Transportation Energy Data Book

30th Edition

Stacy C. Davis Susan W. Diegel Robert G. Boundy

Transportation Energy Data Book
Quick Facts

Petroleum

- The U.S. produces 7.5 million barrels of petroleum per day (M bpd), or 9% of the world's 82.43 M bpd.
- The U.S. consumes 19.15 M bpd, or 22.5% of the world's 85.26 M bpd.
- U.S. transportation petroleum use is 69.7% of total U.S. petroleum use.
- U.S. transportation petroleum use is 172.5% of total U.S. petroleum production.
- Petroleum comprises 93.2% of U.S. transportation energy use.
- Cars and light trucks account for 64% of U.S. transportation petroleum use.
- Medium trucks account for 4% of U.S. transportation petroleum use.
- Heavy trucks account for 17% of U.S. transportation petroleum use.

Energy

- U.S. transportation energy use accounts for 28.1% of total U.S. energy use.
- 99% of ethanol consumed in the U.S. is consumed as ethanol in gasohol (or "E10").
- Cars and light trucks account for 60% of U.S. transportation energy use.
- Medium trucks account for 4% of U.S. transportation energy use.
- Heavy trucks account for 18% of U.S. transportation energy use.

Light Vehicle Characteristics

- There are 134,880,000 cars and 100,154,000 light trucks in the U.S. (235,034,000 total light vehicles).
- U.S. cars:
  - 5,635,000 cars were sold in 2010.
  - The average age of a U.S. car is 10.6 years; the average car lifetime is 16.9 years.
  - The average fuel economy for the U.S. car fleet (all cars on the road today) is 22.5 mpg.
  - Cars comprise 48.8% of new light vehicle sales.
- U.S. light trucks:
  - 5,919,000 light trucks were sold in 2010.
  - The average age of a U.S. light truck is 9.6 years; the average car lifetime is 15.5 years.
  - The average fuel economy for the U.S. light truck fleet (all light trucks on the road today) is 18.0 mpg.
  - Light trucks comprise 51.2% of new light vehicle sales.
- There were 8,030,000 fleet vehicles in 2009: 3,844,000 cars and 4,186,000 trucks.
- U.S. car registrations account for 20.4% of total world car registrations.
- U.S. truck and bus registrations account for 40.8% of total world car registrations.
- The average U.S. household vehicle travels 11,300 miles per year.

Heavy Truck Characteristics

- 10,973,000 heavy trucks were registered in the U.S. in 2009.
- In 2002 (the last time a survey was conducted), heavy trucks accounted for 80% of medium and heavy truck fuel use.

Note: Data are for calendar year 2009 or 2010 unless otherwise noted.

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TRANSPORTATION ENERGY DATA BOOK: EDITION 30

Stacy C. Davis
Susan W. Diegel
Oak Ridge National Laboratory

Robert G. Boundy
Roltek, Inc.

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Stacy C. Davis
Oak Ridge National Laboratory
National Transportation Research Center
2360 Cherahala Boulevard
Knoxville, Tennessee 37932
Telephone: (865) 946-1256
FAX: (865) 946-1314
E-mail: DAVISSC@ornl.gov
Web Site Location: cta.ornl.gov/data

Philip D. Patterson
Vehicle Technologies Program
Energy Efficiency and Renewable Energy
Department of Energy, EE-2G
Forrestal Building, Room
1000 Independence Avenue, S.W.
Washington, D.C. 20585
Telephone: (202) 586-9121
FAX: (202) 586-1637
E-mail: PHILIP.PATTERSON@ee.doe.gov
Web Site Location: www.eere.energy.gov

Jacob W. Ward
Vehicle Technologies Program
Energy Efficiency and Renewable Energy
Department of Energy, EE-2G
Forrestal Building
1000 Independence Avenue, S.W.
Washington, D.C. 20585
Telephone: (202) 586-7606
FAX: (202) 586-1600
E-mail: JACOB.WARD@ee.doe.gov
Web Site Location: www.eere.energy.gov

Spreadsheets of the tables in the
Transportation Energy Data Book
can be found on the web at:
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Find useful data and information in other U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy Data Books.

Vehicle Technologies Market Report:
www1.eere.energy.gov/vehiclesandfuels/pdfs/2010_vt_market_rpt.pdf

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Power Technologies Energy Data Book:
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FOREWORD

Welcome to this 30th edition of the Transportation Energy Data Book. Twenty-two of these editions have been produced by Stacy Davis. I and the Vehicle Technologies Program are grateful for the dedication, consistency, and the skill she has brought to this effort.

I would like to bring to your attention some of the data that are new in this edition:

> **Table 3.13. Heavy Truck Scrappage and Survival Rates --** Data for heavy trucks, which had been in previous editions, is added back into the report.
>
> **Table 6.2. Alternative Fuel Transit Vehicles, 2009 --** For eight modes, the average vehicle age, the percent powered by alternative fuels, and the number of vehicles are provided.

Fifteen new emission standards tables have been added to Chapter 12. They include the following:

- Table 12.12. Light-Duty Vehicle, Light-Duty Truck, and Medium-Duty Passenger Vehicle – Tier 2 Evaporative Exhaust Standards
- Table 12.13. Light-Duty Vehicle, Light-Duty Truck, and Medium-Duty Passenger Vehicle – Tier 2 Evaporative Emission Standards
- Table 12.14. Heavy-Duty Highway Compression-Ignition Engines and Urban Buses – Exhaust Emission Standards
- Table 12.15. Heavy-Duty Highway Spark-Ignition Engines– Exhaust Emission Standards
- Table 12.16. Heavy-Duty Highway Compression-Ignition and Spark-Ignition Engines Evaporative Emission Standards
- Table 12.17. California Car, Light Truck, and Medium Truck Emission Certification Standards
- Table 12.18. Aircraft – Exhaust Emissions Standards
- Table 12.19. Nonroad Compression-Ignition Engine – Exhaust Emission Standards
- Table 12.20. Nonroad Large Spark-Ignition Engines – Exhaust and Evaporative Emission Standards
- Table 12.21. Locomotive – Exhaust Emissions Standards
- Table 12.22. Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards
- Table 12.23. Marine Spark-Ignition Engines and Vessels – Exhaust Emission Standards
- Table 12.24. Nonroad Recreational Engines and Vehicles – Exhaust Emission Standards
- Table 12.25. Gasoline Sulfur Standards
- Table 12.26. Highway, Nonroad, Locomotive, and Marine (NRLM) Diesel Fuel Sulfur Standards

I hope you find value in this data book. Stacy and I welcome suggestions on how to improve it.

ACKNOWLEDGMENTS

The authors would like to express their gratitude to the many individuals who assisted in the preparation of this document. First, we would like to thank Phil Patterson, Jacob Ward, and the Vehicle Technologies Program staff for their continued support of the Transportation Energy Data Book project. We would also like to thank Lindsey Marlar for the cover. 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 30* is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Program. 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 edition of the Data Book is available to a larger audience via the Internet (cta.ornl.gov/data).

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 – highway vehicles; Chapter 4 – light vehicles; Chapter 5 – heavy vehicles; Chapter 6 – alternative fuel vehicles; Chapter 7 – fleet vehicles; Chapter 8 – household vehicles; Chapter 9 – nonhighway modes; Chapter 10 – transportation and the economy; Chapter 11 – greenhouse gas emissions; and Chapter 12 – criteria pollutant emissions. 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 reader's 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.

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 30 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.

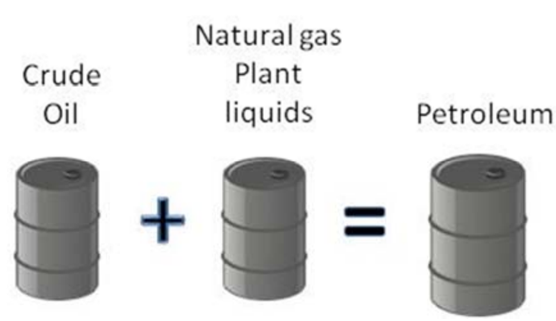
The majority of the statistics contained in the data book are taken directly from published sources, although these data may be reformatted for presentation by ORNL. Consequently, neither ORNL nor DOE endorses the validity of these data.

Chapter 1
Petroleum

Summary Statistics from Tables/Figures in this Chapter

Source			
Table 1.3	World Petroleum Production, 2010 (million barrels per day)[a]		82.43
	U.S. Production (million barrels per day)		7.51
	U.S. Share		9.1%
Table 1.4	World Petroleum Consumption, 2010 (million barrels per day)		85.26
	U.S. Consumption (million barrels per day)		19.15
	U.S. Share		22.5%
Figure 1.5	Average Refinery Yield, 2010	OECD Europe	North America
	Gasoline	*19.3%*	*42.7%*
	Diesel oil	*39.8%*	*25.3%*
	Residual fuel	*13.0%*	*5.8%*
	Kerosene	*6.8%*	*7.3%*
	Other	*21.1%*	*18.9%*
Table 1.11	U.S. transportation petroleum use as a percent of U.S. petroleum production, 2010		172.5%
Table 1.11	Net imports as a percentage of U.S. petroleum consumption, 2010		49.3%
Table 1.12	Transportation share of U.S. petroleum consumption, 2010		69.7%
Table 1.15	Highway share of transportation petroleum consumption, 2009		86.4%
Table 1.15	Light vehicle share of transportation petroleum consumption, 2009		64.3%

In this document, petroleum is defined as crude oil (including lease condensate) and natural gas plant liquids.



[a] Because other liquids and processing gain are not included, the world production is smaller than world petroleum consumption.

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.

[a] Data are not available.

In 2010, the Organization of Petroleum Exporting Countries (OPEC) accounted for more than 40% of world oil production. Responding to low oil prices in early 2000, Mexico, Norway, Russia, and Oman joined OPEC in cutting production. This group of oil countries, referred to here as OPEC+, account for over 60% of world oil production.

Table 1.2
World Crude Oil Production, 1960–2010[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]	Persian Gulf[d] share	World
1960	7.04	33.5%	8.70	41.4%	12.25	58.3%	12.29	5.27	25.1%	20.99
1965	7.80	25.7%	14.35	47.3%	19.83	65.4%	15.98	8.37	27.6%	30.33
1970	9.64	21.0%	23.30	50.8%	31.12	67.8%	22.59	13.39	29.2%	45.89
1975	8.38	15.9%	26.79	50.3%	37.55	71.1%	27.04	18.93	35.8%	52.83
1980	8.60	14.4%	26.38	44.3%	40.80	68.5%	34.18	17.96	30.2%	59.56
1985	8.97	16.6%	15.37	28.5%	30.98	57.4%	38.60	9.63	17.8%	53.97
1986	8.68	15.4%	18.28	32.5%	34.05	60.6%	37.95	11.70	20.8%	56.23
1987	8.35	14.7%	18.52	32.7%	34.72	61.3%	38.15	12.10	21.4%	56.67
1988	8.14	13.9%	20.32	34.6%	36.66	62.4%	38.42	13.46	22.9%	58.74
1989	7.61	12.7%	22.07	36.9%	38.50	64.3%	37.79	14.84	24.8%	59.86
1990	7.36	12.2%	22.49	37.2%	38.34	63.4%	38.00	15.28	25.3%	60.49
1991	7.42	12.3%	23.27	38.6%	38.53	64.0%	36.94	14.74	24.5%	60.21
1992	7.17	11.9%	24.40	40.5%	37.67	62.6%	35.81	15.97	26.5%	60.21
1993	6.85	11.4%	25.12	41.7%	37.65	62.5%	35.12	16.71	27.7%	60.24
1994	6.66	10.9%	25.51	41.8%	37.67	61.8%	35.48	16.96	27.8%	60.99
1995	6.56	10.5%	25.54	40.9%	37.77	60.5%	36.85	17.21	27.6%	62.39
1996	6.47	10.1%	26.02	40.8%	38.70	60.7%	37.73	17.37	27.2%	63.75
1997	6.45	9.8%	27.29	41.5%	40.28	61.3%	38.45	18.10	27.5%	65.74
1998	6.25	9.3%	28.37	42.4%	41.21	61.5%	38.70	19.34	28.9%	66.97
1999	5.88	8.9%	27.22	41.3%	40.14	60.9%	38.70	18.67	28.3%	65.92
2000	5.82	8.5%	28.98	42.3%	42.66	62.3%	39.52	19.89	29.0%	68.49
2001	5.80	8.5%	28.16	41.4%	42.35	62.2%	39.94	19.10	28.0%	68.10
2002	5.75	8.6%	26.39	39.3%	41.01	61.1%	40.77	17.79	26.5%	67.16
2003	5.68	8.2%	27.98	40.3%	43.34	62.4%	41.45	19.06	27.5%	69.43
2004	5.42	7.5%	30.41	42.0%	46.30	63.9%	42.06	20.79	28.7%	72.47
2005	5.18	7.0%	31.87	43.2%	47.72	64.7%	41.84	21.50	29.2%	73.71
2006	5.10	6.9%	31.59	43.0%	47.32	64.4%	41.84	21.23	28.9%	73.43
2007	5.06	6.9%	31.21	42.8%	46.70	64.0%	41.78	20.67	28.3%	72.98
2008	4.96	6.7%	32.48	44.1%	47.57	64.6%	41.17	21.91	29.7%	73.66
2009	5.36	7.4%	30.60	42.3%	45.58	63.1%	41.67	20.40	28.2%	72.26
2010	5.51	7.5%	31.26	42.4%	46.25	62.8%	42.42	20.91	28.4%	73.68
				Average annual percentage change						
1960–2010	-0.5%		2.6%		2.7%		2.7%	2.8%		2.5%
1970–2010	-1.4%		0.7%		1.0%		1.8%	1.1%		1.2%
2000–2010	-0.5%		0.8%		0.8%		0.7%	0.5%		0.7%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2011,* Washington, DC, 2011, Table 11.1a and 11.1b. (Additional resources: www.eia.doe.gov)

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

This table shows petroleum production, which includes both crude oil and natural gas plant liquids. Because other liquids and processing gain are not included, the world total is smaller than world petroleum consumption (Table 1.4). The United States was responsible for 9.1% of the world's petroleum production in 2010 and 7.5% of the world's crude oil production (Table 1.2).

Table 1.3
World Petroleum Production, 1973–2010[a]
(million barrels per day)

Year	United States	U.S. share	Total OPEC[b]	OPEC share	Total non-OPEC	Non-OPEC share	Persian Gulf nations[c]	Persian Gulf[c] share	World
1973	10.95	18.7%	29.99	51.3%	28.48	48.7%	20.86	35.7%	58.47
1974	10.44	17.8%	29.67	50.7%	28.84	49.3%	21.51	36.8%	58.51
1975	10.01	18.0%	26.16	47.0%	28.48	51.2%	19.18	34.5%	55.62
1976	9.74	16.2%	29.55	49.1%	30.66	50.9%	21.81	36.2%	60.21
1977	9.86	15.7%	30.06	47.9%	32.64	52.1%	22.06	35.2%	62.69
1978	10.27	16.2%	28.70	45.4%	34.54	54.6%	21.02	33.2%	63.24
1979	10.14	15.4%	29.95	45.4%	36.01	54.6%	21.52	32.6%	65.96
1980	10.17	16.1%	26.05	41.3%	35.77	56.8%	18.50	29.3%	63.03
1981	10.18	17.1%	21.95	36.8%	37.73	63.2%	15.84	26.5%	59.68
1982	10.20	17.9%	18.54	32.5%	38.55	67.5%	12.77	22.4%	57.09
1983	10.25	18.0%	17.26	30.3%	39.65	69.7%	11.63	20.4%	56.90
1984	10.51	18.0%	17.29	29.6%	41.09	70.4%	11.39	19.5%	58.38
1985	10.58	18.3%	16.22	28.0%	40.90	70.6%	10.28	17.7%	57.91
1986	10.23	16.9%	18.40	30.5%	41.17	68.2%	12.40	20.5%	60.36
1987	9.94	16.3%	18.69	30.7%	41.47	68.1%	12.82	21.0%	60.92
1988	9.77	15.5%	20.79	32.9%	41.86	66.3%	14.27	22.6%	63.18
1989	9.16	14.2%	22.51	35.0%	41.19	64.0%	15.69	24.4%	64.30
1990	8.91	13.7%	23.70	36.4%	40.80	62.6%	16.21	24.9%	65.13
1991	9.08	14.0%	23.71	36.5%	40.53	62.4%	15.67	24.1%	65.01
1992	8.87	13.7%	25.03	38.5%	39.37	60.6%	16.97	26.1%	64.96
1993	8.58	13.2%	25.82	39.6%	38.82	59.5%	17.76	27.2%	65.23
1994	8.39	12.6%	26.54	39.9%	39.30	59.0%	18.29	27.5%	66.57
1995	8.32	12.2%	27.23	40.0%	40.29	59.2%	18.57	27.3%	68.04
1996	8.30	11.9%	27.71	39.9%	41.33	59.4%	18.72	26.9%	69.53
1997	8.27	11.5%	29.07	40.6%	42.12	58.8%	19.52	27.2%	71.66
1998	8.01	11.0%	30.21	41.4%	42.41	58.1%	20.83	28.5%	73.03
1999	7.73	10.7%	29.13	40.4%	43.03	59.6%	20.16	27.9%	72.17
2000	7.73	10.3%	30.99	41.4%	43.96	58.6%	21.45	28.6%	74.95
2001	7.67	10.2%	30.38	40.6%	44.48	59.4%	20.82	27.8%	74.86
2002	7.63	10.3%	28.72	38.8%	45.31	61.2%	19.59	26.5%	74.03
2003	7.40	9.7%	30.45	39.8%	46.11	60.2%	21.04	27.5%	76.57
2004	7.23	9.1%	33.04	41.4%	46.81	58.6%	22.89	28.7%	79.85
2005	6.90	8.5%	34.75	42.7%	46.62	57.3%	23.78	29.2%	81.37
2006	6.84	8.4%	34.55	42.5%	46.77	57.5%	23.52	28.9%	81.31
2007	6.85	8.5%	34.24	42.3%	46.76	57.7%	22.99	28.4%	81.00
2008	6.73	8.2%	35.57	43.6%	46.07	56.4%	24.25	29.7%	81.64
2009	7.27	9.0%	33.70	41.9%	46.67	58.1%	22.77	28.3%	80.36
2010	7.51	9.1%	34.92	42.4%	47.51	57.6%	23.81	28.9%	82.43
Average annual percentage change									
1973–2010	-1.0%		0.4%		1.4%		0.4%		0.9%
2000–2010	-0.3%		1.2%		0.8%		1.0%		1.0%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Statistics Website*, March 2011. (Additional resources: www.eia.doe.gov)

[a] Includes natural gas plant liquids, crude oil and lease condensate. Does not account for all inputs or refinery processing gain.
[b] Organization of Petroleum Exporting Countries. See Glossary for membership.
[c] See Glossary for Persian Gulf Nations.

The United States has accounted for almost one-quarter of the world's petroleum consumption for the last two decades, but in 2010 accounted for only 22.5%. World petroleum consumption decreased in 2009 but rose in 2010. Non-OECD consumption has continued to increase.

Table 1.4
World Petroleum Consumption, 1960–2010
(millions 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%	34.69	12.12	46.81
1975	16.32	29.0%	39.14	17.06	56.20
1976	17.46	29.3%	41.72	17.95	59.67
1977	18.43	29.8%	42.78	19.05	61.83
1978	18.85	29.4%	43.98	20.18	64.16
1979	18.51	28.4%	44.39	20.84	65.22
1980	17.06	27.0%	41.76	21.35	63.11
1981	16.06	26.4%	39.49	21.45	60.94
1982	15.30	25.7%	37.77	21.78	59.54
1983	15.23	25.9%	36.91	21.87	58.78
1984	15.73	26.3%	37.69	22.12	59.82
1985	15.73	26.2%	37.48	22.60	60.09
1986	16.28	26.3%	38.60	23.21	61.81
1987	16.67	26.4%	39.34	23.75	63.10
1988	17.28	26.6%	40.65	24.31	64.97
1989	17.33	26.2%	41.33	24.75	66.08
1990	16.99	25.5%	41.61	25.07	66.68
1991	16.71	24.8%	42.00	25.28	67.28
1992	17.03	25.2%	42.95	24.52	67.46
1993	17.24	25.5%	43.30	24.30	67.60
1994	17.72	25.7%	44.44	24.43	68.86
1995	17.73	25.3%	44.90	25.17	70.07
1996	18.31	25.6%	45.98	25.65	71.63
1997	18.62	25.4%	46.78	26.66	73.43
1998	18.92	25.5%	46.94	27.13	74.07
1999	19.52	25.8%	47.87	27.89	75.76
2000	19.70	25.7%	48.20	28.57	76.77
2001	19.65	25.4%	48.26	29.25	77.51
2002	19.76	25.3%	48.22	29.94	78.16
2003	20.03	25.1%	48.91	30.81	79.72
2004	20.73	25.1%	49.73	32.78	82.51
2005	20.80	24.7%	50.13	33.96	84.09
2006	20.69	24.3%	49.82	35.35	85.17
2007	20.68	24.1%	49.57	36.24	85.81
2008	19.50	22.9%	47.86	37.40	85.26
2009	18.77	22.3%	45.72	38.41	84.13
2010	19.15	22.5%	46.24	39.02	85.26
		Average annual percentage change			
1960–2010	1.3%		2.2%	4.0%	2.8%
1970–2010	0.7%		0.7%	3.0%	1.5%
2000–2010	-0.3%		-0.4%	3.2%	1.1%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Statistics Website*, April 2011. (Additional resources: www.eia.doe.gov)

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

Figure 1.1. World Oil Reserves, Production and Consumption, 2009

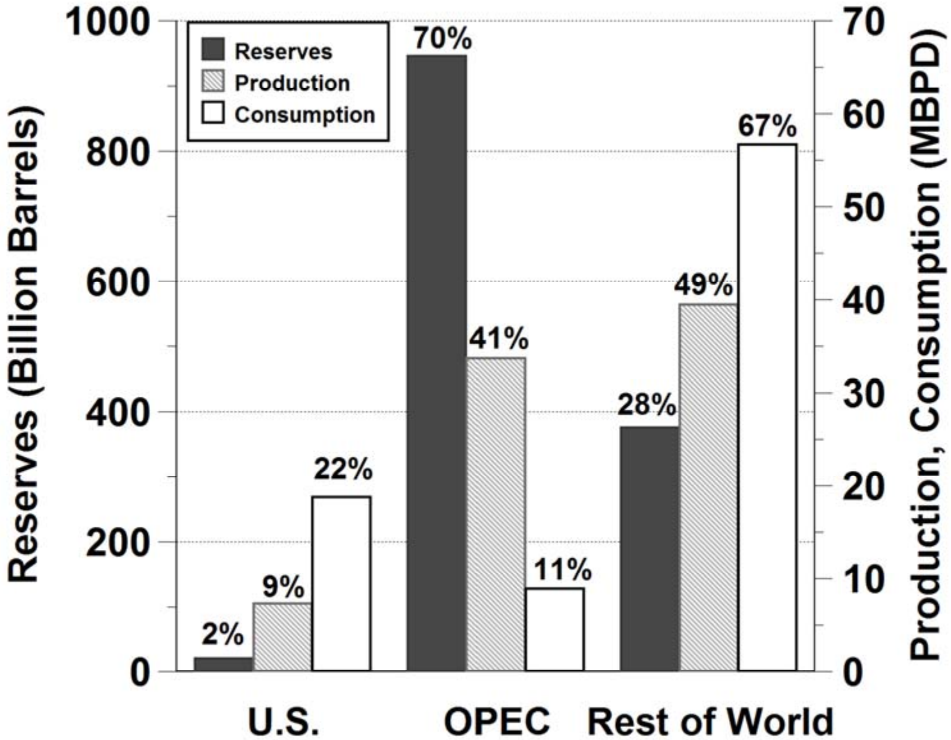


Table 1.5
World Oil Reserves, Production and Consumption, 2009

	Crude oil reserves (billion barrels)	Reserve share	Petroleum production (million barrels per day)	Production share	Petroleum consumption (million barrels per day)	Consumption share
United States	20.7	2%	7.3	9%	18.8	22%
OPEC	946	70%	33.7	41%	8.9	11%
Rest of world	375.9	28%	39.5	49%	56.7	67%

Sources:
Reserves – Energy Information Administration, *International Energy Statistics*, April 2011.
Production – Energy Information Administration, *International Petroleum Monthly*, December 2010, Tables 1.1c, 1.1d, 1.3, and 1.7.
Consumption – Energy Information Administration, *International Energy Statistics,* April 2011, and *International Petroleum Monthly*, March 2011, Table 1.7. (Additional resources: www.eia.doe.gov)

Note: Total consumption is higher than total production due to refinery gains including alcohol and liquid products produced from coal and other sources. OPEC countries include Venezuela, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, Angola, United Arab Emirates, Algeria, Libya, Nigeria, Indonesia, Gabon, and Ecuador.

Figure 1.2. World Natural Gas Reserves, Production and Consumption, 2009

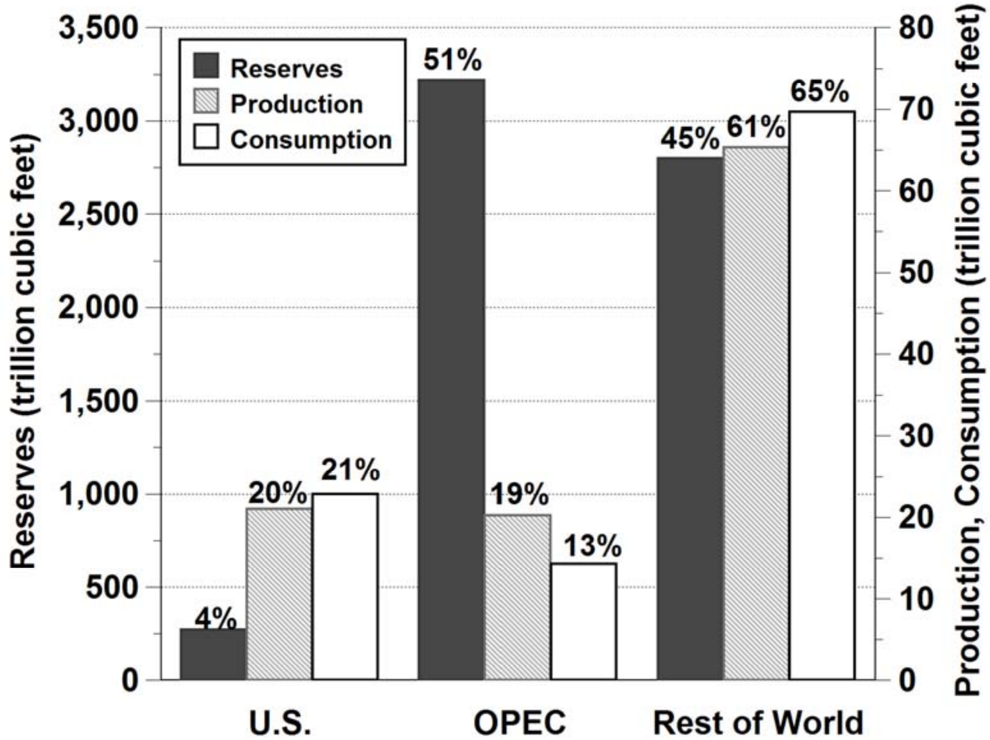


Table 1.6
World Natural Gas Reserves, Production and Consumption, 2009
(trillion cubic feet)

	Natural gas reserves	Reserve share	Natural gas production	Production share	Natural gas consumption	Consumption share
U.S.	272.5	4%	21.0	20%	22.8	21%
OPEC	3,217.0	51%	20.2	19%	14.3	13%
Rest of world	2,799.6	45%	65.3	61%	69.7	65%

Source:
Energy Information Administration, *International Energy Statistics*, 2011. (Additional resources: www.eia.doe.gov)

Note: Reserves as of May 2011. Production data are dry gas production.

The share of petroleum imported to the United States can be calculated using total imports or net imports. Net imports, which are 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 below 50% since 1993.

Table 1.7
U.S. Petroleum Imports by World Region of Origin, 1960–2010
(million barrels per day)

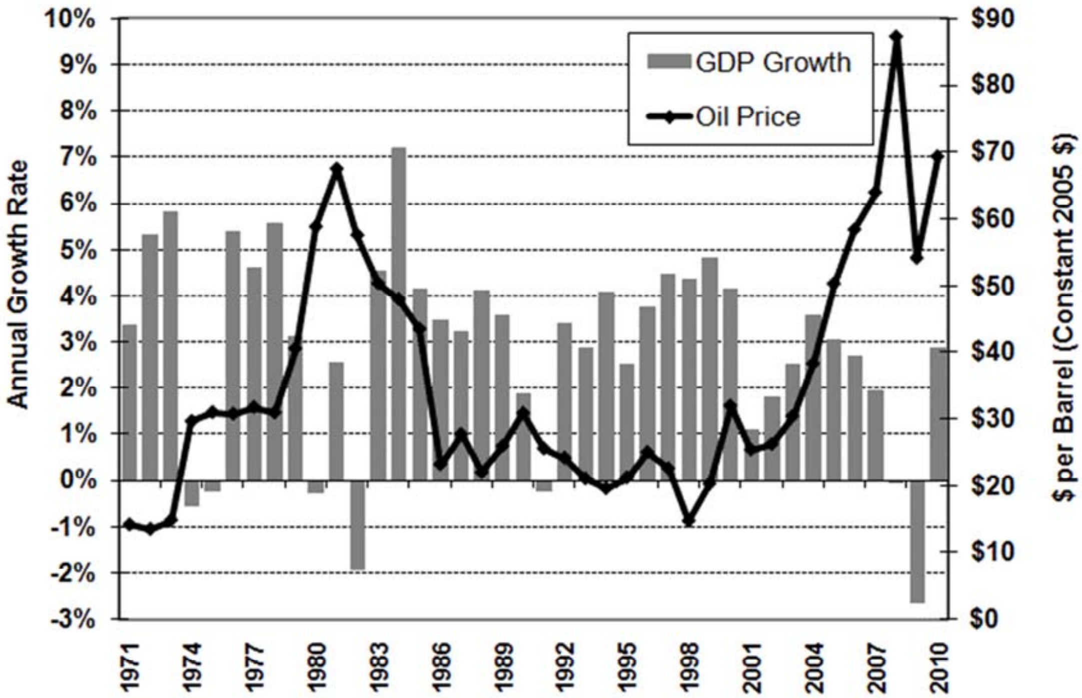
Year	Net OPEC[a] imports	Net OPEC share	Net Persian Gulf nation[b] imports	Net Persian Gulf share	Net imports	Net imports as a share of U.S. consumption	Total imports
1960	1.31	81.3%	[c]	[c]	1.61	[c]	1.82
1965	1.48	64.7%	[c]	[c]	2.28	[c]	2.47
1970	1.34	42.5%	[c]	[c]	3.16	[c]	3.42
1975	3.60	61.6%	1.17	19.2%	5.85	35.8%	6.06
1980	4.30	62.2%	1.52	22.0%	6.36	37.3%	6.91
1981	3.32	55.4%	1.22	20.3%	5.40	33.6%	6.00
1982	2.15	42.0%	0.70	13.7%	4.30	28.1%	5.11
1983	1.86	36.9%	0.44	8.7%	4.31	28.2%	5.05
1984	2.05	37.7%	0.51	9.4%	4.72	29.9%	5.44
1985	1.83	36.1%	0.31	6.1%	4.29	27.3%	5.07
1986	2.84	45.6%	0.91	14.6%	5.44	33.4%	6.22
1987	3.06	45.8%	1.08	16.2%	5.91	35.4%	6.68
1988	3.52	47.6%	1.54	20.8%	6.59	38.0%	7.40
1989	4.14	51.4%	1.86	23.1%	7.20	41.3%	8.06
1990	4.30	53.6%	1.97	24.6%	7.16	42.2%	8.02
1991	4.09	53.7%	1.84	24.1%	6.63	38.9%	7.63
1992	4.09	51.9%	1.78	22.6%	6.94	40.9%	7.89
1993	4.27	49.6%	1.78	20.6%	7.62	44.9%	8.62
1994	4.25	47.2%	1.73	19.2%	8.05	45.7%	9.00
1995	4.00	45.3%	1.57	17.8%	7.89	44.5%	8.84
1996	4.21	44.4%	1.60	16.9%	8.50	46.4%	9.48
1997	4.57	45.0%	1.76	17.3%	9.16	49.2%	10.16
1998	4.91	45.8%	2.14	19.9%	9.76	51.6%	10.71
1999	4.95	45.6%	2.46	22.7%	9.91	50.8%	10.85
2000	5.20	45.4%	2.49	21.7%	10.42	52.9%	11.46
2001	5.53	46.6%	2.76	23.3%	10.90	55.5%	11.87
2002	4.61	39.9%	2.27	19.7%	10.55	53.4%	11.53
2003	5.16	42.1%	2.50	20.4%	11.24	56.1%	12.26
2004	5.70	43.4%	2.49	19.0%	12.10	58.4%	13.15
2005	5.59	40.7%	2.33	17.0%	12.55	60.3%	13.71
2006	5.52	40.2%	2.21	16.1%	12.39	59.9%	13.71
2007	5.98	44.4%	2.16	16.1%	12.04	58.2%	13.47
2008	5.95	46.1%	2.37	18.4%	11.11	57.0%	12.92
2009	4.78	40.9%	1.69	14.4%	9.67	51.5%	11.69
2010	4.89	41.6%	1.71	14.5%	9.44	49.3%	11.73
			Average annual percentage change				
1960–2010	2.7%		[c]		3.6%		3.8%
1970–2010	3.3%		[c]		2.8%		3.1%
2000–2010	-0.6%		-3.7%		-1.0%		0.2%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* Washington, DC, March 2011, Table 3.3a.

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

Major oil price shocks have disrupted world energy markets five times in the past 30 years (1973-74, 1979-80, 1990-91, 1999-2000, 2008). Most of the oil price shocks were followed by an economic recession in the United States.

Figure 1.3. Oil Price and Economic Growth, 1970–2010

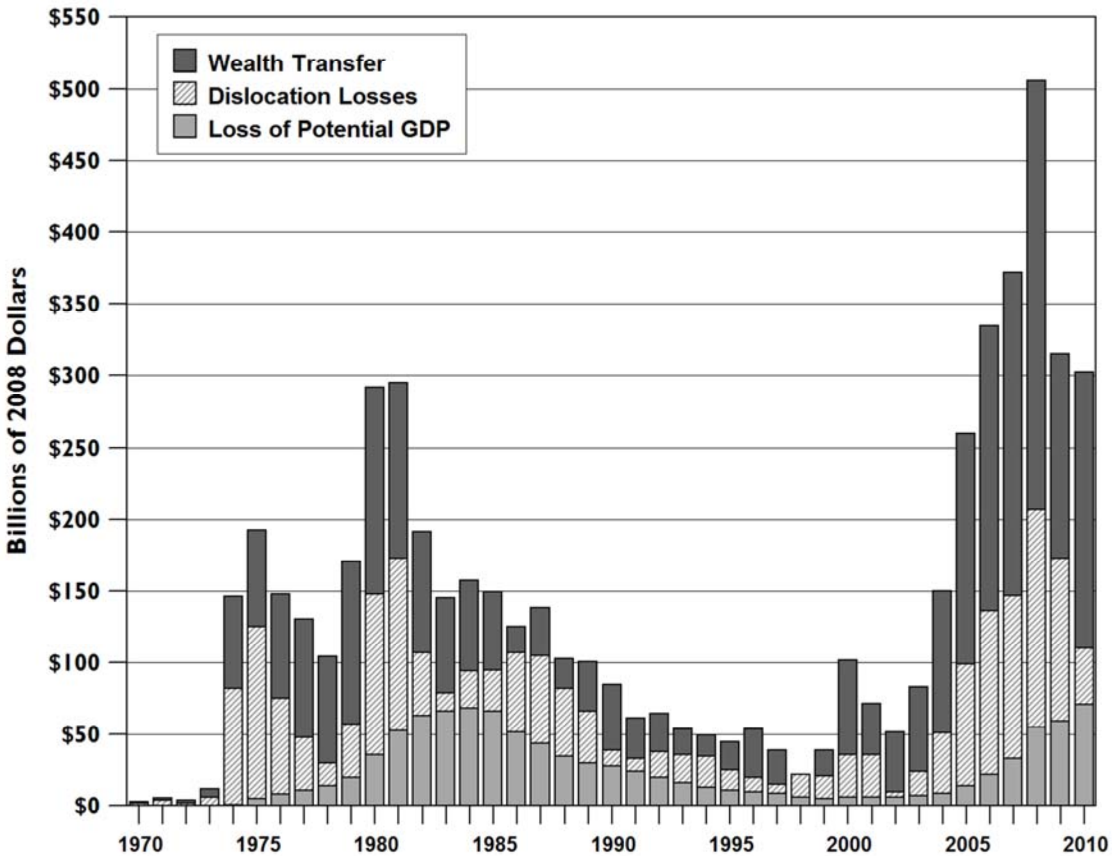


Source:

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, 2011. (A dditional resources: www-cta.ornl.gov/publications)

The United States has long recognized the problem of oil dependence and the economic problems that arise from it. According to Oak Ridge National Laboratory (ORNL) researchers Greene and Hopson, oil dependence is a combination of four factors: (1) a noncompetitive world oil market strongly influenced by the OPEC cartel, (2) high levels of U.S. imports, (3) the importance of oil to the U.S. economy, and (4) the lack of economical and readily available substitutes for oil. ORNL developed a model to estimate the historical cost of oil dependence and analyze the potential effectiveness of policies on likely future costs. The most recent study using this model shows that the U.S. economy suffered the greatest losses in 2008 when wealth transfer and GDP losses (combined) amounted to approximately half a trillion dollars. However, when comparing oil dependence to the size of the economy, the year 1980 is the highest. Oil dependence costs were almost 4.5% of GDP in 1980, but were under 3.5% in 2008. In 2009, the average oil price fell to about $60 per barrel and oil dependence costs fell to about $300 billion for 2009 and 2010.

Figure 1.4. Costs of Oil Dependence to the U.S. Economy, 1970–2010



Source:
Greene, David L., Roderick Lee, and Janet L. Hopson, "OPEC and the Costs to the U.S. Economy of Oil Dependence: 1970-2010," Oak Ridge National Laboratory Memorandum, 2011.

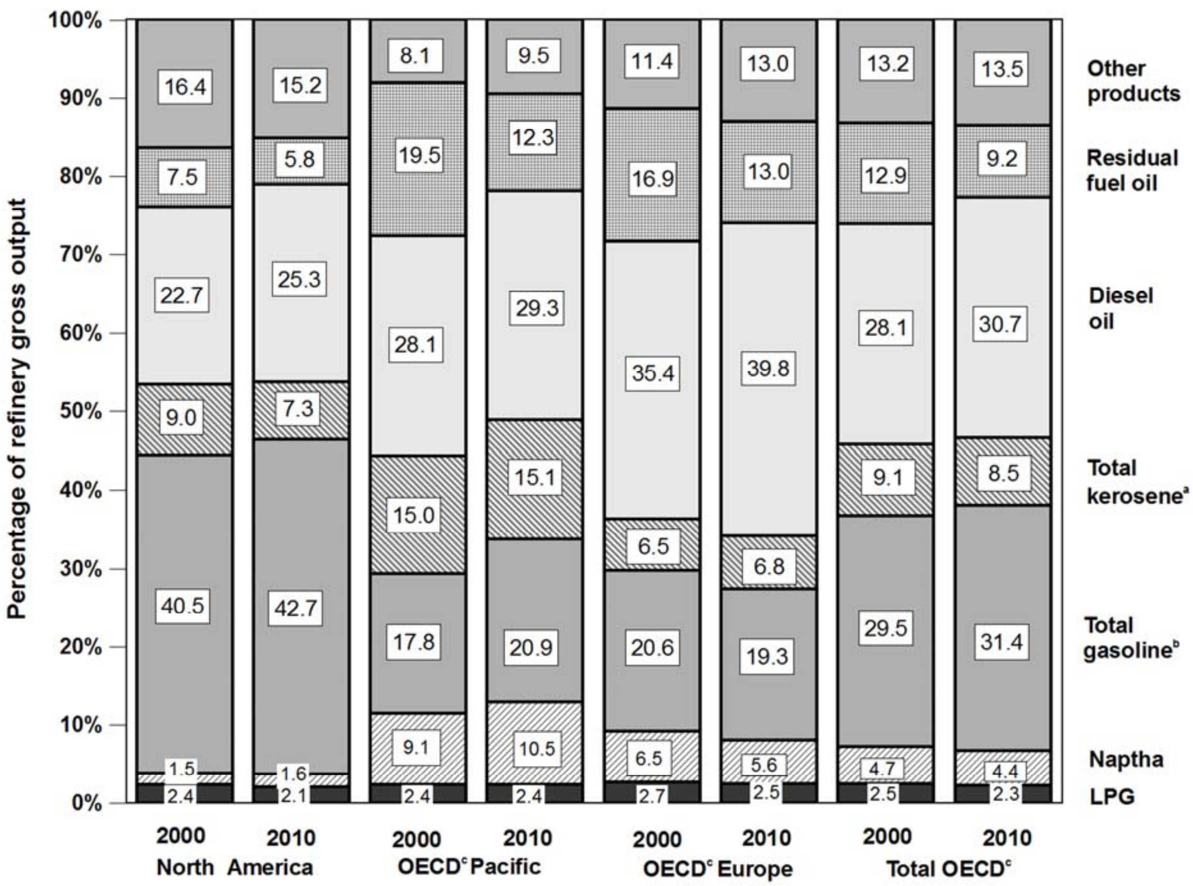
Notes:
Wealth Transfer is the product of total U.S. oil imports and the difference between the actual market price of oil (influenced by market power) and what the price would have been in a competitive market.

Dislocation Losses are temporary reductions in GDP as a result of oil price shocks.

Loss of Potential Gross Domestic Product (GDP) results because a basic resource used by the economy to produce output has become more expensive. As a consequence, with the same endowment of labor, capital, and other resources, our economy cannot produce quite as much as it could have at a lower oil price.

Other parts of the world refine crude oil to produce more diesel fuel and less gasoline than does North America. The OECD Europe countries produce the lowest share of gasoline in 2010.

Figure 1.5. Refinery Gross Output by World Region, 2000 and 2010



Source:
International Energy Agency, *Monthly Oil Survey*, January 2011. (Additional resources: www.iea.org)

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[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. The use of MTBE has declined in recent years due to many states banning the additive. The other hydrocarbons and liquids category includes unfinished oils, motor gasoline blending components and aviation gasoline blending components. In 2005 the gasoline blending components rose significantly.

Table 1.8
U.S. Refinery Input of Crude Oil and Petroleum Products, 1987–2009
(thousand barrels)

			Oxygenates			Other	
Year	Crude oil	Natural gas liquids	Fuel ethanol	MTBE[a]	Other oxygenates[b]	hydrocarbons and liquids	Total input to refineries
1987	4,691,783	280,889	[c]	[c]	[d]	132,720	5,105,392
1988	4,848,175	304,566	[c]	[c]	[d]	105,645	5,258,386
1989	4,891,381	182,109	[c]	[c]	[d]	223,797	5,297,287
1990	4,894,379	170,589	[c]	[c]	[d]	260,108	5,325,076
1991	4,855,016	172,306	[c]	[c]	[d]	280,265	5,307,587
1992	4,908,603	171,701	[c]	[c]	[d]	272,676	5,352,980
1993	4,968,641	179,213	3,351	49,393	1,866	280,074	5,482,538
1994	5,061,111	169,868	3,620	52,937	1,918	193,808	5,483,262
1995	5,100,317	172,026	9,055	79,396	4,122	190,411	5,555,327
1996	5,195,265	164,552	11,156	79,407	3,570	214,282	5,668,232
1997	5,351,466	151,769	11,803	86,240	4,246	201,268	5,806,792
1998	5,434,383	146,921	11,722	89,362	4,038	206,135	5,892,561
1999	5,403,450	135,756	13,735	94,784	4,147	225,779	5,877,651
2000	5,514,395	138,921	15,268	90,288	4,005	201,135	5,964,012
2001	5,521,637	156,479	16,929	87,116	4,544	192,632	5,979,337
2002	5,455,530	155,429	26,320	90,291	2,338	224,567	5,955,475
2003	5,585,875	152,763	55,626	67,592	1,937	163,459	6,027,252
2004	5,663,861	154,356	74,095	47,600	940	194,203	6,135,055
2005	5,555,332	161,037	84,088	39,751	612	295,064	6,135,884
2006	5,563,354	182,924	117,198	11,580	57	322,989	6,198,102
2007	5,532,097	184,383	136,603	1,610	0	349,807	6,204,500
2008	5,361,287	177,559	190,084	480	0	548,843	6,277,893
2009	5,232,656	177,194	240,955	90	0	518,998	6,169,893
			Average annual percentage change				
1987–2009	1.3%	-2.1%	[d]	[d]	[d]	6.4%	0.9%
1999–2009	-0.3%	2.7%	33.2%	-50.1%	-100.0%	8.7%	0.5%

Source:
U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual 2009, Vol. 1*, July 2010, Table 15, and annual. (Additional resources: www.eia.doe.gov)

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[a] Methyl tertiary butyl ether (MTBE).
[b] Includes methanol and other oxygenates.
[c] Reported in "Other" category in this year.
[d] 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 1.9
Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978–2010
(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	9.2	4.1	23.3	104.6
1994	45.5	22.3	9.8	4.2	23.2	105.0
1995	46.4	21.8	9.7	4.5	22.8	105.2
1996	45.7	22.7	10.4	4.5	22.4	105.7
1997	45.7	22.5	10.3	4.6	22.4	105.5
1998	46.2	22.3	9.9	4.4	22.9	105.7
1999	46.5	22.3	10.2	4.5	22.4	105.9
2000	46.2	23.1	10.3	4.5	22.0	106.1
2001	46.2	23.8	9.8	4.3	21.6	105.7
2002	47.3	23.2	9.8	4.3	21.5	106.1
2003	46.9	23.7	9.5	4.2	22.1	106.4
2004	46.8	23.9	9.7	4.0	22.2	106.6
2005	46.2	25.0	9.8	3.6	21.6	106.2
2006	45.8	25.4	9.3	3.9	21.7	106.1
2007	45.5	26.1	9.1	4.1	21.5	106.3
2008	44.2	27.8	9.7	4.1	20.7	106.5
2009	46.1	26.9	9.3	4.1	20.2	106.6
2010	45.7	27.5	9.3	4.3	20.3	107.1

Source:
Department of Energy, Energy Information Administration, *Petroleum Supply Navigator*, Vol.1, March 2011. (Additional resources: www.eia.doe.gov)

[a] Includes aviation gasoline (0.1%), kerosene (0.1%), residual fuel oil (4.0%), naphtha and other oils for petrochemical feedstock use (1.0%), other oils for petrochemical feedstock use (1.0%), special naphthas (0.2%), lubricants (1.0%), waxes (0.1%), petroleum coke (5.3%) asphalt and road oil (2.4%), still gas (4.3%), and miscellaneous products (0.5%).

[b] Products sum greater than 100% due to processing gain. The processing gain for years 1978 to 1980 is assumed to be 4 percent.

Domestic petroleum production increased in 2009 for the first time in 20 years. Most of the petroleum imported by the United States is in the form of crude oil. The United States does export small amounts of petroleum, mainly refined petroleum products which go to Canada and Mexico.

Table 1.10
United States Petroleum Production, Imports and Exports, 1950–2010
(million barrels per day)

	Domestic Production			Net Imports			Exports		
	Crude oil	Natural gas plant liquids	Total[a]	Crude oil	Petroleum products	Total	Crude oil	Petroleum products	Total
1950	5.41	0.50	5.91	0.49	0.36	0.85	0.10	0.21	0.31
1955	6.81	0.77	7.58	0.78	0.47	1.25	0.03	0.34	0.37
1960	7.05	0.93	7.98	1.02	0.80	1.82	0.01	0.19	0.20
1965	7.80	1.21	9.01	1.24	1.23	2.47	0.00	0.18	0.19
1970	9.64	1.66	11.30	1.32	2.10	3.42	0.01	0.25	0.26
1975	8.38	1.63	10.01	4.11	1.95	6.06	0.01	0.20	0.21
1980	8.60	1.57	10.17	5.26	1.65	6.91	0.29	0.26	0.54
1981	8.57	1.61	10.18	4.40	1.60	6.00	0.23	0.37	0.60
1982	8.65	1.55	10.20	3.49	1.63	5.11	0.24	0.58	0.82
1983	8.69	1.56	10.25	3.33	1.72	5.05	0.16	0.58	0.74
1984	8.90	1.63	10.53	3.43	2.01	5.44	0.18	0.54	0.72
1985	8.97	1.61	10.58	3.20	1.87	5.07	0.20	0.58	0.78
1986	8.68	1.55	10.23	4.18	2.05	6.22	0.15	0.63	0.79
1987	8.35	1.60	9.95	4.67	2.00	6.68	0.15	0.61	0.76
1988	8.16	1.63	9.97	5.11	2.30	7.40	0.16	0.66	0.82
1989	7.61	1.55	9.16	5.84	2.22	8.06	0.14	0.72	0.86
1990	7.36	1.56	8.91	5.89	2.12	8.02	0.11	0.75	0.86
1991	7.42	1.66	9.08	5.78	1.84	7.63	0.12	0.89	1.00
1992	7.18	1.70	8.88	6.08	1.81	7.89	0.09	0.86	0.95
1993	6.85	1.74	8.59	6.79	1.83	8.62	0.10	0.90	1.00
1994	6.66	1.73	8.39	7.06	1.93	9.00	0.10	0.84	0.94
1995	6.56	1.76	8.32	7.23	1.61	8.84	0.10	0.86	0.95
1996	6.47	1.83	8.30	7.51	1.97	9.48	0.11	0.87	0.98
1997	6.45	1.82	8.27	8.23	1.94	10.16	0.11	0.90	1.00
1998	6.25	1.76	8.01	8.71	2.00	10.71	0.11	0.84	0.95
1999	5.88	1.85	7.73	8.73	2.12	10.85	0.12	0.82	0.94
2000	5.82	1.91	7.73	9.07	2.39	11.46	0.05	0.99	1.04
2001	5.80	1.87	7.67	9.33	2.54	11.87	0.02	0.95	0.97
2002	5.75	1.88	7.63	9.14	2.39	11.53	0.01	0.98	0.98
2003	5.68	1.72	7.40	9.67	2.60	12.26	0.01	1.01	1.03
2004	5.42	1.81	7.23	10.09	3.06	13.15	0.03	1.02	1.05
2005	5.18	1.72	6.90	10.13	3.59	13.71	0.03	1.13	1.17
2006	5.10	1.74	6.84	10.12	3.59	13.71	0.03	1.29	1.32
2007	5.06	1.78	6.85	10.03	3.44	13.47	0.03	1.41	1.43
2008	4.95	1.78	6.73	9.78	3.13	12.92	0.03	1.77	1.80
2009	5.36	1.91	7.21	9.01	2.67	11.69	0.04	1.98	2.02
2010	5.51	2.00	7.51	9.16	2.59	11.75	0.04	2.27	2.31
				Average annual percentage change					
1950–2010	0.0%	2.3%	0.4%	5.0%	3.3%	4.5%	-1.5%	4.0%	3.4%
1970–2010	-1.4%	0.5%	-1.0%	5.0%	0.5%	3.1%	3.5%	5.7%	5.6%
2000–2010	-0.5%	0.5%	-0.3%	0.1%	0.8%	0.3%	-2.2%	8.7%	8.3%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2011, Tables 3.1 and 3.3b and *Annual Energy Review*, Table 5.3.

[a] Total domestic production includes crude oil, natural gas plant liquids and small amounts of other liquids.

The U.S. share of the world's petroleum consumption is slightly less than one-quarter. The United States relies heavily on imported petroleum. Imports accounted for nearly 50% of U.S. petroleum consumption in 2010.

Table 1.11
Petroleum Production and Consumption and Some Important Percent Shares, 1950–2010

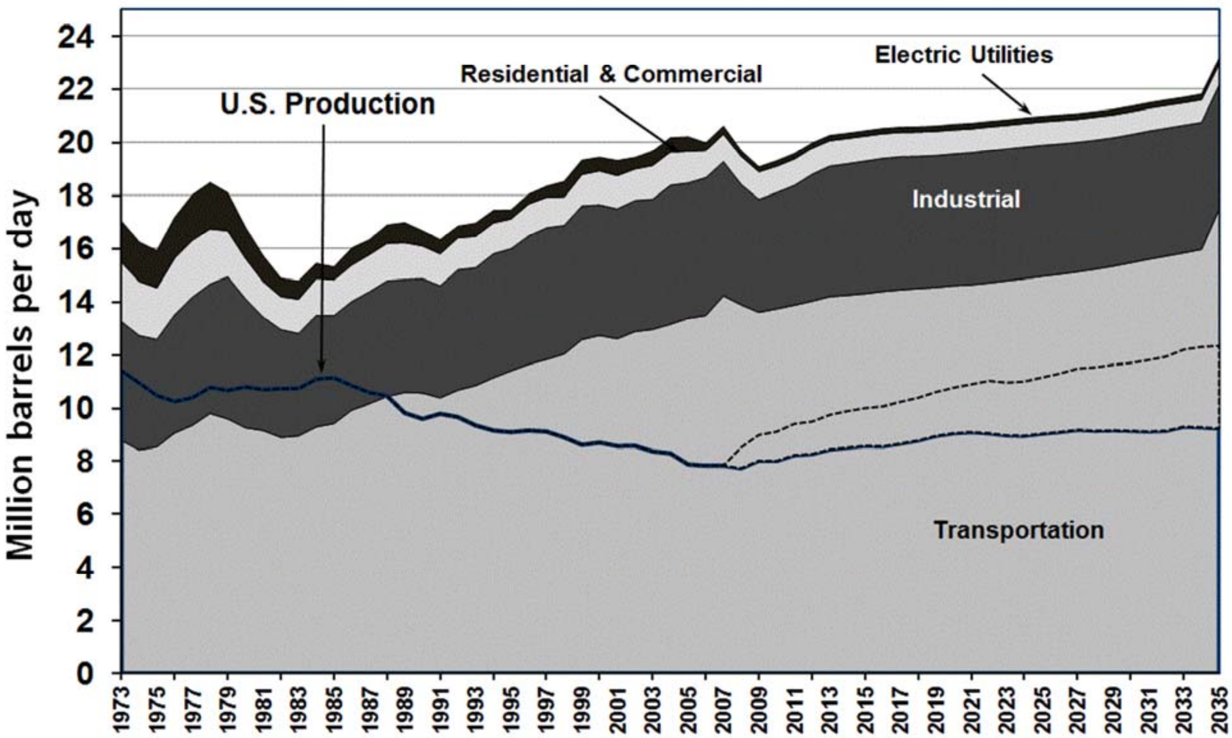
	Domestic petroleum production[a]	Net petroleum imports	Transportation petroleum consumption	U.S. petroleum consumption	World petroleum consumption	Net imports as a share of U.S. consumption	U.S. petroleum consumption as a share of world consumption	Transportation petroleum use as a share of domestic production
	(million barrels per day)							
1950	5.91	0.55	3.36	6.46	[b]	8.4%	[b]	56.8%
1955	7.58	0.88	4.46	8.46	[b]	10.4%	[b]	58.8%
1960	7.99	1.62	5.15	9.82	21.34	16.5%	46.0%	64.5%
1965	9.01	2.28	6.04	11.51	31.14	19.8%	37.0%	67.0%
1970	11.30	3.16	7.78	14.70	46.81	21.5%	31.4%	68.9%
1975	10.01	5.85	8.95	16.32	56.20	35.8%	29.0%	89.4%
1980	10.17	6.36	9.57	17.06	63.11	37.3%	27.0%	94.1%
1981	10.18	5.40	9.49	16.06	60.94	33.6%	26.3%	93.2%
1982	10.20	4.30	9.31	15.30	59.54	28.1%	25.7%	91.2%
1983	10.25	4.31	9.41	15.23	58.78	28.3%	25.9%	91.8%
1984	10.51	4.72	9.71	15.73	59.82	30.0%	26.3%	92.4%
1985	10.58	4.29	9.84	15.73	60.08	27.3%	26.2%	93.0%
1986	10.23	5.44	10.19	16.28	61.81	33.4%	26.3%	99.6%
1987	9.94	5.91	10.50	16.67	63.10	35.5%	26.4%	105.7%
1988	9.76	6.59	10.88	17.28	64.97	38.1%	26.6%	111.4%
1989	9.16	7.20	10.94	17.33	66.08	41.6%	26.2%	119.4%
1990	8.91	7.16	10.89	16.99	66.63	42.2%	25.5%	122.2%
1991	9.08	6.63	10.76	16.71	67.22	39.6%	24.9%	118.5%
1992	8.87	6.94	10.91	17.03	67.39	40.8%	25.3%	123.0%
1993	8.58	7.62	11.12	17.24	67.51	44.2%	25.5%	129.7%
1994	8.39	8.05	11.13	17.72	68.78	45.5%	25.8%	132.6%
1995	8.32	7.89	11.61	17.73	69.99	44.5%	25.3%	139.5%
1996	8.30	8.50	11.91	18.31	71.54	46.4%	25.6%	143.5%
1997	8.27	9.16	12.05	18.62	73.44	49.2%	25.4%	145.7%
1998	8.01	9.76	12.36	18.92	74.08	51.6%	25.5%	154.3%
1999	7.73	9.91	12.70	19.52	75.79	50.8%	25.8%	164.3%
2000	7.73	10.42	12.98	19.70	76.77	52.9%	25.7%	167.9%
2001	7.67	10.90	12.86	19.65	77.51	55.5%	25.3%	167.7%
2002	7.63	10.55	13.12	19.76	78.16	53.4%	25.3%	172.0%
2003	7.40	11.24	13.20	20.03	79.72	56.1%	25.1%	178.4%
2004	7.23	12.10	13.61	20.73	82.51	58.4%	25.1%	188.2%
2005	6.90	12.55	13.79	20.80	84.11	60.3%	24.7%	199.9%
2006	6.84	12.39	13.95	20.69	85.26	59.9%	24.3%	203.9%
2007	6.85	12.04	14.00	20.68	86.29	58.2%	24.0%	204.4%
2008	6.73	11.11	13.33	19.50	85.78	57.0%	22.7%	198.0%
2009	7.27	9.67	12.82	18.77	84.34	51.5%	22.3%	176.4%
2010	7.51	9.44	12.96	19.15	85.26	49.3%	22.5%	172.5%
	Average annual percentage change							
1950–2010	0.4%	4.9%	2.3%	1.8%	[b]			
1970–2010	-1.0%	2.8%	1.3%	0.7%	1.5%			
2000–2010	-0.3%	-1.0%	0.0%	-0.3%	1.0%			

Sources:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2011, Tables 2.5, 3.1, and A3. (Pre-1973 data from the *Annual Energy Review*). World petroleum consumption - U.S. Department of Energy, Energy Information Administration, *International Energy Statistics Website*, March 2011. (Additional resources: www.eia.doe.gov)

[a] Total domestic production includes crude oil, natural gas plant liquids and small amounts of other liquids.
[b] Data are not available.

Before 1989 the U.S. produced enough petroleum to meet the needs of the transportation sector, but was still short of meeting the petroleum needs of all the sectors, including industrial, residential and commercial, and electric utilities. In 1973 the gap between what the U.S. produced and what was consumed was 5.6 million barrels per day. By 2035, the gap is expected to be at least 10.8 million barrels per day if all sources of petroleum are included or 13.9 million barrels per day if only conventional petroleum sources are used.

Figure 1.6. United States Petroleum Production and Consumption – All Sectors, 1973–2035



Source:
See Tables 1.12 and 2.7. Projections are from the Energy Information Administration, *Annual Energy Outlook 2011*, April 2011.

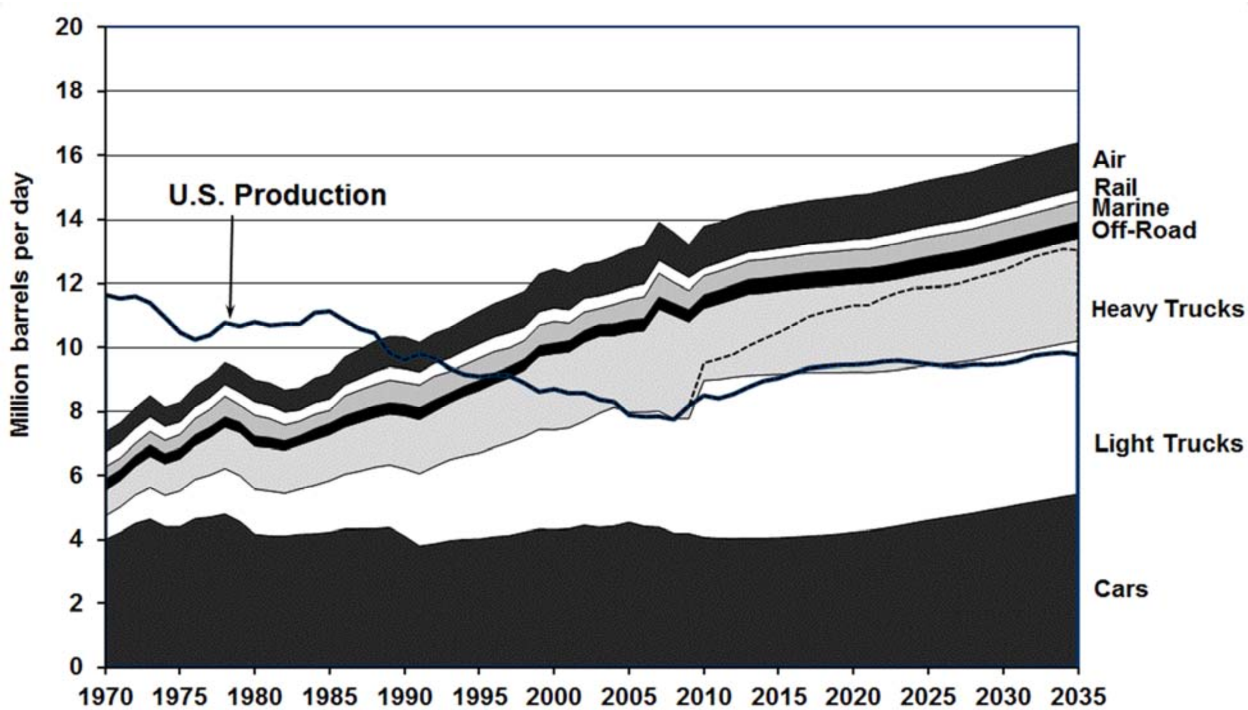
Notes: The U.S. Production has two lines after 2005. The solid line is conventional sources of petroleum, including crude oil, natural gas plant liquids, and refinery gains. The dashed line adds in other non-petroleum sources, including ethanol, biomass, liquids from coal, other blending components, other hydrocarbons, and ethers.

The sharp increase in values between 2006 and 2007 is the result of the FHWA's methodology change.

The data change from historical to projected values occurs between 2009 and 2010.

In 1989 the transportation sector petroleum consumption surpassed U.S. petroleum production for the first time, creating a gap that must be met with imports of petroleum. By the year 2035, transportation petroleum consumption is expected to grow to more than 16 million barrels per day; at that time, the gap between U.S. production and transportation consumption will be about 3.8 million barrels per day (when including the non-petroleum sources).

Figure 1.7. United States Petroleum Production, Transportation and Consumption, 1970–2035



Source:
See Tables 1.12 and 2.7. Projections are from the Energy Information Administration, *Annual Energy Outlook 2011*, April 2011.

Notes: The U.S. Production has two lines after 2005. The solid line is conventional sources of petroleum, including crude oil, natural gas plant liquids, and refinery gains. The dashed line adds in other non-petroleum sources, including ethanol, biomass, liquids from coal, other blending components, other hydrocarbons, and ethers.

The sharp increase in values between 2009 and 2010 are caused by the data change from historical to projected values. The sharp increase in the value for heavy trucks between 2006 and 2007 is the result of the FHWA's methodology change.

Transportation accounted for almost 70% of the U.S. petroleum use in 2010. Total petroleum consumption reached more than 20 million barrels per day from 2004 to 2007, but has been below that level since then.

Table 1.12
Consumption of Petroleum by End-Use Sector, 1973–2010
(million barrels per day)

Year	Transportation	Percentage	Residential	Commercial	Industrial	Electric utilities	Total
1973	9.05	52.3%	1.46	0.77	4.48	1.54	17.31
1974	8.84	53.1%	1.33	0.70	4.30	1.48	16.65
1975	8.95	54.8%	1.29	0.65	4.04	1.39	16.32
1976	9.40	53.7%	1.40	0.72	4.46	1.52	17.51
1977	9.76	52.9%	1.39	0.75	4.83	1.71	18.44
1978	10.16	53.9%	1.35	0.72	4.87	1.75	18.84
1979	10.00	54.0%	1.07	0.66	5.34	1.44	18.51
1980	9.57	56.0%	0.89	0.63	4.86	1.15	17.10
1981	9.49	59.1%	0.79	0.54	4.27	0.96	16.06
1982	9.31	60.8%	0.75	0.50	4.06	0.69	15.30
1983	9.41	61.8%	0.72	0.57	3.85	0.68	15.23
1984	9.62	61.0%	0.79	0.60	4.20	0.56	15.78
1985	9.84	62.6%	0.81	0.53	4.07	0.48	15.72
1986	10.19	62.6%	0.80	0.57	4.09	0.64	16.28
1987	10.51	63.0%	0.85	0.55	4.21	0.55	16.67
1988	10.88	62.7%	0.87	0.54	4.36	0.69	17.34
1989	10.94	62.8%	0.88	0.51	4.33	0.75	17.40
1990	10.89	64.7%	0.74	0.49	4.15	0.57	16.84
1991	10.76	63.2%	0.74	0.46	4.53	0.53	17.03
1992	10.91	64.2%	0.76	0.44	4.45	0.44	16.99
1993	11.08	63.7%	0.77	0.41	4.64	0.50	17.39
1994	11.36	64.7%	0.76	0.41	4.57	0.47	17.57
1995	11.61	64.9%	0.74	0.38	4.83	0.33	17.90
1996	11.91	64.6%	0.81	0.40	4.96	0.36	18.44
1997	12.05	65.2%	0.78	0.38	4.86	0.41	18.47
1998	12.36	65.5%	0.72	0.36	4.84	0.58	18.86
1999	12.70	65.3%	0.82	0.37	5.03	0.53	19.46
2000	12.98	65.9%	0.87	0.42	4.92	0.51	19.68
2001	12.86	65.7%	0.85	0.41	4.89	0.56	19.57
2002	13.12	66.7%	0.82	0.38	4.93	0.43	19.67
2003	13.20	66.3%	0.85	0.43	4.90	0.53	19.91
2004	13.61	65.9%	0.84	0.42	5.23	0.54	20.63
2005	13.79	66.8%	0.81	0.39	5.10	0.55	20.63
2006	13.95	68.2%	0.69	0.34	5.19	0.29	20.45
2007	14.00	68.7%	0.71	0.34	5.05	0.29	20.38
2008	13.33	69.7%	0.72	0.34	4.53	0.21	19.14
2009	12.82	70.0%	0.69	0.35	4.27	0.18	18.31
2010	12.96	69.7%	0.71	0.37	4.38	0.17	18.59
		Average annual percentage change					
1973–2010	1.0%		-1.9%	-2.0%	-0.1%	-5.8%	0.2%
2000–2010	0.0%		-2.0%	-1.3%	-1.2%	-10.4%	-0.6%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* March 2011, Tables 2.2–2.6. Converted to million barrels per day using Table A3. (Additional resources: www.eia.doe.gov)

Due to changes in the FHWA fuel use methodology, motorcycle, bus, and heavy truck data are not comparable with data before the year 2007. Light trucks include pick-ups, minivans, sport-utility vehicles, and vans. See Table 2.7 for highway energy use in trillion Btu.

Table 1.13
Highway Transportation Petroleum Consumption by Mode, 1970–2009[a]
(thousand barrels per day)

Year	Autos	Light trucks	Light vehicles subtotal	Motor-cycles	Buses	Heavy trucks	Highway subtotal	Total transportation[b]
1970	4,424	803	5,227	4	62	738	6,031	7,333
1975	4,836	1,245	6,081	7	58	952	7,099	8,472
1976	5,107	1,359	6,466	8	63	1,005	7,542	8,969
1977	5,157	1,460	6,617	8	65	1,114	7,805	9,314
1978	5,261	1,576	6,837	9	66	1,247	8,160	9,793
1979	4,996	1,595	6,591	11	68	1,299	7,969	9,725
1980	4,565	1,552	6,117	13	68	1,302	7,500	9,118
1981	4,508	1,546	6,054	14	69	1,329	7,466	9,175
1982	4,509	1,481	5,989	13	71	1,330	7,403	8,944
1983	4,587	1,562	6,149	11	72	1,354	7,586	9,077
1984	4,609	1,670	6,280	11	69	1,398	7,758	9,364
1985	4,665	1,785	6,450	12	72	1,396	7,930	9,536
1986	4,773	1,897	6,670	12	76	1,426	8,184	9,896
1987	4,782	1,996	6,778	12	77	1,469	8,336	10,111
1988	4,784	2,130	6,914	13	80	1,495	8,503	10,343
1989	4,821	2,170	6,992	14	79	1,534	8,618	10,505
1990	4,538	2,323	6,861	12	78	1,597	8,549	10,440
1991	4,196	2,493	6,688	12	83	1,630	8,413	10,257
1992	4,268	2,670	6,938	12	87	1,660	8,698	10,595
1993	4,374	2,795	7,169	13	86	1,711	8,979	10,820
1994	4,428	2,878	7,305	13	86	1,806	9,211	11,089
1995	4,440	2,975	7,415	13	87	1,881	9,396	11,346
1996	4,515	3,089	7,604	13	88	1,931	9,636	11,601
1997	4,559	3,222	7,781	13	91	1,949	9,834	11,776
1998	4,677	3,292	7,969	13	93	2,012	10,086	12,060
1999	4,780	3,448	8,228	14	96	2,212	10,550	12,639
2000	4,766	3,453	8,219	14	98	2,298	11,073	13,235
2001	4,798	3,491	8,290	13	93	2,295	11,199	13,181
2002	4,923	3,602	8,525	12	91	2,401	11,457	13,366
2003	4,866	3,963	8,829	12	90	2,334	11,857	13,699
2004	4,919	4,137	9,055	13	92	2,162	12,070	14,090
2005	5,050	3,840	8,890	12	93	2,426	11,905	14,020
2006	4,893	3,959	8,852	14	94	2,476	12,003	14,171
2007	4,852	4,034	8,885	31	145	3,080	12,092	14,298
2008	4,664	3,992	8,656	32	148	3,112	11,898	13,886
2009	4,662	4,019	8,681	31	144	2,901	11,708	11,708
			Average annual percentage change					
1970–2009	0.1%	4.2%	1.3%	5.4%	2.2%	3.6%	1.6%	1.1%
1999–2009	-0.2%	1.5%	0.5%	8.3%	4.1%	2.7%	1.0%	-0.8%

Source:
See Appendix A for Highway Energy Use.

[a] Each gallon of petroleum product was assumed to equal one gallon of crude oil. The oil used to produce electricity is also estimated. See Appendix A, p. 18 for details.

[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).

Although about 18% of transportation energy use is for nonhighway modes, only 14% of transportation petroleum use is for nonhighway. This is because some nonhighway modes, such as pipelines and transit rail, use electricity. An estimate for the petroleum used to make electricity is included in the data. See Table 2.8 for nonhighway transportation energy use in trillion Btu.

Table 1.14
Nonhighway Transportation Petroleum Consumption by Mode, 1970–2009[a]
(thousand barrels per day)

Year	Air	Water	Pipeline	Rail	Nonhighway subtotal	Total transportation[b]
1970	625	381	43	253	1,302	7,333
1975	651	423	50	249	1,373	8,472
1980	697	625	35	262	1,618	9,118
1981	706	722	29	253	1,709	9,175
1982	701	604	21	214	1,541	8,944
1983	699	561	20	212	1,491	9,077
1984	781	577	16	232	1,606	9,364
1985	814	564	13	216	1,606	9,537
1986	884	601	17	210	1,712	9,896
1987	920	626	15	213	1,775	10,111
1988	958	644	18	220	1,840	10,343
1989	960	688	18	221	1,887	10,505
1990	1,006	655	14	216	1,891	10,440
1991	940	690	12	202	1,845	10,257
1992	954	724	10	208	1,897	10,595
1993	961	653	11	215	1,841	10,820
1994	1,002	635	11	230	1,878	11,089
1995	1,036	668	7	239	1,950	11,346
1996	1,068	644	8	245	1,965	11,601
1997	1,114	574	9	246	1,942	11,776
1998	1,148	566	12	248	1,974	12,060
1999	1,196	625	11	257	2,089	12,639
2000	1,234	662	10	256	2,162	12,791
2001	1,167	546	11	257	1,982	12,671
2002	1,071	572	8	257	1,909	12,938
2003	1,073	496	10	263	1,843	13,108
2004	1,136	596	10	278	2,021	13,343
2005	1,199	625	10	281	2,115	13,536
2006	1,216	661	5	286	2,168	13,604
2007	1,215	709	5	277	2,206	14,347
2008	1,159	621	4	265	2,049	13,997
2009	1,035	589	3	220	1,847	13,607
Average annual percentage change						
1970–2009	1.3%	1.1%	-6.6%	-0.4%	0.9%	1.6%
1999–2009	-1.4%	-0.6%	-12.2%	-1.5%	-1.2%	0.7%

Source:
See Appendix A for Nonhighway Energy Use.

[a] Each gallon of petroleum product was assumed to equal one gallon of crude oil. The oil used to produce electricity is also estimated. See Appendix A, p. 18 for details.

[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).

Highway vehicles were responsible for over 86% of all transportation petroleum use in 2009. See Table 2.7 for transportation energy use in trillion Btu.

Table 1.15
Transportation Petroleum Use by Mode, 2008–2009[a]

	Thousand barrels per day		Percentage of total	
	2008	2009	2008	2009
HIGHWAY	**11,897.9**	**11,708.1**	**85.3%**	**86.4%**
Light vehicles	**8,687.9**	**8,712.2**	**62.3%**	**64.3%**
Cars	4,663.9	4,662.3	33.4%	34.4%
Light trucks[b]	3,992.1	4,018.9	28.6%	29.6%
Motorcycles	31.9	31.0	0.2%	0.2%
Buses	**98.1**	**95.0**	**0.7%**	**0.7%**
Transit	45.2	43.7	0.3%	0.3%
Intercity	15.2	14.7	0.1%	0.1%
School	37.7	36.5	0.3%	0.3%
Medium/heavy trucks	**3,111.9**	**2,901.0**	**22.3%**	**21.4%**
NONHIGHWAY	**2,049.2**	**1,847.2**	**14.7%**	**13.6%**
Air	**1,158.6**	**1,035.1**	**8.3%**	**7.6%**
General aviation	130.5	108.8	0.9%	0.8%
Domestic air carriers	826.3	739.7	5.9%	5.5%
International air	201.8	186.6	1.4%	1.4%
Water	**621.4**	**588.5**	**4.5%**	**4.3%**
Freight	495.5	462.8	3.6%	3.4%
Recreational	125.8	125.8	0.9%	0.9%
Pipeline	**3.8**	**3.3**	**0.0%**	**0.0%**
Rail	**265.5**	**220.3**	**1.9%**	**1.6%**
Freight (Class I)	255.1	210.0	1.8%	1.5%
Passenger	10.3	10.2	0.1%	0.1%
Transit	0.7	0.0	0.0%	0.0%
Commuter	5.4	6.2	0.0%	0.0%
Intercity	4.1	4.0	0.0%	0.0%
HWY & NONHWY TOTAL[c]	**13,947.1**	**13,555.3**	**100.0%**	**100.0%**
Off-Highway	**980.5**	**999.5**		

Source:
See Appendix A for Energy Use Sources.

[a] Each gallon of petroleum product was assumed to equal one gallon of crude oil. The oil used to produce electricity is also estimated. See Appendix A, p. 18 for details.

[b] Two-axle, four-tire trucks.

[c] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).

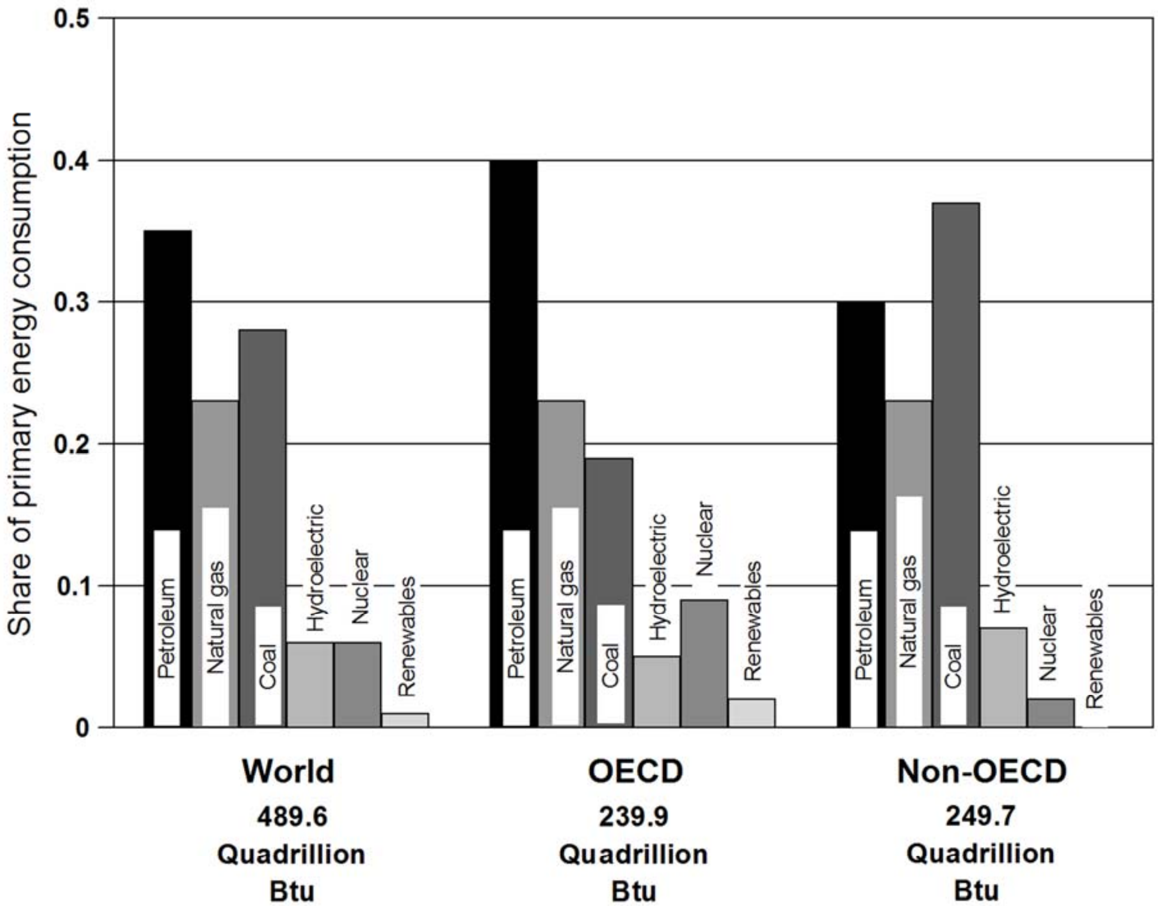
Chapter 2
Energy

Summary Statistics from Tables in this Chapter

Source			
Table 2.1	Transportation share of U.S. energy consumption, 2010		28.1%
Table 2.2	Petroleum share of transportation energy consumption, 2010		93.2%
Table 2.3	Alternative fuel and oxygenate consumption, 2009	(thousand gasoline equivalent gallons)	(share of Total alt fuel/oxygenates)
	Ethanol in gasohol	*7,343,133*	*90.7%*
	MTBE	*0*	*0.0%*
	Liquefied petroleum gas	*129,631*	*1.6%*
	Compressed natural gas	*199,513*	*2.5%*
	E85	*71,213*	*0.9%*
	Liquefied natural gas	*26,652*	*0.3%*
	Electricity	*4,956*	*0.1%*
Table 2.6	Transportation energy use by mode, 2009	(trillion Btu)	(share)
	Cars	*8,811*	*31.9%*
	Light trucks	*7,608*	*27.6%*
	Medium/heavy trucks	*6,084*	*22.1%*
	Buses	*200*	*0.7%*
	Total Highway	*22,763*	*82.5%*
	Air	*2,138*	*7.7%*
	Water	*1,291*	*4.7%*
	Pipeline	*857*	*3.1%*
	Rail	*540*	*2.0%*

Petroleum accounted for 35% of the world's energy use in 2008. 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 hydro-electric power more than OECD countries do.

Figure 2.1. World Consumption of Primary Energy, 2008



Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Statistics Database,* May 2011. (Additional resources: www.eia.doe.gov)

Total energy use was 98.0 quads in 2010 with transportation using 28.1%. The Energy Information Administration includes renewable energy in each sector.

Table 2.1
U. S. Consumption of Total Energy by End-Use Sector, 1973–2010
(quadrillion Btu)

Year	Transportation	Percentage transportation of total	Industrial	Commercial	Residential	Total[a]
1973	18.6	24.6%	32.6	9.5	14.9	75.7
1974	18.1	24.5%	31.8	9.4	14.7	74.0
1975	18.2	25.3%	29.4	9.5	14.8	72.0
1976	19.1	25.1%	31.4	10.1	15.4	76.0
1977	19.8	25.4%	32.3	10.2	15.7	78.0
1978	20.6	25.8%	32.7	10.5	16.1	80.0
1979	20.5	25.3%	33.9	10.6	15.8	80.9
1980	19.7	25.2%	32.0	10.6	15.8	78.1
1981	19.5	25.6%	30.7	10.6	15.3	76.1
1982	19.1	26.1%	27.6	10.9	15.5	73.1
1983	19.2	26.3%	27.4	10.9	15.4	73.0
1984	19.7	25.7%	29.6	11.4	16.0	76.7
1985	20.1	26.3%	28.8	11.4	16.0	76.4
1986	20.8	27.1%	28.3	11.6	16.0	76.7
1987	21.5	27.2%	28.4	11.9	16.3	79.1
1988	22.3	27.0%	30.7	12.6	17.1	82.7
1989	22.5	26.5%	31.3	13.2	17.8	84.8
1990	22.4	26.5%	31.8	13.3	17.0	84.5
1991	22.1	26.2%	31.4	13.4	17.4	84.4
1992	22.4	26.1%	32.6	13.4	17.4	85.8
1993	22.8	26.1%	32.6	13.8	18.2	87.4
1994	23.4	26.3%	33.5	14.1	18.1	89.1
1995	23.8	26.2%	34.0	14.7	18.5	91.0
1996	24.4	26.0%	34.9	15.2	19.5	94.0
1997	24.7	26.2%	35.2	15.7	19.0	94.6
1998	25.3	26.8%	34.8	16.0	19.0	95.0
1999	25.9	26.8%	34.8	16.4	19.6	96.7
2000	26.5	26.9%	34.7	17.2	20.4	98.8
2001	26.3	27.3%	32.7	17.1	20.0	96.2
2002	26.8	27.5%	32.7	17.4	20.8	97.7
2003	27.0	27.5%	32.5	17.3	21.1	98.0
2004	27.9	27.9%	33.5	17.7	21.1	100.1
2005	28.4	28.3%	32.4	17.9	21.6	100.3
2006	28.8	28.9%	32.4	17.7	20.7	99.6
2007	29.1	28.7%	32.4	18.3	21.6	101.4
2008	28.0	28.2%	31.3	18.4	21.6	99.3
2009	27.0	28.6%	28.5	17.9	21.1	94.5
2010	27.5	28.1%	30.1	18.2	22.2	98.0
		Average annual percentage change				
1973–2010	1.1%		-0.2%	1.8%	1.1%	0.7%
2000–2010	0.4%		-1.4%	0.6%	0.8%	-0.1%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* April 2011, Washington, DC, Table 2.1. (Additional resources: www.eia.doe.gov)

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

In transportation, the alcohol fuels blended into gasoline to make gasohol (10% ethanol or less) are counted under "renewables" and are not in with petroleum. The petroleum category, however, still contains other blending agents, such as MTBE, that are not actually petroleum, but are not broken out into a separate category.

Table 2.2
Distribution of Energy Consumption by Source, 1973 and 2010
(percentage)

Energy	Transportation		Residential		Commercial	
source	1973	2010	1973	2010	1973	2010
Petroleum[a]	95.8	93.2	18.9	5.5	16.5	3.9
Natural gas[b]	4.0	2.5	33.3	22.8	27.9	18.0
Coal	0.0	0.0	0.6	0.0	1.7	0.3
Renewable	0.0	4.0	2.4	2.5	0.1	0.7
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0
Electricity[c]	0.2	0.3	44.7	69.1	53.9	77.1
Total	100.00	100.00	100.00	100.00	100.00	100.00

Energy	Industrial		Electric utilities	
source	1973	2010	1973	2010
Petroleum[a]	27.9	26.6	17.8	1.0
Natural gas[b]	31.8	26.9	19.0	19.0
Coal	12.4	5.4	43.8	48.0
Renewable	3.7	7.2	14.5	10.6
Nuclear	0.0	0.0	4.6	21.3
Electricity[c]	24.2	33.8	0.2	0.2
Total	100.00	100.00	100.00	100.00

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2011, Washington, DC, Tables 2.2, 2.3, 2.4, 2.5, and 2.6. (Additional resources: www.eia.doe.gov)

Note: Numbers may not add due to rounding.

[a] In transportation, the petroleum category contains some blending agents which are not petroleum.
[b] Includes supplemental gaseous fuels. Transportation sector includes pipeline fuel and natural gas vehicle use.
[c] Includes electrical system energy losses.

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, 2003–2009
(thousand gasoline–equivalent gallons)

	2003	2004	2005	2006	2007	2008	2009
Alternative fuel							
Liquefied petroleum gas	224,697	211,883	188,171	173,130	152,360	147,784	129,631
Compressed natural gas	133,222	158,903	166,878	172,011	178,585	189,358	199,513
Liquefied natural gas	13,503	20,888	22,409	23,474	24,594	25,554	25,652
E85[a]	26,376	31,581	38,074	44,041	54,091	62,464	71,213
Electricity[b]	5,141	5,269	5,219	5,104	5,037	5,050	4,956
Hydrogen	2	8	25	41	66	117	140
Biodiesel	18,220	28,244	91,649	260,606	367,764	324,329	325,102
Other	0	0 2 2 2 2 2 2					
Subtotal	**421,161**	**456,766**	**512,427**	**678,409**	**782,479**	**754,658**	**756,209**
Oxygenates							
MTBE[c]	2,368,400	1,877,300	1,654,500	435,000	0 0 0		
Ethanol in gasohol	1,919,572	2,414,167	2,756,663	3,729,168	4,694,304	6,442,781	7,343,133
Total	**4,709,133**	**4,748,243**	**4,923,590**	**4,842,577**	**5,476,783**	**7,197,439**	**8,099,342**

Source:
U.S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 2009*, Washington, DC, April 2011, Web site www.eia.doe.gov/renewable/alternative_transport_vehicles/index.cfm. (Additional resources: www.eia.doe.gov)

[a] Consumption includes gasoline portion of the mixture.
[b] Vehicle consumption only; does not include power plant inputs.
[c] 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).

Ethanol is used as an oxygenate, blended with gasoline to be used as gasohol in conventional vehicles. The amount of ethanol used in gasohol dwarfs the amount used in E85. Production of E95 ended in 2000.

Table 2.4
Ethanol Consumption, 1995–2009
(thousand gallons)

	Ethanol blends			
	E85	E95	Ethanol in gasohol	Total
1995	166	970	934,615	935,751
2000	10,530	12	1,114,313	1,124,855
2001	12,756	0	1,173,323	1,186,079
2002	15,513	0	1,450,721	1,466,234
2003	26,376	0	1,919,572	1,945,948
2004	31,581	0	2,414,167	2,445,748
2005	38,074	0	2,756,663	2,794,737
2006	44,041	0	3,729,168	3,773,209
2007	54,091	0	4,694,304	4,748,395
2008	62,464	0	6,442,781	6,505,245
2009	71,213	0	7,343,133	7,414,346
2009 Percentage	1.0%	0.0%	99.0%	100.0%

Source:
U.S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 2009*, Washington, DC, April 2011, Web site: http://www.eia.doe.gov/renewable/alternative_transport_vehicles/index.cfm, Table C1. (Additional resources: www.eia.doe.gov)

Note: Gallons of E85, E95 and Ethanol in gasohol, do not include the gasoline portion of the blended fuel.

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. See Table 1.15 for transportation petroleum use in thousand barrels per day.

Table 2.5
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 2009[a]
(trillion Btu)

	Gasoline	Diesel fuel	Liquefied petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity	Total
HIGHWAY	**16,661.4**	**6,013.6**	**65.3**			**22.0**	**0.7**	**22,763.0**
Light vehicles	**16,042.1**	**391.4**	**45.0**			**0.0**	**0.0**	**16,478.5**
Cars	8,761.4	49.6						8,811.0
Light trucks[b]	7,221.3	341.8	45.0					7,608.1
Motorcycles	59.4							59.4
Buses	**7.8**	**169.5**	**0.0**			**22.0**	**0.7**	**200.0**
Transit	0.8	68.3	0.0			22.0	0.7	91.8
Intercity		31.4						31.4
School	7.0	69.9						76.9
Medium/heavy trucks	**611.5**	**5,452.7**	**20.3**					**6,084.5**
NONHIGHWAY	**237.1**	**721.4**	**0.0**	**2,099.3**	**839.4**	**616.8**	**312.2**	**4,826.1**
Air	**38.2**	**0.0**	**0.0**	**2,099.3**	**0.0**	**0.0**	**0.0**	**2,137.5**
General aviation	38.2			182.3				220.6
Domestic air carriers				1,530.8				1,530.8
International air carriers[c]				386.2				386.2
Water	**198.8**	**253.0**			**839.4**			**1,291.3**
Freight		206.2			839.4			1,045.6
Recreational	198.8	46.8						245.6
Pipeline	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**616.8**	**240.1**	**856.9**
Rail	**0.0**	**468.4**	**0.0**	**0.0**	**0.0**	**0.0**	**72.1**	**540.4**
Freight (Class I)		446.6						446.6
Passenger		21.7					72.1	93.8
Transit		0.0					47.8	47.8
Commuter		13.2					18.4	31.6
Intercity		8.6					5.8	14.4
TOTAL HWY & NONHWY	**16,898.5**	**6,735.0**	**65.3**	**2,099.3**	**839.4**	**638.7**	**312.9**	**27,589.0**

Source:
See Appendix A for Energy Use Sources.

[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
[b] Two-axle, four-tire trucks.
[c] One half of fuel used by domestic carriers in international operation.

Highway vehicles were responsible for 82.5% of all transportation energy use in 2009. See Table 1.15 for transportation energy use in thousand barrels per day.

Table 2.6
Transportation Energy Use by Mode, 2008–2009[a]

	Trillion Btu		Percentage of total based on Btus	
	2008	2009	2008	2009
HIGHWAY	**21,657.1**	**22,763.0**	**80.7%**	**82.5%**
Light vehicles	**16,435.7**	**16,478.5**	**61.3%**	**59.7%**
Cars	8,831.4	8,811.0	32.9%	31.9%
Light trucks[b]	7,572.2	7,608.1	28.2%	27.6%
Motorcycles	32.0	59.4	0.1%	0.2%
Buses	**199.8**	**200.0**	**0.7%**	**0.7%**
Transit	95.3	91.8	0.4%	0.3%
Intercity	30.3	31.4	0.1%	0.1%
School	74.3	76.9	0.3%	0.3%
Medium/heavy trucks	**5,021.6**	**6,084.5**	**18.7%**	**22.1%**
NONHIGHWAY	**5,165.4**	**4,826.1**	**19.3%**	**17.5%**
Air	**2,393.3**	**2,137.5**	**8.9%**	**7.7%**
General aviation	265.7	220.6	1.0%	0.8%
Domestic air carriers	1,710.0	1,530.8	6.4%	5.5%
International air	417.6	386.2	1.6%	1.4%
Water	**1,227.2**	**1,291.3**	**4.6%**	**4.7%**
Freight	981.6	1,045.6	3.7%	3.8%
Recreational	245.7	245.6	0.9%	0.9%
Pipeline	**910.5**	**856.9**	**3.4%**	**3.1%**
Rail	**634.4**	**540.4**	**2.4%**	**2.0%**
Freight (Class I)	542.5	446.6	2.0%	1.6%
Passenger	91.9	93.8	0.3%	0.3%
Transit	47.8	47.8	0.2%	0.2%
Commuter	29.3	31.6	0.1%	0.1%
Intercity	14.8	14.4	0.1%	0.1%
HWY & NONHWY TOTAL	**26,822.6**	**27,589.0**	**100.0%**	**100.0%**
Off-Highway	**1,957.9**	**1,997.5**		

Source:
See Appendix A for Energy Use Sources.

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

Due to changes in the FHWA fuel use methodology, motorcycle, bus, and heavy truck data are not comparable with data before the year 2007. Light trucks include pick-ups, minivans, sport-utility vehicles, and vans. See Table 1.13 for highway petroleum use in thousand barrels per day.

Table 2.7
Highway Transportation Energy Consumption by Mode, 1970–2009
(trillion Btu)

Year	Autos	Light trucks	Light vehicles subtotal	Motor-cycles	Buses	Heavy trucks	Highway subtotal	Total transportation[a]
1970	8,479	1,539	10,018	7	129	1,553	11,707	15,395
1975	9,298	2,384	11,682	14	124	2,003	13,823	17,424
1980	8,800	2,975	11,775	26	143	2,686	14,630	18,940
1981	8,693	2,963	11,656	27	145	2,724	14,552	18,741
1982	8,673	2,837	11,510	25	151	2,707	14,393	18,237
1983	8,802	2,990	11,792	22	152	2,770	14,736	18,368
1984	8,837	3,197	12,034	22	146	2,873	15,075	18,962
1985	8,932	3,413	12,345	23	153	2,883	15,404	19,205
1986	9,138	3,629	12,767	23	160	2,958	15,908	20,276
1987	9,157	3,819	12,976	24	164	3,061	16,225	20,771
1988	9,158	4,078	13,236	25	169	3,118	16,548	21,327
1989	9,232	4,156	13,388	26	169	3,199	16,782	21,685
1990	8,688	4,451	13,139	24	167	3,334	16,664	21,613
1991	8,029	4,774	12,803	23	177	3,402	16,405	21,205
1992	8,169	5,117	13,286	24	184	3,468	16,962	21,866
1993	8,368	5,356	13,724	25	183	3,577	17,509	22,322
1994	8,470	5,515	13,985	26	183	3,778	17,972	22,926
1995	8,489	5,695	14,184	25	184	3,937	18,330	23,465
1996	8,634	5,917	14,551	24	186	4,045	18,806	23,973
1997	8,710	6,168	14,878	25	192	4,086	19,181	24,327
1998	8,936	6,304	15,240	26	196	4,218	19,680	24,757
1999	9,134	6,602	15,736	26	203	4,638	20,603	25,948
2000	9,100	6,607	15,707	26	209	4,819	20,761	26,268
2001	9,161	6,678	15,839	24	196	4,813	20,872	25,958
2002	9,391	6,883	16,274	24	192	5,035	21,525	26,521
2003	9,255	7,551	16,806	24	190	4,895	21,915	26,672
2004	9,331	7,861	17,192	25	194	4,535	21,946	27,065
2005	9,579	7,296	16,875	24	196	5,088	22,183	27,526
2006	9,316	7,550	16,866	28	199	5,193	22,286	27,759
2007	9,221	7,679	16,900	59	306	6,460	23,726	29,334
2008	8,831	7,572	16,404	61	313	6,527	23,305	28,611
2009	8,811	7,608	16,419	59	303	6,085	22,866	27,692
			Average annual percentage change					
1970–2009	0.1%	4.2%	1.3%	5.6%	2.2%	3.6%	1.7%	1.5%
2000–2009	-0.4%	1.6%	0.5%	6.7%	4.1%	0.6%	1.0%	0.7%

Source:
See Appendix A for Highway Energy Use.

Note: Totals may not add due to rounding.

[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). These data have been revised due to a new data series for recreational boats.

*About **18**% of transportation energy use is for nonhighway modes. Air travel accounts for over 44% of nonhighway energy use. See Table 1.14 for nonhighway petroleum use in thousand barrels per day.*

Table 2.8
Nonhighway Transportation Energy Consumption by Mode, 1970–2009
(trillion Btu)

Year	Air	Water	Pipeline	Rail	Nonhighway subtotal	Total transportation[a]
1970	1,307	836	990	555	3,688	15,395
1975	1,274	927	840	559	3,601	17,424
1976	1,333	1,083	803	581	3,800	18,491
1977	1,350	1,177	786	591	3,904	19,126
1978	1,423	1,382	784	588	4,177	20,097
1979	1,488	1,149	860	607	4,104	19,652
1980	1,434	1,393	896	588	4,310	18,940
1981	1,453	1,270	904	561	4,189	18,741
1982	1,445	1,063	855	481	3,844	18,237
1983	1,440	974	740	478	3,632	18,368
1984	1,609	964	782	532	3,887	18,962
1985	1,677	871	755	498	3,801	19,205
1986	1,823	1,323	735	487	4,368	20,276
1987	1,899	1,378	772	498	4,546	20,771
1988	1,978	1,417	874	511	4,779	21,327
1989	1,981	1,516	890	515	4,903	21,685
1990	2,077	1,442	923	506	4,949	21,613
1991	1,939	1,523	860	478	4,800	21,205
1992	1,970	1,599	846	490	4,904	21,866
1993	1,986	1,437	885	505	4,813	22,322
1994	2,070	1,394	951	539	4,954	22,926
1995	2,141	1,468	967	559	5,135	23,465
1996	2,206	1,411	979	572	5,167	23,973
1997	2,300	1,250	1,022	574	5,146	24,327
1998	2,371	1,232	897	578	5,077	24,757
1999	2,471	1,367	908	599	5,345	25,948
2000	2,549	1,454	904	601	5,507	26,268
2001	2,411	1,186	886	603	5,086	25,958
2002	2,213	1,247	931	605	4,996	26,521
2003	2,217	1,074	850	617	4,757	26,672
2004	2,348	1,299	822	650	5,119	27,065
2005	2,477	1,368	842	657	5,343	27,526
2006	2,511	1,450	842	670	5,473	27,759
2007	2,509	1,559	882	657	5,608	29,334
2008	2,393	1,368	911	634	5,306	28,611
2009	2,138	1,291	857	540	4,826	27,692
Average annual percentage change						
1970–2009	1.3%	1.1%	-0.4%	-0.1%	0.7%	1.5%
1999–2009	-1.4%	-0.6%	-0.6%	-1.0%	-1.0%	0.7%

Source:
See Appendix A for Nonhighway Energy Use.

Note: Totals may not add due to rounding.

[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 Environmental Protection Agency's NONROAD2008a model estimates fuel use for different types of equipment and off-highway vehicles. Most of these vehicles/equipment use diesel fuel. Recreational equipment, such as off-highway motorcycles, snowmobiles, and ATVs, are mainly fueled by gasoline.

Table 2.9
Off-highway Transportation-related Fuel Consumption from the NonRoad Model, 2009
(trillion Btus)

	Gasoline	Diesel	LPG	CNG	Total
Agricultural Equipment *Tractors, mowers, combines, balers, and other farm equipment which has utility in its movement.*	8.3	543.0	0.0	0.0	551.3
Airport Ground Equipment	0.3	13.6	0.2	[a]	14.1
Construction and Mining Equipment *Pavers, rollers, drill rigs, graders, backhoes, excavators, cranes, mining equipment*	11.4	868.9	1.8	[a]	882.2
Industrial Equipment *Forklifts, terminal tractors, sweeper/scrubbers*	13.3	123.4	197.3	18.3	352.4
Logging Equipment *Feller/buncher/skidder*	1.6	23.5	[a]	[a]	25.1
Railroad Maintenance Equipment	0.2	3.3	0.0	[a]	3.5
Recreational Equipment *Off-road motorcycles, snowmobiles, all-terrain vehicles, golf carts, specialty vehicles*	166.9	1.9	0.1	[a]	168.9
Total	202.0	1,577.6	199.6	18.4	1,997.5

Source:
Environmental Protection Agency, NONROAD2008a model, www.epa.go/otaq/nonrdmdl.htm.

[a] There is no equipment listed for this fuel type.

Mowing equipment consumes nearly half of all the fuel used by lawn and garden equipment. The gasoline used in lawn and garden equipment is 1.9% of total gasoline use.

Table 2.10
Fuel Consumption from Lawn and Garden Equipment, 2009
(million gallons)

Equipment	Classification	Gasoline	Diesel	LPG	Total fuel consumption
Mowing Equipment					
Front mowers	Commercial	19.49	106.57	0.00	126.06
Lawn & garden tractors	Commercial	225.21	22.00	0.00	247.20
Lawn & garden tractors	Residential	532.94	0.00	0.00	532.94
Lawn mowers	Commercial	150.59	0.00	0.00	150.59
Lawn mowers	Residential	204.05	0.00	0.00	204.05
Rear engine riding mowers	Commercial	16.57	0.00	0.00	16.57
Rear engine riding mowers	Residential	39.69	0.00	0.00	39.69
Total		**1,188.53**	**128.57**	**0.00**	**1,317.10**
Soil and Turf Equipment					
Commercial turf equipment[a]	Commercial	726.08	17.10	0.00	748.18
Rotary tillers < 6 HP	Commercial	84.51	0.00	0.00	84.51
Rotary tillers < 6 HP	Residential	18.56	0.00	0.00	18.56
Total		**829.15**	**17.10**	**0.00**	**846.26**
Wood Cutting Equipment					
Chain saws < 6 HP	Commercial	72.35	0.00	0.00	72.35
Chain saws < 6 HP	Residential	17.60	0.00	0.00	17.60
Chippers/stump grinders	Commercial	38.35	145.02	18.94	202.31
Shredders < 6 HP	Commercial	9.07	0.00	0.00	9.07
Total		**137.37**	**145.02**	**18.94**	**301.33**
Blowers and Vacuums					
Leafblowers/vacuums	Commercial	200.80	0.02	0.00	200.82
Leafblowers/vacuums	Residential	17.88	0.00	0.00	17.88
Snowblowers	Commercial	34.18	1.89	0.00	36.07
Snowblowers	Residential	18.10	0.00	0.00	18.10
Total		**270.96**	**1.91**	**0.00**	**272.87**
Trimming Equipment					
Trimmers/edgers/brush cutter	Commercial	61.18	0.00	0.00	61.18
Trimmers/edgers/brush cutter	Residential	25.54	0.00	0.00	25.54
Other lawn & garden equipment[b]	Commercial	23.21	0.39	0.00	23.62
Other lawn & garden equipment[b]	Residential	19.45	0.00	0.00	19.45
Total		**129.39**	**0.40**	**0.00**	**129.79**
Total All Equipment		**2,555.40**	**293.00**	**18.94**	**2,867.33**

Source:
U.S. Environmental Protection Agency, NONROAD2008a Model, www.epa.gov/otaq/nonrdmdl.htm.

[a] Includes equipment such as aerators, dethatchers, sod cutters, hydro-seeders, turf utility vehicles, golf course greens mowers, and sand trap groomers.

[b] Includes equipment not otherwise classified such as augers, sickle-bar mowers, and wood splitters.

The Federal Highway Administration (FHWA) 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. Now, the FHWA does not publish separate estimates of gasohol or ethanol used in gasohol. See Table 2.3 for details on oxygenate usage.

Table 2.11
Highway Usage of Gasoline and Diesel, 1973–2009
(billion gallons)

Year	Total gasoline and gasohol	Diesel[a]	Percent diesel	Total highway fuel use
1973	100.6	9.8	8.9%	110.5
1975	99.4	9.6	8.8%	109.0
1980	101.2	13.8	12.0%	115.0
1981	99.6	14.9	13.0%	114.5
1982	98.5	14.9	13.1%	113.4
1983	100.1	16.0	13.8%	116.1
1984	101.4	17.3	14.6%	118.7
1985	103.6	17.8	14.6%	121.3
1986	106.8	18.4	14.7%	125.2
1987	108.7	19.0	14.9%	127.7
1988	109.8	20.1	15.5%	129.9
1989	110.6	21.2	16.1%	131.9
1990	110.2	21.4	16.3%	131.6
1991	107.9	20.7	16.1%	128.6
1992	111.0	22.0	16.5%	132.9
1993	113.7	23.5	17.1%	137.2
1994	115.0	25.1	17.9%	140.1
1995	117.1	26.2	18.3%	143.3
1996	119.5	27.2	18.5%	146.7
1997	120.9	29.4	19.6%	150.3
1998	124.7	30.2	19.5%	154.9
1999	128.7	31.9	19.9%	160.7
2000	128.9	33.4	20.6%	162.3
2001	129.7	33.4	20.5%	163.1
2002	133.0	34.8	20.7%	167.8
2003	134.1	35.5	20.9%	169.6
2004	136.5	37.4	21.5%	173.9
2005	135.2	39.1	22.4%	174.3
2006	134.8	40.1	22.9%	174.9
2007	135.4	40.7	23.1%	176.1
2008	132.2	38.6	22.6%	170.8
2009	132.9	35.3	21.0%	168.1
		Average annual percentage change		
1973–2009	0.8%	3.6%		1.2%
1999–2009	0.3%	0.6%		0.4%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011, Table MF-21 and annual. (Additional resources: www.fhwa.dot.gov)

[a] Consists primarily of diesel fuel, with small quantities of other fuels, such as liquefied petroleum gas and E85.

Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences among 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 2.12
Passenger Travel and Energy Use, 2009

	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)
Cars	**134,880.0**	**1,606,815**	**2,490,564**	**1.55**	**5,484**	**3,538**	**8,811.0**
Personal trucks	**88,683.4**	**934,631**	**1,719,722**	**1.84**	**6,740**	**3,663**	**6,299.4**
Motorcycles	**7,929.7**	**20,800**	**24,128**	**1.16**	**2,854**	**2,460**	**59.4**
Demand response[a]	**68.9**	**1,529**	**1,477**	**1.0**	**15,111**	**15,645**	**23.1**
Buses	[b]	[b]	[b]	[b]	[b]	[b]	**200.0**
Transit	65.4	2,345	21,645	9.2	39,160	4,242	91.8
Intercity[c]	[b]	[b]	[b]	[b]	[b]	[b]	31.4
School[c]	683.7	[b]	[b]	[b]	[b]	[b]	76.9
Air	[b]	[b]	[b]	[b]	[b]	[b]	**1,751.4**
Certificated route[d]	[b]	5,453	541,646	99.3	280,734	2,826	1,530.8
General aviation	223.9	[b]	[b]	[b]	[b]	[b]	220.6
Recreational boats	**13,290.7**	[b]	[b]	[b]	[b]	[b]	**245.7**
Rail	**20.7**	**1,402**	**36,150**	**25.8**	**66,916**	**2,594**	**93.8**
Intercity (Amtrak)	0.3	283	5,914	20.9	50,924	2,435	14.4
Transit	13.5	775	19,004	24.5	61,663	2,516	47.8
Commuter	6.9	344	11,232	32.7	91,936	2,812	31.6

Source:
See Appendix A for Passenger Travel and Energy Use.

[a] Includes passenger cars, vans, and small buses operating in response to calls from passengers to the transit operator who dispatches the vehicles.

[b] Data are not available.

[c] Energy use is estimated.

[d] Only domestic service and domestic energy use are shown on this table. (Previous editions included half of international energy.) These energy intensities may be inflated because all energy use is attributed to passengers–cargo energy use is not taken into account.

Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences among 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 2.13
Energy Intensities of Highway Passenger Modes, 1970–2009

	Automobiles		Light truck[a]	Transit Buses[b]	
Year	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)
1970	9,250	4,868	12,480	31,796	2,472
1975	8,993	4,733	11,879	33,748	2,814
1976	9,113	4,796	11,524	34,598	2,896
1977	8,950	4,710	11,160	35,120	2,889
1978	8,839	4,693	10,807	36,603	2,883
1979	8,647	4,632	10,468	36,597	2,795
1980	7,916	4,279	10,224	36,553	2,813
1981	7,670	4,184	9,997	37,745	3,027
1982	7,465	4,109	9,268	38,766	3,237
1983	7,365	4,092	9,124	37,962	3,177
1984	7,202	4,066	8,931	38,705	3,307
1985	7,164	4,110	8,730	38,876	3,423
1986	7,194	4,197	8,560	37,889	3,545
1987	6,959	4,128	8,359	36,247	3,594
1988	6,683	4,033	8,119	36,673	3,706
1989	6,589	4,046	7,746	36,754	3,732
1990	6,169	3,856	7,746	37,374	3,794
1991	5,912	3,695	7,351	37,732	3,877
1992	5,956	3,723	7,239	40,243	4,310
1993	6,087	3,804	7,182	39,043	4,262
1994	6,024	3,765	7,212	37,259	4,262
1995	5,902	3,689	7,208	37,251	4,307
1996	5,874	3,683	7,247	37,452	4,340
1997	5,797	3,646	7,251	38,861	4,434
1998	5,767	3,638	7,260	41,296	4,399
1999	5,821	3,684	7,327	40,578	4,344
2000	5,687	3,611	7,158	41,695	4,531
2001	5,626	3,583	7,080	38,535	4,146
2002	5,662	3,607	7,125	37,548	4,133
2003	5,535	3,525	7,673	37,096	4,213
2004	5,489	3,496	7,653	37,855	4,364
2005	5,607	3,571	7,009	37,430	4,250
2006	5,511	3,510	6,974	39,568	4,316
2007	5,513	3,512	6,904	39,931	4,372
2008	5,465	3,526	6,830	39,906	4,348
2009	5,484	3,538	6,862	39,160	4,242
		Average annual percentage change			
1970–2009	-1.3%	-0.8%	-1.5%	0.5%	1.4%
1999–2009	-0.6%	-0.4%	-0.7%	-0.4%	-0.2%

Source:
See Appendix A for Highway Passenger Mode Energy Intensities.

[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 Transportation 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 2.14
Energy Intensities of Nonhighway Passenger Modes, 1970–2009

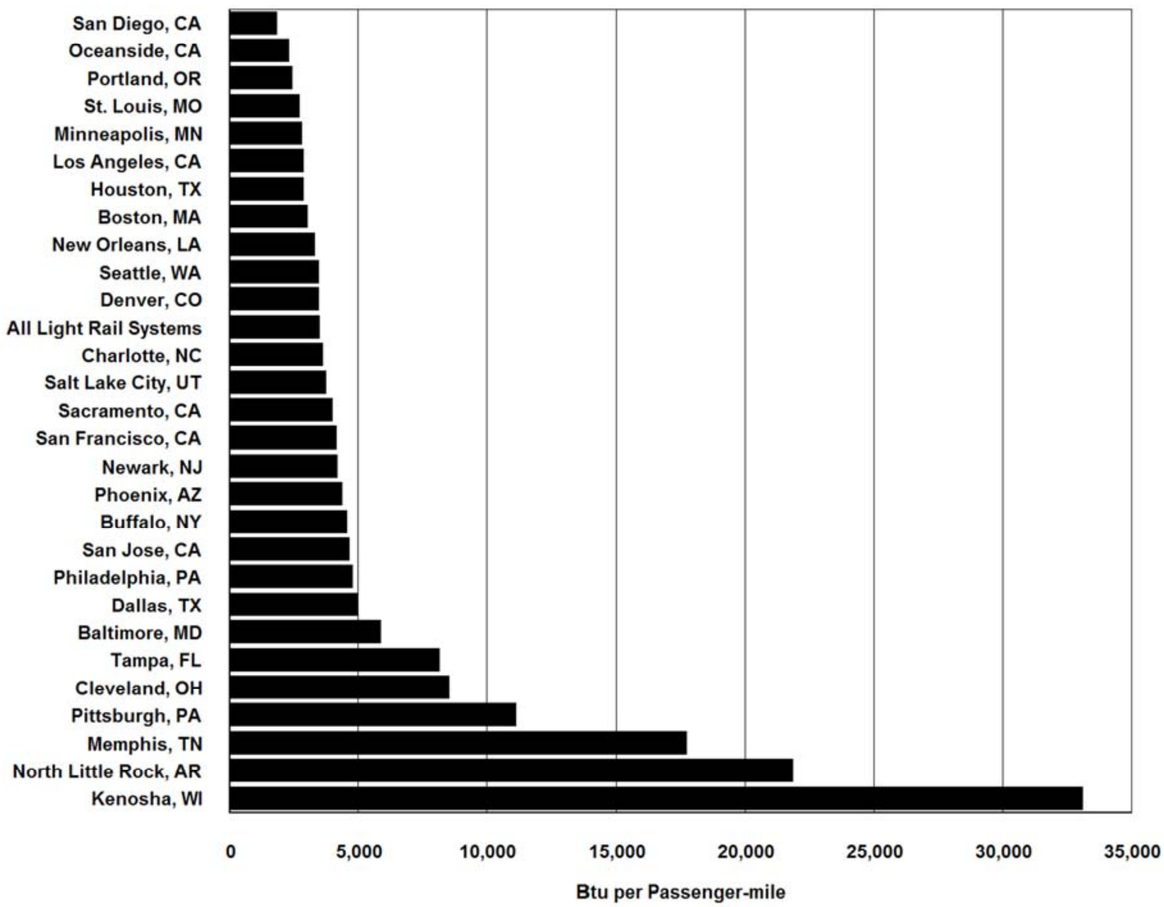
	Air	Rail		
Year	Certificated air carriers[a] (Btu per passenger-mile)	Intercity Amtrak (Btu per passenger-mile)	Rail transit (Btu per passenger-mile)	Commuter rail (Btu per passenger-mile)
1970	10,115	[b]	2,157	[b]
1975	7,625	3,548	2,625	[b]
1976	7,282	3,278	2,633	[b]
1977	6,990	3,443	2,364	[b]
1978	6,144	3,554	2,144	[b]
1979	5,607	3,351	2,290	[b]
1980	5,561	3,065	2,312	[b]
1981	5,774	2,883	2,592	[b]
1982	5,412	3,052	2,699	[b]
1983	5,133	2,875	2,820	[b]
1984	5,298	2,923	3,037	2,804
1985	5,053	2,703	2,809	2,826
1986	5,011	2,481	3,042	2,926
1987	4,827	2,450	3,039	2,801
1988	4,861	2,379	3,072	2,872
1989	4,844	2,614	2,909	2,864
1990	4,875	2,505	3,024	2,822
1991	4,662	2,417	3,254	2,770
1992	4,516	2,534	3,155	2,629
1993	4,490	2,565	3,373	2,976
1994	4,397	2,282	3,338	2,682
1995	4,349	2,501	3,340	2,632
1996	4,172	2,690	3,017	2,582
1997	4,166	2,811	2,856	2,724
1998	4,146	2,788	2,823	2,646
1999	4,061	2,943	2,785	2,714
2000	3,952	3,235	2,797	2,551
2001	3,968	3,257	2,803	2,515
2002	3,703	3,212	2,872	2,514
2003	3,587	2,800	2,837	2,545
2004	3,339	2,760	2,750	2,569
2005	3,264	2,709	2,783	2,743
2006	3,250	2,650	2,707	2,527
2007	3,153	2,516	2,577	2,638
2008	3,051	2,398	2,521	2,656
2009	2,901	2,435	2,516	2,812
		Average annual percentage change[c]		
1970–2009	-3.2%	-1.1%	0.5%	0.0%
1999–2009	-3.3%	-1.9%	-1.0%	0.4%

Source:
See Appendix A for Nonhighway Passenger Mode Energy Intensities.

[a] These data differ from the data on Table 2.12 because they include half of international services. These energy intensities may be inflated because all energy use is attributed to passengers–cargo energy use is not taken into account.
[b] Data are not available.
[c] Average annual percentage calculated to earliest year possible.

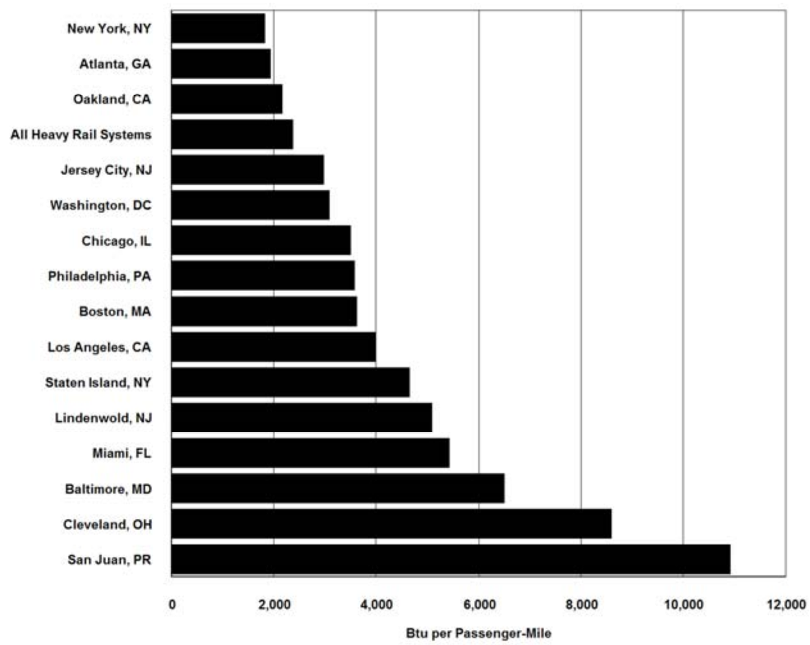
The energy intensity of light rail systems, measured in btu per passenger-mile varies greatly. The weighted average of all light rail systems in 2009 is 3,526 btu/passenger-mile.

Figure 2.2. Energy Intensity of Light Rail Transit Systems, 2009



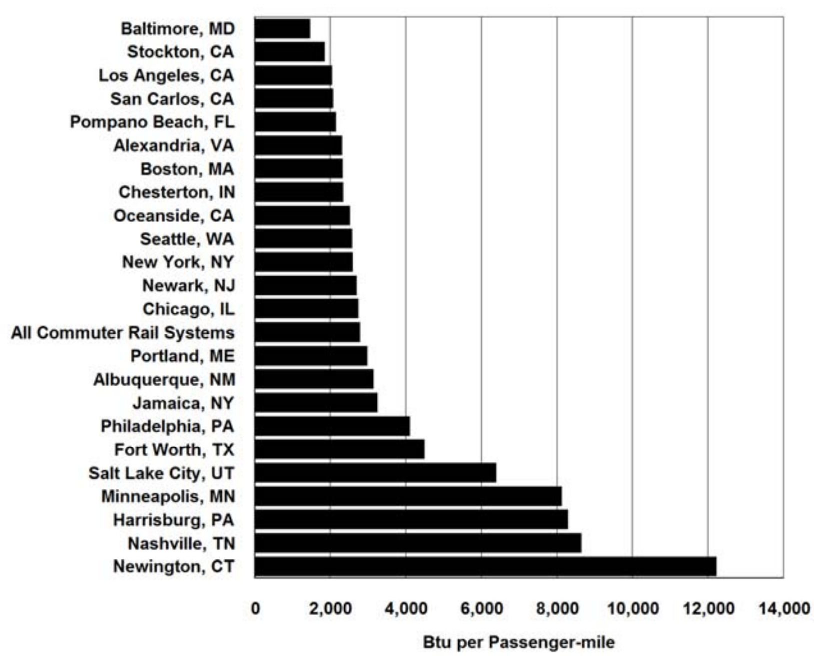
Source:
U.S. Department of Transportation, *National Transit Database*, May 2011. (Additional resources: http://204.68.195.57/ntdprogram/data.htm)

Figure 2.3. Energy Intensity of Heavy Rail Systems, 2009



Source:
U.S. Department of Transportation, *National Transit Database*, May 2011. (A dditional resources: www.ntdprogram.gov)

Figure 2.4. Energy Intensity of Commuter Rail Systems, 2009



Source:
U.S. Department of Transportation, *National Transit Database*, May 2011. (A dditional resources: www.ntdprogram.gov)

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 2.15
Energy Intensities of Freight Modes, 1970–2009

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)
1970	24,960	17,669	691
1971	24,485	18,171	717
1972	24,668	18,291	714
1973	24,777	18,468	677
1974	24,784	18,852	681
1975	24,631	18,739	687
1976	24,567	18,938	680
1977	24,669	19,226	669
1978	24,655	18,928	641
1979	24,746	19,188	618
1980	24,758	18,742	597
1981	25,059	18,629	572
1982	24,297	18,404	553
1983	23,853	17,864	525
1984	23,585	17,795	510
1985	23,343	17,500	497
1986	23,352	17,265	486
1987	22,923	16,790	456
1988	22,596	16,758	443
1989	22,411	16,894	437
1990	22,795	16,619	420
1991	22,749	15,835	391
1992	22,609	16,043	393
1993	22,373	16,056	389
1994	22,193	16,340	388
1995	22,097	15,992	372
1996	22,109	15,747	368
1997	21,340	15,784	370
1998	21,516	15,372	365
1999	22,884	15,363	363
2000	23,449	14,917	352
2001	23,024	15,108	346
2002	23,462	15,003	345
2003	22,461	15,016	344
2004	20,540	15,274	341
2005	22,866	15,152	337
2006	23,340	14,990	330
2007	21,238	14,846	320
2008	21,008	14,573	305
2009	21,127	13,907	291
		Average annual percentage change	
1970–2009	-0.4%	-1.0%	-2.2%
1999–2009	-0.8%	-1.0%	-2.2%

Source:
See Appendix A for Freight Mode Energy Intensities.

Note: Due to changes in the FHWA fuel use methodology, truck data are not comparable with data before the year 2007.

Chapter 3
All Highway Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 3.1	U.S. share of world car registrations, 2009	19.4%
Table 3.2	U.S. share of world truck & bus registrations, 2009	40.8%
Table 3.3	Number of U.S. cars, 2009 (thousands)	132,424
Table 3.3	Number of U.S. trucks, 2009 (thousands)	116,036
Table 3.6	Vehicle miles traveled, 2009 (million miles)	2,953,501
	Cars	*52.7%*
	Two-axle, four-tire trucks	*36.4%*
	Combination trucks	*5.7%*
	Other single-unit trucks	*4.1%*
	Motorcycles	*0.7%*
	Buses	*0.5%*
Table 3.9	Average age of vehicles, 2009	
	Cars (years)	*10.6*
	Light trucks (years)	*9.6*
	All trucks (years)	*10.2*

Use caution comparing historical data because of disconnects in data series. Also, the United States is unique in how many light trucks (SUVs, minivans, pickups) are used for personal travel. Those light trucks are not included on this table. The U.S. share of world cars continues to decline. The growth in the World total comes mainly from developing countries, like China and India.

Table 3.1
Car Registrations for Selected Countries, 1960–2009
(thousands)

Country	1960	1970	1980	1990	2000	2005	2007	2008	2009	Average Annual Percentage Change 1990-2009
Argentina	474	1,482	3,112	4,284	5,060	5,340	6,004	6,244	6,465	2.2%
Brazil	[a]	[a]	[a]	12,127	15,393	18,370	20,430	21,884	23,612	3.6%
Canada[b]	4,104	6,602	10,256	12,622	16,832	18,124	19,199	19,613	19,877	2.4%
China	[a]	[a]	351	1,897	3,750	8,900	13,758	18,270	25,301	14.6%
France	4,950	11,860	18,440	23,550	28,060	30,100	30,550	30,850	31,050	1.5%
Germany[c]	4,856	14,376	23,236	35,512	43,772	46,090	41,184	41,321	41,738	0.9%
India	[a]	[a]	[a]	2,300	5,150	7,654	8,595	9,400	10,400	8.3%
Indonesia	[a]	[a]	[a]	1,200	[a]	3,850	4,355	4,750	5,005	7.8%
Japan	457	8,779	23,660	34,924	52,437	57,091	57,624	57,865	58,020	2.7%
Malaysia	[a]	[a]	[a]	1,811	4,213	6,402	6,804	7,190	7,375	7.7%
Pakistan	[a]	[a]	[a]	[a]	375	411	428	445	460	-2.5%
Russia	[a]	[a]	[a]	[a]	20,353	25,285	28,300	32,021	33,187	[a]
United Kingdom	5,650	11,802	15,438	22,528	27,185	30,652	31,225	31,252	31,036	1.7%
United States	61,671	89,244	121,601	143,550	127,721	132,909	135,222	135,882	132,424	-0.4%
U.S. Percentage of World	62.7%	46.1%	38.0%	32.3%	23.3%	21.5%	20.9%	20.4%	19.4%	
World total	98,305	193,479	320,390	444,900	548,558	617,914	645,837	667,630	681,154	2.3%

Source:
Ward's Communications, *Ward's World Motor Vehicle Data*, *2010 Edition*, Southfield, MI, 2010, pp. 271–274 and annual. (Additional resources: www.wardsauto.com)

[a] Data are not available.
[b] Data from 2000 and later are not comparable to prior data. Canada reclassified autos and trucks prior to 2000.
[c] Data for 1990 and prior include West Germany only. Kraftwagen are included with automobiles.

The United States totals include SUVs, minivans, and light trucks, many of which are used for personal travel.

Table 3.2
Truck and Bus Registrations for Selected Countries, 1960–2009
(thousands)

Country	1960	1970	1980	1990	2000	2005	2009	Average Annual Percentage Change 1990-2009
Argentina	392	788	1,217	1,501	1,554	1,730	2,296	2.3%
Brazil	[a]	[a]	[a]	936	3,917	4,653	6,031	10.3%
Canada[b]	1,056	1,481	2,955	3,931	739	786	915	-7.4%
China	[a]	[a]	1,480	4,314	9,650	21,750	35,875	11.8%
France	1,650	1,850	2,550	4,910	5,733	6,198	6,388	1.4%
India	[a]	[a]	[a]	2,050	2,390	4,145	6,250	6.0%
Indonesia	[a]	[a]	[a]	1,391	2,373	2,950	3,625	5.2%
Germany[c]	786	1,228	1,617	2,764	3,534	3,133	2,895	0.2%
Japan	896	8,803	14,197	22,773	20,211	16,734	15,789	-1.9%
Malaysia	[a]	[a]	[a]	616	1,030	1,323	1,525	4.9%
Pakistan	[a]	[a]	[a]	172	385	414	465	5.4%
Russia	[a]	[a]	[a]	7,200	5,041	5,705	6,323	-0.7%
United Kingdom	1,534	1,769	1,920	3,774	3,361	3,943	4,182	0.5%
United States	12,186	19,175	34,195	45,106	85,579	104,788	116,036	5.1%
U.S. Percentage of World	42.6%	36.2%	37.7%	32.7%	42.1%	42.6%	40.8%	
World total	28,583	52,899	90,592	138,082	203,272	245,798	284,101	3.9%

Source:
Ward's Communications, *Ward's World Motor Vehicle Data, 2010 Edition*, Southfield, MI, 2010, pp. 271–274 and annual. (Additional resources: www.wardsauto.com)

[a] Data are not available.
[b] Data from 2000 and later are not comparable to prior data. Canada reclassified autos and trucks prior to 2000.
[c] Data for 1990 and prior include West Germany only. Kraftwagen are included with automobiles.

VEHICLES IN USE

Both the Federal Highway Administration (FHWA) and The Polk Company report figures on the car and truck population each year. The two estimates, however, differ by as much as 11.2% (1981). 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 chassis, and utility vehicles as cars or trucks causes important differences in the two estimates. The Polk Company data included passenger vans in the car count until 1980; since 1980 all vans have been counted as trucks. Recently, the Federal Highway Administration adjusted their definition of cars and trucks. Starting in 1993, some minivans and sport utility vehicles that were previously included with cars 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 cars in use in the United States 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 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.

In the early 1980's, researchers had to make a conscience choice of which data series to use, since they differed by as much as 11%. In 2009 the two sources differed by about 1%. Both sources show a decline in automobiles from 2008 to 2009 and an increase in trucks. The series, however, seem to be growing further apart.

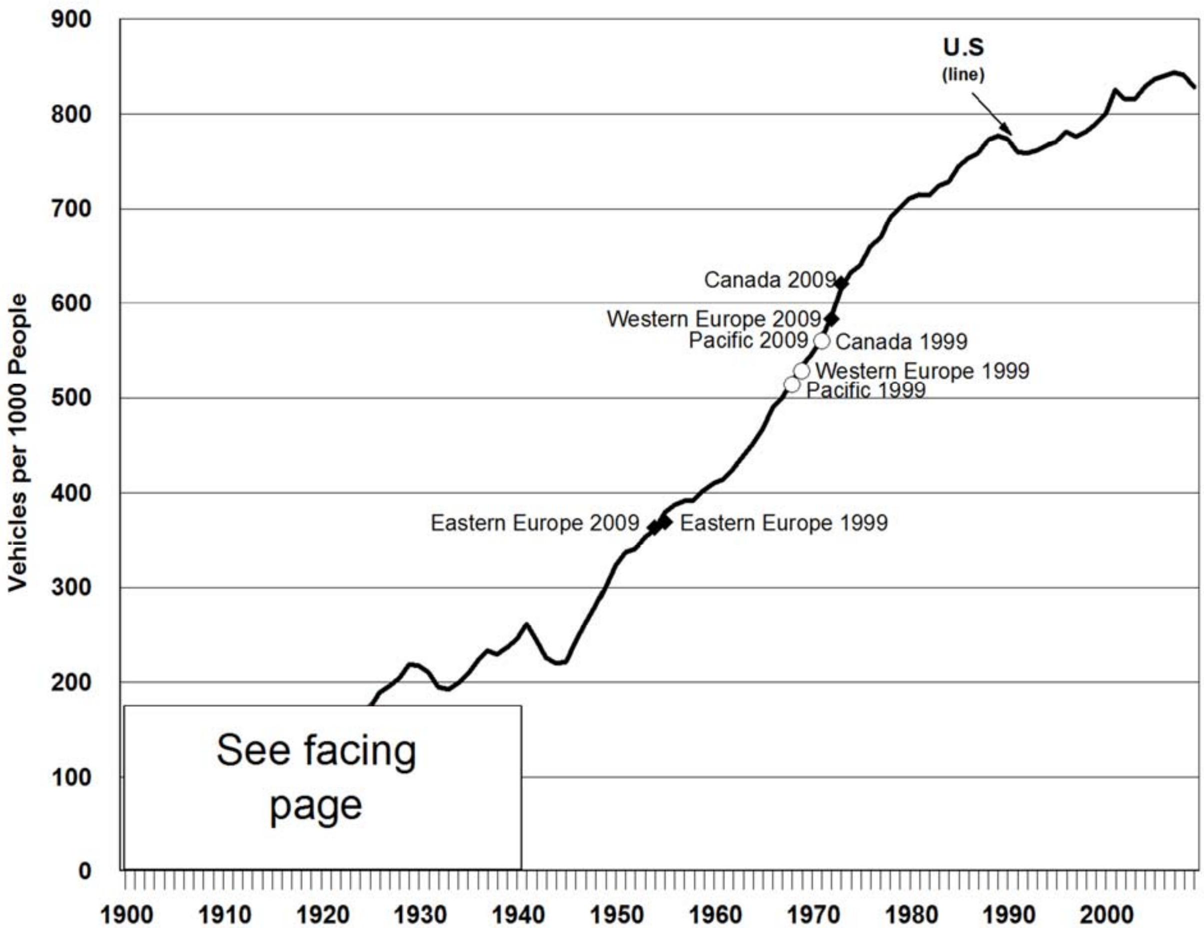
Table 3.3
U.S. Cars and Trucks in Use, 1970–2009
(thousands)

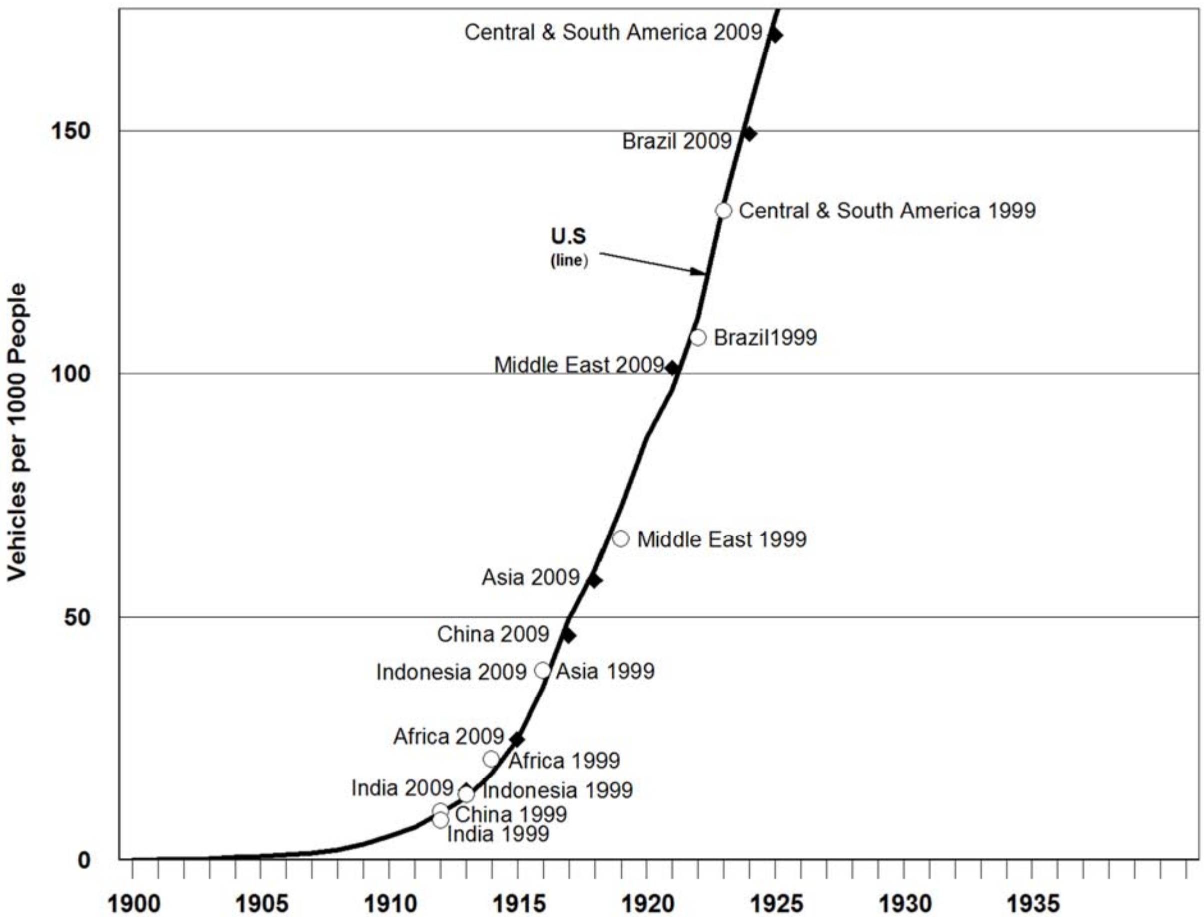
	Automobiles			Trucks			Total		
Year	FHWA	The Polk Company	Percentage difference	FHWA	The Polk Company	Percentage difference	FHWA	The Polk Company	Percentage difference
1970	89,243	80,448	10.9%	18,797	17,688	6.3%	108,040	98,136	10.1%
1975	106,706	95,241	12.0%	25,781	24,813	3.9%	132,487	120,054	10.4%
1976	110,189	97,818	12.6%	27,876	26,560	5.0%	138,065	124,378	11.0%
1977	112,288	99,904	12.4%	29,314	28,222	3.9%	141,602	128,126	10.5%
1978	116,573	102,957	13.2%	31,336	30,565	2.5%	147,909	133,522	10.8%
1979	118,429	104,677	13.1%	32,914	32,583	1.0%	151,343	137,260	10.3%
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	133,621	127,721	4.6%	87,108	85,579	1.8%	220,729	213,300	3.5%
2001	137,633	128,714	6.9%	92,045	87,969	4.6%	229,678	216,683	6.0%
2002	135,921	129,907	4.6%	92,939	91,120	2.0%	228,860	221,027	3.5%
2003	135,670	131,072	3.5%	94,944	94,810	0.1%	230,614	225,882	2.1%
2004	136,431	132,469	3.0%	100,016	99,698	0.3%	236,447	232,167	1.8%
2005	136,568	132,909	2.8%	103,819	105,475	-1.6%	240,387	238,384	0.8%
2006	135,400	135,047	0.3%	107,944	109,596	-1.5%	243,344	244,643	-0.5%
2007	135,933	135,222	0.5%	110,498	113,479	-2.6%	246,431	248,701	-0.9%
2008	137,080	135,882	0.9%	110,242	114,357	-3.6%	247,322	250,239	-1.2%
2009	134,880	132,424	1.9%	110,561	116,036	-4.7%	245,441	248,460	-1.2%

Source:
FHWA - U.S. Department of Transportation, Federal Highway Administration, 1970-2008, *Highway Statistics 2008*, Washington, DC, 2009, T able VM-1 and annual. 2009 data f rom tables MV-1 and MV-9. (Additional resources: www.fhwa.dot.gov)
Polk - The Polk Company, Detroit, Michigan. **FURTHER REPRODUCTION PROHIBITED.** (Additional resources: www.polk.com)

The graphs below show the number of motor vehicles per thousand people for various countries. The data for the United States are displayed in the line which goes from 1900 to 2009. The points labeled on that line show data for the other countries/regions around the world and how their vehicles per thousand people compare to the United States at two different points in time, 1999 and 2009. For instance, the graph shows that in 1999, Western Europe's vehicles per thousand people was about where the United States was in 1969, but by 2009 it is about where the United States was in 1972. The lower part of the graph (1900-1940) is shown enlarged on the facing page.

Figure 3.1. Vehicles per Thousand People: U.S. (Over Time) Compared to Other Countries (in 1999 and 2009)





Source:
See Tables 3.4 and 3.5.

Though some countries are listed separately in this table, those countries are also included in the regional total. For instance, China is listed separately, but is also included in the Asia, Far East region.

Table 3.4
Vehicles per Thousand People in Other Countries, 1999 and 2009

	Vehicles per 1,000 people	
Country/Region	1999	2009
Africa	20.9	24.9
Asia, Far East	39.1	157.7
Asia, Middle East	66.2	101.2
Brazil	107.5	149.2
Canada	560.0	620.9
Central & South America	133.6	169.7
China	10.2	46.2
Europe, East	370.0	363.9
Europe, West	528.8	583.3
India	8.3	14.4
Indonesia	13.7	35.9
Pacific	513.9	560.9

Sources:
Population – (2009) U.S. Census Bureau, Population Division, International Data Base (IDB) World, May 6, 2011. (Additional resources: http://www.census.gov/ipc/www/idb/)
Vehicles – (2009) U.S.: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011. All others: Ward's Communications, Ward's Motor Vehicle Data 2010, pp. 271–274. (Additional resources: www.fhwa.dot.gov, www.wardsauto.com)

The number of vehicles per thousand people in the United States has grown significantly from 1900 to 2009. In 2008 to 2009, however, the number decreased from a high of 843.57 in 2007.

Table 3.5
Vehicles per Thousand People in the United States, 1990-2009

Year	U.S. vehicles per 1,000 people	Year	U.S. vehicles per 1,000 people	Year	U.S. vehicles per 1,000 people	Year	U.S. vehicles per 1,000 people	Year	U.S. vehicles per 1,000 people
1900	0.11	1922	111.53	1944	220.23	1966	489.34	1988	772.92
1901	0.19	1923	134.90	1945	221.80	1967	500.66	1989	776.99
1902	0.29	1924	154.35	1946	243.11	1968	516.49	1990	773.40
1903	0.41	1925	173.26	1947	262.56	1969	533.37	1991	760.19
1904	0.67	1926	189.10	1948	280.20	1970	545.35	1992	757.96
1905	0.94	1927	195.77	1949	299.56	1971	562.45	1993	761.94
1906	1.27	1928	204.87	1950	323.71	1972	585.60	1994	766.94
1907	1.65	1929	219.31	1951	337.14	1973	615.19	1995	770.99
1908	2.24	1930	217.34	1952	340.57	1974	632.32	1996	781.16
1909	3.45	1931	210.37	1953	353.67	1975	640.07	1997	776.02
1910	5.07	1932	195.38	1954	361.40	1976	659.47	1998	781.20
1911	6.81	1933	192.38	1955	379.77	1977	669.03	1999	790.07
1912	9.90	1934	199.90	1956	387.58	1978	690.17	2000	800.30
1913	12.94	1935	208.61	1957	392.11	1979	700.42	2001	825.49
1914	17.79	1936	222.62	1958	392.17	1980	710.71	2002	815.22
1915	24.77	1937	233.33	1959	402.83	1981	715.22	2003	815.50
1916	35.48	1938	229.65	1960	410.37	1982	713.95	2004	829.26
1917	49.57	1939	236.93	1961	415.11	1983	724.30	2005	836.58
1918	59.69	1940	245.63	1962	426.06	1984	728.20	2006	840.09
1919	72.50	1941	261.57	1963	438.75	1985	744.50	2007	843.57
1920	86.78	1942	244.73	1964	451.57	1986	753.33	2008	840.80
1921	96.68	1943	225.89	1965	466.90	1987	758.58	2009	828.04

Sources:

Population – (2009) U.S. Census Bureau, Population Division, International Data Base (IDB) World, May 5, 2011. (Additional resources: http://www.census.gov/ipc/www/idb/)

Vehicles – (2008) U.S.: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011. All others: Ward's Communications, Ward's Motor Vehicle Data 2009, pp. 257–260. (Additional resources: www.fhwa.dot.gov, www.wardsauto.com)

Total vehicle-miles traveled decreased slightly from 2008 to 2009. 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 25.3% more travel in 2009 than in 1970, and cars account for 29.9% less travel in that time period.

Table 3.6
Shares of Highway Vehicle-Miles Traveled by Vehicle Type, 1970–2009

Year	Cars	Motorcycles	Two-axle,four-tire trucks	Other single-unit trucks	Combination trucks	Buses	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
1976	76.9%	0.4%	16.1%	2.6%	3.5%	0.4%	1,402,380
1977	75.6%	0.4%	17.1%	2.7%	3.8%	0.4%	1,467,027
1978	74.2%	0.5%	18.1%	2.8%	4.1%	0.4%	1,544,704
1979	72.8%	0.6%	19.1%	2.7%	4.4%	0.4%	1,529,133
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%	2,691,056
2000	58.3%	0.4%	33.6%	2.6%	4.9%	0.3%	2,746,925
2001	58.4%	0.3%	33.6%	2.6%	4.9%	0.3%	2,790,372
2002	58.1%	0.3%	33.8%	2.7%	4.9%	0.2%	2,855,508
2003	57.8%	0.3%	34.0%	2.8%	4.8%	0.2%	2,890,450
2004	57.3%	0.3%	34.6%	2.6%	4.8%	0.2%	2,964,788
2005	57.1%	0.3%	34.8%	2.6%	4.8%	0.2%	2,989,430
2006	56.1%	0.4%	35.9%	2.7%	4.7%	0.2%	3,014,369
2007	53.3%	0.7%	35.5%	4.0%	6.1%	0.5%	3,031,124
2008	52.4%	0.7%	36.0%	4.3%	6.2%	0.5%	2,976,528
2009	52.7%	0.7%	36.4%	4.1%	5.7%	0.5%	2,953,501
			Average annual percentage change				
1970–2009							2.5%
1999–2009							0.9%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011, Table VM-1 and annual. (Additional resources: www.fhwa.dot.gov)

Note: Due to FHWA methodology changes, data from 2007-on are not comparable with previous data.

Due to data restrictions, the 2001 data are the latest than can be published.

Table 3.7
Cars in Operation and Vehicle Travel by Age, 1970 and 2001

	1970			2001			2001 Estimated vehicle travel		Average annual miles per vehicle
Age (years)	Vehicles (thousands)	Percentage	Cumulative percentage	Vehicles (thousands)	Percentage	Cumulative percentage	Percentage	Cumulative percentage	
Under 1[a]	6,288	7.8%	7.8%	6,183	4.8%	4.8%	6.9%	6.9%	15,000
1	9,299	11.6%	19.4%	8,882	6.9%	11.7%	9.4%	16.3%	14,300
2	8,816	11.0%	30.3%	8,093	6.3%	18.0%	8.2%	24.6%	13,700
3	7,878	9.8%	40.1%	7,555	5.9%	23.9%	7.2%	31.8%	12,900
4	8,538	10.6%	50.8%	7,860	6.1%	30.0%	7.2%	39.1%	12,400
5	8,506	10.6%	61.3%	7,337	5.7%	35.7%	6.5%	45.6%	12,000
6	7,116	8.8%	70.2%	8,555	6.6%	42.3%	7.4%	53.1%	11,700
7	6,268	7.8%	78.0%	7,471	5.8%	48.1%	6.3%	59.4%	11,400
8	5,058	6.3%	84.3%	7,420	5.8%	53.9%	6.1%	65.5%	11,100
9	3,267	4.1%	88.3%	6,807	5.3%	59.2%	5.4%	71.0%	10,700
10	2,776	3.5%	91.8%	6,810	5.3%	64.5%	5.0%	76.0%	9,900
11	1,692	2.1%	93.9%	6,692	5.2%	69.7%	4.5%	80.5%	9,000
12	799	1.0%	94.9%	6,742	5.2%	74.9%	4.7%	85.2%	9,400
13	996	1.2%	96.1%	6,189	4.8%	79.7%	3.8%	88.9%	8,200
14	794	1.0%	97.1%	5,345	4.2%	83.9%	2.9%	91.8%	7,200
15 and older	2,336	2.9%	100.0%	20,773	16.1%	100.0%	8.2%	100.0%	5,300
Subtotal	**80,427**	**100.0%**		**128,714**	**100.0%**		**100.0%**		
Age not given	**22**			**0**					
Total	**80,449**			**128,714**					
Average age			5.6			9.3			
Median age			4.9			8.1			

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 National Household Travel Survey Web site: nhts.ornl.gov. (Additional resources: www.polk.com, nhts.ornl.gov)

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[a] Includes cars from model year 2002 and 2001 which were sold prior to July 1, 2002, and similarly, model years 1971 and 1970 sold prior to July 1, 1970.

Due to data restrictions, the 2001 data are the latest than can be published.

Table 3.8
Trucks in Operation and Vehicle Travel by Age, 1970 and 2001

	1970			2001			2001 Estimated vehicle travel		Average annual miles per vehicle
Age (years)	Vehicles (thousands)	Percentage	Cumulative percentage	Vehicles (thousands)	Percentage	Cumulative percentage	Percentage	Cumulative percentage	
Under 1[a]	1,262	7.1%	7.1%	6,213	7.1%	7.1%	8.5%	8.5%	17,500
1	1,881	10.6%	17.8%	7,958	9.0%	16.1%	12.0%	20.6%	19,200
2	1,536	8.7%	26.5%	7,522	8.6%	24.7%	11.7%	32.3%	19,800
3	1,428	8.1%	34.6%	6,398	7.3%	31.9%	9.0%	41.3%	17,900
4	1,483	8.4%	43.0%	6,109	6.9%	38.9%	8.4%	49.7%	17,500
5	1,339	7.6%	50.5%	5,122	5.8%	44.7%	6.8%	56.6%	17,000
6	1,154	6.5%	57.1%	5,574	6.3%	51.0%	6.8%	63.4%	15,600
7	975	5.5%	62.6%	5,042	5.7%	56.8%	6.1%	69.5%	15,400
8	826	4.7%	67.3%	4,148	4.7%	61.5%	4.9%	74.4%	15,100
9	621	3.5%	70.8%	3,395	3.9%	65.3%	3.5%	77.9%	13,200
10	658	3.7%	74.5%	3,221	3.7%	69.0%	2.3%	80.3%	9,200
11	583	3.3%	77.8%	3,039	3.5%	72.5%	2.2%	82.5%	9,200
12	383	2.2%	80.0%	3,345	3.8%	76.3%	2.4%	84.9%	9,200
13	417	2.4%	82.3%	3,112	3.5%	79.8%	2.3%	89.1%	9,200
14	414	2.3%	84.7%	2,544	2.9%	82.7%	1.8%	89.0%	9,200
15 and older	2,710	15.3%	100.0%	15,227	17.3%	100.0%	11.0%	100.0%	9,200
Subtotal	**17,670**	**100.0%**		**87,969**	**100.0%**		**100.0%**		
Age not given	**15**			**0**					
Total	**17,685**			**87,969**					
Average age		7.3			7.9				
Median age		5.9			6.8				

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 *1997 Truck Inventory and Use Survey* public use tape provided by U.S. Department of Commerce, Bureau of the Census, Washington, DC, 2000. (Additional resources: www.polk.com, www.census.gov)

[a] Includes trucks from model year 2002 and 2001 which were sold prior to July 1, 2002, and similarly, model years 1971 and 1970 sold prior to July 1, 1970.

Table 3.9
U.S. Average Vehicle Age, 1995-2009

	Passenger Cars	Light Trucks	All Light Vehicles
1995	8.4	8.3	8.4
1996	8.5	8.3	8.5
1997	8.7	8.5	8.6
1998	8.9	8.5	8.8
1999	9.1	8.5	8.8
2000	9.1	8.4	8.9
2001	9.3	8.4	8.9
2002	9.4	8.4	9.0
2003	9.6	8.5	9.1
2004	9.8	8.6	9.4
2005	10.1	8.7	9.5
2006	10.3	8.9	9.7
2007	10.4	9.0	9.8
2008	10.6	9.3	10.0
2009	10.6	9.6	10.2

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

Table 3.10
New Retail Vehicle Sales, 1970–2010
(thousands)

Calendar Year	Cars	Light Trucks	Subtotal Light Vehicles	Heavy Trucks	Total Vehicle Sales
1970	8,400	1,463	9,863	334	10,197
1971	10,242	1,757	11,999	340	12,339
1972	10,940	2,239	13,179	438	13,617
1973	11,424	2,745	14,169	497	14,666
1974	8,853	2,338	11,191	424	11,615
1975	8,624	2,281	10,905	298	11,203
1976	10,110	2,956	13,066	324	13,390
1977	11,183	3,430	14,613	376	14,989
1978	11,314	3,808	15,122	441	15,563
1979	10,673	3,311	13,984	391	14,375
1980	8,949	2,230	11,179	265	11,444
1981	8,489	2,054	10,543	235	10,778
1982	7,956	2,399	10,355	183	10,538
1983	9,148	2,974	12,122	189	12,311
1984	10,324	3,883	14,207	277	14,484
1985	10,979	4,461	15,440	285	15,725
1986	11,404	4,654	16,058	265	16,323
1987	10,192	4,714	14,906	287	15,193
1988	10,547	4,910	15,457	334	15,791
1989	9,779	4,755	14,534	312	14,846
1990	9,303	4,569	13,872	277	14,149
1991	8,185	4,144	12,329	221	12,550
1992	8,213	4,655	12,868	249	13,117
1993	8,518	5,378	13,896	303	14,199
1994	8,991	6,068	15,059	353	15,412
1995	8,620	6,108	14,728	388	15,116
1996	8,479	6,619	15,098	359	15,457
1997	8,217	6,904	15,121	376	15,497
1998	8,085	7,458	15,543	424	15,967
1999	8,638	8,256	16,894	521	17,415
2000	8,778	8,572	17,350	462	17,812
2001	8,352	8,700	17,052	350	17,402
2002	8,042	8,774	16,816	322	17,138
2003	7,556	9,084	16,640	328	16,968
2004	7,483	9,384	16,867	432	17,299
2005	7,660	9,288	16,948	497	17,445
2006	7,762	8,743	16,505	545	17,050
2007	7,562	8,527	16,089	371	16,460
2008	6,769	6,426	13,195	298	13,493
2009	5,401	5,001	10,402	200	10,602
2010	5,635	5,919	11,554	218	11,772
			Average annual percentage change		
1970-2010	-1.0%	3.6%	0.4%	-1.1%	0.4%
2000-2010	-4.3%	-3.9%	-4.0%	-7.2%	-4.1%

Source:
1970-2010: Ward’s Communications, www.wardsauto.com.

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 16.9 years. These data are fitted model values which assume constant economic conditions.

Table 3.11
Car 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	1.0	100.0	0.0	100.0	0.0
5	94.1	5.0	96.3	3.7	100.0	0.0
6	88.4	6.1	91.3	5.1	99.4	0.6
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 years		12.5 years		16.9 years	

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

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

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 3.12
Light Truck[a] Scrappage and Survival Rates

Vehicle age[b] (years)	1970 model year		1980 model year		1990 model year	
	Survival rate[b]	Scrappage rate[c]	Survival rate[b]	Scrappage rate[d]	Survival rate[b]	Scrappage rate[c]
4	99.7	0.3	99.1	0.9	99.3	0.7
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	16.2 years		15.3 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 light trucks which will be retired from use during the year.
[d] The percentage of light trucks which will be in use at the end of the year.

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 26,000 lbs. gross vehicle weight) 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 3.13
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	20.0 years		18.5 years		28.0 years	

Source:
Schmoyer, Richard L., unpublished study on scrappage rates, Oak Ridge National Laboratory, Oak Ri dge, 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 light trucks which will be retired from use during the year.
[d] The percentage of light trucks which will be in use at the end of the year.

A typical car will travel 152,137 miles in a lifetime, while a typical light truck will travel 179,954 miles.

Table 3.14
Car and Light Truck Survivability Rates and Lifetime Miles

Vehicle age (Years)	Car Survivability rate	Light truck survivability rate
1	0.9900	0.9741
2	0.9831	0.9603
3	0.9731	0.9420
4	0.9593	0.9190
5	0.9413	0.8913
6	0.9188	0.8590
7	0.8918	0.8226
8	0.8604	0.7827
9	0.8252	0.7401
10	0.7866	0.6956
11	0.7170	0.6501
12	0.6125	0.6040
13	0.5094	0.5517
14	0.4142	0.5009
15	0.3308	0.4522
16	0.2604	0.4062
17	0.2028	0.3633
18	0.1565	0.3236
19	0.1200	0.2873
20	0.0916	0.2542
21	0.0696	0.2244
22	0.0527	0.1975
23	0.0399	0.1735
24	0.0301	0.1522
25	0.0227	0.1332
26	[a]	0.1165
27	[a]	0.1017
28	[a]	0.0887
29	[a]	0.0773
30	[a]	0.0673
31	[a]	0.0586
32	[a]	0.0509
33	[a]	0.0443
34	[a]	0.0385
35	[a]	0.0334
36	[a]	0.0290
Lifetime miles	152,137	179,954

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, *Vehicle Survivability and Travel Mileage Schedules*, January 2006.

Note: Registration data from 1977 to 2002 were used in developing these estimates. In this analysis, vehicle age was cut off when the estimated survival rate reached approximately a two percent threshold; for cars, this was 25 years, and for trucks it was 36 years.

[a] Data are not available.

Chapter 4
Light Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 4.1	Cars, 2009	
	Registrations (thousands)	*134,880*
	Vehicle miles (million miles)	*1,606,815*
	Fuel economy (miles per gallon)	*22.5*
Table 4.2	Two-axle, four-tire trucks, 2009	
	Registrations (thousands)	*100,154*
	Vehicle miles (million miles)	*1,108,656*
	Fuel economy (miles per gallon)	*18.0*
Table 4.6	Light truck share of total light vehicle sales	
	1970 calendar year	*14.8%*
	2010 calendar year	*51.2%*
Table 4.7	Car sales, 2010 model year (thousands)	8,020
	Small	*3,223*
	Midsize	*2,979*
	Large	*1,093*
Table 4.9	Light truck sales, 2010 model year (thousands)	5,601
	Midsize pickup	*196*
	Large pickup	*1,527*
	Midsize van	*450*
	Large van	*18*
	Small SUV	*67*
	Midsize SUV	*1,912*
	Large SUV	*1,420*
Tables 4.20	Corporate average fuel economy	(mpg)
and 4.21	*Car standard, MY 2011*	*30.2*
	Car fuel economy, MY 2011	*34.4*
	Light truck standard, MY 2011 (unreformed)	*24.2*
	Light truck fuel economy, MY 2011	*24.8*
Table 4.26	Average fuel economy loss from 55 to 70 mph	17.1%

Car registrations, along with vehicle travel and fuel use, all declined from 2008 to 2009. The data in this table from 1985–on DO NOT include minivans, pickups, or sport utility vehicles. Much of the data for 2009 were estimated; the FHWA no longer publishes travel and fuel data for cars.

Table 4.1
Summary Statistics for Cars, 1970–2009

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
1975	106,706	1,033,950	74,140	13.9
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	21.6
1999	132,432	1,569,100	73,283	21.4
2000	133,621	1,600,287	73,065	21.9
2001	137,633	1,628,332	73,559	22.1
2002	135,921	1,658,474	75,471	22.0
2003	135,670	1,672,079	74,590	22.2
2004	136,431	1,699,890	75,402	22.5
2005	136,568	1,708,421	77,418	22.1
2006	135,400	1,690,534	75,009	22.5
2007	135,933	1,672,467	74,377	22.5
2008	137,080	1,615,850	71,497	22.6
2009[d]	134,880	1,606,815	71,473	22.5
		Average annual percentage change		
1970–2009	1.1%	1.4%	0.1%	1.3%
1999–2009	0.2%	0.2%	-0.2%	0.5%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011, Table VM-1 and annual. (Additional resources: www.fhwa.dot.gov)

[a] This number differs from R.L. Polk's estimates of "number of cars in use." See Table 3.3.
[b] Fuel economy for car population.
[c] Beginning in this year the data were revised to exclude minivans, pickups and sport utility vehicles which may have been previously included.
[d] Because vehicle travel, fuel use, and fuel economy are no longer published for cars, the 2009 data were estimated.

Much of the data for 2009 were estimated; the FHWA no longer publishes travel and fuel use data for two-axle, four tire trucks.

Table 4.2
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970–2009

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
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	901,022	52,859	17.0
2000	79,085	923,059	52,939	17.4
2001	84,188	943,207	53,522	17.6
2002	85,011	966,034	55,220	17.5
2003	87,187	984,094	60,758	16.2
2004	91,845	1,027,164	63,417	16.2
2005	95,337	1,041,051	58,869	17.7
2006	99,125	1,082,490	60,685	17.8
2007	101,470	1,112,271	61,836	18.0
2008	101,235	1,108,603	61,199	18.1
2009[b]	100,154	1,108,656	61,610	18.0
		Average annual percentage change		
1970–2009	5.1%	5.8%	4.2%	1.5%
1999–2009	2.9%	2.1%	1.5%	0.6%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011, Table MV-9. Previous years Table VM-1. (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.
[b] Because vehicle travel, fuel use, and fuel economy are no longer published for cars, the 2009 data were estimated.

Because data on Class 2b trucks are scarce, the U.S. DOE funded a study to investigate available sources of data. In the final report, four methodologies are described to estimate the sales of Class 2b trucks. Until another study is funded, the 1999 data are the latest available.

Table 4.3
Summary Statistics on Class 1, Class 2a, and Class 2b Light Trucks

	CY 1999 truck sales (millions)	MY 2000 truck population (millions)	Percent diesel trucks in population	Average age (years)	Estimated annual miles[a] (billions)	Estimated fuel use (billion[a] gallons)	Estimated fuel economy (miles per gallon)
Class 1	5.7	49.7	0.3%	7.3	672.7	37.4	18.0
Class 2a	1.8	19.2	2.5%	7.4	251.9	18.0	14.0
Class 2b	0.5	5.8	24.0%	8.6	76.7	5.5	13.9

Source:
Davis, S.C. and L.F. Truett, *Investigation of Class 2b Trucks (Vehicles of 8,500 to 10,000 lbs GVWR)*, ORNL/TM-2002/49, March 2002, Table 16.

Note: CY - calendar year. MY - model year.

Table 4.4
Sales Estimates of Class 1, Class 2a, and Class 2b Light Trucks, 1989–1999

	Sales estimates (thousands)			
Calendar Year	Class 1 (6,000 lbs and under)	Class 2a (6,001-8,500 lbs)	Class 2b (8,501-10,000 lbs)	Total
1989	3,313	918	379	4,610
1990	3,451	829	268	4,548
1991	3,246	670	206	4,122
1992	3,608	827	194	4,629
1993	4,119	975	257	5,351
1994	4,527	1,241	265	6,033
1995	4,422	1,304	327	6,053
1996	4,829	1,356	334	6,519
1997	5,085	1,315	397	6,797
1998	5,263	1,694	342	7,299
1999	5,707	1,845	521	8,073
		Percent change		
1989–1999	72.3%	101.0%	37.5%	75.1%

Source:
Davis, S.C. and L.F. Truett, *Investigation of Class 2b Trucks (Vehicles of 8,500 to 10,000 lbs GVWR)*, ORNL/TM-2002/49, March 2002, Table 1.

Note: These data were calculated using Methodology 4 from the report.

[a] Estimates derived using 2000 population data and 1997 usage data. See source for details.

Car sales in 2009 and 2010 were below 6 million. In 1980, the Big 3 (Chrysler, Ford and General Motors) held 73.8% of the market; by 2010, that had dropped to 31.8%.

Table 4.5
New Retail Car Sales in the United States, 1970–2010

Calendar year	Domestic[a]	Import[b]	Total	Percentage imports	Percentage Big 3 Sales[c]	Percentage diesel	Diesel Cars
	(thousands)						
1970	7,119	1,280	8,400	15.2%	[d]	0.07%	6
1975	7,053	1,571	8,624	18.2%	[d]	0.31%	27
1980	6,580	2,369	8,949	26.5%	73.8%	4.32%	387
1985	8,205	2,775	10,979	25.3%	72.9%	0.83%	91
1986	8,215	3,189	11,404	28.0%	70.9%	0.37%	42
1987	7,085	3,107	10,192	30.5%	67.6%	0.17%	17
1988	7,543	3,004	10,547	28.5%	69.3%	0.02%	2
1989	7,098	2,680	9,779	27.4%	67.9%	0.13%	13
1990	6,919	2,384	9,303	25.6%	65.7%	0.08%	7
1991	6,162	2,023	8,185	24.7%	64.2%	0.10%	8
1992	6,286	1,927	8,213	23.5%	65.8%	0.06%	5
1993	6,742	1,776	8,518	20.8%	67.3%	0.04%	3
1994	7,255	1,735	8,991	19.3%	65.9%	0.04%	4
1995	7,114	1,506	8,620	17.5%	65.3%	0.03%	3
1996	7,206	1,272	8,479	15.0%	64.1%	0.09%	8
1997	6,862	1,355	8,217	16.5%	62.2%	0.09%	7
1998	6,705	1,380	8,085	17.1%	59.7%	0.14%	11
1999	6,919	1,719	8,638	19.9%	58.3%	0.16%	14
2000	6,762	2,016	8,778	23.0%	55.0%	0.26%	23
2001	6,254	2,098	8,352	25.1%	51.4%	0.18%	15
2002	5,817	2,226	8,042	27.7%	48.4%	0.39%	31
2003	5,473	2,083	7,556	27.6%	47.1%	0.52%	39
2004	5,334	2,149	7,483	28.7%	44.9%	0.40%	30
2005	5,473	2,187	7,660	28.6%	43.1%	0.63%	48
2006	5,417	2,345	7,762	30.2%	40.5%	0.86%	67
2007	5,198	2,365	7,562	31.3%	36.9%	0.11%	8
2008	4,490	2,278	6,769	33.7%	34.2%	0.12%	8
2009	3,558	1,843	5,401	34.1%	31.3%	2.94%	159
2010	3,792	1,844	5,635	32.7%	31.7%	2.68%	151
		Average annual percentage change					
1970–2010	-1.6%	0.9%	-1.0%				
2000–2010	-5.6%	-0.9%	-4.3%				

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*. 1998–2010: Ward's Communication, *Ward's Automotive Yearbook*, Detroit, MI, 2009, p. 249. 2010: Ward's Communications, www.wardsauto.com.

Diesel data - Ward's Communications, *Ward's Automotive Yearbook*, Detroit, MI, 2009, p. 31, and Ward's Communications, www.wardsauto.com.

Transplant data - Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares Data System, Oak Ridge, TN, 2004. (Additional resources: www.aama.com, www.wardsauto.com)

[a] North American built.

[b] Does not include import tourist deliveries.

[c] Big 3 includes Chrysler, Ford and General Motors. Beginning in 1998, Ford includes Jaguar and Volvo. GM Includes Saab.

[d] Data are not available.

Light trucks, which include pick-ups, minivans, sport-utility vehicles, and other trucks less than 10,000 pounds gross vehicle weight (GVW), accounted for more than half of light vehicle sales from 2001 to 2007 and again in 2010.

Table 4.6
New Retail Sales of Trucks 10,000 Pounds GVW and Less in the United States, 1970–2010

		Percentages					
Calendar year	Light truck sales[a] (thousands)	Import[b]	Data for Imports	Big 3 Sales[c]	Diesel[d]	Light trucks of light-duty vehicle sales[e]	Light trucks of total truck sales
1970	1,463	4.5%			[f]	14.8%	80.4%
1975	2,281	10.0%			[f]	20.9%	87.9%
1980	2,230	21.5%	479		3.5%	19.9%	89.4%
1985	4,461	18.7%	832	78.2%	3.3%	28.9%	94.0%
1986	4,654	21.0%	978	76.9%	3.7%	29.0%	94.6%
1987	4,714	19.6%	922	78.3%	2.3%	31.6%	94.3%
1988	4,910	14.5%	711	81.6%	2.3%	31.8%	93.6%
1989	4,755	13.5%	641	81.9%	2.9%	32.7%	93.8%
1990	4,569	13.4%	612	80.9%	2.2%	32.9%	94.3%
1991	4,144	13.0%	538	79.4%	3.2%	33.6%	94.9%
1992	4,655	8.8%	408	83.1%	2.4%	36.2%	94.9%
1993	5,378	7.0%	377	83.4%	2.3%	38.7%	94.7%
1994	6,068	6.8%	410	82.9%	2.5%	40.3%	94.5%
1995	6,108	6.6%	402	83.4%	3.8%	41.5%	94.0%
1996	6,619	6.6%	438	83.8%	3.1%	43.8%	94.9%
1997	6,904	8.4%	580	81.9%	2.7%	45.7%	94.8%
1998	7,458	8.8%	656	80.5%	2.6%	48.0%	94.6%
1999	8,256	9.4%	775	78.0%	2.8%	48.9%	94.1%
2000	8,572	9.9%	852	76.1%	3.3%	49.4%	94.9%
2001	8,700	11.3%	981	75.3%	2.8%	51.2%	96.2%
2002	8,774	12.1%	1,066	74.7%	2.7%	52.2%	96.5%
2003	9,084	13.5%	1,227	72.4%	2.8%	54.6%	96.5%
2004	9,384	13.3%	1,246	70.1%	2.7%	55.6%	95.6%
2005	9,288	13.1%	1,215	68.2%	2.7%	54.8%	94.9%
2006	8,743	15.4%	1,347	63.9%	2.8%	53.0%	94.1%
2007	8,527	16.3%	1,388	61.9%	3.1%	53.0%	95.8%
2008	6,426	17.1%	1,096	59.8%	3.3%	48.7%	95.6%
2009	5,001	17.7%	884	56.5%	4.0%	48.1%	96.2%
2010	5,919	15.2%	899	56.3%	4.8%	51.2%	96.5%
		Average annual percentage change					
1970–2010	3.6%						
2000–2010	-3.6%						

Source:
Ward's Communications, *Ward's Automotive Yearbook*, Detroit, MI, 2010, and updates at www.wardsauto.com. (Additional resources: www.wardsauto.com)

[a] Includes all trucks of 10,000 pounds gross vehicle weight and less sold in the United States.
[b] Excluding transplants.
[c] Big 3 includes Chrysler, Ford and General Motors. Beginning in 1998, Ford includes Land Rover and Volvo light trucks and GM includes Saab. Trucks include light, medium and heavy trucks.
[d] Based on model year factory installations.
[e] Light-duty vehicles include cars and light trucks.
[f] Indicates less than 1 percent.

The sales-weighted fuel economy of new cars (including wagons) increased dramatically from 1975 (15.8 mpg) to 1985 (27.0 mpg), but rose only 2.5 mpg from 1985 to 2005. Since 2005, fuel economy rose 3.2 mpg—from 29.5 mpg in 2005 to 32.7 mpg in 2010.

Table 4.7
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Cars, Selected Model Years 1975–2010[a]
(thousands)

	Sales Period							
	1975	1980	1985	1990	1995	2000	2005	2010
CARS								
Small								
Total sales, units	4,089	4,825	5,519	4,999	5,190	4,266	3,185	3,223
Market share, %	49.6%	51.1%	51.1%	56.7%	55.2%	46.7%	39.7%	40.2%
Fuel economy, mpg	18.3	26.1	29.8	29.8	30.7	30.3	31.1	34.0
Midsize								
Total sales, units	1,631	2,987	2,777	2,342	2,515	2,894	2,886	2,979
Market share, %	19.8%	31.6%	25.7%	26.6%	26.8%	31.7%	36.0%	37.1%
Fuel economy, mpg	13.6	21.6	24.9	26.2	26.1	27.0	29.8	33.1
Large								
Total sales, units	1,555	963	1,512	1,092	1,305	1,665	1,234	1,093
Market share, %	18.9%	10.2%	14.0%	12.4%	13.9%	18.2%	15.4%	13.6%
Fuel economy, mpg	13.1	19.1	22.3	23.7	24.5	25.6	26.4	28.2
WAGONS								
Small								
Total sales, units	477	310	496	160	198	68	365	609
Market share, %	5.8%	3.3%	4.6%	1.8%	2.1%	0.7%	4.5%	7.6%
Fuel economy, mpg	22.4	28.6	32.5	29.6	33.3	29.2	32.4	34.5
Midsize								
Total sales, units	289	257	341	184	176	234	238	105
Market share, %	3.5%	2.7%	3.2%	2.1%	1.9%	2.6%	3.0%	1.3%
Fuel economy, mpg	13.2	21.1	25.2	25.3	26.6	27.3	26.0	28.5
Large								
Total sales, units	197	102	145	31	10	0	118	11
Market share, %	2.4%	1.1%	1.4%	0.4%	0.1%	0.0%	1.5%	0.1%
Fuel economy, mpg	11.9	19.1	20.9	22.7	22.8	[b]	22.2	21.0
TOTAL								
Total sales, units	8,238	9,443	10,791	8,810	9,396	9,128	8,027	8,020
Market share, %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100%
Fuel economy, mpg	15.8	23.5	27.0	27.8	28.3	28.2	29.5	32.7

Source:
U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2021*, November 2010. (A dditional resources: www.epa.gov/otaq/fetrends.htm)

[a] The fuel economy data on this table are EPA laboratory test values.
[b] No vehicles in this category were sold in this model year.

The term “wagon” conjures up images of the station wagons from the 1960's. However, most of the cars that are now classified as wagons have little in common with those station wagons. The wagons below make up the category “wagon” on Tables 4.7 through 4.14.

Table 4.8
Definition of Wagons in Model Year 2010

Small Wagon
Audi A3
Audi A3 Quattro
Audi A4 Avant Quattro
BMW 328I Sport Wagon
BMW 328I Sport Wagon xDrive
Cadillac CTS Wagon
Cadillac CTS Wagon AWD
Chevrolet HHR FWD
Chevrolet HHR Panel FWD
Chrysler PT Cruiser
Honda Fit
Hyundai Elantra Touring
Kia Soul
Mitsubishi Lancer Sportback
Nissan Cube
Pontiac Vibe
Saab 9-3 Sportcombi
Saab 9-3X Sportcombi AWD
Subaru Impreza Wagon-Outback Sport
Suzuki SX4
Suzuki SX4 AWD
Toyota Corolla Matrix
Toyota Scion XB
Volkswagen Jetta Sportwagen
Volvo V50 AWD
Volvo V50 FWD
Midsize Wagon
Audi A6 Avant Quattro
BMW 535i Sport Wago xDrive
Kia Rondo
Lincoln MKT AWD
Lincoln MKT FWD
Subaru Outback Wagon AWD
Volkswagen Passat Wagon
Volvo V70 FWD
Volvo XC70 AWD
Large Wagon
Mercedes Benz R350 Bluetec
Mercedes Benz R350 4MATIC

Source:
U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. (Additional resources: www.epa.gov/otaq/fetrends.htm)

Sales of light trucks in 2010 are almost three times that of 1975. Similar to the car trend, the sales-weighted fuel economy of light trucks increased substantially during the late '70's and '80's, but has increased slowly until the mid-2000's. From 2005 to 2010, fuel economy rose from 21.4 mpg to 23.8 mpg.

Table 4.9
Period Sales, Market Shares, and Sales-Weighted Fuel Economies[a] of New Domestic and Import Light Trucks, Model Years 1975–2010
(thousands)

	Sales Period							
	1975	1980	1985	1990	1995	2000	2005	2010
PICKUPS								
Small								
Total sales, units	160	452	497	289	298	101	8	b
Market share, %	8.1%	24.3%	13.5%	7.6%	5.2%	1.4%	0.1%	0.0%
Fuel economy, mpg	22.5	24.3	26.7	24.8	24.4	26.3	25.8	b
Midsize								
Total sales, units	56	98	617	600	700	766	216	196
Market share, %	2.8%	5.3%	16.8%	15.8%	12.2%	10.3%	2.7%	3.5%
Fuel economy, mpg	21.1	25.9	25.7	24.7	24.7	22.8	23.6	25.2
Large								
Total sales, units	1,126	887	964	945	1,273	1,746	2,076	1,527
Market share, %	56.7%	47.6%	26.3%	24.8%	22.1%	23.4%	26.4%	27.3%
Fuel economy, mpg	13.1	17.2	17.7	18.0	18.0	19.3	19.4	20.6
VANS								
Small								
Total sales, units	2	16	93	31	6	b	b	11
Market share, %	0.1%	0.9%	2.5%	0.8%	0.1%	b	b	0.2%
Fuel economy, mpg	20.6	19.0	25.5	23.9	26.5	b	b	30.7
Midsize								
Total sales, units	302	130	600	1,124	1,552	1,522	1,426	450
Market share, %	15.2%	7.0%	16.4%	29.5%	27.0%	20.4%	18.1%	8.0%
Fuel economy, mpg	13.3	16.9	19.8	21.8	22.2	23.5	24.2	25.1
Large								
Total sales, units	153	96	162	107	104	170	55	18
Market share, %	7.7%	5.2%	4.4%	2.8%	1.8%	2.3%	0.7%	0.3%
Fuel economy, mpg	12.6	16.0	16.1	16.5	17.1	18.0	19.4	20.0
SUVS								
Small								
Total sales, units	54	61	115	190	190	400	215	67
Market share, %	2.7%	3.3%	3.1%	5.0%	3.3%	5.4%	2.7%	1.2%
Fuel economy, mpg	16.1	18.8	22.1	23.4	24.2	22.5	24.3	21.4
Midsize								
Total sales, units	123	100	563	447	1,397	1,863	2,080	1,912
Market share, %	6.2%	5.4%	15.3%	11.7%	24.3%	25.0%	26.4%	34.1%
Fuel economy, mpg	12.1	14.3	19.7	19.1	19.6	21.0	23.0	27.4
Large								
Total sales, units	11	24	57	72	230	880	1,790	1,420
Market share, %	0.6%	1.3%	1.6%	1.9%	4.0%	11.8%	22.8%	25.4%
Fuel economy, mpg	12.2	14.3	16.9	16.7	16.6	17.6	19.9	23.2
TOTAL								
Total sales, units	1,987	1,863	3,669	3,805	5,749	7,447	7,866	5,601
Market share, %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Fuel economy, mpg	13.7	18.6	20.6	20.7	20.5	20.8	21.4	23.8

Source:

U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. (A dditional resources: www.epa.gov/otaq/fetrends.htm)

Note: Includes light trucks of 8,500 lbs. or less.

[a] The fuel economy data on this table are EPA laboratory test values.

[b] No vehicles in this category were sold in this model year.

Back in 1975 only 19% of new light vehicle sales were light trucks. Because of the boom in sales of minivans, sport utility vehicles, and pick-up trucks, that number rose to nearly 50% in 2005. In 2010, cars made a comeback to account for 58.9%.

Table 4.10
Light Vehicle Market Shares by Size Class, Model Years 1975–2010

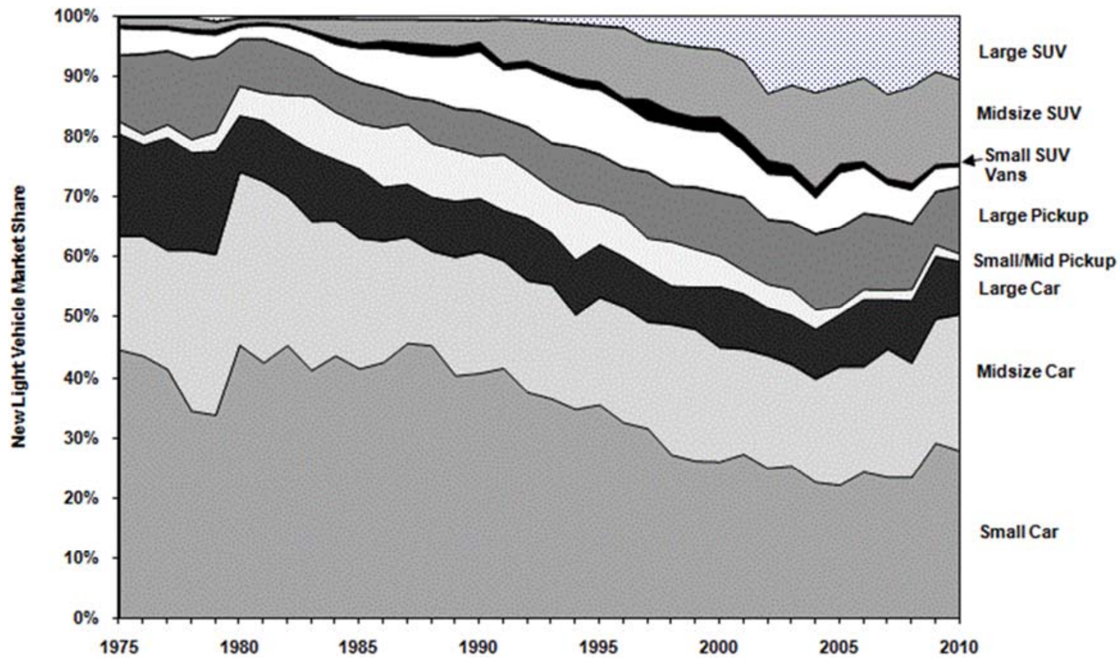
	Model Year							
	1975	1980	1985	1990	1995	2000	2005	2010
Small car	40.0%	42.7%	38.2%	39.6%	34.3%	25.7%	20.0%	23.7%
Midsize car	16.0%	26.4%	19.2%	18.6%	16.6%	17.5%	18.2%	21.9%
Large car	15.2%	8.5%	10.5%	8.7%	8.6%	10.0%	7.8%	8.0%
Small wagon	4.7%	2.7%	3.4%	1.3%	1.3%	0.4%	2.3%	4.5%
Midsize wagon	2.8%	2.3%	2.4%	1.5%	1.2%	1.4%	1.5%	0.8%
Large wagon	1.9%	0.9%	1.0%	0.2%	0.1%	0.0%	0.7%	0.1%
Small pickup	1.6%	4.0%	3.4%	2.3%	2.0%	0.6%	0.1%	0.0%
Midsize pickup	0.5%	0.9%	4.3%	4.8%	4.6%	4.6%	1.4%	1.4%
Large pickup	11.0%	7.8%	6.7%	7.5%	8.4%	10.5%	13.1%	11.2%
Small van	0.0%	0.1%	0.6%	0.2%	0.0%	0.0%	0.0%	0.1%
Midsize van	3.0%	1.1%	4.1%	8.9%	10.2%	9.2%	9.0%	3.3%
Large van	1.5%	0.8%	1.1%	0.9%	0.7%	1.0%	0.3%	0.1%
Small SUV	0.5%	0.5%	0.8%	1.5%	1.3%	2.4%	1.4%	0.5%
Midsize SUV	1.2%	0.9%	3.9%	3.5%	9.2%	11.2%	13.1%	14.0%
Large SUV	0.1%	0.2%	0.4%	0.6%	1.5%	5.3%	11.3%	10.4%
Total light vehicles sold (thousands)	10,225	11,306	14,460	12,615	15,145	16,575	15,893	13,621
Cars	80.6%	83.5%	74.6%	69.8%	62.0%	55.1%	50.5%	58.9%
Light trucks	19.4%	16.5%	25.4%	30.2%	38.0%	44.9%	49.5%	41.1%

Source:
U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. (Additional resources: www.epa.gov/otaq/fetrends.htm)

Note: Includes light trucks of 8,500 lbs. or less.

Light trucks were gaining market share from the early 1980s until 2004, mainly due to increases in the market share of sport utility vehicles (SUVs) and pickup trucks. Small and midsize cars had a large increase in market share in 2009, likely due to the Federal Government incentive program for fuel-efficient vehicles.

Figure 4.1. Light Vehicle Market Shares, Model Years 1975–2010



Source:
See Table 4.10

The midsize and large cars and wagons sales-weighted engine sizes have decreased at an average of about 2% per year since 1975.

Table 4.11
Sales-Weighted Engine Size of New Domestic and Import Cars by Size Class, Model Years 1975–2010
(liters[a])

	Cars			Wagons		
Model Year	Small	Midsize	Large	Small	Midsize	Large
1975	3.67	5.78	6.70	2.10	5.92	6.72
1976	3.70	5.62	6.72	2.23	5.16	6.82
1977	3.67	5.44	6.00	2.20	4.87	5.98
1978	2.90	4.79	5.85	2.20	4.23	5.80
1979	2.72	4.46	5.56	2.02	4.08	5.46
1980	2.25	3.74	5.15	1.85	3.74	5.31
1981	2.13	3.61	4.98	1.77	3.16	5.13
1982	2.15	3.46	4.79	1.79	3.36	5.01
1983	2.25	3.47	4.80	1.72	3.28	5.03
1984	2.31	3.44	4.82	1.75	2.82	5.00
1985	2.26	3.36	4.57	1.75	2.79	5.00
1986	2.26	3.18	4.26	1.85	2.65	4.98
1987	2.20	3.08	4.26	1.90	2.84	4.98
1988	2.18	3.00	4.29	1.85	2.80	4.98
1989	2.15	2.97	4.29	1.84	2.88	4.98
1990	2.15	3.06	4.23	1.97	2.97	4.98
1991	2.15	3.13	4.33	1.97	2.97	4.98
1992	2.20	3.13	4.29	2.00	3.08	5.54
1993	2.18	3.15	4.20	1.93	3.08	5.57
1994	2.25	3.11	4.08	1.98	2.95	5.74
1995	2.25	3.10	4.06	1.93	2.74	5.74
1996	2.23	2.97	4.10	2.00	2.64	5.74
1997	2.18	3.02	3.97	2.05	2.62	[b]
1998	2.25	2.90	3.93	2.03	2.54	[b]
1999	2.31	2.87	3.85	2.05	2.57	[b]
2000	2.28	2.85	3.62	2.08	2.51	[b]
2001	2.29	2.87	3.62	2.38	2.54	[b]
2002	2.31	2.90	3.57	2.38	2.51	[b]
2003	2.34	2.85	3.67	2.08	2.47	[b]
2004	2.39	2.85	3.69	2.06	2.59	3.52
2005	2.36	2.75	3.69	2.00	3.00	3.56
2006	2.47	2.77	3.77	2.08	3.00	3.59
2007	2.39	2.70	3.75	2.08	2.64	3.88
2008	2.43	2.67	3.49	2.13	2.67	3.72
2009	2.29	2.59	3.28	2.05	2.51	3.43
2010	2.41	2.67	3.34	2.02	2.74	3.46
		Average annual percentage change				
1975–2010	-1.2%	-2.2%	-2.0%	-0.1%	-2.2%	-1.9%
2000–2010	0.6%	-0.7%	-0.8%	-0.3%	0.9%	-3.6%[c]

Source:
U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. (Additional resources: www.epa.gov/otaq/fetrends.htm)

[a] 1 liter = 61.02 cubic inches.
[b] No vehicles in this category were sold in this model year.
[c] 1996–2010.

The engine size of large sport utility vehicles (SUVs) declined an average of 2.5% per year from 2000 to 2010, while the size of a small SUV engine increased by 3.1%.

Table 4.12
Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class, Model Years 1975–2010
(liters[a])

	Pickups			Vans			SUVs		
Model Year	Small	Midsize	Large	Small	Midsize	Large	Small	Midsize	Large
1975	1.93	1.79	5.62	1.93	5.08	5.47	4.47	5.72	5.97
1976	1.95	1.79	5.64	1.97	5.20	5.51	4.47	5.80	6.11
1977	1.98	2.03	5.69	1.97	5.34	5.62	4.49	5.72	6.08
1978	1.97	2.03	5.56	1.97	5.36	5.49	4.52	5.87	6.11
1979	1.97	2.15	5.41	1.97	5.24	5.51	4.28	5.64	6.15
1980	2.00	2.18	5.00	1.97	4.72	5.16	3.72	5.31	5.59
1981	2.13	2.15	4.80	1.97	4.57	5.08	3.69	5.20	5.54
1982	2.25	2.49	4.90	1.82	4.65	5.15	3.39	5.24	5.64
1983	2.33	2.39	4.95	1.93	4.82	5.15	3.44	4.10	5.82
1984	2.33	2.43	4.93	1.97	4.06	5.15	3.05	3.70	5.75
1985	2.34	2.52	5.00	1.98	3.82	5.11	2.74	3.47	5.74
1986	2.38	2.41	4.88	2.15	3.67	5.01	2.74	3.36	5.74
1987	2.41	2.61	5.06	2.20	3.70	5.06	2.64	3.54	5.74
1988	2.43	2.70	5.21	2.20	3.65	5.06	2.57	3.83	5.75
1989	2.51	2.90	5.21	2.13	3.57	5.06	2.80	4.16	5.75
1990	2.51	2.87	5.24	2.29	3.59	5.15	2.65	3.98	5.75
1991	2.49	3.11	5.16	2.03	3.51	5.11	2.38	3.87	5.38
1992	2.49	3.20	5.11	2.11	3.57	5.16	2.39	3.82	5.42
1993	2.41	3.24	4.97	2.00	3.46	5.16	2.46	3.97	5.65
1994	2.47	3.23	5.18	2.21	3.59	5.21	2.28	3.90	5.62
1995	2.57	3.11	5.20	2.21	3.70	5.15	2.26	3.88	5.69
1996	2.61	3.06	5.16	2.33	3.47	5.33	1.75	4.08	5.64
1997	2.39	3.21	4.97	[b]	3.44	4.92	2.98	3.85	5.38
1998	2.62	3.15	5.05	[b]	3.43	4.87	2.65	3.87	5.13
1999	2.84	3.28	5.13	[b]	3.49	4.87	2.57	3.74	5.29
2000	2.43	3.15	4.74	[b]	3.41	4.85	2.80	3.75	5.11
2001	2.41	3.39	4.79	[b]	3.38	4.97	2.51	3.51	4.64
2002	2.90	3.70	4.82	[b]	3.44	4.80	2.56	3.34	4.54
2003	2.92	3.23	4.82	[b]	3.47	4.74	2.64	3.39	4.72
2004	3.02	3.59	4.95	[b]	3.51	4.79	2.97	3.51	4.74
2005	2.46	3.15	4.82	[b]	3.49	4.72	2.92	3.34	4.46
2006	2.46	3.23	4.75	[b]	3.47	4.64	3.28	3.34	4.24
2007	[b]	3.31	4.88	[b]	3.54	4.64	3.39	3.18	4.39
2008	[b]	3.29	4.95	2.29	3.59	4.62	3.52	3.10	4.24
2009	[b]	3.31	5.01	2.29	3.56	4.67	3.79	2.93	3.93
2010	[b]	3.21	5.05	2.29	3.51	4.79	3.80	3.00	3.98
				Average annual percentage change					
1975-2010	[c]	1.7%	-1.6%	0.5%	-1.1%	-0.4%	-0.5%	-1.8%	-1.2%
2000-2010	[c]	0.2%	0.6%	[c]	0.3%	-0.1%	3.1%	-2.2%	-2.5%

Source:
U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. (Additional resources: www.epa.gov/otaq/fetrends.htm)

Note: Includes light trucks of 8,500 lbs. or less.

[a] 1 liter = 61.02 cubic inches.
[b] No vehicles in this category were sold in this model year.
[c] Data are not available.

Table 4.13
Sales-Weighted Curb Weight of New Domestic and Import Cars by Size Class, Model Years 1975–2010
(pounds)

	Cars			Wagons		
Model Year	Small	Midsize	Large	Small	Midsize	Large
1975	3,440	4,630	5,142	2,834	4,791	5,453
1976	3,474	4,558	5,156	2,902	4,555	5,444
1977	3,486	4,474	4,482	2,801	4,410	4,713
1978	3,029	3,820	4,394	2,805	3,836	4,664
1979	2,936	3,710	4,210	2,711	3,758	4,467
1980	2,717	3,362	4,130	2,591	3,535	4,423
1981	2,648	3,346	4,108	2,531	3,285	4,394
1982	2,684	3,321	4,034	2,580	3,384	4,396
1983	2,734	3,316	4,041	2,565	3,348	4,380
1984	2,776	3,318	4,022	2,620	3,298	4,371
1985	2,771	3,319	3,841	2,579	3,356	4,354
1986	2,791	3,241	3,719	2,648	3,355	4,381
1987	2,803	3,247	3,696	2,795	3,434	4,348
1988	2,818	3,293	3,730	2,757	3,378	4,349
1989	2,841	3,314	3,721	2,766	3,436	4,334
1990	2,897	3,450	3,799	3,026	3,499	4,337
1991	2,886	3,412	3,893	3,005	3,506	4,403
1992	2,921	3,515	3,872	3,076	3,504	4,500
1993	2,903	3,515	3,831	2,882	3,498	4,500
1994	2,965	3,529	3,859	2,908	3,533	4,500
1995	2,988	3,546	3,830	2,859	3,482	4,500
1996	2,977	3,527	3,895	2,952	3,661	4,500
1997	2,977	3,551	3,821	2,901	3,666	[a]
1998	3,013	3,534	3,784	2,874	3,669	[a]
1999	3,085	3,540	3,854	2,923	3,691	[a]
2000	3,079	3,550	3,782	3,107	3,572	[a]
2001	3,101	3,566	3,774	3,470	3,775	[a]
2002	3,125	3,549	3,768	3,504	3,732	[a]
2003	3,169	3,567	3,841	3,262	3,745	[a]
2004	3,192	3,577	3,858	3,235	3,860	4,769
2005	3,163	3,545	3,933	3,160	3,839	4,791
2006	3,255	3,568	4,014	3,255	3,827	4,806
2007	3,238	3,581	4,026	3,264	3,727	4,785
2008	3,284	3,564	3,966	3,300	3,845	5,017
2009	3,251	3,554	3,883	3,263	3,653	5,500
2010	3,263	3,630	3,924	3,217	4,064	5,500
			Average annual percentage change			
1975-2010	-0.2%	-0.7%	-0.8%	0.4%	-0.5%	0.0%
2000-2010	0.6%	0.2%	0.4%	0.3%	1.3%	1.4%[b]

Source:
U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. (Additional resources: www.epa.gov/otaq/fetrends.htm)

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[a] Data are not available.
[b] 1996–2010.

The interior space of new small and midsize cars in 2010 was about the same as in the late 1990's; large cars, however, had smaller interior space.

Table 4.14
Sales-Weighted Interior Space of New Domestic and Import Cars by Size Class, Model Years 1977–2010
(cubic feet)

	Cars			Wagons		
Model Year	Small	Midsize	Large	Small	Midsize	Large
1977	95.4	112.9	128.1	108.0	143.6	163.1
1978	90.9	113.0	128.5	108.0	140.0	162.4
1979	89.2	113.1	130.0	105.1	139.7	162.5
1980	90.0	113.2	130.9	108.2	139.7	161.5
1981	91.6	113.9	131.0	110.6	136.2	161.4
1982	92.2	113.9	131.0	112.2	136.1	161.3
1983	95.1	113.8	131.3	108.2	136.2	161.6
1984	95.2	113.7	130.9	116.5	135.9	161.7
1985	95.8	113.6	129.3	117.7	134.8	161.7
1986	96.7	113.8	127.4	118.4	137.8	161.4
1987	96.9	113.7	127.0	120.0	140.2	161.8
1988	98.5	113.4	128.1	118.7	139.4	161.7
1989	98.3	113.6	127.4	118.6	139.9	161.8
1990	97.6	113.7	126.7	122.2	141.6	161.6
1991	97.6	113.5	129.0	123.3	142.3	169.1
1992	97.9	113.9	129.6	123.7	142.6	170.3
1993	98.3	113.9	128.9	123.0	137.7	169.3
1994	98.7	113.5	128.3	122.9	137.4	169.2
1995	99.6	114.3	127.9	122.1	135.9	169.3
1996	99.9	114.1	128.1	118.0	136.9	170.2
1997	99.2	114.5	127.4	119.5	136.5	[a]
1998	98.8	114.0	127.4	116.9	135.3	[a]
1999	98.9	114.0	127.0	117.9	136.4	[a]
2000	99.4	113.6	124.9	119.7	134.0	[a]
2001	99.2	113.7	124.8	119.6	133.6	[a]
2002	98.9	114.8	124.3	118.2	133.6	[a]
2003	99.4	114.6	124.8	115.2	133.5	[a]
2004	99.0	114.0	124.7	117.5	135.0	165.0
2005	99.1	114.5	125.0	115.9	133.3	165.0
2006	98.8	114.0	124.7	118.4	135.6	164.4
2007	99.3	113.8	123.8	112.0	135.4	159.2
2008	98.3	113.3	123.2	115.0	134.6	160.1
2009	99.8	113.9	122.6	114.8	133.7	161.7
2010	99.8	114.5	122.9	115.8	139.2	161.7
			Average annual percentage change			
1977-2010	0.1%	0.0%	-0.1%	0.2%	-0.1%	0.0%
2000-2010	0.0%	0.1%	-0.2%	-0.3%	-0.4%	-0.4%[b]

Source:

U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. (Additional resources: www.epa.gov/otaq/fetrends.htm)

[a] No vehicles in this category were sold in this model year.
[b] 1996-2010.

The average light vehicle in 2009 contained more than 2,000 pounds of steel, most of it conventional steel. High and medium strength steel, however, made up more than 10% of the vehicle. The use of aluminum grew from 1995 to 2009, while the use of iron castings declined.

Table 4.15
Average Material Consumption for a Domestic Light Vehicle, Model Years 1995, 2000, and 2009

	1995		2000		2009	
Material	Pounds	Percentage	Pounds	Percentage	Pounds	Percentage
Regular steel	1,630.0	44.1%	1,655.0	42.4%	1,501.0	38.3%
High and medium strength steel	324.0	8.8%	408.0	10.5%	524.0	13.4%
Stainless steel	51.0	1.4%	62.0	1.6%	69.0	1.8%
Other steels	46.0	1.2%	26.0	0.7%	31.0	0.8%
Iron castings	466.0	12.6%	432.0	11.1%	206.0	5.3%
Aluminum	231.0	6.3%	268.0	6.9%	324.0	8.3%
Magnesium castings	4.0	0.1%	8.0	0.2%	12.0	0.3%
Copper and brass	50.0	1.4%	52.0	1.3%	63.0	1.6%
Lead	33.0	0.9%	36.0	0.9%	45.0	1.1%
Zinc castings	19.0	0.5%	13.0	0.3%	9.0	0.2%
Powder metal parts	29.0	0.8%	36.0	0.9%	41.0	1.0%
Other metals	4.0	0.1%	4.0	0.1%	5.0	0.1%
Plastics and plastic composites	240.0	6.5%	286.0	7.3%	384.0	9.8%
Rubber	149.0	4.0%	166.0	4.3%	212.0	5.4%
Coatings	23.0	0.6%	25.0	0.6%	34.0	0.9%
Textiles	42.0	1.10%	44.0	1.10%	53.0	1.4%
Fluids and lubricants	192.0	5.20%	207.0	5.30%	219.0	5.6%
Glass	97.0	2.60%	103.0	2.60%	93.0	2.4%
Other materials	64.0	1.70%	71.0	1.80%	90.0	2.3%
Total	3,694.0	100.0%	3,902.0	100.0%	3,915.0	100.0%

Source:
Ward's Communications, *Ward's Motor Vehicle Facts and Figures, 2010*, Detroit, MI, 2010, p. 65 and updates.

The number of franchised dealerships which sell new light-duty vehicles (cars and light trucks) has declined about 35% since 1970. The average number of vehicles sold per dealer in 2009 was 520 vehicles per dealer, down from a high of 779 vehicles per dealer in 2004.

Table 4.16
New Light Vehicle Dealerships and Sales, 1970–2009

Calendar year	Number of franchised new light vehicle dealerships[a]	New light vehicle sales (thousands)	Light vehicle sales per dealer
1970	30,800	9,862	320
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	11,389	408
1981	26,350	10,678	405
1982	25,700	10,426	406
1983	24,725	12,132	491
1984	24,725	14,187	574
1985	24,725	15,437	624
1986	24,825	15,998	644
1987	25,150	14,802	589
1988	25,025	15,347	613
1989	25,000	14,389	576
1990	24,825	13,851	558
1991	24,200	12,312	509
1992	23,500	12,842	546
1993	22,950	13,869	604
1994	22,850	15,024	658
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	748
2000	22,250	17,234	774
2001	22,150	17,123	773
2002	21,800	16,816	771
2003	21,725	16,548	762
2004	21,650	16,867	779
2005	21,640	16,948	783
2006	21,495	16,505	768
2007	21,200	16,089	759
2008	20,770	13,194	635
2009	20,010	10,402	520
	Average annual percentage change		
1970–2009	-1.1%	0.1%	1.3%
1999–2009	-1.1%	-4.7%	-3.6%

Source:
Number of dealers - National Automobile Dealers Association website, www.nada.org. (Additional resources: http://www.nada.org/Publications/NADADATA/) Light-duty vehicle sales - See tables 4.5 and 4.6.

[a] As of the beginning of the year.

The number of conventional refueling stations has been declining but rose in 2009. The number of vehicles fueling at those stations fell in 2009 for the first time in several years. In 2009, there were 0.65 fueling stations per thousand vehicles or 1.53 thousand vehicles per station.

Table 4.17
Conventional Refueling Stations, 1993-2009

Year	Number of retail outlets	Vehicles in operation (thousands)	Stations per thousand vehicles	Thousand vehicles per station
	Conventional fuels			
1993	207,416	186,315	1.11	0.90
1994	202,878	188,714	1.08	0.93
1995	195,455	193,441	1.01	0.99
1996	190,246	198,294	0.96	1.04
1997	187,892	201,071	0.93	1.07
1998	182,596	205,043	0.89	1.12
1999	180,567	209,509	0.86	1.16
2000	175,941	213,300	0.82	1.21
2001	172,169	216,683	0.79	1.26
2002	170,018	221,027	0.77	1.30
2003	167,571	225,882	0.74	1.35
2004	167,346	232,167	0.72	1.39
2005	168,987	238,384	0.71	1.41
2006	167,476	244,643	0.69	1.46
2007	164,292	248,701	0.66	1.51
2008	161,068	250,239	0.64	1.55
2009	162,350	248,460	0.65	1.53

Sources:
Conventional refueling stations: National Petroleum News Survey, 2010.
Conventional vehicles: The Polk Company, Detroit, MI, **FURTHER REPRODUCTION PROHIBITED**.

Notes: The County Business Patterns (CBP) data published by the Bureau of the Census tells the number of establishments by North American Industry Classification System (NAICS). NAICS is an industry classification system that groups establishments into industries based on the activities in which they are primarily engaged. NAICS 447 represents gasoline stations. However, the CBP gasoline station data differ from the National Petroleum News Survey data by as much as 30% (117,189 stations in 2005); the CBP may not include every gasoline retail outlet due to the classification of the primary activity of the business.

Alternative Fuel Refueling Stations are listed in Chapter 6.

The National Highway Traffic Safety Administration and the Environmental Protection Agency issued joint rulemaking to establish a new National Program to regulate fuel economy and greenhouse gas emissions for model year 2012-2016 cars and light trucks.

Table 4.18
Fuel Economy and Carbon Dioxide Emissions Standards, MY 2012-2016

Year	Cars	Light Trucks	Combined Cars and Light Trucks
	Average Required Fuel Economy (miles per gallon)		
2012	33.3	25.4	29.7
2013	34.2	26.0	30.5
2014	34.9	26.6	31.3
2015	36.2	27.5	32.6
2016	37.8	28.8	34.1
	Average Projected Emissions Compliance Levels under the Footprint-based Carbon Dioxide Standards (grams per mile)		
2012	263	346	295
2013	256	337	286
2014	247	326	276
2015	236	312	263
2016	225	298	250

Source:
Federal Register, Vol. 75, No. 88, May 7, 2010. (Additional resources: www.nhtsa.dot.gov/portal/fueleconomy.jsp)

Note: The required fuel economy, along with projections of CO_2 emissions, are shown here.

The target levels for the proposed fuel economy and carbon dioxide emission standards for vehicles manufactured in model years 2012-2016 are assigned based on a vehicle's "footprint." Each footprint has a different target. The vehicle footprint is calculated as:

footprint = track width × wheelbase,

where
track width = lateral distance between the centerlines of the base tires at ground, and
wheelbase = longitudinal distance between the front and rear wheel centerlines.

Table 4.19
Fuel Economy and Carbon Dioxide Targets for Model Year 2016

Vehicle type	Example models	Example model footprint (square feet)	CO_2 emissions target (grams per mile)	Fuel economy target (miles per gallon)
Example Passenger Cars				
Compact car	Honda Fit	40	214	41.4
Midsize car	Ford Fusion	46	237	37.3
Fullsize car	Chrysler 300	53	270	32.8
Example Light-Duty Trucks				
Small SUV	4WD Ford Escape	44	269	32.8
Midsize crossover	Nissan Murano	49	289	30.6
Minivan	Toyota Sienna	55	313	28.2
Large pickup truck	Chevy Silverado	67	358	24.7

Source:
Federal Register, Vol. 75, No. 88, May 7, 2010.

Note: Examples use model year 2008 vehicle specifications.

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. Some manufacturers fall short of meeting the standards while others exceed them. Legislation passed in December 2007 changed the CAFE standards beginning in the 2011 model year. The new standards have a target of combined fleet fuel economy of 35 mpg by 2020, for all cars and light trucks.

Table 4.20
Car Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2011[a]
(miles per gallon)

	Cars				CAFE estimates
Model	CAFE	CAFE estimates[c]			Cars and light
year[b]	standards	Domestic	Import	Combined	trucks 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	28.5	26.2
1988	26.0	27.4	31.5	28.8	26.0
1989	26.5	27.2	30.8	28.4	25.6
1990	27.5	26.9	29.9	28.0	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	29.6	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	28.7	28.3	28.5	24.8
2001	27.5	28.7	29.0	28.8	24.5
2002	27.5	29.1	28.8	29.0	24.7
2003	27.5	29.1	29.9	29.5	25.1
2004	27.5	29.9	28.7	29.5	24.6
2005	27.5	30.5	29.9	30.3	25.4
2006	27.5	30.3	29.7	30.1	25.8
2007	27.5	30.6	32.2	31.2	26.6
2008	27.5	31.2	31.8	31.5	27.1
2009	27.5	32.1	33.8	32.9	29.0
2010	27.5	32.9	35.1	33.7	29.2
2011	30.2[d]	32.3	34.7	34.4	29.3

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, April 2011. (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.
[d] Projected 2011 required average fuel economy standards value based on pre-model year reports.

The Corporate Average Fuel Economy standards for light trucks are lower than the car standards. Light trucks include pickups, minivans, sport utility vehicles and vans. New legislation passed in December 2007 changed the CAFE standards beginning in the 2011 model year. The new standards have a target of combined fleet fuel economy of 35 mpg by 2020, for all cars and light trucks.

Table 4.21
Light Truck Corporate Average Fuel Economy (CAFE) Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2011[a]
(miles per gallon)

	Light trucks[b]				CAFE estimates
Model	CAFE	CAFE estimates[d]			Cars and light
year[c]	standards	Domestic	Import	Combined	trucks combined
1978	[e]	[f]	[f]	[f]	19.9
1980	[e]	16.8	24.3	18.5	23.1
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	22.1	20.8	24.7
1995	20.6	20.3	21.5	20.5	24.9
1996	20.7	20.5	22.2	20.8	24.9
1997	20.7	20.1	22.1	20.6	24.6
1998	20.7	20.5	23.0	21.0	24.7
1999	20.7	20.4	22.5	20.9	24.5
2000	20.7	21.1	19.7	21.3	24.8
2001	20.7	20.6	21.8	20.9	24.5
2002	20.7	20.6	21.9	21.4	24.7
2003	20.7	21.8	22.4	21.8	25.1
2004	20.7	20.7	22.3	21.5	24.6
2005	21.0	[f]	[f]	22.1	25.4
2006	21.6	[f]	[f]	22.5	25.8
2007	22.2	[f]	[f]	23.1	26.6
2008	22.5[g]	[f]	[f]	23.6	27.1
2009	23.1[g]	[f]	[f]	24.8	29.2
2010	23.5[g]	[f]	[f]	25.1	29.2
2011	24.2[h]	[f]	[f]	24.8	29.3

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, April 2011. (Additional resources: www.nhtsa.dot.gov)

[a] Only vehicles with at least 75% domestic content can be counted in the average domestic fuel economy for a manufacturer.
[b] 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.
[c] Model year as determined by the manufacturer on a vehicle by vehicle basis.
[d] All CAFE calculations are sales-weighted.
[e] Standards were set for two-wheel drive and four-wheel drive light trucks, but no combined standard was set in this year.
[f] Data are not available.
[g] Unreformed standards. See Table 4.18 for reformed standards.
[h] Projected 2011 required average fuel economy standards value based on pre-model year reports.

Manufacturers of cars and light trucks whose vehicles do not meet the CAFE standards are fined. Data from the National Highway Traffic Safety Administration show CAFE fine collection dropped under $25 million in 2002 and 2003; this was due to several factors, including the CAFE credit system, manufacturer mergers, and fines not being paid in the same year they were assessed. Fines for the 2008 and 2009 model years are still being collected.

Table 4.22
Corporate Average Fuel Economy (CAFE) Fines Collected, 1983-2009[a]
(thousands)

Model year	Current dollars	2009 constant dollars[b]
1983	58	125
1984	5,958	12,303
1985	15,565	31,034
1986	29,872	58,473
1987	31,261	59,036
1988	44,519	80,736
1989	47,501	82,182
1990	48,309	79,296
1991	42,243	66,539
1992	38,287	58,545
1993	28,688	42,593
1994	31,499	45,598
1995	40,787	57,418
1996	19,302	26,392
1997	36,212	48,404
1998	21,740	28,613
1999	27,516	35,434
2000	51,067	63,622
2001	35,507	43,013
2002	20,042	23,900
2003	15,225	17,752
2004	33,637	38,203
2005	27,487	30,194
2006	43,183	45,955
2007	37,386	38,683
2008	12,922	12,876
2009	9,148	9,148

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, February 2011. (Additional resources: www.nhtsa.dot.gov)

[a] These are fines which are actually collected. Fines which are assessed in 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 a car that has an Environmental Protection Agency (EPA) fuel economy rating (combined city and highway) 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 4.23
The Gas Guzzler Tax on New Cars
(dollars per vehicle)

Vehicle fuel economy (mpg)	1980	1981	1982	1983	1984	1985	1986–90	1991 - on
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, (R ev. 10-05), "Gas Guzzler Tax." (Additional resources: www.irs.ustreas.gov)

Consumers continue to demand gas guzzling cars though fewer gas guzzlers were bought in model year 2009 than in the previous six years. The IRS collected over $99 million in 2009 from those buying cars with combined city/highway fuel economy less than 22.5 miles per gallon. This tax does not apply to light trucks such as pickups, minivans, sport utility vehicles, and vans. It is worthy to note that total revenue from fines paid by consumers to purchase gas-guzzling vehicles greatly exceeds the overall fines paid by manufacturers whose vehicles fail to meet CAFE standards (see Table 4.23).

Table 4.24
Tax Receipts from the Sale of Gas Guzzlers, 1980–2009
(thousands)

Model year	Current dollars	2009 constant dollars[a]
1980	740	1,927
1981	780	1,841
1982	1,720	3,824
1983	4,020	8,659
1984	8,820	18,212
1985	39,790	79,335
1986	147,660	289,038
1987	145,900	275,537
1988	116,780	211,780
1989	109,640	189,692
1990	103,200	169,397
1991	118,400	186,499
1992	144,200	220,501
1993	111,600	165,691
1994	64,100	92,792
1995	73,500	103,468
1996	52,600	71,923
1997	48,200	64,428
1998	47,700	62,782
1999	68,300	87,952
2000	70,800	88,207
2001	78,200	94,731
2002	79,700	95,045
2003	126,700	147,727
2004	140,800	159,909
2005	163,800	179,934
2006	200,200	213,047
2007	178,700	184,901
2008	172,428	171,815
2009	99,300	99,300

Source:
Ward's Communications, Detroit, MI, 2011. Original data source: Internal Revenue Service.

[a] Adjusted using the Consumer Price Inflation Index.

The Powertrain System Analysis Toolkit (PSAT) provides vehicle simulations for a variety of research purposes. It is used by the Department of Energy to evaluate the fuel efficiency potential of advanced powertrain configurations for different driving conditions. Recently, PSAT was used to develop data on the relationship between speed and fuel economy.

Table 4.25
Fuel Economy by Speed, PSAT Model Results

	Gasoline Conventional			Diesel Conventional			Hybrid Vehicles			
Speed (mph)	Midsize Car	Small SUV	Large SUV	Midsize Car	Small SUV	Large SUV	2000 Insight[a]	2004 Prius	2007 Camry[a]	2008 Tahoe[a]
45	39.1	32.5	29.5	56.4	47.7	43.6	101.3	72.0	52.2	32.2
55	41.7	34.3	30.0	57.0	46.0	39.9	94.3	66.0	46.8	27.1
65	36.9	29.1	23.0	47.9	37.6	32.5	80.0	57.0	40.9	23.7
75	31.9	24.5	19.8	40.2	30.8	26.9	60.6	42.0	35.0	21.1
Fuel economy loss										
55 - 65 mph	11.5%	15.2%	23.5%	16.0%	18.3%	18.5%	15.2%	13.6%	12.6%	12.4%
65 - 75 mph	13.6%	15.8%	13.8%	16.2%	18.1%	17.2%	24.3%	26.3%	14.5%	11.1%
55 - 75 mph	23.5%	28.6%	34.0%	29.6%	33.1%	32.6%	35.8%	36.4%	25.3%	22.1%

Source:
Argonne National Laboratory, Powertrain System Analysis Toolkit, July 16, 2009, www.transportation.anl.gov/modeling_simulation/PSAT/. (Additional resources: www.transportation.anl.gov)

[a] From Argonne National Laboratory Advanced Powertrain Research Facility (Vehicle Test Data).

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.

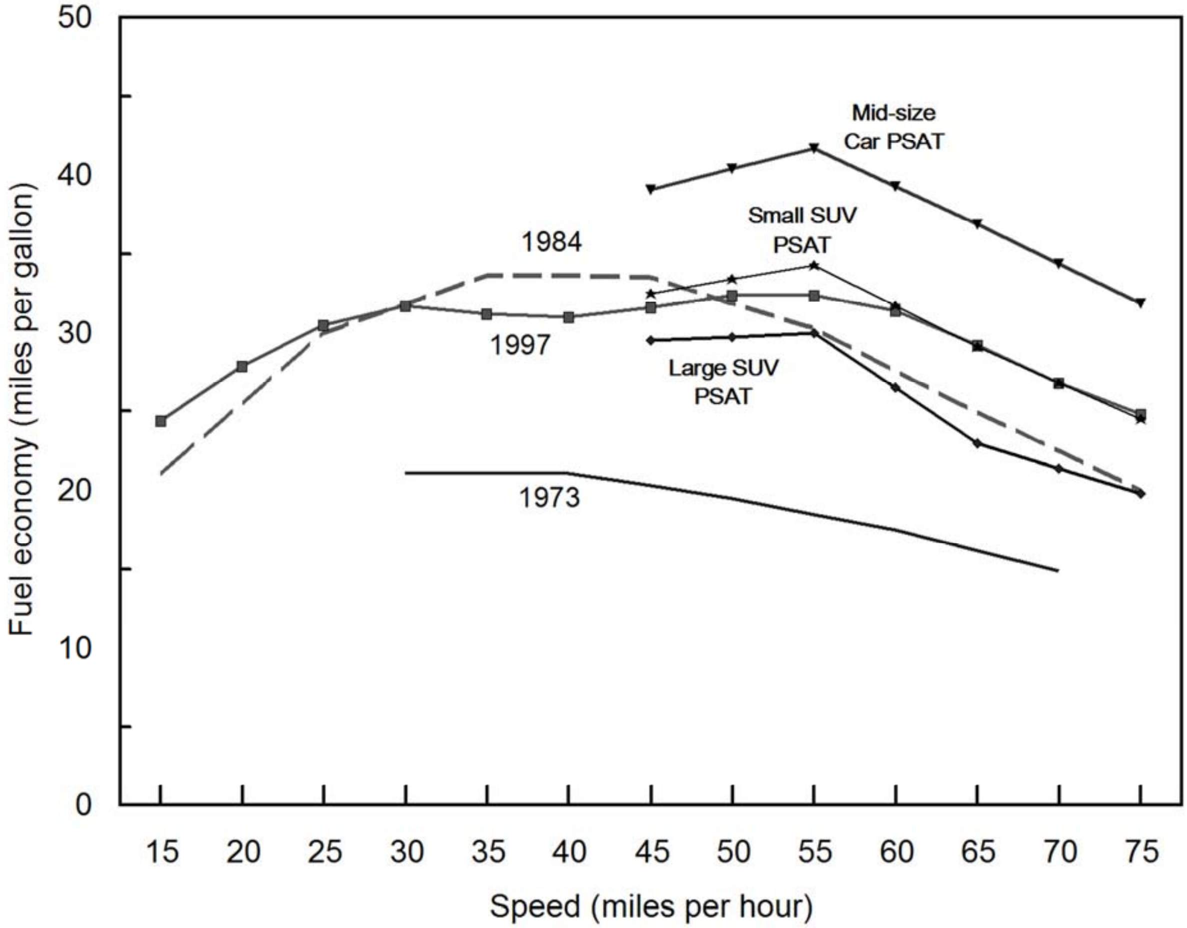
Table 4.26
Fuel Economy by Speed, 1973, 1984, and 1997 Studies
(miles per gallon)

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%

Sources:
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-RD-99-068, U.S. Department of Transportation, Federal Highway Administration, Washington, DC, March 1999. (Additional resources: www.fhwa-tsis.com)

[a] Model years 1970 and earlier cars.
[b] Model years 1981–84 cars and light trucks.
[c] Model years 1988–97 cars and light trucks.
[d] Data are not available.

Figure 4.2. Fuel Economy by Speed, 1973, 1984, and 1997 Studies



Source:
See Tables 4.25 and 4.26.

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 4.27
Steady Speed Fuel Economy for Vehicles Tested in the 1997 Study
(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 mph	1.4%	11.4%	13.3%	14.1%	13.1%	11.3%	20.2%	9.5%	-2.4%
65–75 mph	17.4%	13.8%	20.0%	13.6%	17.0%	10.3%	11.5%	17.0%	15.4%
55–75 mph	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 4.26.

This table shows the new methodology that the Environmental Protection Agency (EPA) used to determine fuel economy ratings for new vehicles beginning in model year 2008. In addition to the Urban Driving Cycle and the Highway Driving cycle, the EPA will also use three additional tests to adjust fuel economy ratings to account for higher speeds, air conditioner use, and colder temperatures. Though the EPA uses a complex combination of these five cycles to determine the fuel economy that will be posted on a new vehicle window sticker, the manufacturer's Corporate Average Fuel Economy is still calculated using only the city and highway driving cycles. To know more about new vehicle fuel economy ratings, visit www.fueleconomy.gov.

Table 4.28
Driving Cycle Attributes

	Test Schedule				
	City	Highway	High Speed	AC	Cold Temp
Trip type	Low speeds in stop-and-go urban traffic	Free-flow traffic at highway speeds	Higher speeds; harder acceleration & braking	AC use under hot ambient conditions	*City* test w/colder outside temperature
Top speed	56 mph	60 mph	**80 mph**	54.8 mph	56 mph
Average speed	20 mph	48 mph	48 mph	22 mph	20 mph
Max. acceleration	3.3 mph/sec	3.2 mph/sec	**8.46 mph/sec**	5.1 mph/sec	3.3 mph/sec
Simulated distance	11 mi.	10 mi.	8 mi.	3.6 mi.	11 mi.
Time	31 min.	12.5 min.	10 min.	9.9 min.	31 min.
Stops	23	None	4	5	23
Idling time	18% of time	None	7% of time	19% of time	18% of time
Engine startup[a]	Cold	Warm	Warm	Warm	**Cold**
Lab temperature	68-86° F	68-86° F	68-86° F	**95° F**	**20° F**
Vehicle air conditioning	Off	Off	Off	**On**	Off

Source:
U.S. Department of Energy and U.S. Environmental Protection Agency, Fuel Economy Web site, www.fueleconomy.gov.

[a] A vehicle's engine doesn't reach maximum fuel efficiency until it is warm.

These driving cycles simulate the performance of an engine while driving in the city and on the highway. Once the city cycle is completed, the engine is stopped, and then started again for the 8.5 minute hot start cycle. Three additional cycles also influence new vehicle fuel economy ratings beginning with the 2008 model year.

Figure 4.3. City Driving Cycle

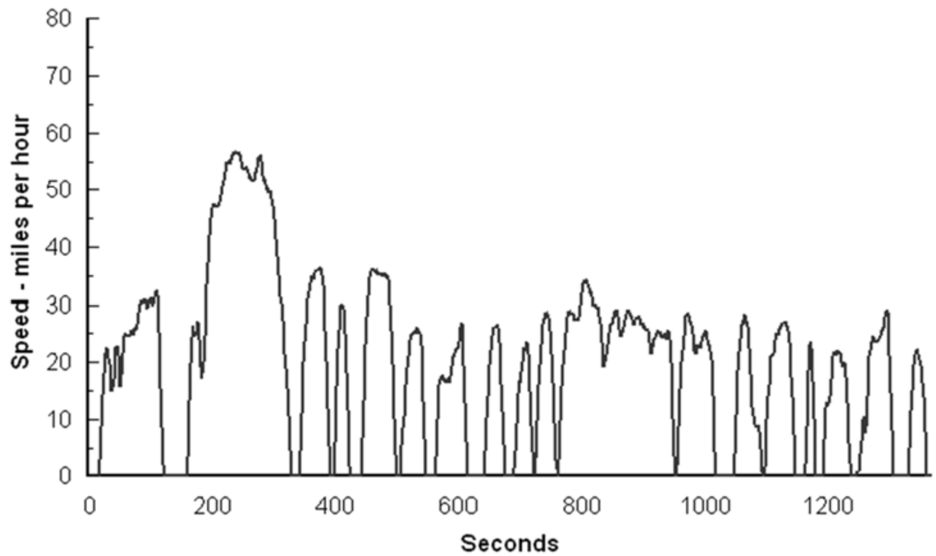
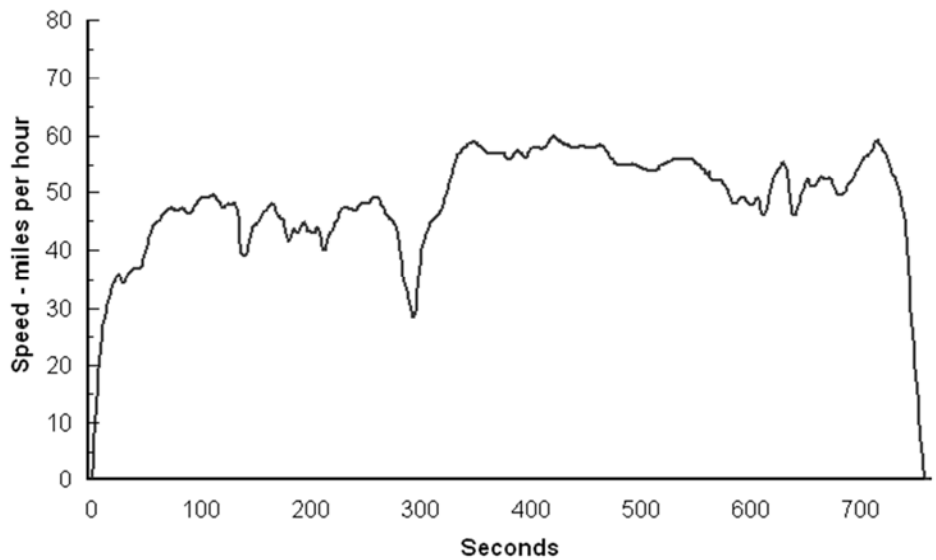


Figure 4.4. Highway Driving Cycle

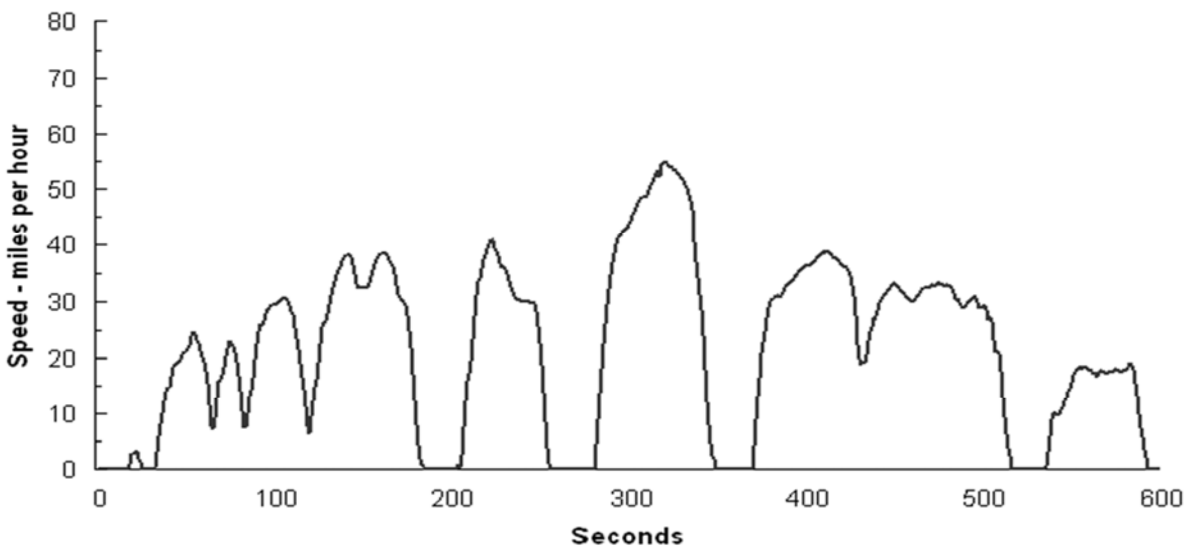


Source:

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.

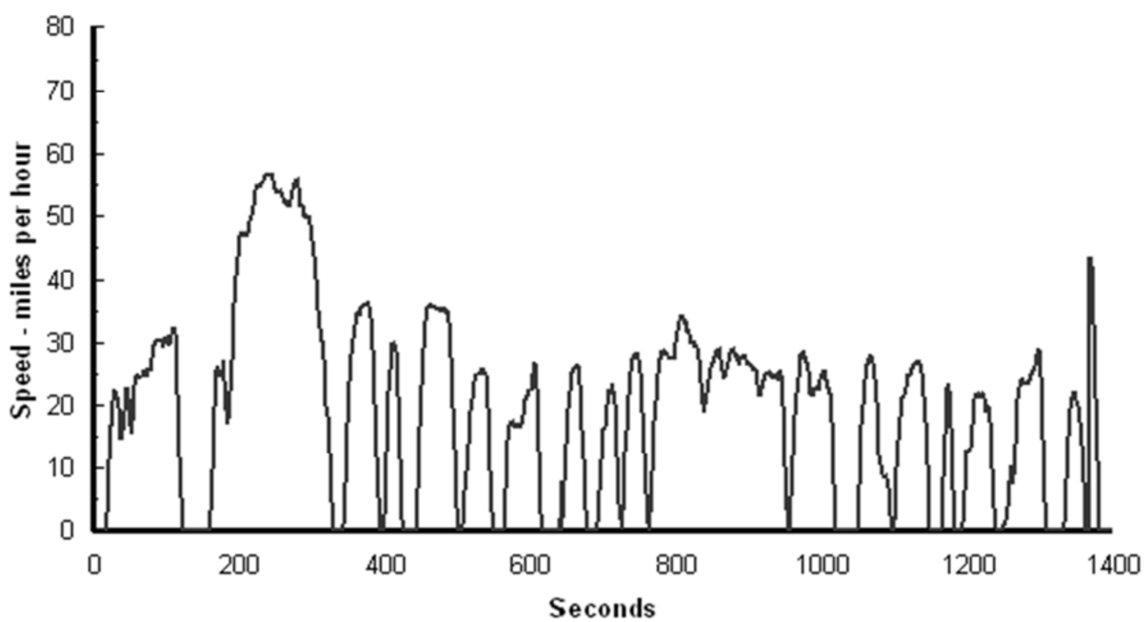
Beginning with the 2008 model year, these cycles influence the new vehicle fuel economy ratings.

Figure 4.5. Air Conditioning (SC03) Driving Cycle



Source:
U.S. Department of Energy and Environmental Protection Agency, Fuel Economy Web site, www.fueleconomy.gov.

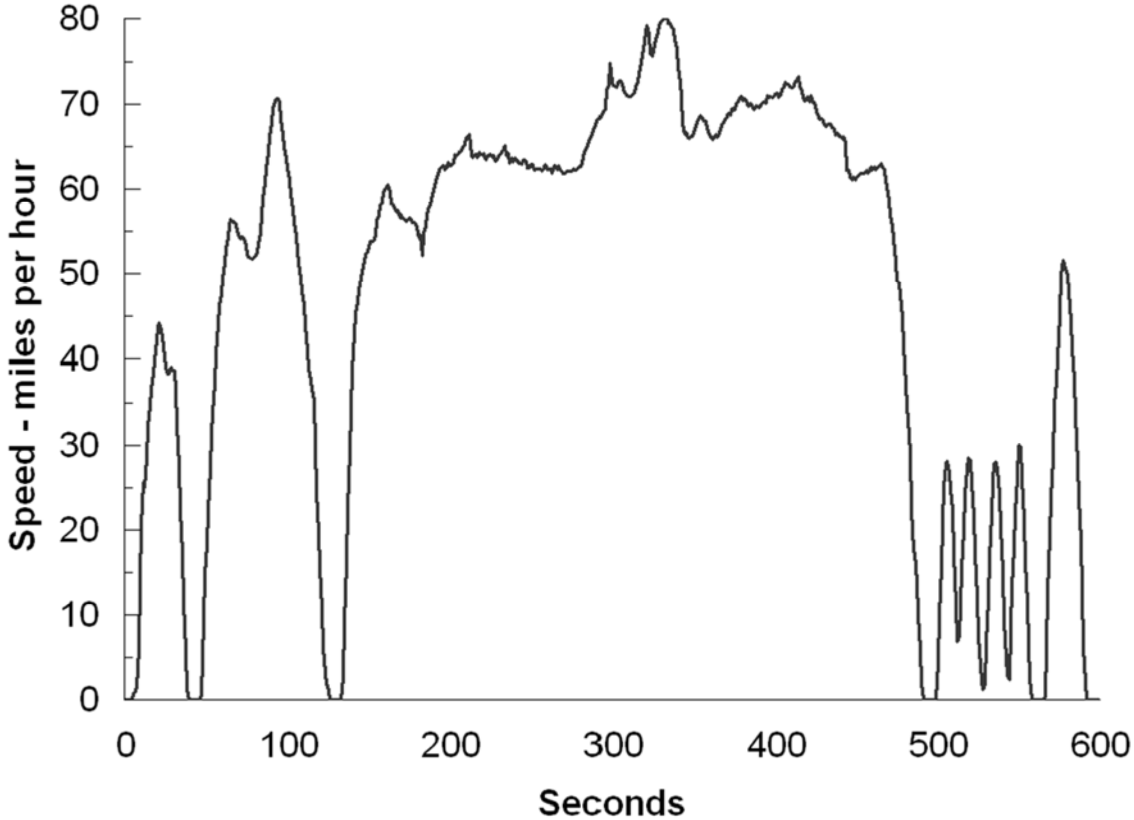
Figure 4.6. Cold Temperature (Cold FTP) Driving Cycle



Source:
U.S. Department of Energy and Environmental Protection Agency, Fuel Economy Web site, www.fueleconomy.gov.

Beginning with the 2008 model year, this cycle influences the new vehicle fuel economy ratings. The US06 driving cycle was originally developed as a supplement to the Federal Test Procedure. It is a short-duration cycle (600 seconds) which represents hard-acceleration driving.

Figure 4.7. High-Speed (US06) Driving Cycle



Source:
U.S. Department of Energy and Environmental Protection Agency, Fuel Economy Web site, www.fueleconomy.gov.

The Environmental Protection Agency also uses other driving cycles to test new vehicles (although these do not affect the fuel economy ratings). 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 in the 1990's to better represent actual on-road driving by combining modern city and freeway driving.

Figure 4.8. New York City Driving Cycle

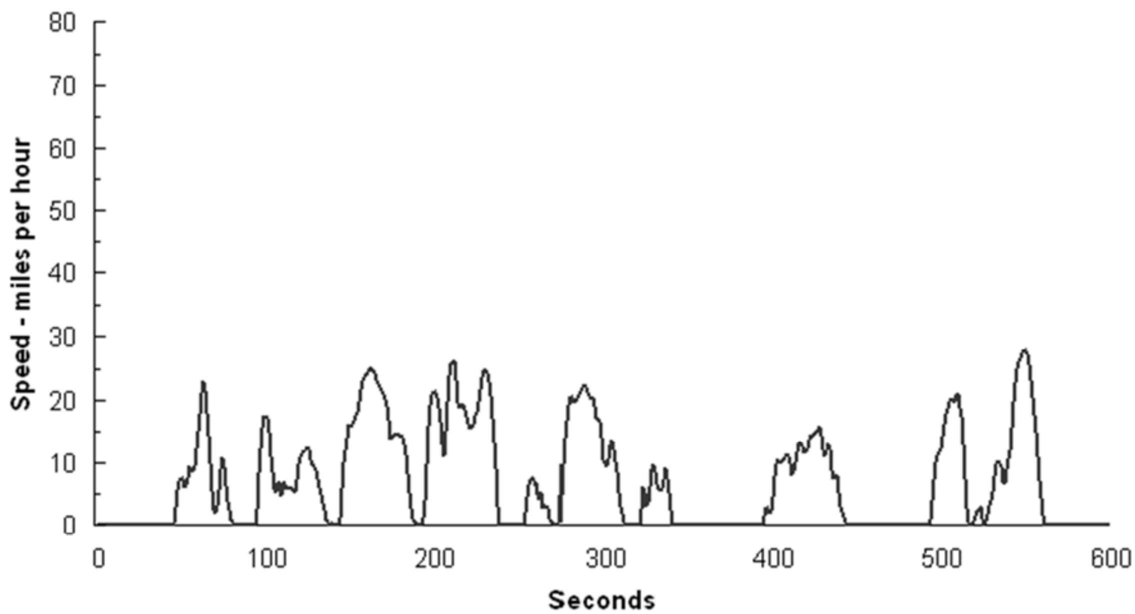
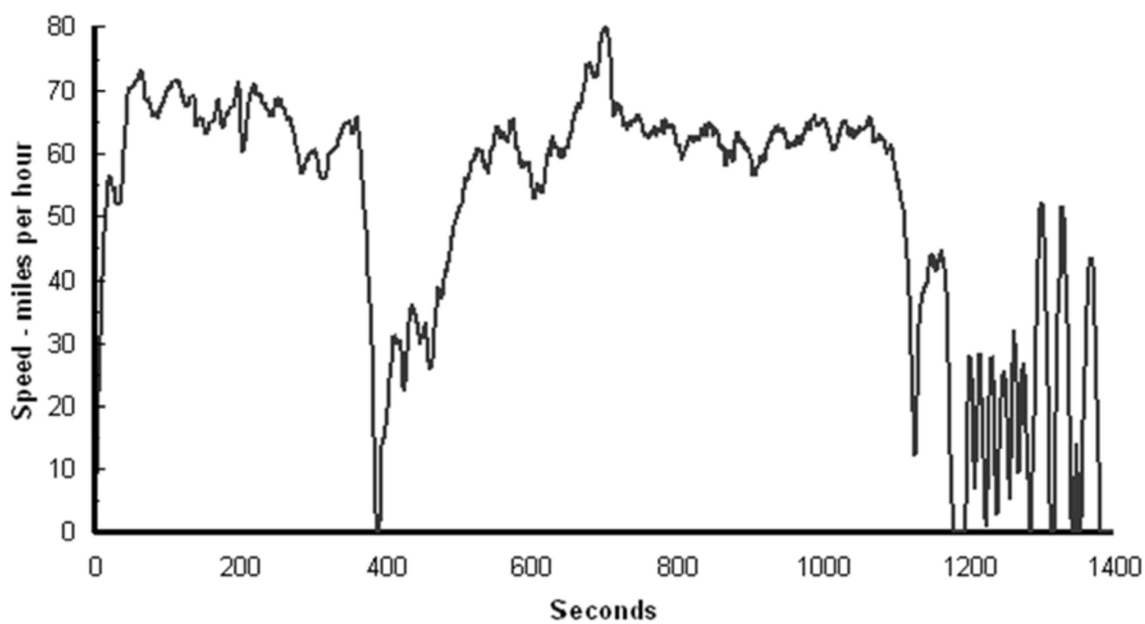


Figure 4.9. Representative Number Five Driving Cycle



Source:
Data obtained from Michael Wang, Argonne National Laboratory, Argonne, IL, 1997.

Researchers at Argonne National Laboratory have estimated the fuel economy of a midsize car using driving cycles from different countries. These results illustrate the difference in fuel economy which can be obtained from the same vehicle using different test cycles.

Table 4.29
Projected Fuel Economies from U.S., European, and Japanese Driving Cycles

Driving Cycle	Projected fuel economy for a 1995 composite midsize vehicle[a]
Japanese 10/15 mode test cycle	17.5 mpg
New European Driving Cycle (NEDC)	22.0 mpg
U.S. EPA city cycle (LA4)	19.8 mpg
U.S. EPA highway cycle	32.1 mpg
U.S. Corporate Average Fuel Economy cycle	23.9 mpg

Source:
Santini, D., A. Vyas, J. Anderson, and F. An, *Estimating Trade-Offs along the Path to the PNGV 3X Goal*, presented at the Transportation Research Board 80th Annual Meeting, Washington, DC, January 2001.

Note: China and India both use the European Driving Cycle, though India uses a modified version called the Modified Indian Driving Cycle which accounts for lower maximum speeds that better represent driving conditions in India.

[a] The 1995 composite midsize vehicle is an average of a Chevrolet Lumina, Chrysler Concord, and Ford Taurus. The fuel economies were projected using the National Renewable Energy Laboratory's Advanced Vehicle Simulator (ADVISOR) model.

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 United States uses the formula, 1/fuel economy = (0.55/city 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 4.30
Comparison of U.S., European, and Japanese Driving Cycles

	Time (seconds)	Percent of time stopped or decelerating	Distance (miles)	Average speed (mph)	Maximum speed (mph)	Maximum acceleration (mph/s)
Japanese 10/15 mode test cycle	631	52.3	2.6	14.8	43.5	1.8
New European Driving Cycle (NEDC)	1,181	24.9	6.84	20.9	74.6	2.4
U.S. EPA city cycle (LA4)[a]	1,372	43.2	7.5	19.5	56.7	3.3
U.S. EPA highway cycle	765	9.3	17.8	48.2	59.9	3.3
U.S. Corporate Average Fuel Economy cycle	2,137	27.9	10.3	29.9	59.9	3.3

Source:
Santini, D., A. Vyas, J. Anderson, and F. An, *Estimating Trade-Offs along the Path to the PNGV 3X Goal*, presented at the Transportation Research Board 80th Annual Meeting, Washington, DC, January 2001.

Note: China and India both use the European Driving Cycle, though India uses a modified version called The Modified Indian Driving Cycle which accounts for lower maximum speeds that better represent driving conditions in India.

[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.

Demand response vehicles (also called paratransit or dial-a-ride) are widely used by transit agencies. The vehicles do not operate over a fixed route or on a fixed schedule. The vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may even be interrupted en route to these destinations to pick up other passengers. Demand response service is provided primarily by vans. In 2007, the data changed substantially due to improved estimation methodologies. Unfortunately, those data are no longer comparable to the rest of the historical series.

Table 4.31
Summary Statistics on Demand Response Vehicles, 1994–2009[a]

Year	Number of agencies	Number of active vehicles	Vehicle-miles (millions)	Average miles per vehicle	Passenger-miles (millions)	Energy use (trillion Btu)
1994	5,214	28,729	463.7	16.14	577	9.5
1995	5,214	29,352	506.5	17.26	607	9.2
1996	5,214	30,804	548.3	17.80	656	9.9
1997	5,214	32,509	585.3	18.00	754	9.8
1998	5,214	29,646	670.9	22.63	735	10.4
1999	5,252	31,884	718.4	22.53	813	10.6
2000	5,252	33,080	758.9	22.94	839	10.8
2001	5,251	34,661	789.3	22.77	855	11.3
2002	5,251	34,699	802.6	23.13	853	11.6
2003	5,346	35,954	864.0	24.03	930	12.9
2004	5,960	37,078	889.5	23.99	962	13.3
2005	5,960	41,958	978.3	23.32	1,058	14.8
2006	5,960	43,509	1,013.0	23.28	1,078	15.5
2007[a]	7,300	64,865	1,471.4	22.68	1,502	24.7
2008	7,200	65,799	1,495.2	22.72	1,412	24.7
2009	6,700	68,947	1,529.2	22.18	1,477	23.1

Source:
American Public Transportation Association, *2011 Public Transportation Fact Book,* Washington, DC, April 2011. (Additional resources: www.apta.com)

Note: See Glossary for detailed definitions of demand response.

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[a] Data are not continuous between 2006 and 2007 due to changes in estimation methodology. See source document for details.

Chapter 5
Heavy Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 5.1	Heavy single-unit trucks, 2009	
	Registration (thousands)	*8,356*
	Vehicle miles (millions)	*120,163*
	Fuel economy (miles per gallon)	*7.4*
Table 5.2	Combination trucks, 2009	
	Registration (thousands)	*2,617*
	Vehicle miles (millions)	*167,842*
	Fuel economy (miles per gallon)	*6.0*
Tables 5.14	Freight Shipments, 2007 Commodity Flow Survey	
and 5.15	*Value (billion dollars)*	*11,685*
	Tons (millions)	*12,543*
	Ton-miles (billions)	*3,348*
Table 5.16	Transit buses in operation, 2009	*65,363*

Heavy 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. The data series was recently changed by the FHWA back to 2007.

Table 5.1
Summary Statistics for Heavy Single-Unit Trucks, 1970–2009

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
1976	4,350	36,390	5,706	6.4
1977	4,450	39,339	6,268	6.3
1978	4,518	42,747	6,955	6.1
1979	4,505	42,012	7,050	6.0
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	5,414	67,894	9,741	7.0
1999	5,763	70,304	9,372	7.5
2000	5,926	70,500	9,563	7.4
2001	5,704	72,448	9,667	7.5
2002	5,651	75,866	10,321	7.4
2003	5,849	77,757	8,881	8.8
2004	6,161	78,441	8,959	8.8
2005	6,395	78,496	9,501	8.3
2006	6,649	80,344	9,852	8.2
2007	8,117	119,979	16,314	7.3
2008	8,228	126,855	17,144	7.4
2009	8,356	120,163	16,342	7.4
		Average annual percentage change		
1970–2009	2.1%	3.9%	3.7%	0.2%
2000–2009	2.6%	2.0%	2.1%	0.0%

Source:
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011, Table VM1 and annual. (Additional resources: www.fhwa.dot.gov)

Note: Due to FHWA methodology changes, data from 2007-on are not comparable with previous data.

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. The data series was recently changed by the FHWA back to 2007.

Table 5.2
Summary Statistics for Combination Trucks, 1970–2009

Year	Registrations (thousands)	Vehicle travel[a] (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	1,831	128,159	21,100	6.1
1999	2,029	132,384	24,537	5.4
2000	2,097	135,020	25,666	5.3
2001	2,154	136,584	25,512	5.4
2002	2,277	138,737	26,480	5.2
2003	1,908	140,160	23,815	5.9
2004	2,010	142,370	24,191	5.9
2005	2,087	144,028	27,689	5.2
2006	2,170	142,169	28,107	5.1
2007	2,635	184,199	30,904	6.0
2008	2,585	183,826	30,561	6.0
2009	2,617	167,842	28,130	6.0
		Average annual percentage change		
1970–2009	2.8%	4.1%	3.5%	0.6%
2000–2009	0.9%	0.4%	-0.1%	-0.6%

Source:
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Washington, DC, 2011, Table VM1 and annual. (Additional resources: www.fhwa.dot.gov)

Note: Due to FHWA methodology changes, data from 2007-on are not comparable with previous data. A methodology change also occurred in 1993.

[a] The Federal Highway Administration changed the combination truck travel methodology in 1993.

Truck sales rose in 2010 for the first time since the sales peak in 2004. Trucks under 10,000 lbs. continue to dominate truck sales.

Table 5.3
New Retail Truck Sales by Gross Vehicle Weight, 1970–2010[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
1976	1,318	1,401	43	[c]	9	153	22	97	3,043
1977	1,306	1,803	36	3	5	163	28	141	3,485
1978	1,334	2,140	73	6	3	156	41	162	3,915
1979	1,271	1,574	15	3	3	146	50	174	3,236
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	107	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	179	7,226
1998	5,263	2,036	102	43	25	32	115	209	7,826
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
2001	6,073	2,525	102	52	24	42	92	140	9,050
2002	6,068	2,565	80	38	24	45	69	146	9,035
2003	6,267	2,671	91	40	29	51	67	142	9,357
2004	6,458	2,796	107	47	36	70	75	203	9,793
2005	6,586	2,528	167	49	46	60	89	253	9,777
2006	6,136	2,438	150	50	49	70	91	284	9,268
2007	5,682	2,623	166	51	45	54	70	151	8,842
2008	4,358	1,888	135	36	40	39	49	133	6,680
2009	3,528	1,306	112	20	24	22	39	95	5,145
2010	4,245	1,513	161	12	31	29	38	107	6,137
Average annual percentage change									
1970–1985	5.7%	7.9%	4.1%	-	-15.1%	-6.6%	6.8%	2.8%	5.5%
1986–2010	1.0%	0.9%	11.4%	8.5%[d]	7.1%	-1.8%	-4.0%	-0.2%	1.0%
2000–2010	-3.3%	-4.6%	3.2%	-12.8%	0.7%	-5.5%	-11.1%	-6.6%	-3.7%

Source:
Ward's Communication's, *Motor Vehicle Facts and Figures 2010*, Southfield, MI, 2010, p. 27, and annual; 2010: Ward's Communications, www.wardsauto.com. (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.
[d] 1987-2010.

The Census Bureau has discontinued the Vehicle Inventory and Use Survey; it was not conducted in 2007. The 2002 data remain the latest 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. In 1997, the survey was changed to the Vehicle Inventory and Use Survey due to future possibilities of including additional vehicle types. The 2002 VIUS, however, only includes trucks. Copies of the 2002 VIUS report or CD 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

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 2002 VIUS and registered in the United States as of July 1, 2002 was 85.2 million. These trucks were estimated to have been driven a total of 1,115 billion miles during 2002, an increase of 6.8% from 1997. The average annual miles traveled per truck was estimated at 13,100 miles.

In the 2002 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. In the tables presented here, the Gross Vehicle Weight Class was used.

Table 5.4
Truck Statistics by Gross Vehicle Weight Class, 2002

Manufacturer's gross vehicle weight class	Number of trucks	Percentage of trucks	Average annual miles per truck	Harmonic mean fuel economy	Percentage of fuel use
1) 6,000 lbs and less	51,941,389	61.0%	11,882	17.6	42.7%
2) 6,001 – 10,000 lbs	28,041,234	32.9%	12,684	14.3	30.5%
Light truck subtotal	79,982,623	93.9%	12,163	16.2	73.2%
3) 10,001 – 14,000 lbs	691,342	0.8%	14,094	10.5	1.1%
4) 14,001 – 16,000 lbs	290,980	0.3%	15,441	8.5	0.5%
5) 16,001 – 19,500 lbs	166,472	0.2%	11,645	7.9	0.3%
6) 19,501 – 26,000 lbs	1,709,574	2.0%	12,671	7.0	3.2%
Medium truck subtotal	2,858,368	3.4%	13,237	8.0	5.2%
7) 26,001 – 33,000 lbs	179,790	0.2%	30,708	6.4	0.9%
8) 33,001 lbs and up	2,153,996	2.5%	45,739	5.7	20.7%
Heavy truck subtotal	2,333,786	2.7%	44,581	5.8	21.6%
Total	85,174,776	100.0%	13,088	13.5	100.0%

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata File on CD, 2005. (Additional resources: www.census.gov/svsd/www.tiusview.html)

Table 5.5
Truck Harmonic Mean Fuel Economy by Size Class, 1992, 1997, and 2002
(miles per gallon)

Manufacturer's gross vehicle weight class	1992 TIUS	1997 VIUS	2002 VIUS
1) 6,000 lbs and less	17.2	17.1	17.6
2) 6,001–10,000 lbs	13.0	13.6	14.3
Light truck subtotal	15.7	15.8	16.2
3) 10,000–14,000 lbs	8.8	9.4	10.5
4) 14,001–16,000 lbs	8.8	9.3	8.5
5) 16,001–19,500 lbs	7.4	8.7	7.9
6) 19,501–26,000 lbs	6.9	7.3	7.0
Medium truck subtotal	7.3	8.6	8.0
7) 26,001–33,000 lbs	6.5	6.4	6.4
8) 33,001 lbs and over	5.5	5.7	5.7
Large truck subtotal	5.6	6.1	5.8

Sources:
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, and *2002 Vehicle Inventory and Use Survey*, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

Note: Based on 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. About sixty percent of heavy trucks travel over 50 miles from their home base and 36% of them refuel at central company-owned refueling stations.

Table 5.6
Truck Statistics by Size, 2002

	Manufacturer's gross vehicle weight class			
	Light (< 10,000 lbs)	Medium (10,001–26,000 lbs)	Heavy (> 26,000 lbs)	Total
	Range of operation			
Under 50 miles	69.2%	61.5%	40.7%	68.2%
51–100 miles	8.5%	11.7%	13.5%	8.7%
101–200 miles	2.4%	3.2%	6.7%	2.5%
201–500 miles	1.1%	1.8%	7.6%	1.3%
501 miles or more	1.4%	2.2%	10.4%	1.7%
Off-road	1.1%	3.5%	3.2%	1.2%
Vehicle not in use	2.2%	4.4%	3.2%	2.3%
Not reported	14.1%	11.7%	14.7%	14.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	Primary refueling facility			
Gas station	96.9%	62.4%	28.4%	93.9%
Truck stop	0.7%	7.7%	31.9%	1.8%
Own facility	2.0%	27.3%	36.2%	3.7%
Other nonpublic facility	0.3%	2.6%	3.5%	0.5%
Other	0.0%	0.0%	0.0%	0.0%
All	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata. File on CD, 2005. (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 5.7
Percentage of Trucks by Size Ranked by Major Use, 2002

Rank	Light (< 10,000 lbs average weight)	Medium (10,001 – 26,000 lbs average weight)	Heavy (> 26,000 lbs average weight)
1	**Personal** 81.5%	**Construction** 18.4%	**For hire** 30.1%
2	**Construction** 4.6%	**Agriculture** 16.2%	**Construction** 15.9%
3	**Other services**[a] 2.5%	**For hire** 9.6%	**Agriculture** 12.2%
4	**Not in use** 2.2%	**Retail** 7.1%	**Retail** 5.4%
5	**Agriculture** 1.9%	**Not in use** 6.4%	**Not in use** 5.1%
6	**Retail** 1.5%	**Leasing** 6.2%	**Waste management** 5.0%
7	**Unknown** 1.3%	**Wholesale** 5.5%	**Manufacturing** 4.9%
8	**Leasing** 0.7%	**Waste management** 5.4%	**Wholesale** 4.8%
9	**Manufacturing** 0.7%	**Utilities** 5.0%	**Leasing** 4.6%
10	**Utilities** 0.6%	**Personal** 4.8%	**Unknown** 3.2%
11	**Waste management** 0.6%	**Unknown** 4.4%	**Personal** 2.5%
12	**Wholesale** 0.6%	**Manufacturing** 3.3%	**Mining** 2.4%
13	**Information services** 0.4%	**Other services**[a] 3.2%	**Other services**[a] 1.3%
14	**For hire** 0.4%	**Food services** 1.6%	**Utilities** 1.1%
15	**Food services** 0.3%	**Information services** 1.3%	**Food services** 1.1%
16	**Arts** 0.2%	**Mining** 1.1%	**Arts** 0.3%
17	**Mining** 0.1%	**Arts** 0.5%	**Information services** 0.1%

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Micro data File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

[a] Business and personal services.

Nearly half of trucks in fleets of 11-20 and 21-50 vehicles use company-owned facilities. Most trucks in smaller fleets use public gas stations for fueling.

Table 5.8
Percentage of Trucks by Fleet Size and Primary Fueling Facility, 2002

Truck fleet size	Primary refueling facility				Total
	Gas station	Truck stop	Own facility	Other's facility	
1–5	73.8%	6.1%	18.2%	1.9%	100.0%
6–10	55.3%	5.7%	35.5%	3.4%	100.0%
11–20	41.1%	5.1%	48.9%	4.9%	100.0%
21–50	42.9%	3.7%	49.8%	3.6%	100.0%
51 or more	48.3%	6.3%	44.4%	1.0%	100.0%
Fleets of 6 or more vehicles	47.6%	5.2%	43.9%	3.4%	100.0%
No fleet	**96.4%**	**1.6%**	**1.7%**	**0.3%**	**100.0%**

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

Most trucks are fueled at gas stations but for-hire or warehousing trucks are more often fueled at truck stops. Mining trucks and vehicle leasing or rental trucks fuel at the companies' own facility more than 30% of the time.

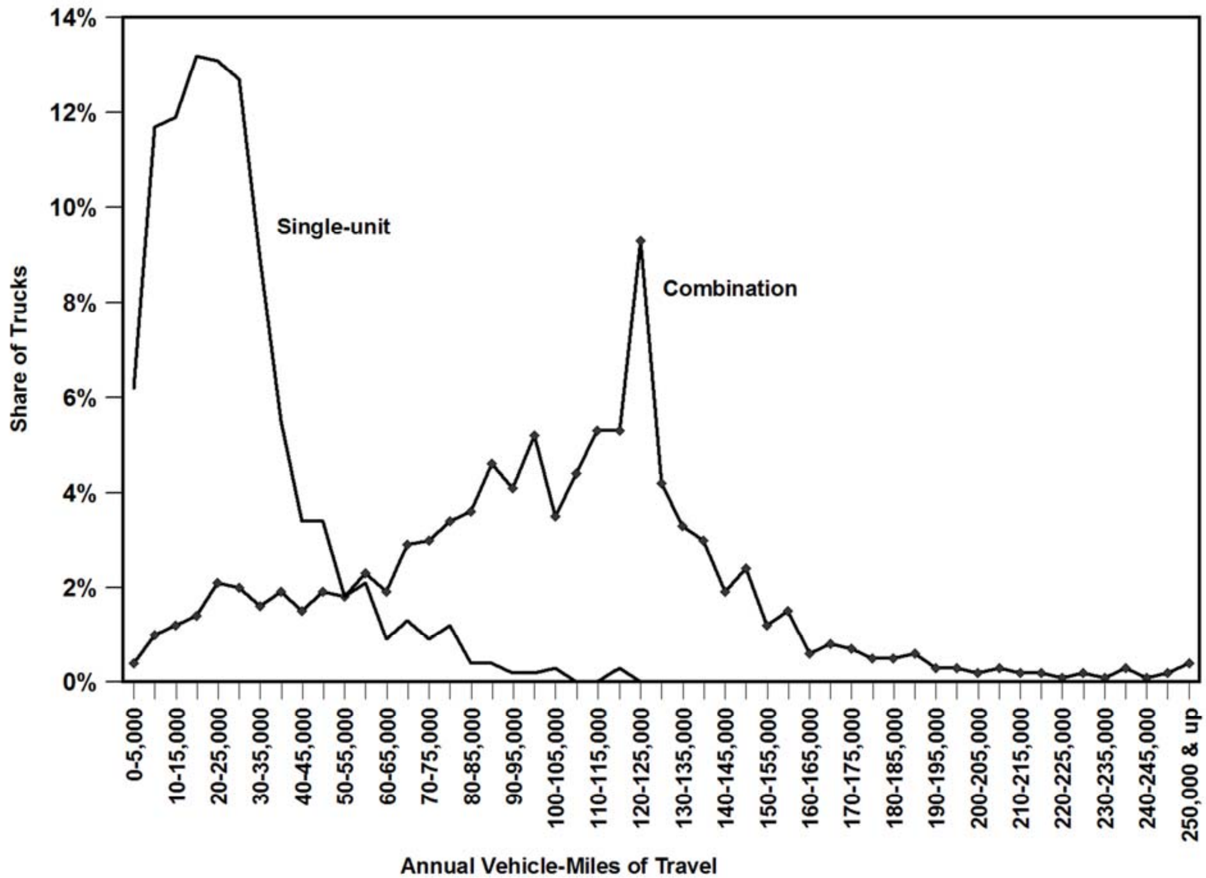
Table 5.9
Share of Trucks by Major Use and Primary Fueling Facility, 2002

Major use	Gas station	Truck stop	Own facility	Others facility	Other	All
Personal	98.6%	0.6%	0.7%	0.1%	0.1%	100.0%
Other services	96.0%	1.4%	1.6%	0.9%	0.1%	100.0%
All	93.9%	1.8%	3.7%	0.5%	0.0%	100.0%
Information services	92.3%	0.4%	7.2%	0.1%	0.0%	100.0%
Retail trade	86.6%	3.5%	8.6%	1.2%	0.0%	100.0%
Construction	84.7%	3.3%	9.8%	2.2%	0.0%	100.0%
Accommodation or food services	82.4%	7.5%	8.8%	1.3%	0.0%	100.0%
Manufacturing	81.5%	5.1%	11.9%	1.5%	0.0%	100.0%
Arts, entertainment, recreation services	81.1%	4.3%	14.2%	0.3%	0.0%	100.0%
Waste mgmt, landscaping, admin/support services	78.2%	3.0%	17.1%	1.6%	0.0%	100.0%
Wholesale trade	76.2%	6.6%	12.0%	5.1%	0.0%	100.0%
Utilities	72.6%	1.8%	24.3%	1.3%	0.0%	100.0%
Agriculture, forestry, fishing, hunting	62.7%	6.7%	29.4%	1.0%	0.1%	100.0%
Vehicle leasing or rental	60.2%	1.3%	31.8%	6.8%	0.0%	100.0%
Mining	48.7%	8.5%	34.3%	8.5%	0.0%	100.0%
For-hire or warehousing	33.3%	38.7%	25.8%	2.3%	0.0%	100.0%
Overall	**93.90%**	**1.80%**	**3.70%**	**0.50%**	**0%**	**100.00%**

Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and Use Survey*, Microdata File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

The figure below shows the distribution of annual travel the two types of Class 7 and 8 vehicles–combination units (separate tractor and trailer) and single units (tractor and trailer on a single chassis). This information is for vehicles two years old or less and comes from the 2002 VIUS. Combination trucks, dominated by box-type trailers, display the greatest amount of annual travel of all heavy vehicle types, as is evidenced both by the range of annual use which is up to 250,000 miles per year, and the peaking that occurs in the 100,000 to 140,000-mile segments. Most of the single-unit trucks in the survey travel 40,000 miles per year or less.

Figure 5.1. Distribution of Trucks over 26,000 lbs. Less than Two Years Old by Vehicle-Miles Traveled

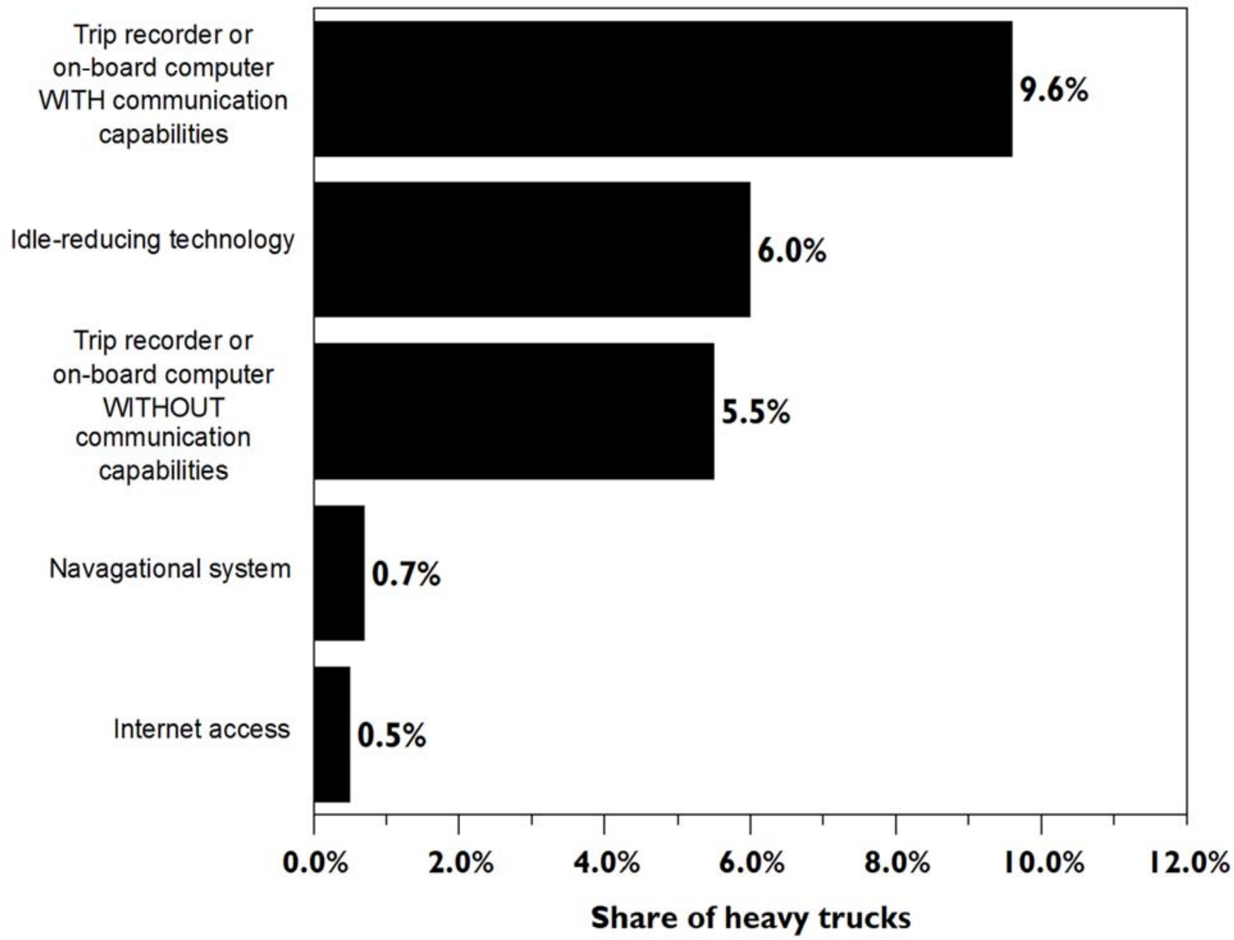


Source:
U.S. Department of Commerce, Bureau of the Census, 2002 Vehicle Inventory and Use Survey, Microdata File on CD, 2005. (Additional resources: www.census.gov/svsd/www/tiusview.html)

Note: Heavy trucks (class 7 & 8) are greater than 26,000 pounds gross vehicle weight based on the manufacturer's rating.

The latest Vehicle Inventory and Use Survey asked truck owners if the truck had certain features as permanent equipment on the truck. Some of the features asked about were onboard computers, idle-reduction devices, navigational systems, and Internet access. Of the 2.3 million heavy trucks (class 7 & 8) in the United States, nearly 10% were equipped with onboard computers that had communication capabilities and another 5% had onboard computers without communication capabilities. Six percent of heavy trucks were equipped with idle-reducing technology. Navigational systems and Internet access were available in less than one percent of heavy trucks.

Figure 5.2. Share of Heavy Trucks with Selected Electronic Features, 2002



Source:
U.S. Department of Commerce, Bureau of the Census, *2002 Vehicle Inventory and User Survey*, Microdata File on CD, 2005.

Note: Heavy trucks (class 7 & 8) are greater than 26,000 pounds gross vehicle weight based on the manufacturer's rating.

Fuel Economy Study for Class 8 Trucks

As part of a long-term study sponsored by the U.S. Department of Energy (DOE) Office of Vehicle Technologies (OVT), the Oak Ridge National Laboratory (ORNL) in conjunction with several industry partners has collected data and information related to heavy-truck operation in real-world highway environments. The primary objective of the project was to collect real-world performance and spatial data for long-haul operations of Class 8 tractor-trailers from a fleet engaged in normal freight operations. Six model year 2005 Class 8 trucks from the selected fleet, which operates within a large area of the country extending from the east coast to Mountain Time Zone and from Canada to the US-Mexican border, were instrumented and 60 channels of data were collected for over a year at a rate of 5 Hz (or 5 readings per second). Those channels included information such as instantaneous fuel rate, engine speed, gear ratio, vehicle speed, and other information read from the vehicle's databus; weather information (wind speed, precipitation, air temperature, etc.) gathered from an on-board weather station; spatial information (latitude, longitude, altitude) acquired from a GPS (Global Positioning System) device; and instantaneous tractor and trailer weight obtained from devices mounted on the six participating tractors and ten trailers. Three of the six instrumented tractors and five of the ten instrumented trailers were mounted with New Generation Single Wide-Based Tires and the others with regular dual tires. Over the duration of this phase of the project (just over a year) the six tractors traveled nearly 700,000 miles.

To find out more about this project, contact Oscar Franzese, franzeseo@ornl.gov, 865-946-1304. The final report on this project is available on-line at:
cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2008-122.pdf.

The type of terrain a truck is traveling on can cause significant differences in fuel efficiency. This study (see page 5–13 for project description) shows fuel economy on severe upslopes is less than half that on flat terrain. On severe downslopes, the fuel economy was three times higher than on flat terrain.

Table 5.10
Effect of Terrain on Class 8 Truck Fuel Economy

	Average Fuel Efficiency (mpg)				
Type of Terrain	Share of Data Records	All Trucks	Tractors with Dual Tires	Tractors with Single (wide) Tires	Difference between Dual and Single Tires (percent)
Severe upslope (>4%)	0.7%	2.90	2.86	2.94	2.91%
Mild upslope (1% to 4%)	13.2%	4.35	4.25	4.44	4.35%
Flat terrain (1% to 1%)	72.4%	7.33	7.08	7.58	7.13%
Mild downslope (-4% to -1%)	12.6%	15.11	14.64	15.57	6.36%
Severe downslope (<-4%)	1.1%	23.5	21.82	25.3	15.97%

Source:
Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascurain, and Pedro Otaduy. *Class-8 Heavy Truck Duty Cycle Project Final Report*, ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008.

Table 5.10 presents a distribution of distance traveled, fuel consumed, and fuel economy by speed and by type of tires for the vehicles participating in the project (see page 5-13 for project description). The speed bins are divided into 5-mile intervals, going from 0+ mph (i.e., speed > 0.00 mph) to 85 mph, while the four main columns of Table 5.10 are organized by the type of tires that were mounted on the tractor and trailers. The first row of the table contains information about fuel consumed while the vehicle was idling (i.e., the vehicle was static with the engine on) with the following rows presenting information about the distance traveled, fuel consumed, and fuel economy for each one of the speed intervals. The next-to-the-last row shows the totals for both traveled distances and fuel consumed as well as the overall fuel economy for each tire-combination category. The latter are then used to compute the percentage difference in terms of fuel economy from dual tire tractors and trailers, which is the most common tire setup for large trucks at the present time.

Table 5.11
Fuel Economy for Class 8 Trucks as Function of Speed and Tractor-Trailer Tire Combination

	Dual Tire Tractor – Dual Tire Trailer			Dual Tire Tractor – Single (Wide) Tire Trailer			Single (Wide) Tire Tractor – Dual Tire Trailer			Single (Wide) Tire Tractor - Single (Wide) Tire Trailer		
Speed (mph)	Distance Traveled (miles)	Fuel Cons. (gal)	Fuel Econ. (MPG)	Distance Traveled (miles)	Fuel Cons. (gal)	Fuel Econ. (MPG)	Distance Traveled (miles)	Fuel Cons. (gal)	Fuel Econ. (MPG)	Distance Traveled (miles)	Fuel Cons. (gal)	Fuel Econ. (MPG)
Idling	N/A	1,858.5	N/A	N/A	967.9	N/A	N/A	1,676.4	N/A	N/A	706.0	N/A
0+ to 5	281	101.8	2.76	148	50.4	2.93	368.0	124.2	3.0	156	52.8	2.96
5+ to 10	674	198.8	3.39	368	103.2	3.56	808.0	245.4	3.3	331	98.8	3.35
10+ to 15	723	192.0	3.77	396	98.3	4.03	848.0	216.5	3.9	343	87.0	3.95
15+ to 20	744	199.1	3.73	404	100.9	4.00	882.0	221.6	4.0	361	90.5	3.98
20+ to 25	938	228.4	4.11	489	113.6	4.31	1,111.0	244.2	4.6	462	101.1	4.57
25+ to 30	1,178	266.9	4.41	609	131.5	4.63	1,420.0	286.9	5.0	580	117.6	4.93
30+ to 35	1,481	336.8	4.40	753	154.2	4.88	1,774.0	341.1	5.2	708	141.1	5.02
35+ to 40	1,917	403.5	4.75	1,000	193.6	5.17	2,284.0	433.6	5.3	941	184.3	5.10
40+ to 45	2,955	584.1	5.06	1,543	285.9	5.40	3,380.0	603.6	5.6	1,350	254.4	5.31
45+ to 50	4,935	907.9	5.43	2,573	447.7	5.75	5,410.0	872.8	6.2	2,177	360.4	6.04
50+ to 55	9,397	1,629.8	5.77	4,962	811.5	6.11	10,046.0	1,622.7	6.2	3,877	625.5	6.20
55+ to 60	20,656	3,297.2	6.26	11,707	1,721.9	6.80	22,373.0	3,257.8	6.9	8,710	1,246.9	6.99
60+ to 65	38,964	5,879.6	6.63	21,472	2,980.8	7.20	34,517.0	4,840.0	7.1	14,944	2,049.4	7.29
NOT ADJUSTED FOR TERRAIN: See note below.												
65+ to 70	58,304	8,313.2	7.01	27,931	3,652.2	7.65	65,063.0	9,256.4	7.0	27,144	3,880.1	7.00
70+ to 75	56,378	7,483.2	7.53	21,751	2,745.5	7.92	66,882.0	8,435.6	7.9	32,887	4,056.1	8.11
75+ to 85	7,849	808.2	9.71	3,610	403.2	8.95	11,513.0	911.1	12.6	6,817	512.2	13.31
Total[a]	207,374	30,831.0	6.73	99,714	13,994.0	7.13	228,680.0	31,913.0	7.2	101,790	13,858.0	7.35
Percent increase in fuel economy from dual tire trac/trail			0.00%			5.93%			6.53%			9.20%

Source:
Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascurain, and Pedro Otaduy. *Class-8 Heavy Truck Duty Cycle Project Final Report*, ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008.

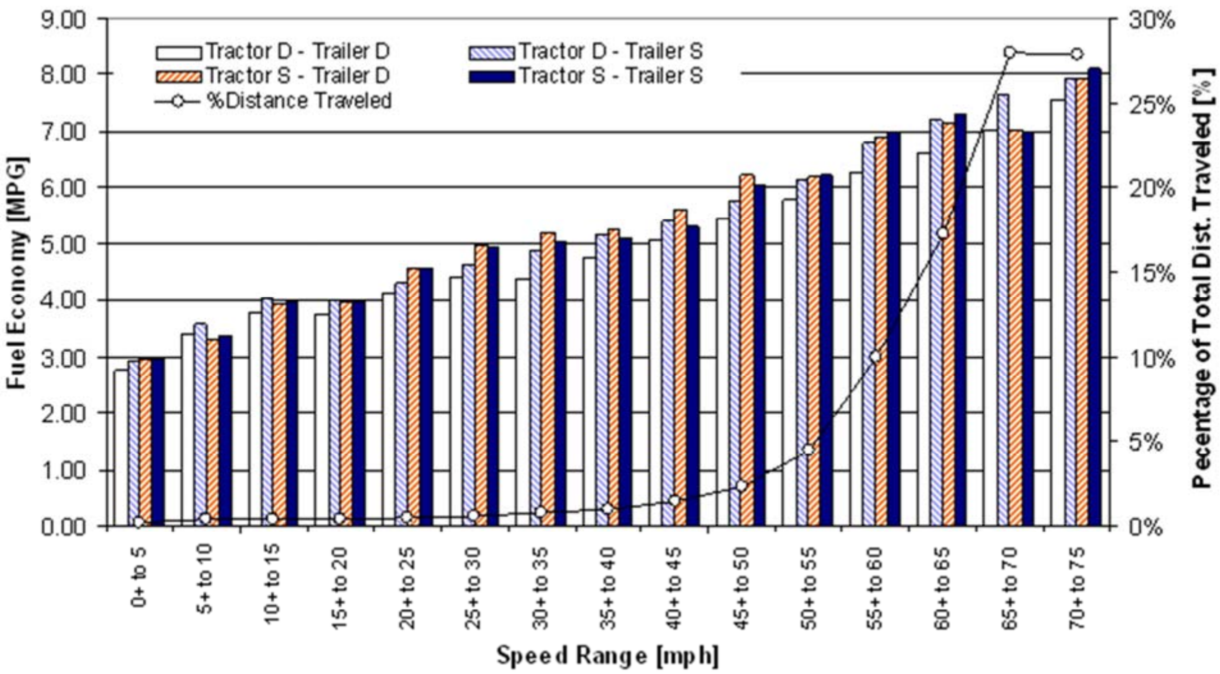
Note: These data were not adjusted to account for the effects of terrain. The increase in fuel economy for speeds above 70 mph is likely due to the vehicle achieving high speeds while traveling down slope. Therefore, this increase in fuel economy is not expected to be characteristic of all travel at these higher speeds.

[a] Total Fuel Consumed does not include fuel consumed while idling.

The fuel economy information presented in Table 5.10 is on the upper limits of today's large-truck fleets and is mostly a result of driver training and the extensive vehicle maintenance (including constant tire pressure) to which the fleet company participating in this project adheres. Nevertheless, the results of this extensive test indicate that there are substantial gains in terms of fuel economy for large trucks when single (wide) tires are used in combination with dual tires or alone (best case). Figure 5.3 shows the information from Table 5.10 in a graphical form (bars) and also displays for each speed bin the percentage of the total distance that is traveled at that speed (line). It is possible to observe that above 80% of the distance traveled by long-haul Class 8 trucks is done at speeds above 55 mph. Therefore, any gains in fuel economies at these speeds derived from a given tire combination would have a very large impact on the overall fuel economy of these types of trucks. Figure 5.3 shows that, except for the D-S combination within the 65+ to 70 mph, the combinations with all single (wide) tires perform better and, therefore, obtain the largest overall fuel economy.

Figure 5.3. Class 8 Truck Fuel Economy as a Function of Speed and Tractor-Trailer Tire Combination and Percentage of Total Distance Traveled as a Function of Speed

NOT ADJUSTED FOR TERRAIN: See note below.



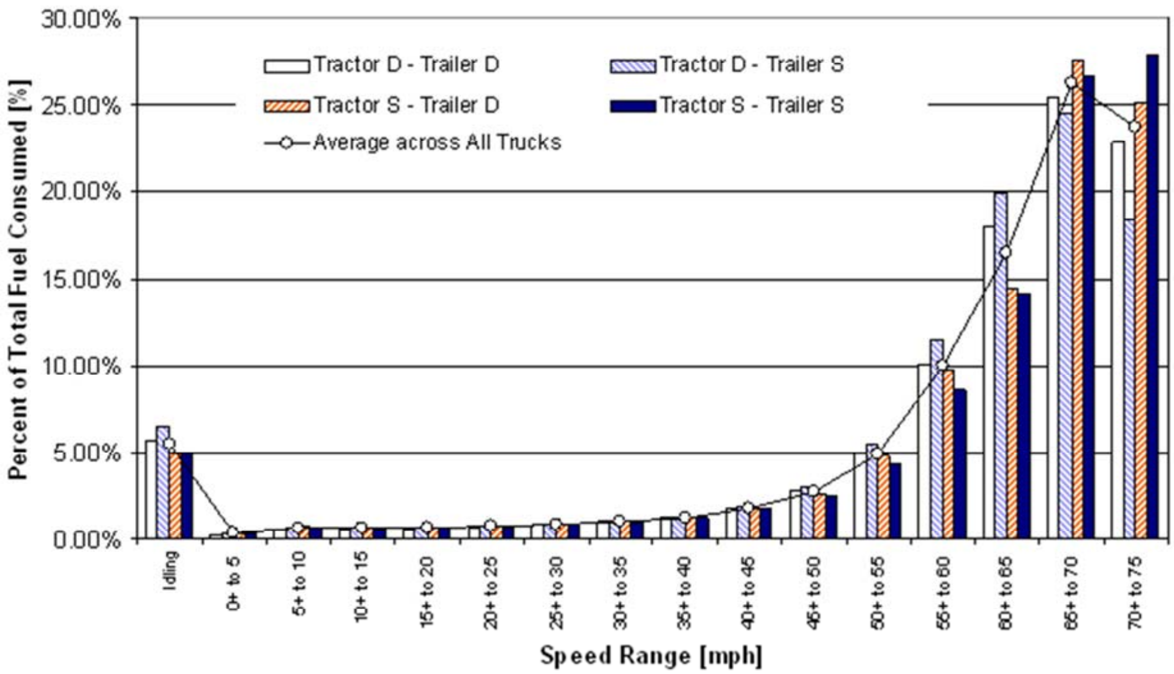
Source:
Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascurain, and Pedro Otaduy. *Class-8 Heavy Truck Duty Cycle Project Final Report*, ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008.

Note: D = Dual tire. S = Single (wide) tire.
These data were not adjusted to account for the effects of terrain. The increase in fuel economy for speeds above 70 mph is likely due to the vehicle achieving high speeds while traveling down slope. Therefore, this increase in fuel economy is not expected to be characteristic of all travel at these higher speeds.

This graph presents for each one of the four tire-combination categories the percent of total fuel that is consumed when traveling at different speeds (bars) as well as the average percent of fuel consumed for each speed bin (line). As opposed to Table 5.10, the total fuel consumed on this graph includes the fuel consumed while idling.

Figure 5.4. Class 8 Truck Percent of Total Fuel Consumed as a Function of Speed and Tractor-Trailer Tire Combination

NOT ADJUSTED FOR TERRAIN: See note below.



Source:
Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascurain, and Pedro Otaduy. *Class-8 Heavy Truck Duty Cycle Project Final Report*, ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008.

Note: D = Dual tire. S = Single (wide) tire.
These data were not adjusted to account for the effects of terrain. The increase in fuel economy for speeds above 70 mph is likely due to the vehicle achieving high speeds while traveling down slope. Therefore, this increase in fuel economy is not expected to be characteristic of all travel at these higher speeds.

A typical class 8 truck tractor weighs about 17,000 lbs. The powertrain is nearly a quarter of the weight (24%) while the truck body structure is 19%.

Table 5.12
Class 8 Truck Weight by Component

	Pounds	Share of Total
Wheels and tires	1,700	10%
Chassis/frame	2,040	12%
Drivetrain and suspension	2,890	17%
Misc. accessories/systems	3,060	18%
Truck body structure	3,230	19%
Powertrain	4,080	24%
Total	17,000	100%

Source:
National Academy of Sciences, *Technologies and Approaches to Reducing the Fuel Consumption of Medium and Heavy-Duty Vehicles*, prepublication copy, March 2010, p. 5-42.

Notes:
- Powertrain includes engine and cooling system, transmission and accessories.
- Truck body structure includes cab-in-white, sleeper unit, hood and fairings, interior and glass.
- Miscellaneous accessories/systems include batteries, fuel system, and exhaust hardware.
- Drivetrain and suspension includes drive axles, steer axle, and suspension system.
- Chassis/frame includes frame rails and crossmembers, fifth wheel and brackets. Wheels and tires include a set of 10 aluminum wheels, plus tires.

The gross weight of a vehicle (GVW) is the weight of the empty vehicle plus the weight of the maximum payload that the vehicle was designed to carry. In cars and small light trucks, the difference between the empty weight of the vehicle and the GVW is not significantly different (1,000 to 1,500 lbs). The largest trucks and tractor-trailers, however, have a payload capacity share of 200%, which means they can carry 200% of their empty weight. The medium-sized trucks (truck classes 3-6) have payload capacity shares between 50% and 100%.

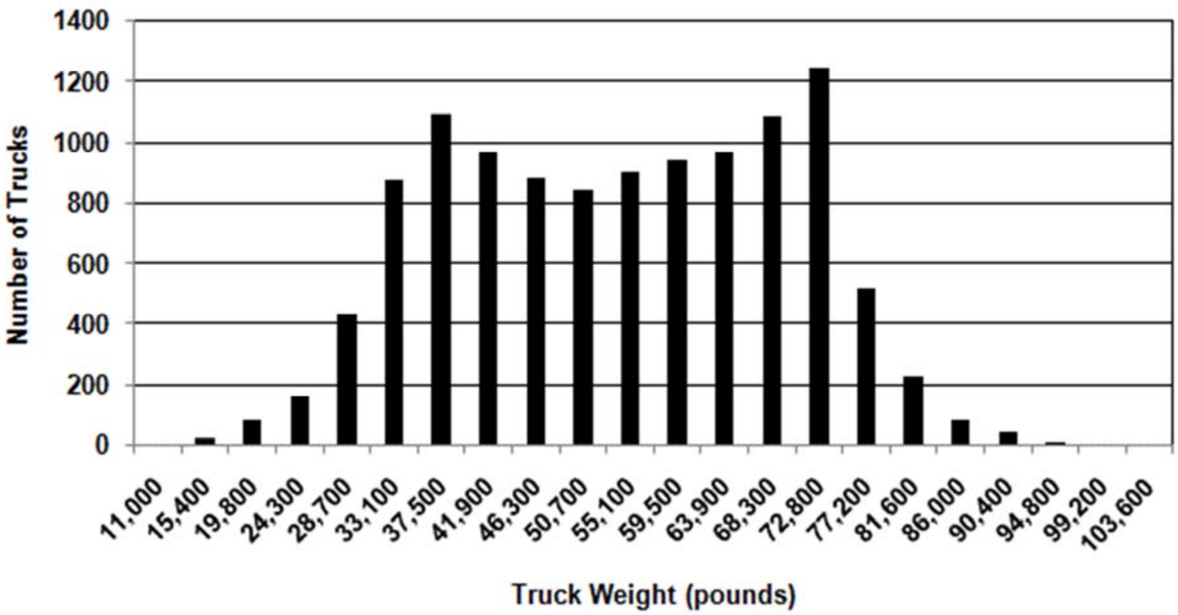
Table 5.13
Gross Vehicle Weight vs. Empty Vehicle Weight

Vehicle Description	Truck Class	Gross Vehicle Weight Range (pounds)	Empty Vehicle Weight Range (pounds)	Maximum Payload Capacity (pounds)	Payload Capacity Share (Percent of Empty Weight)
Cars		3,200-6,000	2,400-5,000	1,000	20%
Minivans, Small SUVs, Small Pick-Ups	1	4,000-2,400	3,200-4,500	1,500	33%
Large SUVs, Standard Pick-Ups	2a	6,001-8,500	4,500-6,000	2,500	40%
Large SUVs, Standard Pick-Ups	2b	8,501-10,000	5,000-6,300	3,700	60%
Utility Van, Multi- Purpose, Mini-Bus, Step Van	3	10,001-14,000	7,650-8,750	5,250	60%
City Delivery, Parcel Delivery, Large Walk-in, Bucket, Landscaping	4	14,001-16,000	7,650-8,750	7,250	80%
City Delivery, Parcel Delivery, Large Walk-in, Bucket	5	16,001-19,500	9,500-10,000	8,700	80%
City Delivery, School Bus, Large Walk-in, Bucket	6	19,501-26,000	11,500-14,500	11,500	80%
City Bus, Furniture, Refrigerated, Refuse, Fuel Tanker, Dump, Tow, Concrete, Fire Engine, Tractor-Trailer	7	26,001-33,000	11,500-14,500	18,500	125%
Refuse, Concrete, Furniture, City Bus, Tow, Fire Engine (straight trucks)	8a	33,001-80,000	20,000-26,000	54,000	200%
Tractor-Trailer: Van, Refrigerated, Bulk Tanker, Flat Bed (combination trucks)	8b	33,001-80,000	20,000-26,000	54,000	200%

Source:
National Academy of Sciences, *Technologies and Approaches to Reducing the Fuel Consumption of Medium and Heavy-Duty Vehicles*, prepublication copy, March 2010, pp. 2-2 and 5-42.

According to weigh-in-motion data collected by fifteen states, the majority of 5-axle tractor-trailers on the road weigh between 33,000 and 73,000 lbs. Eleven percent of the tractor-trailers had weight recorded around 72,800 lbs and 10% around 68,300 lbs. Another 10% of tractor-trailers were on the lighter end of the scale – around 37,500 lbs. These data show that only a small percent of trucks on the road are near the maximum roadway gross vehicle weight of 80,000 lbs. Thus, most trucks are filling the trailer space to capacity (cubing-out) before they reach the maximum weight limit (weighing-out).

Figure 5.5. Distribution of Five-Axle Tractor-Trailers by On-Road Vehicle Weight, 2008



Source:
National Academy of Sciences, *Technologies and Approaches to Reducing the Fuel Consumption of Medium and Heavy-Duty Vehicles*, prepublication copy, March 2010 , p. 5- 45. Ori ginal source: Federal Highway Administration, Vehicle Travel Information System, 2008.

Note: Data are from these 15 States: California, Connecticut, Florida, Georgia, Hawaii, Iowa, Minnesota, Missouri, Montana, North Carolina, Oregon, Pennsylvania, South Dakota, Texas, and Washington.

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, 1997, 2002, and 2007 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. The 2007 CFS covers business establishments with paid employees that are located in the United States and are classified using the North American Industry Classification System (NAICS) in mining, manufacturing, wholesale trade, and select retail trade industries, namely, electronic shopping and mail-order houses. Establishments classified in services, transportation, construction, and most retail industries are excluded from the survey. Farms, fisheries, foreign establishments, and most government-owned establishments are also excluded.[a]

The 1993, 1997, 2002, and 2007 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. Route distance for each mode for each shipment was imputed using methodologies developed by Oak Ridge National Laboratory. Distance, in turn, was used to compute ton-mileage by mode of transport.

The data can be viewed at: **www.bts.gov/publications/commodity_flow_survey.**

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[a] Bureau of Transportation Statistics and U.S. Bureau of the Census, 2007 Economic Census, *2007 Commodity Flow Survey*, December 2008.

Industries covered by the 2007 Commodity Flow Survey (CFS) shipped over 12 billion tons of goods worth over $11 trillion. Compared to the 1997 CFS, the value of shipments is up 1.3% per year and tons shipped are up 1.6% per year. By value, intermodal shipments increased 4.7% per year from 1997 to 2007.

Table 5.14
Growth of Freight in the United States: Comparison of the 1997, 2002 and 2007 Commodity Flow Surveys
(Detail may not add to total because of rounding)

	Value of goods shipped				Tons			
Mode of Transportation	1997 (billion 2007 dollars)	2002 (billion 2007 dollars)	2007 (billions)	Average annual percent change (1997-2007)	1997 (millions)	2002 (millions)	2007 (millions)	Average annual percent change
All modes	**8,970.5**	**9,678.0**	**11,684.9**	**2.7%**	**11,089.7**	**11,667.9**	**12,543.4**	**1.2%**
Single modes	**7,388.8**	**8,124.6**	**9,539.0**	**2.6%**	**10,436.5**	**11,086.7**	**11,698.1**	**1.1%**
Truck[a]	6,435.3	7,186.0	8,335.8	2.6%	7,700.7	7,842.8	8,778.7	1.3%
For-hire truck	3,748.0	4,330.2	4,955.7	2.8%	3,402.6	3,657.3	4,075.1	1.8%
Private truck	2,630.8	2,818.3	3,380.1	2.5%	4,137.3	4,149.7	4,703.6	1.3%
Rail	412.9	359.5	436.4	0.6%	1,549.8	1,873.9	1,861.3	1.8%
Water	97.9	102.9	114.9	1.6%	563.4	681.2	403.6	-3.3%
Shallow draft	69.6	66.3	91.0	2.7%	414.8	458.6	343.3	-1.9%
Great Lakes	1.9	0.9	[b]	[b]	38.4	38.0	17.8	-7.4%
Deep draft	26.4	35.7	23.1	-1.3%	110.2	184.6	42.5	-9.1%
Air (includes truck and air)	296.0	305.4	252.3	-1.6%	4.5	3.8	3.6	-2.2%
Pipeline[b]	146.6	172.0	399.6	10.5%	618.2	685.0	650.9	0.5%
Multiple modes	**1,221.9**	**1,243.8**	**1,866.7**	**4.3%**	**216.7**	**216.7**	**573.7**	**10.2%**
Parcel, U.S. Postal Service or courier	1,105.7	1,138.5	1,561.9	3.5%	23.7	25.5	33.9	3.6%
Truck and rail	97.8	80.6	187.2	6.7%	54.2	43.0	225.6	15.3%
Truck and water	10.6	16.6	58.4	18.6%	33.2	23.3	145.5	15.9%
Rail and water	2.3	3.8	13.9	19.7%	79.3	105.1	54.9	-3.6%
Other multiple modes	5.6	4.4	45.3	-8.0%	26.2	19.8	113.8	15.8%
Other and unknown modes	**359.9**	**309.6**	**279.1**	**-2.5%**	**436.5**	**364.6**	**271.6**	**-4.6%**

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics and U.S. Department of Commerce, Bureau of the Census, *2007 Commodity Flow Survey*, Table 1a. (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] Denotes data do n ot meet publication standards because of high sampling variability or poor res ponse quality.
[c] CFS data for pipeline exclude most shipments of crude oil.

Industries covered by the 2007 Commodity Flow Survey (CFS) accounted for 3.3 trillion ton-miles on the nation's highways, railways, waterways, pipelines, and aviation system. Ton-miles increased an average of 2.7% per year from 1997 to 2007.

Table 5.15
Growth of Freight Miles in the United States: Comparison of the 1997, 2002 and 2007 Commodity Flow Surveys
(Detail may not add to total because of rounding)

	Ton-miles				Average miles per shipment			
Mode of Transportation	1997 (billions)	2002 (billions)	2007 (billions)	Average annual percent change (1997-2007)	1997	2002	2007	Average annual percent change
All modes	**2,661.4**	**3,137.9**	**3,344.7**	**2.3%**	**472**	**546**	**619**	**2.7%**
Single modes	**2,383.5**	**2,867.9**	**2,894.3**	**2.0%**	**184**	**240**	**234**	**2.4%**
Truck[a]	1,023.5	1,255.9	1,342.1	2.7%	144	173	206	3.6%
For-hire truck	741.1	959.6	1,055.6	3.6%	485	523	599	2.1%
Private truck	268.6	291.1	286.5	0.6%	53	64	57	0.7%
Rail	1,022.5	1,261.6	1,344.0	2.8%	769	807	728	-0.5%
Water	261.7	282.7	157.3	-5.0%	482	568	520	0.8%
Shallow draft	189.3	211.5	117.5	-4.7%	177	450	144	-2.0%
Great Lakes	13.4	13.8	6.9	-6.4%	204	339	657	12.4%
Deep draft	59.0	57.4	33.0	-0.1%	1,024	664	923	-1.0%
Air (includes truck and air)	6.2	5.8	4.5	-3.2%	1,380	1,919	1,304	-0.6%
Pipeline[b]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
Multiple modes	**204.5**	**225.7**	**416.6**	**7.4%**	**813**	**895**	**975**	**1.8%**
Parcel, U.S. Postal Service or courier	18.0	19.0	28.0	4.5%	813	894	975	1.8%
Truck and rail	55.6	45.5	196.8	13.5%	1,347	1,413	1,007	-2.9%
Truck and water	34.8	32.4	98.4	11.0%	1,265	1,950	1,429	1.2%
Rail and water	77.6	115.0	47.1	-4.9%	1,092	957	1,928	5.8%
Other multiple modes	18.6	13.8	46.4	0.1%	[c]	[c]	1,182	[c]
Other and unknown modes	**73.4**	**44.2**	**33.8**	**-7.5%**	**122**	**130**	**116**	**-0.5%**

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics and U.S. Department of Commerce, Bureau of the Census, *2007 Commodity Flow Survey*, Table 1a. (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 exclude 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.

In 2007, the data changed substantially due to improved estimation methodologies. Unfortunately, those data are no longer comparable to the rest of the historical series.

Table 5.16
Summary Statistics on Transit Buses and Trolleybuses, 1994–2009

Year	Number of active buses	Vehicle-miles (millions)	Passenger-miles (millions)	Btu/passenger-mile	Energy use (trillion Btu)
1994	68,766	2,176	19,019	4,262	81.1
1995	67,802	2,198	19,005	4,307	81.9
1996	72,353	2,234	19,280	4,340	83.7
1997	73,425	2,259	19,793	4,434	87.8
1998	72,788	2,188	20,542	4,399	90.4
1999	74,885	2,290	21,391	4,344	92.9
2000	75,665	2,329	21,433	4,531	97.1
2001	76,675	2,389	22,209	4,146	92.1
2002	76,806	2,425	22,029	4,133	91.1
2003	78,000	2,435	21,438	4,213	90.3
2004	81,630	2,484	21,550	4,364	94.0
2005	82,642	2,498	21,998	4,250	93.5
2006	83,689	2,507	22,985	4,316	99.2
2007[a]	65,808	2,314	21,132	4,372	92.4
2008	67,096	2,388	21,918	4,348	95.3
2009	65,363	2,345	21,645	4,242	91.8

Source:
American Public Transportation Association, *2011 Public Transportation Fact Book*, Washington, DC, April 2011, Tables 6, 8, 9, and 15. (Additional resources: www.apta.com)

[a] Data are not continuous between 2006 and 2007 due to changes in estimation methodology. See source document for details.

Chapter 6
Alternative Fuel and Advanced Technology Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 6.1	Alternative fuel vehicles in use, 2009	826,315
	E85	*504,297*
	LPG	*147,030*
	CNG	*114,270*
	Electric	*57,185*
	LNG	*3,176*
	M85	*0*
Table 6.4	Number of alternative fuel refuel sites, 2011	7,183
	LPG	*2,589*
	CNG	*873*
	Electric	*687*
	Biodiesel	*610*
	Hydrogen	*58*

Fuel type abbreviations are used throughout this chapter.

B20	=	*20% biodiesel, 80% petroleum diesel*
CNG	=	*compressed natural gas*
E85	=	*85% ethanol, 15% gasoline*
E95	=	*95% ethanol, 5% gasoline*
H_2	=	*hydrogen*
LNG	=	*liquefied natural gas*
LPG	=	*liquefied petroleum gas*
M85	=	*85% methanol, 15% gasoline*
M100	=	*100% methanol*

Alternative Fuels

The Energy Policy Act of 1992 defines alternative fuels and allows the U.S. Department of Energy (DOE) to add to the list of alternative fuels if the fuel is substantially nonpetroleum, yields substantial energy security benefits, and offers substantial environmental benefits. DOE currently recognizes the following as alternative fuels:

- methanol, ethanol, and other alcohols,
- blends of 85% or more of alcohol with gasoline,
- natural gas and liquid fuels domestically produced from natural gas,
- liquefied petroleum gas (propane),
- coal-derived liquid fuels,
- hydrogen,
- electricity,
- biodiesel (BIOO),
- fuels (other than alcohol) derived from biological materials,
- P-series.

Alternative Fuels & Advanced Vehicles Data Center

DOE established the Alternative Fuels Data Center (AFDC) in 1991 to support its work aimed at fulfilling the Alternative Motor Fuels Act directives. Since then, the AFDC has expanded its focus to include all advanced transportation fuels, vehicles, and technologies. It has been renamed the Alternative Fuels & Advanced Vehicles Data Center to reflect this broader scope. 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.

Much of the AFDC data can be obtained through their Web site: **www.eere.energy.gov/afdc**. Several tables and graphs in this chapter contain statistics which were generated by the AFDC. Below are some links to specific areas of the AFDC Web site.

Alternative & Advanced Fuels - www.eere.energy.gov/afdc/fuels/index.html

Alternative Fueling Station Locator - www.eere.energy.gov/afdc/fuels/stations_locator.html

Alternative & Advanced Vehicles - www.eere.energy.gov/afdc/vehicles/index.html

Fleet Information - www.eere.energy.gov/afdc/fleets/index.html

State & Federal Incentives & Laws - www.eere.energy.gov/afdc/incentives_laws.html

Data Analysis & Trends - www.eere.energy.gov/afdc/data/index.html

There are over 826,000 alternative fuel vehicles in the United States, not including flex-fuel E85 vehicles which operate mainly on gasoline. The E85 vehicles in this table are those believed to be regularly fueled with E85.

Table 6.1
Estimates of Alternative Fuel Vehicles in Use[a], 1995–2009

Year	LPG	CNG	LNG	M85	M100	E85[b]	E95	Electricity[c]	Hydrogen	**Total**
1995	172,806	50,218	603	18,319	386	1,527	136	2,860	0	**246,855**
1996	175,585	60,144	663	20,265	172	4,536	361	3,280	0	**265,006**
1997	175,679	68,571	813	21,040	172	9,130	347	4,453	0	**280,205**
1998	177,183	78,782	1,172	19,648	200	12,788	14	5,243	0	**295,030**
1999	178,610	91,267	1,681	18,964	198	24,604	14	6,964	0	**322,302**
2000	181,994	100,750	2,090	10,426	0	87,570	4	11,830	0	**394,664**
2001	185,053	111,851	2,576	7,827	0	100,303	0	17,847	0	**425,457**
2002	187,680	120,839	2,708	5,873	0	120,951	0	33,047	0	**471,098**
2003	190,369	114,406	2,640	0	0	179,090	0	47,485	9	**533,999**
2004	182,864	118,532	2,717	0	0	211,800	0	49,536	43	**565,492**
2005	173,795	117,699	2,748	0	0	246,363	0	51,398	119	**592,122**
2006	164,846	116,131	2,798	0	0	297,099	0	53,526	159	**634,559**
2007	158,254	114,391	2,781	0	0	364,384	0	55,730	223	**695,763**
2008	151,049	113,973	3,101	0	0	450,327	0	56,901	313	**775,664**
2009	147,030	114,270	3,176	0	0	504,297	0	57,185	357	**826,315**
				Average annual percentage change						
1995-2009	-1.1%	6.0%	12.6%	-100.0%	-100.0%	51.3%	-100.0%	23.9%		**9.0%**

Source:

U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels*, 2009, Washington, DC, May 2011, Table VI. 1995-2006, *Annual Energy Review*, Table 10.4. Estimated Number of Alternative-Fueled Vehicles in Use and Replacement Fuel Consumption. (Additional resources: www.eia.doe.gov/emeu/aer/renew.html and www.eere.energy.gov/afdc/data/vehicles.html)

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[a] Vehicles in Use represent accumulated acquisitions, less retirements, as of the end of each calendar year. They do not include concept and demonstration vehicles.

[b] Includes only those E85 vehicles believed to be used as alternative-fuels vehicles (AFVs), primarily fleet-operated vehicles; excludes other vehicles with E85-fueling capability. In 1997, some vehicle manufacturers began including E85-fueling capability in certain model lines of vehicles. For 2007, the Energy Information Administration (EIA) estimates that the number of E85 vehicles that are capable of operating on E85, motor gasoline, or both, is about 7.1 million. Many of these AFVs are sold and used as traditional gasoline-powered vehicles.

[c] Excludes HEVs.

Trollybus, heavy rail, and light rail use nearly all alternative fuels. However, the 33.5% of buses using alternative fuels replace a lot of traditional fuel use. Rail transit vehicles have the highest average age.

Table 6.2
Alternative Fuel Transit Vehicles, 2009

Mode	Average Age	Percent Powered by Alternative Fuels	Number Of Vehicles
Bus	7.5	33.5%	64,832
Commuter Rail	20.5	11.3%	6,941
Ferry Boat	17.8	47.6%	194
Heavy Rail	21.9	100.0%	11,461
Light Rail	15.8	98.3%	2,068
Paratransit	3.5	8.0%	68,957
Trolleybus	8.9	100.0%	531
Vanpool	4.0	2.8%	12,013

Source:
American Public Transportation Association, *2011 Public Transportation Fact Book*, Washington, DC, April 2011, Tables 9 and 10, and historical tables 51 and 52. (Additional resources: www.apta.com)

Note: See Glossary for definition of modes, such as paratransit and vanpool.

Table 6.3
Alternative Fuel Vehicles Available by Manufacturer, Model Year 2011

Model	Fuel	Type	Emission Class
Bentley: 1-800-777-6923; www.bentleymotors.com			
Continental Supersports	E85 flex fuel	Two-seater	Tier 2 Bin 5
Continental GTC	E85 flex fuel	Sedan	Tier 2 Bin 5
Continental Flying Spur	E85 flex fuel	Sedan	Tier 2 Bin 5
Chrysler: 1-800-999-FLEET; www.fleet.chrysler.com			
Chrysler 200	E85 flex fuel	Sedan	N/A
Chrysler 300	E85 flex fuel	Sedan	N/A
Chrysler Town & Country	E85 flex fuel	Minivan	Tier 2 Bin 4
Dodge Avenger	E85 flex fuel	Sedan	N/A
Dodge Charger	E85 flex fuel	Sedan	N/A
Dodge Grand Caravan FWD	E85 flex fuel	Minivan	Tier 2 Bin 4
Dodge Dakota 2WD, 4WD	E85 flex fuel	Pickup	Tier 2 Bin 4
Dodge Durango	E85 flex fuel	SUV	N/A
Dodge Journey	E85 flex fuel	SUV	N/A
Dodge Ram 1500 2WD, 4WD	E85 flex fuel	Pickup	Tier 2 Bin 4
Jeep Grand Cherokee 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Ford: 1-800-34-FLEET; www.fleet.ford.com; www.fordvehicles.com			
Ford E350 FFV 2WD	E85 flex fuel	Van	Tier 2 Bin 8
Ford Escape 4WD	E85 flex fuel	SUV	Tier 2 Bin 4
Ford F250 FFV 4WD	E85 flex fuel	Pickup	Tier 2 Bin 8
Ford Fusion 2WD	E85 flex fuel	Sedan	Tier 2 Bin 5
Crown Victoria Police	E85 flex fuel	Sedan	Tier 2 Bin 4
Lincoln Town Car	E85 flex fuel	Sedan	Tier 2 Bin 4
Mercury Grand Marquis	E85 flex fuel	Sedan	Tier 2 Bin 4
Mercury Mariner FWD	E85 flex fuel	SUV	Tier 2 Bin 4
Mercury Milan AWD	E85 flex fuel	Sedan	Tier 2 Bin 5
Ford E-Series E150 Van	E85 flex fuel	Van	Tier 2 Bin 8
Ford Expedition	E85 flex fuel	SUV	Tier 2 Bin 5
Ford F-150	E85 flex fuel	Pickup	Tier 2 Bin 5
Lincoln Navigator 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
General Motors Corporation: 1-888-GM-AFT-4U; www.gm.com/vehicles			
Buick Lucerne CXL	E85 flex fuel	Sedan	Tier 2 Bin 4
Buick Regal CXL Turbo	E85 flex fuel	Sedan	Tier 2 Bin 4
Cadillac Escalade AWD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Chevrolet Avalanche 1500 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Chevrolet Equinox AWD	E85 flex fuel	SUV	N/A
Chevrolet Express	E85 flex fuel	Van	Tier 2 Bin 5
Chevrolet Express 2500 2WD	E85 flex fuel	Van	Tier 2 Bin 5
Chevrolet Express 3500 2WD	E85 flex fuel	Van	Tier 2 Bin 5
Chevrolet HHR	E85 flex fuel	SUV	Tier 2 Bin 4
Chevrolet Impala	E85 flex fuel	Sedan	Tier 2 Bin 4
Chevrolet Malibu LS	E85 flex fuel	Sedan	Tier 2 Bin 4
Chevrolet Silverado C15 2WD, 4WD	E85 flex fuel	Pickup	Tier 2 Bin 5
Chevrolet Suburban 1500 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Chevrolet Tahoe 1500 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
GMC Sierra C15 4WD	E85 flex fuel	Pickup	Tier 2 Bin 5
GMC Savana	E85 flex fuel	Van	Tier 2 Bin 5
GMC Savana 2500 2WD	E85 flex fuel	Van	Tier 2 Bin 5
GMC Terrain SLE-2 AWD	E85 flex fuel	SUV	Tier 2 Bin 4
GMC Yukon 1500 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Honda: 1-888-CC-HONDA; www.honda.com			
Civic GX	CNG Dedicated	Sedan	AT-PZEV, Tier 2 Bin 2
FCX	Hydrogen fuel cell	Sedan	ZEV, Tier 2 Bin 1
Mazda: 1-800-866-1998; www.mazdausa.com			
Tribute 2WD FFV	E85 flex fuel	SUV	Tier 2 Bin 4

Continued on next page.

Table 6.3 (continued)
Alternative Fuel Vehicles Available by Manufacturer, Model Year 2011

Mercedes-Benz USA: 1-800-FOR-MERCEDES; www.mbusa.com			
C300 Sport	E85 flex fuel	Sedan	LEV II, LEV, Tier 2 Bin 5
Nissan: 1-800-NISSAN-1; www.nissanusa.com			
Armada 4WD	E85 flex fuel	SUV	LEV II, LEV, Tier 2 Bin 5
Leaf	Electric	Sedan	ZEV, Tier 2 Bin 1
Titan	E85 flex fuel	Pickup	LEV II, LEV, Tier 2 Bin 5
Tesla Motors: 1-650-681-5000; www.teslamotors.com			
Roadster 2.5	Electric	Two-seater	ZEV, Tier 2 Bin 1
Toyota: 1-800-331-4331; www.toyota.com			
Sequoia 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Tundra 4WD	E85 flex fuel	Pickup	Tier 2 Bin 5

Source:
U.S. Department of Energy, National Alternative Fuels Data Center, Web site, ww.afdc.energy.gov/afdc/vehicles/index.html, February 2011. (Additional resources: ww.eere.energy.gov/afdc/vehicles/index.html)

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. See Chapter 12 for details on emissions.

Table 6.4
Hybrid Electric Vehicles Available by Manufacturer, Model Year 2011

Model	Battery Type[a]	Type	Emission Class
BMW: 1-800-831-1117; www.bmwusa.com			
ActiveHybrid 7	126V Li-ion	Sedan	Tier 2 Bin 5
ActiveHybrid 7L	126V Li-ion	Sedan	Tier 2 Bin 5
ActiveHybrid X6	NiMH	SUV	Tier 2 Bin 5
Ford: 1-800-34-FLEET; www.fleet.ford.com; www.fordvehicles.com			
Ford Escape Hybrid	NiMH	SUV	LEVII, SULEV, Tier 2 Bin 3
Ford Fusion Hybrid	NiMH	Sedan	PZEV, Tier 2 Bin 3
Lincoln MKZ FWD	NiMH	Sedan	LEVII, SULEV, Tier 2 Bin 3
Mercury Mariner Hybrid	NiMH	SUV	LEVII, SULEV, Tier 2 Bin 3
Mercury Milan FWD Hybrid	NiMH	Sedan	LEVII, SULEV, Tier 2 Bin 3
General Motors: 1-888-GM-AFT-4U; www.gm.com/vehicles			
Cadillac Escalade Hybrid 2WD, 4WD	NiMH	SUV	Tier 2 Bin 5
Chevrolet Silverado 1500 Hybrid 2WD, 4WD	NiMH	Pickup	Tier 2 Bin 5
Chevrolet Tahoe 1500 Hybrid 2WD, 4WD	NiMH	SUV	Tier 2 Bin 5
Chevrolet Volt	Extended Range PHEV	Sedan	ULEV
GMC Sierra 15 Hybrid	NiMH	Pickup	Tier 2 Bin 5
GMC Yukon 1500 Hybrid 2WD, 4WD	NiMH	SUV	Tier 2 Bin 5
Honda: 1-888-CC-HONDA: www.honda.com			
Civic Hybrid	NiMH	Sedan	PZEV, Tier 2 Bin 2
CR-Z	NiMH	Two-seater	AT-PZEV
Insight LX	NiMH	Sedan	Tier 2 Bin 3
Hyundai: 1-800-633-5151; www.hyundaiusa.com			
Sonata	Li-Polymer	Sedan	N/A
Lexus: 1-800-255-3987; www.lexus.com			
Lexus CT 200h	HEV	Sedan	N/A
Lexus GS 450h RWD	HEV	Sedan	LEVII, SULEV, Tier 2 Bin 3
Lexus HS 250h	HEV	Sedan	LEVII, SULEV, Tier 2 Bin 3
Lexus LS 600h L	HEV	Sedan	N/A
Lexus RX 450h 2WD	HEV	SUV	LEVII, SULEV, Tier 2 Bin 3
Mercedes-Benz USA: 1-800-FOR-MERCEDES; www.mbusa.com			
ML450 4Matic Hybrid	HEV	Sedan	LEVII, SULEV, Tier 2 Bin 4
S400 Hybrid	HEV	Sedan	LEVII, SULEV, Tier 2 Bin 4
Nissan: 1-800-NISSAN-1; www.nissanusa.com			
Altima Hybrid	NiMH	Sedan	PZEV, Tier 2 Bin 3
Toyota: 1-800-331-4331; www.toyota.com			
Camry Hybrid	NiMH	Sedan	LEVII, SULEV, Tier 2 Bin 3
Highlander Hybrid	NiMH	SUV	LEVII, SULEV, Tier 2 Bin 3
Prius Hybrid	NiMH	Sedan	AT-PZEV, Tier 2 Bin 3
Volkswagen: 1-800-DRIVE VW; www.volkswagen.com			
Touareg Hybrid	NiMH	SUV	N/A

Source:
U.S. Department of Energy, National Alternative Fuels Data Center, Web site, www.afdc.energy.gov/afdc/vehicles/index.html, February 2011 (Additional resources: www.eere.energy.gov/afdc/progs_vehicles_search.php)

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; AT-PZEV = avanced technology - partial zero emissions vehicle. See Chapter 12 for details on emissions.

[a] NiMH = Nickel-Metal Hydride; PbA = Lead-Acid; Mild hybrid = A vehicle that shuts down the engine when coasting, breaking or stopped while continuing to power accessories. There is however, no electric drivetrain like that found on a full hybrid vehicle.

This list includes public and private refuel sites; therefore, not all of these sites are available to the public.

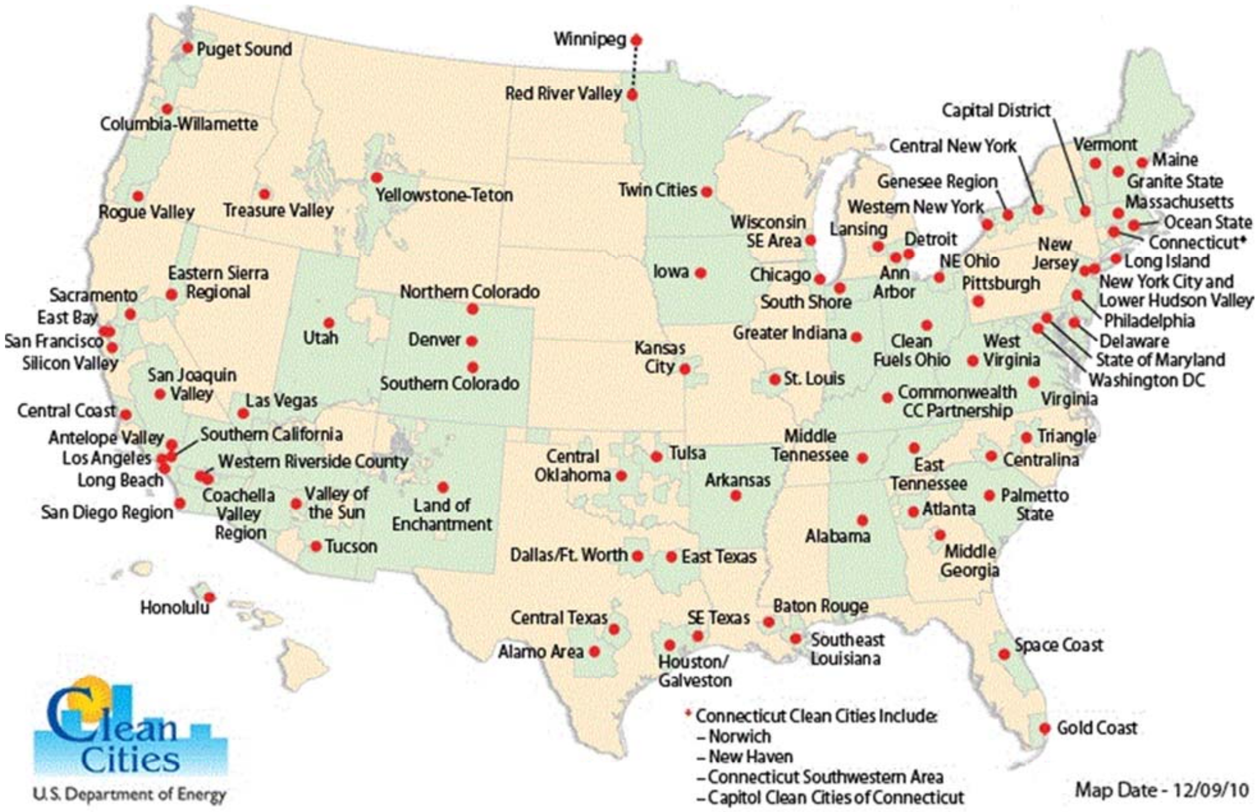
Table 6.5
Number of Alternative Refuel Sites by State and Fuel Type, 2011

State	CNG sites	E85 site	LPG sites	Electric sites	Biodiesel sites	Hydrogen sites	LNG sites	LPG sites	Total
Alabama	4	17	128	0	4	0	1	128	154
Alaska	2	0 8		0	1	0	0	8	11
Arizona	33	31	61	4	14	1	2	61	146
Arkansas	4	14	51	1	6	0	0	51	76
California	215	56	228	433	34	22	32	228	1,020
Colorado	25	84	50	5	14	1	0	50	179
Connecticut	14	0	16	8	3	2	1	16	44
Delaware	1	1 3		0	3	0	0	3	8
Dist. of Columbia	2	3	0	1	2	1	0	0	9
Florida	14	42	75	8	15	0	0	75	154
Georgia	19	48	47	3	25	0	0	47	142
Hawaii	0	1 3		6	5	1	0	3	16
Idaho	7	7	29	5	7	0	0	29	55
Illinois	23	209	72	20	6	1	0	72	331
Indiana	10	139	47	0	6	0	0	47	202
Iowa	0	148	20	6	3	0	0	20	177
Kansas	2	38	37	0	6	0	0	37	83
Kentucky	0	24	44	0	2	0	0	44	70
Louisiana	7	5	17	0	1	0	0	17	30
Maine	1	0 4		0	3	0	0	4	8
Maryland	6	19	22	2	9	0	0	22	58
Massachusetts	22	3	21	3	6	1	0	21	56
Michigan	15	107	65	19	13	5	0	65	224
Minnesota	1	364	33	3	0	0	0	33	401
Mississippi	2	4	40	0	4	0	0	40	50
Missouri	9	102	66	3	2	1	0	66	183
Montana	3	2	53	0	6	0	0	53	64
Nebraska	1	60	17	0	3	0	0	17	81
Nevada	11	26	43	1	6	2	0	43	89
New Hampshire	3	0 7		4	11	0	0	7	25
New Jersey	20	5	10	5	4	0	0	10	44
New Mexico	10	11	53	0	6	0	0	53	80
New York	100	75	31	10	16	10	0	31	242
North Carolina	16	20	72	6	142	0	0	72	256
North Dakota	2	58	24	0	3	1	0	24	88
Ohio	10	69	67	2	23	1	0	67	172
Oklahoma	59	14	58	0	5	0	0	58	136
Oregon	5	7	30	38	23	0	0	30	103
Pennsylvania	24	36	70	1	7	2	0	70	140
Rhode Island	5	0 5		1	2	0	0	5	13
South Carolina	5	104	26	7	30	2	0	26	174
South Dakota	0	104	18	0	2	0	0	18	124
Tennessee	6	37	76	1	48	0	0	76	168
Texas	32	54	519	31	16	1	4	519	657
Utah	71	5	30	2	2	0	0	30	110
Vermont	2	0 6		2	2	1	0	6	13
Virginia	11	12	37	4	16	1	0	37	81
Washington	15	15	67	35	28	0	0	67	160
West Virginia	1	3 8		1	1	1	0	8	15
Wisconsin	16	137	50	6	0	0	0	50	209
Wyoming	7	6	25	0	14	0	0	25	52
Totals by Fuel:	873	2,326	2,589	687	610	58	40	2,589	7,183

Source:
U.S. Department of Energy, Alternative Fuels Data Center Web site, www.eere.energy.gov/afdc/fuels/stations_counts.html, February 2011.

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.

Figure 6.1. Clean Cities Coalitions



Source:
U.S. Department of Energy, Alternative Fuel Data Center, February 2011. (A dditional resources: www.eere.energy.gov/cleancities/progs/coalition_locations.php)

Vehicle Technologies Program

www.eere.energy.gov/vehiclesandfuels

The Vehicle Technologies Program is administered by the Department of Energy's Office of Energy Efficiency and Renewable Energy. The mission of this program is to develop more energy efficient and environmentally friendly highway transportation technologies that enable America to use less petroleum. The long-term aim is to develop "leap frog" technologies that will provide Americans with greater freedom of mobility and energy security, with lower costs and lower impacts on the environment. For additional information about the Vehicle Technologies Program, visit the Web site listed above.

Hydrogen Analysis Resource Center

hydrogen.pnl.gov/

The Hydrogen Analysis Resource Center was developed to provide reliable data and information for hydrogen-related analytical activities. The Center's Web site includes:

- Hydrogen Data Book - contains a wide range of factual information on hydrogen and fuel cells. hydrogen.pnl.gov/cocoon/morf/hydrogen/article/103.
- Hydrogen Glossary – contains acronyms and terms used commonly in the Hydrogen Analysis Resource Center.
- Related Sites - provides links to other sites with data relevant to hydrogen and fuel cell analysis.
- Guidelines and Assumptions for DOE Hydrogen Program Analysis - contains guidelines for conducting analysis (under development) and assumptions.
- Calculator Tools - provides tools to perform conversions of hydrogen and other calculations relevant to hydrogen and fuel cells.
- Analysis Tools - provides links to models and other tools relevant to hydrogen and fuel cells, such as H2A, GREET, PSAT, VISION, MOVES, and other transportation and energy models.

Table 6.6
Properties of Conventional and Alternative Fuels

Property	Gasoline	No. 2 diesel	Methanol	Ethanol
Chemical formula	C_4 to C_{12}	C_8 to C_{25}	CH_3OH	C_2H_5OH
Physical state	Liquid	Liquid	Liquid	Liquid
Molecular weight	100–105	~200	32.04	46.07
Composition (weight %)				
Carbon	85–88	87	37.5	52.2
Hydrogen	12–15	13	12.6	13.1
Oxygen	0	0	49.9	34.7
Main fuel source(s)	Crude oil	Crude oil	Natural gas, coal, or woody biomass	Corn, grains, or agricultural waste
Specific gravity (60° F/ 60° F)	0.72–0.78	0.85	0.796	0.794
Density (lb/gal @ 60° F)	6.0–6.5	7.079	6.63	6.61
Boiling temperature (F°)	80–437	356–644	149	172
Freezing point (F°)	-40	-40–30	-143.5	-173.2
Autoiginition temperature (F°)	495	~600	867	793
Reid vapor pressure (psi)	8–15	<0.2	4.6	2.3

Property	Propane	CNG	Hydrogen
Chemical formula	C_3H_8	CH_4	H_2
Physical state	Compressed gas	Compressed gas	Compressed gas or liquid
Molecular weight	44.1	16.04	2.02
Composition (weight %)			
Carbon	82	75	0
Hydrogen	18	25	100
Oxygen	n/a	n/a	0
Main fuel source	Underground reserves	Underground reserves	Natural gas, methanol, and other energy sources
Specific gravity (60° F/ 60° F)	0.508	0.424	0.07
Density (lb/gal @ 60° F)	4.22	1.07	n/a
Boiling temperature (F°)	-44	-263.2 to -126.4	-423
Freezing point (F°)	-305.8	-296	-435
Autoiginition temperature (F°)	842	900-1,170	932
Reid vapor pressure (psi)	208	2,400	n/a

Source:
Alternative Fuels Data Center, “Properties of Fuel,” www.eere.energy.gov/afdc/pdfs/fueltable.pdf and “Fuel Comparison,” www.eere.energy.gov/afdc/fuels/properties.html, February 2011.

Note: n/a = not applicable.

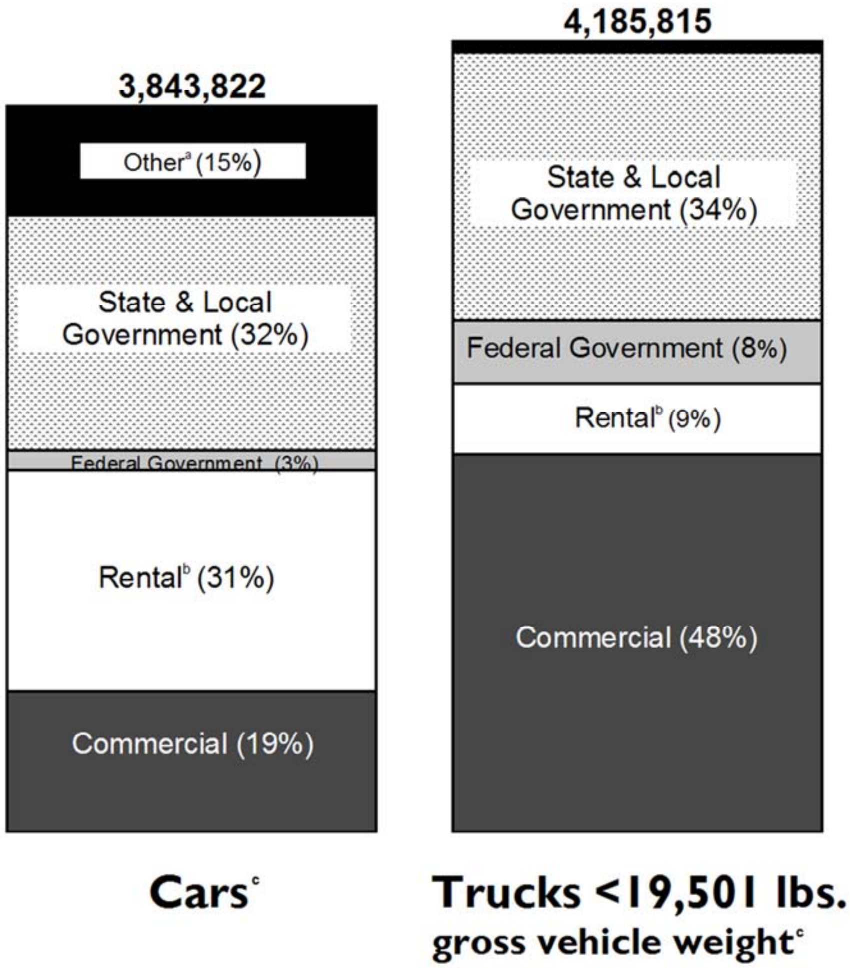
Chapter 7
Fleet Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Figure 7.1	Fleet cars, 2010	3,843,822
Figure 7.1	Fleet trucks 19,500 lbs. GVW, 2010	4,185,815
Table 7.3	Average annual miles per business fleet vehicle	
	Light trucks	*30,240*
	SUVs	*26,604*
	Intermediate cars	*25,740*
Figure 7.2	Average annual miles per Federal Government fleet vehicle, 2010	
	Sedans & station wagons	*11,026*
	SUVs	*10,171*
	Buses	*9,912*
	Heavy trucks	*7,776*
	Medium trucks	*6,873*
	Light trucks	*6,144*
	Ambulances	*5,488*
Table 7.4	Federal government vehicles, FY 2010	659,125
	Light trucks (<8,500 lbs. GVW)	*281,116*
	Cars and other passenger vehicles	*246,330*
	Medium trucks (8,500–26,000 lbs. GVW)	*89,253*
	Heavy trucks (>26,000 lbs. GVW)	*32,760*
	Buses and ambulances	*9,666*

Vehicles in fleets of 15 or more are counted as fleet vehicles, as well as vehicles in fleets where five or more vehicles are purchased annually. Historical data on fleets are not available due to definitional changes of what constitutes a fleet.

Figure 7.1. Fleet Vehicles in Service as of January 1, 2010



Source:
Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2010*, Redondo Beach, CA, 2011. (Additional resources: www.fleet-central.com)

[a] Taxi category includes vans.
[b] Rental category includes vans and sports utility vehicles under cars, not trucks.
[c] Fleets of 15 or more in operation or 5 or more fleet vehicles purchased annually.

Rental companies made the largest light fleet vehicle registrations in 2009 buying over 1.1 million vehicles, most of them cars (64.4%). Only 31.7% of the new commercial fleet registrations were cars.

Table 7.1
New Light Fleet Vehicle Registrations by Vehicle Type, Model Year 2009

	Commercial	Rental	Government	Total
Cars	31.7%	64.4%	41.8%	53.2%
Pickup trucks	28.2%	43.6%	25.7%	12.6%
Vans	20.7%	13.9%	17.5%	16.1%
Sport utility vehicles	19.4%	18.1%	15.0%	18.1%
Total	456,317	1,100,520	215,660	1,772,497

Source:
Bobit Publishing Company, *Automotive Fleet Factbook 2010*, www.automotive-fleet.com/statistics. (Additional resources: www.fleet-central.com)

Table 7.2
Average Length of Time Business Fleet Vehicles are in Service, 2009

Vehicle type	Average months in service
Compact cars	29
Intermediate cars	26
Pickup trucks	35
Minivans	28
Sport utility vehicles	29
Full-size vans	31

Source:
Bobit Publishing Company, *Automotive Fleet Factbook 2010*, www.automotive-fleet.com. (Additional resources: www.fleet-central.com)

Note: Based on data collected from four leading Fleet Management companies.

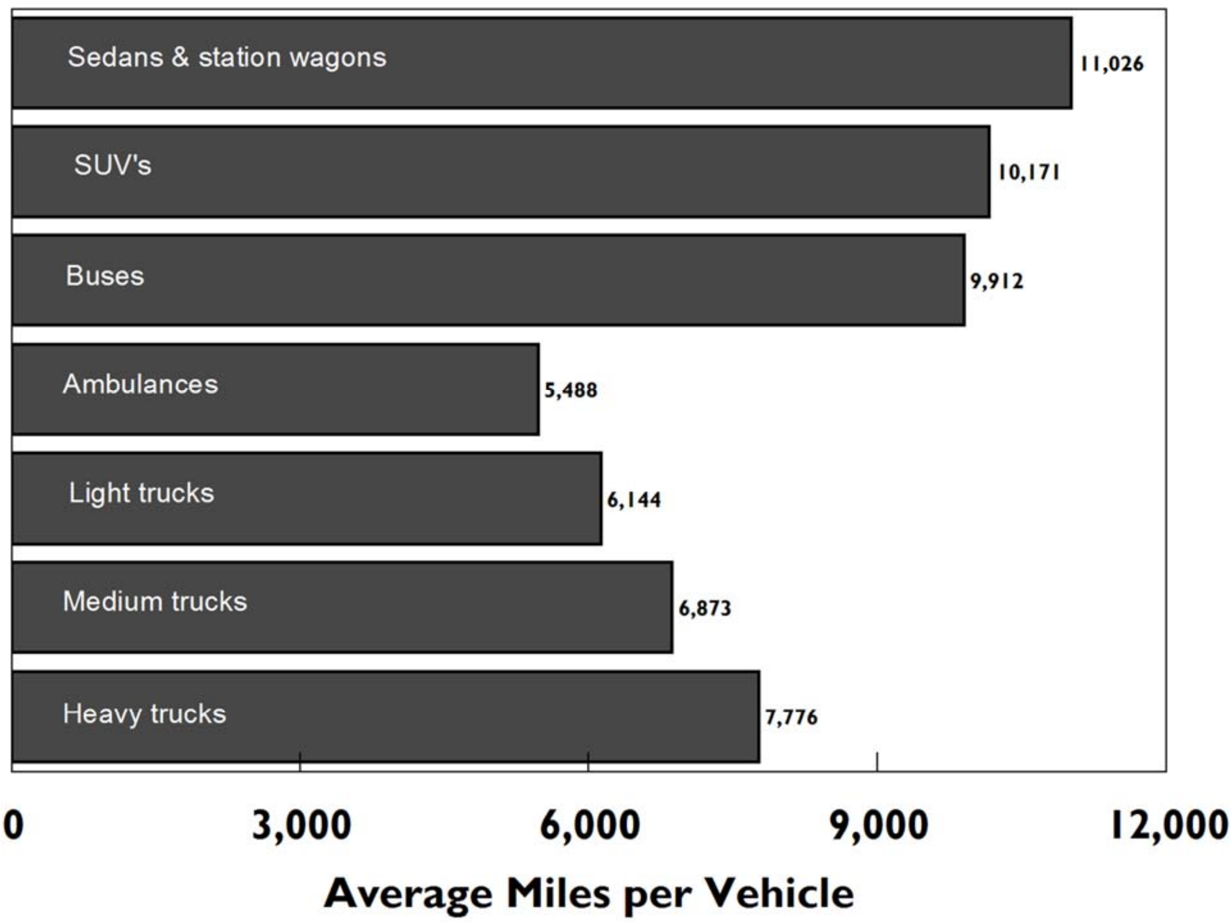
Table 7.3
Average Annual Vehicle-Miles of Travel
for Business Fleet Vehicles, 2009

Business fleet vehicles	Average annual miles of travel
Compact cars	25,572
Intermediate cars	25,740
Pickup trucks	30,240
Minivans	29,952
Sport utility vehicles	26,604
Full-size vans	28,908

Source:
Bobit Publishing Company, *Automotive Fleet Factbook 2010*, www.automotive-fleet.com. (Additional resources: www.fleet-central.com)

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 sport utility vehicles and buses.

Figure 7.2. Average Miles per Domestic Federal Vehicle by Vehicle Type, 2010



Source:
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 2010 Federal Fleet Report*, Washington, DC, 2011, Table 4-2. (Additional resources: www.gsa.gov)

Note: Light trucks = less than 8,500 pounds GVWR.
Medium trucks = 8,501-23,999 pounds GVWR.
Heavy trucks = 24,000 pounds GVWR or more.

The Federal Government vehicle inventory includes more light trucks than passenger vehicles.

Table 7.4
Federal Government Vehicles, 2001-2010

Vehicle Type	2001	2002	2004	2005	2006	2007	2008	2009	2010
Passenger Vehicles									
Subcompact	5,462	4,638	4,485	2,401	2,181	1,968	3,058	5,935	6,797
Compact	60,938	57,002	55,150	58,284	56,220	48,495	41,482	36,662	46,489
Midsize	36,921	40,779	35,012	36,656	39,762	48,622	55,157	57,284	48,242
Large	11,107	11,265	16,235	15,966	11,783	11,907	10,679	10,230	10,063
Limousines	116	130	227	191	318	217	238	349	412
Light Duty Passenger Vans	56,563	61,518	42,213	42,109	41,911	43,203	43,131	41,855	41,676
Medium Duty Passenger Vans	727	1,701	13,282	13,252	15,657	15,231	15,696	15,362	15,218
Light Duty SUVs	40,842	48,343	54,992	50,445	52,393	53,837	56,329	64,793	66,316
Medium Duty SUVs	0	0	7,594	6,096	7,192	7,733	10,837	7,344	11,117
Total Passenger Vehicles	**212,676**	**225,376**	**229,190**	**225,400**	**227,417**	**231,213**	**236,607**	**239,814**	**246,330**
Trucks and Other Vehicles									
Light Trucks 4x2	227,937	220,205	236,123	243,477	241,847	243,720	243,143	244,022	241,011
Light Trucks 4x4	29,975	27,108	32,121	35,417	37,019	40,115	34,962	36,713	40,105
Medium Trucks	88,993	86,949	80,474	83,747	81,721	84,414	88,509	89,052	89,253
Heavy Trucks	27,988	31,426	33,308	35,230	33,383	32,492	32,752	32,629	32,760
Ambulances	1,819	1,710	1,405	1,580	1,601	1,982	1,474	1,433	1,480
Buses	6,726	7,313	7,530	7,837	7,752	8,297	8,044	8,040	8,186
Total Trucks and Other Vehicles	**383,438**	**374,711**	**390,961**	**407,288**	**403,323**	**411,020**	**408,884**	**411,889**	**412,795**
GRAND TOTAL ALL VEHICLES	**596,114**	**600,087**	**620,151**	**632,688**	**630,740**	**642,233**	**645,491**	**651,703**	**659,125**

Source:
U.S. General Services Administration, Federal Supply Service, *FY 2010 Federal Fleet Report*, Washington, DC, 2011, Tables 2-5 and 2-6. (Additional resources: http://www.gsa.gov)

Note: Light trucks = less than 8,500 pounds GVWR.
Medium trucks = 8,501-23,999 pounds GVWR.
Heavy trucks = 24,000 pounds GVWR or more.

Table 7.5
Federal Fleet Vehicle Acquisitions by Fuel Type, FY 2002–2010

	Acquisitions by Year								
Fuel Type	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gasoline	44,850	42,844	43,378	41,247	37,242	32,089	30,376	31,782	26,547
Diesel	8,107	5,831	5,822	6,049	6,809	5,809	5,897	4,742	4,136
Gasoline hybrid	[a]	[a]	[a]	222	516	458	531	3,959	4,853
Diesel hybrid	[b]	[b]	[b]	1	0	4	0	4	27
CNG	1,267	1,223	809	188	243	129	123	77	60
E-85	8,054	19,626	13,991	16,892	18,168	26,581	27,792	27,850	26,789
Electric	7	31	88	13	0	7	6	7	1,376
LNG	3	0	0	0	0	0	0	0	0
LPG	59	49	26	1	0	4	3	23	2
M-85	25	0	0	0	0	0	0	0	0
Hydrogen	0	0	0	0	0	0	1	1	4
Grand Total	62,372	69,604	64,114	64,613	62,978	65,081	64,729	68,445	63,794

Source:
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 2010 Federal Fleet Report*, Washington, DC, 2011, Table 5-4. (Additional resources: www.gsa.gov)

Table 7.6
Fuel Consumed by Federal Government Fleets, FY 2000–2010
(thousand gasoline equivalent gallons)

	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Gasoline	284,480	281,791	281,205	296,017	284,460	300,261	288,923	293,848	292,046	301,340	322,023
Diesel	70,181	70,761	68,487	69,109	59,199	53,363	47,489	57,700	55,617	75,540	75,149
CNG	865	2,335	1,708	575	1,159	1,245	807	889	731	499	504
Electricity	1	35	56	19	3	6	5	5	4	4	36
Biodiesel	569	1,315	2,252	3,753	6,470	8,052	8,334	9,483	6,976	7,379	8,238
Methanol/M-85	14	5	4	3	0	0	0	0	0	0	0
LPG	34	102	108	104	126	231	105	322	399	208	195
Ethanol/E-85	347	5,900	4,673	1,592	1,784	3,060	3,206	3,853	6,293	7,922	8,200
LNG	0	52	27	23	91	102	90	95	59	35	0
Other	0	0	0	0	0	0	0	0	0	0	0
Total	356,491	362,296	358,520	371,195	353,292	366,320	348,959	366,195	362,125	392,927	414,346

Source:
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 2010 Federal Fleet Report*, Washington, DC, 2011, Table 5-1. (Additional resources: www.gsa.gov)

[a] Combined with gasoline.
[b] Combined with diesel.

In FY2000, the General Services Administration owned 143,948 vehicles which they leased to other agencies. In FY2010, they owned 1,273 vehicles.

Table 7.7
Federal Government Vehicles by Agency, FY 2010

Department or Agency	Cars	Buses	Light trucks	Medium trucks	Heavy trucks	Total
CIVILIAN						
American Battle Monuments Commission	23	0	6	11	0	40
Broadcasting Board of Governors	5	10	120	27	19	181
Consumer Product Safety Commission	67	0	29	1	0	97
Court Services and Offender Supervision Agency	53	0	21	0	0	74
Department of Agriculture	5,665	73	29,489	7,924	1,959	45,110
Department of Commerce	421	8	1,570	365	47	2,411
Department of Education	63	1	35	0	0	99
Department of Energy	843	182	8,032	3,859	2,110	15,026
Department of Health and Human Services	1,910	7	1,976	268	136	4,297
Department of Homeland Security	13,534	454	31,367	8,602	960	54,917
Department of Housing and Urban Development	396	0	79	1	0	476
Department of Justice	19,759	225	18,969	1,241	804	40,998
Department of Labor	1,149	279	2,172	192	32	3,824
Department of State	2,559	130	6,640	1,958	512	11,799
Department of the Interior	3,007	484	17,569	9,236	3,608	33,904
Department of Transportation	1,616	3	3,454	980	110	6,163
Department of Treasury	2,717	1	1,146	11	10	3,885
Department of Veterans Affairs	5,647	582	7,053	777	606	14,665
Environmental Protection Agency	290	5	686	106	25	1,112
Equal Employment Opportunity Commission	66	0	10	0	0	76
Federal Communications Commission	1	0	115	0	0	116
Federal Housing Finance Agency	5	0	0	0	0	5
Federal Trade Commission	1	0	2	1	0	4
General Services Administration	701	2	519	44	7	1,273
Government Printing Office	9	0	27	6	5	47
Library of Congress	8	2	7	1	6	24
National Aeronautics and Space Administration	579	103	1,778	808	380	3,648
National Archives & Records Administration	14	0	44	11	6	75
National Gallery of Art	0	0	6	2	1	9
National Labor Relations Board	36	0	5	0	0	41
National Science Foundation	30	10	168	126	41	375
Nuclear Regulatory Commission	11	0	21	0	5	37
Office of Personnel Management	1,535	0	121	1	1	1,658
Peace Corps	34	16	610	0	0	660
Small Business Administration	203	0	50	4	1	258
Smithsonian Institution	13	9	335	75	30	462
Social Security Administration	345	7	148	6	29	535
Tennessee Valley Authority	566	0	1,583	702	45	2,896
US Agency for International Development	211	10	746	29	16	1,012
TOTAL CIVILIAN AGENCIES	**64,092**	**2,603**	**136,708**	**37,375**	**11,511**	**252,289**
MILITARY						
Corps of Engineers, Civil Works	990	0	5,113	1,784	631	8,518
Defense Agencies	1,684	338	2,362	554	419	5,357
Department of Air Force	5,079	1,639	19,990	18,047	5,971	50,726
Department of Army	19,689	2,413	37,987	13,821	5,833	79,743
Department of Navy	7,889	695	18,630	7,059	2,729	37,002
United States Marine Corps	3,746	494	6,021	2,063	1,295	13,619
TOTAL MILITARY AGENCIES	**39,077**	**5,579**	**90,103**	**43,328**	**16,878**	**194,965**
U. S. POSTAL SERVICE	**8,834**	**4**	**190,112**	**8,550**	**4,371**	**211,871**
TOTAL ALL FLEETS	**112,003**	**8,186**	**416,923**	**89,253**	**32,760**	**659,125**

Source:
U.S. General Services Administration, Federal Supply Service, *FY 2010 Federal Fleet Report*, Washington, DC, 2011, Table 2-1. (Additional resources: www.gsa.gov)

Note: Less than 8,500 pounds GVWR (Includes ambulances.)
8,501—23,999 pounds GVWR.
24,000 pounds GVWR or more.

Chapter 8
Household Vehicles and Characteristics

Summary Statistics from Tables/Figures in this Chapter

Source		
Table 8.2	Vehicles per capita, 2009	0.808
Table 8.3	Average household transportation expense, 2009	15.6%
Table 8.4	Share of households owning 3 or more vehicles	
	1960	*2.5%*
	1970	*5.5%*
	1980	*17.5%*
	1990	*17.3%*
	2000	*18.3%*
	2009	*19.9%*
Table 8.5	Vehicles per licensed driver, 2009	1.00
Figure 8.1	Average occupancy rates by vehicle type, 2009	
	Pickup Truck	*1.49*
	Car	*1.55*
	Sports Utility	*1.90*
	Van	*2.35*
Table 8.9	Average annual miles per household vehicle, 2009	11,300
Table 8.15	Share of workers who car pooled, 2009	10.0%
Table 8.20	Long-distance trips in the United States, 2001	
	Person-trips	*2,554 million*
	Person-miles	*1,138 billion*

The number of vehicles in the United States is growing faster than the population. The growth in vehicle-miles has slowed in recent years. See Table 8.2 for vehicles per capita and vehicle-miles per capita.

Table 8.1
Population and Vehicle Profile, 1950–2009

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	43,501	458,246	62,194	58,920
1955	165,069	47,874	56,540	605,646	74,686	62,171
1960	179,979	52,799	67,906	718,762	87,253	65,778
1965	193,526	57,436	82,066	887,812	98,502	71,088
1970	203,984	63,401	98,136	1,109,724	111,543	78,627
1975	215,465	71,120	120,054	1,327,664	129,791	85,846
1980	227,225	80,776	139,831	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	242,804	89,479	167,193	1,921,204	161,975	112,440
1988	245,021	91,061	171,741	2,025,962	162,853	114,968
1989	247,342	92,830	175,960	2,096,487	165,555	117,342
1990	250,132	93,347	179,299	2,144,362	167,015	118,793
1991	253,493	94,312	181,438	2,172,050	168,995	117,718
1992	256,894	95,669	181,519	2,247,151	173,125	118,492
1993	260,255	96,391	186,315	2,296,378	173,149	120,259
1994	263,436	97,107	188,714	2,357,588	175,403	123,060
1995	266,557	98,990	193,441	2,422,696	176,628	124,900
1996	269,667	99,627	198,294	2,485,848	179,539	126,708
1997	272,912	101,018	201,071	2,561,695	182,709	129,558
1998	276,115	102,528	205,043	2,631,522	184,980	131,463
1999	279,295	103,874	209,509	2,691,056	187,170	133,488
2000	282,385	104,705	213,300	2,746,925	190,625	136,891
2001	285,309	108,209	216,683	2,797,287	191,276	136,933
2002	288,105	109,297	221,027	2,855,508	194,296	136,485
2003	290,820	111,278	225,882	2,890,450	196,166	137,736
2004	293,463	112,000	231,398	2,964,788	198,889	139,252
2005	296,186	113,343	237,697	2,989,430	200,549	141,730
2006	298,996	114,384	244,022	3,014,371	202,810	144,427
2007	302,004	116,011	248,701	3,031,124	205,742	146,047
2008	304,798	116,783	250,239	2,976,528	208,321	145,362
2009	307,439	117,181	248,460	2,935,501	209,618	139,877
			Average annual percentage change			
1950–2009	1.2%	1.7%	3.0%	3.2%	2.1%	1.5%
1999–2009	1.0%	1.2%	1.7%	0.9%	1.1%	0.5%

Sources:

Resident population and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States–2011,* Washington, DC, 2011, t ables 2, 59, 601, an d 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 2009*, Tables DL-1C and VM-1, and annual. (Additional resources: www.fhwa.dot.gov)

[a] Estimates as of July 1. Includes Armed Forces in the United States.

Vehicle-miles per capita reached 10,000 miles in 2004 but have declined since then. There were 1.78 vehicles for every employed civilian in the United States in 2009.

Table 8.2
Vehicles and Vehicle-Miles per Capita, 1950–2009[a]

Year	Vehicles per capita	Vehicle-miles per capita	Vehicles per licensed driver	Vehicles per civilian employed persons
1950	0.286	3,017	0.70	0.74
1955	0.343	3,669	0.76	0.91
1960	0.377	3,994	0.78	1.03
1965	0.424	4,588	0.83	1.15
1970	0.481	5,440	0.88	1.25
1975	0.557	6,162	0.92	1.40
1980	0.615	6,722	0.96	1.41
1981	0.618	6,778	0.96	1.41
1982	0.621	6,885	0.96	1.45
1983	0.629	7,069	0.95	1.46
1984	0.645	7,295	0.98	1.45
1985	0.660	7,460	1.00	1.47
1986	0.675	7,641	1.02	1.48
1987	0.689	7,913	1.03	1.49
1988	0.701	8,269	1.05	1.49
1989	0.711	8,476	1.06	1.50
1990	0.717	8,573	1.07	1.51
1991	0.716	8,568	1.07	1.54
1992	0.707	8,747	1.05	1.53
1993	0.716	8,824	1.08	1.55
1994	0.716	8,949	1.08	1.53
1995	0.726	9,089	1.10	1.55
1996	0.735	9,218	1.10	1.56
1997	0.737	9,387	1.10	1.55
1998	0.743	9,531	1.11	1.56
1999	0.750	9,635	1.12	1.57
2000	0.755	9,728	1.12	1.56
2001	0.759	9,804	1.13	1.58
2002	0.767	9,911	1.14	1.62
2003	0.777	9,939	1.15	1.64
2004	0.789	10,103	1.16	1.66
2005	0.803	10,093	1.19	1.68
2006	0.816	10,082	1.20	1.69
2007	0.824	10,037	1.21	1.70
2008	0.821	9,766	1.20	1.72
2009	0.808	9,548	1.19	1.78
		Average annual percentage change		
1950–2009	1.8%	2.0%	0.9%	1.5%
1999–2009	0.7%	-0.1%	0.6%	1.3%

Sources:

Resident population and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States–2011*, Washington, DC, 2011, Tables 2 and 601. (Additional resources: www.census.gov)

Vehicles in operation - The Polk Company. FURTHER REPRODUCTION PROHIBITED. (Additional resources: www.polk.com)

Vehicle-miles - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, Table VM-1 and annual. (Additional resources: www.fhwa.dot.gov)

[a] Includes all vehicles (light and heavy).

Table 8.3
Average Annual Expenditures of Households by Income, 2009[a]

	All households	Income before taxes: Less than $5,000	$5,000–$9,999	$10,000–$14,999	$15,000–$19,999
Total expenditures	$49,067	$22,731	$18,032	$21,741	$23,706
		Percentage of total expenditures[b]			
Food[c]	13.0%	16.9%	16.8%	17.1%	14.1%
Housing	34.4%	39.3%	43.0%	41.4%	42.2%
Apparel and services	3.5%	3.5%	4.4%	5.0%	3.2%
Transportation	15.6%	12.5%	12.7%	12.3%	14.7%
Vehicle purchases (net outlay)	**5.4%**	**4.1%**	**3.6%**	**3.1%**	**4.0%**
Gasoline and motor oil	**4.0%**	**4.1%**	**4.2%**	**4.1%**	**4.7%**
Other vehicle expenditures	**5.2%**	**3.5%**	**4.3%**	**4.4%**	**5.1%**
Public transportation	**1.0%**	**0.8%**	**0.6%**	**0.7%**	**0.9%**
Health care	6.4%	5.9%	6.1%	8.2%	8.6%
Entertainment	5.5%	5.5%	4.6%	4.5%	4.6%
Personal Insurance & pensions	11.2%	2.2%	1.8%	2.2%	3.5%
Others[d]	9.6%	13.1%	9.4%	8.7%	8.5%
Households[e] (thousands)	120,847	4,749	5,203	7,726	7,669
Percentage of households	100%	3.9%	4.3%	6.4%	6.3%
Average number of vehicles in HH	2.0	0.9	0.8	1.0	1.2

	Income before taxes: $20,000–$29,999	$30,000–$39,999	$40,000–$49,999	$50,000–$69,999	$70,000 and over
Total expenditures	$29,397	$35,929	$39,553	$48,900	$82,060
		Percentage of total expenditures[b]			
Food[c]	15.0%	13.2%	13.6%	13.1%	11.9%
Housing	38.9%	36.1%	36.2%	34.3%	32.2%
Apparel and services	3.7%	3.4%	3.4%	3.3%	3.5%
Transportation	14.8%	17.6%	16.2%	17.1%	15.4%
Vehicle purchases (net outlay)	**4.1%**	**5.9%**	**5.3%**	**5.6%**	**5.8%**
Gasoline and motor oil	**4.9%**	**4.7%**	**4.9%**	**4.6%**	**3.5%**
Other vehicle expenditures	**5.1%**	**6.3%**	**5.2%**	**6.0%**	**4.8%**
Public transportation	**0.7%**	**0.7%**	**0.7%**	**0.8%**	**1.2%**
Health care	8.6%	7.5%	7.4%	7.1%	5.4%
Entertainment	5.1%	5.5%	5.1%	5.3%	5.8%
Personal Insurance & pensions	5.0%	6.6%	8.8%	10.0%	14.9%
Others[d]	8.0%	9.3%	8.6%	8.8%	10.1%
Households[e] (thousands)	15,022	13,053	11,444	17,799	38,181
Percentage of households	12.4%	10.8%	9.5%	14.7%	31.6%
Average number of vehicles in HH	1.5	1.7	1.9	2.3	2.7

Source:
U.S. Department of Labor, Bureau of Labor Statistics, Web site: www .bls.gov/cex/, October 2010. (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, re ading, 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 8.1.

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 8.4
Household Vehicle Ownership, 1960–2009 Census
(percentage)

	No vehicles	One vehicle	Two vehicles	Three or More vehicles
1960	21.53%	56.94%	19.00%	2.53%
1970	17.47%	47.71%	29.32%	5.51%
1980	12.92%	35.53%	34.02%	17.52%
1990	11.53%	33.74%	37.35%	17.33%
2000	9.35%	33.79%	38.55%	18.31%
2009	8.90%	33.69%	37.56%	19.85%

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)
2009 data – U.S. Bureau of the Census, American Community Survey, Table DP-4, 2009.

2009 National Household Travel Survey Daily Trip Data

The Department of Transportation (DOT) collected data on daily trips in 1969, 1977, 1983, 1990 and 1995 via the Nationwide Personal Transportation Survey (NPTS). For 2001, the DOT combined the collection of long trip and daily trip data into one survey – the 2001 National Travel Household Travel Survey (NHTS). The long trip data were not included in the 2009 NHTS.

The NHTS is the nation's inventory of daily travel. The survey includes demographic characteristics of households, people, vehicles, and detailed information on daily travel for all purposes by all modes. NHTS survey data are collected from a sample of U.S. households and expanded to provide national estimates of trips and miles by travel mode, trip purpose, and a host of household attributes.

The NHTS was designed to continue the NPTS series, but as with all data surveys, caution should be used when comparing statistics from one survey to another due to changes in terminology, survey procedures, and target population. The 2001 and 2009 surveys collected data on trips of children under 5 years of age, while the previous NPTS did not. Improved methodologies first used in the collection of trip information in the 1995 NPTS make it difficult to compare these data with past NPTS survey data. Thus, the 1990 NPTS trip data have been adjusted to make it comparable with the later surveys.

Table 8.5
Demographic Statistics from the 1969, 1977, 1983, 1990, 1995 NPTS and 2001, 2009 NHTS

	1969	1977	1983	1990	1995	2001	2009	Percent change 1969–2009
Persons per household	3.16	2.83	2.69	2.56	2.63	2.58	2.50	-21%
Vehicles per household	1.16	1.59	1.68	1.77	1.78	1.89	1.87	61%
Workers per household	1.21	1.23	1.21	1.27	1.33	1.35	1.34	11%
Licensed drivers per household	1.65	1.69	1.72	1.75	1.78	1.77	1.88	14%
Vehicles per worker	0.96	1.29	1.39	1.40	1.34	1.39	1.40	46%
Vehicles per licensed driver	0.70	0.94	0.98	1.01	1.00	1.06	1.00	42%
Average vehicle trip length (miles)	8.89	8.34	7.90	8.98	9.06	9.87	9.72	9%

Sources:
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, 2001 and 2009 were generated from the Internet site *nhts.ornl.gov*. (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.

Due to methodology improvements in collecting trip information, the 2001 and 1995 data should be compared only to the 1990 adjusted data. The original 1990 data are comparable to all previous surveys; however, comparisons should always be made with caution because of differing survey methodologies.

Table 8.6
Average Annual Vehicle-Miles, Vehicle Trips and Trip Length per Household
1969, 1977, 1983, 1990, 1995 NPTS and 2001, 2009 NHTS

	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
2001	5,724	21,171
2009	5,513	19,850
	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
2001	479	2,171
2009	457	2,068
	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
2001	12.2	9.9
2009	12.2	9.7

Sources:
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. 1990 adjusted data - Oak Ridge National Laboratory, Oak Ridge, TN, August 1998. 1995 NPTS, 2001, 2009 NHTS data were generated from the Internet site *nhts.ornl.gov*. (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.

In 2001 and 2009 vehicle-miles traveled (vmt) for a three-person household is around 28,000 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 more than double the vmt of households without children.

Table 8.7
Average Number of Vehicles and Vehicle Travel per Household, 1990 NPTS and 2001 and 2009 NHTS

	Average number of vehicles per household			Average vehicle-miles traveled per household		
Number of Licensed Drivers	**1990**	**2001**	**2009**	**1990**	**2001**	**2009**
1	1.5	1.2 1.1		15,200	9,700	8,800
2	2.1	2.2 2.2		22,900	25,800	23,500
3	2.9	3.0 3.0		29,400	37,900	37,700
4 or more	3.8	3.8	3.9	40,500	47,200	55,200
Household size						
1 person	1.2	1.0 1.0		11,400	7,500	7,100
2 persons	1.9	2.0 2.0		19,300	21,200	17,500
3 persons	2.2	2.3 2.3		23,700	28,400	27,900
4 persons	2.4	2.4 2.4		25,300	28,600	33,200
5 persons	2.4	2.4 2.4		24,900	33,200	33,700
6 or more persons	2.7	2.5	2.4	29,200	33,800	33,600
Household urban status						
Urban	1.9	1.8 1.7		19,000	19,300	17,600
Rural	2.1	2.3 2.4		22,200	28,400	27,700
Household composition						
With children	2.2	2.2 2.2		24,100	28,300	30,400
Without children	1.8	1.7 1.7		17,600	16,700	14,400
All households	**1.8**	**1.9**	**1.9**	**18,300**	**21,200**	**19,900**

Source:
Generated from the Department of T ransportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 2000 and the National Household Travel Survey Internet site: nhts.ornl.gov. (Additional resources: www-cta.ornl.gov/npts)

In 2009, 22% of vehicle trips were traveling to and from work. Another 22% of trips were for shopping. Shopping is done close to home, as the average trip length for shopping was only 6.5 miles.

Table 8.8
Trip Statistics by Trip Purpose, 2001 and 2009 NHTS

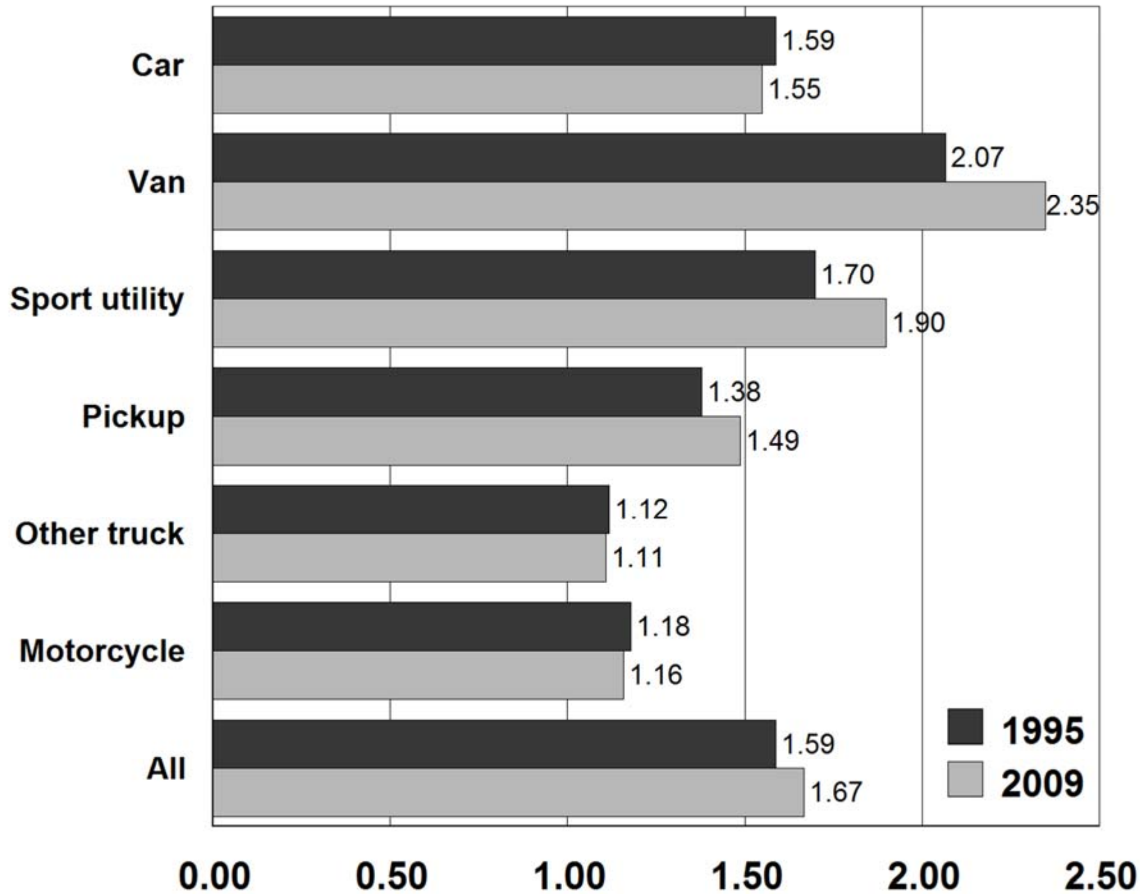
	Share of trips		Share of vehicle-miles traveled		Trip length (miles)		Trip length (minutes)	
Trip purpose	2001	2009	2001	2009	2001	2009	2001	2009
To/from work	22.1%	22.3%	27.0%	28.7%	12.1	12.2	22.3	22.9
Work-related business	4.1%	3.9%	8.4%	7.2%	20.3	17.2	30.9	27.5
Shopping	21.1%	22.8%	14.5%	15.5%	6.7	6.5	14.4	14.4
Other family/personal business	24.7%	21.9%	18.7%	15.7%	7.5	6.8	15.2	14.8
School/church	4.9%	5.0%	3.7%	4.6%	7.5	8.8	15.8	17.5
Medical/dental	2.2%	2.6%	2.2%	2.6%	9.9	9.9	20.7	21.2
Vacation	0.4%	0.7%	1.8%	2.3%	47.4	31.4	59.6	41.3
Visit friends/relatives	6.3%	5.7%	9.4%	9.4%	14.9	15.7	24.4	24.6
Other social/recreational	13.7%	14.9%	13.2%	13.5%	9.6	8.6	18.2	17.2
Other	0.5%	0.3%	1.0%	0.6%	18.1	19.0	31.4	29.7
All	100.0%	100.0%	100.0%	100.0%	9.9	9.7	18.7	18.6

Source:
Generated from the National Household Travel Survey Internet site: nhts.ornl.gov.

Note: The "All" category for average trip length and duration includes records for which trip purpose was not identified.

While car occupancy stayed nearly constant from 1995 to 2009, most other vehicle types showed increased occupancy. Vans and sport utility vehicles have higher vehicle occupancies than cars.

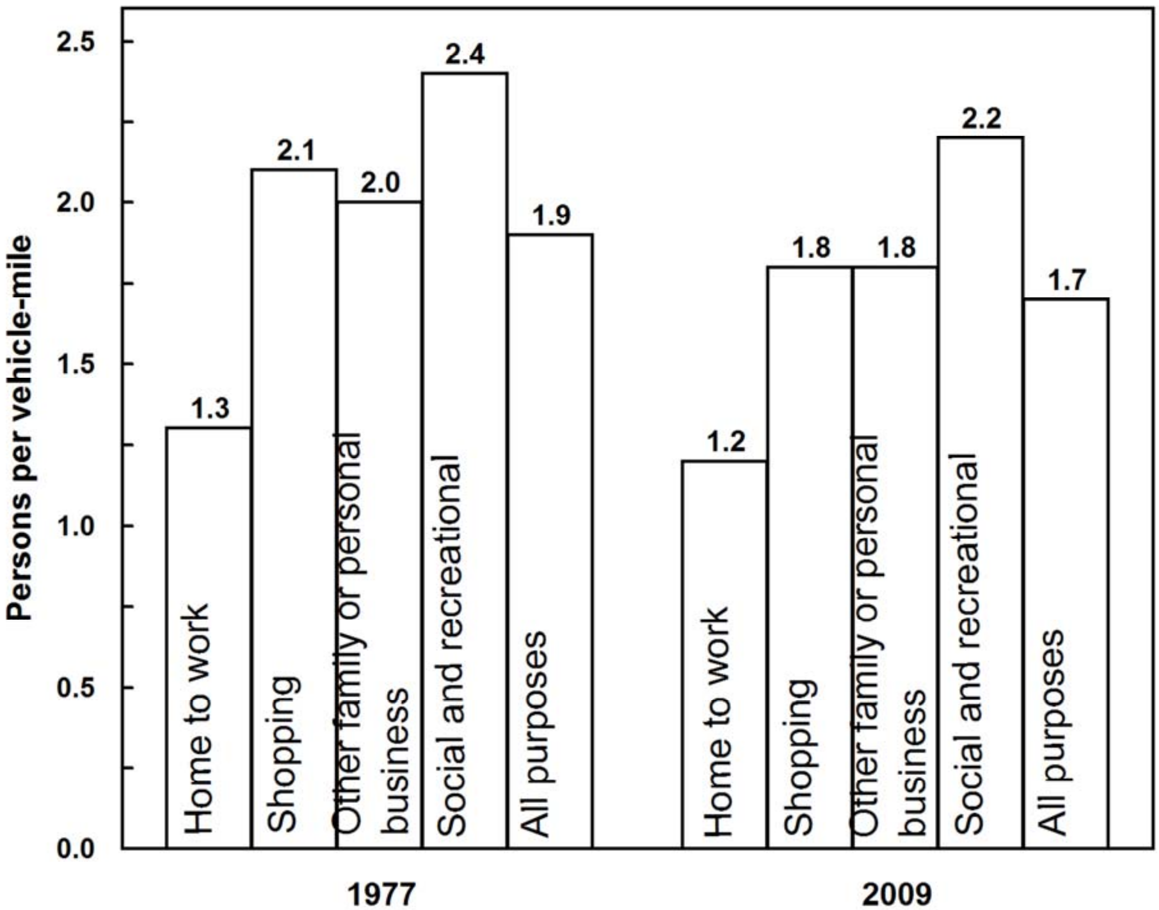
Figure 8.1. Average Vehicle Occupancy by Vehicle Type, 1995 NPTS and 2009 NHTS



Sources:
U.S. Department of Transportation, Federal Highway Administration, 1995 Nationwide Personal Transportation Survey, Washington, DC, 1997, and 2009 National Household Travel Survey, Washington, DC. (Additional resources: www.fhwa.dot.gov, nhts.ornl.gov)

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 8.2. Average Vehicle Occupancy by Trip Purpose
1977 NPTS and 2009 NHTS



Sources:
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 2009 NHTS were generated from the Internet site nhts.ornl.gov, March 2011. (Additional resources: www.fhwa.dot.gov, nhts.ornl.gov)

The 1990 household survey reports the highest average annual miles per vehicle and the 1983 survey reports the lowest. These data show that younger vehicles are typically driven more miles than older vehicles.

Table 8.9
Average Annual Miles per Household Vehicle by Vehicle Age

Vehicle age (years)	1983 self-reported	1990 self-reported	1995 self-reported	2001 self-reported	2009 self-reported
Under 1	8,200	19,600	15,900	15,500	13,200
1	15,200	16,800	16,800	14,300	14,600
2	16,800	16,600	15,500	14,000	13,900
3	14,500	14,700	14,400	13,100	12,700
4	13,000	13,600	14,100	12,500	12,600
5	12,100	12,900	13,500	12,000	12,800
6	11,300	13,200	13,200	11,800	12,100
7	10,000	12,400	12,800	11,600	11,900
8	9,800	12,600	12,200	10,900	11,500
9	9,000	11,500	12,200	10,800	11,300
10 and older	7,300	9,200	8,900	7,400	9,300
All household vehicles	**10,400**	**12,500**	**12,200**	**11,100**	**11,300**

Sources:
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, 2001 and 2009: Generated from the 2009 NHTS datasets, version 2, February 2011. (Additional resources: nhts.ornl.gov)

Note: Data include all household vehicles, and have been rounded to the nearest hundred.

Historically, the data from the Nationwide Personal Transportation Survey (NPTS) are based on estimates reported by survey respondents. For the 1995 NPTS and the 2001 National Household Travel Survey (NHTS), odometer data were also collected. The 1995 data indicate that respondents overestimate the number of miles they drive in a year, but the 2001 data do not show that same trend.

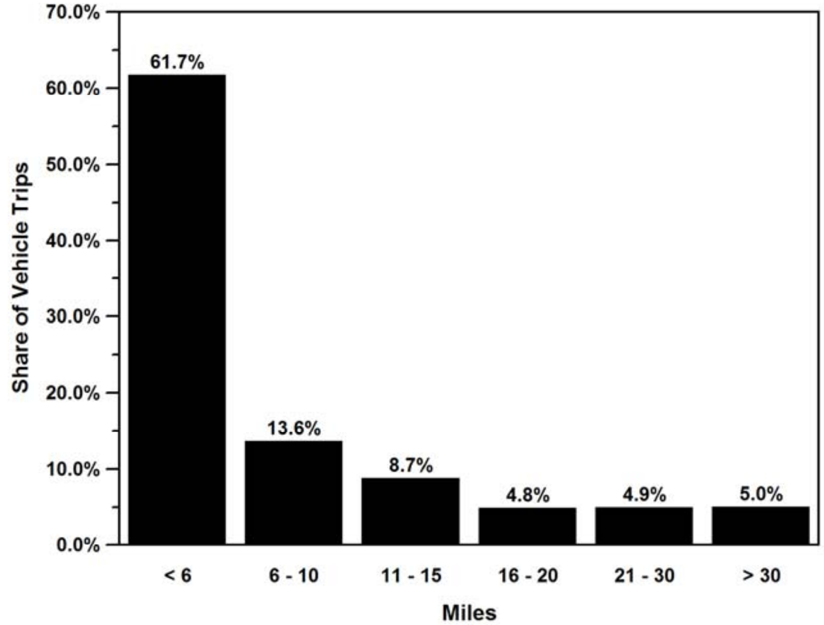
Table 8.10
Self-Reported vs. Odometer Average Annual Miles, 1995 NPTS and 2001 NHTS

Vehicle age (years)	1995 self-reported	1995 odometer	2001 self-reported	2001 odometer
Under 1	15,900	15,600	15,500	14,500
1	16,800	14,500	14,300	14,200
2	15,500	14,800	14,000	13,700
3	14,400	13,800	13,100	14,100
4	14,100	12,900	12,500	13,400
5	13,500	12,700	12,000	12,900
6	13,200	12,400	11,800	12,400
7	12,800	11,600	11,600	12,100
8	12,200	11,300	10,900	11,300
9	12,200	11,200	10,800	10,500
10 and older	8,900	9,000	7,400	8,100
All household vehicles	12,200	11,800	11,000	11,800

Source:
Generated from the Internet site: www-cta.ornl.gov/npts and 2001 NHTS public use file.

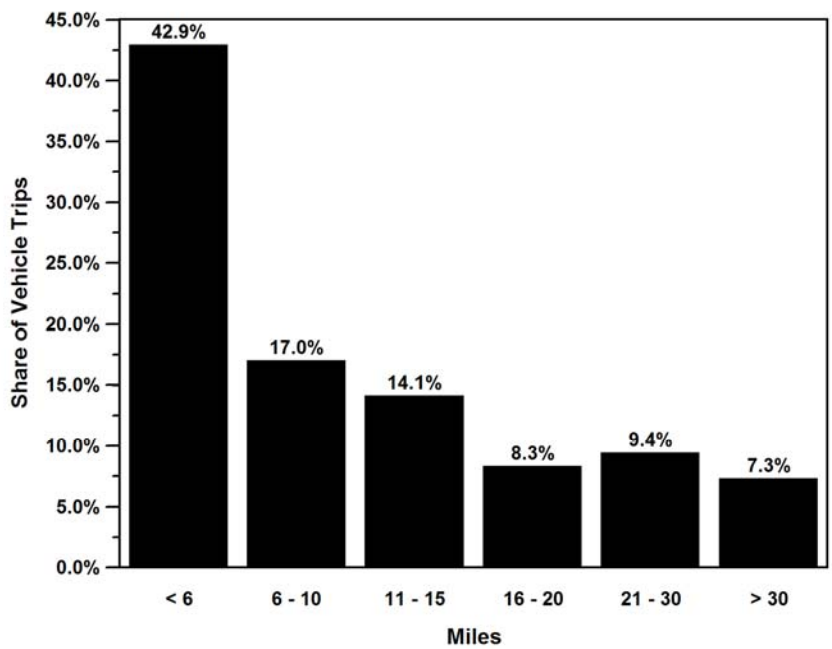
Note: The 2009 NHTS did not collect similar data. Survey methodology on odometer reading data differs from 1995 to 2001 data.

Figure 8.3. Share of Vehicle Trips by Trip Distance, 2009 NHTS



Source:
National Household Travel Survey, https://nhts.ornl.gov.

Figure 8.4. Share of Vehicle Trips to Work by Trip Distance, 2009 NHTS



Source:
National Household Travel Survey, https://nhts.ornl.gov.

Nineteen percent of new vehicles (1 year old and under) travel over 20,000 miles per year. Almost half of the vehicles over 20 years old travel less than 4,000 miles in a year.

Table 8.11
Share of Vehicles by Annual Miles of Travel and Vehicle Age, 2009 NHTS

Annual vehicle miles of travel	Vehicle age (years)						
	1 and under	2	3	4	5	6	7
< 1,000 miles	2%	3%	3%	3%	3%	4%	3%
1 - 2,000 miles	2%	3%	2%	3%	3%	3%	3%
2 - 4,000 miles	5%	6%	7%	7%	6%	7%	9%
4 - 6,000 miles	7%	10%	9%	8%	8%	10%	10%
6 - 8,000 miles	10%	10%	11%	11%	10%	12%	12%
8 - 10,000 miles	11%	11%	11%	11%	11%	12%	12%
10 - 12,000 miles	9%	11%	11%	11%	12%	11%	11%
12 - 15,000 miles	16%	15%	14%	15%	15%	14%	13%
15 - 20,000 miles	18%	15%	17%	17%	16%	14%	14%
20 - 30,000 miles	13%	11%	12%	11%	11%	10%	9%
>30,000 miles	6%	5%	4%	3%	4%	4%	3%
All	100%	100%	100%	100%	100%	100%	100%

	Vehicle age (years)					
	8	9	10	11-15	16-20	Over 20
< 1,000 miles	4%	4%	4%	6%	9%	19%
1 - 2,000 miles	4%	4%	4%	5%	7%	8%
2 - 4,000 miles	9%	9%	10%	11%	16%	19%
4 - 6,000 miles	11%	12%	12%	14%	14%	14%
6 - 8,000 miles	12%	12%	11%	14%	13%	12%
8 - 10,000 miles	13%	11%	12%	12%	10%	7%
10 - 12,000 miles	11%	11%	11%	10%	8%	6%
12 - 15,000 miles	13%	13%	12%	10%	8%	5%
15 - 20,000 miles	12%	13%	14%	9%	7%	5%
20 - 30,000 miles	9%	8%	7%	7%	4%	3%
>30,000 miles	3%	3%	3%	3%	2%	2%
All	100%	100%	100%	100%	100%	100%

Source:
Generated from the Department of Transportation, Federal Highway Administration, 2009 National Household Travel Survey Internet site: nhts.ornl.gov. (Additional resources: nhts.ornl.gov)

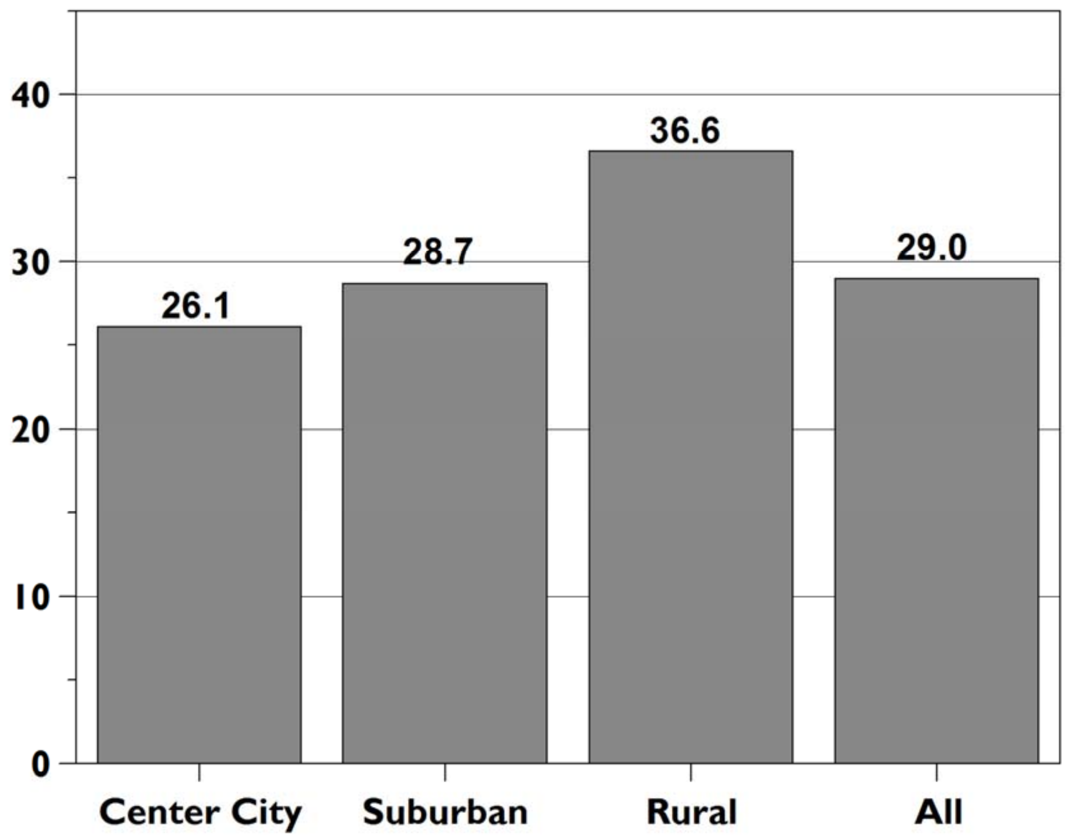
The average driver makes three trips per day with an average of 9.7 miles for each trip.

Table 8.12
Household Vehicle Trips, 2009 NHTS

	Number of daily vehicle trips (per driver)	Average vehicle trip length (miles)	Daily vehicle miles of travel (per driver)
1990	3.3	8.9	28.5
1995	3.6	9.1	32.1
2001	3.4	9.9	32.7
2009	3.0	9.7	29.0

Source:
National Household Travel Survey, nhts.ornl.gov.

Figure 8.5. Average Daily Miles Driven (per Driver), 2009 NHTS



Source:
National Household Travel Survey, nhts.ornl.gov.

Table 8.13
Daily Vehicle Miles of Travel (per Vehicle) by Number of Vehicles in the Household, 2009 NHTS

Number of household vehicles	Daily miles per vehicle	
	2001	2009
1	25.6	29.1
2	27.5	32.7
3	24.2	31.3
4	23.0	30.2
5	21.1	27.6
More than 5	18.4	27.2
All	25.2	31.1

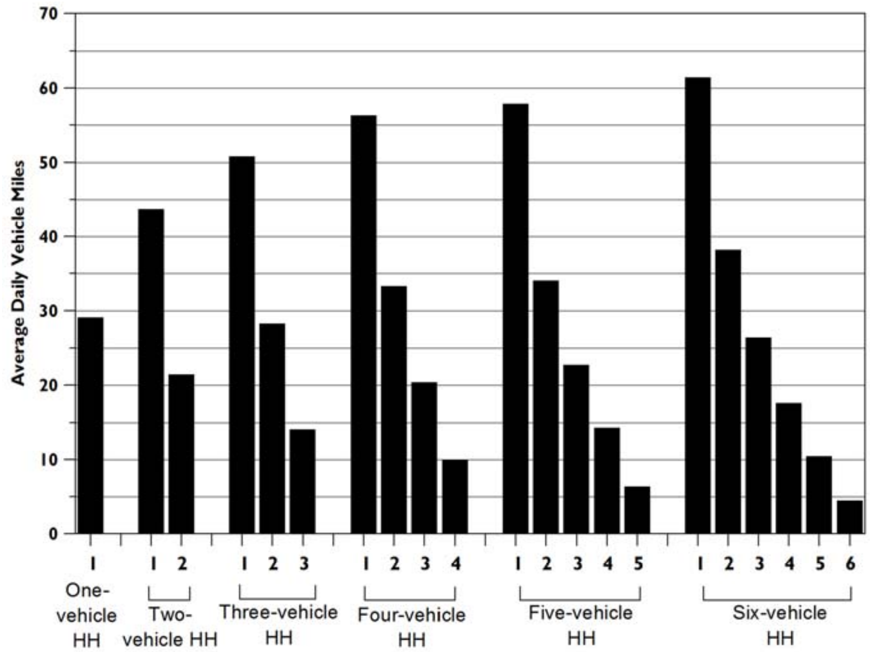
Source:
2009 National Household Travel Survey, nhts.ornl.gov.

Table 8.14
Daily and Annual Vehicle Miles of Travel and Average Age for Each Vehicle in a Household, 2009 NHTS

Vehicle number	Average daily miles	Average annual miles	Average age (years)
One-vehicle household			
1	29.0	10,600	9.0
Two-vehicle household			
1	43.6	15,900	7.6
2	21.4	7,800	9.0
Three-vehicle household			
1	50.7	18,500	7.9
2	28.2	10,300	9.1
3	14.0	5,100	11.8
Four-vehicle household			
1	56.2	20,500	8.5
2	33.2	12,100	8.8
3	20.3	7,400	11.4
4	9.9	3,600	13.2
Five-vehicle household			
1	57.8	21,100	8.5
2	34.0	12,400	9.4
3	22.7	8,300	12.3
4	14.2	5,200	12.7
5	6.3	2,300	16.8
Six-vehicle household			
1	61.4	22,400	10.2
2	38.1	13,900	9.8
3	26.3	9,600	12.2
4	17.5	6,400	12.5
5	10.4	3,800	14.5
6	4.4	1,600	17.9

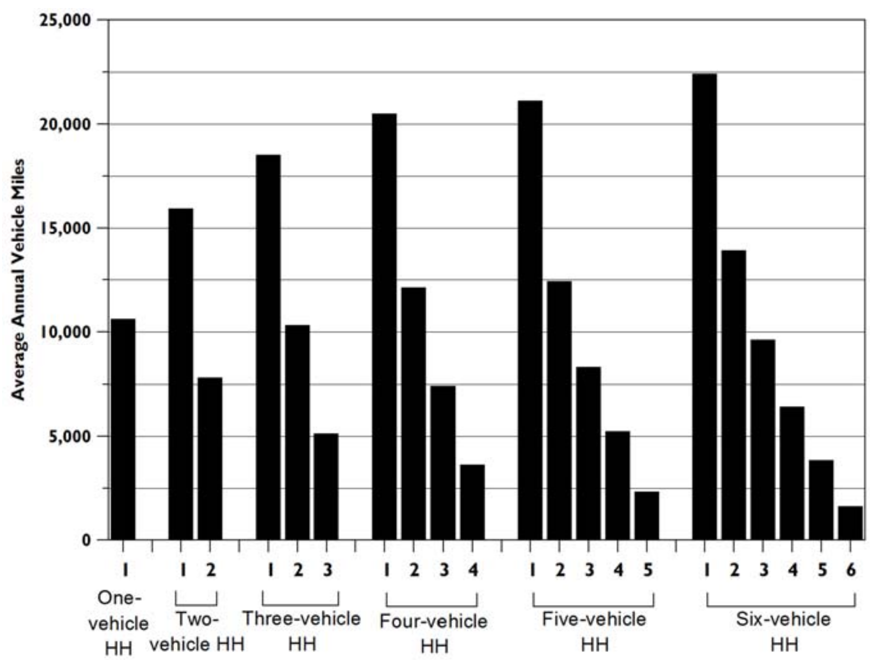
Source:
2009 National Household Travel Survey, nhts.ornl.gov.

Figure 8.6. Daily Vehicle Miles of Travel for Each Vehicle in a Household, 2009 NHTS



Source:
2009 National Household Travel Survey, nhts.ornl.gov.

Figure 8.7. Annual Vehicle Miles of Travel for Each Vehicle in a Household, 2009 NHTS



Source:
2009 National Household Travel Survey, nhts.ornl.gov.

According to the U.S. Census data, the percentage of workers who car pooled has dropped from 19.7% in 1980 to 10% in 2009. 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 2009 (5.0%). The average travel time increased by 3.5 minutes from 1980 to 2009. The American Community Survey (ACS) now collects journey-to-work data on an annual basis. It shows the average commute time rising to 25.2 minutes in 2009.

Table 8.15
Means of Transportation to Work, 1980, 1990, 2000, and 2009

	1980 Census		1990 Census		2000 Census		2009 ACS	
Means of transportation	Number of workers (thousands)	Share	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%	112,736	87.9%	119,393	86.1%
Drove alone	*62,193*	*64.4%*	*84,215*	*73.2%*	*97,102*	*75.7%*	*105,476*	*76.1%*
Car pooled	*19,065*	*19.7%*	*15,378*	*13.4%*	*15,635*	*12.2%*	*13,917*	*10.0%*
Public transportation	6,175	6.4%	6,070	5.3%	6,068	4.7%	6,922	5.0%
Bus or trolley bus[a]	*3,925*	*4.1%*	*3,445*	*3.0%*	*3,207*	*2.5%*	*3,673*	*2.7%*
Streetcar or trolley car[a]	[b]	[b]	*78*	*0.1%*	*73*	*0.1%*	*89*	*0.1%*
Subway or elevated	*1,529*	*1.6%*	*1,755*	*1.5%*	*1,886*	*1.5%*	*2,372*	*1.7%*
Railroad	*554*	*0.6%*	*574*	*0.5%*	*658*	*0.5%*	*750*	*0.5%*
Ferryboat	[b]	[b]	*37*	*0.0%*	*44*	*0.0%*	*37*	*0.0%*
Taxicab	*167*	*0.2%*	*179*	*0.2%*	*200*	*0.2%*	*157*	*0.1%*
Motorcycle	419	0.4%	237	0.2%	142	0.1%	294	0.2%
Bicycle	468	0.5%	467	0.4%	488	0.4%	766	0.6%
Walked only	5,413	5.6%	4,489	3.9%	3,759	2.9%	3,966	2.9%
Other means	703	0.7%	809	0.7%	901	0.7%	1,176	0.8%
Worked at home	2,180	2.3%	3,406	3.0%	4,184	3.3%	5,918	4.3%
Total workers	96,617	100.0%	115,070	100.0%	128,279	100.0%	138,592	100.0%
Average travel time (minutes)	21.7		22.4		25.5		25.2	

Sources:
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, *Journey to Work: 2000*, Tables 1 an d 2, 1990-2000, March 2004 (www.census.gov/population/www/socdemo/journey.html).
2009 data – U.S. Bureau of the Census, *2009 American Community Survey*, Tables B08301 and S0802. (Additional resources: www.census.gov)

[a] This category was "Bus or streetcar" in 1980.
[b] Data are not available.

Table 8.16
Characteristics of U.S. Daily per Vehicle Driving vs. Dwelling Unit Type and Density

	Share of vehicles in density type	Hours per vehicle per day	Average vehicle speed (miles/hour)	Miles per vehicle per day
All classes detached single	77.0%	0.92	32.0	29.6
All classes other	23.0%	0.99	27.7	27.4
<1,000/sq. mile detached single	81.6%	0.91	34.7	31.6
<1,000/sq. mile all other	18.4%	0.91	32.5	29.5
1,000-4,000/sq. mile detached single	75.5%	0.94	27.5	26.0
1,000-4,000/sq. mile all other	24.5%	1.03	25.1	25.9
4,000-10,000/sq. mile detached single	42.5%	0.96	26.1	25.1
4,000-10,000/sq. mile all other	57.5%	1.15	21.5	24.6
10,000-25,000/sq. mile detached single	17.8%	1.02	18.2	18.5
10,000-25,000/sq. mile all other	82.2%	1.05	21.3	22.3
>25,000/sq. mile detached single	9.8%	0.72	20.5	14.8
>25,000/sq. mile all other	90.2%	1.23	21.9	26.9

Source:
Generated from the 2009 National Household Survey Internet site: nhts.ornl.gov.

Table 8.17
Housing Unit Characteristics, 2009

	Share of occupied housing units	% with garage or carport
Type of Housing Unit		
New construction (< = 4 years)	4.3%	82.3%
Manufactured/mobile homes	6.1%	38.6%
Geographic Location (Census Region)		
Northeast	18.3%	52.5%
Midwest	22.7%	73.8%
South	37.2%	60.2%
West	21.8%	80.8%
Tenure		
Owner	68.4%	79.8%
Renter	31.6%	37.5%
All Occupied Units	111,806 units	66.4%

Source:
U.S. Bureau of the Census, *2009 American Housing Survey*, Table 2-7. (Additional information: www.census.gov/prod/2011pubs/h150-09.pdf.)

The average commute time increased to 25 minutes in 2009. Two thirds of workers travel less than 30 minutes to work. In 1990, 15.9% of workers commuted less than 15 minutes; in 2009, 28.6% enjoyed the short commute.

Table 8.18
Workers by Commute Time, 1990, 2000 and 2009

Commute time	1990	2000	2009
Less than 15 minutes	15.9%	30.1%	28.6%
15–29 minutes	51.6%	36.3%	36.5%
30–39 minutes	14.7%	15.7%	16.2%
40–59 minutes	9.0%	10.7%	11.0%
60 minutes or more	5.9%	7.3%	7.8%
Average travel time (minutes)	22.4	24.3	25.2

Sources:
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)
2009 - U.S. Bureau of the Census, *2009 American Community Survey*, Tables S0802 and B08303.

Sales of bicycles with wheel sizes of 20 inches and over have grown at an average annual rate of 0.5% from 1981 to 2009. Bicycle sales experienced a large decline in 2009, which brought total sales to 14.9 million—a new low in the 18-year series.

Table 8.19
Bicycle Sales, 1981–2009
(millions)

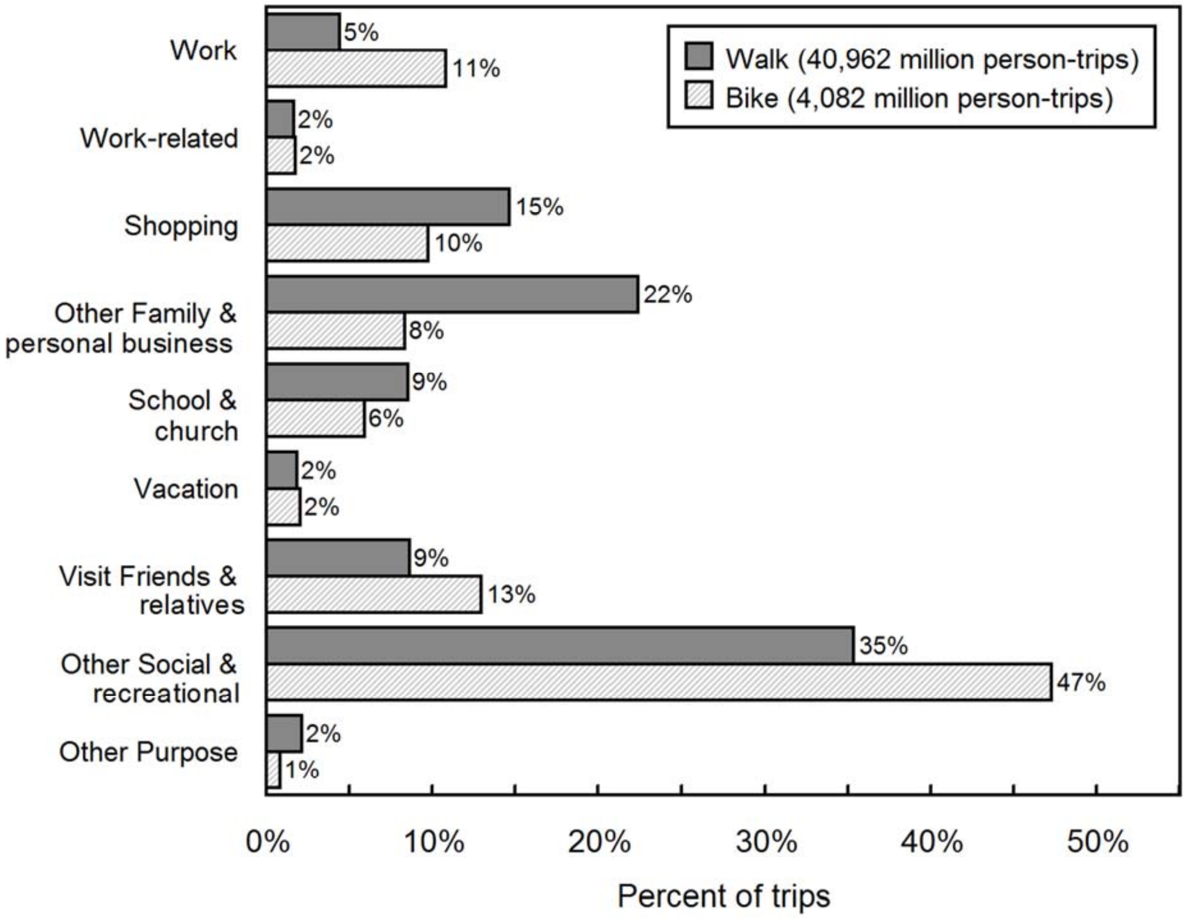
	Wheel sizes under 20 inches	Wheel sizes of 20 inches and over	All wheel sizes
1981	[a]	8.9	[a]
1982	[a]	6.8	[a]
1983	[a]	9.0	[a]
1984	[a]	10.1	[a]
1985	[a]	11.4	[a]
1986	[a]	12.3	[a]
1987	[a]	12.6	[a]
1988	[a]	9.9	[a]
1989	[a]	10.7	[a]
1990	[a]	10.8	[a]
1991	[a]	11.6	[a]
1992	3.7	11.6	15.3
1993	3.8	13.0	16.8
1994	4.2	12.5	16.7
1995	4.1	12.0	16.1
1996	4.5	10.9	15.4
1997	4.2	11.0	15.2
1998	4.7	11.1	15.8
1999	5.9	11.6	17.5
2000	9.0	11.9	20.9
2001	5.4	11.3	16.7
2002	5.9	13.6	19.5
2003	5.6	12.9	18.5
2004	5.3	13.0	18.3
2005	5.8	14.0	19.8
2006	5.5	12.7	18.2
2007	5.4	12.8	18.2
2008	5.1	13.4	18.5
2009	4.7	10.2	14.9
	Average annual percentage change		
1981–2009	[a]	0.5%	[a]
1999–2009	-2.2%	-1.3%	-1.6%

Source:
1981–1996: Bicycle Manufacturers Association. 1997–on: National Bicycle Dealers Association. (Additional resources: www.nbda.com)

[a] Data are not available.

In 2009, 4.5% of walk trips and 10.9% of bike trips were to/from work. Forty-seven percent of all bike trips were for social/recreational purposes. Nearly 15% of walk trips were shopping trips.

Figure 8.8. Walk and Bike Trips by Trip Purpose, 2009 NHTS



Source:
U.S. Department of Transportation, Federal Highway Administration, 2009 National Household Travel Survey Web site: nhts.ornl.gov.

In 2009 only data on daily trips were collected in the NHTS. The 2001 data are still the latest available on long-distance trips.

Long Distance Trips – 2001 National Household Travel Survey

The 2001 National Household Travel Survey (NHTS) collected data on long-distance trips as well as everyday travel. The everyday travel data is a continuation of the Nationwide Personal Transportation Survey (NPTS), while the long-distance travel data is a continuation of the American Travel Survey (ATS) which was collected in 1977 and 1985. The survey collected trip-related data such as mode of transportation, duration, distance and purpose of trip. It also gathered demographic, geographic, and economic data for analysis purposes.

A long-distance trip is defined as a trip of 50 miles or more, one-way. Long-trip data from the 2001 NHTS were released in the summer of 2004. For additional information about the 2001 NHTS data, contact the Bureau of Transportation Statistics at 202-366-3282 or visit the following Internet site: www.bts.gov/programs/national_household_travel_survey.

Table 8.20
Long-Distance Trip[a] Characteristics, 2001 NHTS

	Person trips		Person miles	
Trip characteristic	(thousands)	(percent)	(thousands)	(percent)
Total	2,554,068	100.0	1,138,322,697	100.0
Principal means of transportation:				
Personal use vehicles	2,310,376	90.5	735,882,255	64.7
Airplane	165,039	6.5	367,888,741	32.3
Commercial airplane	158,880	6.2	361,717,015	31.8
Bus[b]	52,962	2.1	23,747,433	2.1
Intercity bus	3,456	0.1	1,765,696	0.2
Charter, tour, or school bus	45,952	1.8	21,019,942	1.9
Train	20,672	0.8	9,266,373	0.8
Round trip distance:				
100 to 300 miles	1,688,358	66.1	284,586,370	25.0
300 to 499 miles	373,550	14.6	143,571,597	12.6
500 to 999 miles	261,802	10.3	180,669,482	15.9
1,000 to 1,999 miles	125,665	4.9	178,629,838	15.7
2,000 miles or more	104,694	4.1	350,865,409	30.8
Mean (miles)	446	[c]	[c]	[c]
Median (miles)	206	[c]	[c]	[c]
Calendar quarter:				
1st quarter	566,502	22.2	246,556,190	21.7
2nd quarter	653,310	25.6	298,154,812	26.2
3rd quarter	734,878	28.8	341,021,290	30.0
4th quarter	599,378	23.5	252,590,405	22.2
Main purpose of trip:				
Commuting	329,395	12.9	65,877,968	5.8
Other business	405,866	15.9	242,353,212	21.3
Personal/leisure	1,406,411	55.1	667,471,358	58.7
Personal business	322,645	12.6	130,020,982	11.4
Other	88,230	3.5	32,031,679	2.8
Nights away from home:				
None	1,454,847	57.0	304,469,524	26.8
1 to 3 nights	808,281	31.7	414,219,147	36.4
4 to 7 nights	214,464	8.4	269,265,597	23.7
8 or more nights	76,475	3.0	150,368,429	13.2
Destination:				
Within Census division	2,077,810	81.4	549,651,116	48.3
Across Census division, within Census	196,890	7.7	134,930,113	11.9
Across Census region	279,367	10.9	453,741,468	39.9

Source:
U.S. Bureau of Transportation Statistics and the U.S. Federal Highway Administration, 2001 National Household Transportation Survey.

Note: Long-distance trips were not included in the 2009 NHTS.

[a] A long-distance trip is defined as a trip of 50 miles or more, one-way.
[b] Includes other types of buses.
[c] Not applicable.

Chapter 9
Nonhighway Modes

Summary Statistics from Tables in this Chapter

Source		
	Passenger-miles	(millions)
Table 9.2	*Domestic and international air carrier, 2009*	*779,982*
Table 9.10	*Amtrak, 2009*	*5,914*
Table 9.11	*Commuter rail, 2009*	*11,232*
Table 9.12	*Transit rail, 2009*	*19,004*
	Freight ton-miles	(millions)
Table 9.5	*Domestic waterborne commerce, 2009*	*477,000*
Table 9.8	*Class I railroad, 2009*	*1,532,214*
	Passenger energy use	(trillion Btus)
Table 9.2	*Domestic and international air carrier, 2009*	*2,303.2*
Table 9.3	*General aviation, 2009*	*220.6*
Table 9.6	*Recreational boats, 2009*	*245.6*
Table 9.10	*Amtrak, 2009*	*14.4*
Table 9.11	*Commuter rail, 2009*	*31.6*
Table 9.12	*Transit rail, 2009*	*47.8*
	Freight energy use	(trillion Btus)
Table 9.8	*Class I railroad, 2009*	*446.6*

Nonhighway transportation modes accounted for 17.4% of total transportation energy use in 2009.

Table 9.1
Nonhighway Energy Use Shares, 1970–2009

	Share of transportation energy use					
Year	Air	Water	Pipeline	Rail	Nonhighway total	Transportation total (trillion Btu)
1970	8.5%	5.4%	6.4%	3.6%	24.0%	15,395
1971	8.1%	4.8%	6.3%	3.5%	22.8%	16,015
1972	7.7%	4.6%	6.1%	3.4%	21.9%	17,036
1973	7.7%	5.0%	5.6%	3.4%	21.7%	17,874
1974	7.3%	5.1%	5.4%	3.6%	21.5%	17,174
1975	7.3%	5.3%	4.8%	3.2%	20.7%	17,424
1976	7.2%	5.9%	4.3%	3.1%	20.6%	18,491
1977	7.1%	6.2%	4.1%	3.1%	20.4%	19,126
1978	7.1%	6.9%	3.9%	2.9%	20.8%	20,097
1979	7.6%	5.8%	4.4%	3.1%	20.9%	19,652
1980	7.6%	7.4%	4.7%	3.1%	22.8%	18,940
1981	7.8%	6.8%	4.8%	3.0%	22.4%	18,741
1982	7.9%	5.8%	4.7%	2.6%	21.1%	18,237
1983	7.8%	5.3%	4.0%	2.6%	19.8%	18,368
1984	8.5%	5.1%	4.1%	2.8%	20.5%	18,962
1985	8.7%	4.5%	3.9%	2.6%	19.8%	19,205
1986	9.0%	6.5%	3.6%	2.4%	21.5%	20,276
1987	9.1%	6.6%	3.7%	2.4%	21.9%	20,771
1988	9.3%	6.6%	4.1%	2.4%	22.4%	21,327
1989	9.1%	7.0%	4.1%	2.4%	22.6%	21,685
1990	9.6%	6.7%	4.3%	2.3%	22.9%	21,613
1991	9.1%	7.2%	4.1%	2.3%	22.6%	21,205
1992	9.0%	7.3%	3.9%	2.2%	22.4%	21,866
1993	8.9%	6.4%	4.0%	2.3%	21.6%	22,322
1994	9.0%	6.1%	4.1%	2.3%	21.6%	22,926
1995	9.1%	6.3%	4.1%	2.4%	21.9%	23,465
1996	9.2%	5.9%	4.1%	2.4%	21.6%	23,973
1997	9.5%	5.1%	4.2%	2.4%	21.2%	24,327
1998	9.6%	5.0%	3.6%	2.3%	20.5%	24,757
1999	9.5%	5.3%	3.5%	2.3%	20.6%	25,948
2000	9.7%	5.5%	3.4%	2.3%	21.0%	26,268
2001	9.3%	4.6%	3.4%	2.3%	19.6%	25,958
2002	8.3%	4.7%	3.5%	2.3%	18.8%	26,521
2003	8.3%	4.0%	3.2%	2.3%	17.8%	26,672
2004	8.7%	4.8%	3.0%	2.4%	18.9%	27,065
2005	9.0%	5.0%	3.1%	2.4%	19.4%	27,526
2006	9.0%	5.2%	3.0%	2.4%	19.7%	27,759
2007	8.6%	5.3%	3.0%	2.2%	19.1%	29,334
2008	8.4%	4.8%	3.2%	2.2%	18.5%	28,611
2009	7.7%	4.7%	3.1%	2.0%	17.4%	27,692

Source:
See Appendix A for Nonhighway Energy Use.

These data include ALL international and domestic certificated route air carrier statistics; therefore, the data are different than those in Chapter 2. Revenue aircraft-miles, passenger-miles, and seat-miles continued to decline in 2009. Passenger load factor was 80% in 2009.

Table 9.2
Summary Statistics for U.S. Domestic and International Certificated Route Air Carriers (Combined Totals), 1970–2009[a]

Year	Revenue aircraft-miles (millions)	Revenue passenger-miles (millions)	Available seat-miles (millions)	Available seats per aircraft[b]	Passenger load factor (percentage)[c]	Revenue cargo ton-miles (millions)	Energy use (trillion Btu)[d]
1970	2,542	148,137	264,904	104	55.9%	3,755	1,363.4
1975	2,241	173,324	315,823	141	54.9%	5,062	1,283.4
1980	2,924	267,722	448,479	153	59.7%	7,885	1,386.0
1985	3,462	351,073	565,677	163	62.1%	9,048	1,701.4
1986	3,873	378,923	623,075	161	60.8%	10,987	1,847.1
1987	4,182	417,808	670,825	160	62.3%	13,137	1,954.9
1988	4,354	437,649	696,337	160	62.9%	14,632	2,049.4
1989	4,442	447,480	703,888	158	63.6%	16,347	2,087.4
1990	4,724	472,236	753,211	159	62.7%	16,403	2,213.0
1991	4,661	463,296	738,030	158	62.8%	16,149	2,085.2
1992	4,899	493,715	772,869	158	63.9%	17,306	2,144.2
1993	5,118	505,996	793,959	155	63.7%	19,083	2,169.7
1994	5,360	537,518	809,259	151	66.4%	21,773	2,266.2
1995	5,627	558,794	832,081	148	67.2%	23,375	2,338.6
1996	5,855	596,164	859,721	147	69.3%	24,892	2,409.1
1997	6,025	620,029	880,715	146	70.4%	27,610	2,514.2
1998	6,220	634,933	899,029	145	70.6%	28,015	2,573.4
1999	6,558	668,626	942,311	144	71.0%	25,147	2,653.1
2000	6,946	708,926	981,080	141	72.3%	30,221	2,743.1
2001	6,814	664,849	950,519	139	69.9%	27,882	2,599.4
2002	6,834	655,215	913,898	134	71.7%	30,507	2,408.3
2003	7,367	674,160	922,440	125	73.1%	32,446	2,402.3
2004	7,479	752,341	1,000,193	134	75.2%	37,958	2,504.8
2005	7,716	795,117	1,029,316	133	77.2%	39,286	2,606.8
2006	8,220	810,086	1,027,526	125	78.8%	38,251	2,661.1
2007	8,415	842,007	1,060,093	126	79.4%	38,433	2,684.6
2008	8,145	823,770	1,040,618	128	79.2%	35,529	2,542.5
2009	7,534	779,982	975,289	129	80.0%	30,317	2,303.2
			Average annual percentage change				
1970–2009	2.8%	4.4%	3.4%	0.6%		5.5%	1.4%
1999–2009	1.4%	1.6%	0.3%	-1.1%		1.9%	-1.4%

Sources:

U.S. Department of Transportation, Bureau of Transportation Statistics, www.transtats.bts.gov. (Additional resources: www.bts.gov/programs/airline_information/air_carrier_traffic_statistics)

1970–76 Energy Use - Department of Transportation, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, 1981, and annual.

[a] Data are for all U.S. air carriers reporting on Form 41.

[b] Available seats per aircraft is calculated as the ratio of available seat-miles to revenue aircraft-miles.

[c] Passenger load factor is calculated as the ratio of revenue passenger-miles to available seat-miles for scheduled and nonscheduled services.

[d] Energy use includes fuel purchased abroad for international flights.

General aviation includes: (1) aircraft operating under general operating and flight rules; (2) not-for-hire airplanes with a seating capacity of 20 or more or a maximum payload capacity of 6,000 lbs. or more; (3) rotorcraft external load operations; (4) on-demand and commuter operations not covered under Federal Aviation Regulations Part 121; and (5) agricultural aircraft operations.

Table 9.3
Summary Statistics for General Aviation, 1970–2009

Calendar year	Total number of aircraft	Aircraft hours flown (thousands)	Energy use (trillion btu)
1970	131,700[a]	26,030[b]	94.4
1975	168,475	30,298	121.5
1976	177,964	31,950	130.3
1977	184,294	33,679	149.7
1978	199,178	36,844	159.4
1979	210,339	40,432	167.2
1980	211,045	41,016	169.0
1981	213,226	40,704	162.4
1982	209,779	36,457	170.5
1983	213,293	35,249	143.9
1984	220,943	36,119	148.9
1985	196,500	31,456	144.0
1986	205,300	31,782	148.0
1987	202,700	30,883	139.1
1988	196,200	31,114	148.6
1989	205,000	32,332	134.0
1990	198,000	32,096	131.9
1991	196,874	29,862	120.4
1992	185,650	26,747	104.7
1993	177,120	24,455	97.5
1994	172,935	24,092	95.3
1995	188,089	26,612	106.6
1996	191,129	26,909	111.1
1997	192,414	27,713	121.1
1998	204,710	28,100	147.4
1999	219,464	31,231	172.1
2000	217,533	29,960	175.2
2001	211,446	27,017	165.1
2002	211,244	27,040	141.5
2003	209,708	27,329	141.4
2004	219,426	28,126	175.9
2005	224,352	26,982	242.4
2006	221,943	27,705	256.3
2007	231,607	27,852	243.6
2008	228,663	26,009	265.7
2009	223,877	23,763	220.6
	Average annual percentage change		
1970–2009	1.4%	-0.2%	2.2%
1999–2009	0.2%	-2.7%	2.5%

Sources:
U.S. Department of Transportation, Federal Aviation Administration, *General Aviation Activity and Avionics Survey: Calendar Year 2009*, Tables 1.2, 1.5, 5.1, and annual. (Additional resources: www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2009/)

[a] Active fixed-wing general aviation aircraft only.
[b] Includes rotorcraft.

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. Total foreign and domestic tons shipped were about 2.2 billion tons in 2009, down from a peak of 2.59 billion tons in 2006.

Table 9.4
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970–2009
(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	2,333	1,221	1,113	47.7%
1998	2,340	1,245	1,094	46.8%
1999	2,323	1,261	1,062	45.7%
2000	2,425	1,355	1,070	44.1%
2001	2,393	1,351	1,042	43.5%
2002	2,340	1,319	1,021	43.6%
2003	2,394	1,378	1,016	42.4%
2004	2,552	1,505	1,047	41.0%
2005	2,527	1,499	1,029	40.7%
2006	2,588	1,565	1,023	39.5%
2007	2,564	1,543	1,022	39.9%
2008	2,477	1,521	956	38.6%
2009	2,211	1,354	857	38.8%
		Average annual percentage change		
1970–2009	0.9%	2.2%	-0.3%	
1999–2009	-0.5%	0.7%	-2.1%	

Source:
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2009*, New Orleans, Louisiana, 2010, Table 1-1. (Additional resources: www.ndc.iwr.usace.army.mil)

[a] All movements between the United States 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 United States, Puerto Rico, and the Virgin Islands, excluding the Panama Canal. Beginning in 1996, fish was excluded for internal and intra port domestic traffic.

The U.S. Army Corps of Engineers Navigation Data Center collects a wealth of waterborne commerce data. Energy use data, however, have never been collected as part of this effort. The energy use data collected by the Energy Information Administration (EIA) on vessel bunkering was formerly displayed on this table. The EIA data include different uses of fuel, not just fuel for domestic waterborne commerce; therefore it was misleading to display those data together.

Table 9.5
Summary Statistics for Domestic Waterborne Commerce, 1970–2009

Year	Number of vessels[a]	Ton-miles (billions)	Tons shipped[b] (millions)	Average length of haul (miles)
1970	25,832	596	949	628.2
1975	31,666	566	944	599.9
1980	38,792	922	1,074	856.4
1985	41,672	893	1,011	883.5
1986	40,308	873	1,033	845.3
1987	40,000	895	1,072	835.0
1988	39,192	890	1,106	804.3
1989	39,209	816	1,097	743.2
1990	41,119	834	1,118	745.7
1991	39,233	848	1,074	789.9
1992	39,210	857	1,090	785.7
1993	39,064	790	1,063	742.7
1994	39,064	815	1,093	745.5
1995	39,445	808	1,086	743.6
1996	41,104	765	1,093	699.4
1997	41,419	707	1,106	639.5
1998	42,032	673	1,087	619.0
1999	41,766	656	1,056	621.1
2000	39,641	646	1,064	606.8
2001	41,588	622	1,037	599.7
2002	41,002	612	1,016	602.5
2003	39,983	606	1,010	600.3
2004	40,290	621	1,042	596.4
2005	41,354	591	1,024	577.4
2006	41,109	562	1,018	548.7
2007	40,695	553	1,016	544.2
2008	40,301	521	952	546.7
2009	40,109	477	852	559.7
		Average annual percentage change		
1970–2009	1.1%	-0.6%	-0.3%	-0.3%
1999–2009	-0.4%	-3.1%	-2.1%	-1.0%

Sources:

Number of vessels -1970–92, 1995–2006 - U.S. Department of the Army, Corps of Engineers, *Waterborne Transportation Lines of the United States, 2009,* New Orleans, LA, 2010, Table 2, p. 6, and annual. 1993–94 - U.S. Department 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 2009, Part 5: National Summaries*, New Orleans, LA, 2010, Table 1-4, pp. 1-6, 1-7, and annual. (Additional resources: www.iwr.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 9.3 because intra-territory tons are not included in this table. Intra-territory traffic is traffic between ports in Puerto Rico and the Virgin Islands.

The data displayed in this table come from the Environmental Protection Agency's NONROAD2008a model.

Table 9.6
Recreational Boat Energy Use, 1970–2009

Year	Number of boats (thousands)	Diesel fuel (trillion Btu)	Gasoline (trillion Btu)	Total energy use (trillion Btu)
1970	10,087	5.5	151.7	157.2
1971	10,137	6.5	152.6	159.2
1972	10,187	7.6	153.6	161.2
1973	10,237	8.6	154.5	163.2
1974	10,287	9.7	155.5	165.1
1975	10,337	10.7	156.4	167.1
1976	10,387	11.8	157.4	169.1
1977	10,437	12.8	158.3	171.1
1978	10,487	13.9	159.3	173.1
1979	10,537	14.9	160.2	175.1
1980	10,587	16.0	161.2	177.1
1981	10,637	17.0	162.1	179.1
1982	10,687	18.0	163.1	181.1
1983	10,737	19.1	164.0	183.1
1984	10,787	20.1	165.0	185.1
1985	10,837	21.2	165.9	187.1
1986	10,887	22.2	166.9	189.1
1987	10,937	23.3	167.8	191.1
1988	11,030	24.3	170.4	194.7
1989	11,122	25.4	172.9	198.3
1990	11,215	26.4	175.4	201.8
1991	11,327	27.5	178.7	206.2
1992	11,440	28.5	182.0	210.5
1993	11,553	29.5	185.3	214.8
1994	11,770	30.6	192.5	223.1
1995	11,988	31.6	199.7	231.3
1996	12,206	32.7	206.8	239.5
1997	12,244	33.7	207.2	240.9
1998	12,283	34.8	207.4	242.2
1999	12,321	35.8	207.1	243.0
2000	12,359	36.8	206.6	243.4
2001	12,464	37.9	206.9	244.9
2002	12,568	39.0	206.7	245.7
2003	12,673	40.2	206.0	246.2
2004	12,777	41.3	205.0	246.2
2005	12,882	42.4	203.7	246.1
2006	12,984	43.5	202.5	245.9
2007	13,086	44.6	201.2	245.8
2008	13,189	45.7	200.0	245.7
2009	13,291	46.8	198.8	245.6
		Average annual percentage change		
1970–2009	0.7%	5.6%	0.7%	0.0%
1999–2009	0.8%	2.7%	-0.4%	0.1%

Source:
U.S. Environmental Protection Agency, NONROAD2008a model, downloadable file from http://www.epa.gov/otaq/nonrdmdl.htm.

The Interstate Commerce Commission designates Class I railroads on the basis of annual gross revenues. In 2009, seven railroads were given this designation. The number of railroads designated as Class I has changed considerably in the last 30 years; in 1976 there were 52 railroads given Class I designation. For detailed information by railroad, see the 2010 Vehicle Technologies Market Report at url http://www1.eere.energy.gov/vehiclesandfuels/pdfs/2010_vt_market_rpt.pdf .

Table 9.7
Class I Railroad Freight Systems in the United States
Ranked by Revenue Ton-Miles, 2009

Railroad	Revenue ton-miles (billions)	Percent
Burlington Northern and Santa Fe Railway Company	594	38.7%
Union Pacific Railroad Company	479	31.2%
CSX Transportation	209	13.6%
Norfolk Southern Railway	159	10.4%
Canadian National, Grand Trunk Corporation	43	2.8%
Kansas City Southern Railway Company	29	1.9%
Soo Line Railroad Company	20	1.3%
Total	**1,533**	**100.0%**

Source:
Association of American Railroads, *Railroad Facts*, *2010 Edition*, Washington, DC, November 2010, p. 66. (Additional resources: www.aar.org)

Revenue ton-miles for Class I freight railroads was over 1.7 trillion in 2009. Though there are many regional and local freight railroads, the Class I freight railroads accounted for 93% of the railroad industry's freight revenue in 2009 and 67% of the industry's mileage operated. The energy intensity of Class I railroads hit an all-time low of 291 btu/ton-mile in 2009.

Table 9.8
Summary Statistics for Class I Freight Railroads, 1970–2009

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	27,846	1,359	403	27,656	1,395	541	754,252	687	518.3
1980	28,094	1,168	428	29,277	1,492	616	918,958	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	469.9
1985	22,548	867	347	24,920	1,320	665	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	363	520.0
2000	20,028	560	504	34,590	1,738	843	1,465,960	352	516.0
2001	19,745	500	500	34,243	1,742	859	1,495,472	346	517.3
2002	20,506	478	500	34,680	1,767	853	1,507,011	345	520.3
2003	20,774	467	516	35,555	1,799	862	1,551,438	344	533.9
2004	22,015	474	535	37,071	1,844	902	1,662,598	341	566.2
2005	22,779	475	548	37,712	1,899	894	1,696,425	337	571.4
2006	23,732	475	563	38,995	1,957	906	1,771,897	330	584.5
2007	24,143	460	543	38,186	1,940	913	1,770,545	320	566.9
2008	24,003	450	524	37,226	1,934	919	1,777,236	305	542.5
2009	24,045	416	436	32,115	1,668	919	1,532,214	291	446.6
				Average annual percentage change					
1970–2009	-0.3%	-3.1%	0.1%	0.2%	0.3%	1.5%	1.8%	-2.2%	-0.4%
1999–2009	1.7%	-3.3%	-1.2%	-0.5%	-0.3%	1.0%	0.7%	-2.2%	-1.5%

Source:
Association of American Railroads, *Railroad Facts*, *2010 Edition*, Washington, DC, November 2010, pp. 27, 28, 33, 34, 36, 49, 52, 61. (Additional resources: www.aar.org)

[a] Does not include self-powered units.

[b] Does not include private or shipper-owned cars. Beginning in 2001, Canadian-owned U.S. railroads are excluded.

[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.

According to the 2007 Commodity Flow Survey, 7% of all freight ton-miles are rail intermodal shipments (truck/rail or rail/water). See Table 5.15 for details. The number of trailers and containers moved by railroads has increased almost six-fold from 1965 to 2009. Containerization has increased in the last two decades, evidenced by the 258% increase in the number of containers from 1988 to 2009. The number of trailers moved by rail, however, fell to an all-time low in 2009.

Table 9.9
Intermodal Rail Traffic, 1965–2009[a]

Year	Trailers & containers	Trailers	Containers
1965	1,664,929	[b]	[b]
1970	2,363,200	[b]	[b]
1975	2,238,117	[b]	[b]
1980	3,059,402	[b]	[b]
1981	3,150,522	[b]	[b]
1982	3,396,973	[b]	[b]
1983	4,090,078	[b]	[b]
1984	4,565,743	[b]	[b]
1985	4,590,952	[b]	[b]
1986	4,997,229	[b]	[b]
1987	5,503,819	[b]	[b]
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	7,936,172	3,492,463	4,443,709
1996	8,143,258	3,302,128	4,841,130
1997	8,698,308	3,453,907	5,244,401
1998	8,772,663	3,353,032	5,419,631
1999	8,907,626	3,207,407	5,700,219
2000	9,176,890	2,888,630	6,288,260
2001	8,935,444	2,603,423	6,332,021
2002	9,312,360	2,531,338	6,781,022
2003	9,955,605	2,625,837	7,329,768
2004	10,993,662	2,928,123	8,065,539
2005	11,693,512	2,979,906	8,713,606
2006	12,282,221	2,882,699	9,399,522
2007	12,026,631	2,600,635	9,425,996
2008	11,499,978	2,478,890	9,021,088
2009	9,880,602	1,640,672	8,239,930
	Average annual percentage change		
1965–2009	4.1%	[b]	[b]
1999–2009	1.0%	-6.5%	3.8%

Source:
Association of American Railroads, *Railroad Facts*, *2010 Edition*, Washington, DC, November 2010, p. 26. Additional resources: www.aar.org)

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[a] Beginning in 1995, the Grand Trunk Western Railroad and the Soo Line Railroad Company are excluded. Beginning in 1999, the Illinois Central data are ex cluded. Beginning in 2002, the Wisconsin Central data are excluded.

[b] Data are not available.

The National Railroad Passenger Corporation, known as Amtrak, began operation in 1971. Amtrak revenue passenger-miles have grown at an average annual rate of 2.9% from 1971 to 2009.

Table 9.10
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971–2009

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	3,548	13.3
1980	448	2,128	29,487	235,235	4,503	217	3,065	13.8
1981	398	1,830	30,380	222,753	4,397	226	2,883	12.7
1982	396	1,929	28,833	217,385	3,993	220	3,052	12.2
1983	388	1,880	28,805	223,509	4,227	223	2,875	12.2
1984	387	1,844	29,133	234,557	4,427	227	2,923	12.9
1985	382	1,818	30,038	250,642	4,785	238	2,703	12.9
1986	369	1,793	28,604	249,665	5,011	249	2,481	12.4
1987	381	1,850	29,515	261,054	5,361	259	2,450	13.1
1988	391	1,845	30,221	277,774	5,686	265	2,379	13.5
1989	312	1,742	31,000	285,255	5,859	274	2,614	15.3
1990	318	1,863	33,000	300,996	6,057	273	2,505	15.2
1991	316	1,786	34,000	312,484	6,273	285	2,417	15.2
1992	336	1,796	34,000	307,282	6,091	286	2,534	15.4
1993	360	1,853	34,936	302,739	6,199	280	2,565	15.9
1994	411	1,874	34,940	305,600	5,869	276	2,282	13.4[b]
1995	422	1,907	31,579	282,579	5,401	266	2,501	13.5
1996	348	1,501	30,542	277,750	5,066	257	2,690	13.6
1997	292	1,572	32,000	287,760	5,166	255	2,811	14.5
1998	362	1,347	32,926	315,823	5,325	251	2,788	14.8
1999	385	1,285	34,080	349,337	5,289	245	2,943	15.6
2000	385	1,891	35,404	371,215	5,574	243	3,235	18.0
2001	401	2,084	36,512	377,705	5,571	238	3,257	18.1
2002	372	2,896	37,624	378,542	5,314	228	3,212	17.1
2003	442	1,623	37,459	331,864	5,680	231	2,800	15.9
2004	276	1,211	37,159	308,437	5,511	219	2,760	15.2
2005	258	1,186	36,199	264,796	5,381	215	2,709	14.6
2006	319	1,191	36,083	263,908	5,410	220	2,650	14.3
2007	270	1,164	37,484	266,545	5,784	218	2,516	14.5
2008	278	1,177	37,736	271,762	6,179	215	2,398	14.8
2009	274	1,214	38,300	282,764	5,914	217	2,435	14.4
				Average annual percentage change				
1971–2009	[a]	0.1%	2.2%	1.9%	2.9%	0.4%	[a]	[a]
1999–2009	-3.3%	-0.6%	1.2%	-2.1%	0.6%	-1.1%	-2.8%	-0.8%

Sources:

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.

1994–2009 - 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*, *2010 Edition*, Washington, DC, 2010, p. 77.

Energy use - Personal communication with the Amtrak, Washington, DC. (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.

Commuter rail, which is also known as regional rail or suburban rail, is long-haul rail passenger service operating between metropolitan and suburban areas, whether within or across state lines. Commuter rail lines usually have reduced fares for multiple rides and commutation tickets for regular, recurring riders.

Table 9.11
Summary Statistics for Commuter Rail Operations, 1984–2009

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)	Passenger-miles (millions)	Average trip length (miles)	Energy intensity (Btu/passenger-mile)	Energy use (trillion Btu)
1984	4,075	167.9	267	6,207	23.2	2,804	17.4
1985	4,035	182.7	275	6,534	23.8	2,826	18.5
1986	4,440	188.6	306	6,723	22.0	2,926	19.7
1987	4,686	188.9	311	6,818	21.9	2,801	19.1
1988	4,649	202.2	325	6,964	21.4	2,872	19.7
1989	4,472	209.6	330	7,211	21.9	2,864	20.7
1990	4,982	212.7	328	7,082	21.6	2,822	20.0
1991	5,126	214.9	318	7,344	23.1	2,770	20.3
1992	5,164	218.8	314	7,320	23.3	2,629	19.2
1993	4,982	223.9	322	6,940	21.6	2,976	20.7
1994	5,126	230.8	339	7,996	23.6	2,682	21.4
1995	5,164	237.7	344	8,244	24.0	2,632	21.7
1996	5,240	241.9	352	8,351	23.7	2,582	21.6
1997	5,426	250.7	357	8,038	22.5	2,724	21.9
1998	5,536	259.5	381	8,704	22.8	2,646	23.0
1999	5,550	265.9	396	8,766	22.1	2,714	23.8
2000	5,498	270.9	413	9,402	22.8	2,551	24.0
2001	5,572	277.3	419	9,548	22.8	2,515	24.0
2002	5,724	283.7	414	9,504	22.9	2,514	23.9
2003	5,959	286.0	410	9,559	23.3	2,545	24.3
2004	6,228	294.7	414	9,719	23.5	2,569	25.0
2005	6,392	303.4	423	9,473	22.4	2,743	26.0
2006	6,403	314.7	441	10,361	23.5	2,527	26.2
2007	6,391	325.7	459	11,153	24.3	2,638	29.4
2008	6,617	310.2	472	11,049	23.4	2,656	29.3
2009	6,941	343.5	468	11,232	24.0	2,812	31.6
Average annual percentage change							
1984–2009	2.2%	2.9%	2.3%	2.4%	0.1%		
1999–2009	2.3%	2.6%	1.7%	2.5%	0.8%		

Source:
American Public Transportation Association, *2011 Public Transportation Fact Book*, Washington, DC, April 2011, Tables 5, 6, 8, and 9. (Additional resources: www.apta.com)

This table on transit rail operations includes data on light rail and heavy rail systems. Light rail vehicles are usually single vehicles driven electrically with power drawn from overhead wires. Heavy rail is characterized by high speed and rapid acceleration of rail cars operating on a separate right-of-way.

Table 9.12
Summary Statistics for Rail Transit Operations, 1970–2009[a]

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)[b]	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]	2,157	26.5
1975	10,617	446.9	1,797	10,423	[f]	2,625	27.4
1980	10,654	402.2	2,241	10,939	4.9	2,312	25.3
1981	10,824	436.6	2,217	10,590	4.8	2,592	27.5
1982	10,831	445.2	2,201	10,428	4.7	2,699	28.1
1983	10,904	423.5	2,304	10,741	4.7	2,820	30.3
1984	10,848	452.7	2,388	10,531	4.4	3,037	32.0
1985	11,109	467.8	2,422	10,777	4.4	2,809	30.3
1986	11,083	492.8	2,467	11,018	4.5	3,042	33.5
1987	10,934	508.6	2,535	11,603	4.6	3,039	35.3
1988	11,370	538.3	2,462	11,836	4.8	3,072	36.2
1989	11,261	553.4	2,704	12,539	4.6	2,909	36.5
1990	11,332	560.9	2,521	12,046	4.8	3,024	36.4
1991	11,426	554.8	2,356	11,190	4.7	3,254	36.4
1992	11,303	554.0	2,395	11,438	4.8	3,155	36.1
1993	11,286	549.8	2,234	10,936	4.9	3,373	36.9
1994	11,192	565.8	2,453	11,501	4.7	3,338	38.4
1995	11,156	571.8	2,284	11,419	5.0	3,340	38.1
1996	11,341	580.7	2,418	12,487	5.2	3,017	37.7
1997	11,471	598.9	2,692	13,091	4.9	2,856	37.4
1998	11,521	609.5	2,669	13,412	5.0	2,823	37.9
1999	11,603	626.4	2,813	14,108	5.0	2,785	39.3
2000	12,168	648.0	2,952	15,200	5.1	2,797	42.5
2001	12,084	662.4	3,064	15,615	5.1	2,803	43.8
2002	12,479	681.9	3,025	15,095	5.0	2,872	43.3
2003	12,236	694.2	3,005	15,082	5.0	2,837	42.8
2004	12,480	709.7	3,098	15,930	5.1	2,750	43.8
2005	12,755	715.4	3,189	16,118	5.1	2,783	44.9
2006	12,853	726.4	3,334	16,587	5.0	2,707	44.9
2007	13,032	741.2	3,879	18,070	4.7	2,577	46.6
2008	13,346	762.8	4,001	18,941	4.7	2,521	47.8
2009	13,529	775.3	3,955	19,004	4.8	2,516	47.8
			Average annual percentage change				
1970–2009	0.6%	1.5%	1.6%	1.1%	-0.1%[g]	0.4%	1.5%
1999–2009	1.5%	2.2%	3.5%	3.0%	-0.4%	-1.0%	2.0%

Sources:
American Public Transportation Association, *2011 Public Transportation Fact Book*, Washington, DC, April 2011, Table 27. (Additional resources: www.apta.com)
Energy use - See Appendix A for Rail Transit Energy Use.

[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 1980–2009.

Chapter 10
Transportation and the Economy

Summary Statistics from Tables/Figures in this Chapter

Source		
Figure 10.2	Share of gasoline cost attributed to taxes, 2010	
	Canada	*35%*
	France	*62%*
	Germany	*63%*
	Japan	*46%*
	United Kingdom	*64%*
	United States	*18%*
Table 10.12	Average price of a new car, 2009 (current dollars)	23,186
	Domestic	*22,107*
	Import	*25,308*
Table 10.13	Car operating costs, 2010	
	Variable costs (constant 2010 dollars per 10,000 miles)	*1,673*
	Fixed costs (constant 2010 dollars per 10,000 miles)	*5,719*
Table 10.17	Transportation sector share of total employment	
	2000	*8.3%*
	2010	*7.1%*

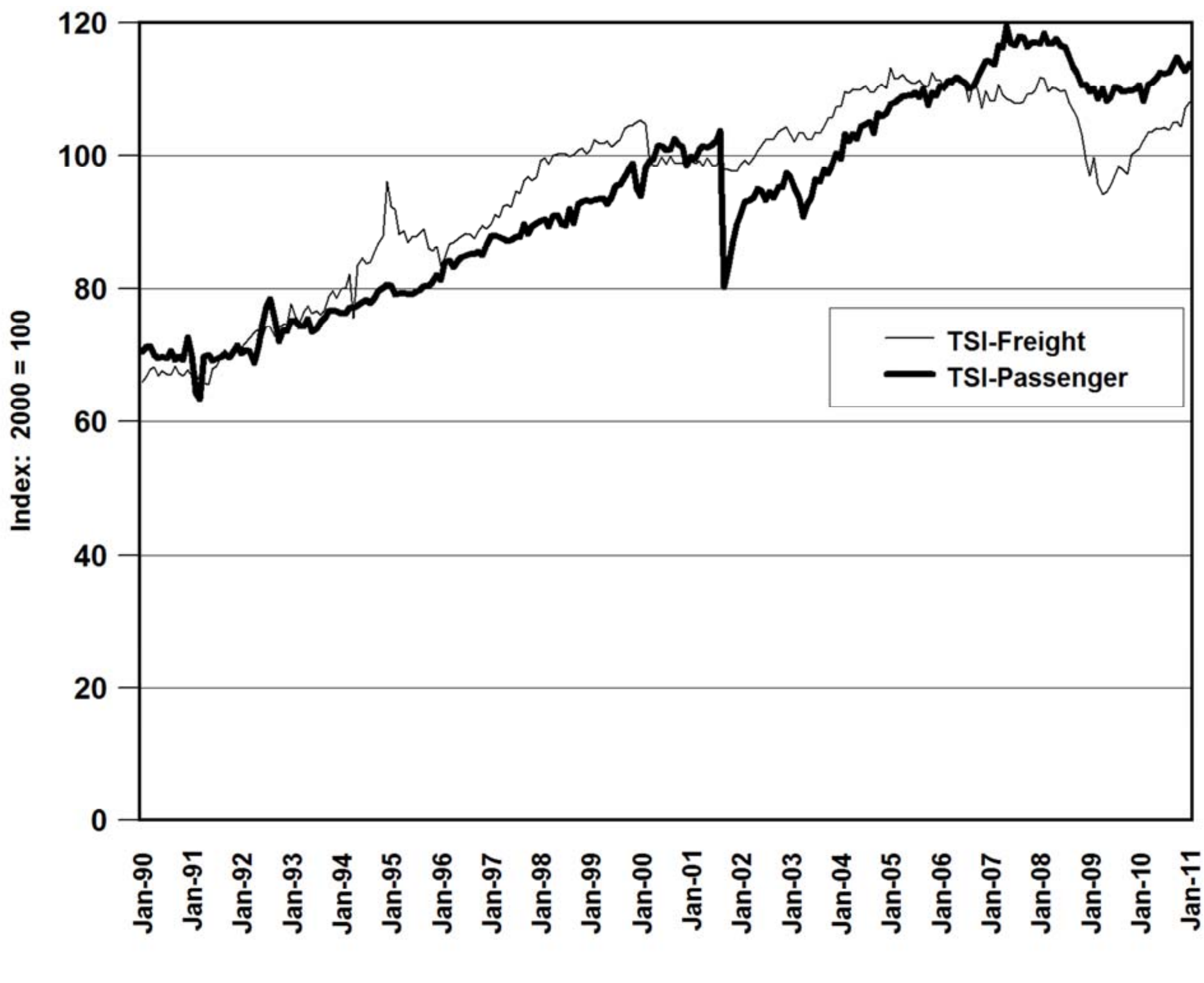
The Transportation Services Index (TSI) was created by the U.S. Department of Transportation Bureau of Transportation Statistics (BTS). It is an index that measures the movement of freight and passengers. The Freight TSI consists of:

- *for-hire trucking (parcel services are not included);*
- *freight railroad services (including rail-based intermodal shipments such as containers on flat cars);inland waterway traffic;*
- *pipeline movements (including principally petroleum and petroleum products and natural gas);*
- *and air freight.*

The index does not include international or coastal steamship movements, private trucking, courier services, or the United States Postal Services.

The index does not include intercity bus, sightseeing services, taxi service, private automobile usage, or bicycling and other nonmotorized means of transportation.

Figure 10.1. Transportation Services Index, January 1990–January 2011



Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index Web site, www.bts.gov/xml/tsi/src. (Additional resources: www.bts.gov.)

Until 2007, gasoline prices in China were, on average, less than the United States. Since then, the United States prices are the lowest of these listed countries. Those in France, the United Kingdom, and Germany paid, on average, more than six dollars per gallon.

Table 10.1
Gasoline Prices[a] for Selected Countries, 1990–2010

	Current dollars per gallon							Average annual percentage change
	1990	1995	2000	2005	2007	2009	2010[b]	1990–2010
China	[c]	1.03	[c]	1.70	2.29	3.27	[c]	[c]
Japan	3.16	4.43	3.65	4.28	4.49	4.86	5.93	3.2%
France[d]	3.63	4.26	3.80	5.46	6.60	6.35	6.72	3.1%
United Kingdom[d]	2.82	3.21	4.58	5.97	7.15	5.86	6.81	4.5%
Germany	2.65	3.96	3.45	5.66	6.88	6.81	6.86	4.9%
Canada	1.87	1.53	1.86	2.89	3.59	3.15	3.72	3.5%
United States[e]	1.16	1.15	1.51	2.27	2.80	2.34	2.72	4.3%
	Constant 2010 dollars[f] per gallon							Average annual percentage change
	1990	1995	2000	2005	2007	2009	2010[b]	1990–2010
China	[c]	1.47	[c]	1.90	2.41	3.33	[c]	[c]
Japan	5.27	6.34	4.62	4.78	4.73	4.94	5.93	0.6%
France[d]	6.06	6.10	4.81	6.09	6.94	6.45	6.72	0.6%
United Kingdom[d]	4.70	4.59	5.80	6.66	7.52	5.96	6.81	1.9%
Germany	4.42	5.67	4.37	6.31	7.24	6.92	6.86	2.3%
Canada	3.12	2.19	2.36	3.22	3.78	3.20	3.72	0.9%
United States[e]	1.94	1.65	1.91	2.54	2.94	2.38	2.72	1.8%

Source:
International Energy Agency, *Energy Prices and Taxes, Fourth Quarter, 2010*, Paris, France, 2011. (Additional resources: www.iea.org)

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.

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[a] Prices represent the retail prices (including taxes) for regular unleaded gasoline, except for France and the United Kingdom which are premium unleaded gasoline.
[b] 3rd quarter 2010.
[c] Data are not available.
[d] Premium gasoline.
[e] These estimates are international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.
[f] Adjusted by the U.S. Consumer Price Inflation Index.

Of these selected countries, the United Kingdom had the highest diesel fuel price average in 2010, while the United States had the lowest. Similar to the trend with gasoline prices, China's diesel prices were lower than the United States until 2007.

Table 10.2
Diesel Fuel Prices[a] for Selected Countries, 1998–2010

	Current dollars per gallon								Average annual percentage change
	1998	2000	2003	2004	2005	2007	2009	2010[b]	1998–2010
China	[c]	[c]	1.32	1.47	1.69	2.42	3.23	[c]	[c]
Japan	2.25	2.85	2.76	3.08	3.45	3.82	4.19	5.04	7.0%
France	2.71	2.95	3.39	4.16	4.81	5.66	5.27	5.59	6.2%
United Kingdom	4.10	4.66	4.82	5.68	6.25	7.34	6.14	6.95	4.5%
Germany	2.45	2.79	3.79	4.41	5.01	6.06	5.73	5.94	7.7%
United States[d]	1.04	1.50	1.51	1.81	2.40	2.88	2.46	2.94	9.0%
	Constant 2010 dollars[e] per gallon								Average annual percentage change
	1998	2000	2003	2004	2005	2007	2009	2010[b]	1998–2010
China	[c]	[c]	1.57	1.70	1.89	2.55	3.28	[c]	[c]
Japan	3.01	3.61	3.27	3.56	3.85	4.02	4.26	5.04	4.4%
France	3.62	3.73	4.02	4.80	5.37	5.95	5.35	5.59	3.7%
United Kingdom	5.49	5.90	5.71	6.56	6.98	7.72	6.24	6.95	2.0%
Germany	3.28	3.54	4.49	5.09	5.59	6.37	5.83	5.94	5.1%
United States[d]	1.40	1.89	1.79	2.08	2.68	3.03	2.50	2.94	6.4%

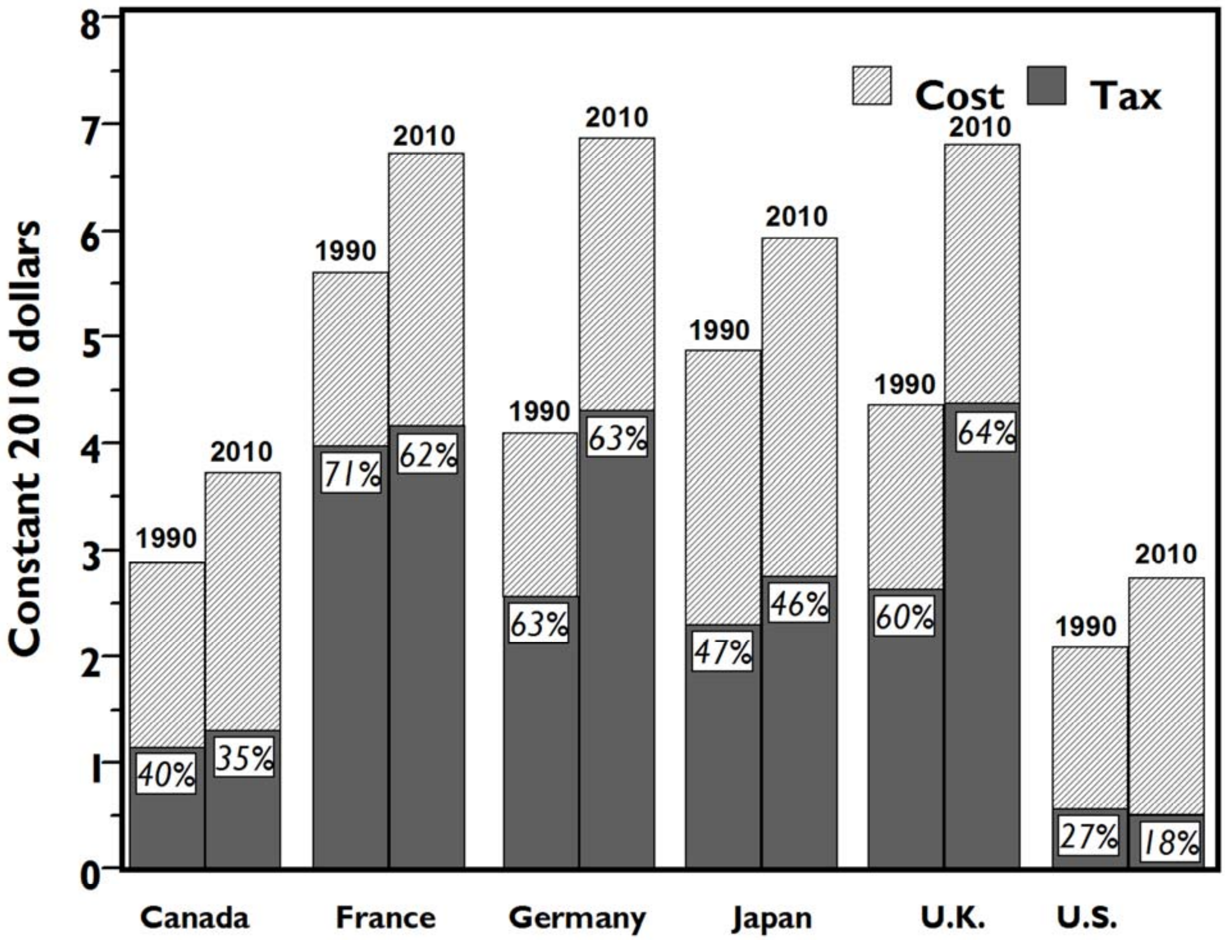
Source:
International Energy Agency, *Energy Prices and Taxes, Fourth Quarter, 2010*, Paris, France, 2011 (Additional resources: www.iea.org)

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 automotive diesel fuel for non-commercial (household) use.
[b] 3rd quarter 2010.
[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 2010 more than sixty percent of the cost of gasoline in France, Germany, and the United Kingdom went for taxes. Of the listed countries, the United States has the lowest percentage of taxes.

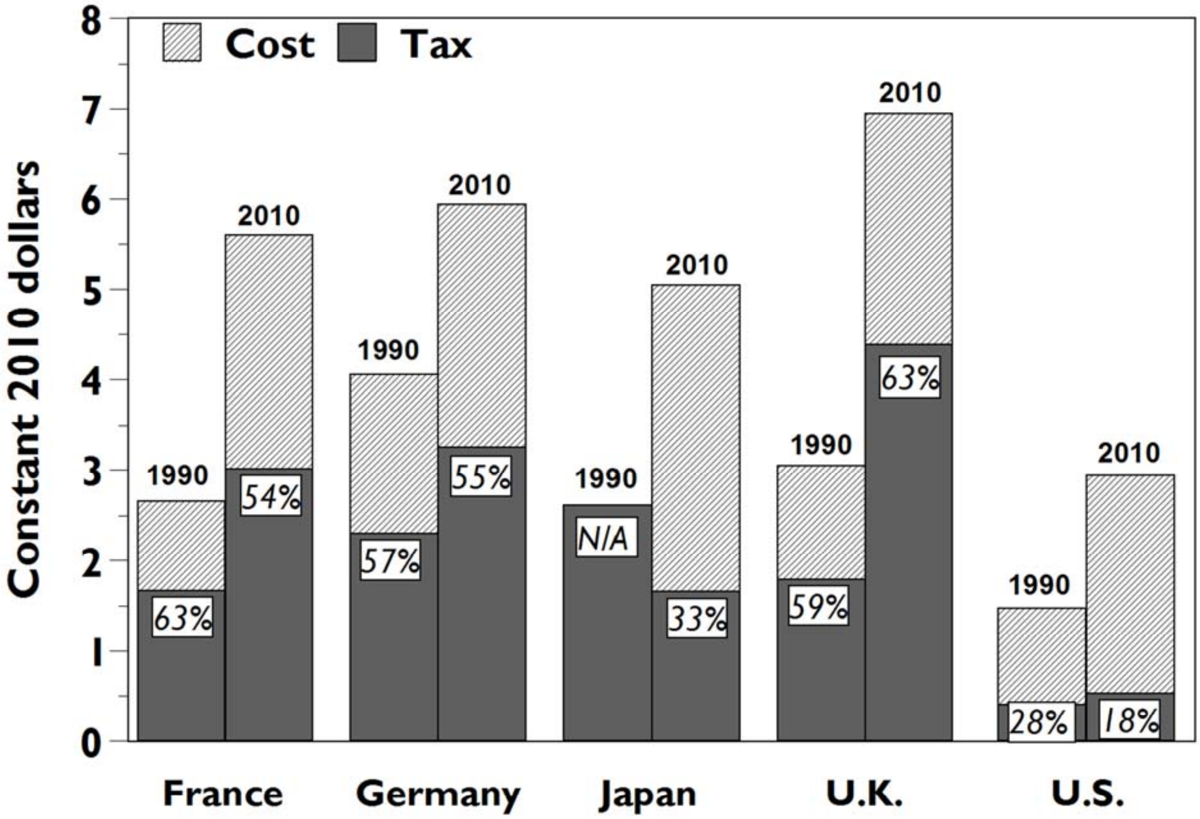
Figure 10.2. Gasoline Prices for Selected Countries, 1990 and 2010



Source:
Table 10.1 and International Energy Agency, *Energy Prices & Taxes, Fourth Quarter, 2010,* Paris, France, 2011. (Additional resources: www.iea.org.)

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 10.3. Diesel Prices for Selected Countries, 1990 and 2010



Source:
Table 10.2 and International Energy Agency, *Energy Prices & Taxes, Fourth Quarter, 2010,* Paris, France, 2011. (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 2010 dollars) increased by 114% from 2000 to 2010, while the average price of a gallon of gasoline increased 43% in this same time period.

Table 10.3
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978–2010

	Crude oil[a] (dollars per barrel)		Gasoline[b] (cents per gallon)		Ratio of gasoline to crude oil
Year	Current	Constant 2010[c]	Current	Constant 2010[c]	
1978	12.5	41.7	65.2	218.1	219.8
1979	17.7	53.2	88.2	264.9	209.1
1980	28.1	74.3	122.1	323.1	182.7
1981	35.2	84.5	135.3	324.6	161.3
1982	31.9	72.0	128.1	289.5	168.8
1983	29.0	63.5	122.5	268.2	177.5
1984	28.6	60.1	119.8	251.4	175.7
1985	26.8	54.2	119.6	242.4	187.8
1986	14.6	28.9	93.1	185.2	268.7
1987	17.9	34.4	95.7	183.7	224.5
1988	14.7	27.0	96.3	177.5	275.7
1989	18.0	31.6	106.0	186.4	247.7
1990	22.2	37.1	121.7	203.0	230.0
1991	19.1	30.5	119.6	191.5	263.5
1992	18.4	28.6	119.0	185.0	271.2
1993	16.4	24.8	117.3	177.0	300.2
1994	15.6	22.9	117.4	172.7	316.3
1995	17.2	24.7	120.5	172.4	293.7
1996	20.7	28.8	128.8	179.0	261.2
1997	19.0	25.9	129.1	175.4	284.8
1998	12.5	16.7	111.5	149.2	374.0
1999	17.5	22.9	122.1	159.8	292.9
2000	28.3	35.8	156.3	197.9	232.3
2001	23.0	28.3	153.1	188.5	280.2
2002	24.1	29.2	144.1	174.7	251.1
2003	28.5	33.8	163.8	194.1	241.1
2004	37.0	42.7	192.3	222.0	218.4
2005	50.2	56.1	233.8	261.0	195.5
2006	60.2	65.2	263.5	285.0	183.7
2007	67.9	71.5	284.9	299.6	176.1
2008	94.7	96.0	331.7	335.9	147.1
2009	59.3	60.2	240.1	244.0	170.1
2010	76.7	76.7	283.6	283.6	155.3
		Average annual percentage change			
1978–2010	5.8%	1.9%	4.7%	0.8%	
2000–2010	10.5%	7.9%	6.1%	3.7%	

Sources:
Crude oil - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* March 2011, Washington, DC, Table 9.1.
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review,* March 2011, 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.

Diesel fuel price has generally been lower than gasoline; however, from 2005 through 2010 the price of diesel fuel was higher than that of gasoline.

Table 10.4
Retail Prices for Motor Fuel, 1978–2010
(cents per gallon, including tax)

	Diesel fuel[a]		Average for all gasoline types[b]	
Year	Current	Constant 2010[c]	Current	Constant 2010[c]
1978	[d]	[d]	65	218
1979	[d]	[d]	88	265
1980	101	267	122	323
1981	118	283	135	325
1982	116	262	128	289
1983	120	263	123	268
1984	122	256	120	251
1985	122	247	120	242
1986	94	187	93	185
1987	96	184	96	184
1988	95	175	96	178
1989	102	179	106	186
1990	107	179	122	203
1991	91	146	120	191
1992	106	165	119	185
1993	98	148	117	177
1994	111	164	117	173
1995	111	159	121	172
1996	124	172	129	179
1997	120	163	129	175
1998	104	140	112	149
1999	112	147	122	160
2000	149	189	156	198
2001	140	172	153	189
2002	132	160	144	175
2003	151	179	164	194
2004	181	209	192	222
2005	240	268	234	261
2006	271	293	264	285
2007	289	303	285	300
2008	380	385	332	336
2009	247	251	240	244
2010	299	299	284	284
	Average annual percentage change			
1978–2010	3.7%[e]	-0.4%[e]	4.7%	0.8%
2000–2010	7.2%	4.7%	6.2%	3.7%

Sources:
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2011, Washington, DC, Table 9.4.
Diesel - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 2004*, Washington, DC, June 2004, Table 7.2. 2005–2010 data from EIA Web site. (Additional resources: www.eia.doe.gov)

[a] 1980-1993: Collected from a survey of prices on January 1 of the current year. 1994-on: Annual average.
[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 percent 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 2010.

*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 10.5
Refiner Sales Prices for Propane and No. 2 Diesel, 1978–2010
(cents per gallon, excluding tax)

	Propane[a]		No 2. diesel fuel	
Year	Current	Constant 2010[b]	Current	Constant 2010[b]
1978	33.5	112.0	37.7	126.1
1979	35.7	107.2	58.5	175.7
1980	48.2	127.6	81.8	216.5
1981	56.5	135.5	99.5	238.7
1982	59.2	133.8	94.2	212.9
1983	70.9	155.2	82.6	180.8
1984	73.7	154.7	82.3	172.7
1985	71.7	145.3	78.9	159.9
1986	74.5	148.2	47.8	95.1
1987	70.1	134.6	55.1	105.8
1988	71.4	131.6	50.0	92.2
1989	61.5	108.1	58.5	102.9
1990	74.5	124.3	72.5	121.0
1991	73.0	116.9	64.8	103.7
1992	64.3	99.9	61.9	96.2
1993	67.3	101.6	60.2	90.8
1994	53.0	78.0	55.4	81.5
1995	49.2	70.4	56.0	80.1
1996	60.5	84.1	68.1	94.6
1997	55.2	75.0	64.2	87.2
1998	40.5	54.2	49.4	66.1
1999	45.8	59.9	58.4	76.4
2000	60.3	76.4	93.5	118.4
2001	50.6	62.3	84.2	103.7
2002	41.9	50.8	76.2	92.4
2003	57.7	68.4	94.4	111.9
2004	83.9	96.8	124.3	143.5
2005	108.9	121.6	178.6	199.4
2006	135.8	146.9	209.6	226.7
2007	148.9	156.6	226.7	238.7
2008	189.2	191.6	315.0	319.0
2009	122.0	124.0	183.3	186.0
2010	148.1	148.1	213.4	213.4
Average annual percentage change				
1978–2010	4.8%	0.9%	5.6%	1.7%
2000–2010	9.4%	6.8%	8.6%	6.1%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2011, Washington, DC, Table 9.7. (Additional resources: www.eia.doe.gov)

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

Prices of finished aviation gasoline and kerosene-type jet fuel began climbing in 1999 and peaked in 2008. In 2010 the prices showed an increase over 2009.

Table 10.6
Refiner Sales Prices for Aviation Gasoline and Jet Fuel, 1978–2010
(cents per gallon, excluding tax)

	Finished aviation gasoline		Kerosene-type jet fuel	
Year	Current	Constant 2010[a]	Current	Constant 2010[a]
1978	51.6	172.6	38.7	129.4
1979	68.9	206.9	54.7	164.3
1980	108.4	286.9	86.6	229.2
1981	130.3	312.6	102.4	245.6
1982	131.2	296.5	96.3	217.6
1983	125.5	274.8	87.8	192.2
1984	123.4	259.0	84.2	176.7
1985	120.1	243.4	79.6	161.3
1986	101.1	201.1	52.9	105.2
1987	90.7	174.1	54.3	104.2
1988	89.1	164.2	51.3	94.6
1989	99.5	175.0	59.2	104.1
1990	112.0	186.9	76.6	127.8
1991	104.7	167.6	65.2	104.4
1992	102.7	159.6	61.0	94.8
1993	99.0	149.4	58.0	87.5
1994	95.7	140.8	53.4	78.6
1995	100.5	143.8	54.0	77.3
1996	111.6	155.1	65.1	90.5
1997	112.8	153.3	61.3	83.3
1998	97.5	130.4	45.2	60.5
1999	105.9	138.6	54.3	71.1
2000	130.6	165.4	89.9	113.8
2001	132.3	162.9	77.5	95.4
2002	128.8	156.1	72.1	87.4
2003	149.3	176.9	87.2	103.3
2004	181.9	210.0	120.7	139.3
2005	223.1	249.1	173.5	193.7
2006	268.2	290.1	199.8	216.1
2007	284.9	299.6	216.5	227.7
2008	327.3	331.5	305.2	309.1
2009	244.2	248.2	170.4	173.2
2010	302.8	302.8	220.1	220.1
	Average annual percentage change			
1978–2010	5.7%	1.8%	5.6%	1.7%
2000–2010	8.8%	6.2%	9.4%	6.8%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 2011, Washington, DC, Table 9.7. (Additional resources: www.eia.doe.gov)

[a] Adjusted by the Consumer Price Inflation Index.

At the end of 2009, only three 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-five years ago.

Table 10.7
State Tax Exemptions for Gasohol, 2009

State	Exemption (cents/gallon of gasohol)
Idaho	2.5
Iowa	2.0
Maine	6.5

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, October 2010, Washington, DC, Table MF-121T. (Additional resources: www.fhwa.dot.gov)

Table 10.8
Federal Excise Taxes on Motor Fuels, 2009

Fuel	Cents per gallon
Gasoline[a]	18.40
Diesel	24.40
Gasohol[b]	18.40
Other special fuels[b]	18.40
CNG	18.30
LNG	24.30
LPG	18.30

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2009*, October 2010, Washington, DC, Table FE-21B. (Additional resources: www.fhwa.dot.gov)

[a] All gasohol blends are taxed at the same rate.
[b] Includes benzol, benzene, naphtha, and other liquids used as a motor fuel.

These states have laws and incentives for alternative fuels production and/or use.

Table 10.9
Federal and State Alternative Fuel Incentives, 2011

State	Biodiesel	Ethanol	Natural Gas	Liquefied petroleum gas (LPG)	Electric vehicles (EVs)	Neighborhood electric vehicles (NEVs)	Hydrogen fuel cells	Aftermarket conversions
Federal	34	29	27	27	22	2	27	6
Alabama	7	5	4	4	3	0	3	0
Alaska	2	3	4	2	2	1	2	2
Arizona	7	6	13	13	13	1	11	0
Arkansas	4	3	6	3	2	0	2	1
California	13	10	25	16	30	3	22	5
Colorado	8	9	11	8	6	1	7	3
Connecticut	5	4	8	5	7	0	7	3
Delaware	3	3	3	5	3	1	2	0
Dist. of Columbia	1	2	4	3	5	0	3	0
Florida	12	13	3	3	7	1	7	0
Georgia	6	6	7	3	5	0	3	2
Hawaii	8	10	5	5	9	1	6	0
Idaho	4	2	3	3	0	1	2	0
Illinois	20	18	10	9	10	2	9	4
Indiana	12	17	9	6	5	1	5	3
Iowa	13	18	6	5	7	1	5	1
Kansas	9	14	5	4	1	1	1	1
Kentucky	8	8	6	4	1	1	1	0
Louisiana	6	10	12	5	4	1	1	2
Maine	7	7	4	4	4	1	3	0
Maryland	2	3	1	1	4	2	0	0
Massachusetts	5	4	4	2	3	0	2	0
Michigan	9	9	4	4	6	0	5	0
Minnesota	9	11	3	2	5	2	4	0
Mississippi	4	4	8	5	2	0	2	1
Missouri	8	6	7	6	4	1	5	0
Montana	8	7	4	4	2	1	2	1
Nebraska	5	6	4	3	2	0	2	1
Nevada	6	5	7	7	6	1	6	0
New Hampshire	7	3	3	3	3	1	3	0
New Jersey	2	2	4	4	4	1	2	0
New Mexico	12	9	7	6	7	1	8	1
New York	9	10	13	8	9	1	9	0
North Carolina	13	11	6	6	6	0	5	1
North Dakota	12	9	3	2	0	1	3	0
Ohio	8	9	4	4	3	0	4	1
Oklahoma	11	12	13	9	9	1	8	5
Oregon	11	11	6	5	9	1	5	2
Pennsylvania	6	5	5	3	3	0	3	1
Rhode Island	2	1	2	1	2	1	2	0
South Carolina	11	9	3	4	2	1	7	0
South Dakota	9	9	1	2	0	0	0	0
Tennessee	11	10	5	4	4	1	2	0
Texas	9	9	14	10	8	1	6	3
Utah	1	1	12	7	7	0	4	2
Vermont	5	5	6	4	4	1	4	1
Virginia	15	10	13	9	12	1	10	3
Washington	18	14	9	8	19	1	6	4
West Virginia	4	4	4	4	4	1	4	0
Wisconsin	15	12	9	9	7	1	8	0
Wyoming	0	1	1	0	0	0	0	0
Totals	436	418	360	283	302	43	260	60

Source:
U.S. Department of Energy, Energy Efficiency and Renewable Energy, Alternative Fuels Data Center. Da ta downloaded April 2011. (Additional resources: www.eere.energy.gov/afdc/laws/matrix/tech)

Table 10.10
Federal and State Advanced Technology Incentives, 2011

State	Hybrid Electric Vehicles (HEV) or Plug-in Hybrid Vehicles (PHEVs)	Fuel Economy or Efficiency	Idle Reduction	Other[a]
Federal	8	13	6	9
Alabama	1	1	2	0
Alaska	0	2	0	0
Arizona	1	0	2	2
Arkansas	0	1	2	0
California	23	5	4	8
Colorado	2	1	3	0
Connecticut	6	2	3	3
Delaware	2	2	3	0
Dist. of Columbia	3	2	1	1
Florida	3	1	2	1
Georgia	0	1	3	1
Hawaii	1	1	1	0
Idaho	1	1	0	0
Illinois	6	3	3	0
Indiana	4	1	1	0
Iowa	0	1	0	0
Kansas	0	1	1	0
Kentucky	1	1	0	0
Louisiana	2	1	0	0
Maine	1	1	2	1
Maryland	3	0	1	2
Massachusetts	2	0	1	1
Michigan	7	2	1	0
Minnesota	2	1	2	1
Mississippi	1	1	0	0
Missouri	0	0	1	0
Montana	0	1	0	0
Nebraska	0	0	1	0
Nevada	5	0	1	0
New Hampshire	2	1	3	0
New Jersey	3	1	1	1
New Mexico	2	1	1	1
New York	4	1	3	2
North Carolina	3	1	3	0
North Dakota	0	0	0	0
Ohio	0	0	2	0
Oklahoma	3	0	1	0
Oregon	3	3	4	5
Pennsylvania	1	1	5	1
Rhode Island	1	1	1	3
South Carolina	3	0	2	0
South Dakota	0	0	0	0
Tennessee	4	2	0	0
Texas	6	0	4	1
Utah	2	1	2	0
Vermont	3	3	2	1
Virginia	4	3	2	1
Washington	6	2	3	3
West Virginia	1	0	2	0
Wisconsin	5	0	2	0
Wyoming	0	0	0	0
Totals	141	68	90	49

Source:
U.S. Department of Energy, Energy Efficiency and Renewable Energy, Alternative Fuels Data Center. Da ta downloaded April 2011. (Additional resources: www.eere.energy.gov/afdc/laws/matrix/tech)

[a] Includes Clean Fuel Initiatives and Pollution Prevention.

The average price of a new car in 2009 ($23,186) was very close to the average price in 1916 ($21,272) when adjusted for inflation. Average new car prices were at their lowest in 1940 ($11,898). Since 1914 the highest average price was in the year 1998 ($26,803).

Table 10.11
Average Price of a New Car, 1906–2009

Year	2009 Constant Dollars	Year	2009 Constant Dollars	Year	2009 Constant Dollars	Year	2009 Constant Dollars
1906	$36,588	1935	$14,783	1961	$19,410	1987	$25,280
1908	$32,755	1936	$12,980	1962	$19,295	1988	$25,266
1910	$27,877	1937	$13,340	1963	$19,082	1989	$24,864
1912	$28,922	1938	$13,701	1964	$19,178	1990	$24,691
1913	$31,007	1939	$12,800	1965	$18,815	1991	$24,376
1914	$32,089	1940	$11,898	1966	$18,800	1992	$24,980
1915	$26,681	1941	$12,052	1967	$20,657	1993	$25,048
1916	$21,272	1942	$12,207	1968	$19,465	1994	$25,917
1917	$19,650	1943	$12,361	1969	$19,465	1995	$25,281
1918	$18,027	1944	$12,515	1970	$19,585	1996	$25,675
1919	$17,847	1945	$12,620	1971	$19,822	1997	$25,712
1920	$17,667	1946	$12,824	1972	$19,909	1998	$26,803
1921	$18,749	1947	$12,978	1973	$19,579	1999	$26,669
1922	$19,830	1948	$13,592	1974	$19,321	2000	$25,665
1923	$18,027	1949	$15,839	1975	$19,739	2001	$26,013
1924	$16,225	1950	$16,232	1976	$20,428	2002	$25,340
1925	$16,044	1951	$16,508	1977	$20,583	2003	$25,238
1926	$15,864	1952	$17,882	1978	$20,990	2004	$24,574
1927	$15,684	1953	$17,904	1979	$20,233	2005	$25,284
1928	$15,504	1954	$17,579	1980	$19,720	2006	$25,151
1929	$15,323	1955	$17,483	1981	$21,029	2007	$24,721
1930	$15,143	1956	$17,987	1982	$21,987	2008	$23,334
1931	$16,946	1957	$19,982	1983	$22,845	2009	$23,186
1932	$18,749	1958	$21,138	1984	$23,488		
1933	$17,667	1959	$21,183	1985	$23,603		
1934	$16,585	1960	$20,384	1986	$24,766		

Sources:
Compiled by Jacob Ward, Vehicle Technologies Program, U.S. Department of Energy, from the following sources. Raff, D.M.G. & T rajtenberg, M. (1995), "Quality-Adjusted Prices for the American Automobile Industry: 1906-1940," National Bureau of Economic Research, Inc.; Gordon, R.J. (1990), *The Measurement of Durable Goods Prices*, National Bureau of Economic Research, Inc.; and U.S. Department of Commerce, Bureau of Economic Analysis (2010), National Income and Product Accounts.

Note: Estimations were used for years 1941-1946.

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

Table 10.12
Average Price of a New Car (Domestic and Import), 1970–2009

	Domestic[a]		Import		Total	
Year	Current dollars	Constant 2009 dollars[b]	Current dollars	Constant 2009 dollars[b]	Current dollars	Constant 2009 dollars[b]
1970	3,708	20,503	2,648	14,642	3,542	19,585
1975	5,084	20,273	4,384	17,482	4,950	19,739
1976	5,506	20,760	4,923	18,562	5,418	20,428
1977	5,985	21,188	5,072	17,956	5,814	20,583
1978	6,478	21,316	5,934	19,525	6,379	20,990
1979	6,889	20,357	6,704	19,811	6,847	20,233
1980	7,609	19,811	7,482	19,480	7,574	19,720
1981	8,912	21,034	8,896	20,996	8,910	21,029
1982	9,865	21,932	9,957	22,136	9,890	21,987
1983	10,516	22,651	10,868	23,410	10,606	22,845
1984	11,079	22,876	12,336	25,472	11,375	23,488
1985	11,589	23,107	12,853	25,627	11,838	23,603
1986	12,319	24,114	13,670	26,758	12,652	24,766
1987	12,922	24,404	14,470	27,327	13,386	25,280
1988	13,418	24,334	15,221	27,603	13,932	25,266
1989	13,936	24,111	15,510	26,834	14,371	24,864
1990	14,489	23,783	16,640	27,314	15,042	24,691
1991	15,192	23,930	16,327	25,718	15,475	24,376
1992	15,644	23,922	18,593	28,431	16,336	24,980
1993	15,976	23,719	20,261	30,081	16,871	25,048
1994	16,930	24,508	21,989	31,832	17,903	26,917
1995	16,864	23,740	23,202	32,662	17,959	25,281
1996	17,468	23,885	26,205	35,831	18,777	25,675
1997	17,600	23,526	27,509	36,771	19,236	25,712
1998	18,479	24,322	29,614	38,977	20,364	26,803
1999	19,032	24,508	27,542	35,467	20,710	26,669
2000	18,577	23,144	27,447	34,195	20,600	25,665
2001	20,042	24,279	25,787	31,238	21,474	26,013
2002	18,897	22,535	27,440	32,723	21,249	25,340
2003	19,971	23,285	26,081	30,409	21,646	25,238
2004	18,910	21,476	28,409	32,265	21,646	24,584
2005	21,593	23,720	26,621	29,243	23,017	25,284
2006	22,166	23,588	27,062	28,799	23,634	25,151
2007	22,273	23,046	27,487	28,441	23,892	24,721
2008	22,166	22,087	25,908	25,816	23,417	23,334
2009	22,107	22,107	25,308	25,308	23,186	23,186
			Average annual percentage change			
1970–2009	4.7%	0.2%	6.0%	1.4%	4.9%	0.4%
1999–2009	1.5%	-1.0%	-0.8%	-3.3%	1.1%	-1.4%

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*, underlying detail estimates for Motor Vehicle Output, Washington, DC, 2011. (A dditional resources: www.stat-usa.gov)

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

The total cost of operating a car 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 gas and oil share of total cost was 15.4% in 2010.

Table 10.13
Car Operating Cost per Mile, 1985–2010

	Constant 2010 dollars per 10,000 miles[a]			Total cost per mile[b] (constant 2010 cents[a])	Percentage gas and oil of total cost
Model year	Variable cost	Fixed cost	Total cost		
1985	1,504	4,177	5,680	56.80	19.9%
1986	1,297	4,590	5,887	58.87	15.1%
1987	1,286	4,469	5,755	57.55	14.7%
1988	1,456	5,585	7,041	70.41	13.6%
1989	1,407	5,135	6,542	65.42	14.2%
1990	1,401	5,432	6,834	68.34	13.2%
1991	1,553	5,709	7,262	72.62	14.6%
1992	1,399	5,881	7,280	72.80	12.6%
1993	1,388	5,617	7,005	70.05	12.7%
1994	1,339	5,644	6,983	69.83	11.8%
1995	1,374	5,730	7,104	71.04	11.7%
1996	1,334	5,827	7,162	71.62	10.9%
1997	1,467	5,907	7,375	73.75	12.2%
1998	1,431	6,057	7,489	74.89	11.1%
1999	1,387	6,099	7,487	74.87	9.8%
2000	1,545	5,982	7,527	75.27	11.6%
2001	1,675	5,690	7,364	73.64	13.2%
2002	1,430	5,908	7,338	73.38	9.7%
2003	1,552	5,788	7,340	73.40	11.6%
2004	1,454	6,502	7,957	79.57	9.4%
2005	1,574	6,043	7,617	76.17	12.0%
2006	1,633	5,069	6,702	67.02	15.3%
2007	1,525	5,011	6,536	65.36	14.3%
2008	1,718	5,468	7,186	71.86	16.4%
2009	1,567	5,617	7,184	71.84	14.3%
2010	1,673	5,719	7,392	73.92	15.4%
		Average annual percentage change			
1985–2010	0.4%	1.3%	1.1%	1.1%	

Source:
Ward's Communications, *Motor Vehicle Facts and Figures 2010*, Southfield, Michigan, 2010, p. 68, and annual. Original data from AAA "Your Driving Costs."

[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 car operation. For 2010 model year autos, the fixed cost is over $16 per day.

Table 10.14
Fixed Car Operating Costs per Year, 1975–2010
(constant 2010 dollars)[a]

Model year	Insurance[b]	License, registration & taxes	Depreciation	Finance charge	Total	Average fixed cost per day
1975	1,552	122	3,133	[c]	4,807	13.17
1977	1,834	262	2,999	[c]	5,094	13.95
1978	1,395	243	2,942	[c]	4,580	12.54
1979	1,427	266	2,784	[c]	5,352	14.66
1980	1,297	217	2,747	[c]	5,380	14.74
1981	1,204	208	3,038	[c]	5,605	15.36
1982	998	120	3,015	[c]	5,331	14.61
1983	1,012	209	2,796	[c]	5,157	14.13
1984	1,043	219	2,492	[c]	4,844	13.28
1985	942	223	2,557	1,082	4,805	13.17
1986	1,013	259	2,626	1,267	5,165	14.15
1987	1,027	246	2,868	1,010	5,150	14.11
1988	1,056	256	3,288	1,041	5,642	15.46
1989	1,134	253	3,549	1,034	5,970	16.35
1990	1,123	275	3,932	1,134	6,465	17.72
1991	1,134	269	4,009	426	5,837	15.99
1992	1,223	270	4,223	1,237	6,954	19.05
1993	1,123	269	4,271	1,011	6,673	18.29
1994	1,131	285	4,326	953	6,696	18.35
1995	1,120	290	4,397	982	6,789	18.60
1996	1,174	299	4,406	998	6,877	18.85
1997	1,151	283	4,445	1,043	6,933	18.99
1998	1,204	302	4,500	1,088	7,094	19.44
1999	1,270	296	4,497	1,084	7,146	19.58
2000	1,228	282	4,422	1,075	7,008	19.20
2001	1,220	256	4,369	1,066	6,911	18.94
2002	1,229	244	4,510	1,004	6,987	19.14
2003	1,306	243	4,430	882	6,860	18.80
2004	1,850	479	4,366	855	7,551	20.69
2005	1,438	434	4,331	825	7,028	19.26
2006	1,002	579	3,669	774	6,024	16.51
2007	1,036	566	3,567	771	5,940	16.27
2008	955	561	3,363	768	5,647	15.48
2009	992	576	3,518	792	5,878	16.10
2010	1,031	585	3,554	806	5,976	16.37
		Average annual percentage change				
1975–2010	-1.2%	4.6%	0.4%	[c]	0.6%	0.6%
2000–2010	-1.7%	7.6%	-2.2%	-2.8%	-1.6%	-1.6%

Source:
Ward's Communications, *Motor Vehicle Facts and Figures 2010*, Southfield, Michigan, 2010, p. 68 and annual. Original data from AAA "Your Driving Costs."

[a] Adjusted by the Consumer Price Inflation Index.
[b] Fire & Theft: $50 deductible 1975 through 1977; $100 deductible 1978 through 1992; $250 deductible for 1993 – on. Collision: $100 deductible through 1977; $250 deductible 1978 through 1992; $500 deductible for 1993 – on. Property Damage & Liability: coverage = $100,000/$300,000.
[c] Data are not available.

Table 10.15
Personal Consumption Expenditures, 1970–2010
(billion dollars)

	Personal consumption expenditures		Transportation personal consumption expenditures		
Year	Current	Constant 2010[a]	Current	Constant 2010[a]	Transportation PCE as a percent of PCE
1970	648.3	2,952.3	80.8	368.0	12.5%
1980	1,755.8	4,070.7	241.7	560.4	13.8%
1990	3,835.5	5,878.4	455.7	698.4	11.9%
2000	6,830.4	8,526.3	814.3	1,016.5	11.9%
2001	7,148.8	8,726.5	829.6	1,012.7	11.6%
2002	7,439.2	8,936.6	832.6	1,000.2	11.2%
2003	7,804.0	9,177.3	874.2	1,028.0	11.2%
2004	8,285.1	9,474.1	927.8	1,060.9	11.2%
2005	8,819.0	9,758.6	1,000.3	1,106.9	11.3%
2006	9,322.7	9,990.3	1,031.0	1,104.8	11.1%
2007	9,806.3	10,208.0	1,076.2	1,120.3	11.0%
2008	10,104.5	10,293.1	1,061.5	1,081.3	10.5%
2009	10,001.3	10,096.7	913.5	922.2	9.1%
2010	10,349.1	10,349.1	1,002.9	1,002.9	9.7%

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, Table 2.3.5, http://www.bea.doc.gov/bea/dn/nipaweb.

Note: Transportation PCE includes the following categories: transportation, motor vehicles and parts, and gasoline and oil.

Table 10.16
Consumer Price Indices, 1970–2010
(1970 = 1.000)

Year	Consumer Price Index	Transportation Consumer Price Index[b]	New car Consumer Price Index	Used car Consumer Price Index	Gross National Product Index
1970	1.000	1.000	1.000	1.000	1.000
1980	2.124	2.216	1.667	1.997	2.702
1990	3.369	3.213	2.286	3.769	5.585
2000	4.438	4.088	2.689	4.994	9.562
2005	5.034	4.637	2.597	4.468	12.191
2006	5.196	4.824	2.591	4.487	12.895
2007	5.344	4.925	2.566	4.351	13.578
2008	5.549	5.215	2.527	4.293	13.921
2009	5.529	4.780	2.554	4.070	13.655
2010	5.620	5.157	2.599	4.587	14.213

Sources:
Bureau of Labor Statistics, Consumer Price Index Table 1A for 2010, and annual. (Additional resources: www.bls.gov)
GNP – U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, Table 1.7.5. (Additional resources: www.bea.doc.gov)

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[a] Adjusted by the GNP price deflator.
[b] Transportation Consumer Price Index includes new and used cars, gasoline, auto insurance rates, intracity mass transit, intracity bus fare, and airline fares.

The data below were summarized from the Bureau of Labor Statistics (BLS) Current Employment Statistics Survey data using the North American Industry Classification System (NAICS). Transportation-related employment was 7.1% of total employment in 2010.

Table 10.17
Transportation-related Employment, 2000 and 2010[a]
(thousands)

	2000	2010	Percent Change
Truck transportation (includes drivers)	1,405.8	1,244.1	-11.5%
Transit and ground transportation	372.1	432.4	16.2%
Air transportation	614.4	464.2	-24.4%
Rail transportation	231.7	214.9	-7.3%
Water transportation	56.0	62.8	12.1%
Pipeline transportation	46.0	42.4	-7.8%
Motor vehicle and parts - retail	1,846.9	1,624.5	-12.0%
Motor vehicles and parts - wholesale	355.7	309.4	-13.0%
Gasoline stations - retail	935.7	816.4	-12.7%
Automotive repair and maintenance	888.1	799.6	-10.0%
Automotive equipment rental and leasing	208.3	162.6	-21.9%
Manufacturing	2,143.9	1,382.0	-35.5%
Autos and light trucks	*237.4*	*127.5*	*-46.3%*
Heavy-duty trucks	*54.0*	*23.8*	*-55.9%*
Motor vehicle bodies and trailers	*182.7*	*107.6*	*-41.1%*
Motor vehicle parts	*839.5*	*415.1*	*-50.6%*
Aerospace products and parts	*516.7*	*477.1*	*-7.7%*
Railroad rolling stock & other transportation equipment	*72.7*	*53.3*	*-26.7%*
Ship & boat building	*154.1*	*125.5*	*-18.6%*
Tires	*86.8*	*52.1*	*-40.0%*
Oil and gas pipeline construction	72.2	94.2	30.5%
Highway street and bridge construction	340.1	289.0	-15.0%
Scenic & sightseeing	27.5	27.3	-0.7%
Support activities for transportation	537.4	540.1	0.5%
Couriers and messengers	605.0	527.1	-12.9%
Travel arrangement and reservation services	298.6	186.6	-37.5%
Total transportation-related employment	**10,985.4**	**9,219.6**	**-16.1%**
Total nonfarm employment	131,785.0	129,818.0	-1.5%
Transportation-related to total employment	8.3%	7.1%	

Source:
Bureau of Labor Statistics Web site q uery system: www.bls.gov/ces/cesnaics.htm, (Additional resources: www.bls.gov)

[a] Not seasonally adjusted.

The total number of employees involved in the manufacture of motor vehicles decreased by almost 56% from 1990 to 2010 and by about 64% for those involved in the manufacture of motor vehicle parts. Beginning in 2008, the share of production workers fell below 80% for manufacturers of both vehicles and parts.

Table 10.18
U.S. Employment for Motor Vehicles and Motor Vehicle Parts Manufacturing, 1990–2010[a]

Year	All Employees	Production Workers	Share of Production Workers to Total Employees
Motor Vehicles			
1990	271.4	243.4	89.68%
1991	258.4	234.8	90.87%
1992	259.9	234.0	90.03%
1993	263.7	234.8	89.04%
1994	281.5	250.9	89.13%
1995	294.7	273.7	92.87%
1996	285.3	271.2	95.06%
1997	286.8	273.6	95.40%
1998	283.6	254.8	89.84%
1999	291.3	254.3	87.30%
2000	291.4	251.0	86.14%
2001	278.7	236.4	84.82%
2002	265.4	220.8	83.20%
2003	264.6	217.1	82.05%
2004	255.9	208.0	81.28%
2005	247.6	198.6	80.21%
2006	236.5	191.8	81.10%
2007	220.0	177.3	80.59%
2008	191.6	151.1	78.86%
2009	146.4	114.2	78.01%
2010	151.3	119.7	79.11%
Motor Vehicle Parts			
1990	653.0	527.4	80.77%
1991	638.9	514.7	80.56%
1992	661.2	537.0	81.22%
1993	677.8	554.7	81.84%
1994	735.6	606.9	82.50%
1995	786.9	647.7	82.31%
1996	799.9	657.4	82.19%
1997	808.9	662.4	81.89%
1998	818.2	660.3	80.70%
1999	837.1	674.2	80.54%
2000	839.5	676.7	80.61%
2001	774.7	624.9	80.66%
2002	733.6	590.9	80.55%
2003	707.8	567.6	80.19%
2004	692.1	561.6	81.14%
2005	678.1	553.9	81.68%
2006	654.7	533.7	81.52%
2007	607.9	488.9	80.42%
2008	543.7	430.6	79.20%
2009	413.7	317.8	76.82%
2010	415.1	320.4	77.19%

Source:
Tabulated from the U.S. Department of Labor, Bureau of Labor Statistics, www.bls.gov, March 2010.

[a] Not seasonally adjusted.

Chapter 11
Greenhouse Gas Emissions

Summary Statistics from Tables/Figures in this Chapter

Source			
Table 11.1	Carbon dioxide emissions (million metric tonnes)	1990	2007
	United States	*4,989*	*5,986*
	OECD Europe	*4,149*	*4,386*
	China	*2,293*	*6,284*
	Russia	*2,393*	*1,663*
	Japan	*1,054*	*1,262*
	Non-OECD Europe	*1,853*	*1,233*
	India	*573*	*1,399*
Table 11.5	Transportation share of U.S. carbon dioxide emissions from fossil fuel consumption		
	1990		*31.5%*
	1995		*31.6%*
	2000		*31.9%*
	2009		*34.2%*
Table 11.6	Motor gasoline share of transportation carbon dioxide emissions		61.3%
Table 11.10	Average annual carbon footprint (short tons of CO_2)		
	Cars		*5.7*
	Light trucks		*7.9*

The U. S. accounted for 23.2% of the World's carbon dioxide emissions in 1990 and 20.2% in 2007. Nearly half (43%) of the U.S. carbon emissions are from oil use.

Table 11.1
World Carbon Dioxide Emissions, 1990 and 2007

	1990		2007	
	Million metric tons	Percent of emissions from oil use	Million metric tons	Percent of emissions from oil use
United States	4,989	44%	5,986	43%
Canada	471	48%	586	49%
Mexico	302	77%	444	61%
OECD[a] Europe	4,149	45%	4,386	47%
OECD[a] Asia	243	59%	516	44%
Japan	1,054	65%	1,262	48%
Australia/New Zealand	298	38%	495	30%
Russia	2,393	33%	1,663	22%
Non-OECD[a] Europe	1,853	32%	1,233	26%
China	2,293	15%	6,284	15%
India	573	28%	1,399	26%
Non-OECD[a] Asia	811	57%	1,743	51%
Middle East	704	70%	1,515	58%
Africa	659	46%	1,011	44%
Central & South America	695	76%	1,169	70%
Total World	21,488	42%	29,694	38%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Outlook 2010*, Washington, DC, July 2010, Tables A10 and A11. (Additional resources: www.eia.doe.gov)

[a] OECD is the Organization for Economic Cooperation and Development. See Glossary for included countries.

Global Warming Potentials (GWP) were developed to allow comparison of the ability of each greenhouse gas 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, the latest of which are shown below. Most analysts use the 100-year time horizon.

Table 11.2
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 (CO_2)	5-200[a]	1	1	1
Methane (CH_4)	12	72	25	8
Nitrous Oxide (N_2O)	114	289	298	153
HFCs[b], PFCs[c], and Sulfur Hexafluoride				
HFC-23	270	12,000	14,800	12,200
HFC-125	29	6,350	3,500	1,100
HFC-134a	14	3,830	1,430	435
HFC-152a	1	437	124	38
HFC-227ea	34	5,310	3,220	1,040
Perfluoromethane (CF_4)	50,000	5,210	7,390	11,200
Perfluoroethane (C_2F_6)	10,000	8,630	12,200	18,200
Sulfur hexafluoride (SF_6)	3,200	16,300	22,800	32,600

Source:
Solomon, S. et al., “Technical Summary,” in *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007.

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

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[a] No single lifetime can be defined for carbon dioxide due to different rates of uptake by different removal processes.
[b] Hydrofluorocarbons
[c] Perfluorocarbons

Carbon dioxide emissions in 2009 were 8% higher than in 1990. Carbon dioxide accounts for the majority of greenhouse gases.

Table 11.3
U.S. Emissions of Greenhouse Gases, based on Global Warming Potential, 1990–2009
(million metric tonnes carbon dioxide equivalent[a])

	Carbon Dioxide	Methane	Nitrous Oxide	High GWP Gases[b]	Total
1990	5,040.9	768.8	221.4	102.1	6,133.2
1991	4,997.2	769.6	223.1	92.9	6,082.8
1992	5,106.2	772.4	227.8	97.5	6,203.9
1993	5,216.7	744.2	229.3	97.1	6,287.3
1994	5,297.3	745.4	240.9	100.0	6,383.6
1995	5,353.4	732.7	236.2	119.4	6,441.7
1996	5,539.8	721.7	237.6	130.4	6,629.6
1997	5,607.5	706.4	224.1	138.1	6,676.1
1998	5,643.6	688.5	221.6	154.2	6,707.8
1999	5,709.1	669.0	220.0	151.8	6,750.0
2000	5,900.3	663.1	217.8	154.0	6,935.3
2001	5,807.7	649.3	210.9	141.5	6,809.4
2002	5,866.8	650.9	210.5	151.8	6,880.0
2003	5,923.3	660.6	211.8	145.4	6,941.1
2004	6,031.3	661.6	222.0	157.0	7,071.9
2005	6,055.2	669.2	223.6	161.3	7,109.4
2006	5,961.6	678.5	223.7	163.6	7,027.4
2007	6,059.5	690.9	228.6	171.4	7,150.4
2008	5,865.5	724.2	223.5	169.9	6,983.1
2009	5,446.8	730.9	219.6	178.2	6,575.5

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 2009*, Washington, DC, March 31, 2011, Table 1. (Additional resources: www.eia.doe.gov)

Note: This greenhouse gas emissions inventory includes two "adjustments to energy consumption" which make the data different from Table 11.5. The adjustments are as follows:
(1) Emissions from U.S. Territories are included.
(2) International bunker fuels and military bunker fuels are excluded from the U.S. total.

[a] Carbon dioxide equivalents are computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (See Table 11.2).
[b] GWP = Global warming potential. Includes HFC-hydrofluorocarbons; PFC-perfluorocarbons; and SF_6-sulfur hexaflouride.

Though the transportation sector accounts for the largest share of carbon dioxide emissions, the industrial sector accounts for the largest share of total greenhouse gas emissions.

Table 11.4
Total U.S. Greenhouse Emissions by End-Use Sector, 2009
(million metric tonnes carbon dioxide equivalent[a])

Greenhouse gas and source	Residential	Commercial	Industrial	Transportation	Transportation Share of Total	Total
Carbon dioxide	1,172.3	1,012.3	1,505.0	1,757.3	32.3%	5,446.8
Methane	4.7	198.8	524.7	2.7	0.4%	730.9
Nitrous oxide	4.4	8.4	177.9	28.9	13.2%	219.6
Hydrofluorocarbons	0.0	56.3	17.6	72.4	49.5%	146.3
Perfluorocarbons	0.0	0.0	8.6	0.0	0.0%	8.6
Other hydrofluorocarbons, perfluorocarbons/perfluoropolyether	0.0	7.9	0.0	0.0	0.0%	7.9
Sulfur hexafluoride	4.8	4.9	6.1	0.0	0.0%	15.4
Total greenhouse gas emissions	1,186.2	1,288.3	2,239.9	1,861.2	28.3%	6,575.5

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 2009*, Washington, DC, March 31, 2011, and annual. (Additional resources: www.eia.doe.gov)

Note: This greenhouse gas emissions inventory includes two "adjustments to energy consumption" which make the data different from Table 11.5. The adjustments are as follows:
(1) Emissions from U.S. Territories are included.
(2) International bunker fuels and military bunker fuels are excluded from the U.S. total.

[a] Carbon dioxide equivalents are computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (See Table 11.2).

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 dioxide gas. The ratio of the weight of carbon to carbon dioxide is 0.2727. The transportation sector accounts for approximately one-third of carbon emissions.

Table 11.5
U.S. Carbon Emissions from Fossil Energy Consumption by End-Use Sector, 1990–2009[a]
(million metric tonnes of carbon dioxide)

	End Use Sector				Transportation	CO_2 From
	Residential	Commercial	Industrial	Transportation	Percentage	All Sectors
1990	963.4	792.6	1,695.1	1,587.7	31.5%	5,038.7
1991	980.1	794.3	1,653.4	1,567.9	31.4%	4,995.7
1992	981.4	795.9	1,724.0	1,591.6	31.3%	5,092.9
1993	1,039.6	819.4	1,715.0	1,611.2	31.1%	5,185.1
1994	1,032.3	833.5	1,745.1	1,647.5	31.3%	5,258.3
1995	1,039.1	851.4	1,742.8	1,681.0	31.6%	5,314.3
1996	1,099.1	882.6	1,794.5	1,725.1	31.4%	5,501.4
1997	1,089.8	926.0	1,814.8	1,744.1	31.3%	5,574.8
1998	1,097.5	946.8	1,795.8	1,781.7	31.7%	5,621.8
1999	1,121.6	960.4	1,771.6	1,828.0	32.2%	5,681.5
2000	1,185.1	1,022.0	1,788.1	1,872.0	31.9%	5,867.2
2001	1,171.5	1,027.3	1,709.2	1,851.5	32.1%	5,759.5
2002	1,203.7	1,027.0	1,685.8	1,892.4	32.6%	5,808.7
2003	1,230.1	1,036.0	1,691.9	1,898.9	32.4%	5,856.9
2004	1,227.8	1,053.5	1,731.1	1,962.3	32.8%	5,974.7
2005	1,261.5	1,069.0	1,675.2	1,990.7	33.2%	5,996.4
2006	1,192.0	1,043.4	1,661.1	2,021.9	34.2%	5,918.3
2007	1,242.0	1,078.6	1,661.6	2,039.6	33.9%	6,021.8
2008	1,229.0	1,073.5	1,597.6	1,937.9	33.2%	5,838.0
2009	1,162.2	1,003.6	1,405.4	1,854.5	34.2%	5,425.6
			Average annual percentage change			
1990–2009	1.0%	1.3%	-1.0%	0.8%		0.4%
2000–2009	-0.2%	-0.2%	-2.4%	-0.1%		-0.8%

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 2009*, Washington, DC, March 31, 2011, Table 7. (Additional resources: www.eia.doe.gov)

Note: Emissions from U.S. Territories are not included. International bunker fuels and military bunker fuels are included in these data.

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

Most U.S. transportation sector 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 11.6
U.S. Carbon Emissions from Energy Use in the Transportation Sector, 1990–2009
(million metric tonnes of carbon dioxide)

	1990		2000		2009	
Fuel	Emissions	Percentage	Emissions	Percentage	Emissions	Percentage
			Petroleum			
Motor gasoline	966.8	60.9%	1,121.3	59.9%	1,137.5	61.3%
LPG[a]	1.4	0.1%	0.8	0.0%	2.6	0.1%
Jet fuel	222.6	14.0%	253.8	13.6%	204.4	11.0%
Distillate fuel	267.8	16.9%	377.8	20.2%	404.7	21.8%
Residual fuel	80.1	5.0%	69.9	3.7%	59.9	3.2%
Lubricants	6.5	0.4%	6.7	0.4%	4.7	0.3%
Aviation gas	3.1	0.2%	2.5	0.1%	1.8	0.1%
Subtotal	**1,548.4**	**97.5%**	**1,832.8**	**97.9%**	**1,815.7**	**97.9%**
			Other energy			
Natural gas	36.1	2.3%	35.7	1.9%	34.1	1.8%
Electricity[b]	3.2	0.2%	3.6	0.2%	4.7	0.3%
Total[c]	**1,587.7**	**100.0%**	**1,872.0**	**100.0%**	**1,854.5**	**100.0%**

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 2009*, Washington, DC, March 31, 2011, Table 11 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.
[c] Totals may not equal sum of components due to independent rounding.

Highway vehicles are responsible for the majority of greenhouse gas emissions in the transportation sector.

Table 11.7
Transportation Greenhouse Gas Emissions by Mode, 1990 and 2009
(Million metric tonnes of carbon dioxide equivalent)

	Carbon Dioxide	Methane	Nitrous Oxide
	1990		
Highway Total	1,190.5	4.2	40.4
Cars, light trucks, motorcycles	952.2	4.0	39.6
Medium & heavy trucks and buses	238.3	0.2	0.8
Water	44.5	0.0	0.6
Air	179.3	0.2	1.7
Rail	38.5	0.1	0.3
Pipeline	36.0	0.0	0.0
Other	0.0	0.2	0.9
Total[a]	1,489.0	4.7	43.9
	2009		
Highway Total	1,478.3	1.8	24.2
Cars, light trucks, motorcycles	1,108.3	1.7	23.2
Medium & heavy trucks and buses	370.0	0.1	1.0
Water	28.5	0.0	0.4
Air	140.6	0.1	1.3
Rail	40.6	0.1	0.3
Pipeline	35.2	0.0	0.0
Other	0.0	0.2	1.5
Total[a]	1,723.3	2.2	27.7
	Percent change 1990–2009		
Highway Total	24.2%	-57.1%	-40.1%
Cars, light trucks, motorcycles	16.4%	-57.5%	-41.4%
Medium & heavy trucks and buses	55.3%	-50.0%	25.0%
Water	-36.0%	0.0%	-33.3%
Air	-21.6%	-50.0%	-23.5%
Rail	5.5%	0.0%	0.0%
Pipeline	-2.2%	0.0%	0.0%
Other	0.0%	0.0%	66.7%
Total[a]	15.7%	-53.2%	-36.9%

Source:
U.S. Environmental Protection Agency, Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2009, Tables 3-12, 3-13, 3-14, February 2011. (Additional resources: www.epa.gov/climatechange/emissions)

Note: Emissions from U.S. Territories, International bunker fuels, and military bunker fuels are not included.

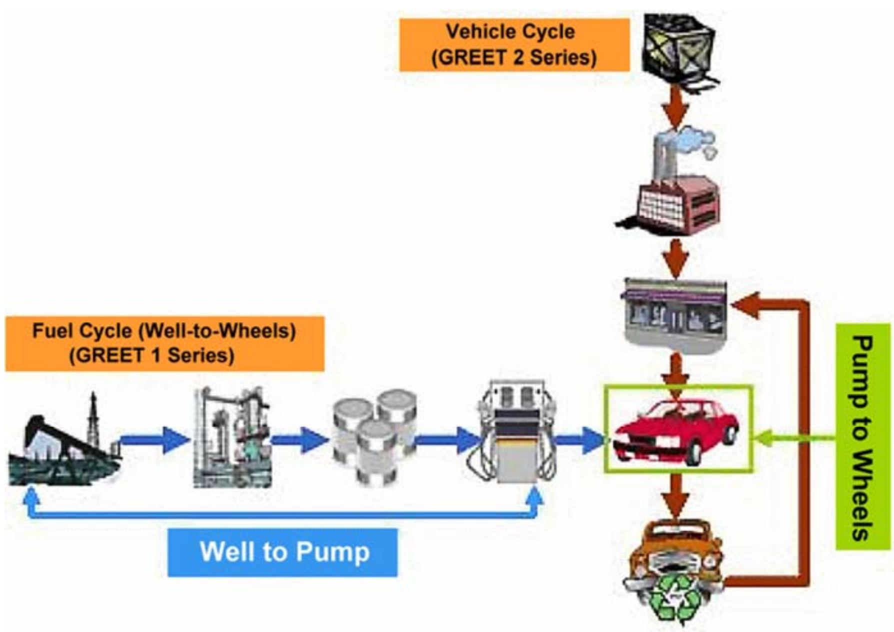
[a] The sums of subcategories may not equal due to rounding.

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

http://www.transportation.anl.gov/modeling_simulation/GREET/

Sponsored by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), Argonne has developed a full life-cycle model called GREET (Greenhouse gases, Regulated Emissions, and Energy use in Transportation). It allows researchers and analysts to evaluate energy and emission impacts of various vehicle and fuel combinations on a full fuel-cycle/vehicle-cycle basis. The first version of GREET was released in 1996. Since then, Argonne has continued to update and expand the model. The most recent GREET versions are GREET 1.8c.0 version for fuel-cycle analysis and GREET 2.7 version for vehicle-cycle analysis.

Figure 11.1. GREET Model



For a given vehicle and fuel system, GREET separately calculates the following:

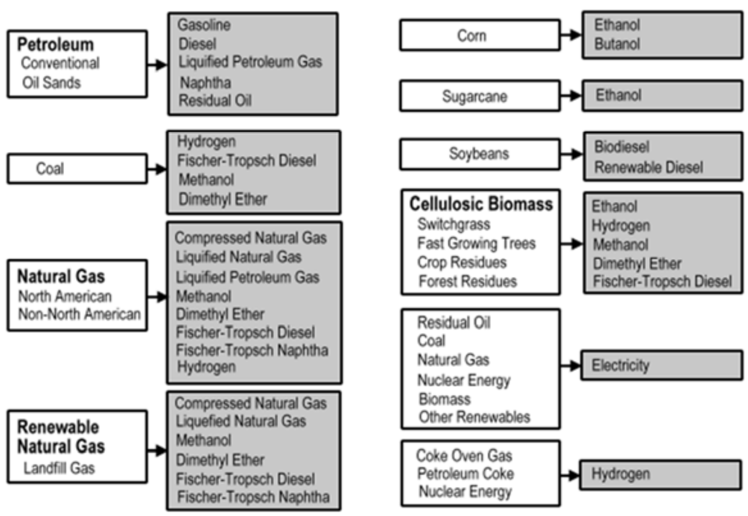
- Consumption of total energy (energy in non-renewable and renewable sources), fossil fuels (petroleum, natural gas, and coal together), petroleum, coal and natural gas.
- Emissions of CO_2-equivalent greenhouse gases - primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

- Emissions of six criteria pollutants: volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxide (NOx), particulate matter with size smaller than 10 micron (PM_{10}), particulate matter with size smaller than 2.5 micron ($PM_{2.5}$),and sulfur oxides (SOx).

GREET includes more than 100 fuel production pathways and more than 80 vehicle/fuel systems. These vehicle/fuel systems cover all major vehicle technologies in the market and R&D arena:

- Conventional spark-ignition (SI) engines
- Direct-injection, SI engines
- Direct injection, compression-ignition (CI) engines
- Grid-independent hybrid electric vehicles (both SI and CI)
- Grid-connected (or plug-in) hybrid electric vehicles (both SI and CI)
- Battery-powered electric vehicles
- Fuel-cell vehicles

Figure 11.2. GREET Model Feedstocks and Fuels



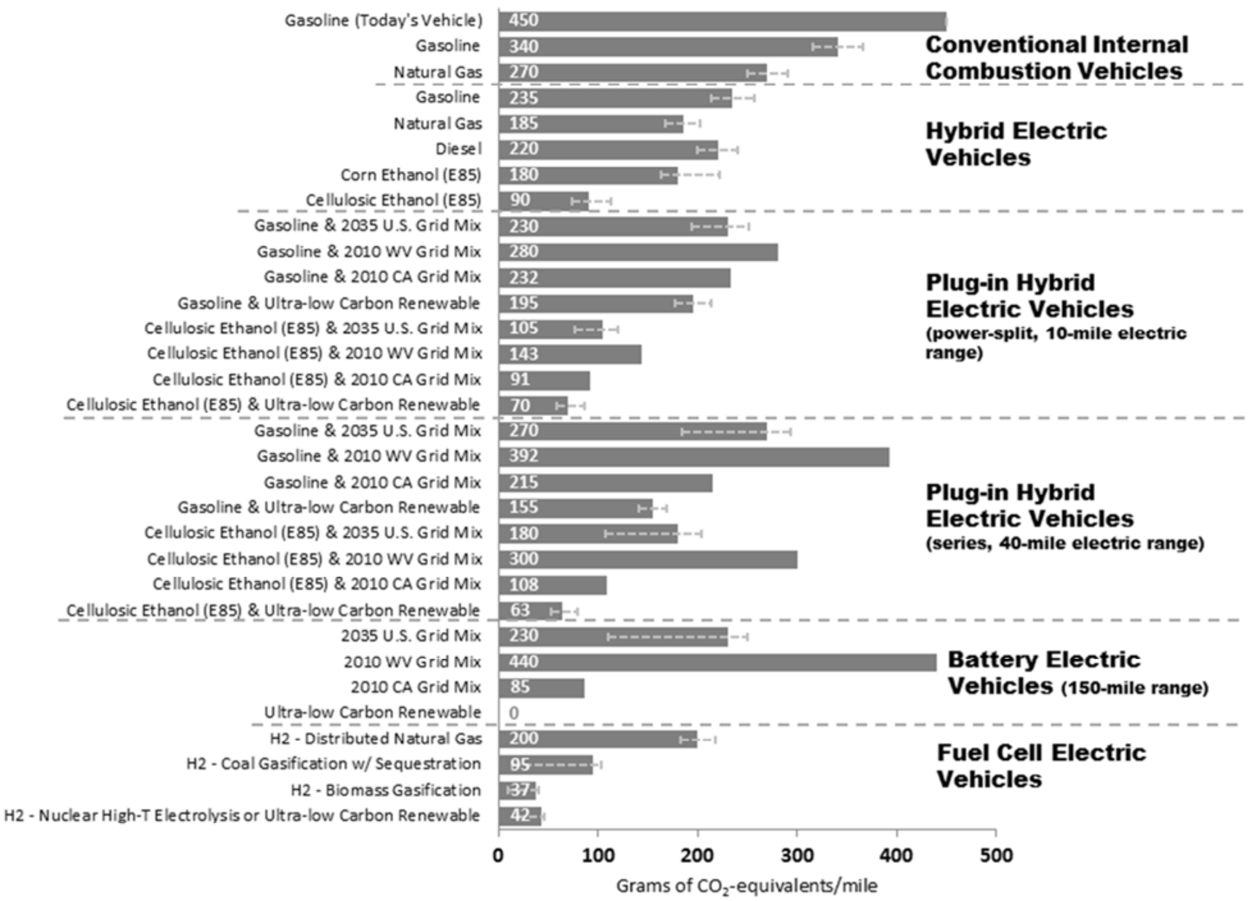
To address technology improvements over time, GREET simulates vehicle/fuel systems over the period from 1990 to 2035, in five-year intervals.

For additional information about the GREET model, see the GREET Web site, 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

These are results from the latest GREET model (see preceding pages for description). California's (CA) grid mix was chosen due to the high renewable energy mix in that state. While in contrast, West Virginia's (WV) grid mix is primarily coal. Both of these are compared against the average U.S. grid mix for various vehicle technologies.

Figure 11.3. Well-to-Wheel Emissions for Various Fuels and Vehicle Technologies



Source: Argonne National Laboratory, GREET Model 1.8d.1.

Note: H2 = hydrogen; High-T = high-temperature.

Carbon Footprint

The carbon footprint measures a vehicle’s impact on climate change in tons of carbon dioxide (CO_2) emitted annually. The following three tables show the carbon footprint for various vehicle classes. The sales-weighted average fuel economy rating for each vehicle class, based on 45% highway and 55% city driving, is used to determine the average annual carbon footprint for vehicles in the class. An estimate of 15,000 annual miles is used for each vehicle class and for each year in the series. The equation to calculate carbon footprint uses results of the GREET model version 1.8.

$$\mathit{CarbonFootprint} = \left(CO_2 \times LHV \times \frac{\mathit{AnnualMiles}}{\mathit{CombinedMPG}} \right) + \left(CH_4 + N_2O \right) \times \mathit{AnnualMiles}$$

where:

CO_2 = (Tailpipe CO_2 + Upstream Greenhouse Gases) in grams per million Btu

LHV = Lower (or net) Heating Value in million Btu per gallon

CH_4 = Tailpipe CO_2 equivalent methane in grams per mile

N_2O = Tailpipe CO_2 equivalent nitrous oxide in grams per mile

The carbon footprint for all classifications of cars declined between 1975 and 2010. Midsize cars have experienced the greatest reduction in carbon footprint with a decrease of almost 59%.

Table 11.8
Sales-Weighted Annual Carbon Footprint of New Domestic and Import Cars by Size Class, Model Years 1975–2010[a]
(short tons of CO_2)

	Cars			Wagons		
Sales period	Small	Midsize	Large	Small	Midsize	Large
1975	10.2	13.7	14.2	8.3	14.1	15.6
1976	9.4	11.9	13.1	7.8	11.6	13.8
1977	9.0	11.4	11.7	7.3	11.4	12.0
1978	8.1	10.0	11.1	7.7	10.0	11.7
1979	8.0	9.8	10.7	7.3	9.8	11.6
1980	7.2	8.6	9.8	6.5	8.8	9.8
1981	6.6	8.2	9.2	6.2	8.1	9.4
1982	6.4	7.8	9.0	6.1	7.9	9.7
1983	6.4	7.8	9.2	5.8	7.7	9.5
1984	6.4	7.8	9.1	5.9	7.5	9.4
1985	6.3	7.5	8.4	5.8	7.4	8.9
1986	6.2	7.2	7.8	6.0	7.2	8.5
1987	6.2	7.2	7.8	6.1	7.3	8.5
1988	6.1	7.0	7.7	6.0	7.1	8.2
1989	6.2	7.0	7.8	5.9	7.3	8.3
1990	6.3	7.1	7.9	6.3	7.4	8.2
1991	6.2	7.2	7.9	6.1	7.2	8.2
1992	6.2	7.2	7.9	6.2	7.1	8.2
1993	6.1	7.2	7.7	5.8	7.1	8.3
1994	6.2	7.2	7.8	5.7	7.2	8.2
1995	6.1	7.2	7.7	5.6	7.0	8.2
1996	6.1	7.1	7.7	5.9	7.1	8.1
1997	6.1	7.1	7.6	5.8	7.1	[b]
1998	6.1	6.9	7.6	5.8	7.1	[b]
1999	6.2	6.9	7.5	5.9	7.1	[b]
2000	6.2	6.9	7.3	6.4	6.9	[b]
2001	6.1	6.9	7.4	6.9	7.0	[b]
2002	6.1	6.8	7.2	7.2	6.8	[b]
2003	6.1	6.6	7.2	6.2	6.9	[b]
2004	6.1	6.5	7.2	6.0	7.1	8.5
2005	6.0	6.3	7.1	5.8	7.2	8.4
2006	6.0	6.3	7.2	6.0	7.1	8.5
2007	5.9	6.0	7.2	5.9	6.9	8.5
2008	5.9	6.0	6.9	5.8	7.0	8.6
2009	5.6	5.8	6.6	5.6	6.7	8.7
2010	5.5	5.7	6.6	5.4	6.6	8.9
			Average annual percentage change			
1975–2010	-1.7%	-2.5%	-2.2%	-1.2%	-2.1%	-1.6%
2000–2010	-1.2%	-1.9%	-1.0%	-1.7%	-0.4%	[c]

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. See page 11-12 for details.

[a] Annual carbon footprint is based on 15,000 miles of annual driving.
[b] No vehicles in this category were sold in this model year.
[c] Data are not available.

The annual carbon footprint of light trucks decreased for all classes of light trucks between 1975 and 2010. In the last ten years, large SUVs experienced the greatest decline with about 24% while small SUVs experienced a slight gain in carbon emissions.

Table 11.9
Sales-Weighted Annual Carbon Footprint of New Domestic and Import Light Trucks by Size Class, Model Years 1975–2010[a]
(short tons of CO_2)

	Pickups			Vans			SUVs		
Sales period	Small	Midsize	Large	Small	Midsize	Large	Small	Midsize	Large
1975	8.3	8.8	14.2	9.1	14.0	14.8	11.6	15.4	15.3
1980	7.7	7.2	10.8	9.8	11.0	11.6	9.9	13.0	13.0
1981	6.6	7.1	10.0	10.1	10.4	11.1	9.2	11.9	12.2
1982	6.9	7.0	10.0	8.6	10.4	11.6	9.1	11.4	9.9
1983	7.0	7.1	10.3	9.5	10.0	11.5	8.7	9.9	10.6
1984	7.2	7.3	10.5	7.3	9.7	11.4	8.6	9.9	11.0
1985	7.0	7.3	10.5	7.3	9.4	11.6	8.5	9.5	11.0
1986	7.2	7.2	10.2	7.3	9.0	10.6	7.9	9.5	11.1
1987	7.2	7.4	10.5	7.7	8.8	11.0	7.7	9.4	11.0
1988	7.5	7.4	10.4	7.6	8.6	11.0	7.7	9.6	11.2
1989	7.8	7.5	10.3	7.5	8.6	11.1	8.2	9.6	11.2
1990	7.5	7.6	10.4	7.8	8.6	11.3	8.0	9.8	11.2
1991	7.5	7.6	10.2	7.8	8.5	11.2	7.9	9.2	11.5
1992	7.6	7.9	10.2	6.9	8.6	11.0	8.0	9.4	11.9
1993	7.1	7.9	10.0	6.6	8.4	11.0	8.1	9.3	11.4
1994	7.5	7.8	10.1	6.9	8.5	11.0	7.8	9.4	11.4
1995	7.7	7.6	10.4	7.1	8.4	10.9	7.7	9.5	11.2
1996	7.6	7.5	10.2	7.1	8.2	10.9	6.6	9.3	10.8
1997	7.5	7.7	9.9	[b]	8.3	10.0	8.2	9.1	10.7
1998	7.6	7.8	10.0	[b]	8.0	10.2	7.9	9.0	10.7
1999	8.1	8.3	10.1	[b]	8.1	10.4	7.8	8.9	10.8
2000	7.1	8.2	9.7	[b]	8.0	10.4	8.3	8.9	10.6
2001	7.1	8.6	9.9	[b]	7.8	10.5	7.5	8.6	10.1
2002	8.1	8.8	10.0	[b]	7.9	10.4	7.6	8.6	9.8
2003	8.1	8.2	9.9	[b]	7.8	10.0	7.4	8.3	9.9
2004	8.3	8.6	9.8	[b]	7.8	9.6	7.6	8.3	9.9
2005	7.2	7.9	9.6	[b]	7.7	9.6	7.7	8.1	9.4
2006	7.0	7.8	9.5	[b]	7.6	9.6	8.7	7.9	9.2
2007	[b]	8.0	9.5	[b]	7.7	9.4	8.3	7.6	8.9
2008	[b]	7.8	9.3	6.1	7.6	9.3	8.2	7.3	8.8
2009	[b]	7.6	9.2	6.2	7.5	9.3	9.0	7.0	8.2
2010	[b]	7.4	9.1	6.1	7.4	9.3	8.7	6.8	8.1
	Average annual percentage change								
1975-2010	[c]	-0.5%	-1.2%	-1.0%	-1.7%	-1.2%	-0.8%	-2.1%	-1.7%
2000-2010	[c]	-1.0%	-0.6%	[c]	-0.8%	-1.1%	0.5%	-2.7%	-2.7%

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. See page 11-12 for details.

Note: Includes light trucks of 8,500 lbs. or less.

[a] Annual carbon footprint is based on 15,000 miles of annual driving.
[b] No vehicles in this category were sold in this model year.
[c] Data are not available.

Between 1975 and 2010, the carbon footprint for light vehicles sold in the United States dropped dramatically. Cars experienced the greatest decrease at 51.4% while the carbon footprint for light trucks decreased by 42.2%.

Table 11.10
Average Annual Carbon Footprint by Vehicle Classification, 1975 and 2010[a]
(short tons of CO_2)

	Market Share		Carbon Footprint		Percent Change
Fuel	1975	2010	1975	2010	1975 - 2010
			Cars		
Small	40.0%	23.7%	10.2	5.5	-45.9%
Midsize	16.0%	21.9%	13.7	5.7	-58.4%
Large	15.2%	18.0%	14.2	6.6	-53.5%
Small Wagon	4.7%	4.5%	8.3	5.4	-34.9%
Midsize Wagon	2.8%	0.8%	14.1	6.6	-53.2%
Large Wagon	1.9%	0.1%	15.6	8.9	-42.9%
Total Cars	**80.6%**	**58.9%**	**11.8**	**5.7**	**-51.4%**
			Light Trucks		
Small Van	0.0%	0.1%	9.1	6.1	-33.0%
Midsize Van	3.0%	3.3%	14.0	7.4	-47.1%
Large Van	1.5%	0.1%	14.8	9.3	-37.2%
Small SUV	0.5%	0.5%	11.6	8.7	-25.0%
Midsize SUV	1.2%	14.0%	15.4	6.8	-55.8%
Large SUV	0.1%	10.4%	15.3	8.1	-47.1%
Small Pickup	1.6%	0.0%	8.3	[c]	[c]
Midsize Pickup	0.5%	1.4%	8.8	7.4	-15.9%
Large Pickup	11.0%	11.2%	14.2	9.1	-35.9%
Total Light Trucks	**19.4%**	**41.1%**	**13.6**	**7.9**	**-42.2%**

Source:
Calculated using fuel economy from the U.S. Environmental Protection Agency, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2010*, November 2010. See page 11-10 for details.

[a] Annual carbon footprint is based on 15,000 miles of annual driving.
[b] Data are not available.
[c] Not applicable.

The amount of carbon dioxide released into the atmosphere by a vehicle is primarily determined by the carbon content of the fuel. However, there is a small portion of the fuel that is not oxidized into carbon dioxide when the fuel is burned. The Environmental Protection Agency (EPA) has published information on carbon dioxide emissions from gasoline and diesel which takes the oxidation factor into account and is based on the carbon content used in EPA's fuel economy analyses. The other fuels listed come from the Energy Information Administration.

Table 11.11
Carbon Dioxide Emissions from a Gallon of Fuel

	Grams per gallon	Kilograms per gallon	Pounds per gallon
Gasoline	8,788	8.8	19.4
Diesel	10,084	10.1	22.2
LPG	5,805	5.8	12.8
Propane	5,760	5.8	12.7
Aviation gasoline	8,345	8.3	18.4
Jet fuel	9,569	9.6	21.1
Keosene	9,751	9.8	21.5
Residual fuel	11,791	11.8	26.0

Sources:
Gasoline and Diesel: U.S. Environmental Protection Agency, "Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel," February 2009. (Additional resources: www.epa.gov/OMS)
All others: Energy Information Administration, Voluntary Reporting of Greenhouse Gases Program, Fuel and Energy Source Codes and Emission Coefficients.

Chapter 12
Criteria Air Pollutants

Summary Statistics from Tables in this Chapter

Source		
Table 12.1	Transportation's share of U.S. emissions, 2008	
	CO	*73.2%*
	NO_X	*57.9%*
	VOC	*37.7%*
	PM-2.5	*7.2%*
	SO_2	*4.5%*
	PM-10	*3.2%*

Note: The latest available data are 2008.

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

Table 12.1
Total National Emissions of the Criteria Air Pollutants by Sector, 2008
(millions of short tons/percentage)

Sector	CO	NOx	VOC	PM-10	PM-2.5	SO_2
Highway vehicles	**38.87**	**5.21**	**3.42**	**0.17**	**0.11**	**0.06**
	50.0%	*31.9%*	*21.5%*	*1.2%*	*0.1%*	*0.6%*
Other off-highway	**18.04**	**4.26**	**2.59**	**0.30**	**0.28**	**0.46**
	23.2%	*26.0%*	*16.2%*	*2.1%*	*5.1%*	*4.0%*
Transportation total	**56.90**	**9.46**	**6.00**	**0.48**	**0.39**	**0.52**
	73.2%	*57.9%*	*37.7%*	*3.2%*	*7.2%*	*4.5%*
Stationary source fuel combustion	**5.28**	**5.57**	**1.45**	**1.33**	**1.03**	**9.80**
	6.8%	*34.1%*	*9.1%*	*9.0%*	*19.0%*	*85.7%*
Industrial processes	**2.18**	**0.93**	**6.77**	**1.17**	**0.48**	**1.00**
	2.8%	*5.7%*	*42.5%*	*7.9%*	*8.8%*	*8.7%*
Waste disposal and recycling total	**1.58**	**0.12**	**0.37**	**0.29**	**0.27**	**0.03**
	2.0%	*0.7%*	*2.3%*	*1.9%*	*4.9%*	*0.2%*
Miscellaneous	**11.73**	**0.26**	**1.33**	**11.54**	**3.28**	**0.09**
	15.1%	*1.6%*	*8.4%*	*77.9%*	*60.2%*	*0.7%*
Total of all sources	**77.69**	**16.34**	**15.93**	**14.81**	**5.45**	**11.43**
	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 Web s ite www.epa.gov/ttn/chief/trends. (Additional resources: www.epa.gov/ttn/chief)

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 latest available data are 2008.

The transportation sector accounted for more than 73% of the nation's carbon monoxide (CO) emissions in 2008. Highway vehicles are by far the source of the greatest amount of CO. For details on the highway emissions of CO, see Table 12.3.

Table 12.2
Total National Emissions of Carbon Monoxide, 1970–2008[a]
(million short tons)

Source category	1970	1980	1990	2000	2005	2008	Percent of total, 2008
Highway vehicles	163.23	143.83	110.26	68.06	48.54	38.87	50.0%
Other off-highway	11.37	16.69	21.45	24.18	20.67	18.04	23.2%
Transportation total	174.60	160.51	131.70	92.24	69.22	56.90	73.2%
Stationary fuel combustion total	4.63	7.30	5.51	4.78	5.13	5.28	6.8%
Industrial processes total	9.84	6.95	4.77	2.63	2.03	2.18	2.8%
Waste disposal and recycling total	7.06	2.30	1.08	1.85	1.55	1.58	2.0%
Miscellaneous total	7.91	8.34	11.12	12.96	15.11	11.73	15.1%
Total of all sources	**204.04**	**185.41**	**154.19**	**114.47**	**93.03**	**77.69**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends Web s ite www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/ttn/chief)

Note: The latest available data are 2008.

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

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 2005 is about a third of what it was in 1970. This is despite the fact that there were many more light vehicles on the road in 2005.

Table 12.3
Emissions of Carbon Monoxide from Highway Vehicles, 1970–2005[a]
(million short tons)

Source category	1970	1980	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered							
Light vehicles & motorcycles	119.14	98.21	67.24	46.54	36.40	24.19	50.2%
Light trucks[b]	22.27	28.83	32.23	29.81	27.04	21.19	43.9%
Heavy vehicles	21.27	15.35	8.92	5.96	3.42	1.97	4.1%
Total	162.68	142.39	108.39	82.31	66.86	47.35	98.2%
Diesel powered							
Light vehicles	0.01	0.03	0.04	0.02	0.01	0.01	0.0%
Light trucks[b]	0.06	0.05	0.03	0.02	0.01	0.01	0.0%
Heavy vehicles	0.49	1.36	1.81	1.53	1.19	0.85	1.8%
Total	0.56	1.43	1.87	1.57	1.20	0.87	1.8%
Total							
Highway vehicle total	**163.23**	**143.83**	**110.26**	**83.88**	**68.06**	**48.22**	**100.0%**
Percent diesel	0.3%	1.0%	1.7%	1.9%	1.8%	1.8%	

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

Note: Data beyond 2005 are not available.

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

The transportation sector accounted for over half of the nation's nitrogen oxide (NOx) emissions in 2008, with the majority coming from highway vehicles. For details on the highway emissions of NOx, see Table 12.5.

Table 12.4
Total National Emissions of Nitrogen Oxides, 1970–2008[a]
(million short tons)

Source category	1970	1980	1990	2000	2005	2008	Percent of total, 2008
Highway vehicles	12.62	11.49	9.59	8.39	6.49	5.21	31.9%
Other off-highway	2.65	3.35	3.78	4.17	4.89	4.26	26.0%
Transportation total	15.28	14.85	13.37	12.56	11.38	9.46	57.9%
Stationary fuel combustion total	10.06	11.32	10.89	8.82	6.34	5.57	34.1%
Industrial processes total	0.78	0.56	0.80	0.81	0.98	0.93	5.7%
Waste disposal and recycling total	0.44	0.11	0.09	0.13	0.15	0.12	0.7%
Miscellaneous total	0.33	0.25	0.37	0.28	0.27	0.26	1.6%
Total of all sources	**26.88**	**27.08**	**25.53**	**22.60**	**19.12**	**16.34**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends Web s ite www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/ttn/chief)

Note: The latest available data are 2008.

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

Heavy diesel-powered vehicles were responsible for nearly one-half (44.1%) of highway vehicle nitrogen oxide emissions in 2005, while light gasoline vehicles were responsible for the rest.

Table 12.5
Emissions of Nitrogen Oxides from Highway Vehicles, 1970–2005[a]
(million short tons)

Source category	1970	1980	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered							
Light vehicles & motorcycles	8.54	6.63	4.26	3.05	2.31	1.63	25.5%
Light trucks[b]	1.54	1.58	1.50	1.46	1.44	1.56	24.4%
Heavy vehicles	0.72	0.62	0.57	0.52	0.45	0.38	5.9%
Total	10.81	8.83	6.33	5.03	4.20	3.57	55.9%
Diesel powered							
Light vehicles	0.00	0.03	0.04	0.02	0.01	0.00	0.0%
Light trucks[b]	0.07	0.05	0.02	0.01	0.01	0.01	0.2%
Heavy vehicles	1.76	2.59	3.19	3.82	4.18	2.81	44.0%
Total	1.83	2.66	3.26	3.85	4.19	2.82	44.1%
Total							
Highway vehicle total	**12.64**	**11.49**	**9.59**	**8.88**	**8.39**	**6.39**	**100.0%**
Percent diesel	14.5%	23.1%	34.0%	43.4%	49.9%	44.1%	

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

Note: Data beyond 2005 are not available.

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

The transportation sector accounted for almost 38% of the nation's volatile organic compound (VOC) emissions in 2008, with the majority coming from highway vehicles. For details on the highway emissions of VOC, see Table 12.7.

Table 12.6
Total National Emissions of Volatile Organic Compounds, 1970–2008[a]
(million short tons)

Source category	1970	1980	1990	2000	2005	2008	Percent of total, 2008
Highway vehicles	16.91	13.87	9.39	5.33	4.11	3.42	21.5%
Off-highway	1.62	2.19	2.66	2.64	2.87	2.59	16.2%
Transportation total	18.53	16.06	12.05	7.97	6.98	6.00	37.7%
Stationary fuel combustion total	0.72	1.05	1.01	1.18	1.77	1.45	9.1%
Industrial processes total	12.33	12.10	9.01	7.21	6.99	6.79	42.5%
Waste disposal and recycling total	1.98	0.76	0.99	0.42	0.39	0.37	2.3%
Miscellaneous total	1.10	1.13	1.06	0.73	3.29	1.33	8.4%
Total of all sources	**34.66**	**31.11**	**24.11**	**17.51**	**18.42**	**15.93**	**100.0%**

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

Note: The latest available data are 2008.

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[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 over 95% of highway vehicle emissions of volatile organic compounds. VOC emissions from highway vehicles in 2005 were about one-quarter of the 1990 level.

Table 12.7
Emissions of Volatile Organic Compounds from Highway Vehicles, 1970–2005[a]
(thousand short tons)

Source category	1970	1980	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered							
Light vehicles & motorcycles	11,996	9,304	5,690	3,768	2,903	2,111	51.8%
Light trucks[b]	2,776	2,864	2,617	2,225	1,929	1,629	39.9%
Heavy vehicles	1,679	1,198	633	421	256	171	4.2%
Total	16,451	13,366	8,940	6,414	5,088	3,911	95.9%
Diesel powered							
Light vehicles	8	16	18	9	3	2	0.0%
Light trucks[b]	41	28	15	10	4	6	0.1%
Heavy vehicles	411	459	415	315	230	159	3.9%
Total	460	503	448	335	238	167	4.1%
Total							
Highway vehicle total	**16,911**	**13,869**	**9,388**	**6,749**	**5,326**	**4,078**	**100.0%**
Percent diesel	2.7%	3.6%	4.8%	5.0%	4.5%	4.1%	

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

Note: Data beyond 2005 are not available.

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

The transportation sector accounted for just over 3% of the nation's particulate matter (PM-10) emissions in 2008. For details on the highway emissions of PM-10, see Table 12.9.

Table 12.8
Total National Emissions of Particulate Matter (PM-10), 1970–2008[a]
(million short tons)

Source category	1970	1980	1990	2000	2005	2008	Percent of total, 2008
Highway vehicles	0.48	0.43	0.39	0.23	0.19	0.17	1.2%
Off-highway	0.16	0.26	0.33	0.32	0.35	0.30	2.1%
Transportation total	0.64	0.69	0.72	0.55	0.54	0.48	3.2%
Stationary fuel combustion total	2.87	2.45	1.20	1.47	1.44	1.33	9.0%
Industrial processes total	7.67	2.75	1.04	0.71	1.22	1.17	7.9%
Waste disposal and recycling total	1.00	0.27	0.27	0.36	0.29	0.29	1.9%
Miscellaneous total	0.84	0.85	24.54	20.65	17.66	11.54	77.9%
Total of all sources	**13.02**	**7.01**	**27.75**	**23.75**	**21.15**	**14.81**	**100.0%**

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

Note: Because PM-10 is fine particle matter less than 10 microns, it also includes PM-2.5. Specific data for PM-2.5 are shown on Tables 12.10 and 12.11. The latest available data are 2008.

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

Since the mid-1980's, diesel-powered vehicles have been responsible for more than half of highway vehicle emissions of particulate matter (PM-10). Heavy vehicles are clearly the main source.

Table 12.9
Emissions of Particulate Matter (PM-10) from Highway Vehicles, 1970–2005[a]
(thousand short tons)

Source category	1970	1980	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered							
Light vehicles & motorcycles	249	141	56	53	51	46	25.1%
Light trucks[b]	74	49	31	32	31	35	19.1%
Heavy vehicles	44	30	17	13	10	8	4.4%
Total	367	220	104	98	92	89	48.6%
Diesel powered							
Light vehicles	2	9	11	4	1	1	0.5%
Light trucks[b]	19	12	5	3	1	1	0.5%
Heavy vehicles	92	191	268	199	135	92	50.3%
Total	113	212	284	206	137	94	51.4%
Total							
Highway vehicle total	**480**	**432**	**387**	**304**	**230**	**183**	**100.0%**
Percent diesel	23.5%	49.1%	73.4%	67.8%	59.6%	51.4%	

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

Note: Because PM-10 is fine particle matter less than 10 microns, it also includes PM-2.5. Specific data for PM-2.5 are shown on Tables 12.10 and 12.11. Data beyond 2005 are not available.

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

The transportation sector accounted for only 4% of the nation's particulate matter (PM-2.5) emissions in 2008. For details on the highway emissions of PM-2.5, see Table 12.11.

Table 12.10
Total National Emissions of Particulate Matter (PM-2.5), 1990–2008
(million short tons)

Source category	1990	1995	2000	2005	2006	2008	Percent of total, 2008
Highway vehicles	0.32	0.25	0.17	0.14	0.13	0.11	2.2%
Off-highway	0.30	0.31	0.30	0.32	0.31	0.28	5.8%
Transportation total	0.62	0.56	0.47	0.46	0.44	0.39	8.0%
Stationary fuel combustion total	0.91	0.90	1.29	1.13	1.09	1.01	20.6%
Industrial processes total	0.56	0.50	0.50	0.53	0.52	0.48	9.9%
Waste disposal and recycling total	0.23	0.25	0.33	0.27	0.27	0.27	5.5%
Miscellaneous total	5.23	4.73	4.69	3.07	2.96	2.74	56.1%
Total of all sources	**7.56**	**6.93**	**7.29**	**5.46**	**5.27**	**4.89**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends Web s ite www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/ttn/chief)

Note: The latest available data are 2008.

Diesel vehicles are responsible for the majority of highway vehicle PM-2.5 emissions. Nearly two-thirds of the highway vehicles' PM-2.5 emissions are from heavy diesel trucks.

Table 12.11
Emissions of Particulate Matter (PM-2.5) from Highway Vehicles, 1990–2005[a]
(thousand short tons)

Source category	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered					
Light vehicles & motorcycles	35	30	27	23	18.0%
Light trucks[b]	21	20	18	18	14.1%
Heavy vehicles	11	9	7	6	4.7%
Total	67	59	52	47	36.7%
Diesel powered					
Light vehicles	9	4	1	1	0.8%
Light trucks[b]	4	2	1	1	0.8%
Heavy vehicles	243	179	119	79	61.7%
Total	256	185	121	81	63.3%
Total					
Highway vehicle total	**323**	**244**	**173**	**128**	**100.0%**
Percent diesel	79.3%	75.8%	69.9%	63.3%	

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

Note: Data beyond 2005 are not available.

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

EMISSION STANDARDS

The U.S. Env ironmental Protection Agency (EPA) regulates emissions from mobile sources including vehicles, engines, and motorized equipment that produce exhaust and evaporative emissions. Mobile sources contribute to four main air pollutants: carbon monoxide, hydrocarbons, nitrogen oxides, and particulate matter. The EPA not only sets standards for the vehicles, engines, and equipment, but also the fuels that they use. Tables 12.12 through 12.25 contain summaries of the current standards.

Acronyms Used on Tables 12.12 through 12.25

bhp	Brake horsepower-hour
CI	Compression-ignition
CO	Carbon Monoxide
DE	Diesel engine
g	Gram
g/kN	Grams per kilonewton
g/mi	Grams per mile
GVW	Gross vehicle weight
HC	Hydrocarbons
HCHO	Formaldehyde
HLDT	Heavy light-duty truck
Hp-hr	Horsepower-hour
kW	Kilowatt
kW-hr	Kilowatt-hour
LDT	Light-duty truck
LDV	Light-duty vehicle
LEV	Low-emission vehicle
LLDT	Light light-duty truck
LVW	Loaded vehicle weight
MDPV	Medium-duty passenger vehicle (8,500-10,000 lbs. GVWR)
NMHC	Non-methane hydrocarbon
NMOG	Non-methane organic gases
NOx	Nitrogen oxides
PM	Particulate matter
ppm	Parts per million
rPR	Rated pressure ratio
SI	Spark-ignition
SULEV	Super-ultra-low-emission vehicle
ULEV	Ultra-low-emission vehicle
ZEV	Zero-emission vehicle

These exhaust emission standards were phased-in from 2004 to 2010.

Table 12.12
Light-Duty Vehicle, Light-Duty Truck, and Medium-Duty Passenger Vehicle – Tier 2 Exhaust Emission Standards

	Standard	Emission Limits at 50,000 Miles					Emission Limits at Full Useful Life (120,000 miles)[a]				
		NOx (g/mi)	NMOG (g/mi)	CO (g/mi)	PM (g/mi)	HCHO (g/mi)	NOx (g/mi)	NMOG (g/mi)	CO (g/mi)	PM (g/mi)	HCHO (g/mi)
Federal	Bin 1	-	- -		-	-	0	0	0	0	0
	Bin 2	-	- -		-	-	0.02	0.01	2.1	0.01	0.004
	Bin 3	-	- -		-	-	0.03	0.055	2.1	0.01	0.011
	Bin 4	-	- -		-	-	0.04	0.07	2.1	0.01	0.011
	Bin 5	0.05	0.075	3.4	-	0.015	0.07	0.09	4.2	0.01	0.018
	Bin 6	0.08	0.075	3.4	-	0.015	0.1	0.09	4.2	0.01	0.018
	Bin 7	0.11	0.075	3.4	-	0.015	0.15	0.09	4.2	0.02	0.018
	Bin 8	0.14	0.100 / 0.125[c]	3.4	-	0.015	0.2	0.125 / 0.156	4.2	0.02	0.018
	Bin 9[b]	0.2	0.075 / 0.140	3.4	-	0.015	0.3	0.090 / 0.180	4.2	0.06	0.018
	Bin 10[b]	0.4	0.125 / 0.160	3.4 / 4.4	-	0.015 / 0.018	0.6	0.156 / 0.230	4.2 / 6.4	0.08	0.018 / 0.027
	Bin 11[b]	0.6	0.195	5	-	0.022	0.9	0.28	7.3	0.12	0.032

Source:
40 CR 86 Subpart S. (Additional resources: www.epa.gov/otaq/standards)

Note: Tests Covered: Federal Test Procedure (FTP), cold carbon monoxide, highway, and idle. Definitions of acronyms are on page 12-13.

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[a] In lieu of intermediate useful life standards (50,000 miles) or to gain additional nitrogen oxides credit, manufacturers may optionally certify to the Tier 2 exhaust emission standards with a useful life of 150,000 miles.

[b] Bins 9-11 expired in 2006 for light-duty vehicles and light light-duty trucks and 2008 for heavy light-duty trucks and medium-duty passenger vehicles.

[c] Pollutants with two numbers have a separate certification standard (1st number) and in-use standard (2nd number).

Table 12.13
Light-Duty Vehicle, Light-Duty Truck, and Medium-Duty Passenger Vehicle – Tier 2 Evaporative Emission Standards

	Vehicle Type	Model Year	3 Day Diurnal + Hot Soak (g/test)	Supplemental 2 Day Diurnal + Hot Soak (g/test)	Running Loss (g/mi)
	LDV/LLDTs[a]	2004	0.95	1.20	0.05
	HLDTs[b]	2004	1.20	1.50	0.05
	MDPVs[a, b]	2004	1.40	1.75	0.05
Federal	LDV[a]	2009	0.50	0.65	0.05
	LLDT[a]	2009	0.65	0.85	0.05
	HLDT[b]	2010	0.90	1.15	0.05
	MDPV[a, b]	2010	1.00	1.25	0.05

Source:
40 CR 86 Subpart S. (Additional resources: www.epa.gov/otaq/standards)

Note: Multi-fuel vehicle phase-in applies. Definitions of acronyms are on page 12-13.

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[a] For liquefied petroleum gas-fueled light-duty vehicles (LDV), light-duty trucks (LDT), and medium-duty passenger vehicles (MDPV): 0.15 grams hydrocarbon per gallon (0.04 grams per liter) of fuel dispensed.

[b] Refueling standards for heavy light-duty trucks (HLDT) are subject to phase-in requirements. MDPVs must also comply with the phase-in requirement and must be grouped with HLDTs to determine phase-in compliance.

Table 12.14
Heavy-Duty Highway Compression-Ignition Engines and Urban Buses – Exhaust Emission Standards

	Year	HC (g/bhp-hr)	NMHC (g/bhp-hr)	NMHC + NOx (g/bhp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)	CO (g/bhp-hr)	Idle CO (percent Exhaust gas flow)	Smoke[a] (Percentage)	Useful Life (hours/years/miles)
Federal[b]	1974-78	-	-	16	-	-	40	-	20 / 15 / 50	-
	1979-84	1.5	-	10	-	-	25	-	20 / 15 / 50	-
	1985-87	1.3	-	-	10.7	-	15.5	-	20 / 15 / 50	LHDDE: - / 8 / 110,000 MHDDE: - / 8 / 185,000 HHDDE: - / 8 / 290,000
	1988-89	1.3[d]	-	-	10.7	0.6	15.5	0.5[c]	20 / 15 / 50	1990-97 and 1998+ for HC, CO, and PM: LHDDE: - / 8 / 110,000 MHDDE: - / 8 / 185,000 HHDDE: - / 8 / 290,000 1994+ urban buses for PM only: LHDDE: - / 10 / 110,000 1998+ for NOx: LHDDE: - / 10 / 110,000 MHDDE: - / 10 / 185,000 HHDDE: - / 10 / 290,000
	1990	1.3[d]	-	-	6.0	0.6	15.5	0.5[c]	20 / 15 / 50	
	1991-93	1.3	-	-	5.0 [ABT]	0.25 [ABT] 0.10[e]	15.5	0.5[c]	20 / 15 / 50	
	1994-97	1.3	-	-	5.0 [ABT]	0.1 [ABT] 0.07[f],0.05[g]	15.5	0.5[c]	20 / 15 / 50	
	1998-2003	1.3	-	-	4.0 [ABT]	0.1 [ABT] 0.05[g]	15.5	0.5[c]	20 / 15 / 50	
	2004-2006[h]	-	-	2.4 (or 2.5 with a limit of 0.5 on NMHC)[o] [ABT[i,j]]	-	0.1 0.05[g]	15.5	0.5	20 / 15 / 50	For all pollutants:[p] LHDDE: - / 10 / 110,000 MHDDE: - / 10 / 185,000 HHDDE: 22,000 / 10 / 435,000
	2007+[h,k,l,m,n]	-	0.14[o]	2.4 (or 2.5 with a limit of 0.5 on NMHC) [ABT]	0.2[o]	0.01	15.5	0.5	20 / 15 / 50	

Sources:
40 CFR 86.099-11 Emission standards for 1999 and later model year diesel heavy-duty engines and vehicles.
40 CFR 86.004-11 Emission standards for 2004 and later model year diesel heavy-duty engines and vehicles.
40 CFR 86.007-11 Emission standards and supplemental requirements for 2007 and later model year diesel heavy-duty engines and vehicles. (Additional resources: www.epa.gov/otaq/standards)

Note: The test procedures are the EPA Transient Test Procedure and the EPA Smoke Test Procedure. Definitions of acronyms are on page 12-13.

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[a] Percentages apply to smoke opacity at acceleration/lug/peak modes.

[b] Standards for 1990 apply only to diesel-fueled heavy-duty engines (HDE). Standards for 1991+ apply to both diesel- and methanol-fueled HDEs. Standards that apply to urban buses specifically are footnoted.

[c] This standard applies to the following fueled engines for the following model years: methanol - 1990+, natural gas and liquefied petroleum gas (LPG) - 1994+.

[d] For petroleum-fueled engines, the standard is for hydrocarbons (HC). For methanol-fueled engines, the standard is for total hydrocarbon equivalent (THCE).

[e] Certification standard for urban buses for 1993.

[f] Certification standard for urban buses from 1994-95.

[g] Certification standard for urban buses from 1996 and later. The in-use standard is 0.07.

[h] Load Response Test certification data submittal requirements take effect for heavy-duty diesel engines beginning in model year 2004. The following requirements take effect with the 2007 model year: steady-state test requirement and Not-to-Exceed (NTE) test procedures for testing of in-use engines. On-board diagnostic requirements applicable to heavy-duty diesel vehicles and engines up to 14,000 pounds gross vehicle weight rating (GVWR) phase in from the 2005 through 2007 model years.

Table 12.14 (continued)
Heavy-Duty Highway Compression-Ignition Engines and Urban Buses – Exhaust Emission Standards

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[i] The modified averaging, banking, and trading program for 1998 and later model year engines applies only to diesel cycle engines. Credits generated under the modified program may be used only in 2004 and later model years.

[j] For heavy-duty diesel engines, there are three options to the measurement procedures currently in place for alternative fueled engines: (1) use a T HC measurement in place of an non-methane hydrocarbon (NMHC) measurement; (2) u se a measurement procedure specified by the manufacturer with prior approval of the Administrator; or (3) subtract two percent from the measured THC value to obtain an NMHC value. The methodology must be specified at time of certification and will remain the same for the engine family throughout the engines' useful life. For natural gas vehicles, EPA allows the option of measuring NMHC through direct quantification of individual species by gas chromatography.

[k] Starting in 2006, refiners must begin producing highway diesel fuel that meets a maximum sulfur standard of 15 parts per million (ppm).

[l] Subject to a Supplemental Emission Test (1.0 x Federal Test Procedure [FTP] standard (or Family Emission Limit [FEL]) for nitrogen oxides [NOx], NMHC, and particulate matter [PM]) and a NTE test (1.5 x FTP standard [or FEL] for NOx, NMHC, and PM).

[m] EPA adopted the lab-testing and field-testing specifications in 40 CFR Part 1065 for heavy-duty highway engines, including both diesel and Otto-cycle engines. These procedures replace those previously published in 40 Code of Federal Regulations (CFR) Part 86, Subpart N. Any new testing for 2010 and later model years must be done using the 40 CFR Part 1065 procedures.

[n] Two-phase in-use NTE testing program for heavy-duty diesel vehicles. The program begins with the 2007 model year for gaseous pollutants and 2008 for PM. The requirements apply to diesel engines certified for use in heavy-duty vehicles (including buses) with GVWRs greater than 8,500 pounds. However, the requirements do not apply to any heavy-duty diesel vehicle that was certified using a chassis dynamometer, including medium-duty passenger vehicles with GVWRs of between 8,500 and 10,000 pounds.

[o] NOx and NMHC standards will be phased in together between 2007 and 2010. The phase-in will be on a percent-of-sales basis: 50 percent from 2007 to 2009 and 100 percent in 2010.

[p] Note that for an individual engine, if the useful life hours interval is reached before the engine reaches 10 years or 100,000 miles, the useful life shall become 10 years or 100,000 miles, whichever occurs first, as required under Clean Air Act section 202(d).

Table 12.15
Heavy-Duty Highway Spark-Ignition Engines – Exhaust Emission Standards

	Engine or Vehicle	Year	Gross Vehicle Weight (lbs)	HC[a] (g/bhp-hr)	NMHC[b] (g/bhp-hr)	NOx (g/bhp-hr)	NOx + NMHC[c] (g/bhp-hr)	PM (g/bhp-hr)	CO (g/bhp-hr)	Idle CO (% exhaust gas flow)	Formaldehyde	Useful Life (years / miles)
Federal	Heavy Duty Engines[d]	Prior to Control	-	12.7	-	-	6.86	-	155	-	-	5 / 50,000
		1970-73	-	275 ppm	-	-	-	-	1.50%	-	-	
		1974-78	-	-	-	16	-	-	40	-	-	
		1979-84	-	1.5	-	10	-	-	25	-	-	
		1985-86	-	1.9	-	-	10.6	-	37.1	-	-	
		1987	14,000	1.1	-	-	10.6	-	14.4	0.5	-	
			> 14,000	1.9	-	-	10.6	-	37.1		-	
		1988-90	14,000	1.1	-	-	6.0	-	14.4	-	-	
			> 14,000	1.9	-	-	6.0	-	37.1	-	-	
		1990[e]	14,000	1.1	-	-	6.0	-	14.4	0.5[j]	-	8 / 110,000[k]
			> 14,000	1.9	-	-	6.0	-	37.1		-	
		1991-97[f]	14,000	1.1[g]	-	-	5.0	-	14.4		-	
			> 14,000	1.9[h]	-	-	5.0	-	37.1		-	
		1998-2004[f]	14,000	1.1[g]	-	-	4.0[i]	-	14.4		-	
			> 14,000	1.9[h]	-	-		-	37.1		-	
		2005-2007[f]	14,000	1.1[g]	-	1.0[l]	-	-	14.4		-	10 / 110,000
			> 14,000	1.9[h]	-		-	-	37.1		-	
		2008+	All	-	0.14	0.2	-	0.01	14.4			
	Complete Heavy-Duty Vehicles[n, q]	2005-2007	8,500 - 10,000	-	0.280[m]	-	0.9	-	7.3		-	11 / 110,000
			10,000 - 14,000	-	0.330[m]	-	1.0	-	8.1		-	
		2008+[p]	8,500 - 10,000	-	0.195[o]	-	0.2	0.02	7.3		0.032	
			10,000 - 14,000	-	0.230[o]	-	0.4	0.02	8.1		0.04	

Sources:
40 CFR 86.1816-05, 86.1816-08 Emission standards for complete heavy-duty vehicles
40 CFR 86.1806-01, 86.1806-04, 86.1806-05 Onboard diagnostics requirements
40 CFR 86.1817-05, 86.1817-08 Complete heavy-duty vehicle averaging, banking, and trading program
40 CFR 86.091-10 Heavy-duty engine averaging, banking, and trading program for 1991 and later - Not available in the e-CFR
40 CFR Part 86 Subpart B Vehicle test procedures (Additional resources: www.epa.gov/otaq/standards)

Note: Definitions of acronyms are on page 12-13.

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[a] For methanol-fueled engines, the standard is for total hydrocarbon equivalent (THCE).
[b] For methanol and alcohol fueled vehicles the standard is for non-methane hydrocarbon equivalent (NMHCE).
[c] For methanol fueled engines the standard is for nitrogen oxides (NOx) plus NMHCE.
[d] Standards for heavy-duty engines are expressed in grams per brake horsepower-hour (g/bhp-hr). Starting with the 1998 model year, crankcase emissions are not allowed.
[e] Standards for 1990 apply to gasoline and methanol-fueled engines.
[f] Standards for 1991 and later apply to gasoline and methanol engines and are optional for natural gas and Liquefied Petroleum Gas-fueled engines through the 1996 model year.
[g] For natural gas fueled engines the standard is 0.9 g/bhp-hr non-methane hydrocarbon (NMHC).

Table 12.15 (continued)
Heavy-Duty Highway Spark-Ignition Engines – Exhaust Emission Standards

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[h] For natural gas fueled engines the standard is 1.7 g/bhp-hr NMHC.

[i] The NOx standard is 5.0 for all natural gas-fueled engines.

[j] This standard applies to the following engines utilizing aftertreatment technology (except for methanol) for the following model years: gasoline/1990+; natural gas and LPG/1991+; methanol/1990+. Starting in 2005, engines certified to on-board diagnostics requirements are not required to meet the idle carbon monoxide (CO) standard.

[k] Useful life is expressed in years or miles, whichever comes first. Useful life for the 1998 and later NOx standard and for all 2004 standards is 10 years or 110,000 miles, whichever comes first.

[l] Manufacturers can choose this standard or one of the following options: (1) a standard of 1.5 g/bhp-hr NMHC+NOX that applies to the 2004 through 2007 model years, with complete heavy-duty vehicle standards taking effect in 2005; or (2) a standard of 1.5 g/bhp-hr NMHC + NOX that would apply to the 2003 through 2007 heavy-duty engines and optionally to 2003 through 2006 complete heavy-duty vehicles.

[m] Standard is expressed as non-methane organic gas, but compliance can optionally be shown using measurement of NMHC or total hydrocarbon (THC).

[n] Complete heavy-duty vehicles have the primary load-carrying container or device attached. Incomplete heavy-duty vehicles are certified to heavy-duty engine standards. Standards for complete heavy-duty vehicles are expressed in grams per mile (g/mi). Starting in 2005 (or 2003 or 2004 depending on the selected phase in option; see footnote l), complete heavy-duty vehicles under 14,000 lbs gross vehicle weight are tested on chassis-based rather than engine-based procedures and must meet these complete heavy-duty vehicle standards.

[o] Although expressed as NMHC, compliance can optionally be shown using measurement of NMOG or THC.

[p] At least 50 percent of a manufacturer's sales must meet these standards in 2008, with 100 percent required in 2009.

[q] Gross vehicle weight ranges are more accurately specified as follows: 8,500 GVW 10,000 and 10,000 < GVW < 14,000.

Table 12.16
Heavy-Duty Highway Compression-Ignition and Spark-Ignition Engines – Evaporative Emission Standards

	Engine Type	Year	Gross Vehicle Weight (lbs)	Conventional Diurnal + Hot Soak (g/test)[a]	Three-Diurnal Test Sequence (g/test)[b]	Supplemental Two-Diurnal Test Sequence (g/test)[c]	Running Loss (gpm)[c]	Spitback (g/test)[c]	Useful Life[d]
Federal	SI	1991-95	14,000	3.0	-	-	-	-	8 / 110,000
			> 14,000[e]	4.0	-	-	-	-	
		1996-2007 (Enhanced)[f]	14,000	-	3.0	3.5	0.05	1.0	10 / 120,000
			> 14,000[e]	-	4.0	4.5		-	
		2008+ (Enhanced)	8500-14,000	-	1.4	1.75		1.0	11 / 110,000
			> 14,000[e]	-	1.9	2.3		-	
	CI	1996-97	14,000	-	3.0	-	-	-	MHDDE: 8 / 185,000 HHDDE: 8 / 290,000 MHDDE: 8 / 185,000 HHDDE: 8 / 290,000
			> 14,000[e]	-	4.0	-	-	-	
		1998+ (Enhanced)[g]	14,000	-	3.0	3.5	0.05	1.0	
			> 14,000[e]	-	4.0	4.5		-	

Sources:
40 CFR 86.099-11 Emission standards for 1999 and later model year diesel heavy-duty engines and vehicles.
40 CFR 86.004-11 Emission standards for 2004 and later model year diesel heavy-duty engines and vehicles.
CFR 86.007-11 Emission standards and supplemental requirements for 2007 and later model year diesel heavy-duty engines and vehicles. (Additional resources: www.epa.gov/otaq/standards)

Note: Definitions of acronyms are on page 12-13.

[a] Applies to gasoline and methanol engines. Standard is hydrocarbon (HC) for gasoline engines, total hydrocarbon equivalent (THCE) for methanol engines.

[b] For spark-ignition (SI) engines, standard applies to gasoline, methanol, natural gas, and liquefied petroleum gas engines. For compression-ignition (CI) engines, standard applies to methanol, natural gas, and liquefied petroleum gas engines. Standard is THCE for methanol engines, HC for others.

[c] For SI engines, standard applies to gasoline and methanol engines. For CI engines, standard applies to methanol engines. Standard is THCE for methanol engines, HC for others.

[d] Useful life is expressed in years or miles, whichever comes first.

[e] Vehicles over 26,000 pounds gross vehicle weight may demonstrate compliance with an engineering design evaluation in lieu of testing.

[f] A new enhanced evaporative test procedure applies, which is considerably more stringent than the previous test procedure despite the fact that the standard values do n ot change from prior years. Gasoline and methanol engines are phased in at the following rates of a manufacturer's sales for the specified model year: 1996: 20 percent; 1997: 40 percent; 1998: 90 percent; 1999: 100 percent.

[g] A new enhanced evaporative test procedure applies, which is considerably more stringent than the previous test procedure despite the fact that the standard values do not change from prior years. Methanol-fueled vehicles are phased in at a rate of 90 percent of a manufacturer's production in 1998 and 100 percent in 1999.

Table 12.17
California Car, Light Truck and Medium Truck Emission Certification Standards

Vehicle Type	Durability Vehicle Basis (mi)	Vehicle Emission Category	NMOG (g/mi)	Carbon Monoxide (g/mi)	Oxides of Nitrogen (g/mi)	Formaldehyde (mg/mi)	Particulates (g/mi)
All passenger cars; LDTs 8,500 lbs GVW or less	50,000	LEV	0.075	3.4	0.05	15	n/a
		LEV, Option 1	0.075	3.4	0.07	15	n/a
		ULEV	0.040	1.7	0.05	8	n/a
Vehicles in this category are tested at their loaded vehicle weight	120,000	LEV	0.090	4.2	0.07	18	0.01
		LEV, Option 1	0.090	4.2	0.10	18	0.01
		ULEV	0.055	2.1	0.07	11	0.01
		SULEV	0.010	1.0	0.02	4	0.01
	150,000 (Optional)	LEV	0.090	4.2	0.07	18	0.01
		LEV, Option 1	0.090	4.2	0.10	18	0.01
		ULEV	0.055	2.1	0.07	11	0.01
		SULEV	0.010	1.0	0.02	4	0.01
MDVs 8,501-10,000 lbs GVW	120,000	LEV	0.195	6.4	0.2	32	0.12
		ULEV	0.143	6.4	0.2	16	0.06
		SULEV	0.100	3.2	0.1	8	0.06
Vehicles in this category are tested at their adjusted loaded vehicle weight	150,000 (Optional)	LEV	0.195	6.4	0.2	32	0.12
		ULEV	0.143	6.4	0.2	16	0.06
		SULEV	0.100	3.2	0.1	8	0.06
MDVs 10,000-14,000 lbs GVW	120,000	LEV	0.230	7.3	0.4	40	0.12
		ULEV	0.167	7.3	0.4	21	0.06
		SULEV	0.117	3.7	0.2	10	0.06
Vehicles in this category are tested at their adjusted loaded vehicle weight	150,000 (Optional)	LEV	0.230	7.3	0.4	40	0.12
		ULEV	0.167	7.3	0.4	21	0.06
		SULEV	0.117	3.7	0.2	10	0.06

Source:
California LEV Regulations with amendments effective 12/8/10. (Additional resources: www.arb.ca.gov)

Note: Definitions of acronyms are on page 12-13.

These exhaust emission standards apply to commercial aircraft engines.

Table 12.18
Aircraft – Exhaust Emission Standards

	Year	Pressure Ratio (PR)	Applicability[a]	HC (g/kN)	NOx	CO (g/kN)	Smoke
Federal[b]	1974+	-	T8	-	-	-	30
	1976+	-	TF with rO[c] 129 kN	-	-	-	83.6(rO)$^{-0.274}$
	1978+	-	T3[d]	-	-	-	25
	1983+	-	TF with rO < 26.7 kN	-	-	-	83.6(rO)$^{-0.274}$ NTE max of SN=50
	1984+	-	T3, T8, TF with rO 26.7 kN	19.6	-	-	83.6(rO)$^{-0.274}$ NTE max of SN=50
		-	TSS	140(.92)^{rPR}	-	-	83.6(rO)$^{-0.274}$ NTE max of SN=50
		-	TSS with rO 26.7 kN	140(.92)^{rPR}	-	-	83.6(rO)$^{-0.274}$ NTE max of SN=50
		-	TP with rO 1,000 kW	-	-	-	187(rO)$^{-0.168}$
	1997+	-	T3, T8, TF with rO > 26.7 kN	19.6	40+2(rPR)	118	83.6(rO)$^{-0.274}$ NTE max of SN=50
		-	T3, T8, TF newly certified with rO > 26.7 kN	19.6	32+1.6(rPR)	118	83.6(rO)$^{-0.274}$ NTE max of SN=50
	2000+	-	T3, T8, TF newly manufactured with rO > 26.7 kN	19.6	32+1.6(rPR)	118	83.6(rO)$^{-0.274}$ NTE max of SN=50
	2005+	PR 30	T3, T8, TF newly certified with rO > 89 kN	-	19+1.6(rPR)	-	-
			T3, T8, TF newly certified with 26.7 kN < rO 89 kN	-	37.572+1.6(rPR)-0.2087(rO)	-	-
		30 < PR < 62.5	T3, T8, TF newly certified with rO>89 kN	-	7+2.0(rPR)	-	-
			T3, T8, TF newly certified with 26.7kN < r0 89kN	-	42.71+1.4286(rPR)-0.4013(rO)+0.00642(rPR)(rO)	-	-
		PR 62.5	T3, T8, TF	-	32+1.6(rPR)	-	-

Source:
40 CFR Part 87, Aircraft emission standards, test procedures, certification requirements (Additional resources: www.epa.gov/otaq/standards)

Note: The test procedures are the International Civil Aviation Organization (ICAO) Smoke Emission Test Procedure and the ICAO Gaseous Emissions Test Procedure. There is no useful life or warranty period for purposes of compliance with aircraft emissions standards. Definitions of acronyms are on page 12-13.

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[a] T8=all aircraft gas turbine engines of the JT8D model family
TF=all turbofan and turbojet aircraft engines except engines of Class T3, T8, and TSS
T3=all aircraft gas turbine engines of the JT3D model family
TSS=all aircraft gas turbine engines for aircraft operations at supersonic flight speeds
TP=all aircraft turboprop engines

[b] Federal standards apply to planes operating in the United States, regardless of where they were manufactured.

[c] Rated output (rO) is the maximum power/thrust available for takeoff.

[d] T3 engines are no longer manufactured but are in the existing fleet.

These standards apply to construction and agricultural equipment, such as excavators, paving equipment, tractors, combines, bulldozers, and skidders.

Table 12.19
Nonroad Compression-Ignition Engines – Exhaust Emission Standards

	Rated Power (kW)	Tier	Model Year	NMHC (g/kW-hr)	NMHC + NOx (g/kW-hr)	NOx (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Smoke[a] Percentage	Useful Life (hours/years)[b]
Federal	kW < 8	1	2000-2004	--	10.5	--	1.0	8.0	20 / 15 / 50	3,000 / 5
		2	2005-2007	--	7.5	--	0.80	8.0		
		4	2008+	--	7.5	--	0.40[c]	8.0		
	8 kW < 19	1	2000-2004	--	9.5	--	0.80	6.6		3,000 / 5
		2	2005-2007	--	7.5	--	0.80	6.6		
		4	2008+	--	7.5	--	0.40	6.6		
	19 kW < 37	1	1999-2003	--	9.5	--	0.80	5.5		5,000 / 7[d]
		2	2004-2007	--	7.5	--	0.60	5.5		
		4	2008-2012	--	7.5	--	0.30	5.5		
			2013+	--	4.7	--	0.03	5.5		
	37 kW < 56	1	1998-2003	--	--	9.2	--	--		8,000 / 10
		2	2004-2007	--	7.5	--	0.40	5.0		
		3[e]	2008-2011	--	4.7	--	0.40	5.0		
		4 (Option 1)[f]	2008-2012	--	4.7	--	0.30	5.0		
		4 (Option 2)[f]	2012	--	4.7	--	0.03	5.0		
		4	2013+	--	4.7	--	0.03	5.0		
	56 kW < 75	1	1998-2003	--	--	9.2	--	--		
		2	2004-2007	--	7.5	--	0.40	5.0		
		3	2008-2011	--	4.7	--	0.40	5.0		
		4	2012-2103[g]	--	4.7	--	0.02	5.0		
			2014+[h]	0.19	--	0.4	0.02	5.0		
	75 kW < 130	1	1997-2002	--	--	9.2	--	--		
		2	2003-2006	--	6.6	--	0.3	5.0		
		3	2007-2011	--	4.0	--	0.3	5.0		
		4	2012-2013[g]	--	4.0	--	0.02	5.0		
			2014+	0.19	--	0.4	0.02	5.0		
	130 kW < 225	1	1996-2002	1.3[i]	--	9.2	0.54	11.4		
		2	2003-2005	--	6.6	--	0.20	3.5		
		3	2006-2010	--	4.0	--	0.20	3.5		
		4	2011-2013[g]	--	4.0	--	0.02	3.5		
			2014+[h]	0.19	--	0.4	0.02	3.5		
	225 kW < 450	1	1996-2000	1.3[i]	--	9.2	0.54	11.4		
		2	2001-2005	--	6.4	--	0.20	3.5		
		3	2006-2010	--	4.0	--	0.20	3.5		
		4	2011-2013[g]	--	4.0	--	0.02	3.5		
			2014+[h]	0.19	--	0.4	0.02	3.5		
	450 kW < 560	1	1996-2001	1.3[i]	--	9.2	0.54	11.4		
		2	2002-2005	--	6.4	--	0.20	3.5		
		3	2006-2010	--	4.0	--	0.20	3.5		
		4	2011-2013[g]	--	4.0	--	0.02	3.5		
			2014+[h]	0.19	--	0.4	0.02	3.5		
	560 kW < 900	1	2000-2005	1.3[i]	--	9.2	0.54	11.4		
		2	2006-2010	--	6.4	--	0.20	3.5		
		4	2011-2014	0.4	--	3.5	0.10	3.5		
			2015+[h]	0.19	--	3.5[j]	0.04[k]	3.5		

Table 12.19 (continued)
Nonroad Compression-Ignition Engines – Exhaust Emission Standards

	Rated Power (kW)	Tier	Model Year	NMHC (g/kW-hr)	NMHC + NOx (g/kW-hr)	NOx (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Smoke[a] Percentage	Useful Life (hours/years)[b]
Federal	kW > 900	1	2000-2005	1.3[i]	--	9.2	0.54	11.4	20 / 15 / 50	8,000 / 10
		2	2006-2010	--	6.4	--	0.20	3.5		
		4	2011-2014	0.4	--	3.5[j]	0.10	3.5		
			2015+[h]	0.19	--	3.5[j]	0.04[k]	3.5		

Source:
40 CFR 98.112 = Exhaust emission standards
40 CFR 1039.101 = Exhaust emission standards for after 2014 model year
40 CFR 1039.102 = Exhaust emission standards for model year 2014 and earlier
40 CFR 1039 Subpart F = Exhaust emissions transient and steady state test procedures
40 CFR Part 86 Subpart I = Smoke emission test procedures
40 CFR Part 1065 = Test equipment and emissions measurement procedures (Additional resources: www.epa.gov/otaq/standards)

Note: Definitions of acronyms are on page 12-13.

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[a] Smoke emissions may not exceed 20 percent during the acceleration mode, 15 percent during the lugging mode, and 50 percent during the peaks in either mode. Smoke emission standards do not apply to single-cylinder engines, constant-speed engines, or engines certified to a PM emission standard of 0.07 grams per kilowatt-hour (g/kW-hr) or lower. Smoke emissions are measured using procedures in 40 CFR Part 86 Subpart I.

[b] Useful life and warranty period are expressed hours and years, whichever comes first.

[c] Hand-startable air-cooled direct injection engines may optionally meet a PM standard of 0.60 g/kW-hr. These engines may optionally meet Tier 2 standards through the 2009 model years. In 2010 these engines are required to meet a PM standard of 0.60 g/kW-hr.

[d] Useful life for constant speed engines with rated speed 3,000 revolutions per minute (rpm) or higher is 5 years or 3,000 hours, whichever comes first.

[e] These Tier 3 standards apply only to manufacturers selecting Tier 4 Option 2. Manufacturers selecting Tier 4 Option 1 will be meeting those standards in lieu of Tier 3 standards.

[f] A manufacturer may certify all their engines to either Option 1 or Option 2 sets of standards starting in the indicated model year. Manufacturers selecting Option 2 must meet Tier 3 standards in the 2008-2011 model years.

[g] These standards are phase-out standards. Not more than 50 percent of a manufacturer's engine production is allowed to meet these standards in each model year of the phase out period. Engines not meeting these standards must meet the final Tier 4 standards.

[h] These standards are phased in during the indicated years. At least 50 percent of a manufacturer's engine production must meet these standards during each year of the phase in. Engines not meeting these standards must meet the applicable phase-out standards.

[i] For Tier 1 engines the standard is for total hydrocarbons.

[j] The NOx standard for generator sets is 0.67 g/kW-hr.

[k] The PM standard for generator sets is 0.03 g/kW-hr.

These standards apply to gasoline and propane industrial equipment such as forklifts, generators, airport service equipment, compressors and ice-grooming machines.

Table 12.20
Nonroad Large Spark-Ignition Engines – Exhaust and Evaporative Emission Standards

<table>
<tr><th rowspan="2"></th><th rowspan="2">Tier</th><th rowspan="2">Year</th><th colspan="2">General Duty-Cycle Standards</th><th colspan="2">Alternative Standards for Severe-Duty Engines</th><th colspan="2">Field Testing Standards</th><th rowspan="2">Useful Life (years/hours)</th></tr>
<tr><th>HC+NOx[a] (g/kW-hr)</th><th>CO (g/kW-hr)</th><th>HC+NOx[a] (g/kW-hr)</th><th>CO (g/kW-hr)</th><th>HC+NOx[a] (g/kW-hr)</th><th>CO (g/kW-hr)</th></tr>
<tr><td rowspan="6">Federal [b]</td><td>1[c]</td><td>2004-2006</td><td>4.0[d]</td><td>50.0</td><td>4.0[d]</td><td>130.0</td><td>-</td><td>-</td><td>7 / 5,000[e]</td></tr>
<tr><td rowspan="5">2[f]</td><td rowspan="5">2007+</td><td>2.7[f]</td><td>4.4[f]</td><td>2.7</td><td>130.0</td><td>3.8[f]</td><td>6.5[f]</td><td>7 / 5,000[e]</td></tr>
<tr><td colspan="7">Evaporative Emission Standards (for engines fueled by a volatile liquid fuel)</td></tr>
<tr><td>Fuel line permeation</td><td colspan="5">Nonmetallic fuel lines must meet the permeation specifications of SAE J2260 (November 1996)</td><td rowspan="3">5 / -</td></tr>
<tr><td>Diurnal emissions</td><td colspan="5">Evaporative HC emissions may not exceed 0.2 grams per gallon of fuel tank capacity</td></tr>
<tr><td>Running loss</td><td colspan="5">Liquid fuel in the fuel tank may not reach boiling during continuous engine operation in the final installation at an ambient temperature of 30°C</td></tr>
</table>

Sources:
40 CFR 1048.101 = Exhaust emission standards
40 CFR 1048.105 = Evaporative emission standards
40 CFR 1048.110 = Engine diagnostic requirements (Additional resources: www.epa.gov/otaq/standards)

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[a] The numerical emission standards for hydrocarbons (HC) must be met based on the following types of hydrocarbon emissions for engines powered by the following fuels: (1) non-methane hydrocarbons (NMHC) for natural gas; (2) total hydrocarbon equivalent (THCE) for alcohol; and (3) total hydrocarbons (THC) for other fuels.

[b] Voluntary Blue Sky standards for large spark-ignition (SI) engines are available. Engines with displacement at or below 1,000 cubic centimeters (cc) and maximum power at or below 30 kilowatts (kW) may be certified under the program for small SI engines.

[c] Emission standards are based on testing over a steady-state duty-cycle.

[d] The Tier 1 HC plus nitrogen oxides (NOx) emission standard for in-use testing is 5.4 grams per kW-hour (g/kW-hr).

[e] Useful life is expressed in years and hours, whichever comes first. These are the minimum useful life requirements. For severe-duty engines, the minimum useful life is seven years or 1,500 hours of operation, whichever comes first. A longer useful life in hours is required if: (a) the engine is designed to operate longer than the minimum useful life based on the recommended rebuild interval; or (b) the basic mechanical warranty is longer than the minimum useful life.

[f] Optional engine certification is allowed according to the following formula: $(HC+NOx) \times CO^{0.784}$ 8.57. The HC+NOx and carbon monoxide (CO) emission levels selected to satisfy this formula, rounded to the nearest 0.1 g/kW-hr, become the emission standards that apply for those engines. One may not select an HC+NOx emission standard higher than 2.7 g/kW-hr or a CO emission standard higher than 20.6 g/kW-hr.

Table 12.21
Locomotives – Exhaust Emission Standards

	Duty-Cycle[b]	Tier	Year[c]	HC[i] (g/hp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)	CO (g/bhp-hr)	Smoke (percentage)[m]	Minimum Useful Life (hours / years / miles)[n]
Federal[a]	Line-haul	Tier 0	1973-1992[d,e]	1.0	9.5 [ABT]	0.22 [ABT]	5.0	30 / 40 / 50	(7.5 x hp) / 10 / 750,000[o]
		Tier 1	1993-2004[d,e]	0.55	7.4 [ABT]	0.22 [ABT]	2.2	25 / 40 / 50	(7.5 x hp) / 10 / 750,000[o] (7.5 x hp) / 10 / -
		Tier 2	2005-2011[d]	0.30	5.5 [ABT]	0.10[k] [ABT]	1.5	20 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 3	2012-2014[f]	0.30	5.5 [ABT]	0.10 [ABT]	1.5	20 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 4	2015+[g]	0.14	1.3 [ABT]	0.03 [ABT]	1.5	-	(7.5 x hp) / 10 / -
	Switch	Tier 0	1973-2001	2.10	11.8 [ABT]	0.26 [ABT]	8.0	30 / 40 / 50	(7.5 x hp) / 10 / 750,000[o]
		Tier 1	2002-2004[h]	1.20	11.0 [ABT]	0.26 [ABT]	2.5	25 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 2	2005-2010[h]	0.60	8.1 [ABT]	0.13[l] [ABT]	2.4	20 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 3	2011-2014	0.60	5.0 [ABT]	0.10 [ABT]	2.4	20 / 40 / 50	(7.5 x hp) / 10 / -
		Tier 4	2015+	0.14[j]	1.3[j][ABT]	0.03 [ABT]	2.4	-	(7.5 x hp) / 10 / -

Sources:
40 CFR 1033.101 = Emission Standards and Useful Life

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[a] These standards apply to locomotives that are propelled by engines with total rated horsepower (hp) of 750 kilowatts (kW) (1006 h p) or more, unless the owner chooses to have the equipment certified to meet the requirements of locomotives. This does not include vehicles propelled by engines with total rated horsepower of less than 750 kW (1006 hp); see the requirements in 40 Code of Federal Regulations (CFR) Parts 86, 89 and 1039. The test procedures specify chassis-based testing of locomotives. These test procedures include certification testing, production line testing, and in-use testing using the Federal Test Procedure (FTP) when the locomotive has reached between 50-70 percent of its useful life.

[b] Line-haul locomotives are powered by an engine with a maximum rated power (or a combination of engines having a total rated power) greater than 2300 hp. Switch locomotives are powered by an engine with a maximum rated power (or a combination of engines having a total rated power) of 2300 hp or less.

[c] The Tier 0 standards apply to loco motives manufactured after 1972 when they are manufactured or remanufactured. Note that interim standards may apply for Tier 0 or Tier 1 locomotives remanufactured in 2008 or 2009, or for Tier 2 locomotives manufactured or remanufactured in 2008-2012.

[d] Line-haul locomotives subject to the Tier 0 through Tier 2 emission standards must also meet switch standards of the same tier.

[e] The Tier 0 standards apply for 1993-2001 locomotives not originally manufactured with a separate loop intake air cooling system.

[f] Tier 3 line-haul locomotives must also meet Tier 2 switch standards.

[g] Manufacturers using credits may elect to meet a combined nitrogen oxides (NOx) plus hydrocarbon (HC) standard of 1.4 grams per brakehorsepower-hour (g/bhp-hr) instead of the otherwise applicable Tier 4 NOx and HC standards.

[h] Tier 1 and Tier 2 switch locomotives must also meet line-haul standards of the same tier.

[i] The numerical emission standards for HC must be met based on the following types of hydrocarbon emissions for locomotives powered by the following fuels: (1) alcohol: total hydrocarbon equivalent (THCE) emissions for Tier 3 and earlier locomotives, and non-methane hydrocarbon equivalent (NMHCE) for Tier 4; (2) natural gas and liquefied petroleum gas: non-methane hydrocarbon (NMHC) emissions; and (3) diesel: total hydrocarbon (THC) emissions for Tier 3 and earlier locomotives, and NMHC for Tier 4.

Table 12.21 (continued)
Locomotives – Exhaust Emission Standards

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[j] Manufacturers may elect to meet a combined NOx+HC standard of 1.4 g/bhp-hr instead of the otherwise applicable Tier 4 NOx and HC standards.

[k] The line-haul particulate matter (PM) standard for newly remanufactured Tier 2 locomotives is 0.20 g/bhp-hr until January 1, 2013, except as specified in 40 CFR Part 1033.150(a).

[l] The switch PM standard for new Tier 2 locomotives is 0.24 g/bhp-hr until January 1, 2013, except as specified in 40 CFR Part 1033.150(a).

[m] The smoke opacity standards apply only for locomotives certified to one or more PM standards or Family Emission Limits (FEL) greater than 0.05 g/bhp-hr. Percentages apply to smoke opacity at steady state/30-second peak/3-second peak, as measured continuously during testing.

[n] Useful life and warranty period are expressed in megawatt-hours (mw-hr), years, or miles, whichever comes first. Manufacturers are required to certify to longer useful lives if their locomotives are designed to last longer between overhauls than the minimum useful life value.

[o] For locomotives originally manufactured before January 1, 2000, and not equipped with mw-hr meters.

These standards apply to auxiliary and propulsion engines used by all types of recreational and commercial vessels, from small fishing boats to ocean-going ships.

Table 12.22
Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards

	Category [a, b]	Tier	Displacement (L/cylinder)	Power [c] (kW)	Speed (rpm)	Model Year	NOx (g/kW-hr)	HC (g/kW-hr)	HC+NOx [d] (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Useful Life[e] (years/hours)
Federal[g]	C1 Commercial	1	2.5	37	rpm < 130		17.0	-	-	-	-	10 / 10,000
					130 rpm < 2000		$45.0 \times N^{-0.20}$ [i]	-	-	-	-	
					rpm 2000	2004[h]	9.8	-	-	-	-	
		2	disp. < 0.9	37	-	2005[h]	-	-	7.5 (ABT)	0.40 (ABT)	5.0	10 / 10,000
			0.9 disp < 1.2	all	-	2004 [h]	-	-	7.2 (ABT)	0.30 (ABT)	5.0	
			1.2 disp < 2.5		-	2004 [h]	-	-	7.2 (ABT)	0.20 (ABT)	5.0	
			2.5 disp < 5.0		-	2007 [h]	-	-	7.2 (ABT)	0.20 (ABT)	5.0	
	C1 Commercial & Recreational	1	2.5	37	rpm < 130		17.0	-	-	-	-	10/ 1,000
					130 rpm < 2000		$45.0 \times N^{-0.20}$ [i]	-	-	-	-	
					rpm 2000	2004	9.8	-	-	-	-	
		2	disp < 0.9	37	-	2007	-	-	7.5 (ABT)	0.40 (ABT)	5.0	10 / 1,000
			0.9 disp < 1.2	all	-	2006	-	-	7.2 (ABT)	0.30 (ABT)	5.0	
			1.2 disp < 2.5		-	2006	-	-	7.2 (ABT)	0.20 (ABT)	5.0	
			2.5 disp < 5.0		-	2009	-	-	7.2 (ABT)	0.20 (ABT)	5.0	
	C1 Commercial & Recreational < 75 kW	3	< 0.9	< 8	-	2009+	-	-	7.5 (ABT)	0.40 (ABT)	8.0	5 / 3,000; 10 / 1,000 for CI Recreational
				8 kW < 19	-	2009+	-	-	7.5 (ABT)	0.40 (ABT)	6.6	
				19 kW < 37	-	2009-2013	-	-	7.5 [j] (ABT)	0.30 [j] (ABT)	5.5	7 / 5,000
					-	2014+	-	-	4.7 [j] (ABT)	0.20 (ABT)	5.0	
				37 kW < 75	-	2009-2013	-	-	7.5 [j] (ABT)	0.30 [j] (ABT)	5.0	10 / 10,000
					-	2014+	-	-	4.7 [j] (ABT)		5.0	
	C1 Commercial Engines with 35 kW/L power density [k]	3 [l]	< 0.9	-	-	2012+	-	-	5.4 (ABT)	0.14 (ABT)	8.0 for < 8 kW	5 / 3,000 for commercial engines < 19 kW
			0.9 disp < 1.2	All	-	2013+	-	-	5.4 (ABT)	0.12 (ABT)	6.6 for 8 kW < 19	7 / 5,000 for commercial engines 19 kW < 37
			1.2 disp < 2.5	< 600	-	2014-2017	-	-	5.6 (ABT)	0.11 (ABT)	5.5 for 19 kW < 37	10 / 10,000 for C1 Commercial 37 kW
					-	2018+	-			0.10 (ABT)	5.0 for 37 kW	
				600	-	2014+	-	-	5.6 (ABT)	0.11 (ABT)		
			2.5 disp < 3.5	< 600	-	2013-2017	-	-	5.6 (ABT)	0.11 (ABT)		
					-	2018+	-			0.10 (ABT)		
				600	-	2013+	-	-	5.6 (ABT)	0.11 (ABT)		
			3.5 disp < 7.0	< 600	-	2012-2017	-	-	5.8 (ABT)	0.11 (ABT)		
					-	2018+	-			0.10 (ABT)		
				600	-	2012+	-	-	5.8 (ABT)	0.11 (ABT)		
	C1 Commercial engines with > 35 kW/L power density & All Recreational Engines [k]	3 [l]	< 0.9	75	-	2012+	-	-	5.8 (ABT)	0.15 (ABT)	8.0 for < 8 kW	5 / 3,000 for commercial engines < 19 kW
			0.9 disp < 1.2	All	-	2013+	-	-	5.8 (ABT)	0.14 (ABT)	6.6 for 8 kW < 19	7 / 5,000 for commercial engines 19 kW < 37
			1.2 disp < 2.5		-	2014+	-	-	5.8 (ABT)	0.14 (ABT)	5.5 for 19 kW < 37	10 / 10,000 for C1 Commercial 37 kW
			2.5 disp < 3.5		-	2013+	-	-	5.8 (ABT)	0.12 (ABT)	5.0 for 37 kW	10 / 1,000 for CI Recreational
			3.5 disp < 7.0		-	2012+	-	-	5.8 (ABT)	0.11 (ABT)		

(Continued on next page)

Table 12.22 (continued)
Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards

	Category [a, b]	Tier	Displacement (L/cylinder)	Power [c] (kW)	Speed (rpm)	Model Year	NOx (g/kW-hr)	HC (g/kW-hr)	HC+NOx [d] (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Useful Life[e] (years/hours)
Federal[g]	C1 Commercial > 600 kW	4[m]	All	600 kW < 1,400	-	2017+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)	5.0	10 / 10,000
			All	1,400 kW < 2,000	-	2016+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		
			All	2,000 kW < 3,700	-	2014+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		
			< 7.0	3,700	-	2014-2015	1.8 (ABT)	-	0.19 HC[n]	0.12 (ABT)		
					-	2016+	1.8 (ABT)	-	0.19 HC[n]	0.06 (ABT)		
	C2	1	2.5	37	rpm < 130	2004	17.0	-	-	-	-	10 / 20,000
					130 rpm < 2,000		$45.0 \times N^{-0.20}$ [i]	-	-	-	-	
					rpm 2,000		9.8	-	-	-	-	
		2	5.0 disp < 15.0	all	-	2007	-	-	7.8 (ABT)	0.27 (ABT)	5.0	10 / 20,000
			15.0 disp < 20.0	< 3,300	-		-	-	8.7 (ABT)	0.50 (ABT)	5.0	
			15.0 disp < 20.0	3,300	-		-	-	9.8 (ABT)	0.50 (ABT)	5.0	
			20.0 disp < 25.0	all	-		-	-	9.8 (ABT)	0.50 (ABT)	5.0	
			25.0 disp < 30.0	all	-		-	-	11.0 (ABT)	0.50 (ABT)	5.0	
		3[o,p]	7.0 disp < 15.0	< 2,000	-	2013+	-	-	6.2 (ABT)	0.14 (ABT)	5.0	10 / 20,000
				2,000 kW < 3,700	-		-	-	7.8 (ABT)	0.14 (ABT)	5.0	
			15.0 disp < 20.0	< 2,000	-	2014+	-	-	7.0 (ABT)	0.34 (ABT)	5.0	
			20.0 disp < 25.0	< 2,000	-		-	-	9.8 (ABT)	0.27 (ABT)	5.0	
			25.0 disp < 30.0	< 2,000	-		-	-	11.0 (ABT)	0.27 (ABT)	5.0	
		4[m,p]	All	600 kW < 1,400	-	2017+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		10 / 20,000
			All	1400 kW < 2,000	-	2016+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		
			All	2,000 kW < 3,700[q]	-	2014+	1.8 (ABT)	-	0.19 HC[n]	0.04 (ABT)		
			< 15.0	3,700	-	2014-2015	1.8 (ABT)	-	0.19 HC[n]	0.12 (ABT)		
			15.0 disp < 30.0		-	2014-2015	1.8 (ABT)	-	0.19 HC[n]	0.25 (ABT)		
			All		-	2016+	1.8 (ABT)	-	0.19 HC[n]	0.06 (ABT)	5.0	
	C3	1	30.0	All	rpm < 130	2004	17.0	-	-	-	-	3 / 10,000
					130 rpm < 2,000		$45.0 \times N^{-0.20}$ [i]	-	-	-	-	
					rpm 2,000		9.8	-	-	-	-	
		2	30.0	All	rpm < 130	2011	14.4	2.0	-	-	5.0	3 / 10,000
					130 rpm < 2,000		$44.0 \times N^{-0.23}$ [i]		-	-		
					rpm 2,000		7.7		-	-		
		3	30.0	All	rpm < 130	2016	3.4	2.0	-	-	5.0	3 / 10,000
					130 rpm < 2,000		$9.0 \times N^{-0.20}$ [i]		-	-		
					rpm 2,000		2.0		-	-		

Sources:
40 CFR 89.104 = Tiers 1 and 2 useful life & warranty period for marine CI engines less than 37 kW
40 CFR 89.112 = Tiers 1 and 2 emission standards for marine CI engines less than 37 kW
40 CFR 89 Subpart E = Tiers 1 and 2 test procedures for marine CI engines less than 37 kW
40 CFR 94.8 = Tiers 1 and 2 emission standards for C1 (both commercial & recreational), C2 and C3 engines
40 CFR 94.9 = Tiers 1 and 2 useful life for C1 (both commercial & recreational), C2 and C3 engines
40 CFR 94 Subpart B = Tiers 1 and 2 test procedures for C1 (both commercial & recreational), C2 and C3 engines
40 CFR 1042.101 = Tiers 3 and 4 exhaust emission standards and useful life

Table 12.22 (continued)
Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards

Sources (continued):
40 CFR 1042.107 = Tiers 3 and 4 evaporative emission standards engines using a volatile liquid fuel (e.g., methanol)
40 CFR 1042.120 = Tiers 3 and 4 warranty period
40 CFR 1042 Subpart F = Tiers 3 and 4 test procedures (Additional resources: www.epa.gov/otaq/standards)

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[a] For Tiers 1 and 2, Category 1 marine engines are greater than or equal to 37 kilowatts (kW) and have a displacement less than 5.0 liters per cylinder (L/cylinder); Category 2 marine engines have a displacement greater than or equal to 5.0 L/cylinder and less than 30 L/cylinder; and Category 3 marine engines have a displacement greater than or equal to 30.0 L /cylinder. For Tiers 3 and 4, Category 1 represents engines up to 7 L/cylinder displacement; and Category 2 includes engines from 7 to 30 L /cylinder. The definition of Category 3 marine engines remains the same.

[b] Tiers 1 and 2 for marine engines less than 37 kW are subject to the same emission standards as for land-based engines. See Table 1 in 40 Code of Federal Regulations (CFR) Part 89.112 and 40 CFR Part 89.104.

[c] For Tiers 1 and 2, this refers to the rated power; for Tiers 3 and 4, this refers to the maximum engine power.

[d] Total hydrocarbon (THC) plus nitrogen oxides (NOx) for Tier 2 standards.

[e] Useful life is expressed in hours or years, whichever comes first. For Tiers 3 and 4, a longer useful life in hours for an engine family must be specified if either:1) the engine is designed, advertised, or marketed to operate longer than the minimum useful life; or 2) the basic mechanical warranty is longer than the minimum useful life.

[f] Warranty period is expressed in years and hours, whichever comes first.

[g] For Tiers 3 and 4, there are no evaporative emission standards for diesel-fueled engines, or engines using other nonvolatile or nonliquid fuels (e.g., natural gas). If an engine uses a volatile liquid fuel, such as methanol, the engine's fuel system and the vessel in which the engine is installed must meet the evaporative emission requirements of 40 Code of Federal Regulations (CFR) Part 1045 that apply with respect to spark-ignition engines. Manufacturers subject to evaporative emission standards must meet the requirements of 40 CFR 1045.112 as described in 40 CFR 1060.1(a)(2).

[h] Indicates the model years for which the specified standards start.

[i] N is the maximum test speed of the engine in revolutions per minute (rpm).

[j] Manufacturers of Tier 3 engines greater than or equal to 19 kW and less than 75 kW with displacement below 0.9 L/cylinder may alternatively certify some or all of their engine families to a particulate matter (PM) emission standard of 0.20 grams per kilowatt-hour (g/kW-hr) and a NOx+HC emission standard fo 5.8 g/kW-hr for 2014 and later model years.

[k] The applicable Tier 2 NOx+HC standards continue to apply instead of the Tier 3 values for engines at or above 2000 kW.

[l] These Tier 3 standards apply to Category 1 engines below 3700 kW except for recreational marine engines at or above 3700 kW (with any displacement), which must meet the Tier 3 standards specified for recreational marine engines with a displacement of 3.5 to 7.0 L/cylinder.

[m] The following provisions are optional: 1)Manufacturers may use NOx credits to certify Tier 4 engines to a NOX+HC emission standard of 1.9 g/kW-hr instead of the NOX and HC standards. See 40 CFR 1042.101(a)(8)(i) for more details. 2) For engines below 1000 kW, manufacturers may delay complying with the Tier 4 standards until October 1, 2017. 3) For engines at or above 3700 kW, manufacturers may delay complying with the Tier 4 standards until December 31, 2016.

[n] The Tier 4 standard is for HC (not HC+NOx) in g/kW-hr.

[o] These Tier 3 standards apply to Category 2 engines below 3700 kW; no Tier 3 standards apply for Category 2 engines at or above 3700 kW, although there are Tier 4 standards that apply.

Table 12.22 (continued)
Marine Compression-Ignition (CI) Engines – Exhaust Emission Standards

[p] An alternative set of Tier 3 and Tier 4 standards for PM, NOx, and HC are available for Category 2 engines at or above 1400 kW, but must be applied to all of a manufacturer's engines in a given displacement category in model years 2012 through 2015.

Tier	Maximum Engine Power	Model Year	PM (g/kW-hr)	NOx (g/kW-hr)	HC (g/kW-hr)
3	kW 1400	2012-2014	0.14	7.8 NOx+HC	
4	1400 kW < 3700	2015	0.04	1.8	0.19
	kW 3700	2015	0.06	1.8	0.19

[q] Interim Tier 4 PM standards apply for 2014 and 2015 model year Category 2 engines with per-cylinder displacement at or above 15.0 liters: 0.34 g/kW-hr for engines 2000 = kW < 3000, and 0.27 g/kW-hr for engines 3300 = kW < 3700.

These standards apply to gasoline boats and personal watercraft, such as pleasure boats, jet-skis, outboard engines and sterndrive/inboard engines.

Table 12.23
Marine Spark-Ignition Engines and Vessels – Exhaust Emission Standards

	Engine Type		Model Year	HC + NOx[a] (g/KW-hr) P 4.3 kW[b]	HC + NOx[a] (g/KW-hr) P > 4.3 kW[b]	CO[c] (g/KW-hr) P 4.3 kW[b]	CO[c] (g/KW-hr) P > 4.3 kW[b]	Useful Life (hours/years)[d]
Federal[e]	Personal Watercraft & Outboard Marine Engines		1998	278 ABT	(0.917 x (151 + 557/$P^{0.9}$ + 2.44) [ABT]	--	--	350 / 5
			1999	253 ABT	(0.833 x (151 + 557/$P^{0.9}$ + 2.89) [ABT]	--	--	
			2000	228 ABT	(0.750 x (151 + 557/$P^{0.9}$) + 3.33 [ABT]	--	--	
			2001	204 ABT	(0.667 x (151 + 557/$P^{0.9}$) + 3.78 [ABT]	--	--	
			2002	179 ABT	(0.583 x (151 + 557/$P^{0.9}$) + 4.22 [ABT]	--	--	
			2003	155 ABT	(0.500 x (151 + 557/$P^{0.9}$) + 4.67 [ABT]	--	--	
			2004	130 ABT	(0.417 x (151 + 557/$P^{0.9}$) + 5.11 [ABT]	--	--	
			2005	105 ABT	(0.333 x (151 + 557/$P^{0.9}$) + 5.56 [ABT]	--	--	
			2006-2009	81 ABT	(0.250 x (151 + 557/$P^{0.9}$) + 6.00 [ABT]	--	--	
			2010 +[g]	30 ABT [ABT]	2.1 + 0.09 x (151 + 557/$P^{0.9}$) [ABT]	500 - 5.0 x P	300	Personal Watercraft: 350 / 5[h] Outboard: 350 / 10[h]
	Sterndrive/ Inboard Engines	Conventional Engines[g]	2010 +	5.0 [ABT]		75 [ABT]		480 / 10[i]
		High-Performance Engines		P kW[b]	P > 485 kW[b]	350		P 485 kW: 150 / 3 P > 485 kW: 50 / 1
			2010	20.0	25.0			
			2011+	16.0	22.0			

Sources:
40 CFR 91.104 = Outboard and personal watercraft (PWC) exhaust emission standards (1998-2009)
40 CFR 91.105 = Outboard and PWC useful life (1998-2009)
40 CFR 1045.103 = Outboard and PWC exhaust emission standards (2010+)
40 CFR 1045.105 = Sterndrive/Inboard exhaust emission standards
40 CFR 1045.107 = Not-to-exceed exhaust emission standards (Additional resources: www.epa.gov/otaq/standards)

[a] The numerical emission standards for hydrocarbons (HC) must be met based on the following types of HC emissions for engines powered by the following fuels: (1) total hydrocarbon equivalent for alcohol; (2) non-methane hydrocarbon for natural gas; and (3) total hydrocarbons for other fuels.

Table 12.23 (continued)
Marine Spark-Ignition Engines and Vessels – Exhaust Emission Standards

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[b] P stands for the maximum engine power in kilowatts.

[c] Manufacturers may generate or use emission credits for averaging, but not for banking or trading.

[d] Useful life and warranty period are expressed hours or years of operation (unless otherwise indicated), whichever comes first.

[e] The test procedure for federal standards uses the International Organization for Standardization (ISO) 8178 E4 5-Mode Steady-State Test Cycle.

[f] Also applies to model year (MY) 1997 engine families certified pursuant to 40 Code of Federal Regulations (CFR) 91.205.

[g] Not-to-exceed emission standards specified in 40 CFR 1045.107 also apply.

[h] A longer useful life in terms of hours must be specified for the engine family if the average service life is longer than the minimum value as described in 40 CFR 1045.103(e)(3).

[i] The useful life may not be shorter than: (1) 150 hours of operation; (2) the recommended overhaul interval; or (3) the engine's mechanical warranty. A longer useful life must be specified in terms of hours if the average service life is longer than the minimum value as described in 40 CFR 1045.105(e)(3).

These standards apply to land-based recreational vehicles, such as snowmobiles, dirt bikes, all-terrain vehicles and go-karts.

Table 12.24
Nonroad Recreational Engines and Vehicles – Exhaust Emission Standards

	Vehicle	Phase	Year	HC[a] g/kW-hr	HC + NOx g/km	CO g/kW-hr	CO g/km	Minimum Useful Life (hours/years/km)[b]
Federal	Snowmobiles[c]	1[d]	2006+	100 [ABT]	-	275 [ABT]	-	400 / 5 / 8,000
		2	2010-2011	75 [ABT]	-	275 [ABT]	-	
		3[e]	2012+	150 [f] [ABT]	-	400 [f] [ABT]	-	
	Off-highway motorcycles[g]	1[d]	2006+	-	2.0[h, i] [ABT]	-	25[h, i] [ABT]	> 70 cc Displacement: - / 5 / 10,000 70 cc Displacement: - / 5 / 5,000
	ATVs[g]	1[d]	2006+	-	1.5[j, k] [ABT]	-	35[k] [ABT]	100 cc Displacement: 1000 / 5 / 10,000 < 100 cc Displacement: 500 / 5 / 5,000

Sources:
40 CFR 1051.101-115 = Emission standards (Additional resources: www.epa.gov/otaq/standards)

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[a] The numerical emission standards for hydrocarbons (HC) must be met based on the following types of hydrocarbon emissions for recreational engines and vehicles powered by the following fuels: (1) non-methane hydrocarbons for natural gas; (2) total hydrocarbon equivalent for alcohol; and (3) total hydrocarbons for other fuels.

[b] Useful life is expressed in hours, years, or kilometers, whichever comes first; warranty period is expressed in hours, months, or kilometers (km), whichever comes first. Nonroad recreational engines and vehicles must meet emission standards over their full useful life. A longer useful life in terms of km and hours must be specified for the engine family if the average service life is longer than the minimum value as described in 40 Code of Federal Regulations (CFR) 1051 Subpart B.

[c] Test procedures for snowmobiles use the equipment and procedures for spark-ignition engines in 40 CFR Part 1065.

[d] Phase 1 standards will be phased in: 50 percent by 2006, 100 percent by 2007.

[e] Litigation on the November 2002 final rule resulted in a court decision that requires EPA to clarify the evidence and analysis upon which the Phase 3 carbon monoxide (CO) and HC standards were based. EPA will address this in a future rulemaking.

[f] These are the maximum allowable family emission limits (FEL). The HC and CO standards are defined by a functional relationship as described in 40 CFR 1051.103(a)(2).

[g] For off-highway motorcycles and ATVs, chassis dynamometer emissions test procedures are specified in 40 CFR Part 86, Subpart F and engine dynamometer emissions test procedures are specified in 40 CFR Part 1065.

[h] Maximum allowable FEL: 20.0 grams per kilometer (g/km) for HC plus nitrogen oxides (NOx) and 50 g/km for CO.

Table 12.24 (continued)
Nonroad Recreational Engines and Vehicles – Exhaust Emission Standards

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[i] Manufacturers may certify off-highway motorcycles with engines that have total displacement of 70 cubic centimeters (cc) or less to an HC+NOx standard of 16.1 grams per kilowatt-hour (g/kW-hr) (with an FEL cap of 32.2 g/kW-hr) and a CO standard of 519 g/kW-hr.

[j] Maximum allowable FEL for HC+NOx is 20.0 g/km.

[k] Manufacturers may certify all-terrain vehicles with engines that have total displacement of less than 100 cc to an HC+NOx standard of 25.0 g/KW-hr (with an FEL cap of 40.0 g/kW-hr) and a CO standard of 500 g/kW-hr.

These standards were established in conjunction with the Tier 2 light vehicle standards to maintain the performance of catalytic converters.

Table 12.25
Gasoline Sulfur Standards

		Refinery Average and Per-gallon Cap by Year (ppm)							
	Regulated Entity	2004	2005	2006	2007	2008	2009	2010	2010
Federal	Large Refiners / Importers[a]	120[b] / 300[c]	30 / 90[b] / 300	30 / 80	30 / 80	30 / 80	30 / 80	30 / 80	30 / 80
	GPA Refiners [d, e]	150 / 300[c]	150 / 300	150 / 300	30 / 80	30 / 80	30 / 80	30 / 80	30 / 80
	Small Refiners [f, g, h]	k	k	k	k	30 / 80	30 / 80	30 / 80	30 / 80
	Downstream Standards [i, j]	378	326	95	95	95	95	95	95

Source:
40 CFR Part 80 Subpart H (Additional resources: www.epa.gov/otaq/standards)

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[a] Standards effective January 1 at the refinery gate.

[b] No Refinery Average Standard applies in 2004; Corporate Average Standard applies in 2004 (120 ppm) and 2005 (90 ppm).

[c] Cap exceedances up to 50 ppm in 2004 must be made up in 2005.

[d] Geographic Phase-in Area (GPA) refiners must also comply with the corporate average standards in 2004 and 2005 if less than 50% of the refiner's gasoline is designated as GPA gasoline in a given compliance period.

[e] GPA refiners may receive an additional two years (i.e., through 2008) to comply with the 30 / 80 ppm gasoline sulfur standards in exchange for producing 95% of their highway diesel fuel at the 15 ppm sulfur standard by June 1, 2006.

[f] Small refiners may receive an additional two years (i.e., through 2009) to comply with the 30 / 80 ppm gasoline sulfur standards via a hardship demonstration.

[g] Small refiners may receive an additional three years (i.e., through 2010) to comply with the 30 / 80 ppm gasoline sulfur standards in exchange for producing 95% of their highway diesel fuel at the 15 ppm sulfur standard by June 1, 2006.

[h] Small refiners may receive a 20% increase in their annual average and per-gallon cap standards in exchange for producing 95% of their highway, nonroad, locomotive, and marine diesel fuel at the 15 ppm sulfur standard by June 1, 2006.

[i] Downstream standards are effective February 1 at any downstream location other than at a retail outlet or wholesale purchaser-consumer (e.g., pipelines and terminals) and March 1 at any downstream location.

[j] Downstream standards for gasoline that is not blended with small refiner gasoline are shown. Refer to the Code of Federal Regulations (CFR) for the downstream standards that apply when a gasoline blend includes small refiner gasoline.

[k]

1997-98 Refinery Baseline Sulfur Level (ppm)	Small Refiner Interim Gasoline Sulfur Standards (ppm) 2004 - 2007	
	Average	Cap
0 to 30	30	300
31 to 200	baseline level	300
201 to 400	200	300
401 to 600	50% of baseline	1.5 x avg. standard
601 and above	300	450

Ultra-low sulfur diesel (ULSD) fuel is necessary for new advanced emission control technologies. It also reduces particulate matter in the existing fleet of nonroad engines and equipment.

Table 12.26
Highway, Nonroad, Locomotive, and Marine (NRLM) Diesel Fuel Sulfur Standards

<table>
<tr><th rowspan="2"></th><th rowspan="2">Regulated Entity</th><th rowspan="2">Covered Fuel</th><th colspan="9">Per-gallon Maximum Sulfur Level by Year (ppm)</th></tr>
<tr><th>2006[a]</th><th>2007[b]</th><th>2008</th><th>2009</th><th>2010[c,d]</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td rowspan="8">Federal</td><td>Large Refiners & Importers</td><td>Highway</td><td colspan="4">80% 15
20% 500</td><td colspan="5" rowspan="2">15</td></tr>
<tr><td>Small Refiners</td><td>Highway</td><td colspan="4">500</td></tr>
<tr><td rowspan="3">Large Refiners & Importers</td><td>NR</td><td>-</td><td>500</td><td>500</td><td>500</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td></tr>
<tr><td>LM</td><td>-</td><td>500</td><td>500</td><td>500</td><td>500</td><td>500</td><td>15</td><td>15</td><td>15</td></tr>
<tr><td>NRLM with Credits[e]</td><td>-</td><td>HS</td><td>HS</td><td>HS</td><td>500</td><td>500</td><td>500</td><td>500</td><td>15</td></tr>
<tr><td>Small Refiners</td><td>NRLM[f]</td><td>-</td><td>HS</td><td>HS</td><td>HS</td><td>500</td><td>500</td><td>500</td><td>500</td><td>15</td></tr>
<tr><td rowspan="2">Transmix Processor & In-use</td><td>NR[e]</td><td>-</td><td>HS</td><td>HS</td><td>HS</td><td>500</td><td>500</td><td>500</td><td>500</td><td>15</td></tr>
<tr><td>LM[e]</td><td>-</td><td>HS</td><td>HS</td><td>HS</td><td>500</td><td>500</td><td>500</td><td>500</td><td>500</td></tr>
</table>

Source:
40 CFR Part 80 Subpart I (Additional resources: www.epa.gov/otaq/standards)

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[a] For highway diesel fuel, standards are effective June 1 for refiners/importers, September 1 for pipelines and terminals, and October 15 for retailers and wholesale purchaser-consumers. Anti-downgrading provisions effective October 16, 2006.

[b] For Nonroad, Locomotive, and Marine (NRLM) diesel fuel, standards are effective June 1 for refiners; downstream requirements apply for Northeast/Mid-Atlantic area only (August 1 for terminals, October 1 for retailers and wholesale purchaser-consumers, and December 1 for in-use).

[c] For highway diesel fuel, standards are effective June 1 for refiners/importers, October 1 for pipelines and terminals, and December 1 for retailers and wholesale purchaser-consumers.

[d] For NRLM diesel fuel, standards are effective June 1 for refiners, August 1 for terminals, October 1 for retailers and wholesale purchaser-consumers, and December 1 for in-use.

[e] Excluding the Northeast and Alaska.

[f] Excluding the Northeast, with approval in Alaska.

APPENDIX A

SOURCES & METHODOLOGIES

SOURCES & METHODOLOGIES

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 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.

Contents of Appendix A

List of Abbreviations Used in Appendix A

AAMA	American Automobile Manufacturers Association
AAR	Association of American Railroads
APTA	American Public Transportation 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
GSA	General Services Administration
gvw	gross vehicle weight
lpg	liquefied petroleum gas
mpg	miles per gallon
NHTS	National Household Travel Survey
NHTSA	National Highway Traffic Safety Administration
NPTS	Nationwide Personal Transportation Survey
NVPP	National Vehicle Population Profile
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

Energy Use Sources

Highway energy use

Automobiles

Fuel use in gallons (1970-2008) from: DOT, FHWA, *Highway Statistics 2008*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary* to 1995. Data for 2009 were estimated; FHWA discontinued automobile fuel use data in 2009. Fuel use was distributed among fuel types using the percentages shown in Table A.1. The FHWA discontinued gasohol data in 2005. Therefore, data from EIA, *Alternatives to Traditional Transportation Fuels*, 2006, Table C1 were used.

Table A.1
Automobile Fuel Use and Fuel Type Shares for Calculation of Energy Use

Year	Fuel use (million gallons)	Source for Gasohol shares	Source for gasoline/diesel shares	Shares by fuel type		
				Gasoline	Gasohol	Diesel
1970	67,820		1984 NVPP	99.8%	0.0%	0.2%
1971	71,346		interpolated	99.2%	0.0%	0.8%
1972	75,937		interpolated	98.7%	0.0%	1.3%
1973	78,233		interpolated	98.1%	0.0%	1.9%
1974	74,229		interpolated	97.5%	0.0%	2.5%
1975	74,140		interpolated	97.0%	0.0%	3.0%
1976	78,297		interpolated	96.4%	0.0%	3.6%
1977	79,060		interpolated	95.8%	0.0%	4.2%
1978	80,652		interpolated	95.3%	0.0%	4.7%
1979	76,588		1979 RTECS	94.7%	0.0%	5.3%
1980	69,981	FHWA, MF-33e	interpolated	93.9%	0.5%	5.6%
1981	69,112	FHWA, MF-33e	1981 RTECS	93.4%	0.7%	5.9%
1982	69,116	FHWA, MF-33e	interpolated	93.5%	2.3%	4.2%
1983	70,322	FHWA, MF-33e	1983 RTECS	93.2%	4.3%	2.5%
1984	70,663	FHWA, MF-33e	interpolated	92.7%	5.3%	2.0%
1985	71,518	FHWA, MF-33e	1985 RTECS	90.8%	7.7%	1.5%
1986	73,174	FHWA, MF-33e	interpolated	91.0%	7.6%	1.4%
1987	73,308	FHWA, MF-33e	interpolated	92.4%	6.3%	1.3%
1988	73,345	FHWA, MF-33e	1988 RTECS	91.4%	7.4%	1.2%
1989	73,913	FHWA, MF-33e	interpolated	92.6%	6.2%	1.2%
1990	69,568	FHWA, MF-33e	interpolated	92.0%	6.8%	1.2%
1991	64,318	FHWA, MF-33e	1991 RTECS	90.8%	8.0%	1.2%
1992	65,436	FHWA, MF-33e	interpolated	90.8%	7.9%	1.2%
1993	67,047	FHWA, MF-33e	interpolated	89.7%	9.1%	1.3%
1994	67,874	FHWA, MF-33e	1994 RTECS	89.1%	9.6%	1.3%
1995	68,072	FHWA, MF-33e	interpolated	87.6%	11.2%	1.2%
1996	69,221	FHWA, MF-33e	interpolated	88.8%	10.1%	1.0%
1997	69,892	FHWA, MF-33e	interpolated	86.9%	12.2%	0.9%
1998	71,695	FHWA, MF-33e	interpolated	88.0%	11.2%	0.8%
1999	73,283	FHWA, MF-33e	interpolated	88.3%	11.0%	0.6%
2000	73,065	FHWA, MF-33e	2000 NVPP	86.9%	12.6%	0.5%
2001	73,559	FHWA, MF-33e	2001 NVPP	86.5%	13.0%	0.5%
2002	75,471	FHWA, MF-33e	2001 NVPP	83.9%	15.6%	0.5%
2003	74,590	FHWA, MF-33e	2001 NVPP	75.3%	24.2%	0.5%
2004	75,402	FHWA, MF-33e	2001 NVPP	67.2%	32.3%	0.5%
2005	77,418	FHWA, MF-33e	2001 NVPP	66.9%	32.6%	0.5%
2006	75,009	EIA, C1	2001 NVPP	78.2%	21.3%	0.5%
2007	74,377	EIA, C1	2001 NVPP	72.9%	26.6%	0.5%
2008	71,497	EIA, C1	2001 NVPP	61.8%	37.7%	0.5%
2009	71,473	EIA, C1	2001 NVPP	55.8%	43.7%	0.5%
Heat content used for conversion to btu:				125,000 btu/gallon	120,900 btu/gallon	138,700 btu/gallon

Motorcycles

DOT, FHWA, *Highway Statistics 2009*, Table VM-1, and annual editions. The FHWA made methodology changes for *Highway Statistics 2009*. At that time, they published historical data back to 2007 which do not match the previous data.

Table A.2
Motorcycle Fuel Use

Year	Fuel use (thousand gallons)	Year	Fuel use (thousand gallons)
1970	59,580	1990	191,140
1971	72,140	1991	183,560
1972	86,620	1992	191,140
1973	103,880	1993	198,120
1974	108,900	1994	204,800
1975	112,580	1995	198,262
1976	120,060	1996	195,940
1977	126,980	1997	201,620
1978	143,160	1998	205,660
1979	172,740	1999	211,680
1980	204,280	2000	209,380
1981	213,800	2001	192,780
1982	198,200	2002	191,040
1983	175,200	2003	190,780
1984	175,680	2004	202,447
1985	181,720	2005	189,495
1986	187,940	2006	221,030
1987	190,120	2007	474,923
1988	200,480	2008	489,419
1989	207,420	2009	474,909
Heat content used for conversion to btu:		125,000 btu/gallon	

Buses

Transit:

APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011. Includes motorbus and trolley bus data.

Table A.3
Transit Bus Fuel Use

Year	LNG (million gallons)	LPG (million gallons)	CNG (million gallons)	Gasoline (million gallons)	Diesel fuel (million gallons)	Electricity (thousand kilowatt hours)	Biodiesel (million gallons)	Methanol (million gallons)
1994	1.1	0.2	3.1	2.1	565.1	102.9		12.5
1995	1.7	0.3	10.0	2.3	563.8	100.0		12.0
1996	2.3	0.6	11.5	1.8	577.7	69.0		11.6
1997	3.3	1.0	20.0	2.7	597.6	78.0		8.7
1998	3.1	0.9	32.6	2.0	606.6	74.0		5.0
1999	5.3	0.8	39.9	1.4	618.0	75.0		2.7
2000	10.5	0.7	50.4	1.3	635.2	77.0		0.8
2001	11.7	1.2	60.9	1.5	587.2	74.0		0.8
2002	16.8	1.8	77.8	1.3	559.0	73.0		1.8
2003	14.2	1.8	94.9	1.1	536.0	69.0		1.9
2004	16.5	1.7	106.7	1.8	550.5	68.0		4.7
2005	18.3	2.0	117.2	1.0	533.8	67.0		8.1
2006	19.6	1.6	138.8	2.3	536.7	62.0	20.5	0.9
2007	18.3	[a]	129.1	2.5	494.1	61.0	25.8	1.3
2008	17.9	[a]	135.5	3.8	493.3	62.2	41.8	0.9
2009	25.5	[a]	141.6	6.7	455.5	69.5	40.6	0.0
Heat content used for conversion to btu:	84,800 btu/gallon	91,300 btu/gallon	138,700 btu/gallon	125,000 btu/gallon	138,700 btu/gallon	64,600 btu/gallon		10,339 but/kWhr

Note: CNG is reported in diesel-gallon equivalents.

[a] Data are not available.

Intercity and School:

Eno Transportation Foundation, *Transportation in America, 2001, Nineteenth Edition*, 2003, Washington, DC, pp. 20–23. School bus fuel was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services. Intercity bus fuel was assumed to be 100% diesel.

Table A.4
Intercity and School Bus Fuel Use

Year	Intercity (million gallons)	School (million gallons)
1970	305.34	299.88
1971	296.73	309.75
1972	288.12	319.62
1973	252.42	327.04
1974	216.72	334.46
1975	181.02	341.88
1976	182.28	389.76
1977	181.86	401.52
1978	180.18	406.98
1979	205.38	404.88
1980	213.78	379.68
1981	205.38	386.82
1982	227.22	398.58
1983	237.30	400.68
1984	169.26	375.06
1985	165.48	425.04
1986	148.68	462.42
1987	155.82	487.20
1988	160.44	511.14
1989	166.74	498.12
1990	159.60	472.08
1991	160.44	533.40
1992	157.08	546.00
1993	171.36	533.40
1994	195.30	546.00
1995	195.30	545.16
1996	199.92	545.16
1997	212.52	544.74
1998	220.08	550.20
1999	241.08	555.66
2000	233.10	577.08
2001	204.40*	506.02*
2002	209.97*	519.82*
2003	210.68*	521.57*
2004	212.92*	527.11*
2005	207.09*	512.69*
2006	221.02*	547.18*
2007	228.55*	565.82*
2008	233.38*	577.78*
2009	226.06*	559.66*
Fuel type shares	100% diesel	90% diesel 10% gasoline
Heat content used for conversion to btu:	138,700 btu/gallon	138,700 btu/gallon 125,000 btu/gallon

*Estimated using the rate of change of bus vehicle-miles traveled from FHWA Highway Statistics, Table VM-1 (recently revised from 2000-2009).

Trucks

Light Trucks:

1970-2008 DOT, FHWA, *Highway Statistics 2008*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary to 1995*. Data for 2009 were estimated; FHWA discontinued light truck fuel use data in 2009. The FHWA discontinued publication of gasohol data in 2005. Therefore, data from EIA, *Alternatives to Traditional Transportation Fuels*, 2006, Table C1, were used.

Table A.5
Light Truck Fuel Use and Fuel Type Shares for Calculation of Energy Use

Year	Fuel use (million gallons)	Source for gasohol shares	Source for gasoline/diesel /lpg shares	Shares by fuel type: Gasoline	Gasohol	Diesel	Lpg
1970	12,313		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1971	13,484		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1972	15,150		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1973	16,828		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1974	16,657		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1975	19,081		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1976	20,828		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1977	22,383		1977 TIUS	97.6%	0.0%	1.6%	0.8%
1978	24,162		Interpolated	97.1%	0.0%	2.0%	0.9%
1979	24,445		Interpolated	96.7%	0.0%	2.4%	1.0%
1980	23,796	FHWA, MF-33e	Interpolated	95.7%	0.5%	2.7%	1.0%
1981	23,697	FHWA, MF-33e	Interpolated	95.1%	0.7%	3.1%	1.1%
1982	22,702	FHWA, MF-33e	1982 TIUS	93.0%	2.3%	3.5%	1.2%
1983	23,945	FHWA, MF-33e	Interpolated	91.0%	4.3%	3.5%	1.2%
1984	25,604	FHWA, MF-33e	Interpolated	90.0%	5.3%	3.5%	1.2%
1985	27,363	FHWA, MF-33e	Interpolated	87.6%	7.7%	3.5%	1.2%
1986	29,074	FHWA, MF-33e	Interpolated	87.7%	7.6%	3.5%	1.2%
1987	30,598	FHWA, MF-33e	1987 TIUS	89.0%	6.3%	3.5%	1.2%
1988	32,653	FHWA, MF-33e	Interpolated	88.2%	7.4%	3.5%	1.0%
1989	33,271	FHWA, MF-33e	Interpolated	89.5%	6.2%	3.4%	0.8%
1990	35,611	FHWA, MF-33e	Interpolated	89.2%	6.8%	3.4%	0.7%
1991	38,217	FHWA, MF-33e	Interpolated	88.1%	8.0%	3.3%	0.5%
1992	40,929	FHWA, MF-33e	1992 TIUS	88.5%	7.9%	3.3%	0.3%
1993	42,851	FHWA, MF-33e	Interpolated	87.3%	9.1%	3.3%	0.3%
1994	44,112	FHWA, MF-33e	Interpolated	86.8%	9.6%	3.3%	0.3%
1995	45,605	FHWA, MF-33e	Interpolated	85.1%	11.2%	3.4%	0.3%
1996	47,354	FHWA, MF-33e	Interpolated	86.2%	10.1%	3.4%	0.3%
1997	49,388	FHWA, MF-33e	1997 VIUS	84.2%	12.2%	3.4%	0.2%
1998	50,462	FHWA, MF-33e	Interpolated	85.0%	11.2%	3.5%	0.3%
1999	52,859	FHWA, MF-33e	Interpolated	84.9%	11.0%	3.6%	0.4%
2000	52,939	FHWA, MF-33e	Interpolated	83.1%	12.6%	3.8%	0.6%
2001	53,522	FHWA, MF-33e	Interpolated	82.4%	13.0%	3.9%	0.7%
2002	55,220	FHWA, MF-33e	2002 VIUS	79.6%	15.6%	4.0%	0.8%
2003	60,758	FHWA, MF-33e	2002 VIUS	71.0%	24.2%	4.0%	0.8%
2004	63,417	FHWA, MF-33e	2002 VIUS	62.9%	32.3%	4.0%	0.8%
2005	58,869	FHWA, MF-33e	2002 VIUS	62.6%	32.6%	4.0%	0.8%
2006	60,685	EIA, C1	2002 VIUS	73.9%	21.3%	4.0%	0.8%
2007	61,836	EIA, C1	2002 VIUS	68.6%	26.6%	4.0%	0.8%
2008	61,199	EIA, C1	2002 VIUS	57.5%	37.7%	4.0%	0.8%
2009	61,610	EIA, C1	2002 VIUS	51.5%	43.7%	4.0%	0.8%
Heat content used for conversion to btu:				125,000 btu/gallon	120,900 btu/gallon	138,700 btu/gallon	90,800 btu/gallon

Medium/Heavy Trucks:

DOT, FHWA, *Highway Statistics 2009*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary to 1995*. The FHWA made methodology changes for *Highway Statistics 2009*. At that time, they published historical data back to 2007 which do not match the previous data. Total gallons for medium/heavy trucks are the sum of single-unit trucks and combination trucks.

Table A.6
Medium/Heavy Truck Fuel Use and Fuel Type Shares for Calculation of Energy Use

Year	Fuel use (million gallons)	Source for gasoline/diesel/lpg shares	Shares by fuel type		
			Gasoline	Diesel	Lpg
1970	11,316	1977 TIUS	10.4%	89.5%	0.1%
1971	11,812	1977 TIUS	10.4%	89.5%	0.1%
1972	12,964	1977 TIUS	10.4%	89.5%	0.1%
1973	14,320	1977 TIUS	10.4%	89.5%	0.1%
1974	14,341	1977 TIUS	10.4%	89.5%	0.1%
1975	14,598	1977 TIUS	10.4%	89.5%	0.1%
1976	15,408	1977 TIUS	10.4%	89.5%	0.1%
1977	17,082	1977 TIUS	10.4%	89.5%	0.1%
1978	19,121	Interpolated	16.2%	83.5%	0.3%
1979	19,913	Interpolated	22.1%	77.5%	0.5%
1980	19,960	Interpolated	27.9%	71.4%	0.6%
1981	20,376	Interpolated	33.8%	65.4%	0.8%
1982	20,386	1982 TIUS	39.6%	59.4%	1.0%
1983	20,761	Interpolated	35.6%	63.6%	0.8%
1984	21,428	Interpolated	31.5%	67.8%	0.7%
1985	21,405	Interpolated	27.5%	72.0%	0.5%
1986	21,861	Interpolated	23.4%	76.2%	0.4%
1987	22,513	1987 TIUS	19.4%	80.4%	0.2%
1988	22,925	Interpolated	18.8%	81.0%	0.3%
1989	23,512	Interpolated	18.1%	81.6%	0.3%
1990	24,490	Interpolated	17.5%	82.1%	0.4%
1991	24,981	Interpolated	16.8%	82.7%	0.4%
1992	25,453	1992 TIUS	16.2%	83.3%	0.5%
1993	26,236	Interpolated	15.4%	84.1%	0.5%
1994	27,685	Interpolated	14.7%	84.8%	0.5%
1995	28,828	Interpolated	13.9%	85.6%	0.5%
1996	29,601	Interpolated	13.2%	86.3%	0.5%
1997	29,878	1997 VIUS	12.4%	87.1%	0.5%
1998	30,841	Interpolated	12.1%	87.4%	0.5%
1999	33,909	Interpolated	11.8%	87.6%	0.5%
2000	35,229	Interpolated	11.6%	87.9%	0.5%
2001	35,179	Interpolated	11.3%	88.1%	0.5%
2002	36,800	2002 VIUS	11.0%	88.4%	0.5%
2003	35,775	2002 VIUS	11.0%	88.4%	0.5%
2004	33,150	2002 VIUS	11.0%	88.4%	0.5%
2005	37,190	2002 VIUS	11.0%	88.4%	0.5%
2006	37,959	2002 VIUS	11.0%	88.4%	0.5%
2007	47,218	2002 VIUS	11.0%	88.4%	0.5%
2008	47,705	2002 VIUS	11.0%	88.4%	0.5%
2009	44,472	2002 VIUS	11.0%	88.4%	0.5%
Heat content used for conversion to btu:			125,000 btu/gallon	138,700 btu/gallon	90,800 btu/gallon

Off-highway energy use

U.S. Environmental Protection Agency, NONROAD2008a model, results generated April 2011. Gallons of fuel by fuel type were produced for agricultural equipment, airport equipment, construction and mining equipment, industrial equipment, lawn and garden equipment, logging equipment, railroad maintenance equipment, and recreational equipment. Some non-transportation-related equipment, such as generators, chain saws, compressors, and pumps, were excluded from the data.

Nonhighway energy use

Air

General Aviation:

DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report Calendar Year 2009*, Table 5.1, and annual.

Table A.7
General Aviation Fuel Use

Year	Jet fuel (million gallons)	Aviation gasoline (million gallons)
1970	208.0	551.0
1971	226.0	508.0
1972	245.0	584.0
1973	304.0	411.0
1974	357.0	443.0
1975	453.0	412.0
1976	495.0	432.0
1977	536.0	456.0
1978	763.0	518.0
1979	736.0	570.0
1980	766.0	520.0
1981	759.0	489.0
1982	887.0	448.0
1983	613.0	428.0
1984	738.9	462.4
1985	691.0	421.0
1986	732.1	408.6
1987	672.7	401.8
1988	746.0	398.0
1989	688.0	342.8
1990	662.0	353.0
1991	579.0	348.0
1992	496.0	306.0
1993	454.1	268.4
1994	470.8	264.1
1995	544.0	276.0
1996	567.5	286.5
1997	639.4	289.7
1998	814.6	311.4
1999	967.2	345.4
2000	998.1	336.3
2001	938.7	319.3
2002	815.5	261.4
2003	820.0	255.5
2004	1,075.2	256.1
2005	1,507.4	323.6
2006	1,636.3	294.7
2007	1,516.3	314.8
2008	1,688.6	306.3
2009	1,350.6	312.0
Heat content used for conversion to btu:	135,000 btu/gallon	120,200 btu/gallon

Domestic and International Air Carrier:

DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables," www.bts.gov/xml/fuel/report/src/index.xml. The table below shows all international fuel use. Because the data for international include fuel purchased abroad, for the tables in Chapter 2, the international total was divided in half to estimate domestic fuel use for international flights.

Table A.8
Air Carrier Fuel Use

Year	Domestic (thousand gallons)	International (thousand gallons)	Total (thousand gallons)
1970			10,085,000
1971			10,140,000
1972	Separate estimates for domestic and international are not available from 1970-1976.		10,302,000
1973			10,671,000
1974			10,417,260
1975			10,412,640
1976			10,400,040
1977	8,202,051	1,708,376	9,910,427
1978	8,446,117	1,741,918	10,188,035
1979	8,865,885	1,828,435	10,694,320
1980	8,519,233	1,747,306	10,266,539
1981	8,555,249	2,032,520	10,587,769
1982	8,432,465	1,967,733	10,400,198
1983	8,672,574	1,998,289	10,670,863
1984	9,625,958	2,286,407	11,912,365
1985	10,115,007	2,487,929	12,602,936
1986	11,137,331	2,544,996	13,682,327
1987	11,586,838	2,893,617	14,480,455
1988	11,917,904	3,262,824	15,180,728
1989	11,905,144	3,557,294	15,462,438
1990	12,429,305	3,963,081	16,392,386
1991	11,506,477	3,939,666	15,446,144
1992	11,762,852	4,120,132	15,882,983
1993	11,958,663	4,113,321	16,071,984
1994	12,475,549	4,310,879	16,786,428
1995	12,811,717	4,511,418	17,323,135
1996	13,187,305	4,658,093	17,845,398
1997	13,659,581	4,964,181	18,623,762
1998	13,876,971	5,185,562	19,062,533
1999	14,402,127	5,250,492	19,652,619
2000	14,844,592	5,474,685	20,319,277
2001	14,017,461	5,237,487	19,254,948
2002	12,848,329	4,990,798	17,839,127
2003	12,958,581	4,836,356	17,794,936
2004	13,622,603	4,931,546	18,554,149
2005	13,778,869	5,520,889	19,309,758
2006	13,694,437	6,017,638	19,712,075
2007	13,681,664	6,204,502	19,886,165
2008	12,666,911	6,186,747	18,853,658
2009	11,339,220	5,721,298	17,060,517
Heat content used for conversion to btu:	135,000 btu/gallon	135,000 btu/gallon	135,000 btu/gallon

Water

Freight:

Total – DOE, EIA, Fue l *Oil and Kerosene Sales* 2009, Table 13. Ad justed sales of distillate and residual fuel oil for vessel bunkering. (This m ay include some amounts of bunker fuels used for recreational purposes.)

Table A.9
Diesel and Residual Fuel Oil for Vessel Bunkering

Year	Distillate fuel oil (thousand gallons)	Residual fuel oil (thousand gallons)
1970	819,000	3,774,120
1971	880,000	3,307,000
1972	1,013,000	3,273,000
1973	1,125,000	3,859,000
1974	1,018,920	3,827,040
1975	1,097,880	4,060,140
1976	1,220,100	4,977,000
1977	1,407,420	5,416,740
1978	1,578,822	6,614,790
1979	1,630,858	8,002,672
1980	717,376	7,454,242
1981	1,723,143	7,922,512
1982	1,423,216	6,408,818
1983	1,418,890	5,724,115
1984	1,692,045	5,688,931
1985	1,894,265	5,269,733
1986	2,034,215	5,690,250
1987	2,223,258	5,869,154
1988	2,310,367	6,025,511
1989	2,356,444	6,621,100
1990	2,197,004	6,248,095
1991	2,167,640	6,786,055
1992	2,240,170	7,199,078
1993	2,043,745	6,269,882
1994	2,026,899	5,944,383
1995	1,978,105	6,431,238
1996	2,177,608	5,804,977
1997	2,107,561	4,789,861
1998	2,125,568	4,640,153
1999	2,064,590	5,598,630
2000	2,041,433	6,192,294
2001	2,099,011	4,345,284
2002	2,056,465	4,783,956
2003	1,863,150	3,801,425
2004	2,313,448	4,886,978
2005	2,115,381	5,533,552
2006	2,206,690	6,000,434
2007	2,158,930	6,773,950
2008	1,365,351	6,230,994
2009	1,486,802	5,607,263
Heat content used for conversion to btu:	138,700 btu/gallon	149,700 btu/gallon
Domestic share of total fuel use	77.5%	9.3%

Recreational Boating:

Fuel use by recreational boating comes from the EPA's NONROAD2008A model.

Table A.10
Recreational Boating Fuel Use

Year	Diesel use (gallons)	Gasoline use (gallons)
1970	39,589,953	1,213,397,311
1971	47,130,906	1,220,995,448
1972	54,671,856	1,228,593,572
1973	62,212,803	1,236,191,635
1974	69,753,735	1,243,789,752
1975	77,294,680	1,251,387,972
1976	84,835,632	1,258,986,070
1977	92,376,573	1,266,584,111
1978	99,917,523	1,274,182,341
1979	107,458,470	1,281,780,460
1980	114,999,421	1,289,378,532
1981	122,540,357	1,296,976,672
1982	130,081,302	1,304,574,832
1983	137,622,248	1,312,172,890
1984	145,163,202	1,319,771,007
1985	152,704,140	1,327,369,146
1986	160,245,074	1,334,967,322
1987	167,786,030	1,342,565,455
1988	175,326,970	1,362,856,034
1989	182,867,916	1,383,146,636
1990	190,408,869	1,403,437,194
1991	197,949,808	1,429,688,292
1992	205,490,749	1,455,939,504
1993	213,031,707	1,482,190,597
1994	220,572,649	1,539,794,180
1995	228,113,596	1,597,269,921
1996	235,654,521	1,654,446,069
1997	243,195,481	1,657,737,628
1998	250,736,414	1,659,056,085
1999	258,159,525	1,657,198,161
2000	265,582,657	1,652,906,973
2001	273,547,835	1,655,303,922
2002	281,512,965	1,653,583,696
2003	289,478,093	1,648,070,959
2004	297,443,197	1,639,713,127
2005	305,408,463	1,629,873,278
2006	313,420,594	1,619,603,593
2007	321,432,801	1,609,567,873
2008	329,445,068	1,599,830,522
2009	337,457,287	1,590,749,216
Heat content used for conversion to btu:	138,700 btu/gallon	125,000 btu/gallon

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 2009*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft3. 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 horsepower 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 10,339 Btu.

Crude petroleum and petroleum product:

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, TN, 1981. (Data held constant; Latest available data.)

Coal slurry and water:

W. F. Banks, Systems, Science and Software, *Energy Consumption in the Pipeline Industry*, LaJolla, CA, October 1977. (Data held constant; Latest available data.)

Table A.11
Pipeline Fuel Use

Year	Natural gas (million cubic feet)	Estimated natural gas pipeline electricity use (million kWhr)	Electricity constant (btu)
1970	722,166	3,272.9	212.1
1971	742,592	3,365.4	212.1
1972	766,156	3,472.2	212.1
1973	728,177	3,300.1	212.1
1974	668,792	3,031.0	212.1
1975	582,963	2,642.0	212.1
1976	548,323	2,485.0	212.1
1977	532,669	2,414.1	212.1
1978	530,451	2,404.0	212.1
1979	600,964	2,723.6	212.1
1980	634,622	2,876.1	212.1
1981	642,325	2,911.0	212.1
1982	596,411	2,703.0	212.1
1983	490,042	2,220.9	212.1
1984	528,754	2,396.3	212.1
1985	503,766	2,283.1	212.1
1986	485,041	2,198.2	212.1
1987	519,170	2,352.9	212.1
1988	613,912	2,782.3	212.1
1989	629,308	2,852.0	212.1
1990	659,816	2,990.3	212.1
1991	601,305	2,725.1	212.1
1992	587,710	2,663.5	212.1
1993	624,308	2,829.4	212.1
1994	685,362	3,106.1	212.1
1995	700,335	3,173.9	212.1
1996	711,446	3,224.3	212.1
1997	751,470	3,405.7	212.1
1998	635,477	2,880.0	212.1
1999	645,319	2,924.6	212.1
2000	642,210	2,910.5	212.1
2001	624,964	2,832.3	212.1
2002	666,920	3,022.5	212.1
2003	591,492	2,680.7	212.1
2004	566,187	2,566.0	212.1
2005	584,026	2,646.8	212.1
2006	584,213	2,647.7	212.1
2007	621,364	2,816.0	212.1
2008	647,956	2,936.6	212.1
2009	598,216	2,711.1	212.1
Heat content used for conversion to btu:	1,031 btu/cubic foot	10,339 Btu/kWhr	

Note: Formula for estimating electricity use for natural gas pipelines is:
Natural gas use (in million cubic ft) × 1,031 btu/cubic ft × 0.015 × 29.305 ×10-5 kWhr/btu

Rail

Freight:

AAR, *Railroad Facts*, 2010 Edition, Washington, DC, 2010.

Table A.12
Class I Freight Railroad Fuel Use

Year	Diesel fuel (thousand gallons)
1970	3,807,663
1971	3,822,907
1972	3,996,985
1973	4,160,730
1974	4,175,375
1975	3,736,484
1976	3,895,542
1977	3,985,069
1978	3,968,007
1979	4,072,187
1980	3,955,996
1981	3,756,439
1982	3,178,116
1983	3,137,295
1984	3,388,173
1985	3,144,190
1986	3,039,069
1987	3,102,227
1988	3,182,267
1989	3,190,815
1990	3,134,446
1991	2,925,970
1992	3,022,108
1993	3,111,981
1994	3,355,802
1995	3,503,096
1996	3,600,649
1997	3,602,793
1998	3,619,341
1999	3,749,428
2000	3,720,107
2001	3,729,985
2002	3,751,413
2003	3,849,229
2004	4,082,236
2005	4,119,879
2006	4,214,459
2007	4,087,405
2008	3,911,178
2009	3,220,059
Heat content used for conversion to btu:	138,700 Btu/gallon

Passenger:

Commuter - APTA, *Public Transportation Fact Book*, 2011, Washington, DC, 2011.

Table A.13
Commuter Rail Fuel Use

Year	Diesel (thousand gallons)	Electricity (million kWhr)
1984	58,320	901
1985	55,372	1,043
1986	54,608	1,170
1987	51,594	1,155
1988	53,054	1,195
1989	52,516	1,293
1990	52,681	1,226
1991	54,315	1,239
1992	54,951	1,124
1993	59,766	1,196
1994	61,900	1,244
1995	63,064	1,253
1996	61,888	1,255
1997	63,195	1,270
1998	69,200	1,299
1999	73,005	1,322
2000	70,818	1,370
2001	72,204	1,354
2002	72,847	1,334
2003	72,264	1,383
2004	71,999	1,449
2005	76,714	1,484
2006	78,600	1,478
2007	80,700	1,763
2008	83,500	1,718
2009	95,000	1,780
Heat content used for conversion to btu:	138,700 Btu/gallon	10,339 Btu/kWhr

Transit – APTA, *Public Transportation Fact Book*, 2011, Wash ington, DC, 2011. Includes light rail and heavy rail.

Table A.14
Transit Rail Fuel Use

	Electricity (million kWhr)		
Year	Light rail	Heavy rail	Total
1970	Light rail and heavy rail data are not available separately from 1970 to 1985.		2,561
1971			2,556
1972			2,428
1973			2,331
1974			2,630
1975			2,646
1976			2,576
1977			2,303
1978			2,223
1979			2,473
1980			2,446
1981			2,655
1982			2,722
1983			2,930
1984			3,092
1985			2,928
1986	173	3,066	3,239
1987	191	3,219	3,410
1988	243	3,256	3,499
1989	242	3,286	3,528
1990	239	3,284	3,523
1991	274	3,248	3,522
1992	297	3,193	3,490
1993	281	3,287	3,568
1994	282	3,431	3,713
1995	288	3,401	3,689
1996	321	3,322	3,643
1997	363	3,253	3,616
1998	382	3,280	3,662
1999	416	3,385	3,801
2000	563	3,549	4,112
2001	587	3,646	4,233
2002	510	3,683	4,193
2003	507	3,632	4,138
2004	553	3,684	4,237
2005	571	3,769	4,339
2006	634	3,709	4,343
2007	687	3,817	4,505
2008	721	3,898	4,619
2009	738	3,866	4,624
Heat content used for conversion to btu:	10,339 Btu/kWhr	10,339 Btu/kWhr	10,339 Btu/kWhr

Intercity – Personal communication with Amtrak, Washington, DC, 2011.

Table A.15
Intercity Rail Fuel Use

Year	Diesel fuel (thousand gallons)	Electricity (thousand kWhr)
1994	73,516	308,948
1995	72,371	335,818
1996	71,226	362,689
1997	75,656	389,559
1998	75,999	416,429
1999	79,173	443,300
2000	94,968	470,170
2001	96,846	455,703
2002	84,432	518,306
2003	74,621	536,950
2004	68,605	550,695
2005	65,477	531,377
2006	62,463	548,856
2007	61,824	577,864
2008	63,428	582,022
2009	61,704	564,968
Heat content used for conversion to Btu	138,700 Btu/gallon	10,339 Btu/kWhr

Calculation of Million Barrels per Day Crude Oil Equivalent

One gallon of gasoline, diesel fuel, or lpg is estimated to be the equivalent of one gallon of crude oil. Petroleum used for electricity was calculated using the following formula:

({[(BTU*S)/G]/P }/365)/1000

BTU	=	Btus of electricity from Table 2.5
S	=	Share of petroleum used in making primary electricity (Calculated from Table 2.6 from the EIA, Monthly Energy Review)
G	=	Electricity generation and distribution (assumed 29%)
P	=	Btus per barrel of petroleum product (Table A3 from the EIA, Monthly Energy Review).

Passenger Travel and Energy Use

Automobiles

Number of vehicles, vehicle-miles – DOT, FHWA, *Highway Statistics, 2009*, Table VM-1. Data series shown in Table 4.1.
Passenger-miles – Vehicle-miles multiplied by an average load factor.
Load factor – 2009 NHTS shows automobile load factor as 1.55 persons per vehicle (preliminary).
Energy intensities –
***Btu per vehicle-mile* –** Automobile energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Automobile energy use divided by passenger-miles.
Energy use – See Energy Use Sources, p. A-5. Data series shown in Table 2.7.

Light Trucks

Number of vehicles, vehicle-miles – DOT, FHWA, *Highway Statistics 2009*, Table VM-1. Data by truck type were multiplied by the shares of trucks/truck travel which are for personal use (Table A.16).
Passenger-miles – Vehicle-miles multiplied by an average load factor.
Load factor – 2009 NHTS shows personal light truck load factor as 1.84 persons per vehicle (preliminary).
Energy intensities -
***Btu per vehicle-mile* –** Personal light truck energy use divided by personal light truck vehicle-miles.
***Btu per passenger-mile* –** Personal light truck energy use divided by personal light truck passenger-miles.
Energy use – See Energy Use Sources, p. A-9, A-10 (light trucks, medium/heavy trucks). Data by truck type were multiplied by the shares of truck fuel use which are for personal use (Table A.16) which were derived by ORNL from the 2002 VIUS Micro Data File on CD.

Table A.16
Share of Trucks, Truck Travel,
and Fuel Use for Personal Travel

Personal trucks	
85.6%	2-axle, 4-tire trucks
26.9%	Other single-unit and combination trucks
Personal truck travel	
80.9%	2-axle, 4-tire trucks
13.1%	Other single-unit and combination trucks
Personal truck fuel use	
78.0%	2-axle, 4-tire trucks
6.0%	Other single-unit and combination trucks

Note: Since these shares come from the 2002 VIUS, they may underestimate the amount of personal trucks, truck travel, and energy use for 2008.

Motorcycles

Number of vehicles, vehicle-miles – DOT, FHWA, *Highway Statistics 2009*, Table VM-1.
Passenger-miles – Vehicle-miles multiplied by an average load factor.
Load factor - 2009 NHTS shows motorcycle load factor as 1.16 persons per vehicle (preliminary).
Energy intensities –
***Btu per vehicle-mile* –** Motorcycle energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Motorcycle energy use divided by passenger-miles.
Energy use – See Energy Use Sources, p. A-6. Data series shown in Table 2.7.

Demand Response

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011.
Load factor – Passenger-miles divided by vehicle-miles.
Energy intensities –
***Btu per vehicle-mile* –** Energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Energy use divided by passenger-miles.
Energy use – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011.

Buses

Transit

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011. Data series shown on Table 5.16.
Load factor – Passenger-miles divided by vehicle-miles.
Energy intensities –
***Btu per vehicle-mile* –** Transit bus energy use divided by transit bus vehicle-miles.
***Btu per passenger-mile* –** Transit bus energy use divided by transit bus passenger-miles.
Energy use – See Energy Use Sources, p. A-7. Data series shown in Table 5.16.

Intercity

Energy use – See Energy Use Sources, p. A-7. Because the 2001and 2002 data are not available, the rate of change in bus VMT from FHWA, *Highway Statistics 2009*, was used to estimate the change in energy use.

School

Number of vehicles – DOT, FHWA, *Highway Statistics 2009*, Table MV-10.
Energy use – See Energy Use Sources, p. A-7. Because the data past 2000 are not available, the rate of change in bus VMT from FHWA, *Highway Statistics 2009*, was used to estimate the change in energy use.

Air

Certificated air carriers

Aircraft-miles, passenger-miles – DOT, BTS, *Air Carrier Traffic Statistics*, www.bts.gov/programs/airline_information/air_carrier_traffic_statistics, Washington, DC.
Load factor – Passenger-miles divided by aircraft-miles.
Energy intensities –
***Btu per passenger-mile* –** Certificated air carrier energy use divided by passenger-miles.
Energy use – See Energy Use Sources, p. A-11. All of domestic fuel use and half of international fuel use was considered to be domestic use.
Note: These data differ from the data in Table 9.2 because that table contains data on ALL domestic AND international air carrier energy use and passenger-miles.

General aviation

Number of vehicles – DOT, FAA, *General Aviation Activity and Avionics Survey: Calendar Year 2009*, Data series shown in Table 9.3.
Energy intensities –
***Btu per passenger-mile* –** General aviation energy use divided by passenger-miles.
Energy use – See Energy Use Sources, p. A-11. Data series shown in Table 9.3.

Recreational boating

Number of vehicles and energy use – U.S. EPA, NONROAD2008a model.

Rail

Intercity

Number of vehicles, vehicle-miles, passenger-miles – AAR, *Railroad Facts, 2010 Edition*, Washington, DC, 2010.
Load factor – Passenger-miles divided by vehicle-miles.
Energy Intensities –
***Btu per vehicle-mile* –** Intercity rail energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Intercity rail energy use divided by passenger-miles.
Energy use – See Energy Use Sources, p. A-20. Data series shown in Table 9.10.

Transit

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011. Sum of light and heavy rail transit. Data series shown on Table 9.12.
Load factor – Passenger-miles divided by vehicle-miles.
Energy intensities –
***Btu per vehicle-mile* –** Light and heavy transit rail energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Light and heavy transit rail energy use divided by passenger-miles.
Energy use – See Energy Use Sources, p. A-19. Data series shown in Table 9.12.

Commuter

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011. Data series shown on Table 9.11.
Load factor – Passenger-miles divided by vehicle-miles.
Energy intensities –
***Btu per vehicle-mile* –** Commuter rail energy use divided by vehicle-miles.
***Btu per passenger-mile* –** Commuter rail energy use divided by passenger-miles.
Energy use – See Energy Use Sources, p. A-18. Data series shown in Table 9.11.

Highway Passenger Mode Energy Intensities

Automobiles

Btu per vehicle-mile – Automobile energy use divided by automobile vehicle miles of travel.
Energy use – See Energy Use Sources, p. A-5. Data series shown in Table 2.7.
Vehicle-miles – DOT, FHWA, *Highway Statistics 2009*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary to 1995*. Data series shown in Table 4.1.

Btu per passenger-mile – Automobile energy use divided by automobile passenger-miles.
Energy use – See Energy Use Sources, p. A-5. Data series shown in Table 2.7.
Passenger miles – Vehicle miles multiplied by an average load factor.
Vehicle-miles – DOT, FHWA, *Highway Statistics 2009*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary to 1995*. Data series shown in Table 4.1.
Load factor – NPTS 1969, 1977, 1983/84, 1990, and 1995; NHTS 2001 and 2009.

Table A.17
Automobile Load Factor used to calculate Passenger-Miles

Year	Source	Load Factor
1970	1969 NPTS	1.90
1971	Interpolated	1.90
1972	Interpolated	1.90
1973	Interpolated	1.90
1974	Interpolated	1.90
1975	Interpolated	1.90
1976	Interpolated	1.90
1977	1977 NPTS	1.90
1978	Interpolated	1.88
1979	Interpolated	1.87
1980	Interpolated	1.85
1981	Interpolated	1.83
1982	Interpolated	1.82
1983	1983/84 NPTS	1.80
1984	Interpolated	1.77
1985	Interpolated	1.74
1986	Interpolated	1.71
1987	Interpolated	1.69
1988	Interpolated	1.66
1989	Interpolated	1.63
1990	1990 NPTS	1.60
1991	Interpolated	1.60
1992	Interpolated	1.60
1993	Interpolated	1.60
1994	Interpolated	1.60
1995	1995 NPTS	1.60
1996	Interpolated	1.60
1997	Interpolated	1.59
1998	Interpolated	1.59
1999	Interpolated	1.58
2000	Interpolated	1.58
2001	2001 NHTS	1.57
2002	2001 NHTS	1.57
2003	2001 NHTS	1.57
2004	2001 NHTS	1.57
2005	2001 NHTS	1.57
2006	2001 NHTS	1.57
2007	2001 NHTS	1.57
2008	2009 NHTS	1.55
2009	2009 NHTS	1.55

Light trucks

Btu per vehicle-mile – Light truck energy use divided by light truck vehicle miles of travel.

Energy use – See Energy Use Sources, p. A-9. Data series shown in Table 2.7.

Vehicle-miles – DOT, FHWA, *Highway Statistics 2009*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary to 1995*. Data series shown in Table 4.2.

Buses

Transit

Btu per vehicle-mile – Transit bus energy use divided by transit bus vehicle-miles.

Energy use – See Energy Use Sources, p. A-7. Data series shown in Table 5.16.

Vehicle-miles – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011. Data series shown on Table 5.16.

Btu per passenger-mile – Transit bus energy use divided by transit bus passenger-miles.

Energy use – See Energy Use Sources, p. A-7. Data series shown in Table 5.16.

Passenger-miles – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011. Data series shown on Table 5.16.

Intercity

Btu per passenger-mile – Intercity bus energy use divided by intercity bus passenger-miles.

Energy use – See Energy Use Sources, p. A-8. Because the data past 2000 are not available, the rate of change in bus VMT from FHWA, *Highway Statistics 2009*, was used to estimate the change in energy use.

Passenger-miles – (Data past 2000 are not available.) Eno Foundation for Transportation, *Transportation in America 2001*, Nineteenth edition, Washington, DC.

Nonhighway Mode Energy Intensities

Air

Certificated air carriers

Btu per passenger-mile – Certificated air carrier energy use divided by passenger-miles.

Energy use – See Energy Use Sources, p. A-12. All of domestic fuel use and half of international fuel use was considered to be domestic use.

Passenger-miles – DOT, BTS, *Air Carrier Traffic Statistics*, Washington, DC, ww.bts.gov/programs/airline_information/air_carrier_traffic_statistics. Pre-1994 data a re from various editions of the *FAA Statistical Handbook of Aviation* (no longer published). Scheduled service passenger-miles of domestic air carriers and half of international air carriers were used to coincide with fuel use.

Note: These data differ from the data in Table 9.2 because that table contains data on ALL domestic AND international air carrier energy use and passenger-miles.

General aviation

Btu per passenger-mile – General aviation energy use divided by passenger-miles.

Energy use – See Energy Use Sources, p. A-11. Data series shown in Table 9.3.

Passenger-miles – (Data past 2000 not available.) Eno Foundation for Transportation, *Transportation in America 2001*, Nineteenth edition, Washington, DC.

Rail

Intercity

Btu per passenger-mile – Intercity rail energy use divided by passenger-miles.

Energy use – See Energy Use Sources, p. A-20. Data series shown in Table 9.10.

Passenger-miles – AAR, *Railroad Facts, 2010 Edition*, and previous annual editions.

Transit

Btu per passenger-mile – Transit rail energy use divided by passenger-miles.

Energy use – See Energy Use Sources, p. A-19. Data series shown in Table 9.12.

Passenger-miles – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011. Data series shown on Table 9.12.

Commuter

Btu per passenger-mile – Commuter rail energy use divided by passenger-miles.

Energy use – See Energy Use Sources, p. A-18. Data series shown in Table 9.11.

Passenger-miles – APTA, *2011 Public Transportation Fact Book*, Washington, DC, 2011. Data series shown on Table 9.11.

Freight Movement and Energy Use

Rail

Number of locomotives, ton-miles, tons shipped, average length of haul – AAR, *Railroad Facts, 2010 Edition*, Washington, DC, 2010. Data series shown in Table 9.8.
Energy intensity – Class I rail energy use divided by freight car-miles.
Energy use – See Energy Use Sources, p. A-16. Data series shown in Table 9.8.

Water

Number of vehicles – U.S. Department of the Army, Army Corps of Engineers, *Waterborne Transportation Lines of the United States, Calendar Year 2009, Volume 1—National Summaries*, New Orleans, LA, 2010.
Ton-miles, tons shipped, average length of haul – U.S. Department of the Army, Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2009, Part 5: National Summaries*, New Orleans, LA, 2010. Data series shown in Table 9.5.
Btu per ton-mile – Domestic waterborne commerce energy use divided by ton-miles.
Energy use – See Energy Use Sources, p. A-13. Data series shown in Table 9.5.

Freight Mode Energy Intensities

Truck

Btu per vehicle-mile – Heavy single-unit and combination truck energy use divided by vehicle miles
Energy use – See Energy Use Sources (medium/heavy trucks), p. A-10.
Vehicle-miles – DOT, FHWA, *Highway Statistics 2009*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary to 1995*. Data series is the total of vehicle travel data on Tables 5.1 and 5.2.

Rail

Btu per freight car-mile – Class I rail energy use divided by freight car-miles.
Energy use – See Energy Use Sources, p. A-17. Data series shown in Table 9.8.
Freight car miles – AAR, *Railroad Facts, 2010 Edition*, Washington, DC, 2010. Data series shown in Table 9.8.

Btu per ton-mile – Class I rail energy use divided by ton-miles.
Energy use – See Energy Use Sources, p. A-17. Data series shown in Table 9.8.
Ton-miles – AAR, *Railroad Facts, 2010 Edition*, Washington, DC, 2010. Data series shown in Table 9.8.

Water

Btu per ton-mile – Domestic waterborne commerce energy use divided by ton-miles.
Energy use – See Energy Use Sources, p. A-13. Data series shown in Table 9.5.
Ton-miles – U.S. Department of the Army, Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2009*, Part 5: National Summaries, New Orleans, LA, 2010. Data series shown in Table 9.5.

APPENDIX B

CONVERSIONS

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.4 may differ from values in other publications. The figures in this report are representative or average values, not absolute ones. The gross (higher) heating values used here agree with those used by the Energy Information Administration (EIA).

Heating values fall into two categories, usually referred to as "higher" (or gross) and "lower" (or 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 the 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
Hydrogen Heat Content

1 kilogram hydrogen =	
Higher heating value	Lower heating value
134,200 Btu	113,400 Btu
39.3 kWhr	33.2 kWhr
141,600 kJ	119,600 kJ
33,800 kCal	28,560 kCal

Table B.2
Hydrogen Conversions

	Weight		Gas		Liquid	
	Pounds (lb)	Kilograms (kg)	Standard cubic feet (SCF)	Normal cubic meter (Nm^3)	Gallons (gal)	Liters (L)
1 lb	1.0	0.4536	192.00	5.047	1.6928	6.408
1 kg	2.205	1.0	423.3	11.126	3.733	14.128
1 SCF gas	0.005209	0.002363	1.0	0.02628	0.00882	0.0339
1 Nm^3 gas	0.19815	0.08988	38.04	1.0	0.3355	1.2699
1 gal liquid	0.5906	0.2679	113.41	2.981	1.0	3.785
1 L liquid	0.15604	0.07078	29.99	0.77881	0.2642	1.0

Table B.3
Pressure Conversions

	Weight		Gas		Liquid	
	Pounds (lb)	Kilograms (kg)	Standard cubic feet (SCF)	Normal cubic meter (Nm^3)	Gallons (gal)	Liters (L)
1 lb	1.0	0.4536	192.00	5.047	1.6928	6.408
1 kg	2.205	1.0	423.3	11.126	3.733	14.128
1 SCF gas	0.005209	0.002363	1.0	0.02628	0.00882	0.0339
1 Nm^3 gas	0.19815	0.08988	38.04	1.0	0.3355	1.2699
1 gal liquid	0.5906	0.2679	113.41	2.981	1.0	3.785
1 L liquid	0.15604	0.07078	29.99	0.77881	0.2642	1.0

Table B.4
Heat Content for Various Fuels

Conventional gasoline	125,000 Btu/gal (gross) = 115,400 Btu/gal (net)
E10	120,900 Btu/gal (gross) = 112,400 Btu/gal (net)
E15	119,000 Btu/gal (gross) = 109,400 Btu/gal (net)
Hydrogen	134,200 Btu/kg (gross) = 113,400 Btu/kg (net)
Diesel motor fuel	138,700 Btu/gal (gross) = 128,700 Btu/gal (net)
Biodiesel	126,200 Btu/gal (gross) = 117,100 Btu/gal (net)
Methanol	64,600 Btu/gal (gross) = 56,600 Btu/gal (net)
Ethanol	84,600 Btu/gal (gross) = 75,700 Btu/gal (net)
E85	90,700 Btu/gal (gross) = 81,600 Btu/gal (net)
Aviation gasoline	120,200 Btu/gal (gross) = 112,000 Btu/gal (net)
Liquefied petroleum gas (LPG)	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)
Liquefied natural gas (LNG)	84,800 Btu/gal (gross) = 74,700 Btu/gal (net)
Compressed natural gas (CNG)	22,500 Btu/lb (gross) = 20,300 Btu/lb (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	
Production average	20.192×10^6 Btu/short ton
Consumption average	19.612×10^6 Btu/short ton

Table B.5
Fuel Equivalents

1 million bbl crude oil/day	= 0.365 billion bbl crude oil/year
	= 2.117 quadrillion Btu/year
	= 107.944 million short tons coal/year
	= 97.927 million metric tons coal/year
	= 2.067 trillion ft^3 natural gas/year
	= 2,233 petajoules/year
1 billion bbl crude oil/year	= 2.740 million bbl crude oil/day
	= 5.800 quadrillion Btu/year
	= 295.737 million short tons coal/year
	= 268.293 million metric tons coal/year
	= 5.644 trillion ft^3 natural gas/year
	= 6,119 petajoules/year
1 quadrillion Btu/year	= 0.5219 gasoline gallon equivalents
	= 0.472 million bbl crude oil/day
	= 172.414 million bbl crude oil/year
	= 50.989 million short tons coal/year
	= 46.257 million metric tons coal/year
	= 976.563 billion ft^3 natural gas/year
	= 1,055 petajoules/year
1 billion short tons coal/year	= 0.907 billion metric tons coal/year
	= 9.264 million bbl crude oil/day
	= 3.381 billion bbl crude oil/year
	= 19.612 quadrillion Btu/year
	= 19.152 trillion ft^3 natural gas/year
	= 20,691 petajoules/year
1 billion metric tons coal/year	= 1.102 billion short tons coal/year
	= 8.404 million bbl crude oil/day
	= 3.068 billion bbl crude oil/year
	= 17.792 quadrillion btu/year
	= 17.375 trillion ft^3 natural gas/year
	= 18,771 petajoules/year
1 trillion ft^3 natural gas/year	= 0.484 million bbl crude oil/day
	= 0.177 billion bbl crude oil/year
	= 1.024 quadrillion Btu/year
	= 52.213 million short tons coal/year
	= 47.368 million metric tons coal/year
	= 1,080 petajoules/year
1 petajoule/year	= 447.741 bbl crude oil/day
	= 163.425 thousand bbl crude oil/year
	= 0.948 trillion Btu/year
	= 48.331 thousand short tons coal/year
	= 43.846 thousand metric tons coal/year
	= 0.926 billion ft^3 natural gas/year

Table B.6
Energy Unit Conversions

1 Btu	= 778.2 ft-lb	1 kWhr	= 3412 Btu[a]
	= 107.6 kg-m		= 2.655 x 10^{6} ft-lb
	= 1055 J		= 3.671 x 10^{5} kg-m
	= 39.30 x 10^{-5} hp-h		= 3.600 x 10^{6} J
	= 39.85 x 10^{-5} metric hp-h		= 1.341 hp-h
	= 29.31 x 10^{-5} kWhr		= 1.360 metric hp-h
1 kg-m	= 92.95 x 10^{-4} Btu	1 Joule	= 94.78 x 10^{-5} Btu
	= 7.233 ft-lb		= 0.7376 ft-lb
	= 9.806 J		= 0.1020 kg-m
	= 36.53 x 10^{-7} hp-h		= 37.25 x 10^{-8} hp-h
	= 37.04 x 10^{-7} metric hp-h		= 37.77 x 10^{-8} metric hp-h
	= 27.24 x 10^{-7} kWhr		= 27.78 x 10^{-8} kWhr
1 hp-h	= 2544 Btu	1 metric hp-h	= 2510 Btu
	= 1.98 x 10^{6} ft-lb		= 1.953 x 10^{6} ft-lb
	= 2.738 x 10^{6} kgm		= 27.00 x 10^{4} kg-m
	= 2.685 x 10^{6} J		= 2.648 x 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 33%. If generation and distribution efficiency are taken into account, 1 kWhr = 10,339 Btu.

Table B.7
International Energy Conversions

To:	Petajoules	Giga-calories	Million tonnes of oil equivalent	Million Btu	Gigawatt-hours
From:	*multiply by:*				
Petajoules	1	238.8 x 10^{3}	2.388 x 10^{-2}	947.8 x 10^{3}	277.8
Gigacalories	4.1868 x 10^{-6}	1	10^{-7}	3.968	1.163 x 10^{-3}
Million tonnes of oil equivalent	41.868	10^{7}	1	3.968 x 10^{7}	11,630
Million Btu	1.0551 x 10^{-6}	0.252	2.52 X 10^{-8}	1	2.931 x 10^{-4}
Gigawatthours	3.6 x 10^{-3}	860 8.6	x 10^{-5}	3412	1

Table B.8
Distance and Velocity Conversions

1 in.	= 83.33×10^{-3} ft	1 ft	= 12.0 in.
	= 27.78×10^{-3} yd		= 0.33 yd
	= 15.78×10^{-6} mile		= 189.4×10^{-3} mile
	= 25.40×10^{-3} m		= 0.3048 m
	= 0.2540×10^{-6} km		= 0.3048×10^{-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.9
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.10
Volume and Flow Rate Conversions[a]

1 U.S. gal	= 231 $in.^3$	1 liter	= 61.02 $in.^3$
	= 0.1337 ft^3		= 3.531×10^{-2} ft^3
	= 3.785 liters		= 0.2624 U.S. gal
	= 0.8321 imperial gal		= 0.2200 imperial gal
	= 0.0238 bbl		= 6.29×10^{-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		= 3.679×10^5 U.S. gal/year
	= 839.3 imperial gal/day		= 3.063×10^5 imperial gal/year
	= 3815 liter/day		= 1.393×10^6 liter/day

[a] The conversions for flow rates are identical to those for volume measures, if the time units are identical.

Table B.11
Power Conversions

	TO					
FROM	Horsepower	Kilowatts	Metric horsepower	Ft-lb per sec	Kilocalories per sec	Btu per sec
Horsepower	1	0.7457	1.014	550	0.1781	0.7068
Kilowatts	1.341	1	1.360	737.6	0.239	0.9478
Metric horsepower	0.9863	0.7355	1	542.5	0.1757	0.6971
Ft-lb per sec	1.36×10^{-3}	1.356×10^{-3}	1.84×10^{-3}	1	0.3238×10^{-3}	1.285×10^{-3}
Kilocalories per sec	5.615	4.184	5.692	3088	1	3.968
Btu per sec	1.415	1.055	1.434	778.2	0.2520	1

Table B.12
Mass Conversions

	TO				
FROM	Pound	Kilogram	Short ton	Long ton	Metric ton
Pound	1	0.4536	5.0×10^{-4}	4.4643×10^{-4}	4.5362×10^{-4}
Kilogram	2.205	1	1.1023×10^{-3}	9.8425×10^{-4}	1.0×10^{-3}
Short ton	2,000	907.2	1	0.8929	0.9072
Long ton	2,240	1,106	1.12	1	1.016
Metric ton	2,205	1,000	1.102	0.9842	1

Table B.13
Fuel Efficiency Conversions

MPG	Miles/liter	Kilometers/L	L/100 kilometers	Grams of CO_2 per mile[a]	Pounds of CO_2 per mile[a]
10	2.64	4.25	23.52	877.80	1.94
15	3.96	6.38	15.68	585.20	1.29
20	5.28	8.50	11.76	438.90	0.97
25	6.60	10.63	9.41	351.12	0.78
30	7.92	12.75	7.84	292.60	0.65
35	9.25	14.88	6.72	250.80	0.55
40	10.57	17.00	5.88	219.45	0.49
45	11.89	19.13	5.23	195.07	0.43
50	13.21	21.25	4.70	175.56	0.39
55	14.53	23.38	4.28	159.60	0.35
60	15.85	25.51	3.92	146.30	0.32
65	17.17	27.63	3.62	135.05	0.30
70	18.49	29.76	3.36	125.40	0.28
75	19.81	31.88	3.14	117.04	0.26
80	21.13	34.01	2.94	109.73	0.24
85	22.45	36.13	2.77	103.27	0.23
90	23.77	38.26	2.61	97.53	0.22
95	25.09	40.38	2.48	92.40	0.20
100	26.42	42.51	2.35	87.78	0.19
105	27.74	44.64	2.24	83.60	0.18
110	29.06	46.76	2.14	79.80	0.18
115	30.38	48.89	2.05	76.33	0.17
120	31.70	51.01	1.96	73.15	0.16
125	33.02	53.14	1.88	70.22	0.16
130	34.34	55.26	1.81	67.52	0.15
135	35.66	57.39	1.74	65.02	0.14
140	36.98	59.51	1.68	62.70	0.14
145	38.30	61.64	1.62	60.54	0.13
150	39.62	63.76	1.57	58.52	0.13
Formula	MPG/3.785	MPG/[3.785/1.609]	235.24/MPG	8,778/MPG	19.4/MPG

[a] For gasoline-fueled vehicles.

Table B.14
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.15
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

Table B.16
Carbon Coefficients, 2002
(Million metric tons carbon per quadrillion Btu)

Fuel Type	
Coal	
Coal (residential)	26.04
Coal (commercial)	26.04
Coal (industrial coking)	25.63
Coal (industrial other)	25.74
Coal (electric utility)	25.98
Natural gas	
Natural gas (pipeline)	14.47
Natural gas (flared)	14.92
Petroleum	
Asphalt and road oil	20.62
Aviation gasoline	18.87
Crude oil	20.30
Distillate fuel	19.95
Jet fuel	19.33
Kerosene	19.72
LPG	16.99
Lubricants	20.24
Motor gasoline	19.34
Petrochemical feed.	19.37
Petroleum coke	27.85
Residual fuel	21.49
Waxes	19.81

Note: All coefficients based on Higher Heating (Gross Calorific) Value and assume 100 percent combustion.

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.17 and B.18). Table B.17 shows conversion factors for the Consumer Price Index inflation factors. Table B.18 shows conversion factors using the Gross National Product inflation factors.

Table B.17
Consumer Price Inflation (CPI) Index

From:	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1970	1.000	1.044	1.077	1.144	1.271	1.387	1.466	1.562	1.680	1.871
1971	0.958	1.000	1.032	1.096	1.217	1.328	1.405	1.496	1.610	1.793
1972	0.928	0.969	1.000	1.062	1.179	1.287	1.361	1.450	1.560	1.737
1973	0.874	0.912	0.941	1.000	1.110	1.212	1.282	1.365	1.468	1.635
1974	0.787	0.822	0.848	0.901	1.000	1.091	1.154	1.229	1.323	1.473
1975	0.721	0.753	0.777	0.825	0.916	1.000	1.058	1.126	1.212	1.349
1976	0.682	0.712	0.735	0.780	0.866	0.946	1.000	1.065	1.146	1.276
1977	0.640	0.668	0.690	0.733	0.814	0.888	0.939	1.000	1.076	1.198
1978	0.595	0.621	0.641	0.681	0.756	0.825	0.873	0.929	1.000	1.113
1979	0.534	0.558	0.576	0.612	0.679	0.741	0.784	0.835	0.898	1.000
1980	0.471	0.492	0.507	0.539	0.598	0.653	0.691	0.735	0.791	0.881
1981	0.427	0.446	0.460	0.488	0.542	0.592	0.626	0.667	0.717	0.799
1982	0.402	0.420	0.433	0.460	0.511	0.558	0.590	0.628	0.676	0.752
1983	0.390	0.407	0.420	0.446	0.495	0.540	0.571	0.608	0.655	0.729
1984	0.373	0.390	0.402	0.427	0.474	0.518	0.548	0.583	0.628	0.699
1985	0.361	0.376	0.388	0.413	0.458	0.500	0.529	0.563	0.606	0.675
1986	0.354	0.370	0.381	0.405	0.450	0.491	0.519	0.553	0.595	0.662
1987	0.342	0.357	0.368	0.391	0.434	0.474	0.501	0.533	0.574	0.639
1988	0.328	0.342	0.353	0.375	0.417	0.455	0.481	0.512	0.551	0.614
1989	0.313	0.327	0.337	0.358	0.398	0.434	0.459	0.489	0.526	0.585
1990	0.297	0.310	0.320	0.340	0.377	0.412	0.435	0.464	0.499	0.555
1991	0.285	0.297	0.307	0.326	0.362	0.395	0.418	0.445	0.479	0.533
1992	0.277	0.289	0.298	0.316	0.351	0.383	0.406	0.432	0.465	0.517
1993	0.269	0.280	0.289	0.307	0.341	0.372	0.394	0.419	0.451	0.502
1994	0.262	0.273	0.282	0.300	0.333	0.363	0.384	0.409	0.440	0.490
1995	0.255	0.266	0.274	0.291	0.323	0.353	0.373	0.398	0.428	0.476
1996	0.247	0.258	0.266	0.283	0.314	0.343	0.363	0.386	0.416	0.463
1997	0.242	0.252	0.260	0.277	0.307	0.335	0.355	0.378	0.406	0.452
1998	0.238	0.248	0.256	0.272	0.302	0.330	0.349	0.372	0.400	0.445
1999	0.233	0.243	0.251	0.267	0.296	0.323	0.342	0.364	0.391	0.436
2000	0.225	0.235	0.243	0.258	0.286	0.312	0.330	0.352	0.379	0.422
2001	0.219	0.229	0.236	0.251	0.278	0.304	0.321	0.342	0.368	0.410
2002	0.216	0.225	0.232	0.247	0.274	0.299	0.316	0.337	0.362	0.404
2003	0.211	0.220	0.227	0.241	0.268	0.292	0.309	0.329	0.354	0.395
2004	0.205	0.214	0.221	0.235	0.261	0.285	0.301	0.321	0.345	0.384
2005	0.199	0.207	0.214	0.227	0.252	0.275	0.291	0.310	0.334	0.372
2006	0.192	0.201	0.207	0.220	0.245	0.267	0.282	0.301	0.323	0.360
2007	0.187	0.195	0.202	0.214	0.238	0.259	0.274	0.292	0.314	0.350
2008	0.180	0.188	0.194	0.206	0.229	0.250	0.264	0.281	0.303	0.337
2009	0.181	0.189	0.195	0.207	0.230	0.251	0.265	0.282	0.304	0.338
2010	0.178	0.186	0.192	0.204	0.226	0.247	0.261	0.278	0.299	0.333

Table B.17
Consumer Price Inflation (CPI) Index (Continued)

From:	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1970	2.124	2.343	2.487	2.567	2.678	2.773	2.825	2.928	3.049	3.196
1971	2.035	2.244	2.383	2.459	2.565	2.657	2.706	2.805	2.921	3.062
1972	1.971	2.175	2.309	2.383	2.486	2.574	2.622	2.718	2.830	2.967
1973	1.856	2.047	2.173	2.243	2.340	2.423	2.468	2.559	2.664	2.793
1974	1.671	1.844	1.957	2.020	2.108	2.183	2.223	2.304	2.400	2.515
1975	1.532	1.690	1.794	1.851	1.931	2.000	2.037	2.112	2.199	2.305
1976	1.448	1.598	1.696	1.750	1.826	1.891	1.926	1.996	2.079	2.179
1977	1.360	1.500	1.592	1.644	1.715	1.776	1.809	1.875	1.952	2.046
1978	1.264	1.394	1.480	1.528	1.594	1.650	1.681	1.742	1.814	1.902
1979	1.135	1.252	1.329	1.372	1.431	1.482	1.510	1.565	1.629	1.708
1980	1.000	1.103	1.171	1.209	1.261	1.306	1.330	1.379	1.436	1.505
1981	0.906	1.000	1.062	1.096	1.143	1.184	1.206	1.250	1.301	1.364
1982	0.854	0.942	1.000	1.032	1.077	1.115	1.136	1.177	1.226	1.285
1983	0.827	0.913	0.969	1.000	1.043	1.080	1.100	1.141	1.188	1.245
1984	0.793	0.875	0.929	0.959	1.000	1.036	1.055	1.093	1.139	1.193
1985	0.766	0.845	0.897	0.926	0.966	1.000	1.019	1.056	1.099	1.152
1986	0.752	0.829	0.880	0.909	0.948	0.982	1.000	1.036	1.079	1.131
1987	0.725	0.800	0.849	0.877	0.915	0.947	0.965	1.000	1.041	1.092
1988	0.697	0.768	0.816	0.842	0.878	0.910	0.926	0.960	1.000	1.048
1989	0.665	0.733	0.778	0.803	0.838	0.868	0.884	0.916	0.954	1.000
1990	0.630	0.695	0.738	0.762	0.795	0.823	0.839	0.869	0.905	0.949
1991	0.605	0.667	0.709	0.731	0.763	0.790	0.805	0.834	0.869	0.910
1992	0.587	0.648	0.688	0.710	0.741	0.767	0.781	0.810	0.843	0.884
1993	0.570	0.629	0.668	0.689	0.719	0.745	0.758	0.786	0.819	0.858
1994	0.556	0.613	0.651	0.672	0.701	0.726	0.740	0.767	0.798	0.837
1995	0.541	0.596	0.633	0.654	0.682	0.706	0.719	0.745	0.776	0.814
1996	0.525	0.579	0.615	0.635	0.662	0.686	0.699	0.724	0.754	0.790
1997	0.513	0.566	0.601	0.621	0.647	0.670	0.683	0.708	0.737	0.773
1998	0.506	0.558	0.592	0.611	0.637	0.660	0.672	0.697	0.726	0.761
1999	0.495	0.546	0.579	0.598	0.624	0.646	0.658	0.682	0.710	0.744
2000	0.479	0.528	0.560	0.578	0.603	0.625	0.636	0.660	0.687	0.720
2001	0.465	0.513	0.545	0.562	0.587	0.608	0.619	0.641	0.668	0.700
2002	0.458	0.505	0.536	0.554	0.578	0.598	0.609	0.631	0.658	0.689
2003	0.448	0.494	0.524	0.541	0.565	0.585	0.596	0.617	0.643	0.674
2004	0.436	0.481	0.511	0.527	0.550	0.570	0.580	0.601	0.626	0.656
2005	0.422	0.465	0.494	0.510	0.532	0.551	0.561	0.582	0.606	0.635
2006	0.409	0.451	0.479	0.494	0.515	0.534	0.544	0.563	0.587	0.615
2007	0.397	0.438	0.465	0.480	0.501	0.519	0.529	0.548	0.571	0.598
2008	0.383	0.422	0.448	0.463	0.483	0.500	0.509	0.528	0.549	0.576
2009	0.384	0.424	0.450	0.464	0.484	0.502	0.511	0.530	0.551	0.578
2010	0.378	0.417	0.443	0.457	0.476	0.493	0.503	0.521	0.543	0.569

Table B.17
Consumer Price Inflation (CPI) Index (Continued)

From:	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1970	3.369	3.510	3.616	3.724	3.820	3.928	4.044	4.137	4.201	4.294
1971	3.227	3.363	3.464	3.568	3.659	3.763	3.874	3.963	4.025	4.114
1972	3.127	3.258	3.356	3.457	3.545	3.646	3.754	3.840	3.900	3.986
1973	2.944	3.068	3.160	3.255	3.338	3.432	3.534	3.615	3.671	3.752
1974	2.651	2.763	2.846	2.931	3.006	3.091	3.183	3.256	3.306	3.379
1975	2.429	2.532	2.608	2.686	2.755	2.833	2.916	2.983	3.030	3.097
1976	2.297	2.394	2.466	2.540	2.605	2.678	2.757	2.821	2.865	2.928
1977	2.157	2.248	2.315	2.384	2.446	2.515	2.589	2.649	2.690	2.749
1978	2.005	2.089	2.152	2.216	2.273	2.337	2.406	2.462	2.500	2.555
1979	1.800	1.876	1.933	1.990	2.041	2.099	2.161	2.211	2.245	2.295
1980	1.586	1.653	1.703	1.754	1.799	1.850	1.904	1.948	1.978	2.022
1981	1.438	1.498	1.543	1.590	1.630	1.677	1.726	1.766	1.793	1.833
1982	1.354	1.411	1.454	1.497	1.536	1.579	1.626	1.663	1.689	1.726
1983	1.312	1.367	1.409	1.451	1.488	1.530	1.575	1.611	1.637	1.673
1984	1.258	1.311	1.350	1.391	1.426	1.467	1.510	1.545	1.569	1.603
1985	1.215	1.266	1.304	1.343	1.377	1.416	1.458	1.492	1.515	1.548
1986	1.193	1.243	1.280	1.318	1.352	1.391	1.432	1.464	1.487	1.520
1987	1.151	1.199	1.235	1.272	1.305	1.342	1.381	1.413	1.435	1.467
1988	1.105	1.151	1.186	1.221	1.253	1.288	1.326	1.357	1.378	1.408
1989	1.054	1.098	1.131	1.165	1.195	1.229	1.265	1.294	1.315	1.344
1990	1.000	1.042	1.073	1.106	1.134	1.166	1.200	1.228	1.247	1.275
1991	0.960	1.000	1.030	1.061	1.088	1.119	1.152	1.178	1.197	1.223
1992	0.932	0.971	1.000	1.030	1.056	1.086	1.118	1.144	1.162	1.187
1993	0.904	0.943	0.971	1.000	1.026	1.055	1.086	1.111	1.128	1.153
1994	0.882	0.919	0.947	0.975	1.000	1.028	1.059	1.083	1.100	1.124
1995	0.858	0.894	0.921	0.948	0.972	1.000	1.030	1.053	1.070	1.093
1996	0.833	0.868	0.894	0.921	0.945	0.971	1.000	1.023	1.039	1.062
1997	0.814	0.849	0.874	0.900	0.923	0.950	0.978	1.000	1.016	1.038
1998	0.802	0.836	0.861	0.887	0.909	0.935	0.963	0.985	1.000	1.022
1999	0.785	0.818	0.842	0.867	0.890	0.915	0.942	0.963	0.978	1.000
2000	0.759	0.791	0.815	0.839	0.861	0.885	0.911	0.932	0.947	0.967
2001	0.738	0.769	0.792	0.816	0.837	0.861	0.886	0.906	0.920	0.941
2002	0.727	0.757	0.780	0.803	0.824	0.847	0.872	0.892	0.906	0.926
2003	0.710	0.740	0.763	0.785	0.805	0.828	0.853	0.872	0.886	0.905
2004	0.692	0.721	0.743	0.765	0.785	0.807	0.831	0.850	0.863	0.882
2005	0.669	0.697	0.718	0.740	0.759	0.780	0.803	0.822	0.835	0.853
2006	0.648	0.676	0.696	0.717	0.735	0.756	0.778	0.796	0.809	0.826
2007	0.630	0.657	0.677	0.697	0.715	0.735	0.757	0.774	0.786	0.804
2008	0.607	0.633	0.652	0.671	0.688	0.708	0.729	0.745	0.757	0.774
2009	0.602	0.635	0.654	0.674	0.691	0.710	0.731	0.748	0.760	0.777
2010	0.599	0.625	0.643	0.663	0.680	0.699	0.720	0.736	0.748	0.764

Table B.17
Consumer Price Inflation (CPI) Index (Continued)

From:	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1970	4.438	4.564	4.637	4.742	4.869	5.034	5.196	5.344	5.549	5.529	5.620
1971	4.252	4.373	4.442	4.543	4.664	4.822	4.978	5.120	5.316	5.297	5.384
1972	4.120	4.237	4.304	4.402	4.519	4.672	4.823	4.960	5.151	5.132	5.217
1973	3.878	3.989	4.052	4.144	4.255	4.399	4.541	4.670	4.849	4.832	4.911
1974	3.493	3.592	3.649	3.732	3.832	3.961	4.089	4.206	4.367	4.352	4.423
1975	3.201	3.292	3.344	3.420	3.511	3.630	3.747	3.854	4.002	3.988	4.053
1976	3.026	3.112	3.162	3.234	3.320	3.432	3.543	3.644	3.784	3.770	3.832
1977	2.842	2.922	2.969	3.036	3.117	3.223	3.327	3.421	3.553	3.540	3.598
1978	2.641	2.716	2.759	2.822	2.897	2.995	3.092	3.180	3.302	3.290	3.344
1979	2.372	2.439	2.478	2.534	2.602	2.690	2.777	2.856	2.966	2.955	3.004
1980	2.090	2.149	2.183	2.233	2.292	2.370	2.447	2.516	2.613	2.604	2.646
1981	1.894	1.948	1.979	2.024	2.078	2.149	2.218	2.281	2.369	2.360	2.399
1982	1.784	1.835	1.864	1.907	1.958	2.024	2.089	2.149	2.231	2.223	2.260
1983	1.729	1.778	1.806	1.847	1.897	1.961	2.024	2.082	2.162	2.154	2.189
1984	1.657	1.705	1.731	1.771	1.818	1.880	1.940	1.996	2.072	2.065	2.099
1985	1.600	1.646	1.672	1.710	1.756	1.815	1.874	1.927	2.001	1.994	2.027
1986	1.571	1.616	1.641	1.679	1.724	1.782	1.839	1.892	1.964	1.957	1.990
1987	1.516	1.559	1.584	1.620	1.663	1.719	1.775	1.825	1.895	1.889	1.920
1988	1.456	1.497	1.521	1.555	1.597	1.651	1.704	1.753	1.820	1.813	1.843
1989	1.389	1.428	1.451	1.484	1.523	1.575	1.626	1.672	1.736	1.730	1.759
1990	1.318	1.355	1.376	1.408	1.445	1.494	1.542	1.586	1.647	1.641	1.668
1991	1.264	1.300	1.321	1.351	1.387	1.434	1.480	1.522	1.581	1.575	1.601
1992	1.227	1.262	1.282	1.311	1.346	1.392	1.437	1.478	1.535	1.529	1.554
1993	1.192	1.226	1.245	1.273	1.307	1.352	1.395	1.435	1.490	1.485	1.509
1994	1.162	1.195	1.214	1.242	1.275	1.318	1.360	1.399	1.453	1.448	1.471
1995	1.130	1.162	1.180	1.207	1.240	1.281	1.323	1.360	1.413	1.408	1.431
1996	1.098	1.129	1.147	1.173	1.204	1.245	1.285	1.321	1.372	1.367	1.390
1997	1.073	1.103	1.121	1.146	1.177	1.217	1.256	1.292	1.341	1.337	1.359
1998	1.056	1.087	1.104	1.129	1.159	1.198	1.237	1.272	1.321	1.316	1.338
1999	1.034	1.063	1.080	1.104	1.134	1.172	1.210	1.245	1.292	1.288	1.309
2000	1.000	1.028	1.045	1.069	1.097	1.134	1.171	1.204	1.250	1.246	1.266
2001	0.972	1.000	1.016	1.039	1.067	1.103	1.138	1.171	1.216	1.211	1.231
2002	0.957	0.984	1.000	1.023	1.050	1.086	1.121	1.153	1.197	1.193	1.212
2003	0.936	0.963	0.978	1.000	1.027	1.061	1.096	1.127	1.170	1.166	1.185
2004	0.912	0.938	0.952	0.974	1.000	1.034	1.067	1.098	1.140	1.136	1.154
2005	0.882	0.907	0.921	0.942	0.967	1.000	1.032	1.062	1.102	1.098	1.117
2006	0.854	0.878	0.892	0.913	0.937	0.969	1.000	1.028	1.068	1.064	1.082
2007	0.831	0.854	0.868	0.887	0.911	0.942	0.972	1.000	1.038	1.035	1.052
2008	0.800	0.823	0.836	0.855	0.877	0.907	0.936	0.963	1.000	0.996	1.013
2009	0.803	0.825	0.839	0.858	0.881	0.910	0.940	0.966	1.004	1.000	1.016
2010	0.790	0.812	0.825	0.844	0.866	0.896	0.925	0.951	0.987	0.984	1.000

Source:
U.S. Bureau of Labor Statistics.

Table B.18
Gross National Product Implicit Price Deflator

From:	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1970	1.000	1.050	1.096	1.157	1.261	1.380	1.460	1.553	1.662	1.800
1971	0.952	1.000	1.043	1.102	1.201	1.315	1.391	1.479	1.583	1.714
1972	0.913	0.958	1.000	1.056	1.151	1.260	1.333	1.418	1.517	1.643
1973	0.864	0.908	0.947	1.000	1.090	1.193	1.262	1.342	1.437	1.556
1974	0.793	0.833	0.869	0.917	1.000	1.094	1.158	1.231	1.318	1.427
1975	0.724	0.761	0.794	0.838	0.914	1.000	1.058	1.125	1.204	1.304
1976	0.685	0.719	0.750	0.792	0.864	0.945	1.000	1.064	1.138	1.233
1977	0.644	0.676	0.705	0.745	0.812	0.889	0.940	1.000	1.070	1.159
1978	0.602	0.632	0.659	0.696	0.759	0.830	0.878	0.934	1.000	1.083
1979	0.555	0.583	0.609	0.643	0.701	0.767	0.811	0.863	0.923	1.000
1980	0.509	0.535	0.558	0.589	0.642	0.703	0.744	0.791	0.847	0.917
1981	0.466	0.489	0.510	0.539	0.587	0.643	0.680	0.723	0.774	0.838
1982	0.439	0.461	0.481	0.508	0.553	0.606	0.641	0.682	0.729	0.790
1983	0.422	0.443	0.462	0.488	0.532	0.583	0.616	0.656	0.702	0.760
1984	0.407	0.427	0.446	0.471	0.513	0.562	0.594	0.632	0.676	0.732
1985	0.395	0.415	0.433	0.457	0.498	0.545	0.576	0.613	0.656	0.711
1986	0.386	0.406	0.423	0.447	0.487	0.533	0.564	0.600	0.642	0.695
1987	0.376	0.395	0.412	0.435	0.747	0.519	0.549	0.584	0.625	0.677
1988	0.364	0.382	0.398	0.421	0.459	0.502	0.531	0.565	0.604	0.654
1989	0.350	0.368	0.384	0.405	0.442	0.483	0.511	0.544	0.582	0.631
1990	0.337	0.354	0.369	0.390	0.425	0.465	0.492	0.524	0.561	0.607
1991	0.326	0.342	0.357	0.377	0.411	0.450	0.476	0.506	0.542	0.587
1992	0.319	0.334	0.349	0.369	0.402	0.440	0.465	0.495	0.530	0.573
1993	0.311	0.327	0.341	0.360	0.393	0.430	0.455	0.483	0.517	0.560
1994	0.305	0.320	0.334	0.353	0.384	0.421	0.445	0.473	0.507	0.549
1995	0.299	0.314	0.327	0.346	0.377	0.412	0.436	0.464	0.497	0.538
1996	0.293	0.308	0.321	0.339	0.370	0.405	0.428	0.455	0.487	0.528
1997	0.288	0.303	0.316	0.334	0.364	0.398	0.421	0.448	0.479	0.519
1998	0.285	0.299	0.312	0.330	0.360	0.394	0.416	0.443	0.474	0.513
1999	0.281	0.295	0.308	0.325	0.355	0.388	0.410	0.437	0.467	0.506
2000	0.275	0.289	0.301	0.318	0.347	0.380	0.402	0.427	0.457	0.495
2001	0.269	0.282	0.294	0.311	0.339	0.371	0.392	0.417	0.447	0.484
2002	0.264	0.277	0.289	0.306	0.333	0.365	0.386	0.410	0.439	0.475
2003	0.259	0.272	0.283	0.299	0.326	0.357	0.378	0.402	0.430	0.465
2004	0.251	0.264	0.276	0.291	0.317	0.347	0.367	0.391	0.418	0.453
2005	0.244	0.256	0.267	0.282	0.308	0.337	0.356	0.379	0.406	0.439
2006	0.236	0.248	0.259	0.273	0.298	0.326	0.345	0.367	0.392	0.425
2007	0.230	0.241	0.252	0.266	0.290	0.317	0.335	0.357	0.382	0.413
2008	0.225	0.236	0.246	0.260	0.283	0.310	0.328	0.349	0.374	0.405
2009	0.221	0.232	0.242	0.256	0.279	0.306	0.323	0.344	0.368	0.399
2010	0.220	0.231	0.241	0.254	0.277	0.303	0.321	0.341	0.365	0.395

Table B.18
Gross National Product Implicit Price Deflator (Continued)

From:	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1970	1.963	2.148	2.279	2.369	2.458	2.533	2.589	2.660	2.751	2.855
1971	1.870	2.046	2.170	2.256	2.341	2.413	2.466	2.533	2.620	2.719
1972	1.792	1.960	2.080	2.162	2.244	2.312	2.363	2.428	2.510	2.606
1973	1.697	1.857	1.970	2.048	2.125	2.190	2.238	2.299	2.378	2.468
1974	1.557	1.703	1.807	1.879	1.949	2.009	2.053	2.109	2.181	2.264
1975	1.422	1.556	1.651	1.716	1.781	1.835	1.876	1.927	1.993	2.068
1976	1.344	1.471	1.561	1.623	1.683	1.735	1.773	1.822	1.884	1.955
1977	1.264	1.383	1.467	1.525	1.583	1.631	1.667	1.713	1.771	1.838
1978	1.181	1.292	1.371	1.425	1.479	1.524	1.557	1.600	1.655	1.717
1979	1.091	1.193	1.266	1.316	1.366	1.407	1.438	1.478	1.528	1.586
1980	1.000	1.094	1.161	1.207	1.252	1.290	1.319	1.355	1.401	1.454
1981	0.914	1.000	1.061	1.103	1.144	1.179	1.205	1.238	1.281	1.329
1982	0.861	0.943	1.000	1.040	1.079	1.112	1.136	1.167	1.207	1.253
1983	0.829	0.907	0.962	1.000	1.038	1.069	1.093	1.123	1.161	1.205
1984	0.799	0.874	0.927	0.964	1.000	1.031	1.053	1.082	1.119	1.161
1985	0.775	0.848	0.900	0.935	0.970	1.000	1.022	1.050	1.086	1.127
1986	0.758	0.830	0.880	0.915	0.950	0.978	1.000	1.027	1.063	1.103
1987	0.738	0.808	0.857	0.891	0.924	0.952	0.973	1.000	1.034	1.073
1988	0.714	0.781	0.828	0.861	0.894	0.921	0.941	0.967	1.000	1.038
1989	0.688	0.752	0.798	0.830	0.861	0.887	0.907	0.932	0.963	1.000
1990	0.662	0.724	0.768	0.799	0.829	0.854	0.873	0.897	0.928	0.963
1991	0.640	0.700	0.743	0.772	0.801	0.825	0.844	0.867	0.896	0.930
1992	0.625	0.684	0.726	0.755	0.783	0.807	0.825	0.847	0.876	0.909
1993	0.611	0.669	0.709	0.738	0.765	0.789	0.806	0.828	0.856	0.889
1994	0.598	0.655	0.695	0.722	0.749	0.772	0.789	0.811	0.838	0.870
1995	0.586	0.642	0.681	0.708	0.734	0.757	0.773	0.794	0.822	0.853
1996	0.575	0.630	0.668	0.694	0.721	0.743	0.759	0.780	0.806	0.837
1997	0.566	0.619	0.657	0.683	0.709	0.730	0.746	0.767	0.793	0.823
1998	0.560	0.613	0.650	0.676	0.701	0.722	0.738	0.759	0.784	0.814
1999	0.552	0.604	0.641	0.666	0.691	0.712	0.728	0.748	0.773	0.803
2000	0.540	0.591	0.627	0.652	0.676	0.697	0.712	0.732	0.757	0.785
2001	0.528	0.577	0.612	0.637	0.660	0.681	0.696	0.715	0.739	0.767
2002	0.518	0.567	0.602	0.626	0.649	0.669	0.684	0.702	0.726	0.754
2003	0.508	0.555	0.589	0.613	0.636	0.655	0.669	0.688	0.711	0.738
2004	0.494	0.540	0.573	0.596	0.618	0.637	0.651	0.669	0.692	0.718
2005	0.479	0.524	0.556	0.578	0.600	0.618	0.632	0.649	0.671	0.697
2006	0.463	0.507	0.538	0.559	0.580	0.598	0.611	0.628	0.649	0.674
2007	0.451	0.493	0.523	0.544	0.564	0.582	0.594	0.611	0.632	0.656
2008	0.441	0.483	0.512	0.533	0.533	0.569	0.582	0.598	0.618	0.642
2009	0.435	0.476	0.505	0.525	0.544	0.561	0.573	0.590	0.610	0.633
2010	0.431	0.472	0.501	0.520	0.540	0.556	0.569	0.585	0.605	0.628

Table B.18
Gross National Product Implicit Price Deflator (Continued)

From:	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1970	2.966	3.069	3.140	3.212	3.281	3.348	3.412	3.468	3.507	3.557
1971	2.824	2.923	2.990	3.059	3.124	3.189	3.249	3.303	3.340	3.388
1972	2.707	2.801	2.865	2.932	2.994	3.056	3.114	3.165	3.200	3.247
1973	2.563	2.653	2.714	2.777	2.836	2.894	2.949	2.998	3.031	3.075
1974	2.351	2.433	2.489	2.547	2.601	2.655	2.705	2.750	2.780	2.821
1975	2.148	2.224	2.274	2.327	2.377	2.426	2.472	2.513	2.540	2.577
1976	2.031	2.102	2.150	2.200	2.247	2.293	2.336	2.375	2.401	2.436
1977	1.909	1.976	2.021	2.068	2.112	2.156	2.197	2.233	2.258	2.290
1978	1.784	1.846	1.889	1.932	1.974	2.014	2.052	2.086	2.109	2.140
1979	1.647	1.705	1.744	1.785	1.822	1.860	1.895	1.927	1.948	1.976
1980	1.510	1.563	1.599	1.636	1.671	1.705	1.738	1.767	1.786	1.812
1981	1.381	1.429	1.462	1.496	1.527	1.559	1.588	1.615	1.633	1.656
1982	1.301	1.347	1.378	1.410	1.440	1.469	1.497	1.522	1.539	1.561
1983	1.252	1.295	1.325	1.356	1.385	1.413	1.440	1.464	1.480	1.501
1984	1.206	1.249	1.277	1.307	1.335	1.362	1.388	1.411	1.426	1.447
1985	1.171	1.212	1.239	1.268	1.295	1.322	1.347	1.369	1.384	1.404
1986	1.145	1.186	1.213	1.241	1.267	1.293	1.318	1.340	1.354	1.374
1987	1.115	1.154	1.180	1.208	1.233	1.259	1.283	1.304	1.318	1.337
1988	1.078	1.116	1.141	1.168	1.193	1.217	1.240	1.261	1.275	1.293
1989	1.039	1.075	1.100	1.125	1.149	1.173	1.195	1.215	1.228	1.246
1990	1.000	1.035	1.059	1.083	1.106	1.129	1.150	1.170	1.182	1.200
1991	0.966	1.000	1.023	1.047	1.069	1.091	1.112	1.130	1.143	1.159
1992	0.945	0.978	1.000	1.023	1.045	1.066	1.087	1.105	1.117	1.133
1993	0.923	0.955	0.977	1.000	1.021	1.042	1.062	1.080	1.092	1.107
1994	0.904	0.935	0.957	0.979	1.000	1.021	1.040	1.057	1.069	1.084
1995	0.886	0.917	0.938	0.959	0.980	1.000	1.019	1.036	1.047	1.062
1996	0.869	0.900	0.920	0.942	0.962	0.981	1.000	1.017	1.028	1.043
1997	0.855	0.885	0.905	0.926	0.946	0.965	0.984	1.000	1.011	1.026
1998	0.846	0.875	0.895	0.916	0.936	0.955	0.973	0.989	1.000	1.014
1999	0.834	0.863	0.883	0.903	0.922	0.941	0.959	0.975	0.986	1.000
2000	0.816	0.844	0.864	0.884	0.903	0.921	0.939	0.954	0.965	0.979
2001	0.797	0.825	0.844	0.863	0.882	0.900	0.917	0.932	0.942	0.956
2002	0.783	0.811	0.829	0.848	0.866	0.884	0.901	0.916	0.926	0.939
2003	0.767	0.794	0.812	0.831	0.848	0.866	0.882	0.897	0.907	0.920
2004	0.746	0.772	0.789	0.808	0.825	0.842	0.858	0.872	0.882	0.894
2005	0.724	0.749	0.766	0.784	0.801	0.817	0.833	0.846	0.856	0.868
2006	0.700	0.724	0.741	0.758	0.774	0.790	0.805	0.819	0.828	0.840
2007	0.681	0.705	0.721	0.738	0.753	0.769	0.783	0.796	0.805	0.817
2008	0.667	0.690	0.706	0.722	0.737	0.753	0.767	0.780	0.788	0.800
2009	0.658	0.681	0.697	0.713	0.728	0.743	0.757	0.770	0.779	0.790
2010	0.652	0.676	0.692	0.707	0.722	0.737	0.751	0.764	0.773	0.784

Table B.18
Gross National Product Implicit Price Deflator (Continued)

From:	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1970	3.635	3.722	3.787	3.867	3.977	4.097	4.237	4.355	4.449	4.517	4.554
1971	3.462	3.544	3.606	3.683	3.787	3.902	4.035	4.147	4.237	4.302	4.337
1972	3.317	3.397	3.456	3.529	3.630	3.739	3.867	3.975	4.061	4.124	4.157
1973	3.142	3.217	3.273	3.343	3.438	3.542	3.662	3.764	3.846	3.907	3.938
1974	2.882	2.951	3.002	3.066	3.153	3.249	3.359	3.453	3.528	3.582	3.611
1975	2.633	2.696	2.743	2.802	2.881	2.968	3.069	3.155	3.223	3.273	3.299
1976	2.489	2.549	2.593	2.648	2.723	2.806	2.901	2.982	3.047	3.094	3.119
1977	2.340	2.396	2.438	2.490	2.561	2.638	2.728	2.804	2.865	2.909	2.932
1978	2.186	2.239	2.278	2.326	2.392	2.465	2.548	2.620	2.676	2.718	2.740
1979	2.019	2.067	2.103	2.148	2.209	2.276	2.353	2.419	2.472	2.509	2.530
1980	1.851	1.896	1.929	1.970	2.026	2.087	2.158	2.218	2.266	2.300	2.318
1981	1.692	1.733	1.763	1.800	1.852	1.908	1.972	2.027	2.071	2.103	2.120
1982	1.595	1.633	1.662	1.697	1.745	1.798	1.859	1.911	1.952	1.982	1.998
1983	1.534	1.571	1.598	1.632	1.679	1.729	1.788	1.838	1.878	1.906	1.922
1984	1.479	1.514	1.540	1.573	1.618	1.667	1.723	1.772	1.810	1.837	1.852
1985	1.435	1.469	1.495	1.527	1.570	1.617	1.672	1.719	1.756	1.783	1.797
1986	1.404	1.438	1.463	1.494	1.536	1.583	1.636	1.682	1.719	1.745	1.759
1987	1.366	1.399	1.424	1.454	1.495	1.540	1.593	1.637	1.673	1.695	1.709
1988	1.321	1.353	1.377	1.406	1.446	1.490	1.540	1.583	1.617	1.639	1.652
1989	1.273	1.304	1.326	1.355	1.393	1.435	1.484	1.525	1.558	1.579	1.592
1990	1.226	1.255	1.277	1.304	1.341	1.382	1.429	1.468	1.500	1.520	1.533
1991	1.184	1.213	1.234	1.260	1.296	1.335	1.380	1.419	1.450	1.468	1.480
1992	1.158	1.185	1.206	1.232	1.267	1.305	1.349	1.387	1.417	1.434	1.446
1993	1.131	1.159	1.179	1.204	1.238	1.275	1.319	1.356	1.385	1.403	1.415
1994	1.108	1.134	1.154	1.179	1.212	1.249	1.291	1.327	1.356	1.374	1.385
1995	1.086	1.112	1.131	1.155	1.188	1.224	1.265	1.301	1.329	1.346	1.357
1996	1.065	1.091	1.110	1.134	1.166	1.201	1.242	1.276	1.304	1.321	1.332
1997	1.048	1.073	1.092	1.115	1.147	1.181	1.222	1.256	1.283	1.298	1.309
1998	1.037	1.061	1.080	1.103	1.134	1.168	1.208	1.242	1.269	1.284	1.294
1999	1.022	1.046	1.064	1.087	1.118	1.152	1.191	1.224	1.251	1.265	1.275
2000	1.000	1.024	1.042	1.064	1.094	1.127	1.166	1.198	1.224	1.238	1.248
2001	0.977	1.000	1.017	1.039	1.069	1.101	1.138	1.170	1.195	1.211	1.221
2002	0.960	0.983	1.000	1.021	1.050	1.082	1.119	1.150	1.175	1.192	1.201
2003	0.940	0.962	0.979	1.000	1.028	1.059	1.096	1.126	1.150	1.167	1.176
2004	0.914	0.936	0.952	0.972	1.000	1.030	1.065	1.095	1.118	1.134	1.144
2005	0.887	0.908	0.924	0.944	0.970	1.000	1.031	1.060	1.083	1.098	1.107
2006	0.858	0.878	0.894	0.913	0.939	0.969	1.000	1.027	1.049	1.063	1.072
2007	0.835	0.855	0.870	0.888	0.914	0.943	0.974	1.000	1.022	1.033	1.041
2008	0.817	0.837	0.851	0.869	0.894	0.923	0.953	0.979	1.000	1.012	1.019
2009	0.808	0.826	0.839	0.857	0.882	0.911	0.941	0.968	0.988	1.000	1.010
2010	0.801	0.819	0.832	0.850	0.875	0.904	0.933	0.961	0.982	0.991	1.000

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Washington, DC, monthly.

APPENDIX C

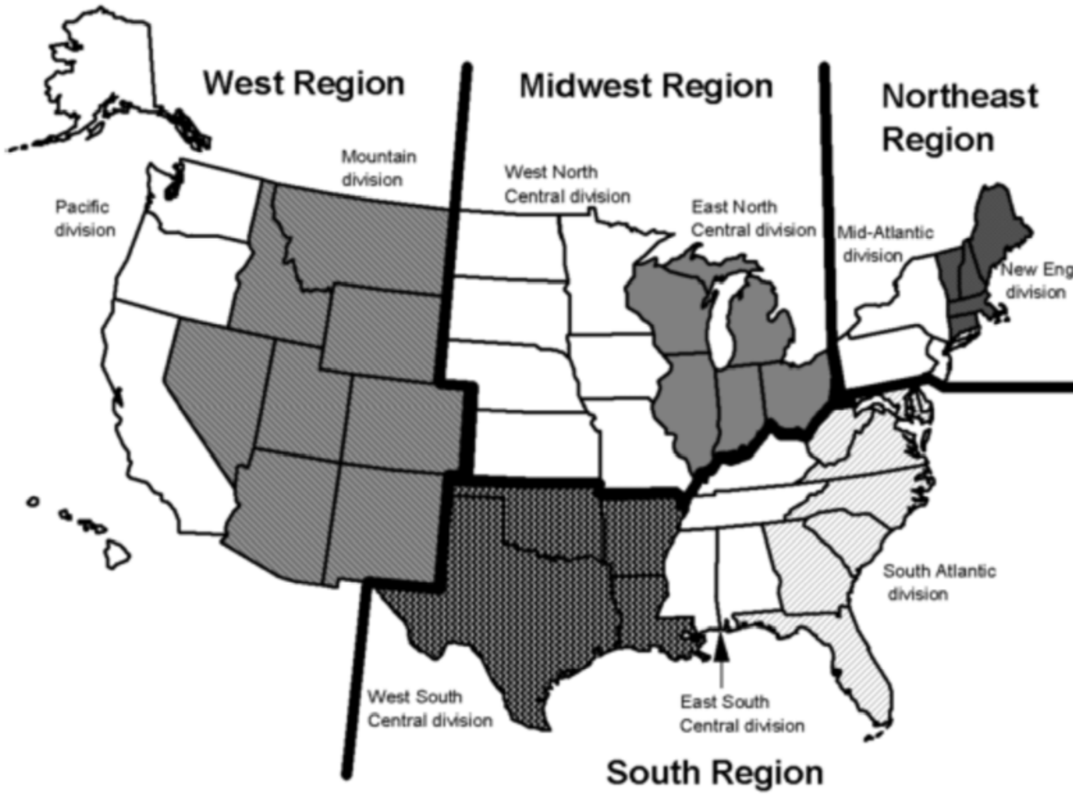
MAPS

Table C.1
Census Regions and Divisions

<table>
<tr><td colspan="4">Northeast Region</td></tr>
<tr><td colspan="2">Mid-Atlantic division</td><td colspan="2">New England division</td></tr>
<tr><td colspan="2">New Jersey
New York
Pennsylvania</td><td colspan="2">Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont</td></tr>
<tr><td colspan="4">South Region</td></tr>
<tr><td>West South Central division</td><td>East South Central division</td><td colspan="2">South Atlantic division</td></tr>
<tr><td>Arkansas
Louisiana
Oklahoma
Texas</td><td>Alabama
Kentucky
Mississippi
Tennessee</td><td colspan="2">Delaware
Florida
Georgia
Maryland
North Carolina
South Carolina
Virginia
Washington, DC
West Virginia</td></tr>
<tr><td colspan="4">West Region</td></tr>
<tr><td colspan="2">Pacific division</td><td colspan="2">Mountain division</td></tr>
<tr><td colspan="2">Alaska
California
Hawaii
Oregon
Washington</td><td colspan="2">Arizona
Colorado
Idaho
Montana
Nevada
New Mexico
Utah
Wyoming</td></tr>
<tr><td colspan="4">Midwest Region</td></tr>
<tr><td colspan="2">West North Central division</td><td colspan="2">East North Central division</td></tr>
<tr><td colspan="2">Iowa
Kansas
Minnesota
Missouri
Nebraska
North Dakota
South Dakota</td><td colspan="2">Illinois
Indiana
Michigan
Ohio
Wisconsin</td></tr>
</table>

Source:
U.S. Census Bureau.

Figure C1. Census Regions and Divisions



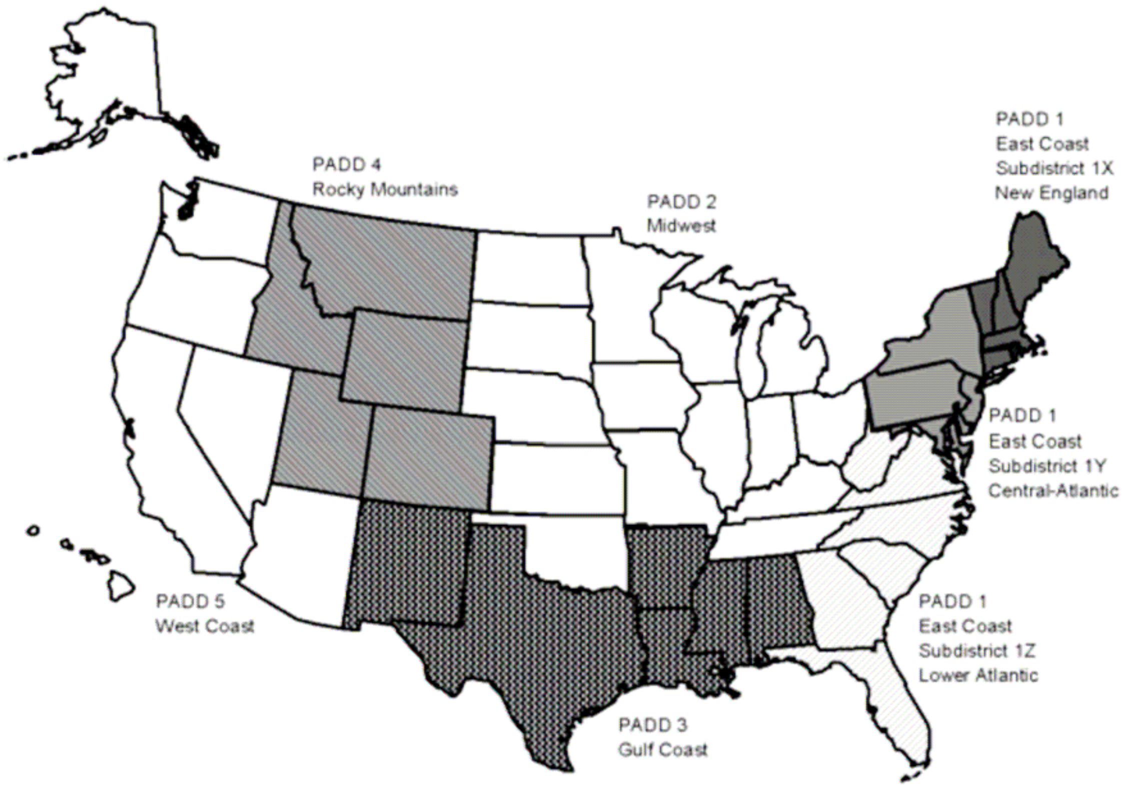
Source:
See Table C.1.

Table C.2
Petroleum Administration for Defense Districts (PADD)

District	Subdistrict	States
PAD District 1 East Coast	Subdistrict 1X New England	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
	Subdistrict 1Y Central Atlantic	Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania
	Subdistrict 1Z Lower Atlantic	Florida, Georgia, North Carolina, South Carolina, Virginia, West Virginia
PAD District 2 Midwest		Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Ohio, Oklahoma, Tennessee, Wisconsin
PAD District 3 Gulf Coast		Alabama, Arkansas, Louisiana, Mississippi, New Mexico, Texas
PAD District 4 Rocky Mountains		Colorado Idaho, Montana, Utah, Wyoming
PAD District 5 West Coast		Alaska, Arizona, California, Hawaii, Nevada, Oregon, Washington

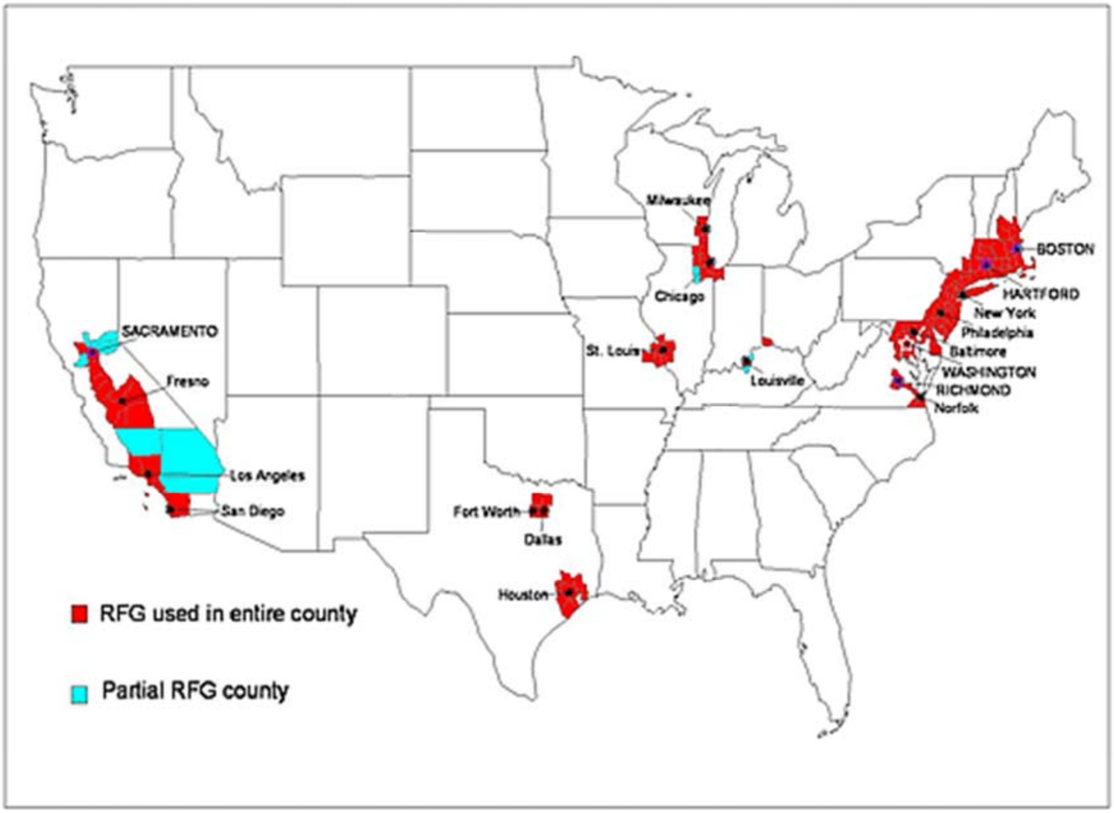
Source:
Energy Information Administration web site: http://tonto.eia.doe.gov/oog/info/twip/padddef.html

Figure C.2. Petroleum Administration for Defense Districts



Source:
See Table C.2.

Figure C.3. Map of Places where Reformulated Gasoline is Sold



Source:
U.S. Environmental Protection Agency, www.epa.gov/otaq/rfg/whereyoulive.htm.

Note: Reformulated gasoline is a motor gasoline specially formulated to achieve significant reductions in vehicle emissions of ozone-forming and toxic air pollutants. The Clean Air Act of 1990 mandates reformulated gasoline use in areas with ozone-air pollution problems.

GLOSSARY

Acceleration power – Measured in kilowatts. Pulse power obtainable from a battery used to accelerate a vehicle. This is based on a constant current pulse for 30 seconds at no less than 2/3 of the maximum open-circuit-voltage, at 80% depth-of-discharge relative to the battery's rated capacity and at 20○ C ambient temperature.

Air Carrier – The commercial system of air transportation consisting of certificated air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

Certificated route air carrier: An air carrier holding a Certificate of Public Convenience and Necessity issued by the Department of Transportation to conduct scheduled interstate services. Nonscheduled or charter operations may also be conducted by these carriers. These carriers operate large aircraft (30 seats or more, or a maximum payload capacity of 7,500 pounds or more) in accordance with Federal Aviation Regulation part 121.

Domestic air operator: Commercial air transportation within and between the 50 States and the District of Columbia. Includes operations of certificated route air carriers, Pan American, local service, helicopter, intra-Alaska, intra-Hawaii, all-cargo carriers and other carriers. Also included are transborder operations conducted on the domestic route segments of U.S. air carriers. Domestic operators are classified based on their operating revenue as follows:

Majors - over $1 billion
Nationals - $100-1,000 million
Large Regionals - $10-99.9 million
Medium Regionals - $0-9.99 million

International air operator: Commercial air transportation outside the territory of the United States, including operations between the U.S. and foreign countries and between the U.S. and its territories and possessions.

Supplemental air carrier: A class of air carriers which hold certificates authorizing them to perform passenger and cargo charter services supplementing the scheduled service of the certificated route air carriers. Supplemental air carriers are often referred to as nonscheduled air carriers or "nonskeds."

Alcohol – The family name of a group of organic chemical compounds composed of carbon, hydrogen, and oxygen. The molecules in the series vary in chain length and are composed of a hydrocarbon plus a hydroxyl group. Alcohol includes methanol and ethanol.

Alternative fuel – For transportation applications, includes the following: methanol; denatured ethanol, and other alcohols; fuel mixtures containing 85 percent or more by volume of m ethanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas (propane); hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials (biofuels such as soy diesel fuel); and electricity (including electricity from solar energy). The term "alternative fuel" does not include alcohol or other blended portions of primarily petroleum-based fuels used as oxygenates or extenders, i.e. MTBE, ETBE, other ethers, and the 10-percent ethanol portion of gasohol.

Amtrak – See Rail.

Anthropogenic – Human made. Usually used in the context of emissions that are produced as the result of human activities.

Automobile size classifications – Size classifications of automobiles are established by the Environmental Protection Agency (EPA) as follows:

Minicompact – less than 85 cubic feet of passenger and luggage volume.
Subcompact – between 85 to 100 cubic feet of passenger and luggage volume.
Compact – between 100 to 110 cubic feet of passenger and luggage volume.
Midsize – between 110 to 120 cubic feet of passenger and luggage volume.
Large – more than 120 cubic feet of passenger and luggage volume.
Two seater – automobiles designed primarily to seat only two adults.
Station wagons are included with the size class for the sedan of the same name.

Aviation – See *General aviation*.

Aviation gasoline – All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) Specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range which will be used for blending or compounding into aviation gasoline.

Barges – Shallow, nonself-propelled vessels used to carry bulk commodities on the rivers and the Great Lakes.

Battery efficiency – Measured in percentage. Net DC energy delivered on discharge, as a percentage of the total DC energy required to restore the initial state-of-charge. The efficiency value must include energy losses resulting from self-discharge, cell equalization, thermal loss compensation, and all battery-specific auxiliary equipment.

Btu – British thermal unit. The amount of energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit at or near 39.2 degrees Fahrenheit. An average Btu content of fuel is the heat value per quantity of fuel as determined from tests of fuel samples.

Bunker – A storage tank.

Bunkering fuels – Fuels stored in ship bunkers.

Bus –A mode of transit service characterized by roadway vehicles powered by diesel, gasoline, battery, or alternative fuel engines contained within the vehicle.

Intercity bus: A standard size bus equipped with front doors only, high backed seats, luggage compartments separate from the passenger compartment and usually with restroom facilities, for high-speed long distance service.

Motor bus: Rubber-tired, self-propelled, manually-steered bus with fuel supply on board the vehicle. Motor bus types include intercity, school, and transit.

School and other nonrevenue bus: Bus services for which passengers are not directly charged for transportation, either on a per passenger or per vehicle basis.

Transit bus: A bus designed for frequent stop service with front and center doors, normally with a rear-mounted diesel engine, low-back seating, and without luggage storage compartments or restroom facilities.

Trolley coach: Rubber-tired electric transit vehicle, manually-steered, propelled by a motor drawing current, normally through overhead wires, from a central power source not on board the vehicle.

Calendar year – The period of time between January 1 and December 31 of any given year.

Captive imports – Products produced overseas specifically for domestic manufacturers.

Carbon dioxide (CO_2) – A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion.

Carbon monoxide (CO) – A colorless, odorless, highly toxic gas that is a by-product of incomplete fossil fuel combustion. Carbon monoxide, one of the major air pollutants, can be harmful in small amounts if breathed over a certain period of time.

Car-mile (railroad) – A single railroad car moved a distance of one mile.

Cargo ton-mile – See *Ton-mile*.

Certificated route air carriers – See *Air carriers*.

Class I freight railroad – See *Rail*.

Coal slurry – Finely crushed coal mixed with sufficient water to form a fluid.

Combination trucks – Consist of a power unit (a truck tractor) and one or more trailing units (a semi-trailer or trailer). The most frequently used combination is popularly referred to as a "tractor-semitrailer" or "tractor trailer".

Commercial sector – An energy-consuming sector that consists of service-providing facilities of: businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social or fraternal groups. Includes institutional living quarters.

Commuter rail – A mode of transit service (also called metropolitan rail, regional rail, or suburban rail) characterized by an electric or diesel propelled railway for urban passenger train service consisting of local short distance travel operating between a central city and adjacent suburbs.

Compact car – See *Automobile size classifications*.

Compression ignition – The form of ignition that initiates combustion in a diesel engine. The rapid compression of air within the cylinders generates the heat required to ignite the fuel as it is injected.

Constant dollars – A time series of monetary figures is expressed in constant dollars when the effect of change over time in the purchasing power of the dollar has been removed. Usually the data are expressed in terms of dollars of a selected year or the average of a set of years.

Consumer Price Index (CPI) – A measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services.

Continuous discharge capacity – Measured as percent of rated energy capacity. Energy delivered in a constant power discharge required by an electric vehicle for hill climbing and/or high-speed cruise, specified as the percent of its rated energy capacity delivered in a one hour constant-power discharge.

Conventional Refueling Station – An establishment for refueling motor vehicles with traditional transportation fuels, such as gasoline and diesel fuel.

Corporate Average Fuel Economy (CAFE) Standards – CAFE standards were originally established by Congress for new automobiles, and later for light trucks, in Title V of the Motor Vehicle Information and Cost Savings Act (15 U.S.C.1901, et seq.) with subsequent amendments. Under CAFE, automobile manufacturers are required by law to produce vehicle fleets with a composite sales-weighted fuel economy which cannot be lower than the CAFE standards in a given year, or for every vehicle which does not meet the standard, a fine of $5.00 is paid for every one-tenth of a mpg below the standard.

Criteria pollutant – A pollutant determined to be hazardous to human health and regulated under EPA's National Ambient Air Quality Standards. The 1970 amendments to the Clean Air Act require EPA to describe the health and welfare impacts of a pollutant as the "criteria" for inclusion in the regulatory regime.

Crude oil – A mixture of hydrocarbons that exists in the liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Crude oil production is measured at the wellhead and includes lease condensate.

Crude oil imports – The volume of crude oil imported into the 50 States and the District of Columbia, including imports from U.S. territories, but excluding imports of crude oil into the Hawaiian Foreign Trade Zone.

Curb weight – The weight of a vehicle including all standard equipment, spare tire and wheel, all fluids and lubricants to capacity, full tank of fuel, and the weight of major optional accessories normally found on the vehicle.

Current dollars – Represents dollars current at the time designated or at the time of the transaction. In most contexts, the same meaning would be conveyed by the use of the term "dollars." See also constant dollars.

Demand Response – A transit mode that includes passenger cars, vans, and small buses operating in response to calls from passengers to the transit operator who dispatches the vehicles. The vehicles do not operate over a fixed route on a fixed schedule. Can also be known as paratransit or dial-a-ride.

Diesel fuel – See *Distillate fuel oil*.

Disposable personal income – See *Income*.

Distillate fuel oil – The lighter fuel oils distilled off during the refining process. Included are products known as ASTM grades numbers 1 and 2 heating oils, diesel fuels, and number 4 fuel oil. The major uses of distillate fuel oils include heating, fuel for on-and off-highway diesel engines, and railroad diesel fuel.

Domestic air operator – See *Air carrier*.

Domestic water transportation – See *Internal water transportation*.

E85 – 85% ethanol and 15% gasoline.

E95 – 95% ethanol and 5% gasoline.

Electric utilities sector – Consists of privately and publicly owned establishments which generate electricity primarily for resale.

Emission standards – Limits or ranges established for pollution levels emitted by vehicles as well as stationary sources. The first standards were established under the 1963 Clean Air Act.

End-use sector – See *Sector*.

Energy capacity – Measured in kilowatt hours. The energy delivered by the battery, when tested at C/3 discharge rate, up to termination of discharge specified by the battery manufacturer. The required acceleration power must be delivered by the battery at any point up to 80% of the battery's energy capacity rating.

Energy efficiency – In reference to transportation, the inverse of energy intensiveness: the ratio of outputs from a process to the energy inputs; for example, miles traveled per gallon of fuel (mpg).

Energy intensity – In reference to transportation, the ratio of energy inputs to a process to the useful outputs from that process; for example, gallons of fuel per passenger-mile or Btu per ton-mile.

Ethanol (C_2H_5OH) – Otherwise known as ethyl alcohol, alcohol, or grain-spirit. A clear, colorless, flammable oxygenated hydrocarbon with a boiling point of 78.5 degrees Celsius in the anhydrous state. In transportation, ethanol is used as a vehicle fuel by itself (E100 – 100% ethanol by volume), blended with gasoline (E85 – 85% ethanol by volume), or as a gasoline octane enhancer and oxygenate (10% by volume).

Excise tax – Paid when purchases are made on a specific good, such as gasoline. Excise taxes are often included in the price of the product. There are also excise taxes on activities, such as highway usage by trucks.

Ferry boat – A transit mode comprising vessels carrying passengers and in some cases vehicles over a body of water, and that are generally steam or diesel-powered.

Fixed operating cost – See *Operating cost*.

Fleet vehicles –

Private fleet vehicles: Ideally, a vehicle could be classified as a member of a fleet if it is:

a) operated in mass by a corporation or institution,
b) operated under unified control, or
c) used for non-personal activities.

However, the definition of a fleet is not consistent throughout the fleet industry. Some companies make a distinction between cars that were bought in bulk rather than singularly, or whether they are operated in bulk, as well as the minimum number of vehicles that constitute a fleet (i.e. 4 or 10).

Government fleet vehicles: Includes vehicles owned by all Federal, state, county, city, and metro units of government, including toll road operations.

Foreign freight – Movements between the United States and foreign countries and between Puerto Rico, the Virgin Islands, and foreign countries. Trade between U.S. territories and possessions (e.g. Guam, Wake, American Samoa) and foreign countries is excluded. Traffic to or from the Panama Canal Zone is included.

Gas Guzzler Tax – Originates from the 1978 Energy Tax Act (Public Law 95-618). A new car purchaser is required to pay the tax if the car purchased has a combined city/highway fuel economy rating that is below the standard for that year. For model years 1986 and later, the standard is 22.5 mpg.

Gasohol – A mixture of 10% anhydrous ethanol and 90% gasoline by volume; 7.5% anhydrous ethanol and 92.5% gasoline by volume; or 5.5% anhydrous ethanol and 94.5% gasoline by volume. There are other fuels that contain methanol and gasoline, but these fuels are not referred to as gasohol.

Gasoline – See *Motor gasoline*.

General aviation – That portion of civil aviation which encompasses all facets of aviation except air carriers. It includes any air taxis, commuter air carriers, and air travel clubs which do not hold Certificates of Public Convenience and Necessity.

Global warming potential (GWP) – An index used to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emission of one kilogram of a greenhouse gas to that from the emission of one kilogram of carbon dioxide over a fixed period of time, such as 100 years.

Greenhouse gases – Those gases, such as water vapor, carbon dioxide, nitrous oxide, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride, that are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, thus preventing long-wave radiant energy from leaving Earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.

Gross National Product – A measure of monetary value of the goods and services becoming available to the nation from economic activity. Total value at market prices of all goods and services produced by the nation's economy. Calculated quarterly by the Department of Commerce, the Gross National Product is the broadest available measure of the level of economic activity.

Gross vehicle weight (gvw) – The weight of the empty truck plus the maximum anticipated load weight.

Gross vehicle weight rating (gvwr) – The gross vehicle weight which is assigned to each new truck by the manufacturer. This rating may be different for trucks of the same model because of certain features, such as heavy-duty suspension. Passenger cars do not have gross vehicle weight ratings.

Heavy-heavy truck – See *Truck size classifications*.

Heavy rail – A mode of transit service (also called metro, subway, rapid transit, or rapid rail) operating on an electric railway with the capacity for a heavy volume of traffic. Characterized by high speed and rapid acceleration of passenger rail cars.

Household – Consists of all persons who occupy a housing unit, including the related family members and all unrelated persons, if any, who share the housing unit.

Housing unit – A house, apartment, a group of rooms, or a single room occupied or intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants do not live and eat with any other persons in the structure and which have either (1) direct access from the outside of the building or through a common hallway intended to be used by the occupants of another unit or by the general public, or (2) complete kitchen facilities for the exclusive use of the occupants. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements.

Hybrid-electric vehicles – Combines the benefits of gasoline engines and electric motors and can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools.

Hydrocarbon (HC) – A compound that contains only hydrogen and carbon. The simplest and lightest forms of hydrocarbon are gaseous. With greater molecular weights they are liquid, while the heaviest are solids.

Income –

Disposable personal income: Personal income less personal tax and non-tax payments.

National income: The aggregate earnings of labor and property which arise in the current production of goods and services by the nation's economy.

Personal income: The current income received by persons from all sources, net of contributions for social insurance.

Industrial sector – Construction, manufacturing, agricultural and mining establishments.

Inertia weight – The curb weight of a vehicle plus 300 pounds.

Intercity bus – See *Bus*.

Intermodal – Transportation activities involving more than one mode of transportation, including transportation connections and coordination of various modes.

Internal water transportation – Includes all local (intraport) traffic and traffic between ports or landings wherein the entire movement takes place on inland waterways. Also termed internal are movements involving carriage on both inland waterways and the water of the Great Lakes, and inland movements that cross short stretches of open water that link inland systems.

International air operator – See *Air carrier*.

International freight – See *Foreign freight*.

Jet fuel – Includes both naphtha-type and kerosene-type fuels meeting standards for use in aircraft turbine engines. Although most jet fuel is used in aircraft, some is used for other purposes such as generating electricity in gas turbines.

Kerosene-type jet fuel: A quality kerosene product with an average gravity of 40.7 degrees API and 10% to 90% distillation temperatures of 217 to 261 degrees centigrade. Used primarily as fuel for commercial turbojet and turboprop aircraft engines. It is a relatively low freezing point distillate of the kerosene type.

Naphtha-type jet fuel: A fuel in the heavy naphtha boiling range with an average gravity of 52.8 degrees API and 10% to 90% distillation temperatures of 117 to 233 degrees centigrade used for turbojet and turboprop aircraft engines, primarily by the military. Excludes ramjet and petroleum.

Kerosene – A petroleum distillate in the 300 to 500 degrees Fahrenheit boiling range and generally having a flash point higher than 100 degrees Fahrenheit by the American Society of Testing and Material (ASTM) Method D56, a gravity range from 40 to 46 degrees API, and a burning point in the range of 150 to 175 degrees Fahrenheit. It is a clean-burning product suitable for use as an illuminant when burned in wick lamps. Includes grades of kerosene called range oil having properties similar to Number 1 fuel oil, but with a gravity of about 43 degrees API and an end point of 625 degrees Fahrenheit. Used in space heaters, cooking stoves, and water heaters.

Kerosene-type jet fuel – See Jet fuel.

Large car – See *Automobile size classifications*.

Lease Condensate – A liquid recovered from natural gas at the well or at small gas/oil separators in the field. Consists primarily of pentanes and heavier hydrocarbons (also called field condensate).

Light duty vehicles – Automobiles and light trucks combined.

Light truck – Unless otherwise noted, light trucks are defined in this publication as two-axle, four-tire trucks. The U.S. Bureau of Census classifies all trucks with a gross vehicle weight less than 10,000 pounds as light trucks (See Truck size classifications).

Light-heavy truck – See *Truck size classifications*.

Light rail – Mode of transit service (also called streetcar, tramway or trolley) operating passenger rail cars singly (or in short, usually two-car or three-car trains) on fixed rails in right-of-way that is often separated from other traffic for part or much of the way.

Liquified petroleum gas (lpg) – Consists of propane and butane and is usually derived from natural gas. In locations where there is no natural gas and the gasoline consumption is low, naphtha is converted to lpg by catalytic reforming.

Load factor – Total passenger miles divided by total vehicle miles.

Low emission vehicle – Any vehicle certified to the low emission standards which are set by the Federal government and/or the state of California.

M85 – 85% methanol and 15% gasoline.

M100 – 100% methanol.

Medium truck – See *Truck size classifications*.

Methanol (CH_3OH) – A colorless highly toxic liquid with essentially no odor and very little taste. It is the simplest alcohol and boils at 64.7 degrees Celsius. In transportation, methanol is used as a vehicle fuel by itself (M100), or blended with gasoline (M85).

Midsize car – See *Automobile size classifications*.

Minicompact car – See *Automobile size classifications*.

Model year – In this publication, model year is referring to the "sales" model year, the period from October 1 to the next September 31.

Motor bus – See *Bus*.

Motor gasoline – A mixture of volatile hydrocarbons suitable for operation of an internal combustion engine whose major components are hydrocarbons with boiling points ranging from 78 to 217 degrees centigrade and whose source is distillation of petroleum and cracking, polymerization, and other chemical reactions by which the naturally occurring petroleum hydrocarbons are converted into those that have superior fuel properties.

Regular gasoline: Gasoline having an antiknock index, i.e., octane rating, greater than or equal to 85 and less than 88. Note: Octane requirements may vary by altitude.

Midgrade gasoline: Gasoline having an antiknock index, i.e., octane rating, greater than or equal to 88 and less than or equal to 90. Note: Octane requirements may vary by altitude.

Premium gasoline: Gasoline having an antiknock index, i.e., octane rating, greater than 90. Note: Octane requirements may vary by altitude.

Reformulated gasoline: Finished motor gasoline formulated for use in motor vehicles, the composition and properties of which meet the requirements of the reformulated gasoline regulations promulgated by the U.S. Environmental Protection Agency under Section 211(k) of the Clean Air Act. For details on this clean fuel program see http://www.epa.gov/otaq/rfg.htm. Note: This category includes oxygenated fuels program reformulated gasoline (OPRG) but excludes reformulated gasoline blendstock for oxygenate blending (RBOB).

MTBE – Methyl Tertiary Butyl Ether–a colorless, flammable, liquid oxygenated hydrocarbon containing 18.15 percent oxygen.

Naphtha-type jet fuel – See *Jet fuel*.

National income – See *Income*.

Nationwide Personal Transportation Survey (NPTS) – A nationwide survey of households that provides information on the characteristics and personal travel patterns of the U.S. population. Surveys were conducted in 1969, 1977, 1983, 1990, and 1995 by the U.S. Bureau of Census for the U.S. Department of Transportation.

Natural gas – A mixture of hydrocarbon compounds and small quantities of various non-hydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions.

Natural gas, dry: Natural gas which remains after: 1) the liquefiable hydrocarbon portion has been removed from the gas stream; and 2) any volumes of nonhydrocarbon gases have been removed where they occur in sufficient quantity to render the gas unmarketable. Dry natural gas is also known as consumer-grade natural gas. The parameters for measurement are cubic feet at 60 degrees Fahrenheit and 14.73 pounds per square inch absolute.

Natural gas, wet: The volume of natural gas remaining after removal of lease condensate in lease and/or field separation facilities, if any, and after exclusion of nonhydrocarbon gases where they

occur in sufficient quantity to render the gas unmarketable. Natural gas liquids may be recovered from volumes of natural gas, wet after lease separation, at natural gas processing plants.

Natural gas plant liquids: Natural gas liquids recovered from natural gas in processing plants and from natural gas field facilities and fractionators. Products obtained include ethane, propane, normal butane, isobutane, pentanes plus, and other products from natural gas processing plants.

Nitrogen oxides (NO_x) – A product of combustion of fossil fuels whose production increases with the temperature of the process. It can become an air pollutant if concentrations are excessive.

Nonattainment area – Any area that does not meet the national primary or secondary ambient air quality standard established by the Environmental Protection Agency for designated pollutants, such as carbon monoxide and ozone.

Oil Stocks – Oil stocks include crude oil (including strategic reserves), unfinished oils, natural gas plant liquids, and refined petroleum products.

Operating cost –

Fixed operating cost: In reference to passenger car operating cost, refers to those expenditures that are independent of the amount of use of the car, such as insurance costs, fees for license and registration, depreciation and finance charges.

Variable operating cost: In reference to passenger car operating cost, expenditures which are dependent on the amount of use of the car, such as the cost of gas and oil, tires, and other maintenance.

Organization for Economic Cooperation and Development (OECD) – Consists of Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States. Total OECD includes the United States Territories (Guam, Puerto Rico, and the U.S. Virgin Islands). Total OECD excludes data for Czech Republic, Hungary, Mexico, Poland, and South Korea which are not yet available.

OECD Europe: Consists of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, and United Kingdom. OECD Europe excludes data for Czech Republic, Hungary, and Poland which are not yet available.

OECD Pacific: Consists of Australia, Japan, and New Zealand.

Organization for Petroleum Exporting Countries (OPEC) – Includes Saudi Arabia, Iran, Venezuela, Libya, Indonesia, United Arab Emirates, Algeria, Nigeria, Ecuador, Gabon, Iraq, Kuwait, and Qatar. Data for Saudi Arabia and Kuwait include their shares from the Partitioned Zone (formerly the Neutral Zone). Angola joined OPEC in December 2006, thus, beginning in 2007, data on OPEC will include Angola.

Arab OPEC – Consists of Algeria, Iraq, Kuwait, Libya, Qatar, Saudi Arabia and the United Arab Emirates.

Other single-unit truck – See *Single-unit truck*.

Oxygenate – A substance which, when added to gasoline, increases the amount of oxygen in that gasoline blend. Includes fuel ethanol, methanol, and methyl tertiary butyl ether (MTBE).

Paratransit – Mode of transit service (also called demand response or dial-a-ride) characterized by the use of passenger automobiles, vans or small buses operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations.

Particulates – Carbon particles formed by partial oxidation and reduction of the hydrocarbon fuel. Also included are trace quantities of metal oxides and nitrides, originating from engine wear, component degradation, and inorganic fuel additives. In the transportation sector, particulates are emitted mainly from diesel engines.

Passenger-miles traveled (PMT) – One person traveling the distance of one mile. Total passenger-miles traveled, thus, give the total mileage traveled by all persons.

Passenger rail – See *Rail*, "*Amtrak*" and "*Transit Railroad*".

Persian Gulf countries – Consists of Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Emirates.

Personal Consumption Expenditures (PCE) – As used in the national accounts, the market value of purchases of goods and services by individuals and nonprofit institutions and the value of food, clothing, housing, and financial services received by them as income in kind. It includes the rental value of owner-occupied houses but excludes purchases of dwellings, which are classified as capital goods (investment).

Personal income – See *Income*.

Petroleum – A generic term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oil, refined petroleum products, natural gas plant liquids, and non-hydrocarbon compounds blended into finished petroleum products.

Petroleum consumption: A calculated demand for petroleum products obtained by summing domestic production, imports of crude petroleum and natural gas liquids, imports of petroleum products, and the primary stocks at the beginning of the period and then subtracting the exports and the primary stocks at the end of the period.

Petroleum exports: Shipments of petroleum products from the 50 States and the District of Columbia to foreign countries, Puerto Rico, the Virgin Islands, and other U.S. possessions and territories.

Petroleum imports: All imports of crude petroleum, natural gas liquids, and petroleum products from foreign countries and receipts from Guam, Puerto Rico, the Virgin Islands, and the Hawaiian Trade Zone. The commodities included are crude oil, unfinished oils, plant condensate, and refined petroleum products.

Petroleum inventories: The amounts of crude oil, unfinished oil, petroleum products, and natural gas liquids held at refineries, at natural gas processing plants, in pipelines, at bulk terminals operated by refining and pipeline companies, and at independent bulk terminals. Crude oil held in storage on leases is also included; these stocks are known as primary stocks. Secondary stocks–those held by jobbers dealers, service station operators, and consumers–are

excluded. Prior to 1975, stock held at independent bulk terminals were classified as secondary stocks.

Petroleum products supplied: For each petroleum product, the amount supplied is calculated by summing production, crude oil burned directly, imports, and net withdrawals from primary stocks and subtracting exports.

Plug-in hybrid-electric vehicles (PHEVs) — Hybrid-electric vehicles with high capacity batteries that can be charged by plugging them into an electrical outlet or charging station. There are two basic PHEV configurations:

Parallel or Blended PHEV: Both the engine and electric motor are mechanically connected to the wheels, and both propel the vehicle under most driving conditions. Electric-only operation usually occurs only at low speeds.

Series PHEVs, also called Extended Range Electric Vehicles (EREVs): Only the electric motor turns the wheels; the gasoline engine is only used to generate electricity. Series PHEVs can run solely on electricity until the battery needs to be recharged. The gasoline engine will then generate the electricity needed to power the electric motor. For shorter trips, these vehicles might use no gasoline at all.

Processing Gain – The amount by which the total volume of refinery output is greater than the volume of input for given period of time. The processing gain arises when crude oil and other hydrocarbons are processed into products that are, on average, less dense than the input.

Processing Loss – The amount by which the total volume of refinery output is less than the volume of input for given period of time. The processing loss arises when crude oil and other hydrocarbons are processed into products that are, on average, more dense than the input.

Proved Reserves of Crude Oil – The estimated quantities of all liquids defined as crude oil, which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

Quad – Quadrillion, 10^{15}. In this publication, a Quad refers to Quadrillion Btu.

Rail –

Amtrak (American Railroad Tracks): Operated by the National Railroad Passenger Corporation of Washington, DC. This rail system was created by President Nixon in 1970, and was given the responsibility for the operation of intercity, as distinct from suburban, passenger trains between points designated by the Secretary of Transportation.

Class I freight railroad: Defined by the Interstate Commerce Commission each year based on annual operating revenue. A railroad is dropped from the Class I list if it fails to meet the annual earnings threshold for three consecutive years.

Commuter railroad: Those portions of mainline railroad (not electric railway) transportation operations which encompass urban passenger train service for local travel between a central city and adjacent suburbs. Commuter railroad service–using both locomotive-hauled and self-propelled railroad passenger cars–is characterized by multi-trip tickets, specific station-to-station fares, and usually only one or two stations in the central business district. Also known as suburban railroad.

Transit railroad: Includes "heavy" and "light" transit rail. **Heavy transit rail** is characterized by exclusive rights-of-way, multi-car trains, high speed rapid acceleration, sophisticated signaling, and high platform loading. Also known as subway, elevated railway, or metropolitan railway (metro). **Light transit rail** may be on exclusive or shared rights-of-way, high or low platform loading, multi-car trains or single cars, automated or manually operated. In generic usage, light rail includes streetcars, trolley cars, and tramways.

Refiner sales price – Sales from the refinery made directly to ultimate consumers, including bulk consumers (such as agriculture, industry, and electric utilities) and residential and commercial consumers.

Reformulated gasoline (RFG) – See *Motor gasoline*.

RFG area – An ozone nonattainment area designated by the Environmental Protection Agency which requires the use of reformulated gasoline.

Residential sector – An energy consuming sector that consists of living quarters for private households. Excludes institutional living quarters.

Residential Transportation Energy Consumption Survey (RTECS) – This survey was designed by the Energy Information Administration of the Department of Energy to provide information on how energy is used by households for personal vehicles. It has been conducted five times since 1979, the most recent being 1991.

Residual fuel oil – The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations. Included are products know as ASTM grade numbers 5 and 6 oil, heavy diesel oil, Navy Special Fuel Oil, Bunker C oil, and acid sludge and pitch used as refinery fuels. Residual fuel oil is used for the production of electric power, for heating, and for various industrial purposes.

Rural – Usually refers to areas with population less than 5,000.

Sales period – October 1 of the previous year to September 30 of the given year. Approximately the same as a model year.

Sales-weighted miles per gallon (mpg) – Calculation of a composite vehicle fuel economy based on the distribution of vehicle sales.

Scrappage rate – As applied to motor vehicles, it is usually expressed as the percentage of vehicles of a certain type in a given age class that are retired from use (lacking registration) in a given year.

School and other nonrevenue bus – See *Bus*.

Sector – A group of major energy-consuming components of U.S. society developed to measure and analyze energy use. The sectors most commonly referred to are: residential, commercial, industrial, transportation, and electric power.

Single-unit truck – Includes two-axle, four-tire trucks and other single-unit trucks.

Two-axle, four-tire truck: A motor vehicle consisting primarily of a single motorized device with two axles and four tires.

Other single-unit truck: A motor vehicle consisting primarily of a single motorized device with more than two axles or more than four tires.

Spark ignition engine – An internal combustion engine in which the charge is ignited electrically (e.g., with a spark plug).

Special fuels – Consist primarily of diesel fuel with small amount of liquified petroleum gas, as defined by the Federal Highway Administration.

Specific acceleration power – Measured in watts per kilogram. Acceleration power divided by the battery system weight. Weight must include the total battery system.

Specific energy – Measured in watt hours per kilogram. The rated energy capacity of the battery divided by the total battery system weight.

Subcompact car – See *Automobile size classifications*.

Supplemental air carrier – See *Air carrier*.

Survival rate – As applied to motor vehicles, it is usually expressed as the percentage of vehicles of a certain type in a given age class that will be in use at the end of a given year.

Tax incentives – In general, a means of employing the tax code to stimulate investment in or development of a socially desirable economic objective without direct expenditure from the budget of a given unit of government. Such incentives can take the form of tax exemptions or credits.

Test weight – The weight setting at which a vehicle is tested on a dynomometer by the U.S. Environmental Protection Agency (EPA). This weight is determined by the EPA using the inertia weight of the vehicle.

Ton-mile – The movement of one ton of freight the distance of one mile. Ton-miles are computed by multiplying the weight in tons of each shipment transported by the distance hauled.

Transmission types –

A3 – Automatic three speed
A4 – Automatic four speed
A5 – Automatic five speed
L4 – Automatic lockup four speed
M5 – Manual five speed

Transit bus – See *Bus*.

Transit railroad – See *Rail*.

Transportation sector – Consists of both private and public passenger and freight transportation, as well as government transportation, including military operations.

Truck Inventory and Use Survey (TIUS) – Survey designed to collect data on the characteristics and operational use of the nation's truck population. It is conducted every five years by the U.S. Bureau of the Census. Surveys were conducted in 1963, 1967, 1972, 1977, 1982, 1987, and 1992. For the 1997 survey, it was renamed the Vehicle Inventory and Use Survey in anticipation

of including additional vehicle types. However, no additional vehicle types were added to the 1997 survey.

Trolleybus – Mode of transit service (also called transit coach) using vehicles propelled by a motor drawing current from overhead wires via connecting poles called a trolley pole, from a central power source not onboard the vehicle.

Truck size classifications – U.S. Bureau of the Census has categorized trucks by gross vehicle weight (gvw) as follows:

Light – Less than 10,000 pounds gvw (Also see Light Truck.)
Medium – 10,001 to 20,000 pounds gvw
Light-heavy – 20,001 to 26,000 pounds gvw
Heavy-heavy – 26,001 pounds gvw or more.

Two-axle, four-tire truck – See *Single-unit truck*.

Two seater car – See *Automobile size classifications*.

Ultra-low emission vehicle – Any vehicle certified to the ultra-low emission standards which are set by the Federal government and/or the state of California.

Urban – Usually refers to areas with population of 5,000 or greater.

Vanpool: A ridesharing prearrangement using vans or small buses providing round-trip transportation between the participants's prearranged boarding points and a common and regular destination.

Variable operating cost – See *Operating cost*.

Vehicle Inventory and Use Survey – See *Truck Inventory and Use Survey*.

Vehicle-miles traveled (vmt) – One vehicle traveling the distance of one mile. Total vehicle miles, thus, is the total mileage traveled by all vehicles.

Volatile organic compounds (VOCs) – Organic compounds that participate in atmospheric photochemical reactions.

Waterborne Commerce –

Coastwise: Domestic traffic receiving a carriage over the ocean, or the Gulf of Mexico. Traffic between Great Lakes ports and seacoast ports, when having a carriage over the ocean, is also termed Coastwise.

Domestic: Includes coastwise, lakewise, and internal waterborne movements.

Foreign: Waterborne import, export, and in-transit traffic between the United States, Puerto Rico and the Virgin Islands and any foreign country.

Internal: Vessel movements (origin and destination) which take place solely on inland waterways. An inland waterway is one geographically located within the boundaries of the contiguous 48 states or within the boundaries of the State of Alaska.

Lakewise: Waterborne traffic between the United States ports on the Great Lakes System. The Great Lakes System is treated as a separate waterway system rather than as a part of the inland waterway system. In comparing historical data for the Great Lakes System, one should note that prior to calendar year 1990, marine products, sand and gravel being moved from the Great Lakes to Great Lake destinations were classified as local traffic. From 1990-on, these activities are classified as lakewise traffic.

Well-to-wheel – A life cycle analysis used in transportation to consider the entire energy cycle for a given mode, rather than just tailpipe emissions. The analysis starts at the oil well and ends with the turning wheels of the vehicle.

Zero-emission vehicle – Any vehicle certified to the zero emission standards which are set by the Federal government and/or the state of California. These standards apply to the vehicle emissions only.

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