ORNL-6966
(Edition 21 of ORNL-5198)

Center for Transportation Analysis
Energy Division

# TRANSPORTATION ENERGY DATA BOOK: EDITION 21

Stacy C. Davis
Oak Ridge National Laboratory

October 2001

Prepared for
Office of Transportation Technologies
U.S. Department of Energy

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6073
managed by
UT-Battelle, LLC
for the
U.S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-00OR22725

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; prices available from (865) 576-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility of the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Users of the *Transportation Energy Data Book* are encouraged to comment on errors, omissions, emphases, and organization of this report to one of the persons listed below. Requests for additional complementary copies of this report, additional data, or information on an existing table should be referred to Ms. Stacy Davis, Oak Ridge National Laboratory.


Stacy C. Davis
Oak Ridge National Laboratory
P. O. Box 2008
Building 3156, MS-6073
Oak Ridge, Tennessee 37831-6073

| | |
|---|---|
| Telephone: | (865) 574-5957 |
| FAX: | (865) 574-3851 |
| E-mail: | DAVISSC@ornl.gov |
| Web Site Location: | www-cta.ornl.gov |

Philip D. Patterson
Office of Transportation Technologies
Department of Energy, EE-30
Forrestal Building, Room 5F-034
1000 Independence Avenue, S.W.
Washington, D.C. 20585

| | |
|---|---|
| Telephone: | (202) 586-9121 |
| FAX: | (202) 586-1637 |
| E-mail: | PHILIP.PATTERSON@hq.doe.gov |
| Web Site Location: | www.ott.doe.gov |
| | analytic page: www.ott.doe.gov/facts.html |


This and previous editions of the
*Transportation Energy Data Book*
can be found on the web at:

**www-cta.ornl.gov/data**

# TABLE OF CONTENTS

**FOREWORD** . . . . . *xv*

**ACKNOWLEDGMENTS** . . . . . *xvii*

**ABSTRACT** . . . . . *xix*

**INTRODUCTION** . . . . . *xxi*

**CHAPTER 1 PETROLEUM** . . . . . **1–1**

Table 1.1 World Fossil Fuel Potential . . . . . 1–2

*Figure 1.1 World Fossil Fuel Potential* . . . . . *1–2*

Table 1.2 World Crude Oil Production, 1960–2000 . . . . . 1–3

Table 1.3 World Oil Consumption, 1960–99 . . . . . 1–4

Table 1.4 Petroleum Stocks in OECD Countries, End of Year 1973–2000 . . . . . 1–5

*Figure 1.2 Crude Oil Prices, 1870–2000* . . . . . *1–6*

Table 1.5 U.S. Petroleum Imports by World Region of Origin, 1960–2000 . . . . . 1–7

*Figure 1.3 Oil Price and Economic Growth, 1970-2001* . . . . . *1–8*

Table 1.6 Summary of 1996 Military Expenditures for Defending Oil Supplies from the Middle East . . . . . 1–9

*Figure 1.4 Refinery Gross Output by World Region, 2000* . . . . . *1–10*

Table 1.7 U.S. Refinery Input of Crude Oil and Petroleum Products, 1987–2000 . . . . . 1–11

Table 1.8 Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978–2000 . . . . 1–12

Table 1.9 United States Petroleum Production and Consumption, 1973–2000 . . . . . 1–13

*Figure 1.5 United States Petroleum Production and Consumption, 1973–2000* . . . . . *1–14*

Table 1.10 Consumption of Petroleum by End-Use Sector, 1973–2000 . . . . . 1–15

Table 1.11 Ton-Miles of Petroleum and Petroleum Products in the U.S. by Mode, 1975–99 . . . . . 1–16

**CHAPTER 2 ENERGY** . . . . . **2–1**

# TABLE OF CONTENTS (Continued)


*Figure 2.1* *World Consumption of Primary Energy, 1999* . . . . . *2–2*

Table 2.1 U. S. Consumption of Total Energy by End-Use Sector, 1973–2000 . . . . . 2–3

Table 2.2 Distribution of Energy Consumption by Source, 1973 and 2000 . . . . . 2–4

Table 2.3 Alternative Fuel and Oxygenate Consumption, 1992–2001 . . . . . 2–5

Table 2.4 Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1999 . . . . . 2–6

Table 2.5 Transportation Energy Use by Mode, 1998–99 . . . . . 2–7

Table 2.6 Highway Transportation Energy Consumption by Mode, 1970–99 . . . . . 2–8

Table 2.7 Nonhighway Transportation Energy Consumption by Mode, 1970-99 . . . . . 2–9

Table 2.8 Highway Usage of Gasoline and Special Fuels, 1973–99 . . . . . 2–10

*Figure 2.2* *Motor Gasoline Quantities by Type, 1981 and 2000* . . . . . *2–11*

Table 2.9 U.S. Production and Imports of MTBE and Fuel Ethanol, 1985–2000 . . . . . 2–12

Table 2.10 Passenger Travel and Energy Use in the United States, 1999 . . . . . 2–13

Table 2.11 Energy Intensities of Highway Passenger Modes, 1970–99 . . . . . 2–14

Table 2.12 Energy Intensities of Nonhighway Passenger Modes, 1970–99 . . . . . 2–15

*Figure 2.3* *Energy Intensity for Transit in the U.S., 1997-99* . . . . . *2-16*

Table 2.13 Intercity Freight Movement and Energy Use in the United States, 1999 . . . . . 2–17

Table 2.14 Energy Intensities of Freight Modes, 1970–99 . . . . . 2–18

**CHAPTER 3 GREENHOUSE GAS EMISSIONS . . . . . 3–1**

Table 3.1 World Carbon Emissions, 1990 and 1997 . . . . . 3–2

Table 3.2 Numerical Estimates of Global Warming Potentials Compared With Carbon Dioxide . . . . . 3–3

Table 3.3 Estimated U.S. Emissions of Greenhouse Gases, 1990–99 . . . . . 3–4

# TABLE OF CONTENTS (Continued)


Table 3.4 U.S. Carbon Dioxide Emissions from Fossil Energy Consumption by End-Use Sector, 1985–99 . . . . . 3–5

Table 3.5 U.S. Carbon Dioxide Emissions from Energy Use in the Transportation Sector, 1980–99 . . . . . 3–6

Table 3.6 Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative and Advanced Vehicle/Fuel Systems . . . . . 3–9

**CHAPTER 4 CRITERIA POLLUTANTS . . . . . 4–1**

Table 4.1 Total National Emissions of the Criteria Air Pollutants by Sector, 1999 . . . . . 4–2

Table 4.2 Total National Emissions of Carbon Monoxide, 1970–99 . . . . . 4–3

Table 4.3 Emissions of Carbon Monoxide from Highway Vehicles, 1970–99 . . . . . 4–4

Table 4.4 Total National Emissions of Nitrogen Oxides, 1970–99 . . . . . 4–5

Table 4.5 Emissions of Nitrogen Oxides from Highway Vehicles, 1970–99 . . . . . 4–6

Table 4.6 Total National Emissions of Volatile Organic Compounds, 1970–99 . . . . . 4–7

Table 4.7 Emissions of Volatile Organic Compounds from Highway Vehicles, 1970–99 . . . . . 4–8

Table 4.8 Total National Emissions of Particulate Matter (PM–10), 1970–99 . . . . . 4–9

Table 4.9 Emissions of Particulate Matter (PM–10) from Highway Vehicles, 1970–99 . . . . . 4–10

Table 4.10 Total National Emissions of Particulate Matter (PM-2.5), 1990–99 . . . . . 4–11

Table 4.11 Emissions of Particulate Matter (PM-2.5) from Highway Vehicles, 1990–99 . . . . . 4-12

Table 4.12 National Lead Emission Estimates, 1970–99 . . . . . 4–13

Table 4.13 Fuel-Cycle Energy and Criteria Pollutant Emission Changes of Alternative and Advanced Vehicle/Fuel Systems . . . . . 4–16

Table 4.14 Pollution from a Typical New Car and Light Truck, 2001 Model Year . . . . . 4–19

Table 4.15 Tier 2 Emission Standards for Cars and Light Trucks Effective for 2004–2009 Model Years . . . . . 4–20

Table 4.16 Light Vehicle Exhaust Emission Standards in Effect in 2009 when U.S. Tier 2 Standards are Final . . . . . 4–21

Table 4.17 Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Vehicles . . . . . 4–22

## TABLE OF CONTENTS (Continued)


Table 4.18 Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT1) . . . . . 4–23

Table 4.19 Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT2) . . . . . 4–24

Table 4.20 Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT3) . . . . . 4–25

Table 4.21 Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT4) . . . . . 4–26

Table 4.22 Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Heavy Trucks . . . . . 4–27

Table 4.23 Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Heavy Heavy Trucks . . . . . 4–28

Table 4.24 *California* Passenger Cars and Light Trucks Emission Certification Standards . . . . . 4–29

Table 4.25 California Vehicle Emission Reduction for Passenger Cars and Light Trucks . . . . . 4–30

**CHAPTER 5 TRANSPORTATION AND THE ECONOMY . . . . . 5–1**

Table 5.1 Gasoline Prices for Selected Countries, 1978–2000 . . . . . 5–2

*Figure 5.1 Gasoline Prices for Selected Countries, 1990 and 1999 . . . . . 5–3*

Table 5.2 Diesel Fuel Prices for Selected Countries, 1978–2000 . . . . . 5–4

*Figure 5.2 Diesel Prices for Selected Countries, 1990 and 1999 . . . . . 5–5*

Table 5.3 Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978–2000 . . . . . 5–6

Table 5.4 Retail Prices for Motor Fuel, 1978–2000 . . . . . 5–7

Table 5.5 Refiner Sales Prices for Propane and No. 2 Diesel, 1978–2000 . . . . . 5–8

Table 5.6 Refiner Sales Prices for Aviation Gasoline and Jet Fuel, 1978–2000 . . . . . 5–9

Table 5.7 State Taxes on Motor Fuels, 2000 . . . . . 5–10

Table 5.8 State Tax Exemptions for Gasohol, December 1, 2000 . . . . . 5–12

Table 5.9 Federal Excise Taxes on Motor Fuels . . . . . 5–12

Table 5.10 States With Ethanol Tax Incentives . . . . . 5–13

# TABLE OF CONTENTS (Continued)


Table 5.11 Average Price of a New Car, 1970–99 . . . . . 5–14

Table 5.12 Automobile Operating Cost per Mile, 1985–2000 . . . . . 5–15

Table 5.13 Fixed Automobile Operating Costs per Year, 1975–2000 . . . . . 5–16

Table 5.14 Economic Indicators, 1970–2000 . . . . . 5–17

Table 5.15 Consumer Price Indices, 1970–2000 . . . . . 5–17

Table 5.16 Motor Vehicle Manufacturing Employment Statistics, 1970–99 . . . . . 5–18

Table 5.17 Employees of Motor Vehicle and Related Industries, 1998 . . . . . 5–19

Table 5.18 Employment in Transportation and Related Industries, 1960–99 . . . . . 5–20

**CHAPTER 6 HIGHWAY VEHICLES AND CHARACTERISTICS . . . . . 6–1**

Table 6.1 Automobile Registrations for Selected Countries, 1950–99 . . . . . 6–2

Table 6.2 Truck and Bus Registrations for Selected Countries, 1950–99 . . . . . 6–3

Table 6.3 Automobiles and Trucks in Use, 1970–2000 . . . . . 6–5

Table 6.4 Vehicle Stock and New Sales in United States, 1999 Calendar Year . . . . . 6–6

Table 6.5 Shares of Highway Vehicle-Miles Traveled by Vehicle Type, 1970–99 . . . . . 6–7

Table 6.6 Automobiles in Operation and Vehicle Travel by Age, 1970 and 1999 . . . . . 6–8

Table 6.7 Trucks in Operation and Vehicle Travel by Age, 1970 and 1999 . . . . . 6–9

Table 6.8 Average Age of Automobiles and Trucks in Use, 1970–99 . . . . . 6–10

Table 6.9 Automobile Scrappage and Survival Rates . . . . . 6–11

*Figure 6.1 Automobile Survival Rates . . . . . 6–12*

Table 6.10 Light Truck Scrappage and Survival Rates . . . . . 6–13

*Figure 6.2 Light Truck Survival Rates . . . . . 6–14*

Table 6.11 Heavy Truck Scrappage and Survival Rates . . . . . 6–15

*Figure 6.3 Heavy Truck Survival Rates . . . . . 6–16*

**CHAPTER 7 LIGHT VEHICLES AND CHARACTERISTICS . . . . . 7–1**

Table 7.1 Summary Statistics for Passenger Cars, 1970–99 . . . . . 7–2

## TABLE OF CONTENTS (Continued)


Table 7.2 Summary Statistics for Two-Axle, Four-Tire Trucks, 1970–99 . . . . . 7–3

Table 7.3 New Retail Automobile Sales in the United States, 1970–2000 . . . . . 7–4

Table 7.4 New Retail Sales of Trucks 10,000 pounds GVW and Less in the United States, 1970–2000 . . . . . 7–5

Table 7.5 Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Automobiles, Selected Sales Periods 1976–2000 . . . . . 7–6

Table 7.6 Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Light Trucks, Selected Sales Periods 1976–2000 . . . . . 7–7

Table 7.7 Light Vehicle Market Shares by Size Class, Sales Periods 1976–2000 . . . . . 7–8

Table 7.8 Sales-Weighted Engine Size of New Domestic and Import Automobiles by Size Class, Sales Periods 1976–2000 . . . . . 7–9

Table 7.9 Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class, Sales Periods 1976–2000 . . . . . 7–10

Table 7.10 Sales-Weighted Curb Weight of New Domestic and Import Automobiles by Size Class, Sales Periods 1976–2000 . . . . . 7–11

Table 7.11 Sales-Weighted Interior Space of New Domestic and Import Automobiles by Size Class, Sales Periods 1976–2000 . . . . . 7–12

*Figure 7.1 Engine Size, Curb Weight, and Interior Space of New Domestic and Import Automobiles, 1976–2000 . . . . . 7–13*

Table 7.12 Sales-Weighted Wheelbase of New Automobiles and Light Trucks, Sales Periods 1976–2000 . . . . . 7–14

Table 7.13 Average Material Consumption for a Domestic Automobile, 1978, 1985, and 2001 . . . . . 7–15

Table 7.14 New Light Vehicle Dealerships and Sales, 1970–99 . . . . . 7–16

Table 7.15 Conventional and Alternative Fuel Refueling Stations . . . . . 7–17

Table 7.16 Automobile Corporate Average Fuel Economy (CAFE) Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2000 . . . . . 7–18

Table 7.17 Light Truck Corporate Average Fuel Economy (CAFE) Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2000 . . . . . 7–19

Table 7.18 Corporate Average Fuel Economy (CAFE) Fines Collected, 1983–99 . . . . . 7–20

Table 7.19 Tax Receipts from the Sale of Gas Guzzlers, 1980–99 . . . . . 7–20

# TABLE OF CONTENTS (Continued)


Table 7.20 The Gas Guzzler Tax on New Cars . . . . . 7–21

Table 7.21 Vehicle Specifications for Tested Vehicles . . . . . 7–23

Table 7.22 Fuel Economy by Speed, 1973, 1984 and 1997 . . . . . 7–24

*Figure 7.2 Fuel Economy by Speed, 1973, 1984 and 1997 . . . . . 7–25*

Table 7.23 Steady Speed Fuel Economy for Tested Vehicles . . . . . 7–26

*Figure 7.3 Urban Driving Cycle . . . . . 7–27*

*Figure 7.4 Highway Driving Cycle . . . . . 7–27*

*Figure 7.5 New York City Driving Cycle . . . . . 7–28*

*Figure 7.6 Representative Number Five Driving Cycle . . . . . 7–28*

*Figure 7.7 US06 Driving Cycle . . . . . 7–29*

Table 7.24 Comparison of U.S., European, and Japanese Emission Testing Cycles . . . . . *7–30*

Table 7.25 Occupant Fatalities by Vehicle Type and Nonoccupant Fatalities, 1975–99 . . . . . 7–31

Table 7.26 Light Vehicle Occupant Safety Data, 1975–99 . . . . . 7–32

Table 7.27 Crashes by Crash Severity, Crash Type, and Vehicle Type, 1999 . . . . . 7-33

*Figure 7.8 Percent Rollover Occurrence in Fatal Crashes by Vehicle Type, 1999 . . . . . 7–34*

**CHAPTER 8 HEAVY VEHICLES AND CHARACTERISTICS . . . . . 8–1**

Table 8.1 Summary Statistics for Other Single-Unit Trucks, 1970–99 . . . . . 8–2

Table 8.2 Summary Statistics for Combination Trucks, 1970–99 . . . . . 8–3

Table 8.3 New Retail Truck Sales by Gross Vehicle Weight, 1970–2000 . . . . . 8–4

Table 8.4 Truck Statistics by Gross Vehicle Weight Class, 1997 . . . . . 8–6

Table 8.5 Truck Fuel Economy by Size Class, 1992 and 1997 . . . . . 8–6

Table 8.6 Truck Statistics by Size, 1997 . . . . . 8–7

Table 8.7 Percentage of Trucks by Size Ranked by Major Use, 1997 . . . . . 8–8

Table 8.8 Percentage of Trucks by Fleet Size and Primary Fueling Facility, 1997 . . . . . 8–9

Table 8.9 Percentage of Trucks by Major Use and Primary Fueling Facility, 1997 . . . . . 8–10

## TABLE OF CONTENTS (Continued)


Table 8.10 Growth of Freight in the United States: Comparison of the 1997 and 1993 Commodity Flow Surveys . . . . . 8–12

Table 8.11 Growth of Freight Miles in the United States: Comparison of the 1997 and 1993 Commodity Flow Surveys . . . . . 8–13

Table 8.12 Summary Statistics on Transit Buses, 1984–99 . . . . . 8–14

Table 8.13 Summary Statistics on Intercity and School Buses, 1970–99 . . . . . 8–15

**CHAPTER 9 ALTERNATIVE FUEL AND ADVANCED TECHNOLOGY VEHICLES AND CHARACTERISTICS . . . . . 9–1**

Table 9.1 Estimates of Alternative Fuel Vehicles in Use, 1992–2001 . . . . . 9–3

Table 9.2 Estimates of Alternative Fuel Vehicles by Ownership, 1996 and 2001 . . . . . 9–4

Table 9.3 Alternative Fuel Vehicles Available by Manufacturer, Model Year 2001 . . . . . 9–5

Table 9.4 Number of Alternative Refuel Sites by State and Fuel Type, 2000 . . . . . 9–6

Table 9.5 List of Clean Cities as of August 2001 by Designation . . . . . 9–7

Table 9.6 Sales and Specifications of Available Advanced Technology Vehicles . . . . . 9–8

Table 9.7 Comparative Specifications of Concept Hybrid-ElectricVehicles . . . . . 9–9

Table 9.8 U.S. Advanced Battery Consortium Goals for Electric Vehicle Batteries . . . . . 9–11

Table 9.9 Energy Storage Requirements for Hybrid Vehicles . . . . . 9–12

**CHAPTER 10 FLEET VEHICLES AND CHARACTERISTICS . . . . . *10–1***

*Figure 10.1 Fleet Vehicles in Service as of February 1, 2000 . . . . . 10–2*

Table 10.1 Fleet Vehicle Composition by Vehicle Type, 1991 . . . . . 10–3

Table 10.2 Average Length of Time Fleet Vehicles are Kept Before Sold to Others, 1991 . . . . . 10–3

Table 10.3 Average Annual and Daily Vehicle-Miles of Travel for Fleet Vehicles, 1991 . . . . . 10–3

*Figure 10.2 Average Miles per Domestic Federal Vehicle by Vehicle Type, 1998 . . . . . 10–4*

Table 10.4 Federal Government Vehicles by Agency, Fiscal Year 1998 . . . . . 10–5

Table 10.5 Federal Fleet Vehicle Acquisitions by Fuel Type, FY 1997– 98 . . . . . 10–6

Table 10.6 Fuel Consumed by Federal Government Fleets, FY 1997–98 . . . . . 10–6

# TABLE OF CONTENTS (Continued)


Table 10.7 Energy Policy Act Purchase Requirements of Light Alternative Fuel Vehicles . . . . . 10-7

**CHAPTER 11 HOUSEHOLD VEHICLES AND CHARACTERISTICS . . . . . 11–1**

Table 11.1 Population and Vehicle Profile, 1950–99 . . . . . 11–2

Table 11.2 Population and Vehicle Ratios, 1950–99 . . . . . 11–3

Table 11.3 Average Annual Expenditures of Households by Income, 1999 . . . . . 11–4

Table 11.4 Household Vehicle Ownership, 1960–2000 Census . . . . . 11–5

Table 11.5 Demographic Statistics, 1969, 1977, 1983, 1990, and 1995 NPTS . . . . . 11–6

Table 11.6 Average Annual Vehicle-Miles, Vehicle Trips and Trip Length per Household 1969, 1977, 1983, 1990, and 1995 NPTS . . . . . 11–7

Table 11.7 Average Annual Person-Miles Traveled (PMT), Person Trips and Trip Length per Household by Selected Trip Purposes, 1983, 1990, and 1995 NPTS . . . . . 11–8

Table 11.8 Average Number of Vehicles and Vehicle Travel per Household, 1990 and 1995 NPTS . . . . . 11–9

*Figure 11.1 Average Vehicle Occupancy by Vehicle Type, 1995 NPTS . . . . . 11–10*

*Figure 11.2 Average Vehicle Occupancy by Trip Purpose, 1977 and 1995 NPTS . . . . . 11–11*

Table 11.9 Vehicle-Miles by Trip Purpose, 1995 NPTS . . . . . 11–12

Table 11.10 Average Annual Miles per Vehicle by Household Vehicle Ownership, 1995 NPTS . . . . . 11–13

Table 11.11 Average Age of Vehicles by Household Vehicle Ownership, 1995 NPTS . . . . . 11–13

Table 11.12 Average Annual Miles per Household Vehicle by Vehicle Age . . . . . 11–14

Table 11.13 Journey-to-Work Statistics, 1983, 1990, and 1995 NPTS . . . . . 11–15

Table 11.14 Means of Transportation to Work, 1980, 1990 and 2000 Census . . . . . 11–16

Table 11.15 Workers by Commute Time, 1990 and 2000 Census . . . . . 11–17

*Figure 11.3 Long-Distance Trips by Destination, 1995 . . . . . 11–18*

Table 11.16 Long-Distance Trips by Mode and Purpose, 1995 . . . . . 11–19

*Figure 11.4 Shares of Long-Distance Person Trips by Mode and Household Income, 1995 . . . 11–20*

## TABLE OF CONTENTS (Continued)

**CHAPTER 12 NONHIGHWAY MODES . . . . . 12–1**

Table 12.1 Summary Statistics for U.S. Domestic and International Certificated Route Air Carriers (Combined Totals), 1970–2000 . . . . . 12–2

Table 12.2 Summary Statistics for General Aviation, 1970–99 . . . . . 12–3

Table 12.3 Tonnage Statistics for Domestic and International Waterborne Commerce, 1970–99 . . . . . 12–4

Table 12.4 Summary Statistics for Domestic Waterborne Commerce, 1970–99 . . . . . 12–5

Table 12.5 Breakdown of Domestic Marine Cargo by Commodity Class, 1999 . . . . . 12–6

Table 12.6 Class I Railroad Freight Systems in the United States Ranked by Revenue Ton–Miles, 1999 . . . . . 12–7

Table 12.7 Summary Statistics for Class I Freight Railroads, 1970–99 . . . . . 12–8

Table 12.8 Railroad Revenue Carloads by Commodity Group, 1974 and 1999 . . . . . 12–9

Table 12.9 Intermodal Rail Traffic, 1965–99 . . . . . 12–10

Table 12.10 Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971–99 . . . . . 12–11

Table 12.11 Summary Statistics for Rail Transit Operations, 1970–99 . . . . . 12–12

**APPENDIX A. SOURCES . . . . . A–1**

**APPENDIX B. CONVERSIONS . . . . . B–1**

**APPENDIX C. CENSUS DIVISIONS AND REGIONS . . . . . C–1**

**GLOSSARY . . . . . G–1**

**INDEX . . . . . I–1**

# FOREWORD

As we endeavor to improve this data book, we find updates and new material to present. Here are some new items you might find interesting.

1. The World Fossil Fuel Potential on p. 1-2 has been updated from a 1997 to a 2000 source.
2. Estimates of the costs of oil dependence to the U.S. are provided on p. 1-8. About $7 trillion in economic costs have been imposed on the U.S. over the last 30 years.
3. Petroleum is the dominant energy source used in OECD and non-OECD countries (p. 2-2).
4. Energy intensity for transit in the U.S. varies greatly from one metropolitan area to another, and for buses it is generally higher than for cars (p. 2-16).
5. To understand the GREET model fuel-cycle comparisons better, the reference car energy use and emissions are provided and the alternative vehicle fuel economies are listed (p. 3-9).
6. The automobile lifetime estimate on p. 6-11 of 16.1 years is two years greater than the estimate in last year's edition of the data book.
7. The heavy truck scrappage and survival estimates on p. 6-15 are a new addition. Heavy trucks are estimated to last 29 years on average.
8. Data from the 2000 Census appears for the first time in Tables 11.14 and 11.15.

I hope you find this data book useful.

Philip D. Patterson

# ACKNOWLEDGMENTS

I would like to express my gratitude to the many individuals who assisted in the preparation of this document. First, I would like to thank Phil Patterson and the staff of the Office of Transportation Technologies (OTT) for their continued support of the Transportation Energy Data Book project. I would also like to thank Patricia Hu of Oak Ridge National Laboratory (ORNL) for her guidance and mentoring. This document benefits from the criticism and careful review of Phil Patterson, OTT; Alicia Birky, National Renewable Energy Laboratory; Tatyana Gurikova, MacroSys, Inc.; James Moore and William Shadis, TA-Engineering, Inc.; and Margaret Singh, Argonne National Laboratory. I would also like to thank Jamie Payne, ORNL, who designed the cover; Sherry Campbell Gambrell, ORNL, who prepared the title index; and Bob Boundy, Q Systems, who assisted with so many tasks I can't name them all. Finally, this book would not have been possible without the dedication of Debbie Bain, who masterfully prepared the manuscript.

# ABSTRACT

The *Transportation Energy Data Book: Edition 21* is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Transportation Technologies in the Department of Energy (DOE). Designed for use as a desk-top reference, the data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use. The purpose of this document is to present relevant statistical data in the form of tables and graphs. The latest editions of the Data Book are available to a larger audience via the Internet (www-cta.ornl.gov/data/tedb.htm).

This edition of the Data Book has 12 chapters which focus on various aspects of the transportation industry. Chapter 1 focuses on petroleum; Chapter 2 – energy; Chapter 3 – greenhouse gas emissions; Chapter 4 – criteria pollutant emissions; Chapter 5 – transportation and the economy; Chapter 6 – highway vehicles; Chapter 7 – light vehicles; Chapter 8 – heavy vehicles; Chapter 9 – alternative fuel vehicles; Chapter 10 – fleet vehicles; Chapter 11 – household vehicles; and Chapter 12– nonhighway modes. The sources used represent the latest available data. There are also three appendices which include detailed source information for some tables, measures of conversion, and the definition of Census divisions and regions. A glossary of terms and a title index are also included for the readers convenience.

# INTRODUCTION

In January 1976, the Transportation Energy Conservation (TEC) Division of the Energy Research and Development Administration contracted with Oak Ridge National Laboratory (ORNL) to prepare a Transportation Energy Conservation Data Book to be used by TEC staff in their evaluation of current and proposed conservation strategies. The major purposes of the data book were to draw together, under one cover, transportation data from diverse sources, to resolve data conflicts and inconsistencies, and to produce a comprehensive document. The first edition of the TEC Data Book was published in October 1976. With the passage of the Department of Energy (DOE) Organization Act, the work being conducted by the former Transportation Energy Conservation Division fell under the purview of the DOE's Office of Transportation Programs (now the Office of Transportation Technologies). DOE, through the Office of Transportation Technologies, has supported the compilation of Editions 3 through 21.

Policymakers and analysts need to be well-informed about activity in the transportation sector. The organization and scope of the data book reflect the need for different kinds of information. For this reason, Edition 21 updates much of the same type of data that is found in previous editions.

In any attempt to compile a comprehensive set of statistics on transportation activity, numerous instances of inadequacies and inaccuracies in the basic data are encountered. Where such problems occur, estimates are developed by ORNL. To minimize the misuse of these statistics, an appendix (Appendix A) is included to document the estimation procedures. The attempt is to provide sufficient information for the conscientious user to evaluate the estimates and to form their own opinions as to their utility. Clearly, the accuracy of the estimates cannot exceed the accuracy of the primary data, an accuracy which in most instances is unknown. In cases where data accuracy is known or substantial errors are strongly suspected in the data, the reader is alerted. In all cases it should be recognized that the estimates are not precise.

The majority of the statistics contained in the data book are taken directly from published sources, although these data may be reformatted for presentation by ORNL. Consequently, neither ORNL nor DOE endorses the validity of these data.

# Chapter 1
# Petroleum

Summary Statistics from Tables/Figures in this Chapter

| Source | | | |
|---|---|---|---|
| Table 1.2 | World Oil Production, 2000 | | |
| | *U.S. Oil Production (million barrels per day)* | | *5.8* |
| | *U.S. Share* | | *8.6%* |
| Table 1.3 | World Oil Consumption, 1999 | | |
| | *U.S. Oil Consumption (million barrels per day)* | | *19.5* |
| | *U.S. Share* | | *26.1%* |
| Figure 1.2 | Average refinery yield, 2000 | OECD Europe | North America |
| | *Gasoline* | *20.6%* | *40.5%* |
| | *Diesel fuel* | *35.4%* | *22.7%* |
| | *Residual fuel* | *16.9%* | *7.5%* |
| | *Kerosene* | *6.4%* | *9.0%* |
| | *Other* | *20.7%* | *20.3%* |
| Table 1.9 | U.S. transportation oil use as a percent of U.S. oil production, 2000 | | 150% |
| Table 1.9 | Net imports as a percentage of U.S. oil consumption, 2000 | | 52% |
| Table 1.10 | Transportation share of oil consumption, 2000 | | 68% |

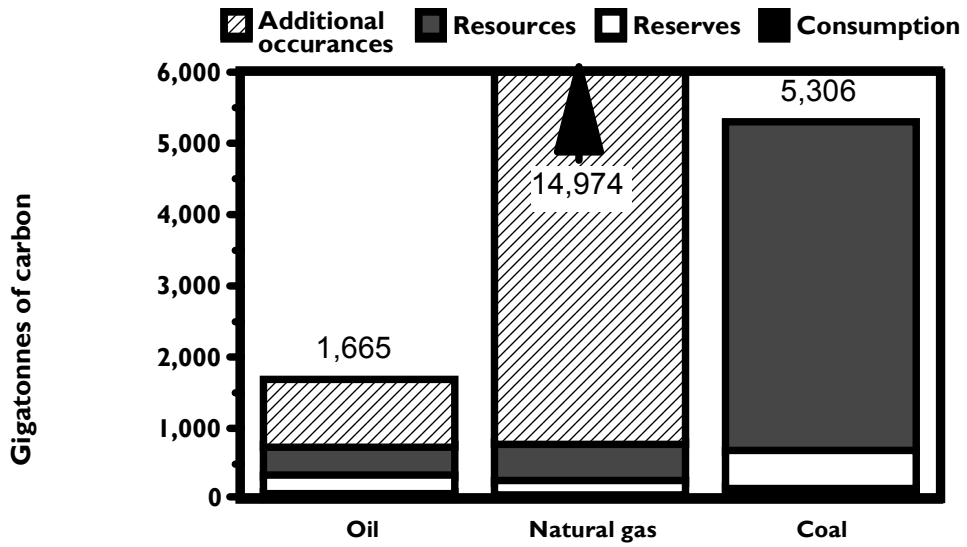
*Although the world has consumed about 40% of estimated conventional oil resources, the total fossil fuel potential is huge. Methane hydrates–a potential source of natural gas–are included in the "additional occurrences" of unconventional natural gas, and constitute the largest resource.*

**Table 1.1**
**World Fossil Fuel Potential**
**(gigatonnes of carbon)**

| | Consumption (1860–1998) | Reserves | Resources | Additional occurrences |
|---|---|---|---|---|
| *Oil* | | | | |
| Conventional | 97 | 120 | 121 | 0 |
| Unconventional | 6 | 102 | 305 | 914 |
| *Natural Gas* | | | | |
| Conventional | 36 | 83 | 170 | 0 |
| Unconventional | 1 | 144 | 364 | 14,176 |
| *Coal* | 155 | 533 | 4,618 | [a] |

**Source:**
Rogner, H.H., *World Energy Assessment: Energy and the Challenge of Sustainability, Part II*, Chapter 5, 2000, p. 149.

**Figure 1.1. World Fossil Fuel Potential**




Source: See Table 1.1.

[a] Data are not available

*In 2000, OPEC accounted for 43% of world oil production. Responding to low oil prices early that year, Mexico, Norway, Russia, and Oman joined OPEC in cutting production. This group of oil countries, referred to here as OPEC+, account for 62% of world oil production.*

**Table 1.2**
**World Crude Oil Production, 1960-2000[a]**
**(million barrels per day)**

| Year | United States | U.S. Share | Total OPEC[b] | OPEC Share | OPEC +[c] | OPEC +[c] Share | Total Non-OPEC | Persian Gulf nations[d] | World |
|---|---|---|---|---|---|---|---|---|---|
| 1960 | 7.04 | 33.5% | 8.70 | 41.4% | 12.25 | 58.3% | 12.29 | 5.27 | 20.99 |
| 1965 | 7.80 | 25.7% | 14.35 | 47.3% | 19.83 | 65.4% | 15.98 | 8.37 | 30.33 |
| 1970 | 9.64 | 21.0% | 23.30 | 50.8% | 31.16 | 67.9% | 22.59 | 13.39 | 45.89 |
| 1975 | 8.37 | 15.8% | 26.77 | 50.7% | 37.56 | 71.1% | 26.06 | 18.93 | 52.83 |
| 1980 | 8.60 | 14.4% | 26.61 | 44.6% | 41.07 | 68.9% | 32.99 | 17.96 | 59.60 |
| 1985 | 8.97 | 16.6% | 16.18 | 30.0% | 31.81 | 58.9% | 37.80 | 9.63 | 53.98 |
| 1986 | 8.68 | 15.4% | 18.28 | 32.5% | 34.05 | 60.6% | 37.95 | 11.70 | 56.23 |
| 1987 | 8.35 | 14.7% | 18.52 | 32.7% | 34.72 | 61.3% | 38.15 | 12.10 | 56.67 |
| 1988 | 8.14 | 13.9% | 20.32 | 34.6% | 36.66 | 62.4% | 38.42 | 13.46 | 58.74 |
| 1989 | 7.61 | 12.7% | 22.07 | 36.9% | 38.50 | 64.3% | 37.79 | 14.84 | 59.86 |
| 1990 | 7.36 | 12.2% | 23.20 | 38.3% | 39.12 | 64.6% | 37.37 | 15.28 | 60.57 |
| 1991 | 7.42 | 12.3% | 23.27 | 38.6% | 38.53 | 64.0% | 36.94 | 14.74 | 60.21 |
| 1992 | 7.17 | 11.9% | 24.40 | 40.5% | 37.67 | 62.6% | 35.81 | 15.97 | 60.21 |
| 1993 | 6.85 | 11.4% | 25.12 | 41.7% | 37.65 | 62.5% | 35.12 | 16.71 | 60.24 |
| 1994 | 6.66 | 10.9% | 25.51 | 41.8% | 37.67 | 61.8% | 35.48 | 16.96 | 60.99 |
| 1995 | 6.56 | 10.5% | 26.00 | 41.7% | 38.24 | 61.4% | 36.33 | 17.21 | 62.33 |
| 1996 | 6.46 | 10.1% | 26.46 | 41.5% | 39.15 | 61.5% | 37.25 | 17.37 | 63.71 |
| 1997 | 6.45 | 9.8% | 27.71 | 42.2% | 40.69 | 61.9% | 37.98 | 18.10 | 65.69 |
| 1998 | 6.25 | 9.3% | 28.77 | 43.0% | 41.61 | 62.1% | 38.19 | 19.34 | 66.96 |
| 1999 | 5.88 | 8.9% | 27.58 | 41.9% | 40.48 | 61.4% | 38.29 | 18.67 | 65.87 |
| 2000 | 5.83 | 8.6% | 29.11 | 42.8% | 42.74 | 62.9% | 38.87 | 19.94 | 67.98 |
| | | | | *Average annual percentage change* | | | | | |
| 1960–2000 | -0.5% | | 3.1% | | 3.2% | | 2.9% | 3.4% | 3.0% |
| 1970–2000 | -1.7% | | 0.7% | | 1.1% | | 1.8% | 1.3% | 1.3% |
| 1990–2000 | -2.3% | | 2.3% | | 0.9% | | 0.4% | 2.7% | 1.2% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2000,* Washington, DC, July 2001, Table 11.4.

[a]Includes lease condensate. Excludes natural gas plant liquids.
[b]Organization of Petroleum Exporting Countries. See Glossary for membership.
[c]OPEC+ includes all OPEC nations plus Russia, Mexico, Norway and Oman.
[d]See Glossary for Persian Gulf nations.

*The United States has accounted for approximately one-quarter of the world's oil consumption for the last two decades. These data are the latest available; oil consumption data generally lags behind production data (previous table) by one year.*

**Table 1.3**
**World Oil Consumption, 1960–99**
**(million barrels per day)**

| Year | United States | U.S. Share | Total OECD[a] | Total Non-OECD | World |
|---|---|---|---|---|---|
| 1960 | 9.80 | 45.9% | 15.78 | 5.56 | 21.34 |
| 1965 | 11.51 | 37.0% | 22.81 | 8.33 | 31.14 |
| 1970 | 14.70 | 31.4% | 34.49 | 12.32 | 46.81 |
| 1975 | 16.32 | 29.0% | 38.82 | 17.38 | 56.20 |
| 1976 | 17.46 | 29.3% | 41.39 | 18.28 | 59.67 |
| 1977 | 18.43 | 29.8% | 42.43 | 19.40 | 61.83 |
| 1978 | 18.85 | 29.4% | 43.62 | 20.54 | 64.16 |
| 1979 | 18.51 | 28.4% | 44.01 | 21.21 | 65.22 |
| 1980 | 17.06 | 27.0% | 41.41 | 21.66 | 63.07 |
| 1981 | 16.06 | 26.4% | 39.14 | 21.76 | 60.90 |
| 1982 | 15.30 | 25.7% | 37.45 | 22.05 | 59.50 |
| 1983 | 15.23 | 25.9% | 36.59 | 22.15 | 58.74 |
| 1984 | 15.73 | 26.3% | 37.43 | 22.41 | 59.84 |
| 1985 | 15.73 | 26.2% | 37.23 | 22.87 | 60.10 |
| 1986 | 16.28 | 26.4% | 38.28 | 23.48 | 61.76 |
| 1987 | 16.67 | 26.5% | 38.96 | 24.04 | 63.00 |
| 1988 | 17.28 | 26.7% | 40.24 | 24.58 | 64.82 |
| 1989 | 17.33 | 26.3% | 40.88 | 25.04 | 65.92 |
| 1990 | 16.99 | 25.8% | 40.92 | 25.05 | 65.97 |
| 1991 | 16.71 | 25.1% | 41.40 | 25.16 | 66.56 |
| 1992 | 17.03 | 25.5% | 42.42 | 24.34 | 66.76 |
| 1993 | 17.24 | 25.7% | 42.98 | 24.02 | 67.00 |
| 1994 | 17.72 | 25.9% | 44.17 | 24.12 | 68.29 |
| 1995 | 17.72 | 25.4% | 44.96 | 24.92 | 69.88 |
| 1996 | 18.31 | 25.6% | 46.07 | 25.34 | 71.41 |
| 1997 | 18.62 | 25.5% | 46.83 | 26.23 | 73.06 |
| 1998 | 18.92 | 25.7% | 46.93 | 26.71 | 73.64 |
| 1999 | 19.52 | 26.1% | 47.61 | 27.30 | 74.91 |
| | | *Average annual percentage change* | | | |
| 1960–99 | 1.8% | | 2.9% | 4.2% | 3.3% |
| 1970–99 | 1.0% | | 1.1% | 2.8% | 1.6% |
| 1988–99 | 1.2% | | 1.5% | 0.9% | 1.3% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2000*, Washington, DC, July 2001, Table 11.9.

[a] Organization for Economic Cooperation and Development. See Glossary for membership.

*The United States increased its petroleum stocks by 51% from 1973 to 1985; but U.S. stocks remained relatively constant from 1985 to 1998. Data for 1999 and 2000 indicate that U.S. stocks are declining. Petroleum demand, however, continues to increase (see Table 1.3). The Strategic Petroleum Reserve accounted for 37% of total U.S. stocks at the end of 2000.*

**Table 1.4**
**Petroleum Stocks in OECD Countries, End of Year 1973–2000[a]**
**(million barrels)**

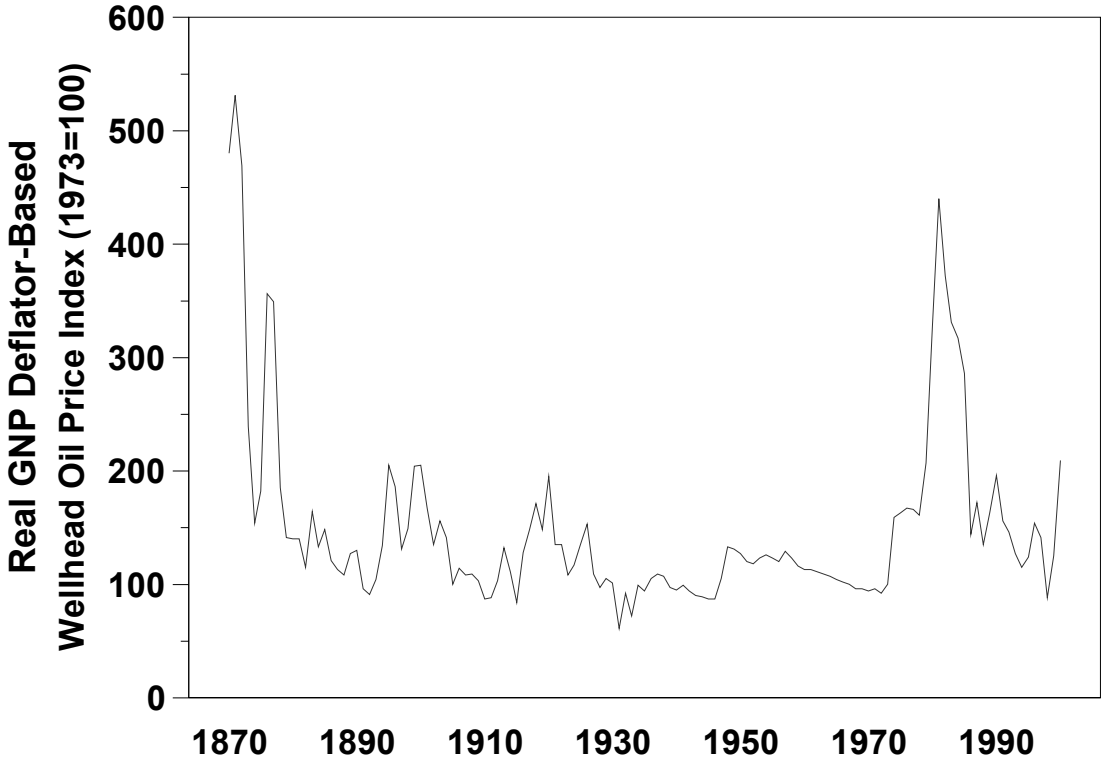
| Year | OECD[b] Europe | Canada | Japan | U.S. Strategic Petroleum Reserve | United States total | Other OECD[c] | OECD[b] | Share of U.S. stocks to U.S. oil consumption | Share of OECD stocks to OECD oil consumption |
|---|---|---|---|---|---|---|---|---|---|
| 1973 | 1,070 | 140 | 303 | [d] | 1,008 | 67 | 2,588 | 16.0% | 17.1% |
| 1975 | 1,154 | 174 | 375 | [d] | 1,133 | 67 | 2,903 | 19.1% | 20.5% |
| 1980 | 1,464 | 164 | 495 | 108 | 1,392 | 72 | 3,587 | 22.4% | 23.8% |
| 1985 | 1,092 | 113 | 494 | 493 | 1,519 | 66 | 3,284 | 26.5% | 24.2% |
| 1990 | 1,163 | 121 | 590 | 586 | 1,621 | 73 | 3,568 | 26.2% | 24.0% |
| 1991 | 1,181 | 119 | 606 | 569 | 1,617 | 65 | 3,588 | 26.6% | 23.8% |
| 1992 | 1,219 | 107 | 603 | 575 | 1,592 | 67 | 3,588 | 25.7% | 23.2% |
| 1993 | 1,221 | 105 | 618 | 587 | 1,647 | 69 | 3,661 | 26.2% | 23.4% |
| 1994 | 1,240 | 119 | 645 | 592 | 1,653 | 69 | 3,726 | 25.6% | 23.2% |
| 1995 | 1,228 | 109 | 630 | 592 | 1,563 | 71 | 3,601 | 24.2% | 22.0% |
| 1996 | 1,256 | 103 | 651 | 566 | 1,507 | 74 | 3,591 | 22.6% | 21.4% |
| 1997 | 1,255 | 115 | 685 | 563 | 1,560 | 74 | 3,689 | 23.0% | 21.7% |
| 1998 | 1,303 | 118 | 649 | 571 | 1,647 | 66 | 3,784 | 23.9% | 22.2% |
| 1999 | 1,232 | 108 | 629 | 567 | 1,493 | 69 | 3,530 | 21.0% | 20.4% |
| 2000 | 1,259 | 112 | 634 | 541 | 1,468 | 70 | 3,542 | [e] | [e] |
| *Average annual percentage change* | | | | | | | | | |
| 1973–2000 | 0.6% | -0.8% | 2.8% | [e] | 1.4% | 0.2% | 1.2% | | |
| 1990–2000 | 0.8% | -0.8% | 0.7% | -0.4% | -1.0% | -0.4% | -0.1% | | |

**Source:**
Country stocks - U.S. Department of Energy, Energy Information Administration, *International Petroleum Statistics Report*, Washington, DC, July 2001, Table 4.5.
U.S. Strategic Petroleum Reserve - U.S. Department of Energy, Energy Information Administration, *Annual Energy Review, 2000*, Washington, DC, July 2001, Table 5.15.
Oil consumption – See Table 1.3.

[a] Includes crude oil (including strategic reserves), lease condensate, natural gas plant liquids, unfinished oils, and finished petroleum products. Oil stocks include all non-military stocks held by importers, refiners, Governments, major non-importing final consumers and by foreign entities in certain facilities. See *Stocks* in Glossary for details.
[b] Organization for Economic Cooperation and Development (OECD). See Glossary for membership.
[c] Australia, New Zealand, and United States Territories. Data for Mexico, which joined the OECD on May 18, 1994, are not available.
[d] Data are not available. The Energy Policy and Conservation Act, effective February 1976, authorized the establishment of the U.S. Strategic Petroleum Reserve.
[e] Data are not available.

*This chart shows the volatility of crude oil prices since 1870. Given this volatility, it is difficult for anyone to predict future crude oil prices with any certainty.*

**Figure 1.2. Crude Oil Prices, 1870–2000**




**Source:**
Santini, Danilo J., "An Assessment of Oil Supply and Its Implications for Future Prices," *Nonrenewable Resources*, Vol. 7, No. 2, 1998, pp. 101-121, and 1994–2000 data updates.

*The share of petroleum imported to the U.S. can be calculated using total imports or net imports. Net imports, which is the preferred data, rose to 50% of U.S. petroleum consumption for the first time in 1998, while total imports reached 50% for the first time in 1993. OPEC share of net imports has been around 50% for the last five years.*

**Table 1.5**
**U.S. Petroleum Imports by World Region of Origin, 1960–2000**
**(thousand barrels per day)**

| Year | Net OPEC[a] imports | Net OPEC share | Net Persian Gulf nation[b] imports | Net Persian Gulf share | Net imports | Net imports as a share of U.S. consumption | Total imports |
|---|---|---|---|---|---|---|---|
| 1960 | 1,311 | 81.3% | [c] | [c] | 1,613 | [c] | 1,815 |
| 1965 | 1,475 | 64.7% | [c] | [c] | 2,281 | [c] | 2,468 |
| 1970 | 1,343 | 42.5% | [c] | [c] | 3,161 | [c] | 3,419 |
| 1975 | 3,599 | 61.6% | [c] | [c] | 5,846 | 35.8% | 6,056 |
| 1980 | 4,293 | 67.5% | [c] | [c] | 6,365 | 37.3% | 6,909 |
| 1981 | 3,315 | 61.4% | 1,215 | 22.5% | 5,401 | 33.6% | 5,996 |
| 1982 | 2,136 | 49.7% | 692 | 16.1% | 4,298 | 28.1% | 5,113 |
| 1983 | 1,843 | 42.7% | 439 | 10.2% | 4,312 | 28.3% | 5,051 |
| 1984 | 2,037 | 43.2% | 502 | 10.6% | 4,715 | 30.0% | 5,437 |
| 1985 | 1,821 | 42.5% | 309 | 7.2% | 4,286 | 27.3% | 5,067 |
| 1986 | 2,828 | 52.0% | 909 | 16.7% | 5,439 | 33.4% | 6,224 |
| 1987 | 3,055 | 51.7% | 1,074 | 18.2% | 5,914 | 35.5% | 6,678 |
| 1988 | 3,513 | 53.3% | 1,529 | 23.2% | 6,587 | 38.1% | 7,402 |
| 1989 | 4,124 | 57.3% | 1,858 | 25.8% | 7,202 | 41.6% | 8,061 |
| 1990 | 4,285 | 59.8% | 1,962 | 27.4% | 7,161 | 42.2% | 8,018 |
| 1991 | 4,065 | 61.3% | 1,833 | 27.7% | 6,626 | 39.6% | 7,627 |
| 1992 | 4,071 | 58.7% | 1,773 | 25.6% | 6,938 | 40.7% | 7,888 |
| 1993 | 4,253 | 55.8% | 1,774 | 23.3% | 7,618 | 44.2% | 8,620 |
| 1994 | 4,233 | 52.6% | 1,723 | 21.4% | 8,054 | 45.5% | 8,996 |
| 1995 | 3,980 | 50.5% | 1,563 | 19.8% | 7,886 | 44.5% | 8,835 |
| 1996 | 4,193 | 49.3% | 1,596 | 18.8% | 8,498 | 46.4% | 9,478 |
| 1997 | 4,542 | 49.6% | 1,747 | 19.1% | 9,158 | 49.2% | 10,162 |
| 1998 | 4,880 | 50.0% | 2,132 | 21.8% | 9,764 | 51.6% | 10,708 |
| 1999 | 4,934 | 49.8% | 2,459 | 24.8% | 9,912 | 50.8% | 10,852 |
| 2000 | 5,115 | 50.9% | 2,463 | 24.5% | 10,053 | 51.6% | 11,093 |
| | | | *Average annual percentage change* | | | | |
| 1960–2000 | 3.5% | | [c] | | 4.7% | | 4.6% |
| 1970–2000 | 4.6% | | [c] | | 3.9% | | 4.0% |
| 1990–2000 | 1.8% | | 2.3% | | 3.5% | | 3.3% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2000,* Washington, DC, July 2001, Tables 5.4 and 5.7.

[a] Organization of Petroleum Exporting Countries. See Glossary for membership.
[b] See Glossary for Persian Gulf nations.
[c] Data are not available.

## The Costs of Oil Dependence

In the *Costs of Oil Dependence: A 2000 Update*, authors Greene and Tishchishyna indicate that the oil market upheavals caused by the OPEC cartel over the last 30 years have cost the U.S. in the vicinity of $7 trillion (present value 1998 dollars) in total economic costs, which is about as large as the sum total of payment on the national debt over the same period.

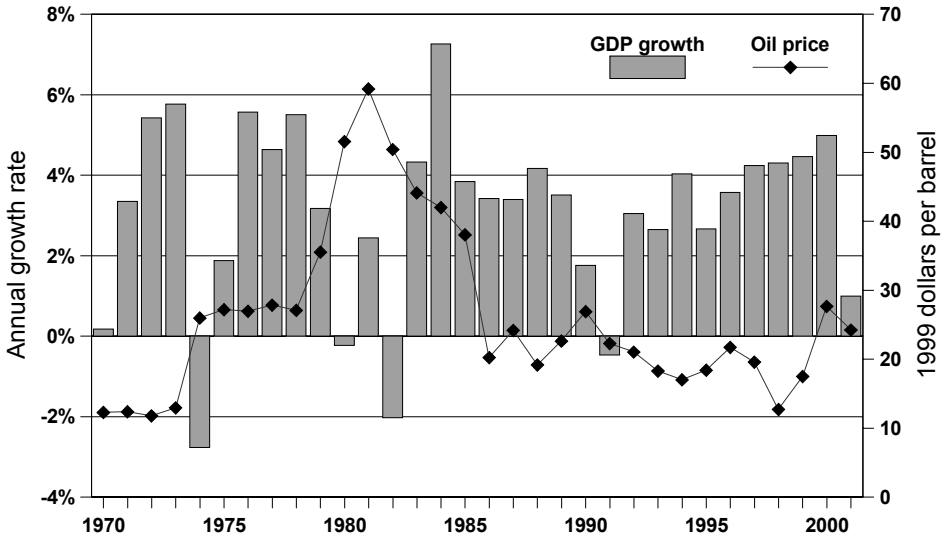
Oil dependence is the product of (1) a noncompetitive world oil market strongly influenced by the OPEC cartel, (2) high levels of U.S. oil imports, (3) oil's critical role in the U.S. economy, and (4) the absence of economical and readily available substitutes for oil. Transportation is key to the problem because transportation vehicles account for 68% of U.S. oil consumption and nearly all of the high-value light products that drive the market.

Oil consuming economies incur three types of costs when monopoly power is used to raise prices above competitive market levels:

- *Loss of potential gross domestic product (GDP)* - the economy's ability to produce is reduced because a key factor of production is more expensive;
- *Macroeconomic Adjustment Costs* - sudden changes in oil prices increase unemployment, further reducing economic output; and
- *Transfer of Wealth* - some of the wealth of oil consuming states is appropriated by foreign oil producers.

Major oil price shocks have disrupted world energy markets four times in the past 30 years (1973-74, 1979-80, 1990-91, 1999-2000). Each of the first three oil price shocks was followed by an economic recession in the U.S.

**Figure 1.3. Oil Price and Economic Growth, 1970–2001[a]**




**Source:**
Greene, D.L. and N. I. Tishchishyna, *Costs of Oil Dependence: A 2000 Update*, Oak Ridge National Laboratory, ORNL/TM-2000/152, Oak Ridge, TN, 2000, and data updates, 2001.
(Additional resources: www-cta.ornl.gov/publications)

[a]First two quarters of 2001.

*Estimates of 1996 military expenditures for defending oil supplies in the Middle East range from $6 to $60 billion per year. This wide range in estimates reflects the difficulty in assigning a precise figure to the military cost of defending the U.S. interests in the Middle East. The two main reasons for the difficulty are 1) the Department of Defense does not divide the budget into regional defense sectors and 2) it is difficult to determine how much of the cost is attributable to defending Persian Gulf oil.*

**Table 1.6**
**Summary of 1996 Military Expenditures for Defending Oil Supplies from the Middle East**

| Source | Original estimates (billion dollars) | Year of original estimate | 1996 estimate (constant 1996 billion dollars) |
|---|---|---|---|
| General Accounting Office [1] | $33 | 1990 | $28[a] |
| Congressional Research Service [2] | $6.4 | 1990 | $6[a] |
| Greene and Leiby [3] | $14.3 | 1990 | $12[a] |
| Ravenal [4] | $50 | 1992 | $60[b] |
| Kaufmann and Steinbruner [5] | $64.5 | 1990 | $55[b] |
| Delucchi and Murphy[c] [6] | $20–40 | 1996 | $20–40[b] |
| Average estimate is $32 billion, with a standard deviation of $22 billion. | | | |


[1] U.S. General Accounting Offices, *Southwest Asia: Cost of Protecting U.S. Interests*, GAO/NSIAD-91-250, Washington, DC, August 1991.

[2] Congressional Research Service, *The External Costs of Oil Used in Transportation*, prepared for the U.S. Alternative Fuels Council, Washington, DC, June 1992.

[3] Greene, D.L., and P. Leiby, *The Social Costs to the U.S. of Monopolization of the World Oil Market*, 1972-1991, ORNL-6744, Oak Ridge National Laboratory, Oak Ridge, TN, March 1993.

[4] Ravenal, E.C., *Designing Defense for a New World Order: The Military Budget in 1992 and Beyond*, Cato Institute, Washington, DC, 1991.

[5] Kaufmann, W.W., and J.D. Steinbruner, *Decisions for Defense: Prospects for a New Order*, The Brookings Institution, Washington, DC, 1991.

[6] Delucchi, M.A., and J. Murphy, *U.S. Military Expenditures to Protect the Use of Persian-Gulf Oil for Motor Vehicles*, UCD-ITS-RR-96-3 (15), University of California, Davis, California, April 1996.


**Source:**
Hu, P.S., "Estimates of 1996 U.S. Military Expenditures on Defending Oil Supplies from the Middle East: A Literature Review," Oak Ridge National Laboratory, Oak Ridge, TN, March 1996.

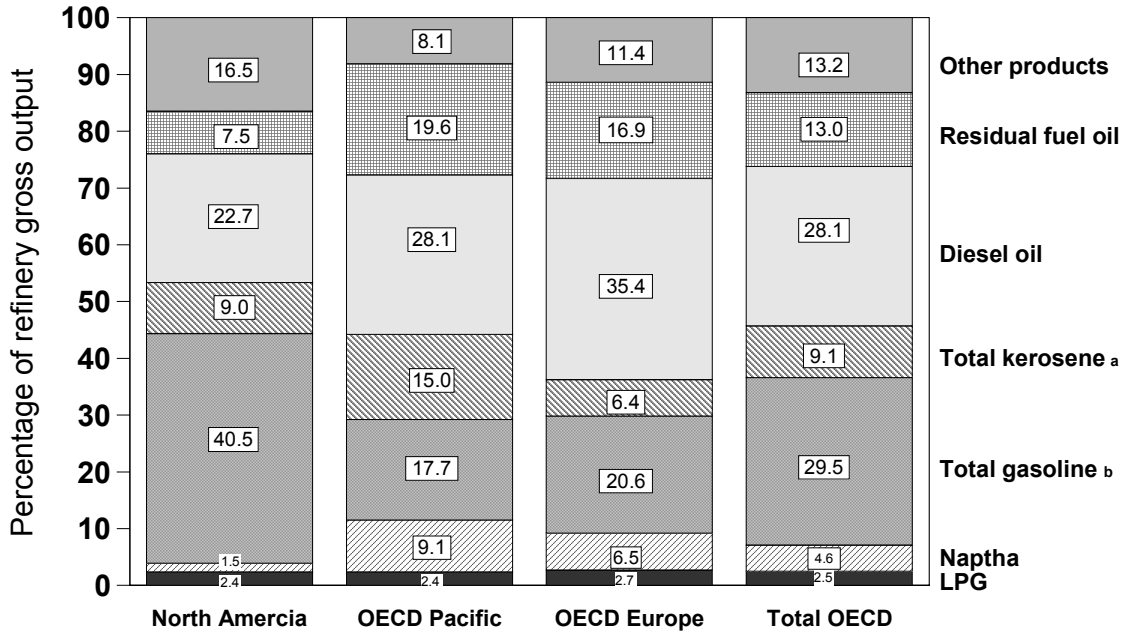
[a]Estimated based on a 3% annual inflation rate and a decrease of 30% in the total Defense budget from 1990 to 1996.

[b]Provided by the author(s); thus, assumptions used for the projection are different from those used in the other estimates.

[c]Annual cost to defend all U.S. interests in the Persian Gulf.

*Other parts of the world refine crude oil to produce more diesel fuel and less gasoline than does North America. The OECD Pacific countries produce the lowest share of gasoline.*

**Figure 1.4. Refinery Gross Output by World Region, 2000**




**Source:**
International Energy Agency, *Monthly Oil Survey*, February 2001, Paris, France, Table 7.

[a] Includes jet kerosene and other kerosene.
[b] Includes motor gasoline, jet gasoline, and aviation gasoline.
[c] Organization for Economic Cooperation and Development. See Glossary for membership.

*Oxygenate refinery input increased significantly in 1995, most certainly due to the Clean Air Act Amendments of 1990 which mandated the sale of reformulated gasoline in certain areas beginning in January 1995.*

**Table 1.7**
**U.S. Refinery Input of Crude Oil and Petroleum Products, 1987–2000**
**(thousand barrels)**

| | | | Oxygenates | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Crude oil | Natural gas liquids | Fuel ethanol | Methanol | MTBE[a] | Other oxygenates[b] | Other hydrocarbons[c] | Other liquids | Total input to refineries |
| 1987 | 4,691,783 | 280,889 | [d] | [d] | [d] | [d] | 23,304 | 220,296 | 5,105,392 |
| 1990 | 4,894,379 | 170,589 | [d] | [d] | [d] | [d] | 28,642 | 231,466 | 5,325,076 |
| 1991 | 4,855,016 | 172,306 | [d] | [d] | [d] | [d] | 31,574 | 248,691 | 5,307,587 |
| 1992 | 4,908,603 | 171,701 | [d] | [d] | [d] | [d] | 47,918 | 224,758 | 5,352,980 |
| 1993 | 4,968,641 | 179,213 | 3,351 | 782 | 49,393 | 1,084 | 15,543 | 264,531 | 5,482,538 |
| 1994 | 5,061,111 | 169,868 | 3,620 | 242 | 52,937 | 1,676 | 14,130 | 179,678 | 5,483,262 |
| 1995 | 5,100,317 | 172,026 | 9,055 | 246 | 79,396 | 3,876 | 14,668 | 175,743 | 5,555,327 |
| 1996 | 5,195,265 | 164,552 | 11,156 | 126 | 79,407 | 3,444 | 20,587 | 193,695 | 5,668,232 |
| 1997 | 5,351,466 | 151,769 | 11,803 | 496 | 86,240 | 3,750 | 22,976 | 178,292 | 5,806,792 |
| 1998 | 5,434,383 | 146,921 | 11,722 | 675 | 89,362 | 3,363 | 22,759 | 183,376 | 5,892,561 |
| 1999 | 5,403,450 | 135,756 | 13,735 | 813 | 94,784 | 3,334 | 21,447 | 204,332 | 5,877,651 |
| 2000 | 5,514,395 | 138,921 | 15,268 | 854 | 90,288 | 3,151 | 24,488 | 176,647 | 5,964,012 |
| | | | | *Average annual percentage change* | | | | | |
| 1987-2000 | 1.3% | -5.3% | [e] | [e] | [e] | [e] | 0.4% | -1.7% | 1.2% |
| 1993-2000 | 1.5% | -3.6% | 24.2% | 1.3% | 9.0% | 16.5% | 6.7% | -5.6% | 1.2% |

**Source:** U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual, 2000*, Vol. 1, June 2001, Table 16, and annual.(Additional resources: www.eia.doe.gov)

[a]Methyl tertiary butyl ether (MTBE).

[b]Includes ethyl tertiary butyl ether (ETBE), tertiary amyl methyl ether (TAME), tertiary butyl alcohol (TBA), and other aliphatic alcohols and ethers intended for motor gasoline blending.

[c]For 1987–92, includes other hydrocarbons/hydrogen/oxygenates. For 1993–on, includes other hydrocarbons/hydrogen.

[d]Reported in "Other hydrocarbons" category in this year.

[e]Data are not available.

*When crude oil and other hydrocarbons are processed into products that are, on average, less dense than the input, a processing volume gain occurs. Due to this gain, the product yield from a barrel of crude oil is more than 100%. The processing volume gain has been growing over the years.*

**Table 1.8**
**Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978–2000**
**(percentage)**

| Year | Motor gasoline | Distillate fuel oil | Jet fuel | Liquified petroleum gas | Other[a] | Total[b] |
|---|---|---|---|---|---|---|
| 1978 | 44.1 | 21.4 | 6.6 | 2.3 | 29.6 | 104.0 |
| 1979 | 43.0 | 21.5 | 6.9 | 2.3 | 30.3 | 104.0 |
| 1980 | 44.5 | 19.7 | 7.4 | 2.4 | 30.0 | 104.0 |
| 1981 | 44.8 | 20.5 | 7.6 | 2.4 | 28.7 | 104.0 |
| 1982 | 46.4 | 21.5 | 8.1 | 2.2 | 26.2 | 104.4 |
| 1983 | 47.6 | 20.5 | 8.5 | 2.7 | 24.8 | 104.1 |
| 1984 | 46.7 | 21.5 | 9.1 | 2.9 | 24.2 | 104.4 |
| 1985 | 45.6 | 21.6 | 9.6 | 3.1 | 24.6 | 104.5 |
| 1986 | 45.7 | 21.2 | 9.8 | 3.2 | 24.8 | 104.7 |
| 1987 | 46.4 | 20.5 | 10.0 | 3.4 | 24.5 | 104.8 |
| 1988 | 46.0 | 20.8 | 10.0 | 3.6 | 24.4 | 104.8 |
| 1989 | 45.7 | 20.8 | 10.1 | 4.0 | 24.2 | 104.8 |
| 1990 | 45.6 | 20.9 | 10.7 | 3.6 | 24.1 | 104.9 |
| 1991 | 45.7 | 21.3 | 10.3 | 3.8 | 24.1 | 105.2 |
| 1992 | 46.0 | 21.2 | 9.9 | 4.3 | 24.0 | 105.4 |
| 1993 | 46.1 | 21.9 | 10.0 | 4.1 | 23.3 | 105.4 |
| 1994 | 45.5 | 22.3 | 10.1 | 4.2 | 23.2 | 105.3 |
| 1995 | 46.4 | 21.8 | 9.7 | 4.5 | 22.9 | 105.3 |
| 1996 | 45.7 | 22.7 | 10.4 | 4.5 | 22.4 | 105.7 |
| 1997 | 45.7 | 22.5 | 10.3 | 4.6 | 22.5 | 105.6 |
| 1998 | 46.2 | 22.3 | 10.4 | 4.4 | 22.5 | 105.8 |
| 1999 | 46.5 | 22.3 | 10.2 | 4.5 | 22.3 | 105.8 |
| 2000 | 46.2 | 23.1 | 10.3 | 4.5 | 22.0 | 106.1 |

**Source:**
Department of Energy, Energy Information Administration, *Petroleum Supply Annual 2000*, Vol. 1, June 2001, Table 19 and annual. (Additional resources: www.eia.doe.gov)

[a] Includes aviation gasoline, kerosene, naphtha and other oils for petrochemical feedstock use, special naphthas, lubricants, waxes, petroleum coke, asphalt and road oil, still gas, and miscellaneous products.
[b] Products sum greater than 100% due to processing gain. The processing gain for years 1978 to 1980 is assumed to be 4%.

*The U.S. does not produce enough oil to meet the nation's demand. Since 1998, the net amount of oil imported has been more than half the U.S. consumption. The U.S. does export a small amount of petroleum, mainly to Canada and Mexico.*

Table 1.9
**United States Petroleum Production and Consumption, 1973–2000**
**(million barrels per day)**

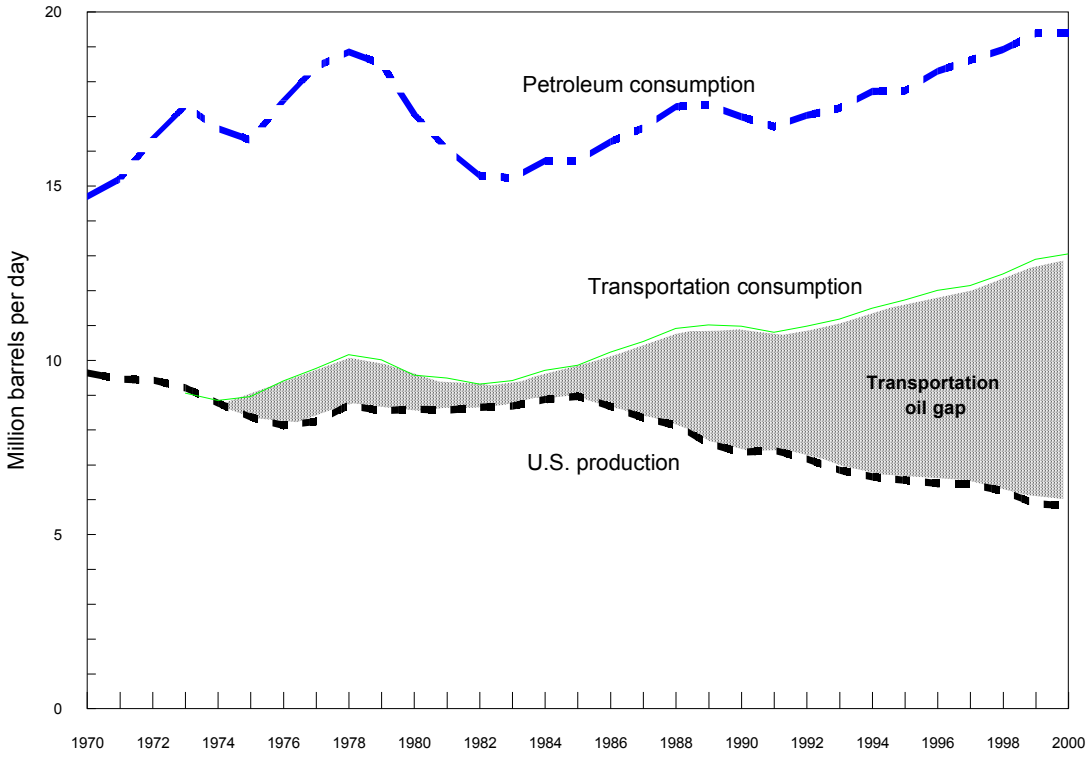
| Year | Domestic crude oil production | Net imports | | | Exports | | U.S. petroleum consumption[a] | World petroleum consumption | Net imports as a percentage of U.S. petroleum consumption | U.S. petroleum consumption as a percentage of world consumption | Transportation petroleum use as a percentage of domestic production[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Crude oil | Petroleum products | Total | Crude oil | Petroleum products | | | | | |
| 1973 | 9.21 | 3.24 | 2.78 | 6.03 | 0.00 | 0.23 | 17.31 | 56.39 | 34.8% | 30.7% | 76.7% |
| 1975 | 8.37 | 4.10 | 1.75 | 5.85 | 0.00 | 0.20 | 16.32 | 55.48 | 35.8% | 29.4% | 82.8% |
| 1980 | 8.60 | 4.98 | 1.39 | 6.37 | 0.29 | 0.26 | 17.06 | 63.07 | 37.3% | 27.0% | 87.9% |
| 1985 | 8.97 | 3.00 | 1.29 | 4.29 | 0.20 | 0.58 | 15.73 | 60.10 | 27.3% | 26.2% | 86.6% |
| 1990 | 7.36 | 4.79 | 1.38 | 7.16 | 0.11 | 0.75 | 16.99 | 65.98 | 42.2% | 25.8% | 114.5% |
| 1991 | 7.42 | 5.67 | 0.96 | 6.63 | 0.12 | 0.89 | 16.71 | 66.57 | 39.6% | 25.1% | 110.6% |
| 1992 | 7.17 | 5.99 | 0.94 | 6.94 | 0.09 | 0.86 | 17.03 | 66.76 | 40.7% | 25.5% | 114.5% |
| 1993 | 6.85 | 6.69 | 0.93 | 7.62 | 0.10 | 0.90 | 17.24 | 67.00 | 44.2% | 25.7% | 118.7% |
| 1994 | 6.66 | 6.96 | 1.09 | 8.05 | 0.10 | 0.84 | 17.72 | 68.30 | 45.5% | 25.9% | 124.4% |
| 1995 | 6.56 | 7.14 | 0.75 | 7.89 | 0.10 | 0.86 | 17.73 | 69.87 | 44.5% | 25.4% | 127.0% |
| 1996 | 6.47 | 7.40 | 1.10 | 8.50 | 0.11 | 0.87 | 18.31 | 71.40 | 46.4% | 25.6% | 130.3% |
| 1997 | 6.45 | 8.12 | 1.04 | 9.16 | 0.11 | 0.90 | 18.62 | 73.13 | 49.2% | 25.5% | 131.7% |
| 1998 | 6.25 | 8.60 | 1.17 | 9.76 | 0.11 | 0.84 | 18.92 | 73.64 | 51.6% | 25.7% | 138.7% |
| 1999 | 5.88 | 8.47 | 1.14 | 9.91 | 0.12 | 0.82 | 19.52 | 74.91 | 50.8% | 26.1 | 148.5% |
| 2000 | 5.83 | 8.88 | 1.17 | 10.05 | 0.05 | 0.99 | 19.48 | [c] | 51.6% | [c] | 150.2% |
| | | | | | *Average annual percentage change* | | | | | | |
| 1973–2000 | -1.7% | 3.8% | -3.2% | 1.9% | [c] | 5.6% | 0.4% | 1.1%[d] | | | |
| 1990–2000 | -2.3% | 6.4% | -1.6% | 2.9% | -7.6% | 2.8% | 1.4% | 1.3%[d] | | | |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2001,* Washington, DC, 2001, Table 3.1a.
World petroleum consumption - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1999*, February 2001, Table1.1.
(Additional resources: www.eia.doe.gov)

[a] Best estimate for U.S. petroleum consumption is the amount of petroleum products supplied to the U.S. in a given year. This is not the sum of crude oil production and net imports due to natural gas plant liquids, refinery processing gains and stock changes.
[b] Transportation petroleum use can be found on Table 1.10. This column has been revised to include domestic production of crude oil, natural gas plant liquids, and other hydrocarbons/hydrogen/oxygenates as shown in the *Monthly Energy Review*, Table 3.1a.
[c] Data are not available.
[d] Average annual percentage change is to the latest possible year.

*The transportation oil gap is the difference between the amount of oil the U.S. produces and the amount of oil used by the transportation sector. This gap has been getting wider not only due to increasing transportation demand, but also due to decreasing U.S. oil production.*

**Figure 1.5. United States Petroleum Production and Consumption, 1973–2000**




**Source:** See Tables 1.9 and 1.10.

*Transportation accounts for more than two-thirds of the U.S. petroleum use. The residential sector and the commercial sector data which were previously combined are now available separately.*

**Table 1.10**
**Consumption of Petroleum by End-Use Sector, 1973–2000**
**(quadrillion Btu)**

| Year | Transportation | Percentage | Residential | Commercial | Industrial | Electric utilities | Total |
|---|---|---|---|---|---|---|---|
| 1973 | 17.83 | 51.2% | 2.83 | 1.57 | 9.10 | 3.52 | 34.84 |
| 1974 | 17.40 | 52.0% | 2.57 | 1.42 | 8.69 | 3.37 | 33.46 |
| 1975 | 17.61 | 53.8% | 2.50 | 1.31 | 8.15 | 3.17 | 32.74 |
| 1976 | 18.51 | 52.6% | 2.72 | 1.46 | 9.01 | 3.48 | 35.18 |
| 1977 | 19.24 | 51.8% | 2.70 | 1.51 | 9.77 | 3.90 | 37.12 |
| 1978 | 20.04 | 52.8% | 2.62 | 1.45 | 9.87 | 3.99 | 37.97 |
| 1979 | 19.83 | 53.4% | 2.11 | 1.33 | 10.57 | 3.28 | 37.13 |
| 1980 | 19.01 | 55.6% | 1.75 | 1.29 | 9.53 | 2.63 | 34.21 |
| 1981 | 18.81 | 58.9% | 1.54 | 1.09 | 8.29 | 2.20 | 31.93 |
| 1982 | 18.42 | 60.9% | 1.44 | 1.01 | 7.79 | 1.57 | 30.23 |
| 1983 | 18.59 | 61.9% | 1.36 | 1.14 | 7.42 | 1.54 | 30.05 |
| 1984 | 19.22 | 61.9% | 1.34 | 1.20 | 8.01 | 1.29 | 31.06 |
| 1985 | 19.50 | 63.1% | 1.48 | 1.04 | 7.81 | 1.09 | 30.92 |
| 1986 | 20.27 | 63.0% | 1.46 | 1.10 | 7.92 | 1.45 | 32.20 |
| 1987 | 20.87 | 63.5% | 1.51 | 1.08 | 8.15 | 1.26 | 32.87 |
| 1988 | 21.63 | 63.2% | 1.56 | 1.04 | 8.43 | 1.56 | 34.22 |
| 1989 | 21.87 | 63.9% | 1.56 | 0.97 | 8.13 | 1.69 | 34.22 |
| 1990 | 21.81 | 65.0% | 1.27 | 0.91 | 8.32 | 1.25 | 33.55 |
| 1991 | 21.46 | 65.3% | 1.29 | 0.86 | 8.06 | 1.18 | 32.85 |
| 1992 | 21.81 | 65.0% | 1.31 | 0.81 | 8.64 | 0.95 | 33.53 |
| 1993 | 22.20 | 65.6% | 1.39 | 0.75 | 8.45 | 1.05 | 33.84 |
| 1994 | 22.76 | 65.6% | 1.34 | 0.75 | 8.85 | 0.97 | 34.67 |
| 1995 | 23.20 | 67.1% | 1.36 | 0.72 | 8.62 | 0.66 | 34.56 |
| 1996 | 23.74 | 66.4% | 1.49 | 0.75 | 9.06 | 0.73 | 35.77 |
| 1997 | 23.99 | 66.2% | 1.45 | 0.71 | 9.29 | 0.82 | 36.26 |
| 1998 | 24.65 | 66.7% | 1.32 | 0.67 | 9.13 | 1.17 | 36.94 |
| 1999 | 24.49 | 67.2% | 1.45 | 0.67 | 9.40 | 0.94 | 37.95 |
| 2000 | 25.84 | 68.1% | 1.48 | 0.70 | 9.16 | 0.78 | 38.63 |
| | | | *Average annual percentage change* | | | | |
| 1973–2000 | 1.4% | | -2.4% | -2.9% | 0.0% | -5.4% | 0.4% |
| 1990–2000 | 1.7% | | 1.5% | -2.6% | 1.0% | -4.6% | 1.4% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March* 2001, Tables 2.2–2.6. (Additional resources: www.eia.doe.gov)

*Pipelines accounted for two-thirds of the domestic movement of crude oil and petroleum products in 1999.*

**Table 1.11**
**Ton-Miles of Petroleum and Petroleum Products in the U.S. by Mode, 1975–99**

| Year | Pipelines[a] | Water carriers | Motor carriers[b] | Railroads | Total |
|---|---|---|---|---|---|
| | (percent) | | | | (billion ton-miles) |
| 1975 | 59.9% | 35.2% | 3.3% | 1.7% | 846.7 |
| 1976 | 59.4% | 35.4% | 3.8% | 1.5% | 867.7 |
| 1977 | 59.1% | 36.1% | 3.2% | 1.6% | 923.4 |
| 1978 | 50.5% | 45.7% | 2.7% | 1.1% | 1,160.2 |
| 1979 | 51.8% | 44.5% | 2.6% | 1.2% | 1,174.8 |
| 1980 | 47.2% | 49.6% | 2.2% | 1.0% | 1,245.3 |
| 1981 | 46.3% | 50.7% | 2.0% | 1.0% | 1,218.4 |
| 1982 | 46.4% | 50.6% | 1.9% | 1.1% | 1,218.2 |
| 1983 | 45.5% | 51.5% | 2.1% | 1.0% | 1,223.5 |
| 1984 | 48.1% | 48.4% | 2.5% | 1.0% | 1,180.2 |
| 1985 | 47.2% | 49.4% | 2.4% | 1.0% | 1,195.5 |
| 1986 | 48.7% | 47.8% | 2.5% | 1.0% | 1,187.8 |
| 1987 | 49.1% | 47.4% | 2.5% | 1.0% | 1,195.8 |
| 1988 | 50.6% | 45.8% | 2.6% | 1.1% | 1,188.1 |
| 1989 | 53.4% | 42.6% | 2.8% | 1.2% | 1,094.2 |
| 1990 | 54.2% | 41.7% | 2.8% | 1.3% | 1,076.8 |
| 1991 | 53.3% | 42.8% | 2.7% | 1.3% | 1,086.1 |
| 1992 | 53.9% | 42.1% | 2.6% | 1.4% | 1,091.7 |
| 1993 | 57.3% | 38.8% | 2.4% | 1.5% | 1,034.6 |
| 1994 | 56.5% | 39.3% | 2.7% | 1.5% | 1,046.7 |
| 1995 | 57.5% | 38.4% | 2.5% | 1.6% | 1,044.9 |
| 1996 | 60.6% | 34.9% | 2.9% | 1.6% | 1,022.2 |
| 1997 | 64.5% | 30.9% | 2.9% | 1.8% | 956.5 |
| 1998 | 66.7% | 28.5% | 3.0% | 1.8% | 929.8 |
| 1999 | 67.7% | 27.1% | 3.2% | 2.1% | 912.9 |
| | *Average annual percentage change* | | | | |
| 1975–99 | | | | | 0.3% |
| 1989–99 | | | | | -1.8% |

**Source:**
Association of Oil Pipelines, *Shifts in Petroleum Transportation*, Washington, DC, February 2001, Table 1.

[a] The amounts carried by pipeline are based on ton-miles of crude and petroleum products for Federally regulated pipelines (84 percent) plus an estimated breakdown of crude and petroleum products of the ton-miles for pipelines not Federally regulated (16 percent).

[b] The amounts carried by motor carriers are estimated.

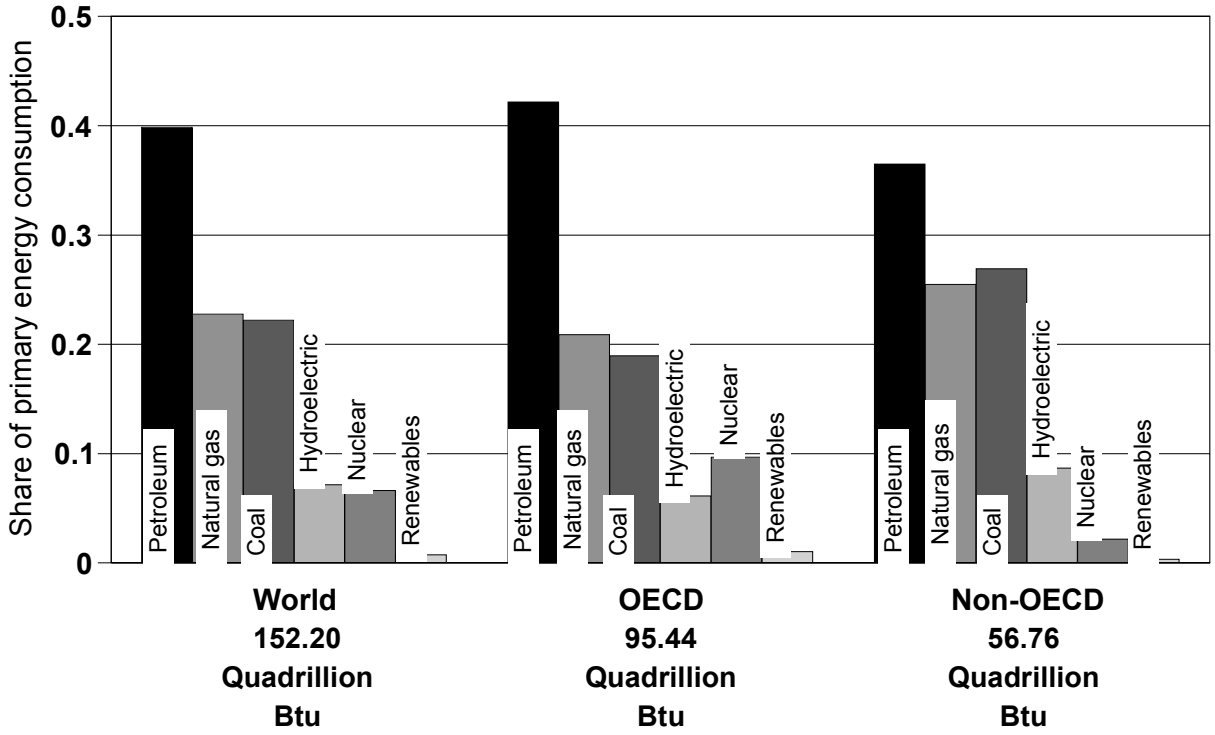
# Chapter 2
# Energy

Summary Statistics from Tables in this Chapter

| Source | | | |
|---|---|---|---|
| Table 2.1 | Transportation share of U.S. energy consumption, 2000 | 27.0% | |
| Table 2.2 | Petroleum share of transportation energy consumption, 1999 | 96.4% | |
| Table 2.3 | Alternative fuel and oxygenate consumption, 2000 | | |
| | | (thousand gasoline equivalent gallons) | (share) |
| | *Liquified petroleum gas* | *242,695* | *5.4%* |
| | *Compressed natural gas* | *86,286* | *2.2%* |
| | *Liquified natural gas* | *6,847* | *0.2%* |
| | *M85/M100* | *1,433* | *0.0%* |
| | *E85/E95* | *3,398* | *0.1%* |
| | *Electricity* | *1,819* | *0.0%* |
| | *MTBE* | *3,104,200* | *69.4%* |
| | *Ethanol in gasohol* | *1,011,800* | *22.6%* |
| Table 2.4 | Transportation energy use by mode, 1999 | (trillion Btu) | (share) |
| | *Automobiles* | *9,126* | *34.2%* |
| | *Light trucks* | *6,617* | *24.8%* |
| | *Heavy trucks* | *4,563* | *17.1%* |
| | *Buses* | *208* | *0.8%* |
| | *Air* | *2,546* | *9.5%* |
| | *Water* | *1,300* | *4.9%* |
| | *Pipeline* | *1,009* | *3.8%* |
| | *Rail* | *607* | *2.3%* |
| | *Off-highway* | *680* | *2.5%* |

*Petroleum accounted for 40% of the world's energy use in 1999. Though petroleum is the dominant energy source for both OECD countries and non-OECD countries, the non-OECD countries rely on coal, natural gas, and hydroelectric power more than OECD countries do.*

**Figure 2.1. World Consumption of Primary Energy, 1999**




**Source:**
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1999*, Washington, DC, February 2001, Table 1.8.

*The Energy Information Administration revised the historical energy data series to include renewable energy in each sector. Also, the residential and commercial sector data are now separated. Total energy use was 99 quads in 2000 with transportation using 27%.*

**Table 2.1**
**U. S. Consumption of Total Energy by End-Use Sector, 1973–2000[a]**
**(quadrillion Btu)**

| Year | Transportation | Percentage transportation of total | Industrial | Commercial | Residential | Total |
|---|---|---|---|---|---|---|
| 1973 | 18.6 | 24.6% | 32.7 | 9.5 | 15.0 | 75.8 |
| 1974 | 18.1 | 24.5% | 31.8 | 9.4 | 14.7 | 74.1 |
| 1975 | 18.2 | 25.3% | 29.4 | 9.5 | 14.9 | 72.0 |
| 1976 | 19.1 | 25.1% | 31.4 | 10.0 | 15.5 | 76.1 |
| 1977 | 19.8 | 25.4% | 32.3 | 10.2 | 15.8 | 78.1 |
| 1978 | 20.6 | 25.7% | 32.8 | 10.5 | 16.2 | 80.1 |
| 1979 | 20.5 | 25.3% | 34.0 | 10.6 | 15.9 | 81.0 |
| 1980 | 19.7 | 25.1% | 32.2 | 10.6 | 15.9 | 78.4 |
| 1981 | 19.5 | 25.5% | 30.9 | 10.7 | 15.5 | 76.6 |
| 1982 | 19.1 | 26.0% | 27.8 | 10.9 | 15.7 | 73.4 |
| 1983 | 19.1 | 26.1% | 27.6 | 11.0 | 15.6 | 73.3 |
| 1984 | 19.8 | 25.7% | 29.7 | 11.5 | 15.9 | 77.0 |
| 1985 | 20.1 | 26.1% | 29.1 | 11.6 | 16.1 | 76.8 |
| 1986 | 20.8 | 27.0% | 28.5 | 11.7 | 16.1 | 77.1 |
| 1987 | 21.5 | 26.9% | 29.7 | 12.1 | 16.4 | 79.6 |
| 1988 | 22.3 | 26.9% | 30.9 | 12.6 | 17.2 | 83.1 |
| 1989 | 22.6 | 26.7% | 31.2 | 13.1 | 17.8 | 84.6 |
| 1990 | 22.5 | 26.8% | 31.7 | 13.1 | 16.8 | 84.2 |
| 1991 | 22.1 | 26.3% | 31.3 | 13.4 | 17.4 | 84.2 |
| 1992 | 22.5 | 26.3% | 32.5 | 13.3 | 17.3 | 85.5 |
| 1993 | 22.9 | 26.2% | 32.7 | 13.6 | 18.1 | 87.3 |
| 1994 | 23.5 | 26.4% | 33.7 | 13.9 | 18.1 | 89.2 |
| 1995 | 24.0 | 26.4% | 34.1 | 14.4 | 18.5 | 90.9 |
| 1996 | 24.5 | 26.1% | 35.0 | 14.9 | 19.5 | 93.9 |
| 1997 | 24.8 | 26.3% | 35.2 | 15.4 | 18.9 | 94.3 |
| 1998 | 25.4 | 26.8% | 34.9 | 15.5 | 18.8 | 94.5 |
| 1999 | 26.3 | 27.1% | 35.7 | 15.9 | 19.2 | 97.1 |
| 2000 | 26.7 | 27.0% | 36.1 | 16.3 | 19.7 | 98.8 |
| | | *Average annual percentage change* | | | | |
| 1973–2000 | 1.3% | | 0.4% | 2.0% | 1.0% | 1.0% |
| 1990–2000 | 1.7% | | 1.3% | 2.2% | 1.6% | 1.6% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2001*, Washington, DC, Table 2.2. (Additional resources: www.eia.doe.gov)

[a]Electrical energy losses have been distributed among the sectors.

*The Energy Information Administration revised the historical energy data series to include renewable energy in each sector. Also, the residential and commercial data, which were previously one category, are now separate. In transportation, the alcohol fuels blended into gasoline to make gasohol are now counted under "renewables."*

**Table 2.2**
**Distribution of Energy Consumption by Source, 1973 and 2000**
**(percentage)**

| Energy source | Transportation | | Residential | | Commercial | | Industrial | | Electric utilities | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1973 | 2000 | 1973 | 2000 | 1973 | 2000 | 1973 | 2000 | 1973 | 2000 |
| Petroleum | 95.8 | 96.4 | 18.9 | 7.4 | 16.4 | 4.1 | 27.9 | 25.4 | 17.7 | 2.2 |
| Natural gas[a] | 4.0 | 2.9 | 33.2 | 25.2 | 27.8 | 20.4 | 31.8 | 30.3 | 18.8 | 8.6 |
| Coal | 0.0 | 0.0 | 0.7 | 2.2 | 1.6 | 3.9 | 12.4 | 6.4 | 43.5 | 55.5 |
| Renewable | 0.0 | 0.5 | 2.4 | 2.4 | 0.1 | 0.4 | 3.6 | 6.3 | 15.4 | 11.5 |
| Nuclear | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.6 | 22.2 |
| Electricity[b] | 0.2 | 0.2 | 44.9 | 62.9 | 54.1 | 71.2 | 24.4 | 31.6 | 0.0 | 0.0 |
| Other[c] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, *March 200*1, Washington, DC, pp. 27, 29, 31, 33. (Additional resources: www.eia.doe.gov)

[a] Includes supplemental gaseous fuels. Transportation sector includes pipeline fuel and natural gas vehicle use.
[b] Includes electrical system energy losses.
[c] Energy generated from geothermal, wood, waste, wind, photovoltaic, and solar thermal energy sources.

*Oxygenates are blended with gasoline to be used in conventional vehicles. The amount of oxygenate use dwarfs the alternative fuel use. Gasoline-equivalent gallons are used in this table to allow comparisons of different fuel types.*

**Table 2.3**
**Alternative Fuel and Oxygenate Consumption, 1992–2001**
**(thousand gasoline–equivalent gallons)**

| Alternative fuel | 1992 | 1995 | 1998 | 1999 | 2000 | 2001[a] | 2001 Percentage |
|---|---|---|---|---|---|---|---|
| Liquified petroleum | 208,142 | 232,701 | 241,583 | 242,141 | 242,695 | 243,196 | 5.6% |
| Compressed natural gas | 16,823 | 35,162 | 73,251 | 86,286 | 97,568 | 107,476 | 2.5% |
| Liquified natural gas | 585 | 2,759 | 5,343 | 5,828 | 6,847 | 7,566 | 0.2% |
| M85[b] | 1,069 | 2,023 | 1,212 | 1,073 | 996 | 918 | 0.0% |
| M100 | 2,547 | 2,150 | 449 | 447 | 437 | 406 | 0.0% |
| E85[b] | 21 | 190 | 1,727 | 2,075 | 3,344 | 4,575 | 0.0% |
| E95[b] | 85 | 995 | 59 | 59 | 54 | 51 | 0.0% |
| Electricity[c] | 359 | 663 | 1,202 | 1,431 | 1,819 | 2,143 | 0.0% |
| **Subtotal** | **229,631** | **276,643** | **324,826** | **339,340** | **353,760** | **366,331** | **8.4%** |
| Oxygenates | | | | | | | |
| MTBE[d] | 1,175,000 | 2,691,200 | 2,903,400 | 3,331,000 | 3,104,200 | 2,937,500 | 67.2% |
| Ethanol in gasohol | 701,000 | 910,700 | 889,500 | 956,900 | 1,011,800 | 1,066,000 | 24.4% |
| **Total** | **2,105,631** | **3,878,543** | **4,117,726** | **4,627,240** | **4,469,760** | **4,369,831** | **100.0%** |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 1999*, Washington, DC, 2000, web site www.eia.doe.gov/cneaf/alternate/page/datatables/atf1-13_00.html, Table 10. (Additional resources: www.eia.doe.gov)

[a]Based on plans or projections.
[b]Consumption includes gasoline portion of the mixture.
[c]Vehicle consumption only; does not include power plant inputs.
[d]Methyl Tertiary Butyl Ether. This category includes a very small amount of other ethers, primarily Tertiary Amyl Methyl Ether (TAME) and Ethyl Tertiary Butyl Ether (ETBE).

*As data about alternative fuel use become available, an attempt is made to incorporate them into this table. Sometimes assumptions must be made in order to use the data. Please see Appendix A for a description of the methodology used to develop these data.*

**Table 2.4**
**Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1999[a]**
**(trillion Btu)**

| | Gasoline | Diesel fuel | Liquified petroleum gas | Jet fuel | Residual fuel oil | Natural gas | Electricity | Methanol |
|---|---|---|---|---|---|---|---|---|
| **HIGHWAY** | **15,958.3** | **4,549.1** | **25.2** | | | **6.4** | **0.9** | **0.1** |
| **Light vehicles** | **15,430.2** | **330.1** | **9.6** | | | **0.0** | | **0.0** |
| Automobiles | 9,044.9[b] | 81.2 | | | | 0.0 | | 0.0 |
| Light trucks[c] | 6,358.9 | 248.9 | 9.6 | | | 0.0 | | 0.0 |
| Motorcycles | 26.4 | | | | | | | |
| **Buses** | **11.0** | **188.5** | **0.5** | | | **6.4** | **0.9** | **0.1** |
| Transit | 4.1 | 85.7 | 0.5 | | | 6.4 | 0.9 | 0.1 |
| Intercity | | 33.4 | | | | | | |
| School | 6.9 | 69.4 | | | | | | 0.0 |
| **Medium/heavy trucks** | **517.1** | **4,030.5** | **15.1** | | | **0.0** | | **0.0** |
| **OFF-HIGHWAY** | **110.0** | **570.1** [d] | | | | | | |
| **Construction** | **22.2** | **178.5** [d] | | | | | | |
| **Agriculture** | **87.8** | **391.6** [d] | | | | | | |
| **NONHIGHWAY** | **351.6** | **835.6** | | **2,504.1** | **694.6** | **757.9** | **317.0** | |
| **Air** | **41.5** | | | **2,504.1** | | | | |
| General aviation | 41.5 | | | 130.6 | | | | |
| Domestic air carriers | | | | 2,004.0 | | | | |
| International air | | | | 369.5 | | | | |
| **Water** | **310.1** | **294.8** | | | **694.6** | | | |
| Freight | | 294.8 | | | 694.6 | | | |
| Recreational | 310.1 | | | | | | | |
| **Pipeline** | | | | | | **757.9** | **251.3** | |
| **Rail** | | **540.8** | | | | | **65.7** | |
| Freight (Class I) | | 520.1 | | | | | | |
| Passenger | | 20.7 | | | | | 65.7 | |
| Transit | | | | | | | 44.7 | |
| Commuter | | 10.1 | | | | | 15.5 | |
| Intercity[c] | | 10.6 | | | | | 5.5 | |
| **TOTAL** | **16,419.9** | **5,954.8** | **25.2** | **2,504.1** | **694.6** | **764.3** | **317.9** | **0.1** |

**Source:**
See Appendix A for Table 2.4

[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
[b] Includes gasohol.
[c] Two-axle, four-tire trucks.
[d] 1985 data.

*The 1998 data have been revised to include the latest data available.*

**Table 2.5**
**Transportation Energy Use by Mode, 1998–99[a]**

| | Trillion Btu | | Thousand barrels per day crude oil equivalent [b] | | Percentage of total | |
|---|---|---|---|---|---|---|
| | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 |
| **HIGHWAY** | **19,871.3** | **20,540.0** | **9,996.7** | **10,333.1** | **77.2%** | **77.0%** |
| **Light vehicles** | **15296.8** | **15,769.9** | **7,695.4** | **7,933.4** | **59.4%** | **59.1%** |
| Automobiles | 8,943.3 | 9,126.1 | 4, 499.1 | 4,591.1 | 34.7% | 34.2% |
| Light trucks [c] | 6,327.8 | 6,617.3 | 3,183.3 | 3,329.0 | 24.6% | 24.8% |
| Motorcycles | 25.7 | 26.4 | 12.9 | 13.3 | 0.1% | 0.1% |
| **Buses** | **201.5** | **207.4** | **101.4** | **104.3** | **0.8%** | **0.8%** |
| Transit | 95.4 | 97.7 | 48.0 | 49.2 | 0.4% | 0.4% |
| Intercity | 30.5 | 33.4 | 15.3 | 16.8 | 0.1% | 0.1% |
| School | 75.6 | 76.3 | 38.0 | 38.4 | 0.3% | 0.3% |
| **Medium/heavy trucks** | **4,373.0** | **4,562.7** | **2,199.9** | **2,295.4** | **17.0%** | **17.1%** |
| **OFF-HIGHWAY** | **712.7** | **680.1** | **358.5** | **342.1** | **2.8%** | **2.5%** |
| **Construction** | **207.8** | **200.7** | **104.5** | **101.1** | **0.8%** | **0.8%** |
| **Agriculture** | **504.9** | **479.4** | **254.0** | **241.2** | **2.0%** | **1.8%** |
| **NONHIGHWAY** | **5,156.0** | **5,460.8** | **2,593.8** | **2,747.2** | **20.0%** | **20.5%** |
| **Air** | **2,370.8** | **2,545.6** | **1,192.7** | **1,280.6** | **9.2%** | **9.5%** |
| General aviation | 147.4 | 172.1 | 74.2 | 86.6 | 0.6% | 0.6% |
| Domestic air carriers | 1,853.4 | 2,004.0 | 942.5 | 1,008.2 | 7.3% | 7.5% |
| International air | 350.0 | 369.5 | 176.1 | 185.9 | 1.4% | 1.4% |
| **Water** | **1,295.3** | **1,299.5** | **651.6** | **653.7** | **5.0%** | **4.9%** |
| Freight | 989.4 | 989.4 | 497.7 | 497.7 | 3.8% | 3.7% |
| Recreational | 305.9 | 310.1 | 153.9 | 156.0 | 1.2% | 1.2% |
| **Pipeline** | **901.2** | **1,009.2** | **453.4** | **507.7** | **3.5%** | **3.8%** |
| **Rail** | **588.7** | **606.5** | **296.2** | **305.1** | **2.3%** | **2.3%** |
| Freight | 502.0 | 520.1 | 252.5 | 261.6 | 2.0% | 1.9% |
| Passenger | 86.7 | 86.4 | 43.6 | 43.5 | 0.3% | 0.3% |
| Transit | 43.1 | 44.7 | 21.7 | 22.5 | 0.2% | 0.2% |
| Commuter | 28.2 | 25.6 | 14.2 | 12.9 | 0.1% | 0.1% |
| Intercity | 15.4 | 16.1 | 7.7 | 8.1 | 0.1% | 0.1% |
| **TOTAL** | **25,740.0** | **26,680.9** | **12,949.1** | **13,422.4** | **100%** | **100.0%** |

**Source:** See Appendix A for Table 2.4 (detailed breakdown).

[a]Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
[b]Thousand barrels per day crude oil equivalents based average on the EIA weighted average of heat content of petroleum products used in transportation.
[c]Two-axle, four-tire trucks.

*The highway sector is by far the largest part of transportation energy use. Light truck energy use has increased at the greatest rate, due to the increased use of light trucks as personal passenger vehicles. Light trucks include pick-ups, minivans, sport-utility vehicles, and vans.*

**Table 2.6**
**Highway Transportation Energy Consumption by Mode, 1970–99**
**(trillion Btu)**

| Year | Autos | Light trucks | Light vehicles subtotal | Motor-cycles | Buses[a] | Heavy trucks | Highway subtotal | Total transportation[b] |
|---|---|---|---|---|---|---|---|---|
| 1970 | 8,527 | 1,540 | 10,067 | 7 | 128 | 1,503 | 11,686 | 15,289 |
| 1975 | 9,321 | 2,386 | 11,707 | 14 | 124 | 1,939 | 13,779 | 17,302 |
| 1976 | 9,844 | 2,605 | 12,449 | 15 | 134 | 2,046 | 14,639 | 18,361 |
| 1977 | 9,940 | 2,799 | 12,739 | 16 | 137 | 2,268 | 15,155 | 19,045 |
| 1978 | 10,140 | 3,022 | 13,162 | 18 | 141 | 2,539 | 15,854 | 20,002 |
| 1979 | 9,629 | 3,057 | 12,686 | 22 | 144 | 2,644 | 15,489 | 20,065 |
| 1980 | 8,798 | 2,976 | 11,774 | 26 | 143 | 2,651 | 14,590 | 19,280 |
| 1981 | 8,695 | 2,964 | 11,659 | 27 | 145 | 2,706 | 14,535 | 19,016 |
| 1982 | 8,695 | 2,839 | 11,534 | 25 | 151 | 2,707 | 14,412 | 18,511 |
| 1983 | 8,814 | 2,995 | 11,809 | 22 | 152 | 2,757 | 14,733 | 18,645 |
| 1984 | 8,857 | 3,202 | 12,059 | 22 | 144 | 2,846 | 15,081 | 19,268 |
| 1985 | 8,954 | 3,422 | 12,376 | 23 | 154 | 2,842 | 15,402 | 19,636 |
| 1986 | 9,162 | 3,636 | 12,798 | 23 | 160 | 2,903 | 15,878 | 20,157 |
| 1987 | 9,179 | 3,827 | 13,006 | 24 | 163 | 2,990 | 16,177 | 20,657 |
| 1988 | 9,180 | 4,095 | 13,275 | 25 | 165 | 3,117 | 16,577 | 21,269 |
| 1989 | 9,251 | 4,173 | 13,424 | 26 | 169 | 3,196 | 16,809 | 21,562 |
| 1990 | 8,707 | 4,466 | 13,173 | 24 | 166 | 3,329 | 16,690 | 21,656 |
| 1991 | 8,048 | 4,793 | 12,841 | 23 | 176 | 3,396 | 16,434 | 21,254 |
| 1992 | 8,188 | 5,133 | 13,321 | 24 | 184 | 3,460 | 16,988 | 21,925 |
| 1993 | 8,389 | 5,374 | 13,763 | 25 | 183 | 3,567 | 17,548 | 22,419 |
| 1994 | 8,494 | 5,529 | 14,023 | 26 | 189 | 3,772 | 18,024 | 22,995 |
| 1995 | 8,519 | 5,717 | 14,236 | 25 | 189 | 3,950 | 18,390 | 23,565 |
| 1996 | 8,622 | 5,936 | 14,558 | 25 | 192 | 4,033 | 18,850 | 24,068 |
| 1997 | 8,746 | 6,191 | 14,937 | 25 | 197 | 4,086 | 19,244 | 24,403 |
| 1998 | 8,943 | 6,328 | 15,271 | 26 | 202 | 4,373 | 19,841 | 24,974 |
| 1999 | 9,126 | 6,617 | 15,743 | 26 | 208 | 4563 | 20,571 | 26,033 |
| *Average annual percentage change* | | | | | | | | |
| 1970–99 | 0.2% | 5.2% | 1.6% | 4.6% | 1.7% | 3.9% | 2.0% | 1.9% |
| 1989–99 | -0.1% | 4.7% | 1.6% | 0.0% | 2.1% | 3.6% | 2.0% | 1.9% |

**Source:** See Appendix A for Table 2.5.

[a] These data have been revised due to revisions of intercity and school bus energy use. Beginning in 1992 data became available on non-diesel fuel use by transit buses.

[b] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g. snowmobiles).

*Only 20% of transportation energy use is for nonhighway modes. Air travel accounts for nearly half of nonhighway energy use.*

**Table 2.7**
**Nonhighway Transportation Energy Consumption by Mode, 1970–99**
**(trillion Btu)**

| Year | Air | Water | Pipeline | Rail | Nonhighway subtotal | Total transportation[a] |
|---|---|---|---|---|---|---|
| 1970 | 1,307 | 753 | 985 | 558 | 3,603 | 15,289 |
| 1975 | 1,274 | 851 | 835 | 563 | 3,523 | 17,302 |
| 1976 | 1,333 | 1,001 | 803 | 585 | 3,722 | 18,361 |
| 1977 | 1,411 | 1,103 | 781 | 595 | 3,890 | 19,045 |
| 1978 | 1,467 | 1,311 | 781 | 589 | 4,148 | 20,002 |
| 1979 | 1,568 | 1,539 | 856 | 613 | 4,576 | 20,065 |
| 1980 | 1,528 | 1,677 | 889 | 596 | 4,690 | 19,280 |
| 1981 | 1,455 | 1,562 | 899 | 565 | 4,481 | 19,016 |
| 1982 | 1,468 | 1,290 | 853 | 488 | 4,099 | 18,511 |
| 1983 | 1,505 | 1,187 | 738 | 482 | 3,912 | 18,645 |
| 1984 | 1,633 | 1,251 | 780 | 523 | 4,187 | 19,268 |
| 1985 | 1,678 | 1,311 | 758 | 487 | 4,234 | 19,636 |
| 1986 | 1,823 | 1,295 | 738 | 423 | 4,279 | 20,157 |
| 1987 | 1,894 | 1,326 | 775 | 485 | 4,480 | 20,657 |
| 1988 | 1,978 | 1,338 | 878 | 498 | 4,692 | 21,269 |
| 1989 | 1,981 | 1,376 | 895 | 501 | 4,753 | 21,562 |
| 1990 | 2,059 | 1,487 | 928 | 492 | 4,966 | 21,656 |
| 1991 | 1,926 | 1,567 | 864 | 463 | 4,820 | 21,254 |
| 1992 | 1,971 | 1,641 | 849 | 476 | 4,937 | 21,925 |
| 1993 | 1,996 | 1,473 | 889 | 513 | 4,871 | 22,419 |
| 1994 | 2,056 | 1,414 | 955 | 546 | 4,971 | 22,995 |
| 1995 | 2,117 | 1,522 | 971 | 565 | 5,175 | 23,565 |
| 1996 | 2,196 | 1,460 | 984 | 578 | 5,218 | 24,068 |
| 1997 | 2,284 | 1,309 | 987 | 579 | 5,159 | 24,403 |
| 1998 | 2,351 | 1,295 | 901 | 586 | 5,133 | 24,974 |
| 1999 | 2,546 | 1,300 | 1,009 | 607 | 5,462 | 26,033 |
| | | | *Average annual percentage change* | | | |
| 1970–99 | 2.3% | 1.9% | 0.1% | 0.3% | 1.4% | 1.9% |
| 1989–99 | 2.5% | -0.6% | 1.2% | 1.9% | 1.4% | 1.9% |

**Source:**
See Appendix A for Table 2.5.

[a] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g. snowmobiles).

*The Federal Highway Administration cautions that data from 1993-on may not be directly comparable to earlier years. Some states have improved reporting procedures in recent years, and the estimation procedures were revised in 1994. Prior to the Energy Policy Act of 1992, gasohol was defined as a blend of gasoline and at least 10%, by volume, alcohol. Effective January 1, 1993, three types of gasohol were defined: 10% gasohol—containing at least 10% alcohol; 7.7% gasohol—containing 7.7% alcohol but less than 10%; and 5.7% gasohol—containing at least 5.7% alcohol but less than 7.7%. See Table 2.3 for details on oxygenate usage.*

**Table 2.8**
**Highway Usage of Gasoline and Special Fuels, 1973–99**
**(billion gallons)**

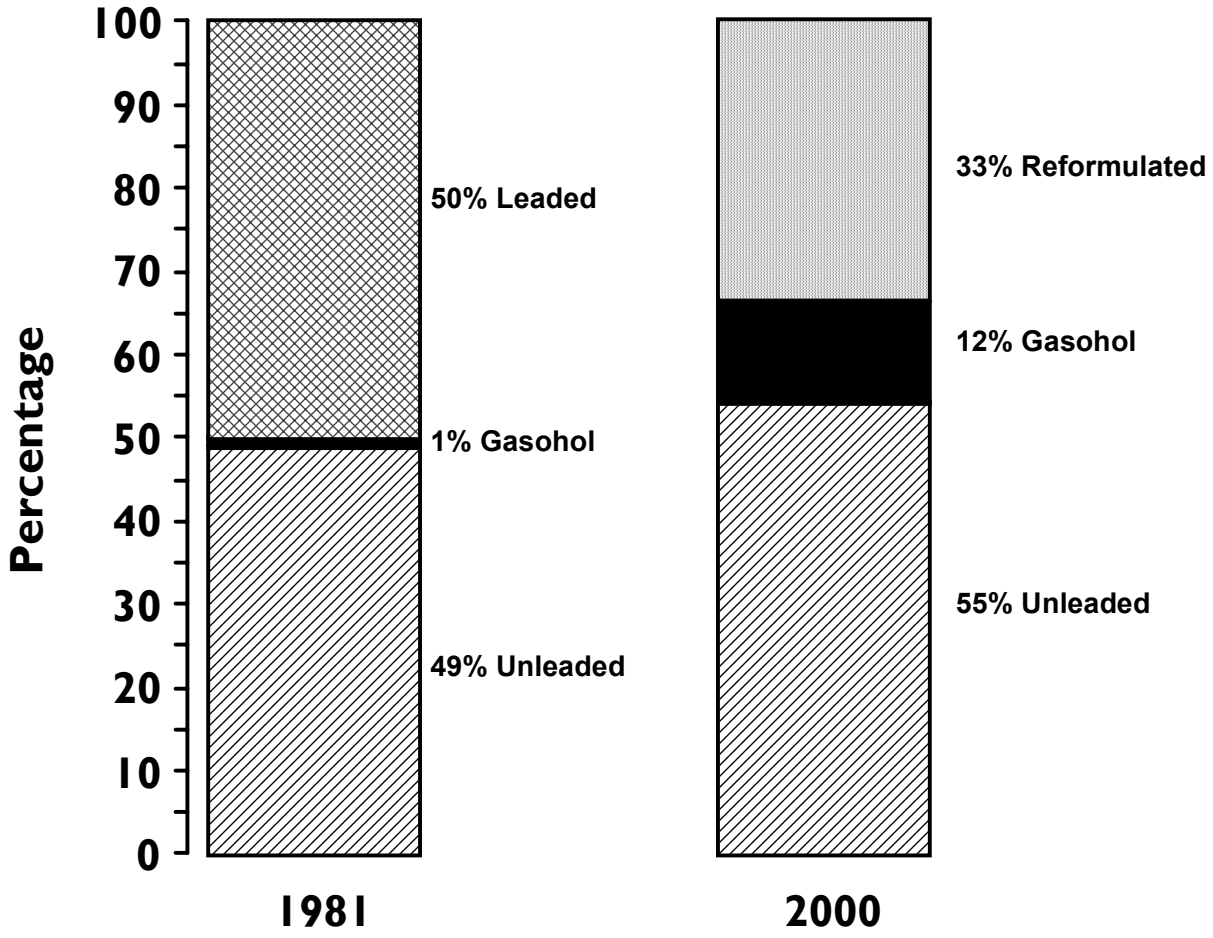
| Year | Gasoline | Gasohol | Ethanol used in gasohol[a] | Total gasoline and gasohol | Diesel[b] | Percent diesel | Total highway fuel use |
|---|---|---|---|---|---|---|---|
| 1973 | [c] | [c] | [c] | 100.6 | 9.8 | 8.9% | 110.5 |
| 1975 | [c] | [c] | [c] | 99.4 | 9.6 | 8.8% | 109.0 |
| 1980 | 100.7 | 0.5 | 0.0 | 101.2 | 13.8 | 12.0% | 115.0 |
| 1981 | 98.9 | 0.7 | 0.1 | 99.6 | 14.9 | 13.0% | 114.5 |
| 1982 | 96.2 | 2.3 | 0.2 | 98.5 | 14.9 | 13.1% | 113.4 |
| 1983 | 95.9 | 4.3 | 0.4 | 100.1 | 16.0 | 13.8% | 116.1 |
| 1984 | 96.0 | 5.4 | 0.5 | 101.4 | 17.3 | 14.6% | 118.7 |
| 1985 | 95.6 | 8.0 | 0.8 | 103.6 | 17.8 | 14.6% | 121.3 |
| 1986 | 98.6 | 8.1 | 0.8 | 106.8 | 18.4 | 14.7% | 125.2 |
| 1987 | 101.8 | 6.9 | 0.8 | 108.7 | 19.0 | 14.9% | 127.7 |
| 1988 | 101.7 | 8.1 | 0.8 | 109.8 | 20.1 | 15.5% | 129.9 |
| 1989 | 103.7 | 6.9 | 0.7 | 110.6 | 21.2 | 16.1% | 131.9 |
| 1990 | 102.6 | 7.5 | 0.8 | 110.2 | 21.4 | 16.3% | 131.6 |
| 1991 | 99.3 | 8.6 | 0.9 | 107.9 | 20.7 | 16.1% | 128.6 |
| 1992 | 102.1 | 8.8 | 0.9 | 111.0 | 22.0 | 16.5% | 132.9 |
| 1993 | 103.4 | 10.3 | 1.0 | 113.7 | 23.5 | 17.1% | 137.2 |
| 1994 | 104.0 | 11.0 | 1.0 | 115.0 | 25.1 | 17.9% | 140.1 |
| 1995 | 104.0 | 13.1 | 1.2 | 117.1 | 26.2 | 18.3% | 143.3 |
| 1996 | 107.4 | 12.1 | 1.1 | 119.5 | 27.2 | 18.5% | 146.7 |
| 1997 | 106.2 | 14.7 | 1.3 | 120.9 | 29.4 | 19.6% | 150.3 |
| 1998 | 110.7 | 14.0 | 1.3 | 124.7 | 30.2 | 19.5% | 154.9 |
| 1999 | 114.6 | 14.2 | 1.3 | 128.7 | 31.9 | 19.9% | 160.7 |
| | | | *Average annual percentage change* | | | | |
| 1973–99 | [d] | [d] | [d] | 1.0% | 4.6% | | 1.5% |
| 1989–99 | 1.0% | 7.4% | 6.4% | 1.5% | 4.2% | | 2.0% |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, 2000, Tables MF-21 and MF-33E, and annual.
(Additional resources: www.fhwa.dot.gov)

[a] Estimated for 1980–92 as 10% of gasohol consumption.
[b] Consists primarily of diesel fuel, with small quantities of liquified petroleum gas.
[c] Data for gasoline and gasohol cannot be separated in this year.
[d] Data are not available.

*The types of gasoline supplied today are significantly different than in 1981, mostly due to air quality mandates. The phase-out of leaded gasoline began in 1978 and the phase-in of reformulated gasoline began in 1995.*

**Figure 2.2. Motor Gasoline Quantities by Type, 1981 and 2000**




**Source:**

U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual 2000*, Washington, DC, Tables 17 and 20, June 2001.

U.S. Department of Energy, Energy Information Administration, *The Motor Gasoline Industry: Past, Present and Future*, Washington, DC, Table 5.

U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, Table MF-33E, and annual.

**Note:**

Reformulated gasoline has lower concentrations of certain volatile organic compounds in a formulation intended to reduce ozone-forming hydrocarbons and air toxics. It is required in the worst ozone-nonattainment areas.

Gasohol category includes all oxygenate blends except reformulated gasoline.

Unleaded gasoline is now known as conventional gasoline.

*Nearly all of the fuel ethanol used in the U.S. is made domestically. One quarter of MTBE was imported in 2000.*

**Table 2.9**
**U.S. Production and Imports of MTBE[a] and Fuel Ethanol, 1985–2000**
**(million gallons)**

| | Production | | Imports | |
|---|---|---|---|---|
| Year | Fuel ethanol | MTBE[a] | Fuel ethanol | MTBE[a] |
| 1985 | 793 | 302 | [b] | [b] |
| 1990 | 756 | [b] | [b] | [b] |
| 1991 | 875 | [b] | [b] | [b] |
| 1992 | 1,080 | 1,542 | [b] | [b] |
| 1993 | 1,156 | 2,081 | 10 | 306 |
| 1994 | 1,280 | 2,205 | 12 | 595 |
| 1995 | 1,355 | 2,506 | 16 | 692 |
| 1996 | 974 | 2,846 | 13 | 733 |
| 1997 | 1,274 | 3,011 | 4 | 918 |
| 1998 | 1,387 | 3,151 | 3 | 1,040 |
| 1999 | 1,472 | 3,315 | 4 | 1,146 |
| 2000 | 1,633 | 3,253 | 5 | 1,176 |
| | | *Average annual percentage change* | | |
| 1985–2000 | 4.9% | 17.2% | [b] | [b] |
| 1989–2000 | 8.0% | [b] | [b] | [b] |

**Source:**
Production - 1992–2000 Ethanol and MTBE: U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Monthly*, Washington, DC, January 2001, Table D1. 1985–91 Ethanol: Information Resources, Inc., Washington, DC, 1991. 1985 MTBE: EA-Mueller,Inc., Baltimore, MD, 1992.
Imports - U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual, 2000, Volume 1,* Washington, DC, June 2001, Table 20, and annual.

Note:
Table 2.3 displays gasoline-equivalent gallons, which differ from these gallons.

[a] Methyl tertiary-butyl ether.
[b] Data are not available.

*Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes. These values are averages, and there is a great deal of variability even within a mode.*

**Table 2.10**
**Passenger Travel and Energy Use in the United States, 1999**

| | Number of vehicles (thousands) | Vehicle-miles (millions) | Passenger-miles (millions) | Load factor (persons/vehicle) | Energy intensities (Btu per vehicle-mile) | Energy intensities (Btu per passenger-mile) | Energy use (trillion Btu) |
|---|---|---|---|---|---|---|---|
| **Automobiles** | **132,432.0** | **1,569,270** | **2,510,832** | **1.6** | **5,815** | **3,635** | **9,126.1** |
| **Personal trucks** | **57,984.7** | **651,484** | **1,042,374** | **1.6** | **7,217** | **4,511** | **4,701.7** |
| **Motorcycles** | **4,152.4** | **10,584** | **12,701** | **1.2** | **2,494** | **2,079** | **26.4** |
| **Buses** | **688.1** | [a] | [a] | [a] | [a] | [a] | **207.4** |
| Transit | 74.2 | 2,276 | 21,205 | 8.9 | 42,955 | 4,802 | 97.7 |
| Intercity | 21.8 | [a] | 34,700 | [a] | [a] | 1,128 | 33.4 |
| School | 592.0 | [a] | [a] | [a] | [a] | [a] | 76.3 |
| **Air** | [a] | [a] | **528,867** | [a] | [a] | **4,116** | **2,176.1** |
| Certificated route | [a] | 5,332 | 515,367 | 96.6 | 375,810 | 3,981 | 2,004.0 |
| General aviation | 219.5 | [a] | 13,500 | [a] | [a] | 8,970 | 172.1 |
| **Recreational boats** | **12,738.3** | [a] | [a] | [a] | [a] | [a] | **310.1** |
| **Rail** | **16.9** | **1,242** | **28,163** | **22.7** | **69,746** | **3,075** | **86.6** |
| Intercity[b] | 0.4[c] | 349[d] | 5,289[e] | 15.1 | 46,374 | 3,063 | 16.2[f] |
| Transit[g] | 11.6 | 626 | 14,108 | 22.5 | 71,360 | 3,168 | 44.7 |
| Commuter | 4.9 | 266 | 8,766 | 33.0 | 96,649 | 2,932 | 25.7 |

**Source:**
See Appendix A for Table 2.11.

[a]Data are not available.
[b]Amtrak only.
[c]Passenger train cars.
[d]Passenger train car-miles.
[e]Revenue passenger-miles.
[f]Estimated using vehicle travel data.
[g]Light and heavy rail.

*Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes. These values are averages, and there is a great deal of variability even within a mode.*

**Table 2.11**
**Energy Intensities of Highway Passenger Modes, 1970–99**

| | Automobiles | | Light truck[a] | Buses | | |
|---|---|---|---|---|---|---|
| | | | | Transit[b] | | Intercity |
| Year | (Btu per vehicle-mile) | (Btu per passenger-mile) | (Btu per vehicle-mile) | (Btu per vehicle-mile) | (Btu per passenger-mile) | (Btu per passenger-mile) |
| 1970 | 9,301 | 4,896 | 12,492 | 31,796 | 2,472 | 1,674 |
| 1975 | 9,015 | 4,745 | 11,890 | 33,748 | 2,814 | 988 |
| 1976 | 9,130 | 4,805 | 11,535 | 34,598 | 2,896 | 1,007 |
| 1977 | 8,961 | 4,716 | 11,171 | 35,120 | 2,889 | 970 |
| 1978 | 8,844 | 4,655 | 10,815 | 36,603 | 2,883 | 976 |
| 1979 | 8,647 | 4,551 | 10,473 | 36,597 | 2,795 | 1,028 |
| 1980 | 7,915 | 4,166 | 10,230 | 36,553 | 2,813 | 1,082 |
| 1981 | 7,672 | 4,038 | 10,001 | 37,745 | 3,027 | 1,051 |
| 1982 | 7,485 | 3,939 | 9,275 | 38,766 | 3,237 | 1,172 |
| 1983 | 7,376 | 4,098 | 9,141 | 37,962 | 3,177 | 1,286 |
| 1984 | 7,218 | 4,010 | 8,945 | 37,507 | 3,204 | 954 |
| 1985 | 7,182 | 3,990 | 8,754 | 38,862 | 2,421 | 964 |
| 1986 | 7,213 | 4,007 | 8,578 | 39,869 | 3,512 | 870 |
| 1987 | 6,975 | 3,875 | 8,376 | 38,557 | 3,542 | 940 |
| 1988 | 6,700 | 3,722 | 8,155 | 39,121 | 3,415 | 963 |
| 1989 | 6,602 | 3,668 | 7,778 | 36,583 | 3,711 | 964 |
| 1990 | 6,183 | 3,864 | 7,773 | 36,647 | 3,735 | 962 |
| 1991 | 5,925 | 3,703 | 7,381 | 36,939 | 3,811 | 963 |
| 1992 | 5,969 | 3,731 | 7,262 | 40,243 | 4,310 | 964 |
| 1993 | 6,103 | 3,814 | 7,207 | 39,050 | 4,262 | 962 |
| 1994 | 6,041 | 3,775 | 7,232 | 40,147 | 4,609 | 964 |
| 1995 | 5,923 | 3,702 | 7,236 | 40,009 | 4,643 | 964 |
| 1996 | 5,893 | 3,683 | 7,269 | 40,209 | 4,675 | 963 |
| 1997 | 5,821 | 3,638 | 7,277 | 41,431 | 4,744 | 963 |
| 1998 | 5,771 | 3,607 | 7,288 | 43,888 | 4,688 | 963 |
| 1999 | 5,815 | 3,635 | 7,343 | 42,955 | 4,610 | 964 |
| | | | *Average annual percentage change* | | | |
| 1970–99 | -1.6% | -1.0% | -1.8% | 1.0% | 2.2% | -1.9% |
| 1989–99 | -1.3% | -0.1% | -0.6% | 1.6% | 2.2% | 0.0% |

**Source:**
See Appendix A for Table 2.12.

[a]All two-axle, four-tire trucks.
[b]Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA).

*Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes.*

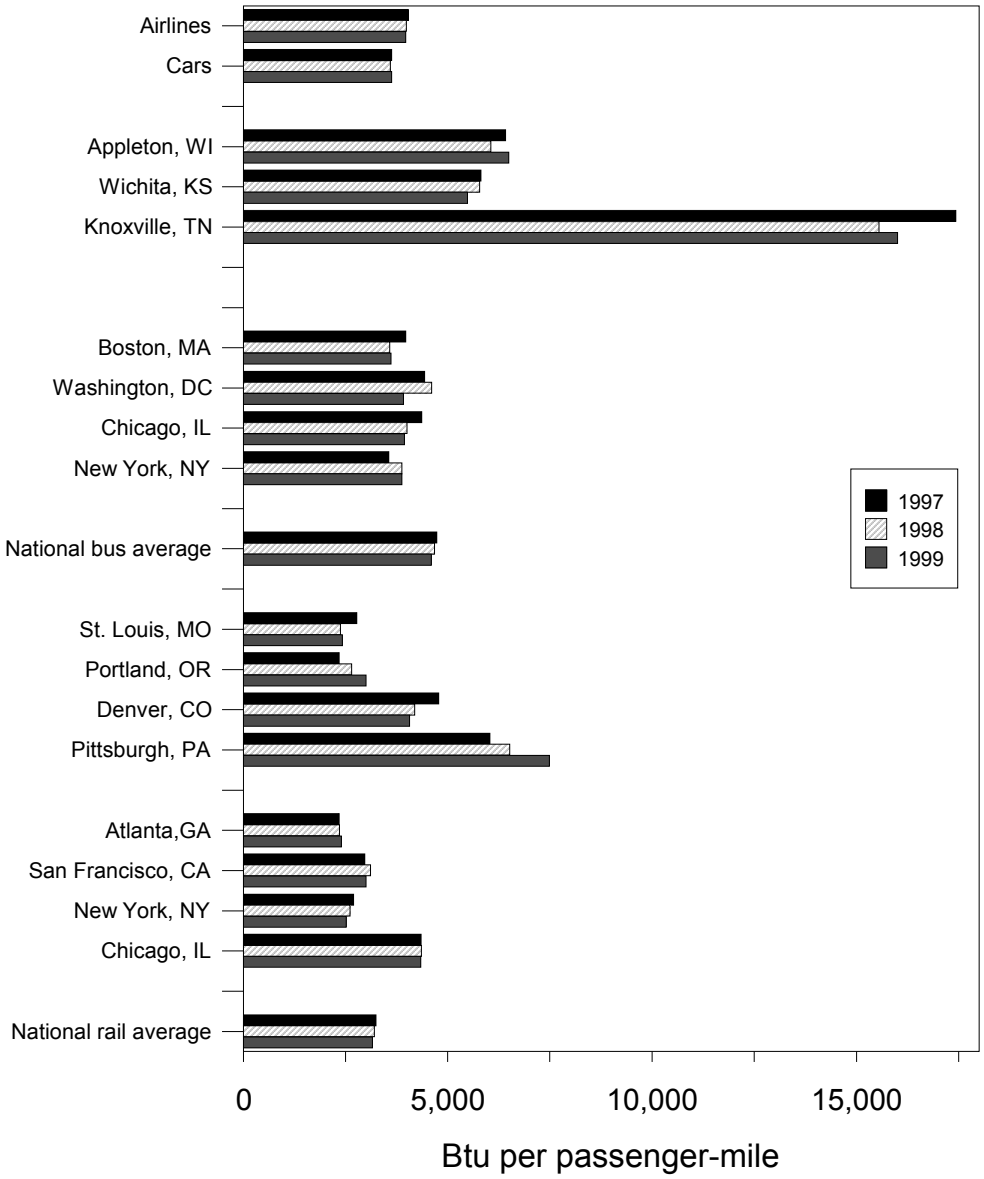
**Table 2.12**
**Energy Intensities of Nonhighway Passenger Modes, 1970–99**

| | Air | | Rail | |
|---|---|---|---|---|
| Year | Certificated air carriers (Btu per passenger-mile) | General aviation (Btu per passenger-mile) | Intercity Amtrak (Btu per passenger-mile) | Rail transit (Btu per passenger-mile) |
| 1970 | 10,351 | 10,374 | [a] | 2,453 |
| 1975 | 7,883 | 10,658 | 3,677 | 2,962 |
| 1976 | 7,481 | 10,769 | 3,397 | 2,971 |
| 1977 | 7,174 | 11,695 | 3,568 | 2,691 |
| 1978 | 6,333 | 11,305 | 3,683 | 2,210 |
| 1979 | 5,858 | 10,787 | 3,472 | 2,794 |
| 1980 | 5,837 | 11,497 | 3,176 | 3,008 |
| 1981 | 5,743 | 11,123 | 2,957 | 2,946 |
| 1982 | 5,147 | 13,015 | 3,156 | 3,069 |
| 1983 | 5,107 | 11,331 | 2,957 | 3,212 |
| 1984 | 5,031 | 11,454 | 3,027 | 3,732 |
| 1985 | 5,679 | 11,707 | 2,800 | 3,461 |
| 1986 | 5,447 | 11,935 | 2,574 | 3,531 |
| 1987 | 4,751 | 11,496 | 2,537 | 3,534 |
| 1988 | 4,814 | 11,794 | 2,462 | 3,585 |
| 1989 | 4,808 | 10,229 | 2,731 | 3,397 |
| 1990 | 5,006 | 10,146 | 2,609 | 3,453 |
| 1991 | 4,595 | 9,869 | 2,503 | 3,710 |
| 1992 | 4,482 | 9,785 | 2,610 | 3,575 |
| 1993 | 4,558 | 9,653 | 2,646 | 3,687 |
| 1994 | 4,336 | 9,163 | 2,351 | 3,828 |
| 1995 | 4,282 | 9,870 | 2,592 | 3,818 |
| 1996 | 4,096 | 9,258 | 2,783 | 3,444 |
| 1997 | 4,044 | 9,688 | 2,923 | 3,253 |
| 1998 | 3,981 | 11,252 | 2,892 | 3,216 |
| 1999 | 3,889 | 12,748 | 3,063 | 3,168 |
| | | *Average annual percentage change* | | |
| 1970–99 | -3.3% | 0.7% | -0.8%[b] | 0.9% |
| 1989–99 | -2.1% | 2.2% | 1.2% | 0.7% |

**Source:**
See Appendix A for Table 2.12.

[a]Data are not available.
[b]Average annual percentage change begins with 1975.

**Figure 2.3. Energy Intensity for Transit in the U.S., 1997–99**




**Source:**
U.S. Department of Transportation, Federal Transit Administration, 1997–1999 National Transit Databases, Washington, DC.
(Additional resources: www.fta.dot.gov/ntl)

*Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes.*

**Table 2.13**
**Intercity Freight Movement and Energy Use in the United States, 1999**

| | Trucks | Waterborne commerce | Class I railroads |
|---|---|---|---|
| Number of vehicles (thousands) | 2,561 | 42 | 20[a] |
| Ton-miles (billions) | 1,093,000 | 656 | 1,433 |
| Tons shipped (millions) | 4,089 | 1,056 | 1,717 |
| Average length of haul (miles) | 717[b] | 621 | 835 |
| Energy intensity (Btu/ton-mile) | 3,037 | 457 | 362 |
| Energy use (trillion Btu) | 3,319 | 300 | 520 |

**Source:**
See Appendix A for Table 2.13.

[a] Number of locomotives.
[b] 717 miles is for general freight (less than truckload). Based on data from the Eno Transportation Foundation, the average length of haul for specialized freight (truckload) is 286 miles.

*Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes.*

**Table 2.14**
**Energy Intensities of Freight Modes, 1970–99**

| Year | Heavy single-unit and combination trucks (Btu per vehicle-mile) | Class I freight railroad (Btu per freight car-mile) | Class I freight railroad (Btu per ton-mile) | Domestic waterborne commerce (Btu per ton-mile) |
|---|---|---|---|---|
| 1970 | 24,154 | 17,668 | 691 | 545 |
| 1971 | 23,694 | 18,814 | 717 | 506 |
| 1972 | 23,871 | 18,292 | 714 | 522 |
| 1973 | 23,977 | 18,468 | 677 | 576 |
| 1974 | 23,983 | 18,852 | 681 | 483 |
| 1975 | 23,836 | 18,741 | 687 | 549 |
| 1976 | 23,773 | 18,938 | 680 | 468 |
| 1977 | 23,873 | 19,225 | 669 | 458 |
| 1978 | 24,013 | 18,930 | 641 | 383 |
| 1979 | 24,260 | 19,187 | 618 | 457 |
| 1980 | 24,431 | 18,742 | 597 | 358 |
| 1981 | 24,892 | 18,628 | 572 | 360 |
| 1982 | 24,296 | 18,403 | 553 | 310 |
| 1983 | 23,740 | 17,863 | 525 | 319 |
| 1984 | 23,363 | 17,797 | 510 | 346 |
| 1985 | 23,015 | 17,500 | 497 | 446 |
| 1986 | 22,917 | 17,265 | 486 | 463 |
| 1987 | 22,391 | 16,791 | 456 | 402 |
| 1988 | 22,586 | 16,758 | 443 | 361 |
| 1989 | 22,391 | 16,896 | 437 | 403 |
| 1990 | 22,765 | 16,618 | 420 | 388 |
| 1991 | 22,710 | 15,834 | 391 | 386 |
| 1992 | 22,559 | 16,044 | 393 | 398 |
| 1993 | 22,308 | 16,055 | 389 | 389 |
| 1994 | 22,159 | 16,338 | 388 | 369 |
| 1995 | 22,172 | 15,993 | 372 | 374 |
| 1996 | 21,964 | 15,747 | 368 | 412 |
| 1997 | 21,340 | 15,783 | 370 | 415 |
| 1998 | 22,268 | 15,372 | 365 | 436 |
| 1999 | 22,510 | 15,364 | 362 | 457 |
| | | *Average annual percentage change* | | |
| 1970–99 | -0.2% | -0.5% | -2.2% | -0.6% |
| 1989–99 | 0.1% | -0.9% | -1.9% | 1.3% |

**Source:**
See Appendix A for Table 2.14.

# Chapter 3
# Greenhouse Gas Emissions

Summary Statistics from Tables in this Chapter

| Source | | | |
|---|---|---|---|
| Table 3.1 | Carbon emissions (million metric tonnes) | 1990 | 1997 |
| | *France* | *103* | *102* |
| | *Germany* | *267* | *234* |
| | *United Kingdom* | *166* | *156* |
| | *Japan* | *274* | *297* |
| | *United States* | *1,345* | *1,480* |
| | *China* | *620* | *822* |
| | *India* | *153* | *236* |
| Table 3.3 | Transportation share of U.S. carbon dioxide emissions from fossil fuel consumption | | |
| | *1985* | | *30.9%* |
| | *1990* | | *32.0%* |
| | *1999* | | *32.8%* |
| Table 3.4 | Carbon dioxide emissions from U.S. transportation energy use, 1999 | | |
| | *Motor gasoline* | | *60.3%* |
| | *Liquified petroleum gas* | | *0.1%* |
| | *Jet fuel* | | *13.4%* |
| | *Distillate fuel* | | *20.2%* |
| | *Residual fuel* | | *3.5%* |
| | *Lubricants* | | *0.4%* |
| | *Aviation gas* | | *0.1%* |
| | *Natural gas* | | *1.9%* |
| | *Electricity* | | *0.2%* |

**Table 3.1**
**World Carbon Emissions, 1990 and 1997**

| | 1990 | | 1997 | |
|---|---|---|---|---|
| | Million metric tons | Percent of emissions from oil use | Million metric tons | Percent of emissions from oil use |
| Industrialized countries | 2,850 | 49% | 3,039 | 49% |
| United States | 1,345 | 44% | 1,480 | 42% |
| Canada | 127 | 48% | 142 | 46% |
| Mexico | 81 | 75% | 94 | 74% |
| United Kingdom | 166 | 40% | 156 | 41% |
| France | 103 | 65% | 102 | 69% |
| Germany | 267 | 37% | 234 | 45% |
| Italy | 113 | 65% | 116 | 66% |
| Netherlands | 60 | 48% | 64 | 45% |
| Other Western Europe | 224 | 63% | 246 | 65% |
| Japan | 274 | 65% | 297 | 63% |
| Other industrialized countries | 90 | 44% | 108 | 42% |
| Eastern Europe | 1,337 | 30% | 878 | 25% |
| Developing countries | 1,649 | 41% | 2,258 | 41% |
| China | 620 | 16% | 822 | 18% |
| India | 153 | 29% | 236 | 28% |
| Other developing countries | 876 | 13% | 1,200 | 3% |
| Total World | 5,836 | 42% | 6,175 | 43% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *International Energy Outlook 2000*, Washington, DC, March 2000, Tables A10 and A11.

*Global Warming Potentials (GWP) were developed to allow comparison of each greenhouse gas' ability to trap heat in the atmosphere relative to carbon dioxide. Extensive research has been performed and it has been discovered that the effects of various gases on global warming are too complex to be precisely summarized by a single number. Further understanding of the subject also causes frequent changes to estimates. Despite that, the scientific community has developed approximations, which are shown below. Most analysts use the 100-year time horizon.*

**Table 3.2**
**Numerical Estimates of Global Warming Potentials Compared With Carbon Dioxide**
**(kilogram of gas per kilogram of carbon dioxide)**

| Gas | Lifetime (years) | Global warming potential direct effect for time horizons of | | |
|---|---|---|---|---|
| | | 20 years | 100 years | 500 years |
| Carbon Dioxide | Variable | 1 | 1 | 1 |
| Methane | 12 ± 3 | 56 | 21 | 7 |
| Nitrous Oxide | 120 | 280 | 310 | 170 |
| HFCs, PFCs, and other gases | | | | |
| HFC-23 | 264 | 9,200 | 12,100 | 9,900 |
| HFC-125 | 33 | 4,800 | 3,200 | 11 |
| HFC-134a | 15 | 3,300 | 1,300 | 420 |
| HFC-152a | 2 | 460 | 140 | 42 |
| HFC-227ea | 37 | 4,300 | 2,900 | 950 |
| Perfluoromethane | 50,000 | 4,400 | 6,500 | 10,000 |
| Perfluoroethane | 10,000 | 6,200 | 9,200 | 14,000 |
| Sulfur hexafluoride | 3,200 | 16,300 | 23,900 | 34,900 |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States 1999*, Washington, DC, October 2000, p. 8. Original source: Intergovernmental Panel on Climate Change. (Additional resources: www.eia.doe.gov, www.ipcc.ch)

**Note:**
The typical uncertainty for global warming potentials is estimated by the Intergovernmental Panel on Climate Change at ± 35 percent.

*Carbon dioxide emissions in 1999 were 13% higher than in 1990. Carbon dioxide accounts for the majority of greenhouse gases.*

**Table 3.3**
**Estimated U.S. Emissions of Greenhouse Gases, 1990–99**

| Greenhouse gas | Unit of measure[a] | 1990 | 1995 | 1998 | 1999 |
|---|---|---|---|---|---|
| Carbon dioxide | million metric tons of gas | 4,951.9 | 5,260.6 | 5,527.1 | 5,598.2 |
| | million metric tons of carbon | 1,351.0 | 1,435.0 | 1,507.0 | 1,527.0 |
| Methane | million metric tons of gas | 31.7 | 31.2 | 29.3 | 28.8 |
| | million metric tons of carbon (gwp)[b] | 182.0 | 179.0 | 168.0 | 165.0 |
| Nitrous oxide | million metric tons of gas | 1.2 | 1.3 | 1.2 | 1.2 |
| | million metric tons of carbon (gwp)[b] | 99.0 | 106.0 | 103.0 | 103.0 |
| HFCs, PFCs, and $SF_6$[c] | million metric tons of carbon (gwp)[b] | 24.0 | 29.0 | 40.0 | 38.0 |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1999*, Washington, DC, October 2000, pp. vii, viii. (Additional resources: www.eia.doe.gov)

[a]Gases that contain carbon can be measured either in terms of the full molecular weight of the gas or just in terms of their carbon content. See Appendix B, Table B.5 for details.

[b]Based on global warming potential.

[c]HFC-hydrofluorocarbons. PFC-perfluorocarbons. $SF_6$=sulfur hexaflouride.

*Gases which contain carbon can be measured in terms of the full molecular weight of the gas or just in terms of their carbon content. This table presents carbon content. The ratio of the weight of carbon to carbon dioxide is 0.2727. The transportation sector accounts for approximately one-third of carbon dioxide emissions.*

**Table 3.4**
**U.S. Carbon Dioxide Emissions from Fossil Energy Consumption by End-Use Sector, 1985–99[a]**
**(million metric tons of carbon)**

| End use sector | 1985 | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|
| Residential | 245.8 | 254.2 | 273.4 | 289.6 | 288.6 | 288.8 | 290.1 |
| Commercial | 189.6 | 207.7 | 220.6 | 229.2 | 241.5 | 244.5 | 243.5 |
| Industrial | 424.1 | 454.8 | 469.2 | 483.8 | 489.7 | 480.2 | 481.2 |
| Transportation | 384.4 | 431.8 | 457.8 | 468.9 | 473.6 | 481.9 | 496.1 |
| Percentage | 30.9% | 32.0% | 32.2% | 31.9% | 31.7% | 32.2% | 32.8% |
| **Total energy** | **1,243.9** | **1,348.6** | **1,421.0** | **1,471.5** | **1,493.4** | **1,495.4** | **1,510.8** |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1999*, Washington, DC, October 2000, p. 25, and annual. (Additional resources: www.eia.doe.gov)

[a]Includes energy from petroleum, coal, and natural gas. Electric utility emissions are distributed across consumption sectors.

*Most U.S. carbon dioxide emissions come from petroleum fuels (98%). Motor gasoline has been responsible for about 60% of U.S. carbon dioxide emissions over the last twenty years.*

**Table 3.5**
**U.S. Carbon Dioxide Emissions from Energy Use in the Transportation Sector, 1980–99**
**(million metric tons of carbon)**

| | 1980 | | 1990 | | 1999 | |
|---|---|---|---|---|---|---|
| Fuel | Emissions | Percentage | Emissions | Percentage | Emissions | Percentage |
| | | | **Petroleum** | | | |
| Motor gasoline | 238.1 | 62.9% | 260.6 | 60.4% | 299.1 | 60.3% |
| LPG[a] | 0.3 | 0.1% | 0.4 | 0.1% | 0.3 | 0.1% |
| Jet fuel | 42.0 | 11.1% | 60.1 | 13.9% | 66.3 | 13.4% |
| Distillate fuel | 55.3 | 14.6% | 75.7 | 17.5% | 100.1 | 20.2% |
| Residual fuel | 30.0 | 7.9% | 21.9 | 5.1% | 17.5 | 3.5% |
| Lubricants | 1.8 | 0.5% | 1.8 | 0.4% | 1.8 | 0.4% |
| Aviation gas | 1.2 | 0.3% | 0.8 | 0.2% | 0.7 | 0.1% |
| **Total** | **368.7** | 97.4% | **421.2** | 97.5% | **485.8** | 97.9% |
| | | | **Other energy** | | | |
| Natural gas | 9.4 | 2.5% | 9.8 | 2.3% | 9.5 | 1.9% |
| Electricity[b] | 0.3 | 0.1% | 0.7 | 0.2% | 0.8 | 0.2% |
| **Total** | **378.4** | 100.0% | **432.1** | 100.0% | **496.1** | 100.0% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1999*, Washington, DC, October 2000, p. 27, and annual. (Additional resources: www.eia.doe.gov)

[a]Liquified petroleum gas.
[b]Share of total electric utility carbon dioxide emissions weighted by sales to the transportation sector.

## The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model

The energy in greenhouse gas estimates of the most recent version (Beta Version 1.6) of the GREET model are displayed in the next table. The model estimates the full fuel-cycle emissions and energy use associated with various transportation fuels and advanced transportation technologies for light-duty vehicles. It calculates fuel-cycle emissions of **three greenhouse gases** (carbon dioxide, methane, and nitrous oxide) and five criteria pollutants (volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter measuring 10 microns or less). **See Chapter 4 for the criteria pollutant data from GREET.** The model also calculates the total fuel-cycle energy consumption, fossil fuel consumption, and petroleum consumption using various transportation fuels. The fuel cycles that are included in the GREET model are:

- petroleum to conventional gasoline, reformulated gasoline, conventional diesel, reformulated diesel, liquefied petroleum gas, and electricity via residual oil;
- natural gas to compressed natural gas, liquefied natural gas, liquefied petroleum gas, methanol, Fischer-Tropsch diesel, dimethyl ether, hydrogen, and electricity;
- coal to electricity;
- uranium to electricity;
- renewable energy (hydropower, solar energy, and wind) to electricity;
- corn, woody biomass, and herbaceous biomass to ethanol;
- soybeans to biodiesel; and
- landfill gases to methanol.

For additional information about the GREET model, see *GREET 1.5 – Transportation Fuel-Cycle Model, Volume 1: Methodology, Development, Use and Results*, ANL/ESD-39, Vol. 1, August 1999, or contact:

Michael Q. Wang
Argonne National Laboratory
9700 South Cass Avenue, ES/362
Argonne, IL 60439-4815
phone: 630-252-2819
fax: 630-252-3443
email: mqwang@anl.gov

GREET Web Site:
http://www.transportation.anl.gov/ttrdc/greet/

## Acronyms and Terms Used on Table 3.6

| | |
|---|---|
| BD20 | mixture of 20% biodiesel and 80% conventional diesel (by volume) |
| CA | California |
| CH4 | methane |
| CIDI | compression ignition, direct injection |
| CIDIV | compression ignition, direct injection vehicle |
| CNG | compressed natural gas |
| CNGV | compressed natural gas vehicle |
| CO2 | carbon dioxide |
| DME | dimethyl ether |
| E90 | mixture of 90% ethanol and 10% gasoline (by volume) |
| EtOH | ethanol |
| EtOHV | ethanol vehicle |
| EV | electric vehicle |
| FCV | fuel-cell vehicle |
| FRFG | Federal reformulated gasoline |
| FT | Fischer-Tropsch |
| FTD | Fischer-Tropsch diesel |
| G.H2 | gaseous hydrogen |
| GC | grid-connected (charge depleting) |
| GGE | gasoline gallon equivalent |
| GHGs | greenhouse gases |
| GI | grid-independent (charge sustaining) |
| GV | gasoline vehicle |
| HEV | hybrid electric vehicle |
| L.H2 | liquid hydrogen |
| LS | low-sulfur |
| M90 | mixture of 90% methanol and 10% gasoline by volume |
| MeOH | methanol |
| MeOHV | methanol vehicle |
| N2O | nitrous oxide |
| NA | North American |
| NE | northeast |
| NG | natural gas |
| NNA | non-North American |
| SI | spark ignition |
| urban | Emissions occurring within air quality control regions in the U.S. These regions have emission controls in place in order to meet or maintain air quality standards. |
| US | United States |

**Table 3.6**
**Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative and Advanced Vehicle/Fuel Systems (percentage relative to internal combustion engine vehicles fueled with reformulated gasoline)**

| | GV: FRFG (btu/mile or grams/mile) | CNGV: NA NG | CNGV: NNA NG | Propane vehicle | M90 MeOHV: NA NG | M90 MeOHV: NNA NG | E90 EtOHV: corn | E90 EtOHV: cellulosic biomass | GI SI HEV: FRFG | GC SI HEV: FRFG |
|---|---|---|---|---|---|---|---|---|---|---|
| MPG - GGE | 24.1 | 24.1 | 24.1 | 25.3 | 25.3 | 25.3 | 25.3 | 25.3 | 33.8 | 54.1 |
| Total energy | 5,891 | -9.5% | 1.2% | -16.2% | 14.6% | 16.3% | 10.4% | 53.8% | -28.6% | -40.7% |
| Fossil fuels | 5,872 | -9.7% | 1.0% | -16.0% | 14.9% | 16.6% | -45.3% | -79.5% | -28.6% | -43.1% |
| Petroleum | 4,665 | -99.5% | -99.5% | -59.1% | -79.1% | -79.9% | -75.0% | -74.9% | -28.6% | -57.7% |
| CO2 | 446 | -26.8% | -18.5% | -20.1% | -5.7% | -4.3% | -41.0% | -88.9% | -28.6% | -40.1% |
| CH4 | 0.684 | 111.0% | 216.8% | -21.9% | -9.5% | 8.5% | -27.6% | -63.3% | -25.9% | -39.4% |
| N2O | 0.030 | -49.6% | -46.4% | -3.1% | 0.5% | 1.3% | 448.3% | 474.8% | -1.6% | -29.2% |
| GHGs | 469 | -23.1% | -13.1% | -19.8% | -5.7% | -3.9% | -31.0% | -77.1% | -28.0% | -39.9% |

| | CIDIV: LS diesel | CIDIV: FTD, NA NG | CIDIV: FTD, NNA NG | CIDIV: BD20 | GI CIDI HEV: LS diesel | GC CIDI HEV: LS diesel | EV: US mix | EV: NE US mix | EV: CA mix |
|---|---|---|---|---|---|---|---|---|---|
| MPG - GGE | 29.6 | 29.6 | 29.6 | 29.6 | 41.0 | 57.7 | 84.4 | 84.4 | 84.4 |
| Total energy | -21.7% | 8.7% | 10.4% | -19.0% | -43.6% | -47.2% | -45.1% | -46.2% | -50.6% |
| Fossil fuels | -21.7% | 9.0% | 10.8% | -19.1% | -43.6% | -49.6% | -52.5% | -55.6% | -61.9% |
| Petroleum | -10.4% | -99.0% | -98.5% | -25.5% | -35.4% | -59.7% | -98.4% | -97.5% | -99.7% |
| CO2 | -17.1% | -13.4% | -12.1% | -28.4% | -40.2% | -44.6% | -43.5% | -53.4% | -61.5% |
| CH4 | -40.4% | -40.3% | -24.9% | -44.2% | -56.6% | -56.3% | -48.8% | -36.3% | -43.2% |
| N2O | -42.3% | -44.9% | -30.0% | -34.1% | -43.3% | -57.0% | -84.1% | -87.1% | -88.6% |
| GHGs | -18.3% | -14.8% | -12.7% | -29.0% | -40.8% | -45.2% | -44.5% | -53.5% | -61.5% |

| | FCV: G.H2, central plant, NA NG | FCV: G.H2, central plant, NNA NG | FCV: G.H2, refueling station, NA NG | FCV: G.H2, refueling station, NNA NG | FCV: G.H2, central electrolysis, renewables | FCV: G.H2, station electrolysis, US generation mix |
|---|---|---|---|---|---|---|
| MPG - GGE | 50.7 | 50.7 | 50.7 | 50.7 | 50.7 | 50.7 |
| Total energy | -35.6% | -30.0% | -32.9% | -28.4% | -37.6% | 40.5% |
| Fossil fuels | -36.6% | -31.0% | -33.2% | -28.6% | -91.9% | 22.4% |
| Petroleum | -99.2% | -99.3% | -99.7% | -99.6% | -99.5% | -96.3% |
| CO2 | -47.7% | -42.7% | -46.9% | -43.3% | -90.6% | 44.7% |
| CH4 | -50.1% | -4.3% | -36.2% | -3.3% | -89.5% | 62.6% |
| N2O | -94.9% | -93.2% | -94.8% | -93.3% | -97.7% | -64.9% |
| GHGs | -48.7% | -42.6% | -47.5% | -43.2% | -90.7% | 43.3% |

(Table continued on next page)

**Note:**
See page preceding Table 3.6 for acronym definitions.

**Table 3.6 (Continued)**
**Fuel-Cycle Energy and Emission Changes of Alternative and Advanced Vehicle/Fuel Systems**
**(percentage relative to intenal combustion engine vehicles fueled with reformulated gasoline)**

| | FCV: L.H2, central plant, NA NG | FCV: L.H2, central plant, NNA NG | FCV: L.H2, refueling station, NA NG | FCV: L.H2, refueling station, NNA NG | FCV: L.H2, central electrolysis, renewables | FCV: L.H2, station electrolysis, US generation mix |
|---|---|---|---|---|---|---|
| MPG - GGE | 50.7 | 50.7 | 50.7 | 50.7 | 50.7 | 50.7 |
| Total energy | -11.6% | -8.5% | 12.4% | 19.5% | -44.0% | 105.3% |
| Fossil fuels | -11.4% | -8.4% | 6.0% | 12.9% | -98.7% | 61.7% |
| Petroleum | -99.3% | -99.0% | -98.4% | -98.4% | -99.4% | -95.2% |
| CO2 | -28.8% | -25.4% | -1.3% | 2.4% | -98.8% | 91.1% |
| CH4 | -25.1% | -21.6% | 6.5% | 81.3% | -98.8% | 114.7% |
| N2O | -86.2% | -85.5% | -84.3% | -82.7% | -99.6% | -53.7% |
| GHGs | -29.7% | -26.4% | -2.5% | 2.9% | -98.8% | 89.2% |

| | FCV: MeOH, NA NG | FCV: MeOH, NNA NG | FCV: gasoline | FCV: cellulosic EtOH | FCV: CNG, NA NG | FCV: CNG, NNA NG | FCV: FT naphtha, NNA NG | FCV: crude naphtha |
|---|---|---|---|---|---|---|---|---|
| MPG - GGE | 42.2 | 42.2 | 37.4 | 39.3 | 37.4 | 37.4 | 37.4 | 37.4 |
| Total energy | -28.7% | -27.4% | -35.5% | 19.9% | -41.6% | -34.7% | -10.3% | -38.6% |
| Fossil fuels | -28.5% | -27.2% | -35.5% | -96.9% | -41.7% | -34.8% | -10.0% | -38.6% |
| Petroleum | -98.5% | -98.1% | -35.5% | -94.4% | -99.7% | -99.7% | -98.7% | -36.4% |
| CO2 | -43.5% | -42.5% | -35.5% | -105.1% | -52.7% | -47.4% | -32.7% | -41.3% |
| CH4 | -46.7% | -33.5% | -39.3% | -91.8% | 15.0% | 85.2% | -38.8% | -41.8% |
| N2O | -77.4% | -76.7% | -77.4% | 338.7% | -79.1% | -77.0% | -79.9% | -78.6% |
| GHGs | -44.3% | -42.9% | -36.3% | -96.0% | -51.1% | -44.6% | -33.7% | -41.9% |

**Source:**
Wang, Michael, Q., model results of Beta Version of GREET 1.6, Argonne National Laboratory, Argonne, IL, August, 2001.

**Note:**
See page preceding Table 3.6 for acronym definitions.

# Chapter 4
# Criteria Pollutants

Summary Statistics from Tables in this Chapter

| Source | | |
|---|---|---|
| Table 4.1 | Transportation's share of U.S. emissions, 1999 | |
| | *CO* | *78.6%* |
| | *$NO_X$* | *53.4%* |
| | *VOC* | *43.5%* |
| | *PM-10* | *2.1%* |
| | *PM-2.5* | *7.6%* |
| | *$SO_2$* | *6.9%* |
| | *$NH_3$* | *5.4%* |
| Table 4.10 | Transportation's share of lead emissions | |
| | *1970* | *82.3%* |
| | *1999* | *12.8%* |

*Transportation accounts for the majority of carbon monoxide and nitrogen oxide emissions. Highway vehicles are responsible for the largest share of transportation emissions.*

**Table 4.1**
**Total National Emissions of the Criteria Air Pollutants by Sector, 1999**
**(millions of short tons/percentage)**

| Sector | CO | $NO_x$ | VOC | PM-10 | PM-2.5 | $SO_2$ | $NH_3$ |
|---|---|---|---|---|---|---|---|
| **Highway vehicles** | **49.99** | **8.59** | **5.30** | **0.30** | **0.23** | **0.36** | **0.26** |
| | *55.9%* | *35.1%* | *29.6%* | *0.8%* | *2.7%* | *1.9%* | *5.2%* |
| **Aircraft** | **1.00** | **0.16** | **0.18** | **0.04** | **0.03** | **0.01** | **0.00** |
| | *1.1%* | *0.7%* | *1.0%* | *0.1%* | *0.3%* | *0.1%* | *0.1%* |
| **Railroads** | **0.12** | **0.95** | **0.05** | **0.03** | **0.03** | **0.11** | **0.00** |
| | *0.1%* | *3.9%* | *0.3%* | *0.1%* | *0.4%* | *0.6%* | *0.0%* |
| **Vessels** | **0.14** | **1.00** | **0.04** | **0.04** | **0.04** | **0.27** | **0.00** |
| | *0.2%* | *4.1%* | *0.2%* | *0.1%* | *0.5%* | *1.4%* | *0.0%* |
| **Other off-highway** | **18.71** | **3.17** | **2.19** | **0.35** | **0.31** | **0.54** | **0.00** |
| | *20.9%* | *13.0%* | *12.2%* | *1.0%* | *3.7%* | *2.9%* | *0.1%* |
| **Transportation total** | **70.30** | **13.05** | **7.79** | **0.72** | **0.64** | **1.30** | **0.27** |
| | *78.6%* | *53.4%* | *43.5%* | *2.1%* | *7.6%* | *6.9%* | *5.4%* |
| **Stationary source fuel combustion** | **5.37** | **10.19** | **0.89** | **1.09** | **0.78** | **16.09** | **0.05** |
| | *6.0%* | *41.7%* | *5.0%* | *3.1%* | *9.3%* | *85.3%* | *1.0%* |
| **Industrial processes** | **3.71** | **0.80** | **8.02** | **0.71** | **0.38** | **1.43** | **0.20** |
| | *4.1%* | *3.3%* | *44.8%* | *2.0%* | *4.6%* | *7.6%* | *4.0%* |
| **Waste disposal and recycling total** | **1.15** | **0.10** | **0.43** | **0.31** | **0.24** | **0.04** | **0.09** |
| | *1.3%* | *0.4%* | *2.4%* | *0.9%* | *2.8%* | *0.2%* | *1.8%* |
| **Miscellaneous** | **8.92** | **0.33** | **0.79** | **31.92** | **6.35** | **0.01** | **4.36** |
| | *10.0%* | *1.3%* | *4.4%* | *91.9%* | *75.8%* | *0.1%* | *87.8%* |
| **Total of all sources** | **89.45** | **24.45** | **17.92** | **34.74** | **8.38** | **18.87** | **4.96** |
| | *100.0%* | *100.0%* | *100.0%* | *100.0%* | *100.0%* | *100.0%* | *100.0%* |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

**Note:**
CO = Carbon monoxide. $NO_x$ = Nitrogen oxides. PM-10 = Particulate matter less than 10 microns. PM-2.5 = Particulate matter less than 2.5 microns. $SO_2$ = Sulfur dioxide. VOC = Volatile organic compounds. $NH_3$ = Ammonia.

*The transportation sector accounted for more than three-fourths of the nation's carbon monoxide (CO) emissions in 1999. Highway vehicles are by far the source of the greatest amount of CO. For details on the highway emissions of CO, see Table 4.3.*

**Table 4.2**
**Total National Emissions of Carbon Monoxide, 1970–99[a]**
**(million short tons)**

| Source category | 1970 | 1980 | 1990 | 1995 | 1998 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|
| Highway vehicles | 88.03 | 78.05 | 58.44 | 54.81 | 52.36 | 49.99 | 51.3% |
| Aircraft | 0.51 | 0.74 | 0.90 | 0.94 | 1.00 | 1.00 | 1.0% |
| Railroads | 0.07 | 0.10 | 0.12 | 0.11 | 0.12 | 0.12 | 0.1% |
| Vessels[b] | 0.02 | 0.06 | 0.13 | 0.13 | 0.14 | 0.14 | 0.1% |
| Other off-highway | 11.38 | 13.59 | 17.04 | 19.04 | 23.87 | 23.90 | 24.5% |
| Transportation total | 100.00 | 92.54 | 76.64 | 75.04 | 77.48 | 75.15 | 77.1% |
| Stationary fuel combustion total | 4.63 | 7.30 | 5.51 | 5.93 | 5.08 | 5.32 | 5.5% |
| Industrial processes total | 9.84 | 6.95 | 4.77 | 4.61 | 3.81 | 3.80 | 3.9% |
| Waste disposal and recycling total | 7.06 | 2.30 | 1.08 | 1.19 | 1.14 | 3.79 | 3.9% |
| Miscellaneous total | 7.91 | 8.34 | 11.12 | 7.30 | 9.36 | 9.38 | 9.6% |
| **Total of all sources** | **129.44** | **117.43** | 99.12 | 94.06 | 96.87 | 97.44 | 100.0% |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

**Note:**
Emission estimation methodology changes indicated by shaded areas. Transportation methodologies changed in 1970, while all others changed in 1990.

[a]The sums of subcategories may not equal total due to rounding.
[b]Recreational marine vessels.

*Though gasoline-powered light vehicles continue to be responsible for the majority of carbon monoxide emissions from highway vehicles, the total pollution from light vehicles in 1999 is less than half what it was in 1970. This is despite the fact that there were many more light vehicles on the road in 1999.*

**Table 4.3**
**Emissions of Carbon Monoxide from Highway Vehicles, 1970–99[a]**
**(million short tons)**

| Source category | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|---|
| **Gasoline powered** | | | | | | | | |
| Light vehicles & motorcycles | 64.03 | 59.28 | 53.56 | 49.45 | 35.00 | 29.79 | 27.38 | 54.8% |
| Light trucks[b] | 16.57 | 15.77 | 16.14 | 18.96 | 17.12 | 19.43 | 16.12 | 32.2% |
| Heavy vehicles | 6.71 | 7.14 | 7.19 | 7.72 | 5.03 | 4.10 | 4.26 | 8.5% |
| Total | 87.31 | 82.19 | 76.89 | 76.13 | 57.14 | 53.32 | 47.76 | 95.5% |
| **Diesel powered** | | | | | | | | |
| Light vehicles | [c] | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 | 0.01 | 0.0% |
| Light trucks[b] | [c] | [c] | 0.00 | 0.00 | 0.05 | 0.01 | 0.01 | 0.0% |
| Heavy vehicles | 0.72 | 0.92 | 1.14 | 1.24 | 1.22 | 1.45 | 2.22 | 4.4% |
| Total | 0.72 | 0.95 | 1.16 | 1.26 | 1.30 | 1.49 | 2.23 | 4.5% |
| **Total** | | | | | | | | |
| **Highway vehicle total** | 88.03 | 83.13 | 78.05 | 77.39 | 58.44 | 54.81 | 49.99 | 100.0% |
| Percent diesel | 0.8% | 1.1% | 1.5% | 1.6% | 2.2% | 2.7% | 4.5% | |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends*
*(Additional resources:* www.epa.gov/oar/oaqps)

[a]The sums of subcategories may not equal total due to rounding.
[b]Less than 8,500 pounds.
[c]Data are not available.

*The transportation sector accounted for over half of the nation's nitrogen oxide (NOx) emissions in 1999, with the majority coming from highway vehicles. For details on the highway emissions of NOx, see Table 4.5.*

**Table 4.4**
**Total National Emissions of Nitrogen Oxides, 1970–99[a]**
**(million short tons)**

| Source category | 1970 | 1980 | 1990 | 1995 | 1998 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|
| Highway vehicles | 7.39 | 8.62 | 7.21 | 7.96 | 8.82 | 8.59 | 33.8% |
| Railroads | 0.50 | 0.73 | 0.93 | 0.99 | 1.22 | 1.20 | 4.7% |
| Other off-highway | 1.44 | 2.80 | 3.88 | 4.14 | 4.32 | 4.31 | 17.0% |
| Transportation total | 9.32 | 12.15 | 12.01 | 13.08 | 14.36 | 14.11 | 55.5% |
| Stationary fuel combustion total | 10.06 | 11.32 | 10.89 | 10.83 | 10.40 | 10.03 | 39.5% |
| Industrial processes total | 0.78 | 0.56 | 0.80 | 0.77 | 0.85 | 0.85 | 3.4% |
| Waste disposal and recycling total | 0.44 | 0.11 | 0.09 | 0.10 | 0.10 | 0.09 | 0.4% |
| Miscellaneous total | 0.33 | 0.25 | 0.37 | 0.27 | 0.32 | 0.32 | 1.3% |
| **Total of all sources** | **20.93** | **24.38** | **24.17** | **25.05** | **26.02** | **25.39** | **100.0%** |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

**Note:**
Emission estimation methodology changes indicated by shaded areas. Transportation methodologies changed in 1970, while all others changed in 1990.

[a]The sums of subcategories may not equal total due to rounding.

*Heavy diesel-powered vehicles were responsible for one-third of highway vehicle nitrogen oxide emissions in 1999, while light gasoline vehicles were responsible for nearly two-thirds.*

**Table 4.5**
**Emissions of Nitrogen Oxides from Highway Vehicles, 1970–99[a]**
**(million short tons)**

| Source category | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|---|
| **Gasoline powered** | | | | | | | | |
| Light vehicles & motorcycles | 4.16 | 4.73 | 4.42 | 3.81 | 3.01 | 3.04 | 2.86 | 33.3% |
| Light trucks[b] | 1.28 | 1.46 | 1.41 | 1.53 | 1.55 | 1.99 | 1.64 | 19.1% |
| Heavy vehicles | 0.28 | 0.32 | 0.30 | 0.33 | 0.31 | 0.33 | 0.46 | 5.3% |
| Total | 5.71 | 6.51 | 6.13 | 5.67 | 4.87 | 5.36 | 4.96 | 57.7% |
| **Diesel powered** | | | | | | | | |
| Light vehicles | [c] | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.01 | 0.1% |
| Light trucks[b] | [c] | [c] | 0.01 | 0.01 | 0.06 | 0.01 | 0.01 | 0.1% |
| Heavy vehicles | 1.68 | 2.12 | 2.46 | 2.39 | 2.25 | 2.54 | 3.62 | 42.1% |
| Total | 1.68 | 2.14 | 2.49 | 2.42 | 2.34 | 2.59 | 3.63 | 42.3% |
| **Total** | | | | | | | | |
| **Highway vehicle total** | **7.39** | **8.65** | **8.62** | **8.09** | **7.21** | **7.96** | **8.59** | **100.0%** |
| Percent diesel | 22.7% | 24.8% | 28.9% | 30.0% | 32.4% | 32.6% | 42.3% | |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

[a]The sums of subcategories may not equal total due to rounding.
[b]Less than 8,500 pounds.
[c]Data are not available.

*The transportation sector accounted for over 45% of the nation's volatile organic compound (VOC) emissions in 1999, with the majority coming from highway vehicles. For details on the highway emissions of VOC, see Table 4.7.*

**Table 4.6**
**Total National Emissions of Volatile Organic Compounds, 1970–99[a]**
**(million short tons)**

| Source category | 1970 | 1980 | 1990 | 1995 | 1998 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|
| Highway vehicles | 12.97 | 8.98 | 6.44 | 5.82 | 5.44 | 5.30 | 29.2% |
| Off-highway | 1.88 | 2.31 | 2.55 | 2.70 | 3.30 | 3.23 | 17.8% |
| Transportation total | 14.85 | 11.29 | 8.99 | 8.52 | 8.74 | 8.53 | 47.0% |
| Stationary fuel combustion total | 0.72 | 1.05 | 1.01 | 1.07 | 0.86 | 0.90 | 5.0% |
| Industrial processes total | 12.33 | 12.10 | 9.01 | 9.71 | 7.88 | 7.41 | 40.8% |
| Waste disposal and recycling total | 1.98 | 0.76 | 0.99 | 1.07 | 0.43 | 0.59 | 3.2% |
| Miscellaneous total | 1.10 | 1.13 | 1.06 | 0.55 | 0.71 | 0.72 | 3.9% |
| **Total of all sources** | **30.98** | **26.34** | **21.05** | **20.92** | **18.61** | **18.15** | **100.0%** |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

**Note:**
Emission estimation methodology changes indicated by shaded areas. Transportation methodologies changed in 1970, while all others changed in 1990.

[a]The sum of subcategories may not equal total due to rounding. The EPA's definition of volatile organic compounds excludes methane, ethane, and certain other nonphotochemically reactive organic compounds.

*Gasoline-powered vehicles are responsible for 95% of highway vehicle emissions of volatile organic compounds. VOC emissions from highway vehicles in 1999 were less than half the 1970 level.*

**Table 4.7**
**Emissions of Volatile Organic Compounds from Highway Vehicles, 1970–99[a]**
**(thousand short tons)**

| Source category | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|---|
| **Gasoline powered** | | | | | | | | |
| Light vehicles & motorcycles | 9,193 | 7,248 | 5,907 | 5,864 | 3,692 | 3,029 | 2,911 | 55.0% |
| Light trucks[b] | 2,770 | 2,289 | 2,059 | 2,425 | 2,016 | 2,135 | 1,722 | 32.5% |
| Heavy vehicles | 743 | 657 | 611 | 716 | 405 | 325 | 375 | 7.1% |
| Total | 12,706 | 10,194 | 8,577 | 9,005 | 6,113 | 5,489 | 5,008 | 94.5% |
| **Diesel powered** | | | | | | | | |
| Light vehicles | [c] | 15 | 8 | 8 | 9 | 12 | 3 | 0.1% |
| Light trucks[b] | [c] | [c] | 2 | 2 | 24 | 5 | 2 | 0.0% |
| Heavy vehicles | 266 | 335 | 392 | 360 | 298 | 309 | 284 | 5.4% |
| Total | 266 | 350 | 402 | 370 | 331 | 326 | 289 | 5.5% |
| **Total** | | | | | | | | |
| **Highway vehicle total** | 12,972 | 10,545 | 8,979 | 9,376 | 6,443 | 5,816 | 5,297 | 100.0% |
| Percent diesel | 2.1% | 3.3% | 4.5% | 3.9% | 5.1% | 5.6% | 5.5% | |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

[a]The sums of subcategories may not equal total due to rounding.
[b]Less than 8,500 pounds.
[c]Data are not available.

*The transportation sector accounted for only 3% of the nation's particulate matter (PM-10) emissions in 1999. For details on the highway emissions of PM-10, see Table 4.9.*

**Table 4.8**
**Total National Emissions of Particulate Matter (PM-10), 1970–99[a]**
**(million short tons)**

| Source category | 1970 | 1980 | 1990 | 1995 | 1998 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|
| Highway vehicles | 0.44 | 0.40 | 0.35 | 0.30 | 0.31 | 0.30 | 1.2% |
| Off-highway | 0.22 | 0.40 | 0.49 | 0.46 | 0.47 | 0.46 | 1.9% |
| Transportation total | 0.66 | 0.80 | 0.84 | 0.76 | 0.78 | 0.75 | 3.2% |
| Stationary fuel combustion total | 2.87 | 2.45 | 1.20 | 1.18 | 1.00 | 1.03 | 4.3% |
| Industrial processes total | 7.67 | 2.75 | 1.04 | 0.95 | 0.67 | 0.68 | 2.9% |
| Waste disposal and recycling total | 1.00 | 0.27 | 0.27 | 0.29 | 0.31 | 0.59 | 2.5% |
| Miscellaneous total | 0.84 | 0.85 | 24.54 | 22.77 | 23.28 | 20.63 | 87.1% |
| **Total of all sources** | **13.04** | **7.12** | **27.88** | **25.93** | **26.04** | **23.68** | **100.0%** |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

**Note:**
Emission estimation methodology changes indicated by shaded areas. Transportation methodologies changed in 1970, while all others changed in 1990.

[a]Fine particle matter less than 10 microns. The sums of subcategories may not equal total due to rounding.

*Since 1980 diesel-powered vehicles have been responsible for more than half of highway vehicle emissions of particulate matter (PM-10). Heavy vehicles are clearly the cause.*

**Table 4.9**
**Emissions of Particulate Matter (PM-10) from Highway Vehicles, 1970–99[a]**
**(thousand short tons)**

| Source category | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|---|
| **Gasoline powered** | | | | | | | | |
| Light vehicles & motorcycles | 225 | 207 | 120 | 77 | 57 | 55 | 59 | 20.0% |
| Light trucks[b] | 70 | 72 | 55 | 43 | 37 | 41 | 36 | 12.2% |
| Heavy vehicles | 13 | 15 | 15 | 14 | 10 | 9 | 12 | 4.1% |
| Total | 308 | 294 | 190 | 134 | 104 | 105 | 107 | 36.3% |
| **Diesel powered** | | | | | | | | |
| Light vehicles | [c] | 10 | 12 | 8 | 7 | 7 | 1 | 0.3% |
| Light trucks[b] | [c] | [c] | 2 | 1 | 13 | 2 | 1 | 0.3% |
| Heavy vehicles | 136 | 166 | 194 | 219 | 225 | 185 | 186 | 63.1% |
| Total | 136 | 176 | 208 | 228 | 245 | 194 | 188 | 63.7% |
| **Total** | | | | | | | | |
| **Highway vehicle total** | **443** | **471** | **397** | **363** | **349** | **300** | **295** | **100.0%** |
| Percent diesel | 30.7% | 37.4% | 52.4% | 62.8% | 70.2% | 64.7% | 63.7% | |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

[a]The sums of subcategories may not equal total due to rounding.
[b]Less than 8,500 pounds.
[c]Data are not available.

*The transportation sector accounted for only 9% of the nation's particulate matter (PM-2.5) emissions in 1998. For details on the highway emissions of PM-2.5, see Table 4.11.*

**Table 4.10**
**Total National Emissions of Particulate Matter (PM-2.5), 1990–99**
**(million short tons)**

| Source category | 1990 | 1995 | 1997 | 1998 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|
| Highway vehicles | 0.29 | 0.24 | 0.26 | 0.25 | 0.23 | 3.4% |
| Off-highway | 0.43 | 0.40 | 0.42 | 0.42 | 0.41 | 6.1% |
| Transportation total | 0.72 | 0.64 | 0.69 | 0.67 | 0.64 | 9.4% |
| Stationary fuel combustion total | 0.91 | 0.90 | 0.78 | 0.74 | 0.77 | 11.3% |
| Industrial processes total | 0.56 | 0.50 | 0.38 | 0.39 | 0.39 | 5.7% |
| Waste disposal and recycling total | 0.23 | 0.25 | 0.24 | 0.24 | 0.53 | 7.8% |
| Miscellaneous total | 5.23 | 4.73 | 5.19 | 5.04 | 4.45 | 65.8% |
| **Total of all sources** | **7.66** | **7.01** | **7.27** | **7.07** | **6.77** | **100.0%** |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

*Diesel vehicles are responsible for the majority of highway vehicle PM-2.5 emissions. More than 70% of the PM-2.5 emissions are from heavy diesel trucks.*

**Table 4.11**
**Emissions of Particulate Matter (PM-2.5) from Highway Vehicles, 1990–99[a]**
**(thousand short tons)**

| Source category | 1990 | 1995 | 1997 | 1998 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|
| **Gasoline powered** | | | | | | |
| Light vehicles & motorcycles | 34 | 32 | 33 | 34 | 34 | 14.8% |
| Light trucks[b] | 24 | 26 | 22 | 22 | 22 | 9.6% |
| Heavy vehicles | 6 | 6 | 9 | 8 | 8 | 3.5% |
| Total | 64 | 64 | 64 | 64 | 64 | 27.9% |
| **Diesel powered** | | | | | | |
| Light vehicles | 6 | 6 | 2 | 1 | 1 | 0.4% |
| Light trucks[b] | 12 | 2 | 1 | 1 | 1 | 0.4% |
| Heavy vehicles | 204 | 165 | 196 | 179 | 164 | 71.6% |
| Total | 222 | 173 | 199 | 181 | 166 | 72.5% |
| **Total** | | | | | | |
| **Highway vehicle total** | **286** | **237** | **263** | **246** | **229** | **100.0%** |
| Percent diesel | 77.6% | 73.0% | 75.7% | 73.6% | 72.5% | |

**Source:**
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website *www.epa.gov/ttn/chief/trends (Additional resources:* www.epa.gov/oar/oaqps)

[a] The sums of subcategories may not equal total due to rounding.
[b] Less than 8,500 pounds.

*Historically the transportation sector, highway vehicles in particular, have been a major source of lead emissions in the U.S. Regulatory action in 1978 required a gradual reduction of the lead content of all gasoline over a period of many years. The transportation sector accounts for only 13% of lead emissions in 1999, mainly due to off-highway fuel use.*

**Table 4.12**
**National Lead Emission Estimates, 1970–99[a]**
**(thousand short tons per year)**

| Source category | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 1999 | Percent of total, 1999 |
|---|---|---|---|---|---|---|---|---|
| Highway vehicles | 171.96 | 130.21 | 60.50 | 18.05 | 0.42 | 0.02 | 0.02 | 0.5% |
| Off-highway | 9.74 | 6.13 | 4.21 | 0.92 | 0.78 | 0.54 | 0.52 | 12.3% |
| Transportation total | 181.70 | 136.34 | 64.71 | 18.97 | 1.20 | 0.56 | 0.54 | 12.8% |
| Stationary source fuel combustion | 10.62 | 10.35 | 4.30 | 0.52 | 0.50 | 0.49 | 0.50 | 11.9% |
| Industrial processes | 26.36 | 11.38 | 3.94 | 2.53 | 2.48 | 2.27 | 2.35 | 55.9% |
| Waste disposal and recycling total | 2.20 | 1.60 | 1.21 | 0.87 | 0.80 | 0.60 | 0.81 | 19.4% |
| **Total of all sources** | **220.87** | **159.66** | **74.15** | **22.89** | **4.98** | **3.93** | **4.20** | **100.0%** |

**Source:**
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1998*, 2000, pp. A-34–A-35, and annual. (Additional resources: www.epa.gov/oar/oaqps)

[a]The sums of subcategories may not equal due to rounding.

# The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model

The energy and criteria pollutant estimates of the most recent version (Beta of Version 1.6) of the GREET model are displayed in the next table. The model estimates the full fuel-cycle emissions and energy use associated with various transportation fuels and advanced transportation technologies for light vehicles. It calculates fuel-cycle emissions of **five criteria pollutants** (volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter measuring 10 microns or less) and three greenhouse gases (carbon dioxide, methane, and nitrous oxide). **See Chapter 3 for the greenhouse gas data from GREET.** The model also calculates the total fuel-cycle energy consumption, fossil fuel consumption, and petroleum consumption using various transportation fuels. The fuel cycles that are included in the GREET model are:

petroleum to conventional gasoline, reformulated gasoline, conventional diesel, reformulated diesel, liquefied petroleum gas, and electricity via residual oil;

1. natural gas to compressed natural gas, liquefied natural gas, liquefied petroleum gas, methanol, Fischer-Tropsch diesel, dimethyl ether, hydrogen, and electricity;
2. coal to electricity;
3. uranium to electricity;
4. renewable energy (hydropower, solar energy, and wind) to electricity;
5. corn, woody biomass, and herbaceous biomass to ethanol;
6. soybeans to biodiesel; and
7. landfill gases to methanol.

For additional information about the GREET model, see *GREET 1.5 – Transportation Fuel-Cycle Model, Volume 1: Methodology, Development, Use and Results*, ANL/ESD-39, Vol. 1, August 1999, or contact:

Michael Q. Wang
Argonne National Laboratory
9700 South Cass Avenue, ES/362
Argonne, IL 60439-4815
phone: 630-252-2819
fax: 630-252-3443
email: mqwang@anl.gov

GREET Web Site:
http://www.transportation.anl.gov/ttrdc/greet/

## Acronyms and Terms Used on Table 4.13

| | |
|---|---|
| BD20 | mixture of 20% biodiesel and 80% conventional diesel (by volume) |
| CA | California |
| CH4 | methane |
| CIDI | compression ignition, direct injection |
| CIDIV | compression ignition, direct injection vehicle |
| CNG | compressed natural gas |
| CNGV | compressed natural gas vehicle |
| CO2 | carbon dioxide |
| DME | dimethyl ether |
| E90 | mixture of 90% ethanol and 10% gasoline (by volume) |
| EtOH | ethanol |
| EtOHV | ethanol vehicle |
| EV | electric vehicle |
| FCV | fuel-cell vehicle |
| FRFG | Federal reformulated gasoline |
| FT | Fischer-Tropsch |
| FTD | Fischer-Tropsch diesel |
| G.H2 | gaseous hydrogen |
| GC | grid-connected (charge depleting) |
| GGE | gasoline gallon equivalent |
| GHGs | greenhouse gases |
| GI | grid-independent (charge sustaining) |
| GV | gasoline vehicle |
| HEV | hybrid electric vehicle |
| L.H2 | liquid hydrogen |
| LS | low-sulfur |
| M90 | mixture of 90% methanol and 10% gasoline by volume |
| MeOH | methanol |
| MeOHV | methanol vehicle |
| N2O | nitrous oxide |
| NA | North American |
| NE | northeast |
| NG | natural gas |
| NNA | non-North American |
| SI | spark ignition |
| urban | Emissions occurring within air quality control regions in the U.S. These regions have emission controls in place in order to meet or maintain air quality standards. |
| US | United States |

**Table 4. 13**
**Fuel-Cycle Energy and Criteria Pollutant Emission Changes of Alternative and Advanced Vehicle/Fuel Systems (percentage relative to internal combustion engine vehicles fueled with reformulated gasoline)**

| | GV: FRFG (btu/mile or grams/mile) | CNGV: NA NG | CNGV: NNA NG | Propane vehicle | M90 MeOHV: NA NG | M90 MeOHV: NNA NG | E90 EtOHV: corn | E90 EtOHV: cellulosic biomass | GI SI HEV: FRFG | GC SI HEV: FRFG |
|---|---|---|---|---|---|---|---|---|---|---|
| MPG - GGE | 24.1 | 24.1 | 24.1 | 25.3 | 25.3 | 25.3 | 25.3 | 25.3 | 33.8 | 54.1 |
| Total energy | 5,891 | -9.5% | 1.2% | -16.2% | 14.6% | 16.3% | 10.4% | 53.8% | -28.6% | -40.7% |
| Fossil fuels | 5,872 | -9.7% | 1.0% | -16.0% | 14.9% | 16.6% | -45.3% | -79.5% | -28.6% | -43.1% |
| Petroleum | 4,665 | -99.5% | -99.5% | -59.1% | -79.1% | -79.9% | -75.0% | -74.9% | -28.6% | -57.7% |
| VOC: total | 0.202 | -68.8% | -66.1% | -55.6% | -14.7% | -15.2% | 83.9% | 1.4% | -20.3% | -45.7% |
| CO: total | 2.838 | -40.4% | -32.5% | -40.2% | 0.3% | 1.2% | 5.7% | 21.1% | -0.8% | -33.2% |
| NOx: total | 0.256 | -41.7% | 98.6% | -37.7% | -12.6% | 34.2% | 151.2% | 389.0% | -24.4% | -18.1% |
| PM10: total | 0.047 | 190.8% | 275.5% | -39.3% | -21.5% | -18.8% | 574.3% | 198.0% | -5.4% | 2.1% |
| SOx: total | 0.138 | -80.7% | -76.4% | -69.1% | -57.7% | -50.7% | 194.0% | -73.6% | -28.6% | 94.5% |
| VOC: urban | 0.150 | -57.9% | -59.8% | -53.1% | -10.0% | -13.6% | -15.2% | -15.2% | -17.4% | -45.6% |
| CO: urban | 2.775 | -38.5% | -37.6% | -40.2% | -0.3% | -0.5% | -0.3% | -0.4% | -0.2% | -33.1% |
| NOx: urban | 0.070 | 104.5% | 111.4% | -33.9% | -30.2% | -40.5% | -25.8% | -33.4% | -13.2% | -36.8% |
| PM10: urban | 0.037 | -35.3% | -40.2% | -35.1% | -23.6% | -28.6% | -12.8% | -13.1% | 0.5% | -13.5% |
| SOx: urban | 0.073 | -92.5% | -91.3% | -83.6% | -81.0% | -80.4% | -82.0% | -83.3% | -28.6% | -44.0% |

| | CIDIV: LS diesel | CIDIV: FTD, NA NG | CIDIV: FTD, NNA NG | CIDIV: BD20 | GI CIDI HEV: LS diesel | GC CIDI HEV: LS diesel | EV: U.S. mix | EV: NE U.S. mix | EV: CA mix |
|---|---|---|---|---|---|---|---|---|---|
| MPG - GGE | 29.6 | 29.6 | 29.6 | 29.6 | 41.0 | 57.7 | 84.4 | 84.4 | 84.4 |
| Total energy | -21.7% | 8.7% | 10.4% | -19.0% | -43.6% | -47.2% | -45.1% | -46.2% | -50.6% |
| Fossil fuels | -21.7% | 9.0% | 10.8% | -19.1% | -43.6% | -49.6% | -52.5% | -55.6% | -61.9% |
| Petroleum | -10.4% | -99.0% | -98.5% | -25.5% | -35.4% | -59.7% | -98.4% | -97.5% | -99.7% |
| VOC: total | -59.9% | -65.3% | -50.9% | -34.6% | -64.4% | -73.4% | -89.7% | -91.4% | -93.5% |
| CO: total | -0.9% | 2.0% | 100.1% | 0.2% | -1.4% | -33.5% | -98.4% | -97.4% | -97.7% |
| NOx: total | -15.7% | -22.6% | 33.8% | 4.9% | -32.0% | -19.9% | 11.6% | 3.7% | -20.7% |
| PM10: total | -8.9% | -34.3% | -22.1% | -9.6% | -15.8% | -3.6% | 24.0% | 4.7% | -9.8% |
| SOx: total | -27.9% | -83.8% | -78.0% | -43.8% | -48.0% | 86.8% | 369.2% | 233.7% | 146.2% |
| VOC: urban | -61.2% | -65.2% | -47.6% | -61.5% | -62.9% | -75.3% | -99.6% | -99.1% | -99.3% |
| CO: urban | -0.1% | -0.2% | 98.8% | -0.2% | -0.3% | -33.3% | -99.8% | -99.5% | -99.5% |
| NOx: urban | 30.4% | 7.6% | 62.2% | 29.5% | 20.3% | -28.1% | -75.5% | -65.5% | -75.1% |
| PM10: urban | -3.5% | -22.2% | -10.1% | -7.2% | -7.3% | -24.0% | -38.5% | -41.1% | -42.8% |
| SOx: urban | -26.3% | -99.2% | -98.9% | -57.5% | -46.9% | -78.0% | -44.6% | -53.7% | -71.1% |

(Table continued on next page)

**Note:**
See page preceding Table 4.13 for acronym definitions.

**Table 4. 13 (Continued)**
**Fuel-Cycle Energy and Criteria Pollutant Emission Changes**
**of Alternative and Advanced Vehicle/Fuel Systems**
**(percentage relative to internal combustion engine vehicles**
**fueled with reformulated gasoline)**

| | FCV: G.H2, central plant, NA NG | FCV: G.H2, central plant, NNA NG | FCV: G.H2, refueling station, NA NG | FCV: G.H2, refueling station, NNA NG | FCV: G.H2, central electrolysis, renewables | FCV: G.H2, station electrolysis, U.S. generation mix |
|---|---|---|---|---|---|---|
| MPG - GGE | 50.7 | 50.7 | 50.7 | 50.7 | 50.7 | 50.7 |
| Total energy | -35.6% | -30.0% | -32.9% | -28.4% | -37.6% | 40.5% |
| Fossil fuels | -36.6% | -31.0% | -33.2% | -28.6% | -91.9% | 22.4% |
| Petroleum | -99.2% | -99.3% | -99.7% | -99.6% | -99.5% | -96.3% |
| VOC: total | -97.1% | -93.6% | -94.7% | -91.9% | -97.9% | -68.6% |
| CO: total | -98.4% | -94.0% | -95.0% | -91.3% | -99.5% | -94.5% |
| NOx: total | -54.4% | 21.6% | -21.5% | 42.4% | -58.8% | 285.4% |
| PM10: total | -36.7% | -33.9% | -44.7% | -40.9% | -44.8% | 191.2% |
| SOx: total | -22.4% | 5.8% | -58.0% | -55.0% | -5.3% | 1390.5% |
| VOC: urban | -99.6% | -99.5% | -95.3% | -95.5% | -99.9% | -98.6% |
| CO: urban | -99.7% | -99.6% | -95.9% | -95.9% | -99.9% | -99.3% |
| NOx: urban | -81.1% | -76.2% | 87.6% | 86.6% | -83.5% | -22.1% |
| PM10: urban | -41.5% | -46.1% | -38.3% | -38.4% | -47.9% | -31.4% |
| SOx: urban | -89.4% | -86.4% | -95.3% | -95.0% | -87.3% | 81.8% |

| | FCV: L.H2, central plant, NA NG | FCV: L.H2, central plant, NNA NG | FCV: L.H2, refueling station, NA NG | FCV: L.H2, refueling station , NNA NG | FCV: L.H2, central electrolysis, renewables | FCV: L.H2, station electrolysis, U.S. generation mix |
|---|---|---|---|---|---|---|
| MPG - GGE | 50.7 | 50.7 | 50.7 | 50.7 | 50.7 | 50.7 |
| Total energy | -11.6% | -8.5% | 12.4% | 19.5% | -44.0% | 105.3% |
| Fossil fuels | -11.4% | -8.4% | 6.0% | 12.9% | -98.7% | 61.7% |
| Petroleum | -99.3% | -99.0% | -98.4% | -98.4% | -99.4% | -95.2% |
| VOC: total | -96.3% | -95.3% | -86.5% | -83.7% | -98.7% | -76.0% |
| CO: total | -96.9% | -96.6% | -96.0% | -92.2% | -99.7% | -85.8% |
| NOx: total | -55.8% | -7.9% | 57.3% | 121.8% | -46.4% | 409.0% |
| PM10: total | -36.8% | -33.6% | 36.1% | 39.9% | -57.5% | 272.0% |
| SOx: total | -85.1% | -80.8% | 434.0% | 437.0% | -94.8% | 1868.2% |
| VOC: urban | -99.5% | -99.5% | -98.3% | -98.5% | -99.9% | -98.2% |
| CO: urban | -99.7% | -99.7% | -98.8% | -98.8% | -100.0% | -99.1% |
| NOx: urban | -91.4% | -91.0% | -76.1% | -77.2% | -96.4% | 2.8% |
| PM10: urban | -47.2% | -47.1% | -41.9% | -41.9% | -48.9% | -25.7% |
| SOx: urban | -99.1% | -99.0% | -99.4% | -99.1% | -99.6% | 140.1% |

(Table continued on next page)

**Note:**
See page preceding Table 4.13 for acronym definitions.

**Table 4. 13 (Continued)**
**Fuel-Cycle Energy and Criteria Pollutant Emission Changes of Alternative and Advanced Vehicle/Fuel Systems (percentage relative to internal combustion engine vehicles fueled with reformulated gasoline)**

| | FCV: MeOH, NA NG | FCV: MeOH, NNA NG | FCV: gasoline | FCV: cellulosic EtOH | FCV: CNG, NA NG | FCV: CNG, NNA NG | FCV: FT naphtha, NNA NG | FCV: crude naphtha |
|---|---|---|---|---|---|---|---|---|
| MPG - GGE | 42.2 | 42.2 | 37.4 | 39.3 | 37.4 | 37.4 | 37.4 | 37.4 |
| Total energy | -28.7% | -27.4% | -35.5% | 19.9% | -41.6% | -34.7% | -10.3% | -38.6% |
| Fossil fuels | -28.5% | -27.2% | -35.5% | -96.9% | -41.7% | -34.8% | -10.0% | -38.6% |
| Petroleum | -98.5% | -98.1% | -35.5% | -94.4% | -99.7% | -99.7% | -98.7% | -36.4% |
| VOC: total | -69.0% | -67.1% | -45.9% | -49.6% | -91.0% | -87.9% | -81.8% | -78.9% |
| CO: total | -78.7% | -77.7% | -78.5% | -60.1% | -79.8% | -74.5% | -75.0% | -78.8% |
| NOx: total | -54.6% | -19.0% | -40.7% | 305.7% | -69.0% | 22.9% | -25.6% | -48.2% |
| PM10: total | -44.1% | -43.6% | -33.6% | 142.9% | 100.8% | 153.8% | -53.7% | -42.4% |
| SOx: total | -81.6% | -76.6% | -36.1% | -91.7% | -88.5% | -85.6% | -82.3% | -57.3% |
| VOC: urban | -72.1% | -73.0% | -50.4% | -72.4% | -87.8% | -88.1% | -88.1% | -84.8% |
| CO: urban | -80.0% | -80.0% | -79.6% | -80.0% | -78.9% | -78.3% | -80.1% | -80.1% |
| NOx: urban | -83.4% | -85.2% | -53.1% | -84.4% | 8.0% | 15.7% | -89.0% | -88.3% |
| PM10: urban | -42.9% | -47.9% | -33.1% | -42.7% | -41.8% | -46.6% | -48.9% | -48.8% |
| SOx: urban | -98.7% | -98.5% | -37.0% | -100.2% | -97.5% | -96.8% | -99.1% | -98.5% |

**Source:**
Wang, Michael, Q., model results of Beta Version of GREET 1.6, Argonne National Laboratory, Argonne, IL, August, 2001.

**Note:**
See page preceding Table 4.13 for acronym definitions.

*The average light truck pollutes 40% more than the average car, according to the American Council for an Energy-Efficient Economy. One reason for the difference is that cars and light trucks have not been held to the same emissions standards. However, that will be changing due to the new Tier 2 standards.*

**Table 4.14**
**Pollution from a Typical New Car and Light Truck, 2001 Model Year**
**(pounds of pollutant per 15,000 miles of travel)**

| | Car | Light truck |
|---|---|---|
| Carbon dioxide | 21,900 | 30,000 |
| Carbon monoxide | 195 | 218 |
| Nitrogen oxide | 34 | 48 |
| Hydrocarbons | 29 | 39 |
| Particulate matter | 3.4 | 4.4 |

**Source:**
DeCicco, John and James Kliesch, *Green Guide to Cars and Trucks: Model Year 2001*, American Council for an Energy-Efficient Economy, Washington, DC, 2001, p. 111. (Additional resources: www.aceee.org)

**Note:**
Includes both tailpipe and fuel-cycle emissions. Assumes 15,000 miles driven per year.

**Table 4.15**
**Tier 2 Emission Standards for Cars and Light Trucks**
**Effective for 2004–2009 Model Years[a]**
**(grams/mile)**

| Bin | NMOG | CO | NOx | PM | HCHO |
|---|---|---|---|---|---|
| | | | 50,000 miles | | |
| 10[b] | 0.125 | 3.4 | 0.4 | [c] | 0.015 |
| 9[b] | 0.075 | 3.4 | 0.2 | [a] | 0.015 |
| 8 | 0.100 | 3.4 | 0.14 | [a] | 0.015 |
| 7 | 0.075 | 3.4 | 0.11 | [a] | 0.015 |
| 6 | 0.075 | 3.4 | 0.08 | [a] | 0.015 |
| 5 | 0.075 | 3.4 | 0.05 | [a] | 0.015 |
| | | | 120,000 miles | | |
| MDPV[b] | 0.280 | 7.3 | 0.9 | 0.12 | 0.032 |
| 10[b] | 0.156 | 4.2 | 0.6 | 0.08 | 0.018 |
| 9[b] | 0.090 | 4.2 | 0.3 | 0.06 | 0.018 |
| 8 | 0.125 | 4.2 | 0.2 | 0.02 | 0.018 |
| 7 | 0.090 | 4.2 | 0.15 | 0.02 | 0.018 |
| 6 | 0.090 | 4.2 | 0.10 | 0.01 | 0.018 |
| 5 | 0.090 | 4.2 | 0.07 | 0.01 | 0.018 |
| 4 | 0.070 | 2.1 | 0.04 | 0.01 | 0.011 |
| 3 | 0.055 | 2.1 | 0.03 | 0.01 | 0.011 |
| 2 | 0.010 | 2.1 | 0.02 | 0.01 | 0.004 |
| 1 | 0.000 | 0.0 | 0.00 | 0.00 | 0.000 |

**Source:**
*Federal Register*, Vol. 65, No. 28, Thursday, February 10, 2000, pp. 6822–6870.

**Acronyms Used on Tables 4.15 and 4.16**

| | |
|---|---|
| CO | Carbon monoxide |
| GVW | Gross vehicle weight |
| HC | Hydrocarbons |
| HCHO | Formaldehyde |
| LDT | Light-duty truck |
| LEV | Low-emission vehicle |
| LVW | Loaded vehicle weight |
| MDPV | Medium-duty passenger vehicle |
| NMOG | Non-methane organic gases |
| NOx | Nitrogen oxides |
| PC | Passenger car |
| PM | Particulate matter |
| SULEV | Super-ultra-low-emission vehicle |
| ULEV | Ultra-low-emission vehicle |
| ZEV | Zero-emission vehicle |

[a]Some temporary standards are not shown.
[b]Bin expires after 2008.
[c]No standard.

**Table 4.16**
**Light Vehicle Exhaust Emission Standards in Effect in 2009**
**When U.S. Tier 2 Standards are Final**
**(grams/mile)**

Vehicle fuels: Gasoline AND diesel unless noted otherwise

Vehicle size: Up to 8,500 lbs GVW unless noted otherwise

| Useful life: | | 50,000 miles | | | | | | 120,000 miles | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bins, category, size | NMOG | CO | NOx | PM | HCHO | HC+NOx | NMOG | CO | NOx | PM | HCHO |
| Government: | | | | | | | | | | | | |
| U.S. | Bins | | | | | | | | | | | |
| | 8 | 0.100 | 3.4 | 0.14 | – | 0.015 | – | 0.125 | 4.2 | 0.20 | 0.02 | 0.018 |
| | 7 | 0.075 | 3.4 | 0.11 | – | 0.015 | – | 0.090 | 4.2 | 0.15 | 0.02 | 0.018 |
| | 6 | 0.075 | 3.4 | 0.08 | – | 0.015 | – | 0.090 | 4.2 | 0.10 | 0.01 | 0.018 |
| | 5 | 0.075 | 3.4 | 0.05 | – | 0.015 | – | 0.090 | 4.2 | 0.07 | 0.01 | 0.018 |
| | 4 | – | – | – | – | – | – | 0.070 | 2.1 | 0.04 | 0.01 | 0.011 |
| | 3 | – | – | – | – | – | – | 0.055 | 2.1 | 0.03 | 0.01 | 0.011 |
| | 2 | – | – | – | – | – | – | 0.010 | 2.1 | 0.02 | 0.01 | 0.004 |
| | 1 | – | – | – | – | – | – | 0.000 | 0.0 | 0.00 | 0.00 | 0.000 |
| | Average[a] | – | – | – | – | – | – | – | – | 0.07 | – | – |
| California | Category | | | (Diesel only) | | | | | | (Diesel only) | | |
| | LEV[b] | 0.075 | 3.4 | 0.05 | – | 0.015 | – | 0.090 | 4.2 | 0.07 | 0.01 | 0.018 |
| | ULEV | 0.04 | 1.7 | 0.05 | – | 0.08 | – | 0.055 | 2.1 | 0.07 | 0.01 | 0.011 |
| | SULEV | – | – | – | – | – | – | 0.010 | 1.0 | 0.02 | 0.01 | 0.004 |
| | ZEV[c] | 0.00 | 0.0 | 0.00 | – | 0.00 | – | 0.000 | 0.0 | 0.00 | 0.00 | 0.000 |
| | Avg. for all PCs + LDTs 0-3750 lbs LVW | 0.038 | – | – | – | – | – | – | – | – | – | – |
| | Avg. for LDTs 3751 lbs LVW - 8500 lbs GVW | 0.047 | – | – | – | – | – | – | – | – | – | – |

**Source:**
U.S.: *Federal Register*, Vol. 65, No. 28, Thursday, February 10, 2000, pp. 6822–6870.
*California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles*, as of December 1, 1999 (adopted August 5, 1999), incorporated by reference in section 1961(d), title 13, CCR.

**Note:**
See acronym list on previous page.

[a] Includes medium-duty passenger vehicles which are also required to meet bin standards.
[b] A LEV Option 1 with higher NOx levels also exists for up to 4% of LDTs above 3,750 lbs.
[c] Only apply to PCs and LDTs 0-3750 lbs LVW.

**Table 4.17**
**Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Vehicles *a,b***
**(grams per mile)**

| Engine Type & Pollutant | Prior to control | 1968-69 | 1970-71 | 1972 | 1973-74 | 1975-76 | 1977-79 | 1980 | 1981 | 1982-86 | 1987-93 | 1994-2004 *b* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gasoline** | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *c* | 2.2 | 3.4 | | 1.5 | | 0.41 | | | | 0.41 | (*e*) |
| Non-methane hydrocarbons | *d* | *e* | | | | | | | | | | 0.25 | (0.31) |
| Carbon monoxide | 80 | *c* | 23 | 39 | | 15 | | 7.0 | 3.4 | | | 3.4 | (4.2) |
| Cold-temp. Carbon monoxide*f* | *d* | *e* | | | | | | | | | | 10 | (*e*) |
| Nitrogen oxides | 4 | *e* | | | 3.0 | 3.1 | 2.0 | | 1.0 | | | 0.4 | (0.6) |
| Particulates | *d* | *e* | | | | | | | | | | 0.08 | (0.10) |
| **Diesel** | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *e* | | | | 1.5 | | 0.41 | | | | 0.41 | (*e*) |
| Non-methane hydrocarbons | *d* | *e* | | | | | | | | | | 0.25 | (0.31) |
| Carbon monoxide | 80 | *e* | | | | 15 | | 7.0 | 3.4 | | | 3.4 | (4.2) |
| Nitrogen oxides | 4 | | | | | 3.1 | 2.0 | | 1.0 | | | 1.0 | (1.25) |
| Particulates | *d* | *e* | | | | | | | | 0.60 | 0.20 | 0.08 | (0.10) |
| **Test Procedure** | | 7-mode | | CVS-72 | | CVS-75 | | | | | | | |
| **Useful Life (intermediate)[b]** | | *e* | | | | | | | | | | 5 yrs/50,000 mi | |
| **(full)** | | 5 yrs/50,000 mi | | | | | | | | | | 10 yrs/100,000 mi | |

**Source:**
40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86.090-8; 40 CFR 86.094-8; 40 CFR 86.096-2; 40 CFR 86.096-8; 40 CFR 86.098-8;40 CFR 86.099-8; 40 CFR 86.082-2; 40 CFR 86.000-8.
Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

---

[a]The test procedure for measuring exhaust emissions has changed several times over the course of vehicle emissions regulation. The 7-mode procedure was used through model year 1971 and was replaced by the CVS-72 procedure beginning in model year 1972. The CVS-75 became the test procedure as of model year 1975. While it may appear that the total hydrocarbon and carbon monoxide standards were relaxed in 1972-74, these standards were actually more stringent due to the more stringent nature of the CVS-72 test procedure. Additional standards for carbon monoxide and composite standards for non-methane hydrocarbons and nitrogen oxides tested over the new Supplemental Federal Test Procedure will be phased-in during model years 2000-02; these standards are not shown in this table.

[b]All emission standards must be met for a useful life of 5 years/50,000 miles. Beginning in with model year 1994, a second set of emission standards must also be met for a full useful life of 10 years/100,000 miles (these standards are shown in parentheses). Tier 1 exhaust standards were phased-in during 1994-96 at a rate of 40, 80, and 100 percent, respectively.

[c]In 1968-69, exhaust emission standards were issued in parts per million (ppm) rather than grams per mile and are, therefore, incompatible with this table.

[d]No estimate available.

[e]No standard set.

[f]The cold CO emission standard is measured at 20 degrees F (rather than 75 degrees F) and is applicable for a 5-year/50,000-mile useful life.

**Table 4.18**
**Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT1) *a,b,c***
**(grams per mile)**

| Engine Type & Pollutant | Prior to control | 1968-69 | 1970-71 | 1972 | 1973-74 | 1975 | 1976-78 | 1979-81 | 1982-83 | 1984 | 1985-86 | 1987 | 1988-93 | 1994 | 1995–2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gasoline** | | | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *d* | 2.2 | 3.4 | | 2.0 | | 1.7 | | 0.80 | | | | *f* (0.80) | |
| Non-methane hydrocarbons | *e* | *f* | | | | | | | | | | | | 0.25 (0.31) | |
| Carbon monoxide | 80 | *d* | 23 | 39 | | 20 | | 18 | | 10 | | | | 3.4 (4.2) | |
| Cold-temp. carbon monoxide *g* | *e* | *f* | | | | | | | | | | | | 10 (*f*) | |
| Nitrogen oxides | 4 | *f* | | | 3.0 | 3.1 | | 2.3 | | | | | 1.2 | 0.4 (0.6) | |
| Particulates | *e* | *f* | | | | | | | | | | | | | 0.08 (0.10) |
| **Diesel** | | | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *f* | | | | | 2.0 | 1.7 | | 0.80 | | | | *f* (0.80) | |
| Non-methane hydrocarbons | *e* | *f* | | | | | | | | | | | | 0.25 (0.31) | |
| Carbon monoxide | 80 | *f* | | | | | 20 | 18 | | 10 | | | | 3.4 (4.2) | |
| Nitrogen oxides | 4 | *f* | | | | | 3.1 | 2.3 | | | | | 1.2 | 1.0 (1.25) | |
| Particulates | *e* | *f* | | | | | | | 0.60 | | | 0.26 | | | 0.08 (0.10) |
| **LDT1 Weight Criteria *h*** | | GVWR up through 6,000 lbs | | | | | | GVWR up through 8,500 lbs | | | | | GVWR up through 6,000 lbs; LVW up through 3,750 lbs | | |
| **Test Procedure *b*** | | 7-mode | | CVS-72 | | CVS-75 | | | | | | | | | |
| **Useful Life (intermediate) *c*** | | *f* | | | | | | | | | | | | 5 yrs/50,000 mi | |
| **(full)** | | 5 yrs/50,000 mi | | | | | | | | | 11 yrs/120,000 mi | | | 11 yrs/120,000 mi | |

**Source:**
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86.090-9; 40 CFR 86.091-9; 40 CFR 86.094-9; 40 CFR 86.096-2; 40 CFR 86.096-9; 40 CFR 86.099-9; 40 CFR 86.000-9; 40 CFR 86.001-9; 40 CFR 86.004-9. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication.

---

[a]Light truck categories LDT1-LDT4 were not actually created until 1994. From 1968 to 1978 all trucks with a Gross Vehicle Weight Rating (GVWR) up to 6,000 lbs were classified as light trucks and were required to meet the same standards. As of 1979, the maximum weight was raised to 8,500 lbs GVWR. During 1988 through 1993, light trucks were divided into two subcategories that coincide with the current LDT1 and LDT2/3/4 categories.

[b]The test procedure for measuring exhaust emissions has changed several times over the course of vehicle emissions regulation. The 7-mode procedure was used through model year 1971 and was replaced by the CVS-72 procedure beginning in model year 1972. The CVS-75 became the test procedure as of model year 1975. While it may appear that the total hydrocarbon and carbon monoxide standards were relaxed in 1972-74, these standards were actually more stringent due to the more stringent nature of the CVS-72 test procedure. Additional standards for carbon monoxide and composite standards for non-methane hydrocarbons and nitrogen oxides tested over the new Supplemental Federal Test Procedure will be phased-in during model years 2000-02; these standards are not shown in this table.

[c]Emission standards had to be met for a useful life of 5 years/50,000 miles through model year 1983, and a full useful life of 11 years 120,000 miles was defined for 1985-93 (several useful life options were available for 1984). Beginning in model year 1994, emission standards were established for an intermediate useful life of 5 years/50,000 miles as well as a full useful life of 11 years/120,000 miles (these standards are shown in parentheses). Hydrocarbon standards, however, were established only for full useful life. Tier 1 exhaust standards, except PM standards, were phased-in during 1994-96 at a rate of 40, 80, and 100 percent, respectively. PM standards were phased-in at a rate of 40, 80, and 100 percent during 1995-97.

[d]In 1968-69, exhaust emission standards were issued in parts per million (ppm) rather than grams per mile and are, therefore, incompatible with this table.

[e]No estimate available.

[f]No standard set.

[g]The cold CO emission standard is measured at 20 degrees F (rather than 75 degrees F) and is applicable for a 5-year/50,000-mile useful life.

[h] Gross vehicle weight rating (GVWR) is the maximum design loaded weight. Loaded vehicle weight (LVW) is the curb weight (nominal vehicle weight) plus 300 lbs.

**Table 4.19**
**Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT2) *a,b,c***
**(grams per mile)**

| Engine Type & Pollutant | Prior to control | 1968-69 | 1970-71 | 1972 | 1973-74 | 1975 | 1976-78 | 1979-81 | 1982-83 | 1984 | 1985-86 | 1987 | 1988-90 | 1991-93 | 1994 | 1995–2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gasoline** | | | | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *d* | 2.2 | 3.4 | | 2.0 | | 1.7 | | 0.80 | | | | | *f* (0.80) | |
| Non-methane hydrocarbons | *e* | *f* | | | | | | | | | | | | | 0.32 (0.40) | |
| Carbon monoxide | 80 | *d* | 23 | 39 | | 20 | | 18 | | 10 | | | | | 4.4 (5.5) | |
| Cold-temp. carbon monoxide *g* | *e* | *f* | | | | | | | | | | | | | 12.5 (*f*) | |
| Nitrogen oxides | 4 | *f* | | | 3.0 | 3.1 | | 2.3 | | | | | 1.7 | | 0.7 (0.97) | |
| Particulates | *e* | *f* | | | | | | | | | | | | | | 0.08 (0.10) |
| **Diesel** | | | | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *f* | | | | | 2.0 | 1.7 | | 0.80 | | | | | *f* (0.80) | |
| Non-methane hydrocarbons | *e* | *f* | | | | | | | | | | | | | 0.32 (0.40) | |
| Carbon monoxide | 80 | *f* | | | | | 20 | 18 | | 10 | | | | | 4.4 (5.5) | |
| Nitrogen oxides | 4 | *f* | | | | | 3.1 | 2.3 | | | | | 1.7 | | *f* (0.97) | |
| Particulates | *e* | *f* | | | | | | | 0.60 | | | 0.50 | 0.45 | 0.13 | | 0.08 (0.10) |
| **LDT2 Weight Criteria *h*** | | GVWR up through 6,000 lbs | | | | | | GVWR up through 8,500 lbs | | | | | GVWR up through 5,000 lbs and LVW over 3,750 lbs | | | |
| **Test Procedure *b*** | | 7-mode | | CVS-72 | | CVS-75 | | | | | | | | | | |
| **Useful Life (intermediate) *c*** | | *f* | | | | | | | | | | | | | 5 yrs/50,000 mi | |
| **(full)** | | 5 yrs/50,000 mi | | | | | | | | | 11 yrs/120,000 mi | | | | 11 yrs/120,000 mi | |

**Source:**
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86.090-9; 40 CFR 86.091-9; 40 CFR 86.094-9; 40 CFR 86.096-2; 40 CFR 86.096-9; 40 CFR 86.099-9; 40 CFR 86.000-9; 40 CFR 86.001-9; 40 CFR 86.004-9. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

---

[a]Light truck categories LDT1-LDT4 were not actually created until 1994. From 1968 to 1978 all trucks with a Gross Vehicle Weight Rating (GVWR) up to 6,000 lbs were classified as light trucks and were required to meet the same standards. As of 1979, the maximum weight was raised to 8,500 lbs GVWR. During 1988-93, light trucks were divided into two subcategories that coincide with the current LDT1 and LDT2/3/4 categories.

[b]The test procedure for measuring exhaust emissions has changed several times over the course of vehicle emissions regulation. The 7-mode procedure was used through model year 1971 and was replaced by the CVS-72 procedure beginning in model year 1972. The CVS-75 became the test procedure as of model year 1975. While it may appear that the total hydrocarbon and carbon monoxide standards were relaxed in 1972-74, these standards were actually more stringent due to the more stringent nature of the CVS-72 test procedure. Additional standards for carbon monoxide and composite standards for non-methane hydrocarbons and nitrogen oxides tested over the new Supplemental Federal Test Procedure will be phased-in during model years 2000-02; these standards are not shown in this table.

[c]Emission standards had to be met for a useful life of 5 years/50,000 miles through model year 1983, and a full useful life of 11 years 120,000 miles was defined for 1985-93 (several useful life options were available for 1984). Beginning in model year 1994, emission standards were established for an intermediate useful life of 5 years/50,000 miles as well as a full useful life of 11 years/120,000 miles (these standards are shown in parentheses). Hydrocarbon standards, however, were established only for full useful life. Tier 1 exhaust standards, except PM standards, were phased-in during 1994-96 at a rate of 40, 80, and 100 percent, respectively. PM standards were phased-in at a rate of 40, 80, and 100 percent during 1995-97.

[d]In 1968-69, exhaust emission standards were issued in parts per million (ppm) rather than grams per mile and are, therefore, incompatible with this table.

[e]No estimate available.

[f]No standard set.

[g]The cold CO emission standard is measured at 20 degrees F (rather than 75 degrees F) and is applicable for a 5-year/50,000-mile useful life.

[h]Gross vehicle weight rating (GVWR) is the maximum design loaded weight. Loaded vehicle weight (LVW) is the curb weight (nominal vehicle weight) plus 300 lbs.

**Table 4.20**
**Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT3) *a,b,c***
**(grams per mile)**

| Engine Type & Pollutant | Prior to control | 1968-69 | 1970-71 | 1972 | 1973-74 | 1975 | 1976-78 | 1979-81 | 1982-83 | 1984 | 1985-86 | 1987 | 1988-89 | 1990 | 1991-95 | 1996–2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gasoline** | | | | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *d* | 2.2 | 3.4 | | 2.0 | | 1.7 | | 0.80 | | | | | | *f* (0.80) |
| Non-methane hydrocarbons | *e* | *f* | | | | | | | | | | | | | | 0.32 (0.46) |
| Carbon monoxide | 80 | *d* | 23 | 39 | | 20 | | 18 | | 10 | | | | | | 4.4 (6.4) |
| Cold-temp. carbon monoxide *g* | *e* | *f* | | | | | | | | | | | | | | 12.5 (*f*) |
| Nitrogen oxides | 4 | *f* | | | 3.0 | 3.1 | | 2.3 | | | | | 2.3 | 1.7 | | 0.7 (0.98) |
| Particulates | *e* | *f* | | | | | | | | | | | | | | *f* (0.10) |
| **Diesel** | | | | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *f* | | | | | 2.0 | 1.7 | | 0.80 | | | | | | *f* (0.80) |
| Non-methane hydrocarbons | *e* | *f* | | | | | | | | | | | | | | 0.32 (0.46) |
| Carbon monoxide | 80 | *f* | | | | | 20 | 18 | | 10 | | | | | | 4.4 (6.4) |
| Nitrogen oxides | 4 | *f* | | | | | 3.1 | 2.3 | | | | | 2.3 | 1.7 | | (0.98) |
| Particulates | *e* | *f* | | | | | | | 0.60 | | | 0.50 | 0.45 | | 0.13 | (0.10) |
| **LDT3 Weight Criteria** | | GVWR up through 6,000 lbs | | | | | | GVWR up through 8,500 lbs | | | | | Any ALW | | | ALW up through 5,750 lbs |
| | | | | | | | | | | | | | GVWR 6,001-8,500 lbs | | | |
| **Test Procedure *b*** | | 7-mode | | CVS-72 | | CVS-75 | | | | | | | | | | |
| **Useful Life (intermediate) *c*** | | *f* | | | | | | | | | | | | | | 5 yrs/50,000 mi |
| **(full)** | | 5 yrs/50,000 mi | | | | | | | | | 11 yrs/120,000 mi | | | | | 11 yrs/120,000 |

**Source:**
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86.090-9; 40 CFR 86.091-9; 40 CFR 86.094-9; 40 CFR 86.096-2; 40 CFR 86.096-9; 40 CFR 86.099-9; 40 CFR 86.000-9; 40 CFR 86.001-9; 40 CFR 86.004-9. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

---

[a]Light truck categories LDT1-LDT4 were not actually created until 1994. From 1968 to 1978 all trucks with a Gross Vehicle Weight Rating (GVWR) up to 6,000 lbs were classified as light trucks and were required to meet the same standards. As of 1979, the maximum weight was raised to 8,500 lbs GVWR. During 1988-93, light trucks were divided into two subcategories that coincide with the current LDT1 and LDT2/3/4 categories.

[b]The test procedure for measuring exhaust emissions has changed several times over the course of vehicle emissions regulation. The 7-mode procedure was used through model year 1971 and was replaced by the CVS-72 procedure beginning in model year 1972. The CVS-75 became the test procedure as of model year 1975. While it may appear that the total hydrocarbon and carbon monoxide standards were relaxed in 1972-74, these standards were actually more stringent due to the more stringent nature of the CVS-72 test procedure. Additional standards for carbon monoxide and composite standards for non-methane hydrocarbons and nitrogen oxides tested over the new Supplemental Federal Test Procedure will be phased-in during model years 2002-04; these standards are not shown in this table.

[c]Emission standards had to be met for a full useful life of 5 years/50,000 miles through model year 1983, and a full useful life of 11 years 120,000 miles was defined for 1985-93 (several useful life options were available for 1984). Beginning in model year 1996, emission standards were established for an intermediate useful life of 5 years/50,000 miles as well as a full useful life of 11 years/120,000 miles (these standards are shown in parentheses). This applied to all pollutants except hydrocarbons and particulates for all LDT3s and NOx for diesel-powered LDT3s, which were only required to meet full useful life standards. Tier 1 exhaust standards were phased-in during 1996-97 at a rate of 50 and 100 percent, respectively.

[d]In 1968-69, exhaust emission standards were issued in parts per million (ppm) rather than grams per mile and are, therefore, incompatible with this table.

[e]No estimate available.

[f]No standard set.

[g]The cold CO emission standard is measured at 20 degrees F (rather than 75 degrees F) and is applicable for a 5-year/50,000-mile useful life.

[h]Gross vehicle weight rating (GVWR) is the maximum design loaded weight. Loaded vehicle weight (LVW) is the curb weight (nominal vehicle weight) plus 300 lbs.

**Table 4.21**
**Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT4) *a,b,c***
**(grams per mile)**

| Engine Type & Pollutant | Prior to control | 1968-69 | 1970-71 | 1972 | 1973-74 | 1975 | 1976-78 | 1979-81 | 1982-83 | 1984 | 1985-86 | 1987 | 1988-89 | 1990 | 1991-95 | 1996–2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gasoline** | | | | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *d* | 2.2 | 3.4 | | 2.0 | | 1.7 | | 0.80 | | | | | | *f* (0.80) |
| Non-methane hydrocarbons | *e* | *f* | | | | | | | | | | | | | | 0.39 (0.56) |
| Carbon monoxide | 80 | *d* | 23 | 39 | | 20 | | 18 | | 10 | | | | | | 5.0 (7.3) |
| Cold-temp. carbon monoxide *g* | *e* | *f* | | | | | | | | | | | | | | 12.5 (*f*) |
| Nitrogen oxides | 4 | *f* | | | 3.0 | 3.1 | | 2.3 | | | | | 2.3 | 1.7 | | 1.1 (1.53) |
| Particulates | *e* | *f* | | | | | | | | | | | | | | *f* (0.12) |
| **Diesel** | | | | | | | | | | | | | | | | |
| Hydrocarbons (total) | 11 | *f* | | | | | 2.0 | 1.7 | | 0.80 | | | | | | *f* (0.80) |
| Non-methane hydrocarbons | *e* | *f* | | | | | | | | | | | | | | 0.39 (0.56) |
| Carbon monoxide | 80 | *f* | | | | | 20 | 18 | | 10 | | | | | | 5.0 (7.3) |
| Nitrogen oxides | 4 | *f* | | | | | 3.1 | 2.3 | | | | | 2.3 | 1.7 | | *f* (1.53) |
| Particulates | *e* | *f* | | | | | | | 0.60 | | | 0.50 | 0.45 | | 0.13 | *f* (0.12) |
| **LDT4 Weight Criteria *h*** | | GVWR up through 6,000 lbs | | | | | | GVWR up through 8,500 lbs | | | | | Any ALVW | | | ALVW over 5,750 lbs |
| | | | | | | | | | | | | | GVWR 6,001-8,500 lbs | | | |
| **Test Procedure *b*** | | 7-mode | | CVS-72 | | CVS-75 | | | | | | | | | | |
| **Useful Life (intermediate) *c*** | | *f* | | | | | | | | | | | | | | 5 yrs/50,000 mi |
| **(full)** | | 5 yrs/50,000 mi | | | | | | | | | 11 yrs/120,000 mi | | | | | 11 yrs/120,000 |

**Source:**
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86.090-9; 40 CFR 86.091-9; 40 CFR 86.094-9; 40 CFR 86.096-2; 40 CFR 86.096-9; 40 CFR 86.099-9; 40 CFR 86.000-9; 40 CFR 86.001-9; 40 CFR 86.004-9. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

---

[a]Light truck categories LDT1-LDT4 were not actually created until 1994. From 1968 to 1978 all trucks with a Gross Vehicle Weight Rating (GVWR) up to 6,000 lbs were classified as light trucks and were required to meet the same standards. As of 1979, the maximum weight was raised to 8,500 lbs GVWR. During 1988-93, light trucks were divided into two subcategories that coincide with the current LDT1 and LDT2/3/4 categories.

[b]The test procedure for measuring exhaust emissions has changed several times over the course of vehicle emissions regulation. The 7-mode procedure was used through model year 1971 and was replaced by the CVS-72 procedure beginning in model year 1972. The CVS-75 became the test procedure as of model year 1975. While it may appear that the total hydrocarbon and carbon monoxide standards were relaxed in 1972-74, these standards were actually more stringent due to the more stringent nature of the CVS-72 test procedure. Additional standards for carbon monoxide and composite standards for non-methane hydrocarbons and nitrogen oxides tested over the new Supplemental Federal Test Procedure will be phased-in during model years 2002-04; these standards are not shown in this table.

[c]Emission standards had to be met for a full useful life of 5 years/50,000 miles through model year 1983, and a full useful life of 11 years 120,000 miles was defined for 1985-93 (several useful life options were available for 1984). Beginning in model year 1996, emission standards were established for an intermediate useful life of 5 years/50,000 miles as well as a full useful life of 11 years/120,000 miles (these standards are shown in parentheses). This applied to all pollutants except hydrocarbons and particulates for all LDT3s and NOx for diesel-powered LDT3s, which were only required to meet full useful life standards. Tier 1 exhaust standards were phased-in during 1996-97 at a rate of 50 and 100 percent, respectively.

[d]In 1968-69, exhaust emission standards were issued in parts per million (ppm) rather than grams per mile and are, therefore, incompatible with this table.

[e]No estimate available.

[f]No standard set.

[g]The cold CO emission standard is measured at 20 degrees F (rather than 75 degrees F) and is applicable for a 5-year/50,000-mile useful life.

[h]Gross vehicle weight rating (GVWR) is the maximum design loaded weight. Adjusted loaded vehicle weight (ALVW) is the numerical average of the GVWR and the curb weight.

## Table 4.22
## Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Heavy Trucks
## (Grams per brake horsepower-hour)

| Engine Type & Pollutant | 1970-73 | 1974-78 | 1979-83 | 1984 | 1985-86 | 1987 | 1988-89 | 1990 | 1991-93 | 1994-97 | 1998-2003 | 2004+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gasoline** | | | | | | | | | | | | |
| Hydrocarbons + nitrogen oxides (HC + NOx) | *a* | 16 | 10 | | *a* | | | | | | | |
| Hydrocarbons (HC) | *b* | *a* | 1.5 | | 1.9 | 1.1 | | | | | | |
| Nitrogen oxides (NOx) | *a* | | | | 10.6 | | | 6.0 | 5.0 | | 4.0 | |
| Carbon Monoxide (CO) | *b* | 40 | 25 | | 37.1 | 14.4 | | | | | | |
| **Diesel** | | | | | | | | | | | | |
| Hydrocarbons + nitrogen oxides (HC + NOx) | *a* | 16 | 10 | *a* | | | | | | | | |
| Hydrocarbons (HC) | *b* | *a* | 1.5 | 1.3 | | | | | | | | |
| Nitrogen oxides (NOx) | *a* | | | 10.7 | | | | 6.0 | 5.0 | | 4.0 | |
| Non-methane hydrocarbons + nitrogen oxides | *a* | | | | | | | | | | | 2.4 |
| Carbon Monoxide (CO) | *b* | 40 | 25 | 15.5 | | | | | | | | |
| Particulates | *a* | | | | | | 0.60 | | 0.25 | 0.10 | | |
| Smoke Opacity (acceleration/lugging/peak) *d* | 40/20/*a* | 20/15/50 | | | | | | | | | | |
| **Weight Criteria for Light Heavy Trucks *e*** | GVWR over 6,000 lbs | | GVWR over 8,500 lbs | | | GVWR 8,501 through 14,000 lbs | | | | | | |
| **Test Procedure (gasoline) *f*** | 9-mode steady-state | | | | MVMA transient | | | | | | | |
| **(diesel) *f*** | 13-mode steady-state | | | EPA transient | | | | | | | | |
| **Useful Life (gasoline) *g*** | 5 years/50,000 miles | | | | 8 years/110,000 miles | | | | | | | |

**Sources:**
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.088-10; 40 CFR 86.090-2; 40 CFR 86.090-10; 40 CFR 86.090-11; 40 CFR 86.091-10; 40 CFR 86.091-11; 40 CFR 86.093-11; 40 CFR 86.094-11; 40 CFR 86.096-2; 40 CFR 86.096-10; 40 CFR 86.096-11; 40 CFR 86.098-10; 40 CFR 86.098-11; 40 CFR 86.099-10; 40 CFR 86.099-11; 40 CFR 86.004-11; 40 CFR 86.004-15. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999. Rob French, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

---

[a]No standard set

[b]Although emission standards for hydrocarbons and carbon monoxide were in effect for these years, they were not measured in grams/brake horsepower-hour and are, therefore, incompatible with this table.

[c]Vehicles can meet a composite non-methane hydrocarbons and nitrogen oxides standard of 2.5, if they meet a non-methane hydrocarbon standard of no more than 0.5.

[d]Smoke opacity is expressed in percentage for acceleration, lugging, and peak modes (acceleration/lugging/peak). Lugging is when a vehicle is carrying a load.

[e]Gross vehicle weight rating (GVWR) is the maximum design loaded weight.

[f]Several testing procedures have been used during the course of exhaust emission control. A steady-state 9-mode test procedure (13-mode for diesel) was used for 1970-83 standards. For 1984, either the steady-state tests or the EPA transient test procedure could be used. For diesels, the EPA transient test was required from 1985 to the present. For gasoline-powered vehicles, either either the EPA or MVMA (Motor Vehicle Manufacturers Association) transient test procedure could be used during 1985-86, and the MVMA procedure was required thereafter.

[g]Emissions standards apply to the useful life of the vehicle. Useful life was 5 years/50,000 miles through 1983, and 8 years/110,000 miles for model year 1985 and after. 1984 was a transitional year in which vehicles could meet the older standard (and test procedure) or the newer one. Useful life requirement for gasoline-powered trucks meeting NOx standards for 1998 and after is *10* years/110,000 miles. The useful life requirements for heavy diesel truck standards are more complex and vary by vehicle weight, pollutant, test procedure, and year. Consult the U.S. Code of Federal Regulations for further information.

**Table 4.23**
**Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Heavy Heavy Trucks**
**(Grams per brake horsepower-hour)**

| Engine Type & Pollutant | 1970-73 | 1974-78 | 1979-83 | 1984 | 1985-86 | 1987 | 1988-89 | 1990 | 1991-93 | 1994-97 | 1998-2003 | 2004+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gasoline** | | | | | | | | | | | | |
| Hydrocarbons + nitrogen oxides (HC + NOx) | *a* | 16 | 10 | | *a* | | | | | | | |
| Hydrocarbons (HC) | *b* | *a* | 1.5 | | 1.9 | | | | | | | |
| Nitrogen oxides (NOx) | *a* | | | | 10.6 | | | 6.0 | 5.0 | | 4.0 | |
| Carbon Monoxide (CO) | *b* | 40 | 25 | | 37.1 | | | | | | | |
| **Diesel** | | | | | | | | | | | | |
| Hydrocarbons + nitrogen oxides (HC + NOx) | *a* | 16 | 10 | *a* | | | | | | | | |
| Hydrocarbons (HC) | *b* | *a* | 1.5 | 1.3 | | | | | | | | |
| Nitrogen oxides (NOx) | *a* | | | 10.7 | | | | 6.0 | 5.0 | | 4.0 | |
| Non-methane hydrocarbons + nitrogen oxides | *a* | | | | | | | | | | | 2.4*c* |
| Carbon Monoxide (CO) | *b* | 40 | 25 | 15.5 | | | | | | | | |
| Particulates | *a* | | | | | | 0.60 | | 0.25 | 0.10 | | |
| Smoke Opacity (acceleration/lugging/peak) *d* | 40/20/*a* | 20/15/50 | | | | | | | | | | |
| **Weight Criteria for Heavy Heavy Trucks *e*** | GVWR over 6,000 lbs | | GVWR over 8,500 lbs | | | GVWR over 14,000 lbs | | | | | | |
| **Test Procedure (gasoline) *f*** | 13-mode steady-state | | | | MVMA | | | | | | | |
| **(diesel) *f*** | 13-mode steady-state | | | EPA transient | | | | | | | | |
| **Useful Life (gasoline) *g*** | 5 years/50,000 miles | | | | 8 years/110,000 miles | | | | | | | |

**Sources:**
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.088-10; 40 CFR 86.090-2; 40 CFR 86.090-10; 40 CFR 86.090-11; 40 CFR 86.091-10; 40 CFR 86.091-11; 40 CFR 86.093-11; 40 CFR 86.094-11; 40 CFR 86.096-2; 40 CFR 86.096-10; 40 CFR 86.096-11; 40 CFR 86.098-10; 40 CFR 86.098-11; 40 CFR 86.099-10; 40 CFR 86.099-11; 40 CFR 86.004-11; 40 CFR 86.004-15. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999. Rob French, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

[a]No standard set.

[b]Although emission standards for hydrocarbons and carbon monoxide were in effect for these years, they were not measured in grams/brake horsepower-hour and are, therefore, incompatible with this table.

[c]Vehicles can meet a composite non-methane hydrocarbons and nitrogen oxides standard of 2.5, if they meet a non-methane hydrocarbon standard of no more than 0.5.

[d]Smoke opacity is expressed in percentage for acceleration, lugging, and peak modes (acceleration/lugging/peak). Lugging is when a vehicle is carrying a load.

[e]Gross vehicle weight rating (GVWR) is the maximum design loaded weight.

[f]Several testing procedures have been used during the course of exhaust emission control. A steady-state 9-mode test procedure (13-mode for diesel) was used for 1970-83 standards. For 1984, either the steady-state tests or the EPA transient test procedure could be used. For diesels, the EPA transient test was required from 1985 to the present. For gasoline-powered vehicles, either either the EPA or MVMA (Motor Vehicle Manufacturers Association) transient test procedure could be used during 1985-86, and the MVMA procedure was required thereafter.

[g]Emissions standards apply to the useful life of the vehicle. Useful life was 5 years/50,000 miles through 1983, and 8 years/110,000 miles for model year 1985 and after. 1984 was a transitional year in which vehicles could meet the older standard (and test procedure) or the newer one. Useful life requirement for gasoline-powered trucks meeting NOx standards for 1998 and after is *10* years/110,000 miles. The useful life requirements for heavy diesel truck standards are more complex and vary by vehicle weight, pollutant, test procedure, and year. Consult the U.S. Code of Federal Regulations for further information.

**Table 4.24**
***California* Passenger Cars and Light Trucks Emission Certification Standards**
**(grams/mile)**

| Vehicle Type | Emission Category | Vehicle Useful Life: 5 Years / 50,000 Miles | | | | | | | Vehicle Useful Life: 10 Years / 100,000 Miles | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | THC[a] | NMHC[b] | NMOG[c] | CO | $NO_X$ | PM | HCHO | THC[a] | NMHC[b] | NMOG[c] | CO | $NO_X$ | PM | HCHO |
| Passenger car | Tier 0 | – | 0.39 | – | 7.0 | 0.4 | 0.08[d] | 0.015[e] | | | | | | | |
| | Tier 1 | – | 0.25 | – | 3.4 | 0.4 | 0.08[d] | 0.015[e] | – | 0.31 | – | 4.2 | 0.6 | – | – |
| | TLEV | – | – | 0.125 | 3.4 | 0.4 | – | 0.015 | – | – | 0.156 | 4.2 | 0.6 | 0.08[d] | 0.018 |
| | LEV | – | – | 0.075 | 3.4 | 0.2 | – | 0.015 | – | – | 0.090 | 4.2 | 0.3 | 0.08[d] | 0.018 |
| | ULEV | – | – | 0.040 | 1.7 | 0.2 | – | 0.008 | – | – | 0.055 | 2.1 | 0.3 | 0.04[d] | 0.011 |
| | ZEV | 0.0 | 0.00 | 0.000 | 0.0 | 0.0 | 0.00 | 0.000 | 0.00 | 0.00 | 0.000 | 0.0 | 0.0 | 0.00 | 0.000 |
| LDT1 | Tier 0 | – | 0.39 | – | 9.0 | 0.4 | 0.08[d] | 0.015[e] | | | | | | | |
| | Tier 1 | – | 0.25 | – | 3.4 | 0.4 | 0.08[d] | 0.015[e] | – | 0.31 | – | 4.2 | 0.6 | – | – |
| | TLEV | – | – | 0.125 | 3.4 | 0.4 | – | 0.015 | – | – | 0.156 | 4.2 | 0.6 | 0.08[d] | 0.018 |
| | LEV | – | – | 0.075 | 3.4 | 0.2 | – | 0.015 | – | – | 0.090 | 4.2 | 0.3 | 0.08[d] | 0.018 |
| | ULEV | – | – | 0.040 | 1.7 | 0.2 | – | 0.008 | – | – | 0.055 | 2.1 | 0.3 | 0.04[d] | 0.011 |
| | ZEV | 0.0 | 0.00 | 0.000 | 0.0 | 0.0 | 0.00 | 0.000 | 0.00 | 0.00 | 0.000 | 0.0 | 0.0 | 0.00 | 0.000 |
| LDT2 | Tier 0 | – | 0.50 | – | 9.0 | 1.0 | 0.08[d] | 0.018[e] | | | | | | | |
| | Tier 1 | – | 0.32 | – | 4.4 | 0.7 | 0.08[d] | 0.018[e] | – | 0.40 | – | 5.5 | 0.97 | – | – |
| | TLEV | – | – | 0.160 | 4.4 | 0.7 | – | 0.018 | – | – | 0.200 | 5.5 | 0.9 | 0.10[d] | 0.023 |
| | LEV | – | – | 0.100 | 4.4 | 0.4 | – | 0.018 | – | – | 0.130 | 5.5 | 0.5 | 0.10[d] | 0.023 |
| | ULEV | – | – | 0.050 | 2.2 | 0.4 | – | 0.009 | – | – | 0.070 | 2.8 | 0.5 | 0.05[d] | 0.013 |

**Source:**
U.S. Environmental Protection Agency, Office of Transportation and Air Quality, EPA 420-B-00-001. (Additional resources: www.epa.gov/otag)
**Note:**
LDT1 = light truck up through 3,750 lbs. loaded vehicle weight; LDT2 = light truck greater than 3,750 lbs. loaded vehicle weight.

[a] THCE for methanol vehicles. Does not apply to CNG vehicles.
[b] THCE for Tier 0 methanol vehicles. NMHCE for other alcohol vehicles.
[c] NMHC for diesel-fueled vehicles.
[d] Diesel-fueled vehicles only.
[e] Ethanol- and methanol-fueled vehicles only.

*California's Low-Emission Vehicle regulations provide for reduced emission vehicles to be available to consumers. Vehicles meeting these standards have even lower emissions than the basic Tier 1 standards for all new vehicles sold in California. Currently, there is a wide array of TLEVs and LEVs, and a few ULEVs, SULEVs and ZEVs on the market. For a listing of the available low emission vehicles, see the California Air Resources Board web site referenced below.*

**Table 4.25**
**California Vehicle Emission Reduction for Passenger Cars and Light Trucks**

| | Emission reduction from Tier 1 California standards[a] | | |
|---|---|---|---|
| | HC | CO | NOx |
| Transitional Low-Emission Vehicle (TLEV) | 50% | = | = |
| Low-Emission Vehicle (LEV) | 70% | = | 50% |
| Ultra-Low-Emission Vehicle (ULEV) | 85% | 50% | 50% |
| Super-Ultra-Low-Emission Vehicle (SULEV) | 96% | 70% | 95% |
| Zero-Emission Vehicles (ZEV) | 100% | 100% | 100% |

**Source:**
California Air Resources Board web site, www.arb.ca.gov/msprog/ccbg/ccbg.htm
(Additional resources: www.arb.ca.gov)

**Note:**
= indicates equivalent emissions to vehicles meeting the Tier 1 California standard.

[a]See Table 4.24.

# Chapter 5

# Transportation and the Economy

Summary Statistics from Tables/Figures in this Chapter

| Source | | |
|---|---|---|
| Figure 5.1 | Share of gasoline cost attributed to taxes, 1999 | |
| | *Canada* | *49%* |
| | *France* | *79%* |
| | *Germany* | *76%* |
| | *Japan* | *60%* |
| | *United Kingdom* | *76%* |
| | *United States* | *33%* |
| Table 5.11 | Average price of a new car, 1999 (current dollars) | 21,022 |
| | *Domestic* | *18,725* |
| | *Import* | *30,350* |
| Table 5.12 | Automobile operating costs, 2000 | |
| | *Variable costs (constant 1999 dollars per 10,000 miles)* | *1,219* |
| | *Fixed costs (constant 1999 dollars per 10,000 miles)* | *4,376* |
| Table 5.18 | Transportation sector share of total employment | |
| | *1960* | *13.5%* |
| | *1980* | *11.4%* |
| | *1999* | *11.0%* |

**Table 5.1**
**Gasoline Prices for Selected Countries, 1978–2000**

| | Current dollars per gallon | | | | | | | | Average annual percentage change | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1978[a] | 1982[a] | 1986[a] | 1990[b] | 1994[b] | 1996[b] | 1999[b] | 2000[b] | 1978–2000 | 1990–2000 |
| China | [c] | [c] | [c] | [c] | [c] | 0.93 | 1.05 | 1.44 | [c] | [c] |
| India | [c] | [c] | [c] | 1.92 | 2.28 | 2.25 | 2.48 | [c] | [c] | [c] |
| Japan | 2.00 | 2.60 | 2.79 | 3.05 | 4.14 | 3.77 | 3.13 | 3.65 | 2.8% | 1.8% |
| France | 2.15 | 2.56 | 2.58 | 3.40 | 3.31 | 4.41 | 3.79 | 4.01 | 2.9% | 1.7% |
| United Kingdom | 1.22 | 2.42 | 2.07 | 2.55 | 2.86 | 3.47 | 3.97 | 5.13 | 6.7% | 7.2% |
| Germany | 1.75 | 2.17 | 1.88 | 2.72 | 3.34 | 4.32 | 3.36 | 3.78 | 3.6% | 3.3% |
| Canada | 0.69 | 1.37 | 1.31 | 1.92 | 1.57 | 1.80 | 1.54 | 2.04 | 5.1% | 0.6% |
| United States[d] | 0.66 | 1.32 | 0.93 | 1.04 | 1.24 | 1.28 | 1.13 | 1.47 | 3.7% | 3.5% |

| | Constant 1999 dollars[e] per gallon | | | | | | | | Average annual percentage change | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1978[a] | 1982[a] | 1986[a] | 1990[b] | 1994[b] | 1996[b] | 1999[b] | 2000[b] | 1978–2000 | 1990–2000 |
| China | [c] | [c] | [c] | [c] | [c] | 0.99 | 1.05 | 1.39 | [c] | [c] |
| India | [c] | [c] | [c] | 2.45 | 2.56 | 2.39 | 2.48 | [c] | [c] | [c] |
| Japan | 5.11 | 4.49 | 4.24 | 3.89 | 4.65 | 4.00 | 3.13 | 3.53 | -1.7% | -1.0% |
| France | 5.49 | 4.42 | 3.92 | 4.33 | 3.72 | 4.68 | 3.79 | 3.88 | -1.6% | -1.1% |
| United Kingdom | 3.12 | 4.18 | 3.15 | 3.25 | 3.22 | 3.68 | 3.97 | 4.96 | 2.1% | 4.3% |
| Germany | 4.47 | 3.75 | 2.86 | 3.47 | 3.75 | 4.59 | 3.36 | 3.66 | -0.9% | 0.5% |
| Canada | 1.76 | 2.37 | 1.99 | 2.45 | 1.76 | 1.91 | 1.54 | 1.97 | 0.5% | -2.2% |
| United States[d] | 1.69 | 2.28 | 1.41 | 1.33 | 1.39 | 1.36 | 1.13 | 1.42 | -0.8% | 0.7% |

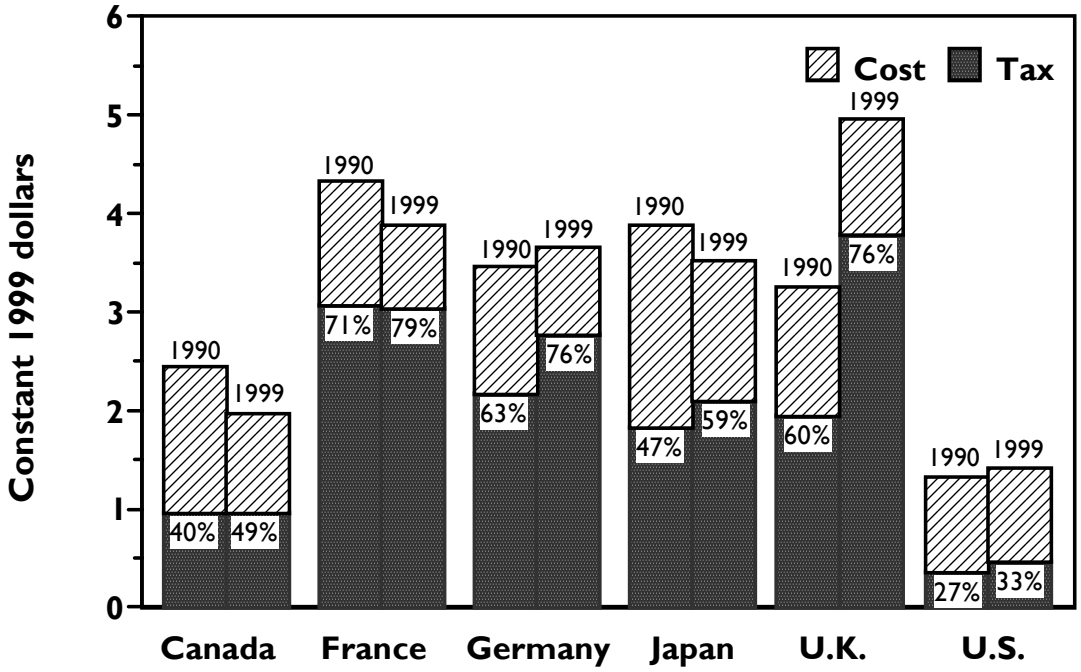
**Source:**
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1999*, Washington, DC, February 2001, Table 7.2 and annual.
(Additional resources: ww.eia.doe.gov)

**Note:**
Comparisons between prices and price trends in different countries require care. They are of limited validity because of fluctuations in exchange rates; differences in product quality, marketing practices, and market structures; and the extent to which the standard categories of sales are representative of total national sales for a given period.

[a] Prices represent the retail prices (including taxes) for premium leaded gasoline. Prices are representative for each country based on quarterly data averaged for the year.
[b] Regular gasoline.
[c] Data are not available.
[d] These estimates are for international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.
[e] Adjusted by the U.S. Consumer Price Inflation Index.

*In 1998 more than seventy percent of the cost of gasoline in France, Germany, and the United Kingdom went for taxes. Of these countries, the U.S. has the lowest percentage of taxes.*

**Figure 5.1. Gasoline Prices for Selected Countries, 1990 and 1999**




**Source:**
Table 5.1 and International Energy Agency, *Energy Prices and Taxes, Fourth Quarter 1999*, Paris, France, 2000. (Additional resources: www.iea.org)

**Table 5.2**
**Diesel Fuel Prices for Selected Countries, 1978–2000[a]**

| | Current dollars per gallon | | | | | | | | Average annual percentage change | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1978 | 1982 | 1986 | 1990 | 1994 | 1996 | 1999 | 2000 | 1978–2000 | 1990–2000 |
| China | [b] | [b] | [b] | [b] | [b] | 0.88 | 2.73 | 1.30 | [b] | [b] |
| India | [b] | [b] | [b] | 0.78 | 0.74 | 0.92 | 1.15 | [b] | [b] | [b] |
| Japan | [b] | 1.78 | 1.90 | 1.75 | 2.48 | 2.51 | 1.95 | 2.89 | [b] | 5.5% |
| France | 1.30 | 1.88 | 1.69 | 1.78 | 2.10 | 3.10 | 2.23 | 3.05 | 4.0% | 8.9% |
| United Kingdom | 1.24 | 2.05 | 1.71 | 2.04 | 2.46 | 3.26 | 3.47 | 4.77 | 6.3% | 0.6% |
| Germany | 1.48 | 1.81 | 1.51 | 2.72 | 2.16 | 3.02 | 2.03 | 2.90 | 3.1% | 0.8% |
| Canada | [b] | 1.27 | 1.27 | 1.55 | 1.47 | 1.43 | 1.32 | 1.68 | [b] | 0.8% |
| United States[c] | 0.54 | 1.16 | 0.94 | 0.99 | 0.96 | 1.15 | 0.97 | 1.36 | 4.3% | 3.2% |

| | Constant 1999 dollars[d] per gallon | | | | | | | | Average annual percentage change | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1978 | 1982[a] | 1986[a] | 1990[b] | 1994[b] | 1996[b] | 1999[b] | 2000[b] | 1978–2000 | 1990–2000 |
| China | [b] | [b] | [b] | [b] | [b] | 0.93 | 2.73 | 1.26 | [b] | [b] |
| India | [b] | [b] | [b] | 0.99 | 0.83 | 0.98 | 1.15 | [b] | [b] | [b] |
| Japan | [b] | 3.07 | 2.89 | 2.23 | 2.79 | 2.67 | 1.95 | 2.80 | [b] | 2.3% |
| France | 3.32 | 3.25 | 2.57 | 2.27 | 2.36 | 3.29 | 2.23 | 2.95 | -0.5% | 2.7% |
| United Kingdom | 3.17 | 3.54 | 2.60 | 2.60 | 2.77 | 3.46 | 3.47 | 4.61 | 1.7% | 5.9% |
| Germany | 3.78 | 3.12 | 2.30 | 3.47 | 2.43 | 3.21 | 2.03 | 2.81 | -1.3% | -2.1% |
| Canada | [b] | 2.19 | 1.93 | 1.98 | 1.65 | 1.52 | 1.32 | 1.63 | [b] | -1.9% |
| United States[c] | 1.38 | 2.00 | 1.43 | 1.26 | 1.08 | 1.22 | 0.97 | 1.32 | -0.2% | -0.4% |

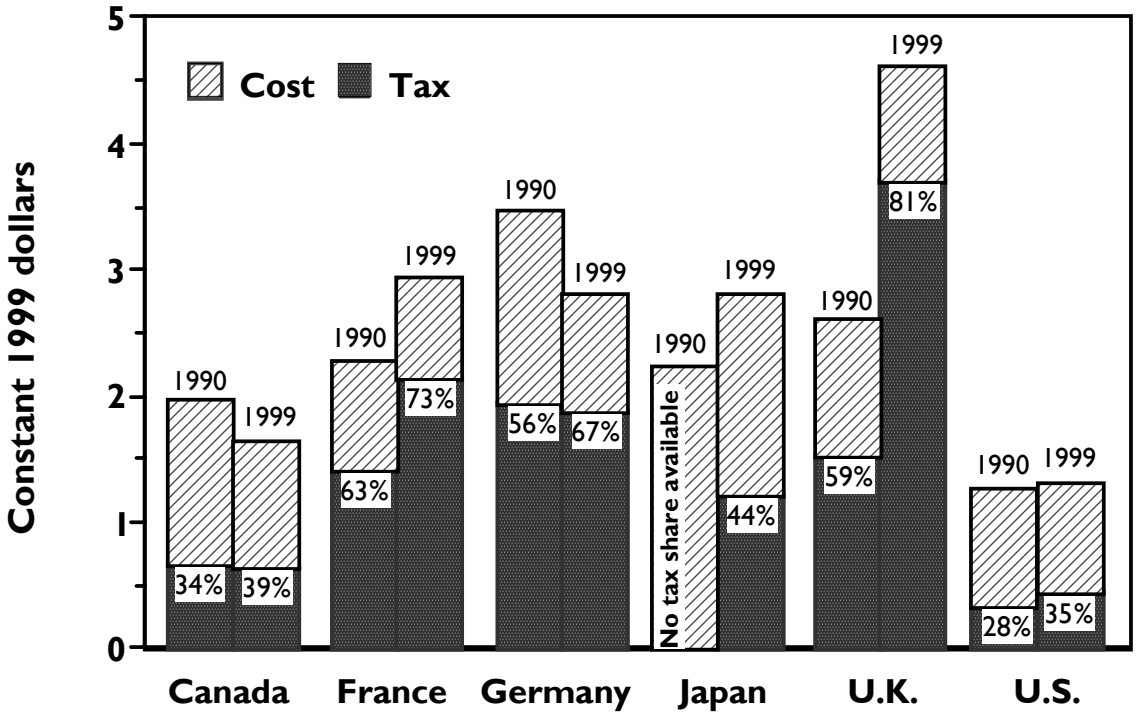
**Source:**
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1999*, Washington, DC, February 2001, Table 7.2 and annual. (Additional resources: www.eia.doe.gov)

**Note:**
Comparisons between prices and price trends in different countries require care. They are of limited validity because of fluctuations in exchange rates; differences in product quality, marketing practices, and market structures; and the extent to which the standard categories of sales are representative of total national sales for a given period.

[a] Prices represent the retail prices (including taxes) for diesel fuel. Prices are representative for each country based on quarterly data averaged for the year or on data as of January 1.
[b] Data are not available.
[c] These estimates are for international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.
[d] Adjusted by the U.S. Consumer Price Inflation Index.

*Diesel fuel is taxed heavily in the European countries shown here. The U.S. diesel fuel tax share is the lowest of the listed countries.*

**Figure 5.2. Diesel Prices for Selected Countries, 1990 and 1999**




**Source:**
Table 5.2 and International Energy Agency, *Energy Prices and Taxes, Fourth Quarter 1999*, Paris, France, 2000. (Additional resources: www.iea.org)

*Though the cost of crude oil certainly influences the price of gasoline, it is not the only factor which determines the price at the pump. Processing cost, transportation cost, and taxes also play a major part of the cost of a gallon of gasoline. The average price of a barrel of crude oil (in constant 1999 dollars) more than doubled from 1998 to 2000, while the average price of a gallon of gasoline increased only 33% in this same time period.*

**Table 5.3**
**Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978–2000**

| | Crude oil[a] (dollars per barrel) | | Gasoline[b] (cents per gallon) | | Ratio of gasoline to crude oil |
|---|---|---|---|---|---|
| Year | Current | Constant1999[c] | Current | Constant 1999[c] | |
| 1978 | 12.5 | 31.8 | 65.2 | 166.5 | 219.8 |
| 1979 | 17.7 | 40.7 | 88.2 | 202.4 | 209.1 |
| 1980 | 28.1 | 56.8 | 122.1 | 246.9 | 182.7 |
| 1981 | 35.2 | 64.6 | 135.3 | 247.9 | 161.3 |
| 1982 | 31.9 | 55.0 | 128.1 | 221.1 | 168.8 |
| 1983 | 29.0 | 48.5 | 122.5 | 204.9 | 177.5 |
| 1984 | 28.6 | 45.9 | 119.8 | 192.2 | 175.7 |
| 1985 | 26.8 | 41.4 | 119.6 | 185.2 | 187.8 |
| 1986 | 14.6 | 22.1 | 93.1 | 141.5 | 268.7 |
| 1987 | 17.9 | 26.2 | 95.7 | 140.3 | 224.5 |
| 1988 | 14.7 | 20.7 | 96.3 | 135.6 | 275.7 |
| 1989 | 18.0 | 24.2 | 106.0 | 142.5 | 247.7 |
| 1990 | 22.2 | 28.3 | 121.7 | 155.2 | 230.0 |
| 1991 | 19.1 | 23.3 | 119.6 | 146.3 | 263.5 |
| 1992 | 18.4 | 21.9 | 119.0 | 141.3 | 271.2 |
| 1993 | 16.4 | 18.9 | 117.3 | 135.3 | 300.2 |
| 1994 | 15.6 | 17.5 | 117.4 | 131.9 | 316.3 |
| 1995 | 17.2 | 18.8 | 120.5 | 131.7 | 293.7 |
| 1996 | 20.7 | 22.0 | 128.8 | 136.8 | 261.2 |
| 1997 | 19.0 | 19.8 | 129.1 | 134.0 | 284.8 |
| 1998 | 12.5 | 12.8 | 111.5 | 113.9 | 372.6 |
| 1999 | 17.5 | 17.5 | 122.1 | 121.1 | 291.3 |
| 2000 | 28.2 | 27.3 | 156.3 | 151.2 | 232.5 |
| | | *Average annual percentage change* | | | |
| 1978–2000 | 3.8% | -0.7% | 4.1% | -0.4% | |
| 1990–2000 | 2.4% | -0.4% | 2.5% | -0.3% | |

**Sources:**
Crude oil - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2001*, Washington, DC, Table 9.1.
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2001*, Washington, DC, Table 9.4. (Additional resources: www.eia.doe.gov)

[a]Refiner acquisition cost of composite (domestic and imported) crude oil.
[b]Average for all types. These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.
[c]Adjusted by the Consumer Price Inflation Index.

*In constant terms, the price of gasoline and diesel fuel were slightly less expensive in 2000 than in 1990. In current dollars, however, the U.S. is seeing a significant increase in gasoline and diesel prices.*

**Table 5.4**
**Retail Prices for Motor Fuel, 1978–2000**
**(cents per gallon, including tax)**

| | Diesel fuel [a] | | Average for all gasoline types[b] | |
|---|---|---|---|---|
| Year | Current | Constant 1999[c] | Current | Constant 1999[c] |
| 1978 | [d] | [d] | 65 | 167 |
| 1979 | [d] | [d] | 88 | 202 |
| 1980 | 101 | 204 | 122 | 247 |
| 1981 | 118 | 216 | 135 | 248 |
| 1982 | 116 | 200 | 128 | 221 |
| 1983 | 120 | 201 | 123 | 205 |
| 1984 | 122 | 196 | 120 | 192 |
| 1985 | 122 | 189 | 120 | 185 |
| 1986 | 94 | 143 | 93 | 142 |
| 1987 | 96 | 141 | 96 | 140 |
| 1988 | 95 | 134 | 96 | 136 |
| 1989 | 102 | 137 | 106 | 142 |
| 1990 | 107 | 136 | 122 | 155 |
| 1991 | 91 | 111 | 120 | 146 |
| 1992 | 106 | 126 | 119 | 141 |
| 1993 | 98 | 113 | 117 | 135 |
| 1994 | 96 | 108 | 117 | 132 |
| 1995 | 97 | 106 | 121 | 132 |
| 1996 | 115 | 122 | 129 | 137 |
| 1997 | 129 | 134 | 129 | 134 |
| 1998 | 112 | 114 | 112 | 114 |
| 1999 | 97 | 97 | 122 | 122 |
| 2000 | 136 | 132 | 156 | 151 |
| | | *Average annual percentage change* | | |
| 1978–2000 | 1.5%[e] | 1.3%[e] | 4.5% | -0.5% |
| 1990–2000 | 2.4% | -0.3% | 2.5% | -0.3% |

**Source:**
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, 2001*, Washington, DC, Table 9.4.
Diesel - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1999*, Washington, DC, February 2001, Table 7.2.
(Additional resources: www.eia.doe.gov)

[a]Collected from a survey of prices on January 1 of the current year.
[b]These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.
[c]Adjusted by the Consumer Price Inflation Index.
[d]Data are not available.
[e]Average annual percentage change is from the earliest year possible to 2000.

*The fuel prices shown here are **refiner sales prices** of transportation fuels to end users, excluding tax. Sales to end users are those made directly to the ultimate consumer, including bulk consumers. Bulk sales to utility, industrial, and commercial accounts previously included in the wholesale category are now counted as sales to end users.*

**Table 5.5**
**Refiner Sales Prices for Propane and No. 2 Diesel, 1978–2000**
**(cents per gallon, excluding tax)**

| | Propane[a] | | No. 2 diesel fuel | |
|---|---|---|---|---|
| Year | Current | Constant 1999[b] | Current | Constant 1999[b] |
| 1978 | 33.5 | 85.6 | 37.7 | 96.3 |
| 1979 | 35.7 | 81.9 | 58.5 | 134.2 |
| 1980 | 48.2 | 97.5 | 81.8 | 165.4 |
| 1981 | 56.5 | 103.6 | 99.5 | 182.4 |
| 1982 | 59.2 | 102.2 | 94.2 | 162.6 |
| 1983 | 70.9 | 118.6 | 82.6 | 138.2 |
| 1984 | 73.7 | 118.2 | 82.3 | 132.0 |
| 1985 | 71.7 | 111.0 | 78.9 | 122.2 |
| 1986 | 74.5 | 113.2 | 47.8 | 72.7 |
| 1987 | 70.1 | 102.8 | 55.1 | 80.8 |
| 1988 | 71.4 | 100.6 | 50.0 | 70.4 |
| 1989 | 61.5 | 82.6 | 58.5 | 78.6 |
| 1990 | 74.5 | 95.0 | 72.5 | 92.4 |
| 1991 | 73.0 | 89.3 | 64.8 | 79.3 |
| 1992 | 64.3 | 76.4 | 61.9 | 73.5 |
| 1993 | 67.3 | 77.6 | 60.2 | 69.4 |
| 1994 | 53.0 | 59.6 | 55.4 | 62.3 |
| 1995 | 49.2 | 53.8 | 56.0 | 61.2 |
| 1996 | 60.5 | 64.2 | 68.1 | 72.3 |
| 1997 | 55.2 | 57.3 | 64.2 | 66.6 |
| 1998 | 40.5 | 41.4 | 49.4 | 50.5 |
| 1999 | 45.8 | 45.8 | 58.4 | 58.4 |
| 2000 | 60.3 | 58.3 | 93.5 | 90.5 |
| | | *Average annual percentage change* | | |
| 1978–2000 | 2.7% | -1.7% | 4.2% | -0.3% |
| 1990–2000 | -2.1% | -4.8% | 2.6% | -0.2% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2001*, Washington, DC, Table 9.7.
(Additional resources: www.eia.doe.gov)

[a]Consumer grade.
[b]Adjusted by the Consumer Price Inflation Index.

*Jet fuel prices jumped more than 30 cents per gallon from 1999 to 2000.*

**Table 5.6**
**Refiner Sales Prices for Aviation Gasoline and Jet Fuel, 1978–2000**
**(cents per gallon, excluding tax)**

| | Finished aviation gasoline | | Kerosene-type jet fuel | |
|---|---|---|---|---|
| Year | Current | Constant 1999[a] | Current | Constant 1999[a] |
| 1978 | 51.6 | 131.8 | 38.7 | 98.9 |
| 1979 | 68.9 | 158.1 | 54.7 | 125.5 |
| 1980 | 108.4 | 219.2 | 86.6 | 175.1 |
| 1981 | 130.3 | 238.8 | 102.4 | 187.7 |
| 1982 | 131.2 | 226.5 | 96.3 | 166.3 |
| 1983 | 125.5 | 209.9 | 87.8 | 146.9 |
| 1984 | 123.4 | 197.9 | 84.2 | 135.0 |
| 1985 | 120.1 | 186.0 | 79.6 | 123.2 |
| 1986 | 101.1 | 153.7 | 52.9 | 80.4 |
| 1987 | 90.7 | 133.0 | 54.3 | 79.6 |
| 1988 | 89.1 | 125.5 | 51.3 | 72.2 |
| 1989 | 99.5 | 133.7 | 59.2 | 79.5 |
| 1990 | 112.0 | 142.8 | 76.6 | 97.6 |
| 1991 | 104.7 | 128.1 | 65.2 | 79.8 |
| 1992 | 102.7 | 122.0 | 61.0 | 72.4 |
| 1993 | 99.0 | 114.1 | 58.0 | 66.9 |
| 1994 | 95.7 | 107.6 | 53.4 | 60.0 |
| 1995 | 100.5 | 109.9 | 54.0 | 59.0 |
| 1996 | 111.6 | 118.0 | 65.1 | 69.1 |
| 1997 | 112.8 | 117.1 | 61.3 | 63.6 |
| 1998 | 97.5 | 99.7 | 45.2 | 46.2 |
| 1999 | 105.9 | 105.9 | 54.3 | 54.3 |
| 2000 | 132.9 | 128.6 | 89.8 | 86.9 |
| | | *Average annual percentage change* | | |
| 1978–2000 | 4.4% | -0.1% | 3.9% | -0.6% |
| 1990–2000 | 1.7% | -1.0% | 1.6% | -1.2% |

**Source:**
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2001*, Washington, DC, Table 9.7.
(Additional resources: www.eia.doe.gov)

[a]Adjusted by the Consumer Price Inflation Index.

**Table 5.7**
**State Taxes on Motor Fuels, 2000**
**(dollars per gallon or gasoline equivalent gallon)**
(Footnotes for this table appear on next page)

| State | Gasoline | Diesel fuel | CNG | Propane | Methanol | Ethanol |
|---|---|---|---|---|---|---|
| Alabama | 0.18 | 0.19 | [a] | [a] | 0.16[b] | 0.16[b] |
| Alaska | 0.08 | 0.08 | 0.08 | 0.00 | 0.08[b] | 0.04 |
| Arizona | 0.18 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 |
| Arkansas | 0.186 | 0.186 | 0.05[c] | [a] | 0.186 | 0.186 |
| California | 0.18 | 0.18 | [a] | [a] | 0.09 | 0.09 |
| Colorado | 0.22 | 0.205 | [a] | [a] | 0.205 | 0.17[b] |
| Connecticut | 0.36 | 0.18 | 0.18 | 0.18 | 0.37[b] | 0.35 |
| Delaware | 0.23 | 0.22 | 0.22 | 0.22 | 0.22 | 0.23 |
| District of Columbia | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Florida | 0.13 | 0.25 | [a] | [a] | 0.04[b] | 0.04[b] |
| Georgia | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| Hawaii | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 |
| Idaho | 0.25 | 0.25 | 0.197[d] | 0.181 | 0.25[b] | 0.23[b] |
| Illinois | 0.19 | 0.215 | 0.19 | 0.19 | 0.19[b] | 0.19[b] |
| Indiana | 0.15 | 0.16 | [a] | [a] | 0.15 | 0.15 |
| Iowa | 0.20 | 0.225 | 0.16[c] | 0.20 | 0.19[b] | 0.19[b] |
| Kansas | 0.18 | 0.20 | 0.17 | 0.17 | 0.20 | 0.20 |
| Kentucky | 0.164 | 0.134 | 0.15 | 0.15 | 0.15 | 0.15 |
| Louisiana | 0.20 | 0.20 | [a] | [a] | 0.20[b] | 0.20[b] |
| Maine | 0.19 | 0.20 | 0.18 | 0.18 | 0.18 | 0.18 |
| Maryland | 0.235 | 0.2425 | 0.235 | 0.235 | 0.235 | 0.235 |
| Massachusetts | 0.21 | 0.21 | 0.10 | 0.10 | 0.21 | 0.21 |
| Michigan | 0.19 | 0.15 | 0.0 | 0.15 | 0.15[b] | 0.025[b] |
| Minnesota | 0.20 | 0.20 | 0.174 | 0.15 | 0.114 | 0.142 |
| Mississippi | 0.184 | 0.184 | 0.184[c] | 0.17 | 0.18[b] | 0.18[b] |
| Missouri | 0.17 | 0.17 | [a] | [a] | 0.17[b] | 0.17[b] |
| Montana | 0.27 | 0.2775 | 0.07[e] | [a] | 0.27 | 0.27 |
| Nebraska | 0.246 | 0.246 | [a] | [a] | [a] | [a] |
| Nevada | 0.2475 | 0.2775 | 0.21 | 0.2475[c] | 0.2475 | 0.2475 |
| New Hampshire | 0.195 | 0.195 | 0.195 | 0.195 | 0.195[b] | 0.195[b] |
| New Jersey | 0.105 | 0.135 | 0.0525 | 0.0525 | 0.105[b] | 0.105[b] |
| New Mexico | 0.188 | 0.198 | [a] | [a] | 0.22[b] | 0.22[b] |
| New York | 0.10[f] | 0.10[f] | 0.08[f] | 0.08[f] | 0.08[f] | 0.08[f] |
| North Carolina | 0.223 | 0.223 | 0.223 | 0.223 | 0.223 | 0.223 |
| North Dakota | 0.20 | 0.20 | 0.20 | 0.20 | 0.20[b] | 0.20[b] |
| Ohio | 0.22 | 0.22 | 0.22 | 0.22 | 0.22[b] | 0.21[b] |

**Table 5.7 (continued)**
**State Taxes on Motor Fuels, 2000**
**(dollars per gallon or gasoline equivalent gallon)**

| State | Gasoline | Diesel fuel | CNG | Propane | Methanol | Ethanol |
|---|---|---|---|---|---|---|
| Oklahoma | 0.17 | 0.14 | [a] | [a] | 0.16[b] | 0.16[b] |
| Oregon | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| Pennsylvania | 0.12[g] | 0.12[g] | 0.12[g] | 0.12[g] | 0.12[g] | 0.12[g] |
| Rhode Island | 0.29 | 0.29 | 0.0 | 0.29 | 0.29 | 0.29 |
| South Carolina | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 |
| South Dakota | 0.21 | 0.21 | 0.06 | 0.16 | 0.06 | 0.19 |
| Tennessee | 0.20 | 0.17 | 0.13 | 0.17 | 0.17 | 0.17 |
| Texas | 0.20 | 0.20 | [a] | [a] | 0.20[b] | 0.20[b] |
| Utah | 0.245 | 0.245 | 0.04 | 0.04 | 0.04 | 0.04 |
| Vermont | 0.20 | 0.17 | 0.20 | [a] | 0.20 | 0.20 |
| Virginia | 0.18 | 0.16 | 0.10 | 0.10 | 0.18[b] | 0.18[b] |
| Washington | 0.23 | 0.23 | [a] | [a] | 0.23 | 0.23 |
| West Virginia | 0.2535 | 0.2535 | 0.2535 | 0.2535 | 0.2535 | 0.2535 |
| Wisconsin | 0.238 | 0.238 | 0.203 | 0.186 | 0.238 | 0.238 |
| Wyoming | 0.09 | 0.09 | 0.00 | 0.00 | 0.09[b] | 0.09[b] |

**Source:**
Energy Futures, Inc., *The Clean Fuels and Electric Vehicles Report*, Boulder, CO, December 2000, pp. 154–155.

[a] Annual flat fee.
[b] Blends with gasoline only.
[c] Per 100 $ft^3$.
[d] Per therm.
[e] Per 120 $ft^3$.
[f] Plus a petroleum business tax; the amount varies but is usually in the ballpark of $0.12–$0.14.
[g] Plus 0.1035 oil franchise tax.

*As of January 2000, only five states offered tax exemptions to encourage the use of gasohol for transportation purposes. This list is quite short compared to the 30 states which offered gasohol tax exemptions twenty years ago. Still, the Federal Government encourages gasohol use via a difference in the Federal tax rates of gasoline and gasohol.*

**Table 5.8**
**State Tax Exemptions for Gasohol, December 1, 2000**

| State | Exemption (Cents/gallon of gasohol) |
|---|---|
| Connecticut | 1.0 |
| Idaho | 2.5 |
| Iowa | 1.0 |
| South Dakota | 2.0 |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, "Monthly Motor Fuel Reported by the States, October 1999," February 2000, Washington, DC, Table MF-121T. (Additional resources: www.fhwa.dat.gov)

**Table 5.9**
**Federal Excise Taxes on Motor Fuels**

| Fuel | | Cents per gallon |
|---|---|---|
| Gasoline | | 18.30 |
| Diesel[a] | | 24.30 |
| Gasohol | 10% Ethanol | 13.00 |
| | 7.7% Ethanol | 14.24 |
| | 5.7% Ethanol | 12.85 |
| Gasohol | 10% Methanol | 12.40 |
| | 7.7% Methanol | 13.78 |
| | 5.7% Methanol | 14.98 |
| Methanol | Qualified[b] | 12.85 |
| | Partially exempt[c] | 9.20 |
| Ethanol | Qualified[b] | 12.85 |
| | Partially exempt[c] | 9.25 |
| CNG | | 48.54/mcf[d] |
| LNG | | 18.30 |
| Propane | | 13.60 |

**Source:**
Energy Futures, Inc., *The Clean Fuels and Electric Vehicles Report*, Boulder, CO, December 2000, p. 155.

[a] Reduced diesel rates are specified for marine fleets, trains and certain intercity buses. Diesel rates are also reduced for diesel/alcohol blends. Diesel used exclusively in state and local government fleets, non-profit organization vehicles, school buses and qualified local buses is exempt from Federal taxes.

[b]Qualified - contains at least 85 percent methanol or ethanol or other alcohol produced from a substance other than petroleum or natural gas.

[c]Partially exempt - 85 percent alcohol and produced from natural gas.

[d]Thousand cubic feet.

*These states currently offer extra incentives for ethanol production or consumption. In addition to these tax incentives, many states have regulations in place that State-owned vehicles must fuel with E10 (gasohol) whenever possible.*

**Table 5.10**
**States With Ethanol Tax Incentives**

| State | Ethanol tax incentives |
|---|---|
| AK | $0.08/ethanol gallon (blender) |
| AR | Income tax credit for manufacturers of advanced biofuels–ethanol, methanol or any derivatives which are produced through biological means other than direct fermentation of a food crop |
| CA | E85 and M85 excise tax is half of the gasoline tax. Neat alcohol fuels are exempt from fuel taxes. |
| FL | County governments receive waste reduction credits for using yard trash, wood, or paper waste as feed stocks for fuel. |
| HI | 4% ethanol sales tax exemption |
| ID | $0.25 excise tax exemption for ethanol or biodiesel |
| IN | 10% gross income tax deduction for improvements to ethanol producing facilities. |
| IL | Rebate offer for purchase of E85. |
| IA | $0.01 (blender) |
| MN | $0.20 (producer), $0.058 excise tax exemption |
| MO | $0.20 (producer), $0.02 excise tax exemption |
| MT | $0.30 (producer) |
| NE | $0.20 (producer) |
| NC | Individual income and corporate tax credit of 20% for the construction of an ethanol plant using agricultural or forestry products; an additional 10% if the distillery is powered with alternative fuels. |
| ND | $0.40 (producer), income tax credit for the construction of new fuel ethanol plants |
| OH | $0.01 (blender), income tax credit |
| SD | Reduced fuel tax for alternative fuels |
| WY | $0.40 (producer) |

**Source:**
U.S. Department of Energy, *Clean Cities Guide to Alternative Fuel Vehicle Incentives and Laws*, 2nd edition, Washington, DC, November 1996 and updates from www.fleets.doe.gov/fleet-tool.cgi?$$, benefits,1.
(Additional resources: www.ccities.doe.gov)

*In current dollars, import cars, on average, were less expensive than domestic cars until 1982. Since then, import prices have nearly tripled, while domestic prices have nearly doubled (current dollars).*

**Table 5.11**
**Average Price of a New Car, 1970–99**

| | Domestic[a] | | Import | | Total | |
|---|---|---|---|---|---|---|
| Year | Current dollars | Constant 1998 dollars[b] | Current dollars | Constant 1998 dollars[b] | Current dollars | Constant 1998 dollars[b] |
| 1970 | 3,708 | 15,568 | 2,648 | 11,118 | 3,542 | 14,872 |
| 1975 | 5,084 | 15,400 | 4,384 | 13,280 | 4,950 | 14,994 |
| 1980 | 7,609 | 15,055 | 7,482 | 14,803 | 7,574 | 14,985 |
| 1981 | 8,912 | 15,976 | 8,896 | 15,947 | 8,910 | 15,972 |
| 1982 | 9,865 | 16,662 | 9,957 | 16,818 | 9,890 | 16,727 |
| 1983 | 10,516 | 17,208 | 10,868 | 17,784 | 10,606 | 17,356 |
| 1984 | 11,079 | 17,390 | 12,336 | 19,362 | 11,375 | 17,854 |
| 1985 | 11,589 | 17,563 | 12,853 | 19,479 | 11,838 | 17,941 |
| 1986 | 12,319 | 18,317 | 13,670 | 20,326 | 12,652 | 18,812 |
| 1987 | 12,922 | 18,536 | 14,470 | 20,757 | 13,386 | 19,202 |
| 1988 | 13,418 | 18,493 | 15,221 | 20,978 | 13,932 | 19,201 |
| 1989 | 13,936 | 18,327 | 15,510 | 20,397 | 14,371 | 18,899 |
| 1990 | 14,489 | 18,076 | 16,640 | 20,760 | 15,042 | 18,766 |
| 1991 | 15,192 | 18,182 | 16,327 | 19,540 | 15,475 | 18,521 |
| 1992 | 15,644 | 18,175 | 18,593 | 21,601 | 16,336 | 18,979 |
| 1993 | 15,976 | 18,029 | 20,261 | 22,864 | 16,871 | 19,039 |
| 1994 | 16,930 | 18,619 | 21,989 | 24,183 | 17,903 | 19,689 |
| 1995 | 16,864 | 18,035 | 23,202 | 24,813 | 17,959 | 19,206 |
| 1996 | 17,468 | 18,152 | 26,205 | 27,231 | 18,777 | 19,512 |
| 1997 | 17,838 | 18,116 | 28,193 | 28,633 | 19,551 | 19,856 |
| 1998 | 18,579 | 18,579 | 31,986 | 31,986 | 20,849 | 20,849 |
| 1999 | 18,725 | 18,323 | 30,350 | 29,699 | 21,022 | 20,571 |
| | | | *Average annual percentage change* | | | |
| 1970–99 | 5.7% | 0.6% | 8.8% | 3.4% | 6.3% | 1.1% |
| 1989–99 | 3.0% | 0.0% | 6.9% | 3.6% | 3.9% | 0.9% |

**Source:**
U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*, underlying detail estimates for Motor Vehicle Output, Washington, DC, 2000.
(Additional resources: www.stat-usa.gov)

[a]Includes transplants.
[b]Adjusted by the Consumer Price Inflation Index.

*The total cost of operating an automobile is the sum of the fixed cost (depreciation, insurance, finance charge, and license fee) and the variable cost (gas and oil, tires, and maintenance), which is related to the amount of travel. The cost of operating a car in 2000 was lower than 1999 despite rising gasoline prices; the fixed cost was lower.*

**Table 5.12**
**Automobile Operating Cost per Mile, 1985–2000**

| Model year | Constant 1999 dollars per 10,000 miles[a] | | | Total cost per mile [b] (constant 1999 cents [a]) | Percentage gas and oil of total cost |
|---|---|---|---|---|---|
| | Variable cost | Fixed cost | Total cost | | |
| 1985 | 1,245 | 2,967 | 4,213 | 42.13 | 22.6% |
| 1986 | 991 | 3,505 | 4,496 | 44.96 | 15.1% |
| 1987 | 1,055 | 3,729 | 4,785 | 47.85 | 14.7% |
| 1988 | 1,113 | 4,267 | 5,380 | 53.80 | 13.6% |
| 1989 | 1,062 | 4,072 | 5,134 | 51.34 | 13.6% |
| 1990 | 1,071 | 4,151 | 5,222 | 52.22 | 13.2% |
| 1991 | 1,199 | 4,139 | 5,337 | 53.37 | 15.4% |
| 1992 | 1,080 | 4,354 | 5,434 | 54.34 | 13.1% |
| 1993 | 1,072 | 4,133 | 5,206 | 52.06 | 13.3% |
| 1994 | 1,034 | 4,209 | 5,243 | 52.43 | 12.0% |
| 1995 | 1,093 | 4,252 | 5,345 | 53.45 | 12.3% |
| 1996 | 1,073 | 4,389 | 5,461 | 54.61 | 11.5% |
| 1997 | 1,121 | 4,388 | 5,509 | 55.09 | 12.4% |
| 1998 | 1,104 | 4,499 | 5,603 | 56.03 | 11.5% |
| 1999 | 1,070 | 4,730 | 5,800 | 58.00 | 9.8% |
| 2000 | 1,219 | 4,376 | 5,595 | 55.95 | 12.6% |
| | *Average annual percentage change* | | | | |
| 1985–2000 | -0.1% | 2.6% | 1.9% | 1.9% | |

**Source:**
American Automobile Association, *Your Driving Costs*, 2000 Edition, Heathrow, FL, and annual.
(Additional resources: www.aaa.com, www.runzheimer.com)

[a] Adjusted by the Consumer Price Inflation Index.
[b] Based on 10,000 miles per year.

*While the previous table shows costs per **mile**, this table presents costs per **year** for fixed costs associated with automobile operation. For 2000 model year autos, the fixed cost is more than $14 per day.*

**Table 5.13**
**Fixed Automobile Operating Costs per Year, 1975–2000**
**(constant 1999 dollars)[a]**

| Model year | Fire & theft[b] | Collision[c] | Property damage & liability[d] | License, registration & taxes | Depreciation | Finance charge | Total | Average fixed cost per day |
|---|---|---|---|---|---|---|---|---|
| 1975 | 164 | 437 | 585 | 93 | 2,394 | [e] | 3,673 | 10.06 |
| 1980 | 142 | 348 | 501 | 166 | 2,099 | 855 | 4,110 | 11.26 |
| 1985 | 142 | 307 | 330 | 178 | 1,940 | 883 | 3,779 | 10.36 |
| 1986 | 131 | 290 | 353 | 198 | 2,006 | 968 | 3,946 | 10.81 |
| 1987 | 128 | 287 | 370 | 205 | 2,209 | 881 | 4,080 | 11.18 |
| 1988 | 121 | 286 | 400 | 196 | 2,512 | 796 | 4,311 | 11.82 |
| 1989 | 146 | 329 | 415 | 203 | 2,813 | 841 | 4,748 | 13.01 |
| 1990 | 140 | 315 | 405 | 210 | 3,004 | 867 | 4,942 | 13.54 |
| 1991 | 141 | 316 | 432 | 207 | 3,111 | 953 | 5,158 | 14.13 |
| 1992 | 134 | 310 | 443 | 213 | 3,301 | 988 | 5,389 | 14.76 |
| 1993 | 123 | 267 | 444 | 211 | 3,324 | 802 | 5,172 | 14.17 |
| 1994 | 102 | 232 | 450 | 229 | 3,359 | 781 | 5,153 | 14.12 |
| 1995 | 104 | 231 | 448 | 231 | 3,388 | 797 | 5,198 | 14.24 |
| 1996 | 116 | 262 | 452 | 243 | 3,406 | 826 | 5,306 | 14.54 |
| 1997 | 110 | 313 | 416 | 228 | 3,392 | 823 | 5,283 | 14.48 |
| 1998 | 118 | 268 | 490 | 228 | 3,367 | 820 | 5,289 | 14.49 |
| 1999 | 123 | 278 | 484 | 223 | 3,355 | 812 | 5,275 | 14.45 |
| 2000 | 120 | 271 | 465 | 211 | 3,297 | 800 | 5,164 | 14.14 |
| | | | *Average annual percentage change* | | | | | |
| 1975–2000 | -2.1% | -3.1% | -1.5% | 5.6% | 2.2% | [e] | 2.3% | 2.3% |
| 1990–2000 | -1.5% | -1.5% | 1.4% | 0.0% | 0.9% | -0.8% | 0.4% | 0.4% |

**Source:**
American Automobile Association, "Your Driving Costs," 2000 Edition, Heathrow, FL, and annual. (Additional resources: www.aaa.com, www.runzheimer.com)

[a] Adjusted by the Consumer Price Inflation Index.
[b] $50 deductible 1975 through 1977; $100 deductible 1978 through 1992; $250 deductible for 1993 – on.
[c] $100 deductible through 1977; $250 deductible 1978 through 1992; $500 deductible for 1993 – on.
[d] Coverage: $100,000/$300,000.
[e] Data are not available.

**Table 5.14**
**Economic Indicators, 1970–2000**
**(billion dollars)**

| Year | Gross National Product: Current | Gross National Product: Constant 1999[a] | Total transportation outlays: Current | Total transportation outlays: Constant 1999[a] | Transportation as a percent of GNP |
|---|---|---|---|---|---|
| 1970 | 1,015.5 | 4,194.0 | 192.8 | 809.5 | 19.0% |
| 1980 | 2,732.0 | 5,327.4 | 533.0 | 1,054.6 | 19.5% |
| 1990 | 5,567.8 | 6,848.4 | 951.0 | 1,186.4 | 17.1% |
| 1999 | 9,288.2 | 9,288.2 | 1,480.9 | 1,480.9 | 15.9% |
| | Personal Consumption Expenditures | | Transportation Personal Consumption Expenditures[b] | | Transportation PCE as a percent of total PCE |
| 1970 | 640.0 | 2,687.1 | 81.5 | 342.2 | 12.7% |
| 1980 | 1,732.6 | 3,428.0 | 238.5 | 471.9 | 13.8% |
| 1990 | 3,761.2 | 4,692.4 | 453.9 | 566.3 | 12.1% |
| 2000 | 6,757.3 | 6,537.6 | 775.8 | 750.6 | 11.5% |

**Sources:**
GNP - U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 2001, Table 1.9, p. D-4, and annual. (Additional resources: www.bea.doc.gov)
Transportation outlays - Eno Transportation Foundation, *Transportation in America 2000*, Eighteenth Edition, Lansdowne, VA, 2001, p. 1.
PCE - U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 2001, Table 2.2 and annual. (Additional resources: www.bea.doc.gov/bea/scbinf.html)

**Table 5.15**
**Consumer Price Indices, 1970–2000**
**(1970 = 1.000)**

| Year | Consumer Price Index | Transportation Consumer Price Index[c] | New car Consumer Price Index | Used car Consumer Price Index | Gross National Product |
|---|---|---|---|---|---|
| 1970 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 1980 | 2.122 | 2.216 | 1.667 | 1.995 | 2.690 |
| 1990 | 3.365 | 3.213 | 2.283 | 3.769 | 5.483 |
| 2000 | 4.435 | 4.088 | 2.694 | 4.994 | 9.807 |

**Source:**
Bureau of Labor Statistics, Consumer Price Index Table 1A for 2000, and annual. [GNP—see above.] (Additional resources: stats.bls.gov/cpihome.htm)

[a] Adjusted by the implicit GNP price deflator.
[b] Transportation Personal Consumption Expenditures include user operating expenses (new and used auto purchases, gas and oil, repair, greasing, washing, parking, storage, rental, other motor vehicles, insurance premiums, tires, tubes and other parts); purchased intercity transportation; and purchased local transportation.
[c] Transportation Consumer Price Index includes new and used cars, gasoline, auto insurance rates, intracity mass transit, intracity bus fare, and airline fares.

*In 1999 there were 7.7 employees for every hundred vehicles sold in the U.S., according to estimates based on domestic light vehicle sales. Using the average domestic automobile price, estimates show 4.1 employees for every million dollars spent on light vehicles. This includes employees of motor vehicle parts manufacturers and tire manufacturers.*

**Table 5.16**
**Motor Vehicle Manufacturing Employment Statistics, 1970–99**

| Year | Motor vehicles, parts and tires manufacturing employees (thousands) | Sales of domestic light vehicles[a] (thousands) | Employees per hundred vehicles sold | Employees per million dollar expenditure (current) | Employees per million dollar expenditure (constant 1999[b]) |
|---|---|---|---|---|---|
| 1970 | 914 | 8,516 | 10.7 | 28.9 | 8.0 |
| 1975 | 892 | 9,106 | 9.8 | 19.3 | 7.4 |
| 1980 | 904 | 8,540 | 10.6 | 13.9 | 7.6 |
| 1981 | 841 | 7,954 | 10.6 | 11.9 | 7.1 |
| 1982 | 792 | 7,821 | 10.1 | 10.3 | 6.5 |
| 1983 | 875 | 9,313 | 9.4 | 8.9 | 5.9 |
| 1984 | 968 | 11,209 | 8.6 | 7.8 | 5.3 |
| 1985 | 964 | 11,896 | 8.1 | 7.0 | 4.9 |
| 1986 | 931 | 11,886 | 7.8 | 6.4 | 4.6 |
| 1987 | 928 | 10,866 | 8.5 | 6.6 | 4.9 |
| 1988 | 964 | 11,721 | 8.2 | 6.1 | 4.7 |
| 1989 | 941 | 11,181 | 8.4 | 6.0 | 4.8 |
| 1990 | 946 | 10,845 | 8.7 | 6.0 | 5.0 |
| 1991 | 870 | 9,732 | 8.9 | 5.9 | 5.0 |
| 1992 | 894 | 10,510 | 8.5 | 5.4 | 4.8 |
| 1993 | 919 | 11,729 | 7.8 | 4.9 | 4.4 |
| 1994 | 988 | 12,893 | 7.7 | 4.5 | 4.2 |
| 1995 | 1,051 | 12,792 | 8.2 | 4.9 | 4.6 |
| 1996 | 1,047 | 13,342 | 7.8 | 4.5 | 4.3 |
| 1997 | 1,063 | 13,143 | 8.1 | 4.5 | 4.4 |
| 1998 | 1,074 | 13,445 | 8.0 | 4.3 | 4.2 |
| 1999 | 1,098 | 14,289 | 7.7 | 4.1 | 4.1 |
| | | *Average annual percentage change* | | | |
| 1970–99 | 0.6% | 1.8% | -1.1% | -6.5% | -2.3% |
| 1989–99 | 1.6% | 2.5% | -0.9% | -3.7% | -1.6% |

**Source:**
Employees - Eno Transportation Foundation, *Transportation in America 2000*, Eighteenth Edition, Lansdowne, VA, 2001, pp. 32-35.
Sales - See Table 6.4. Expenditures - See Table 5.11.

[a] Vehicles produced in North America.
[b] Adjusted by the implicit Gross National Product price deflator.

*Employees of motor vehicle and related industries comprise 8.2% of the labor force. For employment in the entire transportation industry, see the next table.*

**Table 5.17**
**Employees of Motor Vehicle and Related Industries, 1998**

| | 1998 Employees | Percent of total motor vehicle | Percent of total U.S. employment |
|---|---|---|---|
| Motor vehicle and equipment manufacturing | 1,314,317 | 14.8% | 1.2% |
| *Motor vehicles and equipment* | *235,483* | *2.7%* | *0.2%* |
| *Motor vehicle body & trailer* | 128,687 | 1.5% | 0.1% |
| *Motor vehicle parts* | *801,461* | *9.0%* | *0.7%* |
| *Storage batteries* | *22,745* | *0.3%* | *0.0%* |
| *Tires* | *65,298* | *0.7%* | *0.1%* |
| *Rolled steel shape* | *14,169* | *0.2%* | *0.0%* |
| *Other transportation equipment* | *46,474* | *0.5%* | *0.0%* |
| Highway, street, bridge, and tunnel construction | 267,142 | 3.0% | 0.2% |
| Motor freight transportation and related services | 2,227,195 | 25.1% | 2.1% |
| *Trucking and courier services, except by air or by the U.S. Postal Service* | *1,866,637* | *21.1%* | *1.7%* |
| Petroleum refining and wholesale distribution | 227,887 | 2.6% | 0.2% |
| Passenger transportation | 936,025 | 10.6% | 0.9% |
| Automotive sales and servicing | 3,888,265 | 43.9% | 3.6% |
| Total of motor vehicle and related industries | 8,860,831 | 100.0% | 8.2% |
| U.S. Total[a] | 108,117,731 | | 100.0% |

**Source:**
U.S. Department of Commerce, Bureau of the Census, County Business Patterns web site: tier2.census.gov/cbp/, April 2001. (Additional resources: www.census.gov)

[a] Data for employees of establishments totally exempt from FICA are excluded, as are self-employed persons, domestic service workers, railroad employees, agricultural production workers and most government employees.

*Eleven percent of employed civilians in 1999 worked in transportation or transportation-related industries; truck drivers and deliverymen made up 20% of that employment.*

**Table 5.18**
**Employment in Transportation and Related Industries, 1960–99**
**(persons in thousands)**

| | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 1999 |
|---|---|---|---|---|---|---|---|---|---|
| Transportation Service | | | | | | | | | |
| Air transport | 191 | 229 | 351 | 362 | 453 | 537 | 968 | 1,068 | 1,227 |
| Bus, intercity | 41 | 42 | 43 | 39 | 38 | 36 | 26 | 24 | 21 |
| Local transport | 101 | 83 | 77 | 69 | 79 | 90 | 141 | 203 | 240 |
| Railroads | 885 | 735 | 627 | 538 | 532 | 346 | 279 | 238 | 230 |
| Oil pipeline | 23 | 20 | 18 | 17 | 21 | 19 | 19 | 15 | 13 |
| Taxi | 121 | 110 | 107 | 83 | 53 | 38 | 32 | 31 | 31 |
| Trucking & truck materials | 770 | 882 | 998 | 996 | 1,280 | 1,361 | 1,395 | 1,587 | 1,804 |
| Water | 232 | 230 | 215 | 190 | 211 | 185 | 177 | 175 | 187 |
| **Total** | **2,364** | **2,331** | **2,436** | **2,294** | **2,667** | **2,598** | **3,036** | **3,340** | **3,753** |
| Transportation Equipment Manufacturing | | | | | | | | | |
| Aircraft & parts | 646 | 624 | 669 | 514 | 652 | 647 | 712 | 451 | 495 |
| Motor vehicles, equipment, tires | 829 | 945 | 914 | 892 | 904 | 964 | 946 | 1,051 | 1,098 |
| Railroad equipment | 43 | 56 | 51 | 52 | 71 | 34 | 33 | 38 | 38 |
| Ship & boat building & repair | 141 | 160 | 170 | 194 | 221 | 193 | 188 | 160 | 162 |
| Other transportation equipment | 33 | 57 | 111 | 115 | 149 | 130 | 45 | 53 | 51 |
| **Total** | **1,692** | **1,842** | **1,915** | **1,767** | **1,997** | **1,968** | **1,924** | **1,752** | **1,844** |
| Transportation Related Industries | | | | | | | | | |
| Automotive/accessory retail dealers | 807 | 902 | 996 | 1,076 | 1,048 | 1,185 | 1,292 | 1,388 | 1,377 |
| Automotive wholesalers | 215 | 255 | 320 | 367 | 418 | 433 | 456 | 492 | 520 |
| Automotive service & garages | 251 | 324 | 384 | 400 | 571 | 730 | 926 | 981 | 1,341 |
| Gasoline service stations | 461 | 522 | 614 | 616 | 561 | 611 | 647 | 649 | 675 |
| Highway & street construction | 294 | 324 | 331 | 297 | 268 | 264 | 239 | 228 | 250 |
| Petroleum[a] | 311 | 292 | 333 | 390 | 533 | 568 | 513 | 429 | 445 |
| Other industries | | | | | | | | | |
| Truck drivers & deliverymen | 1,477 | 1,521 | 1,565 | 1,796 | 1,931 | 2,050 | 2,148 | 2,861 | 3,116 |
| Freight handlers | 365 | 411 | 456 | 613 | 622 | 574 | 504 | 536 | 625 |
| **Total** | **4,181** | **4,551** | **4,999** | **5,545** | **5,952** | **6,415** | **6,725** | **7,564** | **8,349** |
| Government Transportation Employees | | | | | | | | | |
| U.S. Department of Transportation | 38 | 45 | 66 | 75 | 72 | 61 | 67 | 63 | 64 |
| Highways, state & local | 499 | 550 | 568 | 569 | 532 | 549 | 569 | 560 | 543 |
| U.S. Postal Service[b] | 83 | 83 | 103 | 98 | 92 | 104 | 115 | 110 | 113 |
| Other[c] | 18 | 16 | 12 | 13 | 13 | 11 | 11 | 11 | 12 |
| **Total** | **638** | **694** | **749** | **755** | **709** | **725** | **762** | **744** | **732** |
| **Total transportation employment** | **8,875** | **9,418** | **10,099** | **10,361** | **11,325** | **11,706** | **12,447** | **13,400** | **14,678** |
| **Total employed civilians** | **65,778** | **71,088** | **78,627** | **85,783** | **99,303** | **107,150** | **118,793** | **124,900** | **133,488** |
| Transportation percent of total | 13.5% | 13.2% | 12.8% | 12.1% | 11.4% | 10.9% | 10.5% | 10.7% | 11.0% |

**Source:**
Eno Transportation Foundation, *Transportation in America 2000*, Eighteenth Edition, Lansdowne, VA, 2001, pp. 32-35.

[a] Estimated by assuming transport share of total petroleum industry employment is same as transport share of petroleum domestic demand.
[b] Estimated share (approximately 14%) of total employees engaged in transportation work.
[c] Agencies include Civil Aeronautics Board (sunset in 1985), Federal Maritime Commission, Federal Energy Regulatory Commission, Interstate Commerce Commission, Railroad Retirement Board, and Panama Canal Commission.

# Chapter 6

# Highway Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

| Source | | |
|---|---|---|
| Table 6.1 | U.S. share of world automobile registrations, 1999 | 26.9% |
| Table 6.2 | U.S. share of world truck & bus registrations, 1999 | 43.7% |
| Table 6.3 | Number of automobiles, 1999 (Polk - in thousands) | 126,869 |
| Table 6.3 | Number of trucks, 1999 (Polk - in thousands) | 82,640 |
| Table 6.5 | Vehicle miles traveled, 1999 (million miles) | 2,691,335 |
| | *Automobiles* | *58.3%* |
| | *Motorcycles* | *0.4%* |
| | *Two-axle, four-tire trucks* | *33.5%* |
| | *Other single-unit trucks* | *2.6%* |
| | *Combination trucks* | *4.9%* |
| | *Buses* | *0.3%* |
| Table 6.8 | Average age of vehicles, 1999 | (years) |
| | *Automobiles* | *8.9* |
| | *Trucks* | *8.2* |
| | Median lifetime of vehicles | (years) |
| *Table 6.9* | *Automobiles* | *14.0* |
| *Table 6.10* | *Light trucks* | *15.2* |

*The 1997 data in this series were never published. Use caution comparing historical data because of disconnects in data series, such as China in 1998. Also, the U.S. is unique in how many light trucks (SUVs, minivans, pickups) are used for personal travel. Those light trucks are not included on this table.*

**Table 6.1**
**Automobile Registrations for Selected Countries, 1950–99**
**(thousands)**

| Year | China | India | Japan | France | United Kingdom | Germany[a] | Canada[b] | United States[c] | U.S. percentage of world[c] | World total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1950 | [d] | [d] | 43 | [d] | 2,307 | [d] | 1,913 | 40,339 | 76.0% | 53,051 |
| 1955 | [d] | [d] | 153 | [d] | 360 | [d] | 2,961 | 52,145 | 71.4% | 73,036 |
| 1960 | [d] | [d] | 457 | 4,950 | 5,650 | 4,856 | 4,104 | 61,671 | 62.7% | 98,305 |
| 1965 | [d] | [d] | 2,181 | 8,320 | 9,131 | 9,719 | 5,279 | 75,258 | 53.8% | 139,776 |
| 1970 | [d] | [d] | 8,779 | 11,860 | 11,802 | 14,376 | 6,602 | 89,244 | 46.1% | 193,479 |
| 1975 | [d] | [d] | 17,236 | 15,180 | 14,061 | 18,161 | 8,870 | 106,706 | 41.0% | 260,201 |
| 1980 | 351 | [d] | 23,660 | 18,440 | 15,438 | 23,236 | 10,256 | 121,601 | 38.0% | 320,390 |
| 1985 | 795 | 1,607 | 27,845 | 20,800 | 18,953 | 26,099 | 11,118 | 127,885 | 34.5% | 370,504 |
| 1990 | 1,622 | 2,694 | 34,924 | 23,010 | 22,528 | 30,695 | 12,622 | 133,700 | 30.7% | 435,050 |
| 1991 | 1,852 | 2,954 | 37,076 | 23,550 | 22,744 | 31,309 | 12,578 | 128,300 | 29.1% | 441,377 |
| 1992 | 2,262 | 3,205 | 38,963 | 24,020 | 23,008 | 37,579 | 12,781 | 126,581 | 28.0% | 452,311 |
| 1993 | 2,860 | 3,361 | 40,772 | 24,385 | 23,402 | 39,202 | 12,927 | 127,327 | 28.3% | 450,473 |
| 1994 | 3,497 | 3,569 | 42,678 | 24,900 | 23,832 | 39,918 | 13,122 | 127,883 | 27.0% | 473,487 |
| 1995 | 4,179 | 3,837 | 44,680 | 25,100 | 24,307 | 40,499 | 13,183 | 128,387 | 26.9% | 477,010 |
| 1996 | 4,700 | 4,246 | 46,868 | 25,500 | 24,864 | 41,045 | 13,300 | 129,728 | 26.7% | 485,954 |
| 1997 | Data are not available. | | | | | | | | | |
| 1998 | 2,940[e] | 4,820 | 49,896 | 26,800 | 22,115 | 41,674 | 13,887 | 131,839 | 27.5% | 478,625 |
| 1999 | 3,400 | 5,200 | 51,164 | 27,480 | 27,539 | 42,423 | 14,143 | 132,432 | 26.9% | 491,598 |
| *Average annual percentage change* | | | | | | | | | | |
| 1950–99 | [d] | [d] | 15.5% | [d] | 5.2% | [d] | 4.2% | 2.5% | | 4.6% |
| 1970–99 | [d] | [d] | 6.3% | 2.9% | 3.0% | 3.8% | 2.7% | 1.4% | | 3.3% |
| 1990–99 | 8.6% | 7.6% | 4.3% | 2.0% | 2.3% | 3.7% | 1.3% | -0.1% | | 1.4% |

**Source**:
Ward's Communications, *Ward's World Motor Vehicle Data*, 2000 Edition, Southfield, MI, 1998, pp. 218–220 and annual.
(Additional resources: www.wardsauto.com)

[a] Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles.
[b] Data from 1991 and later are not comparable to prior data.
[c] Data from 1985 and later are not comparable to prior data.
[d] Data are not available.
[e] Data are not comparable to prior data due to reclassification of autos and trucks.

*The 1997 data in this series were never published. Use caution comparing historical data because of disconnects in data series, such as China in 1998. The U.S. totals include SUVs, minivans, and light trucks, many of which are used for personal travel.*

**Table 6.2**
**Truck and Bus Registrations for Selected Countries, 1950–99**
**(thousands)**

| Year | China | India | Japan | France | United Kingdom | Germany[a] | Canada[b] | United States[c] | U.S. percentage of world[c] | World total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1950 | [d] | [d] | 183 | [d] | 1,060 | [d] | 643 | 8,823 | 50.9% | 17,349 |
| 1955 | [d] | [d] | 318 | [d] | 1,244 | [d] | 952 | 10,544 | 46.1% | 22,860 |
| 1960 | [d] | [d] | 896 | 1,540 | 1,534 | 786 | 1,056 | 12,186 | 42.6% | 28,583 |
| 1965 | [d] | [d] | 4,119 | 1,770 | 1,748 | 1,021 | 1,232 | 15,100 | 39.6% | 38,118 |
| 1970 | [d] | [d] | 8,803 | 1,850 | 1,769 | 1,228 | 1,481 | 19,175 | 36.2% | 52,899 |
| 1975 | 811 | [d] | 10,854 | 2,210 | 1,934 | 1,337 | 2,158 | 26,243 | 38.8% | 67,698 |
| 1980 | 1,480 | [d] | 14,197 | 2,550 | 1,920 | 1,617 | 2,955 | 34,195 | 37.7% | 90,592 |
| 1985 | 2,402 | 1,045 | 18,313 | 3,310 | 3,278 | 1,723 | 3,149 | 43,804 | 37.4% | 117,038 |
| 1990 | 4,496 | 1,536 | 22,773 | 4,748 | 3,774 | 1,989 | 3,931 | 55,097 | 37.2% | 148,073 |
| 1991 | 4,721 | 1,687 | 22,839 | 4,910 | 3,685 | 2,114 | 3,402 | 59,837 | 38.9% | 153,695 |
| 1992 | 5,177 | 1,872 | 22,694 | 5,040 | 3,643 | 2,672 | 3,413 | 63,781 | 39.6% | 161,219 |
| 1993 | 5,316 | 1,967 | 22,490 | 5,065 | 3,604 | 2,842 | 3,409 | 66,736 | 40.1% | 166,614 |
| 1994 | 5,922 | 2,083 | 22,333 | 5,140 | 3,605 | 2,960 | 3,466 | 70,162 | 45.1% | 155,591 |
| 1995 | 6,221 | 2,221 | 22,173 | 5,195 | 3,635 | 3,062 | 3,485 | 73,143 | 43.1% | 169,749 |
| 1996 | 6,750 | 2,506 | 21,933 | 5,255 | 3,621 | 3,122 | 3,515 | 76,637 | 41.3% | 185,404 |
| 1997 | Data are not available | | | | | | | | | |
| 1998 | 8,313[e] | 2,610 | 20,919 | 5,500 | 3,169 | 4,357 | 3,694 | 79,062 | 44.0% | 179,498 |
| 1999 | 9,400 | 3,000 | 20,559 | 5,609 | 3,392 | 3,370 | 3,120 | 83,148 | 43.7% | 190,203 |
| | *Average annual percentage change* | | | | | | | | | |
| 1950–99 | [d] | [d] | 10.0% | [d] | 2.4% | [d] | 3.3% | 4.7% | | 5.0% |
| 1970–99 | [d] | [d] | 3.0% | 3.9% | 2.3% | 3.5% | 2.6% | 5.2% | | 4.5% |
| 1990–99 | 8.5% | 7.7% | -1.1% | 1.9% | -1.2% | 6.0% | -2.5% | 4.7% | | 2.8% |

**Source**:
Ward's Communications, *Ward's World Motor Vehicle Data*, 2000 Edition, Southfield, MI, 2000, pp. 218–220 and annual.
(Additional resources: www.wardsauto.com)

[a] Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles.
[b] Data from 1991 and later are not comparable to prior data.
[c] Data from 1985 and later are not comparable to prior data.
[d] Data are not available.
[e] Data not comparable to prior data due to reclassification of autos and trucks.

## VEHICLES IN USE

Both the Federal Highway Administration (FHWA) and The Polk Company report figures on the automobile and truck population each year. The two estimates, however, differ by as much as 25.6% for trucks (1992). The differences can be attributed to several factors:

- The FHWA data include all vehicles which have been registered at any time throughout the calendar year. Therefore, the data include vehicles which were retired during the year and may double count vehicles which have been registered in different states or the same states to different owners. The Polk Company data include only those vehicles which are registered on July 1 of the given year.
- The classification of mini-vans, station wagons on truck chasses, and utility vehicles as passenger cars or trucks causes important differences in the two estimates. The Polk Company data included passenger vans in the automobile count until 1980; since 1980 all vans have been counted as trucks. Recently, the Federal Highway Administration adjusted their definition of automobiles and trucks. Starting in 1993, some minivans and sport utility vehicles that were previously included with automobiles were included with trucks. This change produced a dramatic change in the individual percentage differences of cars and trucks. The difference in total vehicles has been less than 5% each year since 1990 and does not appear to be significantly affected by the FHWA reclassifications.
- The FHWA data include all non-military Federal vehicles, while The Polk Company data include only those Federal vehicles which are registered within a state. Federal vehicles are not required to have State registrations, and, according to the General Services Administration, most Federal Vehicles are not registered.

According to The Polk Company statistics, the number of passenger cars in use in the U.S. declined from 1991 to 1992. This is the first decline in vehicle stock since the figures were first reported in 1924. However, the data should be viewed with caution. A redesign of Polk's approach in 1992 allowed a national check for duplicate registrations, which was not possible in earlier years. Polk estimates that, due to processing limitations, its vehicle population counts may have been inflated by as much as 1½ percent. Assuming that percentage is correct, the number of passenger cars in use would have declined from 1991 to 1992 under the previous Polk method. The growing popularity of light trucks being used as passenger vehicles could also have had an impact on these figures.

**Table 6.3**
**Automobiles and Trucks in Use, 1970–2000**
**(thousands)**

| | Automobiles | | | Trucks | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | FHWA | The Polk Company | Percentage difference | FHWA | The Polk Company | Percentage difference | FHWA | The Polk Company | Percentage difference |
| 1970 | 89,243 | 80,448 | 10.9% | 18,797 | 17,688 | 6.3% | 108,040 | 98,136 | 10.1% |
| 1975 | 106,706 | 95,241 | 12.0% | 25,781 | 24,813 | 3.9% | 132,487 | 120,054 | 10.4% |
| 1980 | 121,601 | 104,564 | 16.3% | 33,667 | 35,268 | -4.5% | 155,267 | 139,832 | 11.0% |
| 1981 | 123,098 | 105,839 | 16.3% | 34,644 | 36,069 | -4.0% | 157,743 | 141,908 | 11.2% |
| 1982 | 123,702 | 106,867 | 15.8% | 35,382 | 36,987 | -4.3% | 159,084 | 143,854 | 10.6% |
| 1983 | 126,444 | 108,961 | 16.0% | 36,723 | 38,143 | -3.7% | 163,166 | 147,104 | 10.9% |
| 1984 | 128,158 | 112,019 | 14.4% | 37,507 | 40,143 | -6.6% | 165,665 | 152,162 | 8.9% |
| 1985 | 127,885 | 114,662 | 11.5% | 43,210 | 42,387 | 1.9% | 171,095 | 157,049 | 8.9% |
| 1986 | 130,004 | 117,268 | 10.9% | 45,103 | 44,826 | 0.6% | 175,106 | 162,094 | 8.0% |
| 1987 | 131,482 | 119,849 | 9.7% | 46,826 | 47,344 | -1.1% | 178,308 | 167,193 | 6.6% |
| 1988 | 133,836 | 121,519 | 10.1% | 49,941 | 50,221 | -0.6% | 183,777 | 171,740 | 7.0% |
| 1989 | 134,559 | 122,758 | 9.6% | 52,172 | 53,202 | -1.9% | 186,731 | 175,960 | 6.1% |
| 1990 | 133,700 | 123,276 | 8.5% | 54,470 | 56,023 | -2.8% | 188,171 | 179,299 | 4.9% |
| 1991 | 128,300 | 123,268 | 4.1% | 59,206 | 58,179 | 1.8% | 187,505 | 181,447 | 3.3% |
| 1992 | 126,581 | 120,347 | 5.2% | 63,136 | 61,172 | 3.2% | 189,717 | 181,519 | 4.5% |
| 1993 | 127,327 | 121,055 | 5.2% | 66,082 | 65,260 | 1.3% | 193,409 | 186,315 | 3.8% |
| 1994 | 127,883 | 121,997 | 4.8% | 69,491 | 66,717 | 4.2% | 197,375 | 188,714 | 4.6% |
| 1995 | 128,387 | 123,242 | 4.2% | 72,458 | 70,199 | 3.2% | 200,845 | 193,441 | 3.8% |
| 1996 | 129,728 | 124,613 | 4.1% | 75,940 | 73,681 | 3.1% | 205,669 | 198,294 | 3.7% |
| 1997 | 129,749 | 124,673 | 4.1% | 77,307 | 76,398 | 1.2% | 207,056 | 201,071 | 3.0% |
| 1998 | 131,839 | 125,966 | 4.7% | 79,062 | 79,077 | 0.0% | 210,901 | 205,043 | 2.9% |
| 1999 | 132,432 | 126,869 | 4.4% | 83,148 | 82,640 | 0.6% | 215,580 | 209,509 | 2.9% |
| 2000 | [a] | 127,721 | [a] | [a] | 85,579 | [a] | [a] | 213,300 | [a] |

**Source:**
FHWA - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, 2000, Table VM-1, p. V-45, and annual. (Additional resources: www.fhwa.dot.gov)
Polk - The Polk Company, Detroit, Michigan. **FURTHER REPRODUCTION PROHIBITED**. (Additional resources: www.polk.com)

[a]Data are not available.

*The data on automobile stock by size class are estimations based on historical sales data. This method assumes a constant scrappage rate for all size classes. The definitions for the size classes are in the Glossary. The data on trucks by weight class are based on estimates from the 1997 Vehicle Inventory and Use Survey (latest available survey). Trucks less than 10,000 lbs. make up 94% of all trucks.*

**Table 6.4**
**Vehicle Stock and New Sales in United States, 1999 Calendar Year**

| | Vehicle stock[a] | | New sales | | |
|---|---|---|---|---|---|
| | Thousands | Percentage | Domestic (thousands) | Import[b] (thousands) | Total (thousands) |
| **Autos** | **126,869** | **100.0%** | **6,979 (80.2%)** | **1,719 (19.8%)** | **8,698 (100.0%)** |
| Two seaters | 2,143 | 1.7% | 52 (49.0%) | 54 (51.0%) | 106 (100.0%) |
| Minicompact | 847 | 0.7% | 0 (0.0%) | 14 (100.0%) | 14 (100.0%) |
| Subcompact | 26,707 | 21.1% | 1,390 (85.5%) | 236 (14.5%) | 1,626 (100.0%) |
| Compact | 42,243 | 33.3% | 1,850 (77.5%) | 536 (22.5%) | 2,386 (100.0%) |
| Midsize | 37,141 | 29.3% | 2,547 (75.1%) | 846 (24.9%) | 3,393 (100.0%) |
| Large | 17,787 | 14.0% | 1,140 (97.2%) | 33 (2.8%) | 1,174 (100.0%) |
| **Autos** | **126,869** | **100.0%** | [c] | [c] | [c] |
| Business fleet autos[d] | 7,742 | 6.1% | [c] | [c] | [c] |
| Personal autos | 119,127 | 93.9% | [c] | [c] | [c] |
| **Motorcycles** | **4,152[e]** | **100.0%** | [c] | [c] | [c] |
| **Recreational vehicles** | [c] | [c] | **481 (100.0%)** | **0 (0.0%)** | **481 (100.0%)** |
| **Trucks** | **82,640** | **100.0%** | 7,922 (90.9%) | 795 (9.1%) | 8,176 (100.0%) |
| Light (0–10,000 lbs) | 77,304 | 93.5% | 7,310 (90.5%) | 763 (9.5%) | 8,073 (100.0%) |
| Medium (10,001–26,000 lbs) | 2,457 | 3.0% | 220 (87.9%) | 30 (12.1%) | 250 (100.0%) |
| Heavy-heavy (26,001 lbs and over) | 2,878 | 3.5% | 392 (99.7%) | 1 (0.3%) | 393 (100.0%) |
| **Trucks** | **82,640** | **100.0%** | [c] | [c] | [c] |
| Business fleet trucks ≤ 19,500 lbs[d] | 7,788 | 9.4% | [c] | [c] | [c] |
| Personal trucks ≤ 19,500 lbs | 71,146 | 86.1% | [c] | [c] | [c] |
| Trucks > 19,500 lbs. | 3,706 | 4.5% | [c] | [c] | [c] |

**Source:**
See Appendix A for Table 6.4. (Additional resources: www.polk.com)

[a] Total auto and truck vehicle stock as of July 1,1999 from The Polk Company (FURTHER REPRODUCTION PROHIBITED).
[b] Includes domestic-sponsored imports.
[c] Data are not available.
[d] In fleets of four or more vehicles.
[e] Includes mostly on-highway motorcycles. Many states do not require registration for off-highway vehicles.

*The trend of using two-axle, four-tire trucks, such as pickups, vans, and sport-utility vehicles, for personal travel is evident in these data; two-axle, four-tire trucks account for 22% more travel in 1999 than in 1970, and automobiles account for 24% less travel in that time period.*

**Table 6.5**
**Shares of Highway Vehicle-Miles Traveled by Vehicle Type, 1970–99**
**(million miles)**

| Year | Automobiles | Motorcycles | Two-axle, four-tire trucks | Other single-unit trucks | Combination trucks | Buses[a] | Total vehicle-miles traveled (million miles) |
|---|---|---|---|---|---|---|---|
| 1970 | 82.6% | 0.3% | 11.1% | 2.4% | 3.2% | 0.4% | 1,109,724 |
| 1975 | 77.9% | 0.4% | 15.1% | 2.6% | 3.5% | 0.5% | 1,327,664 |
| 1980 | 72.8% | 0.7% | 19.0% | 2.6% | 4.5% | 0.4% | 1,527,295 |
| 1981 | 72.9% | 0.7% | 19.1% | 2.5% | 4.4% | 0.4% | 1,555,308 |
| 1982 | 72.8% | 0.6% | 19.2% | 2.5% | 4.4% | 0.4% | 1,595,010 |
| 1983 | 72.3% | 0.5% | 19.8% | 2.6% | 4.5% | 0.3% | 1,652,788 |
| 1984 | 71.3% | 0.5% | 20.8% | 2.6% | 4.5% | 0.3% | 1,720,269 |
| 1985 | 70.2% | 0.5% | 22.0% | 2.6% | 4.4% | 0.3% | 1,774,826 |
| 1986 | 69.2% | 0.5% | 23.1% | 2.5% | 4.4% | 0.3% | 1,834,872 |
| 1987 | 68.5% | 0.5% | 23.8% | 2.5% | 4.5% | 0.3% | 1,921,204 |
| 1988 | 67.6% | 0.5% | 24.8% | 2.4% | 4.4% | 0.3% | 2,025,962 |
| 1989 | 66.8% | 0.5% | 25.6% | 2.4% | 4.4% | 0.3% | 2,096,487 |
| 1990 | 65.7% | 0.4% | 26.8% | 2.4% | 4.4% | 0.3% | 2,144,362 |
| 1991 | 62.5% | 0.4% | 29.9% | 2.4% | 4.4% | 0.3% | 2,172,050 |
| 1992 | 61.0% | 0.4% | 31.5% | 2.4% | 4.4% | 0.3% | 2,247,151 |
| 1993 | 59.9% | 0.4% | 32.5% | 2.5% | 4.5% | 0.3% | 2,296,378 |
| 1994 | 59.6% | 0.4% | 32.4% | 2.6% | 4.6% | 0.3% | 2,357,588 |
| 1995 | 59.4% | 0.4% | 32.6% | 2.6% | 4.8% | 0.3% | 2,422,696 |
| 1996 | 59.1% | 0.4% | 32.8% | 2.6% | 4.8% | 0.3% | 2,485,848 |
| 1997 | 58.7% | 0.4% | 33.2% | 2.6% | 4.9% | 0.3% | 2,561,695 |
| 1998 | 58.9% | 0.4% | 33.0% | 2.6% | 4.9% | 0.3% | 2,631,522 |
| 1999 | 58.3% | 0.4% | 33.5% | 2.6% | 4.9% | 0.3% | 2,691,335 |
| | | | *Average annual percentage change* | | | | |
| 1970–99 | | | | | | | 3.1% |
| 1989–99 | | | | | | | 2.5% |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, 2000, Table VM-1, p. V-45, and annual. (Additional resources: www.fhwa.dot.gov)

[a]The data do not correspond with vehicle-miles of travel presented in the "Bus" section of this chapter due to differing data sources.

**Table 6.6**
**Automobiles in Operation and Vehicle Travel by Age, 1970 and 1999**

| Age (years) | 1970 Vehicles (thousands) | 1970 Percentage | 1970 Cumulative percentage | 1999 Vehicles (thousands) | 1999 Percentage | 1999 Cumulative percentage | 1999 Estimated vehicle travel Percentage | 1999 Estimated vehicle travel Cumulative percentage | Average annual miles per vehicle |
|---|---|---|---|---|---|---|---|---|---|
| Under 1[a] | 6,288 | 7.8% | 7.8% | 6,219 | 4.9% | 4.9% | 6.7% | 6.7% | 15,600 |
| 1 | 9,299 | 11.6% | 19.4% | 7,714 | 6.1% | 11.0% | 7.7% | 14.4% | 14,500 |
| 2 | 8,816 | 11.0% | 30.3% | 7,971 | 6.3% | 17.3% | 8.1% | 22.6% | 14,800 |
| 3 | 7,878 | 9.8% | 40.1% | 7,488 | 5.9% | 23.2% | 7.1% | 29.7% | 13,800 |
| 4 | 8,538 | 10.6% | 50.8% | 8,811 | 6.9% | 30.1% | 7.8% | 37.5% | 12,900 |
| 5 | 8,506 | 10.6% | 61.3% | 7,771 | 6.1% | 36.2% | 6.8% | 44.3% | 12,700 |
| 6 | 7,116 | 8.8% | 70.2% | 7,826 | 6.2% | 42.4% | 6.7% | 51.0% | 12,400 |
| 7 | 6,268 | 7.8% | 78.0% | 7,204 | 5.7% | 48.1% | 5.8% | 56.8% | 11,600 |
| 8 | 5,058 | 6.3% | 84.3% | 7,354 | 5.8% | 53.9% | 5.7% | 62.5% | 11,300 |
| 9 | 3,267 | 4.1% | 88.3% | 7,387 | 5.8% | 59.7% | 5.7% | 68.2% | 11,200 |
| 10 | 2,776 | 3.5% | 91.8% | 7,797 | 6.1% | 65.8% | 4.8% | 73.1% | 9,000 |
| 11 | 1,692 | 2.1% | 93.9% | 7,475 | 5.9% | 71.7% | 4.6% | 77.7% | 9,000 |
| 12 | 799 | 1.0% | 94.9% | 6,780 | 5.3% | 77.1% | 4.2% | 81.9% | 9,000 |
| 13 | 996 | 1.2% | 96.1% | 6,089 | 4.8% | 81.9% | 3.8% | 85.7% | 9,000 |
| 14 | 794 | 1.0% | 97.1% | 4,987 | 3.9% | 85.8% | 3.1% | 88.8% | 9,000 |
| 15 and older | 2,336 | 2.9% | 100.0% | 17,996 | 14.2% | 100.0% | 11.2% | 100.0% | 9,000 |
| **Subtotal** | **80,427** | **100.0%** | | **126,869** | | | | | |
| Age not given | **22** | | | **0** | | | | | |
| **Total** | **80,449** | | | **126,869** | | | | | |
| Average age | | 5.6 | | | 8.9 | | | | |
| Median age | | 4.9 | | | 8.3 | | | | |

**Source:**
The Polk Company, Detroit, MI. **FURTHER REPRODUCTION PROHIBITED.**
Vehicle travel - Average annual miles per auto by age were multiplied by the number of vehicles in operation by age to estimate the vehicle travel. Average annual miles per auto by age - generated by ORNL from the *Nationwide Personal Transportation Survey* web site: www-cta.ornl.gov/npts.
(Additional resources: www.polk.com, www-cta.ornl.gov/npts)

[a]Includes automobiles from model year 2000 and 1999 which were sold prior to July 1, 1999, and similarly, model years 1971 and 1970 sold prior to July 1, 1970.

**Table 6.7**
**Trucks in Operation and Vehicle Travel by Age, 1970 and 1999**

| Age (years) | 1970 Vehicles (thousands) | 1970 Percentage | 1970 Cumulative percentage | 1999 Vehicles (thousands) | 1999 Percentage | 1999 Cumulative percentage | 1999 Estimated vehicle travel Percentage | 1999 Estimated vehicle travel Cumulative percentage | Average annual miles per vehicle |
|---|---|---|---|---|---|---|---|---|---|
| Under 1[a] | 1,262 | 7.1% | 7.1% | 5,953 | 7.2% | 7.2% | 8.8% | 8.8% | 17,500 |
| 1 | 1,881 | 10.6% | 17.8% | 6,750 | 8.2% | 15.4% | 11.1% | 19.9% | 19,200 |
| 2 | 1,536 | 8.7% | 26.5% | 6,507 | 7.9% | 23.2% | 11.0% | 30.9% | 19,800 |
| 3 | 1,428 | 8.1% | 34.6% | 5,492 | 6.6% | 29.9% | 8.4% | 39.3% | 17,900 |
| 4 | 1,483 | 8.4% | 43.0% | 6,063 | 7.3% | 37.2% | 9.0% | 48.3% | 17,500 |
| 5 | 1,339 | 7.6% | 50.5% | 5,437 | 6.6% | 43.8% | 7.9% | 56.2% | 17,000 |
| 6 | 1,154 | 6.5% | 57.1% | 4,539 | 5.5% | 49.3% | 6.0% | 62.2% | 15,600 |
| 7 | 975 | 5.5% | 62.6% | 3,739 | 4.5% | 53.8% | 4.9% | 67.1% | 15,400 |
| 8 | 826 | 4.7% | 67.3% | 3,626 | 4.4% | 58.2% | 4.7% | 71.7% | 15,100 |
| 9 | 621 | 3.5% | 70.8% | 3,494 | 4.2% | 62.4% | 3.9% | 75.7% | 13,200 |
| 10 | 658 | 3.7% | 74.5% | 3,940 | 4.8% | 67.2% | 3.1% | 78.7% | 9,200 |
| 11 | 583 | 3.3% | 77.8% | 3,738 | 4.5% | 71.7% | 2.9% | 81.7% | 9,200 |
| 12 | 383 | 2.2% | 80.0% | 3,145 | 3.8% | 75.5% | 2.5% | 84.1% | 9,200 |
| 13 | 417 | 2.4% | 82.3% | 3,142 | 3.8% | 79.3% | 2.5% | 86.6% | 9,200 |
| 14 | 414 | 2.3% | 84.7% | 2,560 | 3.1% | 82.4% | 2.0% | 88.6% | 9,200 |
| 15 and older | 2,710 | 15.3% | 100.0% | 14,515 | 17.6% | 100.0% | 11.4% | 100.0% | 9,200 |
| **Subtotal** | **17,670** | **100.0%** | | **82,640** | | | **100.0%** | | |
| Age not given | 15 | | | 0 | | | | | |
| **Total** | **17,685** | | | **82,640** | | | | | |
| Average age | | 7.3 | | | 8.2 | | | | |
| Median age | | 5.9 | | | 7.2 | | | | |

**Source:**
The Polk Company, Detroit, MI. **FURTHER REPRODUCTION PROHIBITED.**
Vehicle travel—The average annual vehicle-miles per truck by age were multiplied by the number of trucks in operation by age to estimate the vehicle travel. Average annual miles per truck by age were generated by ORNL from the *1992 Truck Inventory and Use Survey* public use tape provided by U.S. Department of Commerce, Bureau of the Census, Washington, DC, 1995. (Additional resources: www.polk.com, www.census.gov)

[a]Includes trucks from model year 2000 and 1999 which were sold prior to July 1, 1999, and similarly, model years 1971 and 1970 sold prior to July 1, 1970.

*The average age of automobiles was lower than the average age of trucks until 1994. Since then, the average automobile age continues to grow, while the average truck age has held about the same. The increasing popularity of light trucks as personal passenger vehicles may have had an influence on the average age of trucks.*

**Table 6.8**
**Average Age of Automobiles and Trucks in Use, 1970–99**
**(years)**

| Calendar year | Automobiles | | Trucks | |
|---|---|---|---|---|
| | Mean[a] | Median[b] | Mean[a] | Median[b] |
| 1970 | 5.6 | 4.9 | 7.3 | 5.9 |
| 1971 | 5.7 | 5.1 | 7.4 | 6.1 |
| 1972 | 5.7 | 5.1 | 7.2 | 6.0 |
| 1973 | 5.7 | 5.1 | 6.9 | 5.8 |
| 1974 | 5.7 | 5.2 | 7.0 | 5.6 |
| 1975 | 6.0 | 5.4 | 6.9 | 5.8 |
| 1976 | 6.2 | 5.5 | 7.0 | 5.8 |
| 1977 | 6.2 | 5.6 | 6.9 | 5.7 |
| 1978 | 6.3 | 5.7 | 6.9 | 5.8 |
| 1979 | 6.4 | 5.9 | 6.9 | 5.9 |
| 1980 | 6.6 | 6.0 | 7.1 | 6.3 |
| 1981 | 6.9 | 6.0 | 7.5 | 6.5 |
| 1982 | 7.2 | 6.2 | 7.8 | 6.8 |
| 1983 | 7.4 | 6.5 | 8.1 | 7.2 |
| 1984 | 7.5 | 6.7 | 8.2 | 7.4 |
| 1985 | 7.6 | 6.9 | 8.1 | 7.6 |
| 1986 | 7.6 | 7.0 | 8.0 | 7.7 |
| 1987 | 7.6 | 6.9 | 8.0 | 7.8 |
| 1988 | 7.6 | 6.8 | 7.9 | 7.1 |
| 1989 | 7.6 | 6.5 | 7.9 | 6.7 |
| 1990 | 7.8 | 6.5 | 8.0 | 6.5 |
| 1991 | 7.9 | 6.7 | 8.1 | 6.8 |
| 1992 | 8.1 | 7.0 | 8.4 | 7.2 |
| 1993 | 8.3 | 7.3 | 8.6 | 7.5 |
| 1994 | 8.4 | 7.5 | 8.4 | 7.5 |
| 1995 | 8.5 | 7.7 | 8.4 | 7.6 |
| 1996 | 8.6 | 7.9 | 8.3 | 7.7 |
| 1997 | 8.7 | 8.1 | 8.3 | 7.8 |
| 1998 | 8.8 | 8.3 | 8.3 | 7.5 |
| 1999 | 8.9 | 8.3 | 8.2 | 7.2 |

**Source:**
The Polk Company, Detroit, MI. **FURTHER REPRODUCTION PROHIBITED.**
(Additional resources: www.polk.com)

[a]Mean is the sum of the products of units multiplied by age, divided by the total units.
[b]Median is a value in an ordered set of values below and above which there are an equal number of values.

*Using current registration data and a scrappage model by Greenspan and Cohen,* [1996 paper: http://www.federalreserve.gov/pubs/feds/1996/199640/199640pap.pdf]*, ORNL calculated new automobile scrappage rates. The expected median lifetime for a 1990 model year automobile is 16 years. These data are fitted model values which assume constant economic conditions.*

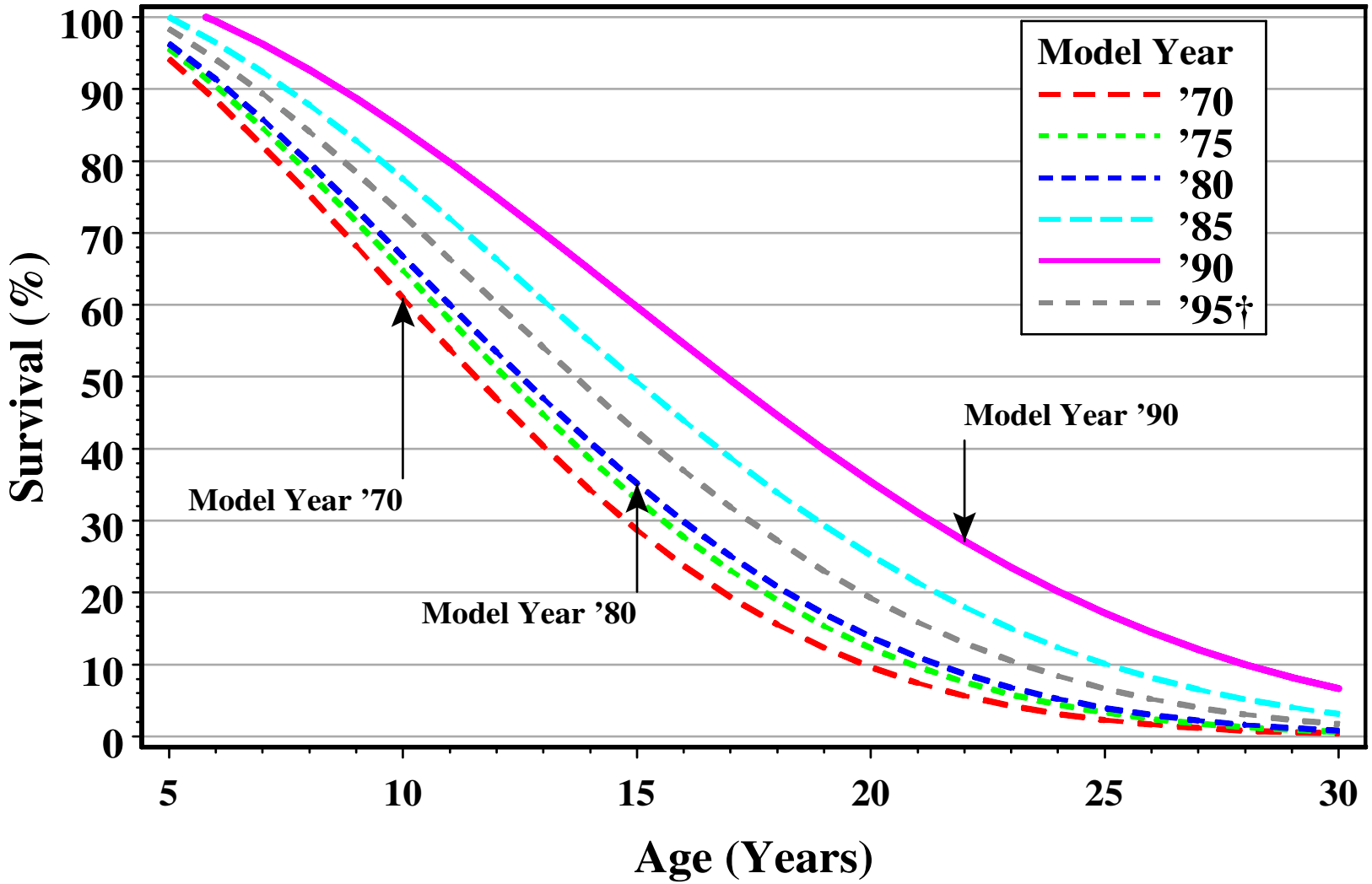
**Table 6.9**
**Automobile Scrappage and Survival Rates**
**1970, 1980 and 1990 Model Years**

| Vehicle age[a] (years) | 1970 model year | | 1980 model year | | 1990 model year | |
|---|---|---|---|---|---|---|
| | Survival rate[b] | Scrappage rate[c] | Survival rate[b] | Scrappage rate[c] | Survival rate[b] | Scrappage rate[c] |
| 4 | 99.0 | 3.9 | 100.0 | 3.2 | 100.0 | 1.6 |
| 5 | 94.1 | 5.0 | 96.3 | 4.2 | 100.0 | 2.1 |
| 6 | 88.4 | 6.1 | 91.3 | 5.1 | 99.4 | 2.6 |
| 7 | 82.0 | 7.2 | 85.7 | 6.1 | 96.3 | 3.2 |
| 8 | 75.2 | 8.3 | 79.7 | 7.1 | 92.7 | 3.7 |
| 9 | 68.1 | 9.5 | 73.3 | 8.1 | 88.7 | 4.3 |
| 10 | 60.9 | 10.6 | 66.6 | 9.0 | 84.4 | 4.9 |
| 11 | 53.8 | 11.7 | 60.0 | 10.0 | 79.8 | 5.5 |
| 12 | 46.9 | 12.8 | 53.3 | 11.0 | 75.0 | 6.1 |
| 13 | 40.3 | 14.0 | 46.9 | 12.0 | 70.0 | 6.7 |
| 14 | 34.2 | 15.1 | 40.8 | 13.0 | 64.9 | 7.3 |
| 15 | 28.7 | 16.2 | 35.1 | 14.0 | 59.7 | 7.9 |
| 16 | 23.7 | 17.4 | 29.8 | 15.0 | 54.6 | 8.6 |
| 17 | 19.3 | 18.5 | 25.0 | 16.1 | 49.5 | 9.3 |
| 18 | 15.5 | 19.6 | 20.8 | 17.1 | 44.6 | 9.9 |
| 19 | 12.3 | 20.8 | 17.0 | 18.1 | 39.9 | 10.6 |
| 20 | 9.6 | 21.9 | 13.8 | 19.1 | 35.4 | 11.3 |
| 21 | 7.4 | 23.0 | 11.0 | 20.1 | 31.1 | 12.0 |
| 22 | 5.6 | 24.2 | 8.7 | 21.2 | 27.2 | 12.7 |
| 23 | 4.2 | 25.3 | 6.7 | 22.2 | 23.5 | 13.5 |
| 24 | 3.1 | 26.4 | 5.2 | 23.2 | 20.2 | 14.2 |
| 25 | 2.2 | 27.5 | 3.9 | 24.2 | 17.1 | 15.0 |
| 26 | 1.6 | 28.6 | 2.9 | 25.3 | 14.5 | 15.7 |
| 27 | 1.1 | 29.7 | 2.2 | 26.3 | 12.1 | 16.5 |
| 28 | 0.8 | 30.8 | 1.6 | 27.3 | 10.0 | 17.2 |
| 29 | 0.5 | 31.9 | 1.1 | 28.4 | 8.2 | 18.0 |
| 30 | 0.4 | 33.0 | 0.8 | 29.4 | 6.6 | 18.8 |
| Median lifetime | 11.5 | | 12.5 | | 16.1 | |

**Source:**
Schmoyer, Richard L., unpublished study on scrappage rates, Oak Ridge National Laboratory, Oak Ridge, TN, 2001.

[a]It was assumed that scrappage for vehicles less than 4 years old is 0.
[b]The percentage of 1970/80/90 model year automobiles which will be in use at the end of a given year.
[c]The percentage of 1970/80/90 model year automobiles which will be retired from use within a given year.

**Figure 6.1. Automobile Survival Rates***




*Data Source: See Table 6.9.
†Model Year '95 estimates are based on minimal preliminary data.

*Using current registration data and a scrappage model by Greenspan and Cohen* [1996 paper: http://www.federalreserve.gov/pubs/feds/1996/199640/199640pap.pdf]*, ORNL calculated new light truck scrappage rates. The expected median lifetime for a 1990 model year light truck is 15.5 years. These data are fitted model values which assume constant economic conditions.*

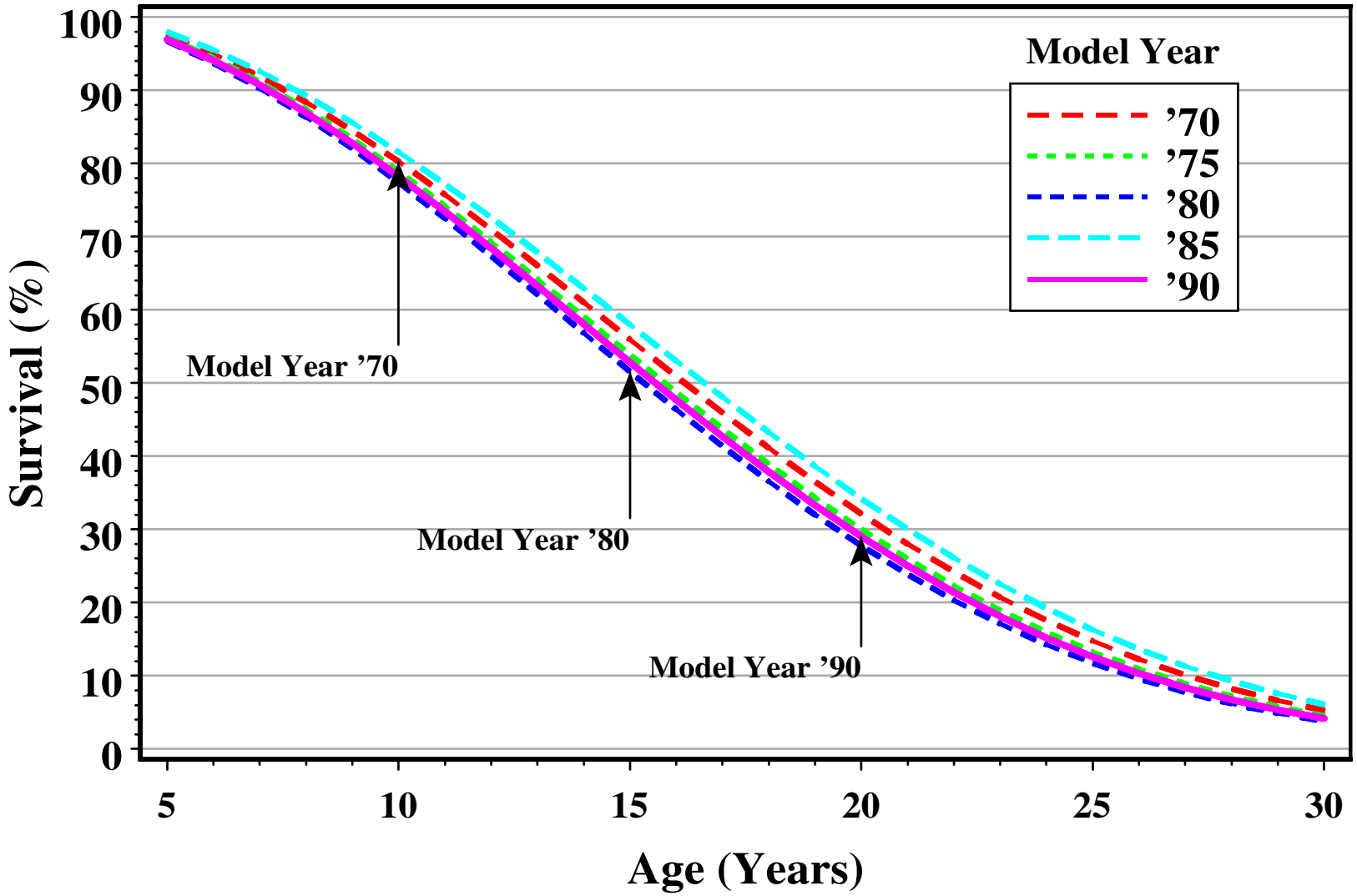
**Table 6.10**
**Light Truck[a] Scrappage and Survival Rates**

| Vehicle age[b] (years) | 1970 model year | | 1980 model year | | 1990 model year | |
|---|---|---|---|---|---|---|
| | Survival rate[c] | Scrappage rate[d] | Survival rate[b] | Scrappage rate[c] | Survival rate[b] | Scrappage rate[c] |
| 4 | 99.7 | 1.6 | 99.1 | 1.9 | | 1.8 |
| 5 | 97.5 | 2.2 | 96.6 | 2.5 | 96.9 | 2.4 |
| 6 | 94.9 | 2.7 | 93.7 | 3.1 | 94.1 | 3.0 |
| 7 | 91.8 | 3.2 | 90.2 | 3.7 | 90.7 | 3.6 |
| 8 | 88.3 | 3.8 | 86.3 | 4.3 | 86.9 | 4.2 |
| 9 | 84.4 | 4.4 | 82.0 | 5.0 | 82.7 | 4.8 |
| 10 | 80.2 | 5.0 | 77.3 | 5.7 | 78.2 | 5.5 |
| 11 | 75.7 | 5.6 | 72.4 | 6.4 | 73.4 | 6.1 |
| 12 | 70.9 | 6.3 | 67.3 | 7.1 | 68.4 | 6.8 |
| 13 | 66.0 | 6.9 | 62.1 | 7.8 | 63.3 | 7.5 |
| 14 | 61.0 | 7.6 | 56.8 | 8.5 | 58.0 | 8.2 |
| 15 | 55.9 | 8.3 | 51.5 | 9.3 | 52.8 | 9.0 |
| 16 | 50.8 | 9.0 | 46.3 | 10.1 | 47.7 | 9.7 |
| 17 | 45.9 | 9.8 | 41.3 | 10.8 | 42.7 | 10.5 |
| 18 | 41.1 | 10.5 | 36.5 | 11.6 | 37.9 | 11.3 |
| 19 | 36.4 | 11.3 | 32.0 | 12.4 | 33.3 | 12.1 |
| 20 | 32.1 | 12.0 | 27.7 | 13.3 | 29.0 | 12.9 |
| 21 | 28.0 | 12.8 | 23.8 | 14.1 | 25.0 | 13.7 |
| 22 | 24.2 | 13.6 | 20.3 | 14.9 | 21.4 | 14.5 |
| 23 | 20.7 | 14.4 | 17.1 | 15.8 | 18.1 | 15.4 |
| 24 | 17.5 | 15.2 | 14.2 | 16.7 | 15.2 | 16.2 |
| 25 | 14.7 | 16.1 | 11.7 | 17.5 | 12.6 | 17.1 |
| 26 | 12.2 | 16.9 | 9.6 | 18.4 | 10.3 | 18.0 |
| 27 | 10.1 | 17.8 | 7.7 | 19.3 | 8.4 | 18.8 |
| 28 | 8.2 | 18.6 | 6.2 | 20.2 | 6.7 | 19.7 |
| 29 | 6.6 | 19.5 | 4.9 | 21.1 | 5.3 | 20.6 |
| 30 | 5.2 | 20.4 | 3.8 | 22.1 | 4.2 | 21.5 |
| Median lifetime | 16.8 years | | 15.7 years | | 15.5 years | |

**Source:**
Schmoyer, Richard L., unpublished study on scrappage rates, Oak Ridge National Laboratory, Oak Ridge, TN, 2001.

[a]Light trucks are trucks less than 10,000 lbs. gross vehicle weight.
[b]It was assumed that scrappage for vehicles less than 4 years old is 0.
[c]The percentage of 1970/80/90 model year light trucks which will be in use at the end of a given year.
[d]The percentage of 1970/80/90 model year light trucks which will be retired from use within a given year.

**Figure 6.2. Light Truck Survival Rates***




*Data Source: See Table 6.10.

*Using current registration data and a scrappage model by Greenspan and Cohen* [1996 paper: http://www.federalreserve.gov/pubs/feds/1996/199640/199640pap.pdf]*, ORNL calculated heavy truck (trucks over scrappage rates. The expected median lifetime for a 1990 model year heavy truck is 29 years. These data are fitted model values which assume constant economic conditions.*

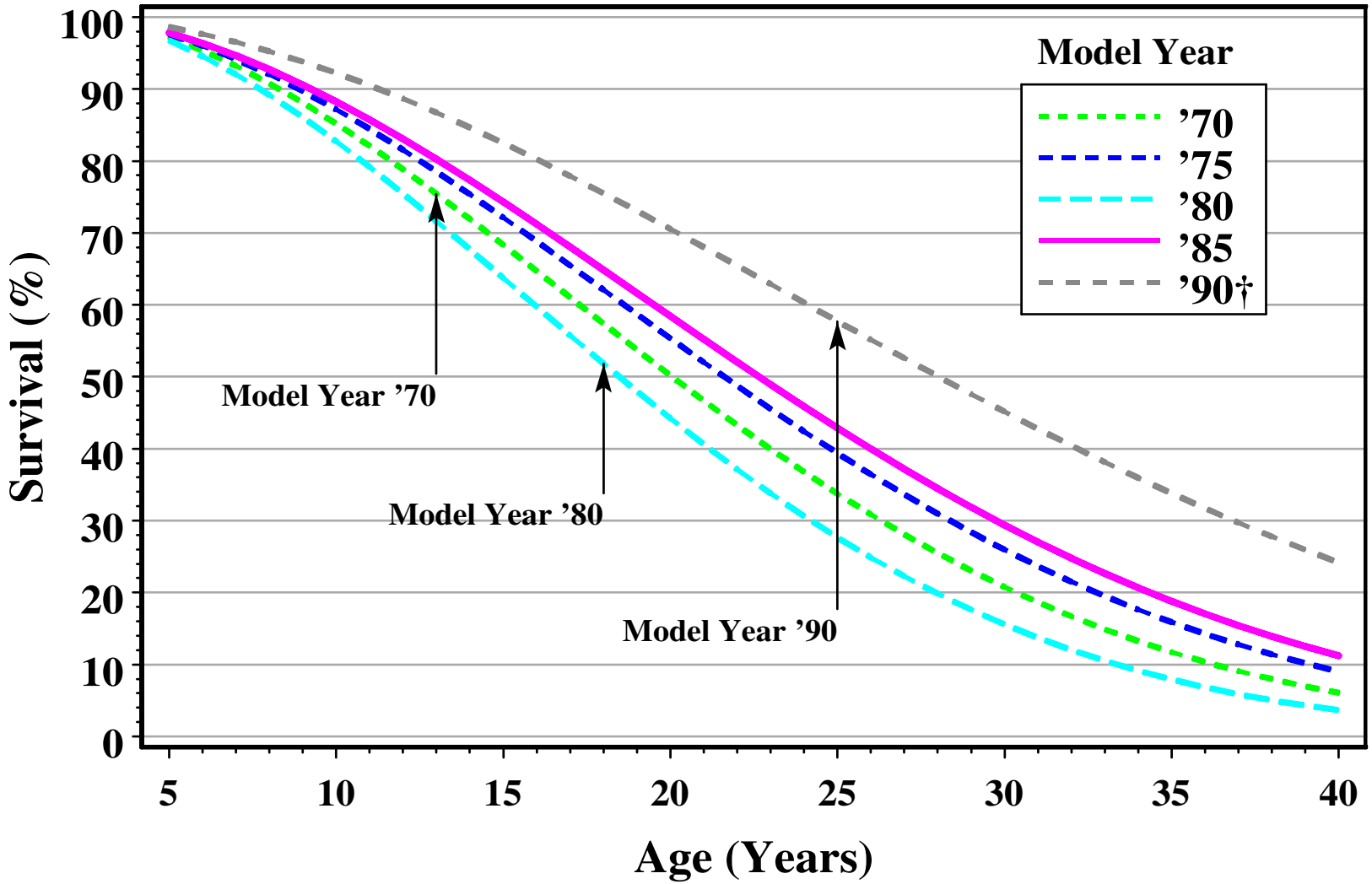
**Table 6.11**
**Heavy Truck[a] Scrappage and Survival Rates**

| Vehicle age[b] (years) | 1970 model year | | 1980 model year | | 1990 model year | |
|---|---|---|---|---|---|---|
| | Survival rate[c] | Scrappage rate[d] | Survival rate[b] | Scrappage rate[c] | Survival rate[b] | Scrappage rate[c] |
| 4 | 98.8 | 1.2 | 98.5 | 1.5 | 99.4 | 0.6 |
| 5 | 97.2 | 1.6 | 96.7 | 1.9 | 98.6 | 0.8 |
| 6 | 95.3 | 1.9 | 94.5 | 2.3 | 97.6 | 1.0 |
| 7 | 93.2 | 2.3 | 92.0 | 2.7 | 96.5 | 1.2 |
| 8 | 90.7 | 2.6 | 89.1 | 3.1 | 95.2 | 1.3 |
| 9 | 88.1 | 3.0 | 86.0 | 3.5 | 93.8 | 1.5 |
| 10 | 85.2 | 3.3 | 82.7 | 3.9 | 92.2 | 1.7 |
| 11 | 82.1 | 3.6 | 79.1 | 4.3 | 90.5 | 1.9 |
| 12 | 78.8 | 4.0 | 75.4 | 4.7 | 88.6 | 2.0 |
| 13 | 75.4 | 4.3 | 71.6 | 5.1 | 86.7 | 2.2 |
| 14 | 71.9 | 4.7 | 67.7 | 5.5 | 84.6 | 2.4 |
| 15 | 68.3 | 5.0 | 63.7 | 5.9 | 82.4 | 2.6 |
| 16 | 64.6 | 5.3 | 59.7 | 6.3 | 80.2 | 2.7 |
| 17 | 61.0 | 5.7 | 55.7 | 6.7 | 77.9 | 2.9 |
| 18 | 57.3 | 6.0 | 51.8 | 7.1 | 75.5 | 3.1 |
| 19 | 53.7 | 6.3 | 47.9 | 7.4 | 73.0 | 3.3 |
| 20 | 50.1 | 6.7 | 44.2 | 7.8 | 70.5 | 3.4 |
| 21 | 46.6 | 7.0 | 40.6 | 8.2 | 68.0 | 3.6 |
| 22 | 43.2 | 7.3 | 37.1 | 8.6 | 65.4 | 3.8 |
| 23 | 39.9 | 7.6 | 33.7 | 9.0 | 62.8 | 3.9 |
| 24 | 36.7 | 8.0 | 30.6 | 9.4 | 60.3 | 4.1 |
| 25 | 33.7 | 8.3 | 27.6 | 9.7 | 57.7 | 4.3 |
| 26 | 30.8 | 8.6 | 24.8 | 10.1 | 55.1 | 4.5 |
| 27 | 28.0 | 8.9 | 22.2 | 10.5 | 52.6 | 4.6 |
| 28 | 25.4 | 9.3 | 19.8 | 10.9 | 50.0 | 4.8 |
| 29 | 23.0 | 9.6 | 17.6 | 11.2 | 47.6 | 5.0 |
| 30 | 20.7 | 9.9 | 15.5 | 11.6 | 45.1 | 5.1 |
| Median lifetime | 21.0 years | | 18.5 years | | 29.0 years | |

**Source:**
Schmoyer, Richard L., unpublished study on scrappage rates, Oak Ridge National Laboratory, Oak Ridge, TN, 2001.

[a]Heavy trucks are trucks more than 26,000 lbs. gross vehicle weight.
[b]It was assumed that scrappage for vehicles less than 4 years old is 0.
[c]The percentage of 1970/80/90 model year light trucks which will be in use at the end of a given year.
[d]The percentage of 1970/80/90 model year light trucks which will be retired from use within a given year.

**Figure 6.3. Heavy Truck Survival Rates***




*Data Source: See Table 6.11. Estimates based on variation of Greenspan-Cohen model for heavy trucks (R. L. Schmoyer, unpublished report).
†Model year '90 estimates are based on minimal preliminary data.

# Chapter 7
# Light Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

| Source | | |
|---|---|---|
| Table 7.1 | Passenger cars, 1999 | |
| | *Registrations (thousands)* | *132,432* |
| | *Vehicle miles (million miles)* | *1,569,270* |
| | *Fuel economy (miles per gallon)* | *21.6* |
| Table 7.2 | Two-axle, four-tire trucks, 1999 | |
| | *Registrations (thousands)* | *75,356* |
| | *Vehicle miles (million miles)* | *901,121* |
| | *Fuel economy (miles per gallon)* | *17.1* |
| Table 7.5 | Automobile sales, 1999 sales period | |
| | *Minicompact* | *12,903* |
| | *Subcompact* | *1,622,483* |
| | *Compact* | *2,367,048* |
| | *Midsize* | *3,359,492* |
| | *Large* | *1,180,739* |
| | *Two-seater* | *103,248* |
| Table 7.7 | Light truck share of total light vehicle sales | |
| | *1976* | *19.8%* |
| | *1999* | *48.1%* |
| Table 7.6 | Light truck sales, 1999 sales period | |
| | *Small pickup* | *302,426* |
| | *Large pickup* | *2,830,271* |
| | *Small van* | *1,319,398* |
| | *Large van* | *416,813* |
| | *Small utility* | *942,298* |
| | *Large utility* | *2,190,549* |
| Table 7.16 | Corporate average fuel economy | (mpg) |
| | *Automobile standard, MY 1999* | *27.5* |
| | *Automobile fuel economy, MY 1999* | *28.5* |
| | *Light truck standard, MY 1999* | *20.7* |
| | *Light truck fuel economy, MY 1999* | *21.2* |
| Table 7.21 | Average fuel economy loss from 55 to 70 mph | 17.1% |

*The Federal Highway Administration released revised historical data back to 1985 in their "Highway Statistics Summary to 1995" report. As a result, the data in this table have been revised. The data in this table from 1985–on* ***DO NOT*** *include minivans, pickups, or sport utility vehicles.*

**Table 7.1**
**Summary Statistics for Passenger Cars, 1970–99**

| Year | Registrations[a] (thousands) | Vehicle travel (million miles) | Fuel use (million gallons) | Fuel economy[b] (miles per gallon) |
|---|---|---|---|---|
| 1970 | 89,244 | 916,700 | 67,820 | 13.5 |
| 1971 | 92,718 | 966,330 | 71,346 | 13.5 |
| 1972 | 97,082 | 1,021,365 | 75,937 | 13.5 |
| 1973 | 101,985 | 1,045,981 | 78,233 | 13.4 |
| 1974 | 104,856 | 1,007,251 | 74,229 | 13.6 |
| 1975 | 106,706 | 1,033,950 | 74,140 | 13.9 |
| 1976 | 110,189 | 1,078,215 | 78,297 | 13.8 |
| 1977 | 112,288 | 1,109,243 | 79,060 | 14.0 |
| 1978 | 116,573 | 1,146,508 | 80,652 | 14.2 |
| 1979 | 118,429 | 1,113,640 | 76,588 | 14.5 |
| 1980 | 121,601 | 1,111,596 | 69,981 | 15.9 |
| 1981 | 123,098 | 1,133,332 | 69,112 | 16.4 |
| 1982 | 123,702 | 1,161,713 | 69,116 | 16.8 |
| 1983 | 126,444 | 1,195,054 | 70,322 | 17.0 |
| 1984 | 128,158 | 1,227,043 | 70,663 | 17.4 |
| 1985[c] | 127,885 | 1,246,798 | 71,518 | 17.4 |
| 1986 | 130,004 | 1,270,167 | 73,174 | 17.4 |
| 1987 | 131,482 | 1,315,982 | 73,308 | 18.0 |
| 1988 | 133,836 | 1,370,271 | 73,345 | 18.7 |
| 1989 | 134,559 | 1,401,221 | 73,913 | 19.0 |
| 1990 | 133,700 | 1,408,266 | 69,568 | 20.2 |
| 1991 | 128,300 | 1,358,185 | 64,318 | 21.1 |
| 1992 | 126,581 | 1,371,569 | 65,436 | 21.0 |
| 1993 | 127,327 | 1,374,709 | 67,047 | 20.5 |
| 1994 | 127,883 | 1,406,089 | 67,874 | 20.7 |
| 1995 | 128,387 | 1,438,294 | 68,072 | 21.1 |
| 1996 | 129,728 | 1,469,854 | 69,221 | 21.2 |
| 1997 | 129,749 | 1,502,556 | 69,892 | 21.5 |
| 1998 | 131,839 | 1,549,577 | 71,695 | 21.4 |
| 1999 | 132,432 | 1,569,270 | 73,160 | 21.6 |
| | | *Average annual percentage change* | | |
| 1970–99 | 1.4% | 1.9% | 0.3% | 1.6% |
| 1989–99 | -0.2% | 1.1% | -0.1% | 1.3% |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, 2001, Table VM-1, p. V-74, and annual.
(Additional resources: www.fhwa.dot.gov)

[a] This number differs from R.L. Polk's estimates of "number of automobiles in use." See Table 6.3.
[b] Fuel economy for automobile population.
[c] Beginning in this year the data were revised to exclude minivans, pickups and sport utility vehicles which may have been previously included.

*The Federal Highway Administration released revised historical data back to 1985 which better reflected two-axle, four-tire trucks. The definition of this category includes vans, pickup trucks, and sport utility vehicles.*

**Table 7.2**
**Summary Statistics for Two-Axle, Four-Tire Trucks, 1970–99**

| Year | Registrations (thousands) | Vehicle travel (million miles) | Fuel use (million gallons) | Fuel economy (miles per gallon) |
|---|---|---|---|---|
| 1970 | 14,211 | 123,286 | 12,313 | 10.0 |
| 1971 | 15,181 | 137,870 | 13,484 | 10.2 |
| 1972 | 16,428 | 156,622 | 15,150 | 10.3 |
| 1973 | 18,083 | 176,833 | 16,828 | 10.5 |
| 1974 | 19,335 | 182,757 | 16,657 | 11.0 |
| 1975 | 20,418 | 200,700 | 19,081 | 10.5 |
| 1976 | 22,301 | 225,834 | 20,828 | 10.8 |
| 1977 | 23,624 | 250,591 | 22,383 | 11.2 |
| 1978 | 25,476 | 279,414 | 24,162 | 11.6 |
| 1979 | 27,022 | 291,905 | 24,445 | 11.9 |
| 1980 | 27,876 | 290,935 | 23,796 | 12.2 |
| 1981 | 28,928 | 296,343 | 23,697 | 12.5 |
| 1982 | 29,792 | 306,141 | 22,702 | 13.5 |
| 1983 | 31,214 | 327,643 | 23,945 | 13.7 |
| 1984 | 32,106 | 358,006 | 25,604 | 14.0 |
| 1985[a] | 37,214 | 390,961 | 27,363 | 14.3 |
| 1986 | 39,382 | 423,915 | 29,074 | 14.6 |
| 1987 | 41,107 | 456,870 | 30,598 | 14.9 |
| 1988 | 43,805 | 502,207 | 32,653 | 15.4 |
| 1989 | 45,945 | 536,475 | 33,271 | 16.1 |
| 1990 | 48,275 | 574,571 | 35,611 | 16.1 |
| 1991 | 53,033 | 649,394 | 38,217 | 17.0 |
| 1992 | 57,091 | 706,863 | 40,929 | 17.3 |
| 1993 | 59,994 | 745,750 | 42,851 | 17.4 |
| 1994 | 62,904 | 764,634 | 44,112 | 17.3 |
| 1995 | 65,738 | 790,029 | 45,605 | 17.3 |
| 1996 | 69,134 | 816,540 | 47,354 | 17.2 |
| 1997 | 70,224 | 850,739 | 49,389 | 17.2 |
| 1998 | 71,330 | 868,275 | 50,462 | 17.2 |
| 1999 | 75,356 | 901,121 | 52,771 | 17.1 |
| | | *Average annual percentage change* | | |
| 1970–99 | 5.9% | 7.1% | 5.1% | 1.9% |
| 1989–99 | 5.1% | 5.3% | 4.7% | 0.6% |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, 2001, Table VM-1, p. V-74, and annual.
(Additional resources: www.fhwa.dot.gov)

[a] Beginning in this year the data were revised to include all vans (including mini-vans), pickups and sport utility vehicles.

*Nearly one-quarter of autos sold in 2000 were transplants–autos built in the U.S. by a foreign firm.*

**Table 7.3**
**New Retail Automobile Sales in the United States, 1970–2000**

| Calendar year | Domestic[a] | Import[b] | Total | Percentage imports | Percentage transplants[c] on model year basis | Percentage imports and transplants | Percentage diesel |
|---|---|---|---|---|---|---|---|
| | (thousands) | | | | | | |
| 1970 | 7,119 | 1,285 | 8,404 | 15.3% | [d] | [d] | [d] |
| 1975 | 7,053 | 1,571 | 8,624 | 18.2% | [d] | [d] | 0.31% |
| 1980 | 6,581 | 2,398 | 8,979 | 26.7% | 2.1% | 28.8% | 4.31% |
| 1981 | 6,209 | 2,327 | 8,536 | 27.3% | 1.8% | 29.1% | 6.10% |
| 1982 | 5,759 | 2,223 | 7,982 | 27.9% | 1.4% | 29.3% | 4.44% |
| 1983 | 6,795 | 2,387 | 9,182 | 26.0% | 1.3% | 27.3% | 2.09% |
| 1984 | 7,952 | 2,439 | 10,391 | 23.5% | 2.0% | 25.5% | 1.45% |
| 1985 | 8,205 | 2,838 | 11,043 | 25.7% | 2.2% | 27.9% | 0.82% |
| 1986 | 8,215 | 3,238 | 11,453 | 28.3% | 2.8% | 31.1% | 0.37% |
| 1987 | 7,081 | 3,197 | 10,278 | 31.1% | 5.2% | 36.3% | 0.16% |
| 1988 | 7,526 | 3,099 | 10,626 | 29.2% | 5.8% | 35.0% | 0.02% |
| 1989 | 7,073 | 2,825 | 9,898 | 28.5% | 7.3% | 35.8% | 0.13% |
| 1990 | 6,897 | 2,404 | 9,301 | 25.8% | 11.2% | 37.0% | 0.08% |
| 1991 | 6,137 | 2,038 | 8,175 | 24.9% | 13.7% | 38.6% | 0.10% |
| 1992 | 6,277 | 1,937 | 8,213 | 23.6% | 14.1% | 37.7% | 0.06% |
| 1993 | 6,742 | 1,776 | 8,518 | 20.9% | 14.9% | 35.8% | 0.03% |
| 1994 | 7,255 | 1,735 | 8,990 | 19.3% | 16.5% | 35.8% | 0.04% |
| 1995 | 7,129 | 1,506 | 8,635 | 17.4% | 18.9% | 36.3% | 0.04% |
| 1996 | 7,255 | 1,271 | 8,526 | 14.9% | 22.3% | 37.2% | 0.10% |
| 1997 | 6,917 | 1,355 | 8,272 | 16.4% | 23.7% | 40.1% | 0.09% |
| 1998 | 6,762 | 1,380 | 8,142 | 16.9% | 25.1% | 42.0% | 0.13% |
| 1999 | 6,979 | 1,719 | 8,698 | 19.8% | 24.6% | 44.4% | 0.16% |
| 2000 | 6,831 | 2,016 | 8,847 | 22.8% | 24.4% | 47.2% | 0.26% |
| | | | *Average annual percentage change* | | | | |
| 1970–2000 | -0.1% | 1.5% | 0.2% | | | | |
| 1990–2000 | -0.1% | -1.7% | -0.5% | | | | |

**Source:**
Domestic and import data - 1970–97: American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1998*, Detroit, MI, 1998, p. 15, and annual. 1997 data from *Economic Indicators, 4th Quarter 1997*. 1998–2000: Ward's Communication, *Ward's 2000 Motor Vehicle Facts and Figures*, Detroit, MI, 2000, p. 15.
Diesel data - Ward's Communications, *Ward's Automotive Yearbook*, Detroit, MI, 2001, p. 59, and annual.
Transplant data - Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares Data System, Oak Ridge, TN, 1996. (Additional resources: www.aama.com, www.wardsauto.com)

[a] North American built.
[b] Does not include import tourist deliveries.
[c] A transplant is an automobile which was built in the U.S. by a foreign firm. Also included are joint ventures which are built in the U.S.
[d] Data are not available.

*In 2000, light trucks, which include pick-ups, minivans, sport-utility vehicles, and other trucks less than 10,000 pounds gross vehicle weight (GVW), accounted for 48.7% of light vehicle sales.*

**Table 7.4**
**New Retail Sales of Trucks 10,000 Pounds GVW and Less in the United States, 1970–2000**

| | | Percentages | | | | | |
|---|---|---|---|---|---|---|---|
| Calendar year | Light truck sales[a] (thousands) | Import[b] | Transplants[c] | Diesel[d] | Four-wheel drive of domestic light trucks[d] | Light trucks of light-duty vehicle sales[e] | Light trucks of total truck sales |
| 1970 | 1,463 | 4.5% | [f] | [g] | [f] | 14.8% | 80.4% |
| 1975 | 2,281 | 10.0% | [f] | [g] | 23.4% | 20.9% | 87.9% |
| 1980 | 2,440 | 19.7% | 0.9% | 3.6% | 20.7% | 21.4% | 88.9% |
| 1981 | 2,189 | 20.3% | 0.0% | 3.1% | 18.6% | 20.4% | 89.8% |
| 1982 | 2,470 | 16.5% | 0.0% | 8.5% | 16.8% | 23.6% | 92.8% |
| 1983 | 2,984 | 15.6% | 0.0% | 6.7% | 28.5% | 24.5% | 93.6% |
| 1984 | 3,863 | 15.7% | 2.0% | 4.8% | 27.0% | 27.1% | 93.0% |
| 1985 | 4,458 | 17.2% | 2.6% | 3.8% | 29.1% | 28.8% | 93.6% |
| 1986 | 4,594 | 20.1% | 2.3% | 3.7% | 27.0% | 28.6% | 94.3% |
| 1987 | 4,610 | 17.9% | 1.7% | 2.3% | 32.0% | 31.0% | 93.9% |
| 1988 | 4,800 | 12.6% | 2.4% | 2.3% | 32.1% | 31.1% | 93.2% |
| 1989 | 4,610 | 10.9% | 2.6% | 2.9% | 31.4% | 31.8% | 93.3% |
| 1990 | 4,548 | 13.2% | 3.4% | 3.1% | 31.6% | 32.8% | 93.9% |
| 1991 | 4,123 | 12.8% | 4.5% | 3.2% | 34.4% | 33.5% | 94.5% |
| 1992 | 4,629 | 8.6% | 5.5% | 3.3% | 31.6% | 36.0% | 94.4% |
| 1993 | 5,351 | 6.8% | 7.1% | 3.7% | 32.6% | 38.6% | 94.2% |
| 1994 | 6,033 | 6.5% | 8.1% | 3.9% | 34.4% | 40.2% | 94.0% |
| 1995 | 6,053 | 6.5% | 7.5% | 4.1% | 39.1% | 41.2% | 93.4% |
| 1996 | 6,519 | 6.6% | 8.4% | 3.7% | 35.7% | 43.3% | 94.1% |
| 1997 | 6,797 | 8.4% | 7.0% | 4.8% | 39.6% | 46.6% | 94.1% |
| 1998 | 7,299 | 8.9% | 7.6% | 1.7% | 43.8% | 47.3% | 93.3% |
| 1999 | 8,073 | 9.5% | 8.7% | 5.9% | 43.3% | 48.1% | 92.6% |
| 2000 | 8,387 | 9.9% | 11.3% | 4.8% | 41.7% | 48.7% | 93.9% |
| | | *Average annual percentage change* | | | | | |
| 1970–2000 | 6.0% | | | | | | |
| 1990–2000 | 6.3% | | | | | | |

**Source:**
Four-wheel drive - 1970–88: Ward's Communications, *Ward's Automotive Yearbook*, Detroit, MI, 1989, p. 168, and annual. 1989–on: Ward's Communications, *Ward's Automotive Yearbook*, Factory Installation Reports, Detroit, MI, 2001, and annual.
Transplants - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1996.
All other - 1970–97: American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1998*, Detroit, MI, 1998, pp. 8, 15, 24, and annual. 1998–on: Ward's Communications, *Ward's 2000 Motor Vehicle Facts and Figures*, Detroit, MI, p. 24, and annual.
(Additional resources: www.aama.com, www.wardsauto.com)

[a] Includes all trucks of 10,000 pounds gross vehicle weight and less sold in the U.S.
[b] Excluding transplants.
[c] Based on model year data. A transplant is a light truck which was built in the U.S. by a foreign firm. Also included are joint ventures built in the U.S.
[d] Based on model year factory installations. Column was revised.
[e] Light-duty vehicles include automobiles and light trucks.
[f] Data are not available.
[g] Indicates less than 1 percent.

*The sales-weighted fuel economy of automobiles increased dramatically from 1976 (17.3 mpg) to 1990 (27.6 mpg), but has remained fairly constant since then.*

**Table 7.5**
**Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Automobiles, Selected Sales Periods[a] 1976–2000**

| Sales Period[a] | 1976 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| **MINICOMPACT** | | | | | | |
| Total sales, units | – | 428,346 | 52,295 | 76,698 | 44,752 | 19,245 |
| Market share, % | – | 4.7 | 0.5 | 0.8 | 0.5 | 0.2 |
| Fuel economy, mpg | – | 29.4 | 32.7 | 26.4 | 27.0 | 25.6 |
| **SUBCOMPACT** | | | | | | |
| Total sales, units | 2,625,929 | 3,441,480 | 2,382,339 | 2,030,226 | 1,518,209 | 1,789,350 |
| Market share, % | 27.1 | 37.8 | 21.7 | 22.0 | 17.4 | 19.9 |
| Fuel economy, mpg | 23.5 | 27.3 | 30.1 | 31.3 | 31.7 | 31.1 |
| **COMPACT** | | | | | | |
| Total sales, units | 2,839,603 | 599,423 | 3,526,118 | 3,156,481 | 3,289,735 | 2,397,813 |
| Market share, % | 29.3 | 6.6 | 32.1 | 34.2 | 37.7 | 26.7 |
| Fuel economy, mpg | 17.1 | 22.3 | 29.6 | 28.9 | 30.2 | 30.4 |
| **MIDSIZE** | | | | | | |
| Total sales, units | 1,815,505 | 3,073,103 | 3,117,817 | 2,511,503 | 2,498,521 | 3,352,198 |
| Market share, % | 18.7 | 33.8 | 28.4 | 27.2 | 28.6 | 37.3 |
| Fuel economy, mpg | 15.3 | 21.3 | 24.9 | 25.9 | 25.9 | 26.8 |
| **LARGE** | | | | | | |
| Total sales, units | 2,206,102 | 1,336,190 | 1,516,249 | 1,279,092 | 1,320,608 | 1,297,237 |
| Market share, % | 22.8 | 14.7 | 13.8 | 13.9 | 15.1 | 14.4 |
| Fuel economy, mpg | 13.9 | 19.3 | 22.3 | 23.5 | 24.1 | 25.3 |
| **TWO SEATER** | | | | | | |
| Total sales, units | 199,716 | 215,964 | 373,697 | 170,465 | 53,045 | 122,259 |
| Market share, % | 2.1 | 2.4 | 3.4 | 1.8 | 0.6 | 1.4 |
| Fuel economy, mpg | 20.1 | 21.0 | 27.6 | 28.0 | 24.7 | 25.8 |
| **TOTAL** | | | | | | |
| Total sales, units | 9,686,855 | 9,094,506 | 10,968,515 | 9,224,465 | 8,724,870 | 8,978,102 |
| Market share, % | 100 | 100 | 100 | 100 | 100 | 100 |
| Fuel economy, mpg | 17.2 | 23.2 | 27.0 | 27.6 | 28.0 | 28.2 |

**Source:**
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001.
(Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the current year through September 30 of the next year. These figures represent only those sales that could be matched to corresponding EPA fuel economy values.

*Light truck sales have more than tripled from 1976 to 2000. Similar to the automobile trend, the sales-weighted fuel economy of light trucks increased during the late '70's and '80's, but has remained fairly constant in the '90's.*

**Table 7.6**
**Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Light Trucks, Selected Sales Periods[a] 1976–2000**

| Sales Period[a] | 1976 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| **SMALL PICKUP** | | | | | | |
| Total sales, units | 170,351 | 516,412 | 863,584 | 1,135,727 | 1,067,764 | 1,071,730 |
| Market share, % | 7.1 | 23.3 | 20.4 | 25.2 | 18.0 | 12.9 |
| Fuel economy, mpg | 23.9 | 25.5 | 26.8 | 24.5 | 24.4 | 22.0 |
| **LARGE PICKUP** | | | | | | |
| Total sales, units | 1,586,020 | 1,115,248 | 1,690,931 | 1,116,490 | 1,472,885 | 1,968,710 |
| Market share, % | 65.8 | 50.3 | 39.9 | 24.7 | 24.8 | 23.7 |
| Fuel economy, mpg | 15.1 | 17.0 | 19.0 | 17.5 | 17.8 | 18.7 |
| **SMALL VAN** | | | | | | |
| Total sales, units | 18,651 | 13,649 | 437,660 | 1,012,141 | 1,330,586 | 1,272,070 |
| Market share, % | 0.8 | 0.6 | 10.3 | 22.4 | 22.4 | 15.3 |
| Fuel economy, mpg | 19.5 | 19.6 | 23.9 | 22.3 | 22.4 | 23.0 |
| **LARGE VAN** | | | | | | |
| Total sales, units | 574,745 | 328,065 | 536,242 | 319,429 | 327,586 | 368,820 |
| Market share, % | 23.9 | 14.8 | 12.7 | 7.1 | 5.5 | 4.4 |
| Fuel economy, mpg | 15.4 | 16.3 | 16.4 | 17.1 | 17.2 | 18.2 |
| **SMALL SUV** | | | | | | |
| Total sales, units | 0 | 51,684 | 441,966 | 402,354 | 509,737 | 756,142 |
| Market share, % | 0.0% | 2.3 | 10.4 | 8.9 | 8.6 | 9.1 |
| Fuel economy, mpg | | 17.7 | 22.1 | 22.5 | 22.0 | 23.8 |
| **MEDIUM SUV** | | | | | | |
| Total sales, units | 50,763 | 151,929 | 187,447 | 434,491 | 1,076,686 | 2,167,329 |
| Market share, % | 2.1 | 6.9 | 4.4 | 9.6 | 18.1 | 26.1 |
| Fuel economy, mpg | 15.1 | 14.9 | 17.2 | 19.7 | 19.2 | 20.4 |
| **LARGE SUV** | | | | | | |
| Total sales, units | 9,228 | 39,550 | 77,535 | 93,993 | 148,622 | 702,152 |
| Market share, % | 0.4 | 1.8 | 1.8 | 2.1 | 2.5 | 8.5 |
| Fuel economy, mpg | 14.2 | 13.7 | 17.1 | 16.5 | 16.1 | 17.5 |
| **TOTAL** | | | | | | |
| Total sales, units | 2,409,758 | 2,216,537 | 4,235,365 | 4,514,625 | 5,933,866 | 8,306,953 |
| Market share, % | 100 | 100 | 100 | 100 | 100 | 100 |
| Fuel economy, mpg | 15.6 | 18.1 | 20.4 | 20.5 | 20.2 | 20.4 |

**Source:**
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001.
(Additional resources: www-cta.ornl.gov)

**Note:**
Revised definitions of light trucks are based on vehicle **curb weight** as follows:
Small pickup= <3,500 lbs. Large pickup=3,500-8,500 lbs.
Small van = <4,500 lbs. Large van=4,500-8,500 lbs
Small utility= <,3500 lbs. Medium utility=3,500-4,799 lbs. Large utility=4,800-8,500 lbs.

[a] Sales period is October 1 of the current year through September 30 of the next year. These figures represent only those sales that could be matched to corresponding EPA fuel economy values.

*Back in 1976 only 20% of new light vehicle sales were light trucks. Because of the boom in sales of minivans, sport utility vehicles, and pick-up trucks, today almost half of light vehicle sales are light trucks.*

**Table 7.7**
**Light Vehicle Market Shares by Size Class, Sales Periods[a] 1976–2000**

| Sales period[a] | 1976 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Minicompact | 0.0% | 3.8% | 0.3% | 0.6% | 0.3% | 0.1% |
| Subcompact | 21.7% | 30.4% | 15.7% | 14.8% | 10.4% | 10.4% |
| Compact | 23.5% | 5.3% | 23.2% | 23.0% | 22.4% | 13.9% |
| Midsize | 15.0% | 27.2% | 20.5% | 18.3% | 17.0% | 19.4% |
| Large | 18.2% | 11.8% | 10.0% | 9.3% | 9.0% | 7.5% |
| Two seater | 1.7% | 1.9% | 2.5% | 1.2% | 0.4% | 0.7% |
| Small pickup | 1.4% | 4.6% | 5.7% | 8.3% | 7.3% | 6.2% |
| Large pickup | 13.1% | 9.9% | 11.1% | 8.1% | 10.0% | 11.4% |
| Small van | 0.2% | 0.1% | 2.9% | 7.4% | 8.6% | 7.4% |
| Large van | 4.8% | 2.9% | 3.5% | 2.3% | 9.1% | 2.1% |
| Small utility | 0.0% | 0.5% | 2.9% | 2.9% | 3.5% | 4.4% |
| Medium utility | 0.4% | 1.3% | 1.2% | 3.2% | 7.3% | 12.5% |
| Large utility | 0.1% | 0.3% | 0.5% | 0.7% | 1.0% | 4.1% |
| Total light vehicles sold | 12,096,613 | 11,311,043 | 15,203,880 | 13,739,090 | 14,658,736 | 17,285,055 |
| Cars | 80.1% | 80.4% | 72.1% | 67.1% | 59.5% | 51.9% |
| Light trucks | 19.9% | 19.6% | 27.9% | 32.9% | 40.5% | 48.1% |

**Source:**
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001.
(Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the current year through September 30 of the next year.

*The compact, midsize, and large automobile sales-weighted engine sizes declined dramatically in the late '70's and early '80's.*

**Table 7.8**
**Sales-Weighted Engine Size of New Domestic and Import Automobiles by Size Class, Sales Periods[a] 1976–2000**
**( liters[b])**

| Sales period[a] | Minicompact | Subcompact | Compact | Midsize | Large | Two seater | Fleet |
|---|---|---|---|---|---|---|---|
| 1976 | [c] | 2.67 | 5.00 | 5.85 | 6.79 | 2.89 | 4.89 |
| 1977 | 1.98 | 2.73 | 4.79 | 5.47 | 6.02 | 2.81 | 4.56 |
| 1978 | 2.06 | 2.67 | 3.95 | 4.89 | 6.17 | 3.01 | 4.33 |
| 1979 | 1.86 | 2.39 | 3.74 | 4.41 | 5.56 | 2.77 | 3.78 |
| 1980 | 1.90 | 2.10 | 3.03 | 3.90 | 5.12 | 2.79 | 3.22 |
| 1981 | 1.57 | 2.04 | 2.20 | 3.63 | 5.00 | 2.49 | 2.98 |
| 1982 | 1.53 | 2.08 | 2.12 | 3.47 | 4.73 | 2.41 | 2.89 |
| 1983 | 1.60 | 2.19 | 2.20 | 3.45 | 4.95 | 2.52 | 2.98 |
| 1984 | 2.17 | 2.22 | 2.21 | 3.40 | 4.87 | 2.50 | 2.97 |
| 1985 | 1.95 | 2.29 | 2.27 | 3.37 | 4.65 | 2.47 | 2.92 |
| 1986 | 1.45 | 2.19 | 2.21 | 3.19 | 4.38 | 2.83 | 2.76 |
| 1987 | 1.48 | 2.19 | 2.20 | 2.99 | 4.36 | 2.57 | 2.68 |
| 1988 | 1.52 | 2.05 | 2.21 | 3.00 | 4.32 | 2.75 | 2.66 |
| 1989 | 2.54 | 2.08 | 2.11 | 3.01 | 4.31 | 2.81 | 2.68 |
| 1990 | 2.42 | 1.96 | 2.25 | 3.13 | 4.33 | 2.57 | 2.72 |
| 1991 | 2.17 | 1.97 | 2.23 | 3.16 | 4.40 | 2.67 | 2.72 |
| 1992 | 1.89 | 2.01 | 2.33 | 3.16 | 4.34 | 3.01 | 2.76 |
| 1993 | 1.96 | 2.07 | 2.28 | 3.16 | 4.27 | 3.47 | 2.78 |
| 1994 | 2.21 | 2.27 | 2.23 | 3.15 | 4.17 | 3.82 | 2.79 |
| 1995 | 2.42 | 2.26 | 2.23 | 3.12 | 4.12 | 3.76 | 2.79 |
| 1996 | 2.49 | 2.23 | 2.19 | 2.98 | 4.09 | 3.67 | 2.71 |
| 1997 | 2.62 | 2.13 | 2.28 | 3.02 | 4.03 | 3.08 | 2.74 |
| 1998 | 3.15 | 2.29 | 2.17 | 2.94 | 3.98 | 3.51 | 2.75 |
| 1999 | 2.86 | 2.31 | 2.25 | 2.91 | 3.91 | 3.62 | 2.76 |
| 2000 | 2.55 | 2.30 | 2.23 | 2.85 | 3.88 | 3.45 | 2.73 |
| *Average annual percentage change* | | | | | | | |
| 1976–2000 | 1.1%[d] | -0.6% | -3.3% | -3.0% | -2.3% | 0.7% | -2.4% |
| 1990–2000 | 0.5% | 1.6% | -0.1% | -0.9% | -1.1% | 3.0% | 0.0% |

**Source:**
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001.
(Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the current year through September 30 of the next year.
[b] 1 liter = 61.02. cubic inches.
[c] There were no minicompact automobiles sold in 1976.
[d] Average annual percentage change begins with 1977.

**Table 7.9**
**Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class**
**Sales Periods[a] 1976–2000**
**(liters[b] )**

| Sales period[a] | Small pickup | Large pickup | Small van | Large van | Small utility | Medium utility | Large utility | Fleet |
|---|---|---|---|---|---|---|---|---|
| 1976 | 1.92 | 4.41 | 1.97 | 4.27 | 0.00 | 4.21 | 5.74 | 4.18 |
| 1977 | 1.95 | 4.41 | 1.97 | 4.37 | 0.00 | 4.21 | 5.74 | 4.11 |
| 1978 | 1.96 | 4.39 | 1.97 | 4.25 | 3.80 | 4.48 | 5.74 | 4.09 |
| 1979 | 2.00 | 5.15 | 1.97 | 4.24 | 4.23 | 4.67 | 5.74 | 4.41 |
| 1980 | 1.99 | 4.41 | 1.97 | 4.85 | 2.47 | 4.51 | 5.74 | 3.88 |
| 1981 | 2.08 | 4.16 | 1.97 | 4.34 | 2.47 | 4.55 | 5.00 | 3.67 |
| 1982 | 2.06 | 4.02 | 1.59 | 4.33 | 2.47 | 4.54 | 5.00 | 3.55 |
| 1983 | 2.04 | 4.05 | 1.59 | 4.32 | 2.28 | 4.84 | 5.59 | 3.37 |
| 1984 | 2.05 | 4.17 | 2.13 | 4.33 | 2.33 | 4.14 | 5.65 | 3.40 |
| 1985 | 2.09 | 4.02 | 2.22 | 4.43 | 2.60 | 4.44 | 4.96 | 3.38 |
| 1986 | 2.13 | 3.79 | 2.29 | 4.41 | 2.28 | 4.33 | 4.95 | 3.12 |
| 1987 | 2.17 | 3.71 | 2.29 | 4.46 | 2.39 | 3.83 | 4.95 | 3.07 |
| 1988 | 2.56 | 4.68 | 3.15 | 5.21 | 3.23 | 4.19 | 5.55 | 3.82 |
| 1989 | 2.64 | 4.70 | 3.11 | 5.22 | 3.77 | 3.77 | 5.58 | 3.93 |
| 1990 | 2.90 | 5.14 | 3.43 | 5.24 | 3.68 | 3.55 | 5.56 | 3.93 |
| 1991 | 2.93 | 5.22 | 3.36 | 5.26 | 3.60 | 3.85 | 5.46 | 3.92 |
| 1992 | 3.09 | 5.15 | 3.43 | 5.31 | 3.62 | 3.94 | 5.45 | 4.00 |
| 1993 | 3.15 | 5.15 | 3.41 | 5.24 | 3.60 | 4.06 | 5.58 | 4.02 |
| 1994 | 3.05 | 5.26 | 3.58 | 5.37 | 3.53 | 4.01 | 5.54 | 4.10 |
| 1995 | 2.99 | 5.13 | 3.50 | 5.16 | 3.56 | 4.04 | 5.41 | 4.06 |
| 1996 | 2.93 | 5.17 | 3.51 | 5.25 | 3.43 | 4.29 | 5.35 | 4.12 |
| 1997 | 3.00 | 5.05 | 3.47 | 5.04 | 2.75 | 3.96 | 5.33 | 4.09 |
| 1998 | 2.89 | 5.01 | 3.45 | 4.99 | 2.84 | 4.15 | 5.39 | 4.16 |
| 1999 | 3.36 | 5.02 | 3.48 | 5.05 | 2.87 | 4.12 | 5.46 | 4.19 |
| 2000 | 3.42 | 4.94 | 3.43 | 5.00 | 2.78 | 4.03 | 5.21 | 4.11 |
| *Average annual percentage change* | | | | | | | | |
| 1976–2000 | 2.4% | 0.5% | 2.3% | -0.7% | [c] | -0.2% | -0.4% | -0.1% |
| 1990–2000 | 1.7% | -0.4% | 0.0% | -0.5% | -2.8% | 1.3% | -0.6% | 0.4% |

**Source:**
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001. (Additional resources: www-cta.ornl.gov)

**Note:**
Revised definitions of light trucks are based on vehicle **curb weight** as follows:
Small pickup= <3,500 lbs. Large pickup=3,500-8,500 lbs.
Small van = <4,500 lbs. Large van=4,500-8,500 lbs.
Small utility= <3,500 lbs. Medium utility=3,500-4,799 lbs. Large utility=4,800-8,500 lbs.

[a] Sales period is October 1 of the current year through September 30 of the next year.
[b] 1 liter = 61.02 cubic inches.
[c] Data are not available.

*The sales-weighted curb weight of new automobiles has gone up for each size class from 1989 to 2000.*

**Table 7.10**
**Sales-Weighted Curb Weight of New Domestic and Import Automobiles by Size Class, Sales Periods[a] 1976–2000**
**(pounds)**

| Sales period[a] | Minicompact | Subcompact | Compact | Midsize | Large | Two seater | Fleet |
|---|---|---|---|---|---|---|---|
| 1976 | [b] | 2,577 | 3,609 | 4,046 | 4,562 | 2,624 | 3,608 |
| 1977 | 2,228 | 2,586 | 3,550 | 3,900 | 4,026 | 2,608 | 3,424 |
| 1978 | 2,200 | 2,444 | 3,138 | 3,427 | 3,956 | 2,763 | 3,197 |
| 1979 | 2,120 | 2,367 | 3,048 | 3,287 | 3,763 | 2,699 | 3,000 |
| 1980 | 2,154 | 2,270 | 2,813 | 3,081 | 3,667 | 2,790 | 2,790 |
| 1981 | 1,920 | 2,370 | 2,382 | 2,996 | 3,672 | 2,744 | 2,744 |
| 1982 | 2,002 | 2,302 | 2,422 | 2,992 | 3,703 | 2,525 | 2,730 |
| 1983 | 2,072 | 2,334 | 2,441 | 3,027 | 3,779 | 2,663 | 2,788 |
| 1984 | 2,376 | 2,380 | 2,454 | 2,990 | 3,734 | 2,559 | 2,788 |
| 1985 | 2,211 | 2,392 | 2,464 | 2,954 | 3,575 | 2,539 | 2,743 |
| 1986 | 2,120 | 2,415 | 2,432 | 2,857 | 3,451 | 2,575 | 2,675 |
| 1987 | 1,960 | 2,423 | 2,474 | 2,857 | 3,483 | 2,602 | 2,689 |
| 1988 | 1,933 | 2,346 | 2,558 | 2,880 | 3,487 | 2,693 | 2,717 |
| 1989 | 2,576 | 2,357 | 2,517 | 2,985 | 3,496 | 2,735 | 2,760 |
| 1990 | 2,651 | 2,368 | 2,637 | 3,065 | 3,594 | 2,656 | 2,828 |
| 1991 | 2,584 | 2,406 | 2,652 | 3,085 | 3,650 | 2,707 | 2,848 |
| 1992 | 2,395 | 2,444 | 2,674 | 3,131 | 3,670 | 2,770 | 2,879 |
| 1993 | 2,449 | 2,478 | 2,659 | 3,142 | 3,615 | 2,967 | 2,894 |
| 1994 | 2,719 | 2,571 | 2,639 | 3,171 | 3,657 | 3,035 | 2,921 |
| 1995 | 2,831 | 2,552 | 2,647 | 3,179 | 3,648 | 2,947 | 2,937 |
| 1996 | 2,847 | 2,533 | 2,667 | 3,203 | 3,671 | 2,985 | 2,950 |
| 1997 | 2,997 | 2,489 | 2,737 | 3,241 | 3,653 | 2,863 | 2,977 |
| 1998 | 3,004 | 2,584 | 2,703 | 3,198 | 3,675 | 2,956 | 3,002 |
| 1999 | 2,835 | 2,626 | 2,755 | 3,198 | 3,689 | 3,007 | 3,034 |
| 2000 | 2,906 | 2,635 | 2,800 | 3,215 | 3,680 | 2,943 | 3,052 |
| | | | *Average annual percentage change* | | | | |
| 1976–2000 | 1.2%[c] | 0.1% | -1.1% | -1.0% | -0.9% | 0.5% | -0.7% |
| 1990–2000 | 0.9% | 1.1% | 0.6% | 0.5% | 0.2% | 1.0% | 0.8% |

**Source:**
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001.
(Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the current year through September 30 of the next year.
[b] There were no minicompact automobiles sold in 1976.
[c] Average annual percentage change begins with 1977.

*The sales-weighted interior space has not changed much for midsize and large automobiles over the last two decades, but has increased for subcompact autos.*

**Table 7.11**
**Sales-Weighted Interior Space of New Domestic and Import Automobiles by Size Class, Sales Periods[a] 1976–2000**
**(cubic feet)**

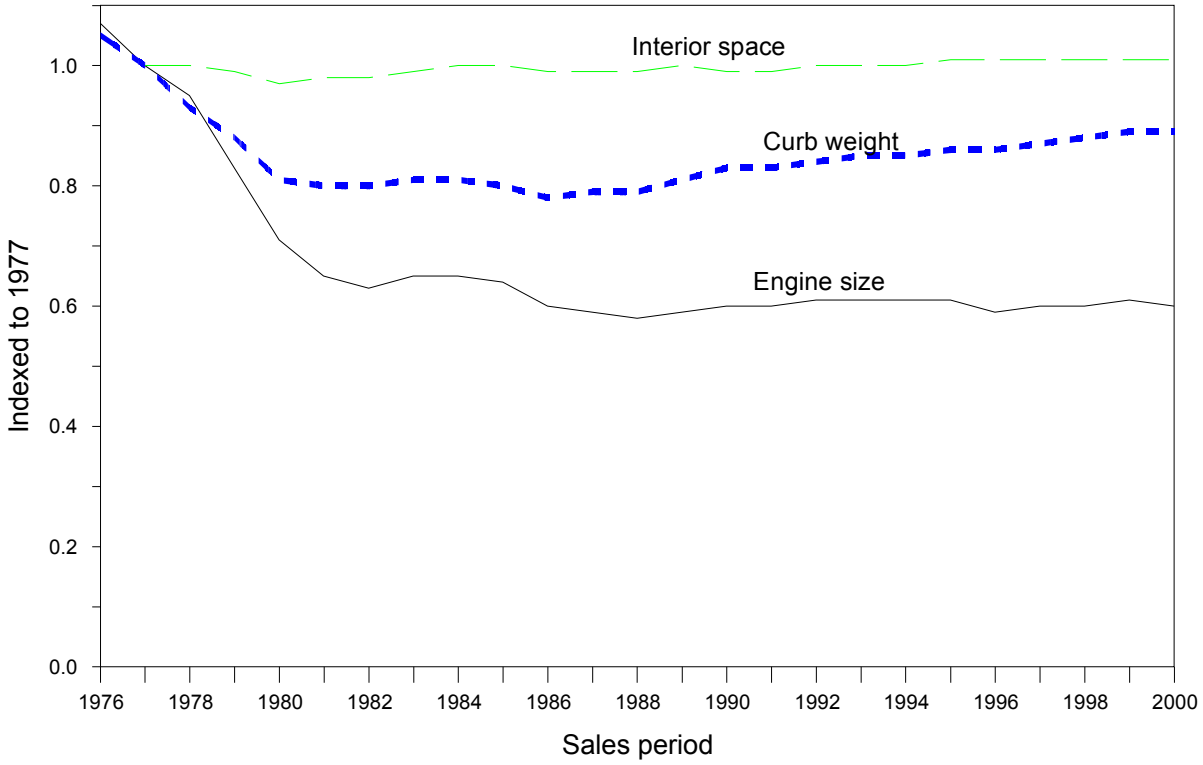
| Sales period[a] | Minicompact ( < 85) | Subcompact (85–99) | Compact (100–109) | Midsize (110–119) | Large ( > 120) | Fleet[b] |
|---|---|---|---|---|---|---|
| 1977 | 78.8 | 89.8 | 107.1 | 113.0 | 128.0 | 107.9 |
| 1978 | 79.4 | 89.8 | 105.3 | 112.9 | 128.5 | 107.9 |
| 1979 | 80.0 | 90.2 | 105.8 | 113.4 | 130.1 | 106.9 |
| 1980 | 82.4 | 89.9 | 105.4 | 113.5 | 130.8 | 104.9 |
| 1981 | 83.3 | 90.2 | 103.6 | 113.7 | 130.6 | 105.5 |
| 1982 | 83.1 | 91.3 | 102.9 | 113.9 | 130.4 | 106.0 |
| 1983 | 82.7 | 93.3 | 103.0 | 113.1 | 131.3 | 107.3 |
| 1984 | 77.0 | 93.8 | 103.0 | 113.3 | 130.4 | 108.0 |
| 1985 | 77.8 | 94.1 | 103.1 | 113.5 | 129.7 | 107.9 |
| 1986 | 80.1 | 94.5 | 102.8 | 113.8 | 127.6 | 107.0 |
| 1987 | 81.6 | 93.1 | 103.0 | 113.9 | 127.5 | 106.9 |
| 1988 | 81.0 | 93.5 | 103.3 | 113.6 | 127.2 | 107.0 |
| 1989 | 75.0 | 93.3 | 102.7 | 113.8 | 127.4 | 107.5 |
| 1990 | 79.9 | 93.9 | 103.2 | 113.8 | 127.8 | 107.3 |
| 1991 | 79.6 | 94.4 | 103.2 | 113.8 | 128.3 | 107.1 |
| 1992 | 79.1 | 94.0 | 104.2 | 114.0 | 129.2 | 107.5 |
| 1993 | 79.2 | 94.5 | 104.0 | 114.0 | 128.9 | 108.0 |
| 1994 | 79.4 | 94.4 | 103.8 | 113.8 | 128.8 | 108.0 |
| 1995 | 78.5 | 93.8 | 103.9 | 114.3 | 128.1 | 108.7 |
| 1996 | 76.7 | 94.9 | 103.4 | 114.2 | 128.0 | 108.8 |
| 1997 | 77.2 | 95.6 | 103.2 | 114.6 | 128.0 | 108.7 |
| 1998 | 66.9 | 97.0 | 102.2 | 114.4 | 127.7 | 109.2 |
| 1999 | 76.3 | 96.7 | 103.3 | 114.1 | 127.1 | 109.5 |
| 2000 | 76.3 | 96.6 | 103.1 | 114.2 | 126.4 | 109.3 |
| | | | *Average annual percentage change* | | | |
| 1977–2000 | -0.1% | 0.3% | -0.2% | 0.0% | -0.1% | 0.1% |
| 1990–2000 | -0.5% | 0.3% | 0.0% | 0.0% | -0.1% | 0.2% |

**Source:**
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001.
(Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the current year through September 30 of the next year.
[b] Interior volumes of two-seaters are not reported to EPA.

*The sales-weighted curb weight for new automobiles declined in the late 1970s and early 1980s, but has been slowly rising since then. The sales-weighted interior space for new automobiles has not changed much over the last 25 years.*

**Figure 7.1. Engine Size, Curb Weight, and Interior Space of New Domestic and Import Automobiles, 1976–2000**




**Source:** See Tables 7.8, 7.10, and 7.11.

*The sales-weighted wheelbase of new automobiles and light trucks (combined) has been rising since the late 1980s.*

**Table 7.12**
**Sales-Weighted Wheelbase of New Automobiles and Light Trucks, Sales Periods[a] 1976–2000 (inches)**

| Sales period[a] | Automobiles | Light trucks | Automobiles and light trucks combined |
|---|---|---|---|
| 1976 | 110.78 | 118.87 | 112.03 |
| 1977 | 109.75 | 117.79 | 111.05 |
| 1978 | 107.67 | 116.23 | 108.65 |
| 1979 | 105.77 | 116.27 | 107.93 |
| 1980 | 103.61 | 114.54 | 105.76 |
| 1981 | 102.97 | 114.86 | 105.10 |
| 1982 | 103.01 | 114.87 | 105.60 |
| 1983 | 103.76 | 113.73 | 106.10 |
| 1984 | 103.50 | 113.87 | 106.21 |
| 1985 | 102.96 | 113.98 | 106.02 |
| 1986 | 102.27 | 113.40 | 105.48 |
| 1987 | 102.11 | 113.27 | 105.52 |
| 1988 | 102.21 | 111.79 | 105.21 |
| 1989 | 102.66 | 112.23 | 105.71 |
| 1990 | 103.13 | 111.41 | 105.85 |
| 1991 | 103.27 | 111.09 | 105.82 |
| 1992 | 103.60 | 112.68 | 106.78 |
| 1993 | 104.03 | 112.57 | 107.21 |
| 1994 | 104.31 | 113.23 | 107.75 |
| 1995 | 104.95 | 113.37 | 108.31 |
| 1996 | 105.04 | 113.36 | 108.53 |
| 1997 | 105.36 | 113.36 | 108.89 |
| 1998 | 105.55 | 114.53 | 109.76 |
| 1999 | 105.77 | 114.70 | 110.06 |
| 2000 | 105.89 | 114.05 | 109.81 |
| | *Average annual percentage change* | | |
| 1976–2000 | -0.2% | -0.2% | -0.1% |
| 1990–2000 | 0.3% | 0.2% | 0.4% |

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001.
(Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the current year through September 30 of the next year.

*The average auto lost over 300 pounds from 1978 to 1985, but gained a few pounds back since then. Much of the weight reduction was due to the declining use of conventional steel and iron and the increasing use of aluminum and plastics. Conventional steel, however, remained the predominant component of automobiles in 2001 with a 40.8% share of total materials. As conventional steel use has been decreasing, use of high-strength steel has increased.*

**Table 7.13**
**Average Material Consumption for a Domestic Automobile, 1978, 1985, and 2001**

| | 1978 | | 1985 | | 2001 | |
|---|---|---|---|---|---|---|
| Material | Pounds | Percentage | Pounds | Percentage | Pounds | Percentage |
| Conventional steel[a] | 1,880.0 | 53.8% | 1,481.5 | 46.5% | 1,349.0 | 40.8% |
| High-strength steel | 127.5 | 3.6% | 217.5 | 6.8% | 351.5 | 10.6% |
| Stainless steel | 25.0 | 0.7% | 29.0 | 0.9% | 54.5 | 1.6% |
| Other steels | 56.0 | 1.6% | 54.5 | 1.7% | 25.5 | 0.8% |
| Iron | 503.0 | 14.4% | 468.0 | 14.7% | 345.0 | 10.4% |
| Aluminum | 112.0 | 3.2% | 138.0 | 4.3% | 256.5 | 7.8% |
| Rubber | 141.5 | 4.1% | 136.0 | 4.3% | 145.5 | 4.4% |
| Plastics/composites | 176.0 | 5.0% | 211.5 | 6.6% | 253.0 | 7.6% |
| Glass | 88.0 | 2.5% | 85.0 | 2.7% | 98.5 | 3.0% |
| Copper | 39.5 | 1.1% | 44.0 | 1.4% | 46.0 | 1.4% |
| Zinc die castings | 28.0 | 0.8% | 18.0 | 0.5% | 11.0 | 0.3% |
| Powder metal parts | 16.0 | 0.5% | 19.0 | 0.6% | 37.5 | 1.1% |
| Fluids & lubricants | 189.0 | 5.4% | 184.0 | 5.8% | 196.0 | 5.9% |
| Other materials | 112.5 | 3.2% | 101.5 | 3.2% | 139.5 | 4.2% |
| Total | 3,494.0 | 100.0% | 3,187.5 | 100.0% | 3,309.0 | 100.0% |

**Source:**
American Metal Market, www.amm.com/ref/carmat98.htm, New York, NY, 2000.
(Additional resources: www.amm.com)

[a] Includes cold-rolled and pre-coated steel.

*The number of franchised dealerships which sell new light-duty vehicles (cars and light trucks) has declined 27% since 1970, though new vehicle sales have increased. The average number of vehicles sold per dealer in 1999 was 749 vehicles per dealer – more than double the 1970 number.*

**Table 7.14**
**New Light Vehicle Dealerships and Sales, 1970–99**

| Calendar year | Number of franchised new light vehicle dealerships[a] | New light vehicle sales (thousands) | Light vehicle sales per dealer |
|---|---|---|---|
| 1970 | 30,800 | 9,867 | 320 |
| 1971 | 30,300 | 12,006 | 396 |
| 1972 | 30,100 | 13,189 | 438 |
| 1973 | 30,100 | 14,184 | 471 |
| 1974 | 30,000 | 11,191 | 373 |
| 1975 | 29,600 | 10,905 | 368 |
| 1976 | 29,300 | 13,066 | 446 |
| 1977 | 29,100 | 14,613 | 502 |
| 1978 | 29,000 | 15,122 | 521 |
| 1979 | 28,500 | 13,984 | 491 |
| 1980 | 27,900 | 11,419 | 409 |
| 1981 | 26,350 | 10,725 | 407 |
| 1982 | 25,700 | 10,452 | 407 |
| 1983 | 24,725 | 12,166 | 492 |
| 1984 | 24,725 | 14,254 | 577 |
| 1985 | 24,725 | 15,501 | 627 |
| 1986 | 24,825 | 16,047 | 646 |
| 1987 | 25,150 | 14,888 | 592 |
| 1988 | 25,025 | 15,426 | 616 |
| 1989 | 25,000 | 14,508 | 580 |
| 1990 | 24,825 | 13,849 | 558 |
| 1991 | 24,200 | 12,298 | 508 |
| 1992 | 23,500 | 12,842 | 546 |
| 1993 | 22,950 | 13,869 | 604 |
| 1994 | 22,850 | 15,023 | 657 |
| 1995 | 22,800 | 14,688 | 644 |
| 1996 | 22,750 | 15,046 | 661 |
| 1997 | 22,700 | 15,069 | 664 |
| 1998 | 22,600 | 15,441 | 683 |
| 1999 | 22,400 | 16,771 | 749 |
| | *Average annual percentage change* | | |
| 1970–99 | -1.1% | 1.8% | 3.0% |
| 1989–99 | -1.1% | 1.5% | 2.6% |

**Source:**
Number of dealers - National Automobile Dealers Association, *Automotive Executive Magazine*, 2001. (Additional resources: www.nada.org)
Light-duty vehicle sales - See tables 7.3 and 7.4.

[a]As of the beginning of the year.

*The number of conventional refueling stations is declining while the number of vehicles fueling at those stations continues to rise. In 1999, there were 0.58 fueling stations per thousand vehicles. Data for alternative fuels in 2000 indicate that there was an average of 12 stations per thousand alternative fuel vehicles.*

**Table 7.15**
**Conventional and Alternative Fuel Refueling Stations**

| Calendar year | Refueling stations[a] | Vehicles in operation (thousands) | Stations per thousand vehicles |
|---|---|---|---|
| | Conventional fuels | | |
| 1997 | 126,889 | 201,071 | 0.63 |
| 1998 | 123,894 | 205,043 | 0.60 |
| 1999 | 121,095 | 209,509 | 0.58 |
| | Alternative fuels, 2000[b] | | |
| LPG | 3,268 | 268 | 12.19 |
| CNG | 1,217 | 101 | 12.05 |
| Electricity | 558 | 9 | 62.00 |
| M85/M100 | 3 | 18 | 0.17 |
| LNG | 44 | 2 | 22.00 |
| E85/E95 | 113 | 35 | 3.23 |
| Total | 5,203 | 432 | 12.02 |

**Source:**
**Refueling stations -** Conventional: U.S. Department of Commerce, Bureau of the Census, County Business Patterns for the United States, www.census.gov/epcd/cbp/view/cbpview.html and electronic communication with the County Business Pattern Office, 1998. Alternative Fuel: Alternative Fuels Data Center, www.afdc.doe.gov.
**Vehicles -** Conventional: The Polk Company, Detroit, MI. FURTHER REPRODUCTION PROHIBITED. Alternative Fuel: Alternative Fuels Data Center, www.afdc.doe.gov.
**Note:**
The Census Bureau changed in 1998 to use the North American Industry Classification System (NAICS) instead of the Standard Industrial Classification (SIC) System. The NAICS to SIC mapover for gasoline stations is not a one-to-one match. Therefore, data before 1997 are not available.

[a] Includes all convenience stores/refueling stations and truck stops which sell fuel.
[b] Additional data on alternative fuel vehicles and refueling stations are in Chapter 9.

*The Corporate Average Fuel Economy standards were established by the U.S. Energy Policy and Conservation Act of 1975 (PL94-163). These standards must be met at the manufacturer level. Though the averages shown here indicate the standards were met in most years, some manufacturers fell short of meeting the standards while others exceeded them.*

**Table 7.16**
**Automobile Corporate Average Fuel Economy (CAFE)**
**Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2000[a]**
**(miles per gallon)**

| Model year[b] | Automobiles | | | | CAFE estimates |
|---|---|---|---|---|---|
| | CAFE standards | CAFE estimates[c] | | | Autos and light trucks combined |
| | | Domestic | Import | Combined | |
| 1978 | 18.0 | 18.7 | 27.3 | 19.9 | 19.9 |
| 1979 | 19.0 | 19.3 | 26.1 | 20.3 | 20.1 |
| 1980 | 20.0 | 22.6 | 29.6 | 24.3 | 23.1 |
| 1981 | 22.0 | 24.2 | 31.5 | 25.9 | 24.6 |
| 1982 | 24.0 | 25.0 | 31.1 | 26.6 | 25.1 |
| 1983 | 26.0 | 24.4 | 32.4 | 26.4 | 24.8 |
| 1984 | 27.0 | 25.5 | 32.0 | 26.9 | 25.0 |
| 1985 | 27.5 | 26.3 | 31.5 | 27.6 | 25.4 |
| 1986 | 26.0 | 26.9 | 31.6 | 28.2 | 25.9 |
| 1987 | 26.0 | 27.0 | 31.2 | 28.4 | 26.2 |
| 1988 | 26.0 | 27.4 | 31.5 | 28.0 | 26.0 |
| 1989 | 26.5 | 27.2 | 30.8 | 28.4 | 25.6 |
| 1990 | 27.5 | 26.9 | 29.9 | 27.9 | 25.4 |
| 1991 | 27.5 | 27.3 | 30.1 | 28.4 | 25.6 |
| 1992 | 27.5 | 27.0 | 29.2 | 27.9 | 25.1 |
| 1993 | 27.5 | 27.8 | 29.6 | 28.4 | 25.2 |
| 1994 | 27.5 | 27.5 | 29.7 | 28.3 | 24.7 |
| 1995 | 27.5 | 27.7 | 30.3 | 28.6 | 24.9 |
| 1996 | 27.5 | 28.1 | 29.6 | 28.5 | 24.9 |
| 1997 | 27.5 | 27.8 | 30.1 | 28.7 | 24.6 |
| 1998 | 27.5 | 28.6 | 29.2 | 28.8 | 24.7 |
| 1999 | 27.5 | 28.0 | 29.0 | 28.3 | 24.5 |
| 2000 | 27.5 | 28.5 | 28.3 | 28.5 | 24.7 |

**Source:**
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, March 2001. (Additional resources: www.nhtsa.dot.gov)

[a]Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer.
[b]Model year as determined by the manufacturer on a vehicle by vehicle basis.
[c]All CAFE calculations are sales-weighted.

*The Corporate Average Fuel Economy standards for light trucks are lower than the automobile standards. Light trucks include pickups, minivans, sport utility vehicles and vans.*

**Table 7.17**
**Light Truck Corporate Average Fuel Economy (CAFE)**
**Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2000[a]**
**(miles per gallon)**

| Model year[b] | Light trucks[c] | | | | CAFE estimates |
|---|---|---|---|---|---|
| | CAFE standards | CAFE estimates[d] | | | Autos and light trucks combined |
| | | Domestic | Import | Combined | |
| 1978 | [e] | [f] | [f] | [g] | 19.9 |
| 1979 | [e] | 17.7 | 20.8 | 18.2 | 20.1 |
| 1980 | [e] | 16.8 | 24.3 | 18.5 | 23.1 |
| 1981 | [e] | 18.3 | 27.4 | 20.1 | 24.6 |
| 1982 | 17.5 | 19.2 | 27.0 | 20.5 | 25.1 |
| 1983 | 19.0 | 19.6 | 27.1 | 20.7 | 24.8 |
| 1984 | 20.0 | 19.3 | 26.7 | 20.6 | 25.0 |
| 1985 | 19.5 | 19.6 | 26.5 | 20.7 | 25.4 |
| 1986 | 20.0 | 20.0 | 25.9 | 21.5 | 25.9 |
| 1987 | 20.5 | 20.5 | 25.2 | 21.7 | 26.2 |
| 1988 | 20.5 | 20.6 | 24.6 | 21.3 | 26.0 |
| 1989 | 20.5 | 20.4 | 23.5 | 21.0 | 25.6 |
| 1990 | 20.0 | 20.3 | 23.0 | 20.8 | 25.4 |
| 1991 | 20.2 | 20.9 | 23.0 | 21.3 | 25.6 |
| 1992 | 20.2 | 20.5 | 22.7 | 20.8 | 25.1 |
| 1993 | 20.4 | 20.7 | 22.8 | 21.0 | 25.2 |
| 1994 | 20.5 | 20.5 | 22.0 | 20.8 | 24.7 |
| 1995 | 20.6 | 20.3 | 21.5 | 20.5 | 24.9 |
| 1996 | 20.7 | 20.5 | 22.1 | 20.8 | 24.9 |
| 1997 | 20.7 | 20.1 | 22.1 | 20.6 | 24.6 |
| 1998 | 20.7 | 20.4 | 23.0 | 21.1 | 24.7 |
| 1999 | 20.7 | [f] | [f] | 20.9 | 24.5 |
| 2000 | 20.7 | [f] | [f] | 21.2 | 24.7 |

**Source:**
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, March 2001. (Additional resources: www.nhtsa.dot.gov)

[a]Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer.
[b]Model year as determined by the manufacturer on a vehicle by vehicle basis.
[c]Represents two- and four-wheel drive trucks combined. Gross vehicle weight of 0–6,000 pounds for model year 1978–1979 and 0–8,500 pounds for subsequent years.
[d]All CAFE calculations are sales-weighted.
[e]Standards were set for two-wheel drive and four-wheel drive light trucks separately, but no combined standard was set in this year.
[f]Data are not available.

**Table 7.18**
**Corporate Average Fuel Economy (CAFE) Fines Collected, 1983–99[a]**
**(thousands)**

| Model year | Current dollars | 1999 constant dollars[b] |
|---|---|---|
| 1983 | 58 | 97 |
| 1984 | 5,958 | 9,557 |
| 1985 | 15,565 | 24,106 |
| 1986 | 29,872 | 45,390 |
| 1987 | 31,261 | 45,826 |
| 1988 | 44,519 | 62,701 |
| 1989 | 47,381 | 63,677 |
| 1990 | 48,449 | 61,768 |
| 1991 | 42,243 | 51,665 |
| 1992 | 38,287 | 45,456 |
| 1993 | 28,688 | 33,084 |
| 1994 | 31,478 | 35,377 |
| 1995 | 40,788 | 44,576 |
| 1996 | 19,302 | 20,497 |
| 1997 | 36,211 | 37,582 |
| 1998 | 23,354 | 23,866 |
| 1999 | 27,465 | 27,465 |

**Source:**
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, March, 2001.
(Additional resources: www.nhtsa.dot.gov)

**Table 7.19**
**Tax Receipts from the Sale of Gas Guzzlers, 1980–99**
**(thousands)**

| Fiscal year | Current dollars | 1999 constant dollars[b] |
|---|---|---|
| 1980 | 740 | 1,496 |
| 1981 | 780 | 1,429 |
| 1982 | 1,720 | 2,969 |
| 1983 | 4,020 | 6,722 |
| 1984 | 8,820 | 14,147 |
| 1985 | 39,790 | 61,624 |
| 1986 | 147,660 | 224,368 |
| 1987 | 145,900 | 231,878 |
| 1988 | 116,780 | 164,474 |
| 1989 | 109,640 | 147,348 |
| 1990 | 103,200 | 131,571 |
| 1991 | 118,400 | 144,808 |
| 1992 | 144,200 | 171,201 |
| 1993 | 111,600 | 128,700 |
| 1994 | 64,100 | 72,040 |
| 1995 | 73,500 | 80,325 |
| 1996 | 52,600 | 55,857 |
| 1997 | 48,200 | 50,025 |
| 1998 | 47,700 | 48,745 |
| 1999 | 68,300 | 68,300 |

**Source:**
Internal Revenue Service, Statistics of Income Bulletin, Summer 2000, Washington, DC, 2000. (Additional resources: www.irs.gov/tax_stats).

[a] These are fines which are actually collected. Fines which are assessed in a certain year may not have been collected in that year.
[b] Adjusted using the Consumer Price Inflation Index.

*Consumers must pay the Gas Guzzler Tax when purchasing an automobile that has an Environmental Protection Agency (EPA) fuel economy rating less than that stipulated in the table below. The Gas Guzzler Tax doubled in 1991 after remaining constant from 1986 to 1990. The tax has not changed since 1991. This tax does not apply to light trucks such as pickups, minivans, sport utility vehicles, and vans.*

**Table 7.20**
**The Gas Guzzler Tax on New Cars**
**(dollars per vehicle)**

| Vehicle fuel economy (mpg) | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986–90 | 1991+ |
|---|---|---|---|---|---|---|---|---|
| Over 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22.0–22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 500 | 1,000 |
| 21.5–22.0 | 0 | 0 | 0 | 0 | 0 | 0 | 500 | 1,000 |
| 21.0–21.5 | 0 | 0 | 0 | 0 | 0 | 0 | 650 | 1,300 |
| 20.5–21.0 | 0 | 0 | 0 | 0 | 0 | 500 | 650 | 1,300 |
| 20.0–20.5 | 0 | 0 | 0 | 0 | 0 | 500 | 850 | 1,700 |
| 19.5–20.0 | 0 | 0 | 0 | 0 | 0 | 600 | 850 | 1,700 |
| 19.0–19.5 | 0 | 0 | 0 | 0 | 450 | 600 | 1,050 | 2,100 |
| 18.5–19.0 | 0 | 0 | 0 | 350 | 450 | 800 | 1,050 | 2,100 |
| 18.0–18.5 | 0 | 0 | 200 | 350 | 600 | 800 | 1,300 | 2,600 |
| 17.5–18.0 | 0 | 0 | 200 | 500 | 600 | 1,000 | 1,300 | 2,600 |
| 17.0–17.5 | 0 | 0 | 350 | 500 | 750 | 1,000 | 1,500 | 3,000 |
| 16.5–17.0 | 0 | 200 | 350 | 650 | 750 | 1,200 | 1,500 | 3,000 |
| 16.0–16.5 | 0 | 200 | 450 | 650 | 950 | 1,200 | 1,850 | 3,700 |
| 15.5–16.0 | 0 | 350 | 450 | 800 | 950 | 1,500 | 1,850 | 3,700 |
| 15.0–15.5 | 0 | 350 | 600 | 800 | 1,150 | 1,500 | 2,250 | 4,500 |
| 14.5–15.0 | 200 | 450 | 600 | 1,000 | 1,150 | 1,800 | 2,250 | 4,500 |
| 14.0–14.5 | 200 | 450 | 750 | 1,000 | 1,450 | 1,800 | 2,700 | 5,400 |
| 13.5–14.0 | 300 | 550 | 750 | 1,250 | 1,450 | 2,200 | 2,700 | 5,400 |
| 13.0–13.5 | 300 | 550 | 950 | 1,250 | 1,750 | 2,200 | 3,200 | 6,400 |
| 12.5–13.0 | 550 | 650 | 950 | 1,550 | 1,750 | 2,650 | 3,200 | 6,400 |
| Under 12.5 | 550 | 650 | 1,200 | 1,550 | 2,150 | 2,650 | 3,850 | 7,700 |

**Source:**
Internal Revenue Service, Form 6197, (Rev. 1-91), "Gas Guzzler Tax."
(Additional resources: www.irs.ustreas.gov)

# Fuel Economy by Vehicle Speed

ORNL has developed fuel consumption and emissions lookup tables for the Federal Highway Administration, for use in their TRAF series of traffic models (NETSIM, CORSIM, FRESIM), although more generic uses are also possible. To develop the data-based models, vehicles are tested both on-road and on a chassis dynamometer. Engine parameters are measured on-road under real-world driving conditions that cover the vehicle's entire operating envelope. Emissions and fuel consumption are then measured on the chassis dynamometer as functions of engine conditions. The two data sets are merged to produce the final three-dimensional maps as functions of vehicle speed and acceleration. Eight well-functioning, late-model vehicles, and one 1997 model vehicle, have been tested thus far in fully warmed-up conditions.

Similar continuing work is planned for the Department of Energy as well as FHWA, which will include more well-functioning, late-model vehicles, pre-control (1960's) vehicles, malfunctioning high-emitter vehicles, light-duty diesel vehicles (cars and pickup trucks), alternative fuel vehicles, and possibly heavy-duty diesel vehicles. ORNL will also be developing cold-start algorithms to enhance the existing models, since emissions and fuel economy generally improve as vehicles warm up to normal operating temperatures.

For further information regarding this study please contact:

Scott Sluder
Fuels, Combustion, and Engine Technology
P.O. Box 2009, Building 9108
Oak Ridge, TN 37831-8087

Phone: 865-241-9133
Fax: 865-241-1747
email: sluders@ornl.gov

**Table 7.21**
**Vehicle Specifications for Tested Vehicles**

| Vehicle | Curb weight | Engine | Fuel delivery system[a] | Trans-mission | EPA fuel economy | |
|---|---|---|---|---|---|---|
| | | | | | City | Highwayy |
| 1988 Chevrolet Corsica | 2,665 | 2.8 liter | PFI | M5 | 19 | 29 |
| 1994 Olds Cutlass Supreme | 3,290 | 3.4 liter | PFI | L4 | 17 | 26 |
| 1994 Oldsmobile 88 | 3,433 | 3.8 | PFI | L4 | 19 | 29 |
| 1994 Mercury Villager | 4,020 | 3.0 liter | PFI | L4 | 17 | 23 |
| 1995 Geo Prizm | 2,359 | 1.6 liter I- | PFI | L3 | 26 | 30 |
| 1994 Jeep Grand Cherokee | 3,820 | 4.0 liter I- | PFI | L4 | 15 | 20 |
| 1994 Chevrolet Pickup | 4,020 | 5.7 liter | TBI | L4 | 14 | 18 |
| 1993 Subaru Legacy | 2,800 | 2.2 liter | PFI | L4 | 22 | 29 |
| 1997 Toyota Celica | 2,395 | 1.8 liter I4 | PFI | L4 | 27 | 34 |

**Source:**
West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, *Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models*, Washington, DC, April 1997 and additional project data, April 1998.

[a] PFI = port fuel injection. TBI = throttle- body fuel injection.

*The two earlier studies by the Federal Highway Administration (FHWA) indicate maximum fuel efficiency was achieved at speeds of 35 to 40 mph. The recent FHWA study indicates greater fuel efficiency at higher speeds. Note that the 1973 study did not include light trucks.*

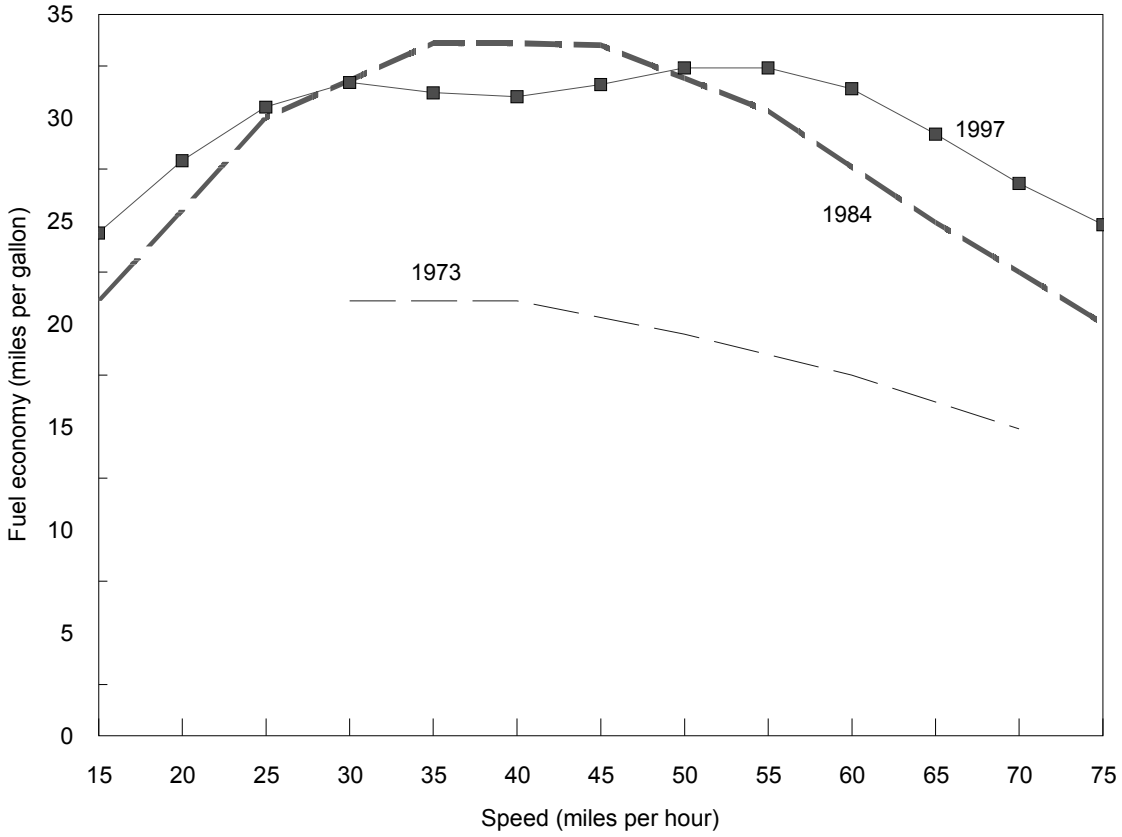
**Table 7.22**
**Fuel Economy by Speed, 1973, 1984, and 1997**
**(miles per gallon)**

| Speed (miles per hour) | 1973[a] (13 vehicles) | 1984[b] (15 vehicles) | 1997[c] (9 vehicles) |
|---|---|---|---|
| 15 | [d] | 21.1 | 24.4 |
| 20 | [d] | 25.5 | 27.9 |
| 25 | [d] | 30.0 | 30.5 |
| 30 | 21.1 | 31.8 | 31.7 |
| 35 | 21.1 | 33.6 | 31.2 |
| 40 | 21.1 | 33.6 | 31.0 |
| 45 | 20.3 | 33.5 | 31.6 |
| 50 | 19.5 | 31.9 | 32.4 |
| 55 | 18.5 | 30.3 | 32.4 |
| 60 | 17.5 | 27.6 | 31.4 |
| 65 | 16.2 | 24.9 | 29.2 |
| 70 | 14.9 | 22.5 | 26.8 |
| 75 | [d] | 20.0 | 24.8 |
| | | *Fuel economy loss* | |
| 55–65 mph | 12.4% | 17.8% | 9.7% |
| 65–70 mph | 8.0% | 9.6% | 8.2% |
| 55–70 mph | 19.5% | 25.7% | 17.1% |

**Source:**
1973- U.S. Department of Transportation, Federal Highway Administration, Office of Highway Planning, *The Effect of Speed on Automobile Gasoline Consumption Rates*, Washington, DC, October 1973.
1984 - U.S. Department of Transportation, Federal Highway Administration, *Fuel Consumption and Emission Values for Traffic Models*, Washington, DC, May 1985.
1997 - West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, *Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models*, FHWA Report (in press), Washington, DC, April 1997, and additional project data, April 1998. (Additional resources: www.fhwa-tsis.com)

[a]Model years 1970 and earlier automobiles.
[b]Model years 1981–84 automobiles and light trucks.
[c]Model years 1988–97 automobiles and light trucks.
[d]Data are not available.

**Figure 7.2. Fuel Economy by Speed, 1973, 1984, and 1997**




**Source:** See Table 7.21.

*Of the tested vehicles, the 1994 Oldsmobile Olds 88 had the greatest fuel economy loss from 55 mph to 75 mpg. The 1997 Toyota Celica tested fuel economy was slightly better at 65 mph than at 55 mph.*

**Table 7.23**
**Steady Speed Fuel Economy for Tested Vehicles**
**(miles per gallon)**

| Speed (mph) | 1988 Chevrolet Corsica | 1993 Subaru Legacy | 1994 Oldsmobile Olds 88 | 1994 Oldsmobile Cutlass | 1994 Chevrolet Pickup | 1994 Jeep Grand Cherokee | 1994 Mercury Villager | 1995 Geo Prizm | 1997 Toyota Celica |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 10.0 | 14.5 | 10.5 | 5.1 | 7.9 | 8.2 | 12.3 | 18.1 | 19.1 |
| 10 | 16.8 | 24.7 | 14.9 | 7.9 | 16.0 | 11.2 | 19.0 | 23.1 | 34.1 |
| 15 | 17.7 | 31.9 | 22.2 | 11.4 | 16.3 | 17.5 | 22.4 | 38.9 | 41.7 |
| 20 | 21.7 | 34.4 | 26.3 | 12.5 | 19.9 | 24.7 | 25.8 | 39.4 | 46.0 |
| 25 | 23.9 | 37.4 | 28.3 | 15.6 | 22.7 | 21.8 | 30.8 | 41.7 | 52.6 |
| 30 | 28.7 | 39.7 | 29.0 | 19.0 | 26.3 | 21.6 | 30.3 | 40.0 | 50.8 |
| 35 | 28.6 | 38.0 | 30.9 | 21.2 | 24.3 | 25.0 | 26.1 | 39.1 | 47.6 |
| 40 | 29.2 | 37.0 | 33.2 | 23.0 | 26.7 | 25.5 | 29.0 | 38.9 | 36.2 |
| 45 | 28.8 | 33.7 | 32.4 | 23.0 | 27.3 | 25.4 | 27.8 | 42.3 | 44.1 |
| 50 | 31.2 | 33.7 | 34.2 | 27.3 | 26.3 | 24.8 | 30.1 | 39.1 | 44.8 |
| 55 | 29.1 | 37.7 | 34.6 | 29.1 | 25.1 | 24.0 | 31.7 | 37.7 | 42.5 |
| 60 | 28.2 | 35.9 | 32.5 | 28.2 | 22.6 | 23.2 | 27.3 | 36.7 | 48.4 |
| 65 | 28.7 | 33.4 | 30.0 | 25.0 | 21.8 | 21.3 | 25.3 | 34.1 | 43.5 |
| 70 | 26.1 | 31.0 | 26.7 | 22.9 | 20.1 | 20.0 | 23.9 | 31.7 | 39.2 |
| 75 | 23.7 | 28.8 | 24.0 | 21.6 | 18.1 | 19.1 | 22.4 | 28.3 | 36.8 |
| | | | | *Fuel economy loss* | | | | | |
| 55–65 | 1.4% | 11.4 | 13.3% | 14.1% | 13.1% | 11.3% | 20.2% | 9.5% | -2.4% |
| 65–75 | 17.4% | 13.8 | 20.0% | 13.6% | 17.0% | 10.3% | 11.5% | 17.0 | 15.4% |
| 55–75 | 18.6% | 23.6 | 30.6% | 25.8% | 27.9% | 20.4% | 29.3% | 24.9 | 13.4% |

**Source:**
B.H. West, R.N. McGill, J.W. Hodgson, S.S. Sluder, D.E. Smith, *Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models*, Washington, DC, April 1997, and additional project data, April 1998.
(Additional resources: www.fhwa-tsis.com)

**Note:**
For specifications of the tested vehicles, please see Table 7.21.

*The Environmental Protection Agency (EPA) tests new vehicles to determine fuel economy ratings. The city and highway fuel economies that are posted on the windows of new vehicles are determined by testing the vehicle during these driving cycles. The driving cycles simulate the performance of an engine while driving in the city and on the highway. Once the urban cycle is completed, the engine is stopped, then started again for the 8.5 minute hot start cycle.*

**Figure 7.3. Urban Driving Cycle**

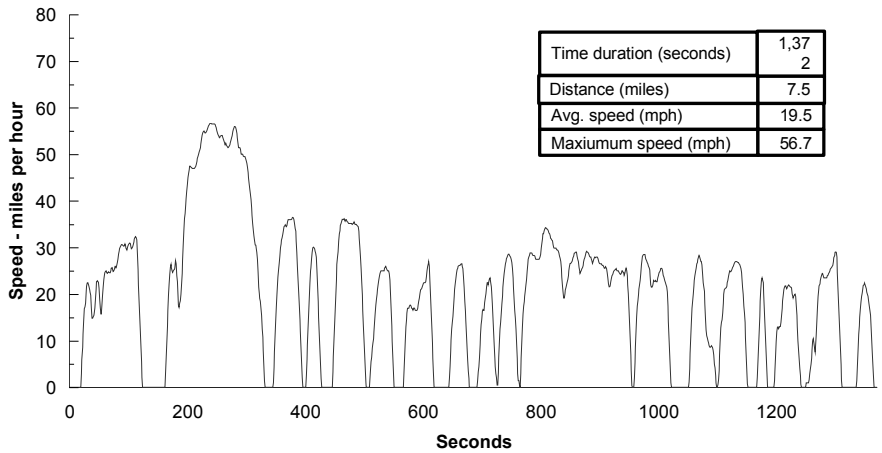
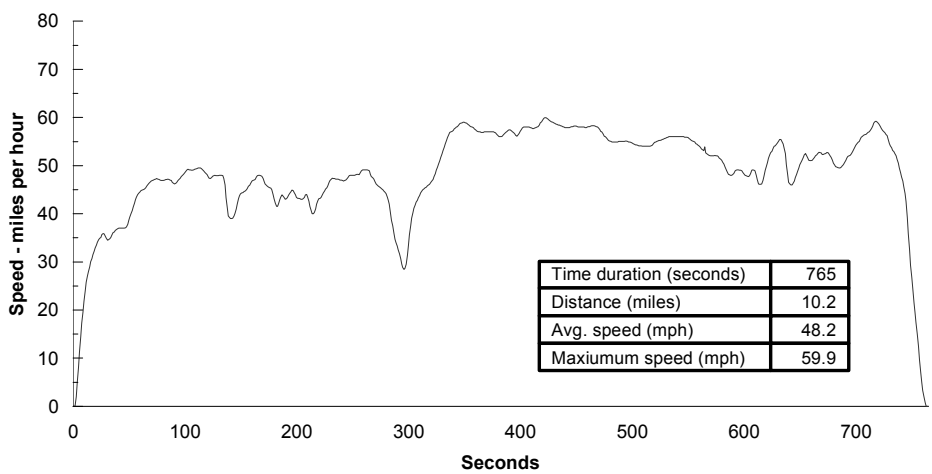



**Figure 7.4. Highway Driving Cycle**




**Source:**
*Code of Federal Regulations*, 40CFR, "Subpart B - Fuel Economy Regulations for 1978 and Later Model Year Automobiles - Test Procedures," July 1, 1988 edition, p. 676.

*The New York Test Cycle was developed in the 1970's in order to simulate driving in downtown congested areas. The Representative Number Five Test Cycle was developed recently to better represent actual on-road driving by combining modern urban and freeway driving.*

**Figure 7.5. New York City Driving Cycle**

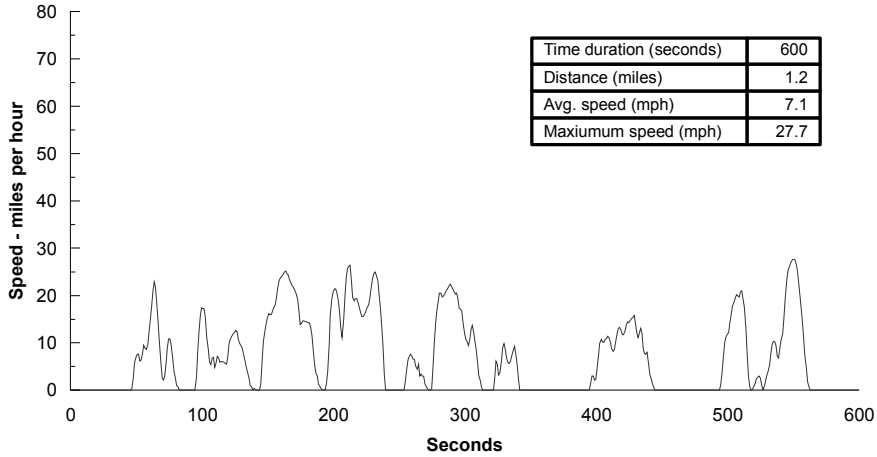
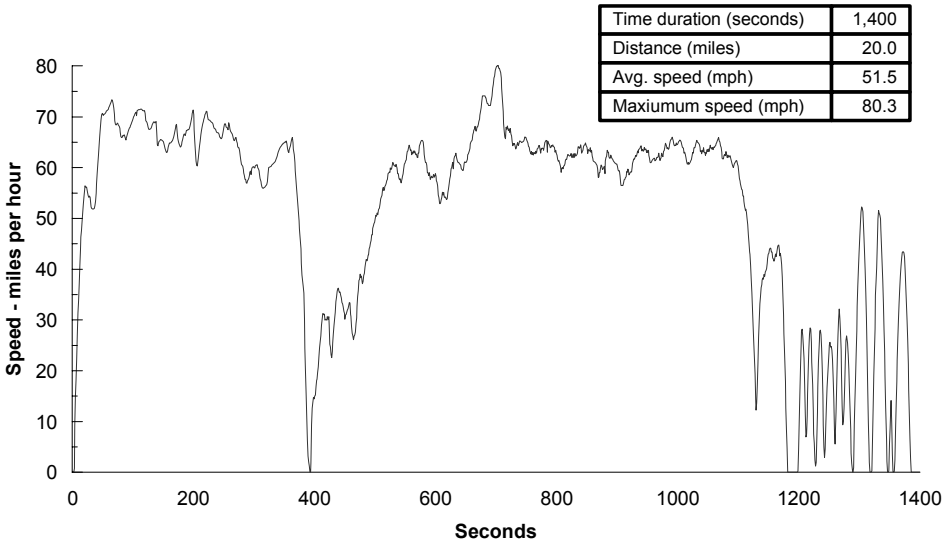


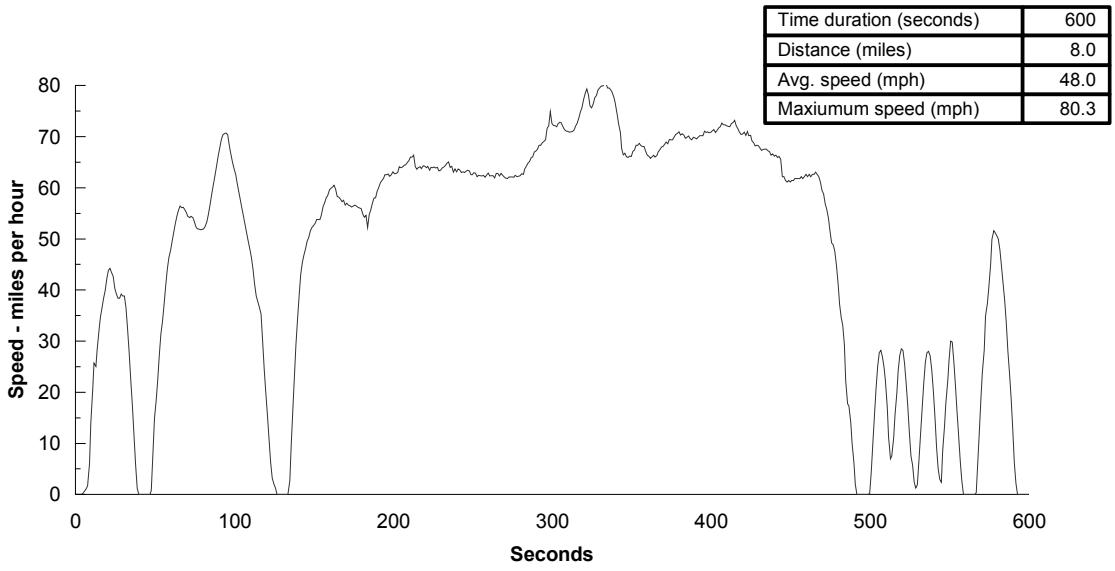

**Figure 7.6. Representative Number Five Driving Cycle**




**Source:**
Data obtained from Michael Wang, Argonne National Laboratory, Argonne, IL, 1997.

*The US06 driving cycle was developed as a supplement to the Federal Test Procedure. It is a short-duration cycle (600 seconds) which represents hard-acceleration driving.*

**Figure 7.7. US06 Driving Cycle**




**Source:**
Data obtained from Michael Wang, Argonne National Laboratory, Argonne, IL, 1997.

*When comparing data between countries, one must realize that different countries have different testing cycles to determine fuel economy and emissions. This table compares various statistics on the European, Japanese, and U.S. testing cycles [for fuel economy measurements, the U.S. uses the formula, 1/fuel economy = (0.55/urban[a] fuel economy) + (0.45/highway fuel economy)]. Most vehicles will achieve higher fuel economy on the U.S. test cycle than on the European or Japanese cycles.*

**Table 7.24**
**Comparison of U.S., European, and Japanese Emission Testing Cycles**

| Cycle | U.S. urban[a] | U.S. highway | European NEDC[b] | Japan 10.15 |
|---|---|---|---|---|
| Type of driving | urban | highway | mixed | urban |
| Start condition | cold | hot | cold | hot |
| Time, seconds | 1372 | 765 | 1180 | 680 |
| Distance, miles | 7.45 | 10.2 | 6.84 | 2.59 |
| Maximum acceleration, g | 0.164 | 0.146 | 0.109 | 0.082 |
| Maximum speed, mph | 56.7 | 59.9 | 74.6 | 43.5 |
| Average speed, mph | 19.5 | 48.2 | 20.9 | 14.1 |
| Maximum power, kW[c] | 31.7 | 25.9 | 33.3 | 18.9 |
| Average power, kW[c] | 5.1 | 9.0 | 4.8 | 3.8 |

**Source:**
Kenney, T.E., "Partitioning Emissions Tasks Across Engine and Aftertreatment Systems," SAE Paper 1999-01-3475, 1999.

[a] The actual Federal Procedure (FTP), which is also the test for emissions certification, repeats the first 505 seconds of the Federal Urban Driving Simulation cycle, hot started, after a 10 minute hot soak. Starting with Model Year 2001, the emissions test–but not the fuel economy test–incorporates a supplemental cycle that simulates aggressive urban driving, coupled with an added air conditioning load.

[b] New European Driving Cycle.

[c] Simulated Ford Contour (3000 lb., 0.33 Cd, manual transmission, 0.0073 rolling resistance coefficient).

*Total traffic fatalities were lower in 1999 than in 1975. Fourteen percent of traffic fatalities in 1999 were not vehicle occupants (pedestrians, cyclists, etc.).*

**Table 7.25**
**Occupant Fatalities by Vehicle Type and Nonoccupant Fatalities, 1975–99**

| | 1975 | 1980 | 1985 | 1990 | 1995 | 1998 | 1999 | 1999 share |
|---|---|---|---|---|---|---|---|---|
| **Vehicle occupant fatalities by vehicle type** | | | | | | | | |
| **Passenger car** | | | | | | | | |
| Subcompact | 3,834 | 7,299 | 7,993 | 8,309 | 6,791 | 5,510 | 4,930 | 11.8% |
| Compact | 614 | 927 | 2,635 | 5,310 | 6,899 | 7,002 | 6,967 | 16.7% |
| Intermediate | 1,869 | 3,878 | 4,391 | 4,849 | 4,666 | 4,788 | 4,743 | 11.4% |
| Full | 10,800 | 11,580 | 6,586 | 4,635 | 3,413 | 3,388 | 2,908 | 7.0% |
| Unknown | 8,812 | 3,765 | 1,607 | 989 | 654 | 476 | 1,270 | 3.1% |
| **Total** | **25,929** | **27,449** | **23,212** | **24,092** | **22,423** | **21,164** | **20,818** | **50.0%** |
| **Truck** | | | | | | | | |
| Light | 4,856 | 7,486 | 6.689 | 8,601 | 9,568 | 10,647 | 11,243 | 27.0% |
| Large | 961 | 1,262 | 977 | 705 | 648 | 728 | 758 | 1.8% |
| **Total** | **5,817** | **8,748** | **7,666** | **9,306** | **10,216** | **11,375** | **12,001** | **28.8%** |
| **Other Vehicles** | | | | | | | | |
| Motorcycle | 3,189 | 5,144 | 4,564 | 3,244 | 2,227 | 2,284 | 2,472 | 5.9% |
| Bus | 53 | 46 | 57 | 32 | 33 | 36 | 58 | 0.1% |
| Other/unknown vehicle type | 937 | 540 | 544 | 460 | 392 | 500 | 457 | 1.1% |
| **Total** | **4,179** | **5,730** | **5,165** | **3,736** | **2,652** | **2,820** | **2,987** | **7.2%** |
| **TOTAL vehicle occupant fatalities** | **35,925** | **41,927** | **36,043** | **37,134** | **35,291** | **35,369** | **35,806** | **86.0%** |
| **Nonoccupant fatalities** | | | | | | | | |
| Pedestrian | 7,516 | 8,070 | 6,808 | 6,482 | 5,584 | 5,220 | 4,906 | 11.8% |
| Pedalcyclist | 1,003 | 965 | 890 | 859 | 833 | 761 | 750 | 1.8% |
| Other | 81 | 129 | 84 | 124 | 109 | 131 | 149 | 0.4% |
| **Total** | **8,600** | **9,164** | **7,782** | **7,465** | **6,526** | **6,112** | **5,805** | **14.0%** |
| **TOTAL traffic fatalities** | **44,525** | **51,091** | **43,825** | **44,599** | **41,817** | **41,501** | **41,611** | **100.0%** |

**Source:**
*Traffic Safety Facts 1999*, Washington, DC, December 2000, p. 18. (Additional resources: www.nhtsa.dot.gov)

*In 1999, the fatality rate for vehicle occupants per 100 million vehicle miles are surprisingly similar for passenger cars and light trucks—1.3 and 1.2 fatalities per 100 million vehicle miles, respectively. However, the injury rate per 100 million vehicle miles is much lower for light trucks (94) than for passenger cars (136).*

**Table 7.26**
**Light Vehicle Occupant Safety Data, 1975–99**

| | 1975 | 1980 | 1985 | 1990 | 1995 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|
| | Passenger cars | | | | | | |
| Fatalities | 25,929 | 27,449 | 23,212 | 24,092 | 22,423 | 21,194 | 20,818 |
| Injuries (thousands) | [a] | [a] | [a] | 2,376 | 2,469 | 2,201 | 2,138 |
| Vehicle-miles (billions)[b] | 1,030 | 1,107 | 1,249 | 1,427 | 1,478 | 1,556 | 1,567 |
| Rates per 100 million vehicle miles | | | | | | | |
| Fatalities | 2.5 | 2.5 | 1.9 | 1.7 | 1.5 | 1.4 | 1.3 |
| Injuries | [a] | [a] | [a] | 167 | 167 | 141 | 136 |
| | Light trucks (10,000 lbs. or less) | | | | | | |
| Fatalities | 4,856 | 7,486 | 6,689 | 8,601 | 9,568 | 10,705 | 11,243 |
| Injuries (thousands) | [a] | [a] | [a] | 505 | 722 | 763 | 847 |
| Vehicle-miles (billions)[b] | 204 | 295 | 389 | 556 | 750 | 862 | 903 |
| Rates per 100 million vehicle-miles | | | | | | | |
| Fatalities | 2.4 | 2.5 | 1.7 | 1.5 | 1.3 | 1.2 | 1.2 |
| Injuries | [a] | [a] | [a] | 91 | 96 | 88 | 94 |

**Source:**
U.S. DOT, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999*, Washington, DC, December 2000, pp. 22, 24.
(Additional resources: www.nhtsa.dot.gov)

[a]Data are not available.
[b]Vehicle-miles are estimated by the National Highway Traffic Safety Administration and do not match Federal Highway data.

*In 1999, nearly 40% of all passenger car and light truck fatal crashes were single-vehicle crashes. Because there are so many passenger cars on the roads compared to the other vehicle types, total passenger car crashes are half of total crashes. Most crashes are multiple-vehicle crashes with property damage only.*

**Table 7.27**
**Crashes by Crash Severity, Crash Type, and Vehicle Type, 1999**

| | Fatal | | Injury | | Property damage only | | |
|---|---|---|---|---|---|---|---|
| Vehicle type | Single-vehicle crash | Multiple-vehicle crash | Single-vehicle crash | Multiple-vehicle crash | Single-vehicle crash | Multiple-vehicle crash | Total crashes |
| Passenger cars | 10,387 | 17,566 | 366,000 | 2,071,000 | 670,000 | 3,799,000 | 6,935,000 |
| Light trucks[a] | 7,847 | 12,048 | 183,000 | 982,000 | 398,000 | 2,094,000 | 3,677,000 |
| Large trucks[b] | 808 | 4,090 | 17,000 | 84,000 | 98,000 | 271,000 | 475,000 |
| Buses | 90 | 228 | 2,000 | 12,000 | 7,000 | 42,000 | 63,000 |
| Motorcycles | 1,132 | 1,387 | 21,000 | 25,000 | 3,000 | 8,000 | 59,000 |
| **Total** | **20,264** | **35,319** | **589,000** | **3,174,000** | **1,176,000** | **6,214,000** | **11,209,000** |
| Share | 0.2% | 0.3% | 5.3% | 28.3% | 10.5% | 55% | 100% |

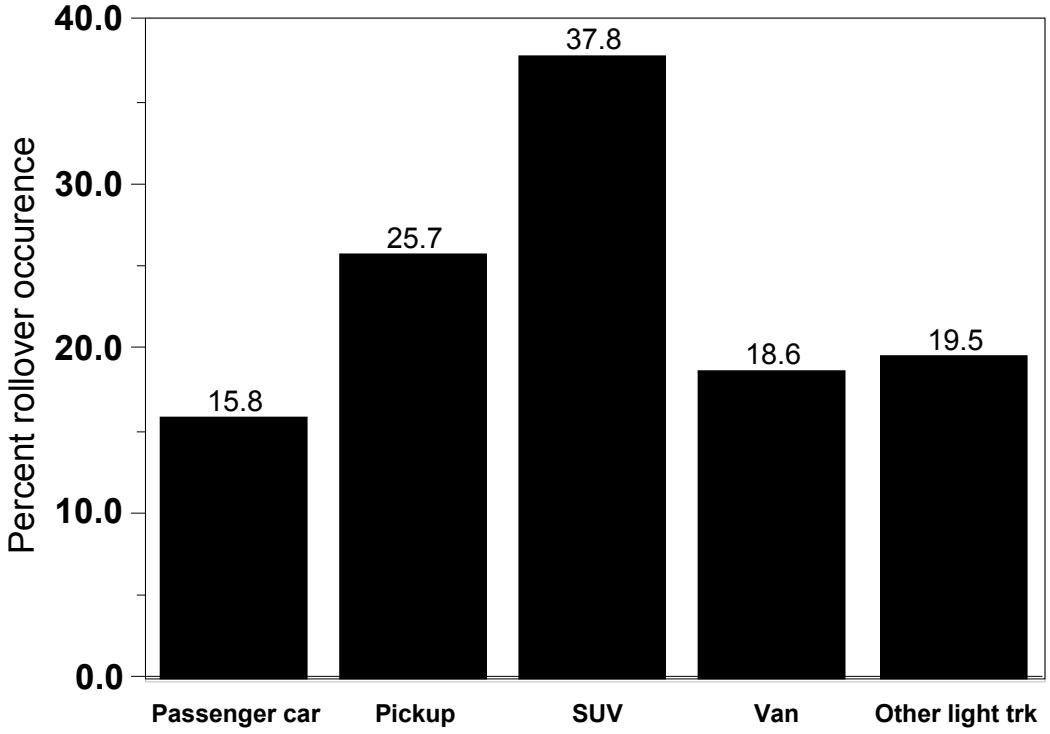
**Source:**
U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999*, Washington, DC, December 2000, pp. 72, 74, 76, 80, 82.

**Note:**
Multiple-vehicle crashes cannot be totaled over vehicle type due to duplication of accidents between vehicle types.

[a] Trucks 10,000 lbs. gross vehicle weight rating or less, including pickups, vans, and utility vehicles.
[b] Trucks over 10,000 pounds gross vehicle weight rating including single-unit trucks and truck tractors.

*For fatal crashes in 1999, sport-utility vehicles (SUVs) had the highest rollover rate (37.8%) while passenger cars had the lowest (15.8%). This does not mean that the rollover caused the fatality, just that a vehicle in the crash rolled over.*

**Figure 7.8. Percent Rollover Occurrence in Fatal Crashes by Vehicle Type, 1999**




**Source:**
U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1999*, Washington, DC, December 2000, p. 64.

# Chapter 8
# Heavy Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

| Source | | |
|---|---|---|
| Table 8.1 | Heavy single-unit trucks, 1999 | |
| | *Registration (thousands)* | *5,763* |
| | *Vehicle miles (millions)* | *70,311* |
| | *Fuel economy (miles per gallon)* | *9.9* |
| Table 8.1 | Combination trucks, 1998 | |
| | *Registration (thousands)* | *2,029* |
| | *Vehicle miles (millions)* | *132,386* |
| | *Fuel economy (miles per gallon)* | *5.0* |
| Table 8.5 | Trucks by size, 1997 Vehicle Inventory & Use Survey | |
| | *Light (0–10,000 lbs average weight)* | *93.5%* |
| | *Medium (10,001–26,000 lbs average weight)* | *3.0%* |
| | *Heavy (26,001 lbs and over average weight)* | *3.5%* |
| Tables 8.11 | Freight Shipments,1997 Commodity Flow Survey | |
| and 8.12 | *Value (billion dollars)* | *8,567* |
| | *Tons (millions)* | *14,800* |
| | *Ton-miles (billions)* | *3,851* |
| Tables 8.13 | Buses in operation, 1999 | |
| and 8.14 | *Transit* | *74,228* |
| | *School* | *592,029* |

*Other single-unit trucks include all single-unit trucks which have more than two axles or more than four tires. Most of these trucks would be used for business or for individuals with heavy hauling or towing needs.*

**Table 8.1**
**Summary Statistics for Other Single-Unit Trucks, 1970–99**

| | Other single-unit trucks | | | |
|---|---|---|---|---|
| Year | Registrations (thousands) | Vehicle travel (million miles) | Fuel use (million gallons) | Fuel economy (miles per gallon) |
| 1970 | 3,681 | 27,081 | 3,968 | 6.8 |
| 1975 | 4,232 | 34,606 | 5,420 | 6.4 |
| 1980 | 4,374 | 39,813 | 6,923 | 5.8 |
| 1981 | 4,455 | 39,568 | 6,867 | 5.8 |
| 1982 | 4,325 | 40,658 | 6,803 | 6.0 |
| 1983 | 4,204 | 42,546 | 6,965 | 6.1 |
| 1984 | 4,061 | 44,419 | 7,240 | 6.1 |
| 1985 | 4,593 | 45,441 | 7,399 | 6.1 |
| 1986 | 4,313 | 45,637 | 7,386 | 6.2 |
| 1987 | 4,188 | 48,022 | 7,523 | 6.4 |
| 1988 | 4,470 | 49,434 | 7,701 | 6.4 |
| 1989 | 4,519 | 50,870 | 7,779 | 6.5 |
| 1990 | 4,487 | 51,901 | 8,357 | 6.2 |
| 1991 | 4,481 | 52,898 | 8,172 | 6.5 |
| 1992 | 4,370 | 53,874 | 8,237 | 6.5 |
| 1993 | 4,408 | 56,772 | 8,488 | 6.7 |
| 1994 | 4,906 | 61,284 | 9,032 | 6.8 |
| 1995 | 5,024 | 62,705 | 9,216 | 6.8 |
| 1996 | 5,266 | 64,072 | 9,409 | 6.8 |
| 1997 | 5,293 | 66,893 | 9,576 | 7.0 |
| 1998[a] | 5,735[a] | 68,021[a] | 6,817[a] | 10.0[a] |
| 1999 | 5,763 | 70,311 | 7,122 | 9.9 |

**Source:**
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, 2001, Table VM1 and annual.
(Additional resources: www.fhwa.dot.gov)

[a] Change in data series due to newly available source data. This change affected both other single-unit trucks and combination trucks (see Table 8.2).

*Combination trucks include all trucks designed to be used in combination with one or more trailers. The average vehicle travel of these trucks (on a per truck basis) far surpasses the travel of other trucks due to long-haul freight movement.*

**Table 8.2**
**Summary Statistics for Combination Trucks, 1970–99[a]**

| | Combination trucks[b] | | | |
|---|---|---|---|---|
| Year | Registrations (thousands) | Vehicle travel (million miles) | Fuel use (million gallons) | Fuel economy (miles per gallon) |
| 1970 | 905 | 35,134 | 7,348 | 4.8 |
| 1975 | 1,131 | 46,724 | 9,177 | 5.1 |
| 1980 | 1,417 | 68,678 | 13,037 | 5.3 |
| 1981 | 1,261 | 69,134 | 13,509 | 5.1 |
| 1982 | 1,265 | 70,765 | 13,583 | 5.2 |
| 1983 | 1,304 | 73,586 | 13,796 | 5.3 |
| 1984 | 1,340 | 77,377 | 14,188 | 5.5 |
| 1985 | 1,403 | 78,063 | 14,005 | 5.6 |
| 1986 | 1,408 | 81,038 | 14,475 | 5.6 |
| 1987 | 1,530 | 85,495 | 14,990 | 5.7 |
| 1988 | 1,667 | 88,551 | 15,224 | 5.8 |
| 1989 | 1,707 | 91,879 | 15,733 | 5.8 |
| 1990 | 1,709 | 94,341 | 16,133 | 5.8 |
| 1991 | 1,691 | 96,645 | 16,809 | 5.7 |
| 1992 | 1,675 | 99,510 | 17,216 | 5.8 |
| 1993 | 1,680 | 103,116 | 17,748 | 5.8 |
| 1994 | 1,681 | 108,932 | 18,653 | 5.8 |
| 1995 | 1,696 | 115,451 | 19,777 | 5.8 |
| 1996 | 1,747 | 118,899 | 20,192 | 5.9 |
| 1997 | 1,790 | 124,584 | 20,302 | 6.1 |
| 1998[c] | 1,997[c] | 128,359[c] | 25,157[c] | 5.1[c] |
| 1999 | 2,029 | 132,386 | 26,240 | 5.0 |

**Source:**
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, 2001, Table VM1 and annual.
(Additional resources: www.fhwa.dot.gov)

[a] The Federal Highway Administration changed the combination truck travel methodology in 1993.

[b] The fuel economy for combination trucks is not the same as the fuel economy for Class 8 trucks. Fuel economy for Class 8 trucks is shown in Table 8.5.

[c] Change in data series due to newly available source data. This change affected both combination and other single-unit trucks (see Table 8.1).

*Sales of the medium trucks, classes 3–6 rose substantially in 1998. Light trucks, under 10,000 lbs., continue to dominate truck sales.*

**Table 8.3**
**New Retail Truck Sales by Gross Vehicle Weight, 1970–2000[a]**
**(thousands)**

| Calendar year | Class 1 6,000 lbs. or less | Class 2 6,001–10,000 lbs. | Class 3 10,001–14,000 lbs. | Class 4 14,001–16,000 lbs. | Class 5 16,001–19,500 lbs. | Class 6 19,501–26,000 lbs. | Class 7 26,001–33,000 lbs. | Class 8 33,001 lbs. and over | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Domestic sales (import data are not available)** | | | | | | | | | |
| 1970[b] | 1,049 | 408 | 6 | 12 | 58 | 133 | 36 | 89 | 1,791 |
| 1975 | 1,101 | 952 | 23 | 1 | 9 | 159 | 23 | 83 | 2,351 |
| 1980 | 985 | 975 | 4 | [c] | 2 | 90 | 58 | 117 | 2,231 |
| 1981 | 896 | 850 | 1 | [c] | 2 | 72 | 51 | 100 | 1,972 |
| 1982 | 1,102 | 961 | 1 | [c] | 1 | 44 | 62 | 76 | 2,248 |
| 1983 | 1,314 | 1,207 | [c] | [c] | 1 | 47 | 59 | 82 | 2,710 |
| 1984 | 2,031 | 1,224 | 6 | [c] | 5 | 55 | 78 | 138 | 3,538 |
| 1985 | 2,408 | 1,280 | 11 | [c] | 5 | 48 | 97 | 134 | 3,983 |
| **Domestic and import sales** | | | | | | | | | |
| 1986 | 3,380 | 1,214 | 12 | [c] | 6 | 45 | 101 | 113 | 4,870 |
| 1987 | 3,435 | 1,175 | 14 | 2 | 8 | 44 | 103 | 131 | 4,912 |
| 1988 | 3,467 | 1,333 | 14 | 21 | 8 | 54 | 103 | 148 | 5,149 |
| 1989 | 3,313 | 1,297 | 19 | 27 | 7 | 39 | 93 | 145 | 4,942 |
| 1990 | 3,451 | 1,097 | 21 | 27 | 5 | 38 | 85 | 121 | 4,846 |
| 1991 | 3,246 | 876 | 21 | 24 | 3 | 22 | 73 | 99 | 4,365 |
| 1992 | 3,608 | 1,021 | 26 | 26 | 4 | 28 | 73 | 119 | 4,903 |
| 1993 | 4,119 | 1,232 | 27 | 33 | 4 | 27 | 81 | 158 | 5,681 |
| 1994 | 4,527 | 1,506 | 35 | 44 | 4 | 20 | 98 | 186 | 6,421 |
| 1995 | 4,422 | 1,631 | 40 | 53 | 4 | 23 | 106 | 201 | 6,481 |
| 1996 | 4,829 | 1,690 | 52 | 59 | 7 | 19 | 104 | 170 | 6,930 |
| 1997 | 5,085 | 1,712 | 53 | 57 | 9 | 18 | 114 | 178 | 7,226 |
| 1998 | 5,263 | 2,036 | 102 | 43 | 25 | 32 | 115 | 209 | 7,825 |
| 1999 | 5,707 | 2,366 | 122 | 49 | 30 | 48 | 130 | 262 | 8,716 |
| 2000 | 5,965 | 2,421 | 117 | 47 | 29 | 51 | 123 | 212 | 8,965 |
| *Average annual percentage change* | | | | | | | | | |
| 1970–1985 | 5.7% | 7.9% | 4.1% | - | -15.1% | -6.6% | 6.8% | 2.8% | 5.5% |
| 1986–2000 | 4.1% | 5.1% | 17.7% | - | 11.9% | 0.9% | 1.4% | 4.6% | 4.5% |

**Source:**
Ward's Communication's, *Motor Vehicle Facts and Figures 2000*, Southfield, MI, 2000, p. 24, and annual. (Additional resources: www.wardsauto.com)

[a] Sales include domestic-sponsored imports.
[b] Data for 1970 is based on new truck registrations.
[c] Data are not available.

## Vehicle Inventory and Use Survey

The Vehicle Inventory and Use Survey (VIUS), which was formerly the Truck Inventory and Use Survey (TIUS), provides data on the physical and operational characteristics of the Nation's truck population. It is based on a probability sample of private and commercial trucks registered (or licensed) in each state. The name of the 1997 survey was changed to the Vehicle Inventory and Use Survey due to future possibilities of including additional vehicle types. Data for 1997 have been released in a report, as well as on CD-ROM. Copies may be obtained by contacting the U.S. Bureau of the Census, Transportation Characteristics Surveys Branch (301) 457-2797. Internet site **www. census.gov/svsd/www/tiusview.html** is the location of the VIUS on-line.

Since 1987 the survey has included minivans, vans, station wagons on truck chassis, and sport utility vehicles in addition to the bigger trucks. The 1977 and 1982 surveys did not include those vehicle types. The estimated number of trucks that were within the scope of the 1997 VIUS and registered in the U.S. as of July 1, 1997, was 72.8 million. These trucks were estimated to have been driven a total of 1,044 billion miles during 1997, an increase of 32.8% from 1992. The average annual miles traveled per truck was estimated at 14,300 miles.

In the 1997 VIUS, there are several ways to classify a truck by weight. The survey respondent was asked the average weight of the vehicle or vehicle-trailer combination when carrying a typical payload; the empty weight (truck minus cargo) of the vehicle as it was usually operated; and the maximum gross weight at which the vehicle or vehicle-trailer combination was operated. The Census Bureau also collected information on the Gross Vehicle Weight Class of the vehicles (decoded from the vehicle identification number) and the registered weight of the vehicles from the State registration files. Some of these weights are only provided in categories, while others are exact weights. Since all these weights could be quite different for a single truck, the tabulations by weight can be quite confusing. For illustration of this, see Tables 8.3 and 8.4. The first set of data are based on the Gross Vehicle Weight Class of the vehicle when it was manufactured; the data on Table 8.5 are based on the average weight as reported by the respondent. There is a 24% difference in the number of Class 1 trucks (6,000 lbs. and less). In most tables, the Gross Vehicle Weight Class was used. However, on the tables comparing different survey estimates, average weight must be used, as the older surveys did not include data on the Gross Vehicle Weight rating.

*These tables illustrate the difference between two weight variables in the Vehicle Inventory and Use Survey. The manufacturer's gross vehicle weight class is likely to be more accurate than the average weight provided by the respondent.*

**Table 8.4**
**Truck Statistics by Gross Vehicle Weight Class, 1997**

| Manufacturer's gross vehicle weight class | Number of trucks | Percentage of trucks | Average annual miles per truck | Average fuel economy | Gallons of fuel used (millions) | Percentage of fuel use |
|---|---|---|---|---|---|---|
| 1) 6,000 lbs and less | 45,240,632 | 62.14% | 13,328 | 17.82 | 35,184 | 44.34% |
| 2) 6,001 – 10,000 lbs | 22,373,167 | 30.73% | 12,952 | 14.11 | 21,226 | 26.75% |
| 3) 10,001 – 14,000 | 510,476 | 0.70% | 15,650 | 10.83 | 771 | 0.97% |
| 4) 14,001 – 16,000 | 194,951 | 0.27% | 16,390 | 10.11 | 320 | 0.40% |
| 5) 16,001 – 19,500 | 178,111 | 0.24% | 6,016 | 8.69 | 117 | 0.15% |
| 6) 19,501 – 26,000 | 1,884,246 | 2.59% | 13,637 | 8.21 | 3,202 | 4.04% |
| 7) 26,001 – 33,000 | 207,386 | 0.28% | 35,588 | 7.07 | 1,096 | 1.38% |
| 8) 33,001 lbs and up | 2,211,283 | 3.04% | 48,095 | 6.69 | 17,427 | 21.96% |
| **Total** | **72,800,252** | **100.00%** | **14,347** | **16.02** | **79,344** | **100.00%** |

**Source:**
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Microdata File on CD, 2000. (Additional resources: www.census.gov/svsd/www.tiusview.html)

**Table 8.5**
**Truck Fuel Economy by Size Class, 1992 and 1997**
**(miles per gallon)**

| Manufacturer's gross vehicle weight class | 1992 TIUS | 1997 VIUS |
|---|---|---|
| 1) 6,000 lbs and less | 17.9 | 17.8 |
| 2) 6,001–10,000 lbs | 13.6 | 14.1 |
| 3) 10,000–14,000 lbs | 10.4 | 10.8 |
| 4) 14,001–16,000 lbs | 9.7 | 10.1 |
| 5) 16,001–19,500 lbs | 7.9 | 8.7 |
| 6) 19,501–26,000 lbs | 7.9 | 8.2 |
| 7) 26,001–33,000 lbs | 7.2 | 7.1 |
| 8) 33,001 lbs and over | 7.0 | 6.7 |

**Source:**
Estimates are based on data provided on the following public use files: U.S. Department of Commerce, Bureau of the Census, Census of Transportation, Washington, DC, *1992 Truck Inventory and Use Survey*, 1995; *1997 Vehicle Inventory and Use Survey*, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

**Note:**
Average fuel economy as reported by respondent.

*As expected, most light trucks travel within 50 miles of their home base and refuel at public stations. Sixty percent of heavy trucks travel over 50 miles from their home base and 40% of them refuel at central company-owned refueling stations.*

**Table 8.6**
**Truck Statistics by Size, 1997**

| | Manufacturer's gross vehicle weight class | | | |
|---|---|---|---|---|
| | Light (< 10,000 lbs) | Medium (10,001–26,000 lbs) | Heavy (> 26,000 lbs) | Total |
| Trucks | 68,099,912 | 2,164,791 | 2,535,549 | 72,800,252 |
| Trucks (%) | 93.54% | 2.97% | 3.48% | 100% |
| Miles per truck | 13,165 | 13,837 | 46,513 | 14,347 |
| Total miles (%) | 85.84% | 2.87% | 11.29% | 100% |
| Fuel use (%) | 71.61% | 3.99% | 24.40% | 100% |
| Fuel economy (mpg) | 16.55 | 9.37 | 6.20 | 16.02 |
| | Range of operation | | | |
| Under 50 miles | 75.15% | 62.50% | 39.55% | 73.53% |
| 51–100 miles | 12.84% | 16.60% | 16.73% | 13.09% |
| 101–200 miles | 3.85% | 5.60% | 10.82% | 4.15% |
| 201–500 miles | 2.05% | 5.74% | 12.18% | 2.52% |
| Over 500 miles | 2.28% | 20.04% | 16.00% | 2.75% |
| Off-road | 3.83% | 7.52% | 4.74% | 3.97% |
| Total | 100% | 100% | 100% | 100% |
| | Primary refueling facility | | | |
| Central company-owned | 14.55% | 24.68% | 39.13% | 29.20% |
| Single off-site contract | 4.27% | 6.11% | 6.89% | 6.08% |
| Pubic station | 77.71% | 64.62% | 49.83% | 60.56% |
| Other | 3.47% | 4.59% | 4.16% | 4.16% |
| Total | 100% | 100% | 100% | 100% |

**Source:**
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Microdata File on CD, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

*More medium truck owners listed construction as the truck's major use than any other major use category. Construction was the second highest major use for light trucks and heavy trucks.*

**Table 8.7**
**Percentage of Trucks by Size Ranked by Major Use, 1997**

| Rank | Light (< 10,000 lbs average weight) | Medium (10,001 – 26,000 lbs average weight) | Heavy (> 26,000 lbs average weight) |
|---|---|---|---|
| **1** | **Personal** | **Construction** | **For Hire** |
| | 74.56% | 20.19% | 31.48% |
| **2** | **Construction** | **Agriculture** | **Construction** |
| | 7.56% | 19.54% | 17.56% |
| **3** | **Services**[a] | **Services**[a] | **Agriculture** |
| | 5.57% | 11.64% | 14.01% |
| **4** | **Agriculture** | **Retail** | **Wholesale** |
| | 3.82% | 9.28% | 7.81% |
| **5** | **Retail** | **Wholesale** | **Services**[a] |
| | 2.79% | 7.31% | 7.39% |
| **6** | **Not in Use** | **Personal** | **Retail** |
| | 1.61% | 7.00% | 5.67% |
| **7** | **Wholesale** | **For Hire** | **Manufacturing** |
| | 1.33% | 5.47% | 5.61% |
| **8** | **Manufacturing** | **Utilities** | **Forestry** |
| | 0.74% | 4.40% | 2.56% |
| **9** | **Utilities** | **Daily Rental** | **Utilities** |
| | 0.75% | 4.21% | 2.18% |
| **10** | **Daily Rental** | **Manufacturing** | **Mining** |
| | 0.53% | 3.72% | 2.18% |
| **11** | **Forestry** | **Not in Use** | **Daily Rental** |
| | 0.26% | 3.21% | 2.11% |
| **12** | **Mining** | **Forestry** | **Not in Use** |
| | 0.25% | 1.64% | 1.11% |
| **13** | **For Hire** | **One-Way Rental** | **Personal** |
| | 0.21% | 1.24% | 0.31% |
| **14** | **One-Way Rental** | **Mining** | **One-Way Rental** |
| | 0.01% | 1.14% | 0.01% |

**Source:**
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Micro data File on CD, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

[a] Business and personal services.

*In 1997 nearly 60% of all truck fleets use public fueling stations as their primary refueling facility. As expected, larger fleets use central company-owned facilities more than smaller fleets. Mid-size fleets (10–500 vehicles) use off-site contract facilities more than the smaller or larger fleets.*

**Table 8.8**
**Percentage of Trucks by Fleet Size and Primary Fueling Facility, 1997**

| | Primary refueling facility | | | | |
|---|---|---|---|---|---|
| Truck fleet size | Central company-owned fueling facility | Single contract fueling facility located off-site | Public fueling stations | Other | Total |
| 1 | 5.94% | 2.70% | 87.26% | 4.09% | 100% |
| 2–5 | 13.80% | 4.56% | 76.12% | 5.52% | 100% |
| 6–9 | 25.77% | 7.32% | 62.02% | 4.88% | 100% |
| 10–24 | 37.08% | 10.43% | 49.70% | 2.79% | 100% |
| 25–99 | 48.48% | 9.65% | 39.29% | 2.59% | 100% |
| 100–499 | 48.76% | 10.62% | 38.40% | 2.22% | 100% |
| 500–999 | 46.39% | 7.46% | 44.38% | 1.77% | 100% |
| 1,000–4,999 | 45.24% | 4.93% | 45.94% | 3.89% | 100% |
| 5,000–9,999 | 35.77% | 6.01% | 53.36% | 4.87% | 100% |
| 10,000 & up | 71.72% | 2.56% | 19.27% | 6.45% | 100% |
| **Overall** | **30.08%** | **6.39%** | **59.37%** | **4.16%** | **100%** |

**Source:**
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Microdata File on CD, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

*Most trucks are fueled at public fueling stations but one-way rental trucks are more often fueled at company-owned central fueling facilities or contract fueling facilities than at public stations. Mining and quarrying activities use central fueling facilities more than 40% of the time.*

**Table 8.9**
**Percentage of Trucks by Major Use and Primary Fueling Facility, 1997**

| | Primary fueling facility | | | | |
|---|---|---|---|---|---|
| Major Use | Central company-owned fueling facility | Single contract fueling facility located off-site | Public fueling stations | Other | Total |
| Agricultural services | 32.09% | 2.99% | 53.92% | 11.00% | 100% |
| Forestry or lumbering activities | 22.49% | 4.50% | 70.33% | 2.68% | 100% |
| Construction work | 33.40% | 5.39% | 58.79% | 2.42% | 100% |
| Contractor activities or special trades | 12.09% | 4.38% | 81.18% | 2.36% | 100% |
| Manufacturing, refining or processing activities | 35.47% | 9.48% | 53.69% | 1.36% | 100% |
| Wholesale trade | 32.56% | 11.90% | 53.62% | 1.92% | 100% |
| Retail trade | 28.21% | 10.25% | 59.41% | 2.12% | 100% |
| Business and personal services | 26.40% | 6.33% | 65.42% | 1.85% | 100% |
| Utilities | 40.56% | 5.09% | 52.25% | 2.09% | 100% |
| Mining or quarrying activities | 43.82% | 9.32% | 44.44% | 2.42% | 100% |
| Daily rental | 39.42% | 13.29% | 45.12% | 2.17% | 100% |
| Not in use | 10.56% | 2.37% | 53.12% | 33.94% | 100% |
| For-hire transportation | 32.87% | 4.90% | 59.53% | 2.70% | 100% |
| One-way rental | 48.47% | 3.10% | 48.43% | 0.00% | 100% |
| Personal transportation | 2.02% | 0.56% | 94.46% | 2.96% | 100% |
| **Overall** | **29.20%** | **6.08%** | **60.56%** | **4.16%** | **100%** |

**Source:**
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Microdata File on CD, 2000.
(Additional resources: www.census.gov/svsd/www/tiusview.html)

## Commodity Flow Survey

The Commodity Flow Survey (CFS) is designed to provide data on the flow of goods and materials by mode of transport. The 1993 and 1997 CFS are a continuation of statistics collected in the Commodity Transportation Survey from 1963 through 1977, and include major improvements in methodology, sample size, and scope. In 1997, CFS used a sample of 100,000 domestic establishments randomly selected from a universe of about 800,000 establishments engaged in mining, manufacturing, wholesale, auxiliary establishments (warehouses) of multi-establishment companies, and some selected activities in retail and service was used. Each selected establishment reported a sample of approximately 25 outbound shipments for a one-week period in each of the four calendar quarters of 1997. This produced a total sample of over 5 million shipments. For each sampled shipment, zip codes of origin and destination, 5-digit Standard Classification of Transported Goods (SCTG) code, weight, value, and modes of transport, were provided. Establishments also reported whether the shipment was containerized, a hazardous material, or an export.

The 1993 and 1997 CFS differ from previous surveys in their greatly expanded coverage of intermodalism (i.e., shipments which travel by at least two different modes, such as rail and truck). Earlier surveys reported only the principal mode. The 1993 and 1997 surveys report all modes used for the shipment (for-hire truck, private truck, rail, inland water, deep sea water, pipeline, air, parcel delivery or U.S. Postal Service, other mode, unknown). Route distance for each mode for each shipment as imputed from a mode-distance table was developed by Oak Ridge National Laboratory. Distance, in turn, was used to compute ton-mileage by mode of transport.

For more information about the CFS, contact the Commodity Flow Survey Branch, Department of Commerce, Bureau of the Census, Services Division at (301) 457-2108, or visit the following Internet site: **www.bts.gov/cfs** .

*Industries covered by the 1997 Commodity Flow Survey (CFS) shipped over 11 billion tons of goods worth almost $7 trillion. Compared to the 1993 CFS, the value of shipments is up 9.2% and ton shipped are up 14.5%. By value, intermodal shipments increased 31.2% over 1993.*

**Table 8.10**
**Growth of Freight in the United States: Comparison of the 1997 and 1993 Commodity Flow Surveys**
**(Detail may not add to total because of rounding)**

| Mode of Transportation | Value | | | Tons | | |
|---|---|---|---|---|---|---|
| | 1997 (billion 1997 dollars) | 1993 (billion 1997 dollars) | Percent change | 1997 (millions) | 1993 (millions) | Percent change |
| **All modes** | 6,944.0 | 6,360.8 | 9.2% | 11,089.7 | 9,688.5 | 14.5% |
| **Single modes** | 5,719.6 | 5,376.3 | 6.4% | 10,436.5 | 8,922.3 | 17.0% |
| Truck[a] | 4981.5 | 4791.0 | 4.0% | 7700.7 | 6385.9 | 20.6% |
| For-hire truck | 2901.3 | 2856.1 | 1.6% | 3402.6 | 2808.3 | 21.2% |
| Private truck | 2036.5 | 1910.4 | 6.6% | 4137.3 | 3543.5 | 16.8% |
| Rail | 319.6 | 269.2 | 18.7% | 1,549.8 | 1,544.1 | 0.4% |
| Water | 75.8 | 67.1 | 13.1% | 563.4 | 505.4 | 11.5% |
| Shallow draft | 53.9 | 44.3 | 21.7% | 414.8 | 362.5 | 14.4% |
| Great Lakes | 1.5 | [c] | [c] | 38.4 | 33.0 | [c] |
| Deep draft | 20.4 | 21.5 | -4.9% | 110.2 | 109.9 | 0.2% |
| Air (includes truck and air) | 229.1 | 151.3 | 51.4% | 4.5 | 3.1 | 42.6% |
| Pipeline[b] | 113.5 | 97.8 | 16.1% | 618.2 | 483.6 | 27.8% |
| **Multiple modes** | 945.9 | 720.9 | 31.2% | 216.7 | 225.7 | -4.0% |
| Parcel, U.S. Postal Service or courier | 855.9 | 612.8 | 39.7% | 23.7 | 18.9 | 25.4% |
| Truck and rail | 75.7 | 90.4 | -16.3% | 54.2 | 40.6 | 33.5% |
| Truck and water | 8.2 | 10.2 | -19.4% | 33.2 | 68.0 | -51.2% |
| Rail and water | 1.8 | 4.0 | -55.2% | 79.3 | 79.2 | 0.1% |
| Other multiple modes | 4.3 | 3.5 | 22.0% | 26.2 | 18.9 | 38.6% |
| **Other and unknown modes** | 278.6 | 263.6 | 5.7% | 436.5 | 540.5 | -19.2% |

**Source:**
U.S. Department of Transportation, Bureau of Transportation Statistics, *Freight USA*, Washington, DC, 2000. (Additional resources: www.bts.gov/cfs)

[a] "Truck" as a single mode includes shipments which went by private truck only, for-hire truck only, or a combination of private truck and for-hire truck.
[b] CFS data for pipeline lack most shipments of crude oil.
[c] Denotes data do not meet publication standards because of high sampling variability or other reasons. Some unpublished estimates can be derived from other data published in this table. However, figures obtained in this manner are subject to these same limitations.

*Industries covered by the 1997 Commodity Flow Survey (CFS) accounted for about 2.7 trillion ton-miles on the nation's highways, railways, waterways, pipelines, and aviation system. Ton-miles increased 9.9% from 1993 to 1997.*

**Table 8.11**
**Growth of Freight Miles in the United States: Comparison of the 1997 and 1993 Commodity Flow Surveys**
**(Detail may not add to total because of rounding)**

| Mode of Transportation | Ton-miles | | | Average miles per shipment | | |
|---|---|---|---|---|---|---|
| | 1997 (billions) | 1993 (billions) | Percent change | 1997 | 1993 | Percent change |
| **All modes** | 2,661.4 | 2,420.9 | 9.9% | 472 | 424 | 11.4% |
| **Single modes** | 2,383.5 | 2,136.9 | 11.5% | 184 | 197 | -6.4% |
| Truck[a] | 1023.5 | 869.5 | 17.7% | 144 | 144 | -0.1% |
| For-hire truck | 741.1 | 629.0 | 17.8% | 485 | 472 | 2.9% |
| Private truck | 268.6 | 235.9 | 13.9% | 53 | 52 | 2.1% |
| Rail | 1,022.5 | 942.6 | 8.5% | 769 | 766 | 3.0% |
| Water | 261.7 | 272.0 | -3.8% | 482 | [c] | [c] |
| Shallow draft | 189.3 | 164.4 | 15.2% | 177 | [c] | [c] |
| Great Lakes | 13.4 | 12.4 | 8.2% | 204 | 534 | -61.8% |
| Deep draft | 59.0 | 95.2 | -38.0% | 1,024 | 1,861 | -45.0% |
| Air (includes truck and air) | 6.2 | 4.0 | 55.5% | 1,380 | 1,415 | -2.5% |
| Pipeline[b] | [c] | [c] | [c] | [c] | [c] | [c] |
| **Multiple modes** | 204.5 | 191.5 | 6.8% | 813 | 736 | 10.5% |
| Parcel, U.S. Postal Service or courier | 18.0 | 13.2 | 36.8% | 813 | 734 | 10.7% |
| Truck and rail | 55.6 | 37.7 | 47.5% | 1,347 | 1,403 | -3.9% |
| Truck and water | 34.8 | 40.6 | -14.4% | 1,265 | 1,417 | -10.7% |
| Rail and water | 77.6 | 70.2 | 10.5% | 1,092 | 627 | 74.1% |
| Other multiple modes | 18.6 | [c] | [c] | [c] | 1,082 | [c] |
| **Other and unknown modes** | 73.4 | 92.6 | -20.7% | 122 | 229 | -46.9% |

**Source:**
U.S. Department of Transportation, Bureau of Transportation Statistics, *Freight USA*, Washington, DC, 2000. (Additional resources: www.bts.gov/cfs)

[a] "Truck" as a single mode includes shipments which went by private truck only, for-hire truck only, or a combination of private truck and for-hire truck.
[b] CFS data for pipeline lack most shipments of crude oil.
[c] Denotes data do not meet publication standards because of high sampling variability or other reasons. Some unpublished estimates can be derived from other data published in this table. However, figures obtained in this manner are subject to these same limitations.

*The number of active transit buses has increased by nearly 7,000 buses from 1984 to 1999, but the number of passenger-miles in 1999 is nearly identical to the 1984 level.*

**Table 8.12**
**Summary Statistics on Transit Buses, 1984–99**

| Year | Number of active buses | Vehicle-miles (millions) | Passenger-miles (millions) | Energy use (trillion Btu) |
|---|---|---|---|---|
| 1984 | 67,294 | 1,845 | 21,595 | 69.2 |
| 1985 | 64,258 | 1,863 | 21,161 | 72.4 |
| 1986 | 66,218 | 2,002 | 21,395 | 75.6 |
| 1987 | 63,017 | 2,079 | 20,970 | 74.3 |
| 1988 | 62,572 | 2,097 | 20,753 | 73.0 |
| 1989 | 58,919 | 2,109 | 20,768 | 77.3 |
| 1990 | 58,714 | 2,130 | 20,981 | 78.9 |
| 1991 | 60,377 | 2,167 | 21,090 | 80.6 |
| 1992 | 63,080 | 2,178 | 20,336 | 87.7[a] |
| 1993 | 64,850 | 2,210 | 20,247 | 86.3 |
| 1994 | 68,123 | 2,162 | 18,832 | 86.8 |
| 1995 | 67,107 | 2,184 | 18,818 | 87.4 |
| 1996 | 71,678 | 2,221 | 19,096 | 89.3 |
| 1997 | 72,770 | 2,245 | 19,604 | 93.0 |
| 1998 | 72,142 | 2,175 | 20,360 | 95.4 |
| 1999 | 74,228 | 2,276 | 21,205 | 97.8 |
| | | *Average annual percentage change* | | |
| 1984–99 | 0.7% | 1.4% | -0.1% | [a] |
| 1992–99 | 2.4% | 0.6% | 0.6% | 1.6% |

**Source:**
American Public Transit Association, *Public Transportation Fact Book*, Washington, DC, 2001, Tables 30, 42, 46, 65, and 66.

[a] Comparisons cannot be made with data before 1992. Beginning in 1992, data were available on non-diesel fuel consumption (i.e. propane, compressed natural gas, methanol).

*There are currently not many sources of data on intercity and school buses. The Eno Foundation for Transportation publishes petroleum use for intercity and school buses, and passenger-miles for intercity buses. The Federal Highway Administration publishes an estimate of the total number of school buses. School Bus Fleet magazine also contains statistics on school buses (www.schoolbusfleet.com/stats.cfm).*

**Table 8.13**
**Summary Statistics on Intercity and School Buses, 1970–99**

| Year | Intercity bus passenger-miles (billions) | Intercity bus energy use (trillion Btu) | Number of school buses | School bus energy use (trillion Btu) |
|---|---|---|---|---|
| 1970 | 25.3 | 42.4 | 288,700 | 41.18 |
| 1975 | 25.4 | 25.1 | 368,300 | 46.95 |
| 1980 | 27.4 | 29.7 | 418,255 | 52.14 |
| 1981 | 27.1 | 28.5 | 432,813 | 53.12 |
| 1982 | 26.9 | 31.5 | 442,133 | 54.74 |
| 1983 | 25.6 | 32.9 | 470,727 | 55.03 |
| 1984 | 24.6 | 23.5 | 471,461 | 51.51 |
| 1985 | 23.8 | 23.0 | 480,400 | 58.37 |
| 1986 | 23.7 | 20.6 | 479,076 | 63.50 |
| 1987 | 23.0 | 21.6 | 486,753 | 66.91 |
| 1988 | 23.1 | 22.3 | 498,907 | 70.19 |
| 1989 | 24.0 | 23.1 | 507,628 | 68.41 |
| 1990 | 23.0 | 22.1 | 508,261 | 64.83 |
| 1991 | 23.1 | 22.3 | 513,227 | 73.25 |
| 1992 | 22.6 | 21.8 | 525,838 | 74.98 |
| 1993 | 24.7 | 23.8 | 534,872 | 73.25 |
| 1994 | 28.1 | 27.1 | 547,718 | 74.98 |
| 1995 | 28.1 | 27.1 | 560,447 | 74.87 |
| 1996 | 28.8 | 27.7 | 569,395 | 74.87 |
| 1997 | 30.6 | 29.5 | 568,113 | 74.81 |
| 1998 | 31.7 | 30.5 | 582,470 | 75.56 |
| 1999 | 34.7 | 33.4 | 592,029 | 76.31 |
| | | *Average annual percentage change* | | |
| 1970–99 | 1.1% | -0.8% | 2.5% | 2.1% |
| 1989–99 | 3.8% | 3.8% | 1.5% | 1.1% |

**Source:**
Intercity bus data and school bus energy use - Eno Foundation for Transportation, *Transportation in America 2000*, Eighteenth edition, Washington, DC, pp. 15, 20–23. See Appendix A for Table 2.6 for detailed methodology on energy use conversion.
School buses - Federal Highway Administration, *Highway Statistics 1999*, Washington, DC, 2001, Table MV-10, and annual.

# Chapter 9
# Alternative Fuel and Advanced Technology Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

| Source | | |
|---|---|---|
| Table 9.1 | Alternative fuel vehicles, 2000 | 432,344 |
| | *LPG* | *268,000* |
| | *CNG* | *100,530* |
| | *LNG* | *1,900* |
| | *M85* | *18,365* |
| | *E85*[a] | *34,680* |
| | *Electric* | *8,661* |
| Table 9.4 | Number of alternative fuel refuel sites, 2000 | 5,205 |
| | *LPG* | *3,268* |
| | *CNG* | *1,217* |
| | *Electric* | *558* |
| Table 9.6 | U.S. sales of advanced technology vehicles (calendar year 2000) | |
| | *Honda Insight* | *3,788* |
| | *Toyota Prius* | *5,562* |

***Fuel type abbreviations are used throughout this chapter.***

| | | |
|---|---|---|
| *LPG* | = | *liquified petroleum gas* |
| *CNG* | = | *compressed natural gas* |
| *M-85* | = | *85% methanol, 15% gasoline* |
| *E-85* | = | *85% ethanol, 15% gasoline* |
| *M-100* | = | *100% methanol* |
| *E-95* | = | *95% ethanol, 5% gasoline* |
| *LNG* | = | *liquified natural gas* |

[a]Does not include flex-fuel vehicles.

## Alternative Fuels

The U.S. Department of Energy (DOE) defines alternative fuels as fuels which are substantially non-petroleum and yield energy security and environmental benefits. DOE currently recognizes the following as alternative fuels:

- methanol and denatured ethanol as alcohol fuels (alcohol mixtures that contain no less than 70% of the alcohol fuel),
- natural gas (compressed or liquefied),
- liquefied petroleum gas,
- hydrogen,
- coal-derived liquid fuels
- fuels derived from biological materials, and
- electricity (including solar energy).

DOE has established the Alternative Fuels Data Center (AFDC) in support of its work aimed at fulfilling the Alternative Motor Fuels Act (AMFA) directives. The AFDC is operated and managed by the National Renewable Energy Laboratory (NREL) in Golden, Colorado.

The purposes of the AFDC are:

- to gather and analyze information on the fuel consumption, emissions, operation, and durability of alternative fuel vehicles, and

- to provide unbiased, accurate information on alternative fuels and alternative fuel vehicles to government agencies, private industry, research institutions, and other interested organizations.

The data are collected for three specific vehicle types: (1) light vehicles, including automobiles, light trucks, and mini-vans; (2) heavy vehicles such as tractor-trailers and garbage trucks; and (3) urban transit buses. Much of the AFDC data can be obtained through their web site: **www.afdc.doe.gov**. Several tables and graphs in this chapter contain statistics which were generated by the AFDC.

DOE is sponsoring the **National Alternative Fuels Hotline** for Transportation Technologies in order to assist the general public and interested organizations in improving their understanding of alternative transportation fuels. The Hotline can be reached by dialing **1-800-423-1DOE,** or on the Internet at **www.afdc.doe.gov/hotline.html**.

*There are more LPG vehicles in use than any other alternative fuel vehicle. The population of E85 vehicles, however, has grown the most since 1992. For details on alternative fuel use by fuel type, see Table 2.3.*

**Table 9.1**
**Estimates of Alternative Fuel Vehicles in Use, 1992–2001**

| Fuel type | 1992 | 1995 | 1998 | 1999 | 2000[a] | 2001[a] | Average annual percentage change 1992–2001 |
|---|---|---|---|---|---|---|---|
| LPG | 221,000 | 259,000 | 266,000 | 267,000 | 268,000 | 269,000 | 2.2% |
| CNG | 23,191 | 50,218 | 78,782 | 89,556 | 100,530 | 109,730 | 18.9% |
| LNG | 90 | 603 | 1,172 | 1,681 | 1,900 | 2,039 | 41.4% |
| M85 | 4,850 | 18,319 | 19,648 | 18,964 | 18,365 | 16,918 | 14.9% |
| M100 | 404 | 386 | 200 | 198 | 195 | 184 | -8.4% |
| E85[b] | 172 | 1,527 | 12,788 | 22,464 | 34,680 | 48,022 | 87.0% |
| E95 | 38 | 136 | 14 | 14 | 13 | 13 | -11.2% |
| Electricity | 1,607 | 2,860 | 5,243 | 6,964 | 8,661 | 10,400 | 23.1% |
| **Total** | **251,352** | **333,049** | **383,847** | **406,841** | **432,344** | **456,306** | **6.9%** |

**Source:**
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels,1999*, Washington, DC, 2000, web site www.eia.doe.gov/cneaf/alternate/page/datatables/atf1-13_00.html.
(Additional resources: www.eia.doe.gov)

[a]Based on plans or projections.
[b]Does not include flex-fuel vehicles.

*Nearly 90% of private alternative fuel vehicles are fueled by LPG and CNG. The Federal Government does not own many LPG vehicles; its alternative fuel vehicle fleet is split almost 50/50 between CNG and E-85 vehicles in 2001.*

**Table 9.2**
**Estimates of Alternative Fuel Vehicles by Ownership, 1996 and 2001**

| | Private | | State and local government | | Federal Government | |
|---|---|---|---|---|---|---|
| Fuel type | 1996 | 2001[a] | 1996 | 2001[a] | 1996 | 2001[a] |
| LPG | 167,000 | 215,000 | 43,000 | 54,000 | 193 | 229 |
| CNG | 25,020 | 57,481 | 11,305 | 35,335 | 13,945 | 16,914 |
| LNG | 10 | 472 | 45 | 1,514 | 72 | 53 |
| M-85 | 6,633 | 8,898 | 5,958 | 7,848 | 7,668 | 172 |
| M-100 | 0 | 0 | 0 | 184 | 0 | 0 |
| E-85 | 793 | 18,697 | 1,995 | 12,471 | 1,748 | 16,854 |
| E-95 | 0 | 0 | 0 | 13 | 0 | 0 |
| Electricity | 2,451 | 4,643 | 487 | 4,977 | 188 | 780 |
| **Total** | **201,907** | **305,191** | **62,790** | **116,342** | **23,814** | **35,002** |

**Source:**
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 1999*, Washington, DC, 2000, web site www.eia.doe.gov/cneaf/alternate/page/datatables/atf1-13_00.html.
(Additional resources: www.eia.doe.gov)

[a]Based on plans or projections.

**Table 9.3**
**Alternative Fuel Vehicles Available by Manufacturer, Model Year 2001**

| Model | Fuel | Type | Emission class |
|---|---|---|---|
| **Daimler Chrysler: 1-800-999-FLEET** | | | |
| Minivan | E-85 flex fuel | Minivan | LEV |
| Ram Wagon | CNG dedicated | Large van | ULEV/ILEV/SULEV |
| Ram Van | CNG dedicated | Large van | ULEV/ILEV/SULEV |
| **Ford: 1-877-ALT-FUEL** | | | |
| Ranger | Electric-lead acid | Standard pickup | ZEV |
| Explorer Sport | E-85 flex-fuel | Sport utility vehicle | N/A |
| Crown Victoria | CNG dedicated | Large car | ULEV |
| Econoline | CNG dedicated | Full-size van | ULEV/ILEV/SULEV |
| F-Series | CNG dedicated or CNG/LPG bi-fuel | Standard pickup | LEV/ULEV/ILEV/ SULEV |
| E-Series Cutaway | CNG dedicated | Passenger van | ULEV |
| Taurus | E-85 flex-fuel | Large car | LEV |
| **General Motors: 1-800-25Electric, 313-556-7723 or 1-888-GM-AFT-4U (CNG)** | | | |
| EV1 (CA and AZ only) | Electric-lead acid or NiMH | Two-seater | ZEV |
| Chevrolet S-10 | Electric-lead acid or NiMH | Small pickup | ILEV/ZEV |
| Chevrolet S-10 | E85 flex-fuel | Small pickup | LEV |
| Chevrolet Cavalier | CNG bi-fuel | Subcompact | LEV |
| **Honda: 1-888-CCHonda** | | | |
| Insight[a] | Hybrid EV-NiMH | Two-seater | LEV/ULEV |
| Civic GX (CA, NY fleets only) | CNG dedicated | Subcompact | ILEV/ULEV/SULEV |
| **Mazda: 1-800-222-5500** | | | |
| B3000 | E85 flex fuel | Standard pickup | LEV |
| **Nissan: 1-310-771-3422** | | | |
| Altra EV (CA fleets only) | Electric lithium-ion | Mid-size wagon | ZEV |
| Hypermini | Electric-lithium ion | Two-seater | ZEV |
| **Solectria Corporation: 1-508-658-2231** | | | |
| Civitan | Electric-lead acid | Service van | ZEV |
| Flash | Electric-lead acid | Small pickup truck | ZEV |
| Force | Electric-lead acid, NiMH, NiCd | Compact | ZEV |
| **Toyota: 1-800-331-4331 (Press 3 for Alternative Fuel Information) (Fleet sales only)** | | | |
| RAV4-EV (fleets only) | Electric-lead acid, NiMH | Sport utility vehicle | ZEV |
| Camry (fleets only) | CNG dedicated | Compact | ULEV |
| Prius[a] | Hybrid EV | Compact | SULEV |

**Source:**
U.S. Department of Energy, National Alternative Fuels Data Center, web site, www.afdc.doe.gov/afvehicles.htm, January 2001. (Additional resources: www.afdc.nrel.gov)

**Note:**
LEV=low emission vehicle. ILEV=inherently low emission vehicle. ULEV=ultra low emission vehicle. ZEV=zero emission vehicle. TLEV=transitional low emission vehicle. SULEV=super ultra low emission vehicle.

[a]The Honda Insight and the Toyota Prius are considered advanced technology vehicles, not alternative fuel vehicles.

*This list includes public and private refuel sites; therefore, not all of these sites are available to the public.*

**Table 9.4**
**Number of Alternative Refuel Sites by State and Fuel Type, 2000**

| State | M85 sites | CNG sites | E85 sites | LPG sites | LNG sites | Electric sites | Biodiesel sites | Total |
|---|---|---|---|---|---|---|---|---|
| Alabama | 0 | 15 | 0 | 75 | 2 | 35 | 0 | 127 |
| Alaska | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 9 |
| Arizona | 0 | 28 | 1 | 105 | 3 | 52 | 1 | 190 |
| Arkansas | 0 | 7 | 0 | 68 | 0 | 0 | 0 | 75 |
| California | 3 | 207 | 0 | 342 | 9 | 335 | 0 | 896 |
| Colorado | 0 | 44 | 1 | 68 | 1 | 0 | 0 | 114 |
| Connecticut | 0 | 25 | 0 | 33 | 0 | 1 | 0 | 59 |
| Delaware | 0 | 6 | 0 | 4 | 0 | 0 | 0 | 10 |
| District of Columbia | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 4 |
| Florida | 0 | 39 | 0 | 149 | 1 | 3 | 0 | 192 |
| Georgia | 0 | 67 | 0 | 55 | 2 | 73 | 0 | 197 |
| Hawaii | 0 | 0 | 0 | 7 | 0 | 3 | 1 | 11 |
| Idaho | 0 | 8 | 1 | 34 | 0 | 1 | 0 | 44 |
| Illinois | 0 | 21 | 13 | 56 | 0 | 2 | 0 | 92 |
| Indiana | 0 | 34 | 2 | 45 | 3 | 1 | 0 | 85 |
| Iowa | 0 | 5 | 8 | 40 | 0 | 0 | 0 | 53 |
| Kansas | 0 | 5 | 1 | 68 | 1 | 0 | 0 | 75 |
| Kentucky | 0 | 6 | 1 | 25 | 0 | 0 | 0 | 32 |
| Louisiana | 0 | 14 | 0 | 33 | 0 | 0 | 0 | 47 |
| Maine | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 20 |
| Maryland | 0 | 25 | 0 | 29 | 2 | 1 | 0 | 57 |
| Massachusetts | 0 | 15 | 0 | 37 | 0 | 3 | 0 | 55 |
| Michigan | 0 | 31 | 6 | 132 | 1 | 6 | 0 | 176 |
| Minnesota | 0 | 12 | 54 | 61 | 1 | 0 | 0 | 128 |
| Mississippi | 0 | 3 | 0 | 32 | 0 | 0 | 0 | 35 |
| Missouri | 0 | 7 | 5 | 130 | 0 | 0 | 0 | 142 |
| Montana | 0 | 10 | 1 | 42 | 1 | 0 | 0 | 54 |
| Nebraska | 0 | 5 | 7 | 29 | 0 | 0 | 0 | 41 |
| Nevada | 0 | 18 | 0 | 32 | 0 | 0 | 0 | 50 |
| New Hampshire | 0 | 1 | 0 | 29 | 0 | 1 | 0 | 31 |
| New Jersey | 0 | 22 | 0 | 28 | 0 | 0 | 0 | 50 |
| New Mexico | 0 | 14 | 1 | 88 | 1 | 0 | 0 | 104 |
| New York | 0 | 59 | 0 | 98 | 0 | 6 | 0 | 163 |
| N. Carolina | 0 | 9 | 0 | 77 | 0 | 8 | 0 | 94 |
| N. Dakota | 0 | 4 | 2 | 14 | 0 | 0 | 0 | 20 |
| Ohio | 0 | 47 | 0 | 75 | 1 | 1 | 0 | 124 |
| Oklahoma | 0 | 53 | 0 | 39 | 0 | 0 | 0 | 92 |
| Oregon | 0 | 14 | 0 | 50 | 1 | 0 | 0 | 65 |
| Pennsylvania | 0 | 53 | 0 | 106 | 1 | 1 | 0 | 161 |
| Rhode Island | 0 | 6 | 0 | 7 | 0 | 0 | 0 | 13 |
| S. Carolina | 0 | 4 | 0 | 60 | 0 | 1 | 0 | 65 |
| S. Dakota | 0 | 4 | 7 | 26 | 0 | 0 | 0 | 37 |
| Tennessee | 0 | 4 | 0 | 59 | 0 | 0 | 0 | 63 |
| Texas | 0 | 69 | 0 | 442 | 7 | 2 | 0 | 520 |
| Utah | 0 | 62 | 0 | 18 | 1 | 0 | 0 | 81 |
| Vermont | 0 | 0 | 0 | 17 | 0 | 7 | 0 | 24 |
| Virginia | 0 | 27 | 1 | 63 | 3 | 8 | 0 | 102 |
| Washington | 0 | 26 | 0 | 88 | 1 | 6 | 0 | 121 |
| W. Virginia | 0 | 39 | 0 | 10 | 0 | 0 | 0 | 49 |
| Wisconsin | 0 | 22 | 1 | 82 | 0 | 0 | 0 | 105 |
| Wyoming | 0 | 18 | 0 | 32 | 1 | 0 | 0 | 51 |
| **Total** | **3** | **1,217** | **113** | **3,268** | **44** | **558** | **2** | **5,205** |

**Source:**
U.S. Department of Energy, Alternative Fuels Data Center web site, www.afdc.doe.gov/refuel/state_tot.shtml, March 2001.

*Clean Cities is a locally-based government/industry partnership, coordinated by the U.S. Department of Energy to expand the use of alternatives to gasoline and diesel fuel. By combining the decision-making with voluntary action by partners, the "grass-roots" approach of Clean Cities departs from traditional "top-down" Federal programs. It establishes a plan, carried out at the local level, for creating a sustainable, nationwide alternative fuels market.*

**Table 9.5**
**List of Clean Cities as of August 2001 by Designation**

1. Atlanta, GA - 9/8/93
2. Denver, CO - 9/13/93
3. Philadelphia, PA - 9/22/93
4. State of Delaware - 10/12/93
5. Las Vegas, NV - 10/18/93
6. Washington, DC - 10/21/93
7. Boston, MA - 3/18/94
8. Austin, TX - 4/18/94
9. Florida Gold Coast - 5/3/94
10. Chicago, IL - 5/13/94
11. Land of Enchantment, NM - 6/1/94
12. Wisconsin - SE Area - 6/30/94
13. Colorado Springs, CO - 7/13/94
14. Long Beach, CA - 8/31/94
15. Lancaster, CA - 9/22/94
16. Salt Lake City, UT - 10/3/94
17. White Plains, NY - 10/4/94
18. Baltimore, MD - 10/7/94
19. Commonwealth CC Partnership, KY - 10/18/94
20. Rogue Valley, OR - 11/10/94
21. State of WV - 10/18/94
22. Sacramento, CA - 10/21/94
23. East Bay, CA - 10/21/94
24. San Joaquin Valley, CA - 10/21/94
25. San Francisco, CA - 10/21/94
26. South Bay (San Jose), CA - 10/21/94
27. Western New York - 11/4/94
28. Columbia-Willamette, OR - 11/10/94
29. St. Louis, MO - 11/18/94
30. Connecticut SW Area, - 11/21/94
31. Waterbury, CT - 11/21/94
32. Norwich, CT - 11/22/94
33. New London, CT - 11/22/94
34. Peoria, IL - 11/22/94
35. Kansas - SW Area - 3/30/95
36. Central New York - 6/15/95
37. Dallas/Ft. Worth, TX - 7/25/95
38. Honolulu, HI - 8/29/95
39. Missoula, MT - 9/21/95
40. New Haven, CT - 10/5/95
41. Central Arkansas - 10/25/95
42. Paso Del Norte, TX - 11/17/95
43. Pittsburgh, PA - 12/5/95
44. S. California Assn. Gov. - 3/1/96
45. Los Angeles, CA - 3/22/96
46. Coachella Valley, CA - 4/22/96
47. Weld/Larimer/Rocky Mountain National Park - 5/21/96
48. Central Oklahoma - 5/29/96
49. Hampton Roads, VA -10/4/96
50. San Diego, CA 12/12/96
51. Long Island, NY -10/18/96
52. Detroit, MI/Toronto, ON -12/18/96
53. Cincinnati, OH - 1/29/97
54. Evansville, IN - 1/30/97
55. Houston-Galveston, TX - 9/4/97
56. Portland, ME - 9/4/97
57. Tulsa, OK - 9/22/97
58. Maricopa Assn. of Govts. - 10/8/97
59. NW Riverside County, CA - 10/24/97
60. North Jersey, NJ - 10/31/97
61. Texas Coastal (Corpus Christi), TX - 3/30/98
62. Genesee Region (Rochester), NY - 5/28/98
63. Red River Valley/Grand Forks, ND - 8/10/98
64. Puget Sound, WA - 8/13/98
65. RI - Ocean States - 9/14/98
66. Omaha, NE - 9/18/98
67. Kansas City, KS/MO - 11/18/98
68. Central Indiana CC Alliance, IN - 3/4/99
69. Ann Arbor, MI - 4/19/99
70. Capital District (Albany), NY - 4/26/99
71. South Shore, IN - 6/15/99
72. Capital Clean Cities of CT - 6/21/99
73. Tuscon, AZ - 8/24/99
74. NE Clean Fuels Coalition (Cleveland) - 9/14/99
75. Florida Space Coast - 10/1/99
76. Manhattan Area, KS - 10/4//99
77. The Alamo Area (San Antonio) - 11/10/99
78. Baton Rouge, LA - 4/12/00
79. Truckee Meadows - 6/28/00
80. Raleigh, Durham, Chapel Hill, NC - 3/19/01
81. Twin Cities, MN - 5/31/01
82. State of Vermont - 6/25/01

**For more information, contact the Clean Cities Hotline at (800) CCITIES, or write to: U.S. Department of Energy, EE-33, Clean Cities Program, 1000 Independence Avenue SW, Washington, DC 20585.**

**Source:**

U.S. Department of Energy, Alternative Fuel Information, *Clean Cities: Guide to Alternative Fuel Vehicle Incentives & Laws*, Washington, DC, November 1996, and updates from web site, August 2001. (Additional resources: www.ccities.doe.gov)

*The Honda Insight and Toyota Prius are the two advanced technology vehicles which are currently available to the public in the U.S. They are both hybrid vehicles, using both electricity (from batteries) and mechanical power (from a small internal combustion engine). Learn more about DOE's hybrid vehicle program at: www.ott.doe.gov/hev.*

**Table 9.6**
**Sales and Specifications of Available Advanced Technology Vehicles**

| | Honda Insight[a] | Toyota Prius |
|---|---|---|
| Fuel economy (city/hwy) | 61/68 mpg | 52/45 mpg |
| Fuel tank capacity | 10.6 gal. | 11.8 gal. |
| Acceleration (0-60 mph) | 12.0 sec. | 12.69 sec. |
| Emissions | ULEV/LEV | SULEV |
| Aerodynamics | 0.25 Cd | 0.29 Cd |
| Curb weight | 1,856 lbs. | 2,765 lbs. |
| Passenger capacity | 2 | 5 |
| Dimensions: | | |
| Length | 155.1 in. | 169.6 in. |
| Width | 66.7 in. | 66.7 in. |
| Cargo Capacity | 16.3 $ft^3$ | 11.8 $ft^3$ |
| Price | $18,980 | $20,450 |
| | **Calendar year sales in the U.S.** | |
| 1999 | 17 | 0 |
| 2000 | 3,788 | 5,562 |
| 2001 (January - July) | 3,296 | 8,443 |
| Total as of July 31, 2001 | 7,101 | 14,005 |

**Source:**
Manufacturer's web sites: www.honda2001.com/models/insight and prius.toyota.com. Sales data - Ward's Communications, Inc., *Wards Automotive Reports*, Southfield, MI, 2001.

[a]Specifications are for the base model. The Insight is also available with continuously variable transmission.

*Hybrid-electric vehicles were chosen by DaimlerChrysler, Ford and General Motors in their efforts to develop environmentally friendly cars with up to triple the fuel efficiency of today's midsize cars--without sacrificing affordability, performance, or safety. The manufacturers are hoping to significantly improve national competitiveness in automotive manufacturing and to apply commercially viable innovation to conventional vehicles with these vehicles, which are currently only at the concept stage.*

**Table 9. 7**
**Comparative Specifications of Concept Hybrid-Electric Vehicles**

| Parameter | Dodge ESX3 | Ford Prodigy | GM Precept |
|---|---|---|---|
| Fuel economy | 72 mpg gas equiv.<br>80 mpg diesel[a] | 72 mpg gas equiv.<br>80 mpg diesel[a] | 80 mpg gas equiv.<br>90 mpg diesel[a] |
| Range | 400 miles | 660 miles | 380 miles |
| Acceleration (0–60 mph) | 11.0 seconds | 12.0 seconds | 11.5 seconds |
| Emissions | Target is Tier 2 | Target is Tier 2 | Target is Tier 2 |
| Areodynamics | 0.22 Cd | 0.199 Cd | 0.163 Cd |
| Curb weight | 2,250 lbs. | 2,387 lbs. | 2,592 lbs. |
| Passenger capacity | 5 | 5 | 5 |
| Dimensions: Length<br>Width | 192.8 in.<br>74.2 in. | 186.9 in.<br>69.1 in. | 193.2 in.<br>67.9 in. |
| Cargo Capacity | 16.0 $ft^3$ | 14.6 $ft^3$ | 4.4 $ft^3$ |
| Safety | Meet FMVSS[b] | Meet FMVSS[b] | Meet FMVSS[b] |

**Source:**
Media Information, 2000.

[a]Fuel economy for Dodge using "Designer" diesel (0 ppm sulfur); Ford using Swedish clean diesel (<10 ppm sulfur); GM using California low-sulfur diesel (<30 ppm sulfur).

**The U.S. Advanced Battery Consortium (USABC)**

Electric and hybrid-electric vehicles are required to be sold in California under the California Low-Emission Vehicle (LEV) program. Other states, such as New York, Texas, and Massachusetts, have indicated that they will also enforce the LEV program. The USABC was established in 1991 to concentrate efforts on battery development for future electric vehicles. The USABC consists of the Big Three U.S. auto manufacturers (Daimler-Chrysler, Ford, General Motors), the Electric Power Research Institute, and the U.S. Department of Energy.

A cooperative agreement between USABC and DOE was signed in September 1991 to develop advanced electric vehicle batteries. Under this agreement, Phase 1 of the USABC Electric Vehicle Battery Program ran from 1991 through 1996. A follow-on Phase 2 effort (1996–2000) was undertaken by a second cooperative agreement signed in August 1996 to continue the development of advanced electric vehicle batteries. An additional Phase 3 effort (2000–2004) is being undertaken by a third cooperative agreement signed in January 2000 to continue development of advanced lithium-based batteries. Similar to these three cooperative agreements between USABC and DOE to develop advanced batteries for electric vehicles, a fourth cooperative agreement (1995–2002) was entered into during September 1995 between USABC and DOE to develop high-power battery storage devices for hybrid vehicles.

*Since its inception, the DOE-USABC Cooperative Program has worked to promote the convergence of advanced battery technologies and focus R&D resources on the most promising battery candidates for EV applications. Nickel-metal hydride batteries, developed by the USABC from 1992 through 1998, are being utilized in current-model EVs. USABC continues to work on lithium-based batteries with goals as shown below.*

**Table 9.8**
**U.S. Advanced Battery Consortium Goals for Electric Vehicle Batteries**

| Primary criteria | Long-term goals[a] (beyond 2002) |
|---|---|
| Power density[b] W/L | 460 |
| Specific power[b] W/kg [80% depth of discharge (DOD)/30 sec] | 300 |
| Energy density[b] Wh/L (C/3 discharge rate) | 230 |
| Specific energy[b] Wh/kg (C/3 discharge rate) | 150 |
| Life (years) | 10 |
| Cycle life[b] (cycles) (80% DOD) | 1000<br>1600 (@ 50% DOD)<br>2670 (@ 30% DOD) |
| Power and capacity degradation[b] (% of rated spec) | 20% |
| Ultimate price[c] ($/kWh) (10,000 units @ 40 kWh) | <$150 (desired to 75) |
| Operating environment | –30 to 65°C |
| Recharge time[b] | < 6 hours |
| Continuous discharge in 1 hour (no failure) | 75% (of rated energy capacity) |
| **Secondary criteria** | **Long-term goals (2002)** |
| Efficiency[b] (C/3 discharge and C/6 charge)[d] | 80% |
| Self-discharge[b] | < 20% in 12 days |
| Maintenance | No maintenance. Service by qualified personnel only. |
| Thermal loss[b] | Covered by self-discharge |
| Abuse resistance[b] | Tolerant<br>Minimized by on-board controls |

**Source:**
U.S. Department of Energy, Office of Transportation Technologies, Washington, DC, March 2001.

[a]For interim commercialization (reflects USABC revisions of September 1996).
[b]Specifics on criteria can be found in *USABC Electric Vehicle Battery Test Procedures Manual, Rev. 2*, DOE/ID-10479, January 1996.
[c]Cost to the original equipment manufacturers.
[d]Roundtrip charge/discharge efficiency.

*The purpose of the Vehicle High-Power Energy Storage Program is to develop a low-cost, high-power energy storage device that meets or exceeds the energy storage requirements for the power-assist and the dual-mode hybrid vehicles by 2008, as shown in this table. Advanced high-power batteries were selected as the technology that has the potential to meet or exceed these requirements.*

**Table 9.9**
**Energy Storage Requirements for Hybrid Vehicles**

| Characteristics | Units | Power-assist hybrid | Dual-mode hybrid |
|---|---|---|---|
| Pulse discharge power[a] [at minimum operating state of change (SOC)] | kW | 25 (constant for 18-sec pulse) | 45 (constant for 12-sec pulse) |
| Peak regenerative pulse power[a] (2-second pulse at maximum operating SOC) | kW | 30 (50-Wh pulse) | 35 (97-Wh pulse) |
| Total available energy[a] (within operating SOC range) | kWh | 0.3 (at C/1 rate) | 1.5 (at 6-kW continuous power) |
| Minimum round-trip efficiency[a] on reference cycle | % | >90 | >88 |
| Cycle life,[a] for specified SOC increments: | cycles | 300K power-assist cycles[a] (7.5 MWh) | 3,750 dual-mode cycles[a] (22.5 MWh) |
| Cold-cranking power[a] at –30°C (three 2-sec pulses, 10-sec rest between pulses) | kW | 5 | 5 |
| Calendar life | year | 15 | 15 |
| Maximum weight | kg | 40 | 100 |
| Maximum volume | l | 32 | 75 |
| Production cost,[b] at 100,000 units per year | $ | 300 | 500 |
| Maximum operating voltage | Vdc | ≤440 | ≤440 |
| Minimum operating voltage | Vdc | $\geq 0.55 \times V_{max}$ | $\geq 0.5 \times V_{max}$ |
| Maximum dc current | A | ≤217 | ≤217 |
| Maximum allowable self-discharge rate[a] | Wh/day | 50 | 50 |
| Temperature range: | °C | | |
| Equipment operation | | –40 to +52 | –40 to +52 |
| Equipment survival | | –46 to +66 | –46 to +66 |

**Source:**
U.S. Department of Energy, Office of Transportation Technologies, Washington, DC, March 2001.

[a]Specifics on characteristics and cycle life protocols can be found in *PNGV Battery Test Manual Rev.* 3, DOE/ID-10597, November 2000.
[b]Selling price to the vehicle manufacturers.
*Note:* The energy storage subsystem is recharged only by the on-board prime power source and regenerative power from braking. Nominal SOC must permit discharge or regenerative recharge without degradation in the performance of the energy storage subsystem. Power and energy values are as delivered/received at the dc terminals of the subsystem. Discharge pulse energy and power requirements are sufficient for the vehicle to reach top speed in 18 sec for the power-assist hybrid and 12 sec for the dual-mode hybrid.

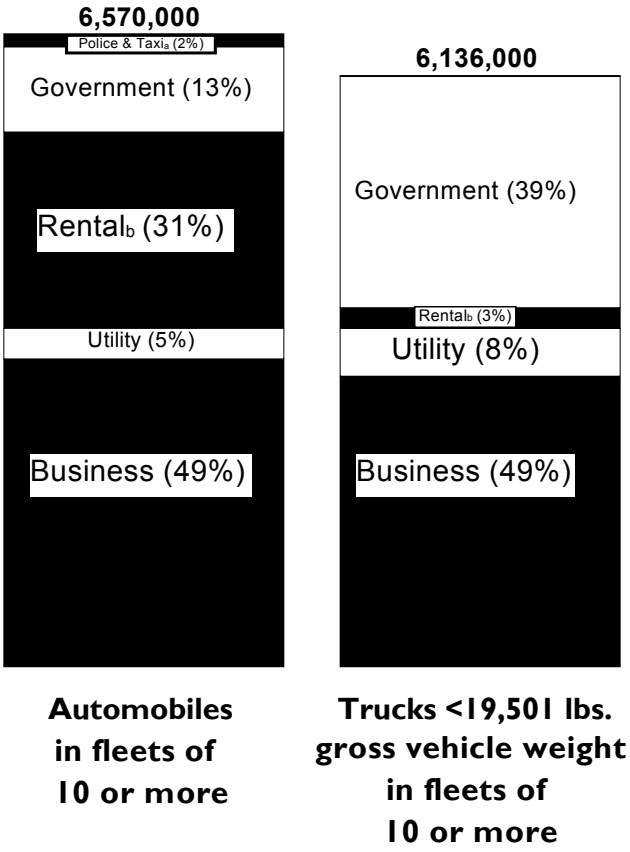
# Chapter 10
# Fleet Vehicles and Characteristics

Summary Statistics from Tables/Figures in this Chapter

| Source | | |
|---|---|---|
| Figure 10.1 | Fleet automobiles, 2000 | 6,570,000 |
| Figure 10.1 | Fleet trucks ≤ 19,500 lbs. GVW, 2000 | 6,136,000 |
| Table 10.3 | Average annual miles per automobile | |
| | *Business fleets* | *29,200* |
| | *Utility fleets* | *14,500* |
| | *Government fleets* | *13,700* |
| Table 10.3 | Average annual miles per light truck (<8,500 lbs. GVW) | |
| | *Business fleets* | *26,600* |
| | *Utility fleets* | *17,500* |
| | *Government fleets* | *13,900* |
| Table 10.4 | Federal government vehicles, FY 1998 | 547,534 |
| | *Automobiles* | *111,990* |
| | *Buses* | *6,051* |
| | *Light trucks (<8,500 lbs. GVW)* | *357,592* |
| | *Medium trucks (8,500–26,000 lbs. GVW)* | *54,033* |
| | *Heavy trucks (>26,000 lbs. GVW)* | *17,898* |

*Significant changes have been made in recent years to fleet vehicle estimations. Newly available data improve the accuracy of fleet vehicle estimates but, at the same time, make it impossible to compare the data historically. Therefore, only the 2000 data are presented here.*

**Figure 10.1. Fleet Vehicles in Service as of February 1, 2000**




**Source:**
Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2001*, Redondo Beach, CA, 2001. (Additional resources: www.fleet-central.com)

[a]Taxi category includes vans.
[b]Rental category includes vans and sports utility vehicles under **automobiles**, not trucks.

*These fleet data, which were generated from a 1991–92 ORNL study, are still the latest available data of this kind.*

**Table 10 .1**
**Fleet Vehicle Composition by Vehicle Type, 1991**
**(percent)**

| | Business | Utility | Government |
|---|---|---|---|
| Cars | 24.2% | 22.6% | 48.5% |
| Light trucks[a] and vans | 21.1% | 39.0% | 42.8% |
| Medium trucks[b] | 45.8% | 15.0% | 6.8% |
| Heavy trucks[c] | 8.9% | 23.4% | 1.8% |
| Total | 100.0% | 100.0% | 100.0% |

**Table 10.2**
**Average Length of Time Fleet Vehicles are Kept Before Sold to Others, 1991**
**(months)**

| | Business | Utility | Government |
|---|---|---|---|
| Cars | 35 | 68 | 81 |
| Light trucks[a] | 56 | 60 | 82 |
| Medium trucks[b] | 83 | 86 | 96 |
| Heavy trucks[c] | 103 | 132 | 117 |

**Table 10.3**
**Average Annual and Daily Vehicle-Miles of Travel for Fleet Vehicles, 1991**

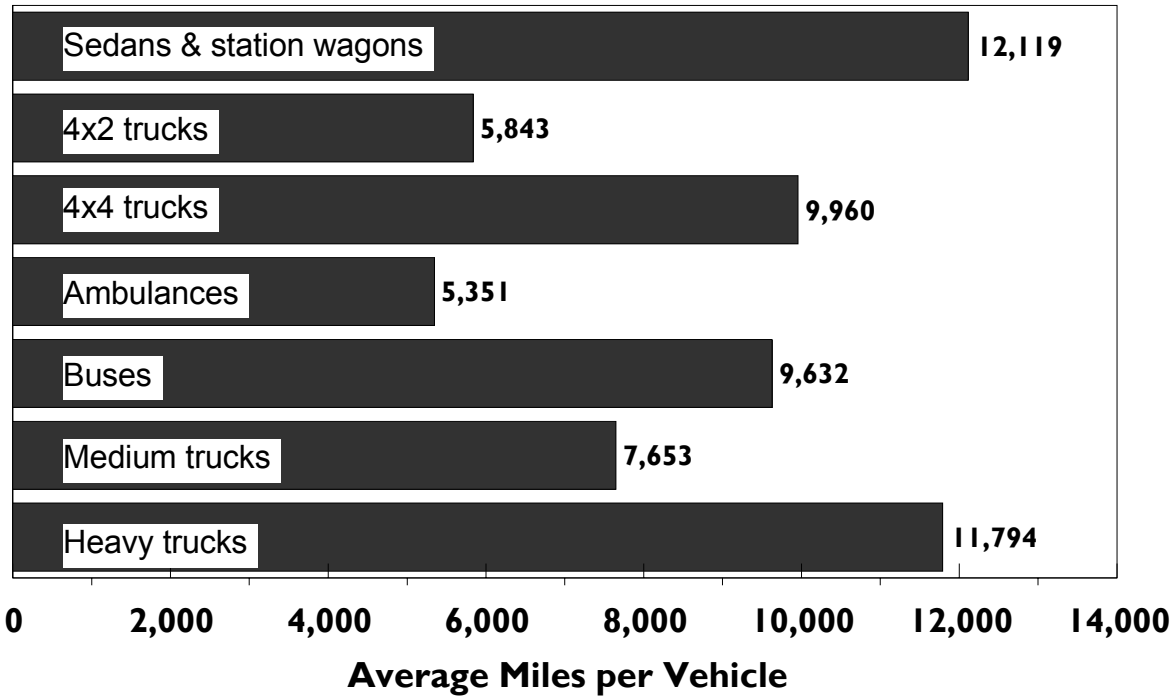
| | Business | | Utility | | Government | |
|---|---|---|---|---|---|---|
| Vehicle type | Miles/year (thousands) | Miles/day @250 days/year | Miles/year (thousands) | Miles/day @250 days/year | Miles/year (thousands) | Miles/day @250 days/year |
| Cars | 29.2 | 117 | 14.5 | 58 | 13.7 | 55 |
| Light trucks[a] | 26.6 | 106 | 17.5 | 70 | 13.9 | 56 |
| Medium trucks[b] | 17.5 | 70 | 11.8 | 47 | 11.9 | 48 |
| Heavy trucks[c] | 64.4 | 258 | 13.8 | 55 | 10.7 | 43 |

**Source:**
Miaou, S. P., et. al., *Fleet Vehicles in the United States: Composition, Operating Characteristics, and Fueling Practices,* (ORNL-6717), Oak Ridge National Laboratory, Oak Ridge, TN, May 1992. (Additional resources: www-cta.ornl.gov)

[a]In this study, light trucks are <8,500 lbs gross vehicle weight.
[b]In this study, medium trucks are between 8,500–26,000 lbs gross vehicle weight.
[c]In this study, heavy trucks are >26,000 lbs gross vehicle weight.

*These data, which apply to domestic Federal fleet vehicles, indicate that sedans and station wagons have the highest average annual miles per vehicle, followed closely by heavy trucks. There is a 4000-mile difference in the average for 4x2 light trucks as opposed to 4x4 light trucks.*

**Figure 10.2. Average Miles per Domestic Federal Vehicle by Vehicle Type, 1998**




**Source:**
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 1998 Federal Fleet Report*, Washington, DC, 2000, Table 5.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

**Table 10.4**
**Federal Government Vehicles by Agency, Fiscal Year 1998[a]**

| Department or Agency | Autos | Buses | Light trucks[b] | Medium trucks[c] | Heavy trucks[d] | Total |
|---|---|---|---|---|---|---|
| Appalachian Regional Commission | 1 | 0 | 0 | 0 | 0 | 1 |
| Commodity Futures Trading Commission | 1 | 0 | 1 | 0 | 0 | 2 |
| Consumer Product Safety Commission | 1 | 0 | 1 | 0 | 0 | 2 |
| Department of Agriculture | 3,211 | 41 | 24,433 | 5,235 | 614 | 33,534 |
| Department of Commerce | 162 | 2 | 419 | 216 | 14 | 813 |
| Department of Education | 1 | 0 | 2 | 0 | 0 | 3 |
| Department of Energy | 761 | 156 | 3,496 | 832 | 492 | 5,737 |
| Department of Health & Human Services | 83 | 7 | 366 | 115 | 108 | 679 |
| Department of Housing & Urban Development | 3 | 0 | 1 | 0 | 0 | 4 |
| Department of Justice | 21,170 | 360 | 13,823 | 1,056 | 273 | 36,682 |
| Department of Labor | 27 | 1 | 144 | 15 | 3 | 190 |
| Department of State | 103 | 0 | 84 | 0 | 11 | 198 |
| Department of Interior | 1,324 | 73 | 9,513 | 3,535 | 1,766 | 16,211 |
| Department of Treasury | 11,205 | 15 | 4,393 | 249 | 89 | 15,951 |
| Department of Transportation | 50 | 18 | 362 | 120 | 76 | 626 |
| Department of Veterans Affairs | 257 | 86 | 1,310 | 218 | 93 | 1,964 |
| Environmental Protection Agency | 16 | 2 | 156 | 64 | 7 | 245 |
| Equal Employment Opportunity Commission | 1 | 0 | 0 | 0 | 0 | 1 |
| Executive Office of the President | 53 | 0 | 2 | 16 | 0 | 71 |
| Federal Communications Commission | 60 | 0 | 64 | 1 | 0 | 125 |
| Federal Election Commission | 0 | 0 | 1 | 0 | 0 | 1 |
| Federal Emergency Management Agency | 27 | 6 | 135 | 3 | 24 | 195 |
| Federal Mediation and Conciliation Service | 1 | 0 | 0 | 0 | 0 | 1 |
| General Services Administration[e] | 55,227 | 3,100 | 68,566 | 28,824 | 3,743 | 159,460 |
| Government Printing Office | 7 | 0 | 49 | 0 | 0 | 56 |
| International Boundary & Water Commission | 3 | 0 | 19 | 5 | 35 | 62 |
| Library of Congress | 1 | 0 | 0 | 0 | 0 | 1 |
| National Aeronautics & Space Administration | 96 | 9 | 394 | 196 | 54 | 749 |
| National Gallery of the Arts | 1 | 0 | 0 | 0 | 2 | 3 |
| National Labor Relations Board | 1 | 0 | 0 | 0 | 0 | 1 |
| National Science Foundation | 1 | 7 | 33 | 7 | 20 | 68 |
| Nuclear Regulatory Commission | 6 | 0 | 0 | 0 | 0 | 6 |
| Office of Personnel Management | 4 | 0 | 0 | 0 | 0 | 4 |
| Securities and Exchange Commission | 1 | 0 | 1 | 0 | 0 | 2 |
| Small Business Administration | 108 | 0 | 0 | 0 | 0 | 108 |
| Smithsonian Institution | 14 | 3 | 149 | 0 | 13 | 179 |
| Social Security Administration | 2 | 0 | 1 | 0 | 1 | 4 |
| Tennessee Valley Authority | 647 | 0 | 1,053 | 931 | 279 | 2,910 |
| United States Information Agency | 6 | 0 | 16 | 3 | 2 | 27 |
| United States International Trade Commission | 1 | 0 | 0 | 0 | 0 | 1 |
| U.S. Soldiers' & Airmen Retirement Home | 3 | 2 | 1 | 4 | 2 | 12 |
| **CIVILIAN AGENCIES** | **94,647** | **3,888** | **128,988** | **41,645** | **7,721** | **276,889** |
| **U.S. POSTAL SERVICE** | **9,396** | **5** | **178,725** | **8,779** | **4,774** | **201,679** |
| Department of the Navy | 3,049 | 629 | 20,516 | 974 | 2,090 | 27,258 |
| Department of the Army | 87 | 44 | 2,053 | 623 | 302 | 3,109 |
| Department of the Air Force | 2,490 | 1,184 | 23,027 | 1,004 | 2,304 | 30,009 |
| Defense Agencies | 1,975 | 13 | 691 | 114 | 145 | 2,938 |
| Corps of Engineers | 81 | 2 | 1,358 | 379 | 210 | 2,030 |
| U.S. Marine Corps | 265 | 286 | 2,234 | 515 | 322 | 3,622 |
| **MILITARY AGENCIES** | **7,947** | **2,158** | **49,879** | **3,609** | **5,373** | **68,966** |
| **TOTAL** | **111,990** | **6,051** | **357,592** | **54,033** | **17,868** | **547,534** |

**Source:**
U.S. General Services Administration, Federal Supply Service, *FY 1998 Federal Fleet Report*, Washington, DC, 2000, Table 14. (Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

[a] Federally-owned and commercially-leased domestic vehicles.
[b] Less than 8,500 lbs GVWR. Includes ambulances.
[c] 8,501–23,999 lbs GVWR.
[d] 24,000 lbs. or more GVWR.
[e] GSA Fleet vehicles. Some of these are foreign-based; most are leased by other Federal agencies.

**Table 10.5**
**Federal Fleet Vehicle Acquisitions**
**by Fuel Type, FY 1997–98[a]**

| | FY97 | FY98 |
|---|---|---|
| Gasoline | 14,097 | 48,338 |
| Diesel | 489 | 2,503 |
| Natural gas | 172 | 1,139 |
| Ethanol/E-85 | 160 | 3,015 |
| Electricity | 139 | 36 |
| Other | 12 | 0 |
| Methanol/M-85 | 9 | 104 |
| LPG | 1 | 91 |
| Biodiesel | 0 | 0 |
| Hydrogen | 0 | 0 |
| Total | 15,079[a] | 55,226 |

**Source:**
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 1998 Federal Fleet Report*, Washington, DC, 2000, Table 18.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

**Table 10.6**
**Fuel Consumed by Federal Government Fleets, FY 1997–98[a]**
**(thousand gasoline equivalent gallons)**

| | FY97 | FY98 |
|---|---|---|
| Gasoline | 280,051 | 261,541 |
| Diesel | 64,834 | 58,272 |
| NG | 4,076 | 5,671 |
| Electricity | 287 | 83 |
| Biodiesel | 186 | 11 |
| Methanol/M-85 | 289 | 251 |
| LPG | 37 | 43 |
| Ethanol/E-85 | 19 | 3,708 |
| Total | 349,780[a] | 329,775 |

**Source:**
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 1998 Federal Fleet Report*, Washington, DC, 2000, Table 6.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

[a]These data are reported under new requirements for FY 1997. Data for some agencies are missing or incomplete.

*The Energy Policy Act of 1992 (EPACT) set alternative fuel vehicle acquisition requirements for Federal and State Governments, alternative fuel providers and the private sector. Additional rule making has adjusted the original purchase requirements. State government and alternative fuel providers requirements began in 1997.*

**Table 10.7**
**Energy Policy Act Purchase Requirements of Light Alternative Fuel Vehicles**

| Year | Federal | State | Alternative fuel providers | Private[a] |
|---|---|---|---|---|
| 1993 | 5,000 | - | - | - |
| 1994 | 7,500 | - | - | - |
| 1995 | 10,000 | - | - | - |
| 1996 | 25% | - | - | - |
| 1997 | 33% | 10% | 30% | - |
| 1998 | 50% | 15% | 50% | - |
| 1999 | 75% | 25% | 70% | - |
| 2000 | 75% | 50% | 90% | - |
| 2001 | 75% | 75% | 90% | - |
| 2002 | 75% | 75% | 90% | 20% |
| 2003 | 75% | 75% | 90% | 40% |
| 2004 | 75% | 75% | 90% | 60% |
| 2005 | 75% | 75% | 90% | 70% |
| 2006–on | 75% | 75% | 90% | 70% |

**Source:**
Final rule for the alternative fuels transportation programs, *Federal Register*, Vol. 61, p. 10622, March 14, 1996.
Private alternative fueled vehicle acquisition requirements for private and local government fleets, *Federal Register*, vol. 62, p. 19701, April 23, 1997.

**Note:**
The Department of Energy has provided an Alternative Fuel Vehicles Acquisitions and Credits Database on the Internet to provide fleet managers with a convenient way to report their compliance with this mandate. (www.ott.doe.gov/credits)

[a]The Department of Energy is presently considering implementation of private and municipal fleet rule making.

# Chapter 11
# Household Vehicles and Characteristics

Summary Statistics from Tables/Figures in this Chapter

| Source | | |
|---|---|---|
| Table 11.2 | Vehicles per licensed driver, 1999 | 1.12 |
| Table 11.3 | Average household transportation expense, 1999 | 18.4% |
| Table 11.4 | Share of households owning 3 or more vehicles | |
| | *1960* | *2.5%* |
| | *1970* | *5.5%* |
| | *1980* | *17.5%* |
| | *1990* | *17.3%* |
| | *2000* | *18.3%* |
| Table 11.12 | Average annual miles per household vehicle, 1995 | 11,800 |
| Figure 11.1 | Average occupancy rates by vehicle type, 1995 | |
| | *Automobile* | *1.6* |
| | *Pickup truck* | *1.4* |
| | *Sports Utility* | *1.7* |
| | *Van* | *2.1* |
| Table 11.14 | Share of workers who car pooled, 2000 | 11.2% |
| Figure 11.3 | Long-distance trips in the U.S., 1995 | |
| | *Trips* | *1,001 million* |
| | *Person-miles* | *827 billion* |

*Vehicle-miles are growing at a faster rate than vehicles and more than twice the rate of population. See Table 11.2 for vehicles per capita and vehicle-miles per capita.*

**Table 11.1**
**Population and Vehicle Profile, 1950–99**

| Year | Resident population[a] (thousands) | Total households (thousands) | Number of vehicles in operation (thousands) | Total vehicle-miles (millions) | Number of licensed drivers (thousands) | Number of civilian employed persons (thousands) |
|---|---|---|---|---|---|---|
| 1950 | 151,868 | 43,554 | 43,256 | 458,246 | 62,194 | 58,918 |
| 1955 | 165,069 | 47,874 | 55,804 | 605,646 | 74,686 | 62,170 |
| 1960 | 179,979 | 52,799 | 66,582 | 718,762 | 87,253 | 65,778 |
| 1965 | 193,526 | 57,251 | 82,067 | 887,812 | 98,502 | 71,088 |
| 1970 | 203,984 | 63,401 | 98,136 | 1,109,724 | 111,543 | 78,678 |
| 1975 | 215,465 | 71,120 | 120,054 | 1,327,664 | 129,791 | 85,846 |
| 1980 | 227,225 | 80,776 | 139,832 | 1,527,295 | 145,295 | 99,303 |
| 1985 | 237,924 | 86,789 | 157,048 | 1,774,826 | 156,868 | 107,150 |
| 1986 | 240,133 | 88,458 | 162,094 | 1,834,872 | 159,487 | 109,597 |
| 1987 | 242,289 | 89,479 | 167,193 | 1,921,204 | 161,975 | 112,440 |
| 1988 | 244,499 | 91,061 | 171,741 | 2,025,962 | 162,853 | 114,968 |
| 1989 | 246,819 | 92,830 | 175,960 | 2,096,487 | 165,555 | 117,342 |
| 1990 | 249,464 | 93,347 | 179,299 | 2,144,362 | 167,015 | 118,793 |
| 1991 | 252,153 | 94,312 | 181,438 | 2,172,050 | 168,995 | 117,718 |
| 1992 | 255,030 | 95,689 | 181,519 | 2,247,151 | 173,125 | 118,492 |
| 1993 | 257,783 | 96,391 | 186,315 | 2,296,378 | 173,149 | 120,259 |
| 1994 | 260,327 | 97,107 | 188,714 | 2,357,588 | 175,403 | 123,060 |
| 1995 | 262,803 | 98,990 | 193,441 | 2,422,696 | 176,628 | 124,900 |
| 1996 | 265,229 | 99,627 | 198,294 | 2,485,848 | 179,539 | 126,708 |
| 1997 | 267,784 | 101,018 | 201,071 | 2,561,695 | 182,709 | 129,558 |
| 1998 | 270,248 | 102,528 | 205,043 | 2,631,522 | 184,980 | 131,463 |
| 1999 | 272,691 | 103,874 | 209,509 | 2,691,335 | 187,170 | 133,488 |
| | | | *Average annual percentage change* | | | |
| 1950–99 | 1.2% | 1.8% | 3.3% | 3.7% | 2.3% | 1.7% |
| 1989–99 | 1.0% | 1.1% | 1.8% | 2.5% | 1.2% | 1.3% |

**Source:**
Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States–2000*, 120th edition, Washington, DC, 2000, pp. 7, 54, 403, and annual. (Additional resources: www.census.gov)
Vehicles in operation - The Polk Company. **FURTHER REPRODUCTION PROHIBITED**. (Additional resources: www.polk.com)
Licensed drivers and vehicle-miles - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Tables DL-20 and VM-1, and annual.
(Additional resources: www.fhwa.dot.gov)

[a]Estimates as of July 1. Includes Armed Forces stationed in the United States.

*In 1999 there were 1.12 vehicles for every licensed driver in the U.S. Vehicle-miles per capita have nearly reached 10,000 miles.*

**Table 11.2**
**Population and Vehicle Ratios, 1950–99**

| Year | Vehicles per capita | Vehicle-miles per capita | Licensed drivers per household | Vehicles per licensed driver | Vehicles per civilian employed persons |
|---|---|---|---|---|---|
| 1950 | 0.28 | 3,029 | 1.43 | 0.70 | 0.73 |
| 1955 | 0.34 | 3,656 | 1.56 | 0.75 | 0.90 |
| 1960 | 0.37 | 3,994 | 1.65 | 0.76 | 1.01 |
| 1965 | 0.42 | 4,587 | 1.72 | 0.83 | 1.15 |
| 1970 | 0.48 | 5,440 | 1.76 | 0.88 | 1.25 |
| 1975 | 0.56 | 6,162 | 1.82 | 0.92 | 1.40 |
| 1980 | 0.62 | 6,722 | 1.80 | 0.96 | 1.41 |
| 1985 | 0.66 | 7,460 | 1.81 | 1.00 | 1.47 |
| 1986 | 0.68 | 7,641 | 1.80 | 1.02 | 1.48 |
| 1987 | 0.69 | 7,929 | 1.81 | 1.03 | 1.49 |
| 1988 | 0.70 | 8,286 | 1.79 | 1.05 | 1.49 |
| 1989 | 0.71 | 8,494 | 1.78 | 1.06 | 1.50 |
| 1990 | 0.72 | 8,596 | 1.79 | 1.07 | 1.51 |
| 1991 | 0.72 | 8,614 | 1.79 | 1.07 | 1.54 |
| 1992 | 0.71 | 8,811 | 1.81 | 1.05 | 1.53 |
| 1993 | 0.72 | 8,908 | 1.80 | 1.08 | 1.55 |
| 1994 | 0.72 | 9,056 | 1.81 | 1.08 | 1.53 |
| 1995 | 0.74 | 9,219 | 1.78 | 1.10 | 1.55 |
| 1996 | 0.75 | 9,372 | 1.80 | 1.10 | 1.56 |
| 1997 | 0.75 | 9,566 | 1.81 | 1.10 | 1.55 |
| 1998 | 0.76 | 9,737 | 1.80 | 1.11 | 1.56 |
| 1999 | 0.77 | 9,870 | 1.80 | 1.12 | 1.57 |
| | | *Average annual percentage change* | | | |
| 1950–99 | 2.1% | 2.4% | 0.5% | 1.0% | 1.6% |
| 1989–99 | 0.8% | 1.5% | 0.1% | 0.6% | 0.5% |

**Source:**

Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States–2000*, 120th edition, Washington, DC, 2000, pp. 7, 54, 403, and annual. (Additional resources: www.census.gov)

Vehicles in operation - The Polk Company. **FURTHER REPRODUCTION PROHIBITED**. (Additional resources: www.polk.com)

Licensed drivers and vehicle-miles - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999*, Tables DL-20 and VM-1, and annual.
(Additional resources: www.fhwa.dot.gov)

*Transportation (18.4%) is second only to housing (31.4%) as the largest expenditure for the average household. In 1999, approximately 15% of transportation expenditures were for purchasing gasoline and motor oil. There is an average of two vehicles per household.*

**Table 11.3**
**Average Annual Expenditures of Households by Income, 1999[a]**

| | | Income before taxes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | All households | Less than $5,000 | $5,000–$9999 | $10,000–$14999 | $15,000–$19,999 | $20,000–$29,999 | $30,000–$39,999 | $40,000–$49,999 | $50,000–$69,999 | $70,000 and over |
| Total expenditures | $39,174 | $18,015 | $14,926 | $19,722 | $24,366 | $28,963 | $35,077 | $40,868 | $49,615 | $76,812 |
| | | | | | Percentage of total expenditures[b] | | | | | |
| Food[c] | 14.2% | 17.5% | 17.9% | 15.7% | 16.5% | 15.9% | 15.3% | 15.1% | 14.0% | 12.3% |
| Housing | 31.5% | 35.6% | 38.5% | 36.1% | 34.2% | 32.6% | 31.0% | 31.0% | 30.0% | 30.1% |
| Apparel and services | 4.8% | 5.5% | 4.7% | 4.5% | 5.6% | 5.4% | 5.4% | 4.1% | 4.3% | 4.7% |
| Transportation | 18.4% | 17.3% | 15.0% | 18.8% | 18.8% | 19.0% | 19.9% | 20.5% | 18.9% | 17.4% |
| **Vehicle purchases (net outlay)** | **8.7%** | **8.1%** | **6.3%** | **9.1%** | **8.7%** | **8.6%** | **9.2%** | **10.1%** | **8.7%** | **8.4%** |
| **Gasoline and motor oil** | **2.7%** | **3.1%** | **2.8%** | **3.1%** | **3.0%** | **3.2%** | **3.2%** | **3.0%** | **2.9%** | **2.2%** |
| **Other vehicle expenditures** | **6.0%** | **5.3%** | **4.7%** | **5.7%** | **6.1%** | **6.1%** | **6.5%** | **6.4%** | **6.3%** | **5.6%** |
| **Public transportation** | **1.0%** | **0.9%** | **1.1%** | **0.9%** | **1.0%** | **1.0%** | **0.9%** | **0.9%** | **0.9%** | **1.2%** |
| Health care | 5.2% | 5.2% | 7.8% | 8.3% | 7.9% | 7.0% | 5.6% | 5.0% | 4.8% | 3.7% |
| Entertainment | 5.1% | 5.0% | 4.3% | 4.9% | 4.2% | 4.6% | 4.8% | 4.6% | 5.6% | 5.4% |
| Personal Insurance & pensions | 11.1% | 2.2% | 2.1% | 3.0% | 4.2% | 6.4% | 8.8% | 11.1% | 12.9% | 15.9% |
| Others[d] | 9.7% | 11.6% | 9.8% | 8.7% | 8.8% | 9.4% | 9.3% | 8.7% | 9.4% | 10.6% |
| Households[e] (thousands) | 81,692 | 3,909 | 7,588 | 8,639 | 6,995 | 11,560 | 9,453 | 7,381 | 10,999 | 15,168 |
| Percentage of households | 100% | 4.8% | 9.3% | 10.6% | 8.6% | 14.2% | 11.6% | 9.0% | 13.5% | 18.6% |
| Average number of vehicles in HH | 2.0 | 1.0 | 0.9 | 1.3 | 1.5 | 1.8 | 2.1 | 2.3 | 2.5 | 2.8 |

**Source:**
U.S. Department of Labor, Bureau of Labor Statistics, web site: www.bls.gov/pub/special.requests/ce/standard/1999/income.txt, February 2001. (Additional resources: www.bls.gov)

[a] Public assistance monies are included in reported income. Data for those reporting income.
[b] Percentages may not sum to totals due to rounding.
[c] Includes alcoholic beverages.
[d] Includes personal care, reading, education, tobacco and smoking supplies, cash contributions, and miscellaneous items.
[e] The term household refers to a "consumer unit," which is defined differently than households on Table 11.1.

*Household vehicle ownership shows a dramatic increase from 1960 to 1990. In 1960, nearly 79% of households owned less than two vehicles; by 1990, it declined to 45%. Census data prior to 1990 indicated that the majority of households owned one vehicle; in 1990 that changed to two vehicles.*

**Table 11.4**
**Household Vehicle Ownership, 1960–2000 Census**
**(percentage)**

| | No vehicles | One vehicle | Two vehicles | Three or more vehicles | Total vehicles[a] |
|---|---|---|---|---|---|
| 1960 | 21.53% | 56.94% | 19.00% | 2.53% | 54,766,718 |
| 1970 | 17.47% | 47.71% | 29.32% | 5.51% | 79,002,052 |
| 1980 | 12.92% | 35.53% | 34.02% | 17.52% | 129,747,911 |
| 1990 | 11.53% | 33.74% | 37.35% | 17.33% | 152,380,479 |
| 2000 | 9.35% | 33.79% | 38.55% | 18.31% | 179,417,526 |

**Source:**
U. S. Department of Transportation, Volpe National Transportation Systems Center, *Journey-to-Work Trends in the United States and its Major Metropolitan Area, 1960–1990*, Cambridge, MA, 1994, p. 2-2.
2000 data - U.S. Bureau of the Census, American Fact Finder, factfinder.census.gov, Table QT-04, August 2001.
(Additional resources: www.census.gov)

[a]Estimates using Census Bureau data; these data on the total number of vehicles do not match the figures on Table 11.1. The figures on Table 11.1, from R.L. Polk and Company, are the preferred data.

## 1995 Nationwide Personal Transportation Survey

The 1995 Nationwide Personal Travel Survey (NPTS) is a national survey designed to collect data on the nature and characteristics of personal travel. The definition of a trip in the NPTS is "any one-way travel from one address to another by private motor vehicle, public transportation, bicycle, or walking." Excluded from the survey are jogging and walking for exercise, as is all bicycling and walking for individuals under 5 years of age. The survey collects detailed data on household trips, their purposes and the transportation modes used. The NPTS is sponsored by several agencies of the U.S. Department of Transportation and is conducted approximately every seven years. Since each of the surveys differ somewhat in terminology, survey procedure, and target population, one should be cautious when comparing statistics from one survey to the next. Improved methodologies used in the collection of the trip information in the 1995 NPTS make it impossible to compare these data with past NPTS survey data. Thus, the 1990 NPTS trip data have been adjusted to make it comparable with the latest survey. Both the original 1990 data and the adjusted 1990 data are shown in tables comparing trip information. The 1995 trip data should only be compared to the adjusted 1990 trip data, and the original trip 1990 data should be compared with previous surveys. Additional analyses can be done on the 1995 NPTS data through the Internet site: **www-cta.ornl.gov/npts**.

**Table 11.5**
**Demographic Statistics**
**1969, 1977, 1983, 1990, and 1995 NPTS**

| | 1969 | 1977 | 1983 | 1990 | 1995 | Percent change 1969–95 |
|---|---|---|---|---|---|---|
| Persons per household | 3.16 | 2.83 | 2.69 | 2.56 | 2.63 | -17% |
| Vehicles per household | 1.16 | 1.59 | 1.68 | 1.77 | 1.78 | 53% |
| Workers per household | 1.21 | 1.23 | 1.21 | 1.27 | 1.33 | 10% |
| Vehicles per worker | 0.96 | 1.29 | 1.39 | 1.40 | 1.34 | 40% |
| Average vehicle trip length (miles) | 8.89 | 8.34 | 7.90 | 8.98 | 9.06 | 2% |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92-027, Washington, DC, March 1992, Table 2. Data for 1995 were generated from the Internet site *www-cta.ornl.gov/npts*.
(Additional resources: www.fhwa.dot.gov)

**Note:**
Average vehicle trip length for 1990 and 1995 is calculated using only those records with trip mileage information present. The 1969 survey does not include pickups and other light trucks as household vehicles.

*The 1995 NPTS data should be compared only to the 1990 adjusted data due to survey methodology improvements in collecting trip information. The original 1990 data are comparable to all previous surveys; however, comparisons should always be made with caution because of differing survey methodologies.*

**Table 11.6**
**Average Annual Vehicle-Miles, Vehicle Trips and Trip Length per Household**
**1969, 1977, 1983, 1990, and 1995 NPTS**

| | Journey-to-work[a] | All trips |
|---|---|---|
| *Average annual vehicle-miles per household* | | |
| 1969 | 4,183 | 12,423 |
| 1977 | 3,815 | 12,036 |
| 1983 | 3,538 | 11,739 |
| 1990 original | 4,853 | 15,100 |
| 1990 adjusted | 4,853 | 18,161 |
| 1995 | 6,492 | 20,895 |
| *Average annual vehicle trips per household* | | |
| 1969 | 445 | 1,396 |
| 1977 | 423 | 1,442 |
| 1983 | 414 | 1,486 |
| 1990 original | 448 | 1,702 |
| 1990 adjusted | 448 | 2,077 |
| 1995 | 553 | 2,321 |
| *Average vehicle trip length (miles)* | | |
| 1969 | 9.4 | 8.9 |
| 1977 | 9.0 | 8.4 |
| 1983 | 8.5 | 7.9 |
| 1990 original | 11.0 | 9.0 |
| 1990 adjusted | 11.0 | 8.9 |
| 1995 | 11.8 | 9.1 |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92-027, Washington, DC, March 1992, Table 7. Data for 1995 were generated from the Internet site *www-cta.ornl.gov/npts*. 1990 adjusted data - Oak Ridge National Laboratory, Oak Ridge, TN, August 1998. (Additional resources: www.fhwa.dot.gov, www-cta.ornl.gov/npts)

[a]It is believed that the methodology changes in the 1995 NPTS did not affect journey-to-work trips; therefore, no adjustment is necessary.

*The 1995 NPTS data should be compared only to the 1990 adjusted data due to survey methodology improvements in collecting trip information. The original 1990 data are comparable to all previous surveys; however, comparisons should always be made with caution because of differing survey methodologies.*

**Table 11.7**
**Average Annual Person-Miles Traveled (PMT), Person Trips and Trip Length per Household by Selected Trip Purposes**
**1983, 1990, and 1995 NPTS**

| | Journey-to-work[a] | Shopping | Social and recreational | All purposes[b] |
|---|---|---|---|---|
| | *Average annual PMT per household* | | | |
| 1983 | 4,586 | 2,567 | 8,964 | 22,802 |
| 1990 original | 5,637 | 2,674 | 8,567 | 24,803 |
| 1990 adjusted | 5,637 | 3,343 | 11,308 | 30,316 |
| 1995 | 7,740 | 4,659 | 10,571 | 34,459 |
| | *Average annual person trips per household* | | | |
| 1983 | 537 | 474 | 728 | 2,628 |
| 1990 original | 539 | 504 | 662 | 2,673 |
| 1990 adjusted | 539 | 630 | 874 | 3,262 |
| 1995 | 676 | 775 | 953 | 3,828 |
| | *Average person trip length (miles)* | | | |
| 1983 | 8.5 | 5.4 | 12.3 | 8.7 |
| 1990 original | 10.7 | 5.4 | 13.2 | 9.5 |
| 1990 adjusted | 10.7 | 5.4 | 13.2 | 9.5 |
| 1995 | 11.6 | 6.1 | 11.3 | 9.1 |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Study, Public Use Tapes, Washington, DC. Data for 1995 were generated from the Internet site *www-cta.ornl.gov/npts*. 1990 adjusted data - Oak Ridge National Laboratory, Oak Ridge, TN, August 1998. (Additional resources: www.fhwa.dot.gov, www-cta.ornl.gov/npts)

**Note:**
Average person trip length for 1990 and 1995 is calculated using only those records with trip mileage information present. "All purposes" includes unreported trip purposes.

[a]It is believed that the methodology changes in the 1995 NPTS did not affect journey-to-work trips; therefore, no adjustment is necessary.

[b]Includes trip purposes not shown on this table.

*In 1995 vehicle-miles traveled (vmt) for a three-person household is nearly 25,000 miles. The number of drivers in a household makes a big difference in vmt, as does the presence of children in the household. Households with children have 46% more vmt than households without children.*

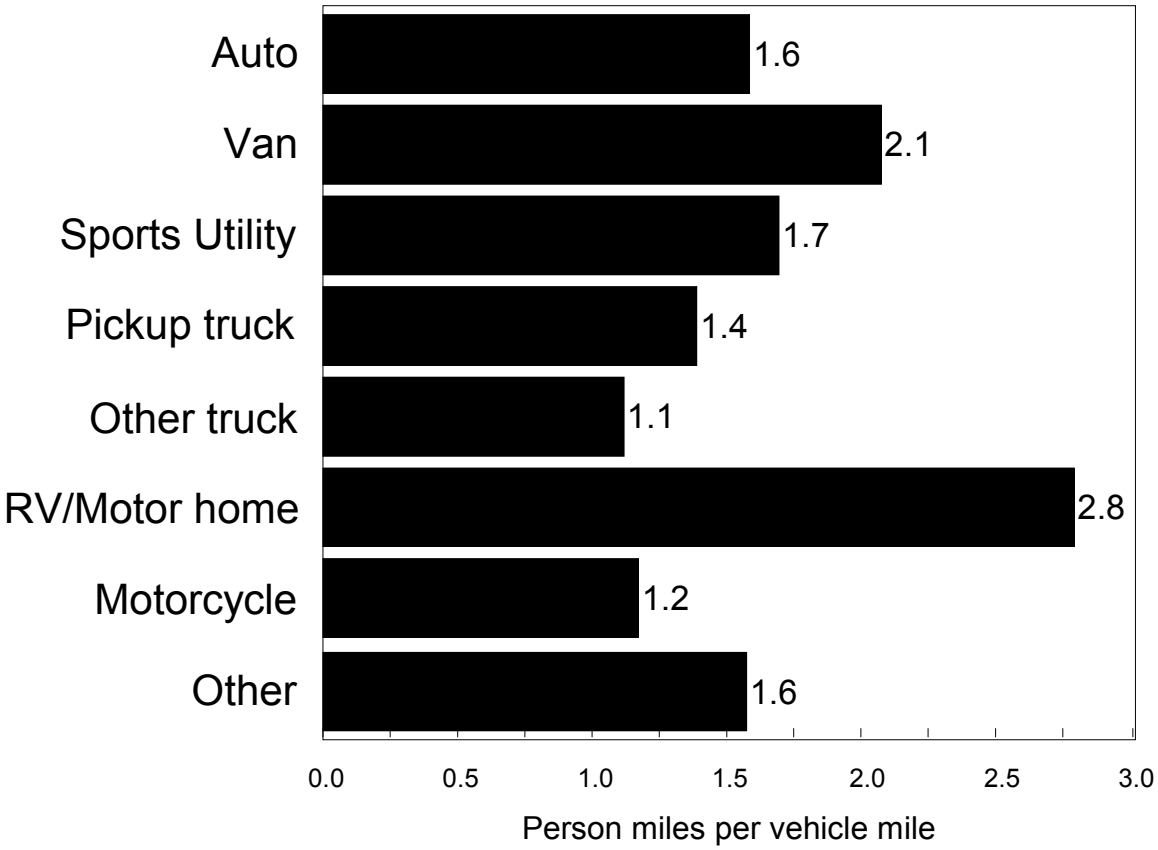
**Table 11.8**
**Average Number of Vehicles and Vehicle Travel per Household, 1990 and 1995 NPTS**

| | Average number of vehicles per household | | Average vehicle-miles traveled per household | |
|---|---|---|---|---|
| **Number of Drivers** | **1990** | **1995** | **1990** | **1995** |
| 1 | 1.5 | 1.2 | 15,200 | 11,000 |
| 2 | 2.1 | 2.1 | 22,900 | 22,600 |
| 3 | 2.9 | 2.8 | 29,400 | 30,100 |
| 4 or more | 3.8 | 3.6 | 40,500 | 39,600 |
| **Household size** | | | | |
| 1 person | 1.2 | 1.2 | 11,400 | 10,800 |
| 2 persons | 1.9 | 1.9 | 19,300 | 19,400 |
| 3 persons | 2.2 | 2.2 | 23,700 | 24,800 |
| 4 persons | 2.4 | 2.3 | 25,300 | 25,600 |
| 5 persons | 2.4 | 2.3 | 24,900 | 27,200 |
| 6 or more persons | 2.7 | 2.5 | 29,200 | 27,900 |
| **Household urban status** | | | | |
| Urban | 1.9 | 1.6 | 19,000 | 16,500 |
| Rural | 2.1 | 2.0 | 22,200 | 22,600 |
| **Household composition** | | | | |
| With children | 2.2 | 2.2 | 24,100 | 25,000 |
| Without children | 1.8 | 1.8 | 17,600 | 17,100 |
| **Total** | **1.8** | **1.8** | **18,300** | **18,700** |

**Source:**
Generated from the Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 2000. (Additional resources: www-cta.ornl.gov/npts)

*Vans and sport utility vehicles have higher vehicle occupancies than automobiles. RV's and motor homes have the highest vehicle occupancy.*

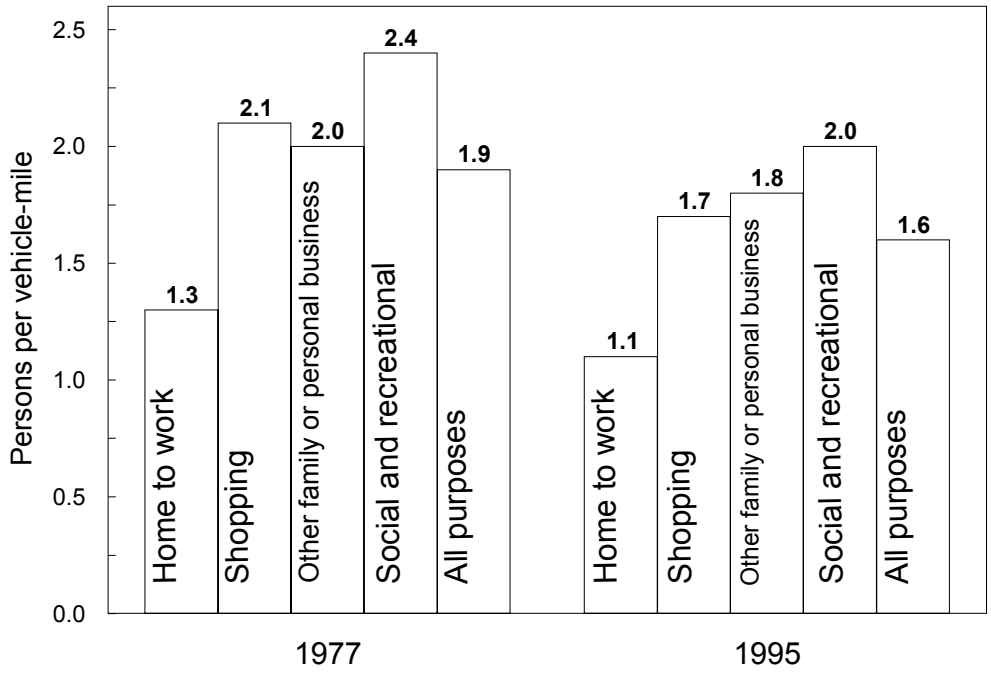
**Figure 11.1. Average Vehicle Occupancy by Vehicle Type, 1995 NPTS**




**Source:**
U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey, Washington, DC, 1997.
(Additional resources: www.fhwa.dot.gov, www-cta.ornl.gov/npts)

*The average vehicle occupancy, calculated as person-miles per vehicle-mile, is highest for social and recreational purposes. The highest vehicle occupancy levels for all purposes were in 1977. The increase in number of vehicles per household and the decrease in average household size could have contributed to the decline since then.*

**Figure 11.2. Average Vehicle Occupancy by Trip Purpose**
**1977 and 1995 NPTS**




**Source:**
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92027, Washington, DC, March 1992, Figure 6. Data from 1995 were generated from the public use file.
(Additional resources: www.fhwa.dot.gov, www-cta.ornl.gov/npts)

*Less than 27% of all household vehicle-miles are trips to or from work. Errands such as family and personal business and shopping (combined) make up almost a third of vehicle travel. One quarter of all trips 75 miles or longer (one way) were for the purpose of visiting friends or relatives.*

**Table 11.9**
**Vehicle-Miles by Trip Purpose, 1995 NPTS**

| Purpose of trip | Daily trip vehicle-miles (<75 miles one-way) | Long trip vehicle-miles (≥75 miles one-way) | Total trip vehicle-miles |
|---|---|---|---|
| To or from work | 31.1% | 4.2% | 26.8% |
| Work-related business | 6.7% | 14.7% | 7.9% |
| Shopping | 13.4% | 3.5% | 11.9% |
| Other family or personal business | 20.6% | 14.2% | 19.6% |
| School/church | 3.8% | 3.1% | 3.7% |
| Doctor/dentist | 1.5% | 1.3% | 1.5% |
| Vacation | 1.0% | 10.0% | 2.4% |
| Visit friends or relatives | 9.4% | 25.7% | 12.0% |
| Other social or recreational | 12.4% | 22.3% | 13.9% |
| Other | 0.1% | 1.1% | 0.3% |
| Not ascertained | 0.0% | 0.0% | 0.0% |
| All (millions) | 2,068,368 | 385,997 | 2,454,365 |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey web site: www-cta.ornl.gov/npts.

*As households owned more vehicles, the average annual miles for the most frequently driven vehicle increased. For example, the most frequently driven vehicle in five-vehicle households was driven 26% more per year than the one in two-vehicle households (21,177 miles vs. 16,804 miles).*

**Table 11.10**
**Average Annual Miles per Vehicle by Household Vehicle Ownership, 1995 NPTS**

| Vehicle [a] | One-vehicle household | Two-vehicle household | Three-vehicle household | Four-vehicle household | Five-vehicle household |
|---|---|---|---|---|---|
| #1 | 12,379 | 16,804 | 18,853 | 20,724 | 21,177 |
| #2 | - | 8,322 | 9,806 | 11,311 | 12,880 |
| #3 | - | - | 4,555 | 6,395 | 7,319 |
| #4 | - | - | - | 3,218 | 4,177 |
| #5 | - | - | - | - | 2,321 |
| **Average** | **12,379** | **12,855** | **11,604** | **11,100** | **10,372** |

**Source:**
Generated from the Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 1998. (Additional resources: www-cta.ornl.gov/npts)

**Table 11.11**
**Average Age of Vehicles by Household Vehicle Ownership, 1995 NPTS**

| Vehicle[a] | One-vehicle household | Two-vehicle household | Three-vehicle household | Four-vehicle household | Five-vehicle household |
|---|---|---|---|---|---|
| #1 | 7.48 | 6.45 | 6.74 | 7.01 | 7.35 |
| #2 | - | 8.54 | 8.55 | 8.68 | 9.54 |
| #3 | - | - | 12.25 | 11.36 | 11.89 |
| #4 | - | - | - | 14.52 | 14.60 |
| #5 | - | - | - | - | 17.81 |
| **Average** | **7.48** | **7.42** | **8.93** | **10.03** | **11.62** |

**Source:**
Generated from the Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 1998. (Additional resources: www-cta.ornl.gov/npts)

[a]Vehicles are ranked by descending annual miles driven.

*Historically, the data from the Nationwide Personal Transportation Survey (NPTS) are based on estimates reported by survey respondents. For the 1995 survey, odometer data was also collected. These data indicate that respondents overestimate the number of miles driven in a year.*

**Table 11.12**
**Average Annual Miles Per Household Vehicle by Vehicle Age**

| Vehicle age (years) | 1983 self-reported | 1990 self-reported | 1995 self-reported | **1995 odometer** |
|---|---|---|---|---|
| Under 1 | 8,200 | 19,600 | 15,900 | **15,600** |
| 1 | 15,200 | 16,800 | 16,800 | **14,500** |
| 2 | 16,800 | 16,600 | 15,500 | **14,800** |
| 3 | 14,500 | 14,700 | 14,400 | **13,800** |
| 4 | 13,000 | 13,600 | 14,100 | **12,900** |
| 5 | 12,100 | 12,900 | 13,500 | **12,700** |
| 6 | 11,300 | 13,200 | 13,200 | **12,400** |
| 7 | 10,000 | 12,400 | 12,800 | **11,600** |
| 8 | 9,800 | 12,600 | 12,200 | **11,300** |
| 9 | 9,000 | 11,500 | 12,200 | **11,200** |
| 10 and older | 7,300 | 9,200 | 8,900 | **9,000** |
| **All household vehicles** | **10,400** | **12,500** | **12,200** | **11,800** |

**Source:**
Nationwide Personal Transportation Study—1983: D. Klinger and J. Richard Kuzmyak, COMSIS Corporation, Personal Travel in the United States, Volume 1: 1983–84 Nationwide Personal Travel Study, prepared for the U.S. Department of Transportation, Washington, DC, August 1986, Table 4-22, p.4-21. 1990: Generated from the 1990 Nationwide Personal Transportation Study Public Use Tape, March 1992. 1995: Generated from the Internet site: www-cta.ornl.gov/npts.
(Additional resources: www.fhwa.dot.gov, www.eia.doe.gov)

**Note:**
Data include all household vehicles, and have been rounded to the nearest hundred.

*In 1995 the average journey-to-work speed was faster (miles per hour increased to 34.6), but the travel time still increased, due to an increase in the average travel distance. Journeys-to-work using public transportation continued to take twice as long as private transportation, though there is only a slight difference in travel distance.*

**Table 11.13**
**Journey-to-Work Statistics**
**1983, 1990, and 1995 NPTS[a]**

| Year | Private transportation | Public transportation | Other[b] | Total |
|---|---|---|---|---|
| *Average travel time (minutes)[c]* | | | | |
| 1983 | 17.6 | 39.8 | 10.6 | 18.2 |
| 1990 | 19.1 | 41.1 | 12.4 | 19.6 |
| 1995 | 20.1 | 42.0 | 18.8 | 20.7 |
| *Average trip length (miles)* | | | | |
| 1983 | 8.9 | 11.8 | 1.4 | 8.5 |
| 1990 | 11.0 | 12.8 | 2.2 | 10.7 |
| 1995 | 11.8 | 12.9 | 8.2 | 11.6 |
| *Average speed (miles per hour)* | | | | |
| 1983 | 30.2 | 17.8 | 7.6 | 28.2 |
| 1990[d] | 34.7 | 18.2 | 7.6 | 33.3 |
| 1995[d] | 35.4 | 19.3 | 25.9 | 34.6 |

**Source:**
U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Study, Public Use Tapes, Washington, DC. Data for 1995 were generated from the Internet site *www-cta.ornl.gov/npts*. (Additional resources: www.fhwa.dot.gov, www-cta.ornl.gov/npts)

[a]It is believed that the methodology changes in the 1995 NPTS did not affect journey-to-work trips; therefore, no adjustment is necessary.
[b]Includes airplane, Amtrak, taxi, bicycle, school bus, moped, walk and other.
[c]Does not include time spent waiting for transportation.
[d]Does not include segmented trips.

*According to the U.S. Census data, the percentage of workers who car pooled has dropped from 19.7% in 1980 to 11.2% in 2000. The percent of workers using public transit declined from 6.4% to 5.3% in the ten year period between 1980 and 1990, but stayed relatively the same from 1990 to 2000 (5.2%). The average travel time increased by 2.6 minutes from 1980 to 2000.*

**Table 11.14**
**Means of Transportation to Work, 1980, 1990 and 2000 Census**

| | 1980 Census | | 1990 Census | | 2000 Census | |
|---|---|---|---|---|---|---|
| Means of transportation | Number of workers (thousands) | Share | Number of workers (thousands) | Share | Number of workers (thousands) | Share |
| Private vehicle | 81,258 | 84.1% | 99,593 | 86.5% | 111,554 | 87.5% |
| *Drove alone* | *62,193* | *64.4%* | *84,215* | *73.2%* | *97,247* | *76.3%* |
| *Car pooled* | *19,065* | *19.7%* | *15,378* | *13.4%* | *14,307* | *11.2%* |
| Public transportation | 6,175 | 6.4% | 6,070 | 5.3% | 6,575 | 5.2% |
| *Bus or trolley bus*[a] | *3,925* | *4.1%* | *3,445* | *3.0%* | *3,572* | *2.8%* |
| *Streetcar or trolley car*[a] | [b] | [b] | *78* | *0.1%* | *88* | *0.1%* |
| *Subway or elevated* | *1,529* | *1.6%* | *1,755* | *1.5%* | *1,981* | *1.6%* |
| *Railroad* | *554* | *0.6%* | *574* | *0.5%* | *696* | *0.5%* |
| *Ferryboat* | [b] | [b] | *37* | *0.0%* | *43* | *0.0%* |
| *Taxicab* | *167* | *0.2%* | *179* | *0.2%* | *194* | *0.2%* |
| Motorcycle | 419 | 0.4% | 237 | 0.2% | 158 | 0.1% |
| Bicycle | 468 | 0.5% | 467 | 0.4% | 563 | 0.4% |
| Walked only | 5,413 | 5.6% | 4,489 | 3.9% | 3,413 | 2.7% |
| Other means | 703 | 0.7% | 809 | 0.7% | 1,099 | 0.9% |
| Worked at home | 2,180 | 2.3% | 3,406 | 3.0% | 4,075 | 3.2% |
| Total workers | 96,617 | 100.0% | 115,070 | 100.0% | 127,437 | 100.0% |
| Average travel time (minutes) | 21.7 | | 22.4 | | 24.3 | |

**Source:**
1980-1990 data - Provided by the Journey-to-Work and Migration Statistics Branch, Population Division, U.S. Bureau of the Census
2000 data - U.S. Bureau of the Census, American Fact Finder, factfinder.census.gov, Tables QT-03 and P047, August 2001. (Additional resources: www.census.gov)

[a] This category was "Bus or streetcar" in 1980.
[b] Data are not available.

*More than half of workers had 15-29 minute commutes in 1990, but that dropped to 35% by 2000. The share of workers commuting less than 15 minutes increased the most in the ten-year period (14 percentage points), but the share of workers commuting 30 minutes or more also saw small increases.*

**Table 11.15**
**Workers by Commute Time, 1990 and 2000 Census**

| Commute time | 1990 | 2000 |
|---|---|---|
| Less than 15 minutes | 15.9% | 30.1% |
| 15–29 minutes | 51.6% | 36.3% |
| 30–39 minutes | 14.7% | 15.7% |
| 40–59 minutes | 9.0% | 10.7% |
| 60 minutes or more | 5.9% | 7.3% |
| Average travel time (minutes) | 22.4 | 24.3 |

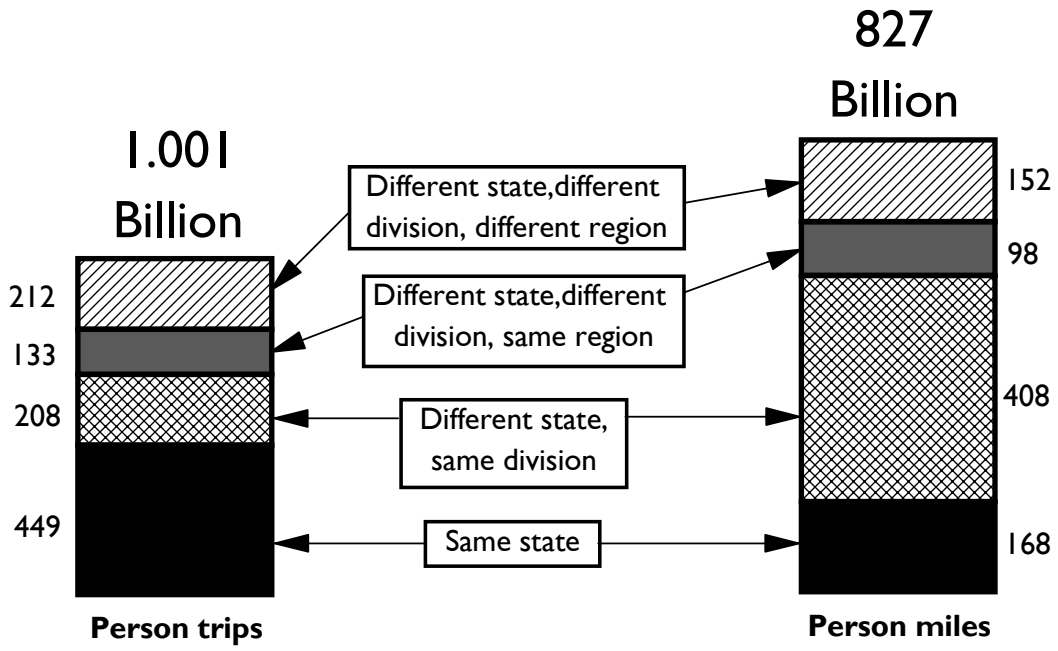
**Source:**
1990 - U. S. Department of Transportation, Volpe National Transportation Systems Center, *Journey-to-Work Trends in the United States and its Major Metropolitan Area, 1960–1990*, FHWA-PL-94-012, Cambridge, MA, 1994, p. 2-6.
2000 - U.S. Bureau of the Census, American Fact Finder, factfinder.census.gov, Tables QT-03 and P048, August 2001.
(Additional resources: www.census.gov)

## 1995 American Travel Survey

The American Travel Survey (ATS) was conducted by the Bureau of Transportation Statistics, U.S. Department of Transportation, to obtain information about the long-distance travel of persons living in the United States. Approximately 80,000 randomly selected households were interviewed for the survey, which collected information about all trips of 100 miles or more, one-way, taken by household members in 1995. The ATS data provide detailed information on state-to-state travel, as well as travel to and from metropolitan areas by mode of transportation.

For additional information about the American Travel Survey, contact the Bureau of Transportation Statistics at (202) 366-3282 or visit the following Internet site: www.bts.gov/ats

**Figure 11.3 Long-Distance Trips by Destination, 1995**




**Source:**
U.S. Department of Transportation, Bureau of Transportation Statistics, *1995 American Travel Survey Profile*, Washington, DC, October 1997, p. 2. (Additional resources: www.bts.gov/ats)
**Note:**
Definitions of divisions and regions are in Appendix C.

*Personal-use vehicles are by far the most predominant means of transportation on long-distance trips (100 miles or more, one way); two-thirds of those personal vehicle trips are pleasure trips.*

**Table 11.16**
**Long-Distance Trips[a] by Mode and Purpose, 1995**

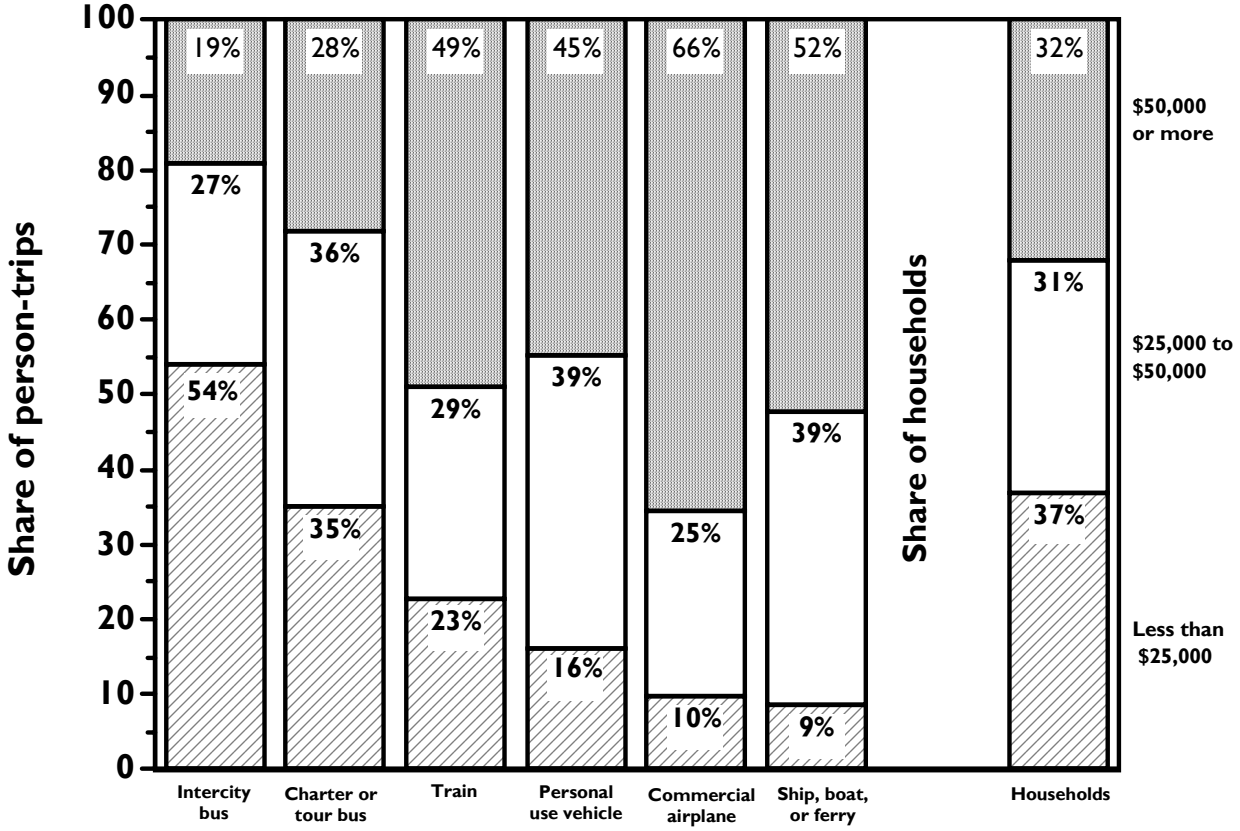
| Principal means of transportation | Main purpose of trip | | | | | |
|---|---|---|---|---|---|---|
| | | Pleasure | | | | |
| | Business | *Visit friends or relatives* | *Leisure* | Total | Personal business | Total |
| | Person trips (thousands) | | | | | |
| Personal use vehicle | 151,697 | *283,153* | *254,186* | 537,339 | 124,791 | 813,858 |
| Commercial airplane | 67,083 | *41,881* | *31,581* | 73,462 | 15,386 | 155,936 |
| Intercity bus | 286 | *1,830* | *690* | 2,519 | 439 | 3,244 |
| Charter or tour bus | 1,281 | *1,198* | *9,253* | 10,451 | 2,514 | 14,247 |
| Train | 1,342 | *2,004* | *944* | 2,948 | 704 | 4,994 |
| Ship, boat, or ferry | 68 | *43* | *483* | 525 | 20 | 614 |
| **Total** | **224,835** | ***330,755*** | ***299,355*** | **630,110** | **146,338** | **1,001,319** |
| | Percentage | | | | | |
| Personal use vehicle | 18.6 | *34.8* | *31.2* | 66.0 | 15.3 | 100.0 |
| Commercial airplane | 43.0 | *26.9* | *20.3* | 47.1 | 9.9 | 100.0 |
| Intercity bus | 8.8 | *56.4* | *21.3* | 77.7 | 13.5 | 100.0 |
| Charter or tour bus | 9.0 | *8.4* | *64.9* | 73.4 | 17.6 | 100.0 |
| Train | 26.9 | *40.1* | *18.9* | 59.0 | 14.1 | 100.0 |
| Ship, boat, or ferry | 11.1 | *7.0* | *78.7* | 85.5 | 3.3 | 100.0 |
| **Total** | **22.5** | ***33.0*** | ***29.9*** | **62.9** | **14.6** | **100.0** |

**Source:**
U.S. Department of Transportation, Bureau of Transportation Statistics, *1995 American Travel Survey Profile*, Washington, DC, October 1997, p. 13. (Additional resources: www.bts.gov/ats)

[a]A long-distance trip is any trip of 100 miles or more, one way.

*Those with a household income of less than $25,000 account for more than half (54%) of intercity bus person-trips. Those with a household income of $50,000 or more account for two-thirds (66%) of commercial airplane person-trips.*

**Figure 11.4. Shares of Long-Distance Person Trips by Mode and Household Income, 1995**




**Source:**

U.S. Department of Transportation, Bureau of Transportation Statistics, *1995 American Travel Survey Profile*, Washington, DC, October 1997, p. 8.

U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, 117th Edition, Washington, DC, 1997, p. 465.

(Additional resources: www.bts.gov/ats, www.census.gov)

# Chapter 12
# Nonhighway Modes

Summary Statistics from Tables in this Chapter

| Source | | |
|---|---|---|
| | Passenger-miles, 1999 | (millions) |
| *Table 12.1* | *Domestic and international air carrier* | *668,626* |
| *Table 12.2* | *General aviation* | *13,500* |
| *Table 12.10* | *Amtrak* | *5,289* |
| *Table 12.11* | *Transit rail* | *14,108* |
| | Freight ton-miles, 1999 | (millions) |
| *Table 12.4* | *Domestic waterborne commerce* | *656,000* |
| *Table 12.7* | *Class I railroad* | *1,433,461* |
| | Passenger energy use, 1999 | (trillion Btus) |
| *Table 12.1* | *Domestic and international air carrier* | *2,653.1* |
| *Table 12.2* | *General aviation* | *172.1* |
| *Table 12.10* | *Amtrak energy use* | *16.2* |
| *Table 12.11* | *Transit rail* | *44.7* |
| | Freight energy use, 1999 | (trillion Btus) |
| *Table 12.4* | *Domestic waterborne commerce* | *299.9* |
| *Table 12.7* | *Class I railroad* | *520.1* |

**Table 12.1**
**Summary Statistics for U.S. Domestic and International Certificated Route Air Carriers (Combined Totals), 1970–2000[a]**

| Year | Revenue aircraft-miles (millions) | Average passenger trip length[b] (miles) | Revenue passenger-miles (millions) | Available seat-miles (millions) | Available seats per aircraft[c] | Passenger load factor (percentage)[d] | Revenue cargo ton-miles (millions) | Energy use (trillion Btu)[e] | Percent domestic of total energy use (percentage) |
|---|---|---|---|---|---|---|---|---|---|
| 1970 | 2,383 | 678 | 131,719 [f] | 264,904 [f] | 111 | 49.7%[f] | 4,994 | 1,363.4 | [g] |
| 1975 | 2,241 | 698 | 173,324 | 315,823 | 135 | 54.9% | 5,944 | 1,283.4 | [g] |
| 1980 | 2,924 | 736 | 267,722 | 448,479 | 148 | 59.7% | 7,515 | 1,386.0 | 83.0% |
| 1985 | 3,462 | 758 | 351,073 | 565,677 | 163 | 62.1% | 9,048 | 1,701.4 | 80.3% |
| 1986 | 3,873 | 767 | 378,923 | 623,073 | 161 | 60.8% | 10,987 | 1,847.1 | 81.4% |
| 1987 | 4,182 | 779 | 417,830 | 670,871 | 160 | 62.3% | 13,130 | 1,945.9 | 80.0% |
| 1988 | 4,355 | 786 | 437,649 | 696,337 | 160 | 62.9% | 14,633 | 2,049.4 | 78.5% |
| 1989 | 4,442 | 792 | 447,480 | 703,888 | 158 | 63.6% | 16,347 | 2,087.4 | 77.0% |
| 1990 | 4,724 | 803 | 472,236 | 753,211 | 159 | 62.7% | 16,411 | 2,213.0 | 75.8% |
| 1991 | 4,661 | 806 | 463,296 | 738,030 | 158 | 62.8% | 16,149 | 2,085.2 | 74.5% |
| 1992 | 4,899 | 806 | 493,715 | 772,869 | 158 | 63.9% | 17,306 | 2,144.2 | 74.1% |
| 1993 | 5,118 | 799 | 505,996 | 793,959 | 155 | 63.7% | 19,083 | 2,169.7 | 74.4% |
| 1994 | 5,360 | 787 | 537,506 | 809,240 | 151 | 66.4% | 21,773 | 2,266.2 | 74.3% |
| 1995 | 5,627 | 791 | 558,757 | 845,012 | 150 | 66.1% | 23,375 | 2,338.6 | 74.0% |
| 1996 | 5,855 | 802 | 596,164 | 859,720 | 147 | 69.3% | 24,892 | 2,409.1 | 73.9% |
| 1997 | 6,025 | 814 | 619,969 | 880,607 | 146 | 70.4% | 27,610 | 2,514.2 | 73.3% |
| 1998 | 6,222 | 813 | 636,410 | 899,115 | 145 | 70.8% | 28,015 | 2,573.4 | 72.8% |
| 1999 | 6,558 | 824 | 668,626 | 942,311 | 144 | 71.0% | 28,984 | 2,653.1 | 73.3% |
| 2000 | 6,919 | 833 | 707,979 | 979,779 | 142 | 72.3% | 30,221 | 2,743.1 | 73.1% |
| | | | | *Average annual percentage change* | | | | | |
| 1970–2000 | 3.4% | 0.7% | 5.6% | 4.3% | 0.9% | | 6.0% | 2.2% | |
| 1990–2000 | 3.3% | 0.3% | 3.5% | 2.3% | -1.0% | | 5.9% | 1.8% | |

**Source:**
U.S. Department of Transportation, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1998/1997, Washington, DC, pp. 1–2, and annual.
1970–81 Energy Use - Department of Transportation, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, 1981, and annual.
1982–99 Energy Use - Department of Transportation, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables," Washington, DC, monthly. Annual totals are derived by summing monthly totals for domestic and international air carriers. (Additional resources: www.bts.gov, www.faa.gov)

[a]Data are for all U.S. air carriers reporting on Form 41.
[b]Scheduled services of domestic operations only. The average passenger trip length for international operations is more than three and a half times longer than for domestic operations.
[c]Available seats per aircraft is calculated as the ratio of available seat-miles to revenue aircraft-miles.
[d]Passenger load factor is calculated as the ratio of revenue passenger-miles to available seat-miles for scheduled and nonscheduled services.
[e]Energy use includes fuel purchased abroad for international flights.
[f]Scheduled services only.
[g]Data are not available.

**Table 12.2**
**Summary Statistics for General Aviation, 1970–99**

| Calendar year | Total number of aircraft | Aircraft hours flown (thousands) | Intercity passenger travel (billion passenger-miles) | Energy use (trillion btu) |
|---|---|---|---|---|
| 1970 | 131,700[a] | 26,030[b] | 9.1 | 94.4 |
| 1975 | 168,475 | 30,298 | 11.4 | 121.5 |
| 1976 | 177,964 | 31,950 | 12.1 | 130.3 |
| 1977 | 184,294 | 33,679 | 12.8 | 149.7 |
| 1978 | 199,178 | 36,844 | 14.1 | 159.4 |
| 1979 | 210,339 | 40,432 | 15.5 | 167.2 |
| 1980 | 211,045 | 41,016 | 14.7 | 169.0 |
| 1981 | 213,226 | 40,704 | 14.6 | 162.4 |
| 1982 | 209,779 | 36,457 | 13.1 | 170.5 |
| 1983 | 213,293 | 35,249 | 12.7 | 143.9 |
| 1984 | 220,943 | 36,119 | 13.0 | 148.9 |
| 1985 | 196,500 | 31,456 | 12.3 | 144.0 |
| 1986 | 205,300 | 31,782 | 12.4 | 148.0 |
| 1987 | 202,700 | 30,883 | 12.1 | 139.1 |
| 1988 | 196,200 | 31,114 | 12.6 | 148.6 |
| 1989 | 205,000 | 32,332 | 13.1 | 134.0 |
| 1990 | 198,000 | 32,096 | 13.0 | 131.9 |
| 1991 | 196,874 | 30,490 | 12.1 | 120.4 |
| 1992 | 185,650 | 27,471 | 10.8 | 104.7 |
| 1993 | 177,120 | 24,455 | 9.9 | 97.5 |
| 1994 | 172,935 | 24,092 | 9.8 | 95.3 |
| 1995 | 188,089 | 26,612 | 10.8 | 106.6 |
| 1996 | 191,129 | 26,909 | 12.0 | 111.1 |
| 1997 | 192,414 | 27,713 | 12.5 | 121.1 |
| 1998 | 204,710 | 28,100 | 13.1 | 147.4 |
| 1999 | 219,464 | 31,756 | 13.5 | 172.1 |
| | | *Average annual percentage change* | | |
| 1970–99 | 1.8% | 0.7% | 1.4% | 2.1% |
| 1989–99 | 0.7% | -0.2% | 0.3% | 2.5% |

**Sources**:
Intercity passenger-miles - Eno Foundation for Transportation, *Transportation in America 2000*, Eighteenth edition, Lansdowne, VA, 2001, p. 15, and annual.
All other- U.S. Department of Transportation, Federal Aviation Administration, *General Aviation Activity and Avionics Survey: Calendar Year 1999*, Tables 1.2, 1.5, 5.1, and annual. (Additional resources: www.faa.gov)

[a]Active fixed-wing general aviation aircraft only.
[b]Includes rotocraft.

*In the early seventies, domestic waterborne commerce accounted for over 60% of total tonnage, but by 1994 foreign tonnage grew to more than half of all waterborne tonnage and has continued to grow each year since.*

**Table 12.3**
**Tonnage Statistics for Domestic and International Waterborne Commerce, 1970–99**
**(million tons shipped)**

| Year | Foreign and domestic total | Foreign total[a] | Domestic total[b] | Percent domestic of total |
|---|---|---|---|---|
| 1970 | 1,532 | 581 | 951 | 62.1% |
| 1975 | 1,695 | 749 | 946 | 55.8% |
| 1976 | 1,835 | 856 | 979 | 53.4% |
| 1977 | 1,908 | 935 | 973 | 51.0% |
| 1978 | 2,021 | 946 | 1,075 | 53.2% |
| 1979 | 2,073 | 993 | 1,080 | 52.1% |
| 1980 | 1,999 | 921 | 1,077 | 53.9% |
| 1981 | 1,942 | 887 | 1,054 | 54.3% |
| 1982 | 1,777 | 820 | 957 | 53.9% |
| 1983 | 1,708 | 751 | 957 | 56.0% |
| 1984 | 1,836 | 803 | 1,033 | 56.3% |
| 1985 | 1,788 | 774 | 1,014 | 56.7% |
| 1986 | 1,874 | 837 | 1,037 | 55.3% |
| 1987 | 1,967 | 891 | 1,076 | 54.7% |
| 1988 | 2,088 | 976 | 1,112 | 53.3% |
| 1989 | 2,140 | 1,038 | 1,103 | 51.5% |
| 1990 | 2,164 | 1,042 | 1,122 | 51.8% |
| 1991 | 2,092 | 1,014 | 1,079 | 51.6% |
| 1992 | 2,132 | 1,037 | 1,095 | 51.4% |
| 1993 | 2,128 | 1,060 | 1,068 | 50.2% |
| 1994 | 2,215 | 1,116 | 1,099 | 49.6% |
| 1995 | 2,240 | 1,147 | 1,093 | 48.8% |
| 1996 | 2,284 | 1,183 | 1,101 | 48.2% |
| 1997 | 2,334 | 1,221 | 1,113 | 47.7% |
| 1998 | 2,339 | 1,245 | 1,094 | 46.8% |
| 1999 | 2,333 | 1,261 | 1,062 | 45.5% |
| | *Average annual percentage change* | | | |
| 1970–99 | 1.5% | 2.7% | 0.4% | |
| 1989–99 | 0.9% | 2.0% | -0.4% | |

**Source:**
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1999*, Part 5: National Summaries, New Orleans, Louisiana, 2001, Table 1-1, p. 1-3, and annual. (Additional resources: www.wrc-ndc.usace.army.mil/ndc)

[a]All movements between the U.S. and foreign countries and between Puerto Rico and the Virgin Islands and foreign countries are classified as foreign trade.

[b]All movements between U.S. ports, continental and noncontiguous, and on the inland rivers, canals, and connecting channels of the U.S., Puerto Rico, and the Virgin Islands, excluding the Panama Canal. Beginning in 1996, fish was excluded for internal and intra port domestic traffic.

**Table 12.4**
**Summary Statistics for Domestic Waterborne Commerce, 1970–99**

| Year | Number of vessels[a] | Ton-miles (billions) | Tons shipped[b] (millions) | Average length of haul (miles) | Energy intensity (Btu/ton-mile) | Energy use (trillion Btu) |
|---|---|---|---|---|---|---|
| 1970 | 25,832 | 596 | 949 | 628.2 | 545 | 324.8 |
| 1975 | 31,666 | 566 | 944 | 599.9 | 549 | 311.0 |
| 1976 | 33,204 | 592 | 976 | 606.3 | 468 | 277.3 |
| 1977 | 35,333 | 599 | 969 | 618.0 | 458 | 274.3 |
| 1978 | 35,723 | 827 | 1,072 | 771.6 | 383 | 316.6 |
| 1979 | 36,264 | 829 | 1,076 | 770.0 | 457 | 378.7 |
| 1980 | 38,792 | 922 | 1,074 | 856.4 | 358 | 329.8 |
| 1981 | 42,079 | 929 | 1,051 | 884.0 | 360 | 334.5 |
| 1982 | 42,079 | 886 | 954 | 929.0 | 310 | 274.9 |
| 1983 | 41,784 | 920 | 953 | 964.6 | 319 | 293.7 |
| 1984 | 41,784 | 888 | 1,029 | 862.5 | 346 | 307.3 |
| 1985 | 41,672 | 893 | 1,011 | 883.5 | 446 | 398.6 |
| 1986 | 40,308 | 873 | 1,033 | 845.3 | 463 | 404.0 |
| 1987 | 40,000 | 895 | 1,072 | 835.0 | 402 | 370.7 |
| 1988 | 39,192 | 890 | 1,106 | 804.3 | 361 | 321.3 |
| 1989 | 39,209 | 816 | 1,097 | 743.2 | 403 | 328.6 |
| 1990 | 39,233 | 834 | 1,118 | 745.7 | 388 | 323.2 |
| 1991 | 39,233 | 848 | 1,074 | 789.9 | 386 | 327.5 |
| 1992 | 39,210 | 857 | 1,090 | 785.7 | 398 | 341.0 |
| 1993 | 39,064 | 790 | 1,063 | 742.7 | 389 | 307.0 |
| 1994 | 39,064 | 815 | 1,093 | 745.5 | 369 | 300.7 |
| 1995 | 39,641 | 808 | 1,086 | 743.6 | 374 | 302.2 |
| 1996 | 41,104 | 765 | 1,093 | 699.4 | 412 | 314.9 |
| 1997 | 41,419 | 707 | 1,106 | 639.5 | 415 | 293.2 |
| 1998 | 42,032 | 673 | 1,087 | 619.0 | 436 | 293.1 |
| 1999 | 41,766 | 656 | 1,056 | 621.1 | 457 | 299.9 |
| | | | *Average annual percentage change* | | | |
| 1970–99 | 1.7% | 0.3% | 0.4% | 0.0% | -0.6% | -0.3% |
| 1989–99 | 0.6% | -2.2% | -0.4% | -1.8% | 1.3% | -0.9% |

**Source:**
Number of vessels -
1970–92, 1995–99 - U.S. Department of the Army, Corps of Engineers, "Summary of U.S. Flag Passenger and cargo vessels, 1999," New Orleans, LA, 2001, and annual.
1993–94 - U.S. Dept of the Army, Corps of Engineers, *The U.S. Waterway System-Facts*, Navigation Data Center, New Orleans, Louisiana, January 1996.
Ton-miles, tons shipped, average length of haul - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1999* Part 5: National Summaries, New Orleans, LA, 2001, Table 1-4, pp. 1-6, 1-7, and annual.
Energy use - See Appendix A for Table 2.5.
(Additional resources: www.wrc-ndc.usace.army.mil/ndc)

[a]Grand total for self-propelled and non-self-propelled.
[b]These figures are not consistent with the figures on Table 6.4 because intra-territory tons are not included in this table. Intra-territory traffic is traffic between ports in Puerto Rico and the Virgin Islands.

*Fifty-four percent of all domestic marine cargo in 1999 were energy-related products (petroleum, coal, coke). The majority of the energy-related products were shipped internally and locally (66%). Barge traffic accounted for 96% of all internal and local waterborne commerce.*

**Table 12.5**
**Breakdown of Domestic Marine Cargo by Commodity Class, 1999**

| | Coastwise | | Lakewise | | Internal and local | | Total domestic[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| Commodity class | Tons shipped (millions) | Average haul[b] (miles) | Tons shipped (millions) | Average haul[b] (miles) | Tons shipped (millions) | Average haul[b] (miles) | Tons shipped (millions) | Percentage | Average haul[b] (miles) |
| Petroleum and products | 162 | 1,316 | 2 | 305 | 192 | 203 | 356 | 33.7% | 710 |
| Chemicals and related products | 14 | 2,060 | [c] | 336 | 61 | 492 | 75 | 7.1% | 790 |
| Crude materials | 17 | 606 | 87 | 508 | 136 | 364 | 239 | 22.7% | 433 |
| Coal and coke | 13 | 650 | 21 | 528 | 185 | 340 | 219 | 20.7% | 396 |
| Primary manufactured goods | 8 | 612 | 4 | 295 | 34 | 833 | 45 | 4.3% | 752 |
| Food and farm products | 7 | 1,862 | [c] | 978 | 93 | 1,032 | 100 | 9.5% | 1,091 |
| Manufactured equipment | 8 | 1,698 | [c] | [c] | 10 | 90 | 18 | 1.7% | 814 |
| Waste and scrap | [c] | 1,000 | 0 | 0 | 4 | 60 | 4 | 0.4% | 60 |
| Unknown | [c] | 2,022 | [c] | [c] | [c] | [c] | [c] | 0.0% | 1,292 |
| Total | 229 | 1,279 | 114 | 501 | 713 | 429 | 1,056 | 100.0% | 621 |
| Barge traffic (million tons) | 107 | | 12 | | 685 | | 804 | | |
| Percentage by barge | 46.8% | | 10.3% | | 96.0% | | 76.1% | | |

**Source:**
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1999*, Part 5: National Summaries, New Orleans, Louisiana, 2001, Tables 2-1, 2-2, and 2-3, pp. 2-1—2-8, and annual.
(Additional resources: www.wrc-ndc.usace.army.mil/ndc)

**Note:**
Coastwise applies to domestic traffic receiving a carriage over the ocean or between the Great Lakes ports and seacoast ports when having a carriage over the ocean. Lakewise applies to traffic between United States ports on the Great Lakes. Internal applies to traffic between ports or landings wherein the entire movement takes place on inland waterways. Local applies to movements of freight within the confines of a port.

[a]Does not include intra-territory tons.
[b]Calculated as ton-miles divided by tons shipped.
[c]Negligible.

*The Interstate Commerce Commission designates Class I railroads on the basis of annual gross revenues. In 1999, nine railroads were given this designation. The number of railroads designated as Class I has changed considerably in the last 25 years; in 1976 there were 52 railroads given Class I designation.*

**Table 12.6**
**Class I Railroad Freight Systems in the United States**
**Ranked by Revenue Ton-Miles, 1999**

| Railroad | Revenue ton-miles (billions) | Percent |
|---|---|---|
| Burlington Northern and Sante Fe Railway Company | 488 | 34.0% |
| Union Pacific Railroad Company | 473 | 33.0% |
| CSX Transportation | 189 | 13.2% |
| Norfolk Southern Corporation | 166 | 11.6% |
| Consolidated Rail Corporation (Conrail) | 40 | 2.8% |
| Illinois Central Railroad Company | 25 | 1.7% |
| Kansas City Southern Railway Company | 22 | 1.5% |
| Soo Line Railroad Company | 21 | 1.5% |
| Grand Trunk Western Railroad Inc. | 11 | 0.8% |
| **Total** | **1,435** | **100.0%** |

**Source:**
Association of American Railroads, *Railroad Facts*, 2000 Edition, Washington, DC, October 2000, p. 66. (Additional resources: www.aar.org)

**Table 12.7**
**Summary Statistics for Class I Freight Railroads, 1970–99**

| Year | Number of locomotives in service[a] | Number of freight cars (thousands)[b] | Train-miles (millions) | Car-miles (millions) | Tons originated[c] (millions) | Average length of haul (miles) | Revenue ton-miles (millions) | Energy intensity (Btu/ton-mile) | Energy use (trillion Btu) |
|---|---|---|---|---|---|---|---|---|---|
| 1970 | 27,077[d] | 1,424 | 427 | 29,890 | 1,485 | 515 | 764,809 | 691 | 528.1 |
| 1975 | 27,855 | 1,359 | 403 | 27,656 | 1,395 | 541 | 754,252 | 687 | 518.3 |
| 1980 | 28,094 | 1,168 | 428 | 29,277 | 1,492 | 616 | 918,621 | 597 | 548.7 |
| 1981 | 27,421 | 1,111 | 408 | 27,968 | 1,453 | 626 | 910,169 | 572 | 521.0 |
| 1982 | 26,795 | 1,039 | 345 | 23,952 | 1,269 | 629 | 797,759 | 553 | 440.8 |
| 1983 | 25,448 | 1,007 | 346 | 24,358 | 1,293 | 641 | 828,275 | 525 | 435.1 |
| 1984 | 24,117 | 948 | 369 | 26,409 | 1,429 | 645 | 921,542 | 510 | 470.0 |
| 1985 | 22,548 | 867 | 347 | 24,920 | 1,320 | 664 | 876,984 | 497 | 436.1 |
| 1986 | 20,790 | 799 | 347 | 24,414 | 1,306 | 664 | 867,722 | 486 | 421.5 |
| 1987 | 19,647 | 749 | 361 | 25,627 | 1,372 | 688 | 943,747 | 456 | 430.3 |
| 1988 | 19,364 | 725 | 379 | 26,339 | 1,430 | 697 | 996,182 | 443 | 441.4 |
| 1989 | 19,015 | 682 | 383 | 26,196 | 1,403 | 723 | 1,013,841 | 437 | 442.6 |
| 1990 | 18,835 | 659 | 380 | 26,159 | 1,425 | 726 | 1,033,969 | 420 | 434.7 |
| 1991 | 18,344 | 633 | 375 | 25,628 | 1,383 | 751 | 1,038,875 | 391 | 405.8 |
| 1992 | 18,004 | 605 | 390 | 26,128 | 1,399 | 763 | 1,066,781 | 393 | 419.2 |
| 1993 | 18,161 | 587 | 405 | 26,883 | 1,397 | 794 | 1,109,309 | 389 | 431.6 |
| 1994 | 18,505 | 591 | 441 | 28,485 | 1,470 | 817 | 1,200,701 | 388 | 465.4 |
| 1995 | 18,812 | 583 | 458 | 30,383 | 1,550 | 843 | 1,305,688 | 372 | 485.9 |
| 1996 | 19,269 | 571 | 469 | 31,715 | 1,611 | 842 | 1,355,975 | 368 | 499.4 |
| 1997 | 19,684 | 568 | 475 | 31,660 | 1,585 | 851 | 1,348,926 | 370 | 499.7 |
| 1998 | 20,261 | 576 | 475 | 32,657 | 1,649 | 835 | 1,376,802 | 365 | 502.0 |
| 1999 | 20,256 | 579 | 490 | 33,851 | 1,717 | 835 | 1,433,461 | 362 | 520.1 |
| | | | | *Average annual percentage change* | | | | | |
| 1970–99 | -1.0% | -3.1% | 0.5% | 0.4% | 0.5% | 1.7% | 2.2% | -2.2% | -0.1% |
| 1989–99 | 0.6% | -1.6% | 2.5% | 2.6% | 2.0% | 1.5% | 3.5% | -1.9% | 1.6% |

**Source:**
Association of American Railroads, *Railroad Facts*, 2000 Edition, Washington, DC, October 2000, pp. 27, 28, 33, 34, 36, 48, 50, 60.
(Additional resources: www.aar.org)

[a]Does not include self-powered units. From 1972 to 1979, the number of locomotives used in Amtrak passenger operations are subtracted from the total locomotives used in passenger and freight service to calculate the number of Class I locomotives in service.

[b]Does not include private or shipper-owned cars.

[c]Tons originated is a more accurate representation of total tonnage than revenue tons. Revenue tons often produces double-counting of loads switched between rail companies.

[d]Data represent total locomotives used in freight and passenger service. Separate estimates are not available.

*The "other" category, which consists primarily of intermodal traffic, has grown 126% in carloads from 1974 to 1998. Coal now accounts for one quarter of all carloads.*

**Table 12.8**
**Railroad Revenue Carloads by Commodity Group, 1974 and 1999**

| Commodity group | Carloads (thousands) 1974 | Carloads (thousands) 1999 | Percent distribution 1974 | Percent distribution 1999 | Percentage change 1974–99 |
|---|---|---|---|---|---|
| Coal | 4,544 | 6,965 | 17.0% | 25.7% | 53.3% |
| Farm products | 3,021 | 1,477 | 11.3% | 5.5% | -51.1% |
| Chemicals and allied products | 1,464 | 1,844 | 5.5% | 6.8% | 26.0% |
| Nonmetallic minerals | 821 | 1,306 | 3.1% | 4.8% | 59.1% |
| Food and kindred products | 1,777 | 1,354 | 6.6% | 5.0% | -23.8% |
| Lumber and wood products | 1,930 | 673 | 7.2% | 2.5% | -65.1% |
| Metallic ores | 1,910 | 295 | 7.1% | 1.1% | -84.6% |
| Stone, clay and glass | 2,428 | 538 | 9.1% | 2.0% | -77.8% |
| Pulp, paper, and allied products | 1,180 | 612 | 4.4% | 2.3% | -48.1% |
| Petroleum products | 877 | 514 | 3.3% | 1.9% | -41.4% |
| Primary metal products | 1,366 | 709 | 5.1% | 2.6% | -48.1% |
| Waste and scrap material | 889 | 624 | 3.3% | 2.3% | -29.8% |
| Transportation equipment | 1,126 | 1,764 | 4.2% | 6.5% | 56.7% |
| Others | 3,451 | 8,422 | 12.9% | 31.1% | 144.0% |
| Total | 26,784 | 27,097 | 100.0% | 100.0% | 1.2% |

**Source:**
1974 - Association of American Railroads, *Railroad Facts*, 1976 Edition, Washington, DC, 1975, p. 26.
1999 - Association of American Railroads, *Railroad Facts*, 2000 Edition, Washington, DC, October 2000, p. 25.
(Additional resources: www.aar.org)

*The number of trailers and containers moved by railroads has increased more than four-fold from 1965 to 1999. Containerization has increased in recent years, evidenced by the 150% increase in the number of containers from 1988 to 1999. According to the 1997 Commodity Flow Survey, 5% of all freight ton-miles are rail intermodal shipments (truck/rail or rail/water). See Table 8.11 for details.*

**Table 12.9**
**Intermodal Rail Traffic, 1965–99**

| Year | Trailers & containers | Trailers | Containers |
|---|---|---|---|
| 1965 | 1,664,929 | [a] | [a] |
| 1970 | 2,363,200 | [a] | [a] |
| 1975 | 2,238,117 | [a] | [a] |
| 1980 | 3,059,402 | [a] | [a] |
| 1985 | 4,590,952 | [a] | [a] |
| 1986 | 4,997,229 | [a] | [a] |
| 1987 | 5,503,819 | [a] | [a] |
| 1988 | 5,779,547 | 3,481,020 | 2,298,527 |
| 1989 | 5,987,355 | 3,496,262 | 2,491,093 |
| 1990 | 6,206,782 | 3,451,953 | 2,754,829 |
| 1991 | 6,246,134 | 3,201,560 | 3,044,574 |
| 1992 | 6,627,841 | 3,264,597 | 3,363,244 |
| 1993 | 7,156,628 | 3,464,126 | 3,692,502 |
| 1994 | 8,128,228 | 3,752,502 | 4,375,726 |
| 1995 | 8,070,309 | 3,519,664 | 4,550,645 |
| 1996[b] | 8,153,942 | 3,320,312 | 4,833,630 |
| 1997[b] | 8,695,860 | 3,453,081 | 5,242,779 |
| 1998[b] | 8,772,663 | 3,353,032 | 5,419,631 |
| 1999[b] | 9,041,771 | 3,298,024 | 5,743,747 |
| *Average annual percentage change* | | | |
| 1965–99 | 5.2% | [a] | [a] |
| 1989–99 | 4.3% | -0.4% | 9.0% |

**Source:**
Association of American Railroads, *Railroad Facts*, 2000 edition, Washington, DC, October 2000 p. 26. (Additional resources: www.aar.org**)**

[a] Data are not available.
[b] The Grand Trunk Western Railroad and the Soo Line Railroad Company data are excluded.

**Table 12.10**
**Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971–99**

| Year | Number of locomotives in service | Number of passenger cars | Train-miles (thousands) | Car-miles (thousands) | Revenue passenger-miles (millions) | Average trip length (miles) | Energy intensity (Btu per revenue passenger-mile) | Energy use (trillion Btu) |
|---|---|---|---|---|---|---|---|---|
| 1971 | [a] | 1,165 | 16,537 | 140,147 | 1,993 | 188 | [a] | [a] |
| 1975 | 355 | 1,913 | 30,166 | 253,898 | 3,753 | 224 | 3,677 | 13.8 |
| 1980 | 448 | 2,128 | 29,487 | 235,235 | 4,503 | 217 | 3,176 | 14.3 |
| 1981 | 398 | 1,830 | 30,380 | 222,753 | 4,397 | 226 | 2,979 | 13.1 |
| 1982 | 396 | 1,929 | 28,833 | 217,385 | 3,993 | 220 | 3,156 | 12.6 |
| 1983 | 388 | 1,880 | 28,805 | 223,509 | 4,227 | 223 | 2,957 | 12.5 |
| 1984 | 387 | 1,844 | 29,133 | 234,557 | 4,427 | 227 | 3,027 | 13.4 |
| 1985 | 382 | 1,818 | 30,038 | 250,642 | 4,785 | 238 | 2,800 | 13.4 |
| 1986 | 369 | 1,793 | 28,604 | 249,665 | 5,011 | 249 | 2,574 | 12.9 |
| 1987 | 381 | 1,850 | 29,515 | 261,054 | 5,361 | 259 | 2,537 | 13.6 |
| 1988 | 391 | 1,845 | 30,221 | 277,774 | 5,686 | 265 | 2,462 | 14.0 |
| 1989 | 312 | 1,742 | 31,000 | 285,255 | 5,859 | 274 | 2,731 | 16.0 |
| 1990 | 318 | 1,863 | 33,000 | 300,996 | 6,057 | 273 | 2,609 | 15.8 |
| 1991 | 316 | 1,786 | 34,000 | 312,484 | 6,273 | 285 | 2,503 | 15.7 |
| 1992 | 336 | 1,796 | 34,000 | 307,282 | 6,091 | 286 | 2,610 | 15.9 |
| 1993 | 360 | 1,853 | 34,936 | 302,739 | 6,199 | 280 | 2,646 | 16.4 |
| 1994 | 411 | 1,874 | 34,940 | 305,600 | 5,869 | 276 | 2,351 | 13.8[b] |
| 1995 | 422 | 1,907 | 31,579 | 282,579 | 5,401 | 266 | 2,592 | 14.0 |
| 1996 | 348 | 1,501 | 30,542 | 277,750 | 5,066 | 257 | 2,783 | 14.1 |
| 1997 | 292 | 1,572 | 32,000 | 287,760 | 5,166 | 255 | 2,923 | 15.1 |
| 1998 | 362 | 1,347 | 32,926 | 315,823 | 5,325 | 251 | 2,892 | 15.4 |
| 1999 | 385 | 1,285 | 34,080 | 349,337 | 5,289 | 245 | 3,063 | 16.2 |
| | | | | *Average annual percentage change* | | | | |
| 1971–99 | [a] | 0.4% | 2.6% | 3.3% | 3.5% | 1.0% | [a] | [a] |
| 1989–99 | 2.1% | -3.0% | 1.0% | 2.0% | -1.0% | -1.1% | 1.2% | -0.1% |

**Source:**
1971–83- Association of American Railroads, Economics and Finance Department, *Statistics of Class I Railroads*, Washington, DC, and annual.
1984–88- Association of American Railroads, *Railroad Facts*, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.
1989–93- Personal communication with the Corporate Accounting Office of Amtrak, Washington, D.C.
1994–99- Number of locomotives in service, number of passenger cars, train-miles, car-miles, revenue passenger-miles, and average trip length - Association of American Railroads, *Railroad Facts*, 1999 Edition, Washington, DC, 2000, p. 77.
Energy use - Personal communication with the Amtrak, Washington, DC, and estimates thereafter based on train-miles.
(Additional resources: www.amtrak.com, www.aar.org)

[a] Data are not available.
[b] Energy use for 1994 on is not directly comparable to earlier years. Some commuter rail energy use may have been inadvertently included in earlier years.

**Table 12.11**
**Summary Statistics for Rail Transit Operations, 1970–99[a]**

| Year | Number of passenger vehicles | Vehicle-miles (millions) | Passenger trips (millions)[b] | Estimated passenger-miles (millions)[c] | Average trip length (miles)[d] | Energy intensity (Btu/passenger-mile)[e] | Energy use (trillion Btu) |
|---|---|---|---|---|---|---|---|
| 1970 | 10,548 | 440.8 | 2,116 | 12,273 | [f] | 2,453 | 30.1 |
| 1975 | 10,617 | 446.9 | 1,797 | 10,423 | [f] | 2,962 | 31.1 |
| 1980 | 10,654 | 402.2 | 2,241 | 10,939 | 4.9 | 3,008 | 32.9 |
| 1981 | 10,824 | 436.6 | 2,217 | 10,590 | 4.8 | 2,946 | 31.2 |
| 1982 | 10,831 | 445.2 | 2,201 | 10,428 | 4.6 | 3,069 | 32.0 |
| 1983 | 10,904 | 423.5 | 2,304 | 10,741 | 4.7 | 3,212 | 34.5 |
| 1984 | 10,848 | 452.7 | 2,388 | 10,531 | 4.4 | 3,732 | 39.3 |
| 1985 | 11,109 | 467.8 | 2,422 | 10,777 | 4.4 | 3,461 | 37.3 |
| 1986 | 11,083 | 492.8 | 2,467 | 11,018 | 4.5 | 3,531 | 38.9 |
| 1987 | 10,934 | 508.6 | 2,535 | 11,603 | 4.6 | 3,534 | 41.0 |
| 1988 | 11,370 | 538.3 | 2,462 | 11,836 | 4.8 | 3,565 | 42.2 |
| 1989 | 11,261 | 553.4 | 2,704 | 12,539 | 4.6 | 3,397 | 42.6 |
| 1990 | 11,332 | 560.9 | 2,521 | 12,046 | 4.8 | 3,453 | 41.6 |
| 1991 | 11,426 | 554.8 | 2,356 | 11,190 | 4.7 | 3,727 | 41.7 |
| 1992 | 11,303 | 554.1 | 2,396 | 11,441 | 4.8 | 3,575 | 40.9 |
| 1993 | 11,286 | 549.8 | 2,234 | 10,936 | 4.9 | 3,687 | 42.2 |
| 1994 | 11,192 | 565.8 | 2,453 | 11,501 | 4.8 | 3,828 | 44.0 |
| 1995 | 11,156 | 571.8 | 2,284 | 11,419 | 5.0 | 3,818 | 43.6 |
| 1996 | 11,341 | 580.7 | 2,417 | 12,484 | 5.2 | 3,444 | 43.0 |
| 1997 | 11,471 | 598.9 | 2,692 | 13,091 | 4.9 | 3,253 | 42.6 |
| 1998 | 11,521 | 609.5 | 2,669 | 13,412 | 5.0 | 3,216 | 43.1 |
| 1999 | 11,603 | 626.4 | 2,813 | 14,108 | 5.0 | 3,168 | 44.7 |
| | | | | *Average annual percentage change* | | | |
| 1970–99 | 0.3% | 1.2% | 1.0% | 0.5% | -0.7%[g] | 0.9% | 1.4% |
| 1989–99 | 0.3% | 1.2% | 0.4% | 1.2% | 0.8% | -0.7% | 0.5% |

**Source:**
American Public Transit Association, *2000 Transit Fact Book*, Washington, DC, March 2000, pp. 69, 70, 78, 83. (Additional resources: www.apta.com)
Energy use - See Appendix A for Table 2.5.

[a]Heavy rail and light rail. Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.
[b]1970–79 data represents total passenger rides; after 1979, data represents unlinked passenger trips.
[c]Estimated for years 1970–76 based on an average trip length of 5.8 miles.
[d]Calculated as the ratio of passenger-miles to passenger trips.
[e]Large system-to-system variations exist within this category.
[f]Data are not available.
[g]Average annual percentage change is calculated for years 1977-98.

# APPENDIX A

## SOURCES

This appendix contains documentation of the estimation procedures used by ORNL. The reader can examine the methodology behind the estimates and form an opinion as to their utility. The appendix is arranged by table number and subject heading. Only tables which contain ORNL estimations are documented in Appendix A; all other tables have sources listed at the bottom of the table. Since abbreviations are used throughout the appendix, a list of abbreviations is also included.

# List of Abbreviations Used in Appendix A

| | |
|---|---|
| AAMA | American Automobile Manufacturers Association |
| AAR | Association of American Railroads |
| APTA | American Public Transit Association |
| Amtrak | National Railroad Passenger Corporation |
| Btu | British thermal unit |
| DOC | Department of Commerce |
| DOE | Department of Energy |
| DOT | Department of Transportation |
| EIA | Energy Information Administration |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FHWA | Federal Highway Administration |
| gvw | gross vehicle weight |
| lpg | liquefied petroleum gas |
| mpg | miles per gallon |
| NHTSA | National Highway Traffic Safety Administration |
| NPTS | Nationwide Personal Transportation Survey |
| ORNL | Oak Ridge National Laboratory |
| pmt | passenger-miles traveled |
| RECS | Residential Energy Consumption Survey |
| RTECS | Residential Transportation Energy Consumption Survey |
| TIUS | Truck Inventory and Use Survey |
| TSC | Transportation Systems Center |
| VIUS | Vehicle Inventory and Use Survey |
| vmt | vehicle-miles traveled |

**Table 2.4**
**Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1999**

Most of the source data were given in gallons. Fuel use was converted to Btu using the conversion factors in Appendix B.

## Highway

### Automobiles

Total gallons of fuel taken from DOT, FHWA, *Highway Statistics 1999*, Table VM-1. These were distributed as follows: 90.2% gasoline, 9.0% gasohol, and 0.8% diesel.

### Motorcycles

DOT, FHWA, *Highway Statistics 1999,* Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

### Buses

***Transit:***
APTA, *2001 Transit Fact Book,* 2000, Washington, DC.
Non-diesel fossil fuel consumption was assumed to be used by motor buses.

***Intercity:***
Eno Transportation Foundation, *Transportation in America 2000*, Eighteenth Edition, 2001, Washington, DC, pp. 20–23. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

***School:***
*Gasoline and Diesel* - Eno Transportation Foundation, *Transportation in America 2000,* Eighteenth Edition, 2001, Washington, DC, pp. 20–23. For conversion purposes, fuel for school buses was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

### Trucks

***Total:***
Sum of light trucks and other trucks.

***Light Trucks:***
DOT, FHWA, *Highway Statistics 1999*, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.3% of fuel assumed to be gasoline, 3.4% diesel, 0.2% lpg; percentages were generated from the 1997 VIUS Public Use CD.

***Other Trucks:***

DOT, FHWA, *Highway Statistics 1999*, Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These gallons were distributed as follows based on data from the 1997 VIUS Public Use CD: 12.4% of fuel assumed to be gasoline, 87.1% diesel, and 0.5% lpg.

## Off-Highway

***Diesel:***

Data supplied by Marianne Mintz, Argonne National Laboratory, from the Public Use Data Base, *National Energy Accounts,* DOC, OBA-NEA-10, August 1988.

***Gasoline:***

DOT, FHWA, *Highway Statistics 1999,* Table MF-24. Agriculture and Construction totals.

## Nonhighway

### Air

***General Aviation:***

DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report Calendar Year 1999,* Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

***Domestic and International Air Carrier:***

DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables." Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel use for international flights.

### Water

***Freight:***

*Total* - DOE, EIA, *Fuel Oil and Kerosene Sales 1999*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

***Recreational Boating:***

Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

### Pipeline

The sum of natural gas, crude petroleum and petroleum product, and coal slurry and water.

*Natural Gas:*

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1999*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft$^3$. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., *End Use Energy Consumption DataBase: Transportation Sector*. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x $10^{-5}$ kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

*Crude petroleum and petroleum product:*

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, TN, 1981. (Latest available data.)

*Coal slurry and water:*

W. F. Banks, Systems, Science and Software, *Energy Consumption in the Pipeline Industry*, LaJolla, CA, October 1977. (Latest available data.)

**Rail**

***Total:***

Sum of freight and passenger rail.

***Freight:***

AAR, *Railroad Facts*, 2000 Edition, Washington, DC, 2000.

***Passenger:***

*Transit and Commuter* - APTA, *2001 Transit Fact Book*, Washington, DC, 2001. Transit was defined as the sum of "heavy rail," "light rail," and "other."

*Intercity* - Personal communication with Amtrak, Washington, DC.

**Table 2.6**
**Highway Energy Consumption by Mode, 1970–99**

**Automobiles**

Total gallons of fuel for automobiles was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996–1999 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

1970–80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980*, p. 10.
1981–82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981*, pp. 11, 13.
1983–84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983*, Jan., 1985, pp. 7, 9.
1985–87 - 98.5% gasoline, 1.5% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles 1985*, April 1987, pp. 25, 27.
1988–90 - 98.8% gasoline and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1988*, March 1990, p. 65.
1991–93 - 97.8% gasoline, 1.0% gasohol, and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1991*, December 1993, p. 46.
1994–97 - 97.7% gasoline, 1.0% gasohol, 1.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Household Vehicles Energy Consumption, 1994*, Washington, DC, August 1997, p. 46.
1998–99 - 90.8% gasoline, 9.0% gasohol, 0.8% diesel.

**Motorcycles**

Department of Transportation, Federal Highway Administration, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996–99 annual editions. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

**Buses**

Sum of transit, intercity and school.

***Transit:***

APTA, *2001 Transit Fact Book*, 2001, Washington, DC, and annual.
Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988–92, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

***Intercity:*** Eno Transportation Foundation, *Transportation in America 1999*, Seventeenth Edition, 2000, Washington, DC, pp.20–23. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

***School:*** Eno Transportation Foundation, *Transportation in America 2000* , Eighteenth Edition, 2000, Washington, DC, pp.20–23. For conversion purposes, fuel for school buses was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

**Trucks**

***Light Trucks:***

Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996–99 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970–87 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988–93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994–97 was distributed based on the 1992 TIUS: 96.4% gasoline; 3.3% diesel; 0.3% lpg. Fuel use for 1998–99 was based on the 1997 VIUS: 96.3% gasoline, 3.4% diesel, 0.2% lpg.

***Other Trucks:***

Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996–99 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970–87 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988–93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994–96 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg. Fuel use for 1997-99 was distributed as follows based on data from the 1997 VIUS Public Use CD: 12.4% of fuel assumed to be gasoline, 87.1% diesel, and 0.5% lpg.

**Total Highway**

Sum of autos, motorcycles, buses, light trucks, and other trucks.

**Table 2.7**
**Nonhighway Energy Consumption by Mode, 1970–99**

**Air**

Sum of fuel use by General Aviation and Certificated Route Air Carrier.

***General Aviation:***

*1970–74* - DOT, TSC, *National Transportation Statistics*, Cambridge, MA, 1981.
*1975–85* - DOT, FAA, *FAA Aviation Forecasts*, Washington, DC, annual.
*1985–97* - DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report, Calendar Year 1999*, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

***Certificated Route Air Carrier:***

*1970–81* - DOT, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, annual.
*1982–99*- DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables." These data are for domestic carriers, but include the international operations of those domestic carriers. The international operations total was divided in half to estimate domestic fuel use for international flights.

**Water**

Sum of vessel bunkering fuel (i.e., freight) and fuel used by recreational boats.

***Freight:***

*Total* - DOE, EIA, *Fuel Oil and Kerosene Sales 1999*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

***Recreational Boating:***

*1970–84* - DOT, FHWA, *Highway Statistics*, Washington, DC, Table MF-24, annual.
*1985–98* - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

**Pipeline**

The sum of natural gas, crude petroleum and petroleum product, and coal slurry and water.

*Natural Gas:*

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1999*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft$^3$. Electricity use was estimated using the following procedure as reported on

p. 5-110 of J. N. Hooker et al., *End Use Energy Consumption DataBase: Transportation Sector*. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x $10^{-5}$ kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

*Crude petroleum and petroleum product:*

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, Tennessee, 1981. (Latest available data.)

*Coal slurry and water:*

W. F. Banks, Systems, Science and Software, *Energy Consumption in the Pipeline Industry*, LaJolla, California, October 1977. (Latest available data.)

**Rail**

***Total:***

Sum of freight and passenger rail.

***Freight:***

AAR, *Railroad Facts*, 2000 Edition, Washington, DC.

***Passenger:***

*Transit and Commuter* - APTA, *2001 Transit Fact Book*, 2001, Washington, DC , annual. Transit was defined as the sum of "heavy rail," "light rail," and "other."

*Intercity* - Personal communication with Amtrak, Washington, DC.

**Table 2.10**
**Passenger Travel and Energy Use in the United States, 1999**

## Highway

### Automobiles

*Number of Vehicles* - DOT, FHWA, *Highway Statistics 1999* Table VM-1.
*Vmt* - DOT, FHWA, *Highway Statistics 1999*, Table VM-1.
*Pmt* - Calculated by ORNL (load factor times vmt).
*Load Factor* - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.
*Energy Use* - Total gallons of fuel taken from DOT, FHWA, *Highway Statistics 1998*, Table VM-1. These were distributed as follows: 90.2% gasoline, 9.0% gasohol, and 0.8% diesel.

### Personal Trucks

*Number of Vehicles* - Based on the 1997 TIUS, 75.2% of total 2-axle, 4-tire trucks and 16.9% of total other trucks were for personal use. Therefore, 75.2% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1999*, Table VM-1) and 16.9% of total other trucks were estimated to be for personal use.
*Vmt* - 70.7% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1999*, Table VM-1) and 7.1% of total vehicle miles traveled by other trucks were for personal use. The percentages were derived by ORNL from the 1997 VIUS Micro Data File on CD.
*Pmt* - Calculated by ORNL as vmt multiplied by load factor.
*Load Factor* - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.
*Energy Use*- Assuming that there is no difference in fuel economy (measured in miles per gallon) between personal-use trucks and non-personal use trucks, 68.5% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1998*, Table VM-1) and 3.7% of total other truck fuel consumption was for personal use. These percentages were derived by ORNL from the 1997 VIUS Public Use tape. Total truck energy use was the sum of light truck and other truck energy use.

Light Trucks: DOT, FHWA, *Highway Statistics 1999*, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.3% of fuel assumed to be gasoline, 3.4% diesel, 0.2% lpg; percentages were generated from the 1997 VIUS Public Use CD.

Other Trucks: DOT, FHWA, *Highway Statistics 1999*, Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These gallons were distributed as follows based on data from the 1997 VIUS Public Use CD: 12.4% of fuel assumed to be gasoline, 87.1% diesel, and 0.5% lpg.

### Motorcycles

*Number of Vehicles and Vmt* - DOT, FHWA, *Highway Statistics 1999*, Table VM-1.
*Pmt* - Calculated by ORNL as vmt multiplied by load factor.

*Load Factor* - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.

*Energy Use* - DOT, FHWA, *Highway Statistics 1999*, Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

**Buses**

***Transit:***

*Number of Vehicles, Vmt, Pmt, and Energy Use* - Motor bus only. APTA, *2001 Transit Fact Book*, 2001, Washington, DC.

*Load Factor* - Calculated by ORNL as pmt/vmt.

***Intercity:***

*Number of Vehicles* - Estimated by ORNL as 18% of commercial bus registrations, DOT, FHWA, *Highway Statistics 1999*, Table MV-10.

*Pmt* - Eno Transportation Foundation, *Transportation in America, 2000*, Eighteenth Edition, Washington, DC, 2001, pp. 14–15.

*Vmt* - Estimated using passenger travel and an average load factor of 23.2 persons/vehicle.

*Load Factor* -Estimated as 23.2 based on historical data.

*Energy Use* - Eno Transportation Foundation, *Transportation in America 2000*, Eighteenth Edition, 2001, Washington, DC, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

***School:***

*Number of Vehicles* - School and other nonrevenue as reported in DOT, FHWA, *Highway Statistics 1999*, Table MV-10.

*Energy Use* - Eno Transportation Foundation, *Transportation in America 2001*, Eighteenth Edition, 2001, Washington, DC, pp. 20–23. For conversion purposes, fuel for school buses was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

## Nonhighway

**Air**

***Large Certified Route Air Carriers:***

*Vmt, Pmt* - DOT, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1999/2000, Washington, DC, p. 2.

*Load Factor* - Calculated by ORNL as pmt/vmt.

*Energy Use* - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables."

***General Aviation:***

*Number of Vehicles, Vmt, Energy Use* - DOT, FAA, *General Aviation Activity and Avionics, Survey: Calendar Year 1999*, Tables 1.2, 1.5, and 5.1.

*Pmt* - Eno Transportation Foundation, *Transportation in America 2000*, Eighteenth Edition, Washington, DC, 2001, pp. 14–15.

*Load Factor* - Calculated by ORNL as pmt/vmt.

**Recreational Boating**

*Number of Vehicles* - U.S. Coast Guard, Office of Boating Safety, Washington, DC, 2001.
*Energy Use* - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

**Rail**

***Intercity:***

*Number of Vehicles, Vmt and Pmt* -AAR, *Railroad Facts*, 2000 Edition, Washington, DC, p. 77.
*Load Factor* - Calculated by ORNL as pmt/vmt.
*Energy Use* - Personal communication with Amtrak, Washington, DC.

***Transit and Commuter:***

*Number of Vehicles, Vmt and Pmt* - APTA, *2001 Transit Fact Book*, Washington, DC, 2001.
*Load Factor* - Calculated by ORNL as pmt/vmt.
*Energy Use* - APTA, *2001 Transit Fact Book*, 2001,Washington, DC. Transit was defined as the sum of "heavy rail," "light rail," and "other."

**Table 2.11**
**Energy Intensities of HighwayPassenger Modes, 1970–99**

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each passenger mode using the following data sources:

**Automobiles**

*Vmt* - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996–99 editions.

*Pmt* - vmt multiplied by the load factor.

*Energy Use* - Total gallons of fuel for automobiles was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996–99 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

1970–80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980*, p. 10.

1981–82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981*, pp. 11, 13.

1983–84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983*, Jan., 1985, pp. 7, 9.

1985–87 - 98.5% gasoline, 1.5% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles 1985*, April 1987, pp. 25, 27.

1988–90 - 98.8% gasoline and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1988*, March 1990, p. 65.

1991–93 - 97.8% gasoline, 1.0% gasohol, and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1991*, December 1993, p. 46.

1994–97 - 97.7% gasoline, 1.0% gasohol, 1.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Household Vehicles Energy Consumption 1994*, Washington, DC, August 1997, p. 46.

1998–99 - 90.2% gasoline, 9.0% gasohol, 0.8% diesel.

1993–99 - Methanol use was estimated using data from DOE, EIA, Alternatives to *Traditional Transportation Fuels 1999*, Washington, DC, 1998, Table 12.

**Light Trucks**

*Vmt* - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996–99 editions. Light trucks were defined as 2-axle, 4-tire trucks.

*Energy Use* - Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996–99 annual

editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970–87 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988–93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994–96 was distributed based on the 1992 TIUS: 96.4% gasoline; 3.3% diesel; 0.3% lpg. Fuel use for 1997–99 was based on the 1997 VIUS: 96.3% gasoline, 3.4% diesel, 0.2% lpg.

**Buses**

***Transit:***

*Vmt, Pmt, Energy Use* - APTA, *2001 Transit Fact Book*, Washington, DC, 2001, and annual.

Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988–91, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department. In 1992 data became available on non-diesel fuels.

***Intercity:***

*Pmt* - 1970–84 - American Bus Association, *Annual Report*, Washington, DC, and annual.

1985–99 - Eno Transportation Foundation, *Transportation in America 2000,* Eighteenth Edition, Washington, DC, 2001, pp. 14–15.

*Vmt* - 1990–99 - Estimated using passenger travel and an average load factor of 23.2.

Energy Use - Eno Transportation Foundation, *Transportation in America 2000*, Eighteenth Edition, Washington, DC, pp. 20–23. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

***School:***

*Vmt* - 1970–84 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, p. 175, and annual.

1985–87 - DOT, TSC, *National Transportation Statistics*, 1989, Figure 2, p. 7, and annual.

1988–98- National Safety Council, *Accident Facts*, 1999 Edition , Chicago, IL, and annual. These data are no longer available.

Energy Use - Eno Transportation Foundation, *Transportation in America 2000*, Eighteenth Edition, Washington, DC, pp. 20–23. For conversion purposes, fuel for school buses was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

**Table 2.12**
**Energy Intensities of Nonhighway Passenger Modes, 1970–99**

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each passenger mode using the following data sources:

**Air**

***Certificated Air Carriers:***

*Pmt* - DOT, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1999/2000, Washington, DC, p. 2.

*Energy Use* - 1970–76 - DOT, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, annual.

1977–99 - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables."

***General Aviation:***

*Pmt* - Eno Transportation Foundation, *Transportation In America 2000*, Eighteenth Edition, Washington, DC, 2001, pp. 14-15.

*Energy Use* - 1970–74 - DOT, TSC, *National Transportation Statistics*, Cambridge, MA, 1981.

1975–85 - DOT, FAA, *FAA Aviation Forecasts*, Washington, DC, annual.

1985–99 - DOT, FAA, *General Aviation Activity and Avionics Survey: Calendar Year 1999*, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

**Rail**

***Passenger (Amtrak):***

*Pmt* - 1971–83 - AAR, *Statistics of Class I Railroads*, Washington, DC, annual.

1984–88, 1995–96 - AAR, *Railroad Facts*, 1987 Edition, Washington, DC, December 1987, p. 78, and annual.

1989–94 - Personal communication with Amtrak.

1995–99 - AAR, *Railroad Facts*, 2000 Edition, Washington, DC, 2000, p. 77, and annual.

*Energy Use* - Personal communication with Amtrak.

***Transit:***

*Pmt and Energy Use* - APTA, *2001 Transit Fact Book*, Washington, DC, 2001.

Transit was defined as the sum of "heavy rail," "light rail."

**Table 2.13**
**Intercity Freight Movement and Energy Use in the United States, 1999**

## Highway

### Trucks

*Vehicles* - 0.4% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1999*, Table VM-1) and 29% of total other trucks were engaged in intercity freight movement. These percentages were derived by ORNL from the 1997 VIUS Micro Data File on CD. Intercity freight trucks were defined as any truck whose:

- greatest share of miles were traveled more than 50 miles away from the vehicle's home base; **and**
- principal use was not personal or passenger transportation; **and**
- body type was not pickup, minivan, or utility vehicle.

Ton Miles, Tons Shipped and Average Length of Haul - Eno Transportation Foundation, *Transportation in America 1999*, Seventeenth Edition, Washington, DC, 2000, pp. 44, 46, 71.

*Energy Intensity* - Energy use divided by ton-miles.

*Energy Use* - 1.0% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1999*, Table VM-1) and 71.3% of total other truck fuel consumption were used in intercity freight movement. These percentages were derived by ORNL from the 1997 VIUS Micro Data File on CD.

## Nonhighway

### Waterborne Commerce

*Vehicles* - U.S. Department of the Army, Army Corps of Engineers, "Summary of U.S. Flag Passenger and Cargo Vessels, 1998," New Orleans, LA, 2000.

*Ton Miles, Tons Shipped, and Average Length of Haul* - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1998, Part 5: National Summaries*, New Orleans, LA, 2000, pp. 1-6, 1-7.

*Energy Intensity* - Energy use divided by ton miles.

*Energy Use* - DOE, EIA, *Fuel Oil and Kerosene Sales 1999* Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Domestic freight energy use was calculated as:

Distillate fuel - 77.5% domestic
Residual fuel - 9.3% domestic.

Percentages were derived from the DOC, U.S. Foreign Trade, *Bunker Fuels*, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988.

### Rail

*Vehicles, Tons, Ton Miles, Average Length of Haul and Energy Use* - AAR, *Railroad Facts*, 2000 Edition, Washington, DC, 2000.

**Table 2.14**
**Energy Intensities of Freight Modes, 1970–99**

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each freight mode using the following data sources:

## Highway

### Heavy Single-Unit and Combination Trucks

*Vmt* - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996–99 editions. Heavy single-unit and combination trucks were defined as the difference between total trucks and 2-axle, 4-tire trucks.

*Energy Use* - Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996–99 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970–87 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988–93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994–96 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg. Fuel use for 1997-99 was distributed as follows based on data from the 1997 VIUS Public Use CD: 12.4% of fuel assumed to be gasoline, 87.1% diesel, and 0.5% lpg.

## Nonhighway

### Water

*Ton Miles* - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1999*, *Part 5: National Summaries*, New Orleans, LA, 2001, p. 1-6, and annual.

*Energy Use* - Calculated as the difference between total water freight energy use and foreign water freight energy use.

Total - DOE, EIA, *Fuel Oil and Kerosene Sales 1999,* Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

### Rail

*Freight Car Miles, Ton Miles and Energy Use* - AAR, *Railroad Facts*, 2000 Edition, Washington, DC, 2000, and annual.

**Table 6.4**
**Vehicle Stock and New Sales in the**
**United States, 1999 Calendar Year**

## Highway

### Automobiles

*Stock* -The number of vehicles in use by EPA size class were derived as follows: Market Shares by EPA size class for new car sales from 1970–75 were taken from the DOT, NHTSA, *Automotive Characteristics Historical DataBase*, Washington, DC. Market shares for the years 1976–90 were found in Linda S. Williams and Patricia S. Hu, *Highway Vehicle MPG and Market Shares Report: Model Year 1990*, ORNL-6672, April 1991, and Table 7 and the ORNL MPG and Market Shares Database, thereafter. These data were assumed to represent the number of cars registered in each size class for each year. These percentages were applied to the automobiles in operation for that year as reported by The Polk Company (FURTHER REPRODUCTION PROHIBITED) and summed to calculate the total mix. This method assumed that all vehicles, large and small, were scrapped at the same rate.

*Sales* - Domestic, import, and total sales were from *Ward's Motor Vehicle Facts and Figures 2000* , p. 15. The domestic sales were distributed by size class according to the following percentages: Two seater, 0.7%; Minicompact, 0.0%; Subcompact, 19.9%; Compact 26.5%; Midsize, 36.5%; and Large, 16.3%. The import sales were distributed by size class according to the following percentages: Two-seater, 3.2%; Minicompact, 0.8%; Subcompact, 13.7%; Compact, 31.2%; Midsize, 49.2; and Large, 1.9%. These percentages were derived from the ORNL MPG and Market Shares Database. Domestic-sponsored imports (captive imports) were included in the import figure only.

*Business fleet autos* - Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2000*, Redondo Beach, CA, 2000.

*Personal autos* - Difference between total vehicle stock and business fleet autos.

***See Glossary for definition of Automobile Size Classifications.***

### Motorcycles

*Stock* - DOT, FHWA, *Highway Statistics 1999*, Table VM-1, 2001.

### Recreational Vehicles

*Sales* - *Ward's Automotive Yearbook 2000*, U.S. Recreation Vehicle Shipments by Type, "Total," p. 242.

**Trucks**

*Stock* - Vehicles in use by weight class were determined by applying the percentage in use by weight class as reported in DOC, Bureau of the Census, 1997 VIUS, (0–10,000 lbs, 93.5%; 10,001–19,500 lbs, 2.0%; 19,501–26,000 lbs, 1.0%; 26,001 lbs and over, 3.5%) to the total number of trucks in use as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED).

*Sales -Ward's Motor Vehicle Facts and Figures 2000*, p. 24.

*Business fleet trucks* - Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2000*, Redondo Beach, CA, 2001.

*Personal trucks* - Difference between total stock and business fleet trucks.

# APPENDIX B
# CONVERSIONS

## A Note About Heating Values

The heat content of a fuel is the quantity of energy released by burning a unit amount of that fuel. However, this value is not absolute and can vary according to several factors. For example, empirical formulae for determining the heating value of liquid fuels depend on the fuels' American Petroleum Institute (API) gravity. The API gravity varies depending on the percent by weight of the chemical constituents and impurities in the fuel, both of which are affected by the combination of raw materials used to produce the fuel and by the type of manufacturing process. Temperature and climatic conditions are also factors.

Because of these variations, the heating values in Table B.1 may differ from values in other publications. The figures in this report are representative or average values, not absolute ones. The gross heating values used here agree with those used by the Energy Information Administration (EIA).

Heating values fall into two categories, gross and net. If the products of fuel combustion are cooled back to the initial fuel-air or fuel-oxidizer mixture temperature and the water formed during combustion is condensed, the energy released by the process is the higher (gross) heating value. If the products of combustion are cooled to the initial fuel-air temperature, but the water is considered to remain as a vapor, the energy released by the process is lower (net) heating value. Usually the difference between the gross and net heating values for fuels used in transportation is around 5 to 8 percent; however, it is important to be consistent in their use.

**Table B.1**
**Approximate Heat Content for Various Fuels**

| | |
|---|---|
| **Automotive gasoline** | 125,000 Btu/gal(gross) = 115,400 Btu/gal(net) |
| **Diesel motor fuel** | 138,700 Btu/gal (gross) = 128,700 Btu/gal (net) |
| **Methanol** | 64,600 Btu/gal (gross) = 56,560 Btu/gal (net) |
| **Ethanol** | 84,600 Btu/gal (gross) = 75,670 Btu/gal (net) |
| **Gasohol** | 120,900 Btu/gal (gross) = 112,417 Btu/gal (net) |
| **Aviation gasoline** | 120,200 Btu/gal (gross) = 112,000 Btu/gal (net) |
| **Propane** | 91,300 Btu/gal (gross) = 83,500 Btu/gal (net) |
| **Butane** | 103,000 Btu/gal (gross) = 93,000 Btu/gal (net) |
| **Jet fuel (naphtha)** | 127,500 Btu/gal (gross) = 118,700 Btu/gal (net) |
| **Jet fuel (kerosene)** | 135,000 Btu/gal (gross) = 128,100 Btu/gal (net) |
| **Lubricants** | 144,400 Btu/gal (gross) = 130,900 Btu/gal (net) |
| **Waxes** | 131,800 Btu/gal (gross) = 120,200 Btu/gal (net) |
| **Asphalt and road oil** | 158,000 Btu/gal (gross) = 157,700 Btu/gal (net) |
| **Petroleum coke** | 143,400 Btu/gal (gross) = 168,300 Btu/gal (net) |
| **Natural gas** | |
| Wet | 1,109 Btu/$ft^3$ |
| Dry | 1,027 Btu/$ft^3$ |
| Compressed | 20,551 Btu/pound |
| | 960 Btu/cubic foot |
| Liquid | 90,800 Btu/gal (gross) = 87,600 Btu/gal (net) |
| **Crude petroleum** | 138,100 Btu/gal (gross) = 131,800 Btu/gal (net) |
| **Fuel Oils** | |
| Residual | 149,700 Btu/gal (gross) = 138,400 Btu/gal (net) |
| Distillate | 138,700 Btu/gal (gross) = 131,800 Btu/gal (net) |
| **Coal** | |
| Anthracite - Consumption | 21.711 x $10^6$ Btu/short ton |
| Bituminous and lignite - Consumption | 21.012 x $10^6$ Btu/short ton |
| Production average | 21.352 x $10^6$ Btu/short ton |
| Consumption average | 21.015 x $10^6$ Btu/short ton |

**Table B.2**
**Fuel Equivalents**

| | |
|---|---|
| 1 million bbl crude oil/day | = 0.3650 billion bbl crude oil/year<br>= 2.117 quadrillion Btu/year<br>= 99.45 million short tons coal/year<br>= 90.22 million metric tons coal/year<br>= 2.061 trillion $ft^3$ natural gas/year<br>= 2,233 petajoule/year |
| 1 billion bbl crude oil/year | = 2.740 million bbl crude oil/day<br>= 5.800 quadrillion Btu/year<br>= 272.5 million short tons coal/year<br>= 247.2 million metric tons coal/year<br>= 5.648 trillion $ft^3$ natural gas/year<br>= 6,119 petajoule/year |
| 1 quadrillion Btu/year | = 0.4724 million bbl crude oil/day<br>= 172.4 million bbl crude oil/year<br>= 46.98 million short tons coal/year<br>= 42.62 million metric tons coal/year<br>= 973.7 billion $ft^3$ natural gas/year<br>= 1.055 petajoule/year |
| 1 billion short tons coal/year | = 0.9072 billion metric tons coal/year<br>= 10.06 million bbl crude oil/day<br>= 3.670 billion bbl crude oil/year<br>= 21.29 quadrillion Btu/year<br>= 20.73 trillion $ft^3$ natural gas/year<br>= 22,468 petajoule/year |
| 1 billion metric tons coal/year | = 1.102 billion short tons coal/year<br>= 9.122 million bbl crude oi l/day<br>= 3.330 billion bbl crude oil/year<br>= 19.31 quadrillion btu/year<br>= 18.80 trillion $ft^3$ natural gas/year<br>= 20.37 exajoules/year |
| 1 trillion $ft^3$ natural gas/year | = 0.4851 million bbl crude oil/day<br>= 0.1771 billion bbl crude oil/year<br>= 1.027 quadrillion Btu/year<br>= 48.25 million short tons coal/year<br>= 43.77 million metric tons coal/year<br>= 1.083 petajoules/year |
| 1 petajoule/year | = 447.7 bbl crude oil/day<br>= 163.4 thousand bbl crude oil/year<br>= 0.947 trillion Btu/year<br>= 44.53 thousand short tons coal/year<br>= 40.40 thousand metric tons coal/year<br>= 0.9229 billion $ft^3$ natural gas/year |

**Table B.3**
**Energy Unit Conversions**

| | | | |
|---|---|---|---|
| 1 Btu | = 778.2 ft-lb | 1 kWhr | = 3412 Btu[a] |
| | = 107.6 kg-m | | = $2.655 \times 10^{6}$ ft-lb |
| | = 1055 J | | = $3.671 \times 10^{5}$ kg-m |
| | = $39.30 \times 10^{-5}$ hp-h | | = $3.600 \times 10^{6}$ J |
| | = $39.85 \times 10^{-5}$ metric hp-h | | = 1.341 hp-h |
| | = $29.31 \times 10^{-5}$ kWhr | | = 1.360 metric hp-h |
| 1 kg-m | = $92.95 \times 10^{-4}$ Btu | 1 Joule | = $94.78 \times 10^{-5}$ Btu |
| | = 7.233 ft-lb | | = 0.7376 ft-lb |
| | = 9.806 J | | = 0.1020 kg-m |
| | = $36.53 \times 10^{-7}$ hp-h | | = $37.25 \times 10^{-8}$ hp-h |
| | = $37.04 \times 10^{-7}$ metric hp-h | | = $37.77 \times 10^{-8}$ metric hp-h |
| | = $27.24 \times 10^{-7}$ kWhr | | = $27.78 \times 10^{-8}$ kWhr |
| 1 hp-h | = 2544 Btu | 1 metric hp-h | = 2510 Btu |
| | = $1.98 \times 10^{6}$ ft-lb | | = $1.953 \times 10^{6}$ ft-lb |
| | = $2.738 \times 10^{6}$ kgm | | = $27.00 \times 10^{4}$ kg-m |
| | = $2.685 \times 10^{6}$ J | | = $2.648 \times 10^{6}$ J |
| | = 1.014 metric hp-h | | = 0.9863 hp-h |
| | = 0.7475 kWhr | | = 0.7355 kWhr |

[a]This figure does not take into account the fact that electricity generation and distribution efficiency is approximately 29%. If generation and distribution efficiency are taken into account, 1 kWhr = 11,765 Btu.

**Table B.4**
**International Energy Conversions**

| **To:** | **Terajoules** | **Giga-calories** | **Million tonnes of oil equivalent** | **Million Btu** | **Gigawatt-hours** |
|---|---|---|---|---|---|
| **From:** | *multiply by:* | | | | |
| **Terajoules** | 1 | 238.8 | $2.388 \times 10^{-5}$ | 947.8 | 0.2778 |
| **Gigacalories** | $4.1868 \times 10^{-3}$ | 1 | $10^{-7}$ | 3.968 | $1.163 \times 10^{-3}$ |
| **Million tonnes of oil equivalent** | $4.1868 \times 10^{4}$ | $10^{7}$ | 1 | $3.968 \times 10^{7}$ | 11,630 |
| **Million Btu** | $1.0551 \times 10^{-3}$ | 0.252 | $2.52 \text{ X } 10^{-8}$ | 1 | $2.931 \times 10^{-4}$ |
| **Gigawatthours** | 3.6 | 860 | $8.6 \times 10^{-5}$ | 3412 | 1 |

**Table B.5**
**Distance and Velocity Conversions**

| | | | |
|---|---|---|---|
| 1 in. | = 83.33 x $10^{-3}$ ft | 1 ft | = 12.0 in. |
| | = 27.78 x $10^{-3}$ yd | | = 0.33 yd |
| | = 15.78 x $10^{-6}$ mile | | = 189.4 x $10^{-3}$ mile |
| | = 25.40 x $10^{-3}$ m | | = 0.3048 m |
| | = 0.2540 x $10^{-6}$ km | | = 0.3048 x $10^{-3}$ km |
| 1 mile | = 63360 in. | 1 km | = 39370 in. |
| | = 5280 ft | | = 3281 ft |
| | = 1760 yd | | = 1093.6 yd |
| | = 1609 m | | = 0.6214 mile |
| | = 1.609 km | | = 1000 m |

1 ft/sec = 0.3048 m/s = 0.6818 mph = 1.0972 km/h
1 m/sec = 3.281 ft/s = 2.237 mph = 3.600 km/h
1 km/h = 0.9114 ft/s = 0.2778 m/s = 0.6214 mph
1 mph = 1.467 ft/s = 0.4469 m/s = 1.609 km/h

**Table B.6**
**Alternative Measures of Greenhouse Gases**

| | | |
|---|---|---|
| 1 pound methane, measured in carbon units ($CH_4$) | = | 1.333 pounds methane, measured at full molecular weight ($CH_4$) |
| 1 pound carbon dioxide, measured in carbon units ($CO_2$-C) | = | 3.6667 pounds carbon dioxide, measured at full molecular weight ($CO_2$) |
| 1 pound carbon monoxide, measured in carbon units (CO-C) | = | 2.333 pounds carbon monoxide, measured at full molecular weight (CO) |
| 1 pound nitrous oxide, measured in nitrogen units ($N_2O$-N) | = | 1.571 pounds nitrous oxide, measured at full molecular weight ($N_2O$) |

**Table B.7**
**Volume and Flow Rate Conversions[a]**

| | | | |
|---|---|---|---|
| 1 U.S. gal | = 231 in.$^3$ | 1 liter | = 61.02 in.$^3$ |
| | = 0.1337 ft$^3$ | | = 3.531 x 10$^{-2}$ ft$^3$ |
| | = 3.785 liters | | = 0.2624 U.S. gal |
| | = 0.8321 imperial gal | | = 0.2200 imperial gal |
| | = 0.0238 bbl | | = 6.29 x 10$^{-3}$ bbl |
| | = 0.003785 m$^3$ | | = 0.001 m$^3$ |
| | **A U.S. gallon of gasoline weighs 6.2 pounds** | | |
| 1 imperial gal | = 277.4 in.$^3$ | 1 bbl | = 9702 in.$^3$ |
| | = 0.1606 ft$^3$ | | = 5.615 ft$^3$ |
| | = 4.545 liters | | = 158.97 liters |
| | = 1.201 U.S. gal | | = 42 U.S. gal |
| | = 0.0286 bbl | | = 34.97 imperial gal |
| | = 0.004546 m$^3$ | | = 0.15897 m$^3$ |
| 1 U.S. gal/hr | = 3.209 ft$^3$/day | | = 1171 ft$^3$/year |
| | = 90.84 liter/day | | = 33157 liter/year |
| | = 19.97 imperial gal/day | | = 7289 imperial gal/year |
| | = 0.5712 bbl/day | | = 207.92 bbl/year |
| | **For Imperial gallons, multiply above values by 1.201** | | |
| 1 liter/hr | = 0.8474 ft$^3$/day | | = 309.3 ft$^3$/year |
| | = 6.298 U.S. gal/day | | = 2299 U.S. gal/year |
| | = 5.28 imperial gal/day | | = 1927 imperial gal/year |
| | = 0.1510 bbl/day | | = 55.10 bbl/year |
| 1 bbl/hr | = 137.8 ft$^3$/year | | = 49187 ft$^3$ year |
| | = 1008 U.S. gal/day | | = 3.679 x 10$^5$ U.S. gal/year |
| | = 839.3 imperial gal/day | | = 3.063 x 10$^5$ imperial gal/year |
| | = 3815 liter/day | | = 1.393 x 10$^6$ liter/day |

[a]The conversions for flow rates are identical to those for volume measures, if the time units are identical.

**Table B.8**
**Power Conversions**

| | TO | | | | | |
|---|---|---|---|---|---|---|
| FROM | Horsepower | Kilowatts | Metric horsepower | Ft-lb per sec | Kilocalories per sec | Btu per sec |
| Horsepower | 1.000 | 0.7457 | 1.014 | 550 | 0.1781 | 0.7068 |
| Kilowatts | 1.341 | 1.000 | 1.360 | 737.6 | 0.239 | 0.9478 |
| Metric horsepower | 0.9863 | 0.7355 | 1.000 | 542.5 | 0.1757 | 0.6971 |
| Ft-lb per sec | $1.36 \times 10^{-3}$ | $1.356 \times 10^{-3}$ | $1.84 \times 10^{-3}$ | 1.000 | $0.3238 \times 10^{-3}$ | $1.285 \times 10^{-3}$ |
| Kilocalories per sec | 5.615 | 4.184 | 5.692 | 3088 | 1.000 | 3.968 |
| Btu per sec | 1.415 | 1.055 | 1.434 | 778.2 | 0.2520 | 1.000 |

**Table B.9**
**Mass Conversions**

| | TO | | | | |
|---|---|---|---|---|---|
| FROM | Pound | Kilogram | Short ton | Long ton | Metric ton |
| Pound | 1 | 0.4536 | $5.0 \times 10^{-4}$ | $4.4643 \times 10^{-4}$ | $4.5362 \times 10^{-4}$ |
| Kilogram | 2.205 | 1 | $1.1023 \times 10^{-3}$ | $9.8425 \times 10^{-4}$ | $1.0 \times 10^{-3}$ |
| Short ton | 2000 | 907.2 | 1 | 0.8929 | 0.9072 |
| Long ton | 2240 | 1016 | 1.12 | 1 | 1.016 |
| Metric ton | 2205 | 1000 | 1.102 | 0.9842 | 1 |

**Table B.10**
**Fuel Efficiency Conversions[a]**

| MPG | Miles/liter | Kilometers/L | L/100 kilometers |
|---|---|---|---|
| 10 | 2.64 | 4.25 | 23.52 |
| 15 | 3.96 | 6.38 | 15.68 |
| 20 | 5.28 | 8.50 | 11.76 |
| 25 | 6.60 | 10.63 | 9.41 |
| 30 | 7.92 | 12.75 | 7.84 |
| 35 | 9.25 | 14.88 | 6.72 |
| 40 | 10.57 | 17.00 | 5.88 |
| 45 | 11.89 | 19.13 | 5.23 |
| 50 | 13.21 | 21.25 | 4.70 |
| 55 | 14.53 | 23.38 | 4.28 |
| 60 | 15.85 | 25.51 | 3.92 |
| 65 | 17.17 | 27.63 | 3.62 |
| 70 | 18.49 | 29.76 | 3.36 |
| 75 | 19.81 | 31.88 | 3.14 |
| 80 | 21.13 | 34.01 | 2.94 |
| 85 | 22.45 | 36.13 | 2.77 |
| 90 | 23.77 | 38.26 | 2.61 |
| 95 | 25.09 | 40.38 | 2.48 |
| 100 | 26.42 | 42.51 | 2.35 |
| 105 | 27.74 | 44.64 | 2.24 |
| 110 | 29.06 | 46.76 | 2.14 |
| 115 | 30.38 | 48.89 | 2.05 |
| 120 | 31.70 | 51.01 | 1.96 |
| 125 | 33.02 | 53.14 | 1.88 |
| 130 | 34.34 | 55.26 | 1.81 |
| 135 | 35.66 | 57.39 | 1.74 |
| 140 | 36.98 | 59.51 | 1.68 |
| 145 | 38.30 | 61.64 | 1.62 |
| 150 | 39.62 | 63.76 | 1.57 |
| Formula | MPG/3.785 | MPG/[3.785/1.609] | 235.24/MPG |

**Table B.11**
**SI Prefixes and Their Values**

| | Value | Prefix | Symbol |
|---|---|---|---|
| One million million millionth | $10^{-18}$ | atto | a |
| One thousand million millionth | $10^{-15}$ | femto | f |
| One million millionth | $10^{-12}$ | pico | p |
| One thousand millionth | $10^{-9}$ | nano | n |
| One millionth | $10^{-6}$ | micro | μ |
| One thousandth | $10^{-3}$ | milli | m |
| One hundredth | $10^{-2}$ | centi | c |
| One tenth | $10^{-1}$ | deci | |
| One | $10^{0}$ | | |
| Ten | $10^{1}$ | deca | |
| One hundred | $10^{2}$ | hecto | |
| One thousand | $10^{3}$ | kilo | k |
| One million | $10^{6}$ | mega | M |
| One billion[a] | $10^{9}$ | giga | G |
| One trillion[a] | $10^{12}$ | tera | T |
| One quadrillion[a] | $10^{15}$ | peta | P |
| One quintillion[a] | $10^{18}$ | exa | E |

[a]Care should be exercised in the use of this nomenclature, especially in foreign correspondence, as it is either unknown or carries a different value in other countries. A "billion," for example, signifies a value of $10^{12}$ in most other countries.

**Table B.12**
**Metric Units and Abbreviations**

| Quantity | Unit name | Symbol |
|---|---|---|
| Energy | joule | J |
| Specific energy | joule/kilogram | J/kg |
| Specific energy consumption | joule/kilogram•kilometer | J/(kg•km) |
| Energy consumption | joule/kilometer | J/km |
| Energy economy | kilometer/kilojoule | km/kJ |
| Power | kilowatt | Kw |
| Specific power | watt/kilogram | W/kg |
| Power density | watt/meter$^3$ | W/m$^3$ |
| Speed | kilometer/hour | km/h |
| Acceleration | meter/second$^2$ | m/s$^2$ |
| Range (distance) | kilometer | km |
| Weight | kilogram | kg |
| Torque | newton•meter | N•m |
| Volume | meter$^3$ | m$^3$ |
| Mass; payload | kilogram | kg |
| Length; width | meter | m |
| Brake specific fuel consumption | kilogram/joule | kg/J |
| Fuel economy (heat engine) | liters/100 km | L/100 km |

## Conversion of Constant Dollar Values

Many types of information in this data book are expressed in dollars. Generally, constant dollars are used--that is, dollars of a fixed value for a specific year, such as 1990 dollars. Converting current dollars to constant dollars, or converting constant dollars for one year to constant dollars for another year, requires conversion factors (Table B.13 and B.14). Table B.13 shows conversion factors for the Consumer Price Index inflation factors. Table B.14 shows conversion factors using the Gross National Product inflation factors.

Due to the size of the tables, the data in Tables B.13 and B.14 were changed to two decimal places starting with Edition 17 and data for years 1971–74 were taken off in Edition 21. However, three decimal places were used to calculate all constant dollar values.

## Table B.13
## Consumer Price Inflation (CPI) Index

| From | To | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1970** | **1975** | **1976** | **1977** | **1978** | **1979** | **1980** | **1981** | **1982** | **1983** | **1984** | **1985** | **1986** | **1987** | **1988** | **1989** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** |
| **1970** | 1.00 | 1.39 | 1.47 | 1.56 | 1.68 | 1.87 | 2.12 | 2.34 | 2.49 | 2.57 | 2.68 | 2.77 | 2.82 | 2.93 | 3.05 | 3.19 | 3.37 | 3.51 | 3.61 | 3.72 | 3.82 | 3.93 | 4.04 | 4.13 | 4.20 | 4.29 | 4.44 |
| **1975** | 0.72 | 1.00 | 1.06 | 1.13 | 1.21 | 1.35 | 1.53 | 1.69 | 1.79 | 1.85 | 1.93 | 2.00 | 2.04 | 2.11 | 2.20 | 2.30 | 2.43 | 2.53 | 2.61 | 2.68 | 2.75 | 2.83 | 2.92 | 2.98 | 3.03 | 3.10 | 3.20 |
| **1976** | 0.68 | 0.95 | 1.00 | 1.07 | 1.15 | 1.28 | 1.45 | 1.60 | 1.70 | 1.75 | 1.82 | 1.89 | 1.93 | 2.00 | 2.08 | 2.18 | 2.30 | 2.39 | 2.47 | 2.54 | 2.60 | 2.68 | 2.76 | 2.82 | 2.86 | 2.93 | 3.03 |
| **1977** | 0.64 | 0.89 | 0.94 | 1.00 | 1.08 | 1.20 | 1.36 | 1.50 | 1.59 | 1.65 | 1.72 | 1.78 | 1.81 | 1.88 | 1.95 | 2.05 | 2.16 | 2.25 | 2.32 | 2.38 | 2.45 | 2.52 | 2.59 | 2.65 | 2.69 | 2.75 | 2.84 |
| **1978** | 0.60 | 0.83 | 0.87 | 0.93 | 1.00 | 1.11 | 1.27 | 1.40 | 1.48 | 1.53 | 1.59 | 1.65 | 1.68 | 1.74 | 1.81 | 1.90 | 2.00 | 2.09 | 2.15 | 2.21 | 2.27 | 2.34 | 2.40 | 2.46 | 2.50 | 2.55 | 2.64 |
| **1979** | 0.54 | 0.74 | 0.78 | 0.84 | 0.90 | 1.00 | 1.14 | 1.25 | 1.33 | 1.37 | 1.43 | 1.48 | 1.51 | 1.57 | 1.63 | 1.71 | 1.80 | 1.88 | 1.93 | 1.99 | 2.04 | 2.10 | 2.16 | 2.21 | 2.25 | 2.30 | 2.37 |
| **1980** | 0.47 | 0.65 | 0.69 | 0.74 | 0.79 | 0.88 | 1.00 | 1.10 | 1.17 | 1.21 | 1.26 | 1.31 | 1.33 | 1.38 | 1.44 | 1.50 | 1.59 | 1.65 | 1.70 | 1.75 | 1.80 | 1.85 | 1.90 | 1.95 | 1.98 | 2.02 | 2.09 |
| **1981** | 0.43 | 0.59 | 0.63 | 0.67 | 0.72 | 0.80 | 0.91 | 1.00 | 1.06 | 1.10 | 1.14 | 1.18 | 1.21 | 1.25 | 1.30 | 1.36 | 1.44 | 1.50 | 1.54 | 1.59 | 1.63 | 1.68 | 1.73 | 1.77 | 1.79 | 1.83 | 1.89 |
| **1982** | 0.40 | 0.56 | 0.59 | 0.63 | 0.68 | 0.75 | 0.85 | 0.94 | 1.00 | 1.03 | 1.08 | 1.11 | 1.14 | 1.18 | 1.23 | 1.28 | 1.35 | 1.41 | 1.45 | 1.50 | 1.54 | 1.58 | 1.63 | 1.66 | 1.69 | 1.73 | 1.78 |
| **1983** | 0.39 | 0.54 | 0.57 | 0.61 | 0.66 | 0.73 | 0.83 | 0.91 | 0.97 | 1.00 | 1.04 | 1.08 | 1.10 | 1.14 | 1.19 | 1.24 | 1.31 | 1.37 | 1.41 | 1.45 | 1.49 | 1.53 | 1.57 | 1.61 | 1.64 | 1.67 | 1.73 |
| **1984** | 0.37 | 0.52 | 0.55 | 0.58 | 0.63 | 0.70 | 0.79 | 0.88 | 0.93 | 0.96 | 1.00 | 1.04 | 1.06 | 1.09 | 1.14 | 1.19 | 1.26 | 1.31 | 1.35 | 1.39 | 1.43 | 1.47 | 1.51 | 1.55 | 1.57 | 1.60 | 1.66 |
| **1985** | 0.36 | 0.50 | 0.53 | 0.56 | 0.61 | 0.68 | 0.77 | 0.85 | 0.90 | 0.93 | 0.97 | 1.00 | 1.02 | 1.06 | 1.10 | 1.15 | 1.22 | 1.27 | 1.30 | 1.34 | 1.38 | 1.42 | 1.46 | 1.49 | 1.52 | 1.55 | 1.60 |
| **1986** | 0.35 | 0.49 | 0.52 | 0.55 | 0.60 | 0.66 | 0.75 | 0.83 | 0.88 | 0.91 | 0.95 | 0.98 | 1.00 | 1.04 | 1.08 | 1.13 | 1.19 | 1.24 | 1.28 | 1.32 | 1.35 | 1.39 | 1.43 | 1.46 | 1.49 | 1.52 | 1.57 |
| **1987** | 0.34 | 0.47 | 0.50 | 0.53 | 0.57 | 0.64 | 0.73 | 0.80 | 0.85 | 0.88 | 0.91 | 0.95 | 0.96 | 1.00 | 1.04 | 1.09 | 1.15 | 1.20 | 1.24 | 1.27 | 1.30 | 1.34 | 1.38 | 1.41 | 1.43 | 1.47 | 1.52 |
| **1988** | 0.33 | 0.46 | 0.48 | 0.51 | 0.55 | 0.61 | 0.70 | 0.77 | 0.82 | 0.84 | 0.88 | 0.91 | 0.93 | 0.96 | 1.00 | 1.05 | 1.11 | 1.15 | 1.19 | 1.22 | 1.25 | 1.29 | 1.33 | 1.36 | 1.38 | 1.41 | 1.46 |
| **1989** | 0.31 | 0.43 | 0.46 | 0.49 | 0.53 | 0.59 | 0.67 | 0.73 | 0.78 | 0.80 | 0.84 | 0.87 | 0.88 | 0.92 | 0.95 | 1.00 | 1.05 | 1.10 | 1.13 | 1.17 | 1.20 | 1.23 | 1.27 | 1.29 | 1.32 | 1.34 | 1.39 |
| **1990** | 0.30 | 0.41 | 0.44 | 0.46 | 0.50 | 0.56 | 0.63 | 0.70 | 0.74 | 0.76 | 0.80 | 0.82 | 0.84 | 0.87 | 0.91 | 0.95 | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.17 | 1.20 | 1.23 | 1.25 | 1.27 | 1.32 |
| **1991** | 0.29 | 0.40 | 0.42 | 0.45 | 0.48 | 0.53 | 0.61 | 0.67 | 0.71 | 0.73 | 0.76 | 0.79 | 0.81 | 0.83 | 0.87 | 0.91 | 0.96 | 1.00 | 1.03 | 1.06 | 1.09 | 1.12 | 1.15 | 1.18 | 1.20 | 1.22 | 1.26 |
| **1992** | 0.28 | 0.38 | 0.41 | 0.43 | 0.47 | 0.52 | 0.59 | 0.65 | 0.69 | 0.71 | 0.74 | 0.77 | 0.78 | 0.81 | 0.84 | 0.88 | 0.93 | 0.97 | 1.00 | 1.03 | 1.06 | 1.09 | 1.12 | 1.14 | 1.16 | 1.19 | 1.23 |
| **1993** | 0.27 | 0.37 | 0.39 | 0.42 | 0.45 | 0.50 | 0.57 | 0.63 | 0.67 | 0.69 | 0.72 | 0.75 | 0.76 | 0.79 | 0.82 | 0.86 | 0.91 | 0.94 | 0.97 | 1.00 | 1.03 | 1.06 | 1.09 | 1.11 | 1.13 | 1.15 | 1.19 |
| **1994** | 0.26 | 0.36 | 0.38 | 0.41 | 0.44 | 0.49 | 0.56 | 0.61 | 0.65 | 0.67 | 0.70 | 0.73 | 0.74 | 0.77 | 0.80 | 0.84 | 0.88 | 0.92 | 0.95 | 0.98 | 1.00 | 1.03 | 1.06 | 1.08 | 1.10 | 1.12 | 1.16 |
| **1995** | 0.26 | 0.35 | 0.37 | 0.40 | 0.43 | 0.48 | 0.54 | 0.60 | 0.63 | 0.65 | 0.68 | 0.71 | 0.72 | 0.75 | 0.78 | 0.81 | 0.86 | 0.89 | 0.92 | 0.95 | 0.97 | 1.00 | 1.03 | 1.05 | 1.07 | 1.09 | 1.13 |
| **1996** | 0.25 | 0.34 | 0.36 | 0.39 | 0.42 | 0.46 | 0.53 | 0.58 | 0.62 | 0.64 | 0.66 | 0.69 | 0.70 | 0.72 | 0.75 | 0.79 | 0.83 | 0.87 | 0.89 | 0.92 | 0.94 | 0.97 | 1.00 | 1.02 | 1.04 | 1.06 | 1.10 |
| **1997** | 0.24 | 0.34 | 0.35 | 0.38 | 0.41 | 0.45 | 0.51 | 0.57 | 0.60 | 0.62 | 0.65 | 0.67 | 0.68 | 0.71 | 0.74 | 0.77 | 0.81 | 0.85 | 0.87 | 0.90 | 0.92 | 0.95 | 0.98 | 1.000 | 1.02 | 1.04 | 1.07 |
| **1998** | 0.24 | 0.33 | 0.35 | 0.37 | 0.40 | 0.45 | 0.51 | 0.56 | 0.59 | 0.61 | 0.64 | 0.66 | 0.67 | 0.70 | 0.73 | 0.76 | 0.80 | 0.84 | 0.86 | 0.89 | 0.91 | 0.94 | 0.96 | 0.980 | 1.00 | 1.02 | 1.06 |
| **1999** | 0.23 | 0.32 | 0.34 | 0.36 | 0.39 | 0.44 | 0.49 | 0.55 | 0.58 | 0.60 | 0.62 | 0.65 | 0.66 | 0.68 | 0.71 | 0.74 | 0.78 | 0.82 | 0.84 | 0.87 | 0.89 | 0.92 | 0.94 | 0.960 | 0.98 | 1.00 | 1.03 |
| **2000** | 0.23 | 0.31 | 0.33 | 0.35 | 0.38 | 0.42 | 0.48 | 0.53 | 0.56 | 0.58 | 0.60 | 0.62 | 0.64 | 0.66 | 0.69 | 0.72 | 0.76 | 0.79 | 0.81 | 0.84 | 0.86 | 0.89 | 0.91 | 0.93 | 0.95 | 0.97 | 1.00 |

**Source:**
U.S. Bureau of Labor Statistics.

## Table B.14
## Gross National Product (GNP) Implicit Price Deflator

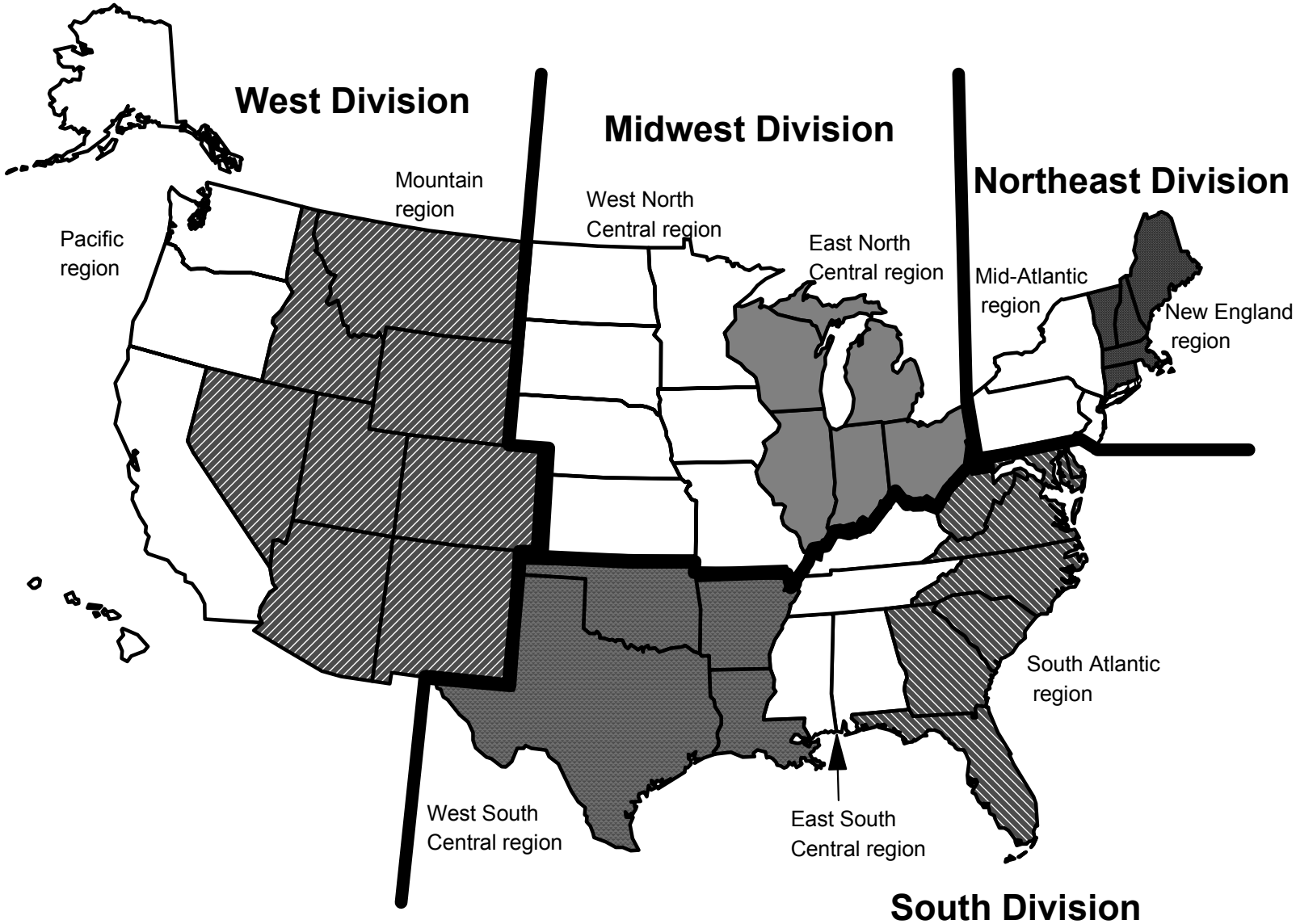
| From | To | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1970** | **1975** | **1976** | **1977** | **1978** | **1979** | **1980** | **1981** | **1982** | **1983** | **1984** | **1985** | **1986** | **1987** | **1988** | **1989** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** |
| **1970** | 1.00 | 1.38 | 1.45 | 1.53 | 1.65 | 1.79 | 1.95 | 2.14 | 2.27 | 2.36 | 2.45 | 2.53 | 2.60 | 2.67 | 2.76 | 2.87 | 2.99 | 3.12 | 3.23 | 3.29 | 3.36 | 3.47 | 3.54 | 3.63 | 3.64 | 3.71 | 3.68 |
| **1975** | 0.73 | 1.00 | 1.05 | 1.11 | 1.20 | 1.30 | 1.42 | 1.55 | 1.65 | 1.71 | 1.78 | 1.84 | 1.89 | 1.94 | 2.01 | 2.08 | 2.17 | 2.27 | 2.34 | 2.39 | 2.44 | 2.52 | 2.57 | 2.63 | 2.64 | 2.69 | 2.67 |
| **1976** | 0.69 | 0.95 | 1.00 | 1.06 | 1.14 | 1.24 | 1.35 | 1.48 | 1.57 | 1.63 | 1.70 | 1.75 | 1.80 | 1.84 | 1.91 | 1.98 | 2.06 | 2.15 | 2.23 | 2.27 | 2.32 | 2.40 | 2.44 | 2.50 | 2.51 | 2.56 | 2.53 |
| **1977** | 0.65 | 0.90 | 0.95 | 1.00 | 1.07 | 1.17 | 1.27 | 1.40 | 1.48 | 1.54 | 1.60 | 1.65 | 1.70 | 1.74 | 1.80 | 1.87 | 1.95 | 2.03 | 2.11 | 2.15 | 2.19 | 2.26 | 2.31 | 2.37 | 2.37 | 2.42 | 2.37 |
| **1978** | 0.61 | 0.84 | 0.88 | 0.93 | 1.00 | 1.09 | 1.19 | 1.30 | 1.38 | 1.43 | 1.49 | 1.54 | 1.58 | 1.62 | 1.68 | 1.74 | 1.81 | 1.89 | 1.96 | 2.00 | 2.04 | 2.11 | 2.15 | 2.20 | 2.21 | 2.25 | 2.22 |
| **1979** | 0.56 | 0.77 | 0.81 | 0.86 | 0.92 | 1.00 | 1.09 | 1.20 | 1.27 | 1.32 | 1.37 | 1.42 | 1.45 | 1.49 | 1.54 | 1.60 | 1.67 | 1.74 | 1.80 | 1.84 | 1.88 | 1.94 | 1.98 | 2.03 | 2.03 | 2.07 | 2.05 |
| **1980** | 0.51 | 0.71 | 0.74 | 0.78 | 0.84 | 0.92 | 1.00 | 1.10 | 1.16 | 1.21 | 1.26 | 1.30 | 1.33 | 1.36 | 1.41 | 1.47 | 1.53 | 1.60 | 1.65 | 1.68 | 1.72 | 1.78 | 1.81 | 1.86 | 1.86 | 1.90 | 1.87 |
| **1981** | 0.47 | 0.64 | 0.68 | 0.72 | 0.77 | 0.84 | 0.91 | 1.00 | 1.06 | 1.10 | 1.15 | 1.18 | 1.21 | 1.25 | 1.29 | 1.34 | 1.40 | 1.46 | 1.51 | 1.54 | 1.57 | 1.62 | 1.66 | 1.70 | 1.70 | 1.74 | 1.71 |
| **1982** | 0.44 | 0.61 | 0.64 | 0.68 | 0.73 | 0.79 | 0.86 | 0.94 | 1.00 | 1.04 | 1.08 | 1.12 | 1.15 | 1.18 | 1.22 | 1.26 | 1.32 | 1.38 | 1.42 | 1.45 | 1.48 | 1.53 | 1.56 | 1.60 | 1.60 | 1.64 | 1.61 |
| **1983** | 0.42 | 0.58 | 0.61 | 0.65 | 0.70 | 0.76 | 0.83 | 0.91 | 0.96 | 1.00 | 1.04 | 1.08 | 1.10 | 1.13 | 1.17 | 1.22 | 1.27 | 1.32 | 1.37 | 1.40 | 1.42 | 1.47 | 1.50 | 1.54 | 1.54 | 1.57 | 1.55 |
| **1984** | 0.41 | 0.56 | 0.59 | 0.62 | 0.67 | 0.73 | 0.80 | 0.87 | 0.92 | 0.96 | 1.00 | 1.04 | 1.06 | 1.08 | 1.12 | 1.16 | 1.21 | 1.27 | 1.31 | 1.34 | 1.37 | 1.41 | 1.44 | 1.47 | 1.48 | 1.51 | 1.50 |
| **1985** | 0.40 | 0.54 | 0.57 | 0.61 | 0.65 | 0.71 | 0.77 | 0.85 | 0.90 | 0.93 | 0.94 | 1.00 | 1.03 | 1.05 | 1.09 | 1.13 | 1.18 | 1.23 | 1.28 | 1.30 | 1.33 | 1.37 | 1.40 | 1.43 | 1.44 | 1.47 | 1.45 |
| **1986** | 0.39 | 0.53 | 0.56 | 0.59 | 0.63 | 0.69 | 0.75 | 0.82 | 0.87 | 0.91 | 0.94 | 0.97 | 1.00 | 1.03 | 1.06 | 1.10 | 1.15 | 1.20 | 1.24 | 1.27 | 1.29 | 1.34 | 1.36 | 1.40 | 1.40 | 1.43 | 1.42 |
| **1987** | 0.38 | 0.52 | 0.54 | 0.58 | 0.62 | 0.67 | 0.73 | 0.80 | 0.85 | 0.89 | 0.92 | 0.95 | 0.98 | 1.00 | 1.04 | 1.08 | 1.12 | 1.17 | 1.21 | 1.24 | 1.26 | 1.30 | 1.33 | 1.36 | 1.36 | 1.39 | 1.38 |
| **1988** | 0.36 | 0.50 | 0.53 | 0.56 | 0.60 | 0.65 | 0.71 | 0.77 | 0.82 | 0.85 | 0.89 | 0.92 | 0.94 | 0.97 | 1.00 | 1.04 | 1.08 | 1.13 | 1.17 | 1.19 | 1.22 | 1.26 | 1.28 | 1.31 | 1.32 | 1.34 | 1.33 |
| **1989** | 0.35 | 0.48 | 0.51 | 0.54 | 0.58 | 0.62 | 0.68 | 0.75 | 0.79 | 0.82 | 0.86 | 0.88 | 0.91 | 0.93 | 0.96 | 1.00 | 1.04 | 1.09 | 1.13 | 1.15 | 1.17 | 1.21 | 1.24 | 1.27 | 1.27 | 1.29 | 1.28 |
| **1990** | 0.34 | 0.46 | 0.49 | 0.51 | 0.55 | 0.60 | 0.66 | 0.72 | 0.76 | 0.79 | 0.83 | 0.85 | 0.87 | 0.89 | 0.93 | 0.96 | 1.00 | 1.05 | 1.08 | 1.10 | 1.13 | 1.16 | 1.19 | 1.22 | 1.22 | 1.24 | 1.24 |
| **1991** | 0.32 | 0.44 | 0.47 | 0.49 | 0.53 | 0.57 | 0.63 | 0.69 | 0.73 | 0.76 | 0.79 | 0.81 | 0.83 | 0.86 | 0.89 | 0.92 | 0.96 | 1.00 | 1.04 | 1.06 | 1.08 | 1.11 | 1.14 | 1.16 | 1.17 | 1.19 | 1.19 |
| **1992** | 0.31 | 0.43 | 0.45 | 0.48 | 0.51 | 0.55 | 0.61 | 0.66 | 0.70 | 0.73 | 0.76 | 0.78 | 0.81 | 0.83 | 0.86 | 0.89 | 0.92 | 0.97 | 1.00 | 1.02 | 1.04 | 1.08 | 1.10 | 1.12 | 1.13 | 1.15 | 1.16 |
| **1993** | 0.30 | 0.42 | 0.44 | 0.47 | 0.50 | 0.54 | 0.59 | 0.65 | 0.69 | 0.72 | 0.75 | 0.77 | 0.79 | 0.81 | 0.84 | 0.87 | 0.91 | 0.95 | 0.98 | 1.00 | 1.02 | 1.05 | 1.08 | 1.10 | 1.10 | 1.13 | 1.14 |
| **1994** | 0.30 | 0.41 | 0.43 | 0.46 | 0.49 | 0.53 | 0.58 | 0.64 | 0.68 | 0.70 | 0.73 | 0.75 | 0.77 | 0.79 | 0.82 | 0.85 | 0.89 | 0.93 | 0.96 | 0.98 | 1.00 | 1.03 | 1.05 | 1.08 | 1.08 | 1.10 | 1.11 |
| **1995** | 0.29 | 0.40 | 0.42 | 0.44 | 0.47 | 0.52 | 0.56 | 0.62 | 0.65 | 0.68 | 0.71 | 0.73 | 0.75 | 0.77 | 0.80 | 0.83 | 0.86 | 0.90 | 0.93 | 0.95 | 0.97 | 1.00 | 1.02 | 1.05 | 1.05 | 1.07 | 1.09 |
| **1996** | 0.28 | 0.39 | 0.41 | 0.43 | 0.46 | 0.51 | 0.55 | 0.60 | 0.64 | 0.67 | 0.69 | 0.71 | 0.73 | 0.75 | 0.78 | 0.81 | 0.84 | 0.88 | 0.91 | 0.93 | 0.95 | 0.98 | 1.00 | 1.02 | 1.03 | 1.05 | 1.07 |
| **1997** | 0.26 | 0.38 | 0.40 | 0.42 | 0.45 | 0.49 | 0.54 | 0.59 | 0.63 | 0.65 | 0.68 | 0.70 | 0.72 | 0.74 | 0.76 | 0.79 | 0.82 | 0.86 | 0.89 | 0.91 | 0.93 | 0.96 | 0.98 | 1.00 | 1.00 | 1.02 | 1.05 |
| **1998** | 0.27 | 0.38 | 0.40 | 0.42 | 0.45 | 0.49 | 0.54 | 0.59 | 0.62 | 0.65 | 0.68 | 0.70 | 0.71 | 0.73 | 0.76 | 0.79 | 0.82 | 0.86 | 0.89 | 0.91 | 0.92 | 0.95 | 0.97 | 1.00 | 1.00 | 1.02 | 1.04 |
| **1999** | 0.270 | 0.37 | 0.39 | 0.41 | 0.44 | 0.48 | 0.53 | 0.58 | 0.61 | 0.64 | 0.66 | 0.68 | 0.70 | 0.72 | 0.74 | 0.77 | 0.80 | 0.84 | 0.87 | 0.89 | 0.91 | 0.94 | 0.96 | 0.98 | 0.98 | 1.00 | 1.02 |
| **2000** | 0.27 | 0.37 | 0.40 | 0.42 | 0.45 | 0.49 | 0.53 | 0.58 | 0.62 | 0.64 | 0.67 | 0.69 | 0.70 | 0.73 | 0.75 | 0.78 | 0.81 | 0.84 | 0.86 | 0.88 | 0.90 | 0.92 | 0.94 | 0.95 | 0.97 | 0.98 | 1.00 |

**Source:**
U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Washington, DC, monthly.

# APPENDIX C

# CENSUS DIVISIONS AND REGIONS

**Table C.1**
**Census Divisions and Regions**

| Northeast Division | | | |
|---|---|---|---|
| Mid-Atlantic region | | New England region | |
| New Jersey<br>New York | Pennsylvania | Connecticut<br>Maine<br>Massachusetts | New Hampshire<br>Rhode Island<br>Vermont |
| South Division | | | |
| West South Central region | East South Central region | South Atlantic region | |
| Arkansas<br>Louisiana<br>Oklahoma<br>Texas | Alabama<br>Kentucky<br>Mississippi<br>Tennessee | Delaware<br>Florida<br>Georgia<br>Maryland<br>North Carolina | South Carolina<br>Virginia<br>Washington, DC<br>West Virginia |
| West Division | | | |
| Pacific region | | Mountain region | |
| Alaska<br>California<br>Hawaii | Oregon<br>Washington | Arizona<br>Colorado<br>Idaho<br>Montana | Nevada<br>New Mexico<br>Utah<br>Wyoming |
| Midwest Division | | | |
| West North Central region | | East North Central region | |
| Iowa<br>Kansas<br>Minnesota<br>Missouri | Nebraska<br>North Dakota<br>South Dakota | Illinois<br>Indiana<br>Michigan | Ohio<br>Wisconsin |

# Census Divisions and Regions