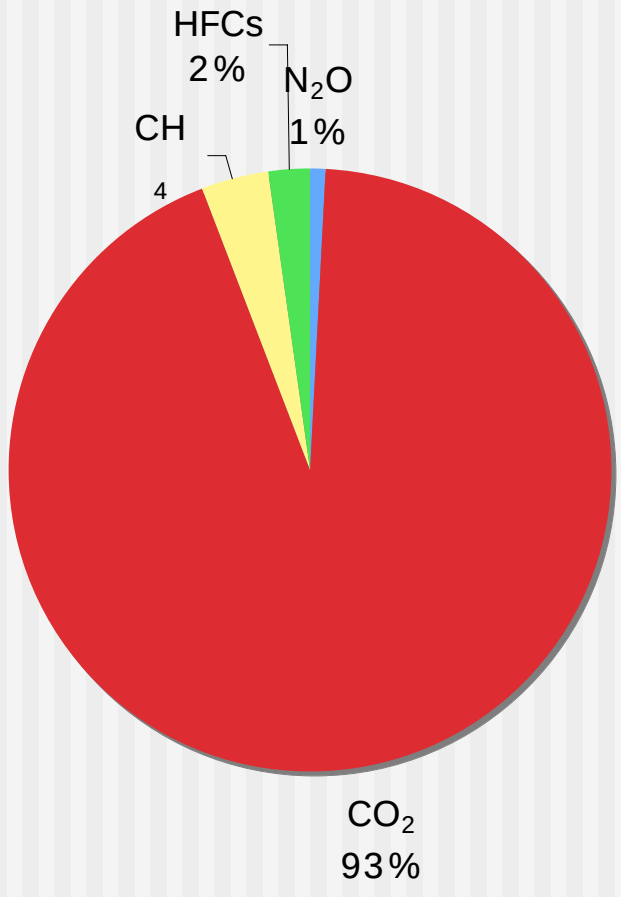
- Ozone-depleting substances, which are not counted in national totals
- Agriculture and construction equipment (generally represented in the industrial sector)
- International bunker fuels
- Lifecycle GHGs

U.S. GHG Emissions by Gas
(Weighted by Global Warming Potential)

Transportation



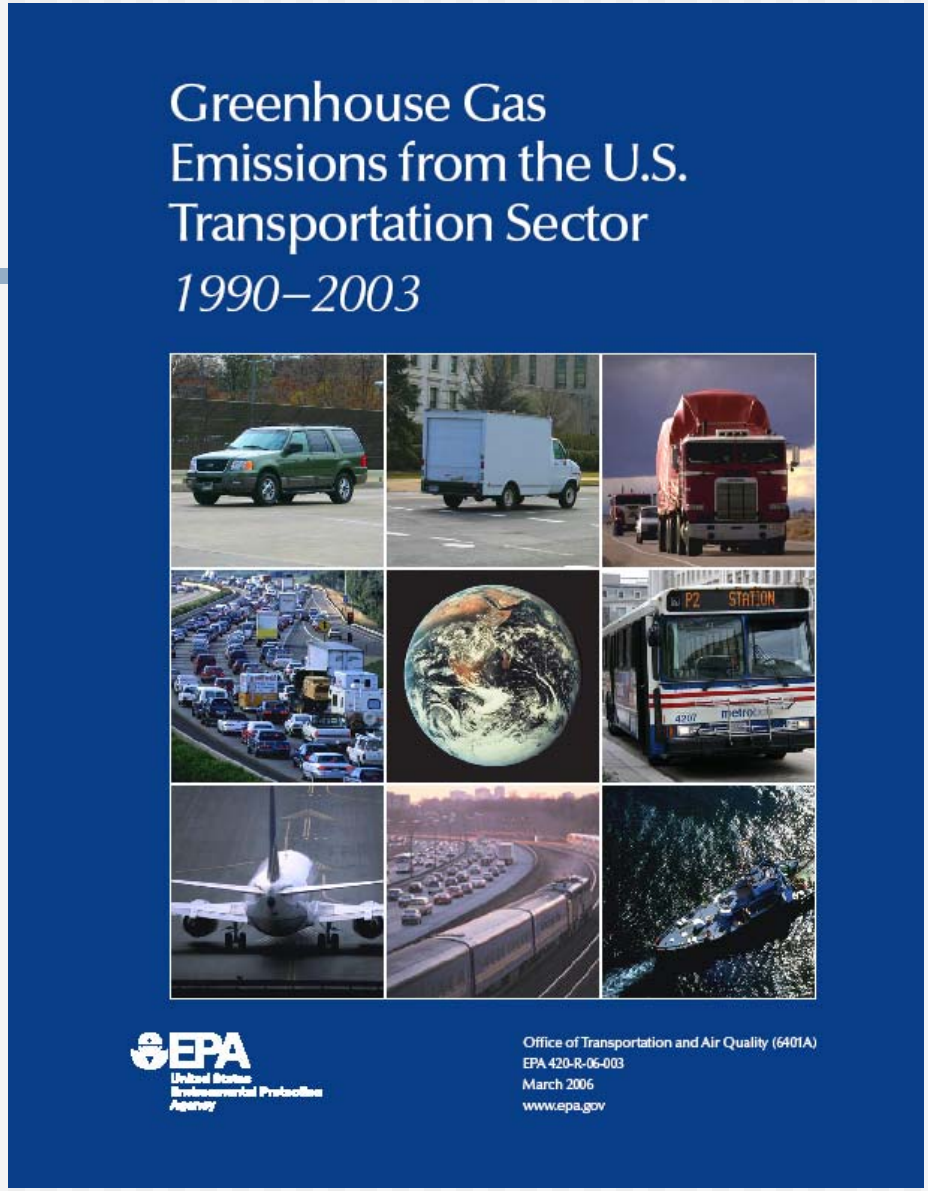
All Sources



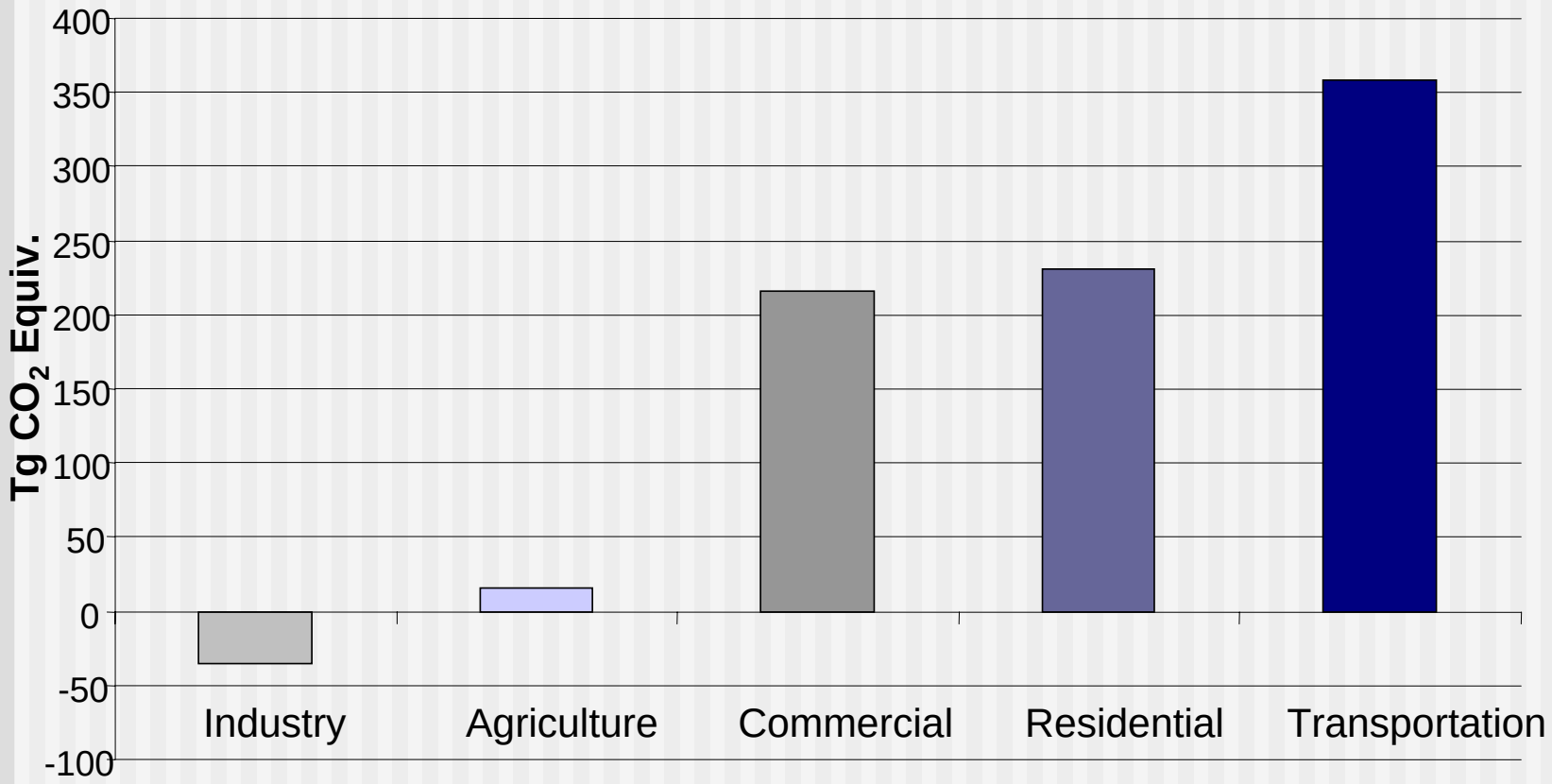
Stand-alone OTAQ Transportation GHG Report

- **Released by OTAQ in March 2006 as a complement to the GHG *Inventory***
- **Provides context for transportation GHGs**
  - **Lifecycle GHG estimates**
  - **Factors affecting emissions**
  - **Emerging issues**

Available at
http://www.epa.gov/otaq/greenhousegases.htm



Change in U.S. GHG Emissions by End-Use Economic Sector, 1990-2003

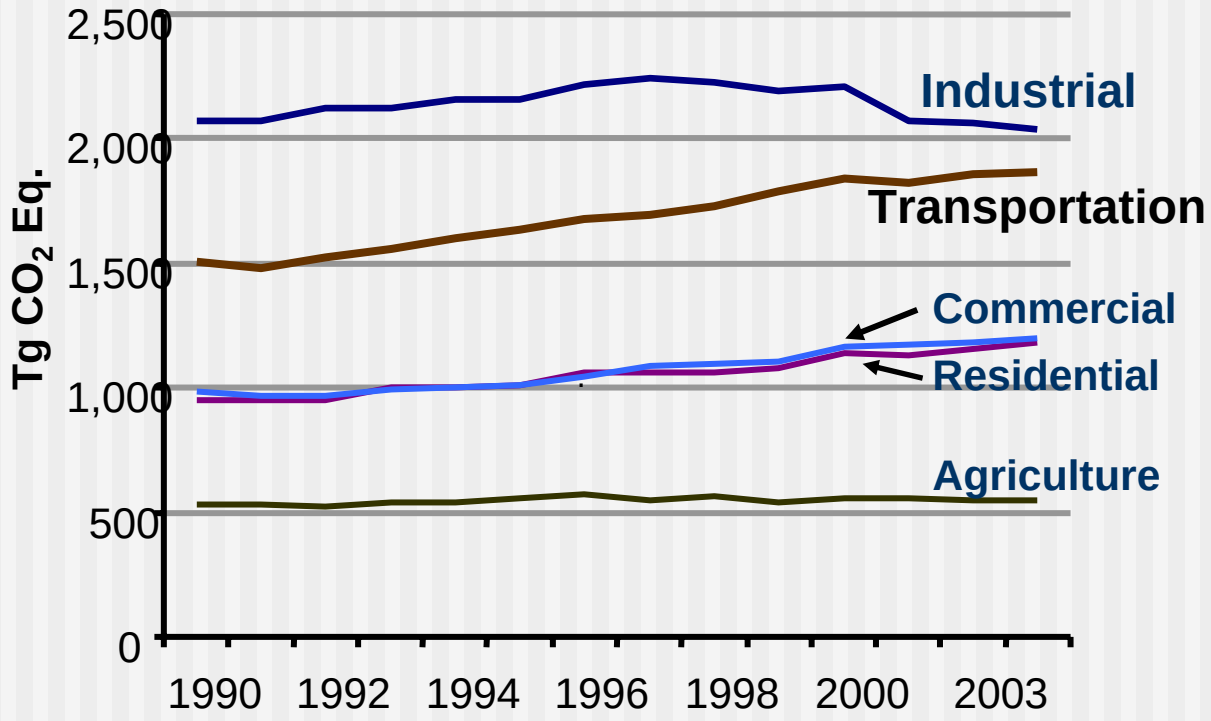


U.S. GHG Emissions by End-Use Economic Sector, 1990-2003

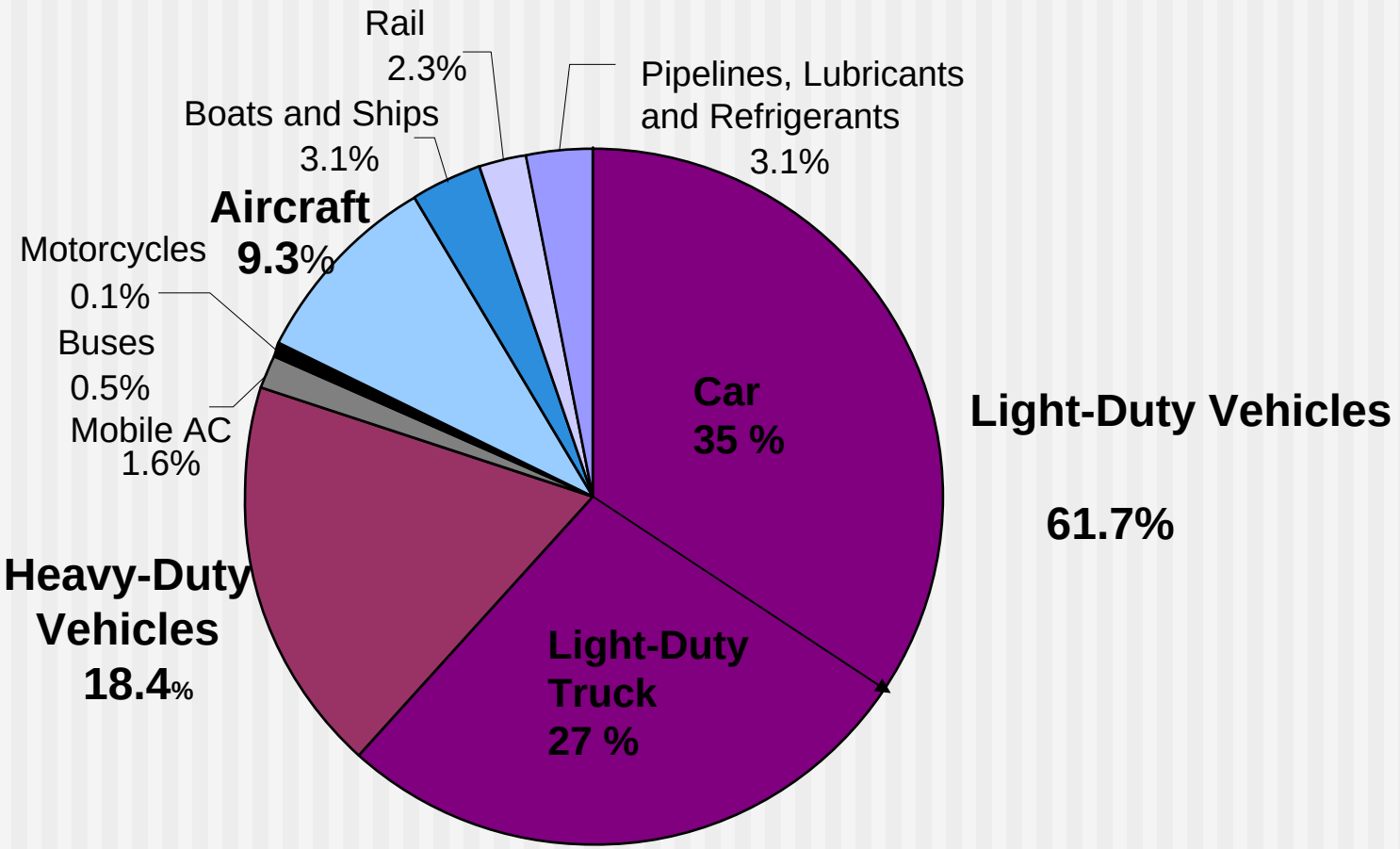
Transportation GHGs up 24 percent

Non-transportation sectors cumulatively up 9.5 percent

Transportation accounted for over 27 percent of U.S. GHG emissions in 2003



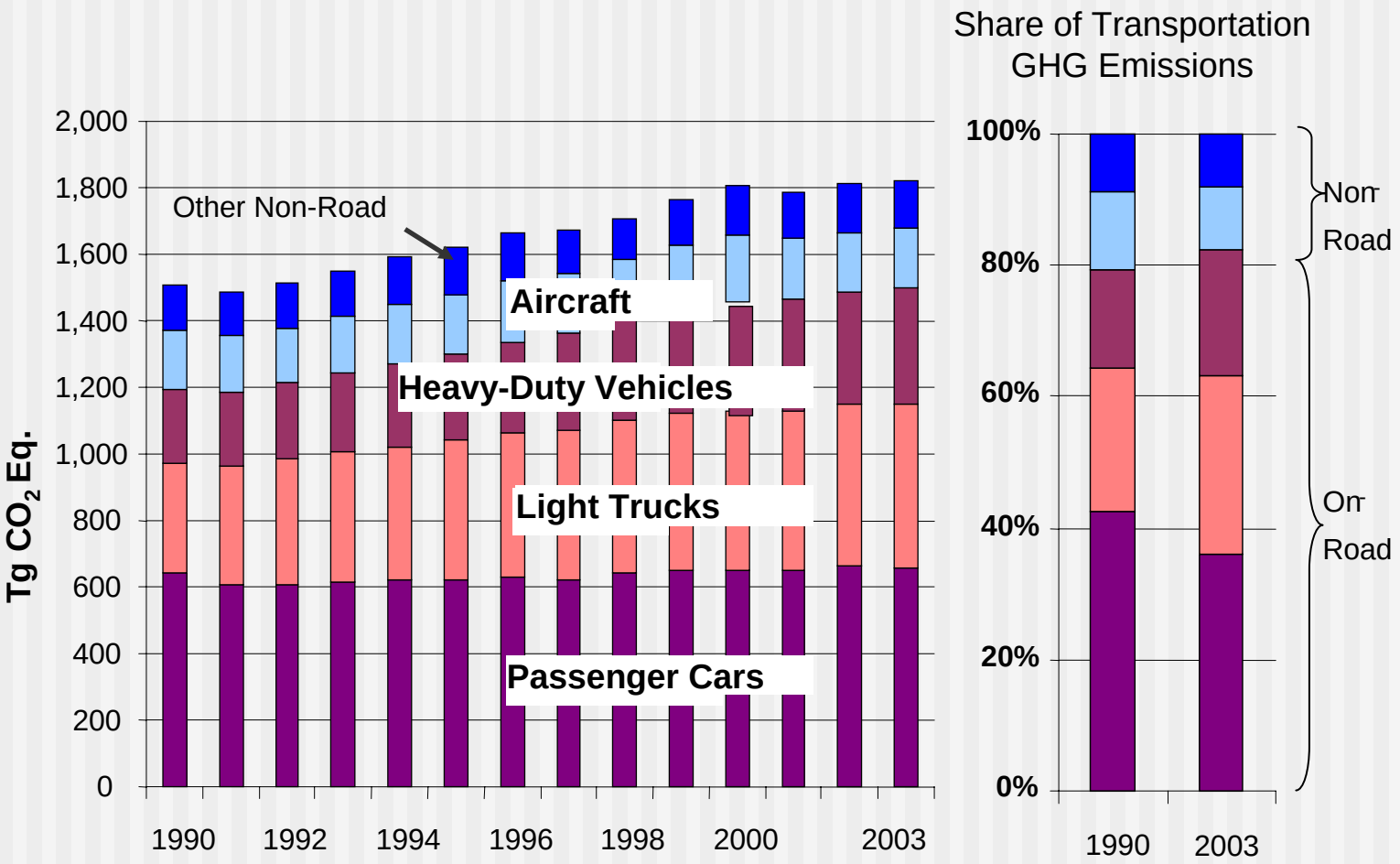
Sources of U.S. Transportation GHG Emissions



Growth in Transportation GHGs by Source, 1990-2003

Source	Change in GHGs
Light-Duty Vehicles	**+19 %**
Passenger Cars	+ 2%
Light-Duty Trucks	+ 51%
Heavy-Duty Vehicles	**+57%**
Aircraft	**-3%**
Commercial Aircraft	+4.8%

Transportation GHG Emissions by Source, 1990-2003



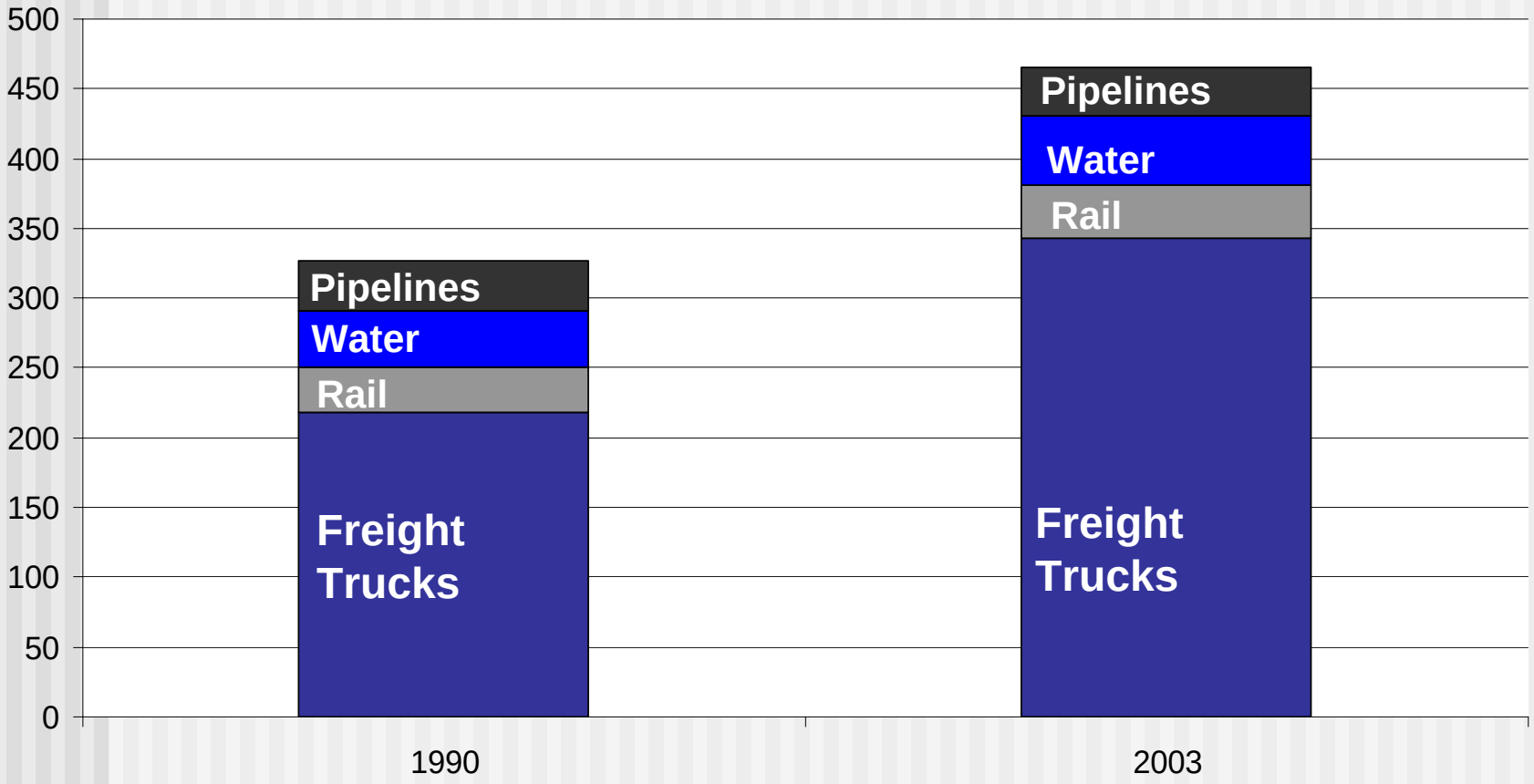
GHG Growth by Source:
Impact of Activity and Vehicle Energy Efficiency

Source	Change in Activity	Change in Energy Efficiency	Change in GHGs
Light-Duty Vehicles	+34%	Small increase in overall fuel economy- but *new* vehicle fuel economy has been declining	+19 %
Heavy-Duty Vehicles	+48%	Virtually unchanged	+57%
Commercial Aircraft	+48%	Significant improvement: aircraft becoming more fuel efficient, and greater passenger loads	4.8%

Passenger versus Freight GHGs, 1990-2003

Source	Change in Activity	Change in GHGs
Passenger	~36 % increase	+20 %
Freight	~42 % increase	+46%

Freight GHGs by Source, 1990 and 2003



Estimating CO_2 Traditional Approach and Uncertainty

- **Have traditionally used EIA's "top-down" estimates of fuel consumption by economic sector**
- **Multiply by carbon content of fuel and adjusting for carbon that does not oxidize during combustion (UNFCCC values)**
- **OTAQ allocates CO_2 to specific modes using "bottom-up" fuel consumption and activity**
  - **FHWA *Highway Statistics***
  - **Oak Ridge National Laboratories *Transportation Energy Data Book***
- **Inconsistencies between the top-down and bottom-up data**

Comparison of EIA and Bottom-Up Fuel Consumption Estimates

Fuel Type/Vehicle Type	2003 Inventory Est.	2003 Bottom-Up Est.	Difference	Percent Difference
Gasoline	**1,143.70**	**1,153.90**	**10.2**	**0.89%**
Automobiles	630.2	635.8	5.6	0.89%
Light-Duty Trucks	460.9	465	4.1	0.89%
Heavy-Duty Trucks	39.6	39.9	0.3	0.76%
Buses	0.3	0.3	0	0
Motorcycles	1.6	1.6	0	0
Boats (Recreational)	11	11.1	0.1	0.91%
Diesel Fuel	**386.6**	**417**	**30.4**	**7.86%**
Automobiles	3.4	3.7	0.3	8.82%
Light-Duty Trucks	17.6	19	1.4	7.95%
Heavy-Duty Trucks	301.1	325.5	24.4	8.10%
Buses	8	8.6	0.6	7.50%
Locomotives	39.6	42.8	3.2	8.08%
Ships and Boats	17	17.4	0.4	2.35%
Electricity	**3.2**	**3.9**	**0.7**	21.88%
Jet Fuel	**169**	**152.7**	**-16.3**	**-9.64%**
Commercial Aircraft	122.8	122.8	0	0
Military Aircraft	20.5	20.5	0	0
General Aviation Aircraft	9.4	9.4	0	0
Other Aircraft	16.3	-		

Comparison of EIA and Bottom-Up Fuel Consumption Estimates

- **Interagency Discussion with EIA and FHWA**
- **Determined that EIA was using older FHWA data in its fuel consumption estimates**
- **Recognized that EPA should calculate CO_2 using best available data sources, which include bottom-up data**

Improvements in the 2006 *Inventory*

- **Implemented bottom-up calculation of transportation diesel**
  - **Held constant EIA estimate of total diesel consumption across all sectors**
  - **Non-transportations sectors adjusted downward**
- **Use of an updated oxidation fraction estimate**
  - **2004 EPA study indicated that light-duty gasoline vehicles combust 100 percent of fuel (default assumption was 99 percent)**
  - **Study has been peer reviewed and may be incorporated into IPCC reporting guidelines**

Planned Improvements for future *Inventory* estimates

- **Continue reconciling bottom-up and top-down data used to estimate CO_2, CH_4 and N_2O**
- **Investigation of bunker fuel data**
- **Use better VMT data to improve estimates by vehicle / fuel category**
- **Updating CH_4 and N_2O emissions factors for Tier-2 vehicles**
- **Improve consideration of off-road vehicle use**