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Center for Transportation Analysis
Engineering Science & Technology Division

TRANSPORTATION ENERGY DATA BOOK: EDITION 23

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

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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:	www-cta.ornl.gov

Philip D. Patterson
Office of Planning, Budget Formulation and Analysis
Energy Efficiency and Renewable Energy
Department of Energy, EE-30
Forrestal Building, Room 5F-034
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Telephone:	(202) 586-9121
FAX:	(202) 586-9811
E-mail:	PHILIP.PATTERSON@hq.doe.gov
Web Site Location:	www.eere.energy.gov

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

FOREWORD

Welcome to this 23rd edition of the Transportation Energy Data Book. I would like to bring to your attention some of the data that is new or of particular interest:

1. The Transportation Oil Gap shows that transportation oil use has exceeded U.S. oil production since 1987 and this gap is projected to continue to grow (Figure 1.7)
2. Between 1991 and 2001, heavy truck energy use grew at a faster rate than for any other mode (Tables 2.6 and 2.7)
3. Vehicles per thousand people varies greatly by region of the world (Figure 3.1)
4. The median lifetime of automobiles in the U.S. rose from 11.5 years for model year 1970 vehicles to 16.9 years for model year 1990 vehicles (Table 3.9)
5. The percent of automobiles that are imports or transplants reached 50% for the first time in 2001 (Table 4.5)
6. SUVs accounted for 6.8% of all light vehicle sales in 1990 and 24.6% in 2002 (Table 4.9)
7. The number of new light vehicle dealerships declined at an annual rate of 1.1% over the 1979-2000 period, but the vehicles sold per dealership grew at an annual rate of 3% (Table 4.16)
8. CAFE fines collected were $34 million in 2001, while tax receipts from the sale of gas guzzlers were $78 million (Tables 4.20 and 4.22)
9. Data for hydrogen has been added that show production methods, production totals, consumption, storage systems, and fuel cell types (Tables 6.6 through 6.12)

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

Philip D. Patterson

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 and the Energy Efficiency and Renewable Energy staff for their continued support of the Transportation Energy Data Book project. We would also like to thank Patricia Hu of Oak Ridge National Laboratory (ORNL) for her guidance and mentoring. This document benefits from the criticism and careful review of Phil Patterson, DOE; Elyse Steiner, National Renewable Energy Laboratory; James Moore, TA-Engineering, Inc.; and Margaret Singh, Argonne National Laboratory. We would also like to thank Jamie Payne, ORNL, who designed the cover; Sherry Campbell Gambrell, ORNL, who prepared the title index; and Bob Boundy, Q Systems, who assisted with so many tasks we can't name them all. Finally, this book would not have been possible without the dedication of Debbie Bain, who masterfully prepared the manuscript.

ABSTRACT

The *Transportation Energy Data Book: Edition 23* is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Planning, Budget Formulation, and Analysis, under the Energy Efficiency and Renewable Energy (EERE) program in the Department of Energy (DOE). Designed for use as a desk-top reference, the data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use. The purpose of this document is to present relevant statistical data in the form of tables and graphs. The latest editions of the Data Book are available to a larger audience via the Internet (www-cta.ornl.gov/data).

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; and 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 readers convenience.

INTRODUCTION

In January 1976, the Transportation Energy Conservation (TEC) Division of the Energy Research and Development Administration contracted with Oak Ridge National Laboratory (ORNL) to prepare a Transportation Energy Conservation Data Book to be used by TEC staff in their evaluation of current and proposed conservation strategies. The major purposes of the data book were to draw together, under one cover, transportation data from diverse sources, to resolve data conflicts and inconsistencies, and to produce a comprehensive document. The first edition of the TEC Data Book was published in October 1976. With the passage of the Department of Energy (DOE) Organization Act, the work being conducted by the former Transportation Energy Conservation Division fell under the purview of the DOE's Office of Transportation Programs, then to the Office of Transportation Technologies. DOE, through the Office of Transportation Technologies, has supported the compilation of Editions 3 through 21. In the most recent DOE organization, Editions 22 and 23 fall under the purview of the Office of Planning, Budget Formulation, and Analysis in the Office of Energy Efficiency and Renewable Energy.

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 23 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.

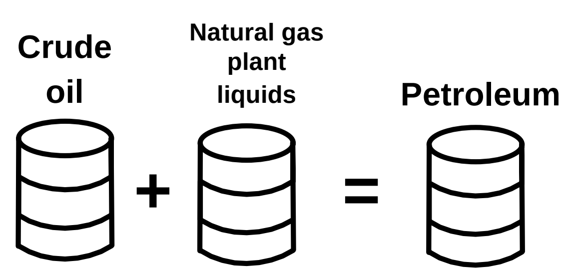
The majority of the statistics contained in the data book are taken directly from published sources, although these data may be reformatted for presentation by ORNL. Consequently, neither ORNL nor DOE endorses the validity of these data.

Chapter 1
Petroleum

Summary Statistics from Tables/Figures in this Chapter

Source			
Table 1.3	World Petroleum Production, 2002 (million barrels per day)		73.65
	U.S. Production (million barrels per day)		*7.63*
	U.S. Share		*10.4%*
Table 1.4	World Petroleum Consumption, 2002 (million barrels per day)		77.46
	U.S. Consumption (million barrels per day)		*19.76*
	U.S. Share		*25.5%*
Figure 1.5	Average refinery yield, 2002	OECD Europe	North America
	Gasoline	*20.8%*	*41.5%*
	Diesel fuel	*35.8%*	*22.7%*
	Residual fuel	*16.3%*	*7.0%*
	Kerosene	*6.0%*	*8.4%*
	Other	*21.1%*	*20.4%*
Table 1.13	U.S. transportation petroleum use as a percent of U.S. petroleum production, 2002		161.9%
Table 1.13	Net imports as a percentage of U.S. petroleum consumption, 2002		52.8%
Table 1.14	Transportation share of U.S. petroleum consumption, 2002		67.1%

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



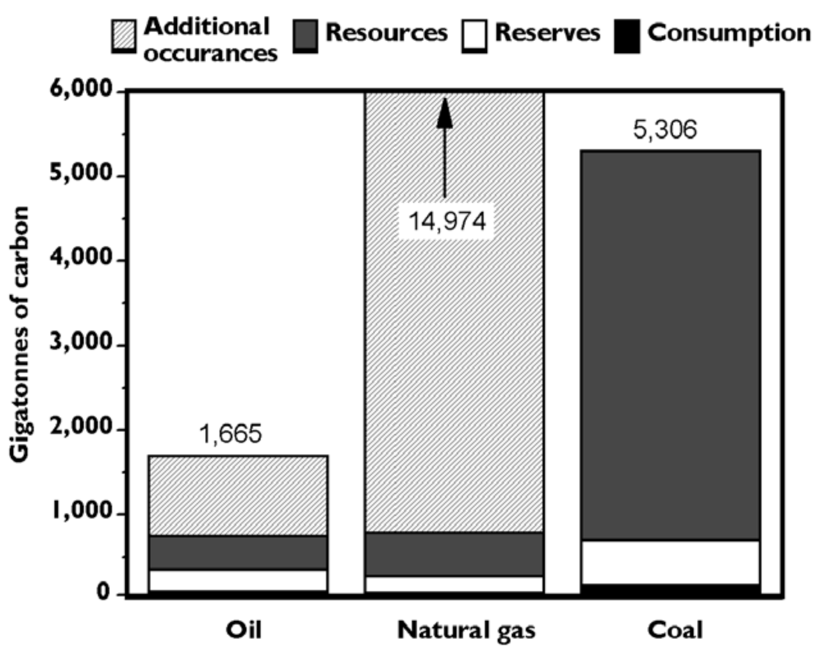
Although the world has consumed about 40% of estimated conventional oil resources, the total fossil fuel potential is huge. Methane hydrates–a potential source of natural gas–are included in the "additional occurrences" of unconventional natural gas, and constitute the largest resource.

Table 1.1
World Fossil Fuel Potential
(gigatonnes of carbon)

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

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

Figure 1.1. World Fossil Fuel Potential



Source:
See Table 1.1.

[a] Data are not available

In 2002, OPEC accounted for 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 almost 60% of world oil production.

Table 1.2
World Crude Oil Production, 1960-2002[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%	31.16	67.9%	22.59	13.39	29.2%	45.89
1975	8.37	15.8%	26.77	50.7%	37.56	71.1%	26.06	18.93	35.8%	52.83
1980	8.60	14.4%	26.61	44.6%	41.07	68.9%	32.99	17.96	30.1%	59.60
1985	8.97	16.6%	16.18	30.0%	31.81	58.9%	37.80	9.63	17.8%	53.98
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%	23.20	38.3%	39.12	64.6%	37.37	15.28	25.2%	60.57
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%	26.00	41.7%	38.24	61.4%	36.33	17.21	27.6%	62.33
1996	6.46	10.1%	26.46	41.5%	39.15	61.5%	37.25	17.37	27.3%	63.71
1997	6.45	9.8%	27.71	42.2%	40.69	61.9%	37.98	18.10	27.6%	65.69
1998	6.25	9.3%	28.77	43.0%	41.61	62.2%	38.19	19.34	28.9%	66.92
1999	5.88	8.9%	27.58	41.9%	40.50	61.5%	38.27	18.67	28.4%	65.85
2000	5.82	8.5%	29.26	42.8%	42.92	62.8%	39.08	19.89	29.1%	68.34
2001	5.80	8.5%	28.32	41.6%	42.61	62.6%	39.74	19.21	28.2%	68.06
2002	5.75	8.6%	26.37	39.5%	39.95	59.8%	40.47	17.79	26.6%	66.84
					Average annual percentage change					
1960–2002	-0.5%		2.7%		2.9%		2.9%	2.9%		2.8%
1970–2002	-1.6%		0.4%		0.8%		1.8%	0.9%		1.2%
1992–2002	-2.2%		0.8%		0.6%		1.2%	1.1%		1.1%

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2002*, Washington, DC, November 2003, Table 11.5. (Additional resources: www.eia.doe.gov)

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

This table shows petroleum production, which includes both crude oil and natural gas plant liquids. The U.S. was responsible for 10.4% of the world's petroleum production in 2002, but only 8.6% of the world's crude oil production (Table 1.2).

Table 1.3
World Petroleum Production, 1973-2002[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%	30.95	52.9%	27.51	47.1%	20.86	35.7%	58.47
1974	10.44	17.8%	30.70	52.5%	27.81	47.5%	21.41	36.6%	58.51
1975	10.00	18.0%	27.14	48.8%	28.48	51.2%	19.18	34.5%	55.62
1976	9.73	16.2%	30.77	51.1%	29.43	48.9%	21.80	36.2%	60.21
1977	9.86	15.7%	31.37	50.0%	31.32	50.0%	22.07	35.2%	62.69
1978	10.28	16.3%	30.03	47.5%	33.21	52.5%	21.02	33.2%	63.24
1979	10.13	15.4%	31.22	47.3%	37.74	52.7%	21.53	32.6%	65.96
1980	10.17	16.1%	27.34	43.4%	35.70	56.6%	18.49	29.3%	63.04
1981	10.18	17.0%	23.31	39.0%	36.40	61.0%	15.85	26.5%	59.71
1982	10.20	17.9%	19.62	34.4%	37.48	65.6%	12.77	22.4%	57.11
1983	10.25	18.0%	18.28	32.1%	38.62	67.9%	11.63	20.4%	56.90
1984	10.51	18.0%	18.31	31.4%	40.05	68.6%	11.38	19.5%	58.36
1985	10.58	18.3%	17.07	29.5%	40.85	70.5%	10.28	17.7%	57.92
1986	10.23	16.9%	19.25	31.9%	41.13	68.1%	12.40	20.5%	60.38
1987	9.95	16.3%	19.53	32.0%	41.42	68.0%	12.82	21.0%	60.95
1988	9.77	15.4%	21.40	33.8%	41.82	66.2%	14.27	22.6%	63.22
1989	9.16	14.2%	23.26	36.1%	41.10	63.9%	15.69	24.4%	64.36
1990	8.92	13.7%	24.48	37.5%	40.72	62.5%	16.21	24.9%	65.20
1991	9.08	14.0%	24.57	37.8%	40.47	62.2%	15.67	24.1%	65.04
1992	8.87	13.6%	25.76	39.5%	39.42	60.5%	16.97	26.0%	65.18
1993	8.59	13.1%	26.56	40.6%	38.87	59.4%	17.75	27.1%	65.43
1994	8.39	12.7%	26.98	40.7%	39.31	59.3%	18.03	27.2%	66.29
1995	8.32	12.3%	27.51	40.6%	40.32	59.4%	18.32	27.0%	67.82
1996	8.29	12.0%	27.96	40.4%	41.33	59.6%	18.45	26.6%	69.30
1997	8.27	11.6%	29.30	41.0%	42.12	59.0%	19.25	27.0%	71.42
1998	8.01	11.0%	30.43	41.8%	42.41	58.3%	20.57	28.2%	72.80
1999	7.73	10.8%	29.23	40.7%	42.62	59.3%	19.78	27.5%	71.85
2000	7.73	10.4%	31.06	41.6%	43.57	58.4%	21.11	28.3%	74.63
2001	7.67	10.3%	30.25	40.5%	44.41	59.5%	20.53	27.5%	74.66
2002	7.63	10.4%	28.47	38.7%	45.18	61.3%	19.27	26.2%	73.65
				Average annual percentage change					
1973–2002	-1.2%		-0.3%		1.7%		-0.3%		0.8%
1992–2002	-1.5%		1.0%		1.4%		1.3%		1.2%

Source:
U.S. Department of Energy, Energy Information Administration, *International Petroleum Monthly*, Tables 4.1 and 4.3. (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 approximately one-quarter of the world's petroleum consumption for the last two decades.

Table 1.4
World Petroleum Consumption, 1960–2002
(million barrels per day)

Year	United States	U.S. share	Total OECD[a]	Total non-OECD	World
1960	9.80	45.9%	15.78	5.56	21.34
1965	11.51	37.0%	22.81	8.33	31.14
1970	14.70	31.4%	34.49	12.32	46.81
1975	16.32	29.0%	38.82	17.38	56.20
1976	17.46	29.3%	41.39	18.28	59.67
1977	18.43	29.8%	42.43	19.40	61.83
1978	18.85	29.4%	43.62	20.54	64.16
1979	18.51	28.4%	44.01	21.21	65.22
1980	17.06	27.0%	41.41	21.66	63.07
1981	16.06	26.4%	39.14	21.76	60.90
1982	15.30	25.7%	37.45	22.05	59.50
1983	15.23	25.9%	36.59	22.15	58.74
1984	15.73	26.3%	37.43	22.40	59.83
1985	15.73	26.2%	37.23	22.86	60.09
1986	16.28	26.4%	38.28	23.48	61.76
1987	16.67	26.5%	38.96	24.04	63.00
1988	17.28	26.7%	40.24	24.58	64.82
1989	17.33	26.3%	40.88	25.04	65.92
1990	16.99	25.7%	40.92	25.16	66.08
1991	16.71	25.0%	41.40	25.32	66.72
1992	17.03	25.4%	42.42	24.51	66.93
1993	17.24	25.7%	42.98	24.14	67.12
1994	17.72	25.9%	44.17	24.25	68.42
1995	17.73	25.3%	44.92	25.07	69.99
1996	18.31	25.6%	46.04	25.54	71.58
1997	18.62	25.5%	46.61	26.49	73.10
1998	18.92	25.6%	46.84	27.02	73.86
1999	19.52	25.8%	47.65	27.96	75.61
2000	19.70	25.6%	47.88	29.02	76.90
2001	19.65	25.5%	47.63	29.50	77.13
2002	19.76	25.5%	47.59	29.87	77.46
			Average annual percentage change		
1960–2002	1.7%		2.7%	4.1%	3.1%
1970–2002	0.9%		1.0%	2.8%	1.6%
1992–2002	1.5%		1.2%	2.0%	1.5%

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2002*, Washington, DC, July 2003, Table 11.9 and updates from the *International Petroleum Monthly*, July 2003. (Additional resources: www.eia.doe.gov)

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

Figure 1.2. World Oil Reserves, Production and Consumption, 2002

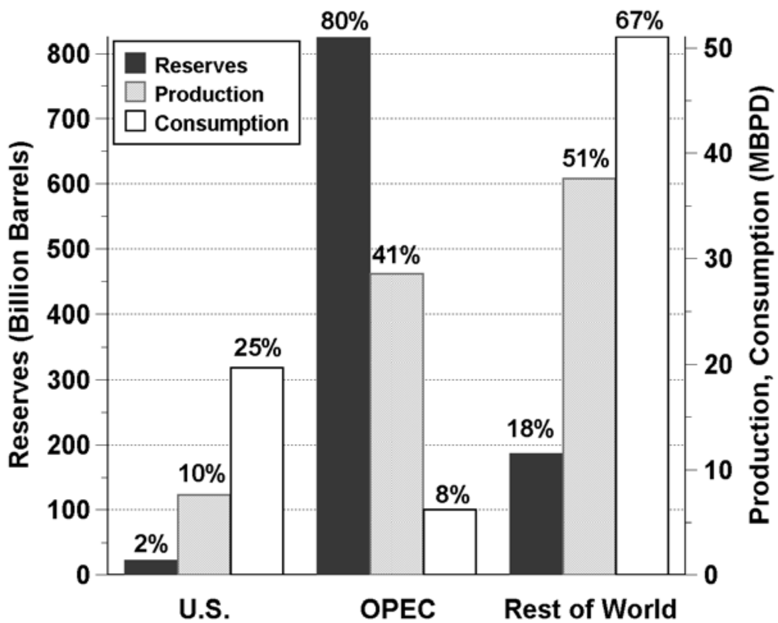


Table 1.5
World Oil Reserves, Production and Consumption, 2002

	Crude oil reserves (billion barrels)	Reserve share	Petroleum production (million barrels per day)	Production share	Petroleum consumption (million barrels per day)	Consumption share
U.S.	22.4	2%	7.6	10%	19.7	25%
OPEC	823.5	80%	28.5	41%	6.2	8%
Rest of world	186.1	18%	37.6	51%	51.6	67%

Source:
Reserves – Energy Information Administration, *International Energy Annual 2001*, Table 8.1.
Production – Energy Information Administration, *International Petroleum Monthly*, *July 2003*, Tables 4.1a – 4.1c and 4.3
Consumption – Energy Information Administration, *International Petroleum Monthly, July 2003*, Table 4.6.
OPEC consumption (2001 data) – Energy Information Administration, *International Energy Annual 2001*, Table 1.2. (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, United Arab Emirates, Algeria, Libya, Nigeria, Indonesia, Gabon, and Ecuador.
OPEC consumption data are for 2001.

Figure 1.3. World Natural Gas Reserves, Production, and Consumption, 2000

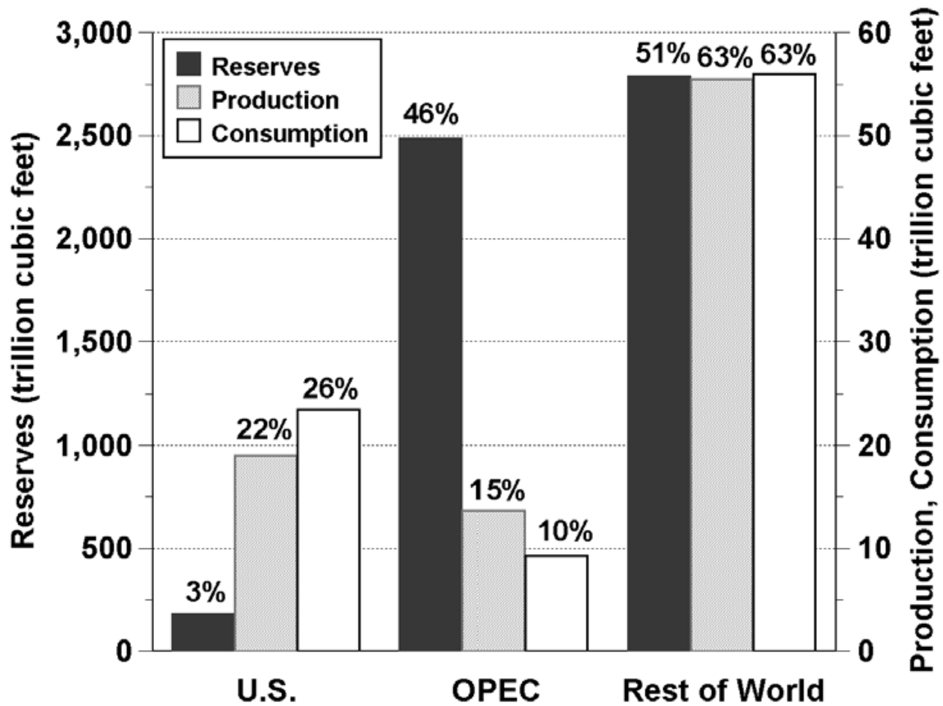


Table 1.6

World Natural Gas Reserves, Production and Consumption, 2000
(trillion cubic feet)

	Natural gas reserves	Reserve share	Natural gas production	Production share	Natural gas consumption	Consumption share
U.S.	183.5	3%	18.987	22%	23.455	26%
OPEC	2,485.1	46%	13.631	15%	9.262	10%
Rest of world	2,788.5	51%	55.5	63%	56.0	63%

Source:
Energy Information Administration, *International Energy Annual 2001*, March 2003, Tables 4.2 and 8.1.
(Additional resources: www.eia.doe.gov)

Note:
Reserves as of January 1, 2002. Production data are dry gas production.

Total OECD government-owned petroleum stocks were slightly higher in 2002 than in 1995. The amount of petroleum held in government stocks is about one-third of what is held in commercial stocks.

Table 1.7
Petroleum Stocks of OECD Countries by Ownership, 1995–2002
(million barrels)

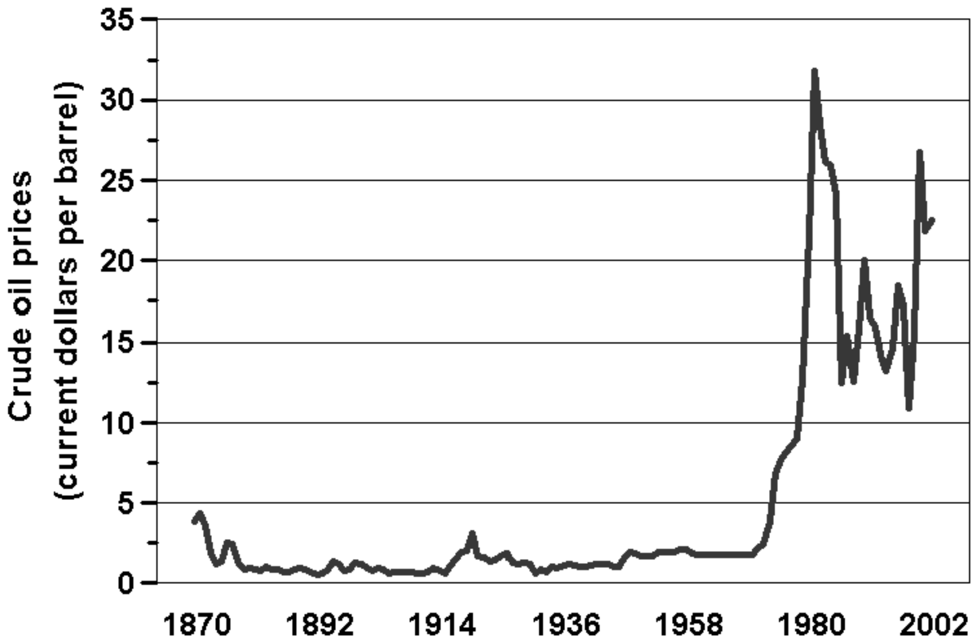
	OECD Europe		Japan		United States[a]		Total OECD[b]	
Year	Commercial	Government-owned	Commercial	Government-owned	Commercial	Government-owned	Commercial	Government-owned
1995	1,153	63	336	295	993	592	2,651	950
1996	1,191	63	351	300	969	566	2,659	929
1997	1,189	63	370	315	1,022	563	2,744	941
1998	1,257	63	334	315	1,098	571	2,851	949
1999	1,174	63	314	315	939	567	2,592	945
2000	1,196	64	322	312	951	541	2,635	917
2001	1,235	57	341	316	1,048	550	2,920	923
2002	1,208	57	298	321	888	599	2,715	977
				Average annual percentage change				
1995–2002	1.2%	-1.7%	0.2%	1.2%	0.9%	-1.2%	1.6%	-0.5%

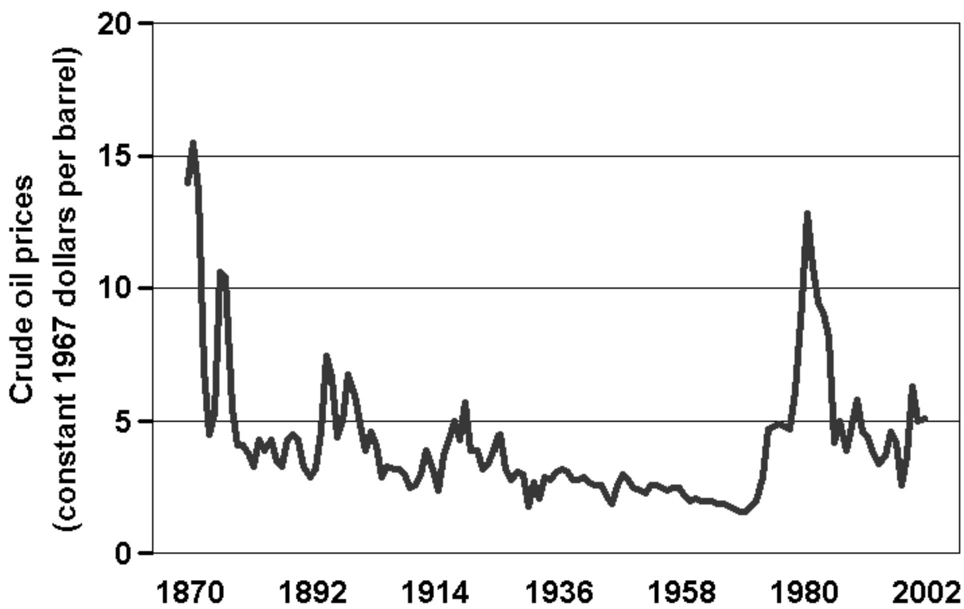
Source:
U.S. Department of Energy, Energy Information Administration, *International Petroleum Monthly*, June 2003, Table 1.6, and annual. (Additional resources: www.eia.doe.gov)

[a]Includes U.S. territories.
[b]Total OECD includes OECD Europe, Japan, United States, and other OECD countries. Look in the Glossary for a complete listing of OECD countries.

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

Figure 1.4. Crude Oil Prices in Current and Constant Terms, 1870–2002





Source:

1870–1972 Crude oil prices – American Petroleum Institute, *Basic Petroleum Data Book*, Volume XXI, Number 2, August 2001.

1973–2001 Crude oil prices – U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, April 2003*, Table 9.1, domestic first purchase price.

The share of petroleum imported to the U.S. can be calculated using total imports or net imports. Net imports, which is the preferred data, rose to 50% of U.S. petroleum consumption for the first time in 1998, while total imports reached 50% for the first time in 1993. OPEC share of net imports dropped from 51% in 2001 to 43.7% in 2002.

Table 1.8
U.S. Petroleum Imports by World Region of Origin, 1960–2002
(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%	[c]	[c]	5.85	35.8%	6.06
1980	4.29	67.5%	[c]	[c]	6.37	37.3%	6.91
1981	3.32	61.4%	1.22	22.5%	5.40	33.6%	6.00
1982	2.14	49.7%	0.69	16.1%	4.30	28.1%	5.11
1983	1.84	42.7%	0.44	10.2%	4.31	28.3%	5.05
1984	2.04	43.2%	0.50	10.6%	4.72	30.0%	5.44
1985	1.82	42.5%	0.31	7.2%	4.29	27.3%	5.07
1986	2.83	52.0%	0.91	16.7%	5.44	33.4%	6.22
1987	3.06	51.7%	1.07	18.2%	5.91	35.5%	6.68
1988	3.51	53.3%	1.53	23.2%	6.59	38.1%	7.40
1989	4.12	57.3%	1.86	25.8%	7.20	41.6%	8.06
1990	4.29	59.8%	1.96	27.4%	7.16	42.2%	8.02
1991	4.07	61.3%	1.83	27.7%	6.63	39.6%	7.63
1992	4.07	58.7%	1.77	25.6%	6.94	40.8%	7.89
1993	4.25	55.8%	1.77	23.3%	7.62	44.2%	8.62
1994	4.23	52.6%	1.72	21.4%	8.05	45.4%	9.00
1995	3.98	50.5%	1.56	19.8%	7.89	44.5%	8.84
1996	4.19	49.3%	1.60	18.8%	8.50	46.4%	9.48
1997	4.54	49.6%	1.75	19.1%	9.16	49.2%	10.16
1998	4.88	50.0%	2.13	21.8%	9.76	51.6%	10.71
1999	4.93	49.8%	2.46	24.8%	9.91	50.8%	10.85
2000	5.18	49.7%	2.48	23.8%	10.42	52.9%	11.46
2001	5.43	51.0%	2.73	25.7%	10.64	55.5%	11.62
2002	4.61	43.7%	2.27	21.5%	10.55	52.8%	11.53
			Average annual percentage change				
1960–2002	3.0%		[c]		4.6%		4.5%
1970–2002	3.9%		[c]		3.8%		3.9%
1992–2002	1.3%		4.2%	2.5%	4.3%		3.9%

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2002*, Washington, DC, July 2002, Tables 5.4 and 5.7 and updates from the *International Petroleum Monthly*, July 2003, Table 4.10. Consumption: *Transportation Energy Databook*, Table 1.12.

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

The Costs of Oil Dependence

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

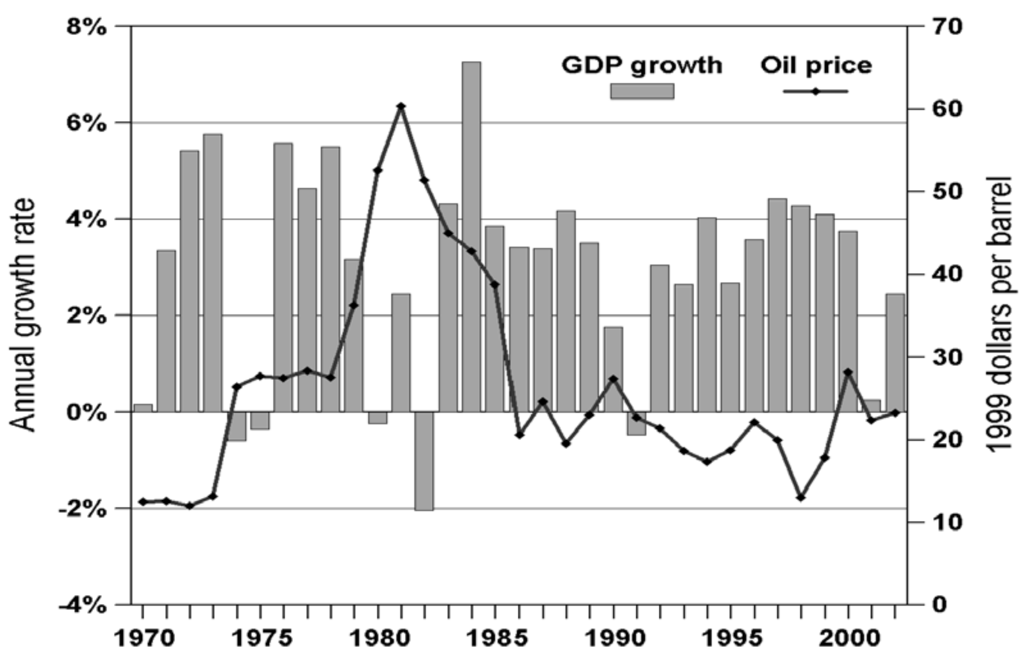
Oil dependence is the product of (1) a noncompetitive world oil market strongly influenced by the OPEC cartel, (2) high levels of U.S. oil imports, (3) oil's critical role in the U.S. economy, and (4) the absence of economical and readily available substitutes for oil. Transportation is key to the problem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

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

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

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

Figure 1.5. Oil Price and Economic Growth, 1970–2002



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, 2003.
(Additional resources: www-cta.ornl.gov/publications)

Estimates of military expenditures for defending oil supplies in the Middle East range from $6 to $60 billion per year. This wide range in estimates reflects the difficulty in assigning a precise figure to the military cost of defending the U.S. interests in the Middle East. The two main reasons for the difficulty are 1) the Department of Defense does not divide the budget into regional defense sectors and 2) it is difficult to determine how much of the cost is attributable to defending Persian Gulf oil. The latest study, done by the National Defense Council Foundation, puts a price of $49 billion dollars/year for the defense of oil.

Table 1.9
Summary of Military Expenditures f or Defending Oil Supplies from the Middle East

Source	Original estimates (billion dollars)	Year of original estimate
General Accounting Office [1]	$33	1990
Congressional Research Service [2]	$6.4	1990
Greene and Leiby [3]	$14.3	1990
Kaufmann and Steinbruner [4]	$64.5	1990
Ravenal [5]	$50	1992
Delucchi and Murphy[a] [6]	$20–40	1996
National Defense Council Foundation [7]	$49.1	2003

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

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

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

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

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

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

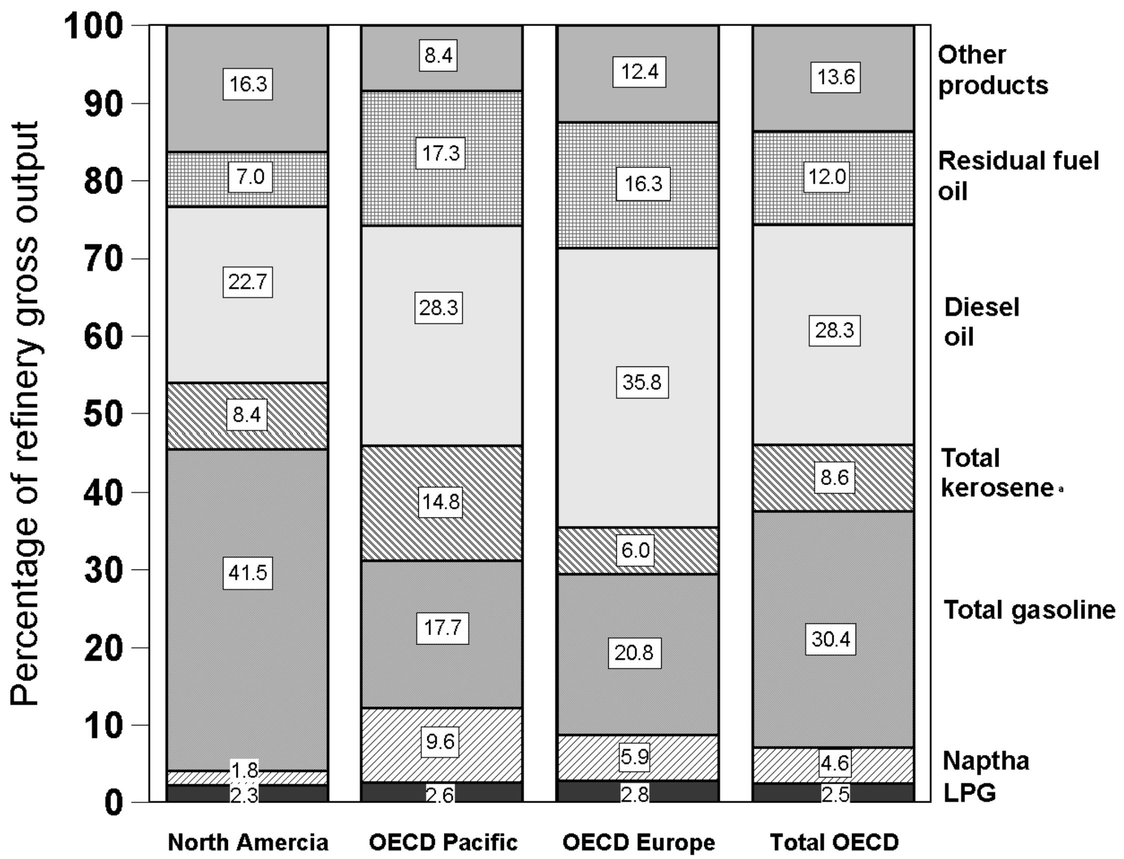
[7] National Defense Council Foundation, Alexandria, VA, forthcoming publication, 2003.

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

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

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

Figure 1.6. Refinery Gross Output by World Region, 2002



Source:
International Energy Agency, *Monthly Oil Survey*, January 2003, Paris, France, Table 7.
(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.

Table 1.10
U.S. Refinery Input of Crude Oil and Petroleum Products, 1987–2002
(thousand barrels)

			Oxygenates						
Year	Crude oil	Natural gas liquids	Fuel ethanol	Methanol	MTBE[a]	Other oxygenates[b]	Other hydrocarbons[c]	Other liquids	Total input to refineries
1987	4,691,783	280,889	[d]	[d]	[d]	[d]	23,304	220,296	5,105,392
1990	4,894,379	170,589	[d]	[d]	[d]	[d]	28,642	231,466	5,325,076
1991	4,855,016	172,306	[d]	[d]	[d]	[d]	31,574	248,691	5,307,587
1992	4,908,603	171,701	[d]	[d]	[d]	[d]	47,918	224,758	5,352,980
1993	4,968,641	179,213	3,351	782	49,393	1,084	15,543	264,531	5,482,538
1994	5,061,111	169,868	3,620	242	52,937	1,676	14,130	179,678	5,483,262
1995	5,100,317	172,026	9,055	246	79,396	3,876	14,668	175,743	5,555,327
1996	5,195,265	164,552	11,156	126	79,407	3,444	20,587	193,695	5,668,232
1997	5,351,466	151,769	11,803	496	86,240	3,750	22,976	178,292	5,806,792
1998	5,434,383	146,921	11,722	675	89,362	3,363	22,759	183,376	5,892,561
1999	5,403,450	135,756	13,735	813	94,784	3,334	21,447	204,332	5,877,651
2000	5,514,395	138,921	15,268	854	90,288	3,151	24,488	176,647	5,964,012
2001	5,521,637	156,479	16,929	1,431	87,116	3,113	24,903	167,729	5,979,337
2002	5,455,530	155,429	26,320	13	90,291	2,325	21,895	202,672	5,955,475
				Average annual percentage change					
1987-2002	1.1%	-3.9%	[e]	[e]	[e]	[e]	-0.4%	-0.6%	1.0%
1993-2002	1.0%	-1.6%	25.7%	-36.6%	6.9%	8.8%	3.9%	-2.9%	0.9%

Source:
U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual, 2002*, Vol. 1, June 2003, Table 16, and annual.
(Additional resources: www.eia.doe.gov)

[a]Methyl tertiary butyl ether (MTBE).
[b]Includes ethyl tertiary butyl ether (ETBE), tertiary amyl methyl ether (TAME), tertiary butyl alcohol (TBA), and other aliphatic alcohols and ethers intended for motor gasoline blending.
[c]For 1987–92, includes other hydrocarbons/hydrogen/oxygenates. For 1993–on, includes other hydrocarbons/hydrogen.
[d]Reported in "Other hydrocarbons" category in this year.
[e]Data are not available.

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

Table 1.11
Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978–2002
(percentage)

Year	Motor gasoline	Distillate fuel oil	Jet fuel	Liquified petroleum gas	Other[a]	Total[b]
1978	44.1	21.4	6.6	2.3	29.6	104.0
1979	43.0	21.5	6.9	2.3	30.3	104.0
1980	44.5	19.7	7.4	2.4	30.0	104.0
1981	44.8	20.5	7.6	2.4	28.7	104.0
1982	46.4	21.5	8.1	2.2	26.2	104.4
1983	47.6	20.5	8.5	2.7	24.8	104.1
1984	46.7	21.5	9.1	2.9	24.2	104.4
1985	45.6	21.6	9.6	3.1	24.6	104.5
1986	45.7	21.2	9.8	3.2	24.8	104.7
1987	46.4	20.5	10.0	3.4	24.5	104.8
1988	46.0	20.8	10.0	3.6	24.4	104.8
1989	45.7	20.8	10.1	4.0	24.2	104.8
1990	45.6	20.9	10.7	3.6	24.1	104.9
1991	45.7	21.3	10.3	3.8	24.1	105.2
1992	46.0	21.2	9.9	4.3	24.0	105.4
1993	46.1	21.9	10.0	4.1	23.3	105.4
1994	45.5	22.3	10.1	4.2	23.2	105.3
1995	46.4	21.8	9.7	4.5	22.9	105.3
1996	45.7	22.7	10.4	4.5	22.4	105.7
1997	45.7	22.5	10.3	4.6	22.5	105.6
1998	46.2	22.3	10.4	4.4	22.5	105.8
1999	46.5	22.3	10.2	4.5	22.3	105.8
2000	46.2	23.1	10.3	4.5	22.0	106.1
2001	46.2	23.8	9.8	4.3	21.7	105.8
2002	47.3	23.2	9.8	4.3	21.5	106.1

Source:
Department of Energy, Energy Information Administration, *Petroleum Supply Annual 2002*, Vol. 1, June 2003, Table 19 and annual. (Additional resources: www.eia.doe.gov)

[a] Includes aviation gasoline(0.1%), kerosene (0.4%), residential fuel oil (3.9%), naphtha and other oils for petrochemical feedstock use (2.6%), special naphthas (0.3%), lubricants (1.1%), waxes (0.1%), petroleum coke (5.1%), asphalt and road oil (3.2%), still gas (4.3%), and miscellaneous products (0.4%).
[b] Products sum greater than 100% due to processing gain. The processing gain for years 1978 to 1980 is assumed to be 4%.

Most of the petroleum imported by the United States is in the form of crude oil. The U.S. does export small amounts of petroleum, mainly refined petroleum products which go to Canada and Mexico.

Table 1.12
United States Petroleum Production, Imports and Exports, 1950–2002
(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	0.22	0.85	0.10	0.21	0.31
1955	6.81	0.77	7.58	0.78	0.46	1.23	0.03	0.34	0.37
1960	7.05	0.93	7.99	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	8.37	1.63	10.05	4.11	1.95	6.06	0.01	0.20	0.21
1980	8.62	1.58	10.24	5.26	1.65	6.91	0.29	0.26	0.54
1981	8.57	1.61	10.23	4.40	1.60	6.00	0.23	0.37	0.60
1982	8.65	1.55	10.25	3.49	1.63	5.11	0.24	0.58	0.82
1983	8.69	1.56	10.30	3.33	1.72	5.05	0.16	0.58	0.74
1984	8.90	1.63	10.58	3.43	2.01	5.44	0.18	0.54	0.72
1985	8.97	1.61	10.64	3.20	1.87	5.07	0.20	0.58	0.78
1986	8.68	1.55	10.29	4.18	2.05	6.22	0.15	0.63	0.79
1987	8.35	1.60	10.01	4.67	2.00	6.68	0.15	0.61	0.76
1988	8.16	1.63	9.84	5.11	2.30	7.40	0.16	0.66	0.82
1989	7.61	1.55	9.22	5.84	2.22	8.06	0.14	0.72	0.86
1990	7.36	1.56	8.99	5.89	2.12	8.02	0.11	0.75	0.86
1991	7.42	1.66	9.17	5.78	1.84	7.63	0.12	0.88	1.00
1992	7.18	1.70	9.01	6.08	1.81	7.89	0.09	0.86	0.95
1993	6.85	1.74	8.84	6.79	1.83	8.62	0.10	0.90	1.00
1994	6.66	1.73	8.65	7.06	1.93	9.00	0.10	0.84	0.94
1995	6.56	1.76	8.63	7.23	1.61	8.84	0.09	0.86	0.95
1996	6.47	1.83	8.61	7.51	1.97	9.48	0.11	0.87	0.98
1997	6.45	1.82	8.61	8.23	1.94	10.16	0.11	0.90	1.00
1998	6.25	1.76	8.39	8.71	2.00	10.71	0.11	0.84	0.95
1999	5.88	1.83	8.11	8.73	2.12	10.85	0.12	0.82	0.94
2000	5.82	1.91	8.11	9.07	2.39	11.46	0.05	0.99	1.04
2001	5.80	1.87	8.05	9.33	2.54	11.87	0.02	0.95	0.97
2002	5.82	1.88	8.12	9.05	2.31	11.36	0.01	0.97	0.98
				Average annual percentage change					
1950–2002	0.1%	2.6%	0.6%	5.8%	4.6%	5.1%	0.0%	3.0%	2.2%
1970–2002	-1.6%	0.4%	-1.0%	6.2%	0.3%	3.8%	0.0%	4.3%	4.2%
1992–2002	-2.1%	1.0%	-1.0%	4.1%	2.5%	3.7%	-19.7%	1.2%	0.3%

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2002*, July 2003, Tables 5.3 and 5.5 and *Monthly Energy Review*, April 2003, Tables 3.1a and 3.1b.

[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 approximately one-quarter. The U.S. relies heavily on imported petroleum. Imports accounted for 53% of U.S. petroleum consumption in 2002.

Table 1.13
Petroleum Production and Consumption Ratios, 1950–2002

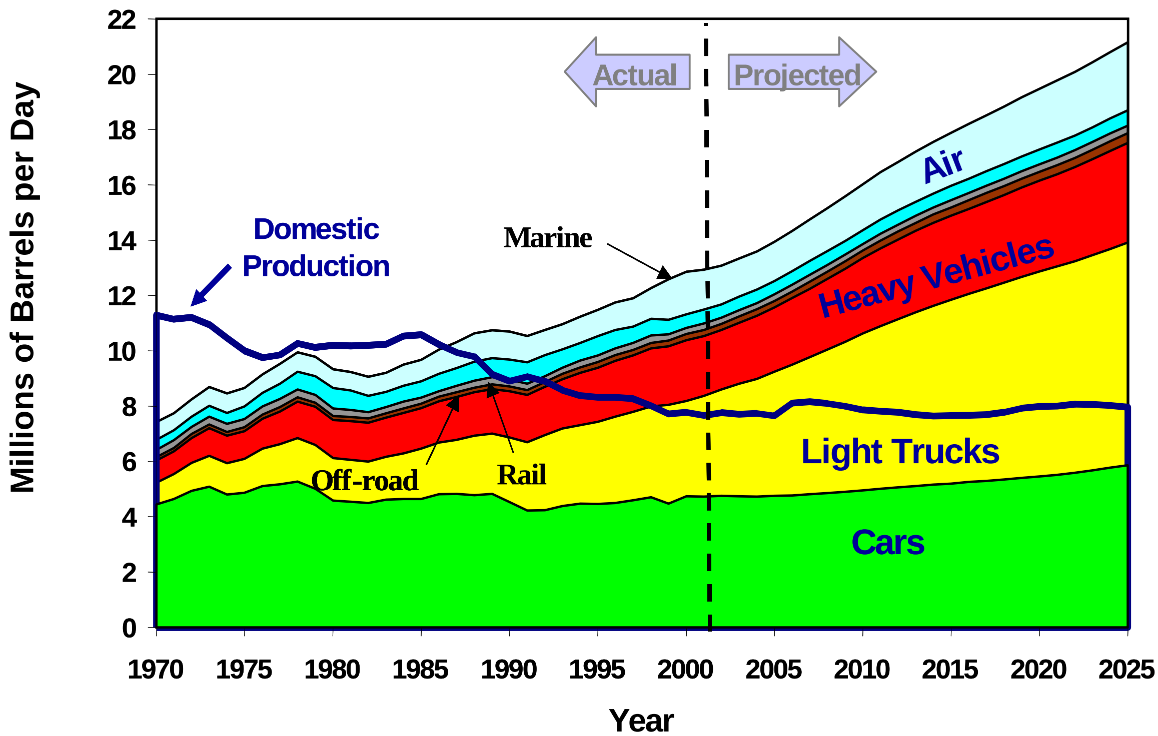
	Domestic petroleum production[a]	Net petroleum imports	Transportation petroleum consumption	U.S. petroleum consumption	World petroleum consumption	Net imports as a share of U.S. consumption	U.S. petroleum consumption as a share of world consumption	Transportation petroleum use as a share of domestic 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	10.05	5.85	8.95	16.32	56.20	35.8%	29.0%	89.1%
1980	10.24	6.38	9.57	17.10	63.07	37.3%	27.1%	93.5%
1981	10.23	5.40	9.49	16.06	60.90	33.6%	26.4%	92.7%
1982	10.25	4.30	9.31	15.30	59.50	28.1%	25.7%	90.8%
1983	10.30	4.31	9.41	15.23	58.74	28.3%	25.9%	91.3%
1984	10.58	4.73	9.71	15.77	59.84	30.0%	26.4%	91.8%
1985	10.64	4.29	9.85	15.73	60.10	27.3%	26.2%	92.6%
1986	10.29	5.44	10.23	16.28	61.76	33.4%	26.4%	99.5%
1987	10.01	5.91	10.53	16.67	63.00	35.5%	26.5%	105.2%
1988	9.84	6.60	10.91	17.28	64.82	38.1%	26.7%	110.9%
1989	9.22	7.20	11.00	17.33	65.92	41.6%	26.3%	119.3%
1990	8.99	7.16	10.97	16.99	65.98	42.2%	25.7%	122.0%
1991	9.17	6.63	10.80	16.71	66.73	39.6%	25.0%	117.8%
1992	9.01	6.94	10.97	17.03	66.92	40.8%	25.4%	121.8%
1993	8.84	7.62	11.18	17.24	67.12	44.2%	25.7%	126.5%
1994	8.65	8.05	11.48	17.72	68.42	45.4%	25.9%	132.7%
1995	8.63	7.89	11.72	17.73	69.99	44.5%	25.3%	135.8%
1996	8.61	8.50	11.99	18.31	71.58	46.4%	25.6%	139.3%
1997	8.61	9.16	12.12	18.62	73.10	49.2%	25.5%	140.8%
1998	8.39	9.76	12.46	18.92	73.86	51.6%	25.6%	148.5%
1999	8.11	9.91	12.83	19.52	75.61	50.8%	25.8%	158.2%
2000	8.11	10.42	13.12	19.70	76.90	52.9%	25.6%	161.8%
2001	8.05	10.90	13.51	19.65	77.13	55.5%	25.5%	167.8%
2002	8.12	10.38	13.15	19.66	[b]	52.8%	[b]	161.9%
	Average annual percentage change							
1950–2002	0.6%	5.8%	2.7%	2.2%	[b]			
1970–2002	-1.0%	3.8%	1.7%	0.9%	1.6%[c]			
1992–2002	-1.0%	4.1%	1.8%	1.4%	1.6%[c]			

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, April 2003, Tables 2.5, 3.1a, 3.1b, and A3. (Pre-1973 data from the *Annual Energy Review*).
World petroleum consumption - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 2001*, March 2003, Table 1.1, and annual.
(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.
[c]Average annual percentage change is to the latest year possible.

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

Figure 1.7. United States Petroleum Production and Consumption, 1970–2025



Source:
See Tables 1.12 and 2.5. Projections are from the Energy Information Administration, *Annual Energy Outlook 2003*, January 2003.

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

Table 1.14
Consumption of Petroleum by End-Use Sector, 1973–2002
(million barrels per day)

Year	Transportation	Percentage	Residential	Commercial	Industrial	Electric utilities	Total
1973	9.06	52.3%	1.49	0.75	4.48	1.54	17.31
1974	8.84	53.1%	1.36	0.68	4.30	1.48	16.65
1975	8.95	54.8%	1.32	0.63	4.04	1.39	16.32
1976	9.40	53.8%	1.43	0.70	4.46	1.52	17.51
1977	9.76	53.0%	1.42	0.72	4.82	1.71	18.43
1978	10.16	53.9%	1.38	0.69	4.87	1.75	18.85
1979	10.01	54.1%	1.09	0.63	5.34	1.44	18.52
1980	9.57	56.1%	0.91	0.61	4.85	1.15	17.10
1981	9.49	59.1%	0.81	0.52	4.27	0.96	16.06
1982	9.31	60.8%	0.76	0.48	4.06	0.69	15.30
1983	9.41	61.8%	0.74	0.55	3.86	0.68	15.23
1984	9.71	61.7%	0.71	0.58	4.20	0.56	15.77
1985	9.85	62.6%	0.79	0.50	4.10	0.48	15.72
1986	10.23	62.9%	0.78	0.53	4.10	0.64	16.28
1987	10.53	63.2%	0.81	0.52	4.25	0.55	16.67
1988	10.90	63.1%	0.84	0.51	4.40	0.69	17.33
1989	11.00	63.5%	0.85	0.47	4.35	0.75	17.42
1990	10.97	64.5%	0.70	0.45	4.18	0.57	16.86
1991	10.80	64.6%	0.72	0.42	4.55	0.53	17.02
1992	10.97	64.4%	0.73	0.40	4.44	0.44	16.96
1993	11.18	64.8%	0.77	0.37	4.64	0.50	17.44
1994	11.48	64.8%	0.74	0.37	4.54	0.47	17.59
1995	11.72	66.1%	0.76	0.35	4.80	0.33	17.96
1996	11.99	65.5%	0.84	0.37	4.92	0.36	18.48
1997	12.12	65.1%	0.81	0.35	4.81	0.41	18.51
1998	12.46	65.9%	0.75	0.33	4.80	0.58	18.92
1999	12.83	65.7%	0.84	0.34	4.98	0.53	19.52
2000	13.12	66.4%	0.87	0.37	4.89	0.51	19.76
2001	13.01	66.2%	0.86	0.37	4.85	0.56	19.66
2002	13.15	67.1%	0.84	0.37	4.85	0.40	19.60
		Average annual percentage change					
1973–2002	1.3%		-2.0%	-2.4%	0.3%	-4.5%	0.4%
1992–2002	1.8%		1.4%	-0.8%	0.9%	-0.9%	1.5%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, April 2003, Tables 2.2–2.6. Converted to million barrels per day using Table A3.
(Additional resources: www.eia.doe.gov)

Pipelines accounted for two-thirds of the domestic movement of petroleum and petroleum products in 2001.

Table 1.15
Ton-Miles of Petroleum and Petroleum Products in the U.S. by Mode, 1975–2001

Year	Pipelines[a]	Water carriers	Motor carriers[b]	Railroads	Total
	(percent)				(billion ton-miles)
1975	59.9%	35.2%	3.3%	1.7%	846.7
1976	59.4%	35.4%	3.8%	1.5%	867.7
1977	59.1%	36.1%	3.2%	1.6%	923.4
1978	50.5%	45.7%	2.7%	1.1%	1,160.2
1979	51.8%	44.5%	2.6%	1.2%	1,174.8
1980	47.2%	49.6%	2.2%	1.0%	1,245.3
1981	46.3%	50.7%	2.0%	1.0%	1,218.4
1982	46.4%	50.6%	1.9%	1.1%	1,218.2
1983	45.5%	51.5%	2.1%	1.0%	1,223.5
1984	48.1%	48.4%	2.5%	1.0%	1,180.2
1985	47.2%	49.4%	2.4%	1.0%	1,195.5
1986	48.7%	47.8%	2.5%	1.0%	1,187.8
1987	49.1%	47.4%	2.5%	1.0%	1,195.8
1988	50.6%	45.8%	2.6%	1.1%	1,188.1
1989	53.4%	42.6%	2.8%	1.2%	1,094.2
1990	54.2%	41.7%	2.8%	1.3%	1,076.8
1991	53.3%	42.8%	2.7%	1.3%	1,086.1
1992	53.9%	42.1%	2.6%	1.4%	1,091.7
1993	57.3%	38.8%	2.4%	1.5%	1,034.6
1994	56.5%	39.3%	2.7%	1.5%	1,046.7
1995	57.5%	38.4%	2.5%	1.6%	1,044.9
1996	60.6%	34.9%	2.9%	1.6%	1,022.2
1997	64.5%	30.9%	2.9%	1.8%	956.5
1998	66.7%	28.5%	3.0%	1.8%	929.8
1999	67.7%	27.1%	3.2%	2.1%	912.9
2000	66.1%	28.0%	3.6%	2.3%	873.3
2001	66.2%	28.1%	3.5%	2.2%	869.8
			Average annual percentage change		
1975–2001					0.1%
1991–2001					-2.2%

Source:
Association of Oil Pipelines, *Shifts in Petroleum Transportation*, Washington, DC, May 2003, Table 1. (Additional resources: www.aopl.org)

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

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

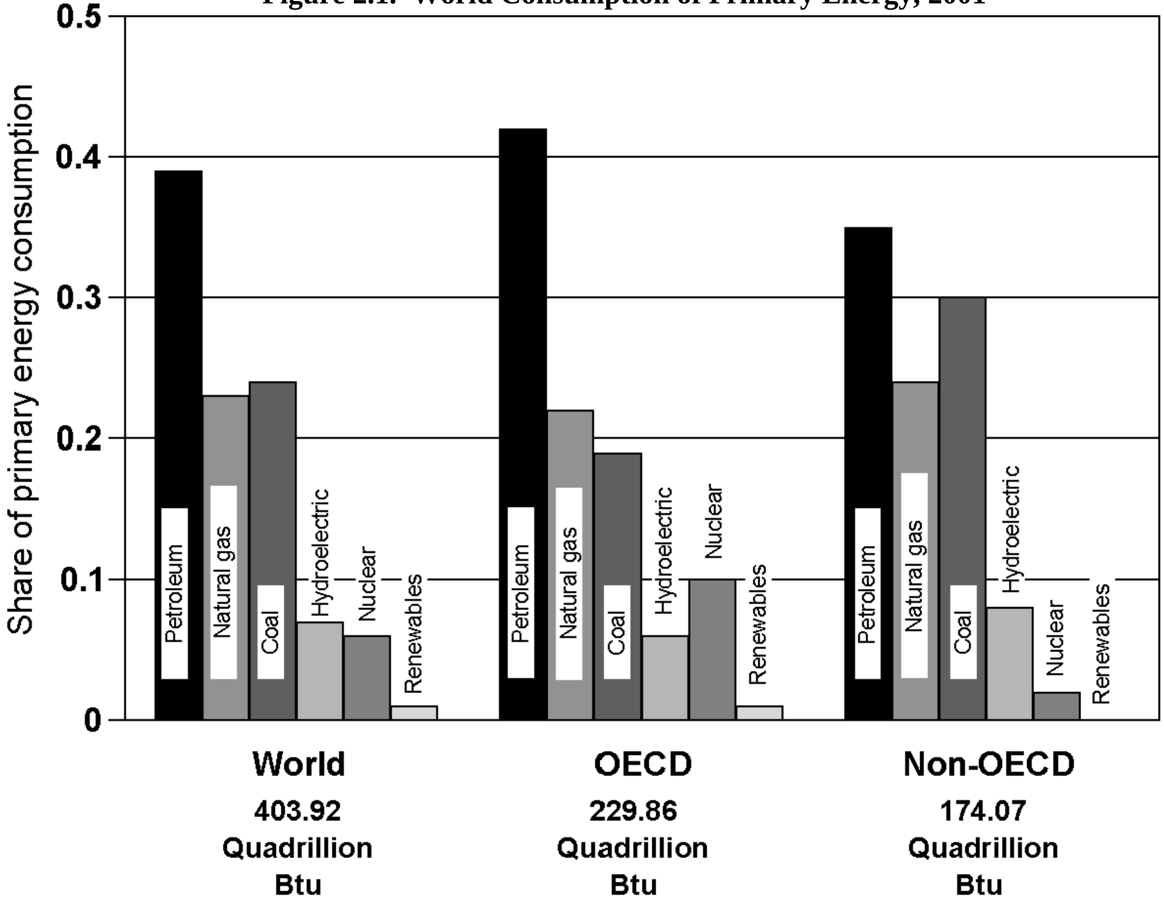
Chapter 2
Energy

Summary Statistics from Tables in this Chapter

Source			
Table 2.1	Transportation share of U.S. energy consumption, 2002	27.3%	
Table 2.2	Petroleum share of transportation energy consumption, 2002	96.8%	
Table 2.3	Alternative fuel and oxygenate consumption, 2002		
		(thousand gasoline equivalent gallons)	(share)
	MTBE	*2,531,000*	*62.6%*
	Ethanol in gasohol	*1,118,900*	*27.7%*
	Liquified petroleum gas	*255,515*	*6.3%*
	Compressed natural gas	*13,554*	*2.8%*
	Liquified natural gas	*10,504*	*0.3%*
	E85/E95	*10,075*	*0.0%*
	Electricity	*4,460*	*0.0%*
	M85/M100	*330*	*0.0%*
Table 2.5	Transportation energy use by mode, 2001	(trillion Btu)	(share)
	Automobiles	*9,124*	*33.9%*
	Light trucks	*6,654*	*24.7%*
	Heavy trucks	*4,826*	*17.9%*
	Air	*2,411*	*9.0%*
	Water	*1,155*	*4.3%*
	Off-highway	*1,036*	*3.8%*
	Pipeline	*889*	*3.3%*
	Rail	*615*	*2.3%*
	Buses	*203*	*0.8%*

Petroleum accounted for 40% of the world's energy use in 2000. 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, 2001



Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 2001*, Washington, DC, February 2003, Table 1.8. (Additional resources: www.eia.doe.gov)

The Energy Information Administration revised the historical energy data series to include renewable energy in each sector. Also, the residential and commercial sector data are now separated. Total energy use was 97.9 quads in 2002 with transportation using 27.3%.

Table 2.1
U. S. Consumption of Total Energy by End-Use Sector, 1973–2002[a]
(quadrillion Btu)

Year	Transportation	Percentage transportation of total	Industrial	Commercial	Residential	Total
1973	18.6	24.6%	32.7	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	10.0	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	16.2	80.0
1979	20.5	25.3%	34.0	10.6	15.8	80.9
1980	19.7	25.2%	32.2	10.6	15.9	78.3
1981	19.5	25.6%	30.8	10.6	15.4	76.3
1982	19.1	26.0%	27.7	10.9	15.6	73.2
1983	19.1	26.2%	27.5	11.0	15.5	73.1
1984	19.8	25.8%	29.6	11.5	15.8	76.7
1985	20.1	26.3%	29.0	11.5	15.9	76.4
1986	20.8	27.1%	28.4	11.6	15.9	76.7
1987	21.5	27.1%	29.5	12.0	16.2	79.2
1988	22.3	27.0%	30.8	12.6	17.1	82.8
1989	22.6	26.6%	31.4	13.2	17.8	84.9
1990	22.5	26.6%	31.9	13.3	16.9	84.6
1991	22.1	26.2%	31.5	13.5	17.4	84.5
1992	22.5	26.2%	32.7	13.4	17.3	85.9
1993	22.9	26.1%	32.7	13.8	18.2	87.6
1994	23.5	26.3%	33.6	14.1	18.1	89.2
1995	24.0	26.3%	33.9	14.7	18.7	91.2
1996	24.5	26.0%	34.9	15.2	19.6	94.2
1997	24.8	26.2%	35.2	15.7	19.1	94.7
1998	25.4	26.8%	34.8	16.0	19.1	95.1
1999	26.1	27.0%	34.7	16.4	19.6	97.8
2000	26.7	27.0%	34.7	17.2	20.5	99.0
2001	26.4	27.5%	32.4	17.3	20.3	96.2
2002	26.7	27.3%	33.1	17.5	20.9	97.9
		Average annual percentage change				
1973–2002	1.3%		0.0%	2.1%	1.2%	0.9%
1992–2002	1.7%		0.1%	2.7%	1.9%	1.3%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, April 2003*, Washington, DC, Table 2.1. (Additional resources: www.eia.doe.gov)

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

The Energy Information Administration revised the historical energy data series to include renewable energy in each sector. In transportation, the alcohol fuels blended into gasoline to make gasohol (10% ethanol or less) are now counted under "renewables" and have been taken out of 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 2002
(percentage)

Energy source	Transportation		Residential		Commercial		Industrial		Electric utilities	
	1973	2002	1973	2002	1973	2002	1973	2002	1973	2002
Petroleum[a]	95.8	96.8	18.9	7.1	16.4	4.1	27.9	27.4	17.7	2.3
Natural gas[b]	4.0	2.3	33.2	24.2	27.8	18.5	31.8	28.0	18.8	14.9
Coal	0.0	0.0	0.7	0.1	1.6	0.6	12.4	6.3	43.5	52.4
Renewable	0.0	0.7	2.4	2.0	0.1	0.6	3.6	5.2	15.4	9.1
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	21.3
Electricity[c]	0.2	0.2	44.9	66.6	54.1	76.3	24.4	33.0	0.0	0.0
Other[d]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, April 2003*, Washington, DC, pp. 27, 29, 31, 33. (Additional resources: www.eia.doe.gov)

[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.
[d] Energy generated from geothermal, wood, waste, wind, photovoltaic, and solar thermal energy sources.

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

Table 2.3
Alternative Fuel and Oxygenate Consumption, 1992–2002
(thousand gasoline–equivalent gallons)

Alternative fuel	1993	1995	1998	2000	2001	2002[a]	2002 Percentage
Liquified petroleum gas	264,655	232,701	241,386	242,062	251,353	255,515	6.3%
Compressed natural gas	21,603	35,162	72,412	98,351	111,797	113,554	2.8%
Liquified natural gas	1,901	2,759	5,343	7,121	8,786	10,504	0.3%
M85[b]	1,593	2,023	1,212	585	440	330	0.0%
M100	3,166	2,150	449	437	406	0	0.0%
E85[b]	48	190	1,727	7,074	8,736	10,075	0.2%
E95[b]	80	995	59	13	0	0	0.0%
Electricity[c]	288	663	1,202	2,670	3,903	4,460	0.1%
Subtotal	**229,334**	**276,643**	**323,790**	**363,313**	**385,421**	**394,438**	**9.8%**
Oxygenates							
MTBE[d]	2,069,200	2,691,200	2,903,400	3,087,900	2,890,400	2,531,000	62.6%
Ethanol in gasohol	760,000	910,700	889,500	1,106,300	1,117,500	1,118,900	27.7%
Total	**3,122,534**	**3,878,543**	**4,116,690**	**4,564,329**	**4,418,752**	**4,044,338**	**100.0%**

Source:
U.S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 2000,* Washington, DC, September 2002, web site www.eia.doe.gov/cneaf/alternate/page/datatables/atf1-13_00.html, Table 10. (Additional resources: www.eia.doe.gov)

Note:
These data were released in September 2002. Please check the source web site for updates which were not available when this document went to press.

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

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

Table 2.4
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 2001[a]
(trillion Btu)

	Gasoline	Diesel fuel	Liquified petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity	Methanol	Total
HIGHWAY	**16,044.3**	**4,750.8**	**25.8**			**8.9**	**0.9**	**0.0**	**20,830.8**
Light vehicles	**15,489.9**	**302.1**	**9.7**			**0.0**		**0.0**	**15,801.7**
Automobiles	9,072.7	50.8				0.0		0.0	9,123.5
Light trucks[b]	6,393.4	251.3	9.7			0.0		0.0	6,654.4
Motorcycles	23.8								23.8
Buses	**7.4**	**185.7**	**0.1**			**8.9**	**0.9**	**0.0**	**203.1**
Transit	0.2	81.4	0.1			8.9	0.9	0.0	91.6
Intercity[c]		32.3							32.3
School[d]	7.2	72.0							79.2
Medium/heavy	**547.0**	**4,263.0**	**16.0**						**4,826.0**
OFF-HIGHWAY	**163.5**	**872.7**							**1,036.2**
Construction	**63.3**	**375.6**							**438.9**
Agriculture	**100.2**	**497.1**							**597.3**
NONHIGHWAY	**351.9**	**831.0**		**2,372.6**	**550.9**	**643.3**	**319.5**		**5,069.2**
Air	**38.4**			**2,372.6**					**2,411.0**
General aviation	38.4			126.7					165.1
Domestic air				1,892.4					1,892.4
International air				353.5					353.5
Water	**313.5**	**290.3**			**550.9**				**1,154.7**
Freight		290.3			550.9				841.2
Recreational	313.5								313.5
Pipeline						**643.3**	**245.4**		**888.7**
Rail		**540.7**					**74.1**		**614.8**
Freight (Class I)		517.3							517.3
Passenger		23.4					74.1		97.5
Transit		0.0					48.6		48.6
Commuter		10.0					15.9		25.9
Intercity[c]		13.4					9.6		23.0
TOTAL	**16,559.7**	**6,454.5**	**25.8**	**2,372.6**	**550.9**	**652.2**	**320.4**	**0.0**	**26,936.2**

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] 2000 data. 2001 data are not yet available.

The 2000 data have been revised to include the latest data available.

Table 2.5
Transportation Energy Use by Mode, 2000–2001[a]

	Trillion Btu		Percentage of total based on Btus		Thousand barrels per day crude oil equivalent[b]	
	2000	2001	2000	2001	2000	2001
HIGHWAY	**20,762.7**	**20,830.8**	**76.1%**	**77.3%**	**10,629.6**	**10,665.7**
Light vehicles	**15,737.4**	**15,801.7**	**57.7%**	**58.7%**	**8,233.2**	**8,267.8**
Automobiles	9,100.3	9,123.5	33.3%	33.9%	4,766.2	4,779.0
Light trucks[c]	6,610.9	6,654.4	24.2%	24.7%	3,453.3	3,476.4
Motorcycles	26.2	23.8	0.1%	0.1%	13.7	12.4
Buses	**208.3**	**203.1**	**0.8%**	**0.8%**	**98.4**	**96.1**
Transit	96.8	91.6	0.4%	0.3%	45.6	43.3
Intercity	32.3	32.3	0.1%	0.1%	15.2	15.2
School	79.2	79.2	0.3%	0.3%	37.6	37.6
Medium/heavy trucks	**4,817.9**	**4,826.0**	**17.7%**	**17.9%**	**2,298.0**	**2,301.8**
OFF-HIGHWAY	**943.7**	**1,036.2**	**3.5%**	**3.8%**	**449.3**	**495.8**
Construction	**383.0**	**438.9**	**1.4%**	**1.6%**	**181.4**	**209.7**
Agriculture	**560.7**	**597.3**	**2.1%**	**2.2%**	**267.9**	**286.1**
NONHIGHWAY	**5,586.1**	**5,069.2**	**20.5%**	**18.8%**	**2,201.4**	**1,978.4**
Air	**2,548.6**	**2,411.0**	**9.3%**	**9.0%**	**1,233.9**	**1,167.3**
General aviation	175.1	165.1	0.6%	0.6%	87.0	82.1
Domestic air carriers	2,004.0	1,892.4	7.3%	7.0%	968.3	914.4
International air	369.5	353.5	1.4%	1.3%	178.6	170.8
Water	**1,521.3**	**1,154.7**	**5.6%**	**4.3%**	**699.5**	**540.2**
Freight	1,210.1	841.2	4.4%	3.1%	537.1	376.6
Recreational	311.2	313.5	1.1%	1.2%	162.4	163.6
Pipeline	**908.4**	**888.7**	**3.3%**	**3.3%**	**11.3**	**12.8**
Rail	**607.8**	**614.8**	**2.2%**	**2.3%**	**256.7**	**258.1**
Freight	516.0	517.3	1.9%	1.9%	242.7	243.3
Passenger	91.8	97.5	0.3%	0.4%	14.0	14.8
Transit	47.2	48.6	0.2%	0.2%	2.2	2.5
Commuter	25.9	25.9	0.1%	0.1%	5.4	5.5
Intercity	18.7	23.0	0.1%	0.1%	6.4	6.8
TOTAL	**27,292.5**	**26,936.2**	**100.0%**	**100.0%**	**12,831.0**	**12,644.1**

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] This year, crude oil equivalent is not a simple conversion from Btu based on the average Btu in a barrel of oil. 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.

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

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

Table 2.6
Highway Transportation Energy Consumption by Mode, 1970–2001[a]
(trillion Btu)

Year	Autos	Light trucks	Light vehicles subtotal	Motor-cycles	Buses	Heavy trucks	Highway subtotal	Total transportation[b]
1970	8,479	1,539	10,018	7	129	1,553	11,707	15,321
1975	9,298	2,384	11,682	14	124	2,003	13,823	17,356
1976	9,826	2,602	12,428	15	134	2,114	14,691	18,426
1977	9,928	2,797	12,724	16	137	2,344	15,222	19,157
1978	10,134	3,020	13,153	18	141	2,607	15,919	20,126
1979	9,629	3,055	12,685	22	144	2,697	15,547	20,135
1980	8,800	2,975	11,774	26	143	2,686	14,629	18,979
1981	8,693	2,963	11,655	27	145	2,724	14,551	19,120
1982	8,673	2,837	11,510	25	151	2,707	14,393	18,560
1983	8,802	2,989	11,791	22	152	2,770	14,735	18,677
1984	8,837	3,197	12,034	22	146	2,873	15,075	19,323
1985	8,932	3,413	12,345	23	154	2,883	15,404	19,659
1986	9,138	3,629	12,767	23	160	2,958	15,908	20,277
1987	9,157	3,819	12,976	24	164	3,061	16,225	20,742
1988	9,158	4,077	13,235	25	169	3,118	16,548	21,280
1989	9,232	4,156	13,388	26	169	3,199	16,782	21,580
1990	8,688	4,451	13,139	24	167	3,334	16,663	21,689
1991	8,029	4,774	12,803	23	177	3,402	16,405	21,279
1992	8,169	5,117	13,286	24	184	3,468	16,963	21,939
1993	8,368	5,356	13,723	25	183	3,577	17,509	22,393
1994	8,470	5,515	13,984	26	183	3,778	17,976	22,997
1995	8,489	5,695	14,183	25	184	3,937	18,334	23,536
1996	8,634	5,917	14,551	24	186	4,045	18,813	24,042
1997	8,710	6,168	14,879	25	192	4,086	19,187	24,404
1998	8,936	6,305	15,241	26	196	4,218	19,686	24,839
1999	9,134	6,605	15,738	26	202	4,638	20,610	26,034
2000	9,100	6,611	15,711	26	208	4,819	20,764	26,350
2001	9,123	6,654	15,778	24	203	4,826	20,830	25,899
			Average annual percentage change					
1970–2001	0.2%	4.8%	1.5%	4.1%	1.5%	3.7%	1.9%	1.7%
1991–2001	1.3%	3.4%	2.1%	0.4%	1.4%	3.6%	2.4%	2.0%

Source:
See Appendix A for Highway Energy Use.

[a] These data have been revised slightly. See Appendix A for detailed methodologies.

[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).

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

Table 2.7
Nonhighway Transportation Energy Consumption by Mode, 1970–2001[a]
(trillion Btu)

Year	Air	Water	Pipeline	Rail	Nonhighway subtotal	Total transportation[b]
1970	1,307	753	995	558	3,614	15,321
1975	1,274	851	844	563	3,533	17,356
1976	1,333	1,010	807	585	3,735	18,426
1977	1,350	1,200	790	595	3,957	19,157
1978	1,423	1,405	787	592	4,201	20,126
1979	1,488	1,626	864	611	4,588	20,135
1980	1,434	1,424	900	592	4,353	18,979
1981	1,453	1,642	909	565	4,570	19,120
1982	1,445	1,378	859	485	4,164	18,560
1983	1,440	1,277	743	482	3,952	18,677
1984	1,609	1,315	785	538	4,242	19,323
1985	1,677	1,316	758	504	4,255	19,659
1986	1,823	1,314	738	494	4,369	20,277
1987	1,899	1,338	775	505	4,517	20,742
1988	1,978	1,358	878	518	4,732	21,280
1989	1,981	1,399	894	523	4,797	21,580
1990	2,077	1,508	928	514	5,026	21,689
1991	1,939	1,586	864	485	4,875	21,279
1992	1,970	1,659	849	497	4,977	21,939
1993	1,986	1,497	889	512	4,888	22,393
1994	2,070	1,449	955	546	5,021	22,997
1995	2,141	1,523	971	567	5,202	23,536
1996	2,206	1,460	984	580	5,229	24,042
1997	2,300	1,309	1,027	581	5,217	24,404
1998	2,371	1,295	901	585	5,153	24,839
1999	2,471	1,435	912	607	5,424	26,034
2000	2,549	1,521	908	608	5,586	26,350
2001	2,411	1,155	889	615	5,069	25,899
			Average annual percentage change			
1970–2001	2.0%	1.4%	-0.4%	0.3%	1.1%	1.7%
1991–2001	2.2%	-3.1%	0.3%	2.4%	0.4%	2.0%

Source:
See Appendix A for Nonhighway Energy Use.

[a] These data have been revised slightly. See Appendix A for detailed methodologies.
[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).

The use of diesel for off-highway purposes has grown from 1985 to 2001. The use of gasoline has declined in agriculture. The construction gasoline 2001 data cannot be compared due to changes in methodology (see footnote b).

Table 2.8
Off-Highway Use of Gasoline and Diesel, 1985–2001
(trillion Btu)

	Agriculture		Construction		Total	
Year	Gasoline	Diesel[a]	Gasoline	Diesel[a]	Gasoline	Diesel[a]
1985	135	430	31	211	166	641
1986	121	463	34	230	155	693
1987	115	416	35	216	150	632
1988	101	439	34	232	135	671
1989	103	466	37	234	140	700
1990	85	472	40	251	125	723
1991	97	438	35	228	132	666
1992	101	485	34	244	135	729
1993	106	473	31	292	137	765
1994	113	454	33	299	146	753
1995	116	482	35	301	151	783
1996	115	498	35	312	150	810
1997	123	492	38	316	161	808
1998	113	473	29	344	142	817
1999	88	473	22	345	110	818
2000	82	479	24	359	106	838
2001	100	497	63[b]	376	163[b]	873
			Average annual percentage change			
1985–2001	-1.9%	0.9%	[b]	3.7%	[b]	1.9%
1991–2001	0.3%	1.3%	[b]	5.1%	[b]	2.7%

Source:
Gasoline: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, Table MF-24, and annual. (Additional resources: www.fhwa.dot.gov)
Diesel: U.S. Department of Energy, Energy Information Administration, *Fuel Oil and Kerosene Sales 2001*, Washington, DC, Table 1, and annual. (Additional resources: www.eia.doe.gov)

[a] Unadjusted sales of distillate fuel oil.
[b] The FHWA methodology for calculating construction gasoline use changed in 2001. Previous years' data are likely underestimated.

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

Table 2.9
Highway Usage of Gasoline and Special Fuels, 1973–2001
(billion gallons)

Year	Gasoline	Gasohol	Ethanol used in gasohol[a]	Total gasoline and gasohol	Diesel[b]	Percent diesel	Total highway fuel use
1973	[c]	[c]	[c]	100.6	9.8	8.9%	110.5
1975	[c]	[c]	[c]	99.4	9.6	8.8%	109.0
1980	100.7	0.5	0.0	101.2	13.8	12.0%	115.0
1981	98.9	0.7	0.1	99.6	14.9	13.0%	114.5
1982	96.2	2.3	0.2	98.5	14.9	13.1%	113.4
1983	95.9	4.3	0.4	100.1	16.0	13.8%	116.1
1984	96.0	5.4	0.5	101.4	17.3	14.6%	118.7
1985	95.6	8.0	0.8	103.6	17.8	14.6%	121.3
1986	98.6	8.1	0.8	106.8	18.4	14.7%	125.2
1987	101.8	6.9	0.8	108.7	19.0	14.9%	127.7
1988	101.7	8.1	0.8	109.8	20.1	15.5%	129.9
1989	103.7	6.9	0.7	110.6	21.2	16.1%	131.9
1990	102.6	7.5	0.8	110.2	21.4	16.3%	131.6
1991	99.3	8.6	0.9	107.9	20.7	16.1%	128.6
1992	102.1	8.8	0.9	111.0	22.0	16.5%	132.9
1993	103.4	10.3	1.0	113.7	23.5	17.1%	137.2
1994	104.0	11.0	1.0	115.0	25.1	17.9%	140.1
1995	104.0	13.1	1.2	117.1	26.2	18.3%	143.3
1996	107.4	12.1	1.1	119.5	27.2	18.5%	146.7
1997	106.2	14.7	1.3	120.9	29.4	19.6%	150.3
1998	110.7	14.0	1.3	124.7	30.2	19.5%	154.9
1999	114.6	14.2	1.3	128.7	31.9	19.9%	160.7
2000	112.6	16.3	1.5	128.9	33.4	20.6%	162.3
2001	112.3	17.4	1.5	129.7	33.4	20.5%	163.1
			Average annual percentage change				
1973–2001	[d]	[d]	[d]	0.9%	4.5%		1.4%
1991–2001	1.2%	7.3%	5.2%	1.9%	4.9%		2.4%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2002, Tables MF-21 and MF-33E, and annual.
(Additional resources: www.fhwa.dot.gov)

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

Nearly all of the fuel ethanol used in the U.S. is made domestically. Twenty-eight percent of MTBE was imported in 2002.

Table 2.10
U.S. Production and Imports of MTBE[a] and Fuel Ethanol, 1985–2002
(million gallons)

	Production		Imports	
Year	Fuel ethanol	MTBE[a]	Fuel ethanol	MTBE[a]
1985	793	302	[b]	[b]
1990	756	[b]	[b]	[b]
1991	875	[b]	[b]	[b]
1992	1,080	1,542	[b]	[b]
1993	1,156	2,081	10	306
1994	1,280	2,205	12	595
1995	1,355	2,506	16	692
1996	974	2,846	13	733
1997	1,274	3,011	4	918
1998	1,387	3,151	3	1,040
1999	1,472	3,315	4	1,146
2000	1,633	3,253	5	1,176
2001	1,765	3,257	13	1,146
2002	2,132	3,133	13	907
		Average annual percentage change		
1985–2002	6.0%	14.8%	[b]	[b]
1992–2002	9.3%	[b]	[b]	[b]

Source:
Production - 1992–2002 Ethanol and MTBE: U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Monthly*, Washington, DC, January 2003, Table D1. 1985–91 Ethanol: Information Resources, Inc., Washington, DC, 1991. 1985 MTBE: EA-Mueller,Inc., Baltimore, MD, 1992.
Imports - U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual*, *2002, Volume 1,* Washington, DC, June 2003, Table 20, and annual. (Additional resources: www.eia.doe.gov)

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

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

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

Table 2.11
Passenger Travel and Energy Use, 2001

	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger-miles (millions)	Load factor (persons/vehicle)	Energy intensities (Btu per vehicle-mile)	Energy intensities (Btu per passenger-mile)	Energy use (trillion Btu)
Automobiles	**137,633.5**	**1,619,422**	**2,542,493**	**1.57**	**5,634**	**3,588**	**9,123.5**
Personal trucks	**64,637.0**	**677,798**	**1,165,812**	**1.72**	**6,989**	**4,063**	**4,736.8**
Motorcycles	**4,903.1**	**9,529**	**11,625**	**1.22**	**2,500**	**2,049**	**23.8**
Demand response	**34.6**	**789**	**855**	**1.1**	**14,375**	**13,271**	**11.3**
Vanpool	**5.4**	**71**	**490**	**6.9**	**8,738**	**1,273**	**0.6**
Buses	[a]	[a]	[a]	[a]	[a]	[a]	**203.2**
Transit	76.7	2,389	22,209	9.3	38,342	4,124	91.6
Intercity[b]	[a]	[a]	37,900	[a]	[a]	852	32.3
School[b]	607.8	[a]	[a]	[a]	[a]	[a]	79.3
Air	[a]	[a]	**581,888**	[a]	[a]	**4,143**	**2,411.0**
Certificated route[c]	[a]	5,925	565,988	95.5	379,055	3,968	2,245.9
General aviation	211.5	[a]	15,900	[a]	[a]	10,384	165.1
Recreational boats	**12,876.3**	[a]	[a]	[a]	[a]	[a]	**313.5**
Rail	**17.6**	**1,317**	**30,734**	**23.3**	**74,032**	**3,172**	**97.5**
Intercity[d]	0.4	378	5,571	14.7	60,847	4,137	23.0
Transit[e]	12.1	662	15,615	23.6	73,414	3,114	48.6
Commuter	5.1	277	9,548	34.5	93,502	2,717	25.9

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

[a] Data are not available.
[b] 2000 energy use data. 2001 data are not available.
[c] Includes domestic scheduled services and ½ of international scheduled services (Table 2.13 shows only domestic services). These energy intensities may be inflated because all energy use is attributed to passengers – cargo energy use is not taken into account.
[d] Amtrak only.
[e] Light and heavy rail.

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

Table 2.12
Energy Intensities of Highway Passenger Modes, 1970–2001

	Automobiles		Light truck[a]	Buses		
				Transit[b]		Intercity
Year	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)
1970	9,250	4,868	12,479	31,796	2,472	1,674
1975	8,993	4,733	11,879	33,748	2,814	988
1976	9,113	4,796	11,523	34,598	2,896	1,007
1977	8,950	4,710	11,160	35,120	2,889	970
1978	8,839	4,693	10,807	36,603	2,883	976
1979	8,647	4,632	10,467	36,597	2,795	1,028
1980	7,916	4,279	10,224	36,553	2,813	1,082
1981	7,670	4,184	9,997	37,745	3,027	1,051
1982	7,465	4,109	9,268	38,766	3,237	1,172
1983	7,365	4,092	9,124	37,962	3,177	1,286
1984	7,202	4,066	8,931	38,705	3,307	954
1985	7,164	4,110	8,730	38,876	3,423	964
1986	7,194	4,197	8,560	37,889	3,545	870
1987	6,959	4,128	8,359	36,247	3,594	940
1988	6,683	4,033	8,119	36,673	3,706	963
1989	6,589	4,046	7,746	36,754	3,732	964
1990	6,169	3,856	7,746	37,374	3,794	962
1991	5,912	3,695	7,351	37,732	3,877	963
1992	5,956	3,723	7,239	40,243	4,310	964
1993	6,087	3,804	7,182	39,043	4,262	962
1994	6,024	3,765	7,212	37,313	4,268	964
1995	5,902	3,689	7,208	37,277	4,310	964
1996	5,874	3,683	7,247	37,450	4,340	963
1997	5,797	3,646	7,251	38,832	4,431	963
1998	5,767	3,638	7,261	41,182	4,387	963
1999	5,821	3,684	7,330	40,460	4,332	964
2000	5,687	3,611	7,162	41,548	4,515	932
2001	5,634	3,588	7,095	38,341	4,125	[c]
			Average annual percentage change			
1970–2001	-1.6%	-1.0%	-1.8%	0.6%	1.7%	[c]
1991–2001	-0.5%	-0.3%	-0.4%	0.2%	0.6%	[c]

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 Transit Association (APTA).

[c]2001data are not yet available.

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

Table 2.13
Energy Intensities of Nonhighway Passenger Modes, 1970–2001

	Air		Rail		
Year	Certificated air carriers[a] (Btu per passenger-mile)	General aviation (Btu per passenger-mile)	Intercity Amtrak (Btu per passenger-mile)	Rail transit (Btu per passenger-mile)	Commuter rail (Btu per passenger-mile
1970	10,282	10,374	[b]	2,453	[b]
1975	7,826	10,658	3,677	2,962	[a]
1976	7,511	10,769	3,397	2,971	[a]
1977	6,990	11,695	3,568	2,691	[a]
1978	6,144	11,305	3,683	2,210	[a]
1979	5,607	10,787	3,472	2,794	[a]
1980	5,561	11,497	3,176	3,008	[a]
1981	5,774	11,123	2,957	2,946	[a]
1982	5,412	13,015	3,156	3,069	[a]
1983	5,133	11,331	2,957	3,212	[a]
1984	5,298	11,454	3,027	3,732	3,011
1985	5,053	11,707	2,800	3,461	3,053
1986	5,011	11,935	2,574	3,531	3,174
1987	4,827	11,496	2,537	3,534	3,043
1988	4,861	11,794	2,462	3,585	3,075
1989	4,844	10,229	2,731	3,397	3,120
1990	4,875	10,146	2,609	3,453	3,068
1991	4,662	9,869	2,503	3,710	3,011
1992	4,516	9,785	2,610	3,575	2,848
1993	4,490	9,653	2,646	3,687	3,222
1994	4,397	9,163	2,357	3,828	2,904
1995	4,349	9,870	2,590	3,818	2,849
1996	4,172	9,258	2,792	3,444	2,796
1997	4,166	9,688	2,918	3,253	2,946
1998	4,146	11,252	2,900	3,216	2,859
1999	4,061	12,206	3,062	3,168	2,929
2000	3,952	11,526	3,356	3,105	2,759
2001	3,968	10,384	4,137	3,114	2,717
			Average annual percentage change		
1970–2001	-3.0%	0.0%	0.4%[c]	0.8%	-0.3%[b]
1991–2001	-1.6%	0.5%	5.2%	-1.7%	-1.0%

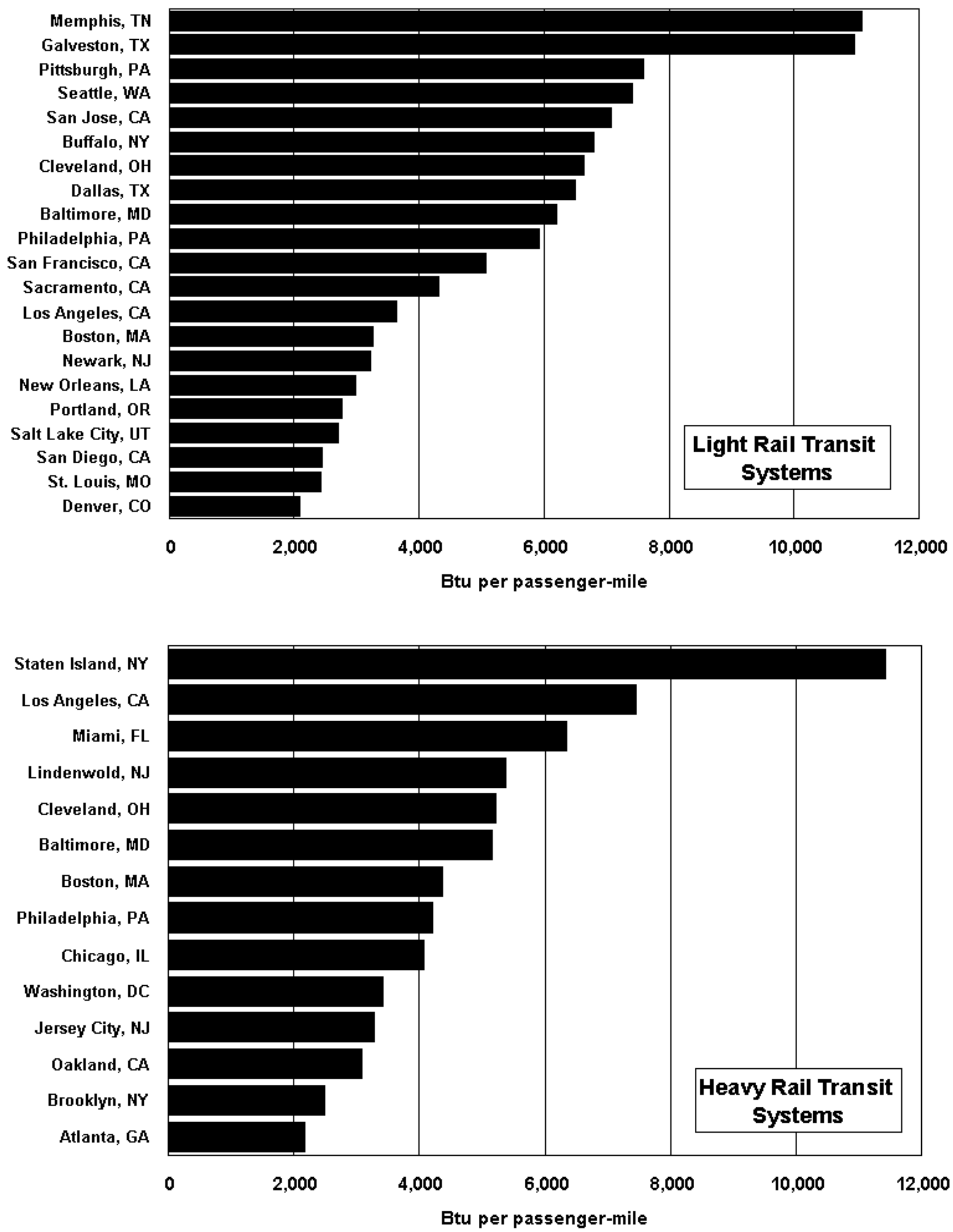
Source:
See Appendix A for Nonhighway Passenger Mode Energy Intensities.

[a] These data differ from the data on Table 2.11 because they do not include any 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.

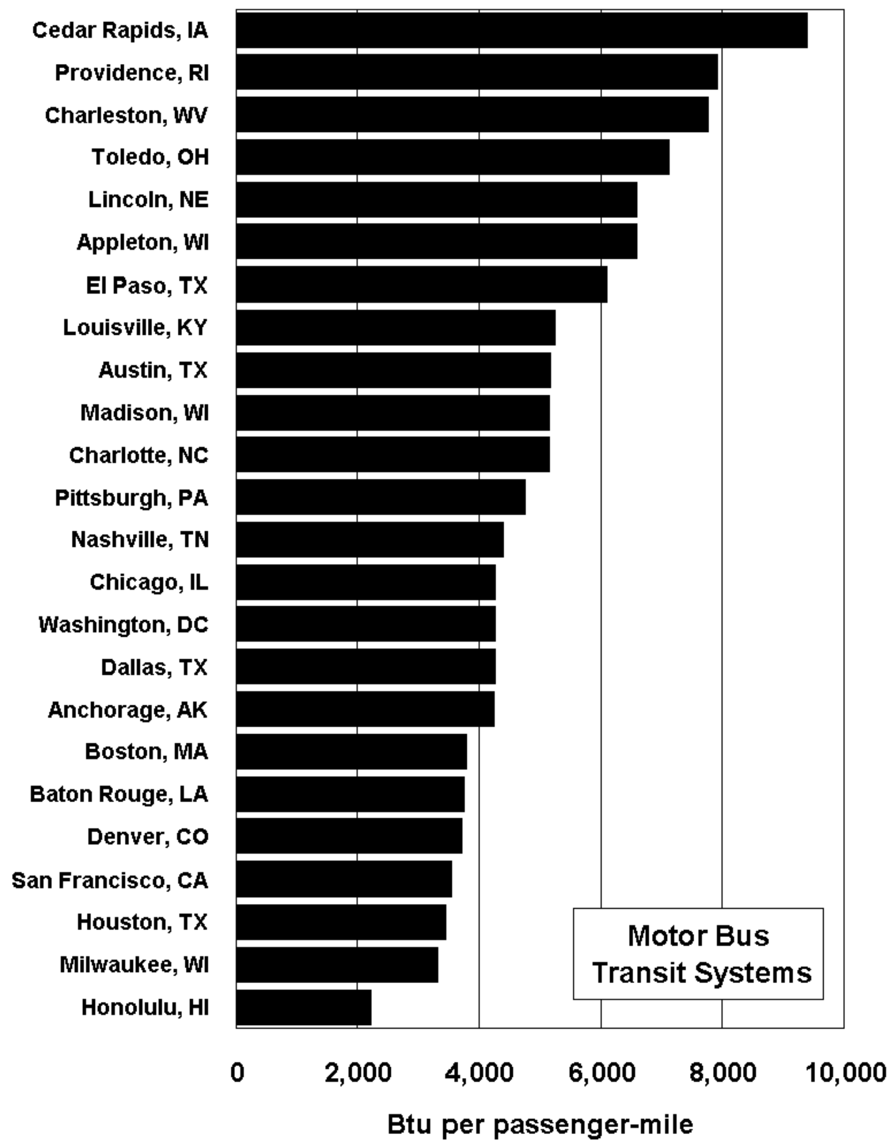
[c]Average annual percentage change begins with the earliest year possible.

Figure 2.2. Energy Intensities for Transit Rail, 2001



Source:
U.S. Department of Transportation, Federal Transit Administration, 2001 National Transit Databases, Washington, DC. (Additional resources: www.fta.dot.gov/ntl)

Figure 2.3. Energy Intensities for Selected Transit Bus Systems, 2001



Source:
U.S. Department of Transportation, Federal Transit Administration, 2001 National Transit Databases, Washington, DC. (Additional resources: www.fta.dot.gov/ntl)

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

Table 2.14
Intercity Freight Movement and Energy Use in the United States, 2001

	Trucks	Waterborne commerce	Class I railroads
Number of vehicles (thousands)	2,615	42	20[a]
Ton-miles (billions)	1,051	622	1,495
Tons shipped (millions)	4,122	1,037	1,742
Average length of haul (miles)	752[b]	600	859
Energy intensity (Btu/ton-mile)	3,337	444	346
Energy use (trillion Btu)	3,507	276	517

Source:
See Appendix A for Freight Movement and Energy Use.

[a] Number of locomotives.
[b] 717 miles is for general freight (less than truckload). Based on data from the Eno Transportation Foundation, the average length of haul for specialized freight (truckload) is 294 miles.

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

Table 2.15
Energy Intensities of Freight Modes, 1970–2001

Year	Heavy single-unit and combination trucks (Btu per vehicle-mile)	Class I freight railroad		Domestic waterborne commerce (Btu per ton-mile)
		(Btu per freight car-mile)	(Btu per ton-mile)	
1970	24,960	17,669	691	545
1971	24,485	18,171	717	506
1972	24,668	18,291	714	522
1973	24,777	18,468	677	576
1974	24,784	18,852	681	483
1975	24,631	18,739	687	549
1976	24,566	18,938	680	468
1977	24,669	19,226	669	458
1978	24,655	18,928	641	383
1979	24,745	19,188	618	436
1980	24,757	18,742	597	358
1981	25,058	18,629	572	360
1982	24,296	18,404	553	310
1983	23,852	17,864	525	286
1984	23,585	17,795	510	346
1985	23,343	17,500	497	446
1986	23,352	17,265	486	463
1987	22,922	16,790	456	402
1988	22,596	16,758	443	361
1989	22,411	16,894	437	403
1990	22,795	16,619	420	387
1991	22,749	15,835	391	386
1992	22,608	16,043	393	398
1993	22,373	16,056	389	389
1994	22,193	16,340	388	369
1995	22,096	15,992	372	374
1996	22,109	15,747	368	412
1997	21,340	15,784	370	415
1998	21,514	15,372	365	435
1999	22,880	15,363	363	457
2000	23,443	14,917	352	508
2001	23,237	15,107	346	444
		Average annual percentage change		
1970–2001	-0.2%	-0.5%	-2.2%	-0.7%
1991–2001	0.2%	-0.6%	-1.2%	1.4%

Source:
See Appendix A for Freight Mode Energy Intensities.

Nearly all of the fuel ethanol used in the U.S. is made domestically. Twenty-eight percent of MTBE was imported in 2002.

Table 2.10
U.S. Production and Imports of MTBE[a] and Fuel Ethanol, 1985–2002
(million gallons)

	Production		Imports	
Year	Fuel ethanol	MTBE[a]	Fuel ethanol	MTBE[a]
1985	793	302	[b]	[b]
1990	756	[b]	[b]	[b]
1991	875	[b]	[b]	[b]
1992	1,080	1,542	[b]	[b]
1993	1,156	2,081	10	306
1994	1,280	2,205	12	595
1995	1,355	2,506	16	692
1996	974	2,846	13	733
1997	1,274	3,011	4	918
1998	1,387	3,151	3	1,040
1999	1,472	3,315	4	1,146
2000	1,633	3,253	5	1,176
2001	1,765	3,257	13	1,146
2002	2,132	3,133	13	907
		Average annual percentage change		
1985–2002	6.0%	14.8%	[b]	[b]
1992–2002	9.3%	[b]	[b]	[b]

Source:
Production - 1992–2002 Ethanol and MTBE: U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Monthly*, Washington, DC, January 2003, Table D1. 1985–91 Ethanol: Information Resources, Inc., Washington, DC, 1991. 1985 MTBE: EA-Mueller,Inc., Baltimore, MD, 1992.
Imports - U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual*, *2002, Volume 1,* Washington, DC, June 2003, Table 20, and annual.

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

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

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

Table 2.11
Passenger Travel and Energy Use, 2001

	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger-miles (millions)	Load factor (persons/vehicle)	Energy intensities (Btu per vehicle-mile)	Energy intensities (Btu per passenger-mile)	Energy use (trillion Btu)
Automobiles	**137,633.5**	**1,619,422**	**2,542,493**	**1.57**	**5,634**	**3,588**	**9,123.5**
Personal trucks	**64,637.0**	**677,798**	**1,165,812**	**1.72**	**6,989**	**4,063**	**4,736.8**
Motorcycles	**4,903.1**	**9,529**	**11,625**	**1.22**	**2,500**	**2,049**	**23.8**
Demand response	**34.6**	**789**	**855**	**1.1**	**14,375**	**13,271**	**11.3**
Vanpool	**5.4**	**71**	**490**	**6.9**	**8,738**	**1,273**	**0.6**
Buses	[a]	[a]	[a]	[a]	[a]	[a]	**203.2**
Transit	76.7	2,389	22,209	9.3	38,342	4,124	91.6
Intercity[b]	[a]	[a]	37,900	[a]	[a]	852	32.3
School[b]	607.8	[a]	[a]	[a]	[a]	[a]	79.3
Air	[a]	[a]	**581,888**	[a]	[a]	**4,143**	**2,411.0**
Certificated route[c]	[a]	5,925	565,988	95.5	379,055	3,968	2,245.9
General aviation	211.5	[a]	15,900	[a]	[a]	10,384	165.1
Recreational boats	**128,876.0**	[a]	[a]	[a]	[a]	[a]	**313.5**
Rail	**17.6**	**1,317**	**30,734**	**23.3**	**74,032**	**3,172**	**97.5**
Intercity[d]	0.4	378	5,571	14.7	60,847	4,137	23.0
Transit[e]	12.1	662	15,615	23.6	73,414	3,114	48.6
Commuter	5.1	277	9,548	34.5	93,502	2,717	25.9

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

[a] Data are not available.
[b] 2000 energy use data. 2001 data are not available.
[c] Includes domestic scheduled services and ½ of international scheduled services.
[d] Amtrak only.
[e] Light and heavy rail.

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

Table 2.12
Energy Intensities of Highway Passenger Modes, 1970–2001

				Buses		
	Automobiles		Light truck[a]	Transit[b]		Intercity
Year	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)
1970	9,250	4,868	12,479	31,796	2,472	1,674
1975	8,993	4,733	11,879	33,748	2,814	988
1976	9,113	4,796	11,523	34,598	2,896	1,007
1977	8,950	4,710	11,160	35,120	2,889	970
1978	8,839	4,693	10,807	36,603	2,883	976
1979	8,647	4,632	10,467	36,597	2,795	1,028
1980	7,916	4,279	10,224	36,553	2,813	1,082
1981	7,670	4,184	9,997	37,745	3,027	1,051
1982	7,465	4,109	9,268	38,766	3,237	1,172
1983	7,365	4,092	9,124	37,962	3,177	1,286
1984	7,202	4,066	8,931	38,705	3,307	954
1985	7,164	4,110	8,730	38,876	3,423	964
1986	7,194	4,197	8,560	37,889	3,545	870
1987	6,959	4,128	8,359	36,247	3,594	940
1988	6,683	4,033	8,119	36,673	3,706	963
1989	6,589	4,046	7,746	36,754	3,732	964
1990	6,169	3,856	7,746	37,374	3,794	962
1991	5,912	3,695	7,351	37,732	3,877	963
1992	5,956	3,723	7,239	40,243	4,310	964
1993	6,087	3,804	7,182	39,043	4,262	962
1994	6,024	3,765	7,212	37,313	4,268	964
1995	5,902	3,689	7,208	37,277	4,310	964
1996	5,874	3,683	7,247	37,450	4,340	963
1997	5,797	3,646	7,251	38,832	4,431	963
1998	5,767	3,638	7,261	41,182	4,387	963
1999	5,821	3,684	7,330	40,460	4,332	964
2000	5,687	3,611	7,162	41,548	4,515	932
2001	5,634	3,588	7,095	38,341	4,125	[c]
			Average annual percentage change			
1970–2001	-1.6%	-1.0%	-1.8%	0.6%	1.7%	[c]
1991–2001	-0.5%	-0.3%	-0.4%	0.2%	0.6%	[c]

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 Transit Association (APTA).
[c]2001data are not yet available.

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

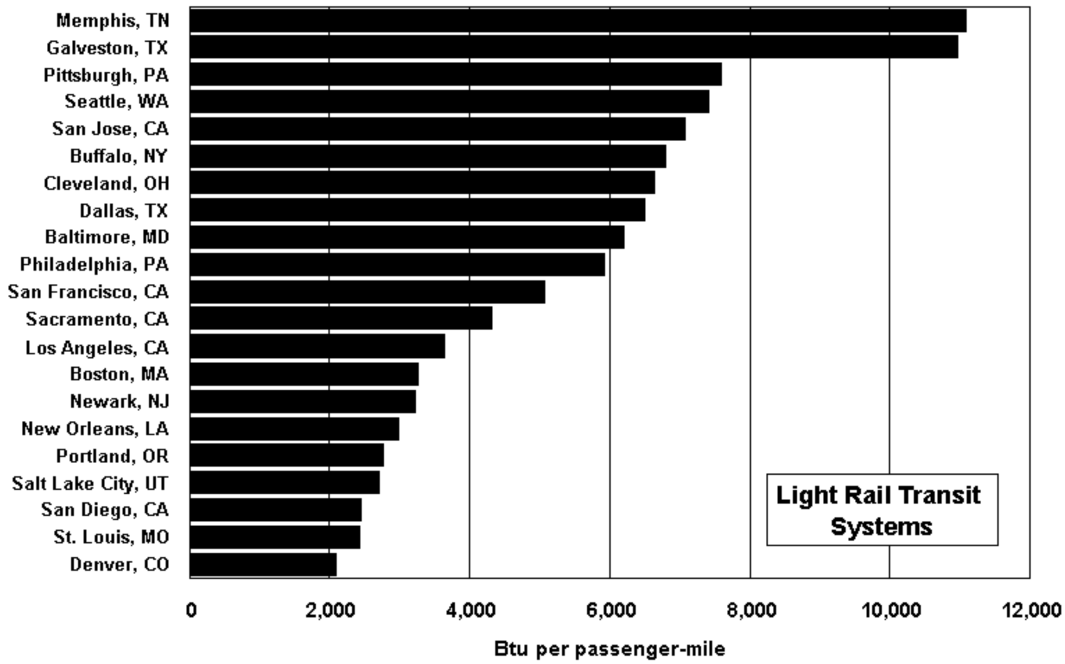
Table 2.13
Energy Intensities of Nonhighway Passenger Modes, 1970–2001

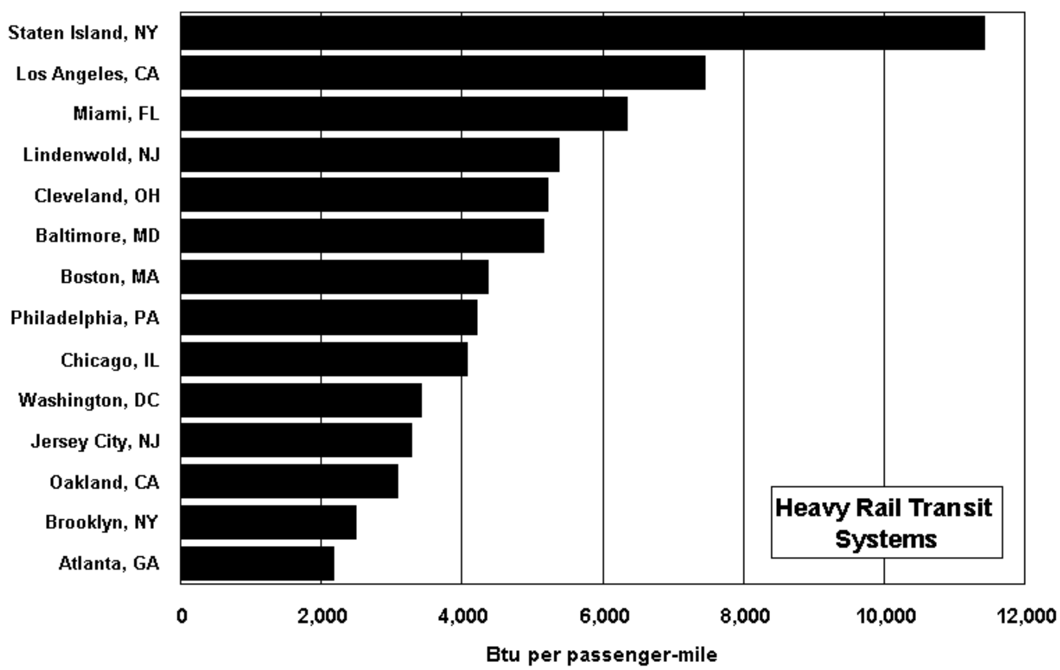
	Air		Rail		
Year	Certificated air carriers (Btu per passenger-mile)	General aviation (Btu per passenger-mile)	Intercity Amtrak (Btu per passenger-mile)	Rail transit (Btu per passenger-mile)	Commuter rail (Btu per passenger-mile
1970	10,282	10,374	[a]	2,453	[a]
1975	7,826	10,658	3,677	2,962	[a]
1976	7,511	10,769	3,397	2,971	[a]
1977	6,990	11,695	3,568	2,691	[a]
1978	6,144	11,305	3,683	2,210	[a]
1979	5,607	10,787	3,472	2,794	[a]
1980	5,561	11,497	3,176	3,008	[a]
1981	5,774	11,123	2,957	2,946	[a]
1982	5,412	13,015	3,156	3,069	[a]
1983	5,133	11,331	2,957	3,212	[a]
1984	5,298	11,454	3,027	3,732	3,011
1985	5,053	11,707	2,800	3,461	3,053
1986	5,011	11,935	2,574	3,531	3,174
1987	4,827	11,496	2,537	3,534	3,043
1988	4,861	11,794	2,462	3,585	3,075
1989	4,844	10,229	2,731	3,397	3,120
1990	4,875	10,146	2,609	3,453	3,068
1991	4,662	9,869	2,503	3,710	3,011
1992	4,516	9,785	2,610	3,575	2,848
1993	4,490	9,653	2,646	3,687	3,222
1994	4,397	9,163	2,357	3,828	2,904
1995	4,349	9,870	2,590	3,818	2,849
1996	4,172	9,258	2,792	3,444	2,796
1997	4,166	9,688	2,918	3,253	2,946
1998	4,146	11,252	2,900	3,216	2,859
1999	4,061	12,206	3,062	3,168	2,929
2000	3,952	11,526	3,356	3,105	2,759
2001	3,968	10,384	4,137	3,114	2,717
		Average annual percentage change			
1970–2001	-3.0%	0.0%	0.4%[b]	0.8%	-0.3%[b]
1991–2001	-1.6%	0.5%	5.2%	-1.7%	-1.0%

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

[a]Data are not available.
[b]Average annual percentage change begins with the earliest year possible.

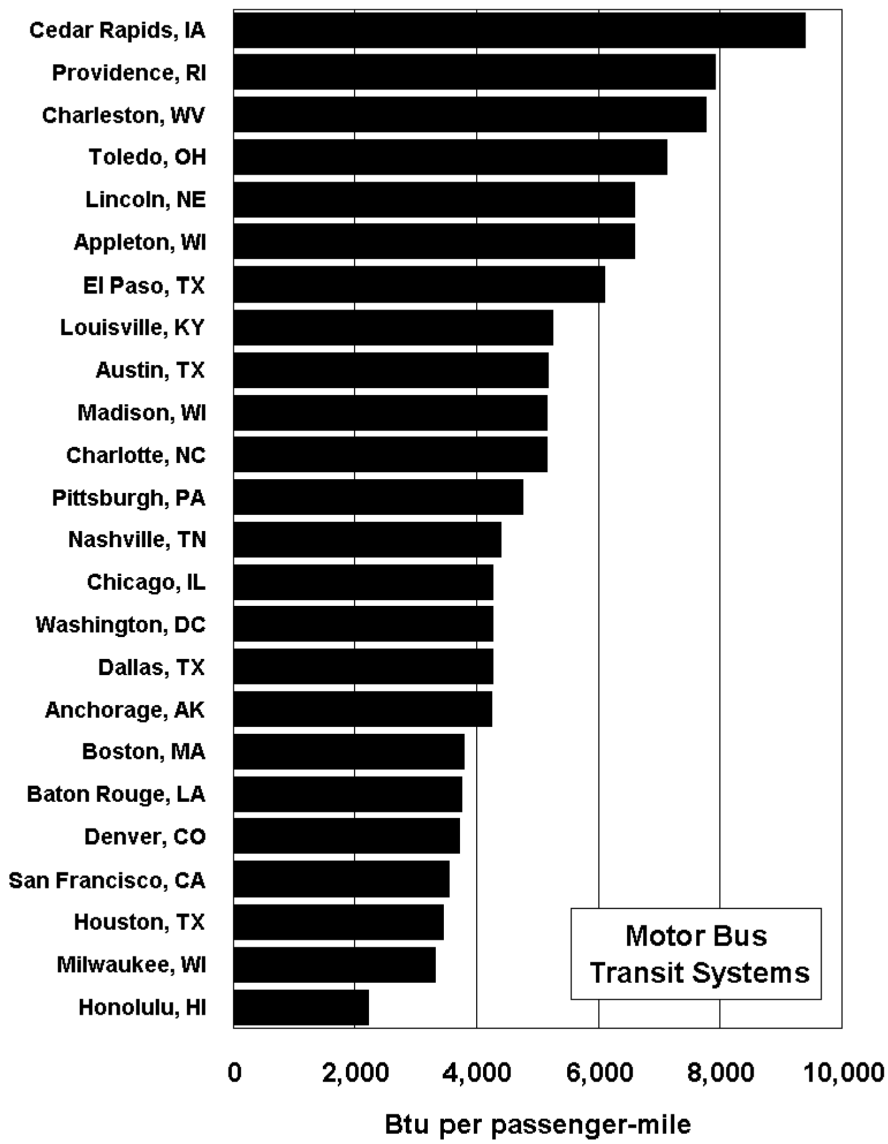
Figure 2.2. Energy Intensities for Transit Rail, 2001





Source:
U.S. Department of Transportation, Federal Transit Administration, 2001 National Transit Databases, Washington, DC.
(Additional resources: www.fta.dot.gov/ntl)

Figure 2.3. Energy Intensities for Selected Transit Bus Systems, 2001



Source:
U.S. Department of Transportation, Federal Transit Administration, 2001 National Transit Databases, Washington, DC.
(Additional resources: www.fta.dot.gov/ntl)

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

Table 2.14
Intercity Freight Movement and Energy Use in the United States, 2001

	Trucks	Waterborne commerce	Class I railroads
Number of vehicles (thousands)	2,615	42	20[a]
Ton-miles (billions)	1,051	622	1,495
Tons shipped (millions)	4,122	1,037	1,742
Average length of haul (miles)	752[b]	600	859
Energy intensity (Btu/ton-mile)	3,337	444	346
Energy use (trillion Btu)	3,507	276	517

Source:
See Appendix A for Freight Movement and Energy Use.

[a] Number of locomotives.
[b] 717 miles is for general freight (less than truckload). Based on data from the Eno Transportation Foundation, the average length of haul for specialized freight (truckload) is 294 miles.

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

Table 2.15
Energy Intensities of Freight Modes, 1970–2001

Year	Heavy single-unit and combination trucks (Btu per vehicle-mile)	Class I freight railroad (Btu per freight car-mile)	Class I freight railroad (Btu per ton-mile)	Domestic waterborne commerce (Btu per ton-mile)
1970	24,960	17,669	691	545
1971	24,485	18,171	717	506
1972	24,668	18,291	714	522
1973	24,777	18,468	677	576
1974	24,784	18,852	681	483
1975	24,631	18,739	687	549
1976	24,566	18,938	680	468
1977	24,669	19,226	669	458
1978	24,655	18,928	641	383
1979	24,745	19,188	618	436
1980	24,757	18,742	597	358
1981	25,058	18,629	572	360
1982	24,296	18,404	553	310
1983	23,852	17,864	525	286
1984	23,585	17,795	510	346
1985	23,343	17,500	497	446
1986	23,352	17,265	486	463
1987	22,922	16,790	456	402
1988	22,596	16,758	443	361
1989	22,411	16,894	437	403
1990	22,795	16,619	420	387
1991	22,749	15,835	391	386
1992	22,608	16,043	393	398
1993	22,373	16,056	389	389
1994	22,193	16,340	388	369
1995	22,096	15,992	372	374
1996	22,109	15,747	368	412
1997	21,340	15,784	370	415
1998	21,514	15,372	365	435
1999	22,880	15,363	363	457
2000	23,443	14,917	352	508
2001	23,237	15,107	346	444
		Average annual percentage change		
1970–2001	-0.2%	-0.5%	-2.2%	-0.7%
1991–2001	0.2%	-0.6%	-1.2%	1.4%

Source:
See Appendix A for Freight Mode Energy Intensities.

Chapter 3

All Highway Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 3.1	U.S. share of world automobile registrations, 2001	22.9%
Table 3.2	U.S. share of world truck & bus registrations, 2001	42.7%
Table 3.3	Number of U.S. automobiles, 2001 (thousands)	128,714
Table 3.3	Number of U.S. trucks, 2001 (thousands)	87,969
Table 3.5	Vehicle miles traveled, 2001 (million miles)	2,746,925
	Automobiles	*58.2%*
	Motorcycles	*0.3%*
	Two-axle, four-tire trucks	*33.7%*
	Other single-unit trucks	*2.6%*
	Combination trucks	*4.9%*
	Buses	*0.3%*
Table 3.8	Average age of vehicles, 2001	
	Automobiles (years)	*9.0*
	Trucks (years)	*7.9*
	Median lifetime of vehicles	
Table 3.9	*Automobiles (years)*	*16.9*
Table 3.10	*Light trucks (years)*	*15.5*

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

Table 3.1
Automobile Registrations for Selected Countries, 1950–2001
(thousands)

Year	China	India	Japan	France	United Kingdom	Germany[a]	Canada[b]	United States[c]	U.S. percentage of world[c]	World total
1950	[d]	[d]	43	[d]	2,307	[d]	1,913	40,339	76.0%	53,051
1955	[d]	[d]	153	[d]	360	[d]	2,961	52,145	71.4%	73,036
1960	[d]	[d]	457	4,950	5,650	4,856	4,104	61,671	62.7%	98,305
1965	[d]	[d]	2,181	8,320	9,131	9,719	5,279	75,258	53.8%	139,776
1970	[d]	[d]	8,779	11,860	11,802	14,376	6,602	89,244	46.1%	193,479
1975	[d]	[d]	17,236	15,180	14,061	18,161	8,870	106,706	41.0%	260,201
1980	351	[d]	23,660	18,440	15,438	23,236	10,256	121,601	38.0%	320,390
1985	795	1,607	27,845	20,800	18,953	26,099	11,118	127,885	34.5%	370,504
1990	1,622	2,694	34,924	23,010	22,528	30,695	12,622	133,700	30.7%	435,050
1991	1,852	2,954	37,076	23,550	22,744	31,309	12,578	128,300	29.1%	441,377
1992	2,262	3,205	38,963	24,020	23,008	37,579	12,781	126,581	28.0%	452,311
1993	2,860	3,361	40,772	24,385	23,402	39,202	12,927	127,327	28.3%	450,473
1994	3,497	3,569	42,678	24,900	23,832	39,918	13,122	127,883	27.0%	473,487
1995	4,179	3,837	44,680	25,100	24,307	40,499	13,183	128,387	26.9%	477,010
1996	4,700	4,246	46,868	25,500	24,864	41,045	13,300	129,728	26.7%	485,954
1997					Data are not available.					
1998	2,940[e]	4,820	49,896	26,800	22,115	41,674	13,887	131,839	27.5%	478,625
1999	3,400	5,200	51,164	27,480	27,539	42,423	16,538	126,869	26.7%	496,059
2000	3,750	5,150	52,437	28,060	27,185	43,772	16,832	127,721	23.3%	547,147
2001	4,325	5,750	53,300	28,700	27,790	44,383	17,055	128,714	22.9%	561,687
					Average annual percentage change					
1950–2001	[d]	[d]	15.0%	[d]	5.0%	[d]	4.4%	2.3%		4.7%
1970–2001	[d]	[d]	6.0%	2.9%	2.8%	3.7%	3.1%	1.2%		3.5%
1991–2001	8.9%	6.9%	3.7%	2.0%	2.0%	3.6%	3.1%	0.0%		2.4%

Source:
Ward's Communications, *Ward's World Motor Vehicle Data*, 2002 Edition, Southfield, MI, 2002, pp. 232–235 and annual.
(Additional resources: www.wardsauto.com)

[a] Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles.
[b] Data from 1991 and later are not comparable to prior data and data from 1999 and later are not comparable to prior data.
[c] Data from 1985 and later are not comparable to prior data.
[d] Data are not available.
[e] Data are not comparable to prior data due to reclassification of autos and trucks.

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

Table 3.2
Truck and Bus Registrations for Selected Countries, 1950–2001
(thousands)

Year	China	India	Japan	France	United Kingdom	Germany[a]	Canada[b]	United States[c]	U.S. percentage of world[c]	World total
1950	[d]	[d]	183	[d]	1,060	[d]	643	8,823	50.9%	17,349
1955	[d]	[d]	318	[d]	1,244	[d]	952	10,544	46.1%	22,860
1960	[d]	[d]	896	1,540	1,534	786	1,056	12,186	42.6%	28,583
1965	[d]	[d]	4,119	1,770	1,748	1,021	1,232	15,100	39.6%	38,118
1970	[d]	[d]	8,803	1,850	1,769	1,228	1,481	19,175	36.2%	52,899
1975	811	[d]	10,854	2,210	1,934	1,337	2,158	26,243	38.8%	67,698
1980	1,480	[d]	14,197	2,550	1,920	1,617	2,955	34,195	37.7%	90,592
1985	2,402	1,045	18,313	3,310	3,278	1,723	3,149	43,804	37.4%	117,038
1990	4,496	1,536	22,773	4,748	3,774	1,989	3,931	55,097	37.2%	148,073
1991	4,721	1,687	22,839	4,910	3,685	2,114	3,402	59,837	38.9%	153,695
1992	5,177	1,872	22,694	5,040	3,643	2,672	3,413	63,781	39.6%	161,219
1993	5,316	1,967	22,490	5,065	3,604	2,842	3,409	66,736	40.1%	166,614
1994	5,922	2,083	22,333	5,140	3,605	2,960	3,466	70,162	45.1%	155,591
1995	6,221	2,221	22,173	5,195	3,635	3,062	3,485	73,143	43.1%	169,749
1996	6,750	2,506	21,933	5,255	3,621	3,122	3,515	76,637	41.3%	185,404
1997				Data are not available						
1998	8,313[e]	2,610	20,919	5,500	3,169	4,357	3,694	79,062	44.0%	179,498
1999	9,400	3,000	20,559	5,609	3,392	3,370	722[f]	86,640	46.9%	188,367
2000	9,650	2,390	20,211	5,753	3,361	3,534	739[f]	85,579	42.1%	203,273
2001	10,212	2,663	19,985	5,897	3,412	3,592	729[f]	87,969	42.7%	206,218
				Average annual percentage change						
1950–2001	[d]	[d]	9.6%	[d]	2.3%	[d]	0.2%	4.6%		5.0%
1970–2001	[d]	[d]	2.7%	3.8%	2.1%	3.5%	-2.3%	5.0%		4.5%
1991–2001	8.0%	4.7%	-1.3%	1.8%	-0.8%	5.4%	-14.3%	3.9%		3.0%

Source:
Ward's Communications, *Ward's World Motor Vehicle Data*, 2002 Edition, Southfield, MI, 2002, pp. 232–235 and annual.
(Additional resources: www.wardsauto.com)

[a] Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles. Data from 1999 and later are not comparable to prior data.
[b] Data from 1991 and later are not comparable to prior data.
[c] Data from 1985 and later are not comparable to prior data.
[d] Data are not available.
[e] Data not comparable to prior data due to reclassification of autos and trucks.
[f] Canada

VEHICLES IN USE

Both the Federal Highway Administration (FHWA) and The Polk Company report figures on the automobile and truck population each year. The two estimates, however, differ by as much as 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 chasses, and utility vehicles as passenger cars or trucks causes important differences in the two estimates. The Polk Company data included passenger vans in the automobile count until 1980; since 1980 all vans have been counted as trucks. Recently, the Federal Highway Administration adjusted their definition of automobiles and trucks. Starting in 1993, some minivans and sport utility vehicles that were previously included with automobiles were included with trucks. This change produced a dramatic change in the individual percentage differences of cars and trucks. The difference in total vehicles has been less than 5% each year since 1990 and does not appear to be significantly affected by the FHWA reclassifications.
- The FHWA data include all non-military Federal vehicles, while The Polk Company data include only those Federal vehicles which are registered within a state. Federal vehicles are not required to have State registrations, and, according to the General Services Administration, most Federal Vehicles are not registered.

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

Table 3.3
U.S. Automobiles and Trucks in Use, 1970–2001
(thousands)

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

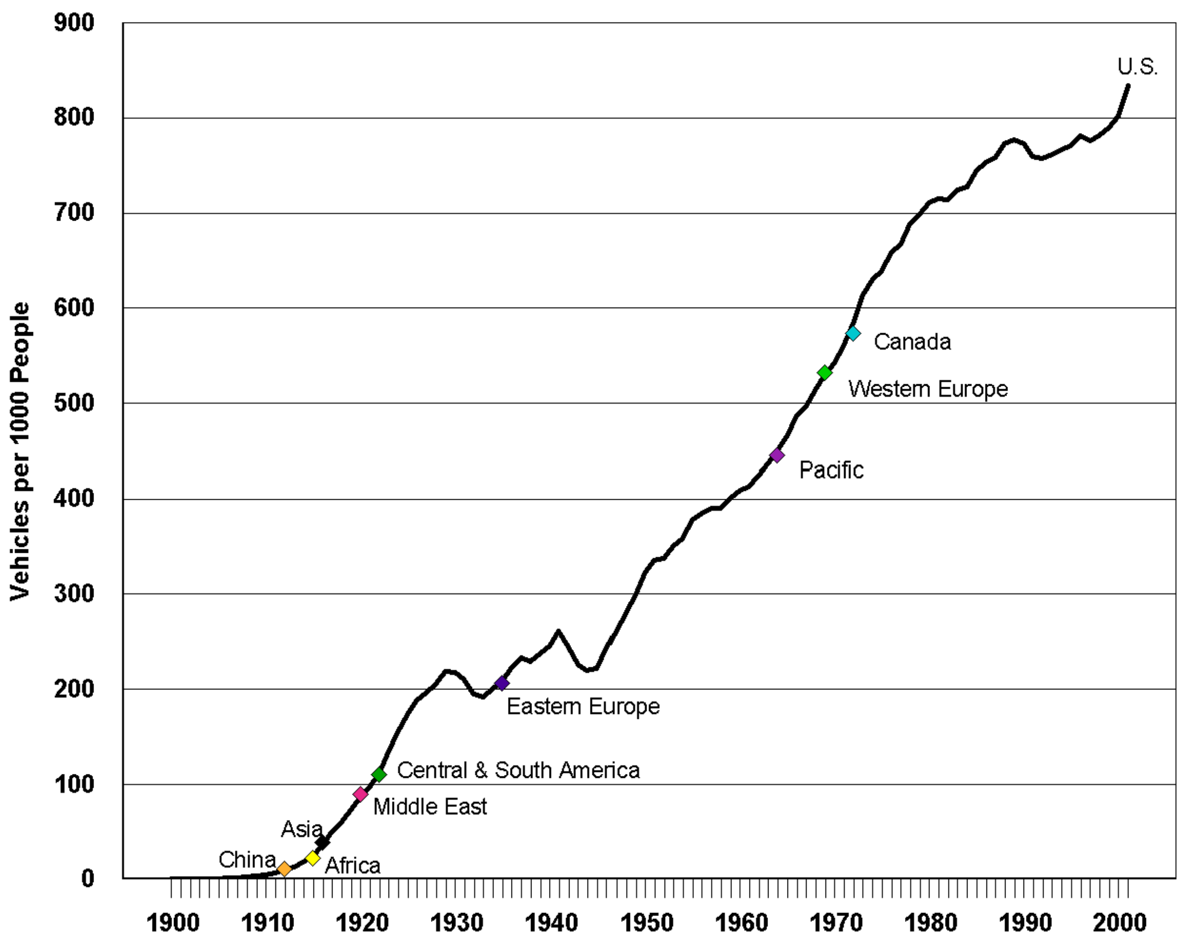
Source:

FHWA - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2002, Table VM-1, p. V-57, and annual. (Additional resources: www.fhwa.dot.gov)

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

The line on this graph shows the trend of vehicles per thousand people for the U.S. from 1900 to 2001. The symbols on the graph show the ***2001*** *vehicles per thousand people for other countries or regions around the world. Canada in 2001 had about the same ratio of vehicles to people as the U.S. did in 1972 and Western Europe had about the same ratio as the U.S. did in 1969. On the other end of the scale, China had about the same ratio of vehicles per thousand people in 2001 as the U.S. had in 1913 and Africa had about the same ratio as the U.S. did in 1915.*

Figure 3.1. Vehicles per Thousand People: U.S. Compared to Other Countries



Source:

Population – U.S.: U.S. Bureau of the Census, *Statistical Abstract of the United States: 2002*, Table No. 2. All others: United Nations Secretariat, Population Division, *World Urbanization Prospects, The 2001 Revision*, March 20, 2002.
(Additional resources: www.un.org/esa/population/unpop.htm

Vehicles – U.S.: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2003. All others: Ward's Communications, *Ward's Motor Vehicle Data 2002*, pp. 232-235.
(Additional resources: www.fhwa.dot.gov, www.wardsauto.com)

The data on automobile and light truck stock by size class are estimations based on historical sales data. This method assumes a constant scrappage rate for all size classes. The definitions for the size classes are in the Glossary. The data on trucks by weight class are based on estimates from the 1997 Vehicle Inventory and Use Survey (latest available survey) and a 2002 report entitled "Investigation of Class 2b Trucks (Vehicles of 8,500 to 10,000 lbs GVWR)."

Table 3.4
Vehicle Stock and New Sales in the United States, 2001 Calendar Year

	Vehicle stock[a]		New sales (in thousands)				
	Thousands	Share	Domestic		Import[b]		Total
Autos	128,714	100.0%	6,325	(75.1%)	2,098	(24.9%)	8,423
Two-seaters	1,908	1.5%	51	(42.5%)	69	(57.5%)	120
Minicompact	1,260	1.0%	0	(0.0%)	34	(100.0	34
Subcompact	26,294	20.4%	715	(76.5%)	220	(23.5%)	935
Compact	41,480	32.2%	2,150	(69.3%)	954	(30.7%)	3,104
Midsize	39,032	30.3%	1,961	(72.3%)	751	(27.7%)	2,712
Large	18,740	14.6%	1,448	(95.5%)	69	(4.5%)	1,517
Autos	128,714	100.0%	[c]	[c]	[c]	[c]	[c]
Business fleet autos	6,640	5.2%	[c]	[c]	[c]	[c]	[c]
Personal autos	122,074	94.8%	[c]	[c]	[c]	[c]	[c]
Trucks	87,969	100.0%	8,048	(88.9%)	1,002	(11.1%)	9,050
Less than 8,500 lbs.	75,835	86.2%	7,137	(88.0%)	978	(12.0%)	8,115
Small pickup	13,151	14.9%	821	(100.0%)	0	(0.0%)	821
Large pickup	21,880	24.9%	1,998	(100.0%)	0	(0.0%)	1,998
Small van	13,141	14.9%	1,113	(96.7%)	38	(3.3%)	1,151
Large van	5,497	6.2%	321	(97.6%)	8	(2.4%)	329
Small SUV	6,302	7.2%	578	(62.9%)	340	(37.1%)	918
Medium SUV	12,266	13.9%	1,542	(73.2%)	565	(26.8%)	2,107
Large SUV	3,599	4.1%	764	(96.7%)	26	(3.3%)	790
8,500 – 10,000 lbs.	6,416	7.3%	492	(100.0%)	0	(0.0%)	492
Pickup	4,728	5.4%	404	(100.0%)	0	(0.0%)	404
Van/SUV	1,687	1.9%	88	(100.0%)	0	(0.0%)	88
10,000 – 26,000 lbs.	2,639	3.0%	188	(88.8%)	24	(11.2%)	212
26,000 lbs. and over	3,079	3.5%	231	(99.7%)	1	(0.3%)	231
Trucks	87,969	100.0%	[c]	[c]	[c]	[c]	[c]
Business fleet trucks <= 19,500 lbs. GVW[d]	7,002	8.0%	[c]	[c]	[c]	[c]	[c]
Personal trucks <=19,500 lbs. GVW	77,008	87.5%	[c]	[c]	[c]	[c]	[c]
Trucks > 19,500 lbs. GVW	3,959	4.5%	[c]	[c]	[c]	[c]	[c]

Source:
See Appendix A Highway Vehicle Stock and New Sales for detailed methodology and sources.
(Additional resources: www.polk.com)

[a] Total auto and truck vehicle stocks as of July 1, 2001 from The Polk Company (FURTHER REPRODUCTION PROHIBITED).
[b] Includes domestic-sponsored imports.
[c] Data are not available.
[d] In fleets of four or more vehicles.

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 23% more travel in 2001 than in 1970, and automobiles account for 24% less travel in that time period.

Table 3.5
Shares of Highway Vehicle-Miles Traveled by Vehicle Type, 1970–2001

Year	Automobiles	Motorcycles	Two-axle, four-tire trucks	Other single-unit trucks	Combination trucks	Buses[a]	Total vehicle-miles traveled (million miles)
1970	82.6%	0.3%	11.1%	2.4%	3.2%	0.4%	1,109,724
1975	77.9%	0.4%	15.1%	2.6%	3.5%	0.5%	1,327,664
1980	72.8%	0.7%	19.0%	2.6%	4.5%	0.4%	1,527,295
1981	72.9%	0.7%	19.1%	2.5%	4.4%	0.4%	1,555,308
1982	72.8%	0.6%	19.2%	2.5%	4.4%	0.4%	1,595,010
1983	72.3%	0.5%	19.8%	2.6%	4.5%	0.3%	1,652,788
1984	71.3%	0.5%	20.8%	2.6%	4.5%	0.3%	1,720,269
1985	70.2%	0.5%	22.0%	2.6%	4.4%	0.3%	1,774,826
1986	69.2%	0.5%	23.1%	2.5%	4.4%	0.3%	1,834,872
1987	68.5%	0.5%	23.8%	2.5%	4.5%	0.3%	1,921,204
1988	67.6%	0.5%	24.8%	2.4%	4.4%	0.3%	2,025,962
1989	66.8%	0.5%	25.6%	2.4%	4.4%	0.3%	2,096,487
1990	65.7%	0.4%	26.8%	2.4%	4.4%	0.3%	2,144,362
1991	62.5%	0.4%	29.9%	2.4%	4.4%	0.3%	2,172,050
1992	61.0%	0.4%	31.5%	2.4%	4.4%	0.3%	2,247,151
1993	59.9%	0.4%	32.5%	2.5%	4.5%	0.3%	2,296,378
1994	59.6%	0.4%	32.4%	2.6%	4.6%	0.3%	2,357,588
1995	59.4%	0.4%	32.6%	2.6%	4.8%	0.3%	2,422,696
1996	59.1%	0.4%	32.8%	2.6%	4.8%	0.3%	2,485,848
1997	58.7%	0.4%	33.2%	2.6%	4.9%	0.3%	2,561,695
1998	58.9%	0.4%	33.0%	2.6%	4.9%	0.3%	2,631,522
1999	58.3%	0.4%	33.5%	2.6%	4.9%	0.3%	2,691,056
2000	58.3%	0.4%	33.6%	2.6%	4.9%	0.3%	2,746,925
2001	58.2%	0.3%	33.7%	2.6%	4.9%	0.3%	2,781,462
			Average annual percentage change				
1970–2001							3.0%
1991–2001							2.5%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2002, Table VM-1, p. V-57, and annual. (Additional resources: www.fhwa.dot.gov)

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

Table 3.6
Automobiles in Operation and Vehicle Travel by Age, 1970 and 2001

	1970			2001			2001 Estimated vehicle travel		
Age (years)	Vehicles (thousands)	Percentage	Cumulative percentage	Vehicles (thousands)	Percentage	Cumulative percentage	Percentage	Cumulative percentage	Average annual miles per vehicle
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%				
Age not given	22			0					
Total	80,449			128,714					
Average age		5.6			9.0				
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 website: nhts.ornl.gov.
(Additional resources: www.polk.com, nhts.ornl.gov)

[a]Includes automobiles 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 3.7
Trucks in Operation and Vehicle Travel by Age, 1970 and 2001

Age (years)	1970 Vehicles (thousands)	1970 Percentage	1970 Cumulative percentage	2001 Vehicles (thousands)	2001 Percentage	2001 Cumulative percentage	2001 Estimated vehicle travel Percentage	2001 Estimated vehicle travel Cumulative percentage	Average annual miles per vehicle
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.

The average age of automobiles was lower than the average age of trucks until 1995. Since then, the average automobile age continues to grow, while the average truck age has held about the same. The increasing popularity of light trucks as personal passenger vehicles may have had an influence on the average age of trucks.

Table 3.8
Average Age of Automobiles and Trucks in Use, 1970–2001
(years)

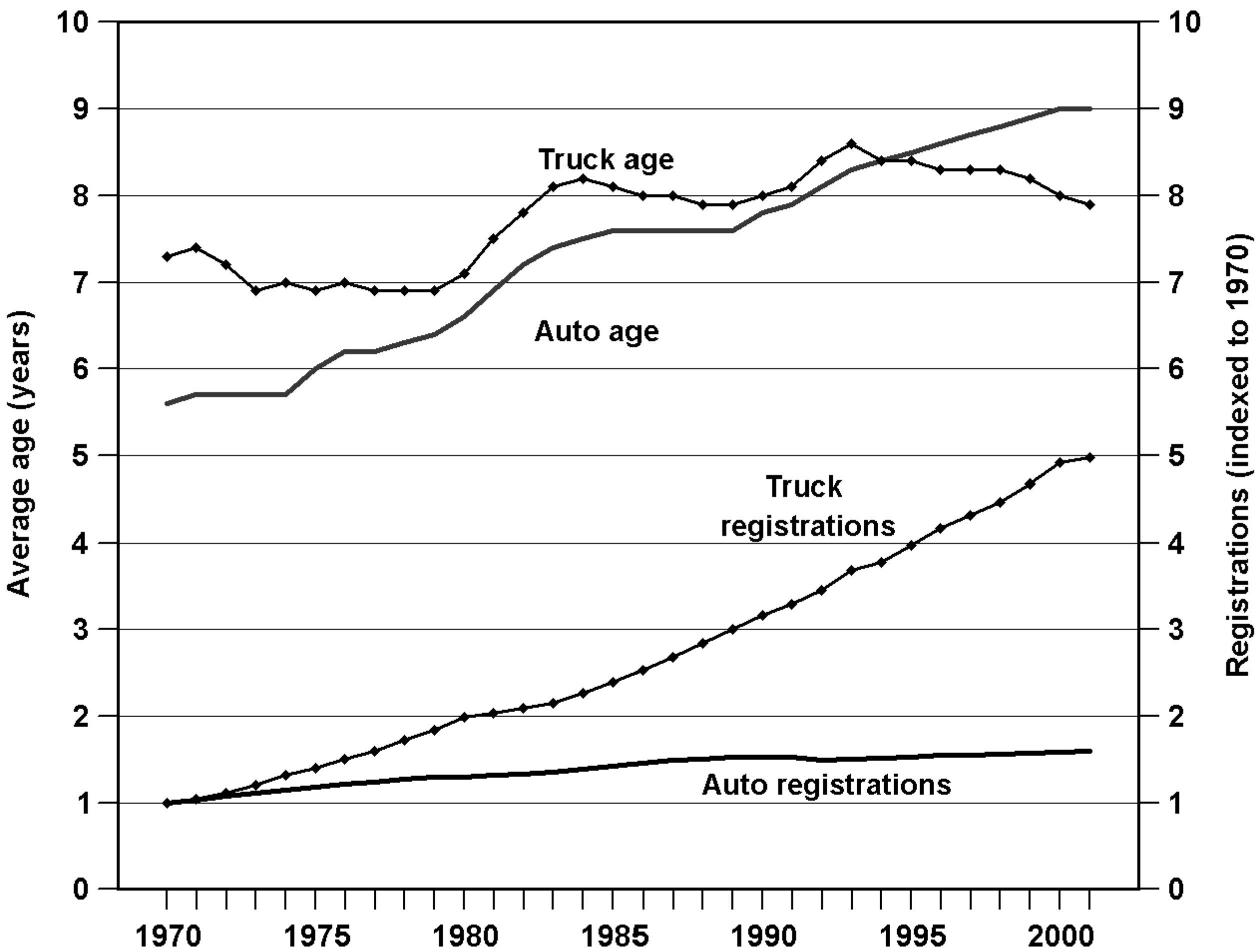
Calendar year	Automobiles		Trucks	
	Mean[a]	Median[b]	Mean[a]	Median[b]
1970	5.6	4.9	7.3	5.9
1971	5.7	5.1	7.4	6.1
1972	5.7	5.1	7.2	6.0
1973	5.7	5.1	6.9	5.8
1974	5.7	5.2	7.0	5.6
1975	6.0	5.4	6.9	5.8
1976	6.2	5.5	7.0	5.8
1977	6.2	5.6	6.9	5.7
1978	6.3	5.7	6.9	5.8
1979	6.4	5.9	6.9	5.9
1980	6.6	6.0	7.1	6.3
1981	6.9	6.0	7.5	6.5
1982	7.2	6.2	7.8	6.8
1983	7.4	6.5	8.1	7.2
1984	7.5	6.7	8.2	7.4
1985	7.6	6.9	8.1	7.6
1986	7.6	7.0	8.0	7.7
1987	7.6	6.9	8.0	7.8
1988	7.6	6.8	7.9	7.1
1989	7.6	6.5	7.9	6.7
1990	7.6	6.5	8.0	6.5
1991	7.8	6.7	8.1	6.8
1992	7.9	7.0	8.4	7.2
1993	8.1	7.3	8.6	7.5
1994	8.3	7.5	8.4	7.5
1995	8.4	7.7	8.4	7.6
1996	8.5	7.9	8.3	7.7
1997	8.6	8.1	8.3	7.8
1998	8.8	8.3	8.3	7.5
1999	8.9	8.3	8.2	7.2
2000	9.0	8.1	8.0	6.9
2001	9.0	8.1	7.9	6.8

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

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

The average age of trucks (classes 1-8) has historically been higher than the average age of automobiles. In 1995, however, this trend reversed, with average automobile age higher than average truck age for the first time. The recent boom in the sales of minivans, sport-utility vehicles, and pick-ups, which are classified as trucks, is influencing the average age of trucks. So many new light trucks are being added into the truck population, that the average age of trucks has been declining since 1993, while the average age of automobiles continues an upward trend.

Figure 3.2. Average Age and Registrations of Automobiles and Trucks, 1970–2001



Source:
See Tables 3.3 and 3.8.

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.*

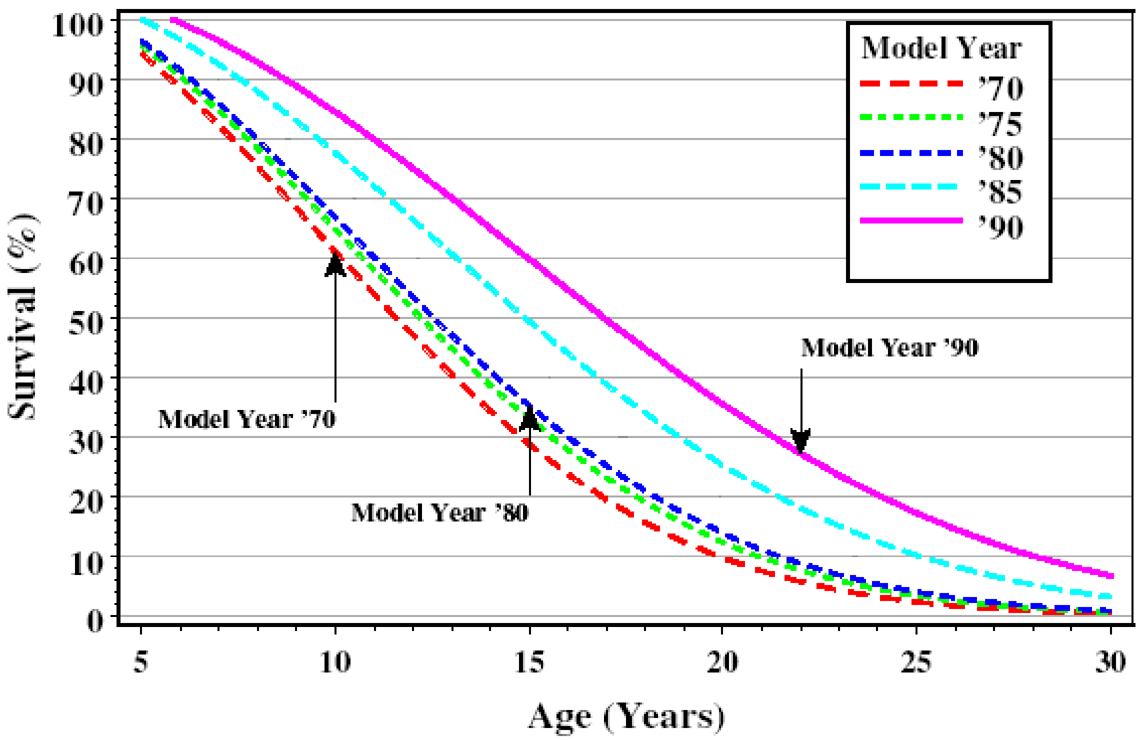
Table 3.9
Automobile Scrappage and Survival Rates
1970, 1980 and 1990 Model Years

Vehicle age[a] (years)	1970 model year		1980 model year		1990 model year	
	Survival rate[b]	Scrappage rate[c]	Survival rate[b]	Scrappage rate[c]	Survival rate[b]	Scrappage rate[c]
4	99.0	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.

[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.

Figure 3.3. Automobile Survival Rates



Source: See Table 3.9.

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.*

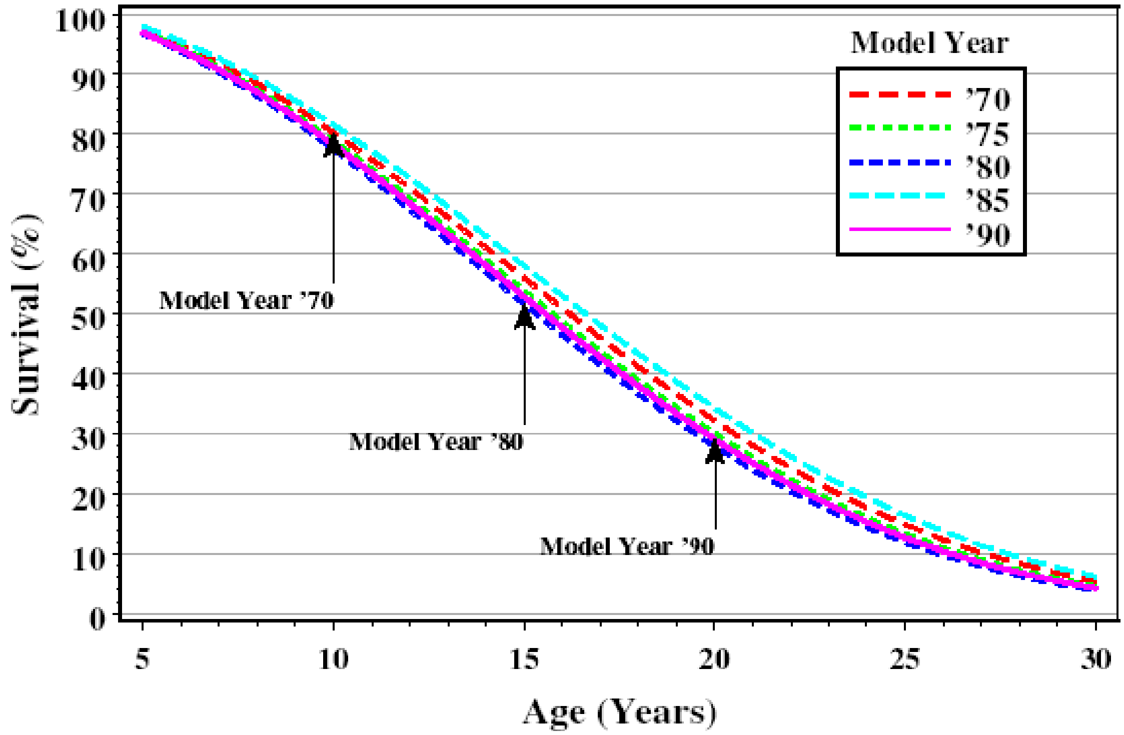
Table 3.10
Light Truck[a] Scrappage and Survival Rates

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

Figure 3.4. Light Truck Survival Rates



Source: See Table 3.10.

Using current registration data and a scrappage model by Greenspan and Cohen [1996 paper: http://www.federalreserve.gov/pubs/feds/1996/199640/199640pap.pdf], *ORNL calculated heavy truck (trucks over 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.*

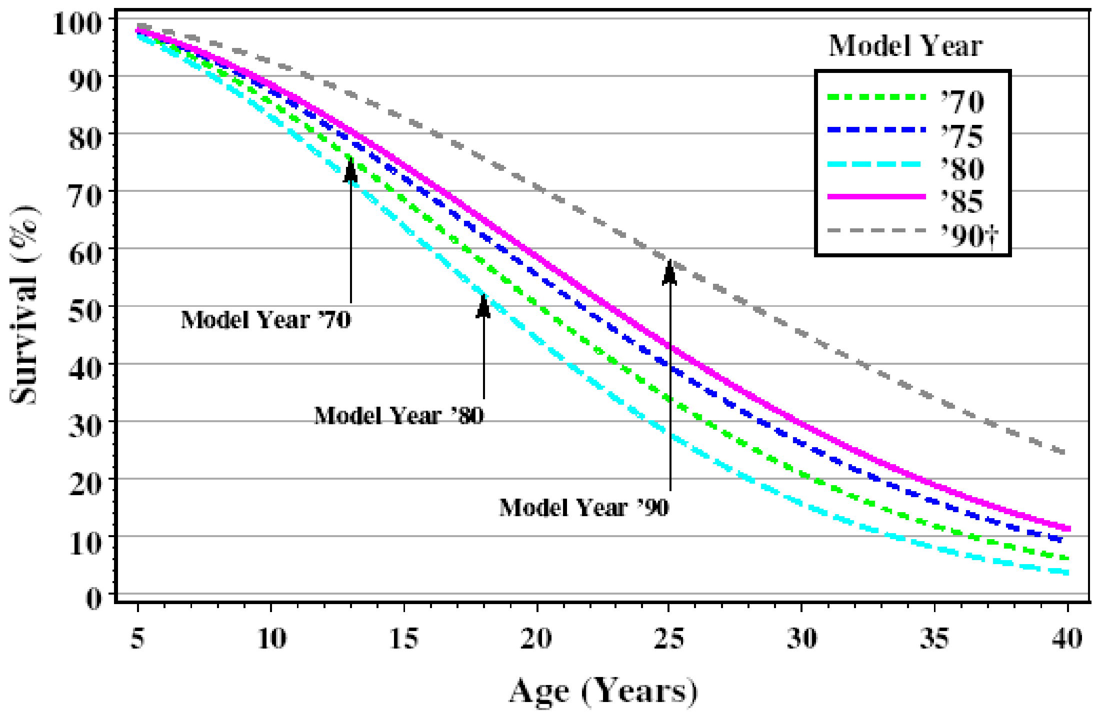
Table 3.11
Heavy Truck[a] Scrappage and Survival Rates

Vehicle age[b] (years)	1970 model year		1980 model year		1990 model year	
	Survival rate[c]	Scrappage rate[d]	Survival rate[b]	Scrappage rate[c]	Survival rate[b]	Scrappage rate[c]
4	98.8	1.2	98.5	1.5	99.4	0.6
5	97.2	1.6	96.7	1.9	98.6	0.8
6	95.3	1.9	94.5	2.3	97.6	1.0
7	93.2	2.3	92.0	2.7	96.5	1.2
8	90.7	2.6	89.1	3.1	95.2	1.3
9	88.1	3.0	86.0	3.5	93.8	1.5
10	85.2	3.3	82.7	3.9	92.2	1.7
11	82.1	3.6	79.1	4.3	90.5	1.9
12	78.8	4.0	75.4	4.7	88.6	2.0
13	75.4	4.3	71.6	5.1	86.7	2.2
14	71.9	4.7	67.7	5.5	84.6	2.4
15	68.3	5.0	63.7	5.9	82.4	2.6
16	64.6	5.3	59.7	6.3	80.2	2.7
17	61.0	5.7	55.7	6.7	77.9	2.9
18	57.3	6.0	51.8	7.1	75.5	3.1
19	53.7	6.3	47.9	7.4	73.0	3.3
20	50.1	6.7	44.2	7.8	70.5	3.4
21	46.6	7.0	40.6	8.2	68.0	3.6
22	43.2	7.3	37.1	8.6	65.4	3.8
23	39.9	7.6	33.7	9.0	62.8	3.9
24	36.7	8.0	30.6	9.4	60.3	4.1
25	33.7	8.3	27.6	9.7	57.7	4.3
26	30.8	8.6	24.8	10.1	55.1	4.5
27	28.0	8.9	22.2	10.5	52.6	4.6
28	25.4	9.3	19.8	10.9	50.0	4.8
29	23.0	9.6	17.6	11.2	47.6	5.0
30	20.7	9.9	15.5	11.6	45.1	5.1
Median lifetime	20.0 years		18.5 years		28.0 years	

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

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

Figure 3.5. Heavy Truck Survival Rates



Source: See Table 3.11.
Model year '90 estimates are based on minimal preliminary data.

Chapter 4
Light Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 4.1	Passenger cars, 2001	
	Registrations (thousands)	*137,633*
	Vehicle miles (million miles)	*1,600,287*
	Fuel economy (miles per gallon)	*21.9*
Table 4.2	Two-axle, four-tire trucks, 2001	
	Registrations (thousands)	*84,188*
	Vehicle miles (million miles)	*937,839*
	Fuel economy (miles per gallon)	*17.6*
Table 4.5	Light truck share of total light vehicle sales	
	1970 calendar year	*14.8%*
	2001 calendar year	*50.5%*
Table 4.7	Automobile sales, 2002 sales period	8,336,459
	Minicompact	*53,840*
	Subcompact	*636,397*
	Compact	*3,217,151*
	Midsize	*2,917,527*
	Large	*1,377,357*
	Two-seater	*134,187*
Table 4.8	Light truck sales, 2002 sales period	*8,673,079*
	Small pickup	*761,802*
	Large pickup	*2,209,671*
	Small van	*1,165,202*
	Large van	*349,706*
	Small SUV	*877,777*
	Medium SUV	*2,448,269*
	Large SUV	*860,652*
Tables 4.18	Corporate average fuel economy	(mpg)
and 4.19	*Automobile standard, MY 2002*	*27.5*
	Automobile fuel economy, MY 2002	*29.5*
	Light truck standard, MY 2002	*20.7*
	Light truck fuel economy, MY 2002	*21.8*
Table 4.24	Average fuel economy loss from 55 to 70 mph	17.1%

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

Table 4.1
Summary Statistics for Passenger Cars, 1970–2001

Year	Registrations[a] (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy[b] (miles per gallon)
1970	89,244	916,700	67,820	13.5
1971	92,718	966,330	71,346	13.5
1972	97,082	1,021,365	75,937	13.5
1973	101,985	1,045,981	78,233	13.4
1974	104,856	1,007,251	74,229	13.6
1975	106,706	1,033,950	74,140	13.9
1976	110,189	1,078,215	78,297	13.8
1977	112,288	1,109,243	79,060	14.0
1978	116,573	1,146,508	80,652	14.2
1979	118,429	1,113,640	76,588	14.5
1980	121,601	1,111,596	69,981	15.9
1981	123,098	1,133,332	69,112	16.4
1982	123,702	1,161,713	69,116	16.8
1983	126,444	1,195,054	70,322	17.0
1984	128,158	1,227,043	70,663	17.4
1985[c]	127,885	1,246,798	71,518	17.4
1986	130,004	1,270,167	73,174	17.4
1987	131,482	1,315,982	73,308	18.0
1988	133,836	1,370,271	73,345	18.7
1989	134,559	1,401,221	73,913	19.0
1990	133,700	1,408,266	69,568	20.2
1991	128,300	1,358,185	64,318	21.1
1992	126,581	1,371,569	65,436	21.0
1993	127,327	1,374,709	67,047	20.5
1994	127,883	1,406,089	67,874	20.7
1995	128,387	1,438,294	68,072	21.1
1996	129,728	1,469,854	69,221	21.2
1997	129,749	1,502,556	69,892	21.5
1998	131,839	1,549,577	71,695	21.4
1999	132,432	1,569,100	73,283	21.4
2000	133,621	1,600,287	73,065	21.9
2001	137,633	1,619,422	73,261	22.1
		Average annual percentage change		
1970–2001	1.4%	1.9%	0.2%	1.6%
1991–2001	0.7%	1.8%	1.3%	0.5%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2002, Table VM-1, p. V-57, and annual.
(Additional resources: www.fhwa.dot.gov)

[a] This number differs from R.L. Polk's estimates of "number of automobiles in use." See Table 3.3.
[b] Fuel economy for automobile population.
[c] Beginning in this year the data were revised to exclude minivans, pickups and sport utility vehicles which may have been previously included.

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

Table 4.2
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970–2001

Year	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	14,211	123,286	12,313	10.0
1971	15,181	137,870	13,484	10.2
1972	16,428	156,622	15,150	10.3
1973	18,083	176,833	16,828	10.5
1974	19,335	182,757	16,657	11.0
1975	20,418	200,700	19,081	10.5
1976	22,301	225,834	20,828	10.8
1977	23,624	250,591	22,383	11.2
1978	25,476	279,414	24,162	11.6
1979	27,022	291,905	24,445	11.9
1980	27,876	290,935	23,796	12.2
1981	28,928	296,343	23,697	12.5
1982	29,792	306,141	22,702	13.5
1983	31,214	327,643	23,945	13.7
1984	32,106	358,006	25,604	14.0
1985[a]	37,214	390,961	27,363	14.3
1986	39,382	423,915	29,074	14.6
1987	41,107	456,870	30,598	14.9
1988	43,805	502,207	32,653	15.4
1989	45,945	536,475	33,271	16.1
1990	48,275	574,571	35,611	16.1
1991	53,033	649,394	38,217	17.0
1992	57,091	706,863	40,929	17.3
1993	59,994	745,750	42,851	17.4
1994	62,904	764,634	44,112	17.3
1995	65,738	790,029	45,605	17.3
1996	69,134	816,540	47,354	17.2
1997	70,224	850,739	49,389	17.2
1998	71,330	868,275	50,462	17.2
1999	75,356	901,022	52,859	17.0
2000	79,085	923,059	52,939	17.4
2001	84,188	937,839	53,294	17.6
		Average annual percentage change		
1970–2001	5.9%	6.8%	4.8%	1.8%
1991–2001	4.7%	3.7%	3.4%	0.3%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2002, Table VM-1, p. V-57, and annual. (Additional resources: www.fhwa.dot.gov)

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

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.

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)
Class 1	5.7	49.7	0.3%	7.3	672.7	37.4
Class 2a	1.8	19.2	2.5%	7.4	251.9	18.0
Class 2b	0.5	5.8	24.0%	8.6	76.7	5.5

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 (8,5001- 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.

Over one-quarter of autos sold in 2002 were transplants–autos built in the U.S. by a foreign firm.

Table 4.5
New Retail Automobile Sales in the United States, 1970–2002

Calendar year	Domestic[a] (thousands)	Import[b] (thousands)	Total (thousands)	Percentage imports	Percentage transplants[c] on model year basis	Percentage imports and transplants	Percentage diesel
1970	7,119	1,285	8,404	15.3%	[d]	[d]	[d]
1975	7,053	1,571	8,624	18.2%	[d]	[d]	0.31%
1980	6,581	2,398	8,979	26.7%	2.1%	28.8%	4.31%
1981	6,209	2,327	8,536	27.3%	1.8%	29.1%	6.10%
1982	5,759	2,223	7,982	27.9%	1.4%	29.3%	4.44%
1983	6,795	2,387	9,182	26.0%	1.3%	27.3%	2.09%
1984	7,952	2,439	10,391	23.5%	2.0%	25.5%	1.45%
1985	8,205	2,838	11,043	25.7%	2.2%	27.9%	0.82%
1986	8,215	3,238	11,453	28.3%	2.8%	31.1%	0.37%
1987	7,081	3,197	10,278	31.1%	5.2%	36.3%	0.16%
1988	7,526	3,099	10,626	29.2%	5.8%	35.0%	0.02%
1989	7,073	2,825	9,898	28.5%	7.3%	35.8%	0.13%
1990	6,897	2,404	9,301	25.8%	11.2%	37.0%	0.08%
1991	6,137	2,038	8,175	24.9%	13.7%	38.6%	0.10%
1992	6,277	1,937	8,213	23.6%	14.1%	37.7%	0.06%
1993	6,742	1,776	8,518	20.9%	14.9%	35.8%	0.03%
1994	7,255	1,735	8,990	19.3%	16.5%	35.8%	0.04%
1995	7,129	1,506	8,635	17.4%	18.9%	36.3%	0.04%
1996	7,255	1,271	8,526	14.9%	22.3%	37.2%	0.10%
1997	6,917	1,355	8,272	16.4%	23.7%	40.1%	0.09%
1998	6,762	1,380	8,142	16.9%	25.1%	42.0%	0.13%
1999	6,979	1,719	8,698	19.8%	24.6%	44.4%	0.16%
2000	6,831	2,016	8,847	22.8%	24.4%	47.2%	0.26%
2001	6,325	2,098	8,423	24.9%	26.0%	50.9%	0.18%
2002	5,878	2,226	8,104	27.5%	26.7%	54.2%	0.39%
			Average annual percentage change				
1970–2002	-0.6%	1.7%	-0.1%				
1992–2002	-0.7%	1.4%	-0.1%				

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*. 1998–2002: Ward's Communication, *Ward's Motor Vehicle Facts and Figures*, Detroit, MI, 2000, p. 15.
Diesel data - Ward's Communications, *Ward's Automotive Yearbook*, Detroit, MI, 2003, p. 52, and annual.
Transplant data - Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares Data System, Oak Ridge, TN, 2002. (Additional resources: www.aama.com, www.wardsauto.com)

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

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

Table 4.6
New Retail Sales of Trucks 10,000 Pounds GVW and Less in the United States, 1970–2002

		Percentages					
Calendar year	Light truck sales[a] (thousands)	Import[b]	Transplants[c]	Diesel[d]	Four-wheel drive of domestic light trucks[d]	Light trucks of light-duty vehicle sales[e]	Light trucks of total truck sales
1970	1,463	4.5%	[f]	[g]	[f]	14.8%	80.4%
1975	2,281	10.0%	[f]	[g]	23.4%	20.9%	87.9%
1980	2,440	19.7%	0.9%	3.6%	20.7%	21.4%	88.9%
1981	2,189	20.3%	0.0%	3.1%	18.6%	20.4%	89.8%
1982	2,470	16.5%	0.0%	8.5%	16.8%	23.6%	92.8%
1983	2,984	15.6%	0.0%	6.7%	28.5%	24.5%	93.6%
1984	3,863	15.7%	2.0%	4.8%	27.0%	27.1%	93.0%
1985	4,458	17.2%	2.6%	3.8%	29.1%	28.8%	93.6%
1986	4,594	20.1%	2.3%	3.7%	27.0%	28.6%	94.3%
1987	4,610	17.9%	1.7%	2.3%	32.0%	31.0%	93.9%
1988	4,800	12.6%	2.4%	2.3%	32.1%	31.1%	93.2%
1989	4,610	10.9%	2.6%	2.9%	31.4%	31.8%	93.3%
1990	4,548	13.2%	3.4%	3.1%	31.6%	32.8%	93.9%
1991	4,123	12.8%	4.5%	3.2%	34.4%	33.5%	94.5%
1992	4,629	8.6%	5.5%	3.3%	31.6%	36.0%	94.4%
1993	5,351	6.8%	7.1%	3.7%	32.6%	38.6%	94.2%
1994	6,033	6.5%	8.1%	3.9%	34.4%	40.2%	94.0%
1995	6,053	6.5%	7.5%	4.1%	39.1%	41.2%	93.4%
1996	6,519	6.6%	8.4%	3.7%	35.7%	43.3%	94.1%
1997	6,797	8.4%	7.0%	4.8%	39.6%	46.6%	94.1%
1998	7,299	8.9%	7.6%	1.7%	43.8%	47.3%	93.3%
1999	8,073	9.5%	8.7%	5.9%	43.3%	48.1%	92.6%
2000	8,387	9.9%	11.3%	4.8%	41.7%	48.7%	93.9%
2001	8,700	11.3%	12.8%	5.3%	42.2%	50.8%	96.1%
2002	8,713	12.2%	12.1%	4.9%	46.4%	51.8%	96.4%
			Average annual percentage change				
1970–2002	5.7%						
1992–2002	6.5%						

Source:
Four-wheel drive and diesel - 1970–88: Ward's Communications, *Ward's Automotive Yearbook*, Detroit, MI, 1989, p. 168, and annual. 1989–on: Ward's Communications, *Ward's Automotive Yearbook*, Factory Installation Reports, Detroit, MI, 2003, and annual.
Transplants - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1996.
All other - 1970–97: American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1998*, Detroit, MI, 1998, pp. 8, 15, 24, and annual. 1998–on: Ward’s Communications, *Ward’s 2003 Motor Vehicle Facts and Figures*, Detroit, MI, p. 24, and annual. (Additional resources: www.aama.com, www.wardsauto.com)

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

The sales-weighted fuel economy of automobiles increased dramatically from 1976 (17.2 mpg) to 1990 (27.6 mpg), but has risen only about 1 mpg since then.

Table 4.7
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Automobiles, Selected Sales Periods[a] 1976–2002

Sales Period[a]	1976	1980	1985	1990	1995	2000	2001	2002
MINICOMPACT								
Total sales, units	–	428,346	52,295	76,698	44,752	19,245	33,206	53,840
Market share, %	–	4.7	0.5	0.8	0.5	0.2	0.4	0.6
Fuel economy, mpg	–	29.4	32.7	26.4	27.0	25.6	24.6	26.2
SUBCOMPACT								
Total sales, units	2,625,929	3,441,480	2,382,339	2,030,226	1,518,209	1,789,350	922,287	636,397
Market share, %	27.1	37.8	21.7	22.0	17.4	19.9	11.1	7.6
Fuel economy, mpg	23.5	27.3	30.1	31.3	31.7	31.1	29.6	27.6
COMPACT								
Total sales, units	2,839,603	599,423	3,526,118	3,156,481	3,289,735	2,397,813	3,058,389	3,217,151
Market share, %	29.3	6.6	32.1	34.2	37.7	26.7	36.8	38.6
Fuel economy, mpg	17.1	22.3	29.6	28.9	30.2	30.4	31.3	31.5
MIDSIZE								
Total sales, units	1,815,505	3,073,103	3,117,817	2,511,503	2,498,521	3,352,198	2,669,116	2,917,527
Market share, %	18.7	33.8	28.4	27.2	28.6	37.3	32.1	35.0
Fuel economy, mpg	15.3	21.3	24.9	25.9	25.9	26.8	27.2	27.4
LARGE								
Total sales, units	2,206,102	1,336,190	1,516,249	1,279,092	1,320,608	1,297,237	1,506,890	1,377,357
Market share, %	22.8	14.7	13.8	13.9	15.1	14.4	18.1	16.5
Fuel economy, mpg	13.9	19.3	22.3	23.5	24.1	25.3	25.4	25.5
TWO SEATER								
Total sales, units	199,716	215,964	373,697	170,465	53,045	122,259	118,097	134,187
Market share, %	2.1	2.4	3.4	1.8	0.6	1.4	1.4	1.6
Fuel economy, mpg	20.1	21.0	27.6	28.0	24.7	25.8	26.5	25.2
TOTAL								
Total sales, units	9,686,855	9,094,506	10,968,51	9,224,465	8,724,870	8,978,102	8,307,985	8,336,459
Market share, %	100	100	100	100	100	100	100	100
Fuel economy, mpg	17.2	23.2	27.0	27.6	28.0	28.2	28.5	28.5

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2003. (Additional resources: www-cta.ornl.gov)

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

Light truck sales have more than tripled from 1976 to 2001. Similar to the automobile trend, the sales-weighted fuel economy of light trucks increased during the late '70's and '80's, but has remained fairly constant since then.

Table 4.8
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Light Trucks, Selected Sales Periods[a] 1976–2002

Sales Period[a]	1976	1980	1985	1990	1995	2000	2001	2002
SMALL PICKUP								
Total sales, units	170,351	516,412	863,584	1,135,727	1,067,764	1,071,730	819,033	761,802
Market share, %	7.1	23.3	20.4	25.2	18.0	12.9	10.2	8.8
Fuel economy, mpg	23.9	25.5	26.8	24.5	24.4	22.0	21.3	21.3
LARGE PICKUP								
Total sales, units	1,586,020	1,115,248	1,690,931	1,116,490	1,472,885	1,968,710	1,987,833	2,209,671
Market share, %	65.8	50.3	39.9	24.7	24.8	23.7	24.8	25.5
Fuel economy, mpg	15.1	17.0	19.0	17.5	17.8	18.7	19.0	18.4
SMALL VAN								
Total sales, units	18,651	13,649	437,660	1,012,141	1,330,586	1,272,070	1,141,109	1,165,202
Market share, %	0.8	0.6	10.3	22.4	22.4	15.3	14.2	13.4
Fuel economy, mpg	19.5	19.6	23.9	22.3	22.4	23.0	23.2	23.0
LARGE VAN								
Total sales, units	574,745	328,065	536,242	319,429	327,586	368,820	323,806	349,706
Market share, %	23.9	14.8	12.7	7.1	5.5	4.4	4.0	4.0
Fuel economy, mpg	15.4	16.3	16.4	17.1	17.2	18.2	18.3	18.5
SMALL SUV								
Total sales, units	0	51,684	441,966	402,354	509,737	756,142	894,788	877,777
Market share, %	0.0	2.3	10.4	8.9	8.6	9.1	11.2	10.1
Fuel economy, mpg		17.7	22.1	22.5	22.0	23.8	24.3	25.3
MEDIUM SUV								
Total sales, units	50,763	151,929	187,447	434,491	1,076,686	2,167,329	2,067,855	2,448,269
Market share, %	2.1	6.9	4.4	9.6	18.1	26.1	25.8	28.2
Fuel economy, mpg	15.1	14.9	17.2	19.7	19.2	20.4	20.5	20.5
LARGE SUV								
Total sales, units	9,228	39,550	77,535	93,993	148,622	702,152	785,094	860,652
Market share, %	0.4	1.8	1.8	2.1	2.5	8.5	9.8	9.9
Fuel economy, mpg	14.2	13.7	17.1	16.5	16.1	17.5	17.6	17.5
TOTAL								
Total sales, units	2,409,758	2,216,537	4,235,365	4,514,625	5,933,866	8,306,953	8,019,518	8,673,079
Market share, %	100	100	100	100	100	100	100	100
Fuel economy, mpg	15.6	18.1	20.4	20.5	20.2	20.4	20.5	20.2

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2003.
(Additional resources: www-cta.ornl.gov)

Note:
Revised definitions of light trucks are based on vehicle **curb weight** as follows:

Small pickup= <3,500 lbs. Large pickup=3,500-8,500 lbs.
Small van = <4,500 lbs. Large van=4,500-8,500 lbs.
Small utility= <3,500 lbs. Medium utility=3,500-4,799 lbs. Large utility=4,800-8,500 lbs.

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

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

Table 4.9
Light Vehicle Market Shares by Size Class, Sales Periods[a] 1976–2002

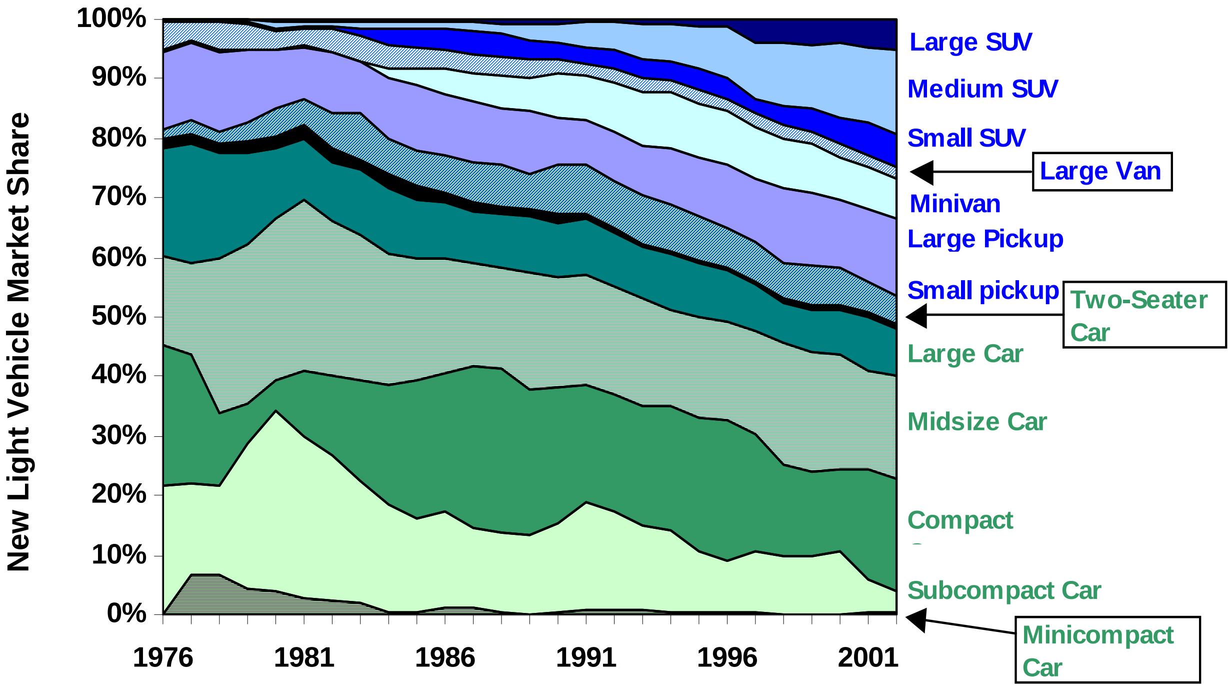
Sales period[a]	1976	1980	1985	1990	1995	2000	2001	2002
Minicompact	0.0%	3.8%	0.3%	0.6%	0.3%	0.1%	0.2%	0.3%
Subcompact	21.7%	30.4%	15.7%	14.8%	10.4%	10.4%	5.6%	3.7%
Compact	23.5%	5.3%	23.2%	23.0%	22.4%	13.9%	18.7%	18.8%
Midsize	15.0%	27.2%	20.5%	18.3%	17.0%	19.4%	16.3%	17.2%
Large	18.2%	11.8%	10.0%	9.3%	9.0%	7.5%	9.2%	8.1%
Two seater	1.7%	1.9%	2.5%	1.2%	0.4%	0.7%	0.7%	0.8%
Small pickup	1.4%	4.6%	5.7%	8.3%	7.3%	6.2%	5.0%	4.5%
Large pickup	13.1%	9.9%	11.1%	8.1%	10.0%	11.4%	12.2%	13.0%
Small van	0.2%	0.1%	2.9%	7.4%	8.6%	7.4%	6.4%	6.9%
Large van	4.8%	2.9%	3.5%	2.3%	9.1%	2.1%	2.0%	2.1%
Small utility	0.0%	0.5%	2.9%	2.9%	3.5%	4.4%	5.5%	5.2%
Medium utility	0.4%	1.3%	1.2%	3.2%	7.3%	12.5%	13.2%	14.3%
Large utility	0.1%	0.3%	0.5%	0.7%	1.0%	4.1%	4.8%	5.1%
Total light vehicles sold	12,096,613	11,311,043	15,203,880	13,739,090	14,658,736	17,285,055	16,327,503	17,009,538
Cars	80.1%	80.4%	72.1%	67.1%	59.5%	51.9%	50.9%	49.0%
Light trucks	19.9%	19.6%	27.9%	32.9%	40.5%	48.1%	49.1%	51.0%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2003.
(Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the current year through September 30 of the next year.

This graph shows the emergence of the mini-van in the early 1980's and the rising popularity of sport utility vehicles in the 1990's.

Figure 4.1. Light Vehicle Market Shares, Sales Periods 1976–2002



Source:
See Table 4.9

The compact, midsize, and large automobile sales-weighted engine sizes declined dramatically in the late '70's and early '80's.

Table 4.10
Sales-Weighted Engine Size of New Domestic and Import Automobiles by Size Class, Sales Periods[a] 1976–2002
(liters[b])

Sales period[a]	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	All
1976	[c]	2.67	5.00	5.85	6.79	2.89	4.89
1977	1.98	2.73	4.79	5.47	6.02	2.81	4.56
1978	2.06	2.67	3.95	4.89	6.17	3.01	4.33
1979	1.86	2.39	3.74	4.41	5.56	2.77	3.78
1980	1.90	2.10	3.03	3.90	5.12	2.79	3.22
1981	1.57	2.04	2.20	3.63	5.00	2.49	2.98
1982	1.53	2.08	2.12	3.47	4.73	2.41	2.89
1983	1.60	2.19	2.20	3.45	4.95	2.52	2.98
1984	2.17	2.22	2.21	3.40	4.87	2.50	2.97
1985	1.95	2.29	2.27	3.37	4.65	2.47	2.92
1986	1.45	2.19	2.21	3.19	4.38	2.83	2.76
1987	1.48	2.19	2.20	2.99	4.36	2.57	2.68
1988	1.52	2.05	2.21	3.00	4.32	2.75	2.66
1989	2.54	2.08	2.11	3.01	4.31	2.81	2.68
1990	2.42	1.96	2.25	3.13	4.33	2.57	2.72
1991	2.17	1.97	2.23	3.16	4.40	2.67	2.72
1992	1.89	2.01	2.33	3.16	4.34	3.01	2.76
1993	1.96	2.07	2.28	3.16	4.27	3.47	2.78
1994	2.21	2.27	2.23	3.15	4.17	3.82	2.79
1995	2.42	2.26	2.23	3.12	4.12	3.76	2.79
1996	2.49	2.23	2.19	2.98	4.09	3.67	2.71
1997	2.62	2.13	2.28	3.02	4.03	3.08	2.74
1998	3.15	2.29	2.17	2.94	3.98	3.51	2.75
1999	2.86	2.31	2.25	2.91	3.91	3.62	2.76
2000	2.55	2.30	2.23	2.85	3.88	3.45	2.73
2001	3.01	2.66	2.16	2.85	3.69	3.48	2.74
2002	2.90	3.01	2.14	2.87	3.69	3.74	2.75
Average annual percentage change							
1976–2002	1.6%[d]	0.5%	-3.3%	-2.9%	-2.5%	1.1%	-2.4%
1992–2002	4.4%	4.1%	-0.8%	-1.0%	-1.6%	2.2%	0.0%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2003. (Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the previous year through September 30 of the current year.
[b] 1 liter = 61.02. cubic inches.
[c] There were no minicompact automobiles sold in 1976.
[d] Average annual percentage change begins with 1977.

Pickups and vans have been increasing over the years while utility vehicles engine sizes are smaller in 2002 than in the 1970's.

Table 4.11
Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class
Sales Periods[a] 1976–2002
(liters[b])

Sales period[a]	Small pickup	Large pickup	Small van	Large van	Small utility	Medium utility	Large utility	All
1976	1.92	4.41	1.97	4.27	[c]	4.21	5.74	4.18
1977	1.95	4.41	1.97	4.37	[c]	4.21	5.74	4.11
1978	1.96	4.39	1.97	4.25	3.80	4.48	5.74	4.09
1979	2.00	5.15	1.97	4.24	4.23	4.67	5.74	4.41
1980	1.99	4.41	1.97	4.85	2.47	4.51	5.74	3.88
1981	2.08	4.16	1.97	4.34	2.47	4.55	5.00	3.67
1982	2.06	4.02	1.59	4.33	2.47	4.54	5.00	3.55
1983	2.04	4.05	1.59	4.32	2.28	4.84	5.59	3.37
1984	2.05	4.17	2.13	4.33	2.33	4.14	5.65	3.40
1985	2.09	4.02	2.22	4.43	2.60	4.44	4.96	3.38
1986	2.13	3.79	2.29	4.41	2.28	4.33	4.95	3.12
1987	2.17	3.71	2.29	4.46	2.39	3.83	4.95	3.07
1988	2.56	4.68	3.15	5.21	3.23	4.19	5.55	3.82
1989	2.64	4.70	3.11	5.22	3.77	3.77	5.58	3.93
1990	2.90	5.14	3.43	5.24	3.68	3.55	5.56	3.93
1991	2.93	5.22	3.36	5.26	3.60	3.85	5.46	3.92
1992	3.09	5.15	3.43	5.31	3.62	3.94	5.45	4.00
1993	3.15	5.15	3.41	5.24	3.60	4.06	5.58	4.02
1994	3.05	5.26	3.58	5.37	3.53	4.01	5.54	4.10
1995	2.99	5.13	3.50	5.16	3.56	4.04	5.41	4.06
1996	2.93	5.17	3.51	5.25	3.43	4.29	5.35	4.12
1997	3.00	5.05	3.47	5.04	2.75	3.96	5.33	4.09
1998	2.89	5.01	3.45	4.99	2.84	4.15	5.39	4.16
1999	3.36	5.02	3.48	5.05	2.87	4.12	5.46	4.19
2000	3.42	4.94	3.43	5.00	2.78	4.03	5.21	4.11
2001	3.50	4.79	3.59	4.96	2.70	3.84	5.13	4.05
2002	3.54	4.88	3.61	4.89	2.60	3.80	5.18	4.09
Average annual percentage change								
1976–2002	2.5%	0.4%	2.5%	0.5%	[c]	-0.4%	-0.4%	-0.1%
1992–2002	1.4%	-0.5%	0.5%	-0.8%	-3.3%	-0.4%	-0.5%	0.2%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2003. (Additional resources: www-cta.ornl.gov)

Note:
Revised definitions of light trucks are based on vehicle **curb weight** as follows:

Small pickup= <3,500 lbs.	Large pickup=3,500-8,500 lbs.	
Small van = <4,500 lbs.	Large van=4,500-8,500 lbs.	
Small utility= <3,500 lbs.	Medium utility=3,500-4,799 lbs.	Large utility=4,800-8,500 lbs.

[a] Sales period is October 1 of the previous year through September 30 of the current year.
[b] 1 liter = 61.02 cubic inches.
[c] Data are not available.

The large car size class is the only class that showed a decline in curb weight from 1992 to 2002.

Table 4.12
Sales-Weighted Curb Weight of New Domestic and Import Automobiles by Size Class, Sales Periods[a] 1976–2002
(pounds)

Sales period[a]	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	All
1976	[b]	2,577	3,609	4,046	4,562	2,624	3,608
1977	2,228	2,586	3,550	3,900	4,026	2,608	3,424
1978	2,200	2,444	3,138	3,427	3,956	2,763	3,197
1979	2,120	2,367	3,048	3,287	3,763	2,699	3,000
1980	2,154	2,270	2,813	3,081	3,667	2,790	2,790
1981	1,920	2,370	2,382	2,996	3,672	2,744	2,744
1982	2,002	2,302	2,422	2,992	3,703	2,525	2,730
1983	2,072	2,334	2,441	3,027	3,779	2,663	2,788
1984	2,376	2,380	2,454	2,990	3,734	2,559	2,788
1985	2,211	2,392	2,464	2,954	3,575	2,539	2,743
1986	2,120	2,415	2,432	2,857	3,451	2,575	2,675
1987	1,960	2,423	2,474	2,857	3,483	2,602	2,689
1988	1,933	2,346	2,558	2,880	3,487	2,693	2,717
1989	2,576	2,357	2,517	2,985	3,496	2,735	2,760
1990	2,651	2,368	2,637	3,065	3,594	2,656	2,828
1991	2,584	2,406	2,652	3,085	3,650	2,707	2,848
1992	2,395	2,444	2,674	3,131	3,670	2,770	2,879
1993	2,449	2,478	2,659	3,142	3,615	2,967	2,894
1994	2,719	2,571	2,639	3,171	3,657	3,035	2,921
1995	2,831	2,552	2,647	3,179	3,648	2,947	2,937
1996	2,847	2,533	2,667	3,203	3,671	2,985	2,950
1997	2,997	2,489	2,737	3,241	3,653	2,863	2,977
1998	3,004	2,584	2,703	3,198	3,675	2,956	3,002
1999	2,835	2,626	2,755	3,198	3,689	3,007	3,034
2000	2,906	2,635	2,800	3,215	3,680	2,943	3,052
2001	3,332	2,803	2,720	3,197	3,606	2,849	3,047
2002	3,068	2,928	2,731	3,218	3,587	3,086	3,066
			Average annual percentage change				
1976–2002	1.3%[c]	0.5%	-1.1%	-0.9%	-0.9%	0.6%	-0.6%
1992–2002	2.5%	1.8%	0.2%	0.3%	-0.2%	1.1%	0.6%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2003.
(Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the previous year through September 30 of the current year.
[b] There were no minicompact automobiles sold in 1976.
[c] Average annual percentage change begins with 1977.

The sales-weighted interior space has not changed much for midsize automobiles over the last two decades, but has increased for subcompact autos and decreased for compact and large autos.

Table 4.13
Sales-Weighted Interior Space of New Domestic and Import Automobiles by Size Class, Sales Periods[a] 1976–2002
(cubic feet)

Sales period[a]	Minicompact (< 85)	Subcompact (85–99)	Compact (100–109)	Midsize (110–119)	Large (> 120)	All[b]
1977	78.8	89.8	107.1	113.0	128.0	107.9
1978	79.4	89.8	105.3	112.9	128.5	107.9
1979	80.0	90.2	105.8	113.4	130.1	106.9
1980	82.4	89.9	105.4	113.5	130.8	104.9
1981	83.3	90.2	103.6	113.7	130.6	105.5
1982	83.1	91.3	102.9	113.9	130.4	106.0
1983	82.7	93.3	103.0	113.1	131.3	107.3
1984	77.0	93.8	103.0	113.3	130.4	108.0
1985	77.8	94.1	103.1	113.5	129.7	107.9
1986	80.1	94.5	102.8	113.8	127.6	107.0
1987	81.6	93.1	103.0	113.9	127.5	106.9
1988	81.0	93.5	103.3	113.6	127.2	107.0
1989	75.0	93.3	102.7	113.8	127.4	107.5
1990	79.9	93.9	103.2	113.8	127.8	107.3
1991	79.6	94.4	103.2	113.8	128.3	107.1
1992	79.1	94.0	104.2	114.0	129.2	107.5
1993	79.2	94.5	104.0	114.0	128.9	108.0
1994	79.4	94.4	103.8	113.8	128.8	108.0
1995	78.5	93.8	103.9	114.3	128.1	108.7
1996	76.7	94.9	103.4	114.2	128.0	108.8
1997	77.2	95.6	103.2	114.6	128.0	108.7
1998	66.9	97.0	102.2	114.4	127.7	109.2
1999	76.3	96.7	103.3	114.1	127.1	109.5
2000	76.3	96.6	103.1	114.2	126.4	109.3
2001	78.2	94.6	103.2	113.5	125.2	109.4
2002	80.3	94.7	103.7	114.8	125.0	110.1
			Average annual percentage change			
1977–2002	0.1%	0.2%	-0.1%	0.1%	-0.1%	0.1%
1992–2002	0.2%	0.1%	0.0%	0.1%	-0.3%	0.2%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2003. (Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the previous year through September 30 of the current year.
[b] Interior volumes of two-seaters are not reported to EPA.

The sales-weighted wheelbase of new automobiles and light trucks was rising in the 1990's. In this decade, automobile wheel-base has not varied much while light truck wheel-base has declined slightly.

Table 4.14
Sales-Weighted Wheelbase of New Automobiles and Light Trucks, Sales Periods[a] 1976–2002
(inches)

Sales period[a]	Automobiles	Light trucks	Automobiles and light trucks combined
1976	110.78	118.87	112.03
1977	109.75	117.79	111.05
1978	107.67	116.23	108.65
1979	105.77	116.27	107.93
1980	103.61	114.54	105.76
1981	102.97	114.86	105.10
1982	103.01	114.87	105.60
1983	103.76	113.73	106.10
1984	103.50	113.87	106.21
1985	102.96	113.98	106.02
1986	102.27	113.40	105.48
1987	102.11	113.27	105.52
1988	102.21	111.79	105.21
1989	102.66	112.23	105.71
1990	103.13	111.41	105.85
1991	103.27	111.09	105.82
1992	103.60	112.68	106.78
1993	104.03	112.57	107.21
1994	104.31	113.23	107.75
1995	104.95	113.37	108.31
1996	105.04	113.36	108.53
1997	105.36	113.36	108.89
1998	105.55	114.53	109.76
1999	105.77	114.70	110.06
2000	105.89	114.05	109.81
2001	105.66	113.04	109.64
2002	105.87	112.91	109.84
	Average annual percentage change		
1976–2002	-0.2%	-0.2%	-0.1%
1992–2002	0.2%	0.0%	0.3%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2003. (Additional resources: www-cta.ornl.gov)

[a] Sales period is October 1 of the current year through September 30 of the next year.

The average auto lost over 300 pounds from 1978 to 1985, but gained a few pounds back since then. Much of the weight reduction was due to the declining use of conventional steel and iron and the increasing use of aluminum and plastics. Conventional steel, however, remained the predominant component of automobiles in 2001 with a 40.8% share of total materials. As conventional steel use has been decreasing, use of high-strength steel has increased.

Table 4.15
Average Material Consumption for a Domestic Automobile, 1978, 1985, and 2001

	1978		1985		2001	
Material	Pounds	Percentage	Pounds	Percentage	Pounds	Percentage
Conventional steel[a]	1,880.0	53.8%	1,481.5	46.5%	1,349.0	40.8%
High-strength steel	127.5	3.6%	217.5	6.8%	351.5	10.6%
Stainless steel	25.0	0.7%	29.0	0.9%	54.5	1.6%
Other steels	56.0	1.6%	54.5	1.7%	25.5	0.8%
Iron	503.0	14.4%	468.0	14.7%	345.0	10.4%
Aluminum	112.0	3.2%	138.0	4.3%	256.5	7.8%
Rubber	141.5	4.1%	136.0	4.3%	145.5	4.4%
Plastics/composites	176.0	5.0%	211.5	6.6%	253.0	7.6%
Glass	88.0	2.5%	85.0	2.7%	98.5	3.0%
Copper	39.5	1.1%	44.0	1.4%	46.0	1.4%
Zinc die castings	28.0	0.8%	18.0	0.5%	11.0	0.3%
Powder metal parts	16.0	0.5%	19.0	0.6%	37.5	1.1%
Fluids & lubricants	189.0	5.4%	184.0	5.8%	196.0	5.9%
Other materials	112.5	3.2%	101.5	3.2%	139.5	4.2%
Total	3,494.0	100.0%	3,187.5	100.0%	3,309.0	100.0%

Source:
American Metal Market, www.amm.com/ref/carmat98.htm, New York, NY, 2000.
(Additional resources: www.amm.com)

[a] Includes cold-rolled and pre-coated steel.

The number of franchised dealerships which sell new light-duty vehicles (cars and light trucks) has declined 27% since 1970, though new vehicle sales have increased. The average number of vehicles sold per dealer in 2000 was 774 vehicles per dealer – more than double the 1970 number.

Table 4.16
New Light Vehicle Dealerships and Sales, 1970–2000

Calendar year	Number of franchised new light vehicle dealerships[a]	New light vehicle sales (thousands)	Light vehicle sales per dealer
1970	30,800	9,867	320
1971	30,300	12,006	396
1972	30,100	13,189	438
1973	30,100	14,184	471
1974	30,000	11,191	373
1975	29,600	10,905	368
1976	29,300	13,066	446
1977	29,100	14,613	502
1978	29,000	15,122	521
1979	28,500	13,984	491
1980	27,900	11,419	409
1981	26,350	10,725	407
1982	25,700	10,452	407
1983	24,725	12,166	492
1984	24,725	14,254	577
1985	24,725	15,501	627
1986	24,825	16,047	646
1987	25,150	14,888	592
1988	25,025	15,426	616
1989	25,000	14,508	580
1990	24,825	13,849	558
1991	24,200	12,298	508
1992	23,500	12,842	546
1993	22,950	13,869	604
1994	22,850	15,023	657
1995	22,800	14,688	644
1996	22,750	15,046	661
1997	22,700	15,069	664
1998	22,600	15,441	683
1999	22,400	16,771	748
2000	22,250	17,234	774
	Average annual percentage change		
1970–2000	-1.1%	1.9%	3.0%
1990–2000	-1.1%	2.2%	3.3%

Source:
Number of dealers - National Automobile Dealers Association, *Automotive Executive Magazine,* 2001. (Additional resources: www.nada.org)
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 is declining while the number of vehicles fueling at those stations continues to rise. In 2001, there were 0.79 fueling stations per thousand vehicles. Data for alternative fuels in 2001 indicate that there was an average of 10.91 stations per thousand alternative fuel vehicles.

Table 4.17
Conventional and Alternative Fuel Refueling Stations

Year	Number of retail outlets	Vehicles in operation (thousands)	Stations per thousand vehicles
		Conventional fuels	
1993	207,416	186,315	1.11
1994	202,878	188,714	1.08
1995	195,455	193,441	1.01
1996	190,246	198,294	0.96
1997	187,892	201,071	0.93
1998	182,596	205,043	0.89
1999	180,567	209,509	0.86
2000	175,941	213,300	0.82
2001	171,169	216,683	0.79
2002	170,678	[a]	[a]
		Alternative fuels, 2002	
LPG	3,431	281	12.21
CNG	1,166	126	9.25
Electricity	872	20	43.60
M85/M100	0	6	0.00
LNG	35	3	11.67
E85/E95	149	82	1.82
Total	5,653	518	10.91

Source:
Conventional refueling stations: National Petroleum News Survey, 2002.
Alternative fuel refueling stations: Alternative Fuels Data Center, www.afdc.doe.gov.
Conventional vehicles: The Polk Company, Detroit, MI, FURTHER REPRODUCTION PROHIBITED.
Alternative fuels vehicles: U.S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels web site, www.eia.doe.gov/cneaf/alternate/page/datatables/atf01-13_00.html

Note:
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; the CBP may not include every gasoline retail outlet due to the classification of the primary activity of the business.

[a] Data are not available.

The Corporate Average Fuel Economy standards were established by the U.S. Energy Policy and Conservation Act of 1975 (PL94-163). These standards must be met at the manufacturer level. Though the averages shown here indicate the standards were met in most years, some manufacturers fell short of meeting the standards while others exceeded them.

Table 4.18
Automobile Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2003[a]
(miles per gallon)

	Automobiles				CAFE estimates
		CAFE estimates[c]			
Model year[b]	CAFE standards	Domestic	Import	Combined	Autos and light 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	28.4	26.2
1988	26.0	27.4	31.5	28.0	26.0
1989	26.5	27.2	30.8	28.4	25.6
1990	27.5	26.9	29.9	27.9	25.4
1991	27.5	27.3	30.1	28.4	25.6
1992	27.5	27.0	29.2	27.9	25.1
1993	27.5	27.8	29.6	28.4	25.2
1994	27.5	27.5	29.7	28.3	24.7
1995	27.5	27.7	30.3	28.6	24.9
1996	27.5	28.1	29.6	28.5	24.9
1997	27.5	27.8	30.1	28.7	24.6
1998	27.5	28.6	29.2	28.8	24.7
1999	27.5	28.0	29.0	28.3	24.5
2000	27.5	28.7	28.3	28.5	24.8
2001	27.5	28.7	29.0	28.8	24.6
2002	27.5	29.0	28.7	28.9	24.6
2003	27.5	29.7	29.1	29.5	25.1

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, March 2003. (Additional resources: www.nhtsa.dot.gov)

[a]Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer.
[b]Model year as determined by the manufacturer on a vehicle by vehicle basis.
[c]All CAFE calculations are sales-weighted.

The Corporate Average Fuel Economy standards for light trucks are lower than the automobile standards. Light trucks include pickups, minivans, sport utility vehicles and vans.

T able 4.19
Light Truck Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates, 1978–2003[a]
(miles per gallon)

	Light trucks[c]				CAFE estimates
		CAFE estimates[d]			
Model year[b]	CAFE standards	Domestic	Import	Combined	Autos and light trucks combined
1978	[e]	[f]	[f]	[g]	19.9
1979	[e]	17.7	20.8	18.2	20.1
1980	[e]	16.8	24.3	18.5	23.1
1981	[e]	18.3	27.4	20.1	24.6
1982	17.5	19.2	27.0	20.5	25.1
1983	19.0	19.6	27.1	20.7	24.8
1984	20.0	19.3	26.7	20.6	25.0
1985	19.5	19.6	26.5	20.7	25.4
1986	20.0	20.0	25.9	21.5	25.9
1987	20.5	20.5	25.2	21.7	26.2
1988	20.5	20.6	24.6	21.3	26.0
1989	20.5	20.4	23.5	21.0	25.6
1990	20.0	20.3	23.0	20.8	25.4
1991	20.2	20.9	23.0	21.3	25.6
1992	20.2	20.5	22.7	20.8	25.1
1993	20.4	20.7	22.8	21.0	25.2
1994	20.5	20.5	22.0	20.8	24.7
1995	20.6	20.3	21.5	20.5	24.9
1996	20.7	20.5	22.1	20.8	24.9
1997	20.7	20.1	22.1	20.6	24.6
1998	20.7	20.4	23.0	21.1	24.7
1999	20.7	[f]	[f]	20.9	24.5
2000	20.7	[f]	[f]	21.3	24.8
2001	20.7	[f]	[f]	20.9	24.6
2002	20.7	[f]	[f]	21.3	24.6
2003	20.7	[f]	[f]	21.8	25.1

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, March 2003. (Additional resources: www.nhtsa.dot.gov)

[a]Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer.

[b]Model year as determined by the manufacturer on a vehicle by vehicle basis.

[c]Represents two- and four-wheel drive trucks combined. Gross vehicle weight of 0–6,000 pounds for model year 1978–1979 and 0–8,500 pounds for subsequent years.

[d]All CAFE calculations are sales-weighted.

[e]Standards were set for two-wheel drive and four-wheel drive light trucks separately, but no combined standard was set in this year.

[f]Data are not available.

Manufacturers of autos and light trucks whose vehicles do not meet the CAFE standards are fined. Data from the National Highway Traffic Safety Administration show that $34 million has been collected from the manufacturers for model year (MY) 2001 and $51 million for MY 2000.

Table 4.20
Corporate Average Fuel Economy (CAFE) Fines Collected, 1983-2001[a]
(thousands)

Model year	Current dollars	2001 constant dollars[b]
1983	58	103
1984	5,958	10,156
1985	15,565	25,618
1986	29,872	48,269
1987	31,261	48,735
1988	44,519	66,647
1989	47,381	67,670
1990	48,429	65,621
1991	42,243	54,928
1992	38,287	48,329
1993	28,688	35,161
1994	31,499	37,641
1995	40,787	47,398
1996	19,302	21,787
1997	36,212	39,957
1998	21,740	23,620
1999	27,516	29,251
2000	51,067	52,520
2001	33,974	33,974

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, January 2003.
(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 an automobile that has an Environmental Protection Agency (EPA) fuel economy rating less than that stipulated in the table below. The Gas Guzzler Tax doubled in 1991 after remaining constant from 1986 to 1990. The tax has not changed since 1991. This tax does not apply to light trucks such as pickups, minivans, sport utility vehicles, and vans.

Table 4.21
The Gas Guzzler Tax on New Cars
(dollars per vehicle)

Vehicle fuel economy (mpg)	1980	1981	1982	1983	1984	1985	1986–90	1991+
Over 22.5	0	0	0	0	0	0	0	0
22.0–22.5	0	0	0	0	0	0	500	1,000
21.5–22.0	0	0	0	0	0	0	500	1,000
21.0–21.5	0	0	0	0	0	0	650	1,300
20.5–21.0	0	0	0	0	0	500	650	1,300
20.0–20.5	0	0	0	0	0	500	850	1,700
19.5–20.0	0	0	0	0	0	600	850	1,700
19.0–19.5	0	0	0	0	450	600	1,050	2,100
18.5–19.0	0	0	0	350	450	800	1,050	2,100
18.0–18.5	0	0	200	350	600	800	1,300	2,600
17.5–18.0	0	0	200	500	600	1,000	1,300	2,600
17.0–17.5	0	0	350	500	750	1,000	1,500	3,000
16.5–17.0	0	200	350	650	750	1,200	1,500	3,000
16.0–16.5	0	200	450	650	950	1,200	1,850	3,700
15.5–16.0	0	350	450	800	950	1,500	1,850	3,700
15.0–15.5	0	350	600	800	1,150	1,500	2,250	4,500
14.5–15.0	200	450	600	1,000	1,150	1,800	2,250	4,500
14.0–14.5	200	450	750	1,000	1,450	1,800	2,700	5,400
13.5–14.0	300	550	750	1,250	1,450	2,200	2,700	5,400
13.0–13.5	300	550	950	1,250	1,750	2,200	3,200	6,400
12.5–13.0	550	650	950	1,550	1,750	2,650	3,200	6,400
Under 12.5	550	650	1,200	1,550	2,150	2,650	3,850	7,700

Source:
Internal Revenue Service, Form 6197, (Rev. 1-91), "Gas Guzzler Tax."
(Additional resources: www.irs.ustreas.gov)

Consumers continue to demand gas guzzling automobiles. The IRS collected over $78 million in 2001 from those buying autos with 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.

Table 4.22
Tax Receipts from the Sale of Gas Guzzlers, 1980–2001
(thousands)

Model year	Current dollars	2001 constant dollars[a]
1980	740	1,590
1981	780	1,520
1982	1,720	3,157
1983	4,020	7,148
1984	8,820	15,034
1985	39,790	65,491
1986	147,660	238,600
1987	145,900	227,455
1988	116,780	174,824
1989	109,640	156,591
1990	103,200	139,837
1991	118,400	153,955
1992	144,200	182,023
1993	111,600	136,778
1994	64,100	76,600
1995	73,500	85,412
1996	52,600	59,372
1997	48,200	53,185
1998	47,700	51,826
1999	68,300	72,605
2000	70,800	72,815
2001	78,200	78,200

Source:
Ward's Communications, *Motor Vehicle Facts and Figures*, 2002, Detroit, MI, 2002, p. 85. Original data source: Internal Revenue Service.

[a]Adjusted using the Consumer Price Inflation Index.

Fuel Economy by Vehicle Speed

ORNL has developed fuel consumption and emissions lookup tables for the Federal Highway Administration, for use in their TRAF series of traffic models (NETSIM, CORSIM, FRESIM), although more generic uses are also possible. To develop the data-based models, vehicles are tested both on-road and on a chassis dynamometer. Engine parameters are measured on-road under real-world driving conditions that cover the vehicle's entire operating envelope. Emissions and fuel consumption are then measured on the chassis dynamometer as functions of engine conditions. The two data sets are merged to produce the final three-dimensional maps as functions of vehicle speed and acceleration. Eight well-functioning, late-model vehicles, and one 1997 model vehicle, have been tested thus far in fully warmed-up conditions.

Similar continuing work is planned for the Department of Energy as well as FHWA, which will include more well-functioning, late-model vehicles, pre-control (1960's) vehicles, malfunctioning high-emitter vehicles, light-duty diesel vehicles (cars and pickup trucks), alternative fuel vehicles, and possibly heavy-duty diesel vehicles. ORNL will also be developing cold-start algorithms to enhance the existing models, since emissions and fuel economy generally improve as vehicles warm up to normal operating temperatures.

For further information regarding this study please contact:

Scott Sluder
Fuels, Combustion, and Engine Technology
P.O. Box 2009, Building 9108
Oak Ridge, TN 37831-8087

Phone: 865-241-9133
Fax: 865-241-1747
email: sluders@ornl.gov

Table 4.23
Vehicle Specifications for Vehicles Tested in the 1997 Study

Vehicle	Curb weight	Engine	Fuel delivery system[a]	Trans-mission	EPA fuel economy	
					City	Highway
1988 Chevrolet Corsica	2,665	2.8 liter V6	PFI	M5	19	29
1994 Olds Cutlass Supreme	3,290	3.4 liter V6	PFI	L4	17	26
1994 Oldsmobile 88	3,433	3.8 literV6	PFI	L4	19	29
1994 Mercury Villager	4,020	3.0 liter V6	PFI	L4	17	23
1995 Geo Prizm	2,359	1.6 liter I-4	PFI	L3	26	30
1994 Jeep Grand Cherokee	3,820	4.0 liter I-6	PFI	L4	15	20
1994 Chevrolet Pickup	4,020	5.7 liter V8	TBI	L4	14	18
1993 Subaru Legacy	2,800	2.2 liter H4	PFI	L4	22	29
1997 Toyota Celica	2,395	1.8 liter I4	PFI	L4	27	34

Source:
West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, *Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models*, Washington, DC, April 1997 and additional project data, April 1998.

[a] PFI = port fuel injection. TBI = throttle- body fuel injection.

The two earlier studies by the Federal Highway Administration (FHWA) indicate maximum fuel efficiency was achieved at speeds of 35 to 40 mph. The recent FHWA study indicates greater fuel efficiency at higher speeds. Note that the 1973 study did not include light trucks.

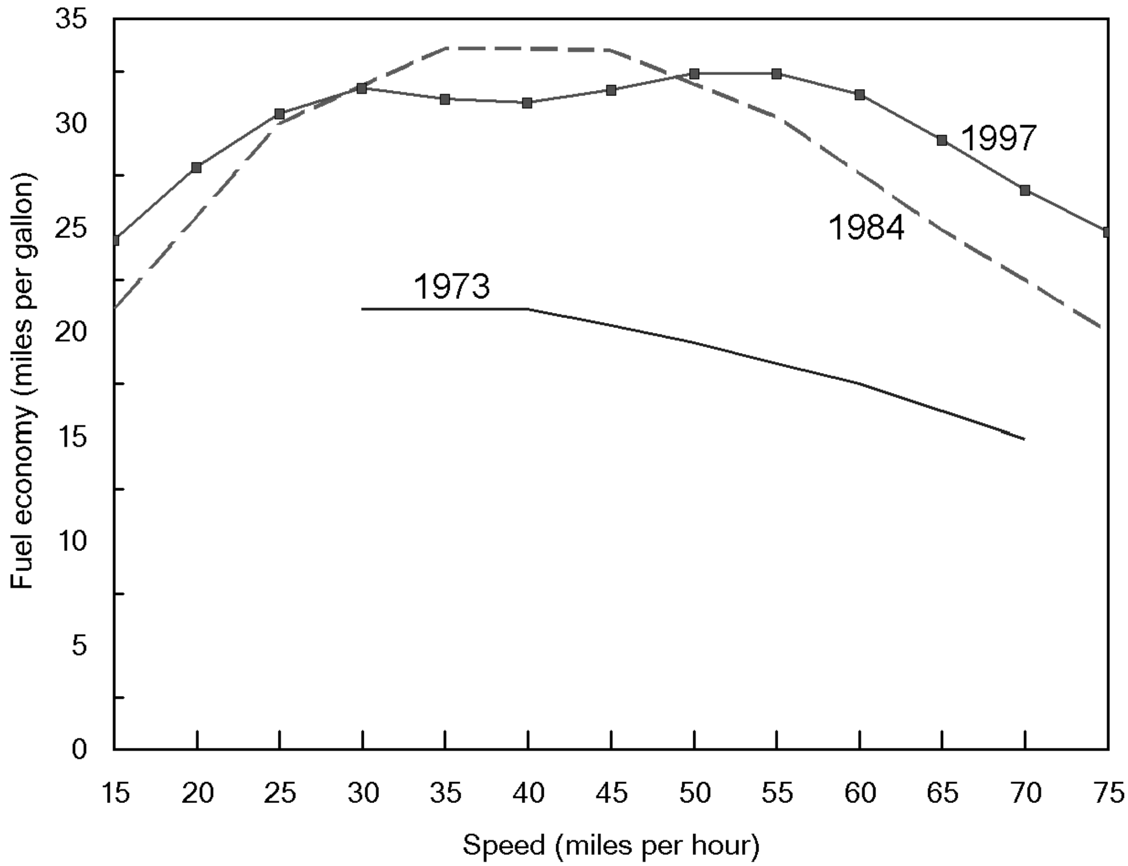
Table 4.24
Fuel Economy by Speed, 1973, 1984, and 1997 Studies
(miles per gallon)

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%

Source:
1973- U.S. Department of Transportation, Federal Highway Administration, Office of Highway Planning, *The Effect of Speed on Automobile Gasoline Consumption Rates*, Washington, DC, October 1973.
1984 - U.S. Department of Transportation, Federal Highway Administration, *Fuel Consumption and Emission Values for Traffic Models*, Washington, DC, May 1985.
1997 - West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, *Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models*, FHWA Report (in press), Washington, DC, April 1997, and additional project data, April 1998. (Additional resources: www.fhwa-tsis.com)

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

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



Source: See Table 4.23.

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 4.25
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 4.21.

The Environmental Protection Agency (EPA) tests new vehicles to determine fuel economy ratings. The city and highway fuel economies that are posted on the windows of new vehicles are determined by testing the vehicle during these driving cycles. The driving cycles simulate the performance of an engine while driving in the city and on the highway. Once the urban cycle is completed, the engine is stopped, then started again for the 8.5 minute hot start cycle.

Figure 4.3. Urban Driving Cycle

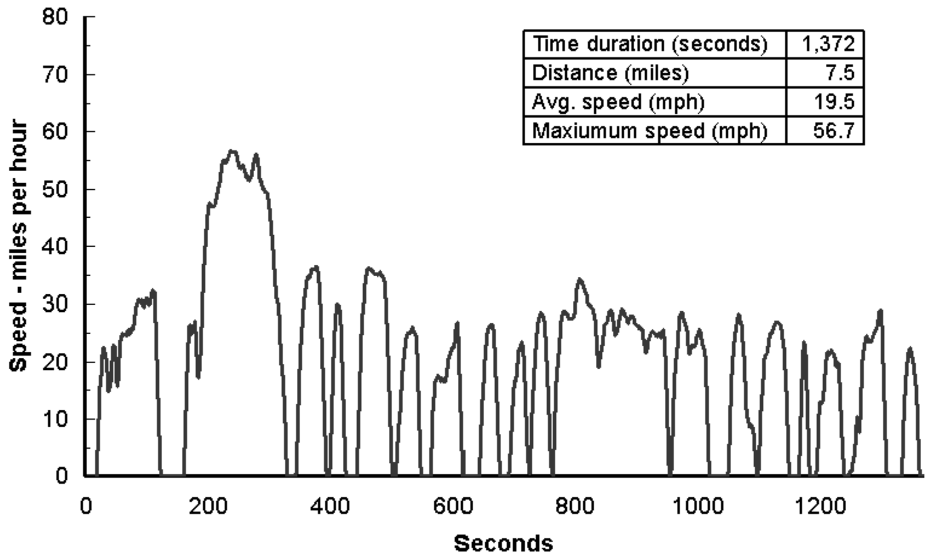
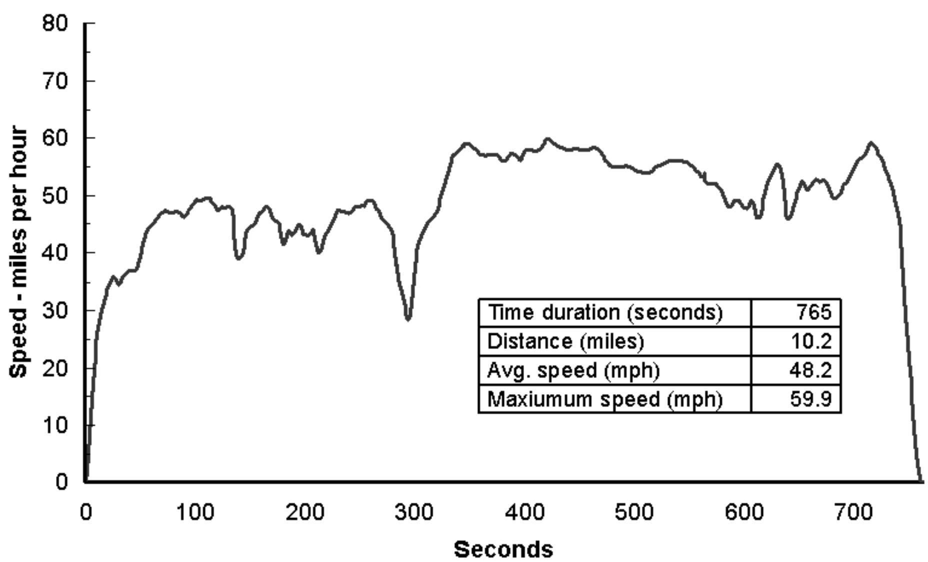


Figure 4.4. Highway Driving Cycle



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.

The New York Test Cycle was developed in the 1970's in order to simulate driving in downtown congested areas. The Representative Number Five Test Cycle was developed recently to better represent actual on-road driving by combining modern urban and freeway driving.

Figure 4.5. New York City Driving Cycle

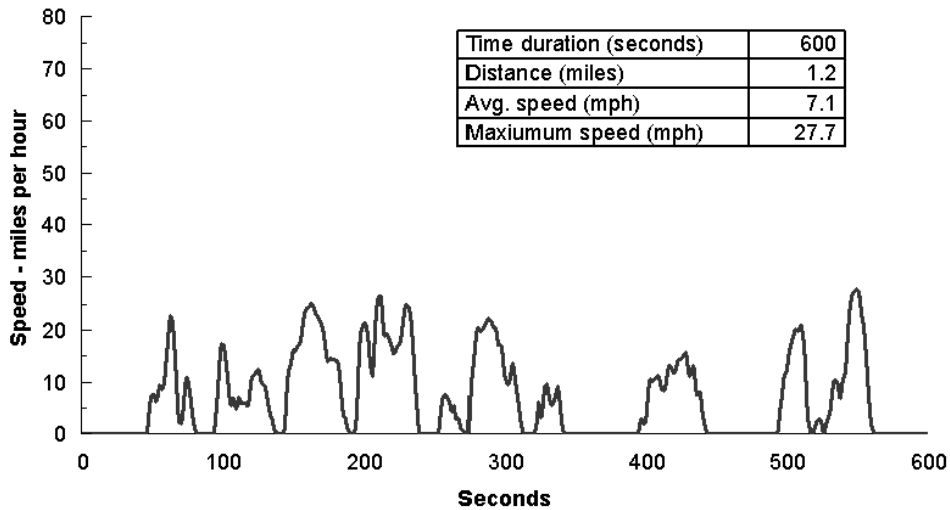
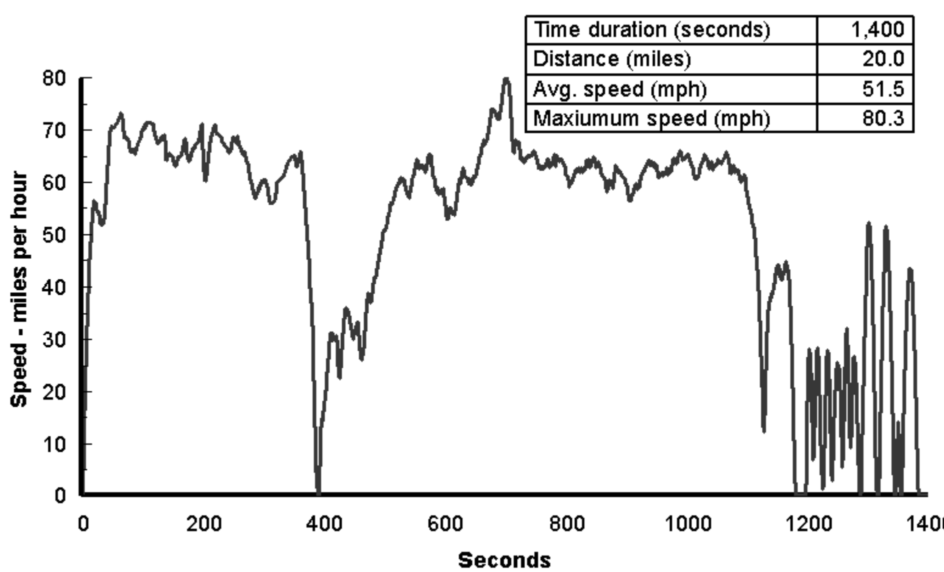


Figure 4.6. Representative Number Five Driving Cycle

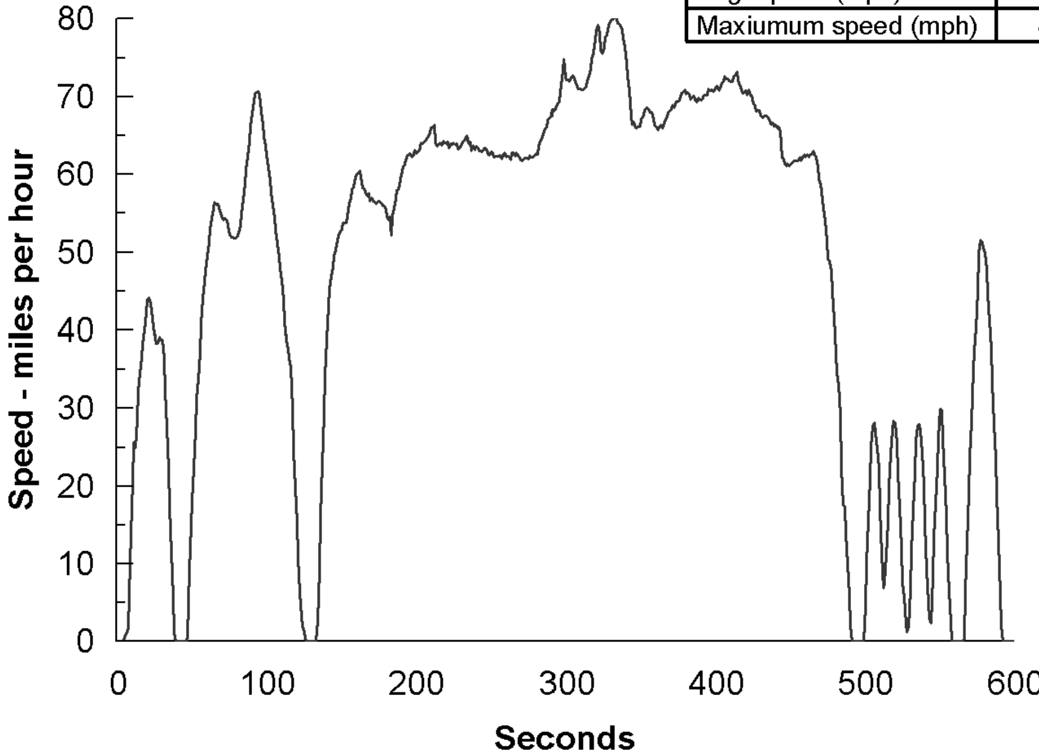


Source:
Data obtained from Michael Wang, Argonne National Laboratory, Argonne, IL, 1997.

The US06 driving cycle was developed as a supplement to the Federal Test Procedure. It is a short-duration cycle (600 seconds) which represents hard-acceleration driving.

Figure 4.7. US06 Driving Cycle

Time duration (seconds)	600
Distance (miles)	8.0
Avg. speed (mph)	48.0
Maxiumum speed (mph)	80.3



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 4.26
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.

[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 U.S. 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 4.27
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	1.78
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.

[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.

Total traffic fatalities were lower in 2001 than in 1975. Fourteen percent of traffic fatalities in 2001 were not vehicle occupants (pedestrians, cyclists, etc.).

Table 4.28
Occupant Fatalities by Vehicle Type and Nonoccupant Fatalities, 1975–2001

	1975	1980	1985	1990	1995	2000	2001	2001 share
Vehicle occupant fatalities by vehicle type								
Passenger car								
Subcompact	3,834	7,299	7,993	8,309	6,791	4,718	4,417	10.5%
Compact	614	927	2,635	5,310	6,899	6,933	6,718	16.0%
Intermediate	1,869	3,878	4,391	4,849	4,666	5,131	5,401	12.8%
Full	10,800	11,580	6,586	4,635	3,413	2,259	2,304	5.5%
Unknown	8,812	3,765	1,607	989	654	1,451	1,393	3.3%
Total	**25,929**	**27,449**	**23,212**	**24,092**	**22,423**	**20,492**	**20,233**	**48.1%**
Truck								
Light	4,856	7,486	7	8,601	9,568	11,418	11,677	27.7%
Large	961	1,262	977	705	648	741	704	1.7%
Total	**5,817**	**8,748**	**7,666**	**9,306**	**10,216**	**12,159**	**12,381**	**29.4%**
Other Vehicles								
Motorcycle	3,189	5,144	4,564	3,244	2,227	2,862	3,181	7.6%
Bus	53	46	57	32	33	22	34	0.1%
Other/unknown vehicle type	937	540	544	460	392	714	557	1.3%
Total	**4,179**	**5,730**	**5,165**	**3,736**	**2,652**	**3,598**	**3,772**	**9.0%**
TOTAL vehicle occupant fatalities	**35,925**	**41,927**	**36,043**	**37,134**	**35,291**	**36,249**	**36,386**	**86.4%**
Nonoccupant fatalities								
Pedestrian	7,516	8,070	6,808	6,482	5,584	4,739	4,882	11.6%
Pedalcyclist	1,003	965	890	859	833	690	728	1.7%
Other	81	129	84	124	109	143	105	0.2%
Total	**8,600**	**9,164**	**7,782**	**7,465**	**6,526**	**5,572**	**5,715**	**13.6%**
TOTAL traffic fatalities	**44,525**	**51,091**	**43,825**	**44,599**	**41,817**	**41,821**	**42,101**	**100.0%**

Source:
Traffic Safety Facts 2001, Washington, DC, December 2002, pp. 86, 101 and 110.
(Additional resources: www.nhtsa.dot.gov)

In 2001, the fatality rate for vehicle occupants per 100 million vehicle miles are surprisingly similar for passenger cars and light trucks—1.3 and 1.2 fatalities per 100 million vehicle miles, respectively. However, the injury rate per 100 million vehicle miles is much lower for light trucks (88) than for passenger cars (122).

Table 4.29
Light Vehicle Occupant Safety Data, 1975–2001

	1975	1980	1985	1990	1995	2000	2001
				Passenger cars			
Fatalities	25,929	27,449	23,212	24,092	22,423	20,699	20,233
Injuries (thousands)	[a]	[a]	[a]	2,376	2,469	2,052	1,927
Vehicle-miles (billions)[b]	1,030	1,107	1,249	1,427	1,478	1,580	1,585
Rates per 100 million vehicle miles							
Fatalities	2.5	2.5	1.9	1.7	1.5	1.3	1.3
Injuries	[a]	[a]	[a]	167	167	130	122
				Light trucks (10,000 lbs. or less)			
Fatalities	4,856	7,486	6,689	8,601	9,568	11,526	11,677
Injuries (thousands)	[a]	[a]	[a]	505	722	887	861
Vehicle-miles (billions)[b]	204	295	389	556	750	943	973
Rates per 100 million vehicle-miles							
Fatalities	2.4	2.5	1.7	1.5	1.3	1.2	1.2
Injuries	[a]	[a]	[a]	91	96	94	88

Source:
U.S. DOT, National Highway Traffic Safety Administration, *Traffic Safety Facts 2001*, Washington, DC, December 2002, pp. 22, 24. (Additional resources: www.nhtsa.dot.gov)

[a]Data are not available.
[b]Vehicle-miles are estimated by the National Highway Traffic Safety Administration and do not match Federal Highway data.

In 2001, 38% of all passenger car and light truck fatal crashes were single-vehicle crashes. Because there are so many passenger cars on the roads compared to the other vehicle types, total passenger car crashes are half of total crashes. Most crashes are multiple-vehicle crashes with property damage only.

Table 4.30
Crashes by Crash Severity, Crash Type, and Vehicle Type, 2001

	Fatal		Injury		Property damage only		
Vehicle type	Single-vehicle crash	Multiple-vehicle crash	Single-vehicle crash	Multiple-vehicle crash	Single-vehicle crash	Multiple-vehicle crash	Total crashes
Passenger cars	10,314	17,115	344,000	1,935,000	725,000	3,674,000	6,705,429
Light trucks[a]	8,114	12,608	201,000	1,017,000	473,000	2,206,000	3,917,722
Large trucks[b]	810	3,983	14,000	76,000	81,000	253,000	428,793
Buses	100	192	1,000	11,000	8,000	35,000	55,292
Motorcycles	1,454	1,795	26,000	31,000	7,000	8,000	75,249
Total	**20,792**	**35,693**	**586,000**	**3,070,000**	**1,294,000**	**6,176,000**	**11,182,485**
Share	0.2%	0.3%	5.2%	27.5%	11.6%	55.2%	100%

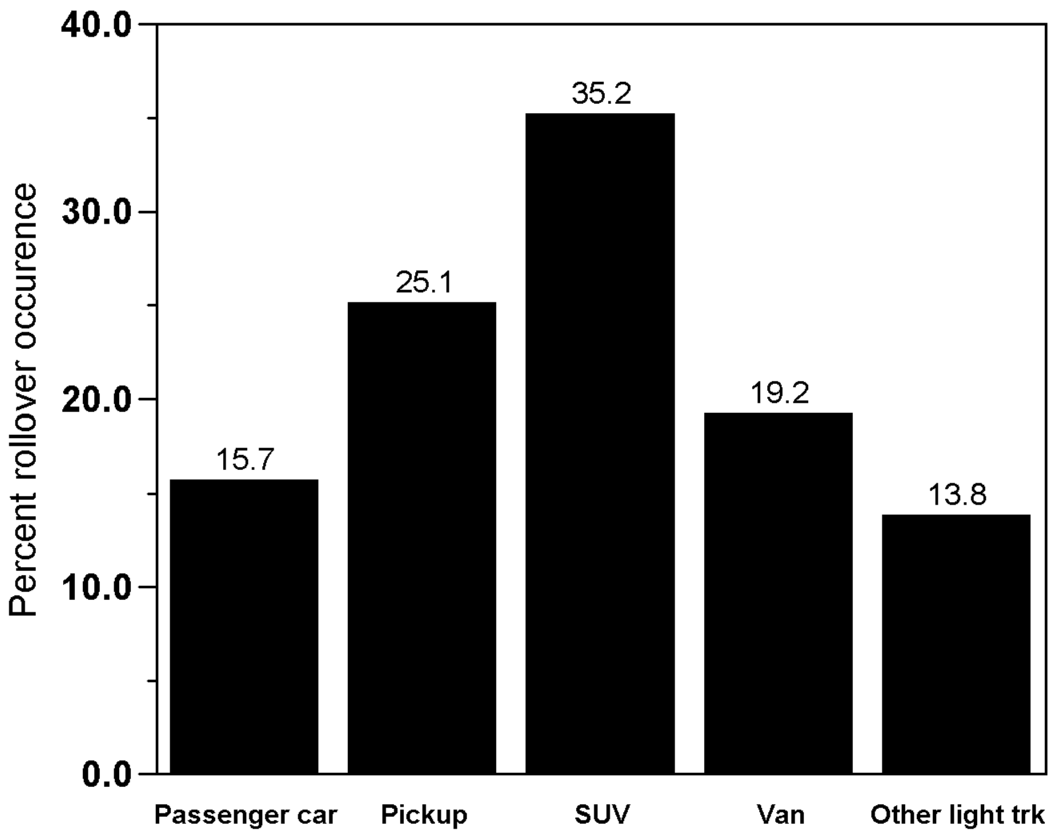
Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 2001*, Washington, DC, December 2002, pp. 72, 74, 76, 80, 82.
(Additional resources: www.nhtsa.dot.gov)

Note:
Multiple-vehicle crashes cannot be totaled over vehicle type due to duplication of accidents between vehicle types.

[a] Trucks 10,000 lbs. gross vehicle weight rating or less, including pickups, vans, and utility vehicles.
[b] Trucks over 10,000 pounds gross vehicle weight rating including single-unit trucks and truck tractors.

For fatal crashes in 2001, sport-utility vehicles (SUVs) had the highest rollover rate (35.2%) while other light trucks had the lowest (13.8%). This does not mean that the rollover caused the fatality, just that a vehicle in the crash rolled over.

Figure 4.8. Percent Rollover Occurrence in Fatal Crashes by Vehicle Type, 2001



Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 2001* Washington, DC, December 2002, p. 64.
(Additional resources: www.nhtsa.dot.gov)

Demand response (also called paratransit or dial-a-ride) and public vanpools are widely used by transit agencies. There were over 40 thousand of these vehicles active in 2001.

Table 4.31
Summary Statistics on Light Transit Vehicles, 1994–2001[a]

Year	Number of active vehicles	Vehicle-miles (millions)	Passenger-miles (millions)	Energy use (trillion Btu)
1994	31,090	490	781	9.8
1995	31,773	538	856	9.6
1996	33,472	588	958	10.2
1997	35,657	627	1,075	10.3
1998	33,481	721	1,103	10.9
1999	36,651	784	1,258	11.2
2000	37,957	826	1,274	11.4
2001	40,049	861	1,345	12.0
		Average annual percentage change		
1994–2001	3.7%	8.4%	8.1%	2.9%

Source:
American Public Transit Association, *2003 Public Transportation Fact Book*, Washington, DC, February 2003, Tables 6, 18, 22, 77 and 95. Historical van pool data are from earlier editions. (Additional resources: www.apta.com)

Note:
See Glossary for detailed definitions of demand response and vanpool.

[a] Includes demand response service and public van pools.

Chapter 5

Heavy Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 5.1	Heavy single-unit trucks, 2001	
	Registration (thousands)	*5,704*
	Vehicle miles (millions)	*72,286*
	Fuel economy (miles per gallon)	*7.4*
Table 5.2	Combination trucks, 2001	
	Registration (thousands)	*2,154*
	Vehicle miles (millions)	*135,400*
Table 5.6	Trucks by size, 1997 Vehicle Inventory & Use Survey	
	Light (0–10,000 lbs average weight)	*92.88%*
	Medium (10,001–26,000 lbs average weight)	*3.80%*
	Heavy (26,001 lbs and over average weight)	*3.32%*
Tables 5.10	Freight Shipments,1997 Commodity Flow Survey	
and 5.11	*Value (billion dollars)*	*6,944*
	Tons (millions)	*11,089*
	Ton-miles (billions)	*2,661*
Tables 5.12	Buses in operation, 2001	
and 5.13	*Transit*	*75,013*
	School	*607,835*

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.

Table 5.1
Summary Statistics for Heavy Single-Unit Trucks, 1970–2001

Year	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	3,681	27,081	3,968	6.8
1975	4,232	34,606	5,420	6.4
1980	4,374	39,813	6,923	5.8
1981	4,455	39,568	6,867	5.8
1982	4,325	40,658	6,803	6.0
1983	4,204	42,546	6,965	6.1
1984	4,061	44,419	7,240	6.1
1985	4,593	45,441	7,399	6.1
1986	4,313	45,637	7,386	6.2
1987	4,188	48,022	7,523	6.4
1988	4,470	49,434	7,701	6.4
1989	4,519	50,870	7,779	6.5
1990	4,487	51,901	8,357	6.2
1991	4,481	52,898	8,172	6.5
1992	4,370	53,874	8,237	6.5
1993	4,408	56,772	8,488	6.7
1994	4,906	61,284	9,032	6.8
1995	5,024	62,705	9,216	6.8
1996	5,266	64,072	9,409	6.8
1997	5,293	66,893	9,576	7.0
1998	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	72,286	9,732	7.4
		Average annual percentage change		
1970–2001	1.4%	3.2%	2.9%	0.3%
1991–2001	2.4%	3.2%	1.8%	1.3%

Source:
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2002, Table VM1 and annual.
(Additional resources: www.fhwa.dot.gov)

Note:
Highway Statistics 1999 data were not used.

Combination trucks include all trucks designed to be used in combination with one or more trailers. The average vehicle travel of these trucks (on a per truck basis) far surpasses the travel of other trucks due to long-haul freight movement.

Table 5.2
Summary Statistics for Combination Trucks, 1970–2001[1]

Year	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	905	35,134	7,348	4.8
1975	1,131	46,724	9,177	5.1
1980	1,417	68,678	13,037	5.3
1981	1,261	69,134	13,509	5.1
1982	1,265	70,765	13,583	5.2
1983	1,304	73,586	13,796	5.3
1984	1,340	77,377	14,188	5.5
1985	1,403	78,063	14,005	5.6
1986	1,408	81,038	14,475	5.6
1987	1,530	85,495	14,990	5.7
1988	1,667	88,551	15,224	5.8
1989	1,707	91,879	15,733	5.8
1990	1,709	94,341	16,133	5.8
1991	1,691	96,645	16,809	5.7
1992	1,675	99,510	17,216	5.8
1993	1,680	103,116	17,748	5.8
1994	1,681	108,932	18,653	5.8
1995	1,696	115,451	19,777	5.8
1996	1,747	118,899	20,192	5.9
1997	1,790	124,584	20,302	6.1
1998	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	135,400	25,555	5.3
		Average annual percentage change		
1970–2001	2.8%	4.4%	4.1%	0.3%
1991–2001	2.4%	3.4%	4.3%	-0.7%

Source:
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2002, Table VM1 and annual.
(Additional resources: www.fhwa.dot.gov)

Note:
Highway Statistics 1999 data were not used.

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

Sales of the medium trucks, classes 3–6 rose substantially in 1998. Light trucks under 10,000 lbs., continue to dominate truck sales.

Table 5.3
New Retail Truck Sales by Gross Vehicle Weight, 1970–2002[a]
(thousands)

Calendar year	Class 1 6,000 lbs. or less	Class 2 6,001– 10,000 lbs.	Class 3 10,001– 14,000 lbs.	Class 4 14,001– 16,000 lbs.	Class 5 16,001– 19,500 lbs.	Class 6 19,501– 26,000 lbs.	Class 7 26,001– 33,000 lbs.	Class 8 33,001 lbs. and over	Total
Domestic sales (import data are not available)									
1970[b]	1,049	408	6	12	58	133	36	89	1,791
1975	1,101	952	23	1	9	159	23	83	2,351
1980	985	975	4	[c]	2	90	58	117	2,231
1981	896	850	1	[c]	2	72	51	100	1,972
1982	1,102	961	1	[c]	1	44	62	76	2,248
1983	1,314	1,207	[c]	[c]	1	47	59	82	2,710
1984	2,031	1,224	6	[c]	5	55	78	138	3,538
1985	2,408	1,280	11	[c]	5	48	97	134	3,983
Domestic and import sales									
1986	3,380	1,214	12	[c]	6	45	101	113	4,870
1987	3,435	1,175	14	2	8	44	103	131	4,912
1988	3,467	1,333	14	21	8	54	103	148	5,149
1989	3,313	1,297	19	27	7	39	93	145	4,942
1990	3,451	1,097	21	27	5	38	85	121	4,846
1991	3,246	876	21	24	3	22	73	99	4,365
1992	3,608	1,021	26	26	4	28	73	119	4,903
1993	4,119	1,232	27	33	4	27	81	158	5,681
1994	4,527	1,506	35	44	4	20	98	186	6,421
1995	4,422	1,631	40	53	4	23	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
Average annual percentage change									
1970–1985	5.7%	7.9%	4.1%	-	-15.1%	-6.6%	6.8%	2.8%	5.5%
1986–2002	3.7%	4.8%	12.6%	-	9.1%	0.0%	-2.4%	1.6%	3.9%

Source:
Ward's Communication's, *Motor Vehicle Facts and Figures 2000*, Southfield, MI, 2000, p. 24, and annual. (Additional resources: www.wardsauto.com)

[a] Sales include domestic-sponsored imports.
[b] Data for 1970 is based on new truck registrations.
[c] Data are not available.

Vehicle Inventory and Use Survey

The Vehicle Inventory and Use Survey (VIUS), which was formerly the Truck Inventory and Use Survey (TIUS), provides data on the physical and operational characteristics of the Nation's truck population. It is based on a probability sample of private and commercial trucks registered (or licensed) in each state. The name of the 1997 survey was changed to the Vehicle Inventory and Use Survey due to future possibilities of including additional vehicle types. The 2002 VIUS, however, will only include trucks. Data from the 2002 VIUS is expected in 2004. Copies of the 1997 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 1997 VIUS and registered in the U.S. as of July 1, 1997, was 72.8 million. These trucks were estimated to have been driven a total of 1,044 billion miles during 1997, an increase of 32.8% from 1992. The average annual miles traveled per truck was estimated at 14,300 miles.

In the 1997 VIUS, there are several ways to classify a truck by weight. The survey respondent was asked the average weight of the vehicle or vehicle-trailer combination when carrying a typical payload; the empty weight (truck minus cargo) of the vehicle as it was usually operated; and the maximum gross weight at which the vehicle or vehicle-trailer combination was operated. The Census Bureau also collected information on the Gross Vehicle Weight Class of the vehicles (decoded from the vehicle identification number) and the registered weight of the vehicles from the State registration files. Some of these weights are only provided in categories, while others are exact weights. Since all these weights could be quite different for a single truck, the tabulations by weight can be quite confusing. In most tables, the Gross Vehicle Weight Class was used.

Table 5.4
Truck Statistics by Gross Vehicle Weight Class, 1997

Manufacturer's gross vehicle weight class	Number of trucks	Percentage of trucks	Average annual miles per truck	Average fuel economy	Gallons of fuel used (millions)	Percentage of fuel use
1) 6,000 lbs and less	45,240,632	62.14%	13,328	17.82	35,184	44.34%
2) 6,001 – 10,000 lbs	22,373,167	30.73%	12,952	14.11	21,226	26.75%
3) 10,001 – 14,000	510,476	0.70%	15,650	10.83	771	0.97%
4) 14,001 – 16,000	194,951	0.27%	16,390	10.11	320	0.40%
5) 16,001 – 19,500	178,111	0.24%	6,016	8.69	117	0.15%
6) 19,501 – 26,000	1,884,246	2.59%	13,637	8.21	3,202	4.04%
7) 26,001 – 33,000	207,386	0.28%	35,588	7.07	1,096	1.38%
8) 33,001 lbs and up	2,211,283	3.04%	48,095	6.69	17,427	21.96%
Total	**72,800,252**	**100.00%**	**14,347**	**16.02**	**79,344**	**100.00%**

Source:
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Microdata File on CD, 2000. (Additional resources: www.census.gov/svsd/www.tiusview.html)

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

Manufacturer's gross vehicle weight class	1992 TIUS	1997 VIUS
1) 6,000 lbs and less	17.2	17.1
2) 6,001–10,000 lbs	13.0	13.6
3) 10,000–14,000 lbs	8.8	9.4
4) 14,001–16,000 lbs	8.8	9.3
5) 16,001–19,500 lbs	7.4	8.7
6) 19,501–26,000 lbs	6.9	7.3
7) 26,001–33,000 lbs	6.5	6.4
8) 33,001 lbs and over	5.5	5.7

Source:
Estimates are based on data provided on the following public use files: U.S. Department of Commerce, Bureau of the Census, Census of Transportation, Washington, DC, *1992 Truck Inventory and Use Survey*, 1995; *1997 Vehicle Inventory and Use Survey*, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

Note:
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. 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, 1997

	Manufacturer's gross vehicle weight class			
	Light (< 10,000 lbs)	Medium (10,001–26,000 lbs)	Heavy (> 26,000 lbs)	Total
Trucks	67,613,799	2,767,784	2,418,669	72,800,252
Trucks (%)	92.88%	3.80%	3.32%	100%
Miles per truck	13,204	13,712	47,022	14,347
Total miles (%)	86.35%	3.35%	10.31%	100%
Fuel use (%)	71.10%	5.56%	23.35%	100%
Fuel economy (mpg)	15.81	7.84	5.75	13.02
	Range of operation			
Under 50 miles	75.11%	64.45%	39.37%	73.53%
51–100 miles	12.83%	16.53%	16.44%	13.09%
101–200 miles	3.86%	5.64%	10.54%	4.15%
201–500 miles	2.09%	4.65%	12.19%	2.52%
Over 500 miles	2.31%	1.25%	16.80%	2.75%
Off-road	3.81%	7.49%	4.66%	3.97%
Total	**100%**	**100%**	**100%**	**100%**
	Primary refueling facility			
Central company-owned	11.52%	27.32%	35.94%	29.20%
Single off-site contract	3.61%	5.84%	7.00%	6.08%
Pubic station	82.49%	61.96%	53.25%	60.56%
Other	2.38%	4.88%	3.80%	4.16%
Total	**100%**	**100%**	**100%**	**100%**

Source:
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Microdata File on CD, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

More medium truck owners listed construction as the truck's major use than any other major use category. Construction was the second highest major use for light trucks and heavy trucks.

Table 5.7
Percentage of Trucks by Size Ranked by Major Use, 1997

Rank	Light (< 10,000 lbs average weight)	Medium (10,001 – 26,000 lbs average weight)	Heavy (> 26,000 lbs average weight)
1	**Personal** 74.56%	**Construction** 20.19%	**For Hire** 31.48%
2	**Construction** 7.56%	**Agriculture** 19.54%	**Construction** 17.56%
3	**Services**[a] 5.57%	**Services**[a] 11.64%	**Agriculture** 14.01%
4	**Agriculture** 3.82%	**Retail** 9.28%	**Wholesale** 7.81%
5	**Retail** 2.79%	**Wholesale** 7.31%	**Services**[a] 7.39%
6	**Not in Use** 1.61%	**Personal** 7.00%	**Retail** 5.67%
7	**Wholesale** 1.33%	**For Hire** 5.47%	**Manufacturing** 5.61%
8	**Utilities** 0.75%	**Utilities** 4.40%	**Forestry** 2.56%
9	**Manufacturing** 0.74%	**Daily Rental** 4.21%	**Utilities** 2.18%
10	**Daily Rental** 0.53%	**Manufacturing** 3.72%	**Mining** 2.18%
11	**Forestry** 0.26%	**Not in Use** 3.21%	**Daily Rental** 2.11%
12	**Mining** 0.25%	**Forestry** 1.64%	**Not in Use** 1.11%
13	**For Hire** 0.21%	**One-Way Rental** 1.24%	**Personal** 0.31%
14	**One-Way Rental** 0.01%	**Mining** 1.14%	**One-Way Rental** 0.01%

Source:
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Micro data File on CD, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

[a] Business and personal services.

In 1997 nearly 60% of all truck fleets use public fueling stations as their primary refueling facility. As expected, larger fleets use central company-owned facilities more than smaller fleets. Mid-size fleets (10–500 vehicles) use off-site contract facilities more than the smaller or larger fleets.

Table 5.8
Percentage of Trucks by Fleet Size and Primary Fueling Facility, 1997

	Primary refueling facility				
Truck fleet size	Central company-owned fueling facility	Single contract fueling facility located off-site	Public fueling stations	Other	Total
1	5.94%	2.70%	87.26%	4.09%	100%
2–5	13.80%	4.56%	76.12%	5.52%	100%
6–9	25.77%	7.32%	62.02%	4.88%	100%
10–24	37.08%	10.43%	49.70%	2.79%	100%
25–99	48.48%	9.65%	39.29%	2.59%	100%
100–499	48.76%	10.62%	38.40%	2.22%	100%
500–999	46.39%	7.46%	44.38%	1.77%	100%
1,000–4,999	45.24%	4.93%	45.94%	3.89%	100%
5,000–9,999	35.77%	6.01%	53.36%	4.87%	100%
10,000 & up	71.72%	2.56%	19.27%	6.45%	100%
Overall	**30.08%**	**6.39%**	**59.37%**	**4.16%**	**100%**

Source:
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Microdata File on CD, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

Most trucks are fueled at public fueling stations but one-way rental trucks are more often fueled at company-owned central fueling facilities or contract fueling facilities than at public stations. Mining and quarrying activities use central fueling facilities more than 40% of the time.

Table 5.9
Percentage of Trucks by Major Use and Primary Fueling Facility, 1997

	Primary fueling facility				
Major Use	Central company-owned fueling facility	Single contract fueling facility located off-site	Public fueling stations	Other	Total
Agricultural services	32.09%	2.99%	53.92%	11.00%	100%
Forestry or lumbering activities	22.49%	4.50%	70.33%	2.68%	100%
Construction work	33.40%	5.39%	58.79%	2.42%	100%
Contractor activities or special trades	12.09%	4.38%	81.18%	2.36%	100%
Manufacturing, refining or processing activities	35.47%	9.48%	53.69%	1.36%	100%
Wholesale trade	32.56%	11.90%	53.62%	1.92%	100%
Retail trade	28.21%	10.25%	59.41%	2.12%	100%
Business and personal services	26.40%	6.33%	65.42%	1.85%	100%
Utilities	40.56%	5.09%	52.25%	2.09%	100%
Mining or quarrying activities	43.82%	9.32%	44.44%	2.42%	100%
Daily rental	39.42%	13.29%	45.12%	2.17%	100%
Not in use for more than six months	10.56%	2.37%	53.12%	33.94%	100%
For-hire transportation	32.87%	4.90%	59.53%	2.70%	100%
One-way rental	48.47%	3.10%	48.43%	0.00%	100%
Personal transportation	2.02%	0.56%	94.46%	2.96%	100%
Overall	**29.20%**	**6.08%**	**60.56%**	**4.16%**	**100%**

Source:
U.S. Department of Commerce, Bureau of the Census, *1997 Vehicle Inventory and Use Survey*, Microdata File on CD, 2000. (Additional resources: www.census.gov/svsd/www/tiusview.html)

Commodity Flow Survey

The Commodity Flow Survey (CFS) is designed to provide data on the flow of goods and materials by mode of transport. The 1993 and 1997 CFS are a continuation of statistics collected in the Commodity Transportation Survey from 1963 through 1977, and include major improvements in methodology, sample size, and scope. In 1997, CFS used a sample of 100,000 domestic establishments randomly selected from a universe of about 800,000 establishments engaged in mining, manufacturing, wholesale, auxiliary establishments (warehouses) of multi-establishment companies, and some selected activities in retail and service was used. Each selected establishment reported a sample of approximately 25 outbound shipments for a one-week period in each of the four calendar quarters of 1997. This produced a total sample of over 5 million shipments. For each sampled shipment, zip codes of origin and destination, 5-digit Standard Classification of Transported Goods (SCTG) code, weight, value, and modes of transport, were provided. Establishments also reported whether the shipment was containerized, a hazardous material, or an export.

The 1993 and 1997 CFS differ from previous surveys in their greatly expanded coverage of intermodalism (i.e., shipments which travel by at least two different modes, such as rail and truck). Earlier surveys reported only the principal mode. The 1993 and 1997 surveys report all modes used for the shipment (for-hire truck, private truck, rail, inland water, deep sea water, pipeline, air, parcel delivery or U.S. Postal Service, other mode, unknown). Route distance for each mode for each shipment as imputed from a mode-distance table was developed by Oak Ridge National Laboratory. Distance, in turn, was used to compute ton-mileage by mode of transport.

For more information about the CFS, contact the Commodity Flow Survey Branch, Department of Commerce, Bureau of the Census, Services Division at (301) 457-2108, or visit the following Internet site: **www.bts.gov/cfs** .

Industries covered by the 1997 Commodity Flow Survey (CFS) shipped over 11 billion tons of goods worth almost $7 trillion. Compared to the 1993 CFS, the value of shipments is up 2.2% per year and ton shipped are up 3.4% per year. By value, intermodal shipments increased 7.0% per year from 1993 to 1997.

Table 5.10
Growth of Freight in the United States: Comparison of the 1997 and 1993 Commodity Flow Surveys
(Detail may not add to total because of rounding)

Mode of Transportation	Value of goods shipped			Tons		
	1997 (billion 1997 dollars)	1993 (billion 1997 dollars)	Average annual percent change	1997 (millions)	1993 (millions)	Average annual percent change
All modes	**6,944.0**	**6,360.8**	**2.2%**	**11,089.7**	**9,688.5**	**3.4%**
Single modes	**5,719.6**	**5,376.3**	**1.6%**	**10,436.5**	**8,922.3**	**4.0%**
Truck[a]	4981.5	4791.0	1.0%	7700.7	6385.9	4.8%
For-hire truck	2901.3	2856.1	0.4%	3402.6	2808.3	4.9%
Private truck	2036.5	1910.4	1.6%	4137.3	3543.5	3.9%
Rail	319.6	269.2	4.4%	1,549.8	1,544.1	0.1%
Water	75.8	67.1	3.1%	563.4	505.4	2.8%
Shallow draft	53.9	44.3	5.0%	414.8	362.5	3.4%
Great Lakes	1.5	[c]	[c]	38.4	33.0	3.9%
Deep draft	20.4	21.5	-1.3%	110.2	109.9	0.1%
Air (includes truck and air)	229.1	151.3	10.9%	4.5	3.1	9.8%
Pipeline[b]	113.5	97.8	3.8%	618.2	483.6	6.3%
Multiple modes	**945.9**	**720.9**	**7.0%**	**216.7**	**225.7**	**-1.0%**
Parcel, U.S. Postal Service or courier	855.9	612.8	8.7%	23.7	18.9	5.8%
Truck and rail	75.7	90.4	-4.3%	54.2	40.6	7.5%
Truck and water	8.2	10.2	-5.3%	33.2	68.0	-16.4%
Rail and water	1.8	4.0	-18.1%	79.3	79.2	0.0%
Other multiple modes	4.3	3.5	5.3%	26.2	18.9	8.5%
Other and unknown modes	**278.6**	**263.6**	**1.4%**	**436.5**	**540.5**	**-5.2%**

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *Freight USA*, Washington, DC, 2000. (Additional resources: www.bts.gov/cfs)

[a] "Truck" as a single mode includes shipments which went by private truck only, for-hire truck only, or a combination of private truck and for-hire truck.
[b] CFS data for pipeline lack most shipments of crude oil.
[c] Denotes data do not meet publication standards because of high sampling variability or other reasons. Some unpublished estimates can be derived from other data published in this table. However, figures obtained in this manner are subject to these same limitations.

Industries covered by the 1997 Commodity Flow Survey (CFS) accounted for about 2.7 trillion ton-miles on the nation's highways, railways, waterways, pipelines, and aviation system. Ton-miles increased an average of 2.4% per year from 1993 to 1997.

Table 5.11
Growth of Freight Miles in the United States: Comparison of the 1997 and 1993 Commodity Flow Surveys
(Detail may not add to total because of rounding)

Mode of Transportation	Ton-miles			Average miles per shipment		
	1997 (billions)	1993 (billions)	Average annual percent change	1997	1993	Average annual percent change
All modes	**2,661.4**	**2,420.9**	**2.4%**	**472**	**424**	**2.7%**
Single modes	**2,383.5**	**2,136.9**	**2.8%**	**184**	**197**	**-1.7%**
Truck[a]	1023.5	869.5	4.2%	144	144	0.0%
For-hire truck	741.1	629.0	4.2%	485	472	0.7%
Private truck	268.6	235.9	3.3%	53	52	0.5%
Rail	1,022.5	942.6	2.1%	769	766	0.1%
Water	261.7	272.0	-1.0%	482	[c]	[c]
Shallow draft	189.3	164.4	3.6%	177	[c]	[c]
Great Lakes	13.4	12.4	2.0%	204	534	-21.4%
Deep draft	59.0	95.2	-11.3%	1,024	1,861	-13.9%
Air (includes truck and air)	6.2	4.0	11.6%	1,380	1,415	-0.6%
Pipeline[b]	[c]	[c]	[c]	[c]	[c]	[c]
Multiple modes	**204.5**	**191.5**	**1.7%**	**813**	**736**	**2.5%**
Parcel, U.S. Postal Service or courier	18.0	13.2	8.1%	813	734	2.6%
Truck and rail	55.6	37.7	10.2%	1,347	1,403	-1.0%
Truck and water	34.8	40.6	-3.8%	1,265	1,417	-2.8%
Rail and water	77.6	70.2	2.5%	1,092	627	14.9%
Other multiple modes	18.6	[c]	[c]	[c]	1,082	[c]
Other and unknown modes	**73.4**	**92.6**	**-5.6%**	**122**	**229**	**-14.6%**

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *Freight USA*, Washington, DC, 2000. (Additional resources: www.bts.gov/cfs)

[a] "Truck" as a single mode includes shipments which went by private truck only, for-hire truck only, or a combination of private truck and for-hire truck.
[b] CFS data for pipeline lack most shipments of crude oil.
[c] Denotes data do not meet publication standards because of high sampling variability or other reasons. Some unpublished estimates can be derived from other data published in this table. However, figures obtained in this manner are subject to these same limitations.

The American Public Transportation Association recently published data by mode and fuel type that were not previously available. Transit bus energy use had been overestimated in previous editions due to this lack of data.

Table 5.12
Summary Statistics on Transit Buses and Trolleybuses, 1994–2001

Year	Number of active buses	Vehicle-miles (millions)	Passenger-miles (millions)	Btu/ passenger-mile	Energy use (trillion Btu)
1994	69,000	2,176	19,019	4,268	81.2
1995	67,992	2,198	19,005	4,310	81.9
1996	72,549	2,234	19,280	4,340	83.7
1997	73,629	2,259	19,793	4,431	87.7
1998	73,022	2,188	20,542	4,387	90.1
1999	75,087	2,290	21,391	4,332	92.7
2000	75,964	2,329	21,433	4,515	96.8
2001	76,675	2,389	22,209	4,125	91.6
			Average annual percentage change		
1994–2001	1.5%	1.3%	2.2%	-0.5%	1.7%

Source:
American Public Transportation Association, *2003 Public Transportation Fact Book*, Washington, DC, February 2003, Tables 6, 18, 22, and 77. (Additional resources: www.apta.com)

[a] Comparisons cannot be made with data before 1992. Beginning in 1992, data were available on non-diesel fuel consumption (i.e. propane, compressed natural gas, methanol).

There are currently not many sources of data on intercity and school buses. The Eno Foundation for Transportation publishes petroleum use for intercity and school buses, and passenger-miles for intercity buses. The Federal Highway Administration publishes an estimate of the total number of school buses. School Bus Fleet magazine also contains statistics on school buses (www.schoolbusfleet.com/stats.cfm).

Table 5.13
Summary Statistics on Intercity and School Buses, 1970–2001

Year	Intercity bus passenger-miles (billions)	Intercity bus energy use (trillion Btu)	Number of school buses	School bus energy use (trillion Btu)
1970	25.3	42.4	288,700	41.18
1975	25.4	25.1	368,300	46.95
1980	27.4	29.7	418,255	52.14
1981	27.1	28.5	432,813	53.12
1982	26.9	31.5	442,133	54.74
1983	25.6	32.9	470,727	55.03
1984	24.6	23.5	471,461	51.51
1985	23.8	23.0	480,400	58.37
1986	23.7	20.6	479,076	63.50
1987	23.0	21.6	486,753	66.91
1988	23.1	22.3	498,907	70.19
1989	24.0	23.1	507,628	68.41
1990	23.0	22.1	508,261	64.83
1991	23.1	22.3	513,227	73.25
1992	22.6	21.8	525,838	74.98
1993	24.7	23.8	534,872	73.25
1994	28.1	27.1	547,718	74.98
1995	28.1	27.1	560,447	74.87
1996	28.8	27.7	569,395	74.87
1997	30.6	29.5	568,113	74.81
1998	31.7	30.5	582,470	75.56
1999	34.7	33.4	592,029	76.31
2000	37.9	32.3	606,028	79.3
2001	41.5	[a]	607,835	[a]
		Average annual percentage change		
1970–2001	1.6%	[a]	2.4%	[a]
1991–2001	6.0%	[a]	1.7%	[a]

Source:

Intercity bus data and school bus energy use - Eno Foundation for Transportation, *Transportation in America 2001*, Nineteenth edition, Washington, DC, pp. 13 and 45. See Appendix A Energy Use Sources for detailed methodology on energy use conversion. (Additional resources: www.enotrans.com)

School buses - Federal Highway Administration, *Highway Statistics 2001*, Washington, DC, 2002, Table MV-10, and annual. (Additional resources: www.fhwa.dot.gov/policy/ohpi)

[a] Data are not yet available.

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, 2002 estimates	518,919
	LPG	*281,286*
	CNG	*126,341*
	E85[a]	*82,477*
	Electric	*19,755*
	M85	*5,873*
	LNG	*3,187*
Table 6.4	Number of alternative fuel refuel sites, 2002	5,739
	LPG	*3,431*
	CNG	*1,166*
	Electric	*872*
Table 6.5	U.S. sales of advanced technology vehicles, 1999–2002	
	Honda Insight	*10,747*
	Toyota Prius	*41,237*
	Honda Civic Hybrid	*~12,000*

Fuel type abbreviations are used throughout this chapter.

B20	=	*20% biodiesel, 80% petroleum diesel*
CNG	=	*compressed natural gas*
E-85	=	*85% ethanol, 15% gasoline*
E-95	=	*95% ethanol, 5% gasoline*
H_2	=	*hydrogen*
LNG	=	*liquified natural gas*
LPG	=	*liquified petroleum gas*
M-85	=	*85% methanol, 15% gasoline*
M-100	=	*100% methanol*

[a]Does not include flex-fuel vehicles.

Alternative Fuels

The U.S. Department of Energy (DOE) defines alternative fuels as fuels which are substantially non-petroleum and yield energy security and environmental benefits. DOE currently recognizes the following as alternative fuels:

- methanol and denatured ethanol as alcohol fuels (alcohol mixtures that contain no less than 70% of the alcohol fuel),
- natural gas (compressed or liquefied),
- liquefied petroleum gas,
- hydrogen,
- coal-derived liquid fuels
- fuels derived from biological materials, and
- electricity (including solar energy).

DOE has established the Alternative Fuels Data Center (AFDC) in support of its work aimed at fulfilling the Alternative Motor Fuels Act (AMFA) directives. The AFDC is operated and managed by the National Renewable Energy Laboratory (NREL) in Golden, Colorado.

The purposes of the AFDC are:

- to gather and analyze information on the fuel consumption, emissions, operation, and durability of alternative fuel vehicles, and

- to provide unbiased, accurate information on alternative fuels and alternative fuel vehicles to government agencies, private industry, research institutions, and other interested organizations.

The data are collected for three specific vehicle types: (1) light vehicles, including automobiles, light trucks, and mini-vans; (2) heavy vehicles such as tractor-trailers and garbage trucks; and (3) urban transit buses. Much of the AFDC data can be obtained through their web site: **www.afdc.doe.gov**. Several tables and graphs in this chapter contain statistics which were generated by the AFDC.

DOE is sponsoring the **National Alternative Fuels Hotline** for Transportation Technologies in order to assist the general public and interested organizations in improving their understanding of alternative transportation fuels. The Hotline can be reached by dialing **1-800-423-1DOE,** or on the Internet at **www.afdc.doe.gov/hotline.html**.

There are more LPG vehicles in use than any other alternative fuel vehicle. The population of E85 vehicles, however, has grown the most since 1993. For details on alternative fuel use by fuel type, see Table 2.3.

Table 6.1
Estimates of Alternative Fuel Vehicles in Use, 1993–2002

Fuel type	1993	1995	1998	2000	2001[a]	2002[a]	Average annual percentage change 1993–2002
LPG	269,000	259,000	266,000	272,193	276,597	281,286	0.5%
CNG	32,714	50,218	78,782	100,738	113,835	126,341	16.2%
LNG	299	603	1,172	2,090	2,576	3,187	30.1%
M85	10,263	18,319	19,648	10,426	7,827	5,873	-6.0%
M100	414	386	200	0	0	0	-100.0%
E85[b]	441	1,527	12,788	58,621	71,336	82,477	78.8%
E95	27	136	14	4	0	0	-100.0%
Electricity	1,690	2,860	5,243	11,834	17,848	19,755	31.4%
Total	**314,848**	**333,049**	**383,847**	**455,906**	**490,019**	**518,919**	**5.7%**

Source:
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 2000*, Washington, DC, 2002, web site www.eia.doe.gov/cneaf/alternate/page/datatables.html. (Additional resources: www.eia.doe.gov)

[a]2001 data are preliminary. 2002 data are based on plans or projections.
[b]Does not include flex-fuel vehicles.

Nearly 90% of private alternative fuel vehicles are fueled by LPG and CNG. The Federal Government does not own many LPG vehicles; its alternative fuel vehicle fleet is 30% CNG and 65% E-85 vehicles in 2002.

Table 6.2
Estimates of Alternative Fuel Vehicles by Ownership, 1998 and 2002

	Private		State and local government		Federal Government	
Fuel type	1998	2002[a]	1998	2002[a]	1998	2002[a]
LPG	213,000	222,727	53,000	56,999	175	1,560
CNG	43,329	66,866	22,291	38,619	13,162	20,856
LNG	279	876	879	2,216	14	95
M-85	10,773	3,061	8,332	2,809	543	3
M-100	0	0	200	0	0	0
E-85	2,595	25,294	5,906	12,571	4,287	44,612
E-95	0	0	14	0	0	0
Electricity	3,461	8,362	1,621	9,629	161	1,764
Total	**273,437**	**327,186**	**92,243**	**122,843**	**18,342**	**68,890**

Source:
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 2000*, Washington, DC, 2002, web site www.eia.doe.gov/cneaf/alternate/page/datatables.html. (Additional resources: www.eia.doe.gov)

[a]Based on plans or projections.

Table 6.3
Alternative Fuel Vehicles Available by Manufacturer, Model Year 2001

Model	Fuel	Type	Emission class
Daimler Chrysler: 1-800-999-FLEET			
Chrysler Sebring Sedan	E-85 flex fuel	Mid-Size Sedan	LEV
Chrysler Sebring Convertible	E-85 flex fuel	Convertible	LEV
Dodge Stratus Sedan	E-85 flex fuel	Sedan	LEV
Chrysler Town and Country	E-85 flex fuel	Minivan	LEV
Dodge Caravan	E-85 flex fuel	Minivan	LEV
Dodge Grand Caravan	E-85 flex fuel	Minivan	LEV
Dodge Ram Maxi Van	CNG dedicated	Van	ILEV/ULEV/CA-SULEV
Dodge Ram Van	CNG dedicated	Van	ILEV/ULEV/CA-SULEV
Ford: 1-877-ALT-FUEL			
Ford F-150	CNG Bi-Fuel	Light-duty pickup	ULEV
Ford E-Series Van	CNG Dedicated	Van	SULEV
Ford E-Series Wagon	CNG Dedicated	Wagon	CA-SULEV
Ford F-150	CNG Dedicated	Light-duty pickup	ILEV/SULEV/CA-SULEV
Ford Crown Victoria	CNG dedicated	Large sedan	ULEV
Ford Taurus	E-85 flex fuel	Mid-size sedan	ULEV
Mercury Sable	E-85 flex fuel	Wagon	ULEV
Ford Explorer	E-85 flex fuel	Sport utility vehicle	LEV
Mercury Mountaineer	E-85 flex fuel	Sport utility vehicle	LEV
Ford Explorer Sport	E-85 flex-fuel	Sport utility vehicle	LEV
Ford Ranger	E-85 flex-fuel	Light-duty pickup	LEV
Ford F-150	LPG Bi-fuel	Light-duty pickup	ULEV
General Motors: 1-800-25Electric, 313-556-7723 or 1-888-GM-AFT-4U (CNG)			
Chevy Silverado	CNG Bi-fuel	Light-duty pickup	LEV
GMC Sierra	CNG Bi-fuel	Light-duty pickup	LEV
Chevy Express	CNG Bi-fuel/CNG Dedicated	Cargo or passenger van	ULEV/(Dedicated CA-SULEV)
GMC Savana	CNG Bi-fuel/CNG Dedicated	Cargo or passenger van	ULEV/(Dedicated CA-SULEV)
Chevrolet Cavalier	CNG Bi-fuel	Compact sedan	LEV
GMC Yukon	E-85 flex-fuel	Sport utility vehicle	Tier 1
Chevrolet Suburban	E-85 flex fuel	Sport utility vehicle	Tier 1
GMC Yukon XL	E-85 flex fuel	Sport utility vehicle	Tier 1
Chevrolet Silverado	E-85 flex fuel	Light-duty pickup	Tier 1
GMC Sierra	E-85 flex fuel	Light-duty pickup	Tier 1
Honda: 1-888-CCHonda			
Civic GX	CNG dedicated	Compact sedan	ILEV/SULEV (Tier II Bin II)
Mazda: 1-800-222-5500			
B3000	E-85 flex fuel	Light-duty pickup	LEV
Nissan: 1-310-771-3422			
Altra EV (CA fleets only)	Electric-lithium ion	Mid-size wagon	ZEV
Hypermini (CA fleets only)	Electric-lithium ion	Two-seater	ZEV
Solectria Corporation: 1-508-658-2231			
Civitan	Electric-lead acid	Service van	ZEV

Source:
U.S. Department of Energy, National Alternative Fuels Data Center, web site, www.afdc.doe.gov/afvehicles.htm, May 2003. (Additional resources: www.afdc.nrel.gov)

Note:
LEV=low emission vehicle. ILEV=inherently low emission vehicle. ULEV=ultra low emission vehicle. ZEV=zero emission vehicle. TLEV=transitional low emission vehicle. SULEV=super ultra low emission vehicle. See Chapter 12 for details on emissions.

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

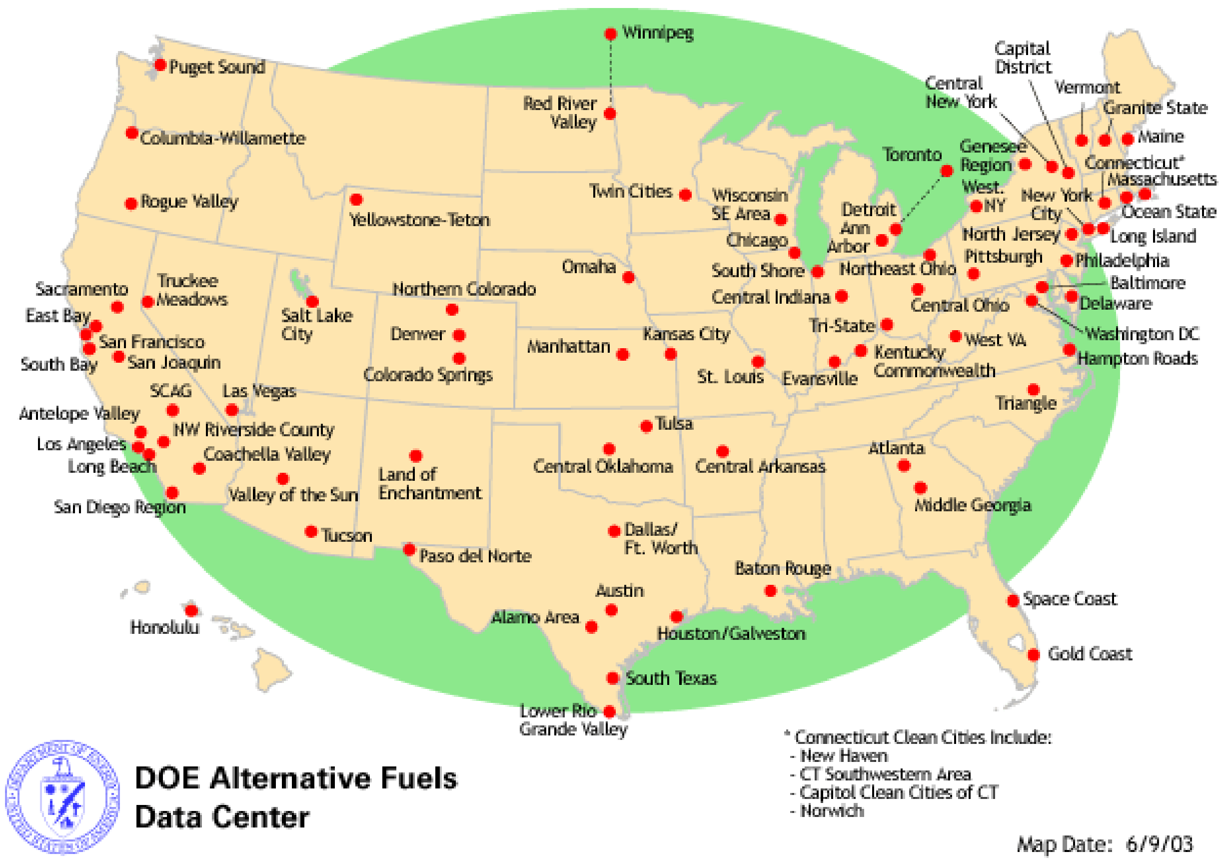
Table 6.4
Number of Alternative Refuel Sites by State and Fuel Type, 2002

State	CNG sites	E85 sites	LPG sites	LNG sites	Electric sites	Biodiesel sites	Hydrogen sites	Total
Alabama	9	0	77	2	34	0	0	122
Alaska	0	0	9	0	0	0	0	9
Arizona	27	1	109	1	63	2	1	204
Arkansas	4	0	85	0	0	0	0	89
California	188	0	345	5	545	9	5	1,097
Colorado	35	8	83	1	6	1	0	134
Connecticut	25	0	29	0	5	0	0	59
Delaware	4	0	4	0	0	0	0	8
District of Columbia	2	0	0	0	0	0	0	2
Florida	42	0	154	1	3	0	0	199
Georgia	65	0	54	1	83	0	0	203
Hawaii	0	0	7	0	11	3	0	21
Idaho	9	1	33	0	1	0	0	43
Illinois	21	13	91	0	0	2	0	127
Indiana	32	1	54	3	0	1	0	91
Iowa	0	11	44	0	0	0	0	55
Kansas	5	1	67	1	0	0	0	74
Kentucky	6	7	26	0	0	0	0	39
Louisiana	14	0	45	0	0	0	0	59
Maine	0	0	20	0	0	2	0	22
Maryland	28	2	28	1	1	3	0	63
Massachusetts	12	0	44	0	41	1	0	98
Michigan	25	4	138	1	5	6	0	179
Minnesota	11	69	58	1	0	0	0	139
Mississippi	3	0	34	0	0	0	0	37
Missouri	7	5	151	0	0	1	0	164
Montana	9	1	40	1	0	1	0	52
Nebraska	5	5	27	0	0	1	0	38
Nevada	20	0	34	0	0	6	1	61
New Hampshire	1	0	30	0	12	2	0	45
New Jersey	30	0	29	0	0	0	0	59
New Mexico	15	1	81	1	0	1	0	99
New York	60	0	95	0	16	0	0	171
N. Carolina	11	0	75	0	6	21	0	113
N. Dakota	4	2	18	0	0	0	0	24
Ohio	35	2	73	1	0	1	0	112
Oklahoma	58	0	93	0	0	0	0	151
Oregon	16	0	49	1	4	2	0	72
Pennsylvania	55	0	104	1	0	1	0	161
Rhode Island	6	0	7	0	2	0	0	15
S. Carolina	4	1	62	0	0	1	0	68
S. Dakota	2	6	26	0	0	0	0	34
Tennessee	2	0	59	0	0	0	0	61
Texas	67	0	423	7	7	1	0	505
Utah	62	2	38	1	0	0	0	103
Vermont	0	0	16	0	11	0	0	27
Virginia	24	1	58	3	11	1	0	98
Washington	23	0	83	1	6	7	0	120
W. Virginia	43	0	9	0	0	0	0	52
Wisconsin	22	4	77	0	0	0	0	103
Wyoming	18	1	36	1	0	2	0	58
Total	**1,166**	**149**	**3,431**	**35**	**872**	**79**	**7**	**5,739**

Source:
U.S. Department of Energy, Alternative Fuels Data Center web site, www.afdc.doe.gov/refuel/state_tot.shtml, April 2003.

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, July 2003.
(Additional resources: www.ccities.doe.gov)

The Honda Insight, Civic Hybrid and Toyota Prius are the three advanced technology vehicles which are currently available to the public in the U.S. They are hybrid vehicles, using both electricity (from batteries) and mechanical power (from a small internal combustion engine). Learn more about DOE's hybrid vehicle program at: www.ott.doe.gov/hev.

Table 6.5
Sales and Specifications of Available Advanced Technology Vehicles

	Honda Insight CVT[a]	Toyota Prius CVT[a]	Honda Civic Hybrid CVT SULEV[a]
Fuel economy (city/hwy)	57/56 mpg	52/45 mpg	47/48 mpg
Fuel tank capacity	10.6 gal.	11.9 gal.	11.9 gal.
Acceleration (0-60 mph)	11.5 sec.	12.3 sec.	11.6 sec.
Emissions rating	SULEV	SULEV	SULEV
Aerodynamics	0.25 Cd	0.29 Cd	0.28 Cd
Curb weight	1,967 lbs.	2,765 lbs.	2,740 lbs.
Passenger capacity	2	5	5
Dimensions:			
Length	155.1 in.	169.6 in.	174.8 in.
Width	66.7 in.	66.7 in.	67.5 in.
Cargo Capacity	16.3 ft^3	11.8 ft^3	10.1 ft^3
Price	$21,280	$20,480	$20,550
Calendar year sales in the U.S.			
1999	17	0	0
2000	3,788	5,562	0
2001	4,726	15,556	0
2002	2,216	20,119	~ 12,000[b]
Total	10,747	41,237	~ 12,000[b]

Source:
Manufacturer's web sites: www.hondacars.com and www.toyota.com.
Insight and Prius sales data - Ward's Communications, Inc., *Wards Automotive Reports,* Southfield, MI, 2003.
Civic sales data - Crain Communications, Automotive News, December 23, 2002.

Note:
SULEV = Super ultra low emission vehicle. See Chapter 12 for details on emissions.

[a]Specifications are for the model containing a continuously variable transmission (CVT).
[b]Sales for the Civic Hybrid are not shown separately from other Civic models, but estimates of 2002 sales are approximately 12,000 vehicles since its March 2002 debut.

FreedomCAR and Fuel Initiative

www.eere.energy.gov/hydrogenfuel

www.eere.energy.gov/vehiclesandfuels

www.eere.energy.gov/hydrogenandfuelcells

Freedom Cooperative Automotive Research (FreedomCAR) is a government-industry partnership for the advancement of high-efficiency vehicles, focused on fuel cells and hydrogen produced from renewable energy sources. The U.S. Department of Energy and the U.S. Council for Automotive Research (composed of automakers Ford, General Motors, and DaimlerChrysler) began this effort in January 2002 with the long-term goal of developing technologies for hydrogen-powered fuel cell cars and trucks that will require no foreign oil and emit no harmful pollutants or greenhouse gases.

But, successful marketing of hydrogen cars may depend on the development of a hydrogen infrastructure, like today's petroleum infrastructure, at the same time automakers are perfecting hydrogen vehicles. That means the creation of everything from hydrogen manufacturing plants, to distribution and storage networks, to convenient hydrogen fueling stations.

The FreedomCAR and Hydrogen Fuel Initiative is aimed at coordinating the efforts of the energy companies, automakers, utilities, state and local governments, foreign interests and other appropriate players. By working on parallel tracks, developing the hydrogen vehicles and infrastructure concurrently instead of consecutively, a decision to go forward with the commercialization of hydrogen automobiles could be made as early as 2015, 15 years ahead of current projections.

For additional information about the FreedomCAR and Hydrogen Fuel Initiative, visit the websites listed above or call 1-800-DOE-3732.

The relative efficiencies of seven different hydrogen production methods are summarized here as a result of research done by Argonne National Laboratory. The study indicates that:

- *Steam methane reforming is a very efficient and cost-effective way to manufacture hydrogen, but there are issues with natural gas supply and carbon sequestration.*
- *Electrolysis is well understood but its overall efficiency depends largely on efficient electrical generation.*
- *Thermochemical cycles have the potential to produce hydrogen from any high-temperature heat source with high efficiency in very high volumes. New research into lower-temperature cycles should increase the applicability of this method.*

Table 6.6
Hydrogen Production Methods

Method	Maximum process temperature (°C)	Overall efficiency (%)	Status
Sulfur-iodine thermo-chemical cycle	850	45!49	Calculation[a]
Calcium-bromine thermo-chemical cycle	760	36!40	Pilot plant[b]
Copper-chlorine thermo-chemical cycle	500	41	Bench[c]
Electrolysis	90	20!30[d]	Commercial[e]
High-temperature electrolysis	900	40	Experiment[f]
Steam methane reforming (SMR)	900	77	Commercial[e]
SMR with CO_2 sequestration	900	58	Calculation[g]

Source:
Argonne National Laboratory (ANL), *Meeting U.S. Transportation Needs in the Hydrogen Economy*, http://www.hydrogen.anl.gov/pdfs/meeting_transportation_needs.pdf, May 2003, and updates from ANL.

Note:
The efficiency is the ratio of the energy value of the hydrogen produced to that of the heat used in the process, except in the case of steam methane reforming, where it is the ratio of the energy of the hydrogen produced to that of the methane consumed.

[a] Calculated from laboratory experiments and thermodynamic data. A full-scale pilot plant has not yet been built.
[b] A pilot plant has been constructed.
[c] The efficiency calculation is based on thermodynamics.
[d] Takes electricity generation efficiency into account.
[e] Commercial Data.
[f] Calculated from commercial electrolysis data and thermodynamic data. No pilot plant data are yet available.
[g] Calculated from SMR commercial plant data and estimates of the energy required to sequester the CO_2.

According to recent data compiled by Argonne National Laboratory, there are more than 200 hydrogen production plants in existence today. Many of the plants that produce hydrogen are part of other processes, like petroleum refining, ammonia production, and methanol production.

Table 6.7
U.S. Hydrogen Production Plants and Storage Terminals

	Number of production plants	Number of storage terminals
Gaseous hydrogen	81	14
Liquid hydrogen	10	3
Gaseous and liquid hydrogen	Not applicable	3
Petroleum refineries	61	Not available
Ammonia producers	54	Not available
Methanol producers	15	4
Total	221	24

Source:
Mintz, Marianne, Argonne National Laboratory, September 2003.

In 1999 (the latest year for which data are available) the U.S. accounted for about 20% of world hydrogen consumption. Ammonia producers made up 61% of World hydrogen consumption, but only 38% of U.S. hydrogen consumption.

Table 6.8
U.S. and World Hydrogen Consumption by End-Use Category, 1999

	United States		World total		U.S. share of World total
	(trillion cubic feet)	(share)	(trillion cubic feet)	(share)	
Captive users:					
Ammonia producers	1.185	38%	9.662	61%	12%
Oil refiners[a]	1.164	37%	3.721	23%	31%
Methanol producers	0.303	10%	1.428	9%	21%
Other	0.121	4%	0.482	3%	25%
Merchant users	0.379	12%	0.570	4%	67%
Total	3.153	100%	15.864	100%	20%

Source:
Hydrogen, *Chemical Economics Handbook program*, SRI Consulting, Menlo Park, CA, July 2001.

Note:
Captive users consume hydrogen at the site where it is produced. Merchant users consume hydrogen at sites other than where it is produced.

[a]Excluding byproduct hydrogen.

The Department of Energy is currently developing systems which will store hydrogen on-board a light vehicle. Below is a list of storage technologies and the advantages/disadvantages of each The DOE goals for on-board hydrogen storage systems are listed at the bottom of the table.

Table 6.9
Hydrogen Storage Systems for On-Board Light Vehicles

Storage technology	System status	Advantages/disadvantages
Chemical hydride	1.6 kWh/kg, 1.4 kWh/L, $8/kWh	☑ Low pressure ☒ Low cost, energy-efficient regeneration processes have not been developed ☒ By-product removal
Complex metal hydride	0.8 kWh/kg, 0.6 kWh/L, $16/kWh	☑ Low pressure ☑ Reversible H_2 uptake and release ☒ Insufficient storage capacity at practical temperature and pressure
Liquid hydrogen	2.0 kWh/kg, 1.6 kWh/L, $6/kWh	☑ Lowest capital cost ☑ Highest gravimetric and volumetric capacities ☒ Most energy intensive ☒ Boil-off requires venting, and presents an energy penalty and a potential safety hazard
10,000 psi compressed hydrogen tanks 5,000 psi compressed hydrogen tanks	1.9 kWh/kg, 1.3 kWh/L, $16/kWh 2.1 kWh/kg, 0.8 kWh/L, $12/kWh	☑ Near-term solution to hydrogen storage ☑ Most energy efficient method to densify H_2 ☒ High pressure ☒ Cost is high due to high pressure containment materials
Department of Energy 2010 and 2015 System Goals[a]		
	Year 2010 • 2.0 kWh/kg (6 wt%) • 1.5 kWh/L • $4/k Wh	Year 2015 • 3.0 kWh/kg (9 wt%) • 2.7 kWh/L • $2/kWh

Source:
U.S. Department of Energy, Hydrogen, Fuel Cells & Infrastructure Technologies Program, 2003.

[a] Goals apply to all storage technologies and are for the complete system including storage material, packaging, regulators, valves, and any thermal management or other ancillary equipment; cost goals and status are based on high-volume production.

Table 6.10
Properties of Conventional and Alternative Fuels

Property	Gasoline	No. 2 diesel	Methanol	Ethanol
Chemical formula	C_4 to C_{12}	C_{10} to C_{20}	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	84–87	37.5	52.2
Hydrogen	12–15	33–16	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	0.81–0.89	0.796	0.796
Density (lb/gal @ 60 F)	6.0–6.5	6.7–7.4	6.63	6.61
Boiling temperature (F)	80–437	370–650	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	-259	-423
Freezing point (F‹)	-305.8	-296	-435
Autoiginition temperature (F‹)	850–950	1,004	1,050–1,080
Reid vapor pressure (psi)	208	2,400	n/a

Source:
Alternative Fuels Data Center, “Properties of Fuel,” www.afdc.doe.gov/pdfs/fueltable.pdf and “Fuel Comparison,” www.afdc.doe.gov/fuel_comp.html, August 2003.

Note:
n/a = not applicable.

There are many types of fuel cells which can be used in many different applications. The Proton Exchange Membrane Fuel Cells (PEMFCs) are the best candidates for transportation-related applications, such as cars, trucks, buses and small portable devices, due to their relatively low operating temperatures and their ability to vary their output to meet changing power demands.

Table 6.11
Fuel Cell Type Comparison

	Electrolyte	Operating Temperature	Efficiency	Electrical Power	Possible Applications
Alkaline	Potassium Hydroxide	60 - 90°C	45 - 60%	Up to 20 kW	Submarines, spacecraft
Direct Methanol	Polymer Membrane	60 - 130°C	40%	< 1 kW	Portable applications
Molten Carbonate	Immobilized Liquid Molten Carbonate	650°C	45 - 60%	> 1 MW	Power stations
Phosphoric Acid	Immobilized Liquid Phosphoric Acid	200°C	36 - 38%	> 50 kW	Power stations
Proton Exchange Membrane	Ion Exchange Membrane	80°C	35 - 60%	Up to 250 kW	Cars, buses, residential energy supply
Solid Oxide	Ceramic	1,000°C	50 - 65%	Up to 1 MW	Small power stations

Source:
Fuel Cell Today, http://www.fuelcelltoday.com .

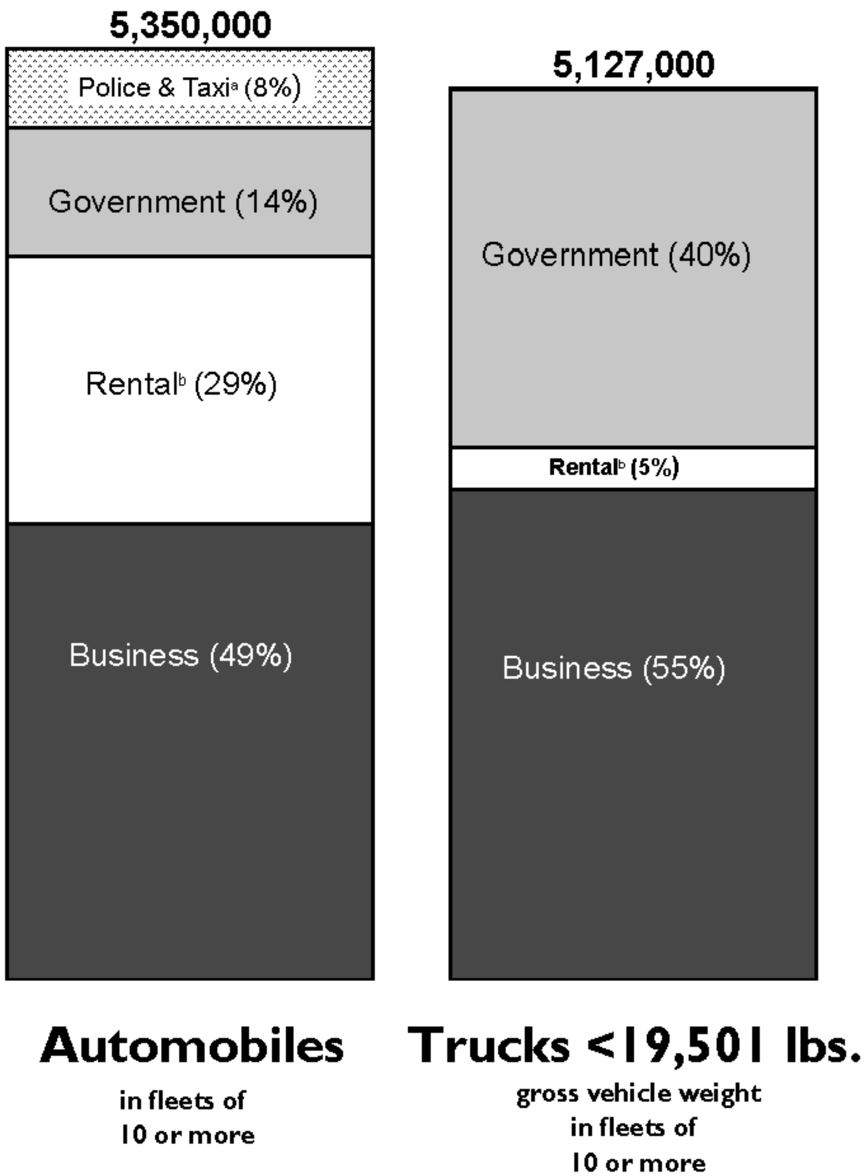
Chapter 7
Fleet Vehicles and Characteristics

Summary Statistics from Tables/Figures in this Chapter

Source		
Figure 7.1	Fleet automobiles, 2002	5,350,000
Figure 7.1	Fleet trucks # 19,500 lbs. GVW, 2002	5,127,000
Table 7.4	Average annual miles per automobile	
	Business fleets	*22,780*
	Utility fleets	*13,399*
	Government fleets	*12,895*
Table 7.4	Average annual miles per light truck (<8,500 lbs. GVW)	
	Business fleets	*26,282*
	Utility fleets	*12,096*
	Government fleets	*6,797*
Table 7.5	Federal government vehicles, FY 2001	567,581
	Automobiles	*114,544*
	Buses	*6,726*
	Light trucks (<8,500 lbs. GVW)	*357,136*
	Medium trucks (8,500–26,000 lbs. GVW)	*89,720*
	Heavy trucks (>26,000 lbs. GVW)	*27,988*

Significant changes have been made in recent years to fleet vehicle estimations. Newly available data improve the accuracy of fleet vehicle estimates but, at the same time, make it impossible to compare the data historically. Therefore, only the latest data are presented here.

Figure 7.1. Fleet Vehicles in Service as of February 1, 2002



Source:
Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2003,* Redondo Beach, CA, 2003. (Additional resources: www.fleet-central.com)

[a]Taxi category includes vans.
[b]Rental category includes vans and sports utility vehicles under **automobiles**, not trucks.

According to these estimates of light fleet vehicle population, utility and government fleets have a greater share of light trucks in their light vehicle population than business fleets do. This is also reflected in the new vehicle purchases.

Table 7.1
Light Vehicles in Fleets of 10 or More, 2000

	Business	Utility	Government
Cars	60.7%	41.5%	37.7%
Light trucks[a] and vans	39.3%	58.5%	62.3%
Total light vehicles	7,694,733	763,190	3,152,831

Source:
See Appendix A for Fleet Vehicle Data, Light Fleet Vehicle Population.

Table 7.2
New Light Fleet Vehicle Purchases by Vehicle Type, 2000

	Business	Utility	Government
Cars	73.2%	11.8%	47.1%
Light trucks[a] and vans	26.8%	88.2%	52.9%
Total light vehicles	2,146,351	355,989	235,085

Source:
See Appendix A for Fleet Vehicle Data., Light Fleet Vehicle New Sales.

[a]In this study, light trucks are <10,000 lbs gross vehicle weight.

The average length of service for an intermediate size fleet car is 30 months. Of the light vehicle types, full-size vans have the longest average months in service. Medium trucks are in service for an average of 70 months.

Table 7.3
Average Length of Time Business Fleet Vehicles are in Service, 2001

Vehicle type	Average months in service
Compact cars	21.1
Intermediate cars	25.8
Pickup trucks	30.4
Minivans	27.1
Sport utility vehicles	25.1
Full-size vans	29.4
Medium trucks	70.4

Source:
Bobit Publishing Company, *Automotive Fleet Factbook 2002*, pp. 52-60.
(Additional resources: www.fleet-central.com)

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

Table 7.4
Average Annual Vehicle-Miles of Travel for Fleet Vehicles, 2000

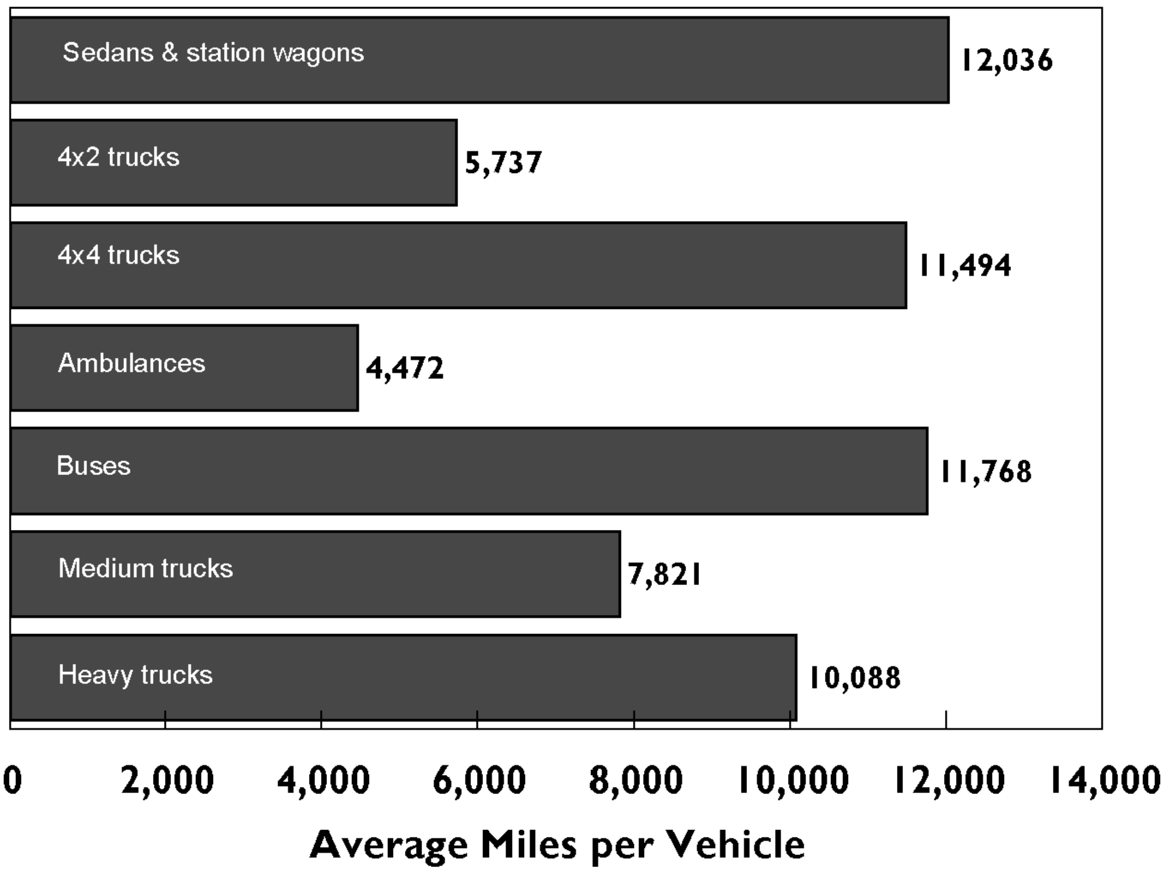
Vehicle type	Business	Utility	Government
Cars	22,780	13,399	12,895
Light trucks[a]	26,282	12,096	6,797
All light vehicles	24,158	12,583	8,328

Source:
See Appendix A for Fleet Vehicle Data, Light Fleet Vehicle Travel.

[a]In this study, light trucks are <10,000 lbs gross vehicle weight.

These data, which apply to domestic Federal fleet vehicles, indicate that sedans and station wagons have the highest average annual miles per vehicle, followed closely by buses. There is a 6,000-mile difference in the average for 4x2 light trucks as opposed to 4x4 light trucks.

Figure 7.2. Average Miles per Domestic Federal Vehicle by Vehicle Type, 2001



Source:
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 2001 Federal Fleet Report*, Washington, DC, 2002, Table 5.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

Table 7.5
Federal Government Vehicles by Agency, Fiscal Year 2001[a]

Department or Agency	Autos	Buses	Light trucks[b]	Medium trucks[c]	Heavy trucks[d]	Total
DOMESTIC						
General Services Administration[e]	54,039	3,145	76,593	30,885	3,902	168,564
Department of Justice	21,414	373	14,519	3,958	504	40,768
Department of Agriculture	3,439	39	24,762	5,395	650	34,285
Department of Treasury	11,030	12	5,114	434	202	16,792
Department of the Interior	1,299	158	9,502	3,293	2,014	16,266
Department of Energy	467	141	2,321	960	1,402	5,291
Tennessee Valley Authority	585	0	921	905	353	2,764
Department of Veterans Affairs	121	106	1,056	225	136	1,644
National Aeronautics and Space Administration	104	71	357	223	111	866
Department of Transportation	73	11	415	96	198	793
Department of Health and Human Services	155	6	351	68	102	682
Department of Commerce	117	2	313	50	10	492
Department of State	132	1	143	8	12	296
Department of Housing and Urban Development	133	0	83	4	0	220
Environmental Protection Agency	15	1	80	39	28	163
Smithsonian Institution	9	5	122	21	5	162
Federal Communications Commission	53	0	63	0	0	116
National Science Foundation	14	5	66	8	16	109
All other departments or agencies	45	2	65	28	10	150
DOMESTIC CIVILIAN AGENCIES	**93,244**	**4,078**	**136,846**	**46,600**	**9,655**	**290,423**
Department of Air Force	1,073	968	9,301	12,838	4,451	28,631
Department of Navy	2,428	373	11,648	6,181	3,215	23,845
Department of Army	471	205	2,983	4,603	1,670	9,932
United States Marine Corps	170	191	541	707	751	2,360
Defense Agencies	1,923	0	75	1	0	1,999
Corps of Engineers Civil	0	0	95	234	355	684
DOMESTIC MILITARY AGENCIES	**6,065**	**1,737**	**24,643**	**24,564**	**10,442**	**67,451**
U.S. POSTAL SERVICE	**9,214**	**0**	**181,504**	**10,874**	**4,713**	**206,305**
TOTAL DOMESTIC FLEETS	**108,523**	**5,815**	**342,993**	**82,038**	**24,810**	**564,179**
FOREIGN						
Department of State	1,743	20	2,113	1,843	99	5,818
General Services Administration[e]	1,753	160	2,260	402	150	4,725
Department of Justice	312	0	512	14	0	838
U.S. Agency for International Development	99	9	635	64	15	822
Department of Agriculture	23	0	160	1	1	185
Department of Commerce	87	0	90	0	0	177
Department of Health and Human Services	24	0	151	0	0	175
All other departments or agencies	88	1	61	4	0	154
FOREIGN CIVILIAN AGENCIES	**4,129**	**190**	**5,982**	**2,328**	**265**	**12,894**
Department of Air Force	865	482	3,830	4,471	1,848	11,496
Department of Navy	465	163	2,572	662	850	4,712
Department of Army	368	62	1,156	166	176	1,928
United States Marine Corps	194	14	603	55	39	905
FOREIGN MILITARY AGENCIES	**1,892**	**721**	**8,161**	**5,354**	**2,913**	**19,041**
TOTAL FOREIGN FLEETS	**6,021**	**911**	**14,143**	**7,682**	**3,178**	**31,935**
GRAND TOTAL OF ALL FLEETS	**114,544**	**6,726**	**357,136**	**89,720**	**27,988**	**596,114**

Source:
U.S. General Services Administration, Federal Supply Service, *FY 2001 Federal Fleet Report*, Washington, DC, 2003, Table 14. (Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

[a] Federally-owned and commercially-leased domestic vehicles.
[b] Less than 8,500 lbs GVWR. Includes ambulances.
[c] 8,501–23,999 lbs GVWR.
[d] 24,000 lbs. or more GVWR.
[e] Most are leased by other Federal agencies.

Table 7.6
Federal Fleet Vehicle Acquisitions
by Fuel Type, FY 1998–2001

	FY98	FY99	FY00	FY01
Gasoline	48,338	54,625	38,561	18,886
Diesel	2,503	3,100	1,700	2,569
Natural gas	1,139	1,836	1,469	371
Ethanol/E-85	3,015	3,886	5,615	1,466
Electricity	36	11	620	8
Other	0	107	0	0
Methanol/M-85	104	33	10	3
LPG	91	33	63	22
Biodiesel	0	5	0	0
Hydrogen	0	0	0	0
Total	55,226	63,636	48,038	23,325

Source:
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 2001 Federal Fleet Report*, Washington, DC, 2003, Chart 16.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

Table 7.7
Fuel Consumed by Federal Government Fleets, FY 1998–2001
(thousand gasoline equivalent gallons)

	FY98	FY99	FY00	FY01
Gasoline	251,478	275,879	284,480	281,791
Diesel	55,188	63,942	70,181	70,761
CNG	5,510	4,019	865	2,387
Electricity	63	25	1	35
Biodiesel	11	128	569	1,315
Methanol/M-85	232	13	14	5
LPG	43	26	34	102
Ethanol/E-85	3,708	130	347	5,900
LNG	0	1	0	0
Other	195	2,143	0	0
Total	316,428	346,306	356,491	362,296

Source:
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 2001 Federal Fleet Report*, Washington, DC, 2003, Charts 8 and 9.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

The Energy Policy Act of 1992 (EPACT) set alternative fuel vehicle acquisition requirements for Federal and State Governments, alternative fuel providers and the private sector. Additional rule making has adjusted the original purchase requirements. State government and alternative fuel providers requirements began in 1997.

Table 7.8
Energy Policy Act Purchase Requirements of Light Alternative Fuel Vehicles

Year	Federal	State	Alternative fuel providers	Private[a]
1993	5,000	-	-	-
1994	7,500	-	-	-
1995	10,000	-	-	-
1996	25%	-	-	-
1997	33%	10%	30%	-
1998	50%	15%	50%	-
1999	75%	25%	70%	-
2000	75%	50%	90%	-
2001	75%	75%	90%	-
2002	75%	75%	90%	20%
2003	75%	75%	90%	40%
2004	75%	75%	90%	60%
2005	75%	75%	90%	70%
2006–on	75%	75%	90%	70%

Source:

Final rule for the alternative fuels transportation programs, *Federal Register*, Vol. 61, p. 10622, March 14, 1996.

Private alternative fueled vehicle acquisition requirements for private and local government fleets, *Federal Register*, vol. 62, p. 19701, April 23, 1997.

[a] The Department of Energy is presently considering implementation of private and municipal fleet rule making.

Chapter 8
Household Vehicles and Characteristics

Summary Statistics from Tables/Figures in this Chapter

Source		
Table 8.2	Vehicles per licensed driver, 2001	1.13
Table 8.3	Average household transportation expense, 2000	19.1%
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%*
Figure 8.1	Average occupancy rates by vehicle type, 2001	
	Automobile	*1.57*
	Pickup truck	*1.48*
	Sports Utility	*1.76*
	Van	*2.22*
Table 8.12	Average annual miles per household vehicle, 2001	11,000
Table 8.14	Share of workers who car pooled, 2000	11.2%
Figure 8.4	Long-distance trips in the U.S., 1995	
	Trips	*1,001 million*
	Person-miles	*827 billion*

Vehicle-miles are growing at a faster rate than vehicles and more than twice the rate of population. See Table 8.2 for vehicles per capita and vehicle-miles per capita.

Table 8.1
Population and Vehicle Profile, 1950–2001

Year	Resident population[a] (thousands)	Total households (thousands)	Number of vehicles in operation (thousands)	Total vehicle-miles (millions)	Number of licensed drivers (thousands)	Number of civilian employed persons (thousands)
1950	151,868	43,554	43,256	458,246	62,194	58,918
1955	165,069	47,874	55,804	605,646	74,686	62,170
1960	179,979	52,799	66,582	718,762	87,253	65,778
1965	193,526	57,251	82,067	887,812	98,502	71,088
1970	203,984	63,401	98,136	1,109,724	111,543	78,678
1975	215,465	71,120	120,054	1,327,664	129,791	85,846
1980	227,225	80,776	139,832	1,527,295	145,295	99,303
1985	237,924	86,789	157,048	1,774,826	156,868	107,150
1986	240,133	88,458	162,094	1,834,872	159,487	109,597
1987	242,289	89,479	167,193	1,921,204	161,975	112,440
1988	244,499	91,061	171,741	2,025,962	162,853	114,968
1989	246,819	92,830	175,960	2,096,487	165,555	117,342
1990	249,623	93,347	179,299	2,144,362	167,015	118,793
1991	252,981	94,312	181,438	2,172,050	168,995	117,718
1992	256,514	95,689	181,519	2,247,151	173,125	118,492
1993	259,916	96,391	186,315	2,296,378	173,149	120,259
1994	263,126	97,107	188,714	2,357,588	175,403	123,060
1995	266,278	98,990	193,441	2,422,696	176,628	124,900
1996	269,394	99,627	198,294	2,485,848	179,539	126,708
1997	272,647	101,018	201,071	2,561,695	182,709	129,558
1998	275,854	102,528	205,043	2,631,522	184,980	131,463
1999	279,040	103,874	209,509	2,691,056	187,170	133,488
2000	282,797	104,705	213,300	2,746,925	190,625	135,208
2001	284,797	[b]	216,683	2,781,462	191,276	135,073
			Average annual percentage change			
1950–2001	1.2%	[b]	3.2%	3.6%	2.2%	1.6%
1991–2001	1.2%	[b]	1.8%	2.5%	1.2%	1.4%

Source:
Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States–2002*, 122nd edition, Washington, DC, 2002, pp. 8, 49, 367, and annual. (Additional resources: www.census.gov)
Vehicles in operation - The Polk Company. **FURTHER REPRODUCTION PROHIBITED**. (Additional resources: www.polk.com)
Licensed drivers and vehicle-miles - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2001*, Tables DL-20 and VM-1, and annual. (Additional resources: www.fhwa.dot.gov)

[a]Estimates as of July 1. Includes Armed Forces stationed in the United States.
[b]Data is not available.

Vehicle-miles per capita have nearly reached 10,000 miles. There were 1.6 vehicles for every employed civilian in the U.S. in 2001.

Table 8.2
Population and Vehicle Ratios, 1950–2001

Year	Vehicles per capita	Vehicle-miles per capita	Vehicles per civilian employed persons
1950	0.285	3,029	0.73
1955	0.338	3,656	0.90
1960	0.370	3,994	1.01
1965	0.424	4,587	1.15
1970	0.481	5,440	1.25
1975	0.557	6,162	1.40
1980	0.615	6,722	1.41
1985	0.660	7,460	1.47
1986	0.675	7,641	1.48
1987	0.690	7,929	1.49
1988	0.702	8,286	1.49
1989	0.713	8,494	1.50
1990	0.718	8,590	1.51
1991	0.717	8,586	1.54
1992	0.708	8,760	1.53
1993	0.717	8,835	1.55
1994	0.717	8,960	1.53
1995	0.726	9,098	1.55
1996	0.736	9,228	1.56
1997	0.737	9,396	1.55
1998	0.743	9,540	1.56
1999	0.751	9,644	1.57
2000	0.754	9,713	1.58
2001	0.761	9,766	1.60
	Average annual percentage change		
1950–2001	2.0%	2.3%	1.6%
1991–2001	0.5%	1.3%	0.4%

Source:

Resident population and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States–2002*, 122nd edition, Washington, DC, 2002, pp. 8, 367, and annual.
(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 2001*, Table VM-1 and annual.
(Additional resources: www.fhwa.dot.gov)

Transportation (19.1%) is second only to housing (31.7%) as the largest expenditure for the average household. In 2001, approximately 16.3% of transportation expenditures were for purchasing gasoline and motor oil. There is an average of two vehicles per household.

Table 8.3
Average Annual Expenditures of Households by Income, 2001[a]

		Income before taxes								
	All households	Less than $5,000	$5,000–$9999	$10,000–$14999	$15,000–$19,999	$20,000–$29,999	$30,000–$39,999	$40,000–$49,999	$50,000–$69,999	$70,000 and over
Total expenditures	$41,395	$20,517	$16,625	$20,642	$25,028	$28,623	$35,430	$40,900	$50,136	$76,124
		Percentage of total expenditures[b]								
Food[c]	14.6%	18.9%	19.5%	17.6%	16.0%	16.5%	15.2%	15.4%	14.5%	12.8%
Housing	31.7%	35.6%	36.2%	36.2%	33.2%	33.3%	31.1%	29.9%	30.6%	31.0%
Apparel and services	4.5%	5.4%	4.5%	4.2%	5.1%	3.7%	4.6%	4.6%	4.3%	4.6%
Transportation	19.1%	16.7%	16.4%	17.1%	18.5%	19.7%	21.3%	21.2%	19.7%	18.2%
Vehicle purchases (net outlay)	**9.1%**	**8.3%**	**8.1%**	**8.2%**	**8.6%**	**9.4%**	**10.9%**	**10.2%**	**9.2%**	**8.5%**
Gasoline and motor oil	**3.1%**	**3.1%**	**3.1%**	**3.1%**	**3.4%**	**3.7%**	**3.5%**	**3.6%**	**3.2%**	**2.7%**
Other vehicle expenditures	**5.9%**	**4.1%**	**4.3%**	**4.9%**	**5.4%**	**5.8%**	**6.1%**	**6.8%**	**6.4%**	**5.8%**
Public transportation	**1.0%**	**1.0%**	**0.8%**	**0.9%**	**0.9%**	**0.8%**	**0.8%**	**0.6%**	**0.9%**	**1.2%**
Health care	5.4%	5.6%	7.7%	8.7%	8.6%	7.3%	6.2%	5.5%	5.0%	3.8%
Entertainment	4.9%	4.5%	3.8%	3.8%	5.2%	4.1%	4.6%	4.8%	5.3%	5.2%
Personal Insurance & pensions	10.9%	1.7%	2.0%	3.4%	4.8%	6.2%	8.5%	9.9%	11.8%	15.2%
Others[d]	9.0%	11.6%	10.0%	8.9%	8.7%	9.1%	8.5%	8.6%	8.7%	9.1%
Households[e] (thousands)	88,735	4,100	6,829	8,099	7,014	12,075	10,508	8,737	12,480	18,892
Percentage of households	100%	4.6%	7.7%	9.1%	7.9%	13.6%	11.8%	9.8%	14.1%	21.3%
Average number of vehicles in HH	2.0	1.0	0.9	1.1	1.5	1.7	1.9	2.2	2.5	2.9

Source:
U.S. Department of Labor, Bureau of Labor Statistics, web site: www.bls.gov/pub/special.requests/ce/share/2001/income.txt, April 2003. (Additional resources: www.bls.gov)

[a] Public assistance monies are included in reported income. Data for those reporting income.
[b] Percentages may not sum to totals due to rounding.
[c] Includes alcoholic beverages.
[d] Includes personal care, reading, education, tobacco and smoking supplies, cash contributions, and miscellaneous items.
[e] The term household refers to a "consumer unit," which is defined differently than households on Table 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, 1960–2000 Census
(percentage)

	No vehicles	One vehicle	Two vehicles	Three or more vehicles	Total vehicles[a]
1960	21.53%	56.94%	19.00%	2.53%	54,766,718
1970	17.47%	47.71%	29.32%	5.51%	79,002,052
1980	12.92%	35.53%	34.02%	17.52%	129,747,911
1990	11.53%	33.74%	37.35%	17.33%	152,380,479
2000	9.35%	33.79%	38.55%	18.31%	179,417,526

Source:
U. S. Department of Transportation, Volpe National Transportation Systems Center, *Journey-to-Work Trends in the United States and its Major Metropolitan Area, 1960–1990*, Cambridge, MA, 1994, p. 2-2.
2000 data - U.S. Bureau of the Census, American Fact Finder, factfinder.census.gov, Table QT-04, August 2001. (Additional resources: www.census.gov)

[a]Estimates using Census Bureau data; these data on the total number of vehicles do not match the figures on Table 8.1. The figures on Table 8.1, from R.L. Polk and Company, are the preferred data.

2001 National Household Travel Survey

The Department of Transportation (DOT) colleted data on daily trips in 1969, 1977, 1983, 1990 and 1995 via the Nationwide Personal Transportation Survey (NPTS). Data on longer trips were collected in 1977 and 1995 via the American Travel Survey (ATS). 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 NHTS is the nation's inventory of daily and long-distance travel. The survey includes demographic characteristics of households, people, vehicles, and detailed information on daily and longer-distance 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 and ATS 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 survey 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 impossible to compare these data with past NPTS survey data. Thus, the 1990 NPTS trip data have been adjusted to make it comparable with the later surveys.

Version 1 of the NHTS data containing the daily trip data were released in January 2003 and are available at the Internet site: nhts.ornl.gov. Data in this report are all generated from the Version 1 NHTS databases. Subsequent versions of the databases will contain long trip data and revisions to the daily trip data.

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

	1969	1977	1983	1990	1995	2001	Percent change 1969–2001
Persons per household	3.16	2.83	2.69	2.56	2.63	2.58	-18%
Vehicles per household	1.16	1.59	1.68	1.77	1.78	1.90	64%
Workers per household	1.21	1.23	1.21	1.27	1.33	1.35	12%
Licensed drivers per household	1.65	1.69	1.72	1.75	1.78	1.77	8%
Vehicles per worker	0.96	1.29	1.39	1.40	1.34	1.41	46%
Vehicles per licensed driver	0.70	0.94	0.98	1.01	1.00	1.07	52%
Average vehicle trip length (miles)	8.89	8.34	7.90	8.98	9.06	9.82	10%

Source:
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92-027, Washington, DC, March 1992, Table 2. Data for 1995 and 2001 were generated from the Internet sites *www-cta.ornl.gov/npts,* and *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 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	5,783	21,253
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	2,189
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	9.8

Source:
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92-027, Washington, DC, March 1992, Table 7. Data for 1995 were generated from the Internet site *www-cta.ornl.gov/npts*. 1990 adjusted data - Oak Ridge National Laboratory, Oak Ridge, TN, August 1998. 2001 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.

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 8.7
Average Annual Person-Miles Traveled (PMT), Person Trips and Trip Length per Household by Selected Trip Purposes
1983, 1990, 1995 NPTS and 2001 NHTS

	Journey-to-work[a]	Shopping	Social and recreational	All purposes[b]
	Average annual PMT per household			
1983	4,586 (20%)	2,567 (11%)	8,964 (39%)	22,802 (100%)
1990 original	5,637 (23%)	2,674 (11%)	8,567 (35%)	24,803 (100%)
1990 adjusted	5,637 (19%)	3,343 (11%)	11,308 (37%)	30,316 (100%)
1995	7,740 (22%)	4,659 (14%)	10,571 (31%)	34,459 (100%)
2001	6,770 (18%)	5,086 (14%)	11,215 (30%)	37,498 (100%)
	Average annual person trips per household			
1983	537 (20%)	474 (18%)	728 (28%)	2,628 (100%)
1990 original	539 (20%)	504 (19%)	662 (25%)	2,673 (100%)
1990 adjusted	539 (17%)	630 (19%)	874 (27%)	3,262 (100%)
1995	676 (18%)	775 (20%)	953 (25%)	3,828 (100%)
2001	567 (15%)	742 (19%)	1,031 (27%)	3,828 (100%)
	Average person trip length (miles)			
1983	8.5	5.4	12.3	8.7
1990 original	10.7	5.4	13.2	9.5
1990 adjusted	10.7	5.4	13.2	9.5
1995	11.6	6.1	11.3	9.1
2001	12.2	7.0	11.1	10.0

Source:
U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Study, Public Use Tapes, Washington, DC. Data for 1995 and 2001 were generated from the Internet sites *www-cta.ornl.gov/npts* and *nhts.ornl.gov*. 1990 adjusted data - Oak Ridge National Laboratory, Oak Ridge, TN, August 1998. (Additional resources: www.fhwa.dot.gov, www-cta.ornl.gov/npts)

Note:
Average person trip length for 1990 and 1995 is calculated using only those records with trip mileage information present. "All purposes" includes unreported trip purposes.

[a]It is believed that the methodology changes in the 1995 NPTS did not affect journey-to-work trips; therefore, no adjustment is necessary.
[b]Includes trip purposes not shown on this table.

In 2001 vehicle-miles traveled (vmt) for a three-person household is over 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 74% more vmt than households without children.

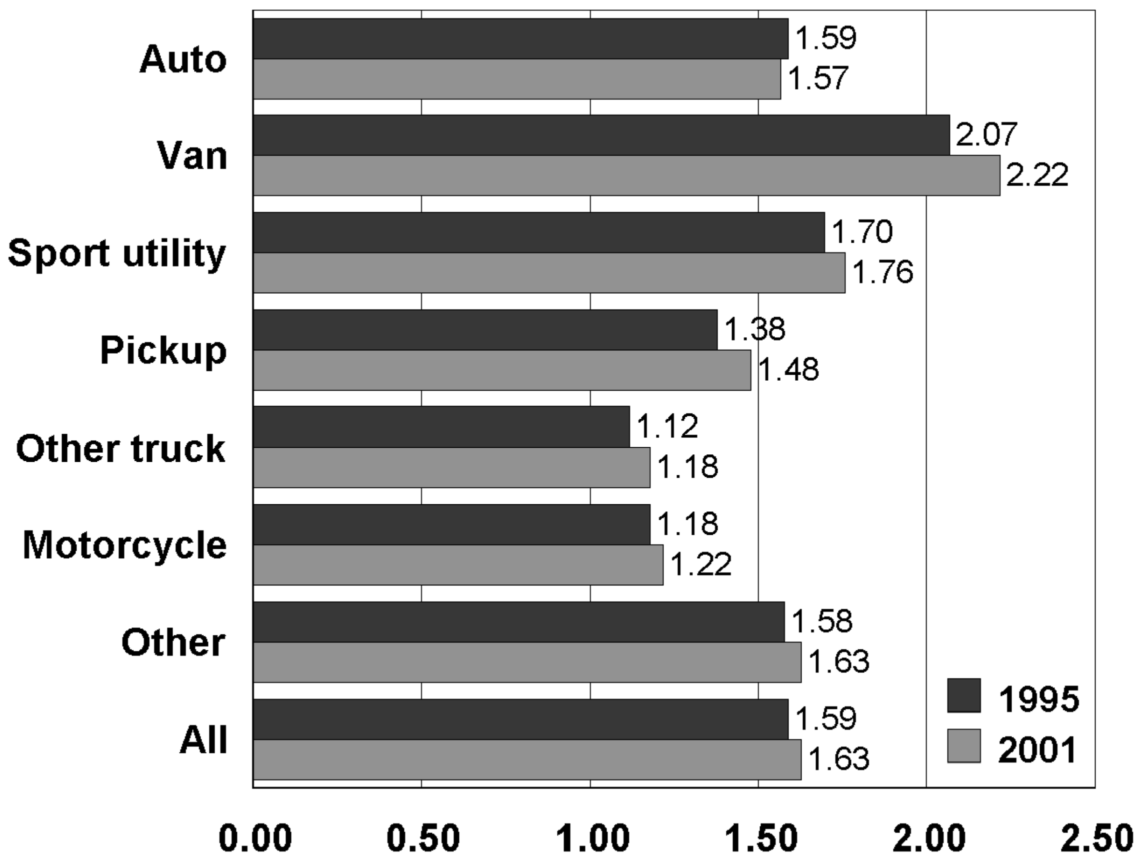
Table 8.8
Average Number of Vehicles and Vehicle Travel per Household, 1990 NPTS and 2001 NHTS

	Average number of vehicles per household		Average vehicle-miles traveled per household	
Number of Licenced Drivers	**1990**	**2001**	**1990**	**2001**
1	1.5	1.2	15,200	9,800
2	2.1	2.2	22,900	26,000
3	2.9	3.0	29,400	36,400
4 or more	3.8	3.9	40,500	48,400
Household size				
1 person	1.2	1.0	11,400	7,800
2 persons	1.9	2.0	19,300	21,000
3 persons	2.2	2.3	23,700	28,200
4 persons	2.4	2.4	25,300	29,400
5 persons	2.4	2.5	24,900	32,600
6 or more persons	2.7	2.6	29,200	35,000
Household urban status				
Urban	1.9	1.8	19,000	19,400
Rural	2.1	2.3	22,200	28,500
Household composition				
With children	2.2	2.3	24,100	28,700
Without children	1.8	1.7	17,600	16,500
All households	**1.8**	**1.9**	**18,300**	**21,300**

Source:
Generated from the Department of Transportation, 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)

While automobile occupancy declined slightly from 1995 to 2001, all other vehicle types showed increased occupancy. Vans and sport utility vehicles have higher vehicle occupancies than automobiles.

Figure 8.1. Average Vehicle Occupancy by Vehicle Type, 1995 NPTS and 2001 NHTS

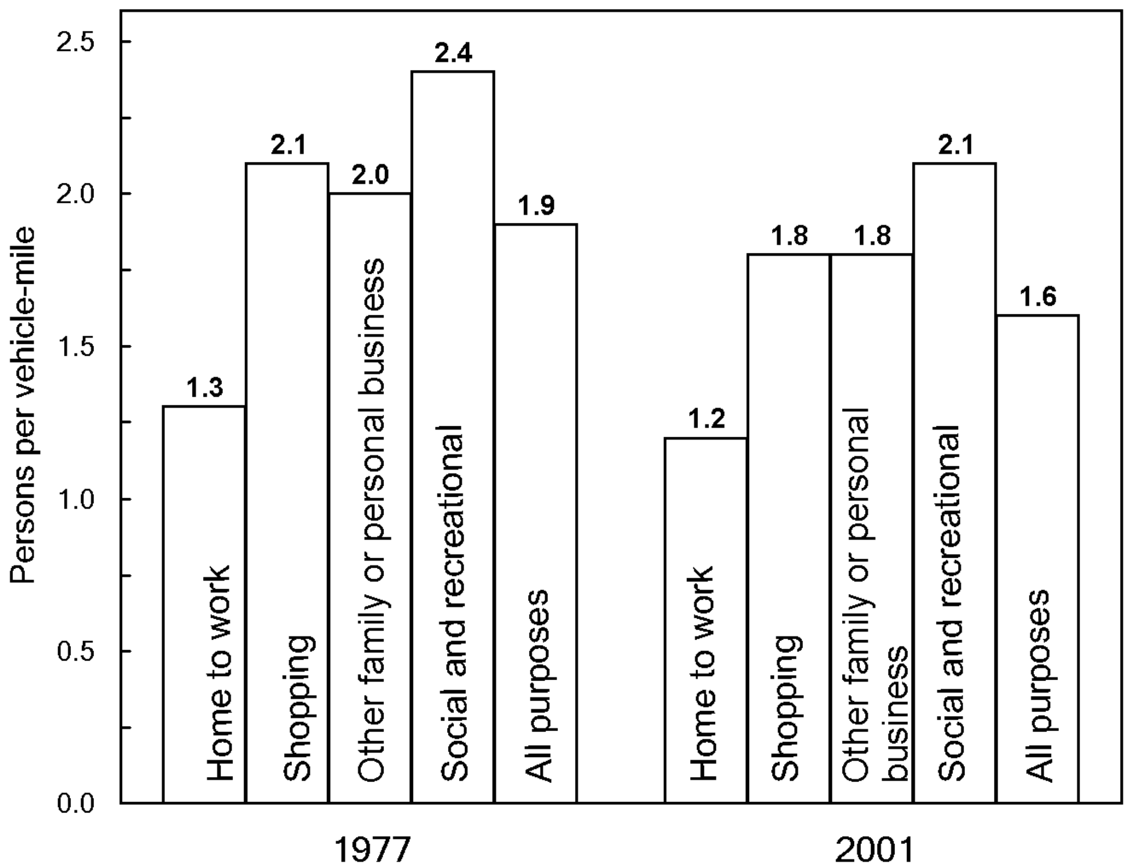


Source:

U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey, Washington, DC, 1997.
(Additional resources: www.fhwa.dot.gov, www-cta.ornl.gov/npts, 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 2001 NHTS



Source:

U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92027, Washington, DC, March 1992, Figure 6. Data from 2001 NHTS were generated from the Internet site nhts.ornl.gov, June 2003.
(Additional resources: www.fhwa.dot.gov, nhts.ornl.gov)

As households owned more vehicles, the average annual miles for the most frequently driven vehicle increased. For example, the most frequently driven vehicle in five-vehicle households was driven 36% more per year than the one in two-vehicle households (15,019 miles vs. 20,467 miles).

Table 8.9
Average Annual Miles per Vehicle by Household Vehicle Ownership, 2001 NHTS

Vehicle [a]	One-vehicle household	Two-vehicle household	Three-vehicle household	Four-vehicle household	Five-vehicle household
#1	10,306	15,019	16,951	19,092	20,467
#2	-	7,505	8,951	10,212	11,433
#3	-	-	4,101	5,673	6,825
#4	-	-	-	2,851	3,883
#5	-	-	-	-	2,000
Average	**10,306**	**11,775**	**11,000**	**10,711**	**10,327**

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

Table 8.10
Average Age of Vehicles by Household Vehicle Ownership, 2001 NHTS

Vehicle[a]	One-vehicle household	Two-vehicle household	Three-vehicle household	Four-vehicle household	Five-vehicle household
#1	8.1	6.8	7.1	7.2	7.6
#2	-	8.9	9.1	9.2	9.1
#3	-	-	12.5	11.7	11.4
#4	-	-	-	15.0	14.8
#5	-	-	-	-	16.3
Average	**8.1**	**7.7**	**9.1**	**10.1**	**11.0**

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

[a]Vehicles are ranked by descending annual miles driven.

The average annual miles per vehicle declined from 1995 to 2001. With households having more and more vehicles at their disposal, each vehicle is being driven fewer miles.

Table 8.11
Average Annual Miles Per Household Vehicle by Vehicle Age

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

Source:
Nationwide Personal Transportation Study—1983: D. Klinger and J. Richard Kuzmyak, COMSIS Corporation, Personal Travel in the United States, Volume 1: 1983–84 Nationwide Personal Travel Study, prepared for the U.S. Department of Transportation, Washington, DC, August 1986, Table 4-22, p.4-21. 1990: Generated from the 1990 Nationwide Personal Transportation Study Public Use Tape, March 1992. 1995: Generated from the Internet site: www-cta.ornl.gov/npts.
(Additional resources: www.fhwa.dot.gov, www.eia.doe.gov)

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

Historically, the data from the Nationwide Personal Transportation Survey (NPTS) are based on estimates reported by survey respondents. For the 1995 survey, odometer data was also collected. These data indicate that respondents overestimate the number of miles driven in a year.

Table 8.12
Self-Reported vs. Odometer Average Annual Miles, 1995 NPTS

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

Source:
Generated from the Internet site www-cta.ornl.gov/npts.

According to the U.S. Census data, the percentage of workers who car pooled has dropped from 19.7% in 1980 to 11.2% in 2000. The percent of workers using public transit declined from 6.4% to 5.3% in the ten year period between 1980 and 1990, but stayed relatively the same from 1990 to 2000 (5.2%). The average travel time increased by 2.6 minutes from 1980 to 2000.

Table 8.13
Means of Transportation to Work, 1980, 1990 and 2000 Census

	1980 Census		1990 Census		2000 Census	
Means of transportation	Number of workers (thousands)	Share	Number of workers (thousands)	Share	Number of workers (thousands)	Share
Private vehicle	81,258	84.1%	99,593	86.5%	111,554	87.5%
Drove alone	*62,193*	*64.4%*	*84,215*	*73.2%*	*97,247*	*76.3%*
Car pooled	*19,065*	*19.7%*	*15,378*	*13.4%*	*14,307*	*11.2%*
Public transportation	6,175	6.4%	6,070	5.3%	6,575	5.2%
Bus or trolley bus[a]	*3,925*	*4.1%*	*3,445*	*3.0%*	*3,572*	*2.8%*
Streetcar or trolley car[a]	[b]	[b]	*78*	*0.1%*	*88*	*0.1%*
Subway or elevated	*1,529*	*1.6%*	*1,755*	*1.5%*	*1,981*	*1.6%*
Railroad	*554*	*0.6%*	*574*	*0.5%*	*696*	*0.5%*
Ferryboat	[b]	[b]	*37*	*0.0%*	*43*	*0.0%*
Taxicab	*167*	*0.2%*	*179*	*0.2%*	*194*	*0.2%*
Motorcycle	419	0.4%	237	0.2%	158	0.1%
Bicycle	468	0.5%	467	0.4%	563	0.4%
Walked only	5,413	5.6%	4,489	3.9%	3,413	2.7%
Other means	703	0.7%	809	0.7%	1,099	0.9%
Worked at home	2,180	2.3%	3,406	3.0%	4,075	3.2%
Total workers	96,617	100.0%	115,070	100.0%	127,437	100.0%
Average travel time (minutes)	21.7		22.4		24.3	

Source:
1980-1990 data - Provided by the Journey-to-Work and Migration Statistics Branch, Population Division, U.S. Bureau of the Census
2000 data - U.S. Bureau of the Census, American Fact Finder, factfinder.census.gov, Tables QT-03 and P047, August 2001. (Additional resources: www.census.gov)

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

More than half of workers had 15-29 minute commutes in 1990, but that dropped to 35% by 2000. The share of workers commuting less than 15 minutes increased the most in the ten-year period (14 percentage points), but the share of workers commuting 30 minutes or more also saw small increases.

Table 8.14
Workers by Commute Time, 1990 and 2000 Census

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

Source:
1990 - U. S. Department of Transportation, Volpe National Transportation Systems Center, *Journey-to-Work Trends in the United States and its Major Metropolitan Area, 1960–1990*, FHWA-PL-94-012, Cambridge, MA, 1994, p. 2-6.
2000 - U.S. Bureau of the Census, American Fact Finder, factfinder.census.gov, Tables QT-03 and P048, August 2001.
(Additional resources: www.census.gov)

Sales of bicycles with wheel sizes of 20-inches and over have grown at an average annual rate of 2% from 1981 to 2002. The largest growth in bicycle sales, however, were bicycles with wheel sizes under 20 inches which grew at an average annual rate of 4.8%.

Table 8.15
Bicycle Sales, 1981–2002
(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
	Average annual percentage change		
1981–2002	[a]	2.0%	[a]
1992–2002	4.8%	1.6%	2.5%

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

[a] Data are not available.

One-third of bicycle sales in 2002 were mountain bikes, which sold for an average of $450 per bike. Road bicycles, which list the most expensive average price, have been slowly gaining market share from 2000 to 2002. Youth bicycles account for 28% of the bicycle market.

Table 8.16
Specialty Bicycle Sales by Year, 2000–2002[a]

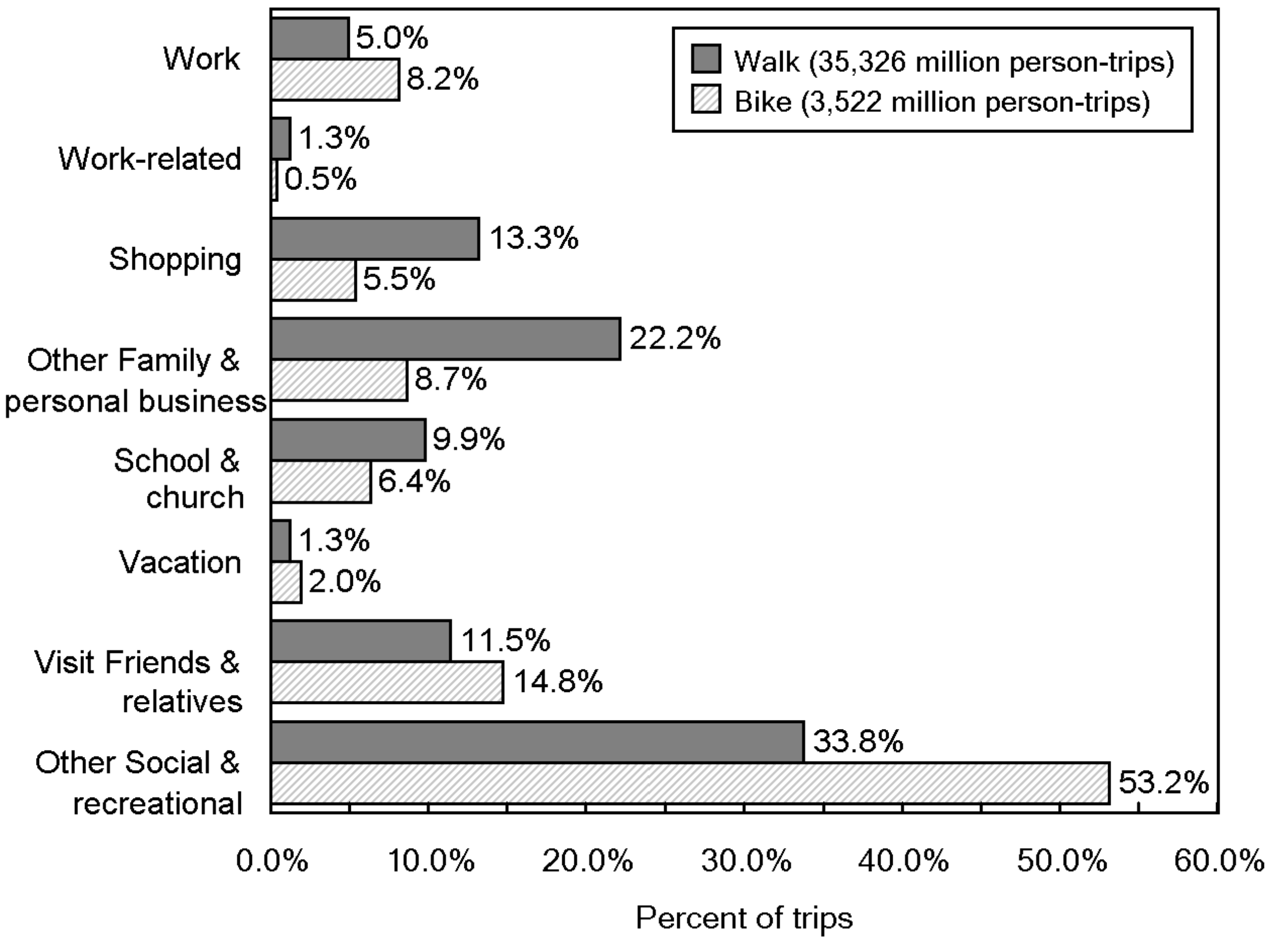
Category	2000	2001	2002	Average 2002 price
Mountain	41.0%	36.8%	33.8%	$450.30
Youth	28.5%	26.1%	28.3%	$197.49
Comfort	13.6%	20.8%	20.6%	$339.15
Hybrid	10.2%	8.8%	9.4%	$404.66
Road	3.6%	4.4%	5.3%	$1,194.68
Cruiser	2.8%	2.8%	2.2%	$275.17
Tandem	0.12%	0.11%	0.15%	$887.91

Source:
National Bicycle Dealers Association Retail Data Capture Program.

[a] Sales of top 19 bicycle brands through panel of retailers.

In 2001, 5% of walk trips and 8% of bike trips were to/from work. More than half of all bike trips were for social/recreational purposes. Thirteen-percent of walk trips were shopping trips.

Figure 8.3 Walk and Bike Trips by Trip Purpose, 2001 NHTS



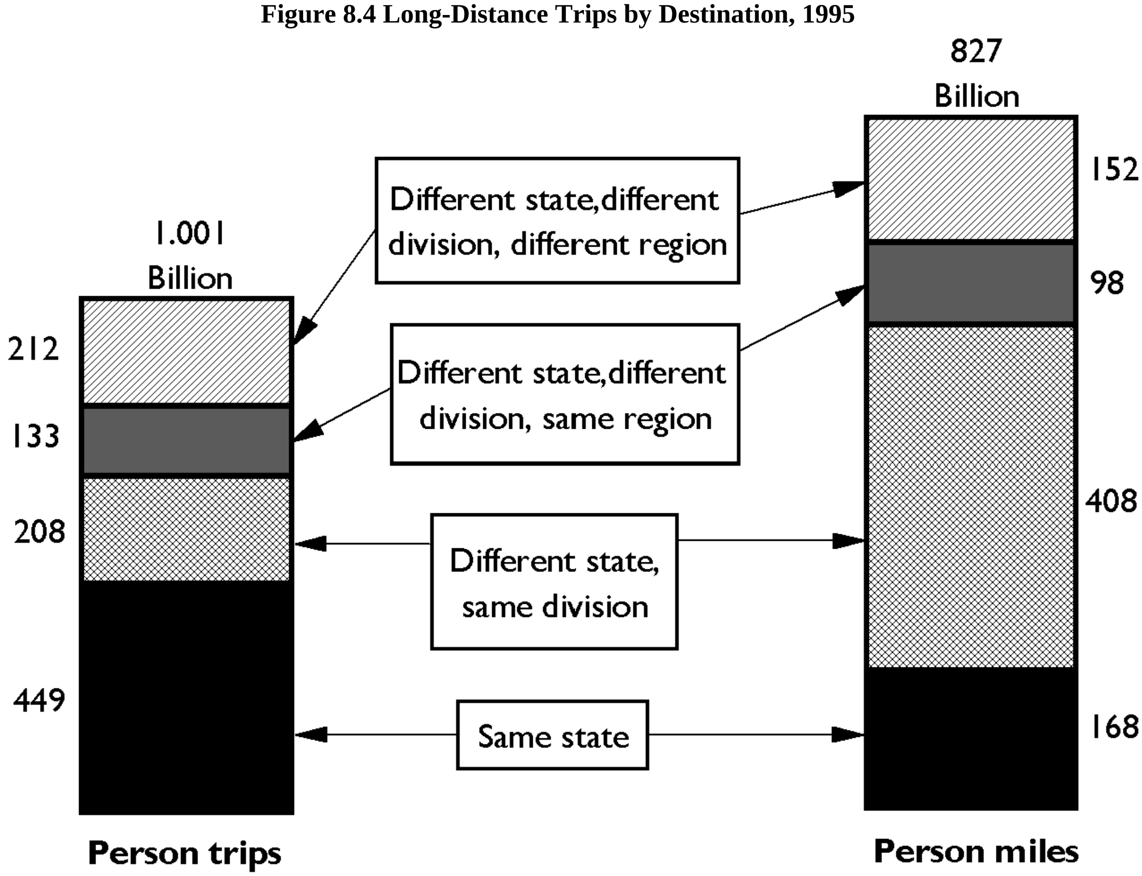
Source:
U.S. Department of Transportation, Federal Highway Administration, National Household Travel Survey web site: nhts.ornl.gov.

1995 American Travel Survey

The American Travel Survey (ATS) was conducted by the Bureau of Transportation Statistics, U.S. Department of Transportation, to obtain information about the long-distance travel of persons living in the United States. Approximately 80,000 randomly selected households were interviewed for the survey, which collected information about all trips of 100 miles or more, one-way, taken by household members in 1995. The ATS data provide detailed information on state-to-state travel, as well as travel to and from metropolitan areas by mode of transportation.

For additional information about the American Travel Survey, contact the Bureau of Transportation Statistics at (202) 366-3282 or visit the following Internet site: www.bts.gov/ats. New data on long-distance travel will be available in late 2003 from the 2001 National Household Travel Survey at nhts.ornl.gov.

Figure 8.4 Long-Distance Trips by Destination, 1995



Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *1995 American Travel Survey Profile*, Washington, DC, October 1997, p. 2. (Additional resources: www.bts.gov/ats)
Note:
Definitions of divisions and regions are in Appendix C.

Personal-use vehicles are by far the most predominant means of transportation on long-distance trips (100 miles or more, one way); two-thirds of those personal vehicle trips are pleasure trips.

Table 8.17
Long-Distance Trips[a] by Mode and Purpose, 1995

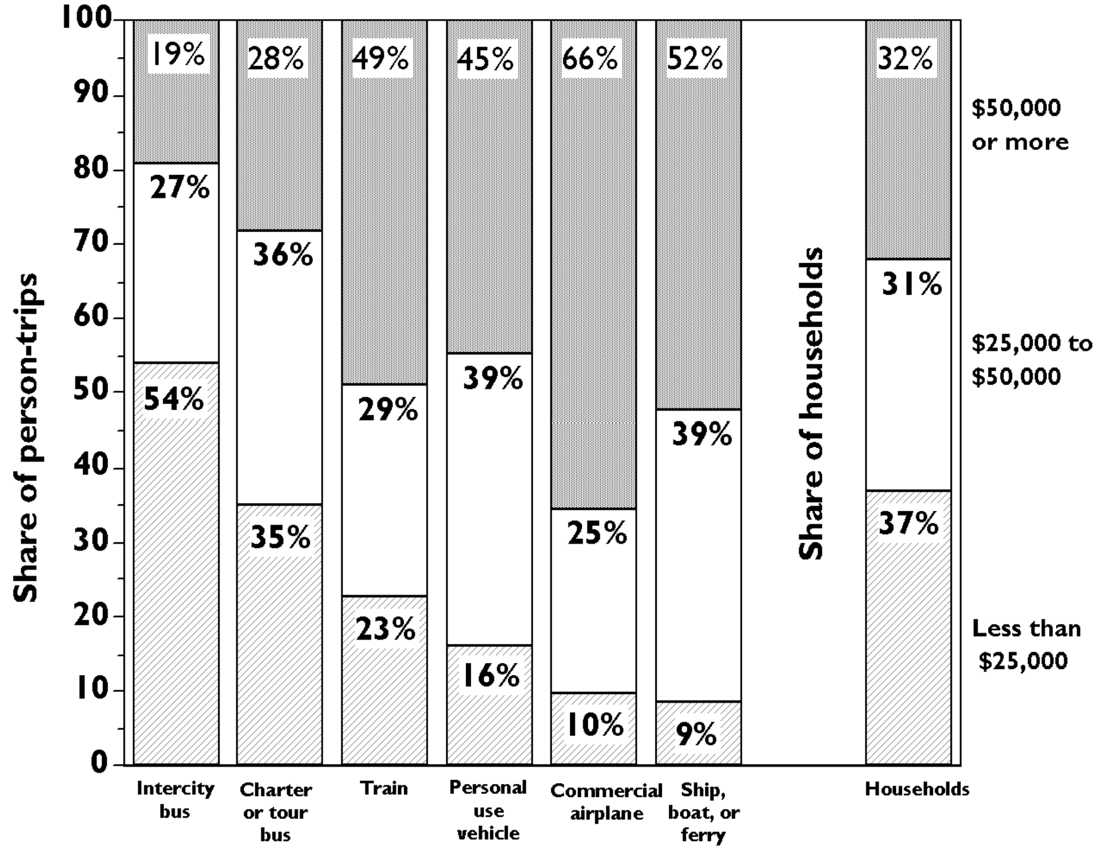
	Main purpose of trip					
		Pleasure				
Principal means of transportation	Business	*Visit friends or relatives*	*Leisure*	Total pleasure	Personal business	Total
	Person trips (thousands)					
Personal use vehicle	151,697	*283,153*	*254,186*	537,339	124,791	813,858
Commercial airplane	67,083	*41,881*	*31,581*	73,462	15,386	155,936
Intercity bus	286	*1,830*	*690*	2,519	439	3,244
Charter or tour bus	1,281	*1,198*	*9,253*	10,451	2,514	14,247
Train	1,342	*2,004*	*944*	2,948	704	4,994
Ship, boat, or ferry	68	*43*	*483*	525	20	614
Total person-trips	**224,835**	***330,755***	***299,355***	**630,110**	**146,338**	**1,001,31**
	Percentage					
Personal use vehicle	18.6	*34.8*	*31.2*	66.0	15.3	100.0
Commercial airplane	43.0	*26.9*	*20.3*	47.1	9.9	100.0
Intercity bus	8.8	*56.4*	*21.3*	77.7	13.5	100.0
Charter or tour bus	9.0	*8.4*	*64.9*	73.4	17.6	100.0
Train	26.9	*40.1*	*18.9*	59.0	14.1	100.0
Ship, boat, or ferry	11.1	*7.0*	*78.7*	85.5	3.3	100.0
Total	**22.5**	***33.0***	***29.9***	**62.9**	**14.6**	**100.0**

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *1995 American Travel Survey Profile*, Washington, DC, October 1997, p. 13. (Additional resources: www.bts.gov/ats)

[a]A long-distance trip is any trip of 100 miles or more, one way.

Those with a household income of less than $25,000 account for more than half (54%) of intercity bus person-trips. Those with a household income of $50,000 or more account for two-thirds (66%) of commercial airplane person-trips.

Figure 8.5. Shares of Long-Distance Person Trips by Mode and Household Income, 1995



Source:

U.S. Department of Transportation, Bureau of Transportation Statistics, *1995 American Travel Survey Profile*, Washington, DC, October 1997, p. 8.

U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, 117th Edition, Washington, DC, 1997, p. 465.

(Additional resources: www.bts.gov/ats, www.census.gov)

Chapter 9
Nonhighway Modes

Summary Statistics from Tables in this Chapter

Source		
	Passenger-miles, 2001	(millions)
Table 9.2	*Domestic and international air carrier*	*664,841*
Table 9.3	*General aviation*	*16*
Table 9.12	*Amtrak*	*5,571*
Table 9.13	*Commuter rail*	*9,548*
Table 9.14	*Transit rail*	*15,615*
	Freight ton-miles, 2001	(millions)
Table 9.5	*Domestic waterborne commerce*	*622,000*
Table 9.9	*Class I railroad*	*1,495,472*
	Passenger energy use, 2001	(trillion Btus)
Table 9.2	*Domestic and international air carrier*	*2,599.4*
Table 9.3	*General aviation*	*165.1*
Table 9.7	*Recreational boats*	*313.5*
Table 9.12	*Amtrak*	*19.8*
Table 9.13	*Commuter rail*	*25.9*
Table 9.14	*Transit rail*	*48.6*
	Freight energy use, 2001	(trillion Btus)
Table 9.5	*Domestic waterborne commerce*	*276.2*
Table 9.9	*Class I railroad*	*517.3*

Nonhighway transportation modes accounted for about 20% of total transportation energy use in 2001.

Table 9.1
Nonhighway Energy Use Shares, 1970–2001

	Share of transportation energy use					
Year	Air	Water	Pipeline	Rail	Nonhighway total	Transportation total (trillion Btu)
1970	8.5%	4.9%	6.5%	3.6%	23.6%	15,321
1971	8.2%	4.4%	6.4%	3.5%	22.4%	15,945
1972	7.7%	4.2%	6.1%	3.4%	21.5%	16,969
1973	7.7%	4.6%	5.6%	3.5%	21.4%	17,824
1974	7.3%	4.7%	5.5%	3.6%	21.1%	17,104
1975	7.3%	4.9%	4.9%	3.2%	20.4%	17,356
1976	7.2%	5.5%	4.4%	3.2%	20.3%	18,426
1977	7.0%	6.3%	4.1%	3.1%	20.5%	19,157
1978	7.1%	7.0%	3.9%	2.9%	20.9%	20,126
1979	7.4%	8.1%	4.3%	3.0%	22.8%	20,135
1980	7.6%	7.5%	4.7%	3.1%	22.9%	18,979
1981	7.6%	8.6%	4.8%	3.0%	23.9%	19,120
1982	7.8%	7.4%	4.6%	2.6%	22.5%	18,560
1983	7.7%	6.8%	4.0%	2.6%	21.1%	18,677
1984	8.3%	6.8%	4.1%	2.8%	22.0%	19,323
1985	8.5%	6.7%	3.9%	2.6%	21.6%	19,659
1986	9.0%	6.5%	3.6%	2.4%	21.5%	20,277
1987	9.2%	6.5%	3.7%	2.4%	21.8%	20,742
1988	9.3%	6.4%	4.1%	2.4%	22.2%	21,280
1989	9.2%	6.5%	4.1%	2.4%	22.2%	21,580
1990	9.6%	7.0%	4.3%	2.4%	23.2%	21,689
1991	9.1%	7.5%	4.1%	2.3%	22.9%	21,279
1992	9.0%	7.6%	3.9%	2.3%	22.7%	21,939
1993	8.9%	6.7%	4.0%	2.3%	21.8%	22,393
1994	9.0%	6.3%	4.2%	2.4%	21.8%	22,997
1995	9.1%	6.5%	4.1%	2.4%	22.1%	23,536
1996	9.2%	6.1%	4.1%	2.4%	21.8%	24,042
1997	9.4%	5.4%	4.2%	2.4%	21.4%	24,404
1998	9.5%	5.2%	3.6%	2.4%	20.7%	24,839
1999	9.5%	5.5%	3.5%	2.3%	20.8%	26,034
2000	9.7%	5.8%	3.4%	2.3%	21.2%	26,350
2001	9.3%	4.5%	3.4%	2.4%	19.6%	25,899

Source:
Table 2.7.

These data include all international and domestic certificated route air carrier statistics; therefore, the data are different than those in Chapter 2. All of the air carrier statistics declined in the year 2001, most likely due to the events of September 11, 2001, which caused air travel to decline drastically in the last quarter of the year.

Table 9.2
Summary Statistics for U.S. Domestic and International Certificated Route Air Carriers (Combined Totals), 1970–2001[a]

Year	Revenue aircraft-miles (millions)	Average passenger trip length[b] (miles)	Revenue passenger-miles (millions)	Available seat-miles (millions)	Available seats per aircraft[c]	Passenger load factor (percentage)[d]	Revenue cargo ton-miles (millions)	Energy use (trillion Btu)[e]
1970	2,383	678	131,719 [f]	264,904 [f]	111	49.7%[f]	4,994	1,363.4
1975	2,241	698	173,324	315,823	135	54.9%	5,944	1,283.4
1980	2,924	736	267,722	448,479	148	59.7%	7,515	1,386.0
1985	3,462	758	351,073	565,677	163	62.1%	9,048	1,701.4
1986	3,873	767	378,923	623,073	161	60.8%	10,987	1,847.1
1987	4,182	779	417,830	670,871	160	62.3%	13,130	1,945.9
1988	4,355	786	437,649	696,337	160	62.9%	14,633	2,049.4
1989	4,442	792	447,480	703,888	158	63.6%	16,347	2,087.4
1990	4,724	803	472,236	753,211	159	62.7%	16,411	2,213.0
1991	4,661	806	463,296	738,030	158	62.8%	16,149	2,085.2
1992	4,899	806	493,715	772,869	158	63.9%	17,306	2,144.2
1993	5,118	799	505,996	793,959	155	63.7%	19,083	2,169.7
1994	5,360	787	537,506	809,240	151	66.4%	21,773	2,266.2
1995	5,627	791	558,757	845,012	150	66.1%	23,375	2,338.6
1996	5,855	802	596,164	859,720	147	69.3%	24,892	2,409.1
1997	6,025	814	619,969	880,607	146	70.4%	27,610	2,514.2
1998	6,227	812	635,517	899,851	145	70.6%	28,102	2,573.4
1999	6,558	824	668,626	942,311	144	71.0%	28,984	2,653.1
2000	6,944	833	708,419	980,379	141	72.3%	30,863	2,743.1
2001	6,807	842	664,841	950,530	140	69.9%	27,882	2,599.4
			Average annual percentage change					
1970–2001	3.4%	0.7%	5.4%	4.2%	0.8%		5.7%	2.1%
1991–2001	3.9%	0.4%	3.7%	2.6%	-1.2%		5.6%	2.2%

Source:

U.S. Department of Transportation, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly,* December 2001/2000, Washington, DC, pp. 1–2, and annual.

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

1977–2001 Energy Use - Department of Transportation, Bureau of Transportation Statistics, "Fuel Cost and Consumption Table," Washington, DC. (Additional resources: www.bts.gov, www.faa.gov)

[a]Data are for all U.S. air carriers reporting on Form 41.
[b]Scheduled services of domestic operations only. The average passenger trip length for international operations is more than three and a half times longer than for domestic operations.
[c]Available seats per aircraft is calculated as the ratio of available seat-miles to revenue aircraft-miles.
[d]Passenger load factor is calculated as the ratio of revenue passenger-miles to available seat-miles for scheduled and nonscheduled services.
[e]Energy use includes fuel purchased abroad for international flights.
[f]Scheduled services only.

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) rotocraft 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, 1970–2001

Calendar year	Total number of aircraft	Aircraft hours flown (thousands)	Intercity passenger travel (billion passenger-miles)	Energy use (trillion btu)
1970	131,700[a]	26,030[b]	9.1	94.4
1975	168,475	30,298	11.4	121.5
1976	177,964	31,950	12.1	130.3
1977	184,294	33,679	12.8	149.7
1978	199,178	36,844	14.1	159.4
1979	210,339	40,432	15.5	167.2
1980	211,045	41,016	14.7	169.0
1981	213,226	40,704	14.6	162.4
1982	209,779	36,457	13.1	170.5
1983	213,293	35,249	12.7	143.9
1984	220,943	36,119	13.0	148.9
1985	196,500	31,456	12.3	144.0
1986	205,300	31,782	12.4	148.0
1987	202,700	30,883	12.1	139.1
1988	196,200	31,114	12.6	148.6
1989	205,000	32,332	13.1	134.0
1990	198,000	32,096	13.0	131.9
1991	196,874	29,862	12.1	120.4
1992	185,650	26,747	10.8	104.7
1993	177,120	24,455	9.9	97.5
1994	172,935	24,092	9.8	95.3
1995	188,089	26,612	10.8	106.6
1996	191,129	26,909	12.0	111.1
1997	192,414	27,713	12.5	121.1
1998	204,710	28,100	13.1	147.4
1999	219,464	31,756	14.1	172.1
2000	217,533	30,975	15.2	175.2
2001	211,446	29,133	15.9	165.1
		Average annual percentage change		
1970–2001	1.5%	0.4%	1.8%	1.8%
1991–2001	0.7%	-0.2%	2.8%	3.2%

Sources:
Intercity passenger-miles - Eno Foundation for Transportation, *Transportation in America 2001*, Nineteenth edition, Lansdowne, VA, 2002, p. 45, and annual.
All other- U.S. Department of Transportation, Federal Aviation Administration, *General Aviation Activity and Avionics Survey: Calendar Year 2001*, Tables 1.2, 1.5, 5.1, and annual.
(Additional resources: apo.faa.gov/pubs.asp)

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

In the early seventies, domestic waterborne commerce accounted for over 60% of total tonnage, but by 1994 foreign tonnage grew to more than half of all waterborne tonnage and has continued to grow each year since.

Table 9.4
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970–2001
(million tons shipped)

Year	Foreign and domestic total	Foreign total[a]	Domestic total[b]	Percent domestic of total
1970	1,532	581	951	62.1%
1975	1,695	749	946	55.8%
1976	1,835	856	979	53.4%
1977	1,908	935	973	51.0%
1978	2,021	946	1,075	53.2%
1979	2,073	993	1,080	52.1%
1980	1,999	921	1,077	53.9%
1981	1,942	887	1,054	54.3%
1982	1,777	820	957	53.9%
1983	1,708	751	957	56.0%
1984	1,836	803	1,033	56.3%
1985	1,788	774	1,014	56.7%
1986	1,874	837	1,037	55.3%
1987	1,967	891	1,076	54.7%
1988	2,088	976	1,112	53.3%
1989	2,140	1,038	1,103	51.5%
1990	2,164	1,042	1,122	51.8%
1991	2,092	1,014	1,079	51.6%
1992	2,132	1,037	1,095	51.4%
1993	2,128	1,060	1,068	50.2%
1994	2,215	1,116	1,099	49.6%
1995	2,240	1,147	1,093	48.8%
1996	2,284	1,183	1,101	48.2%
1997	2,334	1,221	1,113	47.7%
1998	2,339	1,245	1,094	46.8%
1999	2,323	1,261	1,062	45.6%
2000	2,425	1,355	1,070	44.1%
2001	2,387	1,344	1,042	43.7%
	Average annual percentage change			
1970–2001	1.4%	2.7%	0.3%	
1991–2001	1.3%	2.9%	-0.3%	

Source:
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2001*, Part 5: National Summaries, New Orleans, Louisiana, 2002, Table 1-1, p. 1-3, and annual. (Additional resources: www.wrc-ndc.usace.army.mil/ndc)

[a]All movements between the U.S. and foreign countries and between Puerto Rico and the Virgin Islands and foreign countries are classified as foreign trade.

[b]All movements between U.S. ports, continental and noncontiguous, and on the inland rivers, canals, and connecting channels of the U.S., Puerto Rico, and the Virgin Islands, excluding the Panama Canal. Beginning in 1996, fish was excluded for internal and intra port domestic traffic.

Table 9.5
Summary Statistics for Domestic Waterborne Commerce, 1970–2001

Year	Number of vessels[a]	Ton-miles (billions)	Tons shipped[b] (millions)	Average length of haul (miles)	Energy intensity (Btu/ton-mile)	Energy use (trillion Btu)
1970	25,832	596	949	628.2	545	324.8
1975	31,666	566	944	599.9	549	311.0
1976	33,204	592	976	606.3	468	277.3
1977	35,333	599	969	618.0	458	274.3
1978	35,723	827	1,072	771.6	383	316.6
1979	36,264	829	1,076	770.0	457	378.7
1980	38,792	922	1,074	856.4	358	329.8
1981	42,079	929	1,051	884.0	360	334.5
1982	42,079	886	954	929.0	310	274.9
1983	41,784	920	953	964.6	319	293.7
1984	41,784	888	1,029	862.5	346	307.3
1985	41,672	893	1,011	883.5	446	398.6
1986	40,308	873	1,033	845.3	463	404.0
1987	40,000	895	1,072	835.0	402	370.7
1988	39,192	890	1,106	804.3	361	321.3
1989	39,209	816	1,097	743.2	403	328.6
1990	39,233	834	1,118	745.7	388	323.2
1991	39,233	848	1,074	789.9	386	327.5
1992	39,210	857	1,090	785.7	398	341.0
1993	39,064	790	1,063	742.7	389	307.0
1994	39,064	815	1,093	745.5	369	300.7
1995	39,641	808	1,086	743.6	374	302.2
1996	41,104	765	1,093	699.4	412	314.9
1997	41,419	707	1,106	639.5	415	293.2
1998	42,032	673	1,087	619.0	436	293.1
1999	41,766	656	1,056	621.1	457	299.9
2000	41,354	646	1,064	606.8	473	305.6
2001	41,588	622	1,037	599.7	444	276.2
			Average annual percentage change			
1970–2001	1.5%	0.1%	0.3%	-0.1%	-0.7%	-0.5%
1991–2001	0.6%	-3.1%	-0.3%	-2.7%	1.4%	-1.7%

Source:
Number of vessels -
1970–92, 1995–2001 - U.S. Department of the Army, Corps of Engineers, "Summary of U.S. Flag Passenger and cargo vessels, 2001," New Orleans, LA, 2002, and annual.
1993–94 - U.S. Dept of the Army, Corps of Engineers, *The U.S. Waterway System-Facts*, Navigation Data Center, New Orleans, Louisiana, January 1996.
Ton-miles, tons shipped, average length of haul - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2001* Part 5: National Summaries, New Orleans, LA, 2002, Table 1-4, pp. 1-6, 1-7, and annual.
Energy use - See Appendix A for Water Energy Use.
(Additional resources: www.wrc-ndc.usace.army.mil/ndc)

[a]Grand total for self-propelled and non-self-propelled.
[b]These figures are not consistent with the figures on Table 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.

Fifty-six percent of all domestic marine cargo in 2001 were energy-related products (petroleum, coal, coke). The majority of the energy-related products were shipped internally and locally (62%). Barge traffic accounted for 96.3% of all internal and local waterborne commerce.

Table 9.6
Breakdown of Domestic Marine Cargo by Commodity Class, 2001

	Coastwise		Lakewise		Internal and local		Total domestic[a]		
Commodity class	Tons shipped (millions)	Average haul[b] (miles)	Tons shipped (millions)	Average haul[b] (miles)	Tons shipped (millions)	Average haul[b] (miles)	Tons shipped (millions)	Percentage	Average haul[b] (miles)
Petroleum and products	165	1,260	2	328	154	265	321	34.0%	777
Chemicals and related products	13	1,906	[c]	349	48	632	61	6.4%	899
Crude materials	11	503	75	507	116	408	202	21.4%	450
Coal and coke	13	638	19	561	174	365	206	21.8%	400
Primary manufactured goods	8	511	3	323	27	823	38	4.0%	712
Food and farm products	6	1,646	[c]	981	90	1,002	96	10.2%	1,041
Manufactured equipment	9	1,771	[c]	[c]	10	85	19	2.0%	862
Waste and scrap	[c]	0	0	0	1	198	1	0.1%	198
Unknown	[c]	2,167	[c]	1,000	[c]	[c]	[c]	0.0%	2,135
Total	224	1,228	100	509	620	476	943	100.0%	658
Barge traffic (million tons)	102		13		597		712		
Percentage by barge	45.6%		13.4%		96.3%		75.5%		

Source:
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2001*, Part 5: National Summaries, New Orleans, Louisiana, 2002, Tables 2-1, 2-2, and 2-3, pp. 2-1—2-8, and annual.
(Additional resources: www.wrc-ndc.usace.army.mil/ndc)

Note:
Coastwise applies to domestic traffic receiving a carriage over the ocean or between the Great Lakes ports and seacoast ports when having a carriage over the ocean. Lakewise applies to traffic between United States ports on the Great Lakes. Internal applies to traffic between ports or landings wherein the entire movement takes place on inland waterways. Local applies to movements of freight within the confines of a port.

[a]Does not include intra-territory tons.
[b]Calculated as ton-miles divided by tons shipped.
[c]Negligible.

According to the U.S. Coast Guard there are 4,900 more recreational boats in 2001 than in 1977. Even so, recreational boat fatalities are on the decline. There were only 5.3 fatalities per 100,000 boats in 2001.

Table 9.7
Recreational Boating Statistics, 1977–2001

Year	Number of boats (thousands)	Fatalities	Fatalities per 100,000 numbered boats	Energy use[a] (trillion btu)
1977	7,976	1,312	16.5	194.2
1978	8,036	1,321	16.4	195.6
1979	8,279	1,400	16.9	201.5
1980	8,578	1,360	15.9	208.8
1981	8,905	1,280	14.4	216.8
1982	9,074	1,178	13.0	220.9
1983	9,165	1,241	13.5	223.1
1984	9,420	1,063	11.3	229.3
1985	9,589	1,116	11.6	233.4
1986	9,876	1,066	10.8	240.4
1987	9,964	1,036	10.4	242.6
1988	10,363	946	9.1	252.3
1989	10,777	896	8.3	262.4
1990	10,996	865	7.8	267.7
1991	11,068	924	8.3	269.4
1992	11,132	816	7.3	271.0
1993	11,283	800	7.1	274.7
1994	11,430	784	6.9	278.2
1995	11,735	829	7.1	285.7
1996	11,878	709	5.9	289.2
1997	12,313	821	6.7	299.7
1998	12,566	815	6.5	305.9
1999	12,738	734	5.8	310.1
2000	12,782	701	5.5	311.2
2001	12,876	681	5.3	313.5
		Average annual percentage change		
1977–2001	2.0%	-2.7%	-4.6%	2.0%
1991–2001	1.5%	-3.0%	-4.4%	1.5%

Source:
U.S. Department of Transportation, United States Coast Guard, *Boating Statistics - 2001*, pp. 5 and annual.

[a]Energy use estimated using the methodology developed by D.L. Greene in the report *Off-Highway Gasoline in the United States*, (DOT, FHWA, July 1986, p. 3–22) [0.95 x 205 gallons/boat x number of boats].

The Interstate Commerce Commission designates Class I railroads on the basis of annual gross revenues. In 2001, eight railroads were given this designation. The number of railroads designated as Class I has changed considerably in the last 25 years; in 1976 there were 52 railroads given Class I designation.

Table 9.8
Class I Railroad Freight Systems in the United States
Ranked by Revenue Ton-Miles, 2001

Railroad	Revenue ton-miles (billions)	Percent
Union Pacific Railroad Company	504	33.7%
Burlington Northern and Sante Fe Railway Company	502	33.6%
CSX Transportation	228	15.2%
Norfolk Southern Corporation	182	12.2%
Illinois Central Railroad Company	25	1.7%
Soo Line Railroad Company	23	1.5%
Kansas City Southern Railway Company	20	1.3%
Grand Trunk Western Railroad Inc.	12	0.8%
Total	**1,496**	**100.0%**

Source:
Association of American Railroads, *Railroad Facts*, 2002 Edition, Washington, DC, October 2002, p. 66. (Additional resources: www.aar.org)

Revenue ton-miles for Class I freight railroads was nearly 1.5 trillion in 2001. Though there are many regional and local freight railroads, the Class I freight railroads accounted for 92% of the railroad industry's freight revenue in 2001 and 68% of the industry's mileage operated. The energy intensity of Class I railroads hit an all-time low of 346 btu/ton-mile in 2001.

Table 9.9
Summary Statistics for Class I Freight Railroads, 1970–2001

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
				Average annual percentage change					
1970–2001	-1.0%	-3.3%	0.5%	0.4%	0.5%	1.7%	2.1%	-2.2%	-0.1%
1991–2001	0.7%	-2.3%	2.9%	2.9%	2.3%	1.4%	3.7%	-1.2%	2.5%

Source:
Association of American Railroads, *Railroad Facts*, 2002 Edition, Washington, DC, October 2002, pp. 27, 28, 33, 34, 36, 49, 51, 61. (Additional resources: www.aar.org)

[a]Does not include self-powered units.

[b]Does not include private or shipper-owned cars.

[c]Tons originated is a more accurate representation of total tonnage than revenue tons. Revenue tons often produces double-counting of loads switched between rail companies.

[d]Data represent total locomotives used in freight and passenger service. Separate estimates are not available.

The "other" category, which consists primarily of intermodal traffic, has grown 146% in carloads from 1974 to 2001. Coal now accounts for more than one quarter of all carloads.

Table 9.10
Railroad Revenue Carloads by Commodity Group, 1974 and 2001

	Carloads (thousands)		Percent distribution		Percentage change
Commodity group	1974	2001	1974	2001	1974–2001
Coal	4,544	7,295	17.0%	26.8%	60.5%
Farm products	3,021	1,461	11.3%	5.4%	-51.6%
Chemicals and allied products	1,464	1,801	5.5%	6.6%	23.0%
Nonmetallic minerals	821	1,280	3.1%	4.7%	55.9%
Food and kindred products	1,777	1,446	6.6%	5.3%	-18.6%
Lumber and wood products	1,930	603	7.2%	2.2%	-68.8%
Metallic ores	1,910	251	7.1%	0.9%	-86.9%
Stone, clay and glass	2,428	528	9.1%	1.9%	-78.3%
Pulp, paper, and allied products	1,180	601	4.4%	2.2%	-49.1%
Petroleum products	877	523	3.3%	1.9%	-40.4%
Primary metal products	1,366	692	5.1%	2.5%	-49.3%
Waste and scrap material	889	591	3.3%	2.2%	-33.5%
Transportation equipment	1,126	1,650	4.2%	6.1%	46.5%
Others	3,451	8,483	12.9%	31.2%	145.8%
Total	26,784	27,205	100.0%	100.0%	1.6%

Source:
1974 - Association of American Railroads, *Railroad Facts*, 1976 Edition, Washington, DC, 1975, p. 26.
2001 - Association of American Railroads, *Railroad Facts*, 2002 Edition, Washington, DC, October 2002, p. 25.
((Additional resources: www.aar.org)

According to the 1997 Commodity Flow Survey, 5% of all freight ton-miles are rail intermodal shipments (truck/rail or rail/water). ***See Table 5.11 for details.*** *The number of trailers and containers moved by railroads has increased more than five-fold from 1965 to 2001. Containerization has increased in recent years, evidenced by the 175% increase in the number of containers from 1988 to 2001.*

Table 9.11
Intermodal Rail Traffic, 1965–2001

Year	Trailers & containers	Trailers	Containers
1965	1,664,929	[a]	[a]
1970	2,363,200	[a]	[a]
1975	2,238,117	[a]	[a]
1980	3,059,402	[a]	[a]
1985	4,590,952	[a]	[a]
1986	4,997,229	[a]	[a]
1987	5,503,819	[a]	[a]
1988	5,779,547	3,481,020	2,298,527
1989	5,987,355	3,496,262	2,491,093
1990	6,206,782	3,451,953	2,754,829
1991	6,246,134	3,201,560	3,044,574
1992	6,627,841	3,264,597	3,363,244
1993	7,156,628	3,464,126	3,692,502
1994	8,128,228	3,752,502	4,375,726
1995[b]	7,936,172	3,492,463	4,443,709
1996[b]	8,143,258	3,302,128	4,841,130
1997[b]	8,698,308	3,453,907	5,244,401
1998[b]	8,772,663	3,353,032	5,419,631
1999[c]	8,907,626	3,207,407	5,700,219
2000[c]	9,176,890	2,888,630	6,288,260
2001	8,935,444	2,603,423	6,332,021
Average annual percentage change			
1965–2001	4.8%	[a]	[a]
1991–2001	3.6%	-2.0%	7.6%

Source:
Association of American Railroads, *Railroad Facts*, 2002 edition, Washington, DC, October 2002 p. 26. (Additional resources: www.aar.org)

[a] Data are not available.
[b] The Grand Trunk Western Railroad and the Soo Line Railroad Company data are excluded.
[c] The Illinois Central, Grand Trunk Western Railroad and the Soo Line Railroad Company data are excluded.

The National Railroad Passenger Corporation, known as Amtrak, began operation in 1971. Though Amtrak revenue passenger-miles have grown at an average annual rate of 3.5% from 1971 to 2001, they showed a small decline in annual percentage change from 1991 to 2001.

Table 9.12
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971–2001

Year	Number of locomotives in service	Number of passenger cars	Train-miles (thousands)	Car-miles (thousands)	Revenue passenger-miles (millions)	Average trip length (miles)	Energy intensity (Btu per revenue passenger-mile)	Energy use (trillion Btu)
1971	[a]	1,165	16,537	140,147	1,993	188	[a]	[a]
1975	355	1,913	30,166	253,898	3,753	224	3,677	13.8
1980	448	2,128	29,487	235,235	4,503	217	3,176	14.3
1981	398	1,830	30,380	222,753	4,397	226	2,979	13.1
1982	396	1,929	28,833	217,385	3,993	220	3,156	12.6
1983	388	1,880	28,805	223,509	4,227	223	2,957	12.5
1984	387	1,844	29,133	234,557	4,427	227	3,027	13.4
1985	382	1,818	30,038	250,642	4,785	238	2,800	13.4
1986	369	1,793	28,604	249,665	5,011	249	2,574	12.9
1987	381	1,850	29,515	261,054	5,361	259	2,537	13.6
1988	391	1,845	30,221	277,774	5,686	265	2,462	14.0
1989	312	1,742	31,000	285,255	5,859	274	2,731	16.0
1990	318	1,863	33,000	300,996	6,057	273	2,609	15.8
1991	316	1,786	34,000	312,484	6,273	285	2,503	15.7
1992	336	1,796	34,000	307,282	6,091	286	2,610	15.9
1993	360	1,853	34,936	302,739	6,199	280	2,646	16.4
1994	411	1,874	34,940	305,600	5,869	276	2,357	13.8[b]
1995	422	1,907	31,579	282,579	5,401	266	2,590	14.0
1996	348	1,501	30,542	277,750	5,066	257	2,792	14.1
1997	292	1,572	32,000	287,760	5,166	255	2,918	15.1
1998	362	1,347	32,926	315,823	5,325	251	2,900	15.4
1999	385	1,285	34,080	349,337	5,289	245	3,062	16.2
2000	385	1,891	35,404	371,215	5,574	243	3,356	18.7
2001	401	2,084	36,512	377,705	5,571	238	4,137	23.0
				Average annual percentage change				
1971–2001	[a]	2.0%	2.7%	3.4%	3.5%	0.8%	[a]	[a]
1991–2001	2.4%	1.6%	0.7%	1.9%	-1.2%	-1.8%	5.2%	3.9%

Source:
1971–83- Association of American Railroads, Economics and Finance Department, *Statistics of Class I Railroads*, Washington, DC, and annual.
1984–88- Association of American Railroads, *Railroad Facts*, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.
1989–93- Personal communication with the Corporate Accounting Office of Amtrak, Washington, D.C.
1994–2001 - 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*, 2002 Edition, Washington, DC, 2002, 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. In 2001, commuter rail operations showed higher vehicle-miles, passenger-miles, and passenger trips than any other year in this series.

Table 9.13
Summary Statistics for Commuter Rail Operations, 1984–2001

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	3,011	18.7
1985	4,035	182.7	275	6,534	23.8	3,053	20.0
1986	4,440	188.6	306	6,723	22.0	3,174	21.3
1987	4,686	188.9	311	6,818	21.9	3,043	20.7
1988	4,649	202.2	325	6,964	21.4	3,075	21.4
1989	4,472	209.6	330	7,211	21.9	3,120	22.5
1990	4,415	212.7	328	7,082	21.6	3,068	21.7
1991	4,370	214.9	318	7,344	23.1	3,011	22.1
1992	4,413	218.8	314	7,320	23.3	2,848	20.8
1993	4,494	223.9	322	6,940	21.6	3,222	22.4
1994	4,517	230.8	339	7,996	23.6	2,904	23.2
1995	4,565	237.7	344	8,244	24.0	2,849	23.5
1996	4,665	241.9	352	8,351	23.7	2,796	23.3
1997	4,943	250.7	357	8,038	22.5	2,949	23.7
1998	4,963	259.5	381	8,704	22.8	2,859	24.9
1999	4,883	265.9	396	8,766	22.1	2,929	25.7
2000	5,073	270.9	413	9,402	22.8	2,759	25.9
2001	5,124	277.3	419	9,548	22.8	2,717	25.9
				Average annual percentage change			
1984–2001	1.4%	3.0%	2.7%	2.6%	-0.1%	-0.6%	1.9%
1991–2001	1.6%	2.6%	2.8%	2.7%	-0.1%	-1.0%	1.6%

Source:
American Public Transportation Association, *2003 Public Transportation Fact Book*, Washington, DC, February 2003, pp. 31, 32, 37, 41, and 46. (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. Transit rail operations were hitting all-time highs in vehicle-miles, passenger-miles, and passenger trips in 2001.

Table 9.14
Summary Statistics for Rail Transit Operations, 1970–2001[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]	2,453	30.1
1975	10,617	446.9	1,797	10,423	[f]	2,962	31.1
1980	10,654	402.2	2,241	10,939	4.9	3,008	32.9
1981	10,824	436.6	2,217	10,590	4.8	2,946	31.2
1982	10,831	445.2	2,201	10,428	4.7	3,069	32.0
1983	10,904	423.5	2,304	10,741	4.7	3,212	34.5
1984	10,848	452.7	2,388	10,531	4.4	3,732	39.3
1985	11,109	467.8	2,422	10,777	4.4	3,461	37.3
1986	11,083	492.8	2,467	11,018	4.5	3,531	38.9
1987	10,934	508.6	2,535	11,603	4.6	3,534	41.0
1988	11,370	538.3	2,462	11,836	4.8	3,565	42.2
1989	11,261	553.4	2,704	12,539	4.6	3,397	42.6
1990	11,332	560.9	2,521	12,046	4.8	3,453	41.6
1991	11,426	554.8	2,356	11,190	4.7	3,727	41.7
1992	11,303	554.0	2,395	11,438	4.8	3,575	40.9
1993	11,286	549.8	2,234	10,936	4.9	3,687	42.2
1994	11,192	565.8	2,453	11,501	4.7	3,828	44.0
1995	11,156	571.8	2,284	11,419	5.0	3,818	43.6
1996	11,341	580.7	2,418	12,487	5.2	3,444	43.0
1997	11,471	598.9	2,692	13,091	4.9	3,253	42.6
1998	11,521	609.5	2,669	13,412	5.0	3,216	43.1
1999	11,603	626.4	2,813	14,108	5.0	3,168	44.7
2000	12,168	648.0	2,952	15,200	5.1	3,105	47.2
2001	12,084	662.4	3,064	15,615	5.1	3,114	48.6
			Average annual percentage change				
1970–2001	0.6%	2.4%	1.5%	1.7%	0.2%[g]	0.8%	1.6%
1991–2001	0.6%	1.8%	2.7%	3.4%	0.8%	-1.8%	1.5%

Source:
American Public Transit Association, *2003 Public Transportation Fact Book*, Washington, DC, February 2003, pp. 31, 32, 41, and 46. (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 1980–2001.

Chapter 10

Transportation and the Economy

Summary Statistics from Tables/Figures in this Chapter

Source		
Figure 10.1	Share of gasoline cost attributed to taxes, 2002	
	Canada	*41%*
	France	*73%*
	Germany	*73%*
	Japan	*57%*
	United Kingdom	*77%*
	United States	*27%*
Table 10.11	Average price of a new car, 2001 (current dollars)	21,605
	Domestic	*19,654*
	Import	*27,477*
Table 10.12	Automobile operating costs, 2002	
	Variable costs (constant 2002 dollars per 10,000 miles)	*1,180*
	Fixed costs (constant 2002 dollars per 10,000 miles)	*4,874*
Table 10.18	Transportation sector share of total employment	
	1960	*13.5%*
	1980	*11.4%*
	2001	*11.0%*

Table 10.1
Gasoline Prices for Selected Countries, 1978–2002

	Current dollars per gallon								Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1994[b]	1996[b]	2000[b]	2002[b]	1978–2002	1990–2002
China	[c]	[c]	[c]	[c]	[c]	0.93	1.21	[c]	[c]	[c]
India	[c]	[c]	[c]	1.92	2.28	2.25	[c]	[c]	[c]	[c]
Japan	2.00	2.60	2.79	3.05	4.14	3.77	3.65	2.94	1.6%	-0.3%
France	2.15	2.56	2.58	3.40	3.31	4.41	4.01	3.31	1.8%	-0.2%
United Kingdom	1.22	2.42	2.07	2.55	2.86	3.47	5.13	4.16	5.2%	4.2%
Germany	1.75	2.17	1.88	2.72	3.34	4.32	3.78	3.49	2.9%	2.1%
Canada	0.69	1.37	1.31	1.92	1.57	1.80	2.04	1.73	3.9%	-0.9%
United States[d]	0.66	1.32	0.93	1.04	1.24	1.28	1.47	1.29	2.8%	1.8%

	Constant 2002 dollars[e] per gallon								Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1994[b]	1996[b]	2000[b]	2002[b]	1978–2002	1990–2002
China	[c]	[c]	[c]	[c]	[c]	1.07	1.26	[c]	[c]	[c]
India	[c]	[c]	[c]	2.64	2.77	2.58	[c]	[c]	[c]	[c]
Japan	5.52	4.85	4.58	4.20	5.03	4.32	3.81	2.94	-2.6%	-2.9%
France	5.93	4.77	4.23	4.68	4.02	5.06	4.19	3.31	-2.4%	-2.8%
United Kingdom	3.37	4.51	3.40	3.51	3.47	3.98	5.36	4.16	0.9%	1.4%
Germany	4.83	4.05	3.09	3.74	4.05	4.95	3.95	3.49	-1.3%	-0.6%
Canada	1.90	2.55	2.15	2.64	1.91	2.06	2.13	1.73	-0.4%	-3.5%
United States[d]	1.82	2.46	1.53	1.43	1.51	1.47	1.54	1.29	-1.4%	-0.9%

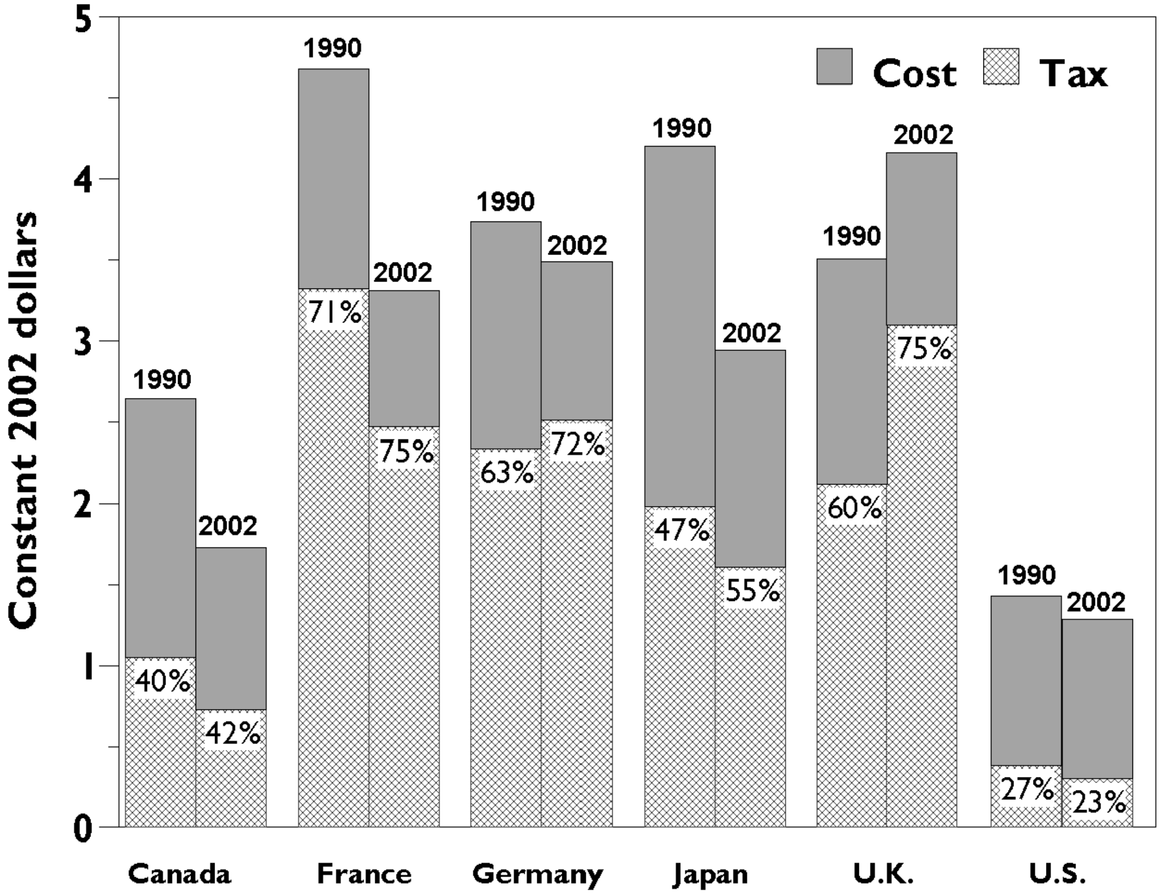
Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 2001*, Washington, DC, March 2003, Table 7.2 and annual.
(Additional resources: ww.eia.doe.gov)

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

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

In 2002 more than seventy percent of the cost of gasoline in France, Germany, and the United Kingdom went for taxes. Of the listed countries, the U.S. has the lowest percentage of taxes.

Figure 10.1. Gasoline Prices for Selected Countries, 1990 and 2002



Source:
Table 10.1 and International Energy Agency, *Energy Prices and Taxes, Fourth Quarter 2002*, Paris, France, 2003. (Additional resources: www.iea.org)

Table 10.2
Diesel Fuel Prices for Selected Countries, 1978–2002[a]

	Current dollars per gallon								Average annual percentage change	
	1978	1982	1986	1990	1994	1996	2000	2002	1978–2002	1990–2002
China	[b]	[b]	[b]	[b]	[b]	0.88	1.27	[b]	[b]	[b]
India	[b]	[b]	[b]	0.78	0.74	0.92	[b]	[b]	[b]	[b]
Japan	[b]	1.78	1.90	1.75	2.48	2.51	2.89	2.39	[b]	2.6%
France	1.30	1.88	1.69	1.78	2.10	3.10	3.05	2.47	2.7%	2.8%
United Kingdom	1.24	2.05	1.71	2.04	2.46	3.26	4.77	3.94	4.9%	5.6%
Germany	1.48	1.81	1.51	2.72	2.16	3.02	2.90	2.27	2.6%	0.0%
Canada	[b]	1.27	1.27	1.55	1.47	1.43	1.68	1.43	[b]	0.7%
United States[c]	0.54	1.16	0.94	0.99	0.96	1.15	1.36	1.15	3.2%	1.3%
	Constant 2002 dollars[d] per gallon								Average annual percentage change	
	1978	1982[a]	1986[a]	1990[b]	1994[b]	1996[b]	2000[b]	2002[b]	1978–2002	1990–2002
China	[b]	[b]	[b]	[b]	[b]	1.01	1.33	[b]	[b]	[b]
India	[b]	[b]	[b]	1.07	0.90	1.05	[b]	[b]	[b]	[b]
Japan	[b]	3.32	3.12	2.41	3.01	2.88	3.02	2.39	[b]	-0.1%
France	3.59	3.50	2.77	2.45	2.55	3.55	3.19	2.47	-1.5%	0.1%
United Kingdom	3.42	3.82	2.81	2.81	2.99	3.74	4.98	3.94	0.6%	2.9%
Germany	4.08	3.37	2.48	3.74	2.62	3.46	3.03	2.73	-1.7%	-2.6%
Canada	[b]	2.37	2.08	2.13	1.78	1.64	1.76	1.43	[b]	-3.3%
United States[c]	1.49	2.16	1.54	1.36	1.17	1.32	1.42	1.15	-1.1%	-1.4%

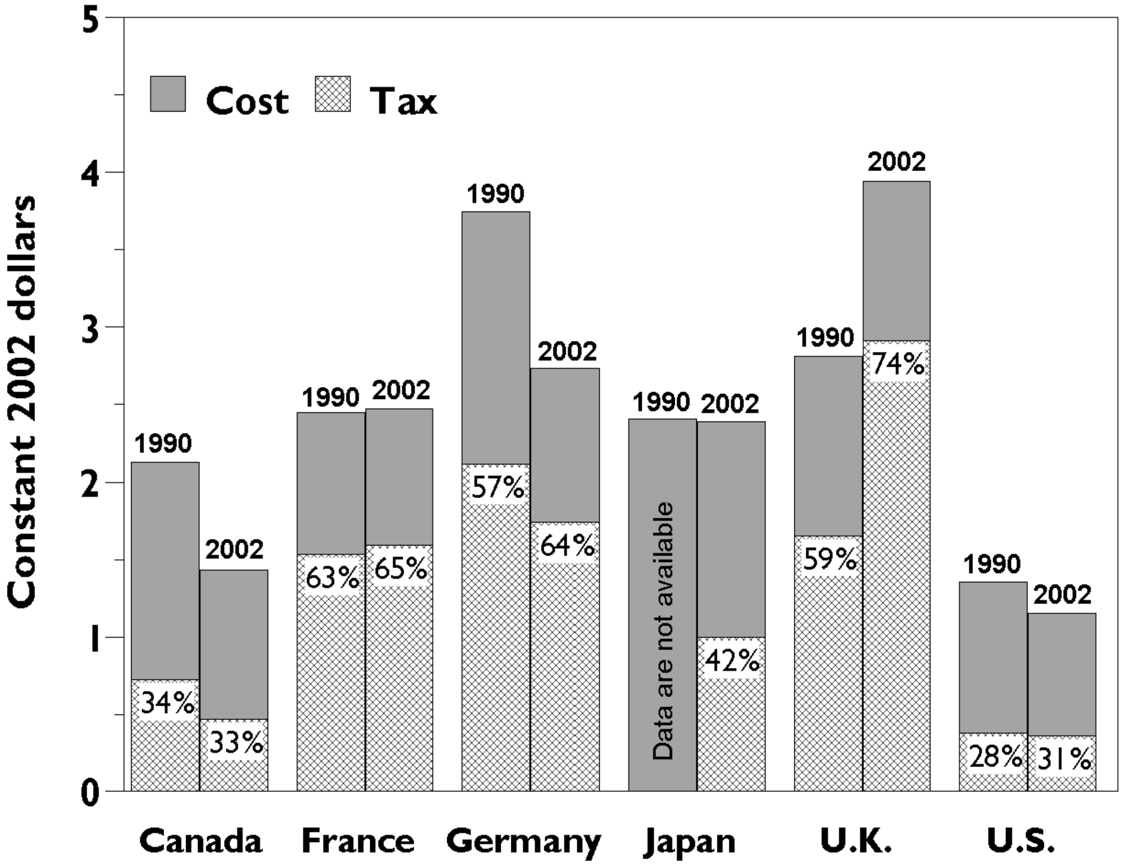
Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 2001*, Washington, DC, March 2003, Table 7.2 and annual. (Additional resources: www.eia.doe.gov)

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

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

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

Figure 10.2. Diesel Prices for Selected Countries, 1990 and 2002



Source:
Table 10.2 and International Energy Agency, *Energy Prices and Taxes, Fourth Quarter 2002*, Paris, France, 2003. (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 2002 dollars) rose by 75% from 1998 to 2002, while the average price of a gallon of gasoline increased only 17% in this same time period.

Table 10.3
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978–2002

	Crude oil[a] (dollars per barrel)		Gasoline[b] (cents per gallon)		Ratio of gasoline to crude oil
Year	Current	Constant 2002[c]	Current	Constant 2002[c]	
1978	12.5	34.4	65.2	179.9	219.8
1979	17.7	43.9	88.2	218.6	209.1
1980	28.1	61.3	122.1	266.6	182.7
1981	35.2	69.7	135.3	267.8	161.3
1982	31.9	59.4	128.1	238.6	168.8
1983	29.0	52.4	122.5	221.3	177.5
1984	28.6	49.6	119.8	207.4	175.7
1985	26.8	44.7	119.6	200.0	187.8
1986	14.6	23.9	93.1	152.8	268.7
1987	17.9	28.1	95.7	151.6	224.5
1988	14.7	22.3	96.3	146.4	275.7
1989	18.0	26.1	106.0	153.8	247.7
1990	22.2	30.6	121.7	167.5	230.0
1991	19.1	25.2	119.6	158.0	263.5
1992	18.4	23.6	119.0	152.6	271.2
1993	16.4	20.4	117.3	146.0	300.2
1994	15.6	18.9	117.4	142.5	316.3
1995	17.2	20.3	120.5	142.2	293.7
1996	20.7	23.7	128.8	147.7	261.2
1997	19.0	21.3	129.1	144.7	284.8
1998	12.5	13.8	111.5	123.1	374.0
1999	17.5	18.9	122.1	131.8	292.9
2000	28.3	29.5	156.3	163.3	232.3
2001	23.1	23.3	153.1	155.5	280.2
2002	24.1	24.1	144.1	144.1	251.2
		Average annual percentage change			
1978–2001	2.8%	-1.5%	3.4%	-0.9%	
1992–2002	2.7%	0.2%	1.9%	-0.6%	

Sources:
Crude oil - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, April 2003,* Washington, DC, Table 9.1.
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, April 2003,* Washington, DC, Table 9.4.
(Additional resources: www.eia.doe.gov)

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[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 is generally lower than gasoline; however, in 2001 the price of gasoline and diesel fuel were almost equal.

Table 10.4
Retail Prices for Motor Fuel, 1978–2002
(cents per gallon, including tax)

Year	Diesel fuel [a]		Average for all gasoline types[b]	
	Current	Constant 2002[c]	Current	Constant 2002[c]
1978	[d]	[d]	65	180
1979	[d]	[d]	88	219
1980	101	221	122	267
1981	118	234	135	268
1982	116	216	128	239
1983	120	217	123	221
1984	122	211	120	207
1985	122	204	120	200
1986	94	154	93	153
1987	96	152	96	152
1988	95	144	96	146
1989	102	148	106	154
1990	107	147	122	168
1991	91	120	120	158
1992	106	136	119	153
1993	98	122	117	146
1994	96	117	117	143
1995	97	115	121	142
1996	115	132	129	148
1997	129	145	129	145
1998	112	124	112	123
1999	97	105	122	132
2000	136	142	156	163
2001	152	154	153	156
2002	115	115	144	144
Average annual percentage change				
1978–2002	0.5%[e]	-2.7%[e]	3.4%	2.5%
1992–2002	0.8%	-1.7%	1.9%	-0.6%

Source:
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, 2003*, Washington, DC, Table 9.4.
Diesel - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 2001*, Washington, DC, March 2003, Table 7.2 (Additional resources: www.eia.doe.gov)

[a]Collected from a survey of prices on January 1 of the current year.
[b]These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.
[c]Adjusted by the Consumer Price Inflation Index.
[d]Data are not available.
[e]Average annual percentage change is from the earliest year possible to 2002.

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, 1978–2002
(cents per gallon, excluding tax)

	Propane[a]		No. 2 diesel fuel	
Year	Current	Constant 2002[b]	Current	Constant 2002[b]
1978	33.5	92.4	37.7	104.0
1979	35.7	88.5	58.5	145.0
1980	48.2	105.2	81.8	178.6
1981	56.5	111.8	99.5	196.9
1982	59.2	110.4	94.2	175.6
1983	70.9	128.1	82.6	149.2
1984	73.7	127.6	82.3	142.5
1985	71.7	119.9	78.9	131.9
1986	74.5	122.3	47.8	78.5
1987	70.1	111.0	55.1	87.3
1988	71.4	108.6	50.0	76.0
1989	61.5	89.2	58.5	84.9
1990	74.5	102.5	72.5	99.8
1991	73.0	96.4	64.8	85.6
1992	64.3	82.4	61.9	79.4
1993	67.3	83.8	60.2	74.9
1994	53.0	64.3	55.4	67.3
1995	49.2	58.1	56.0	66.1
1996	60.5	69.4	68.1	78.1
1997	55.2	61.9	64.2	72.0
1998	40.5	44.7	49.4	54.5
1999	45.8	49.5	58.4	63.1
2000	60.3	63.0	93.5	97.7
2001	50.6	51.4	84.2	85.5
2002	41.9	41.9	76.2	76.2
		Average annual percentage change		
1978–2002	0.9%	-3.2%	3.0%	-1.3%
1992–2002	-4.2%	-6.5%	2.1%	-0.4%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, April 2003*, Washington, DC, Table 9.7.
(Additional resources: www.eia.doe.gov)

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

Average jet fuel prices jumped more than 30 cents per gallon from 1999 to 2000, but lowered again in 2001 and 2002.

Table 10.6
Refiner Sales Prices for Aviation Gasoline and Jet Fuel, 1978–2002
(cents per gallon, excluding tax)

	Finished aviation gasoline		Kerosene-type jet fuel	
Year	Current	Constant 2002[a]	Current	Constant 2002[a]
1978	51.6	142.4	38.7	106.8
1979	68.9	170.7	54.7	135.5
1980	108.4	236.7	86.6	189.1
1981	130.3	257.9	102.4	202.7
1982	131.2	244.6	96.3	179.5
1983	125.5	226.7	87.8	158.6
1984	123.4	213.7	84.2	145.8
1985	120.1	200.8	79.6	133.1
1986	101.1	165.9	52.9	86.8
1987	90.7	143.6	54.3	86.0
1988	89.1	135.5	51.3	78.0
1989	99.5	144.4	59.2	85.9
1990	112.0	154.2	76.6	105.4
1991	104.7	138.3	65.2	86.1
1992	102.7	131.7	61.0	78.2
1993	99.0	123.3	58.0	72.2
1994	95.7	116.2	53.4	64.8
1995	100.5	118.2	54.0	63.7
1996	111.6	128.0	65.1	74.6
1997	112.8	126.4	61.3	68.7
1998	97.5	107.6	45.2	49.9
1999	105.9	114.4	54.3	58.6
2000	130.6	136.4	89.9	93.9
2001	132.3	134.4	77.5	78.7
2002	131.7	131.7	72.2	72.2
		Average annual percentage change		
1978–2002	4.0%	-0.3%	2.6%	-1.6%
1992–2002	2.5%	0.0%	1.7%	-0.8%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, April 2003*, Washington, DC, Table 9.7.
(Additional resources: www.eia.doe.gov)

[a]Adjusted by the Consumer Price Inflation Index.

Table 10.7
State Taxes on Motor Fuels, 2000
(dollars per gallon or gasoline equivalent gallon)
(Footnotes for this table appear on next page)

State	Gasoline	Diesel fuel	CNG	Propane	Methanol	Ethanol
Alabama	0.18	0.19	[a]	[a]	0.16[b]	0.16[b]
Alaska	0.08	0.08	0.08	0.00	0.08[b]	0.04
Arizona	0.18	0.27	0.00	0.00	0.00	0.00
Arkansas	0.186	0.186	0.05[c]	[a]	0.186	0.186
California	0.18	0.18	[a]	[a]	0.09	0.09
Colorado	0.22	0.205	[a]	[a]	0.205	0.17[b]
Connecticut	0.36	0.18	0.18	0.18	0.37[b]	0.35
Delaware	0.23	0.22	0.22	0.22	0.22	0.23
District of Columbia	0.20	0.20	0.20	0.20	0.20	0.20
Florida	0.13	0.25	[a]	[a]	0.04[b]	0.04[b]
Georgia	0.075	0.075	0.075	0.075	0.075	0.075
Hawaii	0.16	0.16	0.16	0.16	0.16	0.16
Idaho	0.25	0.25	0.197[d]	0.181	0.25[b]	0.23[b]
Illinois	0.19	0.215	0.19	0.19	0.19[b]	0.19[b]
Indiana	0.15	0.16	[a]	[a]	0.15	0.15
Iowa	0.20	0.225	0.16[c]	0.20	0.19[b]	0.19[b]
Kansas	0.18	0.20	0.17	0.17	0.20	0.20
Kentucky	0.164	0.134	0.15	0.15	0.15	0.15
Louisiana	0.20	0.20	[a]	[a]	0.20[b]	0.20[b]
Maine	0.19	0.20	0.18	0.18	0.18	0.18
Maryland	0.235	0.2425	0.235	0.235	0.235	0.235
Massachusetts	0.21	0.21	0.10	0.10	0.21	0.21
Michigan	0.19	0.15	0.0	0.15	0.15[b]	0.025[b]
Minnesota	0.20	0.20	0.174	0.15	0.114	0.142
Mississippi	0.184	0.184	0.184[c]	0.17	0.18[b]	0.18[b]
Missouri	0.17	0.17	[a]	[a]	0.17[b]	0.17[b]
Montana	0.27	0.2775	0.07[e]	[a]	0.27	0.27
Nebraska	0.246	0.246	[a]	[a]	[a]	[a]
Nevada	0.2475	0.2775	0.21	0.2475[c]	0.2475	0.2475
New Hampshire	0.195	0.195	0.195	0.195	0.195[b]	0.195[b]
New Jersey	0.105	0.135	0.0525	0.0525	0.105[b]	0.105[b]
New Mexico	0.188	0.198	[a]	[a]	0.22[b]	0.22[b]
New York	0.10[f]	0.10[f]	0.08[f]	0.08[f]	0.08[f]	0.08[f]
North Carolina	0.223	0.223	0.223	0.223	0.223	0.223
North Dakota	0.20	0.20	0.20	0.20	0.20[b]	0.20[b]
Ohio	0.22	0.22	0.22	0.22	0.22[b]	0.21[b]
Oklahoma	0.17	0.14	[a]	[a]	0.16[b]	0.16[b]
Oregon	0.24	0.24	0.24	0.24	0.24	0.24
Pennsylvania	0.12[g]	0.12[g]	0.12[g]	0.12[g]	0.12[g]	0.12[g]
Rhode Island	0.29	0.29	0.0	0.29	0.29	0.29

Table 10.7 (continued)
State Taxes on Motor Fuels, 2000
(dollars per gallon or gasoline equivalent gallon)

State	Gasoline	Diesel fuel	CNG	Propane	Methanol	Ethanol
South Carolina	0.16	0.16	0.16	0.16	0.16	0.16
South Dakota	0.21	0.21	0.06	0.16	0.06	0.19
Tennessee	0.20	0.17	0.13	0.17	0.17	0.17
Texas	0.20	0.20	[a]	[a]	0.20[b]	0.20[b]
Utah	0.245	0.245	0.04	0.04	0.04	0.04
Vermont	0.20	0.17	0.20	[a]	0.20	0.20
Virginia	0.18	0.16	0.10	0.10	0.18[b]	0.18[b]
Washington	0.23	0.23	[a]	[a]	0.23	0.23
West Virginia	0.2535	0.2535	0.2535	0.2535	0.2535	0.2535
Wisconsin	0.238	0.238	0.203	0.186	0.238	0.238
Wyoming	0.09	0.09	0.00	0.00	0.09[b]	0.09[b]

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

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

At the end of 2001, only four states offered tax exemptions to encourage the use of gasohol for transportation purposes. This list is quite short compared to the 30 states which offered gasohol tax exemptions twenty years ago. Still, the Federal Government encourages gasohol use via a difference in the Federal tax rates of gasoline and gasohol.

Table 10.8
State Tax Exemptions for Gasohol, 2001

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

Source:
U.S. Department of Transportation, Federal Highway Administration, "Highway Statistics," January 2003, Washington, DC, Table MF-121T. (Additional resources: www.fhwa.dot.gov)

Table 10.9
Federal Excise Taxes on Motor Fuels

Fuel		Cents per gallon
Gasoline		18.30
Diesel[a]		24.30
Gasohol	10% Ethanol	13.00
	7.7% Ethanol	14.24
	5.7% Ethanol	15.32
Gasohol	10% Methanol	12.40
	7.7% Methanol	13.78
	5.7% Methanol	14.98
Methanol	Qualified[b]	12.85
	Partially exempt[c]	9.20
Ethanol	Qualified[b]	12.85
	Partially exempt[c]	9.25
CNG		48.54/mcf[d]
LNG		18.30
Propane		13.60

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

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

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

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

[d]Thousand cubic feet.

These states currently offer extra incentives for ethanol production or consumption (gasohol or E85). Details on these incentives can be found at www.fleets.doe.gov/fleet_tool.cgi?27519,benefits,2,3957 .

Table 10.10
State Ethanol Incentives, 2003

State	Producer incentives	State tax incentives	Other incentives
Arkansas	T		
California		T	
Connecticut		T	
Florida			T
Hawaii	T	T	
Idaho			T
Illinois	T	T	
Indiana	T		
Iowa	T	T	T
Kansas	T		
Maine	T	T	
Minnesota	T		T
Missouri	T		
Montana	T	T	
Nebraska	T		
North Carolina	T		
North Dakota	T		
Ohio		T	
South Dakota	T	T	
Wyoming	T		

Source:
U.S. Department of Energy, "Alternative Fuel Vehicle Fleet Buyer's Guide, Incentives and Laws," www.fleets.doe.gov/fleet_tool.cgi?27519,benefits,2,3957.

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

Table 10.11
Average Price of a New Car, 1970–2001

	Domestic[a]		Import		Total	
Year	Current dollars	Constant 2001 dollars[b]	Current dollars	Constant 2001 dollars[b]	Current dollars	Constant 2001 dollars[b]
1970	3,708	16,925	2,648	12,087	3,542	16,167
1975	5,084	16,736	4,384	14,431	4,950	16,295
1980	7,609	16,354	7,482	16,081	7,574	16,279
1981	8,912	17,363	8,896	17,332	8,910	17,359
1982	9,865	18,105	9,957	18,273	9,890	18,150
1983	10,516	18,699	10,868	19,325	10,606	18,859
1984	11,079	18,884	12,336	21,027	11,375	19,389
1985	11,589	19,074	12,853	21,155	11,838	19,484
1986	12,319	19,906	13,670	22,089	12,652	20,444
1987	12,922	20,145	14,470	22,558	13,386	20,868
1988	13,418	20,087	15,221	22,786	13,932	20,857
1989	13,936	19,904	15,510	22,152	14,371	20,525
1990	14,489	19,633	16,640	22,547	15,042	20,382
1991	15,192	19,754	16,327	21,230	15,475	20,122
1992	15,644	19,747	18,593	23,470	16,336	20,621
1993	15,976	19,580	20,261	24,832	16,871	20,677
1994	16,930	20,231	21,989	26,277	17,903	21,394
1995	16,864	19,597	23,202	26,962	17,959	20,870
1996	17,468	19,717	26,205	29,579	18,777	21,194
1997	17,907	19,759	27,722	30,589	19,531	21,551
1998	18,479	20,077	29,614	32,176	20,364	22,126
1999	18,630	19,804	28,931	30,754	20,658	21,960
2000	18,684	19,216	27,767	28,557	20,355	20,934
2001	19,654	19,654	27,477	27,477	21,605	21,605
			Average annual percentage change			
1970–2001	5.5%	0.5%	7.8%	2.7%	6.0%	0.9%
1991–2001	2.6%	-0.1%	5.3%	2.6%	3.4%	0.7%

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts,* underlying detail estimates for Motor Vehicle Output, Washington, DC, 2002. (Additional resources: www.stat-usa.gov)

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

The total cost of operating an automobile is the sum of the fixed cost (depreciation, insurance, finance charge, and license fee) and the variable cost (gas and oil, tires, and maintenance), which is related to the amount of travel. The total auto operating cost declined slightly in 2001 and again in 2002. The gas and oil share of total cost in 2002 was only 9.7%, which is the lowest in the history of this series.

Table 10.12
Automobile Operating Cost per Mile, 1985–2002

Model year	Constant 2002 dollars per 10,000 miles[a]			Total cost per mile[b] (constant 2002 cents[a])	Percentage gas and oil of total cost
	Variable cost	Fixed cost	Total cost		
1985	1,241	3,446	4,686	46.86	19.9%
1986	1,070	3,787	4,857	48.57	15.1%
1987	1,061	3,687	4,748	47.48	14.7%
1988	1,201	4,608	5,809	58.09	13.6%
1989	1,161	4,236	5,397	53.97	14.2%
1990	1,156	4,482	5,638	56.38	13.2%
1991	1,281	4,710	5,991	59.91	14.6%
1992	1,154	4,852	6,006	60.06	12.6%
1993	1,145	4,634	5,779	57.79	12.7%
1994	1,105	4,657	5,761	57.61	11.8%
1995	1,133	4,728	5,861	58.61	11.7%
1996	1,101	4,808	5,908	59.08	10.9%
1997	1,211	4,874	6,095	60.95	12.1%
1998	1,181	4,997	6,167	61.67	11.1%
1999	1,145	5,032	6,177	61.77	9.8%
2000	1,275	4,935	6,210	62.10	11.6%
2001	1,382	4,694	6,076	60.76	13.2%
2002	1,180	4,874	6,054	60.54	9.7%
		Average annual percentage change			
1985–2002	-0.3%	2.1%	1.5%	1.8%	

Source:
American Automobile Association, *Your Driving Costs*, 2002 Edition, Heathrow, FL, and annual. (Additional resources: www.aaa.com, www.runzheimer.com)

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

*While the previous table shows costs per **mile**, this table presents costs per **year** for fixed costs associated with automobile operation. For 2002 model year autos, the fixed cost is almost $16 per day.*

Table 10.13
Fixed Automobile Operating Costs per Year, 1975–2002
(constant 2002 dollars)[a]

Model year	Fire & theft[b]	Collision[c]	Property damage & liability[d]	License, registration & taxes	Depreciation	Finance charge	Total	Average fixed cost per day
1975	177	471	632	100	2,585	[e]	3,966	10.87
1980	153	376	541	179	2,269	924	4,439	12.16
1985	125	296	356	184	2,110	893	3,964	10.87
1986	141	314	381	213	2,167	1,046	4,261	11.67
1987	138	310	399	203	2,366	833	4,249	11.64
1988	131	309	432	211	2,713	859	4,655	12.76
1989	148	339	448	209	2,928	853	4,925	13.49
1990	151	337	438	227	3,244	936	5,334	14.62
1991	143	326	466	222	3,307	1,144	4,816	13.20
1992	164	367	478	223	3,484	1,021	5,737	15.72
1993	144	303	479	222	3,523	834	5,505	15.09
1994	149	299	486	235	3,569	787	5,524	15.14
1995	143	297	484	240	3,628	810	5,601	15.35
1996	165	315	488	247	3,635	823	5,673	15.55
1997	135	365	449	242	3,667	861	5,720	15.67
1998	148	317	529	249	3,713	897	5,853	16.04
1999	175	350	523	244	3,710	894	5,896	16.15
2000	170	341	503	233	3,648	887	5,781	15.84
2001	170	350	487	206	3,604	880	5,702	15.62
2002	173	357	484	201	3,721	828	5,764	15.79
				Average annual percentage change				
1975–2002	-0.1%	-1.0%	-1.0%	2.6%	1.4%	[e]	1.4%	1.4%
1992–2002	0.5%	-0.3%	0.1%	-1.0%	0.7%	-2.1%	0.0%	0.0%

Source:
American Automobile Association, "Your Driving Costs," 2002 Edition, Heathrow, FL, and annual. (Additional resources: www.aaa.com, www.runzheimer.com)

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

Table 10.14
Economic Indicators, 1970–2002
(billion dollars)

Year	Gross National Product: Current	Gross National Product: Constant 2001[a]	Total transportation outlays: Current	Total transportation outlays: Constant 2001[a]	Transportation as a percent of GNP
1970	1,046.1	3,938.8	192.8	725.9	18.4%
1980	2,830.8	5,427.4	560.9	1,075.4	19.8%
1990	5,832.2	7,372.3	975.6	1,233.2	16.7%
2000	9,848.0	10,080.2	1,549.0	1,586.5	15.7%
2001	10,104.1	10,104.1	1,572.0	1,572.0	15.6%
	Personal Consumption Expenditures		Transportation Personal Consumption Expenditures[b]		Transportation PCE as a percent of total PCE
1970	648.9	2,443.3	81.1	305.4	12.5%
1980	1,762.9	3,379.9	238.4	457.1	13.5%
1990	3,831.5	4,843.3	455.5	575.8	11.9%
2000	6,683.7	6,841.3	768.8	788.9	11.5%
2001	6,987.0	6,987.0	794.8	794.8	11.4%
2002	7,303.7	7,221.2	810.4	801.2	11.1%

Sources:
GNP - U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 2003, Table 1.9, p. D-4, and annual. (Additional resources: www.bea.doc.gov)
Transportation outlays - Eno Transportation Foundation, *Transportation in America 2001*, Nineteenth Edition, Lansdowne, VA, 2002, p. 1.
PCE - U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 2002, Table 2.2 and annual. (Additional resources: www.bea.doc.gov/bea/scbinf.html)

Table 10.15
Consumer Price Indices, 1970–2002
(1970 = 1.000)

Year	Consumer Price Index	Transportation Consumer Price Index[c]	New car Consumer Price Index	Used car Consumer Price Index	Gross National Product Index
1970	1.000	1.000	1.000	1.000	1.000
1980	2.124	2.216	1.667	1.997	2.706
1990	3.369	3.213	2.286	3.769	5.575
2000	4.438	4.088	2.689	4.994	9.414
2002	4.637	4.077	2.637	4.872	9.977

Source:
Bureau of Labor Statistics, Consumer Price Index Table 1A for 2002, and annual. [GNP—see above.] (Additional resources: stats.bls.gov/cpihome.htm)

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

Knowing the number of employees that are in transportation-related jobs is not an easy task. 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). Employment statistics shown in previous editions used the Standard Industrial Classification System (SIC) and do not match these data due to the differences between the two classification systems and other survey revisions by the BLS.

Table 10.16
Transportation-related Employment, 1993 and 2002
(thousands)

	1993	2002
Truck transportation	1,154.8	1,339.1
Transit and ground transportation	299.9	371.5
Air transportation	516.6	559.3
Rail transportation	242.2	218.1
Water transportation	52.8	51.6
Pipeline transportation	58.7	41.5
Motor vehicle and parts - retail	1,475.3	1,879.2
Motor vehicles and parts - wholesale	305.9	345.5
Gasoline stations - retail	881.2	903.6
Automotive repair	669.9	896.9
Automotive equipment rental and leasing	155.7	197.2
Manufacturing	1,972.0	1,882.1
Autos and light trucks	*225.1*	*234.6*
Heavy-duty trucks	*38.6*	*32.4*
Motor vehicle bodies and trailers	*136.3*	*153.5*
Motor vehicle parts	*677.8*	*731.1*
Aerospace products and parts	*624.0*	*468.3*
Ship & boat building	*146.5*	*146.4*
All other transportation equipment	*36.5*	*39.6*
Tires	*87.2*	*76.2*
Oil and gas pipeline construction	66.0	75.7
Highway street and bridge construction	270.9	344.4
Scenic & sightseeing	19.3	25.9
Support activities for transporation	381.8	526.7
Couriers and messengers	414.3	558.0
Travel arrangement and reservation services	255.7	258.0
Total transportation-related employment	**9,193.0**	**10,474.3**
Total nonfarm employment	110,844.0	130,376.0
Transportation-related to total employment	8.3%	8.0%

Source:
Bureau of Labor Statistics web site query system: data.bls.gov/labjava/outside.jsp?survey=ce
(Additional resources: www.bls.gov)

Chapter 11
Greenhouse Gas Emissions

Summary Statistics from Tables in this Chapter

Source			
Table 11.1	Carbon emissions (million metric tonnes)	1990	2001
	United States	*1,352*	*1,559*
	China	*617*	*832*
	Germany	*271*	*223*
	Japan	*269*	*316*
	United Kingdom	*164*	*109*
	India	*153*	*250*
	France	*102*	*108*
Table 11.4	Transportation share of U.S. carbon dioxide emissions from fossil fuel consumption		
	1990		*31.7%*
	1995		*31.9%*
	2001		*32.8%*

The U. S. accounted for 23.0% of the World's carbon emissions in 1990 and 23.9% in 2001. Nearly half (48%) of the U.S. carbon emissions are from oil use.

Table 11.1
World Carbon Emissions from Energy Consumption, 1990 and 2001

	1990		2001	
	Million metric tons	Percent of emissions from oil use	Million metric tons	Percent of emissions from oil use
Industrialized countries	2,844	49%	3,179	48%
United States	1,352	44%	1,559	43%
Canada	129	47%	155	45%
Mexico	84	77%	96	71%
United Kingdom	164	40%	153	41%
France	102	66%	108	68%
Germany	271	38%	223	43%
Italy	113	65%	121	59%
Netherlands	58	47%	68	40%
Other Western Europe	223	62%	271	64%
Japan	269	67%	316	58%
Other industrialized countries	80	46%	109	34%
Eastern Europe	1,337	30%	856	23%
Developing countries	1,691	40%	2,487	41%
China	617	15%	832	21%
India	153	29%	250	30%
Other developing countries	921	58%	1,405	55%
Total World	5,872	42%	6,522	42%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Outlook 2003*, Washington, DC, May 2003, Tables A10 and A11. (Additional resources: www.eia.doe.gov)

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, 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	62	23	7
Nitrous Oxide (N_2O)	114	275	296	156
HFCs[b], PFCs[c], and Sulfur Hexafluoride				
HFC-23	260	9,400	12,000	10,000
HFC-125	29	5,900	3,400	1,100
HFC-134a	14	3,300	1,300	400
HFC-152a	1	410	120	37
HFC-227ea	33	5,600	3,500	1,100
Perfluoromethane (CF_4)	50,000	3,900	5,700	8,900
Perfluoroethane (C_2F_6)	10,000	8,000	11,900	18,000
Sulfur hexafluoride (SF_6)	3,200	15,100	22,200	32,400

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, Washington, DC, December 2002, Table G1. Original source: Intergovernmental Panel on Climate Change; *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2000), pp. 38 and 388-389. (Additional resources: www.eia.doe.gov, www.ipcc.ch)

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

[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 2001 were 16% higher than in 1990. Carbon dioxide accounts for the majority of greenhouse gases.

Table 11.3
Estimated U.S. Emissions of Greenhouse Gases, 1990–2001

Greenhouse gas	Unit of measure[a]	1990	1995	2000	2001
Carbon dioxide	million metric tons of gas	5,002.8	5,320.9	5,855.1	5,788.5
	million metric tons of carbon	1,364.0	1,451.0	1,597.0	1,579.0
Methane	million metric tons of gas	31.7	31.1	28.3	28.0
	million metric tons of carbon (gwp)[b]	199.0	195.0	178.0	176.0
Nitrous oxide	million metric tons of gas	1.2	1.3	1.2	1.2
	million metric tons of carbon (gwp)[b]	94.0	102.0	98.0	97.0
HFCs, PFCs, and SF_6[c]	million metric tons of carbon (gwp)[b]	25.0	27.0	34.0	31.0

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 2001*, Washington, DC, December 2002, Tables ES1 andES2.
(Additional resources: www.eia.doe.gov)

[a]Gases that contain carbon can be measured either in terms of the full molecular weight of the gas or just in terms of their carbon content. See Appendix B, Table B.5 for details.
[b]Based on global warming potential.
[c]HFC-hydrofluorocarbons. PFC-perfluorocarbons. SF_6-sulfur hexaflouride.

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

Table 11.4
U.S. Carbon Emissions from Fossil Energy Consumption by End-Use Sector, 1990–2001[a]
(million metric tons of carbon)

End use sector	1990	1995	1996	1997	1998	1999	2000	2001
Residential	257.5	280.1	297.0	295.0	297.6	302.5	318.1	314.9
Commercial	212.6	228.5	237.4	249.3	253.9	258.0	274.4	279.7
Industrial	458.0	468.0	482.2	486.9	479.5	474.2	478.4	452.4
Transportation	431.4	457.4	468.5	473.2	481.3	495.3	507.3	511.6
Percentage	31.7%	31.9%	31.5%	31.5%	31.8%	32.4%	32.1%	32.8%
Total energy	**1,359.5**	**1,434.0**	**1,485.1**	**1,504.4**	**1,512.3**	**1,530.0**	**1,578.2**	**1,558.6**

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 2001*, Washington, DC, December 2002, Table 5, and annual.
(Additional resources: www.eia.doe.gov)

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

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

Table 11.5
U.S. Carbon Emissions from Energy Use in the Transportation Sector, 1990–2001
(million metric tons of carbon)

	1990		1995		2001	
Fuel	Emissions	Percentage	Emissions	Percentage	Emissions	Percentage
			Petroleum			
Motor gasoline	260.5	60.4%	279.0	61.0%	308.0	60.2%
LPG[a]	0.4	0.1%	0.3	0.1%	0.2	0.0%
Jet fuel	60.1	13.9%	60.0	13.1%	65.6	12.8%
Distillate fuel	75.6	17.5%	85.1	18.6%	107.5	21.0%
Residual fuel	21.6	5.0%	19.4	4.2%	17.8	3.5%
Lubricants	1.8	0.4%	1.7	0.4%	1.6	0.3%
Aviation gas	0.8	0.2%	0.7	0.2%	0.7	0.1%
Subtotal	**420.8**	97.5%	**446.2**	97.5%	**501.4**	98.0%
			Other energy			
Natural gas	9.8	2.3%	10.4	2.3%	9.2	1.8%
Electricity[b]	0.7	0.2%	0.9	0.2%	1.0	0.2%
Total	**431.3**	100.0%	**457.5**	100.0%	**511.6**	100.0%

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 2001*, Washington, DC, December 2002, Table 9, and annual.
(Additional resources: www.eia.doe.gov)

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

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

greet.anl.gov

The GREET model, which is sponsored by the Department of Energy, estimates the full fuel-cycle emissions and energy use associated with various transportation fuels and advanced transportation technologies for light-duty vehicles. It calculates fuel-cycle emissions of three greenhouse gases (carbon dioxide, methane, and nitrous oxide) and five criteria pollutants (volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter measuring 10 microns or less). The model also calculates the total fuel-cycle energy consumption, fossil fuel consumption, and petroleum consumption using various transportation fuels. The fuel cycles that are included in the GREET model are:

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

For additional information about the GREET model, see the GREET website, 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

Chapter 12
Criteria Air Pollutants

Summary Statistics from Tables in this Chapter

Source		
Table 12.1	Transportation's share of U.S. emissions, 2001	
	CO	*82.4%*
	NO_X	*55.5%*
	VOC	*41.7%*
	PM-10	*2.2%*
	PM-2.5	*6.1%*
	SO_2	*4.4%*
	NH_3	*6.3%*

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, 2001
(millions of short tons/percentage)

Sector	CO	NO_x	VOC	PM-10	PM-2.5	SO_2	NH_3
Highway vehicles	74.83	8.25	4.87	0.22	0.16	0.26	0.28
	62.0%	*36.9%*	*27.1%*	*0.9%*	*2.2%*	*1.7%*	*5.6%*
Aircraft	0.26	0.08	0.02	0.00	0.00	0.01	0.00
	0.2%	*0.4%*	*0.1%*	*0.0%*	*0.0%*	*0.1%*	*0.0%*
Railroads	0.10	1.00	0.04	0.03	0.02	0.06	0.00
	0.1%	*4.5%*	*0.2%*	*0.1%*	*0.3%*	*0.4%*	*0.0%*
Vessels	0.13	1.01	0.03	0.04	0.04	0.16	0.00
	0.1%	*4.5%*	*0.2%*	*0.2%*	*0.5%*	*1.0%*	*0.0%*
Other off-highway	24.19	2.07	2.53	0.24	0.23	0.22	0.04
	20.0%	*9.2%*	*14.1%*	*1.0%*	*3.1%*	*1.4%*	*0.7%*
Transportation total	99.50	12.41	7.50	0.53	0.45	0.70	0.32
	82.4%	*55.5%*	*41.7%*	*2.2%*	*6.1%*	*4.4%*	*6.3%*
Stationary source fuel combustion	4.59	8.60	1.18	1.50	1.32	13.63	0.07
	3.8%	*38.5%*	*6.6%*	*6.2%*	*17.9%*	*86.3%*	*1.4%*
Industrial processes	2.74	0.86	7.45	0.76	0.52	1.41	0.17
	2.3%	*3.9%*	*41.5%*	*3.1%*	*7.1%*	*8.9%*	*3.4%*
Waste disposal and recycling total	3.23	0.17	0.54	0.50	0.48	0.04	0.09
	2.7%	*0.8%*	*3.0%*	*2.1%*	*6.4%*	*0.2%*	*1.8%*
Miscellaneous	10.69	0.31	1.29	20.80	4.61	0.01	4.35
	8.9%	*1.4%*	*7.2%*	*86.3%*	*62.5%*	*0.1%*	*87.1%*
Total of all sources	120.76	22.35	17.96	24.10	7.38	15.79	5.00
	100.0%	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*

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

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

The transportation sector accounted for more than 80% of the nation's carbon monoxide (CO) emissions in 2001. 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, 1980–2001[a]
(million short tons)

Source category	1980	1985	1990	1995	2000	2001	Percent of total, 2001
Highway vehicles	143.83	134.19	110.26	83.88	68.06	74.83	62.0%
Aircraft	0.21	0.22	0.24	0.25	0.27	0.26	0.2%
Railroads	0.12	0.10	0.09	0.10	0.10	0.10	0.1%
Vessels[b]	0.13	0.14	0.13	0.14	0.13	0.13	0.1%
Other off-highway	16.23	18.58	20.98	23.39	23.68	24.19	20.0%
Transportation total	160.51	153.22	131.70	107.76	92.24	99.50	82.4%
Stationary fuel combustion total	7.30	8.49	5.51	5.93	4.60	4.59	3.8%
Industrial processes total	6.95	5.28	4.77	4.61	2.62	2.74	2.3%
Waste disposal and recycling total	2.30	1.94	1.08	1.19	3.23	3.23	2.7%
Miscellaneous total	8.34	7.93	11.12	7.30	20.90	10.69	8.9%
Total of all sources	**185.41**	**176.85**	**154.19**	**126.78**	**123.59**	**120.76**	**100.0%**

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

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

Though gasoline-powered light vehicles continue to be responsible for the majority of carbon monoxide emissions from highway vehicles, the total pollution from light vehicles in 2001 is less than half what it was in 1980. This is despite the fact that there were many more light vehicles on the road in 2001.

Table 12.3
Emissions of Carbon Monoxide from Highway Vehicles, 1980–2001[a]
(million short tons)

Source category	1980	1985	1990	1995	2000	2001	Percent of total, 2001
Gasoline powered							
Light vehicles & motorcycles	98.21	87.80	67.24	46.54	36.40	41.23	55.1%
Light trucks[b]	28.83	32.11	32.23	29.81	27.04	29.33	39.2%
Heavy vehicles	15.35	12.40	8.92	5.96	3.42	3.13	4.2%
Total	142.39	132.32	108.39	82.31	66.86	73.70	98.5%
Diesel powered							
Light vehicles	0.03	0.04	0.04	0.02	0.01	0.01	0.0%
Light trucks[b]	0.05	0.04	0.03	0.02	0.01	0.01	0.0%
Heavy vehicles	1.36	1.80	1.81	1.53	1.19	1.12	1.5%
Total	1.43	1.87	1.87	1.57	1.20	1.13	1.5%
Total							
Highway vehicle total	**143.83**	**134.19**	**110.26**	**83.88**	**68.06**	**74.83**	**100.0%**
Percent diesel	1.0%	1.4%	1.7%	1.9%	1.8%	1.5%	

Source:

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

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

The transportation sector accounted for over half of the nation's nitrogen oxide (NOx) emissions in 2001, 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, 1980–2001[a]
(million short tons)

Source category	1980	1985	1990	1995	2000	2001	Percent of total, 2001
Highway vehicles	11.49	10.93	9.59	8.88	8.39	8.25	36.9%
Railroads	1.19	0.96	0.95	1.03	1.00	1.00	4.5%
Other off-highway	2.17	2.62	2.84	3.08	3.17	3.16	14.1%
Transportation total	14.85	14.51	13.38	12.99	12.56	12.41	55.5%
Stationary fuel combustion total	11.32	10.05	10.89	10.83	9.04	8.60	38.5%
Industrial processes total	0.56	0.80	0.80	0.77	0.83	0.86	3.9%
Waste disposal and recycling total	0.11	0.09	0.09	0.10	0.17	0.17	0.8%
Miscellaneous total	0.25	0.31	0.37	0.27	0.61	0.31	1.4%
Total of all sources	**27.08**	**25.76**	**25.53**	**24.96**	**23.20**	**22.35**	**100.0%**

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

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

Heavy diesel-powered vehicles were responsible for nearly one-half of highway vehicle nitrogen oxide emissions in 2001, while light gasoline vehicles were responsible for the rest.

Table 12.5
Emissions of Nitrogen Oxides from Highway Vehicles, 1980–2001[a]
(million short tons)

Source category	1980	1985	1990	1995	2000	2001	Percent of total, 2001
Gasoline powered							
Light vehicles & motorcycles	6.63	5.68	4.26	3.05	2.31	2.39	28.9%
Light trucks[b]	1.58	1.60	1.50	1.46	1.44	1.50	18.2%
Heavy vehicles	0.62	0.58	0.57	0.52	0.45	0.46	5.5%
Total	8.83	7.85	6.33	5.03	4.20	4.35	52.7%
Diesel powered							
Light vehicles	[c]	0.04	0.04	0.02	0.01	0.01	0.1%
Light trucks[b]	[c]	[c]	0.02	0.01	0.01	0.01	0.1%
Heavy vehicles	2.59	3.00	3.19	3.82	4.18	3.89	47.2%
Total	2.66	3.08	3.26	3.85	4.19	3.90	47.3%
Total							
Highway vehicle total	**11.49**	**10.93**	**9.59**	**8.88**	**8.69**	**8.25**	**100.0%**
Percent diesel	23.1%	28.2%	34.0%	43.4%	48.2%	47.3%	

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

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

The transportation sector accounted for over 40% of the nation's volatile organic compound (VOC) emissions in 2001, 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, 1980–2001[a]
(million short tons)

Source category	1980	1985	1990	1995	2000	2001	Percent of total, 2001
Highway vehicles	13.87	12.65	9.39	6.75	5.33	4.87	27.1%
Off-highway	2.19	2.44	2.66	2.89	2.64	2.62	14.6%
Transportation total	16.06	15.09	12.05	9.64	7.97	7.50	41.7%
Stationary fuel combustion total	1.05	1.57	1.01	1.07	1.18	1.18	6.6%
Industrial processes total	12.10	9.50	9.01	9.71	7.28	7.45	41.5%
Waste disposal and recycling total	0.76	0.98	0.99	1.07	0.54	0.54	3.0%
Miscellaneous total	1.13	0.57	1.06	0.55	2.74	1.29	7.2%
Total of all sources	**31.11**	**27.70**	**24.12**	**22.04**	**19.70**	**17.96**	**100.0%**

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

[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 80% of highway vehicle emissions of volatile organic compounds. VOC emissions from highway vehicles in 2001 were less than half the 1980 level.

Table 12.7
Emissions of Volatile Organic Compounds from Highway Vehicles, 1980–2001[a]
(thousand short tons)

Source category	1980	1985	1990	1995	2000	2001	Percent of total, 2001
Gasoline powered							
Light vehicles & motorcycles	9,304	7,962	5,690	3,768	2,903	2,620	45.0%
Light trucks[b]	2,864	2,908	2,617	2,225	1,929	1,805	31.0%
Heavy vehicles	1,198	959	633	421	256	224	3.9%
Total	13,366	11,829	8,940	6,414	5,088	4,649	79.9%
Diesel powered							
Light vehicles	16	19	18	9	3	3	0.1%
Light trucks[b]	28	22	15	10	4	4	0.1%
Heavy vehicles	459	483	415	315	230	218	3.7%
Total	503	525	448	335	238	225	3.9%
Total							
Highway vehicle total	**13,869**	**10,545**	**9,388**	**9,376**	**6,443**	**5,816**	**100.0%**
Percent diesel	3.6%	5.0%	4.8%	3.6%	3.7%	3.9%	

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

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

The transportation sector accounted for only 2% of the nation's particulate matter (PM-10) emissions in 2001. For details on the highway emissions of PM-10, see Table 12.9.

Table 12.8
Total National Emissions of Particulate Matter (PM-10), 1980–2001[a]
(million short tons)

Source category	1980	1985	1990	1995	2000	2001	Percent of total, 2001
Highway vehicles	0.43	0.41	0.39	0.30	0.23	0.22	0.9%
Off-highway	0.26	0.30	0.33	0.34	0.32	0.32	1.3%
Transportation total	0.69	0.71	0.72	0.64	0.55	0.53	2.2%
Stationary fuel combustion total	2.45	1.54	1.20	1.18	1.53	1.50	6.2%
Industrial processes total	2.75	1.06	1.04	0.95	0.73	0.76	3.1%
Waste disposal and recycling total	0.27	0.28	0.27	0.29	0.50	0.50	2.1%
Fugitive dust	[b]	29.73	18.08	17.01	14.31	14.66	60.8%
Other miscellaneous	[b]	8.01	6.46	5.76	7.08	6.14	25.5%
Miscellaneous total	0.85	37.74	24.54	22.77	21.39	20.80	86.3%
Total of all sources	**7.01**	**41.32**	**27.76**	**25.82**	**24.70**	**24.10**	**100.0%**

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

Note:
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.

[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 1985, 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, 1980–2001[a]
(thousand short tons)

Source category	1980	1985	1990	1995	2000	2001	Percent of total, 2001
			Gasoline powered				
Light vehicles & motorcycles	141	86	57	53	51	51	23.4%
Light trucks[b]	49	37	31	32	31	31	14.2%
Heavy vehicles	30	23	17	13	10	10	4.6%
Total	220	146	105	98	92	92	42.2%
			Diesel powered				
Light vehicles	9	13	11	4	1	1	0.5%
Light trucks[b]	12	8	5	3	1	1	0.5%
Heavy vehicles	191	240	266	199	135	125	57.3%
Total	212	262	282	206	137	127	58.3%
			Total				
Highway vehicle total	**432**	**408**	**387**	**304**	**230**	**218**	**100.0%**
Percent diesel	49.1%	64.2%	72.9%	67.8%	59.6%	58.3%	

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

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.

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

The transportation sector accounted for only 6% of the nation's particulate matter (PM-2.5) emissions in 2001. 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), 1990–2001
(million short tons)

Source category	1990	1995	2000	2001	Percent of total, 2001
Highway vehicles	0.32	0.25	0.17	0.16	2.2%
Off-highway	0.30	0.31	0.30	0.29	3.9%
Transportation total	0.63	0.56	0.47	0.45	6.1%
Stationary fuel combustion total	0.91	0.90	1.34	1.32	17.9%
Industrial processes total	0.56	0.50	0.50	0.52	7.1%
Waste disposal and recycling total	0.23	0.25	0.47	0.48	6.4%
Fugitive dust	3.17	3.04	2.57	2.63	35.6%
Other miscellaneous	2.06	1.69	2.82	1.98	26.8%
Miscellaneous total	5.23	4.73	5.39	4.61	62.5%
Total of all sources	**7.56**	**6.93**	**8.17**	**7.38**	**100.0%**

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

Diesel vehicles are responsible for the majority of highway vehicle PM-2.5 emissions. More than 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, 1990–2001[a]
(thousand short tons)

Source category	1990	1995	2000	2001	Percent of total, 2001
Gasoline powered					
Light vehicles & motorcycles	35	30	27	27	16.7%
Light trucks[b]	21	20	18	17	10.5%
Heavy vehicles	11	9	7	7	4.3%
Total	67	59	52	51	31.5%
Diesel powered					
Light vehicles	10	4	1	1	0.6%
Light trucks[b]	4	2	1	1	0.6%
Heavy vehicles	243	179	119	109	67.3%
Total	257	185	121	111	68.5%
Total					
Highway vehicle total	**324**	**245**	**173**	**162**	**100.0%**
Percent diesel	79.3%	75.5%	69.9%	68.5%	

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

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

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

greet.anl.gov

The GREET model, which is sponsored by the Department of Energy, estimates the full fuel-cycle emissions and energy use associated with various transportation fuels and advanced transportation technologies for light vehicles. It calculates fuel-cycle emissions of five criteria pollutants (volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter measuring 10 microns or less) and three greenhouse gases (carbon dioxide, methane, and nitrous oxide). The model also calculates the total fuel-cycle energy consumption, fossil fuel consumption, and petroleum consumption using various transportation fuels. The fuel cycles that are included in the GREET model are:

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

For additional information about the GREET model, see the GREET website, 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

Table 12.12
Tier 2 Emission Standards for Cars and Light Trucks
Effective for 2004–2009 Model Years[a]
(grams/mile)

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

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

Acronyms Used on Tables 12.12 and 12.13

CO	Carbon monoxide
GVW	Gross vehicle weight
HC	Hydrocarbons
HCHO	Formaldehyde
LDT	Light-duty truck
LEV	Low-emission vehicle
LVW	Loaded vehicle weight
MDPV	Medium-duty passenger vehicle (8,500–10,000 lbs. GVWR)
NMOG	Non-methane organic gases
NOx	Nitrogen oxides
PC	Passenger car
PM	Particulate matter
SULEV	Super-ultra-low-emission vehicle
ULEV	Ultra-low-emission vehicle
ZEV	Zero-emission vehicle

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

Table 12.13
Light Vehicle Exhaust Emission Standards in Effect in 2009
When U.S. Tier 2 Standards are Final
(grams/mile)

Vehicle fuels: Gasoline AND diesel unless noted otherwise | Vehicle size: Up to 8,500 lbs GVW unless noted otherwise

Useful life:		50,000 miles						120,000 miles				
	Bins, category, size	NMOG	CO	NOx	PM	HCHO	HC+NOx	NMOG	CO	NOx	PM	HCHO
U.S. emission standards	Bins											
	8	0.100	3.4	0.14	–	0.015	–	0.125	4.2	0.20	0.02	0.018
	7	0.075	3.4	0.11	–	0.015	–	0.090	4.2	0.15	0.02	0.018
	6	0.075	3.4	0.08	–	0.015	–	0.090	4.2	0.10	0.01	0.018
	5	0.075	3.4	0.05	–	0.015	–	0.090	4.2	0.07	0.01	0.018
	4	–	–	–	–	–	–	0.070	2.1	0.04	0.01	0.011
	3	–	–	–	–	–	–	0.055	2.1	0.03	0.01	0.011
	2	–	–	–	–	–	–	0.010	2.1	0.02	0.01	0.004
	1	–	–	–	–	–	–	0.000	0.0	0.00	0.00	0.000
	Average[a]	–	–	–	–	–	–	–	–	0.07	–	–
California LEV II emission standards	Category	(Diesel only)						(Diesel only)				
	LEV[b]	0.075	3.4	0.05	–	0.015	–	0.090	4.2	0.07	0.01	0.018
	ULEV	0.04	1.7	0.05	–	0.08	–	0.055	2.1	0.07	0.01	0.011
	SULEV	–	–	–	–	–	–	0.010	1.0	0.02	0.01	0.004
	ZEV[c]	0.00	0.0	0.00	–	0.00	–	0.000	0.0	0.00	0.00	0.000
	Avg. for all PCs + LDTs 0-3,750 lbs LVW	0.038	–	–	–	–	–	–	–	–	–	–
	Avg. for LDTs 3,751 lbs LVW - 8,500 lbs GVW	0.047	–	–	–	–	–	–	–	–	–	–

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

Note:
See acronym list on previous page.

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

Table 12.14
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Vehicles [a,b]
(grams per mile)

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

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

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

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

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

[d]No estimate available.

[e]No standard set.

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

Table 12.15
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT1) [a,b,c]
(grams per mile)

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

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

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

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

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

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

[e]No estimate available.

[f]No standard set.

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

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

Table 12.16
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT2) [a,b,c]
(grams per mile)

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

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

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

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

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

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

[e]No estimate available.

[f]No standard set.

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

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

Table 12.17
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT3) [a,b,c]
(grams per mile)

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

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

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

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

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

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

[e]No estimate available.

[f]No standard set.

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

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

Table 12.18
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT4) [a,b,c]
(grams per mile)

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

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

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

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

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

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

[e]No estimate available.

[f]No standard set.

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

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

Table 12.19
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Heavy Trucks
(Grams per brake horsepower-hour)

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

Sources:

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

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[a] No standard set

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

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

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

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

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

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

Table 12.20
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Heavy Heavy Trucks
(Grams per brake horsepower-hour)

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

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

[a]No standard set.

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

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

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

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

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

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

Table 12.21
***California* Passenger Cars and Light Trucks Emission Certification Standards for Model Years 2001-2006**
(grams/mile)

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

Source:
U.S. Environmental Protection Agency, Office of Transportation and Air Quality, EPA 420-B-00-001.
(Additional resources: www.epa.gov/otag)

Note:
After 2003, Tier 1 and TLEV standards will be eliminated.
LDT1 = light truck (6,000 lbs. or less GVWR) up through 3,750 lbs. loaded vehicle weight; LDT2 = light truck (6,000 lbs. or less GVWR) greater than 3,750 lbs. loaded vehicle weight.

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

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

Table 12.22
California Vehicle Emission Reduction for Passenger Cars and Light Trucks[a]

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

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

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

[a]Light trucks less than 6,000 lbs. gross vehicle weight rating.
[b]See Table 12.23.

APPENDIX A
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 Transit Association
Amtrak	National Railroad Passenger Corporation
Btu	British thermal unit
DOC	Department of Commerce
DOE	Department of Energy
DOT	Department of Transportation
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
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 from: DOT, FHWA, *Highway Statistics 2001*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary to 1995.* Fuel use was distributed among fuel types using the percentages shown in Table A.1.

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-24	interpolated	93.9%	0.5%	5.6%
1981	69,112	FHWA, MF-24	1981 RTECS	93.4%	0.7%	5.9%
1982	69,116	FHWA, MF-24	interpolated	93.5%	2.3%	4.2%
1983	70,322	FHWA, MF-24	1983 RTECS	93.2%	4.3%	2.5%
1984	70,663	FHWA, MF-24	interpolated	92.7%	5.3%	2.0%
1985	71,518	FHWA, MF-24	1985 RTECS	90.8%	7.7%	1.5%
1986	73,174	FHWA, MF-24	interpolated	91.0%	7.6%	1.4%
1987	73,308	FHWA, MF-24	interpolated	92.4%	6.3%	1.3%
1988	73,345	FHWA, MF-24	1988 RTECS	91.4%	7.4%	1.2%
1989	73,913	FHWA, MF-24	interpolated	92.6%	6.2%	1.2%
1990	69,568	FHWA, MF-24	interpolated	92.0%	6.8%	1.2%
1991	64,318	FHWA, MF-24	1991 RTECS	90.8%	8.0%	1.2%
1992	65,436	FHWA, MF-24	interpolated	90.8%	7.9%	1.2%
1993	67,047	FHWA, MF-24	interpolated	89.7%	9.1%	1.3%
1994	67,874	FHWA, MF-24	1994 RTECS	89.1%	9.6%	1.3%
1995	68,072	FHWA, MF-24	interpolated	87.6%	11.2%	1.2%
1996	69,221	FHWA, MF-24	interpolated	88.8%	10.1%	1.0%
1997	69,892	FHWA, MF-24	interpolated	86.9%	12.2%	0.9%
1998	71,695	FHWA, MF-24	interpolated	88.0%	11.2%	0.8%
1999	73,283	FHWA, MF-24	interpolated	88.3%	11.0%	0.6%
2000	73,065	FHWA, MF-24	2000 NVPP	86.9%	12.6%	0.5%
2001	73,261	FHWA, MF-24	2001 NVPP	86.5%	13.0%	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 2001*, Table VM-1, and annual editions.

Table A.2
Motorcycle Fuel Use

Year	Fuel use (million gallons)	Year	Fuel use (million gallons)
1970	59580000	1986	187,940,000
1971	72,140,000	1987	190,120,000
1972	86,620,000	1988	200,480,000
1973	103,880,000	1989	207,420,000
1974	108,900,000	1990	191,140,000
1975	112,580,000	1991	183,560,000
1976	120,060,000	1992	191,140,000
1977	126,980,000	1993	198,120,000
1978	143,160,000	1994	204,800,000
1979	172,740,000	1995	198,262,073
1980	204,280,000	1996	195,940,000
1981	213,800,000	1997	201,620,000
1982	198,200,000	1998	205,660,000
1983	175,200,000	1999	211,680,000
1984	175,680,000	2000	209,380,000
1985	181,720,000	2001	190,580,000
Heat content used for conversion to btu:			125,000 btu/gallon

Buses

Transit:

APTA, *2002 Transit Fact Book*, 2002, Washington, DC. Includes motorbus and trolley bus data. This data series was detailed separately from other transit modes for the first time in 2003.

Table A.3
Transit Bus Fuel Use

Year	Methanol (thousand gallons)	LNG (thousand gallons)	LPG (thousand gallons)	CNG (thousand gal3109lons)	Gasoline (thousand gallons)	Diesel fuel (thousand gallons)	Electricity (thousand kilowatt hours)
1994	12,470	1,138	249	3,109	2,103	565,064	102,945
1995	11,967	1,737	269	10,011	2,297	563,767	100,659
1996	11,600	2,278	591	11,527	1,844	577,680	69,130
1997	8,705	3,276	1,033	20,050	2,722	597,636	78,561
1998	4,976	3,075	879	32,260	1,959	606,631	74,352
1999	2,711	5,251	659	39,861	1,402	618,024	75,920
2000	821	10,464	723	50,449	1,315	635,160	78,062
2001	763	11,670	1,171	60,917	1,472	587,184	75,108
Heat content used for conversion to btu:	64,600 btu/gallon	90,800 btu/gallon	91,300 btu/gallon	129,400 btu/gallon	125,000 btu/gallon	138,700 btu/gallon	11,765 btu/kWhr

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. Because the 2001 data were not available at the time this report went to press, the 2000 data were used again for 2001.

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	Not available	Not available
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

Trucks

Light Trucks:

DOT, FHWA, *Highway Statistics 2001*, Table VM-1 and annual editions back to 1996;
DOT, FHWA, *Highway Statistics Summary to 1995.*

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-24	Interpolated	95.7%	0.5%	2.7%	1.0%
1981	23,697	FHWA, MF-24	Interpolated	95.1%	0.7%	3.1%	1.1%
1982	22,702	FHWA, MF-24	1982 TIUS	93.0%	2.3%	3.5%	1.2%
1983	23,945	FHWA, MF-24	Interpolated	91.0%	4.3%	3.5%	1.2%
1984	25,604	FHWA, MF-24	Interpolated	90.0%	5.3%	3.5%	1.2%
1985	27,363	FHWA, MF-24	Interpolated	87.6%	7.7%	3.5%	1.2%
1986	29,074	FHWA, MF-24	Interpolated	87.7%	7.6%	3.5%	1.2%
1987	30,598	FHWA, MF-24	1987 TIUS	89.0%	6.3%	3.5%	1.2%
1988	32,653	FHWA, MF-24	Interpolated	88.2%	7.4%	3.5%	1.0%
1989	33,271	FHWA, MF-24	Interpolated	89.5%	6.2%	3.4%	0.8%
1990	35,611	FHWA, MF-24	Interpolated	89.2%	6.8%	3.4%	0.7%
1991	38,217	FHWA, MF-24	Interpolated	88.1%	8.0%	3.3%	0.5%
1992	40,929	FHWA, MF-24	1992 TIUS	88.5%	7.9%	3.3%	0.3%
1993	42,851	FHWA, MF-24	Interpolated	87.3%	9.1%	3.3%	0.3%
1994	44,112	FHWA, MF-24	Interpolated	86.8%	9.6%	3.3%	0.3%
1995	45,605	FHWA, MF-24	Interpolated	85.1%	11.2%	3.4%	0.3%
1996	47,354	FHWA, MF-24	Interpolated	86.2%	10.1%	3.4%	0.3%
1997	49,388	FHWA, MF-24	1997 VIUS	84.2%	12.2%	3.4%	0.2%
1998	50,462	FHWA, MF-24	1997 VIUS	85.2%	11.2%	3.4%	0.2%
1999	52,859	FHWA, MF-24	1997 VIUS	85.4%	11.0%	3.4%	0.2%
2000	52,832	FHWA, MF-24	1997 VIUS	83.8%	12.6%	3.4%	0.2%
2001	53,294	FHWA, MF-24	1997 VIUS	83.4%	13.0%	3.4%	0.2%
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 2001*, Table VM-1 and annual editions back to 1996; DOT, FHWA, *Highway Statistics Summary to 1995.* Total gallons for other trucks was the difference between total trucks and 2-axle, 4-tire 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	1997 VIUS	12.4%	87.1%	0.5%
1999	33,909	1997 VIUS	12.4%	87.1%	0.5%
2000	35,193	1997 VIUS	12.4%	87.1%	0.5%
2001	35,287	1997 VIUS	12.4%	87.1%	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

Diesel:

DOE, EIA, *Fuel Oil and Kerosene Sales 2001*, Table 1. Unadjusted sales of distillate.

Gasoline:

DOT, FHWA, *Highway Statistics 2001,* Table MF-24, and annual editions back to 1985.

Table A.7
Off-Highway Fuel Use

	Gasoline (thousand gallons)		Diesel (thousand gallons)	
Year	Agriculture	Construction	Agriculture	Construction
1985	1,080,677	250,935	3,102,106	1,522,041
1986	964,226	275,997	3,340,813	1,659,365
1987	921,692	278,767	2,998,681	1,559,873
1988	806,097	275,927	3,162,575	1,671,387
1989	821,612	297,577	3,360,092	1,689,651
1990	681,220	318,184	3,403,400	1,808,646
1991	776,217	278,237	3,158,477	1,641,560
1992	805,511	272,896	3,499,518	1,757,788
1993	845,320	245,299	3,410,827	2,104,299
1994	903,682	266,560	3,270,227	2,153,153
1995	926,732	280,046	3,476,472	2,173,054
1996	918,085	283,911	3,591,383	2,245,922
1997	984,450	300,491	3,547,699	2,276,548
1998	906,941	234,705	3,410,801	2,477,199
1999	702,700	177,758	3,411,623	2,490,492
2000	652,256	191,516	3,454,861	2,589,383
2001	801,552	506,682	3,584,104	2,708,228
Heat content used for conversion to btu:	125,000 btu/gallon	125,000 btu/gallon	138,700 btu/gallon	138,700 btu/gallon

Note:
The FHWA methodology for estimating construction gasoline use changed in 2001. Previous years' data are likely understated.

Nonhighway energy use

Air

General Aviation:

DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report Calendar Year 2001,* Table 5.1, and annual.

Table A.8
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
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." Because the data for international included fuel purchased abroad, **the international total was divided in half to estimate domestic fuel use for international flights**.

Table A.9
Air Carrier Fuel Use

Year	Domestic (thousand gallons)	All 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
Heat content used for conversion to btu:	135,000 btu/gallon	135,000 btu/gallon	135,000 btu/gallon

Water

Freight:

Total – DOE, EIA, *Fuel Oil and Kerosene Sales 2001*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Table A.10
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	1,692,141	5,687,375
1985	1,894,016	5,473,614
1986	2,034,215	5,287,347
1987	2,223,258	5,259,272
1988	2,310,367	5,248,981
1989	2,356,444	5,410,263
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	2,093,252	3,679,843
Heat content used for conversion to btu:	138,700 btu/gallon	149,700 btu/gallon

Recreational Boating:

Fuel use by recreational boating from 1977-on was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats). Fuel use for recreational boating from 1970 to 1976 was from FHWA, *Highway Statistics, 1976*, Table MF-24, and annual editions 1970-75.

Table A.11
Recreational Boating Fuel Use

Year	Number of numbered boats	Source	Estimated gasoline use (thousand gallons)
1970		FHWA, MF-24	598,000
1971		FHWA, MF-24	645,000
1972		FHWA, MF-24	687,000
1973		FHWA, MF-24	717,000
1974		FHWA, MF-24	696,780
1975		FHWA, MF-24	729,540
1976		FHWA, MF-24	763,980
1977	7,975,587		1,553,246
1978	8,035,905		1,564,992
1979	8,278,723		1,612,281
1980	8,577,857		1,670,538
1981	8,905,097		1,734,268
1982	9,073,972	Multiply by:	1,767,156
1983	9,165,094	0.95 ×	1,784,902
1984	9,420,011	205 gallons/boat	1,834,547
1985	9,589,483		1,867,552
1986	9,876,197		1,923,389
1987	9,963,696		1,940,430
1988	10,362,613		2,018,119
1989	10,777,370		2,098,893
1990	10,996,253		2,141,520
1991	11,068,440		2,155,579
1992	11,132,386		2,168,032
1993	11,282,736		2,197,313
1994	11,429,585		2,225,912
1995	11,734,710		2,285,335
1996	11,877,938		2,313,228
1997	12,312,982		2,397,953
1998	12,565,930		2,447,215
1999	12,738,271		2,480,778
2000	12,782,143		2,489,322
2001	12,876,346		2,507,668
Heat content used for conversion to btu:			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 2001*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft^3. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., *End Use Energy Consumption DataBase: Transportation Sector*. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude petroleum and petroleum product:

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, TN, 1981. (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.12
Pipeline Fuel Use

Year	Natural gas (million cubic feet)	Formula for estimating electricity use	Estimated 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	Multiply natural gas by	3,472.2	212.1
1973	728,177	heat content to get btu	3,300.1	212.1
1974	668,792	$\times$ 0.015	3,031.0	212.1
1975	582,963	$\times$ (29.305 $\times 10^{-5}$ kWhr/btu)	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	623,929		2,827.7	212.1
Heat content used for conversion to btu:	1,031 btu/cubic foot		11,765 Btu/kWhr	

Rail

Freight:

AAR, *Railroad Facts*, 2002 Edition, Washington, DC, 2002.

Table A.13
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
Heat content used for conversion to btu:	138,700 Btu/gallon

Passenger:

Commuter - APTA, *2003 Transit Fact Book*, Washington, DC, 2003.

Table A.14
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
Heat content used for conversion to btu:	138,700 Btu/gallon	11,765 Btu/kWhr

Transit – APTA, *2003 Transit Fact Book*, Washington, DC, 2003. Includes light rail and heavy rail.

Table A.15
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	361	3,253	3,614
1998	381	3,280	3,661
1999	416	3,385	3,801
2000	463	3,549	4,012
2001	487	3,646	4,133
Heat content used for conversion to btu:	11,765 Btu/kWhr	11,765 Btu/kWhr	11,765 Btu/kWhr

Intercity – Personal communication with Amtrak, Washington, DC.

Table A.16
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	817,274
Heat content used for conversion to btu:	138,700 Btu/gallon	11,765 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 2.4
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, 2001*, Table VM-1. Data series shown in Table 4.1.

Passenger-miles – Vehicle-miles multiplied by an average load factor.

Load factor – 2001 NHTS shows automobile load factor as 1.1 persons per vehicle.

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-3. Data series shown in Table 2.6.

Light trucks

Number of vehicles, vehicle-miles – DOT, FHWA, *Highway Statistics 2001*, Table VM-1. Data by truck type were multiplied by the shares of trucks/truck travel which are for personal use (Table A.17).

Passenger-miles – Vehicle-miles multiplied by an average load factor.

Load factor – 2001 NHTS shows personal light truck load factor as 1.72 persons per vehicle.

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-6, A-7 (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.17) which were derived by ORNL from the 1997 VIUS Micro Data File on CD.

Table A.17
Share of Trucks, Truck Travel, and Fuel Use for Personal Travel

Personal trucks	
75.2%	2-axle, 4-tire trucks
16.9%	Other single-unit and combination trucks
Personal truck travel	
70.7%	2-axle, 4-tire trucks
7.1%	Other single-unit and combination trucks
Personal truck fuel use	
68.5%	2-axle, 4-tire trucks
3.7%	Other single-unit and combination trucks

Note:
Since these shares come from the 1997 VIUS, they may underestimate the amount of personal trucks, truck travel, and energy use for 2001.

Motorcycles

Number of vehicles, vehicle-miles – DOT, FHWA, *Highway Statistics 2000*1 Table VM-1.
Passenger-miles – Vehicle-miles multiplied by an average load factor.
Load factor - 2001 NHTS shows motorcycle load factor as 1.22 persons per vehicle.
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-4. Data series shown in Table 2.6.

Demand Response

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2003 Public Transportation Fact Book,* Washington, DC, 2003.
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, *2003 Public Transportation Fact Book*, Washington, DC, 2003, Table 95.

Vanpool

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2003 Public Transportation Fact Book,* Washington, DC, 2003.
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, *2003 Public Transportation Fact Book*, Washington, DC, 2003, Table 144.

Buses

Transit

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2003 Public Transportation Fact Book*, Washington, DC, 2003. Data series shown on Table 5.12.
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-4. Data series shown in Table 5.12.

Intercity

Passenger-miles – Eno Foundation for Transportation, *Transportation in America 2001*, Nineteenth edition, Washington, DC. Data series shown in Table 5.13. Because the 2001 data were not available at the time this report went to press, the 2000 data were used again for 2001.

Energy intensities –

***Btu per passenger-mile* –** Intercity bus energy use divided by intercity bus passenger-miles.

Energy use – See Energy Use Sources, p. A-5 . Data series shown in Table 5.13. Because the 2001 data were not available at the time this report went to press, the 2000 data were used again for 2001.

School

Number of vehicles – DOT, FHWA, *Highway Statistics 2001*, Table MV-10. Data series shown in Table 5.13.

Energy use – See Energy Use Sources, p. A-5 . Data series shown in Table 5.13. Because the 2001 data were not available at the time this report went to press, the 2000 data were used again for 2001.

Air

Certificated air carriers

Aircraft-miles, passenger-miles – DOT, BTS, *Air Carrier Traffic Statistics Monthly, December 2001/2000*, 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-10. 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 9.1 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 2001*. Data series shown in Table 9.2.

Passenger-miles – Eno Foundation for Transportation, *Transportation in America 2001*, Nineteenth edition, Washington, DC. Data series shown in Table 9.2.

Energy intensities –

***Btu per passenger-mile* –** General aviation energy use divided by passenger-miles.

Energy use – See Energy Use Sources, p. A-9. Data series shown in Table 9.2.

Recreational boating

Number of vehicles – DOT, U.S. Coast Guard, Office of Boating Safety, Washington, DC, 2003.

Energy use – See Energy Use Sources, p. A-12.

Rail

Intercity

Number of vehicles, vehicle-miles, passenger-miles – AAR, *Railroad Facts, 2002 Edition*, Washington, DC, 2002.
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-18. Data series shown in Table 9.11.

Transit

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2003 Public Transportation Fact Book*, Washington, DC, 2003. Sum of light and heavy rail transit. Data series shown on Table 9.13.
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-17. Data series shown in Table 9.13.

Commuter

Number of vehicles, vehicle-miles, passenger-miles – APTA, *2003 Public Transportation Fact Book*, Washington, DC, 2003. Data series shown on Table 9.12.
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-16. Data series shown in Table 9.12.

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-3. Data series shown in Table 2.6.
Vehicle-miles – DOT, FHWA, *Highway Statistics 2001*, 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-3. Data series shown in Table 2.6.
Passenger miles – Vehicle miles multiplied by an average load factor.
Vehicle-miles – DOT, FHWA, *Highway Statistics 2001*, 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, and NHTS 2001.

Table A.18
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

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-6. Data series shown in Table 2.6.
Vehicle-miles – DOT, FHWA, *Highway Statistics 2001*, 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-4. Data series shown in Table 5.12.
Vehicle-miles – APTA, *2003 Public Transportation Fact Book*, Washington, DC, 2003. Data series shown on Table 5.12.

Btu per passenger-mile – Transit bus energy use divided by transit bus passenger-miles.
Energy use – See Energy Use Sources, p. A-4. Data series shown in Table 5.12.
Passenger-miles – APTA, *2003 Public Transportation Fact Book,* Washington, DC, 2003. Data series shown on Table 5.12.

Intercity

Btu per passenger-mile – Intercity bus energy use divided by intercity bus passenger-miles.
Energy use – See Energy Use Sources, p. A-5 . Data series shown in Table 5.13. Because the 2001 data were not available at the time this report went to press, the 2000 data were used again for 2001.
Passenger-miles – Eno Foundation for Transportation, *Transportation in America 2001*, Nineteenth edition, Washington, DC. Data series shown in Table 5.13. Because the 2001 data were not available at the time this report went to press, the 2000 data were used again for 2001.

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-10. 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 Monthly*, *December 2001/2000*, Washington, DC, and annual editions back to 1994. Pre-1994 data are 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 9.1 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-9. Data series shown in Table 9.2.
Passenger-miles – Eno Foundation for Transportation, *Transportation in America 2001*, Nineteenth edition, Washington, DC. Data series shown in Table 9.2.

Rail

Intercity

Btu per passenger-mile – Intercity 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 – AAR, *Railroad Facts*, *2002 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-17. Data series shown in Table 9.13.
Passenger-miles – APTA, *2003 Public Transportation Fact Book*, Washington, DC, 2003. Data series shown on Table 9.13.

Commuter

Btu per passenger-mile – Commuter rail energy use divided by passenger-miles.
Energy use – See Energy Use Sources, p. A-16. Data series shown in Table 9.12.
Passenger-miles – APTA, *2003 Public Transportation Fact Book*, Washington, DC, 2003. Data series shown on Table 9.12.

Freight Movement and Energy Use

Truck

Number of vehicles – DOT, FHWA, *Highway Statistics 2001*, Table VM-1. Data by truck type were multiplied by the shares of trucks engaged in intercity freight movement (Table A.19).
Ton miles, tons shipped and average length of haul – Eno Transportation Foundation, *Transportation in America 2001*, Nineteenth Edition, Washington, DC, 2002.
Energy intensity – Freight truck energy use divided by ton-miles.
Energy use – See Energy Use Sources (light trucks, medium/heavy trucks), pp. A-6, A-7. Data by truck type were multiplied by the shares of trucks engaged in intercity freight movement (Table A.19).

Table A.19
Share of Trucks and Truck Fuel Use
for Trucks Engaged in Intercity Freight Movement

Intercity freight trucks	
0.4%	2-axle, 4-tire trucks
29.0%	Other single-unit and combination trucks
Intercity freight truck fuel use	
1.0%	2-axle, 4-tire trucks
71.3%	Other single-unit and combination trucks

These percentages were derived by ORNL from the 1997 VIUS Micro Data File on CD. Intercity freight trucks were defined as any truck whose:
- greatest share of miles were traveled more than 50 miles away from the vehicle's home base; **and**
- principal use was not personal or passenger transportation; **and**
- body type was not pickup, minivan, or utility vehicle.

Rail

Number of locomotives, ton-miles, tons shipped, average length of haul – AAR, *Railroad Facts, 2002 Edition*, Washington, DC, 2002. 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-15. Data series shown in Table 9.8.

Water

Number of vehicles – U.S. Department of the Army, Army Corps of Engineers, "Summary of U.S. Flag Passenger and Cargo Vessels, 2001," New Orleans, LA, 2002.
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 2001,* Part 5: National Summaries, New Orleans, LA, 2002. Data series shown in Table 9.4.
Btu per ton-mile – Domestic waterborne commerce energy use divided by ton-miles.
Energy use – See Energy Use Sources, p. A-11. Data series shown in Table 9.4.

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-7.
Vehicle-miles – DOT, FHWA, *Highway Statistics 2001*, 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-15. Data series shown in Table 9.8.
Freight car miles – AAR, *Railroad Facts, 2002 Edition*, Washington, DC, 2002. 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-15. Data series shown in Table 9.8.
Ton-miles – AAR, *Railroad Facts, 2002 Edition*, Washington, DC, 2002. 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-11. Data series shown in Table 9.4.
Ton-miles – U.S. Department of the Army, Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 2001*, Part 5: National Summaries, New Orleans, LA, 2002. Data series shown in Table 9.4.

Highway Vehicle Stock and New Sales
2001 Calendar Year

Automobiles

Stock – Vehicle registrations by model year are from The Polk Company's National Vehicle Population Profile. Vehicles were distributed into size classes using the percentages in Table A.20. This method assumed that all vehicles, large and small, were scrapped at the same rate. Shares were generated from the ORNL MPG and Market Shares Database, 2003.

Table A.20
Shares by Automobile Size Class and Model Year

Year	Minicompact	Subcompact	Compact	Midsize	Large	Two-seater	Total
Pre-1977	7.1%	22.0%	16.4%	29.5%	23.0%	2.0%	100.0%
1977	7.2%	16.2%	25.7%	21.7%	27.4%	1.8%	100.0%
1978	8.5%	19.0%	15.2%	33.0%	22.3%	2.0%	100.0%
1979	5.5%	30.7%	8.4%	33.8%	19.4%	2.2%	100.0%
1980	4.7%	37.8%	6.6%	33.8%	14.7%	2.4%	100.0%
1981	3.3%	33.0%	13.4%	35.1%	12.5%	2.7%	100.0%
1982	2.9%	31.4%	17.0%	33.1%	13.0%	2.6%	100.0%
1983	2.6%	26.8%	22.0%	31.7%	14.5%	2.4%	100.0%
1984	0.4%	24.6%	27.1%	30.0%	14.7%	3.2%	100.0%
1985	0.6%	21.7%	32.1%	28.4%	13.8%	3.4%	100.0%
1986	1.8%	22.4%	33.2%	26.9%	13.2%	2.5%	100.0%
1987	1.4%	19.5%	39.1%	25.2%	12.5%	2.3%	100.0%
1988	0.8%	19.1%	40.5%	24.6%	13.2%	1.8%	100.0%
1989	0.2%	19.3%	36.2%	28.9%	13.8%	1.6%	100.0%
1990	0.9%	22.0%	34.2%	27.2%	13.9%	1.8%	100.0%
1991	0.9%	26.1%	29.5%	27.9%	13.9%	1.7%	100.0%
1992	1.2%	25.3%	30.6%	27.7%	14.1%	1.1%	100.0%
1993	0.9%	22.6%	32.3%	29.1%	14.2%	0.9%	100.0%
1994	0.5%	22.1%	35.2%	26.5%	14.9%	0.8%	100.0%
1995	0.5%	17.4%	37.8%	28.6%	15.1%	0.6%	100.0%
1996	0.4%	15.2%	40.3%	28.8%	14.6%	0.7%	100.0%
1997	0.5%	18.3%	35.5%	30.6%	14.1%	1.0%	100.0%
1998	0.2%	18.5%	28.6%	38.4%	13.0%	1.3%	100.0%
1999	0.1%	18.8%	27.4%	38.8%	13.7%	1.2%	100.0%
2000	0.2%	19.9%	26.7%	37.4%	14.4%	1.4%	100.0%
2001	0.4%	11.2%	36.8%	32.1%	18.1%	1.4%	100.0%

Business fleet autos – Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2002*, Redondo Beach, CA, 2002.
Personal autos – Difference between total vehicle stock and business fleet autos.

Sales – Domestic and import totals are from *Ward's Motor Vehicle Facts and Figures 2002*. Domestic-sponsored imports (captive imports) were included in the import figure only. Domestic and import sales were distributed into size classes using the percentages in Table A.21 from the ORNL MPG and Market Shares Database, 2003.

Table A.21
Automobile Sales Shares by Size Class, 2001

Size class	Domestic	Import
Two-seaters	0.8%	3.3%
Minicompact	0.0%	1.6%
Subcompact	11.3%	10.5%
Compact	34.0%	45.5%
Midsize	31.0%	35.8%
Large	22.9%	3.3%

See Glossary for definition of Automobile Size Classifications.

Trucks

Stock – Total truck population from The Polk Company, 2002. The trucks were distributed using shares of trucks by standard weight classes from VIUS 1997 (Table A.22).

Table A.22

Share of Trucks by Weight Class

Weight classes	Share of trucks in the population
0 - 10,000 lbs	93.5%
10,001-19,500 lbs	2.0%
19,501–26,000 lbs	1.0%
26,001 lbs and over	3.5%
Total	100.0%

Then, the number of trucks in Class 2b were split from Classes 1 and 2 by model year (Polk NVPP data) using shares from ORNL's Class 2b study (Table A.23).

Table A.23
Share of Class 1 and 2 Trucks
that are Class 2b Trucks (8,500-10,000 lbs)

Model Year	Share of class 2b trucks
Pre-1974	7.35%
1974	15.64%
1975	17.15%
1976	18.29%
1977	14.60%
1978	17.90%
1979	17.79%
1980	18.20%
1981	13.87%
1982	14.05%
1983	8.13%
1984	9.74%
1985	9.56%
1986	8.77%
1987	8.91%
1988	6.90%
1989	8.34%
1990	6.73%
1991	4.91%
1992	5.04%
1993	5.60%
1994	5.60%
1995	7.05%
1996	6.71%
1997	7.86%
1998	5.01%
1999	9.36%
2000	8.94%
2001	8.61%

Trucks less than 8,500 lbs (Classes 1 and 2a) were distributed into size classes using the percentages in Table A.24. This method assumed that all vehicles, large and small, were scrapped at the same rate. Shares were generated from the ORNL MPG and Market Shares Database, 2003.

Table A.24
Shares by Light Truck Size Class and Model Year for Trucks under 8,500 lbs

Sales period	Small pickup	Large pickup	Small van	Large van	Small utility	Medium utility	Large utility	Total
Pre-1976	9.5%	66.1%	0.9%	21.1%	0.0%	2.0%	0.4%	100.0%
1976	7.1%	65.7%	0.8%	23.9%	0.0%	2.1%	0.4%	100.0%
1977	11.0%	68.5%	1.0%	16.6%	0.0%	2.5%	0.4%	100.0%
1978	10.5%	64.0%	0.8%	22.8%	0.1%	1.4%	0.4%	100.0%
1979	16.1%	58.5%	0.6%	20.7%	1.8%	1.9%	0.4%	100.0%
1980	23.3%	50.3%	0.6%	14.8%	2.3%	6.9%	1.8%	100.0%
1981	24.4%	50.0%	0.6%	16.9%	2.0%	4.7%	1.4%	100.0%
1982	27.2%	46.8%	0.6%	17.8%	1.3%	4.8%	1.5%	100.0%
1983	33.3%	35.7%	0.5%	18.0%	6.3%	4.5%	1.7%	100.0%
1984	23.7%	38.1%	6.2%	15.1%	10.6%	4.4%	1.9%	100.0%
1985	20.4%	40.0%	10.3%	12.7%	10.4%	4.4%	1.8%	100.0%
1986	21.7%	35.2%	14.1%	11.3%	11.7%	4.1%	1.9%	100.0%
1987	21.2%	33.7%	16.0%	10.3%	12.3%	4.8%	1.7%	100.0%
1988	21.6%	30.6%	18.0%	10.3%	12.5%	4.9%	2.1%	100.0%
1989	18.4%	33.2%	18.0%	9.9%	9.8%	8.6%	2.1%	100.0%
1990	25.2%	24.7%	22.4%	7.1%	8.9%	9.6%	2.1%	100.0%
1991	24.8%	23.1%	23.4%	6.1%	8.6%	12.2%	1.8%	100.0%
1992	22.8%	23.6%	23.6%	6.4%	8.7%	13.3%	1.6%	100.0%
1993	21.6%	22.2%	23.8%	6.2%	8.2%	15.5%	2.5%	100.0%
1994	20.3%	24.5%	23.6%	5.6%	7.6%	16.0%	2.4%	100.0%
1995	18.0%	24.9%	22.4%	5.5%	8.6%	18.1%	2.5%	100.0%
1996	16.2%	25.7%	21.0%	4.7%	9.3%	20.4%	2.7%	100.0%
1997	15.0%	24.3%	19.9%	4.7%	5.4%	22.2%	8.5%	100.0%
1998	12.5%	27.4%	17.8%	4.6%	6.8%	22.2%	8.7%	100.0%
1999	13.9%	25.3%	17.1%	4.5%	8.3%	22.0%	8.9%	100.0%
2000	12.9%	23.7%	15.3%	4.4%	9.1%	26.1%	8.5%	100.0%

The Class 2b trucks were split into two truck types - pickups and van/SUV using shares from the report *Investigation of Class 2b Trucks*, ORNL/TM-2002/49, Table 11, which are shown here in Table A.25.

Table A.25
Shares of Class 2b Trucks by Truck Type

Truck types	Shares of class 2b truck population
Pickup	73.7%
Van/SUV	26.3%

Business fleet trucks – Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 2002*, Redondo Beach, CA, 2002.

Personal trucks – Difference between total stock and business fleet trucks.

Sales – Domestic and import totals are from *Ward's Motor Vehicle Facts and Figures 2002*. Domestic-sponsored imports (captive imports) were included in the import figure only.

According to the *Investigation of Class 2b Trucks*, ORNL/TM-2002/49, 6.5% of all classes 1 and 2 truck sales were Class 2b trucks. Also, there were no class 2b trucks which were imported into the U.S. in 2000.

Domestic and import sales of trucks less than 8,500 lbs were distributed into size classes using the percentages in Table A.26 from the ORNL MPG and Market Shares Database, 2003.

Table A.26
Light Truck Sales Shares by Size Class, 2001
for Trucks less than 8,500 lbs

Size class	Domestic	Import
Small pickup	11.5%	0.0%
Large pickup	28.0%	0.0%
Small van	15.6%	3.9%
Large van	4.5%	0.8%
Small SUV	8.1%	34.8%
Medium SUV	21.6%	57.8%
Large SUV	10.7%	2.7%

The Class 2b truck sales were split into two truck types - pickups and van/SUV using shares from the report *Investigation of Class 2b Trucks*, ORNL/TM-2002/49, Table 6, which are shown here in Table A.27.

Table A.27
Shares of Class 2b Truck Sales
by Truck Type, 2000

Truck types	Shares of class 2b truck population
Pickup	82.1%
Van/SUV	17.9%

Fleet Vehicle Data

Light Fleet Vehicle Population

Automobiles – Bobit Publishing Company, *Automotive Fleet Factbook 2001*, Redondo Beach, CA, 2002, p. 12. Fleets of 10 or more units. Taxi and Rental categories were considered Business fleets.

Light trucks – Bobit Publishing Company, *Automotive Fleet Factbook 2001*, Redondo Beach, CA, 2002, p. 12. Trucks under 19,501 lbs GVW in fleets of 10 or more units. Light trucks were split from the total using shares from the 1997 VIUS (business, rental, and utility) and the GSA *Federal Fleet Factbook* (government) shown in Table A.28.

Table A.28
Light Truck Share of Fleet Trucks
Less than 19,501 lbs GVW

Vehicles in Fleets of 10 or more	
Business	92.1%
Utility	89.6%
Rental	97.3%
Federal Government	81.6%

Light Fleet Vehicle New Sales

Automobiles – Bobit Publishing Company, *Automotive Fleet Factbook 2001*, Redondo Beach, CA, 2002, p. 40–48, Fleet 2000 Model Year registrations. New registrations are considered a proxy for new vehicle sales. Commercial and rental categories were considered Business fleets. Utility fleets were estimated as share of business fleet purchases based on data from the National Association of Fleet Administrators shown in Table A.29.

Light trucks – Bobit Publishing Company, *Automotive Fleet Factbook 2001*, Redondo Beach, CA, 2002, p. 48–52, Fleet 2000 Model Year registrations. New registrations are considered a proxy for new vehicle sales. Commercial and rental categories were considered Business fleets. Utility fleets were estimated as a share of business fleet purchases based on data from the National Association of Fleet Administrators shown in Table A.29.

Table A.29
Share of Business Fleet Vehicles
which are Utility Fleet Vehicles

Vehicle type	
Automobiles	2.6%
Passenger vans	7.3%
Cargo vans	64.3%
Sport utility vehicles	14.8%
Pickup trucks	66.2%

Light Fleet Vehicle Travel

Automobiles

Business

Bobit Publishing Company, *Automotive Fleet Factbook 2001*, Redondo Beach, CA, 2002, p.58-67. Average annual miles of compact and intermediate size automobiles were based on data from four leading fleet management companies. Weighted average of automobile travel was derived based on the estimated share of vehicles in the population from The Polk Company. Compact autos and smaller were assumed to travel as compact cars. Intermediate autos and larger were assumed to travel like intermediate autos. Average annual miles and weights are shown in Table A.30.

Government

The only source of data on government fleet travel was for the Federal Government fleet vehicles. Data on sedans and station wagons from the GSA *Federal Fleet Factbook* was used for government fleet travel and is shown in Table A.30.

Utility

The only source of data available on utility fleet vehicle travel was for the fleets of the Tennessee Valley Authority (TVA). Data on the TVA automobile fleet from the GSA *Federal Fleet Factbook* was used for utility fleet travel and is shown in Table A.30.

Table A.30
Average Annual Miles and Population Shares of Fleet Automobiles

	Average annual miles, 2000	Estimated share of vehicles in the population, 2000
Business automobiles		
Compact	22,689	55.6%
Intermediate	22,893	44.4%
Government automobiles		
Sedans and station wagons	12,895	
Utility automobiles		
Sedans and station wagons	13,399	

Light trucks

Business

Bobit Publishing Company, *Automotive Fleet Factbook 2001*, Redondo Beach, CA, 2002, p.58-67. Average annual miles of pickups, minivans, sport utility vehicles and full-size vans were based on data from four leading fleet management companies. Weighted average of light truck travel was derived based on the estimated share of vehicles in the population from The Polk Company. Average annual miles and weights are shown in Table A.31.

Government

The only source of data on government fleet travel was for the Federal Government fleet vehicles. Data on ambulances, 2x4 trucks, and 4x4 trucks from the GSA *Federal Fleet Factbook* were used for government fleet travel. Weighted average of light truck travel was derived based on the estimated share of vehicles in the population from the same GSA report. Average annual miles and weights are shown in Table A.31.

Utility

The only source of data available on utility fleet vehicle travel was for the fleets of the Tennessee Valley Authority (TVA). Data on the 2x4 trucks and 4x4 trucks in the TVA fleet from the GSA *Federal Fleet Factbook* were used for utility fleet travel. The weighted average of travel was derived based on the share of vehicles in the population from the same GSA report. Average annual miles and weights are shown in Table A.31.

Table A.31
Average Annual Miles and Population Shares of Fleet Light Trucks

	Average annual miles, 2000	Estimated share of vehicles in the population, 2000
Business light trucks		
Pickup trucks	28,515	48.8%
Minivans	25,677	17.1%
Sport utility vehicles	24,003	28.4%
Full-size vans	20,412	5.8%
Government light trucks		
Ambulances	5,946	0.5%
2x4 trucks	5,747	82.8%
4x4 trucks	12,022	16.7%
Utility light trucks		
2x4 trucks	10,405	55.5%
4x4 trucks	14,208	44.5%

APPENDIX B
CONVERSIONS

A Note About Heating Values

The heat content of a fuel is the quantity of energy released by burning a unit amount of that fuel. However, this value is not absolute and can vary according to several factors. For example, empirical formulae for determining the heating value of liquid fuels depend on the fuels' American Petroleum Institute (API) gravity. The API gravity varies depending on the percent by weight of the chemical constituents and impurities in the fuel, both of which are affected by the combination of raw materials used to produce the fuel and by the type of manufacturing process. Temperature and climatic conditions are also factors.

Because of these variations, the heating values in Table B.1 may differ from values in other publications. The figures in this report are representative or average values, not absolute ones. The gross heating values used here agree with those used by the Energy Information Administration (EIA).

Heating values fall into two categories, usually referred to as "higher" and "lower." If the products of fuel combustion are cooled back to the initial fuel-air or fuel-oxidizer mixture temperature and the water formed during combustion is condensed, the energy released by the process is the higher (gross) heating value. If the products of combustion are cooled to the initial fuel-air temperature, but the water is considered to remain as a vapor, the energy released by the process is lower (or 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	0.008820	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
Heat Content for Various Fuels

Automotive gasoline	125,000 Btu/gal(gross) = 115,400 Btu/gal(net)
Diesel motor fuel	138,700 Btu/gal (gross) = 128,700 Btu/gal (net)
Biodiesel	126,206 Btu/gal (gross) = 117,093 Btu/gal (net)
Methanol	64,600 Btu/gal (gross) = 56,560 Btu/gal (net)
Ethanol	84,600 Btu/gal (gross) = 75,670 Btu/gal (net)
Gasohol	120,900 Btu/gal (gross) = 112,417 Btu/gal (net)
Aviation gasoline	120,200 Btu/gal (gross) = 112,000 Btu/gal (net)
Propane	91,300 Btu/gal (gross) = 83,500 Btu/gal (net)
Butane	103,000 Btu/gal (gross) = 93,000 Btu/gal (net)
Jet fuel (naphtha)	127,500 Btu/gal (gross) = 118,700 Btu/gal (net)
Jet fuel (kerosene)	135,000 Btu/gal (gross) = 128,100 Btu/gal (net)
Lubricants	144,400 Btu/gal (gross) = 130,900 Btu/gal (net)
Waxes	131,800 Btu/gal (gross) = 120,200 Btu/gal (net)
Asphalt and road oil	158,000 Btu/gal (gross) = 157,700 Btu/gal (net)
Petroleum coke	143,400 Btu/gal (gross) = 168,300 Btu/gal (net)
Natural gas	
Wet	1,109 Btu/ft^3
Dry	1,027 Btu/ft^3
Compressed	20,551 Btu/pound
	960 Btu/cubic foot
Liquid	90,800 Btu/gal (gross) = 87,600 Btu/gal (net)
Crude petroleum	138,100 Btu/gal (gross) = 131,800 Btu/gal (net)
Fuel Oils	
Residual	149,700 Btu/gal (gross) = 138,400 Btu/gal (net)
Distillate	138,700 Btu/gal (gross) = 131,800 Btu/gal (net)
Coal	
Anthracite - Consumption	21.711 x 10^6 Btu/short ton
Bituminous and lignite - Consumption	21.012 x 10^6 Btu/short ton
Production average	21.352 x 10^6 Btu/short ton
Consumption average	21.015 x 10^6 Btu/short ton

Table B.4
Fuel Equivalents

1 million bbl crude oil/day	= 0.365 billion bbl crude oil/year = 2.117 quadrillion Btu/year = 100.465 million short tons coal/year = 91.142 million metric tons coal/year = 2.065 trillion ft^3 natural gas/year = 2,233.435 petajoules/year
1 billion bbl crude oil/year	= 2.740 million bbl crude oil/day = 5.800 quadrillion Btu/year = 275.247 million short tons coal/year = 249.704 million metric tons coal/year = 5.659 trillion ft^3 natural gas/year = 6,119 petajoules/year
1 quadrillion Btu/year	= 0.472 million bbl crude oil/day = 172.414 million bbl crude oil/year = 47.456 million short tons coal/year = 43.052 million metric tons coal/year = 975.610 billion ft^3 natural gas/year = 1,055 petajoules/year
1 billion short tons coal/year	= 0.907 billion metric tons coal/year = 9.954 million bbl crude oil/day = 3.633 billion bbl crude oil/year = 21.072 quadrillion Btu/year = 20.558 trillion ft^3 natural gas/year = 22,230.960 petajoules/year
1 billion metric tons coal/year	= 1.102 billion short tons coal/year = 9.030 million bbl crude oi l/day = 3.296 billion bbl crude oil/year = 19.117 quadrillion btu/year = 18.650 trillion ft^3 natural gas/year = 20,167.927 petajoules/year
1 trillion ft^3 natural gas/year	= 0.484 million bbl crude oil/day = 0.177 billion bbl crude oil/year = 1.025 quadrillion Btu/year = 48.643 million short tons coal/year = 44.129 million metric tons coal/year = 1,081.375 petajoules/year
1 petajoule/year	= 447.741 bbl crude oil/day = 163.425 thousand bbl crude oil/year = 0.948 trillion Btu/year = 44.982 thousand short tons coal/year = 40.808 thousand metric tons coal/year = 0.925 billion ft^3 natural gas/year

Table B.5
Energy Unit Conversions

1 Btu	= 778.2 ft-lb	1 kWhr	= 3412 Btu[a]
	= 107.6 kg-m		= 2.655×10^{6} ft-lb
	= 1055 J		= 3.671×10^{5} kg-m
	= 39.30×10^{-5} hp-h		= 3.600×10^{6} J
	= 39.85×10^{-5} metric hp-h		= 1.341 hp-h
	= 29.31×10^{-5} kWhr		= 1.360 metric hp-h
1 kg-m	= 92.95×10^{-4} Btu	1 Joule	= 94.78×10^{-5} Btu
	= 7.233 ft-lb		= 0.7376 ft-lb
	= 9.806 J		= 0.1020 kg-m
	= 36.53×10^{-7} hp-h		= 37.25×10^{-8} hp-h
	= 37.04×10^{-7} metric hp-h		= 37.77×10^{-8} metric hp-h
	= 27.24×10^{-7} kWhr		= 27.78×10^{-8} kWhr
1 hp-h	= 2544 Btu	1 metric hp-h	= 2510 Btu
	= 1.98×10^{6} ft-lb		= 1.953×10^{6} ft-lb
	= 2.738×10^{6} kgm		= 27.00×10^{4} kg-m
	= 2.685×10^{6} J		= 2.648×10^{6} J
	= 1.014 metric hp-h		= 0.9863 hp-h
	= 0.7475 kWhr		= 0.7355 kWhr

[a]This figure does not take into account the fact that electricity generation and distribution efficiency is approximately 29%. If generation and distribution efficiency are taken into account, 1 kWhr = 11,765 Btu.

Table B.6
International Energy Conversions

To:	Terajoules	Giga-calories	Million tonnes of oil equivalent	Million Btu	Gigawatt-hours
From:	*multiply by:*				
Terajoules	1	238.8	2.388×10^{-5}	947.8	0.2778
Gigacalories	4.1868×10^{-3}	1	10^{-7}	3.968	1.163×10^{-3}
Million tonnes of oil equivalent	4.1868×10^{4}	10^{7}	1	3.968×10^{7}	11,630
Million Btu	1.0551×10^{-3}	0.252	2.52×10^{-8}	1	2.931×10^{-4}
Gigawatthours	3.6	860	8.6×10^{-5}	3412	1

Table B.7
Distance and Velocity Conversions

1 in.	= 83.33 x 10^{-3} ft	1 ft	= 12.0 in.
	= 27.78 x 10^{-3} yd		= 0.33 yd
	= 15.78 x 10^{-6} mile		= 189.4 x 10^{-3} mile
	= 25.40 x 10^{-3} m		= 0.3048 m
	= 0.2540 x 10^{-6} km		= 0.3048 x 10^{-3} km
1 mile	= 63360 in.	1 km	= 39370 in.
	= 5280 ft		= 3281 ft
	= 1760 yd		= 1093.6 yd
	= 1609 m		= 0.6214 mile
	= 1.609 km		= 1000 m

1 ft/sec = 0.3048 m/s = 0.6818 mph = 1.0972 km/h
1 m/sec = 3.281 ft/s = 2.237 mph = 3.600 km/h
1 km/h = 0.9114 ft/s = 0.2778 m/s = 0.6214 mph
1 mph = 1.467 ft/s = 0.4469 m/s = 1.609 km/h

Table B.8
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.9
Volume and Flow Rate Conversions[a]

1 U.S. gal	= 231 $in.^3$	1 liter	= 61.02 $in.^3$
	= 0.1337 ft^3		= 3.531 x 10^{-2} ft^3
	= 3.785 liters		= 0.2624 U.S. gal
	= 0.8321 imperial gal		= 0.2200 imperial gal
	= 0.0238 bbl		= 6.29 x 10^{-3} bbl
	= 0.003785 m^3		= 0.001 m^3
A U.S. gallon of gasoline weighs 6.2 pounds			
1 imperial gal	= 277.4 $in.^3$	1 bbl	= 9702 $in.^3$
	= 0.1606 ft^3		= 5.615 ft^3
	= 4.545 liters		= 158.97 liters
	= 1.201 U.S. gal		= 42 U.S. gal
	= 0.0286 bbl		= 34.97 imperial gal
	= 0.004546 m^3		= 0.15897 m^3
1 U.S. gal/hr	= 3.209 ft^3/day		= 1171 ft^3/year
	= 90.84 liter/day		= 33157 liter/year
	= 19.97 imperial gal/day		= 7289 imperial gal/year
	= 0.5712 bbl/day		= 207.92 bbl/year
For Imperial gallons, multiply above values by 1.201			
1 liter/hr	= 0.8474 ft^3/day		= 309.3 ft^3/year
	= 6.298 U.S. gal/day		= 2299 U.S. gal/year
	= 5.28 imperial gal/day		= 1927 imperial gal/year
	= 0.1510 bbl/day		= 55.10 bbl/year
1 bbl/hr	= 137.8 ft^3/year		= 49187 ft^3 year
	= 1008 U.S. gal/day		= 3.679 x 10^5 U.S. gal/year
	= 839.3 imperial gal/day		= 3.063 x 10^5 imperial gal/year
	= 3815 liter/day		= 1.393 x 10^6 liter/day

[a]The conversions for flow rates are identical to those for volume measures, if the time units are identical.

Table B.10
Power Conversions

FROM	TO: 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.11
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	2000	907.2	1	0.8929	0.9072
Long ton	2240	1016	1.12	1	1.016
Metric ton	2205	1000	1.102	0.9842	1

Table B.12
Fuel Efficiency Conversions[a]

MPG	Miles/liter	Kilometers/L	L/100 kilometers
10	2=64	4=25	23=52
15	3=96	6=38	15=68
20	5=28	8=50	11=76
25	6=60	10=63	9=41
30	7=92	12=75	7=84
35	9=25	14=88	6=72
40	10=57	17=00	5=88
45	11=89	19=13	5=23
50	13=21	21=25	4=70
55	14=53	23=38	4=28
60	15=85	25=51	3=92
65	17=17	27=63	3=62
70	18=49	29=76	3=36
75	19=81	31=88	3=14
80	21=13	34=01	2=94
85	22=45	36=13	2=77
90	23=77	38=26	2=61
95	25=09	40=38	2=48
100	26=42	42=51	2=35
105	27=74	44=64	2=24
110	29=06	46=76	2=14
115	30=38	48=89	2=05
120	31=70	51=01	1=96
125	33=02	53=14	1=88
130	34=34	55=26	1=81
135	35=66	57=39	1=74
140	36=98	59=51	1=68
145	38=30	61=64	1=62
150	39=62	63=76	1=57
Formula	MPG/3.785	MPG/[3.785/1.609]	235.24/MPG

Table B.13
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	:
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.14
Metric Units and Abbreviations

Quantity	Unit name	Symbol
Energy	joule	J
Specific energy	joule/kilogram	J/kg
Specific energy consumption	joule/kilogram•kilometer	J/(kg•km)
Energy consumption	joule/kilometer	J/km
Energy economy	kilometer/kilojoule	km/kJ
Power	kilowatt	Kw
Specific power	watt/kilogram	W/kg
Power density	watt/meter^3	W/m^3
Speed	kilometer/hour	km/h
Acceleration	meter/second^2	m/s^2
Range (distance)	kilometer	km
Weight	kilogram	kg
Torque	newton•meter	N•m
Volume	meter^3	m^3
Mass; payload	kilogram	kg
Length; width	meter	m
Brake specific fuel consumption	kilogram/joule	kg/J
Fuel economy (heat engine)	liters/100 km	L/100 km

Conversion of Constant Dollar Values

Many types of information in this data book are expressed in dollars. Generally, constant dollars are used--that is, dollars of a fixed value for a specific year, such as 1990 dollars. Converting current dollars to constant dollars, or converting constant dollars for one year to constant dollars for another year, requires conversion factors (Table B.15 and B.16). Table B.15 shows conversion factors for the Consumer Price Index inflation factors. Table B.16 shows conversion factors using the Gross National Product inflation factors.

Due to the size of the tables, the data in Tables B.15 and B.16 were changed to two decimal places starting with Edition 17 and data for years 1971–74 were taken off in Edition 21. However, three decimal places were used to calculate all constant dollar values.

Table B.15
Consumer Price Inflation (CPI) Index

	To:																												
From:	**1970**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
1970	1.00	1.39	1.47	1.56	1.68	1.87	2.12	2.34	2.49	2.57	2.68	2.77	2.82	2.93	3.05	3.20	3.37	3.51	3.62	3.72	3.82	3.93	4.04	4.14	4.20	4.29	4.44	4.56	4.64
1975	0.72	1.00	1.06	1.13	1.21	1.35	1.53	1.69	1.79	1.85	1.93	2.00	2.04	2.11	2.20	2.30	2.43	2.53	2.61	2.69	2.75	2.83	2.92	2.98	3.03	3.10	3.20	3.29	3.34
1976	0.68	0.95	1.00	1.07	1.15	1.28	1.45	1.60	1.70	1.75	1.83	1.89	1.93	2.00	2.08	2.18	2.30	2.39	2.47	2.54	2.60	2.68	2.76	2.82	2.86	2.93	3.03	3.11	3.16
1977	0.64	0.89	0.94	1.00	1.08	1.20	1.36	1.50	1.59	1.64	1.71	1.78	1.81	1.87	1.95	2.05	2.16	2.25	2.32	2.38	2.45	2.51	2.59	2.65	2.69	2.75	2.84	2.92	2.97
1978	0.60	0.83	0.87	0.93	1.00	1.11	1.26	1.39	1.48	1.53	1.59	1.65	1.68	1.74	1.81	1.90	2.00	2.09	2.15	2.22	2.27	2.34	2.41	2.46	2.50	2.56	2.64	2.72	2.76
1979	0.53	0.74	0.78	0.83	0.90	1.00	1.14	1.25	1.33	1.37	1.43	1.48	1.51	1.56	1.63	1.71	1.80	1.88	1.93	1.99	2.04	2.10	2.16	2.21	2.25	2.29	2.37	2.44	2.48
1980	0.47	0.65	0.69	0.74	0.79	0.88	1.00	1.10	1.17	1.21	1.26	1.31	1.33	1.38	1.44	1.50	1.59	1.65	1.70	1.75	1.80	1.85	1.90	1.95	1.98	2.02	2.09	2.15	2.18
1981	0.43	0.59	0.63	0.67	0.72	0.80	0.91	1.00	1.06	1.10	1.14	1.18	1.21	1.25	1.30	1.36	1.44	1.50	1.54	1.59	1.63	1.68	1.73	1.77	1.79	1.83	1.89	1.95	1.98
1982	0.40	0.56	0.59	0.63	0.68	0.75	0.85	0.94	1.00	1.03	1.08	1.12	1.14	1.18	1.23	1.29	1.35	1.41	1.45	1.50	1.54	1.58	1.63	1.66	1.69	1.73	1.78	1.84	1.86
1983	0.39	0.54	0.57	0.61	0.65	0.73	0.83	0.91	0.97	1.00	1.04	1.08	1.10	1.14	1.19	1.25	1.31	1.37	1.41	1.45	1.49	1.53	1.58	1.61	1.64	1.67	1.73	1.78	1.81
1984	0.37	0.52	0.55	0.58	0.63	0.70	0.79	0.87	0.93	0.96	1.00	1.04	1.05	1.09	1.14	1.19	1.26	1.31	1.35	1.39	1.43	1.47	1.51	1.54	1.57	1.60	1.66	1.70	1.73
1985	0.36	0.50	0.53	0.56	0.61	0.67	0.77	0.84	0.90	0.93	0.97	1.00	1.02	1.06	1.10	1.15	1.21	1.27	1.30	1.34	1.38	1.42	1.46	1.49	1.51	1.55	1.60	1.65	1.67
1986	0.35	0.49	0.52	0.55	0.59	0.66	0.75	0.83	0.88	0.91	0.95	0.98	1.00	1.04	1.08	1.13	1.19	1.24	1.28	1.32	1.35	1.39	1.43	1.46	1.49	1.52	1.57	1.62	1.64
1987	0.34	0.47	0.50	0.53	0.57	0.64	0.73	0.80	0.85	0.88	0.91	0.95	0.96	1.00	1.04	1.09	1.15	1.20	1.24	1.27	1.30	1.34	1.38	1.41	1.43	1.47	1.52	1.56	1.58
1988	0.33	0.45	0.48	0.51	0.55	0.61	0.70	0.77	0.82	0.84	0.88	0.91	0.93	0.96	1.00	1.05	1.10	1.15	1.19	1.22	1.25	1.29	1.33	1.36	1.38	1.41	1.46	1.50	1.52
1989	0.31	0.43	0.46	0.49	0.53	0.59	0.66	0.73	0.78	0.80	0.84	0.87	0.88	0.92	0.95	1.00	1.05	1.10	1.13	1.17	1.20	1.23	1.27	1.29	1.31	1.34	1.39	1.43	1.45
1990	0.30	0.41	0.44	0.46	0.50	0.56	0.63	0.70	0.74	0.76	0.80	0.82	0.84	0.87	0.91	0.95	1.00	1.04	1.07	1.11	1.13	1.17	1.20	1.23	1.25	1.27	1.32	1.36	1.38
1991	0.28	0.40	0.42	0.44	0.48	0.53	0.61	0.67	0.71	0.73	0.76	0.79	0.80	0.83	0.87	0.91	0.96	1.00	1.03	1.06	1.09	1.12	1.15	1.18	1.20	1.22	1.26	1.30	1.32
1992	0.28	0.38	0.41	0.43	0.46	0.52	0.59	0.65	0.69	0.71	0.74	0.77	0.78	0.81	0.84	0.88	0.93	0.97	1.00	1.03	1.06	1.09	1.12	1.14	1.16	1.19	1.23	1.26	1.28
1993	0.27	0.37	0.39	0.42	0.45	0.50	0.57	0.63	0.67	0.69	0.72	0.74	0.76	0.79	0.82	0.86	0.90	0.94	0.97	1.00	1.03	1.05	1.09	1.11	1.13	1.15	1.19	1.23	1.24
1994	0.26	0.36	0.38	0.41	0.44	0.49	0.56	0.61	0.65	0.67	0.70	0.73	0.74	0.77	0.80	0.84	0.88	0.92	0.95	0.98	1.00	1.03	1.06	1.08	1.10	1.12	1.16	1.20	1.21
1995	0.25	0.35	0.37	0.40	0.43	0.48	0.54	0.60	0.63	0.65	0.68	0.71	0.72	0.75	0.78	0.81	0.86	0.89	0.92	0.95	0.97	1.00	1.03	1.05	1.07	1.09	1.13	1.16	1.18
1996	0.25	0.34	0.36	0.39	0.42	0.46	0.53	0.58	0.62	0.63	0.66	0.69	0.70	0.72	0.75	0.79	0.83	0.87	0.89	0.92	0.94	0.97	1.00	1.02	1.04	1.06	1.10	1.13	1.15
1997	0.24	0.34	0.35	0.38	0.41	0.45	0.51	0.57	0.60	0.62	0.65	0.67	0.68	0.71	0.74	0.77	0.81	0.85	0.87	0.90	0.92	0.95	0.98	1.00	1.02	1.04	1.07	1.10	1.12
1998	0.24	0.33	0.35	0.37	0.40	0.45	0.51	0.56	0.59	0.61	0.64	0.66	0.67	0.70	0.73	0.76	0.80	0.84	0.86	0.89	0.91	0.94	0.96	0.98	1.00	1.02	1.06	1.09	1.10
1999	0.23	0.32	0.34	0.36	0.39	0.44	0.49	0.55	0.58	0.60	0.62	0.65	0.66	0.68	0.71	0.74	0.78	0.82	0.84	0.87	0.89	0.91	0.94	0.96	0.98	1.00	1.03	1.06	1.08
2000	0.23	0.31	0.33	0.35	0.38	0.42	0.48	0.53	0.56	0.58	0.60	0.62	0.64	0.66	0.69	0.72	0.76	0.79	0.81	0.84	0.86	0.89	0.91	0.93	0.95	0.97	1.00	1.03	1.04
2001	0.22	0.30	0.32	0.34	0.37	0.41	0.47	0.51	0.54	0.56	0.59	0.61	0.62	0.64	0.67	0.70	0.74	0.77	0.79	0.82	0.84	0.86	0.89	0.91	0.92	0.94	0.98	1.00	1.02
2002	0.22	0.30	0.32	0.34	0.36	0.40	0.46	0.51	0.54	0.55	0.58	0.60	0.61	0.63	0.66	0.69	0.73	0.76	0.78	0.80	0.82	0.85	0.87	0.89	0.91	0.93	0.96	0.98	1.00

Source:
U.S. Bureau of Labor Statistics.

Table B.16
Gross National Product Implicit Price Deflator

	To																												
From	**1970**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
1970	1.00	1.38	1.46	1.55	1.66	1.80	1.96	2.15	2.28	2.37	2.46	2.54	2.59	2.67	2.87	2.87	2.98	3.09	3.16	3.24	3.31	3.38	3.44	3.51	3.55	3.60	3.68	3.76	3.81
1975	0.73	1.00	1.06	1.12	1.21	1.31	1.43	1.56	1.66	1.72	1.78	1.84	1.88	1.94	2.08	2.08	2.16	2.24	2.29	2.35	2.40	2.45	2.50	2.55	2.58	2.61	2.67	2.73	2.76
1976	0.69	0.95	1.00	1.06	1.14	1.24	1.35	1.47	1.57	1.63	1.69	1.74	1.78	1.83	1.97	1.97	2.05	2.12	2.17	2.22	2.27	2.32	2.36	2.41	2.44	2.47	2.53	2.58	2.61
1977	0.65	0.89	0.94	1.00	1.07	1.16	1.27	1.39	1.47	1.53	1.59	1.64	1.67	1.72	1.85	1.85	1.92	1.99	2.04	2.09	2.13	2.18	2.22	2.26	2.29	2.32	2.38	2.43	2.46
1978	0.60	0.83	0.88	0.93	1.00	1.08	1.18	1.29	1.37	1.43	1.48	1.53	1.56	1.61	1.73	1.73	1.79	1.86	1.90	1.95	1.99	2.03	2.07	2.11	2.14	2.17	2.22	2.27	2.29
1979	0.56	0.77	0.81	0.86	0.92	1.00	1.09	1.19	1.27	1.32	1.37	1.41	1.44	1.48	1.59	1.59	1.66	1.72	1.76	1.80	1.84	1.88	1.91	1.95	1.97	2.00	2.05	2.09	2.12
1980	0.51	0.70	0.74	0.79	0.85	0.92	1.00	1.09	1.16	1.21	1.25	1.29	1.32	1.36	1.46	1.46	1.52	1.57	1.61	1.65	1.68	1.72	1.75	1.79	1.81	1.83	1.88	1.92	1.94
1981	0.47	0.64	0.68	0.72	0.77	0.84	0.91	1.00	1.06	1.10	1.15	1.18	1.21	1.24	1.34	1.34	1.39	1.44	1.47	1.51	1.54	1.57	1.60	1.63	1.65	1.68	1.72	1.75	1.77
1982	0.44	0.60	0.64	0.68	0.73	0.79	0.86	0.94	1.00	1.04	1.08	1.11	1.14	1.17	1.26	1.26	1.31	1.35	1.39	1.42	1.45	1.48	1.51	1.54	1.56	1.58	1.61	1.65	1.67
1983	0.42	0.58	0.61	0.65	0.70	0.76	0.83	0.91	0.96	1.00	1.04	1.07	1.09	1.13	1.21	1.21	1.26	1.30	1.33	1.37	1.39	1.42	1.45	1.48	1.50	1.52	1.55	1.59	1.61
1984	0.41	0.56	0.59	0.63	0.68	0.73	0.80	0.87	0.93	0.96	1.00	1.03	1.05	1.09	1.17	1.17	1.21	1.26	1.29	1.32	1.34	1.37	1.40	1.43	1.44	1.46	1.50	1.53	1.55
1985	0.39	0.54	0.57	0.61	0.65	0.71	0.77	0.85	0.90	0.93	0.97	1.00	1.02	1.05	1.13	1.13	1.17	1.22	1.25	1.28	1.30	1.33	1.36	1.38	1.40	1.42	1.45	1.48	1.50
1986	0.39	0.53	0.56	0.60	0.64	0.69	0.76	0.83	0.88	0.91	0.95	0.98	1.00	1.03	1.11	1.11	1.15	1.19	1.22	1.25	1.27	1.30	1.33	1.35	1.37	1.39	1.42	1.45	1.47
1987	0.37	0.52	0.55	0.58	0.62	0.67	0.74	0.80	0.85	0.89	0.92	0.95	0.97	1.00	1.07	1.07	1.12	1.16	1.18	1.21	1.24	1.26	1.29	1.31	1.33	1.35	1.38	1.41	1.43
1988	0.36	0.50	0.53	0.56	0.60	0.65	0.71	0.78	0.83	0.86	0.89	0.92	0.94	0.97	1.04	1.04	1.08	1.12	1.14	1.17	1.20	1.22	1.25	1.27	1.29	1.30	1.33	1.36	1.38
1989	0.35	0.48	0.51	0.54	0.58	0.63	0.69	0.75	0.80	0.83	0.86	0.89	0.90	0.93	1.00	1.00	1.04	1.08	1.10	1.13	1.15	1.18	1.20	1.22	1.24	1.26	1.28	1.31	1.33
1990	0.34	0.46	0.49	0.52	0.56	0.60	0.66	0.72	0.77	0.80	0.83	0.85	0.87	0.90	0.96	0.96	1.00	1.04	1.06	1.09	1.11	1.13	1.16	1.18	1.19	1.21	1.24	1.26	1.28
1991	0.32	0.45	0.47	0.50	0.54	0.58	0.64	0.70	0.74	0.77	0.80	0.82	0.84	0.87	0.93	0.93	0.97	1.00	1.02	1.05	1.07	1.09	1.12	1.14	1.15	1.17	1.19	1.22	1.23
1992	0.32	0.44	0.46	0.49	0.53	0.57	0.62	0.68	0.72	0.75	0.78	0.80	0.82	0.84	0.91	0.91	0.94	0.98	1.00	1.02	1.05	1.07	1.09	1.11	1.12	1.14	1.17	1.19	1.20
1993	0.31	0.43	0.45	0.48	0.51	0.56	0.61	0.66	0.70	0.73	0.76	0.78	0.80	0.82	0.89	0.89	0.92	0.95	0.98	1.00	1.02	1.04	1.06	1.08	1.10	1.11	1.14	1.16	1.18
1994	0.30	0.42	0.44	0.47	0.50	0.54	0.59	0.65	0.69	0.72	0.74	0.77	0.78	0.81	0.87	0.87	0.90	0.93	0.96	0.98	1.00	1.02	1.04	1.06	1.07	1.09	1.11	1.14	1.15
1995	0.30	0.41	0.43	0.46	0.49	0.53	0.58	0.64	0.68	0.70	0.73	0.75	0.77	0.79	0.85	0.85	0.88	0.91	0.94	0.96	0.98	1.00	1.02	1.04	1.05	1.07	1.09	1.11	1.13
1996	0.29	0.40	0.42	0.45	0.48	0.52	0.57	0.62	0.66	0.69	0.71	0.74	0.75	0.78	0.83	0.83	0.87	0.90	0.92	0.94	0.96	0.98	1.00	1.02	1.03	1.05	1.07	1.09	1.11
1997	0.29	0.39	0.42	0.44	0.47	0.51	0.56	0.61	0.65	0.68	0.70	0.72	0.74	0.76	0.82	0.82	0.85	0.88	0.90	0.92	0.94	0.96	0.98	1.00	1.01	1.03	1.05	1.07	1.09
1998	0.28	0.39	0.41	0.44	0.47	0.51	0.55	0.60	0.64	0.67	0.69	0.71	0.73	0.75	0.81	0.81	0.84	0.87	0.89	0.91	0.93	0.95	0.97	0.99	1.00	1.01	1.04	1.06	1.07
1999	0.28	0.38	0.40	0.43	0.46	0.50	0.55	0.60	0.63	0.66	0.68	0.70	0.72	0.74	0.80	0.80	0.83	0.86	0.88	0.90	0.92	0.94	0.96	0.97	0.99	1.00	1.02	1.04	1.06
2000	0.27	0.37	0.40	0.42	0.45	0.49	0.53	0.58	0.62	0.64	0.67	0.69	0.70	0.73	0.78	0.78	0.81	0.84	0.86	0.88	0.90	0.92	0.93	0.95	0.96	0.98	1.00	1.02	1.04
2001	0.27	0.37	0.39	0.41	0.44	0.48	0.52	0.57	0.61	0.63	0.65	0.67	0.69	0.71	0.76	0.76	0.79	0.82	0.84	0.86	0.88	0.90	0.91	0.93	0.94	0.96	0.98	1.00	1.01
2002	0.26	0.36	0.39	0.41	0.44	0.47	0.52	0.56	0.60	0.62	0.65	0.67	0.68	0.70	0.73	0.75	0.78	0.81	0.83	0.85	0.87	0.89	0.90	0.92	0.93	0.95	0.97	0.99	1.00

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Washington, DC, monthly.

APPENDIX C

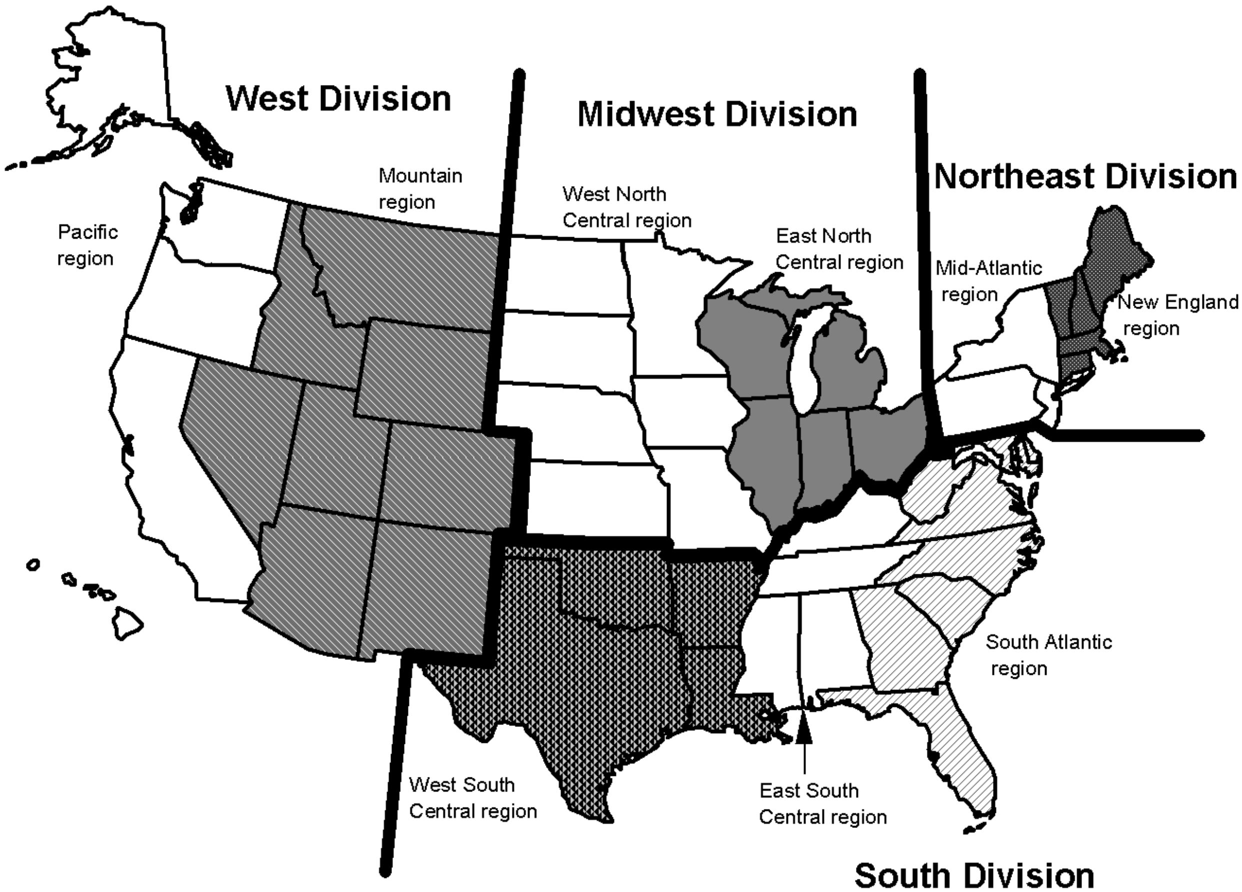
MAPS

Table C.1
Census Divisions and Regions

<table>
<tr><td colspan="4">Northeast Division</td></tr>
<tr><td colspan="2">Mid-Atlantic region</td><td colspan="2">New England region</td></tr>
<tr><td>New Jersey
New York</td><td>Pennsylvania</td><td>Connecticut
Maine
Massachusetts</td><td>New Hampshire
Rhode Island
Vermont</td></tr>
<tr><td colspan="4">South Division</td></tr>
<tr><td>West South Central region</td><td>East South Central region</td><td colspan="2">South Atlantic region</td></tr>
<tr><td>Arkansas
Louisiana
Oklahoma
Texas</td><td>Alabama
Kentucky
Mississippi
Tennessee</td><td>Delaware
Florida
Georgia
Maryland
North Carolina</td><td>South Carolina
Virginia
Washington, DC
West Virginia</td></tr>
<tr><td colspan="4">West Division</td></tr>
<tr><td colspan="2">Pacific region</td><td colspan="2">Mountain region</td></tr>
<tr><td>Alaska
California
Hawaii</td><td>Oregon
Washington</td><td>Arizona
Colorado
Idaho
Montana</td><td>Nevada
New Mexico
Utah
Wyoming</td></tr>
<tr><td colspan="4">Midwest Division</td></tr>
<tr><td colspan="2">West North Central region</td><td colspan="2">East North Central region</td></tr>
<tr><td>Iowa
Kansas
Minnesota
Missouri</td><td>Nebraska
North Dakota
South Dakota</td><td>Illinois
Indiana
Michigan</td><td>Ohio
Wisconsin</td></tr>
</table>

Source:
U.S. Census Bureau.

Figure C1. Census Divisions and Regions



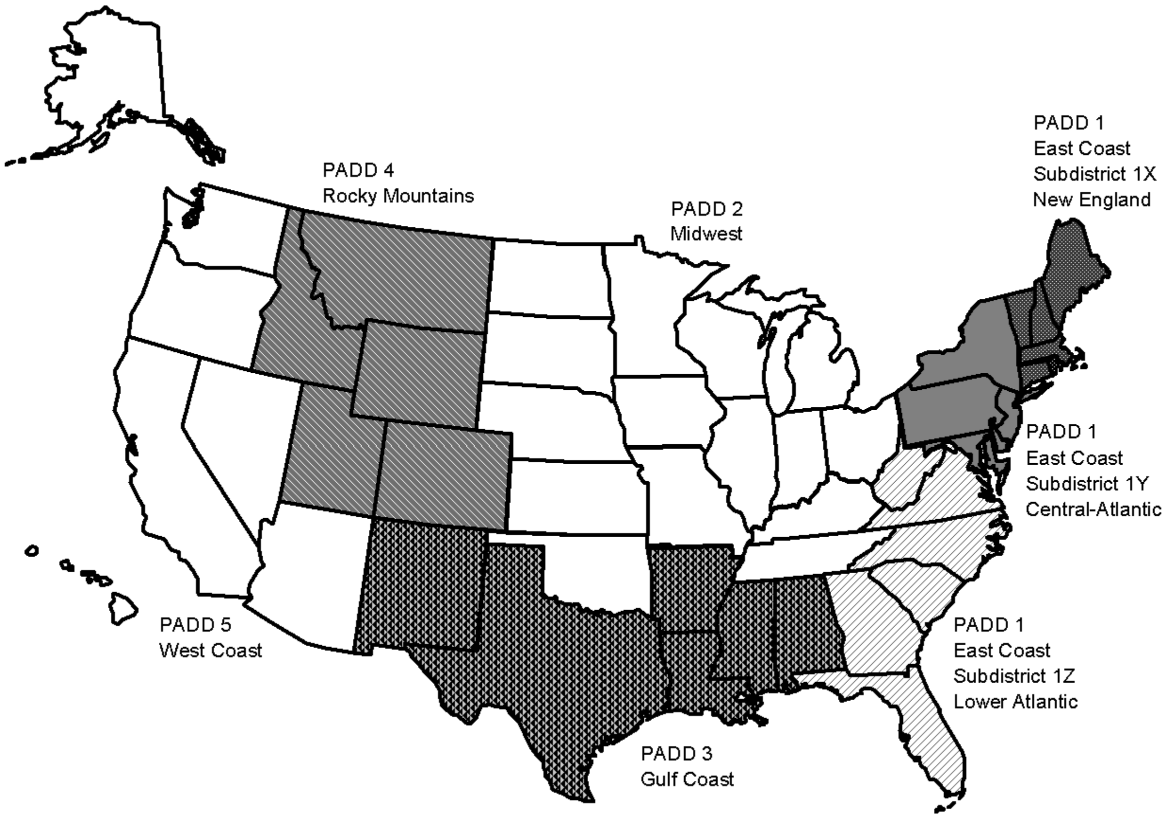
Source: See Table C.1.

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.

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.

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 -

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 railroad - See *Rail*.

Compact car - See *Automobile size classifications*.

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) - An index issued by the U.S. Department of Labor, Bureau of Labor Statistics. The CPI is designed to measure changes in the prices of goods and services bought by wage earners and clerical workers in urban areas. It represents the cost of a typical consumption bundle at current prices as a ratio to its cost at a base year.

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.

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.

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*.

E85 - 85% ethanol and 15% gasoline.

E95 - 95% ethanol and 5% gasoline.

Domestic water transportation - See *Internal water transportation*.

Electric utilities sector - Consists of privately and publicly owned establishments which generate electricity primarily for resale.

Emission standards - Standards for the levels of pollutants emitted from automobiles and trucks. Congress established the first standards in the Clean Air Act of 1963. Currently, standards are set for four vehicle classes - automobiles, light trucks, heavy-duty gasoline trucks, and heavy-duty diesel trucks.

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).

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.

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*.

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.

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*.

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*.

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.

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.

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).

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).

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 know 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.

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.

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*.

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.

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*.

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.

Trolley coach - See *Bus*.

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 transit mode made up of vans and sometimes small buses operating as a ridesharing arrangement to provide transportation to a group of individuals traveling directly between their homes and a regular destination within the same geographical area. Most vanpools are privately-operated, are not available to the public, and are not considered public transportation. Vanpool data in this report are for vanpools that are owned, purchased or leased by a public entity and are publicly available.

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.

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.

TITLE INDEX