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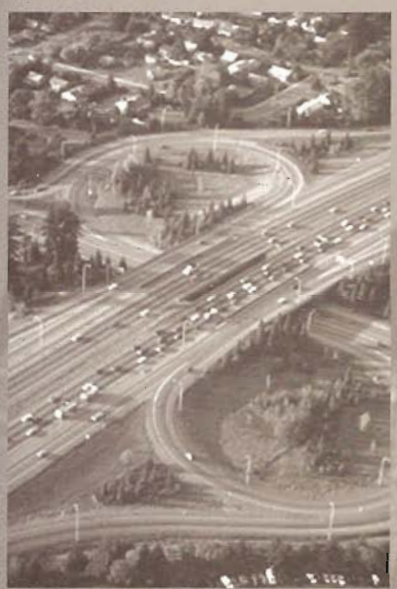

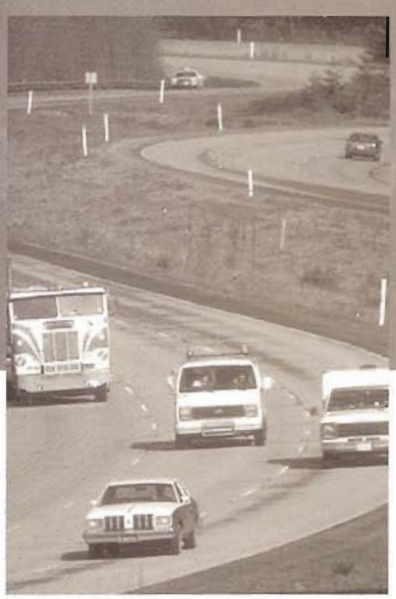

Transportation Energy Data Book

Edition 18

Stacy C. Davis

Center for Transportation Analysis

Oak Ridge National Laboratory

ORNL-6941
(Edition 18 of ORNL-5198)

Center for Transportation Analysis
Energy Division

TRANSPORTATION ENERGY DATA BOOK: EDITION 18

Stacy C. Davis
Oak Ridge National Laboratory

September 1998

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FOREWORD

This year (1998) marks the 25th anniversary of the first Oil Crisis. It was the sudden sharp rise in oil prices and the shortages in gasoline availability that provided the stimulus to create the two Federal agencies that ultimately became the Department of Energy. More specifically, it was the concern for oil and the nation's great dependency on imported oil that provided the rationale for the creation of the Office of Transportation Technologies.

This 18th edition of the Transportation Data Book is different from earlier editions in that it starts in the first chapter with a focus on oil. It shows the growing U.S. reliance on imported oil (from 28% in 1982 to 48% in 1997)[Table 1.7] and the transportation sector's rising share of U.S. oil consumption (from 51% in 1973 to 66% in 1997)[Table 1.8].

Chapter 2 deals with all forms of energy and shows that over 96% of the energy used in U.S. transportation is oil [Table 2.4]. This chapter contains the very popular information on specific modes and the types of fuels they use [Tables 2.5 and 2.6]. The energy intensities of passenger modes [Table 2.13] and of freight modes [Table 2.14] are also in this chapter.

Chapter 3 contains information on transportation emissions and standards. It also has a list of the areas that have joined DOE's Clean Cities Program [Table 3.22].

Chapter 4 has economic data such as motor fuel prices and taxes, new vehicle prices, the cost of owning and operating a vehicle, and employment statistics. Motor vehicle and related industries account for about 7% of U.S. employment [Table 4.17].

In Chapter 5, data is provided for vehicle registrations, sales, miles of travel, age, and scrappage rates. The average age of autos in the U.S. grew from 5.6 years in 1970 to 8.6 years in 1996 [Table 5.8].

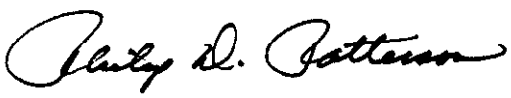
The characteristics of light vehicles (autos and light trucks) are presented in Chapter 6. More detail is provided on vehicle sales, fuel economy, engine size, curb weight, and interior volume. Data is also provided for vehicle occupancy, fuel economy standards, and the test cycles used for emission and mpg testing.

Chapter 7 deals with information on trucks, with an emphasis on the eight classes of trucks. Chapter 8 has data on light and heavy alternative fuel vehicles, alternative refueling sites, the U.S. Advanced Battery Consortium, and DOE's hybrid vehicle program.

The characteristics of vehicles in private and government fleets are provided in Chapter 9. There are about nine million cars and trucks in fleet use [Figure 9.1]. The ownership and use of vehicles by households is shown in Chapter 10. Between 1960 and 1990, the percent of households that owned two or more vehicles grew from 22% to 55% [Table 10.8].

Chapter 11 contains information on activity levels and energy use by aircraft, ships, railroads, and rail transit. Appendix A provides the documentation used by ORNL Appendix B contains conversion tables. The data book concludes with a glossary and an index.

As we try to make improvements in this data book, we rely on suggestions and comments from its users. Please send any you have to me or to Stacy Davis (the data book's untiring author).



ACKNOWLEDGMENTS

I would like to express my gratitude to the many individuals who assisted in the preparation of this document. First, I would like to thank Phil Patterson and the staff of the Office of Transportation Tcchnologies for their continued support of the *Transportation Energy Data Book* project. I would also like to thank Patricia Hu of Oak Ridge National Laboratory (ORNL) for her dedicated leadership of this project. This document benefits from the criticism and careful review of Phil Patterson of the U.S. Department of Energy, David Greene of ORNL, and John Maples of the University of Tennessee (UT). I would also like to thank Bob Boundy, UT, who assisted with the icons for each chapter; Jamie Payne, ORNL, who designed the new cover of the book; and Sherry Campbell Gambrell, ORNL, who prepared the title index. 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 18* is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Transportation Technologies in the Department of Energy (DOE). Designed for use as a desk-top reference, the data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use. The purpose of this document is to present relevant statistical data in the form of tables and graphs.

This edition of the Data Book has 11 chapters which focus on various aspects of the transportation industry. Chapter 1 focuses on petroleum; Chapter 2 - energy; Chapter 3 - emissions; Chapter 4 - transportation and the economy; Chapter 5 - highway vehicles; Chapter 6 - Light vehicles; Chapter 7 - heavy vehicles; Chapter 8 - alternative fuel vehicles; Chapter 9 - fleet vehicles; Chapter 10 - household vehicles; and Chapter 11 - nonhighway modes. The sources used represent the latest available data.

INTRODUCTION

In January 1976, the Transportation Energy Conservation (TEC) Division of the Energy Research and Development Administration contracted with Oak Ridge National Laboratory (ORNL) to prepare a Transportation Energy Conservation Data Book to be used by TEC staff in their evaluation of current and proposed conservation strategies. The major purposes of the data book were to draw together, under one cover, transportation data from diverse sources, to resolve data conflicts and inconsistencies, and to produce a comprehensive document. The first edition of the TEC Data Book was published in October 1976. With the passage of the Department of Energy (DOE) Organization Act, the work being conducted by the former Transportation Energy Conservation Division fell under the purview of the DOE's Office of Transportation Programs (now the Office of Transportation Technologies). DOE, through the Office of Transportation Technologies, has supported the compilation of Editions 3 through 18.

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 18 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 his or her 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

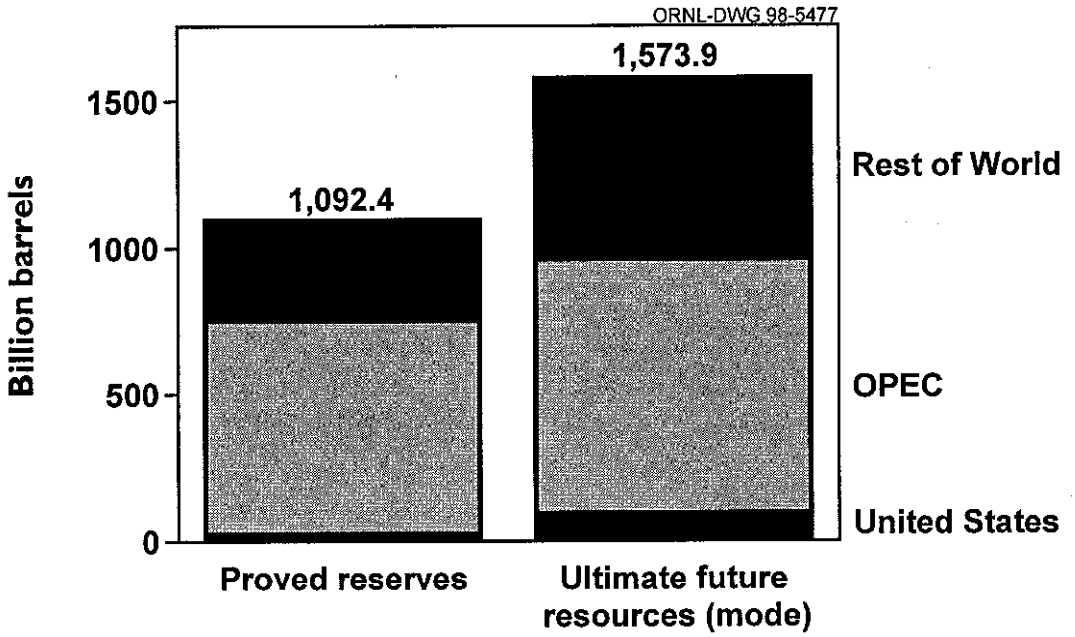
Petroleum

Summary Statistics

Table/Figure			
F 1.1	World oil proved reserves, 1993 (most recent survey)		billion barrels
	Proved reserves		*1,092*
	Ultimate reserves		*1,574*
T 1.2	World Oil Production, 1996		
	U.S. Oil Production (million barrels per day)		*6.5*
	U.S. Share		*10.1%*
T 1.3	World Oil Consumption, 1995		
	U.S. Oil Consumption (million barrels per day)		*17.7*
	U.S. Share		*25.5%*
F 1.6	Refinery yield, 1997	OECD	North America
	Gasoline	*31.1%*	*41.7%*
	Diesel fuel	*28.1%*	*22.3%*
	Residual fuel	*11.8%*	*5.5%*
	Kerosene	*8.9%*	*9.3%*
	Other	*20.2%*	*21.2%*
T 1.8	U.S. transportation oil use as a percent of U.S. oil production, 1997		189%
T 1.8	Net imports as a percentage of U.S. oil consumption, 1997		48%
T 1.9	Transportation share of oil consumption, 1997		66%

No one knows the exact amount of oil which is in the Earth. The Energy Information Administration (EIA) produces annual estimates of the proved reserves of oil, and the U.S. Geological Survey (USGS) produces estimates of the ultimate world oil resources periodically. Still, the USGS indicates that because of the evolving understanding of world recoverable resources, their assessments are valid for the perceptions at that point in time. The surveys that produced the data shown in Table 1.1 were conducted using consistent methodologies and the same core group of geologists. The differences among the surveys are largely due to better understanding of world recoverable resources and technological change. As understanding of the subject grows, so may the estimates of world oil resources.

Figure 1.1. World Oil Resource Estimates, 1993



Source:

Proved reserves - U. S. Department of Energy, Energy Information Administration, *International Energy Annual 1992*, Washington, DC, January 1994, p. 105.

Ultimate future resources (mode) - Masters C. D., E. D. Attanasi and D. H. Root, *World Petroleum Assessment and Analysis*, U.S. Geological Survey, National Center, Reston, VA, 1994, Table 1.

Table 1.1
Summary of Recent World Oil Assessments
(billion barrels of oil)

	Effective date of assessment			
	1/1/81	1/1/83	1/1/90	1/1/93
1. Cumulative production	445	524	629	699
2. Identified (discovered) resources	724	795	1,053	1,103
3. Undiscovered conventional resources (mode)	550	425	489	471
4. Future resources (mode) (categories 2+3)	1,274	1,220	1,542	1,574
5. Total resources (categories 1+2+3)	1,719	1,744	2,171	2,273

Source:

U.S. Geological Survey, *U.S. Geological Survey Fact Sheet*, FS-145-97, 1997.
(Additional resources: http://energy.er.usgs.gov)

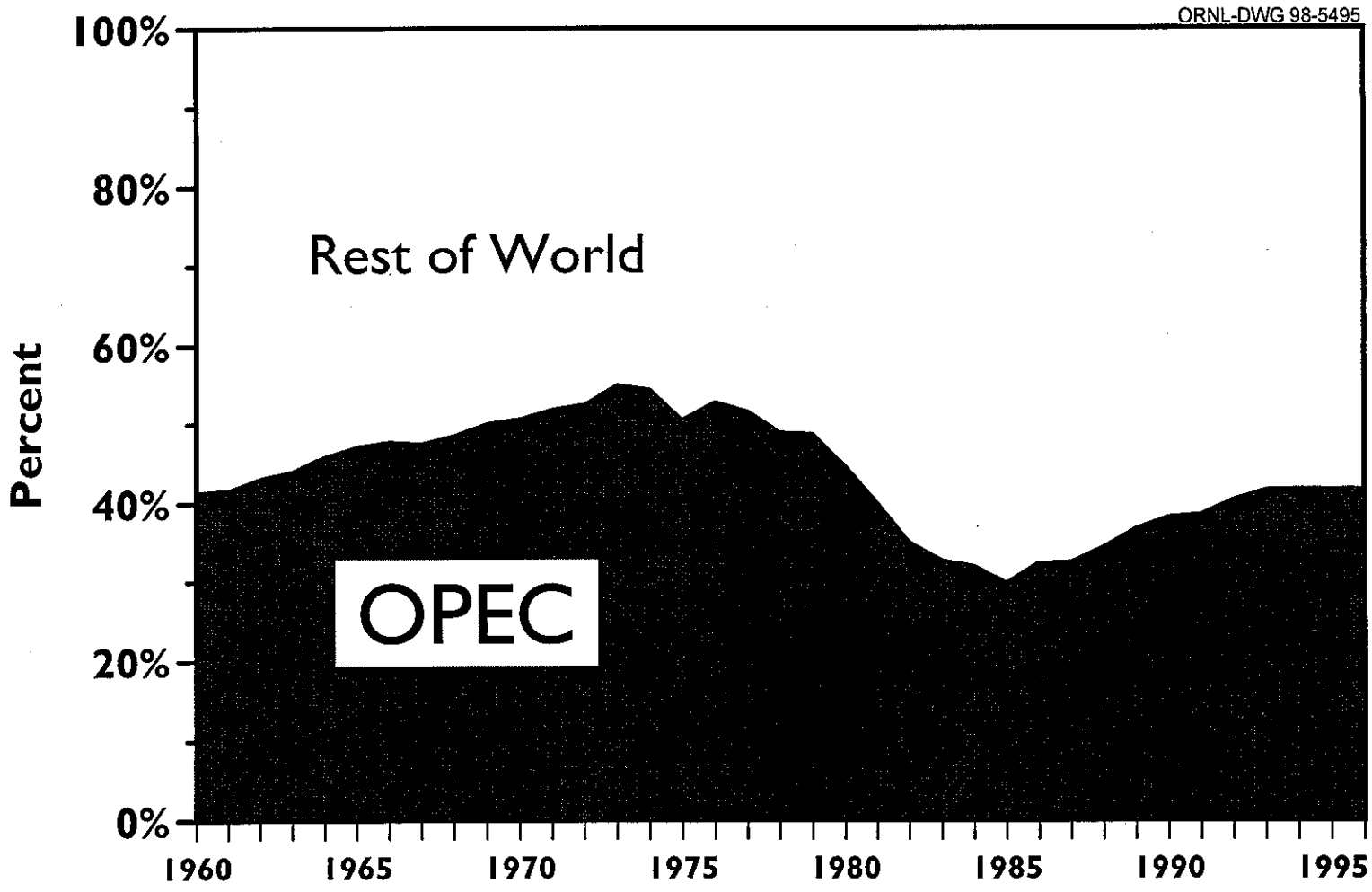
Table 1.2
World Crude Oil Production, 1960-96
(million barrels per day)

Year	United States	Total OPEC[a]	Total Non-OPEC	Persian Gulf nations[b]	World
1960	7.04	8.70	12.29	5.27	20.99
1965	7.80	14.35	15.98	8.37	30.33
1970	9.64	23.30	22.59	13.39	45.89
1971	9.46	25.21	23.31	15.77	48.52
1972	9.44	26.89	24.25	17.54	51.14
1973	9.21	30.63	25.05	20.67	55.68
1974	8.77	30.35	25.37	21.28	55.72
1975	8.37	26.77	26.06	18.93	52.83
1976	8.13	30.33	27.01	21.51	57.34
1977	8.24	30.89	28.82	21.73	59.71
1978	8.71	29.46	30.70	20.61	60.16
1979	8.55	30.58	32.09	21.07	62.67
1980	8.60	26.61	32.99	17.96	59.60
1981	8.57	22.48	33.60	15.25	56.08
1982	8.65	18.78	34.70	12.16	53.48
1983	8.69	17.50	35.76	11.08	53.26
1984	8.88	17.44	37.05	10.78	54.49
1985	8.97	16.18	37.80	9.63	53.98
1986	8.68	18.28	37.95	11.70	56.23
1987	8.35	18.52	38.15	12.10	56.67
1988	8.14	20.32	38.42	13.46	58.74
1989	7.61	22.07	37.79	14.84	59.86
1990	7.36	23.20	37.37	15.28	60.57
1991	7.42	23.27	36.94	14.74	60.21
1992	7.17	24.40	35.82	15.97	60.22
1993	6.85	25.12	35.13	16.71	60.25
1994	6.66	25.51	35.49	16.96	61.00
1995	6.56	26.09	36.36	17.30	62.45
1996	6.47	26.77	37.23	17.37	64.00
			Average annual percentage change		
1960-96	-0.2%	3.2%	3.1%	3.4%	3.1%
1970-96	-1.5%	0.5%	1.9%	1.0%	1.3%
1986-96	-2.9%	3.9%	-0.2%	4.0%	1.3%

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 1996,* Washington, DC, July 1997, pp. 299-301.

[a]Organization of Petroleum Exporting Countries. See Glossary for membership.
[b]See Glossary for Persian Gulf nations.

Figure 1.2. OPEC Market Share, 1960–96



Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 1996*, Washington, DC, July 1997, pp. 299-301.

These data are the latest available; oil consumption data generally lags behind production data (previous table) by one year.

Table 1.3
World Oil Consumption, 1960–95
(million barrels per day)

Year	United States	Total OECD[a]	Total Non-OECD	World
1960	9.80	15.77	5.57	21.34
1965	11.51	22.78	8.36	31.14
1970	14.70	33.99	12.82	46.81
1971	15.21	35.51	13.91	49.42
1972	16.37	38.14	14.95	53.09
1973	17.31	40.85	16.39	57.24
1974	16.65	39.40	17.28	56.68
1975	16.32	38.04	18.16	56.20
1976	17.46	40.52	19.15	59.67
1977	18.43	41.46	20.37	61.83
1978	18.85	42.54	21.62	64.16
1979	18.51	42.85	22.37	65.22
1980	17.06	40.24	22.83	63.07
1981	16.06	38.02	22.88	60.90
1982	15.30	36.37	23.13	59.50
1983	15.23	35.48	23.26	58.74
1984	15.73	36.29	23.55	59.84
1985	15.73	36.10	24.00	60.10
1986	16.28	37.13	24.63	61.76
1987	16.67	37.77	25.23	63.00
1988	17.28	38.96	25.86	64.82
1989	17.33	39.51	26.41	65.92
1990	16.99	39.44	26.55	65.99
1991	16.71	39.76	26.82	66.58
1992	17.03	40.49	26.25	66.74
1993	17.24	40.75	26.29	67.04
1994	17.72	41.71	26.60	68.31
1995	17.72	42.34	27.21	69.55
		Average annual percentage change		
1960–95	1.7%	2.9%	4.6%	3.4%
1970–95	0.8%	0.9%	3.1%	1.6%
1985–95	1.2%	1.6%	1.3%	1.5%

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 1996*, Washington, DC, July 1997, p. 307.

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

Table 1.4
Petroleum Stocks in OECD Countries, End of Year 1973–96[a]
(million barrels)

Year	France	Germany[b]	Italy	United Kingdom	Other OECD[c] Europe	OECD[c] Europe	Canada	Japan	U.S. Strategic Petroleum Reserve	United States total	Other OECD[d]	OECD[c]
1973	201	181	152	156	380	1,070	140	303	[e]	1,008	67	2,588
1974	249	213	167	191	437	1,227	145	370	[e]	1,074	64	2,880
1975	225	187	143	165	434	1,154	174	375	[e]	1,133	67	2,903
1976	234	208	143	165	455	1,205	153	380	[e]	1,112	68	2,918
1977	239	225	161	148	495	1,268	167	409	7	1,312	68	3,224
1978	201	238	154	157	469	1,219	144	413	67	1,278	68	3,122
1979	226	272	163	169	523	1,353	150	460	91	1,341	75	3,379
1980	243	319	170	168	564	1,464	164	495	108	1,392	72	3,587
1981	214	297	167	143	516	1,337	161	482	230	1,484	67	3,531
1982	193	272	179	125	489	1,258	136	484	294	1,430	68	3,376
1983	153	249	149	118	473	1,142	121	470	379	1,454	68	3,255
1984	152	239	159	112	468	1,130	128	479	451	1,556	69	3,362
1985	139	233	157	123	440	1,092	113	494	493	1,519	66	3,284
1986	127	252	155	124	475	1,133	111	509	512	1,593	72	3,418
1987	127	259	169	121	454	1,130	126	540	541	1,607	71	3,474
1988	140	266	155	112	445	1,118	116	538	560	1,597	71	3,440
1989	138	271	164	118	442	1,133	114	577	580	1,581	71	3,476
1990	140	265	172	112	474	1,163	121	590	586	1,621	73	3,568
1991	153	288	160	119	461	1,181	119	606	569	1,617	65	3,588
1992	146	310	174	113	476	1,219	107	603	575	1,592	67	3,588
1993	158	309	163	118	475	1,221	105	618	587	1,647	69	3,661
1994	158	312	164	115	490	1,240	119	645	592	1,653	69	3,726
1995	159	301	162	107	499	1,228	109	630	592	1,563	71	3,601
1996	158	300	152	108	538	1,256	103	651	566	1,507	74	3,591
Average annual percentage change												
1973–96	-1.0%	2.2%	0.0%	-1.6%	1.5%	0.7%	-1.3%	3.4%	[e]	1.8%	0.4%	1.4%
1986–96	2.2%	1.8%	-0.2%	-1.4%	1.3%	1.0%	-0.7%	2.5%	1.0%	-0.6%	0.3%	0.5%

Source:
Country stocks - U.S. Department of Energy, Energy Information Administration, *International Petroleum Statistics Report*, Washington, DC, December 1997, p. 44.
U.S. Strategic Petroleum Reserve - U.S. Department of Energy, Energy Information Administration, *Annual Energy Review, 1996*, Washington, DC, July 1997, p. 167.

[a] Includes crude oil (including strategic reserves), lease condensate, natural gas plant liquids, unfinished oils, and finished petroleum products. Oil stocks include all non-military stocks held by importers, refiners, Governments, major non-importing final consumers and by foreign entities in certain facilities. See *Stocks* in Glossary for details.

[b] Through 1990, the data for Germany are for the former West Germany only. Beginning in 1991, the data for Germany are for the unified Germany, i.e., the former East Germany and West Germany.

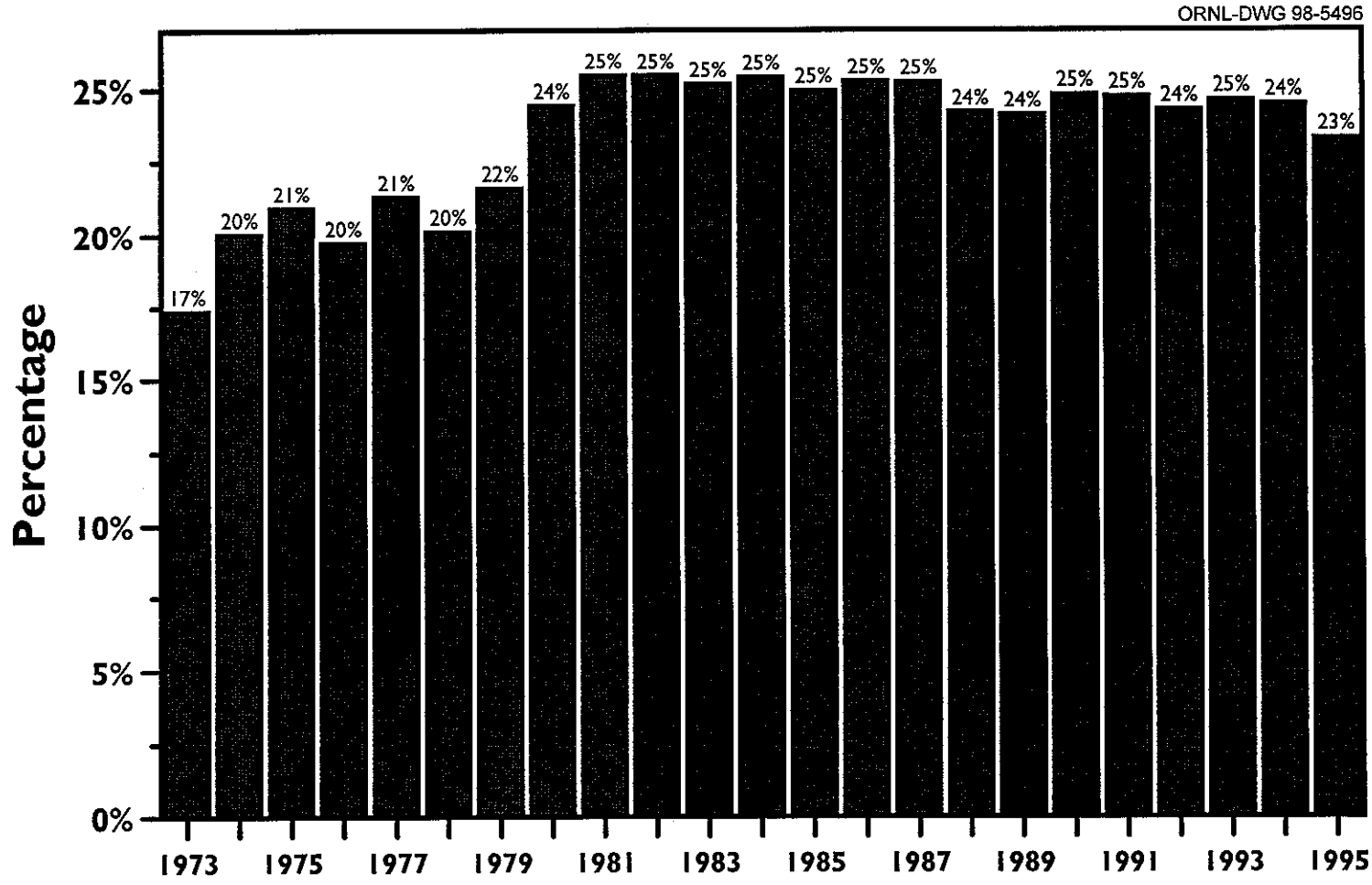
[c] Organization for Economic Cooperation and Development (OECD). See Glossary for membership.

[d] Australia, New Zealand, and United States Territories. Data for Mexico, which joined the OECD on May 18, 1994, are not available.

[e] Data are not available. The Energy Policy and Conservation Act, effective February 1976, authorized the establishment of the U.S. Strategic Petroleum Reserve.

The countries which make up the Organization for Economic Cooperation and Development (OECD) had combined stocks which totaled 23% of their petroleum consumption in 1995; this is up from 17% in 1973. This includes stocks which are privately-controlled as well as government-owned holdings.

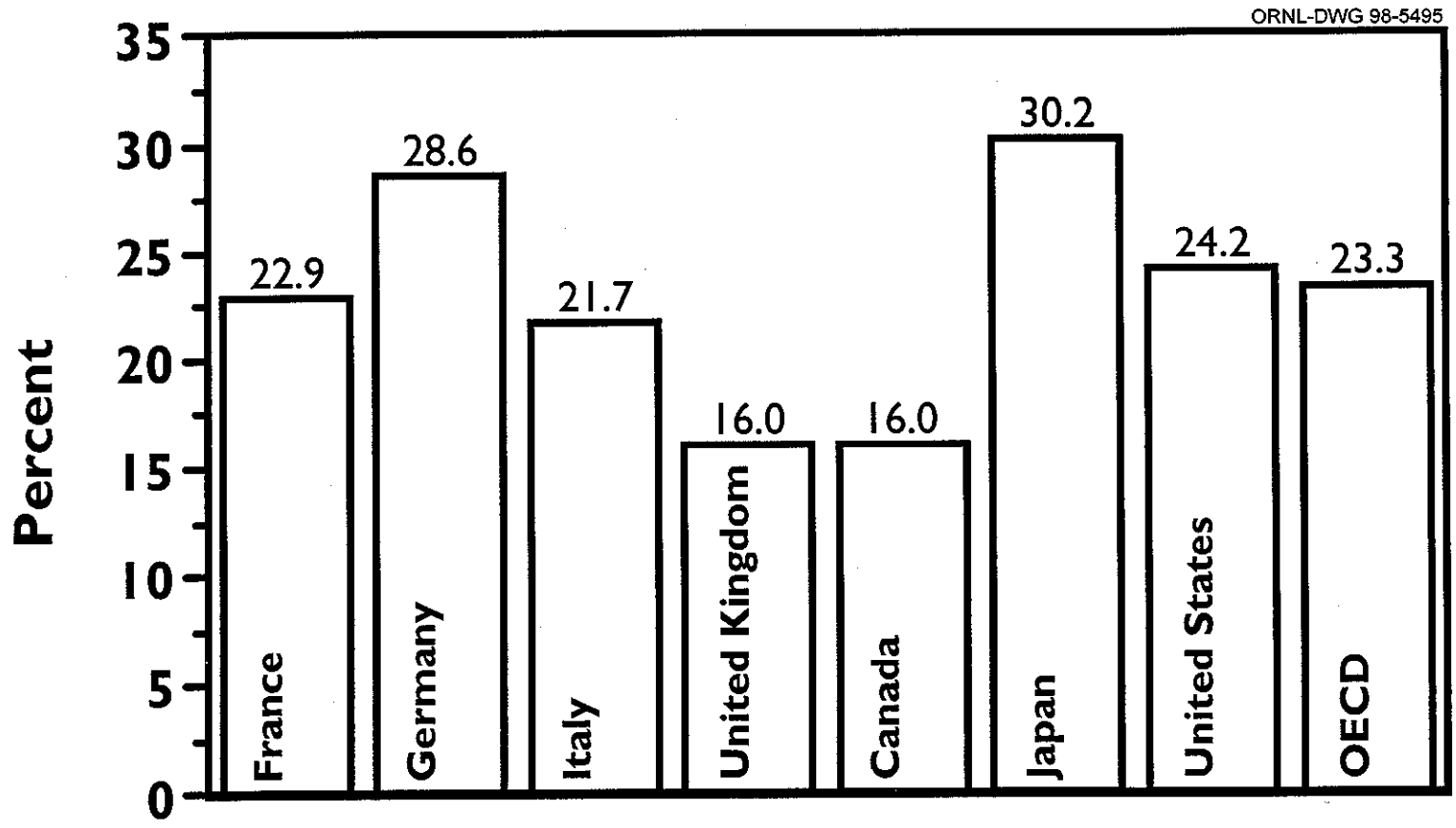
Figure 1.3. Share of OECD Petroleum Stocks to OECD Petroleum Consumption, 1973-95



Source: See Tables 1.3 and 1.4.

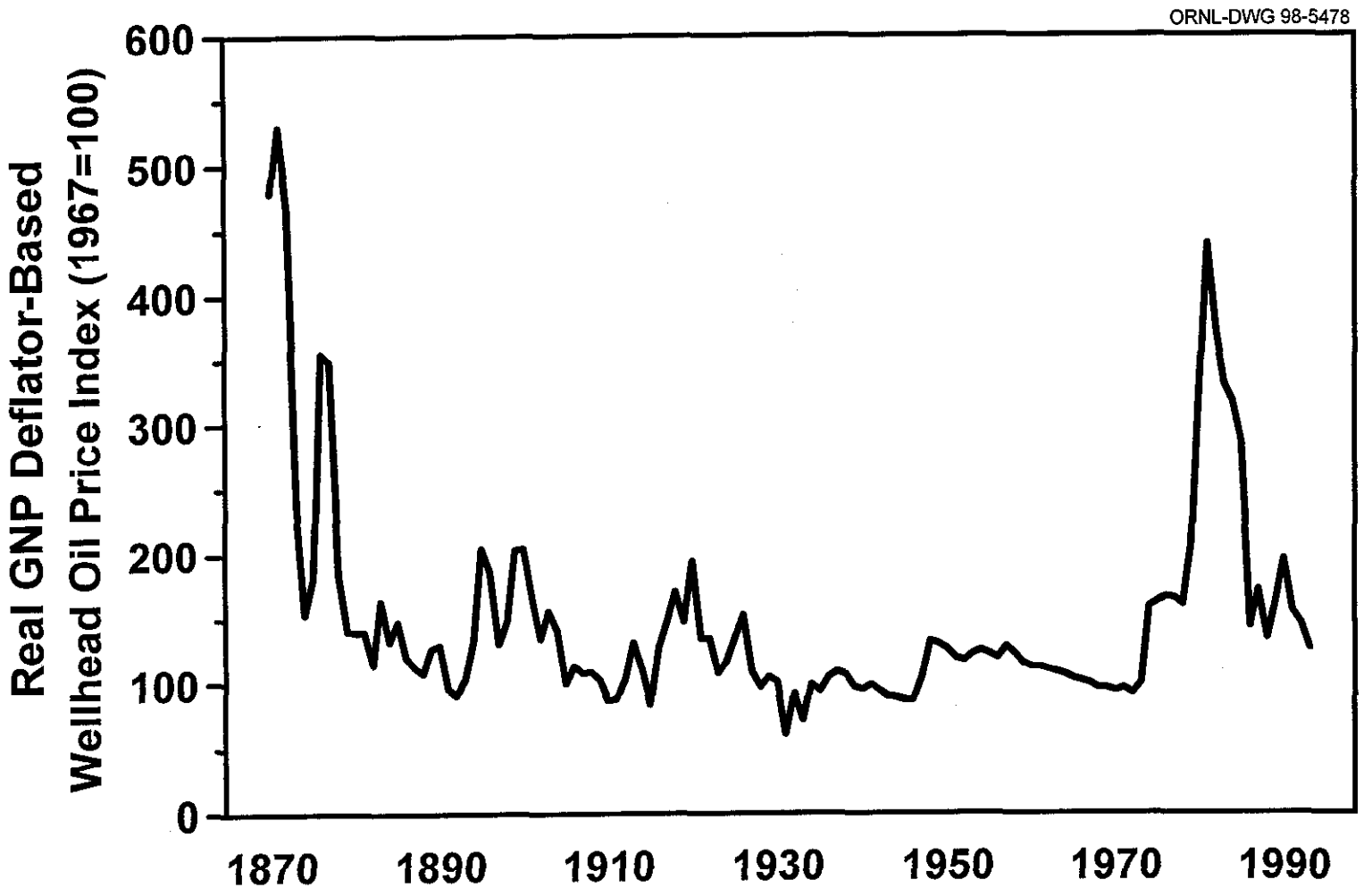
The United States had petroleum stocks of nearly one quarter of U.S. petroleum consumption in 1995, which was slightly above the average for OECD countries. Germany and Japan held higher reserves relative to their consumption of petroleum.

Figure 1.4. Share of Petroleum Reserves to Petroleum Consumption by Country, 1995



Source: Table 1.4 and U.S. Department of Energy, Energy Information Administration, *Annual Energy Review, 1996*, Washington, DC, July 1997, p. 307.

Figure 1.5. Crude Oil Prices, 1870–93



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

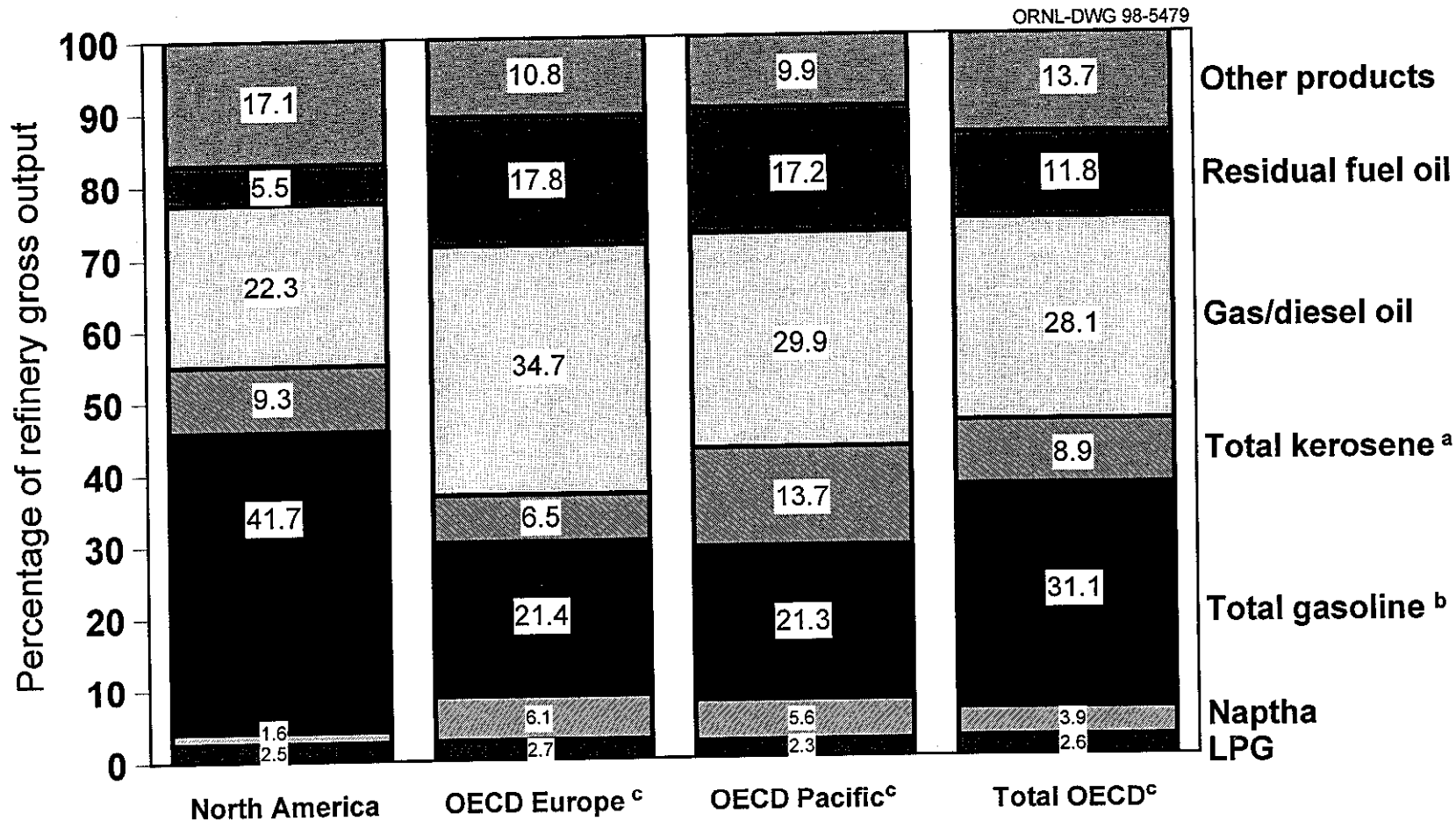
Table 1.5
U.S. Petroleum Imports by World Region of Origin, 1960–96
(thousand barrels per day)

Year	Total OPEC[a]	Total Non-OPEC	Persian Gulf nations[b]	Total net imports	OPEC share of net imports	OPEC share of consumption[c]
1960	1,311	302	[d]	1,613	81.3%	13.4%
1965	1,475	806	[d]	2,281	64.7%	12.8%
1970	1,343	1,817	[d]	3,161	42.5%	9.1%
1971	1,671	2,030	[d]	3,701	45.2%	11.0%
1972	2,061	2,458	[d]	4,519	45.6%	12.6%
1973	2,991	3,034	[d]	6,025	49.6%	17.3%
1974	3,277	2,615	[d]	5,892	55.6%	19.7%
1975	3,599	2,248	[d]	5,846	61.6%	22.1%
1976	5,063	2,027	[d]	7,090	71.4%	29.0%
1977	6,190	2,375	[d]	8,565	72.3%	33.6%
1978	5,747	2,255	[d]	8,002	71.8%	30.5%
1979	5,633	2,352	[d]	7,985	70.5%	30.4%
1980	4,293	2,071	[d]	6,365	67.5%	25.2%
1981	3,315	2,086	1,215	5,401	61.4%	20.6%
1982	2,136	2,163	692	4,298	49.7%	14.0%
1983	1,843	2,469	439	4,312	42.7%	12.1%
1984	2,037	2,679	502	4,715	43.2%	13.0%
1985	1,821	2,465	309	4,286	42.5%	11.6%
1986	2,828	2,611	909	5,439	52.0%	17.4%
1987	3,055	2,859	1,074	5,914	51.7%	18.3%
1988	3,513	3,074	1,529	6,587	53.3%	20.3%
1989	4,124	3,078	1,858	7,202	57.3%	23.8%
1990	4,285	2,876	1,962	7,161	59.8%	25.2%
1991	4,065	2,561	1,833	6,626	61.3%	24.3%
1992	4,071	2,867	1,773	6,938	58.7%	23.9%
1993	4,253	3,365	1,774	7,618	55.8%	24.7%
1994	4,233	3,822	1,723	8,054	52.6%	23.9%
1995	3,980	3,906	1,563	7,886	50.5%	22.5%
1996	4,170	4,249	1,595	8,419	49.5%	22.9%
			Average annual percentage change			
1960–96	3.3%	7.6%	[d]	4.7%		
1970–96	4.5%	3.3%	[d]	3.8%		
1986–96	4.0%	5.0%	5.8%	4.5%		

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 1996,* Washington, DC, July 1997, p. 149.

[a] Organization of Petroleum Exporting Countries. See Glossary for membership.
[b] See Glossary for Persian Gulf nations.
[c] See Table 1.7 for U.S. petroleum consumption.
[d] Data are not available.

Figure 1.6. Refinery Gross Output by World Region, 1997



Source:
International Energy Agency, *Monthly Oil Survey*, December 1997, Paris, France, p.7.

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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 1.6
U.S. Refinery Input of Crude Oil and Petroleum Products, 1987–97
(thousand barrels)

Year	Crude oil	Natural gas liquids	Oxygenates: Fuel ethanol	Oxygenates: Methanol	Oxygenates: MTBE[a]	Oxygenates: 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
1988	4,848,175	304,566	[d]	[d]	[d]	[d]	19,515	203,794	5,258,386
1989	4,891,381	182,109	[d]	[d]	[d]	[d]	21,757	202,040	5,297,287
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
Average annual percentage change									
1987-97	1.3%	-6.0%	[e]	[e]	[e]	[e]	-0.1%	-2.1%	1.3%
1993-97	1.9%	-4.1%	37.0%	-10.8%	15.0%	36.4%	10.3%	-9.4%	1.4%

Source:
U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual, 1997*, Vol. 1, June 1998, Table 16, p. 49, and annual.
(Additional resources: http://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 gain occurs. Due to this gain, the product yield from a barrel of crude oil is more than 100%. The processing gain has been growing over the years.

Table 1.7
Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978–96
(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

Source:
Department of Energy, Energy Information Administration, *Petroleum Supply Annual 1996*, Vol. 1, June 1997, Table 19, p. 54, and annual. (Additional resources: http://www.eia.doe.gov)

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

Table 1.8
United States Petroleum Production and Consumption, 1973–97
(million barrels per day)

Year	Domestic crude oil production	Net imports			Exports		U.S. petroleum consumption[a]	World petroleum consumption	Net imports as a percentage of U.S. petroleum consumption	U.S. petroleum consumption as a percentage of world consumption	Transportation petroleum use as a percentage of domestic production[b]
		Crude oil	Petroleum products	Total	Crude oil	Petroleum products					
1973	9.21	3.24	2.78	6.03	0.00	0.23	17.31	56.39	34.8%	30.7%	98.3%
1974	8.77	3.47	2.42	5.89	0.00	0.22	16.65	55.91	35.4%	29.8%	100.8%
1975	8.37	4.10	1.75	5.85	0.00	0.20	16.32	55.48	35.8%	29.4%	106.9%
1976	8.13	5.28	1.81	7.09	0.00	0.22	17.46	58.74	40.6%	29.7%	115.6%
1977	8.25	6.57	2.00	8.57	0.05	0.19	18.43	61.63	46.5%	29.9%	118.3%
1978	8.71	6.20	1.80	8.00	0.16	0.20	18.85	63.30	42.5%	29.8%	116.6%
1979	8.55	6.28	1.70	7.99	0.24	0.24	18.51	65.17	43.1%	28.4%	117.1%
1980	8.60	4.98	1.39	6.37	0.29	0.26	17.06	63.07	37.3%	27.0%	111.3%
1981	8.57	4.17	1.23	5.40	0.23	0.37	16.06	60.87	33.6%	26.4%	110.7%
1982	8.65	3.25	1.05	4.30	0.24	0.58	15.30	59.50	28.1%	25.7%	107.6%
1983	8.69	3.17	1.15	4.31	0.16	0.58	15.23	58.74	28.3%	25.9%	108.2%
1984	8.88	3.25	1.47	4.72	0.18	0.54	15.73	59.84	30.0%	26.3%	109.4%
1985	8.97	3.00	1.29	4.29	0.20	0.58	15.73	60.10	27.3%	26.2%	109.8%
1986	8.68	4.02	1.41	5.44	0.15	0.63	16.28	61.76	33.4%	26.4%	117.9%
1987	8.35	4.52	1.39	5.91	0.15	0.61	16.67	63.00	35.5%	26.5%	126.1%
1988	8.14	4.95	1.63	6.59	0.16	0.66	17.28	64.82	38.1%	26.7%	134.0%
1989	7.61	5.70	1.50	7.20	0.14	0.72	17.33	65.92	41.6%	26.3%	144.7%
1990	7.36	4.79	1.38	7.16	0.11	0.75	16.99	65.99	42.2%	25.7%	149.1%
1991	7.42	5.67	0.96	6.63	0.12	0.89	16.71	66.58	39.6%	25.1%	145.6%
1992	7.17	5.99	0.94	6.94	0.09	0.86	17.03	66.74	40.7%	25.5%	153.1%
1993	6.85	6.69	0.93	7.62	0.10	0.90	17.24	67.04	44.2%	25.7%	163.3%
1994	6.66	6.96	1.09	8.05	0.10	0.84	17.72	68.31	45.5%	25.9%	172.5%
1995	6.56	7.14	0.75	7.89	0.10	0.86	17.73	69.93	44.5%	25.4%	178.8%
1996	6.47	7.40	1.10	8.50	0.11	0.87	18.30	71.52	46.2%	25.6%	185.8%
1997	6.41	7.89	1.02	8.90	0.11	0.90	18.58	[c]	47.9%	[c]	188.8%
					Average annual percentage change						
1973–97	-1.5%	3.8%	-4.1%	1.6%	[c]	5.8%	0.3%	1.0%[d]			
1987–97	-2.6%	5.7%	-3.0%	4.2%	-3.1%	4.0%	1.1%	1.4%[d]			

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, February 1998*, pp. 42–47.
World petroleum consumption - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1996*, February 1998, p. 7.
(Additional resources: http://www.eia.doe.gov)

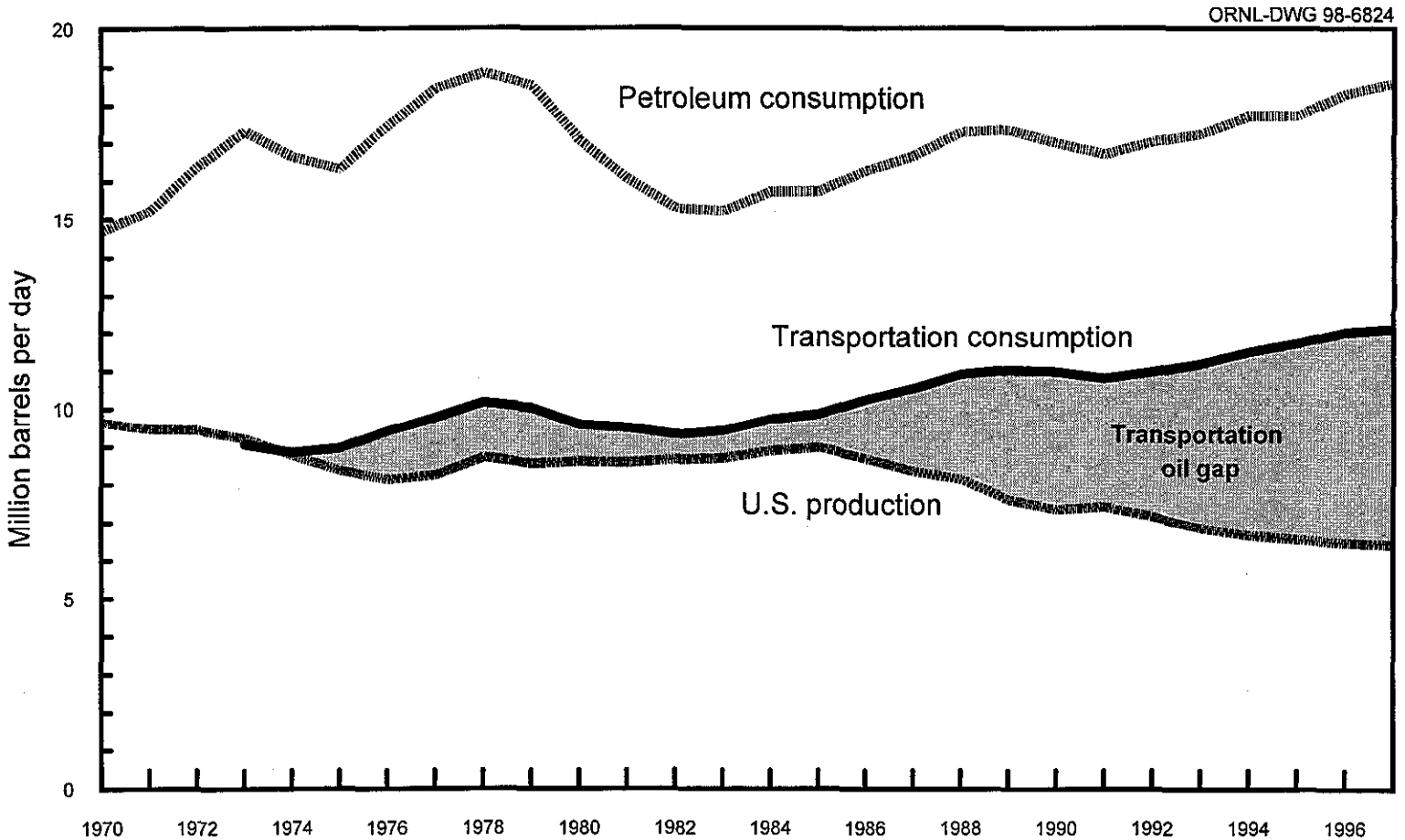
[a] Best estimate for U.S. petroleum consumption is the amount of petroleum products supplied to the U.S. in a given year. This is not the sum of crude oil production and net imports due to processing gain and stock changes.

[b] Transportation petroleum use can be found on Table 1.9.

[c] Data are not available.

[d] Average annual percentage change is to latest year possible.

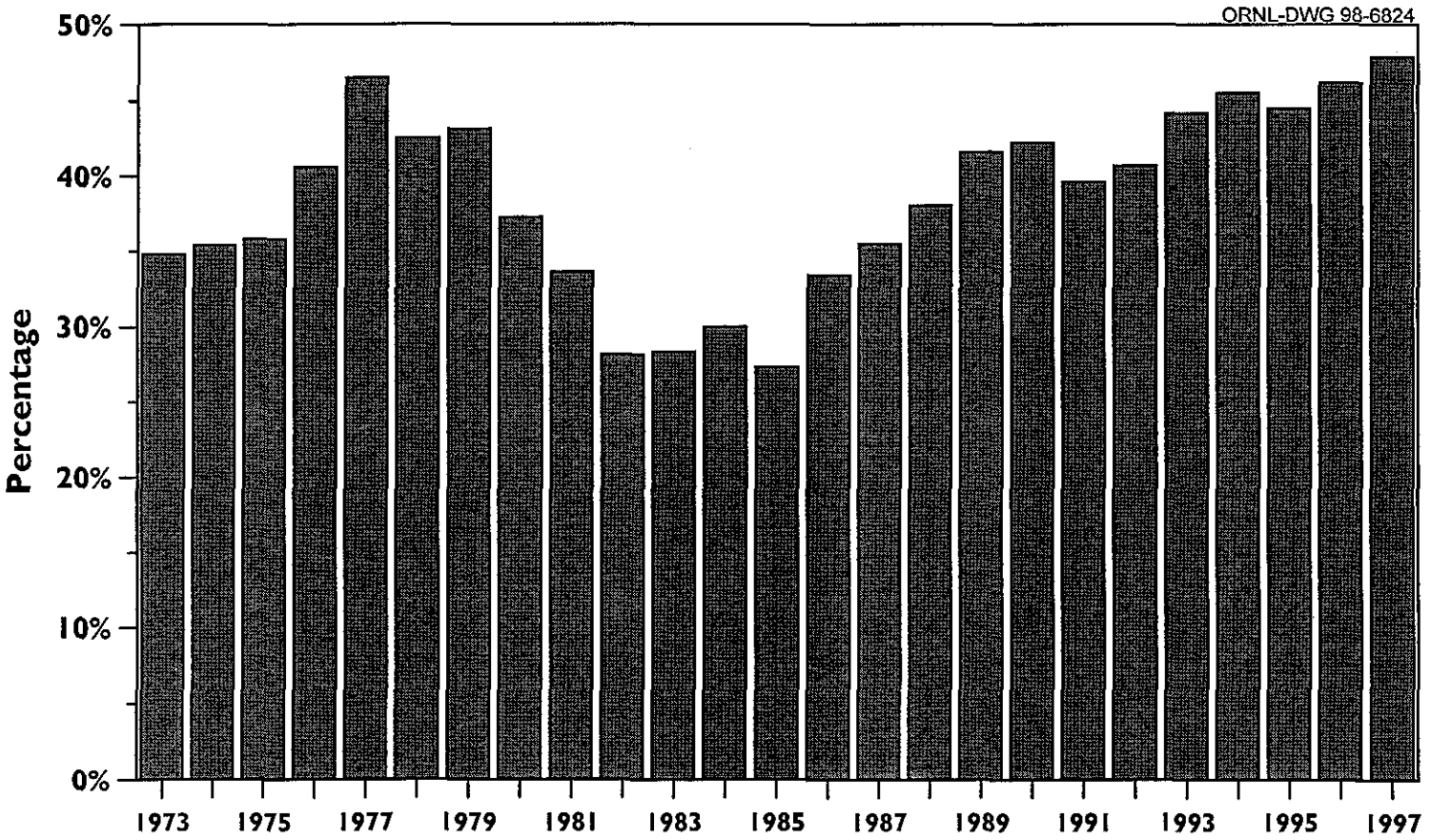
Figure 1.7. United States Petroleum Production and Consumption, 1973–97



Source: See Tables 1.8 and 1.9.

Net imports as a percentage of U.S. petroleum consumption rose to a new high in 1997, surpassing the previous high of 46.5% in 1977.

Figure 1.8. Import Share of U.S. Petroleum Consumption, 1973–97



Source: See Table 1.8.

Table 1.9
Consumption of Petroleum by End-Use Sector, 1973–97
(quadrillion Btu)

Year	Transportation	Percentage	Residential and commercial	Percentage	Industrial	Percentage	Electric utilities	Percentage	Total	Total in million barrels per day[a]
1973	17.83	51.2%	4.39	12.6%	9.10	26.1%	3.52	10.1%	34.84	17.31
1974	17.40	52.0%	4.00	12.0%	8.69	26.0%	3.37	10.1%	33.46	16.65
1975	17.61	53.8%	3.81	11.6%	8.15	24.9%	3.17	9.7%	32.74	16.32
1976	18.51	52.6%	4.18	11.9%	9.01	25.6%	3.48	9.9%	35.18	17.46
1977	19.24	51.8%	4.21	11.3%	9.77	26.3%	3.90	10.5%	37.12	18.43
1978	20.04	52.8%	4.07	10.7%	9.87	26.0%	3.99	10.5%	37.97	18.85
1979	19.83	53.4%	3.45	9.3%	10.57	28.5%	3.28	8.8%	37.13	18.51
1980	19.01	55.6%	3.04	8.9%	9.53	27.9%	2.63	7.7%	34.21	17.06
1981	18.81	58.9%	2.63	8.2%	8.29	26.0%	2.20	6.9%	31.93	16.06
1982	18.42	60.9%	2.45	8.1%	7.79	25.8%	1.57	5.2%	30.23	15.30
1983	18.59	61.9%	2.50	8.3%	7.42	24.7%	1.54	5.1%	30.05	15.23
1984	19.22	61.9%	2.54	8.2%	8.01	25.8%	1.29	4.2%	31.06	15.73
1985	19.50	63.1%	2.52	8.2%	7.81	25.3%	1.09	3.5%	30.92	15.73
1986	20.27	63.0%	2.56	8.0%	7.92	24.6%	1.45	4.5%	32.20	16.28
1987	20.87	63.5%	2.59	7.9%	8.15	24.8%	1.26	3.8%	32.87	16.67
1988	21.63	63.2%	2.60	7.6%	8.43	24.6%	1.56	4.6%	34.22	17.28
1989	21.87	63.9%	2.53	7.4%	8.13	23.8%	1.69	4.9%	34.22	17.33
1990	21.81	65.0%	2.17	6.5%	8.32	24.8%	1.25	3.7%	33.55	16.99
1991	21.46	65.3%	2.15	6.5%	8.06	24.5%	1.18	3.6%	32.85	16.71
1992	21.81	65.0%	2.13	6.4%	8.64	25.8%	0.95	2.8%	33.53	17.03
1993	22.20	65.6%	2.14	6.3%	8.45	25.0%	1.05	3.1%	33.84	17.24
1994	22.82	65.7%	2.09	6.0%	8.85	25.5%	0.97	2.8%	34.73	17.72
1995	23.31	66.9%	2.08	6.1%	8.62	25.1%	0.66	1.9%	34.67	17.73
1996	23.89	66.2%	2.18	6.2%	9.07	25.5%	0.73	2.0%	35.72	18.23
1997	24.04	66.2%	2.19	6.0%	9.25	25.5%	0.84	2.3%	36.31	18.58
				Average annual percentage change						
1973–97	1.3%		-2.9%		0.1%		-5.8%		0.2%	0.3%
1987–97	1.4%		-1.7%		1.3%		-4.0%		1.0%	1.1%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 1998*, pp. 27, 29, 31, 33.
(Additional resources: http://www.eia.doe.gov)

[a] Calculated from Total column using Table A.3. Approximate Heat Content of Petroleum Products, Weighted Average, from the *Monthly Energy Review*, March 1997.

Table 1.10
Transportation of Petroleum in the U.S. by Mode, 1975–95

Year	Pipelines[a] (billion ton-miles)	Pipelines[a] (percent)	Water carriers (billion ton-miles)	Water carriers (percent)	Motor carriers[b] (billion ton-miles)	Motor carriers[b] (percent)	Railroads (billion ton-miles)	Railroads (percent)	Total (billion ton-miles)
1975	507.0	59.88%	298.0	35.20%	27.6	3.26%	14.1	1.66%	846.7
1976	515.0	59.35%	306.9	35.37%	32.5	3.75%	13.3	1.53%	867.7
1977	546.0	59.13%	333.3	36.09%	29.6	3.21%	14.5	1.57%	923.4
1978	585.8	50.49%	530.6	45.73%	30.6	2.65%	13.2	1.14%	1,160.2
1979	608.3	51.78%	522.9	44.51%	30.1	2.56%	13.5	1.15%	1,174.8
1980	588.2	47.24%	617.8	49.61%	26.8	2.15%	12.5	1.00%	1,245.3
1981	563.7	46.27%	617.2	50.66%	24.9	2.04%	12.6	1.03%	1,218.4
1982	565.7	46.44%	616.9	50.64%	22.7	1.86%	12.9	1.06%	1,218.2
1983	556.1	45.45%	630.5	51.53%	25.1	2.05%	11.8	0.97%	1,223.5
1984	568.1	48.14%	570.7	48.36%	29.2	2.47%	12.2	1.03%	1,180.2
1985	564.3	47.20%	590.4	49.39%	28.7	2.40%	12.1	1.01%	1,195.5
1986	577.9	48.65%	568.1	47.83%	29.7	2.50%	12.1	1.02%	1,187.8
1987	586.8	49.08%	566.5	47.37%	30.4	2.54%	12.1	1.01%	1,195.8
1988	601.1	50.59%	543.7	45.76%	30.5	2.57%	12.8	1.08%	1,188.1
1989	584.2	53.39%	466.2	42.61%	30.4	2.78%	13.4	1.22%	1,094.2
1990	584.1	54.24%	449.0	41.70%	29.7	2.76%	14.0	1.30%	1,076.8
1991	578.5	53.27%	465.0	42.81%	28.8	2.65%	13.8	1.27%	1,086.1
1992	588.8	53.93%	459.3	42.07%	28.8	2.64%	14.8	1.36%	1,091.7
1993	592.9	57.31%	401.7	38.82%	24.8	2.40%	15.2	1.47%	1,034.6
1994	591.4	56.50%	411.4	39.31%	28.1	2.68%	15.8	1.51%	1,046.7
1995	601.1	57.53%	400.9	38.37%	26.3	2.51%	16.6	1.59%	1,044.9
				Average annual percentage change					
1975–95	0.9%		1.5%		-0.2%		0.8%		1.1%
1985–95	0.6%		-3.8%		-0.9%		3.2%		-1.3%

Source:
Association of Oil Pipelines, *Shifts in Petroleum Transportation*, Washington, DC, 1997, Table 1.

[a] The amounts carried by pipeline are based on ton-miles of crude and petroleum products for Federally regulated pipelines (84 percent) pluc 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

Table		
2.4	Transportation share of U.S. energy consumption, 1997	27.4%
2.5	Petroleum share of Transportation energy consumption, 1997	96.9%
2.7	Transportation energy use by mode, 1996	(trillion Btu)
	Automobiles	*8,622*
	Trucks	*9,923*
	Buses	*177*
	Air	*2,196*
	Water	*1,460*
	Pipeline	*984*
	Rail	*578*
2.10	Alternative vehicle fuel consumption, 1997 (thousand gasoline equivalent gallons)	
	Liquified petroleum gas	*244,612*
	Compressed natural gas	*63,258*
	Liquified natural gas	*4,567*
	M85/M100	*3,972*
	E85/E100	*4,044*
	Electricity	*936*
2.10	Oxygenate consumption, 1997 (thousand gasoline equivalent gallons)	
	MTBE	*2,923,700*
	Ethanol in gasohol	*787,800*

Table 2.1
World Production of Primary Energy by Selected Country Groups, 1987–96

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996[a]
Petroleum (thousand barrels per day)[b]										
World total	**62,427**	**64,705**	**65,892**	**66,754**	**66,632**	**66,960**	**67,361**	**68,250**	**69,860**	**71,764**
OECD[c]	20,793	20,727	20,019	20,142	20,710	21,060	21,217	21,894	22,354	23,102
Non OECD	41,633	43,978	45,873	46,611	45,922	45,901	46,145	46,356	47,506	48,663
Natural gas (trillion cubic feet)										
World total	**66.54**	**69.81**	**72.25**	**73.61**	**74.81**	**74.87**	**76.30**	**76.80**	**77.92**	**81.96**
OECD[c]	29.14	29.78	30.47	31.03	31.77	32.49	33.60	34.82	35.42	37.49
Non OECD	37.41	40.03	41.78	42.58	43.04	42.38	42.69	41.98	42.50	44.47
Coal (million short tons)										
World total	**5,130**	**5,235**	**5,324**	**5,356**	**5,033**	**5,052**	**4,930**	**5,033**	**5,144**	**5,185**
OECD[c]	2,417	2,425	2,457	2,418	2,257	2,200	2,167	2,225	2,218	2,254
Non OECD	2,713	2,811	2,867	2,938	2,776	2,852	2,762	2,808	2,926	2,931
Hydroelectric power (billion kilowatthours)										
World total	**2,027.9**	**2,106.4**	**2,089.6**	**2,173.6**	**2,213.2**	**2,215.2**	**2,348.4**	**2,348.9**	**2,486.7**	**2,530.2**
OECD[c]	1,144.4	1,168.0	1,137.4	1,177.8	1,190.4	1,178.2	1,249.4	1,198.9	1,284.3	1,317.2
Non OECD	883.5	938.4	952.2	995.8	1,022.8	1,037.0	1,099.0	1,150.1	1,202.4	1,212.9
Nuclear electric power (billion kilowatthours)										
World total	**1,654.0**	**1,794.8**	**1,843.4**	**1,905.1**	**1,992.0**	**2,011.8**	**2,073.7**	**2,117.8**	**2,203.0**	**2,280.0**
OECD[c]	1,390.6	1,499.8	1,540.2	1,607.6	1,694.1	1,718.5	1,791.1	1,851.6	1,925.1	1,972.8
Non OECD	263.4	295.1	303.3	297.6	297.9	293.3	282.7	266.2	277.8	307.2
Geothermal, solar, and wind electric power (billion kilowatthours)[d]										
World total	**34.0**	**34.8**	**79.4**	**234.5**	**235.7**	**249.9**	**257.0**	**265.3**	**268.9**	**282.4**
OECD[c]	23.0	23.3	67.7	221.8	222.3	235.8	241.9	248.8	251.7	264.2
Non OECD	11.0	11.5	11.6	12.6	13.4	14.2	15.1	16.5	17.2	18.2

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1996*, Washington, DC, February 1998, pp. 23–24. (Additional resources: http://www.eia.doe.gov)

[a] Preliminary.
[b] Data include the production of crude oil, natural gas plant liquids, refinery gain, and other liquid fuels.
[c] Organization for Economic Cooperation and Development (OECD). See Glossary for membership.
[d] Includes biofuels electric power generation for United States and Brazil.

Table 2.2
World Consumption of Primary Energy by Selected Country Groups, 1987–96

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996[a]
Petroleum (thousand barrels per day)										
World total	**62,999**	**64,819**	**65,917**	**65,985**	**66,577**	**66,742**	**67,043**	**68,313**	**69,926**	**71,524**
OECD[b]	38,957	40,238	40,881	40,917	41,400	42,414	43,054	44,197	45,072	46,147
Non OECD	24,042	24,581	25,036	25,068	25,177	24,327	23,989	24,116	24,855	25,376
Natural gas (trillion cubic feet)										
World total	**66.28**	**69.57**	**72.52**	**72.96**	**74.52**	**74.44**	**76.69**	**76.37**	**78.29**	**82.17**
OECD[b]	33.19	34.24	35.87	35.88	37.23	37.91	39.65	40.55	42.67	45.00
Non OECD	33.09	35.33	36.65	37.08	37.30	36.53	37.04	35.82	35.62	37.17
Coal (million short tons)										
World total	**5,134**	**5,283**	**5,281**	**5,263**	**5,006**	**5,017**	**4,995**	**5,063**	**5,120**	**5,167**
OECD[b]	2,432	2,468	2,490	2,415	2,296	2,229	2,280	2,279	2,268	2,320
Non OECD	2,701	2,815	2,791	2,848	2,710	2,788	2,716	2,784	2,852	2,848
Hydroelectric power (billion kilowatthours)										
World total	**2,074.2**	**2,138.1**	**2,096.3**	**2,182.6**	**2,232.6**	**2,238.9**	**2,373.1**	**2,376.7**	**2,512.7**	**2,561.5**
OECD[b]	1,190.8	1,199.8	1,144.2	1,186.8	1,209.8	1,201.9	1,274.1	1,226.7	1,310.3	1,348.6
Non OECD	883.5	938.4	952.2	995.8	1,022.8	1,037.0	1,099.0	1,150.1	1,202.4	1,212.9
Nuclear electric power (billion kilowatthours)										
World total	**1,654.0**	**1,794.8**	**1,843.4**	**1,905.1**	**1,992.0**	**2,011.8**	**2,073.7**	**2,117.8**	**2,203.0**	**2,280.0**
OECD[b]	1,390.6	1,499.8	1,540.2	1,607.6	1,694.1	1,718.5	1,791.1	1,851.6	1,925.1	1,972.8
Non OECD	263.4	295.1	303.3	297.6	297.9	293.3	282.7	266.2	277.8	307.2
Geothermal, solar, and wind electric power (billion kilowatthours)[c]										
World total	**34.0**	**34.8**	**79.4**	**234.5**	**235.7**	**249.9**	**257.0**	**265.3**	**268.9**	**282.4**
OECD[b]	23.0	23.3	67.7	221.8	222.3	235.8	241.9	248.8	251.7	264.2
Non OECD	11.0	11.5	11.6	12.6	13.4	14.2	15.1	16.5	17.2	18.2

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1996*, Washington, DC, February 1998, pp. 3–4. (Additional resources: http://www.eia.doe.gov)

[a] Preliminary.
[b] Organization for Economic Cooperation and Development (OECD). See Glossary for membership.
[c] Includes the consumption of biofuels electric power for United States and Brazil.

Table 2.3
World Energy Production and Consumption, 1996[a]
(trillion Btu)

	Production	Consumption
Petroleum		
World total	**151.93**	**151.41**
OECD[b]	48.91	97.69
Non OECD	103.02	53.72
Natural gas		
World total	**84.17**	**84.39**
OECD[b]	38.50	46.22
Non OECD	45.67	38.17
Coal		
World total	**0.000110**	**0.000110**
OECD[b]	0.000048	0.000049
Non OECD	0.000062	0.000061
Hydroelectric power[c]		
World total	**8,633**	**8,740**
OECD[b]	4,494	4,601
Non OECD	4,138	4,138
Nuclear electric power		
World total	**7,779**	**7,779**
OECD[b]	6,731	6,731
Non OECD	1,048	1,048
Geothermal, solar, and wind electric power [d]		
World total	963	963
OECD[b]	901	901
Non OECD	62	62

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1996*, Washington, DC, February 1998, pp. 3–4, 23–24. (Additional resources: http://www.eia.doe.gov)

[a] Preliminary.
[b] Organization for Economic Cooperation and Development (OECD). See Glossary for membership.
[c] Electricity generation and distribution were not taken into account when converting kWhr to Btu.
[d] Includes the consumption of biofuels electric power for United States and Brazil.

Total energy use in the U.S. rose to 90 quads in 1996. The transportation sector continues to account for more than 27% of total energy use.

Table 2.4
U. S. Consumption of Total Energy by End-Use Sector, 1970–97[a]
(quadrillion Btu)

Year	Transportation	Percentage transportation of total	Residential and commercial	Industrial	Total
1970	16.07	24.2%	21.71	28.65	66.43
1971	16.70	24.6%	22.59	28.59	67.88
1972	17.70	24.8%	23.69	29.88	71.27
1973	18.61	25.1%	24.14	31.53	74.28
1974	18.12	25.0%	23.73	30.69	72.54
1975	18.24	25.9%	23.90	28.40	70.54
1976	19.10	25.7%	25.02	30.24	74.36
1977	19.82	26.0%	25.39	31.08	76.29
1978	20.61	26.4%	26.08	31.39	78.09
1979	20.47	25.9%	25.81	32.62	78.90
1980	19.70	25.9%	25.66	30.61	75.96
1981	19.51	26.4%	25.24	29.24	73.99
1982	19.07	26.9%	25.63	26.15	70.85
1983	19.13	27.1%	25.63	25.76	70.52
1984	19.80	26.7%	26.47	27.87	74.14
1985	20.07	27.1%	26.70	27.21	73.98
1986	20.81	28.0%	26.85	26.63	74.30
1987	21.45	27.9%	27.62	27.83	76.89
1988	22.31	27.8%	28.93	28.99	80.22
1989	22.56	27.7%	29.40	29.35	81.33
1990	22.54	27.7%	28.79	29.94	81.27
1991	22.12	27.3%	29.42	29.57	81.12
1992	22.46	27.3%	29.11	30.58	82.15
1993	22.88	27.3%	30.24	30.75	83.87
1994	23.57	27.5%	30.44	31.59	85.60
1995	24.07	27.6%	31.27	31.86	87.21
1996	24.63	27.4%	32.63	32.74	90.04
1997	24.78	27.4%	32.83	32.92	90.59
		Average annual percentage change			
1970–97	1.6%		1.5%	0.5%	1.2%
1987–97	1.5%		1.7%	1.7%	1.7%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 1998*, Washington, DC, Table 2.2, p. 25. (Additional resources: http://www.eia.doe.gov)

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

Due to the lack of consistent historical data, renewable energy sources are not included for sectors other than the electric utilities.

Table 2.5
Distribution of Energy Consumption by Source, 1973, 1980, and 1997
(percentage)

	Transportation			Residential & Commercial			Industrial			Electric utilities		
Energy source	1973	1980	1997	1973	1980	1997	1973	1980	1997	1973	1980	1997
Petroleum	95.8	96.5	96.9	18.2	11.8	6.7	28.9	31.1	28.1	17.7	10.7	2.5
Natural gas[a]	4.0	3.3	2.9	31.6	29.4	25.9	32.9	27.4	31.3	18.9	15.5	9.2
Coal	0.0	0.0	0.0	1.1	0.6	0.4	12.8	10.3	7.2	43.6	49.5	55.9
Hydroelectric	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	15.0	12.6	11.7
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	11.2	20.3
Electricity[b]	0.2	0.2	0.2	49.2	58.2	67.0	25.2	31.1	33.3	0.0	0.0	0.0
Other[c]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 1998, Washington, DC, pp. 27, 29, 31, 33.
(Additional resources: http://www.eia.doe.gov)

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

As data about alternative fuel use come available, an attempt is made to incorporate it into this table. Sometimes assumptions must be made in order to use the data. Please see Appendix A for detailed methodology of all energy data.

Table 2.6
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1996[a]
(trillion Btu)

	Gasoline	Diesel fuel	Liquified petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity	Methanol
HIGHWAY	**14,829.2**	**3,885.9**	**26.7**			**2.8**	**0.8**	**0.4**
Automobiles	**8,497.3[b]**	**124.2**				**0.2**		**0.0**
Motorcycles	**24.8**							
Buses	**31.0**	**141.9**	**0.5**			**1.9**	**0.8**	**0.4**
Transit	5.3	76.1	0.5			1.9	0.8	0.4
Intercity[c]		23.1						
School[c]	25.7	42.7						0.0
Trucks	**6,276.1**	**3,619.8**	**26.2**			**0.7**		**0.0**
Light trucks[d]	5,679.5	215.7	12.8			0.7		0.0
Other trucks	596.6	3,404.1	13.4			0.0		0.0
OFF-HIGHWAY	**150.3**	**570.1[e]**						
Construction	**35.5**	**178.5[e]**						
Agriculture	**114.8**	**391.6[e]**						
NONHIGHWAY	**323.6**	**791.6**		**2,161.5**	**962.7**	**733.5**	**311.1**	
Air	**34.4**			**2,161.5**				
General aviation	34.4			76.6				
Domestic air carriers				1,773.1				
International air carriers[f]				311.8				
Water	**289.2**	**302.0**			**869.0**			
Freight		302.0			869.0			
Recreational	289.2							
Pipeline						**733.5**	**250.0**	
Rail		**517.3**					**61.1**	
Freight (Class I)		499.4						
Passenger		17.9					61.1	
Transit							43.0	
Commuter		9.0					14.9	
Intercity[c]		8.9					3.2	
TOTAL	**15,303.1**	**5,275.3**	**26.7**	**2,161.5**	**869.0**	**736.3**	**311.9**	**0.4**

Source:
See Appendix A for Table 2.6

[a] Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
[b] Includes gasohol.
[c] Estimated using vehicle travel information.
[d] Two-axle, four-tire trucks.
[e] 1985 data.
[f] Represents an estimate of energy purchased in the U.S. for international air carrier consumption.

The 1995 data have been revised to include the latest data available.

Table 2.7
Transportation Energy Use by Mode, 1995–96[a]

	Trillion Btu		Thousand barrels per day crude oil equivalent [b]		Percentage of total	
	1995	1996	1995	1996	1995	1996
HIGHWAY	**18,388.9**	**18,745.8**	**9,254.3**	**9,430.5**	**75.7%**	**75.9%**
Automobiles	**8,518.6**	**8,621.7**	**4,287.0**	**4,337.3**	**35.1%**	**34.9%**
Motorcycles	**24.5**	**24.8**	**12.3**	**12.5**	**0.1%**	**0.1%**
Buses	**178.5**	**176.5**	**89.8**	**88.8**	**0.7%**	**0.7%**
Transit	87.5	85.0	44.0	42.8	0.4%	0.3%
Intercity	22.6	23.1[c]	11.4	11.6[c]	0.1%	0.1%
School	68.4	68.4[c]	34.4	34.4[c]	0.3%	0.3%
Trucks	**9,667.3**	**9,922.8**	**4,865.1**	**4,991.9**	**39.8%**	**40.2%**
Light trucks [d]	5,717.3	5,908.7	2,877.3	2,972.5	23.5%	23.9%
Other trucks	3,950.0	4,014.1	1,987.9	2,019.4	16.3%	16.3%
OFF-HIGHWAY	**720.9**	**720.4**	**362.8**	**362.4**	**3.0%**	**2.9%**
Construction	**213.5**	**214.0**	**107.4**	**107.7**	**0.9%**	**0.9%**
Agriculture	**507.4**	**506.4**	**255.5**	**254.8**	**2.1%**	**2.1%**
NONHIGHWAY	**5,174.9**	**5,284.0**	**2,604.3**	**2,658.2**	**21.3%**	**21.1%**
Air	**2,117.2**	**2,195.9**	**1,065.5**	**1,104.7**	**8.7%**	**8.9%**
General aviation	106.6	111.0	53.6	55.8	0.4%	0.4%
Domestic air carriers	1,710.7	1,773.1	860.9	892.0	7.0%	7.2%
International air carriers	299.9	311.8	150.9	156.9	1.2%	1.3%
Water	**1,521.8**	**1,460.2**	**765.9**	**734.6**	**6.3%**	**5.9%**
Freight	1,237.0	1,171.0	622.5	589.1	5.1%	4.7%
Recreational	284.8	289.2	143.3	145.5	1.2%	1.2%
Pipeline	**970.5**	**983.5**	**488.4**	**494.8**	**4.0%**	**4.0%**
Rail	**565.4**	**578.4**	**284.5**	**291.0**	**2.3%**	**2.3%**
Freight	485.9	499.4	244.5	251.2	2.0%	2.0%
Passenger	79.5	79.0	40.0	39.7	0.3%	0.3%
Transit	43.6	43.0	21.9	21.6	0.2%	0.2%
Commuter	23.4	23.9	11.8	12.0	0.1%	0.1%
Intercity	12.5[c]	12.1[c]	6.3	6.1[c]	0.1%	0.0%
TOTAL	**24,284.7**	**24,684.2**	**12,221.4**	**12,417.9**	**100.0%**	**100.0%**

Source: See Appendix A for Table 2.6 (detailed breakdown).

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

The Federal Highway Administration produced revised estimates of auto, light truck, and other truck historical fuel use in order to produce a consistent trend. Light trucks include pickups, vans, and sport utility vehicles.

Table 2.8
Transportation Energy Consumption by Mode, 1970–96
(trillion Btu)

Year	Automobiles	Motorcycles	Buses[a]	Light trucks	Other trucks	Total highway	Air	Water	Pipeline	Rail	Total nonhighway	Total transportation[b]
1970	8,527	7	109	1,540	1,503	11,686	1,307	753	985	558	3,603	15,289
1971	8,970	9	108	1,686	1,569	12,342	1,304	698	1,007	560	3,569	15,911
1972	9,547	11	106	1,895	1,722	13,281	1,314	703	1,039	583	3,639	16,920
1973	9,836	13	109	2,105	1,902	13,965	1,377	827	996	619	3,819	17,784
1974	9,332	14	113	2,083	1,904	13,446	1,254	804	932	624	3,614	17,060
1975	9,321	14	119	2,386	1,939	13,779	1,274	851	835	563	3,523	17,302
1976	9,844	15	129	2,605	2,046	14,639	1,333	1,001	803	585	3,722	18,361
1977	9,940	16	132	2,799	2,268	15,155	1,411	1,103	781	595	3,890	19,045
1978	10,140	18	135	3,022	2,539	15,854	1,467	1,311	781	589	4,148	20,002
1979	9,629	22	137	3,057	2,644	15,489	1,568	1,539	856	613	4,576	20,065
1980	8,798	26	139	2,976	2,651	14,590	1,528	1,677	889	596	4,690	19,280
1981	8,695	27	143	2,964	2,706	14,535	1,455	1,562	899	565	4,481	19,016
1982	8,695	25	146	2,839	2,707	14,412	1,468	1,290	853	488	4,099	18,511
1983	8,814	22	145	2,995	2,757	14,733	1,505	1,187	738	482	3,912	18,645
1984	8,857	22	154	3,202	2,846	15,081	1,633	1,251	780	523	4,187	19,268
1985	8,954	23	161	3,422	2,842	15,402	1,678	1,311	758	487	4,234	19,636
1986	9,162	23	154	3,636	2,903	15,878	1,823	1,295	738	423	4,279	20,157
1987	9,179	24	157	3,827	2,990	16,177	1,894	1,326	775	485	4,480	20,657
1988	9,180	25	159	4,096	3,117	16,577	1,978	1,338	878	498	4,692	21,269
1989	9,251	26	163	4,173	3,196	16,809	1,981	1,376	895	501	4,753	21,562
1990	8,707	24	163	4,467	3,329	16,690	2,059	1,487	928	492	4,966	21,656
1991	8,048	23	174	4,793	3,396	16,434	1,926	1,567	864	463	4,820	21,254
1992	8,188	24	182	5,134	3,460	16,988	1,971	1,641	849	476	4,937	21,925
1993	8,389	25	192	5,375	3,567	17,548	1,996	1,473	889	513	4,871	22,419
1994	8,494	26	202	5,530	3,772	18,024	2,056	1,414	955	546	4,971	22,995
1995	8,519	25	179	5,717	3,950	18,390	2,117	1,522	971	565	5,175	23,565
1996	8,622	25	177	5,909	4,014	18,747	2,196	1,460	984	578	5,218	23,965
					Average annual percentage change							
1970–96	0.0%	5.0%	1.9%	5.3%	3.9%	1.8%	2.0%	2.6%	0.0%	0.1%	1.4%	1.7%
1986–96	-0.6%	0.8%	1.4%	5.0%	3.3%	1.7%	1.9%	1.2%	2.5%	3.2%	2.0%	1.7%

Source:
See Appendix A for Table 2.8.

[a] Beginning in 1992 data became available on alternative fuel use by transit buses.
[b] Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g. snowmobiles).

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%.

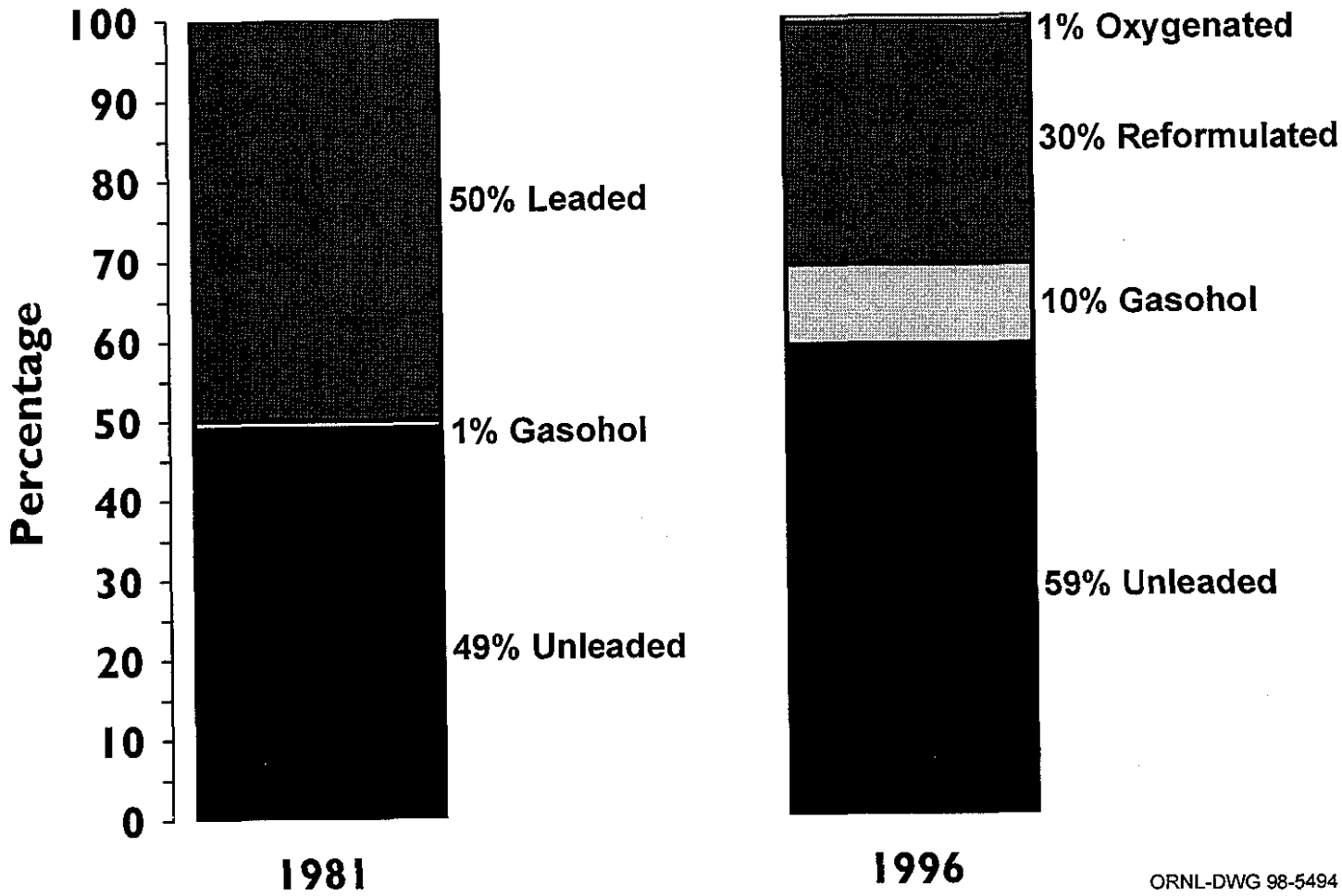
Table 2.9
Highway Usage of Gasoline and Special Fuels, 1973–96
(million gallons)

Year	Gasoline	Gasohol	Ethanol used in gasohol[a]	Total gasoline and gasohol	Special fuels[b]	Percent special fuels	Total highway fuel use
1973	[c]	[c]	[c]	100,636	9,837	8.9%	110,473
1974	[c]	[c]	[c]	96,505	9,796	9.2%	106,301
1975	[c]	[c]	[c]	99,354	9,631	8.8%	108,985
1976	[c]	[c]	[c]	104,978	10,721	9.3%	115,699
1977	[c]	[c]	[c]	107,978	11,646	9.7%	119,624
1978	[c]	[c]	[c]	112,239	12,828	10.3%	125,067
1979	[c]	[c]	[c]	108,126	13,989	11.5%	122,115
1980	100,686	497	49.7	101,183	13,777	12.0%	114,960
1981	98,884	713	71.3	99,597	14,856	13.0%	114,453
1982	96,220	2,259	225.9	98,479	14,905	13.1%	113,384
1983	95,852	4,254	425.5	100,106	15,975	13.8%	116,081
1984	95,996	5,420	542.0	101,416	17,320	14.6%	118,736
1985	95,567	8,004	781.7	103,571	17,751	14.6%	121,322
1986	98,618	8,138	780.7	106,756	18,427	14.7%	125,183
1987	101,790	6,912	800.4	108,702	19,046	14.9%	127,748
1988	101,678	8,138	813.8	109,816	20,070	15.5%	129,886
1989	103,691	6,941	694.1	110,632	21,232	16.1%	131,864
1990	102,645	7,539	753.9	110,184	21,399	16.3%	131,583
1991	99,304	8,644	864.4	107,948	20,676	16.1%	128,624
1992	102,119	8,831	883.1	110,950	21,988	16.5%	132,938
1993	103,417	10,287	978.8	113,704	23,490	17.1%	137,194
1994	103,997	11,010	1,042.0	115,007	25,124	17.9%	140,131
1995	103,968	13,093	1,213.7	117,061	26,206	18.3%	143,267
1996	107,390	12,125	1,076.1	119,515	27,160	18.5%	146,675
				Average annual percentage change			
1973–96	[d]	[d]	[d]	0.8%	4.5%		1.2%
1986–96	0.9%	4.1%	3.3%	1.1%	4.0%		1.6%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, 1997, Tables MF-21 and MF-33E, pp. I-3, I-6, and annual.
(Additional resources: http://www.fhwa.dot.gov)

[a] Estimated for 1980–92 as 10% of gasohol consumption.
[b] Special fuels consist 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.

Figure 2.1. Motor Gasoline Quantities by Type, 1981 and 1996



Source:

U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual 1996*, Washington, DC, Tables 17 and 20.

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

U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, Tables MF-21 and MF-33E, and annual.

Table 2.10
Alternative Vehicle Fuel Consumption, 1992–98
(thousand gasoline equivalent gallons)

Alternative fuel	1992	1993	1994	1995	1996	1997	1998[a]
Liquified petroleum gas	208,142	264,655	248,467	232,701	239,158	244,612	252,981
Compressed natural gas	16,823	21,603	24,160	35,162	46,923	63,258	74,998
Liquified natural gas	585	1,900	2,345	2,759	3,247	4,567	5,090
M85[b]	1,069	1,593	2,340	2,887	3,390	3,625	3,832
M100	2,547	3,166	3,190	2,150	347	347	347
E85[b]	21	48	80	190	694	1,416	1,614
E95[b]	85	80	140	995	2,699	2,628	2,628
Electricity	359	288	430	663	773	936	1,067
Subtotal	**229,631**	**293,334**	**281,152**	**277,507**	**297,231**	**321,389**	**342,557**
Oxygenates							
MTBE[c]	1,175,000	2,069,200	2,018,800	2,691,200	2,749,700	2,923,700	2,840,800
Ethanol in gasohol	701,000	760,000	845,900	910,700	660,200	787,800	852,500
Total	**2,105,631**	**3,122,534**	**3,145,852**	**3,879,407**	**3,707,131**	**4,032,889**	**4,035,857**

Source:
U.S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 1996*, Washington, DC, December 1997, p. 20. (Additional resources: http://www.eia.doe.gov)

[a]Based on plans or projections.
[b]Consumption includes gasoline portion of the mixture.
[c]Methyl Tertiary Butyl Ether. This category includes a very small amount of other ethers, primarily Tertiary Amyl Methyl Ether (TAME) and Ethyl Tertiary Butyl Ether (ETBE).

Table 2.11
U.S. Production of MTBE[a] and Fuel Ethanol, 1978–97
(million gallons)

Year	Fuel ethanol	MTBE[a]
1978	20	[b]
1979	40	[b]
1980	80	[b]
1981	85	122
1982	234	132
1983	443	134
1984	567	235
1985	793	302
1986	798	359
1987	825	[b]
1988	800	[b]
1989	750	[b]
1990	756	[b]
1991	875	[b]
1992	1,080	1,542
1993	1,156	2,081
1994	1,280	2,205
1995	1,355	2,506
1996	974	2,846
1997	1,274	3,011
Average annual percentage change		
1978–97	24.4%	[b]
1987–97	4.4%	[b]

Source:
1992–97 Ethanol and MTBE - U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Monthly*, January 1998, Table D1.
1978–90 Ethanol - Information Resources, Inc., Washington, DC, 1991.
1981–86 MTBE - EA-Mueller,Inc., Baltimore, MD, 1992.

[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.

Table 2.12
Passenger Travel and Energy Use in the United States, 1996

	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	**129,728.3**	**1,467,703**	**2,348,325**	**1.6**	**5,874**	**3,671**	**8,620.8**
Personal trucks	**52,028.0**	**573,903**	**918,245**	**1.6**	**7,040**	**4,400**	**4,040.2**
Motorcycles	**3,871.2**	**9,906**	**11,887**	**1.2**	**2,504**	**2,086**	**24.8**
Buses	**657.3**	**8,385**	**146,160**	**17.4**	**21,050**	**1,208**	**176.5**
Transit	67.8	2,165	18,860	8.7	39,261	4,507	85.0
Intercity	20.1	1,220	28,300	23.2	18,394[a]	816[a]	23.1[a]
School	569.4	5,000	99,000	19.8	13,680[a]	691[a]	68.4[a]
Air	[b]	**7,871**	**445,068**	**56.5**	**239,385**	**4,234**	**1,884.2**
Certificated route	[b]	4,809	434,468	90.3	368,705	4,081	1,773.1
General aviation	187.3	3,062[c]	10,600	3.5	36,284	10,481	111.1
Recreational boats	**11,877.9**	[b]	[b]	[b]	[b]	[b]	**289.2**
Rail	**17.8**	**1,101**	**25,921**	**23.5**	**71,753**	**3,048**	**79.0**
Intercity[d]	1.8[e]	278[f]	5,066[g]	18.2	43,525	2,389	12.1[a]
Transit[h]	11.3	581	12,484	21.5	74,010	3,444	43.0
Commuter	4.7	242	8,371	34.6	98,760	2,855	23.9

Source:
See Appendix A for Table 2.12.

[a]Estimated using vehicle travel data.
[b]Data are not available.
[c]Nautical miles.
[d]Amtrak only.
[e]Sum of passenger train cars and locomotive units.
[f]Passenger train car-miles.
[g]Revenue passenger miles.
[h]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.

Table 2.13
Intercity Freight Movement and Energy Use in the United States, 1996

	Number of vehicles (thousands)	Vehicle-miles (millions)	Ton-miles (millions)	Tons shipped (millions)	Average length of haul (miles)	Energy intensity (Btu/ton-mile)	Energy use (trillion Btu)
Truck[a]	**1,888**	**113,632**	**986,000**	**3,578**	**668[b]**	**2,790**	**2,750.7**
Waterborne commerce[c]	**41**	[d]	**764,686**	**1,093**	**699**	**412**	**314.9**
Coastwise	[d]	[d]	408,086	267	1,526	[d]	[d]
Lakewise	[d]	[d]	58,335	115	508	[d]	[d]
Internal and local	[d]	[d]	298,264	711	419	[d]	[d]
Pipeline	[d]	[d]	[d]	**1,748**	[d]	[d]	**929.8**
Natural gas	[d]	[d]	[d]	571	[d]	[d]	771.4
Crude oil and products	[d]	[d]	631,000	1,177	[d]	251	158.4
Class I railroads[e]	**571**	**31,715**	**1,355,975**	**2,229**	**842**	**368**	**499.4**

Source:
See Appendix A for Table 2.13.

[a]The definition of intercity truck was "tightened" to exclude smaller trucks. See Appendix A for details.

[b]668 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) was 301 miles.

[c]Includes commerce by foreign and domestic carriers in the U.S.

[d]Data are not available.

[e]Railroad measures are: number vehicles = number freight cars, vehicle-miles = car-miles, ton-miles = revenue ton-miles.

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

Table 2.14
Energy Intensities of Passenger Modes, 1970–96

	Automobiles		Light truck[a]	Buses				Air		Rail	
				Transit[b]		Intercity	School	Certificated air carriers	General aviation	Intercity Amtrak	Rail transit
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)	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)
1970	9,301	4,896	12,492	31,796	2,472	1,051	17,857	10,351	10,374	[c]	2,453
1975	9,015	4,745	11,890	33,748	2,814	976	17,040	7,883	10,658	3,677	2,962
1976	9,130	4,805	11,535	34,598	2,896	996	17,051	7,481	10,769	3,397	2,971
1977	8,961	4,716	11,171	35,120	2,889	961	16,983	7,174	11,695	3,568	2,691
1978	8,844	4,655	10,815	36,603	2,883	953	17,018	6,333	11,305	3,683	2,210
1979	8,647	4,551	10,473	36,597	2,795	963	16,980	5,858	10,787	3,472	2,794
1980	7,915	4,166	10,230	36,553	2,813	1,069	16,379	5,837	11,497	3,176	3,008
1981	7,672	4,038	10,001	37,745	3,027	1,155	16,385	5,743	11,123	2,957	2,946
1982	7,485	3,939	9,275	38,766	3,237	1,149	16,296	5,147	13,015	3,156	3,069
1983	7,376	4,098	9,141	37,962	3,177	1,174	16,236	5,107	11,331	2,957	3,212
1984	7,218	4,010	8,945	37,507	3,204	1,247	14,912	5,031	11,454	3,027	3,732
1985	7,182	3,990	8,754	38,862	2,421	1,324	16,531	5,679	11,707	2,800	3,461
1986	7,213	4,007	8,578	39,869	3,512	869	15,622	5,447	11,935	2,574	3,531
1987	6,975	3,875	8,376	38,557	3,542	939	15,615	4,753	11,496	2,537	3,534
1988	6,700	3,722	8,155	39,121	3,415	965	15,585	4,814	11,794	2,462	3,585
1989	6,602	3,668	7,779	36,583	3,711	963	15,575	4,796	10,229	2,731	3,397
1990	6,183	3,864	7,774	36,647	3,735	944	16,368	4,811	10,146	2,609	3,453
1991	5,925	3,703	7,381	36,939	3,811	978	16,419	4,560	9,869	2,503	3,710
1992	5,970	3,731	7,263	40,472	4,303	978	16,386	4,482	9,785	2,610	3,575
1993	6,103	3,814	7,208	39,005	4,257	972	19,093	4,304	9,653	2,646	3,687
1994	6,041	3,775	7,232	40,102	4,604	876	20,591	4,455	9,163	2,351	3,828
1995	5,923	3,702	7,237	40,175	4,650	816	13,680	4,236	10,152	2,314	3,818
1996	5,874	3,671	7,247	39,307	4,512	816	13,680	4,081	10,481	2,389	3,444
						Average annual percentage change					
1970–96	-1.8%	-1.1%	-2.1%	0.8%	2.3%	-1.0%	-1.0%	-3.5%	0.0%	-2.0%[d]	1.3%
1986–96	-2.0%	-0.9%	-1.7%	-0.1%	2.5%	-0.6%	-1.3%	-2.8%	-1.3%	-0.7%	-0.2%

Source:
See Appendix A for Table 2.14.

[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]Data are not available.
[d]Average annual percentage change is for years 1973–95.

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, 1970–96

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	24,154	17,668	691	545
1971	23,694	18,814	717	506
1972	23,871	18,292	714	522
1973	23,977	18,468	677	576
1974	23,983	18,852	681	483
1975	23,836	18,741	687	549
1976	23,773	18,938	680	468
1977	23,873	19,225	669	458
1978	24,013	18,930	641	383
1979	24,260	19,187	618	457
1980	24,431	18,742	597	358
1981	24,892	18,628	572	360
1982	24,296	18,403	553	310
1983	23,740	17,863	525	319
1984	23,363	17,797	510	346
1985	23,015	17,500	497	446
1986	22,917	17,265	486	463
1987	22,391	16,791	456	402
1988	22,586	16,758	443	361
1989	22,391	16,896	437	403
1990	22,765	16,618	420	388
1991	22,710	15,834	391	386
1992	22,559	16,044	393	398
1993	22,308	16,055	389	389
1994	22,159	16,338	388	369
1995	22,172	15,993	372	374
1996	21,964	15,747	368	412
		Average annual percentage change		
1970–96	-0.4%	-0.4%	-2.4%	-1.1%
1986–96	-0.4%	-0.9%	-2.7%	-1.2%

Source:
See Appendix A for Table 2.15.

Chapter 3

Emissions and Transportation

Summary Statistics

Table		
3.5	Transportation share of carbon dioxide emissions from fossil fuel consumption	
	1984	*30.5%*
	1990	*32.1%*
	1996	*32.1%*
3.6	Carbon dioxide emissions from Transportation energy use, 1996	
	Motor gasoline	*61.1%*
	Liquified petroleum gas	*0.1%*
	Jet fuel	*13.4%*
	Distillate fuel	*18.8%*
	Residual fuel	*3.7%*
	Lubricants	*0.3%*
	Aviation gas	*0.1%*
	Natural gas	*2.2%*
	Electricity	*0.1%*
	Transportation share of emissions of criteria pollutants, 1996	
3.9	*Carbon Monoxide*	*78.7%*
3.10	*Nitrogen oxidies*	*50.4%*
3.12	*Voltile organic compounds*	*41.5%*
3.13	*PM-10*	*2.8%*
3.16	*Lead*	*14.6%*

Table 3.1
International Anthropogenic Emissions of All Greenhouse Gases, 1990–94[a]

	1990	1991	1992	1993	1994
	(gigagrams)	(percentage relative to 1990, 1990=100)			
Australia	465,305	[b]	[b]	[b]	[b]
Austria	75,286	[b]	[b]	[b]	[b]
Bulgaria (1990)	123,755	[b]	[b]	[b]	[b]
Bulgaria (1988)[c]	141,345	[b]	[b]	[b]	[b]
Canada	577,954	99%	102%	103%	106%
Czech Republic	196,551	[b]	[b]	[b]	[b]
Denmark	65,517	117%	108%	111%	119%
Denmark[d]	71,770	104%	103%	103%	103%
Estonia	46,479	96%	73%	55%	57%
Finland	67,114	100%	91%	92%	102%
France	494,032	104%	101%	99%	[b]
Germany	1,241,509	94%	90%	90%	[b]
Greece	94,888	[b]	[b]	[b]	[b]
Hungary (1990)	88,674	[b]	[b]	[b]	[b]
Hungary (1985–1987)[c]	104,082	[b]	[b]	[b]	[b]
Iceland	3,227	95%	92%	94%	[b]
Ireland	63,757	[b]	[b]	[b]	[b]
Italy	563,117	[b]	[b]	[b]	[b]
Japan	1,206,523	102%	103%	101%	[b]
Latvia	27,640	[b]	[b]	[b]	[b]
Liechtenstein	265	[b]	[b]	[b]	[b]
Luxembourg	12,123	[b]	[b]	[b]	[b]
Monaco	71	[b]	[b]	[b]	[b]
Netherlands	213,946	105%	103%	104%	105%
Netherlands[e]	220,346	102%	102%	101%	103%
New Zealand	80,266	99%	101%	99%	100%
Norway	52,235	96%	92%	96%	100%
Poland (1990)	614,300	[b]	73%	[b]	[b]
Poland (1988)[c]	572,257	[b]	78%	[b]	[b]
Portugal	51,045	[b]	[b]	[b]	[b]
Romania (1990)	253,152	84%	72%	75%	[b]
Romania (1989)[c]	276,859	77%	66%	68%	[b]
Russian Federation	3,078,892	[b]	[b]	[b]	[b]
Slovakia	71,900	[b]	[b]	[b]	[b]
Spain	310,070	[b]	[b]	[b]	[b]
Sweden	75,573	[b]	91%	[b]	95%
Switzerland	58,196	103%	100%	98%	97%
United Kingdom	724,754	101%	97%	94%	94%
United States	5,842,371	99%	101%	102%	103%

Source:
United Nations Framework Convention on Climate Change, FCCC/CP/1996/12/Add.1, June 1996.
(Additional resources: http://www.unfccc.de)

[a]Excluding land-use change and forestry.
[b]Data are not available.
[c]Some parties with economies in transition have chosen different base years than 1990.
[d]All figures are adjusted for electricity trade.
[e]All figures are adjusted for temperature.

Table 3.2
International Anthropogenic Emissions of Carbon Dioxide, 1990–94[a]

	1990	1991	1992	1993	1994
	(gigagrams)	(percentage relative to 1990, 1990=100)			
Australia	288,965	[b]	[b]	[b]	[b]
Austria	59,200	108%	100%	[b]	[b]
Bulgaria (1990)	82,990	[b]	[b]	[b]	[b]
Bulgaria (1988)[c]	96,878	[b]	[b]	[b]	[b]
Canada	462,643	98%	101%	102%	105%
Czech Republic	165,792	94%	86%	84%	[b]
Denmark	52,025	121%	110%	114%	121%
Denmark[d]	58,278	105%	104%	103%	101%
Estonia	37,797	97%	74%	55%	57%
Finland	53,900	100%	96%	97%	108%
France	366,536	106%	102%	100%	[b]
Germany	1,014,155	96%	91%	90%	[b]
Greece	82,100	[b]	[b]	[b]	[b]
Hungary (1990)	71,673	[b]	[b]	[b]	[b]
Hungary (1985–1987)[c]	83,676	[b]	[b]	[b]	[b]
Iceland	2,172	96%	101%	106%	[b]
Ireland	30,719	[b]	[b]	[b]	[b]
Italy	428,941	[b]	[b]	[b]	[b]
Japan	1,155,000	102%	103%	101%	107%
Latvia	22,976	[b]	[b]	[b]	[b]
Liechtenstein	208	[b]	[b]	[b]	[b]
Luxembourg	11,343	[b]	[b]	[b]	[b]
Monaco	71	[b]	[b]	[b]	[b]
Netherlands	167,600	104%	103%	104%	105%
Netherlands[e]	174,000	100%	101%	100%	102%
New Zealand	25,476	102%	110%	107%	108%
Norway	35,514	95%	96%	101%	106%
Poland (1990)	414,930	96%	90%	[b]	[b]
Poland (1988)[c]	478,880	83%	78%	[b]	[b]
Portugal	42,148	[b]	[b]	[b]	[b]
Romania (1990)	171,103	83%	72%	70%	[b]
Romania (1989)[c]	198,479	71%	62%	61%	[b]
Russian Federation	2,388,720	[b]	[b]	[b]	[b]
Slovakia	58,278	[b]	[b]	[b]	[b]
Spain	227,322	[b]	[b]	[b]	[b]
Sweden	61,256	89%	92%	90%	95%
Switzerland	45,070	103%	101%	98%	96%
United Kingdom	577,012	102%	99%	97%	96%
United States	4,957,022	99%	100%	103%	103%

Source:
United Nations Framework Convention on Climate Change, FCCC/CP/1996/12/Add.1, June 1996.
(Additional resources: http://www.unfccc.de)

[a]Excluding land-use change and forestry.
[b]Data are not available.
[c]Some parties with economies in transition have chosen different base years than 1990.
[d]All figures are adjusted for electricity trade.
[e]All figures are adjusted for temperature.

Table 3.3
International Anthropogenic Emissions of Nitrogen Oxides, 1990–94

	1990	1991	1992	1993	1994
	(gigagrams)	(percentage relative to 1990, 1990=100)			
Australia	60.1	[a]	[a]	[a]	[a]
Austria	4.1	[a]	[a]	[a]	[a]
Bulgaria (1990)	22.5	[a]	[a]	[a]	[a]
Bulgaria (1988)[b]	30.8	[a]	[a]	[a]	[a]
Canada	95.5	99%	103%	105%	116%
Czech Republic	24.0	[a]	[a]	[a]	[a]
Denmark	10.3	104%	103%	105%	106%
Estonia	2.4	96%	75%	58%	54%
Finland	22.0	100%	45%	50%	50%
France	176.7	101%	99%	97%	[a]
Germany	211.0	91%	94%	91%	[a]
Greece	13.7	[a]	[a]	[a]	[a]
Hungary (1990)	11.4	[a]	[a]	[a]	[a]
Hungary (1985–1987)[b]	12.9	[a]	[a]	[a]	[a]
Iceland	0.6	100%	100%	100%	[a]
Ireland	42.3	[a]	[a]	[a]	[a]
Italy	120.3	[a]	[a]	[a]	[a]
Japan	55.2	97%	97%	98%	[a]
Latvia	2.4	[a]	[a]	[a]	[a]
Liechtenstein	0.1	[a]	[a]	[a]	[a]
Luxembourg	0.6	[a]	[a]	[a]	[a]
Monaco	[a]	[a]	[a]	[a]	[a]
Netherlands	51.5	117%	116%	113%	113%
New Zealand	17.1	99%	103%	109%	112%
Norway	15.0	100%	87%	93%	93%
Poland (1990)	156.0	[a]	32%	[a]	[a]
Poland (1988)[b]	58.9	[a]	85%	[a]	[a]
Portugal	10.5	[a]	[a]	[a]	[a]
Romania (1990)	106.8	85%	64%	92%	[a]
Romania (1989)[b]	66.7	[a]	[a]	[a]	[a]
Russian Federation	89.6	[a]	[a]	[a]	[a]
Slovakia	16.0	[a]	[a]	[a]	[a]
Spain	93.9	[a]	[a]	[a]	[a]
Sweden	15.2	[a]	132%	[a]	161%
Switzerland	15.6	101%	101%	100%	104%
United Kingdom	108.3	99%	84%	75%	87%
United States	411.4	97%	97%	97%	87%

Source:
United Nations Framework Convention on Climate Change, FCCC/CP/1996/12/Add.1, June 1996.
(Additional resources: http://www.unfccc.de)

[a]Data are not available.
[b]Some parties with economies in transition have chosen different base years than 1990.

Table 3.4
Estimated U.S. Emissions of Greenhouse Gases, 1989–96

Greenhouse gas	Unit of measure[a]	1989	1990	1991	1992	1993	1994	1995	1996
Carbon dioxide	million metric tons of gas	5,091.8	5,037.1	4,987.3	5,059.8	5,175.9	5,256.1	5,296.9	5,484.9
	million metric tons of carbon	1,389.0	1,374.0	1,360.0	1,380.0	1,412.0	1,433.0	1,445.0	1,496.0
Methane	million metric tons of gas	31.3	31.6	31.6	31.7	30.8	31.4	30.9	30.9
	million metric tons of carbon (gwp)[b]	179.0	181.0	181.0	182.0	177.0	180.0	177.0	177.0
Nitrous oxide	million metric tons of gas	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.4
	million metric tons of carbon (gwp)[b]	38.0	38.0	38.0	38.0	39.0	40.0	38.0	38.0
Carbon monoxide	million metric tons of gas	94.8	87.6	89.3	86.3	86.4	90.4	81.4	80.6
Nitrogen oxide	million metric tons of gas	21.8	21.6	21.6	21.9	22.2	22.6	21.7	21.2
Nonmethane VOCs[c]	million metric tons of gas	20.3	19.0	19.1	18.8	19.0	19.5	18.7	17.3
CFC-11,12,113[c]	million metric tons of gas	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
HCFC-22[c]	million metric tons of gas	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		[d]	[d]	[d]	[d]	[d]	[d]	[d]	[d]
HCFC-23 and PFCs[c]	million metric tons of gas								
	million metric tons of carbon (gwp)[b]	26.0	25.0	26.0	28.0	27.0	31.0	36.0	42.0

Source:

U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1996*, Washington, DC, October 1997, p. x. (Additional resources: http://www.eia.doe.gov)

Criteria pollutants (CO, NO_X, VOC) – U.S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1996*, 1997, pp. A-6, A-11, A-18. (Additional resources: http://www.epa.gov/oar/oaqps)

[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]VOC=volatile organic compounds. CFC=chlorofluorocarbons. HCFC=hydrochlorofluorocarbons. HFC=hydrofluorocarbons. PFC=perfluorocarbons.

[d]Data are not available.

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.

Table 3.5
U.S. Carbon Dioxide Emissions from Fossil Energy Consumption by End-Use Sector, 1984–96[a]
(million metric tons of carbon)

End use	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Energy consumption sectors													
Residential	241.1	245.8	244.0	251.0	264.8	267.5	253.0	257.1	255.9	271.6	268.3	269.7	286.8
Commercial	188.8	189.6	190.4	197.2	207.6	210.1	206.8	206.5	205.5	212.0	213.8	218.3	230.3
Industrial	434.4	424.1	409.0	422.7	444.1	450.4	453.8	442.4	458.8	458.2	467.0	464.9	476.9
Transportation	379.0	384.4	399.1	411.1	427.5	432.7	432.1	424.5	431.4	439.1	452.2	458.5	469.0
Percentage	30.5%	30.9%	32.1%	32.1%	31.8%	31.8%	32.1%	31.9%	31.9%	31.8%	32.3%	32.5%	32.1%
Total energy	**1,243.3**	**1,243.9**	**1,242.5**	**1,282.0**	**1,344.0**	**1,360.9**	**1,345.8**	**1,330.6**	**1,351.5**	**1,380.9**	**1,401.3**	**1,411.4**	**1,463.0**
Electric utility sector													
Electric utility	427.9	438.9	435.4	452.6	475.9	484.0	477.0	473.7	472.9	490.3	494.0	493.7	516.8

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1996*, Washington, DC, October 1997, p. 8, and annual. (Additional resources: http://www.eia.doe.gov)

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

Table 3.6
U.S. Carbon Dioxide Emissions from Energy Use in the Transportation Sector, 1980–96
(million metric tons of carbon)

Fuel	1980		1985		1990		1995		1996	
	Emissions	Percentage	Emissions	Percentage	Emissions	Percentage	Emissions	Percentage	Emissions	Percentage
Petroleum										
Motor gasoline	238.1	62.9%	245.1	63.8%	260.9	60.4%	282.2	61.5%	286.7	61.1%
LPG[a]	0.3	0.1%	0.5	0.1%	0.4	0.1%	0.6	0.1%	0.6	0.1%
Jet fuel	42.0	11.1%	48.0	12.5%	60.1	13.9%	60.0	13.1%	62.7	13.4%
Distillate fuel	55.3	14.6%	63.3	16.5%	75.7	17.5%	83.8	18.3%	88.2	18.8%
Residual fuel	30.0	7.9%	16.7	4.3%	21.9	5.1%	18.5	4.0%	17.3	3.7%
Lubricants	1.8	0.5%	1.6	0.4%	1.8	0.4%	1.7	0.4%	1.6	0.3%
Aviation gas	1.2	0.3%	0.9	0.2%	0.8	0.2%	0.7	0.2%	0.7	0.1%
Total	**368.7**	97.4%	**376.1**	97.8%	**421.5**	97.5%	**447.5**	97.6%	**457.9**	97.6%
Other energy										
Natural gas	9.4	2.5%	7.5	2.0%	9.8	2.3%	10.4	2.3%	10.5	2.2%
Electricity	0.3	0.1%	0.7	0.2%	0.7	0.2%	0.6	0.1%	0.7	0.1%
Total	**378.4**	100.0%	**384.4**	100.0%	**432.1**	100.0%	**458.5**	100.0%	**469.0**	61.1%

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1996*, Washington, DC, October 1997, p. 20, and annual. (Additional resources: http://www.eia.doe.gov)

[a]Liquified petroleum gas.

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

Table 3.7
Numerical Estimates of Global Warming Potentials Compared With Carbon Dioxide
(kilogram of gas per kilogram of carbon dioxide)

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

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States 1996*, Washington, DC, October 1997, p. 7. Original source: Intergovernmental Panel on Climate Change. (Additional resources: http://www.eia.doe.gov, http://www.ipcc.ch)

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

Table 3.8
Total National Emissions of the Criteria Air Pollutants by Sector, 1996
(millions of short tons/percentage)

Sector	CO	NO_x	VOC	PM-10	SO_2
Highway vehicles	**52.94**	**7.17**	**5.50**	**0.27**	**0.31**
	59.6%	*30.7%*	*28.8%*	*0.9%*	*1.6%*
Aircraft	**0.95**	**0.17**	**0.18**	**0.04**	**0.01**
	1.1%	*0.7%*	*0.9%*	*0.1%*	*0.1%*
Railroads	**0.11**	**0.92**	**0.05**	**0.03**	**0.24**
	0.1%	*3.9%*	*0.3%*	*0.1%*	*1.2%*
Vessels	**0.08**	**0.23**	**0.05**	**0.03**	**0.11**
	0.1%	*1.0%*	*0.3%*	*0.1%*	*0.6%*
Other off-highway	**15.86**	**3.29**	**2.15**	**0.49**	**0.01**
	17.9%	*14.1%*	*11.3%*	*1.6%*	*0.0%*
Transportation total	**69.95**	**11.78**	**7.93**	**0.87**	**0.68**
	78.7%	*50.4%*	*41.5%*	*2.8%*	*3.5%*
Stationary source fuel combustion	**5.96**	**10.49**	**1.08**	**1.19**	**16.79**
	6.7%	*44.9%*	*5.6%*	*3.8%*	*87.8%*
Industrial processes	**4.62**	**0.78**	**9.05**	**0.94**	**1.60**
	5.2%	*3.3%*	*47.4%*	*3.0%*	*8.4%*
Waste disposal and recycling total	**1.20**	**0.10**	**0.43**	**0.29**	**0.05**
	1.4%	*0.4%*	*2.3%*	*0.9%*	*0.3%*
Miscellaneous	**7.10**	**0.24**	**0.60**	**28.02**	**0.01**
	8.0%	*1.0%*	*3.1%*	*89.5%*	*0.0%*
Total of all sources	**88.83**	**23.29**	**19.08**	**31.30**	**19.11**
	100.0%	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source:
All other–U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1996*, 1997, Appendix A. (Additional resources: http://www.epa.gov/oar/oaqps)

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

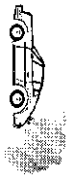


Table 3.9
Total National Emissions of Carbon Monoxide, 1940–96[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1994	1995	1996	Percent of total, 1996
Highway vehicles	30.12	45.20	64.27	88.03	78.05	57.85	61.83	54.11	52.94	59.6%
Aircraft	0.00	0.93	1.76	0.51	0.74	0.90	0.92	0.94	0.95	1.1%
Railroads	4.08	3.08	0.33	0.07	0.10	0.12	0.11	0.11	0.11	0.1%
Vessels[b]	0.06	0.12	0.52	0.01	0.04	0.08	0.08	0.08	0.08	0.1%
Other off-highway	3.91	7.48	8.96	10.70	12.88	15.01	15.76	15.70	15.86	17.9%
Transportation total	38.17	56.81	69.87	99.32	91.81	73.97	78.71	70.95	69.95	78.7%
Stationary fuel combustion total	15.33	11.32	7.02	4.63	7.30	5.51	5.52	5.93	5.96	6.7%
Industrial processes total	7.28	11.64	10.28	9.84	6.95	4.77	4.61	4.61	4.62	5.2%
Waste disposal and recycling total	3.63	4.72	5.60	7.06	2.30	1.08	1.23	1.19	1.20	1.4%
Miscellaneous total	29.21	18.14	11.01	7.91	8.34	11.21	9.61	7.05	7.10	8.0%
Total of all sources	**93.62**	**102.61**	**109.75**	**128.76**	**116.70**	96.54	99.68	89.72	88.83	100.0%

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1996*, 1997, pp. A-2–A-6, and annual.
(Additional resources: http://www.epa/oar/oaqps)

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

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

Table 3.10
Total National Emissions of Nitrogen Oxides, 1940–96[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1994	1995	1996	Percent of total, 1996
Highway vehicles	1.33	2.14	3.98	7.39	8.62	7.04	7.67	7.32	7.17	30.7%
Railroads	0.66	0.99	0.77	0.50	0.73	0.93	0.95	0.99	0.92	3.9%
Other off-highway	0.33	0.55	0.67	2.15	3.29	3.66	4.00	3.69	3.69	15.8%
Transportation total	2.32	3.68	5.43	10.03	12.64	11.63	12.62	12.00	11.78	50.4%
Stationary fuel combustion total	3.73	5.16	7.37	10.06	11.32	10.89	11.02	10.83	10.49	44.9%
Industrial processes total	0.22	0.38	0.57	0.78	0.56	0.80	0.77	0.77	0.78	3.3%
Waste disposal and recycling total	0.11	0.22	0.33	0.44	0.11	0.09	0.11	0.10	0.10	0.4%
Miscellaneous total	0.99	0.67	0.44	0.33	0.25	0.37	0.38	0.24	0.24	1.0%
Total of all sources	**7.37**	**10.09**	**14.14**	**21.64**	**24.88**	**23.79**	**24.89**	**23.93**	**23.39**	**100.0%**

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1996*, 1997, pp. A-7–A-11, and annual.
(Additional resources: http://www.epa/oar/oaqps)

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

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

Table 3.11
Emissions of Nitrogen Oxides from Highway Vehicles, 1970–96[a]
(million short tons)

Source category	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	Percent of total, 1996
Gasoline powered												
Light-duty vehicles & motorcycles	4.16	4.73	4.42	3.81	3.22	3.46	3.61	3.68	3.57	3.44	3.40	47.4%
Light-duty trucks[b]	1.28	1.46	1.41	1.53	1.26	1.34	1.36	1.42	1.66	1.52	1.51	21.1%
Heavy-duty vehicles	0.28	0.32	0.30	0.33	0.33	0.33	0.31	0.32	0.35	0.33	0.33	4.5%
Total	5.71	6.51	6.13	5.67	4.80	5.13	5.28	5.42	5.58	5.30	5.24	73.0%
Diesel powered												
Light-duty vehicles	[c]	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.5%
Light-duty trucks[b]	[c]	[c]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.1%
Heavy-duty vehicles	1.68	2.12	2.46	2.39	2.19	2.20	2.12	2.05	2.04	1.98	1.88	26.3%
Total	1.68	2.14	2.49	2.42	2.24	2.24	2.16	2.09	2.09	2.03	1.93	27.0%
Total												
Highway vehicle total	**7.39**	**8.65**	**8.62**	**8.09**	**7.04**	**7.37**	**7.44**	**7.51**	**7.67**	**7.32**	**7.17**	**100.0%**
Percent diesel	22.7%	24.8%	28.9%	30.0%	31.8%	30.4%	29.1%	27.9%	27.3%	27.7%	27.0%	

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1996*, 1997, p. A-10 and annual.
(Additional resources: http://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.

Table 3.12
Total National Emissions of Volatile Organic Compounds, 1940–96[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1994	1995	1996	Percent of total, 1996
Highway vehicles	4.82	7.25	10. 51	12.97	8.98	6.31	6.40	5.70	5.50	28.8%
Off-highway	0.78	1.21	1.22	1.71	2.14	2.50	2.62	2.43	2.43	12.7%
Transportation total	5.60	8.46	11.73	14.69	11.12	8.82	9.02	8.13	7.93	41.5%
Stationary fuel combustion total	1.98	1.44	0.88	0.72	1.05	1.01	0.99	1.07	1.08	5.6%
Industrial processes total	4.52	7.40	8.73	12.33	12.10	9.01	9.69	9.71	9.05	47.4%
Waste disposal and recycling total	0.99	1.10	1.55	1.98	0.76	0.99	1.05	1.07	0.43	2.3%
Miscellaneous total	4.08	2.53	1.57	1.10	1.13	1.16	0.80	0.60	0.60	3.1%
Total of all sources	**17.16**	**20.94**	**24.46**	**30.82**	**26.17**	**20.98**	**21.55**	**20.59**	**19.08**	**100.0%**

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1996*, 1997, pp. A-12–A-18, and annual.
(Additional resources: http://www.epa.gov/oar/oaqps)

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

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

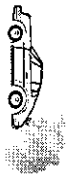


Table 3.13
Total National Emissions of Particulate Matter (PM-10), 1940–96[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1994	1995	1996	Percent of total, 1996
Highway vehicles	0.21	0.31	0.55	0.44	0.40	0.34	0.32	0.29	0.27	0.9%
Off-highway	2.48	1.79	0.20	0.37	0.57	0.60	0.65	0.59	0.59	1.9%
Transportation total	2.69	2.10	0.76	0.81	0.96	0.93	0.97	0.88	0.87	2.8%
Stationary fuel combustion total	4.01	3.75	3.56	2.87	2.45	1.20	1.11	1.18	1.19	3.8%
Industrial processes total	5.90	8.85	9.24	7.67	2.75	1.04	0.91	0.95	0.94	3.0%
Waste disposal and recycling total	0.39	0.51	0.76	1.00	0.27	0.27	0.31	0.29	0.29	0.9%
Miscellaneous total	2.97	1.93	1.24	0.84	0.85	26.51	27.62	23.60	28.02	89.5%
Total of all sources	**15.96**	**17.13**	**15.56**	**13.19**	**7.29**	**29.95**	**30.92**	**26.89**	**31.30**	**100.0%**

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1996*, 1997, pp. A-23–A-27, and annual.
(Additional resources: http:/www.epa.gov/oar/oaqps)

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

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

Table 3.14
Emissions of Particulate Matter (PM-10) from Highway Vehicles, 1970–96[a]
(thousand short tons)

Source category	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	Percent of total, 1996
Gasoline powered												
Light-duty vehicles & motorcycles	225	207	120	77	61	63	64	65	62	62	63	23.0%
Light-duty trucks[b]	70	72	55	43	30	32	31	31	35	32	31	11.3%
Heavy-duty vehicles	13	15	15	14	10	10	9	10	10	9	9	3.3%
Total	308	294	190	134	101	105	104	106	107	103	103	37.6%
Diesel powered												
Light-duty vehicles	[c]	10	12	8	9	9	9	8	8	8	8	2.9%
Light-duty trucks[b]	[c]	[c]	2	1	1	2	2	2	2	2	2	0.7%
Heavy-duty vehicles	136	166	194	219	224	234	228	205	204	181	162	59.1%
Total	136	176	208	228	234	245	239	215	214	191	172	62.8%
Total												
Highway vehicle total	**443**	**471**	**397**	**363**	**336**	**349**	**343**	**321**	**320**	**293**	**274**	**100.0%**
Percent diesel	30.7%	37.4%	52.4%	62.8%	69.6%	70.2%	69.7%	67.0%	66.9%	65.2%	62.8%	

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1996*, 1997, p. A-26 and annual.
(Additional resources: http://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.

Table 3.15
Estimates of Particulate Matter, 1990
$PM_{2.5}$ versus PM_{10} (tons)

Source category	$PM_{2.5}$	PM_{10}	$PM_{2.5}$ / PM_{10} Ratio
Electric utility-coal	99,402	268,779	37%
Electric utility-oil & gas	6,539	11,413	57%
Fuel combustion-industrial	176,607	248,974	71%
Fuel combustion-commercial & institutional	14,763	35,079	42%
Residential wood combustion	477,431	477,431	100%
Chemical & allied product manufacturing	41,811	61,537	68%
Metals processing	96,429	138,096	70%
Petroleum & related industries	20,797	30,112	69%
Other industrial processes[a]	250,536	408,632	61%
Solvent use	1,807	2,134	85%
Storage & transport (oil/chemicals)	26,489	64,319	41%
Waste disposal & recycling[b]	197,251	226,085	87%
Highway vehicles-gasoline	66,467	106,720	62%
Highway vehicles-diesel	226,207	250,018	90%
Nonroad gas engines	35,034	42,141	83%
Nonroad diesel engines	170,787	185,638	92%
Boats, aircraft & railroads	86,303	108,564	79%
Agricultural & prescribed burning	464,836	541,570	86%
Other combustion[c]	563,643	624,825	90%
Wind erosion-agricultural lands	777,715	8,184,785	15%
Paved roads	1,497,964	8,991,858	25%
Unpaved roads	1,700,367	11,335,782	15%
Construction	1,662,280	8,311,402	20%
Agricultural tilling	1,382,009	6,910,045	20%
Agricultural feedlots	60,257	401,715	15%
Miscellaneous fugitive dust	667	3,571	19%
Biogenic	0	0	0%
Total	**10,122,486**	**41,991,504**	**24%**

Source:
E. H. Pechan & Associates, *National PM Study: OPPE Particulate Programs Implementation Evaluation System*, Final Report to EPA, September 1994; and E.H. Pechan & Associates, *Updates to Fugitive Emission Components of the National Particulate Inventory*, January 1996.
(Additional resources: http://www.pechan.com)

Note: Selected source categories appear in this table, therefore, total is not the sum of the column.

[a]Other Industrial Processes includes the wood, pulp and paper industry, and mineral products industries, and other categories.

[b]Waste Disposal and Recycling includes incineration and open burning.

[c]Other Combustion includes wildfires and prescribed burning.

Table 3.16
National Lead Emission Estimates, 1970–96[a]
(thousand short tons per year)

Source category	1970	1975	1980	1985	1990	1994	1995	1996	Percent of total, 1996
Highway vehicles	171.96	130.21	60.50	18.05	0.42	0.02	0.02	0.02	0.5%
Off-highway	9.74	6.13	4.21	0.92	0.78	0.53	0.55	0.55	14.1%
Transportation total	181.70	136.34	64.71	18.97	1.20	0.54	0.56	0.56	14.6%
Stationary source fuel combustion	10.62	10.35	4.30	0.52	0.50	0.49	0.49	0.49	12.7%
Industrial processes	26.36	11.38	3.94	2.53	2.47	2.18	2.27	2.17	56.2%
Waste disposal and recycling total	2.20	1.60	1.21	0.87	0.80	0.83	0.62	0.64	16.5%
Total of all sources	**220.87**	**159.66**	**74.15**	**22.89**	**4.98**	**4.04**	**3.94**	**3.87**	**100.0%**

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1996*, 1997, pp. A-28–A-29, and annual.
(Additional resources: http://www.epa.gov/oar/oaqps)

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

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

The results of the most recent version (Version 1.4) of the GREET model are displayed in the next two tables. The model estimates the full fuel-cycle emissions and energy use associated with various transportation fuels and advanced transportation technologies for light-duty vehicles. It calculates fuel-cycle emissions of 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 elcctricity;
- 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.

Near-term technologies are ones which may be applied to 2000 model-year cars and long-term technologies are ones which may be applied to 2010 model-year cars.

For additional information about the GREET model, contact:

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Acronyms Used on Tables 3.17 and 3.18

Emissions acronyms (both tables)

VOC - volatile organic compounds
CO - carbon monoxide
NOx - nitrogen oxides
PM10 - particulate matter measuring 10 microns or less
SOx - sulfur oxides
GHGs - greenhouse gases
CH4 - methane
N2O - nitrous oxide
CO2 - carbon dioxide

Near-term technology acronyms (Table 3.17)

FRFG2	Federal Phase 2 reformulated gasoline
CARFG2	California Phase 2 reformulated gasoline
Conv. CI: CD	Conventional compression ignition engines fueled with conventional diesel
CIDI: CD	Compression ignition, direct injection engines fueled with conventional diesel
CNG: bi-fuel	Bi-fuel CNG vehicles
CNG: dedicated	Dedicated CNG vehicles
MeOH FFV: M85	Methanol flexible-fuel vehicles fueled with M85
LPG: converted, NG	Aftermarket converted LPG vehicles fueled with LPG produced from natural gas
LPG: converted, crude	Aftermarket converted LPG vehicles fueled with LPG produced from crude
EtOH FFV, E85, corn	Ethanol flexible-fueled vehicles fueled with E85, ethanol produced from corn
E10, corn	Gasoline vehicles fueled with E10, ethanol produced from corn
EV: U.S. mix	Electric vehicles with the U.S. electric generation mix
EV: CA mix	Electric vehicles with the California electric generation mix
EV: U.S. NE mix	Electric vehicles with the northeast U.S. electric generation mix
Grid C. HEV: FRFG2, US mix	Grid-connected hybrid electric vehicles with federal Phase 2 reformulated gasoline and the U.S. electric generation mix
Grid C. HEV: CARFG2, CA mix	Grid-connected hybrid electric vehicles with California Phase 2 reformulated gasoline and the California electric generation mix
Grid I. HEV, FRFG2	Grid-independent hybrid electric vehicles with federal Phase 2 reformulated gasoline
Grid I. HEV, CD	Grid-independent hybrid electric vehicles with conventional diesel

Long-term technology acronyms (Table 3.18)

SIDI: FRFG2	Spark ignition, direction injection engines fueled with federal Phase 2 reformulated gasoline
SIDI: CARFG2	Spark ignition, direction injection engines fueled with California Phase 2 reformulated gasoline
Conv. CI: RFD	Conventional compression ignition engines fueled with reformulated diesel
CIDI; RFD	Compression ignition, direct injection engines fueled with reformulated diesel
CIDI: FTD50	Compression ignition, direct injection engines fueled with the blend of 50% Fischer-Tropsch diesel and 50% conventional diesel
CIDI: BD20	Compression ignition, direct injection engines fueled with blend of 20% biodiesel and 80% of conventional diesel
CIDI: DME	Compression ignition, direct injection engines fueled with dimethyl ether
CNG: dedicated	Dedicated CNG vehicles
LNG	Liquefied natural gas vehicles
MeOH dedicated: M95	Methanol dedicated vehicles fueled with M95
LPG: OEM, NG	OEM-produced LPG vehicles fueled with LPG produced from natural gas
LPG: OEM, crude	OEM-produced LPG vehicles fueled with LPG produced from crude
Dedi. E95, corn	Ethanol dedicated vehicles fueled with E95, ethanol produced from corn
Dedi. E95, W. biomass	Ethanol dedicated vehicles fueled with E95, ethanol produced from woody biomass
Dedi. E95, H. biomass	Ethanol dedicated vehicles fueled with E95, ethanol produced from herbaceous biomass
EV: U.S. mix	Electric vehicles with the U.S. electric generation mix
EV: CA mix	Electric vehicles with the California electric generation mix
EV: U.S. NE mix	Electric vehicles with the northeast U.S. electric generation mix
Grid C. HEV: FRFG2, US mix	Grid-connected hybrid electric vehicles with federal Phase 2 reformulated gasoline and the U.S. electric generation mix
Grid C. HEV: CARFG2, CA mix	Grid-connected hybrid electric vehicles with California Phase 2 reformulated gasoline and the California electric generation mix
Grid C. HEV: NG, US mix	Grid-connected hybrid electric vehicles with natural gas and the U.S. electric generation mix
Grid C. HEV: NG, CA mix	Grid-connected hybrid electric vehicles with natural gas and the California electric generation mix
Grid I. HEV, FRFG2	Grid-independent hybrid electric vehicles with federal Phase 2 reformulated gasoline
Grid I. HEV, NG	Grid-independent hybrid electric vehicles with natural gas
Grid I. HEV, FRFG2	Grid-independent hybrid electric vehicles with reformulated diesel
H2 FCV, NG	Hydrogen fuel-cell vehicles, hydrogen from natural gas
H2 FCV, solar	Hydrogen fuel-cell vehicles, hydrogen from solar energy
MeOH FCV	Methanol fuel-cell vehicles
FRFG2 FCV	Fuel-cell vehicles fueled with federal Phase 2 reformulated gasoline
EtOH FCV, corn	Ethanol fuel-cell vehicles, ethanol produced from corn
EtOH FCV, W. biomass	Ethanol fuel-cell vehicles, ethanol produced from woody biomass
EtOH FCV, H. biomass	Ethanol fuel-cell vehicles, ethanol produced from herbaceous biomass
NG FCV	Natural gas fuel-cell vehicles

Table 3.17
Changes in Per-Mile, Fuel-Cycle Energy Use and Emissions for Passenger Cars using Near-Term Technologies
(Percentage relative to conventional gasoline vehicles fueled with conventional gasoline)

	FRFG2	CARFG2	Conv. CI: CD	CIDI: CD	CNG: bi-fuel	CNG: dedicated	MeOH FFV: M85	LPG: converted, NG	LPG: converted, crude
Total energy	2.6%	2.6%	-13.6%	-30.9%	3.3%	1.1%	18.5%	-9.6%	-8.6%
Fossil fuels	2.5%	2.5%	-13.5%	-30.8%	2.0%	-0.1%	19.2%	-9.2%	-8.6%
Petroleum	1.4%	1.4%	-11.5%	-29.2%	-99.3%	-99.4%	-72.6%	-98.2%	-5.0%
VOC: Total	-23.3%	-24.2%	-25.2%	-26.1%	-56.6%	-86.7%	-20.7%	-53.7%	-52.1%
VOC: Urban	-25.2%	-26.2%	-23.6%	-23.8%	-56.7%	-89.2%	-19.8%	-52.1%	-52.8%
CO: Total	-19.7%	-27.6%	-81.5%	-81.7%	-51.0%	-58.9%	-43.2%	-20.0%	-19.9%
CO: Urban	-20.0%	-28.0%	-82.2%	-82.2%	-51.7%	-59.7%	-44.0%	-20.0%	-20.0%
NOx: Total	-1.9%	-9.7%	82.7%	79.6%	-12.9%	-29.5%	2.9%	-8.4%	-6.0%
NOx: Urban	-4.9%	-14.7%	110.3%	110.0%	-28.5%	-48.4%	-0.4%	0.1%	0.2%
PM10: Total	2.4%	2.4%	172.1%	167.7%	-34.7%	-35.1%	-27.4%	-44.0%	-34.1%
PM10: Urban	-1.7%	-1.7%	261.3%	261.0%	-32.8%	-32.9%	-21.4%	-31.7%	-31.6%
SOx: Total	-8.4%	-15.6%	-23.4%	-38.7%	-38.2%	-39.5%	-55.9%	-77.1%	-56.3%
SOx: Urban	-58.4%	-83.0%	-5.4%	-24.4%	-95.8%	-95.9%	-70.0%	-97.9%	-97.8%
GHGs	0.7%	0.7%	-8.9%	-26.3%	-10.7%	-12.2%	-3.0%	-12.3%	-11.9%
CH4	1.4%	1.4%	-29.1%	-42.8%	307.8%	303.2%	2.1%	27.3%	-3.4%
N2O	1.5%	1.5%	-3.7%	-5.4%	-46.6%	-42.5%	-6.5%	-8.1%	-4.1%
CO2	0.6%	0.6%	-8.7%	-27.0%	-16.3%	-18.0%	-3.0%	-13.5%	-12.5%

Table continued on next page. See previous pages for acronym definitions.

Table 3.17 (continued)
Changes in Per-Mile, Fuel-Cycle Energy Use and Emissions for Passenger Cars using Near-Term Technologies
(Percentage relative to conventional gasoline vehicles fueled with conventional gasoline)

	EtOH FFV, E85, corn	E10, corn	EV: U.S. mix	EV: CA mix	EV: U.S. NE mix	Grid C. HEV: FRFG2, US mix	Grid C. HEV: CARFG2, CA mix	Grid I. HEV: FRFG2	Grid I. HEV: CD
Total energy	19.9%	2.2%	-26.6%	-28.1%	-26.1%	-30.1%	-30.6%	-31.6%	-42.4%
Fossil fuels	-40.2%	-3.2%	-48.5%	-72.7%	-53.7%	-36.7%	-44.0%	-31.6%	-42.3%
Petroleum	-73.6%	-6.2%	-98.5%	-99.6%	-97.3%	-52.2%	-52.6%	-32.4%	-41.0%
VOC: Total	11.1%	6.9%	-98.1%	-98.8%	-98.0%	-44.3%	-44.5%	-21.2%	-40.8%
VOC: Urban	-14.5%	5.1%	-99.9%	-99.8%	-99.7%	-44.2%	-44.2%	-20.4%	-39.0%
CO: Total	-24.0%	-31.3%	-99.2%	-99.4%	-99.1%	-54.9%	-55.0%	-35.9%	-85.3%
CO: Urban	-27.9%	-32.0%	-99.9%	-99.8%	-99.8%	-55.2%	-55.1%	-36.0%	-85.8%
NOx: Total	36.0%	5.5%	-14.8%	-80.2%	-46.4%	-19.5%	-39.0%	-21.5%	44.1%
NOx: Urban	-26.2%	0.3%	-97.8%	-96.1%	-95.3%	-43.5%	-43.0%	-20.2%	68.0%
PM10: Total	49.3%	6.0%	68.7%	-32.2%	18.2%	11.4%	-18.3%	-13.1%	123.4%
PM10: Urban	-18.0%	0.3%	-34.8%	-33.0%	-31.5%	-15.8%	-15.3%	-7.7%	201.4%
SOx: Total	162.7%	15.2%	395.3%	-17.3%	201.0%	88.0%	-38.7%	-38.9%	-49.0%
SOx: Urban	-78.4%	-6.7%	-93.4%	-98.1%	-83.6%	-90.1%	-91.6%	-72.3%	-37.0%
GHGs	-22.2%	-1.6%	-35.5%	-74.5%	-49.7%	-33.2%	-45.0%	-32.2%	-38.7%
CH4	31.8%	2.4%	20.0%	-39.6%	2.5%	-14.2%	-32.1%	-28.8%	-52.4%
N2O	167.8%	15.3%	21.0%	-82.0%	-32.8%	-8.1%	-38.8%	-20.6%	-24.1%
CO2	-33.8%	-2.6%	-39.9%	-74.9%	-51.8%	-35.0%	-45.6%	-33.0%	-39.2%

Source:
Wang, Michael Q., GREET Model Results, Argonne National Laboratory, Argonne, IL, September 1998.

Note:
See previous pages for acronym definitions.

Table 3.18
Changes in Per-Mile, Fuel-Cycle Energy Use and Emissions for Passenger Cars using Long-Term Technologies
(Percentage relative to conventional gasoline vehicles fueled with conventional gasoline)

	FRFG2	CARFG2	Conv. CI: CD	CIDI: CD	CNG: bi-fuel	CNG: dedicated	MeOH FFV: M85	LPG: converted, NG	LPG: converted, crude
Total energy	2.6%	2.6%	-13.6%	-30.9%	3.3%	1.1%	18.5%	-9.6%	-8.6%
Fossil fuels	2.5%	2.5%	-13.5%	-30.8%	2.0%	-0.1%	19.2%	-9.2%	-8.6%
Petroleum	1.4%	1.4%	-11.5%	-29.2%	-99.3%	-99.4%	-72.6%	-98.2%	-5.0%
VOC: Total	-23.3%	-24.2%	-25.2%	-26.1%	-56.6%	-86.7%	-20.7%	-53.7%	-52.1%
VOC: Urban	-25.2%	-26.2%	-23.6%	-23.8%	-56.7%	-89.2%	-19.8%	-52.1%	-52.8%
CO: Total	-19.7%	-27.6%	-81.5%	-81.7%	-51.0%	-58.9%	-43.2%	-20.0%	-19.9%
CO: Urban	-20.0%	-28.0%	-82.2%	-82.2%	-51.7%	-59.7%	-44.0%	-20.0%	-20.0%
NOx: Total	-1.9%	-9.7%	82.7%	79.6%	-12.9%	-29.5%	2.9%	-8.4%	-6.0%
NOx: Urban	-4.9%	-14.7%	110.3%	110.0%	-28.5%	-48.4%	-0.4%	0.1%	0.2%
PM10: Total	2.4%	2.4%	172.1%	167.7%	-34.7%	-35.1%	-27.4%	-44.0%	-34.1%
PM10: Urban	-1.7%	-1.7%	261.3%	261.0%	-32.8%	-32.9%	-21.4%	-31.7%	-31.6%
SOx: Total	-8.4%	-15.6%	-23.4%	-38.7%	-38.2%	-39.5%	-55.9%	-77.1%	-56.3%
SOx: Urban	-58.4%	-83.0%	-5.4%	-24.4%	-95.8%	-95.9%	-70.0%	-97.9%	-97.8%
GHGs	0.7%	0.7%	-8.9%	-26.3%	-10.7%	-12.2%	-3.0%	-12.3%	-11.9%
CH4	1.4%	1.4%	-29.1%	-42.8%	307.8%	303.2%	2.1%	27.3%	-3.4%
N2O	1.5%	1.5%	-3.7%	-5.4%	-46.6%	-42.5%	-6.5%	-8.1%	-4.1%
CO2	0.6%	0.6%	-8.7%	-27.0%	-16.3%	-18.0%	-3.0%	-13.5%	-12.5%

Table continued on next page. See previous pages for acronym definitions.

Table 3.18 (continued)
Changes in Per-Mile, Fuel-Cycle Energy Use and Emissions for Passenger Cars using Long-Term Technologies
(Percentage relative to conventional gasoline vehicles fueled with conventional gasoline)

	EtOH FFV, E85, corn	E10, corn	EV: U.S. mix	EV: CA mix	EV: U.S. NE mix	Grid C. HEV: FRFG2, US mix	Grid C. HEV: CARFG2, CA mix	Grid I. HEV: FRFG2	Grid I. HEV: CD
Total energy	19.9%	2.2%	-26.6%	-28.1%	-26.1%	-30.1%	-30.6%	-31.6%	-42.4%
Fossil fuels	-40.2%	-3.2%	-48.5%	-72.7%	-53.7%	-36.7%	-44.0%	-31.6%	-42.3%
Petroleum	-73.6%	-6.2%	-98.5%	-99.6%	-97.3%	-52.2%	-52.6%	-32.4%	-41.0%
VOC: Total	11.1%	6.9%	-98.1%	-98.8%	-98.0%	-44.3%	-44.5%	-21.2%	-40.8%
VOC: Urban	-14.5%	5.1%	-99.9%	-99.8%	-99.7%	-44.2%	-44.2%	-20.4%	-39.0%
CO: Total	-24.0%	-31.3%	-99.2%	-99.4%	-99.1%	-54.9%	-55.0%	-35.9%	-85.3%
CO: Urban	-27.9%	-32.0%	-99.9%	-99.8%	-99.8%	-55.2%	-55.1%	-36.0%	-85.8%
NOx: Total	36.0%	5.5%	-14.8%	-80.2%	-46.4%	-19.5%	-39.0%	-21.5%	44.1%
NOx: Urban	-26.2%	0.3%	-97.8%	-96.1%	-95.3%	-43.5%	-43.0%	-20.2%	68.0%
PM10: Total	49.3%	6.0%	68.7%	-32.2%	18.2%	11.4%	-18.3%	-13.1%	123.4%
PM10: Urban	-18.0%	0.3%	-34.8%	-33.0%	-31.5%	-15.8%	-15.3%	-7.7%	201.4%
SOx: Total	162.7%	15.2%	395.3%	-17.3%	201.0%	88.0%	-38.7%	-38.9%	-49.0%
SOx: Urban	-78.4%	-6.7%	-93.4%	-98.1%	-83.6%	-90.1%	-91.6%	-72.3%	-37.0%
GHGs	-22.2%	-1.6%	-35.5%	-74.5%	-49.7%	-33.2%	-45.0%	-32.2%	-38.7%
CH4	31.8%	2.4%	20.0%	-39.6%	2.5%	-14.2%	-32.1%	-28.8%	-52.4%
N2O	167.8%	15.3%	21.0%	-82.0%	-32.8%	-8.1%	-38.8%	-20.6%	-24.1%
CO2	-33.8%	-2.6%	-39.9%	-74.9%	-51.8%	-35.0%	-45.6%	-33.0%	-39.2%

Source:
Wang, Michael Q., GREET Model Results, Argonne National Laboratory, Argonne, IL, September 1998.

Note:
See previous pages for acronym definitions.

The Clean Air Act of 1963 and its subsequent amendments set national air quality standards for all new cars and light trucks sold. The most recent amendments in 1990 established more restrictive emission control standards which became effective in 1994.

Table 3.19
Federal Emission Control Requirements for Automobiles and Light Trucks, 1968–98[a]
(grams per mile)

Model Year	Automobiles				Light trucks[b]			
	Hydrocarbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO_x)	Particulates[c]	Hydrocarbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO_x)	Particulates[c]
1968–71	4.10	34.0	[d]	[d]	8.0	102.0	3.6	[d]
1972–74	3.00	28.0	3.1	[d]	8.0	102.0	3.6	[d]
1975–76	1.50	15.0	3.1	[d]	2.0	20.0	3.1	[d]
1977–78	1.50	15.0	2.0	[d]	2.0	20.0	3.1	[d]
1979	1.50	15.0	2.0	[d]	1.7	18.0	2.3	[d]
1980	0.41	7.0	2.0	[d]	1.7	18.0	2.3	[d]
1981	0.41	3.4	1.0	[d]	1.7	18.0	2.3	[d]
1982–83	0.41	3.4	1.0	0.60	1.7	18.0	2.3	0.60
1984–86	0.41	3.4	1.0	0.60	0.8	10.0	2.3	0.60
1987	0.41	3.4	1.0	0.20	0.8	10.0	2.3	0.26
1988–93	0.41	3.4	1.0	0.20	0.8	10.0	1.2[e]	0.26
1994	0.25	3.4	0.4	0.08	0.25	3.4[e]	1.2[e]	0.26
1995–on	0.25	3.4	0.4	0.08	0.25	3.4[e]	0.4[f]	0.08

Source:
1968–75: Motor Vehicle Manufacturers Association, *Motor Vehicle Facts & Figures '85*, 1985, p. 88.
1976–93: *Code of Federal Regulations* 40CFR86, "Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines: Certification and Testing Procedures," July 1, 1987 edition, p. 264.
1994–on: Clean Air Act Amendments of 1990.

[a] California standards not included.
[b] Applies to trucks under 6,000 pounds gross vehicle weight rating (GVWR) until model year 1978 and under 8,500 pounds GVWR beginning in model year 1979.
[c] Applies to diesel engines only.
[d] No standard was set for this year.
[e] Applies to light trucks up to and including 3,750 pounds loaded vehicle weight (LVW).
[f] Applies to light trucks up to and including 3,750 pounds LVW. Does not apply to diesel-fueled light trucks.

Table 3.20
Federal Emission Control Requirements for Heavy-Duty Gasoline Trucks, 1974–98[a]
(grams per brake horsepower hour)

Model Year	Hydrocarbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO_x)	Hydrocarbons + nitrogen oxides (HC + NO_x)
1974–78	[b]	40.0	[b]	16.0
1979–83	1.5	25.0	[b]	10.0
1984	1.3	15.5	10.7	[b]
1985–86	2.5	40.0	10.7	[b]
1987–89	1.9	37.1	10.6	[b]
1990	1.9	37.1	6.0	[b]
1991–93	1.9	37.1	5.0	[b]
1994	1.9[c]	37.1	5.0[c]	[b]
1995–97	1.9[c]	37.1[c]	5.0[c]	[b]
1998-on	1.9[c]	37.1[c]	4.0[c]	[b]

Source:
1974–75: MVMA, *Motor Vehicle Facts & Figures '85*, 1985, p. 88.
1976–93: *Code of Federal Regulations*, 40CFR86, "Control of Air Pollution from New Motor Vehicles and New Motor Vehicles Engines: Certification and Testing Procedures," July 1, 1987, p. 264.
1994–on: Clean Air Act Amendments of 1990.

Table 3.21
Federal Emission Control Requirements for Heavy-Duty Diesel Trucks, 1976–98[d]
(grams per brake horsepower hour)

Model Year	Hydrocarbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO_x)	Hydrocarbons + nitrogen oxides (HC + NO_x)	Particulates
1976–78	[b]	40.0	[b]	16.0	[b]
1979–83	1.5	25.0	[b]	10.0	[b]
1984	1.3	15.5	10.7	5.0	[b]
1985–87	1.3	15.5	10.7	[b]	[b]
1988–89	1.3	15.5	10.7	[b]	0.60
1990	1.3	15.5	6.0	[b]	0.60
1991–93	1.3	15.5	5.0	[b]	0.25
1994–97	1.3[c]	15.5	5.0	[b]	0.10
1998-on	1.3[c]	15.5[c]	4.0[c]	[b]	0.10[c]

Source:
1976–93: *Code of Federal Regulations*, 40CFR86, "Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines: Certification and Testing Procedures," July 1, 1987, p. 264.
1994–on: Clean Air Act Amendments of 1990.

[a]Applies to trucks greater than 6,000 pounds gross vehicle weight until model year 1978, greater than 8,500 pounds gross vehicle weight for model years 1979–1986, and greater than 14,000 pounds gross vehicle weight starting in 1987.

[b]No standard was set for this year.

[c]Heavy-duty trucks must meet these standards or standards which reflect the greatest degree of emission reduction achievable through the application of the technology available.

[d]Applies to trucks greater than 6,000 pounds gross vehicle weight through model year 1978 and to trucks greater than 8,500 pounds gross vehicle weight beginning in model year 1979.

Table 3.22
Light-Duty Vehicles and Trucks Federal Emission Certification Standards
(grams/mile)

Vehicle Type	Emission Category	Vehicle Useful Life											
		5 Years / 50,000 Miles						10 Years / 100,000 Miles					
		THC[a]	NMHC[b]	NMOG[c]	CO	NO_x	PM	THC[a]	NMHC[b]	NMOG[c]	CO	NO_x	PM
LDV	Tier 0	0.41	0.34[d]	–	3.4	1.0	0.20[e]						
	Tier 1	0.41	0.25	–	3.4	0.4[f]	0.08	–	0.31	–	4.2	0.6[g]	0.10
LDT1	Tier 0							0.80	0.67[d]	–	10	1.2	0.26[e]
	Tier 1	–	0.25	–	3.4	0.4[f]	0.08	0.80[h]	0.31	–	4.2	0.6[g]	0.10
LDT2	Tier 0							0.80	0.67[d]	–	10	1.7	0.13[e]
	Tier 1	–	0.32	–	4.4	0.7[i]	0.08	0.80[h]	0.40	–	5.5	0.97	0.10
		5 Years / 50,000 Miles						11 Years / 120,000 Miles					
LDT3	Tier 0							0.80	0.67[d]	–	10	1.7	0.26[e]
	Tier 1	–	0.32	–	4.4	0.7[i]	–	0.80	0.46	–	6.4	0.98	0.10
LDT4	Tier 0							0.80	0.67[d]	–	10	1.7	0.13[e]
	Tier 1	–	0.39	–	5.0	1.1[i]	–	0.80	0.56	–	7.3	1.53	0.12

Source:
U.S. Environmental Protection Agency, Office of Mobil Sources, EPA 420-B-98-001. (Additional resources: http://www.epa.gov/OMSWWW)

Note:
California standards, supplemental Federal Test Procedure standards, and Implementation schedules can be found on the Internet: http://www.epa.gov/OMSWWW/stds-ld.htm; LDV = passenger car or passenger car derivative; LDT1 = light-duty truck up through 3,750 lbs. loaded vehicle weight; LDT2 = light-duty truck greater than 3,750 lbs. loaded vehicle weight; LDT3 = light-duty truck with GVWR ≥ 6,000 lbs. and adjusted loaded vehicle weight ≤ 5,750 lbs.; LDT4 = light-duty truck with GVWR ≥ 6,000 lbs. and adjusted loaded vehicle weight ≥ 5,750 lbs.

[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] CNG vehicles only.
[e] Applies to diesel-fueled vehicles only.
[f] 1.0 for diesel-fueled vehicles through 2003 model year.
[g] 1.25 for diesel-fueled vehicles through 2003 model year.
[h] Standards apply at a useful life of 11 years / 120,000 miles.
[i] Does not apply to diesel-fueled vehicles.

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 standards for all new vehicles sold in California. Currently, there is a wide array of TLEVs and LEVs, and a few ULEVs 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 3.23
California Vehicle Emission Reduction for Passenger Cars and Light-Duty Trucks

	Emission reduction from the basic California standards[a]		
	HC	CO	NOx
Transitional Low-Emission Vehicle (TLEV)	50%	=	=
Low-Emission Vehicle (LEV)	70%	=	50%
Ultra-Low-Emission Vehicle (ULEV)	85%	50%	50%
Zero-Emission Vehicles (ZEV)	100%	100%	100%

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

Note:
= indicates equivalent emissions to vehicles meeting the basic California standard.

[a]California standards can be found on the Internet: http://www.epa.gov/OMSWWW/stds-ld.htm

The California Air Resources Board adopted requirements in 1991 for fleet mixture in order to meet the emission standards. By the year 2001, it is proposed that 90% of each vehicle manufacturer's fleet be low-emission vehicles. A March 1996 amendment to the plan allows the marketplace to determine the number of zero emission vehicles from 1998 to 2002.

Table 3.24
California Air Resources Board Requirements for Meeting Emission Standards

Year	Percent of manufacturers' fleet	Vehicle type[a]
1989	100	CV
1993	100	CV
1994	90	CV
	10	TLEV
1995	85	CV
	15	TLEV
1996	80	CV
	20	TLEV
1997	73	CV
	25	LEV
	2	ULEV
1998–2000	48	CV
	48	LEV
	2	ULEV
	[b]	ZEV
2001–2002	90	LEV
	5	ULEV
	[b]	ZEV
2003[c]	75	LEV
	15	ULEV
	10	ZEV

Source:
California Air Resources Board, Mobile Sources Division, El Monte, CA, 1996.
(Additional resources: http://www.arb.ca.gov)

[a]CV = Conventional vehicles
TLEV = Transitional low-emission vehicles
LEV = Low-emission vehicles
ULEV = Ultra-low-emission vehicles
ZEV = Zero emission vehicles
[b]According to revised regulations, the marketplace is to determine the amount of ZEVs that are offered for sale.
[c]Fleet average of non-methane organic gases = 0.062 in 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. It establishes a plan, carried out at the local level, for creating a sustainable, nationwide alternative fuels market.

Table 3.25
List of Clean Cities as of 4/24/98

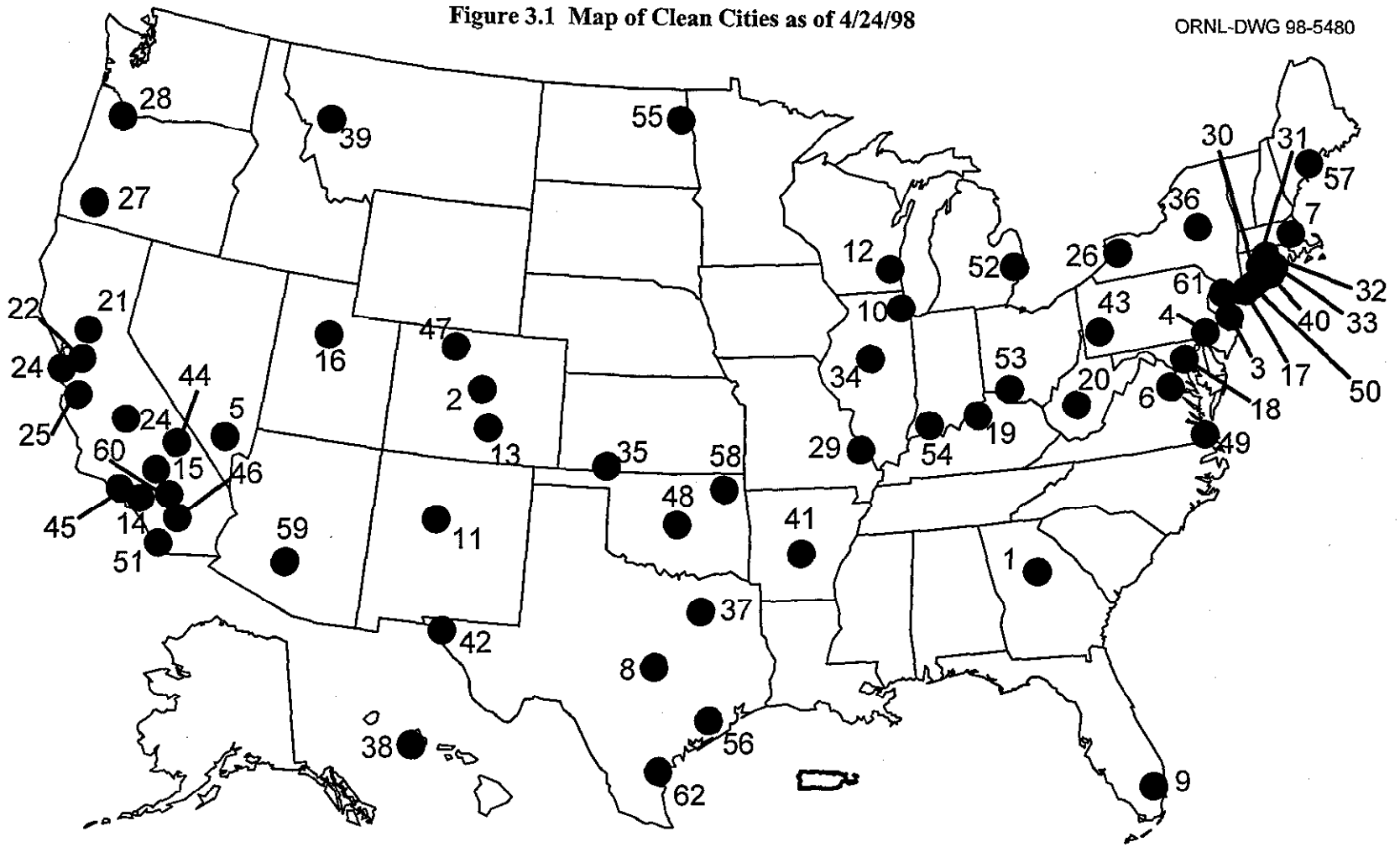
1. Atlanta, GA - 9/8/93
2. Denver, CO - 9/13/93
3. Philadelphia, PA - 9/22/93
4. Wilmington, DE - 10/12/93
5. Las Vegas, NV - 10/18/93
6. Washington, DC - 10/21/93
7. Boston, MA - 3/18/94
8. Austin, TX - 4/18/94
9. Florida Gold Coast - 5/3/94
10. Chicago, IL - 5/13/94
11. Albuquerque, NM - 6/1/94
12. Wisconsin - SE Area - 6/30/94
13. Colorado Springs, CO - 7/13/94
14. Long Beach, CA - 8/31/94
15. Lancaster, CA - 9/22/94
16. Salt Lake City, UT - 10/3/94
17. White Plains, NY - 10/4/94
18. Baltimore, MD - 10/7/94
19. Louisville, KY - 10/18/94
20. State of WV - 10/18/94
21. Sacramento, CA - 10/21/94
22. Oakland, CA - 10/21/94
23. San Joaquin Valley, CA - 10/21/94
24. San Francisco, CA - 10/21/94
25. South Bay (San Jose), CA - 10/21/94
26. Western New York - 11/4/94
27. Rogue Valley, OR - 11/10/94
28. Portland, OR - 11/10/94
29. St. Louis, MO - 11/18/94
30. Norwalk, CT - 11/21/94
31. Waterbury, CT - 11/21/94
32. Norwich, CT - 11/22/94
33. New London, CT - 11/22/94
34. Peoria, IL - 11/22/94
35. Kansas - SW Area - 3/30/95
36. Central New York - 6/15/95
37. Dallas/Ft. Worth, TX - 7/25/95
38. Honolulu, HI - 8/29/95
39. Missoula, MT - 9/21/95
40. New Haven, CT - 10/5/95
41. Central Arkansas - 10/25/95
42. Paso Del Norte - 11/17/95
43. Pittsburgh, PA - 12/5/95
44. S. California Assn. Gov. - 3/1/96
45. Los Angeles, CA - 3/22/96
46. Coachella Valley, CA - 4/22/96
47. Weld/Larimer/Rocky Mountain National Park - 5/21/96
48. Central Oklahoma - 5/29/96
49. Hampton Roads, VA -10/4/96
50. Long Island, NY -10/18/96
51. San Diego, CA 12/12/96
52. Detroit, MI/Toronto,ON -12/18/96
53. Cincinatti, OH - 1/29/97
54. Evansville, IL - 1/30/97
55. Red River Valley/Grand Forks, ND [postponed]
56. Houston, TX - 9/4/97
57. Portland, ME - 9/4/97
58. Tulsa, OK - 9/22/97
59. Maricopa Assn. of Govts. - 10/8/97
60. Riverside, CA - 10/24/97
61. North Jersey, NJ - 10/31/97
62. Corpus Christi, TX - 3/30/98

For more information, contact the Clean Cities Hotline at (800) CCITIES, or write to: U.S. Department of Energy, EE-33, Clean Cities Program, 1000 Independence Avenue SW, Washington, DC 20585.

Source:

U.S. Department of Energy, Alternative Fuel Information, *Clean Cities: Guide to Alternative Fuel Vehicle Incentives & Laws*, Washington, DC, November 1996, and updates from web site, April 1998.
(Additional resources: http://www.ccities.doe.gov)

Figure 3.1 Map of Clean Cities as of 4/24/98



Source:

U.S. Department of Energy, Alternative Fuel Information, *Clean Cities: Guide to Alternative Fuel Vehicle Incentives & Laws*, Washington, DC, November 1996, and updates from the web site, April 1998.
(Additional resources: http://www.ccities.doe.gov)

Chapter 4

Transportation and the Economy

Summary Statistics

Table/Figure		
F 4.1	Share of gasoline cost attributed to taxes, 1996	
	Canada	*48%*
	France	*80%*
	Germany	*75%*
	Japan	*54%*
	United Kingdom	*76%*
	United States	*31%*
T 4.4	Retail prices for motor fuel in the U.S., 1997 (current cents per gallon)	
	Gasoline, average for all types	*129.1*
	Diesel fuel	*129.0*
T 4.11	Average price of a new car, 1997 (constant 1990 dollars)	16,644
	Domestic	*15,160*
	Import	*24,182*
T 4.12	Automobile operating costs, 1997	
	Variable costs (constant 1990 dollars per 10,000 miles)	*879*
	Fixed costs (constant 1990 dollars per 10,000 miles)	*3,442*
T 4.18	Transportation share of total employment	
	1960	*13.5%*
	1980	*11.3%*
	1996	*11.2%*

Table 4.1
Gasoline Prices for Selected Countries, 1978–97

	Current dollars per gallon									Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1992[b]	1994[b]	1995[b]	1996[b]	1997[b]	1978–97	1990–97
China	[d]	[d]	[d]	[d]	[d]	[d]	1.08	0.93[c]	[d]	[d]	[d]
India	[d]	[d]	[d]	1.92	2.59	2.28	2.32	2.25[c]	[d]	[d]	[d]
Japan	2.00[c]	2.60[c]	2.79[c]	3.05[c]	3.78[c]	4.14	4.56	3.77	3.28[c]	2.6%	1.0%
France	2.15	2.56	2.58	3.40	3.69	3.31	4.02	4.41	4.22	3.6%	3.1%
United Kingdom	1.22	2.42	2.07	2.55	3.28	2.86	3.21	3.47	4.25	6.8%	7.6%
Germany	1.75	2.17	1.88	2.72	3.84	3.34	3.91	4.32	3.87	4.3%	5.2%
Canada	0.69[c]	1.37[c]	1.31[c]	1.92[c]	2.11[c]	1.57	1.68	1.80	1.92	5.5%	0.0%
United States[e]	0.66[c]	1.32[c]	0.93[c]	1.04[c]	1.07[c]	1.24	1.32	1.28	1.42	4.1%	4.5%

	Constant 1990 dollars[f] per gallon									Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1992[b]	1994[b]	1995[b]	1996[b]	1997[b]	1978–97	1990–97
China	[d]	[d]	[d]	[d]	[d]	[d]	0.93	0.77	[d]	[d]	[d]
India	[d]	[d]	[d]	1.92	2.41	2.01	1.99	1.87	[d]	[d]	[d]
Japan	4.01[c]	3.52[c]	3.33[c]	3.05[c]	3.52[c]	3.65	3.91	3.14	2.67	-2.1%	-1.9%
France	4.31	3.47	3.07	3.40	3.44	2.92	3.45	3.67	3.44	-1.2%	0.2%
United Kingdom	2.44	3.28	2.47	2.55	3.05	2.52	2.75	2.89	3.46	1.9%	4.5%
Germany	3.51	2.94	2.24	2.72	3.58	2.95	3.35	3.60	3.15	-0.6%	4.1%
Canada	1.38[c]	1.85[c]	1.56[c]	1.92[c]	1.96[c]	1.38	1.44	1.50	1.56	0.6%	-2.9%
United States[e]	1.32[c]	1.79[c]	1.11[c]	1.04[c]	1.00[c]	1.09	1.13	1.07	1.16	-0.7%	1.6%

Source:

U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1996*, Washington, DC, February 1998, pp.102, 103, and annual. (Additional resources: http://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.

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[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] Prices represent the retail prices (including taxes) for premium gasoline on January 1 of the year, or the available time period closest to January 1.

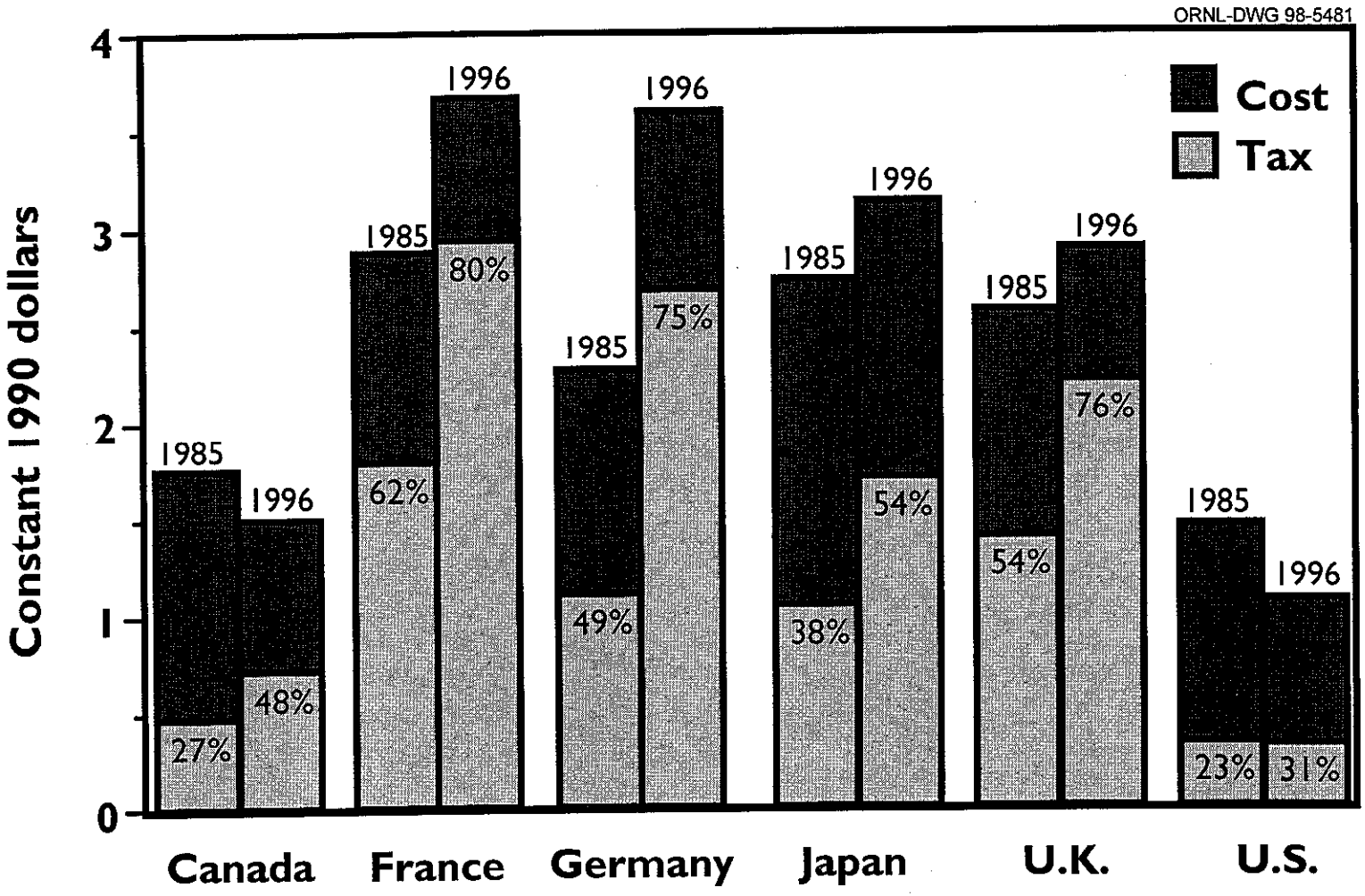
[c] Regular gasoline.

[d] Data are not available.

[e] These estimates are for international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.

[f] Adjusted by the U.S. Consumer Price Inflation Index.

Figure 4.1. Gasoline Prices for Selected Countries, 1985 and 1996



Source:
Table 4.1 and International Energy Agency, *Energy Prices and Taxes, Fourth Quarter 1996*, Paris, France, 1998.
(Additional resources: http://www.iea.org)

Table 4.2
Diesel Fuel Prices for Selected Countries, 1978–97

	Current dollars per gallon									Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1992[b]	1994[b]	1995[b]	1996[b]	1997[b]	1978–97	1990–97
China	[c]	[c]	[c]	[c]	[c]	[c]	0.94	0.88	[c]	[c]	[c]
India	[c]	[c]	[c]	0.78	0.73	0.74	0.84	0.92	[c]	[c]	[c]
Japan	[c]	1.78	1.90	1.75	[c]	2.48	3.00	2.51	2.34	[c]	4.2%
France	1.30	1.88	1.69	1.78	[c]	2.10	2.37	3.10	3.08	4.6%	8.1%
United Kingdom	1.24	2.05	1.71	2.04	[c]	2.46	2.75	3.26	3.78	6.0%	9.2%
Germany	1.48	1.81	1.51	2.72	2.81	2.16	2.48	3.02	2.91	3.6%	1.0%
Canada	[c]	1.27	1.27	1.55	1.78	1.47	1.38	1.43	1.56	[c]	0.1%
United States[d]	0.54	1.16	0.94	0.99	1.06	0.96	0.97	1.15	1.29	4.7%	3.9%

	Constant 1990 dollars[e] per gallon									Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1992[b]	1994[b]	1995[b]	1996[b]	1997[b]	1978–97	1990–97
China	[c]	[c]	[c]	[c]	[c]	[c]			[c]	[c]	[c]
India	[c]	[c]	[c]	0.78	0.68	0.65	0.72	0.77	[c]	[c]	[c]
Japan	[c]	2.41	2.26	1.75	[c]	2.19	2.57	2.09	1.90	[c]	1.2%
France	2.60	2.55	2.01	1.78	[c]	1.85	2.03	2.58	2.51	-0.2%	5.0%
United Kingdom	2.48	2.78	2.04	2.04	[c]	2.17	2.36	2.72	3.08	1.1%	6.1%
Germany	2.96	2.45	1.80	2.72	2.62	1.91	2.13	2.52	2.37	-1.2%	-1.9%
Canada	[c]	1.72	1.51	1.55	1.66	1.30	1.18	1.19	1.27	[c]	-2.8%
United States[d]	1.08	1.57	1.12	0.99	0.99	0.85	0.83	0.96	1.05	-0.1%	0.8%

Source:

U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1996*, Washington, DC, February 1998, pp.102, 103, and annual. (Additional resources: http://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.

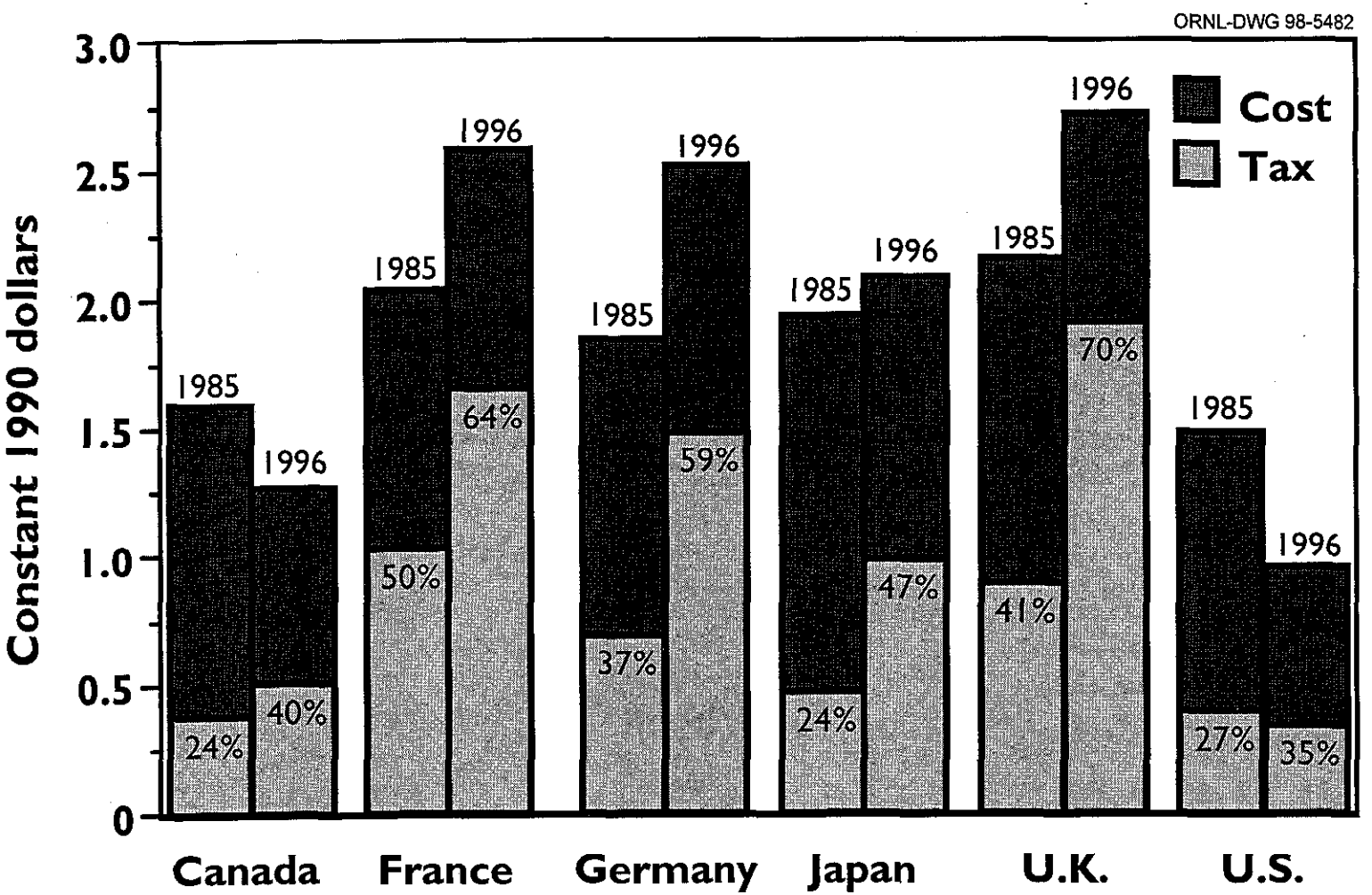
[b] Prices represent the retail prices (including taxes) for diesel fuel on January 1 of the year, or the available time period closest to January 1.

[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.

Figure 4.2. Diesel Prices for Selected Countries, 1985 and 1996



Source:
Table 4.2 and International Energy Agency, *Energy Prices and Taxes, Fourth Quarter 1996*, Paris, France, 1998.
(Additional resources: http://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 1990 dollars) declined by 30% from 1990 to 1997, while the average price of a gallon of gasoline declined 14% in this same time period.

Table 4.3
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978–97

	Crude oil[a] (dollars per barrel)		Gasoline[b] (cents per gallon)		Ratio of gasoline to crude oil
Year	Current	Constant 1990[c]	Current	Constant 1990[c]	
1978	12.46	24.96	65.2	130.6	0.22
1979	17.72	31.90	88.2	158.8	0.21
1980	28.07	44.52	122.1	193.6	0.18
1981	35.24	50.63	135.3	194.4	0.16
1982	31.87	43.15	128.1	173.4	0.17
1983	28.99	38.03	122.5	160.7	0.18
1984	28.63	36.02	119.8	150.7	0.18
1985	26.75	32.50	119.6	145.3	0.19
1986	14.55	17.34	93.1	111.0	0.27
1987	17.90	20.58	95.7	110.0	0.23
1988	14.67	16.21	96.3	106.4	0.28
1989	17.97	18.94	106.0	111.7	0.25
1990	22.22	22.22	121.7	121.7	0.23
1991	19.06	18.28	119.6	114.7	0.26
1992	18.43	17.16	119.0	110.8	0.27
1993	16.41	14.85	117.3	106.2	0.30
1994	15.59	13.75	117.4	103.6	0.32
1995	17.23	14.77	120.5	103.3	0.34
1996	20.71	17.25	128.8	107.3	0.38
1997	19.08	15.53	129.1	105.1	0.35
		Average annual percentage change			
1978–97	2.3%	-2.5%	3.7%	-1.1%	
1987–97	0.6%	-2.8%	3.0%	-0.5%	

Sources:
Crude oil - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 1998*, Washington, DC, Table 9.1, p. 111.
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 1998*, Washington, DC, Table 9.4, p. 114.
(Additional resources: http://www.eia.doe.gov)

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

Table 4.4
Retail Prices for Motor Fuel, 1978–97
(cents per gallon, including tax)

Year	Diesel fuel [a]		Unleaded regular gasoline [b] (87 to 88.9 octane)		Unleaded premium gasoline [b] (91 octane and above)		Average for all gasoline types [b]	
	Current	Constant 1990[c]	Current	Constant 1990[c]	Current	Constant 1990[c]	Current	Constant 1990[c]
1978	[d]	[d]	67.0	134.2	[d]	[d]	65.2	130.6
1979	[d]	[d]	90.3	162.6	[d]	[d]	88.2	158.8
1980	101.0	160.2	124.5	197.4			122.1	193.6
1981	118.0	169.5	137.8	198.0	147.0	211.2	135.3	194.4
1982	116.0	157.0	129.6	175.5	141.5	191.6	128.1	173.4
1983	120.0	157.4	124.1	162.8	138.3	181.4	122.5	160.7
1984	122.0	153.5	121.2	152.5	136.6	171.9	119.8	150.7
1985	122.0	148.2	120.2	146.0	134.0	162.8	119.6	145.3
1986	94.0	112.0	92.7	110.5	108.5	129.3	93.1	111.0
1987	96.0	110.4	94.8	109.0	109.3	125.7	95.7	110.0
1988	95.0	104.9	94.6	104.5	110.7	122.3	96.3	106.4
1989	102.0	107.5	102.1	107.6	119.7	126.2	106.0	111.7
1990	99.0	99.0	116.4	116.4	134.9	134.9	121.7	121.7
1991	91.0	87.3	114.0	109.3	132.1	126.7	119.6	114.7
1992	106.0	98.7	112.7	104.9	131.6	122.5	119.0	110.8
1993	98.0	88.7	110.8	100.3	130.2	117.8	117.3	106.2
1994	96.0	84.7	111.2	98.1	130.5	115.1	117.4	103.6
1995	97.0	83.1	114.7	98.3	133.6	114.5	120.5	103.3
1996	115.0	95.8	123.1	102.5	141.3	117.7	128.8	107.3
1997	129.0	105.0	123.4	100.5	141.6	115.3	129.1	105.1
				Average annual percentage change				
1978–97	1.4%[e]	-2.5%[e]	3.3%	-1.5%	-0.3%[e]	-3.8%[e]	3.7%	-1.1%
1987–97	3.0%	-0.5%	2.7%	-0.8%	2.6%	-0.9%	3.0%	-0.5%

Source:
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 1998*, Washington, DC, Table 9.4, p. 114.
Diesel - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1996*, Washington, DC, February 1998, p.102
(Additional resources: http://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 1997.

*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 4.5
Prices for Selected Transportation Fuels, 1978–97
(cents per gallon, excluding tax)

	Propane[a]		Finished aviation gasoline		Kerosene-type jet fuel		No. 2 diesel fuel	
Year	Current	Constant 1990[b]	Current	Constant 1990	Current	Constant 1990[b]	Current	Constant 1990[b]
1978	33.5	67.1	51.6	103.4	38.7	77.5	37.7	75.5
1979	35.7	64.3	68.9	124.0	54.7	98.5	58.5	105.3
1980	48.2	76.4	108.4	171.9	86.6	137.3	81.8	129.7
1981	56.5	81.2	130.3	187.2	102.4	147.1	99.5	143.0
1982	59.2	80.1	131.2	177.6	96.3	130.4	94.2	127.5
1983	70.9	93.0	125.5	164.6	87.8	115.2	82.6	108.4
1984	73.7	92.7	123.4	155.3	84.2	105.9	82.3	103.5
1985	71.7	87.1	120.1	145.9	79.6	96.7	78.9	95.9
1986	74.5	88.8	101.1	120.5	52.9	63.0	47.8	57.0
1987	70.1	80.6	90.7	104.3	54.3	62.4	55.1	63.4
1988	71.4	78.9	89.1	98.4	51.3	56.7	50.0	55.3
1989	61.5	64.8	99.5	104.9	59.2	62.4	58.5	61.7
1990	74.5	74.5	112.0	112.0	76.6	76.6	72.5	72.5
1991	73.0	70.0	104.7	100.4	65.2	62.6	64.8	62.1
1992	64.3	59.9	102.7	95.6	61.0	58.3	61.9	57.6
1993	67.3	60.9	99.0	89.6	58.0	52.5	60.2	54.5
1994	53.0	46.7	95.7	84.3	53.4	47.1	55.4	48.9
1995	49.2	42.2	100.5	86.1	54.0	46.2	56.0	48.0
1996	60.5	50.4	111.6	93.0	65.1	54.2	68.1	56.7
1997	55.2	44.9	113.8	92.6	61.2	49.8	64.2	52.3
				Average annual percentage change				
1978–97	2.7%	-2.1%	4.3%	-0.6%	2.4%	-2.3%	2.8%	-1.9%
1987–97	-2.4%	-5.7%	2.3%	-1.2%	1.2%	-2.2%	1.5%	-1.9%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 1998*, Washington, DC, Table 9.7, p. 117.
(Additional resources: http://www.eia.doe.gov)

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

The prices of CNG and unleaded gasoline vary from place to place. A comparison of fuel prices by "Natural Gas Fuels" in September 1997 (latest available data) showed that CNG is less expensive than unleaded gasoline in most places, as much as 52% less in Salt Lake City, UT.

Table 4.6
Comparison of Station Prices: Compressed Natural Gas and Regular Unleaded Gasoline, September 1997[a]

Region	Station	CNG	Unleaded gasoline	Percentage CNG to gasoline
	Dollars per gallon or equivalent gallon			
1	Super America/Minneapolis, MN	$0.899	$1.299	69.2%
	Exxon/Billings, MT	$0.829	$1.279	64.8%
2	Unocal Vista, CA	$0.964	$1.379	69.9%
	Total/Denver, CO	$0.849	$1.359	62.5%
	Sinclair/Salt Lake City, UT	$0.646	$1.339	48.2%
3	Fina/Garland, TX	$0.799	$1.199	66.6%
	Shell/Houston, TX	$0.849	$1.199	70.8%
	Chevron/Houston, TX	$0.799	$1.139	70.1%
	Sav-a-Stop/Oklahoma City, OK	$0.679	$1.179	57.6%
4	Conoco/Mobile, AL	$0.799	$1.169	68.3%
	Shell/Palm Beach Gardens, FL	$1.499	$1.379	108.7%
	Petroleum Source UFO/Atlanta, GA	$0.999	$1.089	91.7%
5	Texaco/Hartford, CT	$0.999	$1.449	68.9%
	Mobil/Brooklyn, NY	$1.089	$1.479	73.6%
	Best/Harrisburg, PA	$1.039	$1.279	81.2%
	Canadian dollars per liter or equivalent liter			
Canada	Petro-Canada/Vancouver, BC	$0.348	$0.599	58.1%

Source:
R.P. Publishing, Inc., *Natural Gas Fuels*, Denver, CO, October 1997, p. 10.

[a]*Natural Gas Fuels* no longer publishes these data; September 1997 data are the latest available.

Table 4.7
State Taxes on Motor Fuels, 1998
(dollars per gallon or gasoline equivalent gallon)
(Footnotes for this table appear on next page)

State	Gasoline	Diesel fuel	Gasohol	CNG	Propane	Methanol	Ethanol
Alabama	0.16	0.17	0.16	[a]	[a]	0.16[b]	0.16[b]
Alaska	0.08	0.08	0.08[c]	0.08	0.00	0.08[b]	0.08[b]
Arizona	0.18	0.18	0.00	0.10[d]	0.18	0.18	0.00
Arkansas	0.185	0.185	0.185	0.05[e]	0.165	0.185	0.185
California	0.18	0.18	0.18	0.07	0.06	0.09	0.09
Colorado	0.22	0.205	0.22	0.205	0.205	0.205	0.205
Connecticut	0.39	0.18	0.38	0.18[f]	0.18[f]	0.37[b]	0.37[b]
Delaware	0.23	0.22	0.23	0.22	0.22	0.22	0.23
District of Columbia	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Florida	0.04	0.04	0.04	[a]	[a]	0.04[b]	0.04[b]
Georgia	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Hawaii (Honolulu)[g]	0.325	0.325	0.325	0.325	0.22	0.325	0.325
Idaho	0.25	0.25	0.25	0.197[h]	0.181	0.25[b]	0.25[b]
Illinois	0.19	0.215	0.19	0.19	0.19	0.19[b]	0.19[b]
Indiana	0.15	0.16	0.15	[a]	[a]	0.15	0.15
Iowa	0.20	0.225	0.19	0.16[e]	0.20	0.19[b]	0.19[b]
Kansas	0.18	0.20	0.18	0.17	0.17	0.20	0.20
Kentucky	0.15	0.12	0.15	0.12	0.15	0.15	0.15
Louisiana	0.20	0.20	0.20	0.16[i]	0.16[i]	0.20[b]	0.20[b]
Maine	0.19	0.20	0.19	0.18	0.18	0.18	0.18
Maryland	0.235	0.2425	0.235	0.235	0.235	0.235	0.235
Massachusetts	0.21	0.21	0.21	0.089	0.089	0.21	0.21
Michigan	0.15	0.15	0.15	0.0	0.15	0.15[b]	0.025[b]
Minnesota	0.20	0.20	0.20	0.001739[j]	0.15	NA	0.20[b]
Mississippi	0.18	0.18	0.18	0.18[e]	0.17	0.18[b]	0.18[b]
Missouri	0.17	0.17	0.17	[a]	[a]	0.17[b]	0.17[b]
Montana	0.27	0.2775	0.27	0.07[k]	[a]	0.27	0.27
Nebraska	0.253	0.253	0.253	0.253	0.253	0.253	0.253[b]
Nevada	0.23	0.27	0.23	0.23[e]	0.23[e]	0.23	0.23
New Hampshire	0.18	0.18	0.18	0.18	0.18	0.18[b]	0.18[b]
New Jersey	0.105	0.135	0.105	0.0525	0.0525	0.105[b]	0.105[b]
New Mexico	0.22	0.18	0.22	0.03[i]	0.03[i]	0.22[b]	0.22[b]
New York	0.08[l]	0.10[l]	0.08[l]	0.08[l]	0.08[l]	0.08[l]	0.08[l]
North Carolina	0.217	0.217	0.217	0.217	0.217	0.217	0.217
North Dakota	0.20	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	0.22[b]	0.22[b]
Oklahoma	0.16	0.13	0.16	[a]	0.16	0.16[b]	0.16[b]
Oregon	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Pennsylvania	0.12[m]	0.12[m]	0.12[m]	0.12[m]	0.12[m]	0.12[m]	0.12[m]
Rhode Island	0.28	0.28	0.28	0.0	0.28	0.28	0.28

Table 4.7 (continued)
State Taxes on Motor Fuels, 1998
(dollars per gallon or gasoline equivalent gallon)

State	Gasoline	Diesel fuel	Gasohol	CNG	Propane	Methanol	Ethanol
South Carolina	0.16	0.16	0.16	0.16	0.16	0.16	0.16
South Dakota	0.18	0.18	0.16	0.06	0.16	0.06	0.06
Tennessee	0.20	0.17	0.17	0.13	0.17	0.17	0.17
Texas	0.20	0.20	0.20	0.15	0.15	0.20[b]	0.20[b]
Utah	0.19	0.19	0.19	0.19[m]	0.19[m]	0.19	0.19
Vermont	0.16	0.17	0.16	0.16	[a]	0.16	0.16
Virginia	0.175	0.16	0.175	0.10	0.10	0.175[b]	0.175[b]
Washington	0.23	0.23	0.23	[a]	[a]	0.23	0.23
West Virginia	0.205	0.205	0.205	0.205	0.205	0.205	0.205
Wisconsin	0.237	0.237	0.237	0.237	0.237	0.237	0.237
Wyoming	0.08	0.08	0.00	0.00	0.00	0.08[b]	0.08[b]

Source:
J. E. Sinor Consultants, Inc., Niwot, CO, March 1998.
(Additional resources: http://phidias.colorado.edu/sinor)

[a]Annual flat fee.
[b]Blends with gasoline only.
[c]November-February tax rate is $0.02.
[d]Per 1.25 therm.
[e]Per 100 ft^3.
[f]CNG, LNG, and LPG are exempt from motor fuel taxes when used as vehicle fuel until July 1, 2001.
[g]For County of Honolulu; for County of Maui LPG tax is $0.20/gal. and all other fuels are taxed at $0.18/gal.; other counties have all fuels taxed at $0.26/gal.
[h]Per therm.
[i]Optional: flat fee may be paid instead.
[j]Per cubic foot; LNG is taxed at $0.12/gal.
[k]Per 120 ft^3.
[l]Plus a petroleum business tax; the amount varies but is usually in the ballpark of $0.12–$0.14.
[m]Plus 0.1035 oil franchise tax.

As of January 1998, only five states offered tax exemptions to encourage the use of gasohol for transportation purposes. This list is quite short compared to the 30 states which offered gasohol tax exemptions fifteen years ago. Still, the Federal Government encourages gasohol use via a difference in the Federal tax rates of gasoline and gasohol.

Table 4.8
State Tax Exemptions for Gasohol, January 1998

State	Exemption (Cents/gallon of gasohol)
Alaska	8.0
Connecticut	1.0
Idaho	2.5
Iowa	1.0
South Dakota	2.0

Source:
U.S. Department of Transportation, Federal Highway Administration, "Monthly Motor Fuel Reported by the States, November 1997," February 1998, Washington, DC, Table MF-121T. (Additional resources: http://www.fhwa.dat.gov)

Table 4.9
Federal Excise Taxes on Motor Fuels

Fuel		Cents per gallon
Gasoline		18.40
Diesel[a]		24.40
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		11.90
LPG		13.60

Source:
J. E. Sinor Consultants, Inc., Niwot, CO, March 1998.
(Additional resources: http://phidias.colorado.edu/sinor)

[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.

Table 4.10
States With Ethanol Tax Incentives

State	Ethanol tax incentives
AK	$0.08/ethanol gallon (blender)
CA	E85 and M85 excise tax is half of the gasoline tax. Neat alcohol fuels are exempt from fuel taxes.
FL	County governments receive waste reduction credits for using yard trash, wood, or paper waste as feed stocks for fuel.
HI	4% ethanol sales tax exemption
ID	$0.21 excise tax exemption for ethanol or biodiesel
IN	10% gross income tax deduction for improvements to ethanol producing facilities.
IL	2% sales tax exemption for 10% volume ethanol blends
IA	$0.01 (blender)
MN	$0.25 (producer), $0.005 (blender) until Oct. 1, 1997
MO	$0.20 (producer)
MT	$0.30 (producer)
NE	$0.20 (producer), $0.50 ETBE (producer)
NC	Individual income and corporate tax credit of 20% for the construction of an ethanol plant using agricultural or forestry products; an additional 10% if the distillery is powered with alternative fuels.
ND	$0.40 (producer)
OH	$0.01 (blender), income tax credit
SD	$0.20 (blender), $0.20 (producer) Alternative fuels are taxed at $0.06/gal
WY	$0.40 (producer)

Source:
U.S. Department of Energy, *Clean Cities Guide to Alternative Fuel Vehicle Incentivesand Laws*, 2nd edition, Washington, DC, November 1996.
(Additional resources: http://www.ccities.doe.gov)

Table 4.11
Average Price of a New Car, 1970–97

Year	Domestic[a] Current dollars	Domestic[a] Constant 1990 dollars[b]	Import Current dollars	Import Constant 1990 dollars[b]	Total Current dollars	Total Constant 1990 dollars[b]	Estimated Average New Car Price for a 1967 "Comparable Car" With added safety & emissions equipment[c]	Estimated Average New Car Price for a 1967 "Comparable Car" Without added safety & emissions equipment[d]
1970	3,708	12,479	2,648	8,912	3,542	11,920	3,601	3,459
1971	3,919	12,645	2,769	8,935	3,742	12,074	3,777	3,601
1972	4,034	12,601	2,994	9,352	3,879	12,117	3,789	3,570
1973	4,181	12,295	3,344	9,834	4,052	11,915	3,903	3,572
1974	4,524	11,988	4,206	11,146	4,440	11,766	4,237	3,779
1975	5,084	12,344	4,384	10,645	4,950	12,019	4,686	4,103
1976	5,506	12,640	4,923	11,301	5,418	12,438	4,988	4,362
1977	5,985	12,906	5,072	10,938	5,814	12,538	5,272	4,593
1978	6,478	12,976	5,934	11,886	6,379	12,778	5,687	4,944
1979	6,889	12,403	6,704	12,070	6,847	12,327	6,176	5,337
1980	7,609	12,067	7,482	11,886	7,574	12,012	6,863	5,764
1981	8,912	12,805	8,896	12,782	8,910	12,802	7,700	6,115
1982	9,865	13,356	9,957	13,480	9,890	13,390	8,078	6,350
1983	10,516	13,797	10,868	14,259	10,606	13,915	8,387	6,544
1984	11,172	14,054	12,354	15,541	11,450	14,404	8,685	6,742
1985	11,589	14,081	12,853	15,616	11,902	14,461	8,984	6,958
1986	12,526	14,931	13,815	16,467	12,894	15,370	9,395	7,259
1987	12,922	14,860	14,470	16,641	13,386	15,394	9,743	7,518
1988	13,542	14,964	15,378	16,993	14,065	15,542	9,995	7,668
1989	14,193	14,959	15,829	16,684	14,645	15,436	10,248	7,825
1990	14,886	14,886	17,164	17,164	15,472	15,472	10,581	7,938
1991	15,773	15,126	17,019	16,321	16,083	15,424	11,152	8,224
1992	16,389	15,258	19,601	18,249	18,141	16,889	11,458	8,424
1993	16,673	15,089	21,477	19,437	17,678	15,999	11,806	8,631
1994	17,575	15,501	23,211	20,472	18,657	16,455	12,427	8,925
1995	17,174	14,718	23,995	20,564	18,360	15,735	12,857	9,115
1996	18,199	15,160	27,695	23,070	19,620	16,343	13,196	9,281
1997	18,624	15,160	29,708	24,182	20,444	16,644	13,324	9,297
				Average annual percentage change				
1970–97	6.2%	0.7%	9.4%	3.8%	6.7%	1.2%	5.0%	3.7%
1987–97	3.7%	0.2%	7.5%	3.8%	4.3%	0.8%	3.2%	2.1%

Source:
American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1997*, Detroit, MI, 1997, p.60.
1997 Data: American Automobile Manufacturers Association, *Economic Indicators*, Fourth Quarter 1997, Detroit, MI, February 1998, p.24.
(Additional resources: http://www.aama.com)

[a]Includes transplants.
[b]Adjusted by the Consumer Price Inflation Index.
[c]1967 "Average Transaction Price" plus the value of added safety and emissions equipment as determined by the U.S. Bureau of Labor Statistics (BLS), all inflated to current dollars, using the U.S. BLS, "New Car Consumer Price Index - All Urban Consumers." For example, 1969 is equal to the 1968 value plus the BLS stated value of added safety and emissions equipment for the 1969 model year multiplied by 1968–1969 monthly changes in the New Car Consumer Price Index.
[d]1967 "Average Transaction Price" inflated to current dollars.

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, which is related to the amount of travel. The cost of operating a car in 1997 (constant 1990 cents) was approximately 43 cents per mile. Gas and oil accounted for more than 12% of total cost per mile in 1997, which was up almost 1% from 1996.

Table 4.12
Automobile Operating Cost per Mile, 1975–97

Model year [c]	Variable costs (constant 1990 cents per mile [a])				Constant 1990 dollars per 10,000 miles [a]			Total cost per mile [b] (constant 1990 cents [a])
	Gas and oil	Percentage gas and oil of total cost	Maintenance	Tires	Variable cost	Fixed cost	Total cost	
1975	11.70	26.3%	2.36	1.60	1,566	2,880	4,446	44.46
1977	8.86	20.3%	2.22	1.42	1,251	3,103	4,354	43.54
1979	7.40	17.1%	1.98	1.17	1,055	3,260	4,315	43.15
1980	9.29	21.0%	1.78	1.01	1,208	3,224	4,433	44.33
1981	9.01	19.6%	1.70	1.03	1,174	3,413	4,586	45.86
1982	9.12	21.5%	1.35	0.97	1,133	3,145	4,243	42.43
1983	8.71	19.9%	1.36	0.89	1,097	3,287	4,384	43.84
1984	7.79	19.8%	1.31	0.79	989	2,952	3,940	39.40
1985	7.48	22.6%	1.49	0.79	977	2,328 [d]	3,304 [d]	33.04 [d]
1986	5.34	15.1%	1.63	0.80	777	2,750 [d]	3,577 [d]	35.27 [d]
1987	5.52	14.7%	1.84	0.92	828	2,925 [d]	3,753 [d]	37.53 [d]
1988	5.74	15.6%	1.77	0.88	840	2,851 [d]	3,691 [d]	36.91 [d]
1989	5.48	13.6%	2.00	0.84	833	3,194 [d]	4,027 [d]	40.27 [d]
1990	5.40	13.2%	2.10	0.90	840	3,256 [d]	4,096 [d]	40.96 [d]
1991	6.43	15.4%	2.11	0.86	940	3,245 [d]	4,185 [d]	41.85 [d]
1992	5.59	13.1%	2.05	0.84	847	3,414 [d]	4,261 [d]	42.61 [d]
1993	5.43	13.3%	2.17	0.81	842	3,244 [d]	4,085 [d]	40.85 [d]
1994	4.94	12.0%	2.21	0.97	811	3,303 [d]	4,115 [d]	41.15 [d]
1995	5.14	12.3%	2.23	1.20	857	3,335 [d]	4,192 [d]	41.92 [d]
1996	4.91	11.5%	2.33	1.17	841	3,443 [d]	4,284 [d]	42.84 [d]
1997	5.37	12.4%	2.28	1.14	879	3,442 [d]	4,321 [d]	43.21 [d]
			Average annual percentage change					
1975–84	-4.4%		-6.3%	-7.5%	-5.0%	0.3%	-1.3%	-1.3%
1987–97	-0.3%		2.2%	2.2%	0.6%	1.6%	1.4%	1.4%

Source:
American Automobile Association, *Your Driving Costs*, 1997 Edition, Heathrow, FL, and annual. (Additional resources: http://www.aaa.com, http://www.runzheimer.com)

[a] Adjusted by the Consumer Price Inflation Index.
[b] Based on 10,000 miles per year.
[c] Data for 1976 and 1978 are not available.
[d] Fixed and total operating costs preceding 1985 are not comparable with 1985 and later data. Fixed cost depreciation from 1975–84 was based on four years or 60,000 miles. After 1984, the depreciation was based on six years or 60,000 miles.

Table 4.13
Fixed Automobile Operating Costs per Year, 1975–97
(constant 1990 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	129	342	459	73	1,877	[e]	2,880	7.89
1977	172	405	539	160	1,826	[e]	3,102	8.49
1978	114	276	459	148	1,791	[e]	2,788	7.63
1979	133	302	434	162	1,696	533	3,260	8.93
1980	111	273	393	130	1,646	671	3,224	8.83
1981	109	259	365	126	1,849	704	3,413	9.35
1982	72	207	329	73	1,836	730	3,247	8.90
1983	105	264	291	134	1,762	732	3,288	9.01
1984	101	252	283	133	1,518	664	2,951	8.09
1985	112	241	259	140	1,522	693	2,966	8.13
1986	103	228	277	155	1,573	759	3,094	8.48
1987	100	225	290	161	1,732	691	3,199	8.76
1988	95	224	314	154	1,971	624	3,382	9.27
1989	115	258	326	159	2,207	660	3,725	10.20
1990	110	247	318	165	2,357	680	3,877	10.62
1991	110	247	339	162	2,439	747	4,044	11.08
1992	105	243	347	167	2,588	775	4,225	11.57
1993	97	210	348	166	2,609	630	4,060	11.12
1994	80	182	353	180	2,635	613	4,043	11.08
1995	81	181	351	181	2,656	625	4,075	11.17
1996	91	206	355	191	2,672	648	4,163	11.40
1997	86	246	326	179	2,660	646	4,143	11.36

Source:
American Automobile Association, "Your Driving Costs," 1997 Edition, Heathrow, FL, and annual. (Additional resources: http://www.aaa.com, http://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 through 1996.
[c] $100 deductible through 1977; $250 deductible 1978 through 1992; $500 deductible for 1993 through 1996.
[d] Coverage: $100,000/$300,000.
[e] Data are not available.

Table 4.14
Economic Indicators, 1970–97
(billion dollars)

Year	Gross National Product		Total transportation outlays		
	Current	Constant 1990[a]	Current	Constant 1990[a]	Transportation as a percent of GNP
1970	1,015.5	3,031.3	195.2	582.7	19.2%
1980	2,732.0	4,167.4	542.9	827.9	19.8%
1990	5,567.8	5,567.8	964.6	964.6	17.3%
1996	7,637.7	6,430.9	1,245.6	1,048.8	16.3%
	Personal Consumption Expenditures		Transportation Personal Consumption Expenditures[b]		Transportation PCE as a percent of total PCE
1970	640.0	1,910.4	81.5	243.3	0.127
1980	1,732.6	2,642.9	238.5	363.8	13.8%
1990	3,761.2	3,761.2	453.9	453.7	12.1%
1997	5,488.1	4,621.0	624.3	525.7	11.4%

Sources:

GNP - U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 1998, Table 1.9, p. D-4, and annual. (Additional resources: http://www.bea.doc.gov)

Transportation outlays - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1998, p. 38.

PCE - U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, March 1998, Table 2.2, p. D-6, and annual. (Additional resources: http://www.bea.doc.gov/bea/scbinf.html)

Table 4.15
Consumer Price Indices, 1970–97
(1970 = 1.000)

Year	Consumer Price Index	Transportation Consumer Price Index[c]	New car Consumer Price Index	Used car Consumer Price Index	Gross National Product
1970	1.000	1.000	1.000	1.000	1.000
1980	2.122	2.216	1.667	1.995	2.690
1990	3.365	3.213	2.283	3.769	5.483
1997	4.134	3.848	2.674	4.843	7.937

Source:

Bureau of Labor Statistics, Consumer Price Index Table 1A for 1997, and annual. [GNP—see above.] (Additional resources: http://stats.bls.gov/cpihome.htm)

[a] Adjusted by the implicit GNP price deflator.

[b] Transportation Personal Consumption Expenditures include user operating expenses (new and used auto purchases, gas and oil, repair, greasing, washing, parking, storage, rental, other motor vehicles, insurance premiums, tires, tubes and other parts); purchased intercity transportation; and purchased local transportation.

[c] Transportation Consumer Price Index includes new and used cars, gasoline, auto insurance rates, intracity mass transit, intracity bus fare, and airline fares.

Table 4.16
Motor Vehicle Manufacturing Employment Statistics, 1972–96

Year	Motor vehicle manufacturing employees (thousands)	Sales of domestic automobiles[a] (thousands)	Sales of domestic light trucks[b] (thousands)	Employees per hundred vehicles sold	Expenditure per new domestic vehicle	Total domestic vehicle expenditures[c] (millions)	Employees per million dollar expenditure (current)	Employees per million dollar expenditure (constant 1990[d])
1972	415	9,327	2,096	3.6	$4,034	$46,080	9.0	3.3
1973	462	9,676	2,512	3.8	$4,181	$50,958	9.1	3.5
1974	416	7,454	2,163	4.3	$4,524	$43,507	9.6	4.0
1975	375	7,053	2,053	4.1	$5,084	$46,295	8.1	3.7
1976	416	8,611	2,720	3.7	$5,506	$62,388	6.7	3.2
1977	442	9,109	3,108	3.6	$5,985	$73,119	6.0	3.1
1978	470	9,312	3,473	3.7	$6,478	$82,821	5.7	3.1
1979	463	8,341	2,844	4.1	$6,889	$77,053	6.0	3.6
1980	368	6,581	1,959	4.3	$7,609	$64,981	5.7	3.7
1981	359	6,209	1,745	4.5	$8,912	$70,886	5.1	3.6
1982	318	5,759	2,062	4.1	$9,865	$77,154	4.1	3.1
1983	349	6,795	2,518	3.7	$10,516	$97,936	3.6	2.7
1984	392	7,952	3,257	3.5	$11,172	$125,227	3.1	2.5
1985	409	8,205	3,691	3.4	$11,589	$137,863	3.0	2.4
1986	400	8,215	3,671	3.4	$12,526	$148,884	2.7	2.3
1987	381	7,081	3,785	3.5	$12,922	$140,410	2.7	2.4
1988	357	7,526	4,195	3	$13,542	$158,725	2.2	2.0
1989	350	7,073	4,108	3.1	$14,193	$158,692	2.2	2.1
1990	329	6,897	3,948	3	$14,886	$161,439	2.0	2.0
1991	316	6,137	3,595	3.2	$15,773	$153,503	2.1	2.1
1992	314	6,277	4,233	3	$16,389	$172,248	1.8	2.0
1993	319	6,742	4,987	2.7	$16,673	$195,558	1.6	1.8
1994	340	7,255	5,638	2.6	$17,575	$226,594	1.5	1.7
1995	355	7,129	5,663	2.8	$17,174	$219,690	1.6	1.9
1996	352	7,254	6,088	2.6	$16,998	$226,787	1.6	1.8
				Average annual percentage change				
1972–96	-0.7%	-1.0%	4.5%	-1.3%	6.2%	6.9%	-6.9%	-2.5%
1986–96	-1.3%	-1.2%	5.2%	-2.6%	3.1%	4.3%	-5.1%	-2.4%

Source:
Employees - American Automobile Manufacturers Association, *Economic Indicators*, Fourth Quarter,1997, Detroit, MI, 1998, p. 18.
Sales and expenditures - American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1997*, Detroit, MI, 1997, pp. 19, 20, 60, and annual.

[a] Vehicles produced in North America.
[b] Less than 10,000 pounds gross vehicle weight.
[c] Estimated as vehicle sales multiplied by average expenditure.
[d] Adjusted by the implicit Gross National Product price deflator.

Table 4.17
Employees of Motor Vehicle and Related Industries, 1990 and 1994

Industry	1990 Employees	1990 Percent of total motor vehicle	1990 Percent of total U.S. employment[a]	1994 Employees	1994 Percent of total motor vehicle	1994 Percent of total U.S. employment[a]	Percent change 1990–94
Motor vehicle and equipment manufacturing	1,055,595	15.0%	1.1%	1,118,948	15.5%	1.2%	6.0%
Motor vehicles and equipment	*707,160*	*10.0%*	*0.8%*	*760,209*	*10.6%*	*0.8%*	*7.5%*
Travel trailers and campers	*14,301*	*0.2%*	*0.0%*	[b]	[b]	[b]	[b]
Transportation equipment not elsewhere classified	*17,263*	*0.2%*	*0.0%*	*51,370*	*0.7%*	*0.1%*	*197.6%*
Automotive stampings	*111,548*	*1.6%*	*0.1%*	*112,162*	*1.6%*	*0.1%*	*0.6%*
Carburetors, pistons, piston rings, and valves	*19,674*	*0.3%*	*0.0%*	*17,667*	*0.2%*	*0.0%*	*-10.2%*
Vehicular lighting equipment	*15,586*	*0.2%*	*0.0%*	*15,494*	*0.2%*	*0.0%*	*-0.6%*
Storage batteries	*23,518*	*0.3%*	*0.0%*	*22,338*	*0.3%*	*0.0%*	*-5.0%*
Electrical equipment for internal combustion engines	*61,675*	*0.9%*	*0.1%*	*56,302*	*0.8%*	*0.1%*	*-8.7%*
Tires and inner tubes	*68,505*	*1.0%*	*0.1%*	*66,678*	*0.9%*	*0.1%*	*-2.7%*
Cold-rolled steel sheet, strip, and bars	*16,365*	*0.2%*	*0.0%*	*16,728*	*0.2%*	*0.0%*	*2.2%*
Road construction and maintenance	261,461	3.7%	0.3%	[b]	[b]	[b]	[b]
Motor freight transportation and related services	1,662,836	23.6%	1.8%	1,780,880	24.7%	1.8%	7.1%
Trucking and courier services, except by air or by the U.S. Postal Service	*1,458,847*	*20.7%*	*1.6%*	*15,286,991*	*22.0%*	*1.6%*	*8.8%*
Petroleum refining and wholesale distribution	264,820	3.8%	0.3%	258,658	3.6%	0.3%	-2.3%
Passenger transportation	672,271	9.5%	0.7%	763,973	10.6%	0.8%	13.6%
Automotive sales and servicing	3,135,783	44.5%	3.4%	3,281,525	45.6%	3.4%	4.6%
Total of motor vehicle and related industries	7,052,766	100.0%	7.5%	7,203,984	100.0%	7.4%	2.1%
U.S. Total[a]	93,476,087		100.0%	96,733,300		100.0%	3.5%

Source:
American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1997*, Detroit, MI, 1997, p. 71, and annual.
(Additional resources: http://www.aama.com)

[a]Data for employees of establishments totally exempt from FICA are excluded, as are self-employed persons, domestic service workers, railroad employees, agricultural production workers and most government employees.
[b]Data are not available.

Table 4.18
Employment in Transportation and Related Industries, 1960-96
(persons in thousands)

	1960	1965	1970	1975	1980	1985	1990	1995	1996
Transportation Service									
Air transport	191	229	351	362	453	537	789	766	818
Bus, intercity	41	42	43	39	38	36	20	24	24
Local transport	101	83	77	69	79	90	136	222	257
Railroads	885	735	627	538	532	346	285	239	281
Oil pipeline	23	20	18	17	21	19	20	16	16
Taxi	121	110	107	83	53	38	33	34	36
Trucking & truck materials	770	882	998	996	1,189	1,285	1,534	1,878	2,293
Water	232	230	215	190	213	214	173	160	182
Total	**2,364**	**2,331**	**2,436**	**2,294**	**2,578**	**2,565**	**2,990**	**3,339**	**3,907**
Transportation Equipment Manufacturing									
Aircraft & parts	646	624	669	514	652	647	709	442	404
Motor vehicles, equipment, tires	829	945	914	892	904	964	886	1,071	1,305
Railroad equipment	43	56	51	52	71	34	34	38	37
Ship & boat building & repair	141	160	170	194	221	193	189	162	182
Other transportation equipment	33	57	111	115	149	130	46	51	76
Total	**1,692**	**1,842**	**1,915**	**1,767**	**1,997**	**1,968**	**1,864**	**1,764**	**2,004**
Transportation Related Industries									
Automotive/accessory retail dealers	807	902	996	1,076	1,048	1,185	1,292	1,388	1,330
Automotive wholesalers	215	255	320	367	418	433	451	484	498
Automotive service & garages	251	324	384	400	571	730	926	981	1,256
Gasoline service stations	461	522	614	616	561	611	641	643	646
Highway & street construction	294	324	331	297	268	264	245	228	240
Petroleum[a]	311	292	333	390	533	568	521	490	487
Other industries									
Truck drivers & deliverymen	1,477	1,521	1,565	1,796	1,931	2,050	2,148	2,861	2,542
Freight handlers	365	411	456	613	622	574	504	536	551
Total	**4,181**	**4,551**	**4,999**	**5,545**	**5,952**	**6,415**	**6,728**	**7,611**	**7,550**
Government Transportation Employees									
U.S. Department of Transportation	38	45	66	75	72	61	65	65	63
Highways, state & local	499	550	568	569	532	549	569	582	543
U.S. Postal Service[b]	83	83	103	98	92	104	115	118	119
Other[c]	18	16	12	13	13	11	11	11	11
Total	**638**	**694**	**749**	**755**	**709**	**725**	**760**	**776**	**736**
Total transportation employment	**8,875**	**9,418**	**10,099**	**10,361**	**11,236**	**11,673**	**12,342**	**13,490**	**14,197**
Total employed civilians	**65,778**	**71,088**	**78,627**	**85,783**	**99,303**	**107,150**	**117,914**	**125,136**	**126,708**
Transportation percent of total	13.5%	13.2%	12.8%	12.1%	11.3%	10.9%	10.5%	10.8%	11.2%

Source:
Eno Transportation Foundation, *Transportation in America 1997*, Lansdowne, VA, 1997, p. 61.

[a] Estimated by assuming transport share of total petroleum industry employment is same as transport share of petroleum domestic demand.

[b] Estimated share (approximately 14%) of total employees engaged in transportation work.

[c] Agencies include Civil Aeronautics Board (sunset in 1985), Federal Maritime Commission, Federal Energy Regulatory Commission, Interstate Commerce Commission, Railroad Retirement Board, and Panama Canal Commission.

Chapter 5

Highway Vehicles and Characteristics

Summary Statistics

Table		
5.1	U.S. share of world automobile registrations, 1996	26.7%
5.2	U.S. share of world truck & bus registrations, 1996	41.3%
5.3	Number of automobiles, 1996 (Polk - in thousands)	124,613
5.3	Number of trucks, 1996 (Polk - in thousands)	73,681
5.5	Vehicle miles traveled, 1996	(million miles)
	Automobiles	*1,467,703*
	Motorcycles	*9,906*
	Two-axle, four-tire trucks	*815,302*
	Other single-unit trucks	*63,967*
	Combination trucks	*118,789*
	Buses	*6,535*
5.8	Average age of vehicles, 1996	(years)
	Automobiles	*8.6*
	Trucks	*8.3*
	Average lifetime of vehicles	(years)
5.9	*Automobiles, 1990 model year*	*13.7*
5.10	*Trucks, 1979-89 model years*	*16.0*

Table 5.1
Automobile Registrations for Selected Countries, 1950–96
(thousands)

Year	China	India	Japan	France	United Kingdom	Germany[a]	Canada[b]	United States[c]	U.S. percentage of world[c]	World total[d]
1950	[e]	[e]	43	[e]	2,307	[e]	1,913	40,339	76.0%	53,051
1955	[e]	[e]	153	[e]	360	[e]	2,961	52,145	71.4%	73,036
1960	[e]	[e]	457	4,950	5,650	4,856	4,104	61,671	62.7%	98,305
1965	[e]	[e]	2,181	8,320	9,131	9,719	5,279	75,258	53.8%	139,776
1970	[e]	[e]	8,779	11,860	11,802	14,376	6,602	89,244	46.1%	193,479
1975	[e]	[e]	17,236	15,180	14,061	18,161	8,870	106,706	41.0%	260,201
1980	351	[e]	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
1986	966	1,780	28,654	21,090	19,415	27,224	11,586	130,004	34.1%	380,923
1987	1,112	2,007	29,478	21,500	20,108	28,304	11,686	131,482	33.9%	388,188
1988	1,304	2,295	30,776	21,970	20,977	29,190	12,086	133,836	33.0%	405,491
1989	1,464	2,486	32,621	22,520	21,919	30,152	12,380	134,559	32.4%	415,844
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
				Average annual percentage change						
1950–96	[e]	[e]	16.4%	[e]	5.3%	[e]	[e]	[e]		4.9%
1970–96	[e]	[e]	6.7%	3.0%	2.9%	[e]	[e]	[e]		3.6%
1986–96	17.1%	9.1%	5.0%	1.9%	2.5%	[e]	[e]	0.0%		2.5%

Source:
Motor Vehicle Manufacturers Association, *World Motor Vehicle Data*, 1998 Edition, Detroit, MI, 1998, pp. 8, 23, 28, 42, 85, 98, 169, 206, 230 and annual.
(Additional resources: http://www.aama.com)

[a] Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles.
[b] Data from 1991 and later are not comparable to prior data.
[c] Data from 1985 and later are not comparable to prior data.
[d] World totals were recalculated from 1985–94 based on change in U.S. data.
[e] Data are not available.

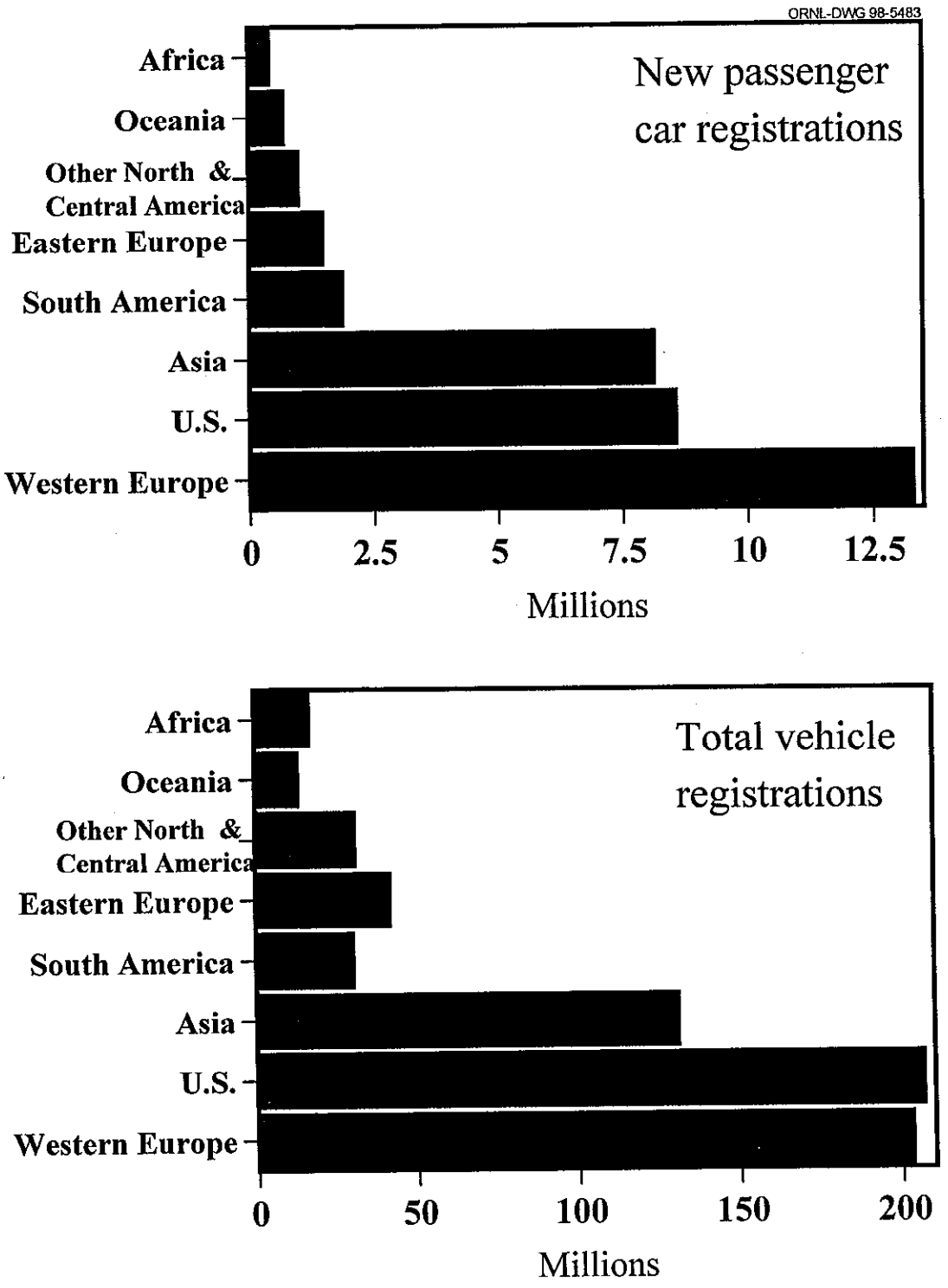
Table 5.2
Truck and Bus Registrations for Selected Countries, 1950–96
(thousands)

Year	China	India	Japan	France	United Kingdom	Germany[a]	Canada[b]	United States[c]	U.S. percentage of world[c]	World total[d]
1950	[e]	[e]	183	[e]	1,060	[e]	643	8,823	50.9%	17,349
1955	[e]	[e]	318	[e]	1,244	[e]	952	10,544	46.1%	22,860
1960	[e]	[e]	896	1,540	1,534	786	1,056	12,186	42.6%	28,583
1965	[e]	[e]	4,119	1,770	1,748	1,021	1,232	15,100	39.6%	38,118
1970	[e]	[e]	8,803	1,850	1,769	1,228	1,481	19,175	36.2%	52,899
1975	811	[e]	10,854	2,210	1,934	1,337	2,158	26,243	38.8%	67,698
1980	1,480	[e]	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
1986	2,884	1,090	19,319	3,980	3,336	1,760	3,213	45,697	38.6%	118,373
1987	3,247	1,229	20,424	4,200	3,452	1,801	3,576	47,428	37.4%	126,890
1988	3,716	1,383	21,674	4,370	3,621	1,846	3,766	50,557	37.6%	134,294
1989	4,118	1,457	22,472	4,570	3,754	1,914	3,889	52,797	37.4%	141,184
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
				Average annual percentage change						
1950–96	[e]	[e]	11.0%	[e]	2.7%	[e]	[e]	[e]		5.3%
1970–96	[e]	[e]	3.6%	4.1%	2.8%	[e]	[e]	[e]		4.9%
1986–96	8.9%	8.7%	1.3%	2.8%	0.8%	[e]	[e]	5.3%		4.6%

Source:
Motor Vehicle Manufacturers Association, *World Motor Vehicle Data*, 1998 Edition, Detroit, MI, 1998, pp. 8, 23, 28, 42, 85, 98, 169, 206, 230 and annual.
(Additional resources: http://www.aama.com)

[a] Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles (Table 1.1).
[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] World totals were recalculated from 1985–94 based on change in U.S. data.
[e] Data are not available.

Figure 5.1. World Vehicle Registrations by Region, 1996



Source:
American Automobile Manufacturers Association, *World Motor Vehicle Data*, 1997 Edition, Detroit, MI, 1997, pp. 6-11.

VEHICLES IN USE

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

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

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

Table 5.3
Automobiles and Trucks in Use, 1970–96
(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%
1971	92,718	83,138	11.5%	19,871	18,462	7.6%	112,589	101,600	10.8%
1972	97,082	86,439	12.3%	21,308	19,773	7.8%	118,390	106,212	11.5%
1973	101,985	89,805	13.6%	23,244	21,412	8.6%	125,229	111,217	12.6%
1974	104,856	92,608	13.2%	24,630	23,312	5.7%	129,487	115,920	11.7%
1975	106,706	95,241	12.0%	25,781	24,813	3.9%	132,487	120,054	10.4%
1976	110,189	97,818	12.6%	27,876	26,560	5.0%	138,065	124,378	11.0%
1977	112,288	99,904	12.4%	29,314	28,222	3.9%	141,602	128,126	10.5%
1978	116,573	102,957	13.2%	31,336	30,565	2.5%	147,909	133,522	10.8%
1979	118,429	104,677	13.1%	32,914	32,583	1.0%	151,343	137,260	10.3%
1980	121,601	104,564	16.3%	33,667	35,268	-4.5%	155,267	139,832	11.0%
1981	123,098	105,839	16.3%	34,644	36,069	-4.0%	157,743	141,908	11.2%
1982	123,702	106,867	15.8%	35,382	36,987	-4.3%	159,084	143,854	10.6%
1983	126,444	108,961	16.0%	36,723	38,143	-3.7%	163,166	147,104	10.9%
1984	128,158	112,019	14.4%	37,507	40,143	-6.6%	165,665	152,162	8.9%
1985	127,885	114,662	11.5%	43,210	42,387	1.9%	171,095	157,049	8.9%
1986	130,004	117,268	10.9%	45,103	44,826	0.6%	175,106	162,094	8.0%
1987	131,482	119,849	9.7%	46,826	47,344	-1.1%	178,308	167,193	6.6%
1988	133,836	121,519	10.1%	49,941	50,221	-0.6%	183,777	171,740	7.0%
1989	134,559	122,758	9.6%	52,172	53,202	-1.9%	186,731	175,960	6.1%
1990	133,700	123,276	8.5%	54,470	56,023	-2.8%	188,171	179,299	4.9%
1991	128,300	123,268	4.1%	59,206	58,179	1.8%	187,505	181,447	3.3%
1992	126,581	120,347	5.2%	63,136	61,172	3.2%	189,717	181,519	4.5%
1993	127,327	121,055	5.2%	66,082	65,260	1.3%	193,409	186,315	3.8%
1994	127,883	121,997	4.8%	69,491	66,717	4.2%	197,375	188,714	4.6%
1995	128,387	123,242	4.2%	72,458	70,199	3.2%	200,845	193,441	3.8%
1996	129,728	124,613	4.1%	75,940	73,681	3.1%	205,669	198,294	3.7%

Source:

FHWA - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, 1997, Table VM-1, p. V-94, and annual. (Additional resources: http://www.fhwa.dot.gov)

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

The data on automobile stock by size class are estimations based on historical sales data. This method assumes a constant scrappage rate for all size classes. The data on trucks by weight class are based on estimates from the 1992 Truck Inventory and Use Survey (latest available survey).

Table 5.4
Vehicle Stock and New Sales in United States, 1996 Calendar Year

	Vehicle stock[a]		New sales		
	Thousands	Percentage	Domestic (thousands)	Import[b] (thousands)	Total (thousands)
Autos	**124,613**	**100.0%**	**7,254 (85.1%)**	**1,273 (14.9%)**	**8,527 (100.0%)**
Two seaters	2,326	1.9%	33 (53.1%)	29 (46.9%)	61 (100.0%)
Minicompact	1,546	1.2%	0 (0.0%)	34 (100.0%)	34 (100.0%)
Subcompact	28,876	23.2%	958 (64.3%)	338 (35.7%)	1,296 (100.0%)
Compact	38,794	31.1%	3,018 (87.7%)	425 (12.3%)	3,442 (100.0%)
Midsize	35,903	28.8%	2,044 (83.4%)	408 (16.6%)	2,452 (100.0%)
Large	17,168	13.8%	1,201 (96.8%)	40 (3.2%)	1,241 (100.0%)
Autos	**124,613**	**100.0%**	[c]	[c]	[c]
Business fleet autos[d]	9,124	7.3%	[c]	[c]	[c]
Personal autos	115,489	92.7%	[c]	[c]	[c]
Motorcycles	**3,871[e]**	**100.0%**	[c]	[c]	[c]
Recreational vehicles	[c]	[c]	**467 (100.0%)**	**0 (0.0%)**	**467 (100.0%)**
Trucks	**73,681**	**100.0%**	**6,478 (93.6%)**	**451 (6.4%)**	**6,929 (100.0%)**
Light (0–10,000 lbs)	68,744	93.3%	6,088 (93.5%)	431 (6.5%)	6,519 (100.0%)
Medium (10,001–26,000 lbs)	2,432	3.3%	118 (86.1%)	19 (13.9%)	137 (100.0%)
Heavy-heavy (26,001 lbs and over)	2,505	3.4%	272 (99.3%)	1 (0.7%)	273 (100.0%)
Trucks	**73,681**	**100.0%**	[c]	[c]	[c]
Business fleet trucks≤19,500 lbs[d]	6,466	8.8%	[c]	[c]	[c]
Personal trucks ≤ 19,500 lbs	63,825	86.6%	[c]	[c]	[c]
Trucks > 19,500 lbs.	3,389	4.6%	[c]	[c]	[c]

Source:
See Appendix A for Table 5.4. (Additional resources: http://www.aama.com, http://www.polk.com)

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

Table 5.5
Highway Vehicle Miles Traveled by Mode, 1970–96
(million miles)

Year	Automobiles	Motorcycles	Two-axle, four-tire trucks	Other single-unit trucks	Combination trucks	Buses[a]	Total
1970	916,700	2,979	123,286	27,081	35,134	4,544	1,109,724
1971	966,330	3,607	137,870	28,985	37,217	4,802	1,178,811
1972	1,021,365	4,331	156,622	31,414	40,706	5,348	1,259,786
1973	1,045,981	5,194	176,833	33,661	45,649	5,792	1,313,110
1974	1,007,251	5,445	182,757	33,441	45,966	5,684	1,280,544
1975	1,033,950	5,629	200,700	34,606	46,724	6,055	1,327,664
1976	1,078,215	6,003	225,834	36,390	49,680	6,258	1,402,380
1977	1,109,243	6,349	250,591	39,339	55,682	5,823	1,467,027
1978	1,146,508	7,158	279,414	42,747	62,992	5,885	1,544,704
1979	1,113,640	8,637	291,905	42,012	66,992	5,947	1,529,133
1980	1,111,596	10,214	290,935	39,813	68,678	6,059	1,527,295
1981	1,133,332	10,690	296,343	39,568	69,134	6,241	1,555,308
1982	1,161,713	9,910	306,141	40,658	70,765	5,823	1,595,010
1983	1,195,054	8,760	327,643	42,546	73,586	5,199	1,652,788
1984	1,227,043	8,784	358,006	44,419	77,377	4,640	1,720,269
1985	1,246,798	9,086	390,961	45,441	78,063	4,478	1,774,826
1986	1,270,167	9,397	423,915	45,637	81,038	4,717	1,834,872
1987	1,315,982	9,506	456,870	48,022	85,495	5,330	1,921,204
1988	1,370,271	10,024	502,207	49,434	88,551	5,475	2,025,962
1989	1,401,221	10,371	536,475	50,870	91,879	5,670	2,096,487
1990	1,408,266	9,557	574,571	51,901	94,341	5,726	2,144,362
1991	1,358,185	9,178	649,394	52,898	96,645	5,750	2,172,050
1992	1,371,569	9,557	706,863	53,874	99,510	5,778	2,247,151
1993	1,374,709	9,906	745,750	56,772	103,116	6,125	2,296,378
1994	1,406,089	10,240	764,634	61,284	108,932	6,409	2,357,588
1995	1,438,294	9,797	790,029	62,705	115,451	6,420	2,422,696
1996	1,467,703	9,906	815,302	63,967	118,789	6,535	2,482,202
			Average annual percentage change				
1970–96	1.8%	4.7%	7.5%	3.4%	4.8%	1.4%	3.1%
1986–96	1.5%	0.5%	6.8%	3.4%	3.9%	3.3%	3.1%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, 1997, Table VM-1, p. V-94, and annual.
(Additional resources: http://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 5.6
Automobiles in Operation and Vehicle Travel by Age, 1970 and 1996

Age (years)	1970 Vehicles (thousands)	1970 Percentage	1970 Cumulative percentage	1996 Vehicles (thousands)	1996 Percentage	1996 Cumulative percentage	1996 Estimated vehicle travel Percentage	1996 Estimated vehicle travel Cumulative percentage
Under 1[a]	6,288	7.8%	7.8%	6,153	4.9%	4.9%	6.4%	6.4%
1	9,299	11.6%	19.4%	9,179	7.4%	12.3%	9.0%	15.5%
2	8,816	11.0%	30.3%	7,973	6.4%	18.7%	7.5%	23.0%
3	7,878	9.8%	40.1%	8,040	6.5%	25.2%	7.2%	30.2%
4	8,538	10.6%	50.8%	7,474	6.0%	31.2%	6.4%	36.7%
5	8,506	10.6%	61.3%	7,753	6.2%	37.4%	6.7%	43.4%
6	7,116	8.8%	70.2%	7,932	6.4%	43.7%	6.7%	50.1%
7	6,268	7.8%	78.0%	8,692	7.0%	50.7%	7.2%	57.3%
8	5,058	6.3%	84.3%	8,803	7.1%	57.8%	6.6%	63.9%
9	3,267	4.1%	88.3%	8,431	6.8%	64.5%	6.4%	70.3%
10	2,776	3.5%	91.8%	8,134	6.5%	71.1%	5.5%	75.7%
11	1,692	2.1%	93.9%	7,191	5.8%	76.8%	4.8%	80.6%
12	799	1.0%	94.9%	6,107	4.9%	81.7%	4.1%	84.7%
13	996	1.2%	96.1%	3,945	3.2%	84.9%	2.7%	87.3%
14	794	1.0%	97.1%	2,871	2.3%	87.2%	1.9%	89.3%
15 and older	2,336	2.9%	100.0%	15,935	12.8%	100.0%	10.7%	100.0%
Subtotal	**80,427**	**100.0%**		**124,613**	**100.0%**		**100.0%**	
Age not given	**22**			**0**				
Total	**80,449**			**124,613**				
Average age		5.6			8.6			
Median age		4.9			7.9			

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 *Household Vehicle Energy Consumption 1994*, provided by the U.S. Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division, 1996.
(Additional resources: http://www.polk.com, http://www.eia.doe.gov)

[a]Automobiles sold as of July 1 of each year.

Table 5.7
Trucks in Operation and Vehicle Travel by Age, 1970 and 1996

Age (years)	1970 Vehicles (thousands)	1970 Percentage	1970 Cumulative percentage	1996 Vehicles (thousands)	1996 Percentage	1996 Cumulative percentage	1996 Estimated vehicle travel Percentage	1996 Estimated vehicle travel Cumulative percentage	Average annual miles per vehicle
Under 1[a]	1,262	7.1%	7.1%	4,497	6.1%	6.1%	6.8%	6.8%	14,288
1	1,881	10.6%	17.8%	6,448	8.8%	14.9%	11.2%	18.0%	16,439
2	1,536	8.7%	26.5%	5,847	7.9%	22.8%	11.4%	29.4%	18,388
3	1,428	8.1%	34.6%	4,976	6.8%	29.5%	9.3%	38.6%	17,601
4	1,483	8.4%	43.0%	4,097	5.6%	35.1%	7.3%	45.9%	16,775
5	1,339	7.6%	50.5%	4,020	5.5%	40.6%	6.8%	52.7%	16,020
6	1,154	6.5%	57.1%	3,906	5.3%	45.9%	6.0%	58.7%	14,574
7	975	5.5%	62.6%	4,498	6.1%	52.0%	6.5%	65.3%	13,710
8	826	4.7%	67.3%	4,385	6.0%	57.9%	6.1%	71.4%	13,255
9	621	3.5%	70.8%	3,844	5.2%	63.1%	5.0%	76.4%	12,237
10	658	3.7%	74.5%	3,969	5.4%	68.5%	3.5%	79.8%	8,224
11	583	3.3%	77.8%	3,360	4.6%	73.1%	2.9%	82.8%	8,224
12	383	2.2%	80.0%	2,847	3.9%	76.9%	2.5%	85.2%	8,224
13	417	2.4%	82.3%	1,748	2.4%	79.3%	1.5%	86.7%	8,224
14	414	2.3%	84.7%	1,414	1.9%	81.2%	1.2%	88.0%	8,224
15 and older	2,710	15.3%	100.0%	13,825	18.8%	100.0%	12.0%	100.0%	8,224
Subtotal	**17,670**	**100.0%**		**73,681**	**100.0%**		**100.0%**		
Age not given	15			0					
Total	**17,685**			**73,681**					
Average age		7.3			8.3				
Median age		5.9			7.7				

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

[a]Trucks sold as of July 1 of each year.

The average age of automobiles continued to grow in 1996 while trucks declined slightly. The increasing popularity of light trucks as personal passenger vehicles may have had an influence on the average age of trucks.

Table 5.8
Average Age of Automobiles and Trucks in Use, 1970–96
(years)

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

Source:
The Polk Company, Detroit, MI. **FURTHER REPRODUCTION PROHIBITED.**
(Additional resources: http://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.

1990 model year (MY) automobiles will be in service an average of three years longer than their 1970 counterparts. The average lifetime of autos increased by 1.4 years from MY 1970 to MY 1980, then rose another 1.6 years in MY 1990.

Table 5.9
Scrappage and Survival Rates for Automobiles
1970, 1980 and 1990 Model Years

Vehicle age (years)	1970 model year		1980 model year		1990 model year	
	Scrappage rate[a]	Survival rate[b]	Scrappage rate[a]	Survival rate[b]	Scrappage rate[a]	Survival rate[b]
0	0.000000	1.000000	0.000000	1.000000	0.000000	1.000000
1	0.006050	0.993950	0.005553	0.994447	0.005255	0.994745
2	0.009650	0.984359	0.007636	0.986854	0.007538	0.987246
3	0.014590	0.969997	0.011011	0.975988	0.010522	0.976858
4	0.022892	0.947792	0.013567	0.962746	0.014414	0.962778
5	0.030522	0.918864	0.020498	0.943011	0.019623	0.943885
6	0.040956	0.881231	0.034718	0.910272	0.025096	0.920197
7	0.057029	0.830975	0.047366	0.867156	0.032690	0.890116
8	0.084560	0.760708	0.055299	0.819204	0.042014	0.852719
9	0.118527	0.670543	0.071153	0.760915	0.053468	0.807126
10	0.151858	0.568716	0.092931	0.690202	0.066230	0.753669
11	0.166996	0.473743	0.117300	0.609241	0.081338	0.692367
12	0.171955	0.392280	0.158696	0.512557	0.096959	0.625236
13	0.201774	0.313128	0.187663	0.416369	0.114297	0.553773
14	0.198887	0.250851	0.208822	0.329422	0.131169	0.481135
15	0.233611	0.192250	0.228359	0.254196	0.149005	0.409444
16	0.271810	0.139994	0.238412	0.193592	0.166710	0.341186
17	0.283363	0.100325	0.250547	0.145088	0.183826	0.278467
18	0.283078	0.071925	0.261438	0.107157	0.199477	0.222919
19	0.287708	0.051232	0.270527	0.078168	0.211449	0.175783
20	0.292908	0.036226	0.277234	0.056497	0.223461	0.136502
Average lifetime	10.7 years		12.1 years		13.7 years	

Source:
Miaou, Shaw-Pin, "Factors Associated with Aggregated Car Scrappage Rate in the United States: 1966–1992," Oak Ridge National Laboratory, Oak Ridge, TN, January 1995.
(Additional resources: http://www-cta.ornl.gov)

[a]The probability that a 1970/80/90 model year automobile will be retired from use within a given year.
[b]The probability that a 1970/80/90 model year automobile will be in use at the end of a given year.

Table 5.10
Scrappage and Survival Rates for Trucks

Vehicle age (years)	All trucks (1966–73)[a] Scrappage rate	All trucks (1966–73)[a] Survival rate	All trucks (1973–78)[a] Scrappage rate	All trucks (1973–78)[a] Survival rate	All trucks (1978–89)[a] Scrappage rate	All trucks (1978–89)[a] Survival rate	Light trucks (1978–89)[a] Scrappage rate	Light trucks (1978–89)[a] Survival rate
0	0.00000	1.00000	0.00000	1.00000	0.00000	1.00000	0.00000	1.00000
1	0.00582	0.99418	0.00505	0.99495	0.00312	0.99688	0.00249	0.99751
2	0.00814	0.98608	0.00698	0.98801	0.00461	0.99228	0.00383	0.99369
3	0.01129	0.97495	0.00958	0.97854	0.00676	0.98557	0.00583	0.98790
4	0.01550	0.95983	0.01306	0.96576	0.00980	0.97591	0.00877	0.97923
5	0.02101	0.93967	0.01762	0.94873	0.01399	0.96226	0.01296	0.96654
6	0.02798	0.91337	0.02347	0.92647	0.01957	0.94343	0.01869	0.94848
7	0.03649	0.88005	0.03073	0.89800	0.02663	0.91830	0.02606	0.92376
8	0.04638	0.83923	0.03943	0.86260	0.03507	0.88609	0.03488	0.89154
9	0.05730	0.79114	0.04940	0.81999	0.04445	0.84671	0.04454	0.85182
10	0.06863	0.73685	0.06026	0.77058	0.05408	0.80092	0.05416	0.80569
11	0.07970	0.67812	0.07147	0.71551	0.06320	0.75030	0.06285	0.75505
12	0.08987	0.61718	0.08239	0.65656	0.07121	0.69687	0.07006	0.70215
13	0.09872	0.55625	0.09247	0.59585	0.07776	0.64268	0.07562	0.64905
14	0.10605	0.49726	0.10130	0.53548	0.08285	0.58944	0.07967	0.59734
15	0.11189	0.44162	0.10871	0.47727	0.08662	0.53838	0.08251	0.54805
16	0.11638	0.39023	0.11468	0.42254	0.08932	0.49029	0.08443	0.50178
17	0.11976	0.34349	0.11936	0.37210	0.09122	0.44557	0.08571	0.45877
18	0.12225	0.30150	0.12294	0.32636	0.09253	0.40434	0.08655	0.41907
19	0.12406	0.26410	0.12562	0.28536	0.09343	0.36656	0.08710	0.38257
20	0.12536	0.23099	0.12761	0.24894	0.09403	0.33209	0.08745	0.34911
21	0.12629	0.20182	0.12906	0.21681	0.09444	0.30073	0.08768	0.31850
22	0.12696	0.17620	0.13012	0.18860	0.09471	0.27225	0.08783	0.29052
23	0.12743	0.15374	0.13089	0.16392	0.09490	0.24641	0.08793	0.26498
24	0.12776	0.13410	0.13144	0.14237	0.09502	0.22300	0.08799	0.24166
25	0.12799	0.11694	0.13183	0.12360	0.09510	0.20179	0.08803	0.22039
Average lifetime	14.0 years		14.6 years		15.8 years		16.0 years	

Source:
Miaou, Shaw-Pin, "Study of Vehicle Scrappage Rates," Oak Ridge National Laboratory, Oak Ridge, TN, August 1990.
(Additional resources: http://www-cta.ornl.gov)

[a]Average scrappage and survival rates for all vehicles registered within this time period.

Chapter 6

Light Vehicles and Characteristics

Summary Statistics

Table		
6.1	Passenger cars, 1996	
	Registrations (thousands)	*129,728*
	Vehicle miles (million miles)	*1,467,703*
	Fuel economy (miles per gallon)	*21.3*
6.8	Two-axle, four tire trucks, 1996	
	Registrations (thousands)	*68,934*
	Vehicle miles (million miles)	*815,302*
	Fuel economy (miles per gallon)	*17.3*
6.3	Automobile sales, 1997 sales period	
	Minicompact	*39,519*
	Subcompact	*1,510,050*
	Compact	*2,937,064*
	Midsize	2,531,196
	Large	*1,162,290*
	Two-seater	*80,921*
6.10	Light truck sales, 1997 sales period	
	Small pickup	520,834
	Large pickup	*2,051,144*
	Small van	*1,215,776*
	Large van	*386,563*
	Small utility	*1,715,259*
	Large utility	*637,140*
6.12	Corporate average fuel economy	(mpg)
	Automobile standard, MY 1998	*27.5*
	Automobile fuel economy, MY 1998	*28.8*
	Light truck standard, MY 1998	*20.7*
	Light truck fuel economy, MY 1998	*20.8*
6.17	Average fuel economy loss from 55 to 70 mph	17.1%

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

Table 6.1
Summary Statistics for Passenger Cars, 1970–96

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	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	1,467,703	68,897	21.3
		Average annual percentage change		
1970–96	1.4%	1.8%	0.1%	1.8%
1986–96	0.0%	1.5%	-0.6%	2.0%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, 1997, Table VM-1, p. V-94, and annual.
(Additional resources: http://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.

Table 6.2
New Retail Automobile Sales in the United States, 1970–97

Calendar year	Domestic[a]	Import[b]	Total	Percentage imports	Percentage transplants[c] on model year basis	Percentage imports and transplants	Percentage diesel
	(thousands)						
1970	7,119	1,285	8,404	15.3%	[d]	[d]	[d]
1971	8,681	1,568	10,249	15.3%	[d]	[d]	0.06%
1972	9,327	1,623	10,950	14.8%	[d]	[d]	0.05%
1973	9,676	1,763	11,439	15.4%	[d]	[d]	0.06%
1974	7,454	1,399	8,853	15.8%	[d]	[d]	0.20%
1975	7,053	1,571	8,624	18.2%	[d]	[d]	0.31%
1976	8,611	1,499	10,110	14.8%	0.0%	14.8%	0.22%
1977	9,109	2,074	11,183	18.5%	0.0%	18.5%	0.34%
1978	9,312	2,002	11,314	17.7%	0.0%	17.7%	1.02%
1979	8,341	2,332	10,673	21.8%	1.3%	23.1%	2.54%
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	7,254	1,273	8,527	14.9%	[d]	[d]	0.10%
1997	6,917	1,355	8,272	16.4%	[d]	[d]	[d]
			Average annual percentage change				
1970–97	-0.1%	0.2%	-0.1%				
1987–97	-0.2%	-8.2%	-2.1%				

Source:

Domestic and import data - American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1997*, Detroit, MI, 1997, p. 15, and annual. 1997 data from *Economic Indicators, 4th Quarter 1997*.

Diesel data - H. A. Stark (ed), Ward's Communications, Inc., *Ward's Automotive Yearbook*, Detroit, MI, 1997, p. 39, and annual.

Transplant data - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares Data System, Oak Ridge, TN, 1996. (Additional resources: http://www.aama.com, http://www.wardsauto.com)

[a] North American built.

[b] Does not include import tourist deliveries.

[c] A transplant is an automobile which was built in the U.S. by a foreign firm. Also included are joint ventures which are built in the U.S.

[d] Data are not available.

Table 6.3
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Automobiles, Selected Sales Periods 1976–97[a]

	1976	1980	1984	1988	1990	1992	1993	1994	1995	1996	1997
MINICOMPACT											
Total sales, units		428,346	41,368	84,186	76,698	107,634	84,345	57,198	44,752	34,234	39,519
Market share, %		4.7	0.4	0.8	0.8	1.3	1.0	0.6	0.5	0.4	0.5
Fuel economy, mpg		29.4	29	37.8	26.4	30.6	29.9	27.8	27.0	27.2	26.3
SUBCOMPACT											
Total sales, units	2,625,929	3,441,480	2,510,929	1,983,353	2,030,226	2,074,351	1,944,892	2,015,280	1,518,209	1,315,281	1,510,050
Market share, %	27.1	37.8	24.6	19.1	22	25.6	23.2	22.6	17.4	15.2	18.3
Fuel economy, mpg	23.5	27.3	30.5	31.7	31.3	31.8	31.9	31.3	31.7	32.1	32.6
COMPACT											
Total sales, units	2,839,603	599,423	2,768,056	4,199,638	3,156,481	2,451,498	2,655,378	3,077,203	3,289,735	3,492,957	2,937,064
Market share, %	29.3	6.6	27.1	40.5	34.2	30.2	31.7	34.5	37.7	40.4	35.6
Fuel economy, mpg	17.1	22.3	30.6	29.8	28.9	28.7	29.3	29.8	30.2	30.4	30.0
MIDSIZE											
Total sales, units	1,815,505	3,073,103	3,059,647	2,550,964	2,511,503	2,249,553	2,445,842	2,359,898	2,498,521	2,487,880	2,531,196
Market share, %	18.7	33.8	30	24.6	27.2	27.7	29.2	26.5	28.6	28.8	30.6
Fuel economy, mpg	15.3	21.3	24.1	26.9	25.9	25.8	25.7	25.6	25.9	26.4	26.3
LARGE											
Total sales, units	2,206,102	1,336,190	1,502,097	1,368,717	1,279,092	1,140,775	1,186,991	1,339,863	1,320,608	1,259,266	1,162,290
Market share, %	22.8	14.7	14.7	13.2	13.9	14.1	14.2	15.0	15.1	14.6	14.1
Fuel economy, mpg	13.9	19.3	20.2	24.2	23.5	23.7	24.0	24.2	24.1	24.2	24.5
TWO SEATER											
Total sales, units	199,716	215,964	328,968	186,127	170,465	83,192	70,480	67,020	53,045	62,231	80,921
Market share, %	2.1	2.4	3.2	1.8	1.8	1.0	0.8	0.8	0.6	0.7	1.0
Fuel economy, mpg	20.1	21	26.5	27.3	28	25.9	24.8	23.9	24.7	25.4	26.3
TOTAL											
Total sales, units	9,686,855	9,094,506	10,211,06	10,372,98	9,224,465	8,107,003	8,387,928	8,916,462	8,724,870	8,651,849	8,261,040
Market share, %	100	100	100	100	100	100	100	100	100	100	100
Fuel economy, mpg	17.2	23.2	26.3	28.5	27.6	27.7	27.8	27.8	28.0	28.3	28.3

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1998. (Additional resources: http://www-cta.ornl.gov)

[a] These figures represent only those sales that could be matched to corresponding EPA fuel economy values.

Table 6.4
Sales-Weighted Engine Size of New Domestic and Import Automobiles by Size Class, Sales Periods 1976–97
(liters[a])

Model year	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	Fleet
1976	[b]	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
			Average annual percentage change				
1976–97	1.4%[c]	-1.1%	-3.7%	-3.1%	-2.5%	0.3%	-2.7%
1987–97	5.9%	0.3%	0.4%	0.1%	-0.8%	1.8%	0.2%

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1998.
(Additional resources: http://www-cta.ornl.gov)

[a] 1 liter = 61.02. cubic inches.
[b] There were no minicompact automobiles sold in 1976.
[d] Average annual percentage change begins with 1977.

Table 6.5
Sales-Weighted Curb Weight of New Domestic and Import Automobiles by Size Class,
Sales Periods 1976–97
(pounds)

Model year	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	Fleet
1976	[a]	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
			Average annual percentage change				
1976–97	1.5%[b]	-0.2%	-1.3%	-1.1%	-1.1%	0.4%	-0.9%
1987–97	4.3%	0.3%	1.0%	1.3%	0.5%	1.0%	1.0%

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1998.
(Additional resources: http://www-cta.ornl.gov)

[a] There were no minicompact automobiles sold in 1976.
[c] Average annual percentage change begins with 1977.

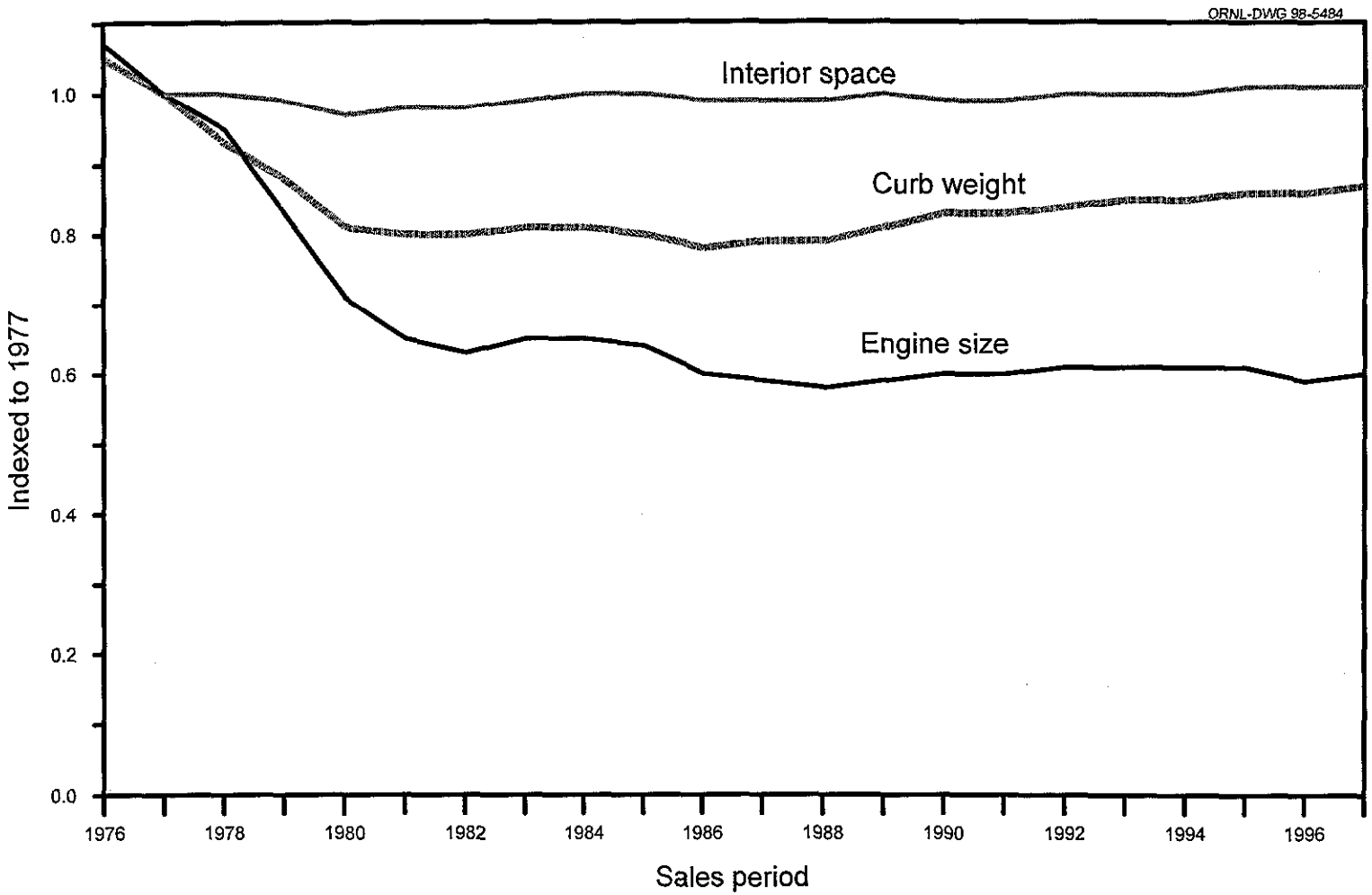
Table 6.6
Sales-Weighted Interior Space of New Domestic and Import Automobiles by Size Class, Sales Periods 1976–97
(cubic feet)

Model year	Minicompact (< 85)	Subcompact (85–99)	Compact (100–109)	Midsize (110–119)	Large (> 120)	Fleet[a]
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
			Average annual percentage change			
1977–97	-0.1%	0.3%	-0.2%	0.1%	0.0%	0.0%
1987–97	-0.6%	0.3%	0.1%	0.0%	0.0%	0.2%

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1998.
(Additional resources: http://www-cta.ornl.gov)

[a] Interior volumes of two seaters are not reported to EPA.

Figure 6.1. Engine Size, Curb Weight, and Interior Space of New Domestic and Import Automobiles, 1976–96



Source: See Tables 6.4, 6.5, and 6.6.

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 1997 with a 43.4% share of total materials. As conventional steel use has been decreasing, use of high-strength steel has increased.

Table 6.7
Average Material Consumption for a Domestic Automobile, 1978, 1985, and 1997

	1978		1985		1997	
Material	Pounds	Percentage	Pounds	Percentage	Pounds	Percentage
Conventional steel[a]	1,880.0	53.8%	1,481.5	46.5%	1,411.0	43.4%
High-strength steel	127.5	3.6%	217.5	6.8%	295.5	9.1%
Stainless steel	25.0	0.7%	29.0	0.9%	47.5	1.5%
Other steels	56.0	1.6%	54.5	1.7%	36.0	1.1%
Iron	503.0	14.4%	468.0	14.7%	378.0	11.6%
Aluminum	112.0	3.2%	138.0	4.3%	206.0	6.3%
Rubber	141.5	4.1%	136.0	4.3%	138.5	4.3%
Plastics/composites	176.0	5.0%	211.5	6.6%	242.0	7.5%
Glass	88.0	2.5%	85.0	2.7%	96.5	3.0%
Copper	39.5	1.1%	44.0	1.4%	46.5	1.4%
Zinc die castings	28.0	0.8%	18.0	0.5%	14.0	0.4%
Powder metal parts	16.0	0.5%	19.0	0.6%	31.0	1.0%
Fluids & lubricants	189.0	5.4%	184.0	5.8%	197.5	6.1%
Other materials	112.5	3.2%	101.5	3.2%	102.0	3.1%
Total	3,494.0	100.0%	3,187.5	100.0%	3,248.0	100.0%

Source:
H. A. Stark (ed.), Ward's Communications, Inc., *Wards Automotive Yearbook*, Detroit, MI, 1997, p. 19, and annual. (Additional resources: http://www.wardsauto.com)

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

The Federal Highway Administration released revised historical data in 1997 which better reflected two-axle, four-tire trucks. The definition of this category includes vans, pickup trucks, and sport utility vehicles.

Table 6.8
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970–96

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	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	68,934	815,302	47,133	17.3
		Average annual percentage change		
1970–96	6.3%	7.5%	5.3%	2.1%
1986–96	5.8%	6.8%	4.9%	1.7%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, 1997, Table VM-1, p. V-94, and annual.
(Additional resources: http://www.fhwa.dot.gov)

Table 6.9
New Retail Sales of Trucks 10,000 Pounds GVW and Less in the United States, 1970–96

Calendar year	Light truck sales[a] (thousands)	Percentages					
		Import[b]	Transplants[c]	Diesel	Four-wheel drive of domestic light trucks	Light trucks of light-duty vehicle sales[d]	Light trucks of total truck sales
1970	1,463	4.5%	[e]	[f]	[e]	14.8%	80.4%
1971	1,757	4.8%	[e]	[f]	[e]	14.6%	83.4%
1972	2,239	6.4%	[e]	[f]	[e]	17.0%	83.3%
1973	2,745	8.5%	[e]	[f]	[e]	19.4%	84.2%
1974	2,338	7.5%	[e]	[f]	18.0%	20.9%	84.2%
1975	2,281	10.0%	[e]	[f]	23.4%	20.9%	87.9%
1976	2,956	8.0%	0.0%	[f]	23.8%	22.6%	89.8%
1977	3,430	9.4%	0.0%	[f]	24.6%	23.5%	89.7%
1978	3,808	8.8%	0.0%	1.0%	28.5%	25.2%	89.2%
1979	3,311	14.1%	0.0%	1.0%	29.4%	23.7%	88.7%
1980	2,440	19.7%	0.9%	3.2%	20.7%	21.4%	88.9%
1981	2,189	20.3%	0.0%	3.3%	18.6%	20.4%	89.8%
1982	2,470	16.5%	0.0%	5.0%	16.8%	23.6%	92.8%
1983	2,984	15.6%	0.0%	4.0%	28.5%	24.5%	93.6%
1984	3,863	15.7%	2.0%	3.8%	27.0%	27.1%	93.0%
1985	4,458	17.2%	2.6%	3.3%	29.1%	28.8%	93.6%
1986	4,594	20.1%	2.3%	2.6%	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%	2.0%	32.1%	31.1%	93.2%
1989	4,610	10.9%	2.6%	2.1%	31.4%[g]	31.8%	93.3%
1990	4,548	13.2%	3.4%	2.2%[g]	31.6%[g]	32.8%	93.9%
1991	4,123	12.8%	4.5%	2.2%[g]	34.4%[g]	33.5%	94.5%
1992	4,629	8.6%	5.5%	2.5%[g]	31.6%[g]	36.0%	94.4%
1993	5,351	6.8%	7.1%	2.3%[g]	32.6%[g]	38.6%	94.2%
1994	6,033	6.5%	8.1%	2.7%[g]	34.4%[g]	40.2%	94.0%
1995	6,053	6.5%	7.5%	3.8%[g]	39.1%[g]	41.2%	93.4%
1996	6,519	6.6%	[e]	3.7%[g]	35.7%[g]	43.3%	94.1%
		Average annual percentage change					
1970–96	5.8%						
1985–96	3.6%						

Source:

Four-wheel drive - 1970–88: H. A. Stark (ed.), Ward's Communications, Inc., *Ward's Automotive Yearbook*, Detroit, MI, 1989, p. 168, and annual. 1989–96: H. A. Stark (ed.), Ward's Communications, Inc., *Ward's Automotive Yearbook*, Factory Installation Reports, Detroit, MI, 1997.

Transplants - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1996.

All other - American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1997*, Detroit, MI, 1997, pp. 8, 19, 20, 21, and annual. (Additional resources: http:/www.aama.com, http://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] Light-duty vehicles include automobiles and light trucks.

[e] Data are not available.

[f] Indicates less than 1 percent.

[g] Based on factory installations or factory sales.

Table 6.10
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Light Trucks, Selected Sales Periods 1976–97[a]

	1976	1980	1984	1988	1990	1992	1993	1994	1995	1996	1997
SMALL PICKUP											
Total sales, units	170,351	516,412	1,012,298	1,026,551	678,488	586,752	332,470	365,322	356,856	574,930[b]	520,834
Market share, %	7.1	23.3	28.0	21.6	15.0	13.4	6.6	6.4	6.0	9.2	8.0
Fuel economy, mpg	23.9	25.5	27.2	26.1	25.2	25.0	24.9	25.3	25.6	25.6	24.6
LARGE PICKUP											
Total sales, units	1,586,020	1,115,248	1,218,972	1,453,255	1,573,729	1,452,192	1,877,806	2,199,224	2,183,793	2,042,179	2,051,144
Market share, %	66.4	50.3	33.7	30.6	34.9	33.1	37.1	38.4	36.8	32.7	31.4
Fuel economy, mpg	15.1	17	17.5	18.5	18.9	18.9	19.6	20.1	19.4	18.9	19.4
SMALL VAN											
Total sales, units	18,651	13,649	222,798	851,384	932,693	968,361	1,129,459	1,263,933	1,257,116	1,229,650	1,215,776
Market share, %	0.8	0.6	6.2	18.0	20.7	22.0	22.3	22.1	21.2	19.7	18.6
Fuel economy, mpg	19.5	19.6	25.0	22.9	23.1	22.5	22.9	22.1	22.8	22.8	22.9
LARGE VAN											
Total sales, units	574,745	328,065	545,595	486,981	398,877	350,013	388,435	407,737	401,056	370,126	386,563
Market share, %	24.1	14.8	15.1	10.3	8.8	8.0	7.7	7.1	6.8	5.9	5.9
Fuel economy, mpg	15.4	16.3	16.3	17.0	16.9	16.9	17.3	17.4	17.1	17.2	17.8
SMALL UTILITY											
Total sales, units	4,716	75,875	398,000	701,005	738,294	867,934	948,797	1,042,584	1,225,131	1,378,696	1,715,259
Market share, %	0.2	3.4	11.0	14.8	16.4	19.8	18.8	18.2	20.6	22.1	26.3
Fuel economy, mpg	15.5	16.9	23.0	22.4	21.9	20.9	21.3	20.7	20.8	21.1	19.6
LARGE UTILITY											
Total sales, units	32,427	167,288	215,271	223,824	192,544	167,199	378,710	445,601	509,914	641,280	637,140
Market share, %	1.4	7.5	6.0	4.7	4.3	3.8	7.5	7.8	8.6	10.3	9.8
Fuel economy, mpg	14.7	14.6	15.7	16.2	16.1	16.9	17.5	17.8	17.4	18.2	18.2
TOTAL											
Total sales, units	2,386,910	2,216,537	3,612,934	4,743,000	4,514,625	4,392,451	5,055,677	5,724,401	5,933,866	6,236,861	6,526,716
Market share, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fuel economy, mpg	15.6	18.1	20.0	20.7	20.5	20.4	20.5	20.4	20.2	20.4	20.1

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1998. (Additional resources: http://www-cta.ornl.gov)

[a] These figures represent only those sales that could be matched to corresponding EPA fuel economy values.
[b] Some four-wheel drive pickups previously classified as large pickups were correctly reclassified as small pickups.

Table 6.11
Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class
Sales Periods 1976–97
(liters[a])

Model year	Small pickup	Large pickup	Small van	Large van	Small utility	Large utility	Fleet
1976	1.91	5.57	1.97	5.39	5.39	4.97	5.23
1977	2.01	5.48	1.97	5.32	5.46	4.95	5.03
1978	2.03	5.45	1.97	5.29	5.09	5.40	5.02
1979	2.05	5.15	1.97	5.13	4.52	5.30	4.62
1980	2.05	5.05	1.97	5.03	4.29	5.39	4.33
1981	2.14	4.82	1.97	4.84	3.94	5.15	4.15
1982	2.34	4.99	1.79	4.92	3.88	5.27	4.24
1983	2.35	4.97	1.87	5.06	3.05	5.34	4.00
1984	2.38	4.95	2.23	5.06	2.81	5.39	3.87
1985	2.38	4.77	2.65	5.12	2.83	5.37	3.77
1986	2.43	4.68	2.78	5.13	2.78	5.55	3.65
1987	2.44	4.69	2.96	5.21	2.80	5.42	3.65
1988	2.56	4.68	3.15	5.21	3.14	5.51	3.82
1989	2.64	4.70	3.11	5.22	3.50	5.45	3.93
1990	2.90	4.49	3.29	5.21	3.38	5.48	3.93
1991	2.91	4.57	3.29	5.23	3.62	5.40	3.94
1992	3.07	4.57	3.32	5.28	3.69	5.47	4.00
1993	3.25	4.32	3.30	5.21	3.80	5.58	4.02
1994	3.10	4.45	3.48	5.31	3.77	5.54	4.10
1995	2.95	4.44	3.40	5.15	3.75	5.49	4.06
1996	2.83	4.72	3.41	5.21	3.68	5.11	4.12
1997	2.90	4.62	3.36	5.04	3.98	4.97	4.14
			Average annual percentage change				
1976–97	2.0%	-0.9%	2.6%	-0.3%	-1.4%	0.0%	-1.1%
1987–97	1.7%	-0.2%	1.3%	-0.3%	3.6%	-0.9%	1.3%

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1998.
(Additional resources: http://www-cta.ornl.gov)

[a] 1 liter = 61.02 cubic inches.

Table 6.12
Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates
for Automobiles and Light Trucks, 1978–98[a]
(miles per gallon)

Model Year	Automobiles				Light Trucks[b]			
	CAFE Standards	CAFE Estimates[c]			CAFE Standards	CAFE Estimates[c]		
		Domestic	Import	Combined		Domestic	Import	Combined
1978	18.0	18.7	27.3	19.9	[d]	[e]	[e]	[e]
1979	19.0	19.3	26.1	20.3	[d]	17.7	20.8	18.2
1980	20.0	22.6	29.6	24.3	[d]	16.8	24.3	18.5
1981	22.0	24.2	31.5	25.9	[d]	18.3	27.4	20.1
1982	24.0	25.0	31.1	26.6	17.5	19.2	27.0	20.5
1983	26.0	24.4	32.4	26.4	19.0	19.6	27.1	20.7
1984	27.0	25.5	32.0	26.9	20.0	19.3	26.7	20.6
1985	27.5	26.3	31.5	27.6	19.5	19.6	26.5	20.7
1986	26.0	26.9	31.6	28.2	20.0	20.0	25.9	21.5
1987	26.0	27.0	31.2	28.5	20.5	20.5	25.2	21.7
1988	26.0	27.4	31.5	28.8	20.5	20.6	24.6	21.3
1989	26.5	27.2	30.8	28.4	20.5	20.4	23.5	20.9
1990	27.5	26.9	29.9	28.0	20.0	20.3	23.0	20.8
1991	27.5	27.3	30.0	28.4	20.2	20.9	23.0	21.3
1992	27.5	27.0	29.2	27.9	20.2	20.5	22.7	20.8
1993	27.5	27.8	29.6	28.4	20.4	20.7	22.8	21.0
1994	27.5	27.5	29.6	28.3	20.5	20.5	22.0	20.7
1995	27.5	27.7	30.3	28.6	20.6	20.3	21.5	20.5
1996	27.5	28.3	29.7	28.7	20.7	20.5	22.1	20.7
1997	27.5	27.9	29.8	28.6	20.7	20.1	22.1	20.4
1998	27.5	28.1	28.1	28.8	20.7	20.4	23.0	20.8

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, March 1998. (Additional resources: http://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]Represents two- and four-wheel drive trucks combined. Gross vehicle weight of 0–6,000 pounds for model year 1978–1979 and 0–8,500 pounds for subsequent years.

[c]All CAFE calculations are sales-weighted.

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

[e]Data are not available.

Table 6.13
Corporate Average Fuel Economy (CAFE) Fines Collected, 1983–96[a]
(thousands)

Model year	Current dollars	1990 constant dollars[b]
1983	58	76
1984	5,958	7,496
1985	15,565	18,908
1986	29,872	35,603
1987	31,261	35,945
1988	44,519	49,181
1989	47,381	49,946
1990	48,449	48,449
1991	42,243	40,511
1992	38,287	35,645
1993	28,688	25,963
1994	31,478	27,764
1995	40,788	34,955
1996	[c]	[c]
Total	404,547	410,442

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, March, 1998.
(Additional resources: http://www.nhtsa.dot.gov)

Table 6.14
Tax Receipts from the Sale of Gas Guzzlers, 1980–96
(thousands)

Fiscal year	Current dollars	1990 constant dollars[b]
1980	740	1,174
1981	780	1,121
1982	1,720	2,329
1983	4,020	5,273
1984	8,820	11,097
1985	39,790	48,336
1986	147,660	175,987
1987	145,900	167,759
1988	116,780	129,008
1989	109,640	115,575
1990	103,200	103,200
1991	118,400	113,546
1992	144,200	134,250
1993	111,600	100,998
1994	64,100	56,536
1995	73,500	62,990
1996	52,600	43,816

Source:
Motor Vehicle Manufacturers Association, *Motor Vehicle Facts and Figures 1997*, Detroit, MI, 1997, p. 82.
(Additional resources: http://www.aama.com)

[a] These are fines which are actually collected. Fines which are assessed in a certain year may not have been collected in that year.

[b] Adjusted using the Consumer Price Inflation Index.

[c] No CAFE fines have been collected for MY 1996.

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.

Table 6.15
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: http://www.irs.ustreas.gov)

New Data 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.

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Table 6.16
Vehicle Specifications for Tested Vehicles

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.

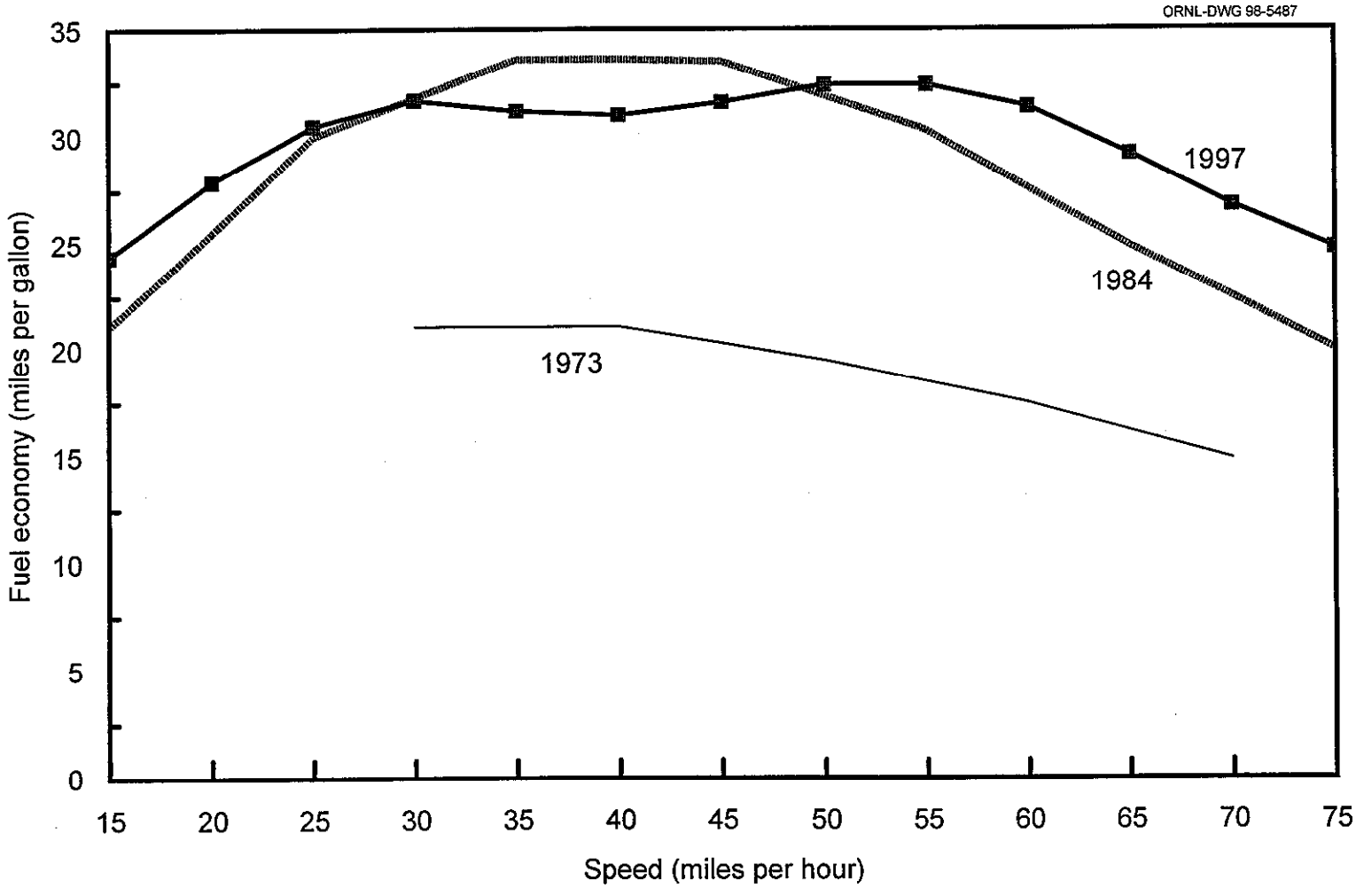
Table 6.17
Fuel Economy by Speed, 1973, 1984, and 1997
(miles per gallon)

Speed (miles per hour)	1973[a] (13 vehicles)	1984[b] (15 vehicles)	1997[c] (9 vehicles)
15	[d]	21.1	24.4
20	[d]	25.5	27.9
25	[d]	30.0	30.5
30	21.1	31.8	31.7
35	21.1	33.6	31.2
40	21.1	33.6	31.0
45	20.3	33.5	31.6
50	19.5	31.9	32.4
55	18.5	30.3	32.4
60	17.5	27.6	31.4
65	16.2	24.9	29.2
70	14.9	22.5	26.8
75	[d]	20.0	24.8
		Fuel economy loss	
55–65 mph	12.4%	17.8%	9.7%
65–70 mph	8.0%	9.6%	8.2%
55–70 mph	19.5%	25.7%	17.1%

Source:
1973- U.S. Department of Transportation, Federal Highway Administration, Office of Highway Planning, *The Effect of Speed on Automobile Gasoline Consumption Rates*, Washington, DC, October 1973.
1984 - U.S. Department of Transportation, Federal Highway Administration, *Fuel Consumption and Emission Values for Traffic Models*, Washington, DC, May 1985.
1997 - West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, *Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models*, FHWA Report (in press), Washington, DC, April 1997, and additional project data, April 1998.
(Additional resources: http://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 6.4. Fuel Economy by Speed, 1973, 1984, and 1997



Source: See Table 6.17.

Table 6.18
Steady Speed Fuel Economy for Tested Vehicles
(miles per gallon)

Speed (mph)	1988 Chevrolet Corsica	1993 Subaru Legacy	1994 Oldsmobile Olds 88	1994 Oldsmobile Cutlass	1994 Chevrolet Pickup	1994 Jeep Grand Cherokee	1994 Mercury Villager	1995 Geo Prizm	1997 Toyota Celica
5	10.0	14.5	10.5	5.1	7.9	8.2	12.3	18.1	19.1
10	16.8	24.7	14.9	7.9	16.0	11.2	19.0	23.1	34.1
15	17.7	31.9	22.2	11.4	16.3	17.5	22.4	38.9	41.7
20	21.7	34.4	26.3	12.5	19.9	24.7	25.8	39.4	46.0
25	23.9	37.4	28.3	15.6	22.7	21.8	30.8	41.7	52.6
30	28.7	39.7	29.0	19.0	26.3	21.6	30.3	40.0	50.8
35	28.6	38.0	30.9	21.2	24.3	25.0	26.1	39.1	47.6
40	29.2	37.0	33.2	23.0	26.7	25.5	29.0	38.9	36.2
45	28.8	33.7	32.4	23.0	27.3	25.4	27.8	42.3	44.1
50	31.2	33.7	34.2	27.3	26.3	24.8	30.1	39.1	44.8
55	29.1	37.7	34.6	29.1	25.1	24.0	31.7	37.7	42.5
60	28.2	35.9	32.5	28.2	22.6	23.2	27.3	36.7	48.4
65	28.7	33.4	30.0	25.0	21.8	21.3	25.3	34.1	43.5
70	26.1	31.0	26.7	22.9	20.1	20.0	23.9	31.7	39.2
75	23.7	28.8	24.0	21.6	18.1	19.1	22.4	28.3	36.8
				Fuel economy loss					
55–65 mph	1.4%	11.4%	13.3%	14.1%	13.1%	11.3%	20.2%	9.5%	9.7%
65–75 mph	17.4%	13.8%	20.0%	13.6%	17.0%	10.3%	11.5%	17.0%	15.3%
55–75 mph	18.6%	23.6%	30.6%	25.8%	27.9%	20.4%	29.3%	24.9%	23.6%

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: http://www.fhwa-tsis.com)

Note:
For specifications of the tested vehicles, please see page 6–21.

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 6.5. Urban Driving Cycle

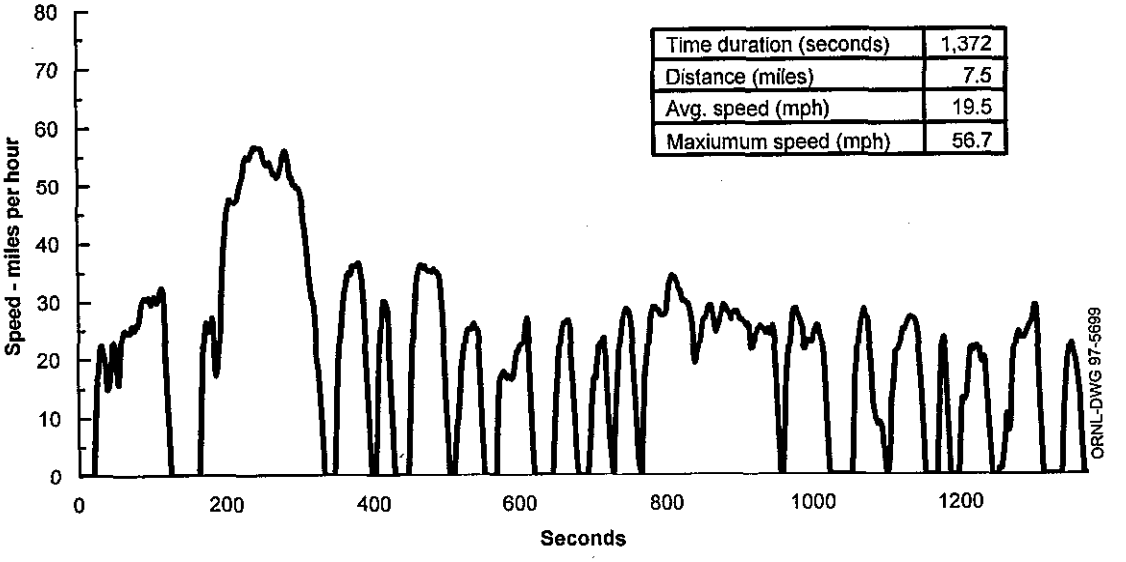
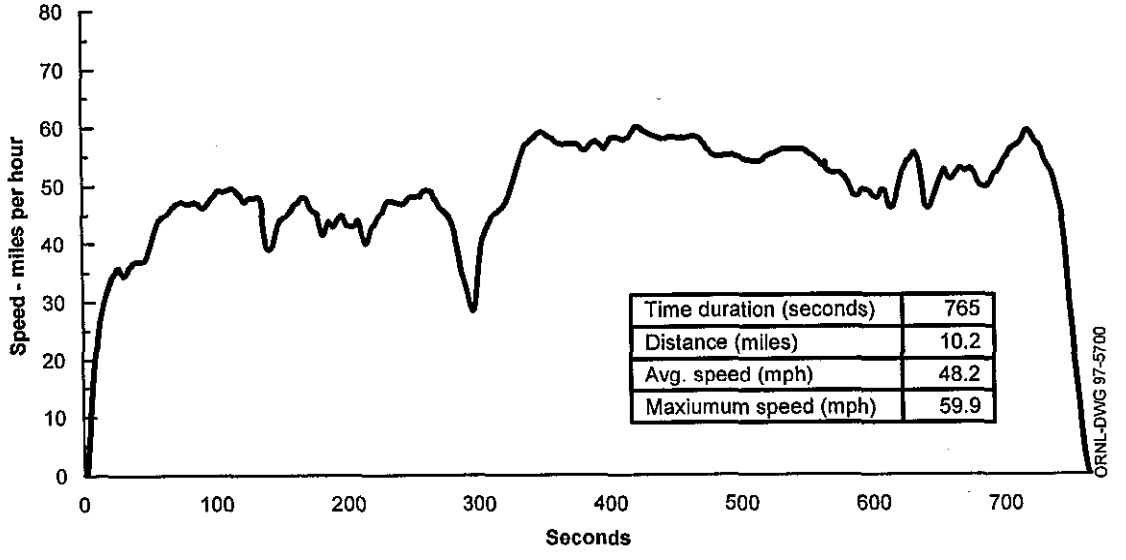


Figure 6.6. Highway Driving Cycle



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 6.7. New York City Driving Cycle

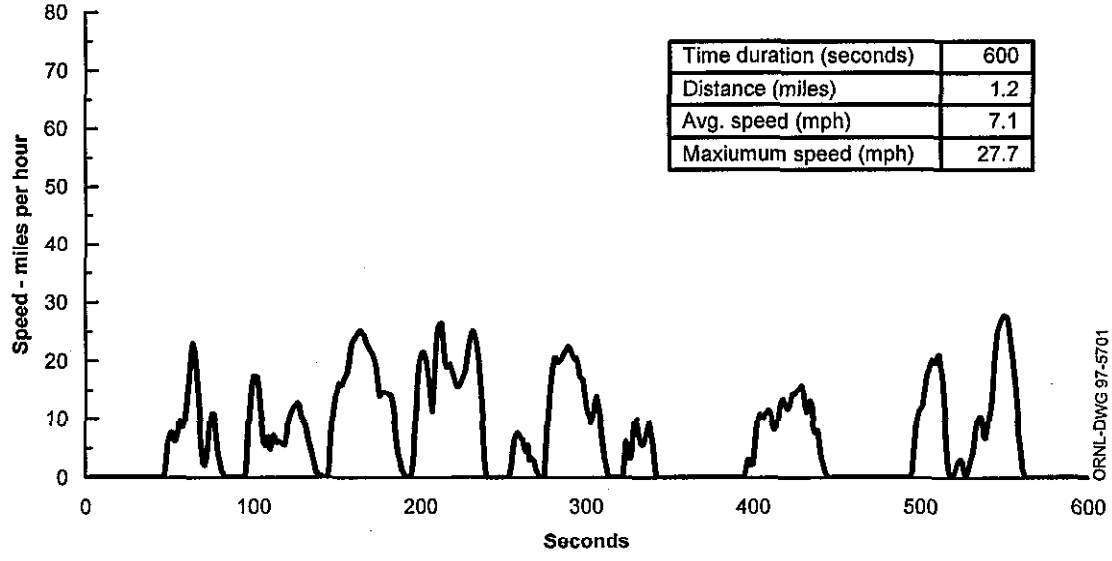
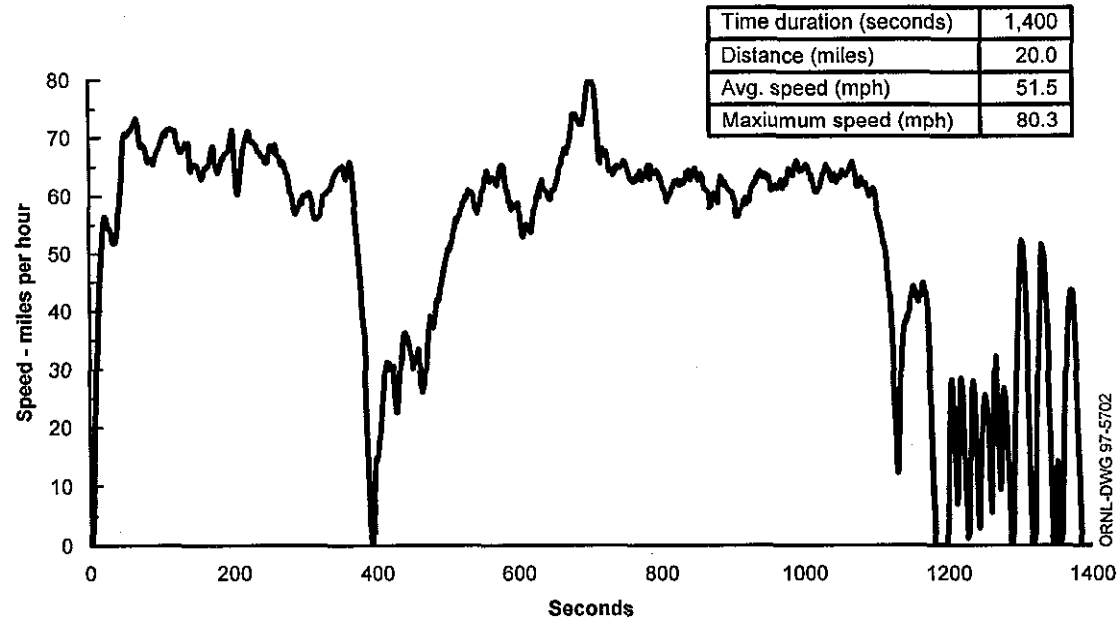


Figure 6.8. Representative Number Five Driving Cycle



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

Chapter 7

Heavy Vehicles and Characteristics

Summary Statistics

Table		
7.1	Heavy single-unit trucks, 1996	
	Registration (thousands)	*5,265*
	Vehicle miles (millions)	*63,967*
	Fuel economy (miles per gallon)	*6.8*
7.1	Combination trucks, 1996	
	Registration (thousands)	*1,742*
	Vehicle miles (millions)	*118,789*
	Fuel economy (miles per gallon)	*5.9*
7.3	Trucks by size, 1992 Truck Inventory & Use Survey	
	Light (0–10,000 lbs)	*93.3%*
	Medium (10,001–26,000 lbs)	*3.4%*
	Heavy (26,001 lbs and over)	*3.5%*
7.11	Freight Shipments,1993 Commodity Flow Survey	
	Value (million dollars)	*6,123,832*
	Tons (thousands)	*12,157,105*
	Ton-miles (millions)	*3,627,919*
7.13	Bus passenger miles, 1996	(millions)
	Transit	*18,860*
	Intercity	*28,300*
	School	*99,000*

Table 7.1
Summary Statistics for Other Single-Unit and Combination Trucks, 1970–96[a]

	Other single-unit trucks[b]				Combination trucks[c]			
Year	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	3,681	27,081	3,968	6.8	905	35,134	7,348	4.8
1971	3,770	28,985	4,217	6.9	919	37,217	7,595	4.9
1972	3,918	31,414	4,844	6.5	961	40,706	8,120	5.0
1973	4,131	33,661	5,294	6.4	1,029	45,649	9,026	5.1
1974	4,211	33,441	5,261	6.4	1,085	45,966	9,080	5.1
1975	4,232	34,606	5,420	6.4	1,131	46,724	9,177	5.1
1976	4,350	36,390	5,706	6.4	1,225	49,680	9,703	5.1
1977	4,450	39,339	6,268	6.3	1,240	55,682	10,814	5.1
1978	4,518	42,747	6,955	6.1	1,342	62,992	12,165	5.2
1979	4,505	42,012	7,050	6.0	1,386	66,992	12,864	5.2
1980	4,374	39,813	6,923	5.8	1,417	68,678	13,037	5.3
1981	4,455	39,568	6,867	5.8	1,261	69,134	13,509	5.1
1982	4,325	40,658	6,803	6.0	1,265	70,765	13,583	5.2
1983	4,204	42,546	6,965	6.1	1,304	73,586	13,796	5.3
1984	4,061	44,419	7,240	6.1	1,340	77,377	14,188	5.5
1985	4,593	45,441	7,399	6.1	1,403	78,063	14,005	5.6
1986	4,313	45,637	7,386	6.2	1,408	81,038	14,475	5.6
1987	4,188	48,022	7,523	6.4	1,530	85,495	14,990	5.7
1988	4,470	49,434	7,701	6.4	1,667	88,551	15,224	5.8
1989	4,519	50,870	7,779	6.5	1,707	91,879	15,733	5.8
1990	4,487	51,901	8,357	6.2	1,709	94,341	16,133	5.8
1991	4,481	52,898	8,172	6.5	1,691	96,645	16,809	5.7
1992	4,370	53,874	8,237	6.5	1,675	99,510	17,216	5.8
1993	4,408	56,772	8,488	6.7	1,680	103,116	17,748	5.8
1994	4,906	61,284	9,032	6.8	1,681	108,932	18,653	5.8
1995	5,024	62,705	9,216	6.8	1,696	115,451	19,777	5.8
1996	5,265	63,967	9,365	6.8	1,742	118,789	20,098	5.9
				Average annual percentage change				
1970–96	1.4%	3.4%	3.4%	0.0%	2.6%	4.8%	3.9%	0.8%
1986–96	2.0%	3.4%	2.4%	0.9%	2.2%	3.9%	3.3%	0.5%

Source:
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, 1997, Table VM1, p. V-94 and annual.
(Additional resources: http://www.fhwa.dot.gov)

[a] The Federal Highway Administration changed the combination truck travel methodology in 1993.
[b] Other single-unit trucks are defined as all single-unit trucks with more than two axles or more than four tires.
[c] The fuel economy for combination trucks is not the same as the fuel economy for Class 8 trucks. Fuel economy for Class 8 trucks is shown in Table 3.24.

Table 7.2
New Retail Truck Sales by Gross Vehicle Weight, 1970–96[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– 26000 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
1971	1,185	488	6	15	46	140	34	99	2,013
1972	1,498	599	55	11	29	182	35	126	2,535
1973	1,754	758	50	3	16	236	37	155	3,009
1974	1,467	696	21	3	14	207	31	148	2,587
1975	1,101	952	23	1	9	159	23	83	2,351
1976	1,318	1,401	43	[c]	9	153	22	97	3,043
1977	1,306	1,803	36	3	5	163	28	141	3,485
1978	1,334	2,140	73	6	3	156	41	162	3,915
1979	1,271	1,574	15	3	3	146	50	174	3,236
1980	985	975	4	[c]	2	90	58	117	2,231
1981	896	850	1	[c]	2	72	51	100	1,972
1982	1,102	961	1	[c]	1	44	62	76	2,248
1983	1,314	1,207	[c]	[c]	1	47	59	82	2,710
1984	2,031	1,224	6	[c]	5	55	78	138	3,538
1985	2,408	1,280	11	[c]	5	48	97	134	3,983
Domestic and import sales									
1986	3,380	1,214	12	[c]	6	45	101	113	4,870
1987	3,435	1,175	14	2	8	44	103	131	4,912
1988	3,467	1,333	14	21	8	54	103	148	5,149
1989	3,313	1,297	19	27	7	39	93	145	4,942
1990	3,451	1,097	21	27	5	38	85	121	4,846
1991	3,246	876	21	24	3	22	73	99	4,365
1992	3,608	1,021	26	26	4	28	73	119	4,903
1993	4,119	1,232	27	33	4	27	81	158	5,681
1994	4,527	1,506	35	44	4	20	98	186	6,421
1995	4,422	1,631	40	53	4	23	106	201	6,481
1996	4,829	1,690	52	59	7	19	104	170	6,930
Average annual percentage change									
1970–85	5.7%	7.9%	4.1%	-	-15.1%	-6.6%	6.8%	2.8%	5.5%
1986–96	3.6%	3.4%	15.8%	-	1.6%	-8.3%	0.3%	4.2%	3.6%

Source:
American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1997*, Detroit, MI, 1997, p. 20, and annual.
(Additional resources: http://www.aama.com)

[a] Sales include domestic-sponsored imports.
[b] Data for 1970 is based on new truck registrations.
[c] Less than 500 trucks.

Truck Inventory and Use Survey

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. Data for 1992 have been released in a report, as well as on CD-ROM. Copies may be obtained by contacting the U.S. Bureau of the Census, Transportation Characteristics Surveys Branch (301)457-2797. Internet site http://www.census.gov/svsd/www/tiusview.html is the location of the TIUS on-line.

The 1987 and 1992 surveys, in addition to trucks, included minivans, vans, station wagons on truck chassis, and jeep-like vehicles. The 1977 and 1982 surveys did not include those vehicle types. The estimated number of trucks that were within the scope of the 1992 TIUS and registered in the U.S. as of July 1, 1992, was 59.2 million. These trucks were estimated to have been driven a total of 786.3 billion miles during 1992, an increase of 33.7% from 1987. The average annual miles traveled per truck was estimated at 11,900 miles.

In the 1992 TIUS, there are several ways to classify a truck by weight. The survey respondent was asked the average weight of the vehicle or vehicle-trailer combination when carrying a typical payload; the empty weight (truck minus cargo) of the vehicle as it was usually operated; and the maximum gross weight at which the vehicle or vehicle-trailer combination was operated. The Census Bureau also collected information on the Gross Vehicle Weight Class of the vehicles (decoded from the vehicle identification number) and the registered weight of the vehicles from the State registration files. Some of these weights are only provided in categories, while others are exact weights. Since all these weights could be quite different for a single truck, the tabulations by weight can be quite confusing. For illustration of this, see Tables 3.25 and 3.26. The first set of data are based on the average weight as reported by the respondent; the data on Table 3.26 are based on the Gross Vehicle Weight Class of the vehicle when it was manufactured. There is a 22.8% difference in the number of Class 1 trucks. In most tables, the Gross Vehicle Weight Class was used. However, on the tables comparing different survey estimates, average weight must be used, as the older surveys did not include data on the Gross Vehicle Weight rating.

These tables illustrate the difference between two weight variables in the Truck Inventory and Use Survey. The manufacturer's gross vehicle weight class is likely to be a more accurate representation.

Table 7.3
Truck Statistics by Gross Vehicle Weight Class, 1992

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
6,000 lbs and less	37,068,163	62.61%	12,739	17.23	27,397	44.76%
6,001 – 10,000 lbs	17,519,216	29.59%	11,610	13.00	15,646	25.56%
10,001 – 14,000 lbs	349,301	5.90%	15,814	9.48	583	0.95%
14,001 – 16,000 lbs	127,219	0.21%	14,420	9.19	200	0.33%
16,001 – 19,500 lbs	209,158	0.35%	4,876	8.21	124	0.20%
19,501 – 26,000 lbs	1,859,529	3.14%	11,746	7.26	3,008	4.91%
26,001 – 33,000 lbs	197,985	0.33%	30,074	6.64	897	1.46%
33,001 lbs and up	1,870,183	3.16%	39,832	5.58	13,353	21.82%
Total	**59,200,755**	**100.00%**	**13,281**	**12.85**	**61,206**	**100.00%**

Source:
U.S. Department of Commerce, Bureau of the Census, *1992 Truck Inventory and Use Survey*, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www.tiusview.html)

Table 7.4
Percentage of Trucks by Size Class, 1977, 1982, 1987, and 1992
(percentage)

Size class	Average weight as reported by respondent	1977 TIUS	1982 TIUS	1987 TIUS	1992 TIUS
Class 1	6,000 lbs and less	66.0%	77.8%	85.4%	85.4%
Class 2	6,001–10,000 lbs	17.9%	11.6%	6.5%	7.9%
Class 3	10,000–14,000 lbs	3.1%	1.6%	1.2%	1.2%
Class 4	14,001–16,000 lbs	1.3%	0.9%	0.5%	0.5%
Class 5	16,001–19,500 lbs	2.1%	1.0%	0.6%	0.5%
Class 6	19,501–26,000 lbs	3.4%	2.4%	1.7%	1.2%
Class 7	26,001–33,000 lbs	1.5%	1.0%	0.8%	0.7%
Class 8	33,001 lbs and over	4.6%	3.8%	3.3%	2.8%

Source:
Estimates are based on data provided on the following public use tapes: U.S. Department of Commerce, Bureau of the Census, 1977 Census of Transportation, *Truck Inventory and Use Survey*, Washington, DC, 1980; U.S. Department of Commerce, Bureau of the Census, 1982 Census of Transportation, *Truck Inventory and Use Survey*, Washington, DC, 1985; U.S. Department of Commerce, Bureau of the Census, 1987 Census of Transportation, *Truck Inventory and Use Survey*, Washington, DC, 1990; and U.S. Department of Commerce, Bureau of the Census, 1992 Census of Transportation, *Truck Inventory and Use Survey*, Washington, DC, 1995.
(Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 7.5
Truck Fuel Economy by Size Class, 1977, 1982, 1987, and 1992
(miles per gallon)

Size class	Average weight as reported by respondent	1977 TIUS	1982 TIUS	1987 TIUS	1992 TIUS
Class 1	6,000 lbs and less	13.2	14.2	15.0	16.1
Class 2	6,001–10,000 lbs	11.5	11.1	10.9	12.2
Class 3	10,000–14,000 lbs	9.4	8.1	8.1	9.2
Class 4	14,001–16,000 lbs	6.9	7.5	7.5	8.5
Class 5	16,001–19,500 lbs	7.6	7.2	7.1	8.1
Class 6	19,501–26,000 lbs	6.1	6.9	6.4	7.2
Class 7	26,001–33,000 lbs	5.3	6.2	6.1	6.8
Class 8	33,001 lbs and over	4.8	5.2	5.3	5.5

Source:
Estimates are based on data provided on the following public use tapes: U.S. Department of Commerce, Bureau of the Census, 1977 Census of Transportation, *Truck Inventory and Use Survey*, Washington, DC, 1980; U.S. Department of Commerce, Bureau of the Census, 1982 Census of Transportation, *Truck Inventory and Use Survey*, Washington, DC, 1985; U.S. Department of Commerce, Bureau of the Census, 1987 Census of Transportation, *Truck Inventory and Use Survey*, Washington, DC, 1990; and U.S. Department of Commerce, Bureau of the Census, 1992 Census of Transportation, *Truck Inventory and Use Survey*, Washington, DC, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 7.6
Percentage of Trucks by Fleet Size and Primary Refueling Facility, 1992

	Primary refueling facility				
Truck fleet size	Central company-owned fueling facility	Single contract fueling facility located off-site	Public fueling stations	Other	Total
1	7.91%	2.52%	84.55%	5.02%	100%
2–5	16.41%	4.44%	72.51%	6.64%	100%
6–9	31.40%	7.73%	55.53%	5.33%	100%
10–24	43.90%	9.44%	43.70%	2.96%	100%
25–99	56.98%	7.39%	33.50%	2.13%	100%
100–499	58.34%	7.50%	31.18%	2.98%	100%
500–999	57.93%	7.26%	30.89%	3.92%	100%
1,000–4,999	60.71%	3.28%	32.65%	3.36%	100%
5,000–9,999	58.90%	5.05%	29.09%	6.96%	100%
10,000 & up	59.96%	4.68%	25.69%	9.66%	100%
Total	**33.26%**	**5.76%**	**56.15%**	**4.83%**	**100%**

Source:
U.S. Department of Commerce, Bureau of the Census, *1992 Truck Inventory and Use Survey*, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Though diesel engines are generally more efficient than gasoline engines, variations in patterns of use and weight distributions within a weight category can cause the fuel economies to be more similar. Data in the ***Total*** *row give a good indication that the gasoline trucks are mainly lighter vehicles and diesels are used in heavier applications.*

Table 7.7
Truck Fuel Economy by Fuel Type and Size Class, 1992
(miles per gallon)

Size class	Manufacturer's gross vehicle weight class	Gasoline trucks	Diesel trucks
Class 1	6,000 lbs and less	17.2	18.8
Class 2	6,001–10,000 lbs	12.9	15.0
Class 3	10,001–14,000 lbs	9.3	9.5
Class 4	14,001–16,000 lbs	8.3	10.1
Class 5	16,001–19,500 lbs	7.6	10.0
Class 6	19,501–26,000 lbs	7.3	7.3
Class 7	26,001–33,000 lbs	6.1	6.7
Class 8	33,001 lbs and up	5.5	5.5
Total		15.4	6.5

Source:
U.S. Department of Commerce, Bureau of the Census, *1992 Truck Inventory and Use Survey*, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 7.8
Truck Statistics by Size, 1992

	Manufacturer's gross vehicle weight class			
	Light (< 10,000 lbs)	Medium (10,001–26,000 lbs)	Heavy (> 26,000 lbs)	Total
Trucks	54,587,379	685,679	3,927,697	59,200,755
Trucks (%)	92.21%	1.16%	6.63%	100%
Miles per truck	12,377	12,219	26,044	13,281
Total miles (%)	85.92%	1.07%	13.01%	100%
Fuel use (%)	70.32%	1.48%	28.20%	100%
Fuel economy (mpg)	15.70	9.24	5.93	12.85
	Range of operation			
Under 50 miles	75.84%	68.55%	56.47%	74.49%
50–100 miles	11.33%	14.40%	14.55%	11.57%
100–200 miles	3.31%	4.43%	6.53%	3.53%
200–500 miles	2.14%	1.68%	6.33%	2.41%
Over 500 miles	2.17%	1.36%	7.51%	2.51%
Off-road	5.21%	9.59%	8.61%	5.48%
Total	100%	100%	100%	100%
	Primary refueling facility			
Central company-owned	15.83%	23.56%	36.73%	32.06%
Single off-site contract	3.51%	4.34%	6.30%	5.65%
Pubic station	77.05%	66.72%	51.86%	57.37%
Other	3.61%	5.39%	5.10%	4.93%
Total	100%	100%	100%	100%

Source:
U.S. Department of Commerce, Bureau of the Census, *1992 Truck Inventory and Use Survey*, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 7.9
Percentage of Trucks by Major Use and Primary Refueling Facility, 1992

	Primary refueling facility				
Major Use	Central company-owned fueling facility	Single contract fueling facility located off-site	Public fueling stations	Other	Total
Agricultural services	32.66%	2.73%	51.68%	12.93%	100%
Forestry or Lumbering Activities	26.34%	6.43%	63.71%	3.52%	100%
Construction work	35.79%	4.93%	56.71%	2.57%	100%
Contractor Activities or special trades	16.62%	4.93%	77.01%	1.44%	100%
Manufacturing, refining or processing activities	37.54%	11.21%	49.05%	2.20%	100%
Wholesale trade	35.55%	12.72%	49.99%	1.74%	100%
Retail trade	31.35%	8.18%	58.67%	1.81%	100%
Business and Personal services	23.48%	5.94%	68.24%	2.34%	100%
Utilities	58.68%	2.31%	36.42%	2.58%	100%
Mining or quarryng activities	53.75%	5.82%	38.05%	2.38%	100%
Daily rental	49.95%	2.79%	44.75%	2.50%	100%
Not in use	14.42%	3.64%	46.70%	35.24%	100%
For-hire transportation	37.80%	5.22%	53.65%	3.33%	100%
One-way rental	5.28%	0.07%	93.05%	1.60%	100%
Personal transportation	1.51%	0.68%	93.14%	4.67%	100%
Total	32.06%	5.65%	57.37%	4.93%	100%

Source:
U.S. Department of Commerce, Bureau of the Census, *1992 Truck Inventory and Use Survey*, Microdata File on CD, 1995.
(Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 7.10
Percentage of Trucks by Size Ranked by Major Use, 1992

Rank	Light (< 10,000 lbs)	Medium (10,001 – 26,000 lbs)	Heavy (> 26,000 lbs)
1	**Personal**	**Agriculture**	**For Hire**
	73.54%	21.12%	18.21%
2	**Construction**	**Construction**	**Construction**
	7.57%	20.59%	18.17%
3	**Services[a]**	**Services[a]**	**Agriculture**
	5.12%	12.32%	17.42%
4	**Agriculture**	**Retail**	**Wholesale**
	4.99%	9.05%	8.73%
5	**Retail**	**Utilities**	**Retail**
	2.94%	6.44%	7.22%
6	**Not in Use**	**Wholesale**	**Personal**
	1.50%	6.04%	6.56%
7	**Wholesale**	**For Hire**	**Services[a]**
	1.38%	5.90%	6.20%
8	**Manufacturing**	**Personal**	**Manufacturing**
	1.02%	5.86%	5.53%
9	**Utilities**	**Manufacturing**	**Not in Use**
	0.72%	3.51%	3.49%
10	**Daily Rental**	**Not in Use**	**Utilities**
	0.40%	3.43%	2.66%
11	**Forestry**	**Daily Rental**	**Forestry**
	0.31%	2.89%	2.16%
12	**Mining**	**Forestry**	**Daily Rental**
	0.27%	1.48%	1.70%
13	**For Hire**	**Mining**	**Mining**
	0.24%	1.00%	1.69%
14	**One-Way Rental**	**One-Way Rental**	**One-Way Rental**
	0.01%	0.36%	0.26%
15	**Other**	**Other**	**Other**
	0.00%	0.00%	0.00%

Source:
U.S. Department of Commerce, Bureau of the Census, *1992 Truck Inventory and Use Survey*, Micro data File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

[a] Business and personal services.

1993 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 CFS is a continuation of statistics collected in the Commodity Transportation Survey from 1963 through 1977, and includes major improvements in methodology, sample size, and scope. A sample of 200,000 domestic establishments randomly selected from a universe of about 900,000 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 30 outbound shipments for a two-week period in each of the four calendar quarters of 1993. This produced a total sample of about 20 million shipments. For each sampled shipment, zip codes of origin and destination, 5-digit Standard Transportation Commodity Classification (STCC) code, weight, value, and modes of transport, were provided. Establishments were also asked to indicate whether the shipment was containerized, a hazardous material, or an export.

The 1993 CFS differs from previous surveys in its greatly expanded coverage of intermodalism. Earlier surveys reported only the principal mode. The 1993 survey reports 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 developed by Oak Ridge National Laboratory. Distance, in turn, was used to compute ton-mileage by mode of transport.

For more information about the Commodity Flow Survey, 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: **http://www.bts.gov/cfs/cfs.html**

Table 7.11
1993 Commodity Flow Survey: Shipment Characteristics by Mode of Transportation

Mode	Value (million dollars)	Tons (thousands)	Ton miles (millions)	Value (percent)	Tons (percent)	Ton miles (percent)	Value per ton (dollars)	Value per pound (dollars)	Ton miles per ton
CFS plus ORNL	$6,123,832	12,157,105	3,627,91	100.0%	100.0%	100.0%	$503.7	$0.25	298
Parcel, postal, courier service	$563,277	18,892	13,151	9.2%	0.2%	0.4%	$29,815.6	$14.91	696
Truck (for-hire, private, both)	$4,403,495	6,385,915	869,536	71.9%	52.5%	24.0%	$689.6	$0.34	136
Air (including truck and air)	$139,087	3,139	4,009	2.3%	0.0%	0.1%	$44,309.3	$22.15	1,277
Rail	$247,394	1,544,148	942,561	4.0%	12.7%	26.0%	$160.2	$0.08	610
Water	$64,077	518,912	271,981	1.0%	4.3%	7.5%	$123.5	$0.06	524
Pipeline	$89,849	483645	[a]	1.5%	4.0%	[a]	$185.8	$0.09	[a]
Truck and rail	$83,082	40,624	37,675	1.4%	0.3%	1.0%	$2,045.1	$1.02	927
Other intermodal	$13,382	148,883	185,030	0.2%	1.2%	5.1%	$89.9	$0.04	1,243
Other and unknown	$242,691	544,335	96,972	4.0%	4.5%	2.7%	$445.8	$0.22	178
ORNL estimates:									
Water (not in CFS)	$187,085	1,609,309	614,104	3.1%	13.2%	16.9%	$116.3	$0.06	382
Pipeline (not in CFS)	$90,413	859,303	592,900	1.5%	7.1%	16.3%	$105.2	$0.05	690
Intermodal[b] total	$659,741	208,399	235,856	10.8%	1.7%	6.5%	$3,165.8	$1.58	1,132

Source:
U.S. Department of Commerce, Bureau of the Census, *1993 Commodity Flow Survey: United States, TC92-CF-52*, and Oak Ridge National Laboratory estimates, Washington, DC, 1996, p. 3. (Additional resources: http://www.bts.gov/cfs/cfs.html)

[a]Data do not meet publication standards.
[b]Intermodal is a combination of parcel, postal or courier; truck and rail; truck and water, rail and water; and other intermodal. It excludes truck and air which is added to air transportation.

Table 7.12
Value, Tons, and Ton-Miles of Commodity Shipments, 1993

Commodity description[a]	Value (million dollars)	Tons (thousands)	Value per ton (dollars)	Ton-miles (millions)
Energy[b]				
Petroleum or coal products	$359,471	1,885,833	$191	287,081
Coal	$23,449	1,129,945	$21	487,791
Lumber and forest				
Pulp, paper, or allied products	$195,002	217,233	$898	100,721
Lumber or wood products, excluding furniture	$126,662	663,351	$191	120,669
Forest products	$1,700	30,520	$56	3,635
Mining				
Metallic ores	$20,278	149,562	$136	36,895
Nonmetallic minerals	$20,695	1,786,381	$12	155,417
Farm and food				
Food or kindred products	$856,884	859,764	$997	270,984
Farm products	$142,442	636,630	$224	276,260
Fresh fish or other marine products	$11,062	2,995	$3,693	1,746
Equipment, machinery, and instruments				
Transportation equipment	$652,474	87,617	$7,447	49,098
Machinery, excluding electrical	$442,770	34,180	$12,954	19,112
Electrical machinery, equipment, or supplies	$411,030	30,156	$13,630	19,591
Instruments, photographic goods, optical goods, watches, or clocks	$198,492	8,600	$23,080	5,390
Industrial products				
Chemicals or allied products	$532,907	545,405	$977	236,856
Fabricated metal products	$237,316	84,895	$2,795	30,489
Primary metal products	$228,610	266,409	$858	97,266
Rubber or miscellaneous plastics products	$175,267	52,349	$3,348	25,528
Clay, concrete, glass, or stone products	$91,365	799,481	$114	84,032
Consumer goods				
Apparel or other finished textile products	$291,203	15,128	$19,249	9,967
Textile mill products	$102,189	24,757	$4,128	11,341
Furniture or fixtures	$69,471	16,568	$4,193	9,789
Tobacco products, excluding insecticides	$60,640	3,225	$18,803	931
Leather or leather products	$50,645	2,401	$21,093	2,182
Waste materials[c]				
Waste or scrap materials	$18,258	130,894	$139	27,591
Waste hazardous materials or substances	$558	813	$686	314
Miscellaneous and other unknown				
Miscellaneous products of manufacturing	$200,803	20,731	$9,686	10,992
Miscellaneous freight shipments	$81,297	20,830	$3,903	5,038
Ordnance or accessories	$17,174	663	$25,903	629
Containers, carriers or devices, shipping, returned empty	$1,144	702	$1,630	230
Commodity unknown	$21,941	7,804	$2,812	2,522

Source:

U.S. Department of Commerce, Bureau of the Census, *1993 Commodity Flow Survey, United States, TC92-CF-52*, Washington, DC, 1996.

Note:

The sum of the data by commodity groups in this table is not equal to the total in previous table because it includes additional estimates of water and pipeline shipments by ORNL.

[a]Excludes data for printed matter because the data do not meet publication standards.

[b]Excludes data for pipeline shipments calculated by Oak Ridge National Laboratory (ORNL)that are included in previous table.

[c]Excludes data on municipal solid wastes.

Table 7.13
Summary Statistics on Buses by Type, 1970–96

Year	Transit motor bus[a]	Intercity bus	School bus
		Number in operation	
1970	49,700	22,000	288,700
1975	50,811	20,500	368,300
1980	59,411	21,400	418,255
1985	64,258	20,200	480,400
1990	58,714	20,680	508,261
1993	64,850	19,119	534,872
1994	68,123	19,146	547,718
1995	67,107	20,138	560,447
1996	67,874	20,649	569,395
		Vehicle-miles (millions)	
1970	1,409	1,209	2,100
1975	1,526	1,126	2,500
1980	1,677	1,162	2,900
1985	1,863	933	3,448
1990	2,123	991	3,800
1993	2,210	1,065	4,300
1994	2,162	1,211	4,400
1995	2,178	1,194	5,000
1996	2,165	1,220	5,000
		Passenger-miles (millions)	
1970	18,210	25,300	[b]
1975	18,300	25,400	[b]
1980	21,790	27,400	[b]
1985	21,161	23,800	[b]
1990	20,981	23,000	74,200
1993	20,247	24,700	94,200
1994	18,832	28,100	85,000
1995	18,818	27,700	95,000
1996	18,860	28,300	99,000
		Energy use (trillion Btu)	
1970	44.8	26.6	37.5
1975	51.5	24.8	42.6
1980	61.3	29.3	47.5
1985	72.4	31.5	57.0
1990	78.9	21.7	62.2
1993	86.2[c]	24.0	82.1
1994	86.7	24.7	90.6
1995	87.5	22.6	68.4[d]
1996	85.1	23.1[e]	68.4

Source:
See Appendix A for Table 7.13. (Additional resources: http://www.apta.com, http://www.fhwa.dot.gov, http://www.schoolbusfleet.com)

[a] Data for transit buses after 1983 are not comparable with prior data. Data for prior years were provided voluntarily and statistically expanded; in 1984 reporting became mandatory.

[b] Data are not available.

[c] Beginning in 1992, data became available on alternative fuel use by transit buses.

[d] Assumptions about fuel type changed in this year. See Appendix for details.

[e] Estimated using vehicle-miles.

Chapter 8

Alternative Fuel Vehicles and Characteristics

Summary Statistics

Table		
8.1	Light-duty alternative fuel vehicles, 1996	288,511
	LPG	*210,193*
	CNG	*50,270*
	LNG	*127*
	M85	*20,259*
	E85	*4,536*
	Electric	*3,126*
8.2	Heavy-duty alternative fuel vehicles, 1996	64,105
	LPG	*53,002*
	CNG	*9,874*
	LNG	*536*
	M85/M100	*178*
	E85	*361*
	Electric	*154*
8.5	Number of alternative fuel refuel sites, 1997	6,240
	LPG	*4,255*
	CNG	*1,426*
	LNG	*71*
	M85	*106*
	E85	*71*
	Electric	*310*

Fuel type abbreviations are used throughout this chapter.

LPG	=	*liquified petroleum gas*
CNG	=	*compressed natural gas*
M-85	=	*85% methanol, 15% gasoline*
E-85	=	*85% ethanol, 15% gasoline*
M-100	=	*100% methanol*
E-95	=	*95% ethanol, 5% gasoline*
LNG	=	*liquified natural gas*

THE ALTERNATIVE FUELS DATA CENTER

The Department of 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-duty vehicles, including automobiles, light trucks, and mini-vans; (2) heavy-duty vehicles such as tractor-trailers and garbage trucks; and (3) urban transit buses. An Oracle Relational Database Management System is used to manage the data, along with a statistical software package capable of providing statistical, graphic, and textual information to users. Several tables and graphs in this chapter contain statistics which were generated by the AFDC. Future editions of the *Transportation Energy Data Book* will continue to present graphical and statistical information from the AFDC.

The Department of Energy 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 **http://www.afdc.nrel.gov**.

Table 8.1
Estimates of Light-Duty Alternative Fuel Vehicles, 1994, 1996, and 1998

	Private			State and local government			Federal Government		
Fuel type	1994	1996	1998[a]	1994	1996	1998[a]	1994	1996	1998[a]
LPG	169,000	167,000	178,000	43,000	43,000	45,000	33	193	380
CNG	21,496	25,020	37,755	7,452	11,305	16,823	7,022	13,945	14,156
LNG	27	10	12	32	45	74	35	72	181
M-85	2,675	6,633	9,302	2,410	5,958	7,329	9,291	7,668	4,733
M-100	0	0	0	0	0	0	0	0	0
E-85	58	793	1,906	408	1,995	4,830	139	1,748	4,136
E-95	1	0	0	1	0	0	0	0	0
Electricity	2,047	2,451	3,398	14	487	764	102	188	400
Total	**196,304**	**201,907**	**230,373**	**53,317**	**62,790**	**74,820**	**16,622**	**23,814**	**23,986**

Source:
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 1996*, Washington, DC, December 1997, pp. 16–18.
(Additional resources: http://www.eia.doe.gov)

[a]Based on plans or projections.

Table 8.2
Estimates of Heavy-Duty Alternative Fuel Vehicles, 1994, 1996, and 1998

	Private			State and local government			Federal government		
Fuel type	1994	1996	1998[a]	1994	1996	1998[a]	1994	1996	1998[a]
LPG	42,000	43,000	45,000	10,000	10,000	11,000	2	2	2
CNG	2,935	5,485	9,104	2,322	4,389	7,284	0	0	0
LNG	12	77	136	378	453	727	0	6	6
M85	0	0	0	108	6	6	0	0	0
M100	1	0	0	414	172	172	0	0	0
E85	0	0	0	0	0	0	0	0	0
E95	5	4	0	26	357	357	0	0	0
Electricity	8	32	42	53	113	148	0	9	9
Total	**44,961**	**48,598**	**54,282**	**13,301**	**15,490**	**19,694**	**2**	**17**	**17**

Source:
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels,1996*, Washington, DC, December 1997, pp. 16–18.
(Additional resources: http://www.eia.doe.gov)

[a]Based on plans or projections.

Table 8.3
Alternative Fuel Vehicles Available by Manufacturer[a]

Model	Model Year Availability	Fuel	Type	Emission Class
Chrysler Products: 1-800-255-2616				
EPIC	MY 1997 (limited)	Electric lead acid	Minivan	ZEV
Minivan	MY 1998	Ethanol	Minivan	N/A
Ram Wagon	Fall 1998	CNG dedicated	Passenger van	SULEV
Ram Van	Fall 1998	CNG dedicated	Full-size van	SULEV
Ford Products: 1-800-ALT-FUEL				
Ranger	MY 1997 MY 1998	Electric lead acid	Light truck	ZEV
Contour (QVM)	MY 1997 MY1998	CNG bi-fuel	Compact sedan	Gasoline equivalent
Crown Victoria	MY 1997 MY 1998	CNG dedicated	Full-size sedan	ULEV
Econoline	MY 1997 MY 1998	CNG/LPG dedicated or bi-fuel	Full-size van	Various
F-Series	MY 1997 MY 1998	CNG/LPG dedicated or bi-fuel	Light truck	Various
Taurus	MY 1997 MY 1998	E-85 or M-85 gasoline	Mid-size sedan	TLEV
General Motors Products: 1-800-25Electric, 313-556-7723 or 1-888-GM-AFT-4U (CNG)				
EV1	MY 1997 MY 1998	Electric lead acid Nickel-metal hydride option	Sedan two-seater	ZEV
Chevrolet S-10	MY 1997 MY 1998	Electric lead acid	Light truck	California Certified ZEV
GMC Sierra 2500	MY 1997 MY 1998	CNG bi-fuel	Medium truck	LEV
Honda: 1-888-CCHonda				
Honda EV Plus	MY 1997	Electric-NiMH batteries	Sedan	ZEV
Civic GX	MY 1998	CNG dedicated	Compact sedan	ULEV California ILEV Federal
Nissan: 1-310-771-3422 (Demonstration fleets only)				
Altra EV	MY 1998	Electric lithium batteries	Minivan	ZEV
Toyota: 1-800-331-4331 (Press 3 for Alternative Fuel Information) (Fleet sales only)				
RAV4-EV	MY 1998-US	Electric-lead acid/NiMH	Sports utility vehicle	ZEV

Source:
U.S. Department of Energy, National Alternative Fuels Hotline, "Light-Duty Alternative Fuel Vehicle Resource Guide," January 1998. (Additional resources: http://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.

[a]In addition, Mazda (1-800-248-0459) and Volvo (1-800-970-0888) have experimental alternative fuel vehicles which are not yet on the market.

Table 8.4
Number of Onroad Alternative Fuel Vehicles Made Available,[a] by Fuel Type and Vehicle Type, 1996

Fuel type	Automobiles	Passenger vans	Cargo vans/ pickups	Other trucks	Buses	Other onroad vehicles	Total
Liquefied Petroleum Gas (LPG)	1,158	238	2,221	3,506	564	28	7,715
Dedicated	390	70	524	3,294	480	18	4,776
Nondedicated	768	168	1,697	212	84	10	2,939
Compressed Natural Gas (CNG)	2,764	599	4,083	2,054	1,125	9	10,634
Dedicated	411	357	600	179	926	9	2,482
Nondedicated	2,353	242	3,483	1,875	199	0	8,152
Liquefied Natural Gas (LNG)	0	0	33	29	12	0	74
Dedicated	0	0	0	26	12	0	38
Nondedicated	0	0	33	3	0	0	36
Methanol, 85 percent[b] (M85)	2,011	0	0	0	0	0	2,011
Dedicated	0	0	0	0	0	0	0
Nondedicated	2,011	0	0	0	0	0	2,011
Methanol, Neat (M100)	0	0	0	0	60	0	60
Dedicated	0	0	0	0	60	0	60
Nondedicated	0	0	0	0	0	0	0
Ethanol, 85 percent[b] (E85)	3,273	0	0	0	0	0	3,273
Dedicated	0	0	0	0	0	0	0
Nondedicated	3,273	0	0	0	0	0	3,273
Ethanol, 95 percent[b] (E95)	0	0	0	0	0	0	0
Dedicated	0	0	0	0	0	0	0
Nondedicated	0	0	0	0	0	0	0
Electricity	370	2	84	62	146	29	693
Nonhybrid	369	2	83	62	144	29	689
Hybrid	1	0	1	0	2	0	4
Other[c]	0	0	0	0	5	0	5
Dedicated	0	0	0	0	0	0	0
Nondedicated	0	0	0	0	5	0	5
Total	**9,576**	**839**	**6,421**	**5,651**	**1,912**	**66**	**24,465**
Dedicated and Nonhybrid	1,170	429	1,207	3,561	1,622	56	8,045
Nondedicated and Hybrid	8,406	410	5,214	2,090	290	10	16,420

Source:
U.S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 1996*, Washington, DC, December 1997, p. 28.
(Additional resources: http://www.eia.doe.gov)

[a]Vehicles made available are vehicles that are completed and made available for delivery to dealers or users in a given year.
[b]The remaining portion of 85-percent methanol and both ethanol fuels is gasoline.
[c]Includes hydrogen, neat biodiesel, and other alternative fuels.

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

Table 8.5
Number of Alternative Refuel Sites by State and Fuel Type, 1997

State	M85 sites	CNG sites	E85 sites	LPG sites	LNG sites	Electric sites	Total
Alabama	0	17	0	114	2	0	133
Alaska	0	1	0	9	0	0	10
Arizona	1	31	0	71	3	40	146
Arkansas	0	9	0	156	0	0	165
California	66	203	0	219	18	197	703
Colorado	2	45	1	48	3	0	99
Connecticut	0	22	0	18	0	1	41
Delaware	0	6	0	6	0	0	12
District of Columbia	1	8	1	0	0	2	12
Florida	3	60	0	222	0	4	289
Georgia	1	89	0	80	3	0	173
Hawaii	0	0	0	0	0	3	3
Idaho	0	7	1	20	1	1	30
Illinois	2	24	14	163	0	0	203
Indiana	0	47	2	125	3	1	178
Iowa	0	5	10	107	0	1	123
Kansas	0	18	2	38	1	0	59
Kentucky	0	13	3	35	0	0	51
Louisiana	0	21	0	44	2	0	67
Maine	0	0	0	12	0	0	12
Maryland	2	31	0	21	3	0	57
Massachusetts	0	18	0	42	0	4	64
Michigan	2	39	3	187	2	10	243
Minnesota	0	17	11	125	2	0	155
Mississippi	0	3	0	75	0	0	78
Missouri	0	11	3	83	0	0	97
Montana	0	13	0	48	1	0	62
Nebraska	0	11	6	47	1	0	66
Nevada	0	13	0	20	0	0	33
New Hampshire	0	1	0	31	0	1	33
New Jersey	0	24	0	37	0	0	61
New Mexico	0	18	0	46	1	0	65
New York	18	59	0	100	0	5	182
N. Carolina	0	11	0	72	0	1	84
N. Dakota	0	5	1	17	0	0	23
Ohio	2	70	0	98	1	1	172
Oklahoma	0	56	0	56	0	0	112
Oregon	0	9	0	21	1	0	31
Pennsylvania	1	61	0	141	1	1	205
Rhode Island	0	3	0	6	0	0	9
S. Carolina	0	3	0	67	0	1	71
S. Dakota	0	5	10	30	0	0	45
Tennessee	2	7	0	95	0	2	106
Texas	0	92	0	862	15	0	969
Utah	0	67	0	23	1	0	91
Vermont	0	1	0	40	0	9	50
Virginia	0	30	0	51	3	18	102
Washington	2	32	0	69	1	6	110
W. Virginia	1	42	0	21	0	1	65
Wisconsin	0	29	3	190	0	0	222
Wyoming	0	19	0	47	2	0	68
Total	**106**	**1,426**	**71**	**4,255**	**71**	**310**	**6,240**

Source:
U.S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 1996*, Washington, DC, December 1997, p. 15.

U.S. ADVANCED BATTERY CONSORTIUM

Electric and hybrid-electric vehicles are the subject of intense research and development because they are required to be sold in California (10% in 2003) under the California Low-Emission Vehicle (LEV) program. Other states, such as New York and Massachusetts, have indicated that they will also enforce the LEV program. One of the greatest advantages in using electric vehicles is that there are no tailpipe emissions. The U.S. Advanced Battery Consortium (USABC) was established in January 1991 to concentrate efforts on battery development for future electric vehicles. The USABC consists of the Big Three U.S. auto manufacturers (Chrysler, Ford, General Motors), the Electric Power Research Institute, and the U.S. Department of Energy. Five major U.S. electric utilities are also direct participants in USABC.

The USABC has established research contracts with several companies for the development of advanced batteries. Also, a series of Cooperative Research and Development Agreements (CRADAs) with several DOE National Laboratories have been established.

Table 8.6
U.S. Advanced Battery Consortium Research Agreements, Phase II

Research contracts	
General Motors–Ovonic Joint Venture	Cost reduction program for nickel-metal hydride battery and testing of nickel-metal hydride pilot production modules
SAFT	Cost reduction program for nickel-metal hydride battery
3M Hydro-Quebec	Phase II development of lithium-polymer battery
Duracell/VARTA	Phase II development of lithium-ion battery
CRADAs for advanced battery testing	
Argonne National Laboratory, Argonne, IL	
Sandia National Laboratory, Albuquerque, NM	
Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID	

Source:
U.S. Advanced Battery Consortium, February, 1998.

Today's lead acid batteries provide 30–40 watt hours per kilogram, cost between $50–150 per kilowatt hour, and have a two- to three-year lifetime. However, the batteries currently used in electric vehicles do not provide the energy or performance sufficient to make these vehicles competitive with gasoline-fueled vehicles. When attained, the Advanced Battery Technology goals will effectively double the range and performance of electric vehicles compared to the range and performance possible with today's battery technology.

Table 8.7
U.S. Advanced Battery Consortium Goals for Electric Vehicle Batteries

Primary criteria	Mid-term goals (1997)	Long-term goals[a] (2000)
Power density[b] W/L	250	460
Specific power[b] W/kg (80% DOD/30 sec)	150 (200 desired)	300
Energy density[b] Wh/L (C/3 discharge rate)	135	230
Specific energy[b] Wh/kg (C/3 discharge rate)	80 (100 desired)	150
Life (years)	5	10
Cycle life[b] (cycles) (80% DOD)	800	1000 1800 (@ 50% DOD) 2670 (@ 30% DOD)
Power and capacity degradation[b] (% of rated spec)	20%	20%
Ultimate price[c] ($/kWh) (10,000 units @ 40 kWh)	< $150	< $150 (desired to75)
Operating environment	-30 to 65°C	-30 to 65°C
Recharge time[b]	< 6 hours	< 6 hours
Continuous discharge in 1 hour (no failure)	75% (of rated energy capacity)	75% (of rated energy capacity)
Secondary criteria		
Efficiency (C/3 discharge & C/3 charge)[d]	75%	80%
Self discharge[b]	< 15% in 48 hours	< 20% in 12 days
Maintenance	No maintenance. Service by qualified personnel only.	No maintenance. Service by qualified personnel only.
Thermal loss[b]	3.2 W/kWh; 15% of capacity; 48 hour period	Covered by self discharge
Abuse resistance[b]	Tolerant Minimized by on-board controls	Tolerant Minimized by on-board controls

Source:
U.S. Department of Energy, Office of Transportation Technologies, Washington, DC, February, 1998.
Note:
W=watt; kg=kilogram; L=liter; DOD=depth of discharge; Wh=watt-hour; kWh=kilowatt-hour.

[a]For interim commercialization (Reflects USABC revisions of September 1996).
[b]Specifics on criteria can be found in "USABC Electric Vehicle Battery Test Procedures Manual Revision 2" DOE/ID-10479, Rev. 2, January 1996.
[c]Cost to the Original Equipment Manufacturers.
[d]Roundtrip charge/discharge efficiency.

Hybrid Electric Vehicle Program

The U.S. Department of Energy (DOE) is working closely with other Federal agencies and key auto industry partners to develop hybrid electric vehicles (HEVs) as a practical way of providing clean and efficient transportation for the future that will significantly contribute to reducing our Nation's growing dependence on imported oil. HEV R&D is a key component of DOE's Advanced Automotive Technologies Program and is focused on two strategic goals:

1. Develop a production-feasible hybrid propulsion system by 1998 that will enable subsequent market introduction of a 50-mpg light-duty vehicle.
2. Develop production-feasible hybrid vehicle technologies by 2004 that will enable subsequent market introduction of an 80-mpg light-duty vehicle.

The 50-mpg and 80-mpg fuel economy targets represent two- and three-fold improvements over current six-passenger family sedans. In addition, the HEV technologies must meet Environmental Protection Agency Tier II light-duty emission standards; be acceptable to consumers with respect to performance, range, safety, and cost; and support the introduction of alternative fuels.

The Hybrid Electric Vehicle (HEV) Program is managed by DOE's Office of Transportation Technologies with technical program support from the National Renewable Energy Laboratory. Hybrid Propulsion System Development is focused on systems-driven development, system design, integration, and testing. This is a two-phased effort with the Phase I major milestone of 50-mpg capable hybrid propulsion system by 1998. Phase II, which will be initiated in the near future, will combine further advances in the hybrid propulsion system with other vehicle advances (in materials, etc.) to achieve the 80-mpg goal by 2004. In the first phase of the effort, DOE is supporting three versatile system development teams led by GM, Ford, and Chrysler through 50/50 cost-shared contracts. These teams have successfully mobilized the extensive internal resources of the three major automakers as well as that of key suppliers.

Enabling Technologies Development is focused on technologies that will ensure HEVs will be marketplace-acceptable. The key technologies are:

- Fuel-efficient, low-emission engines (gas turbine and four-stroke, direct-injection engine)
- High-power energy storage (battery, ultra-capacitor, and flywheel)
- Cost-effective, high-efficiency power electronics

To learn more about the DOE HEV Program, visit the Internet site: http://www.ott.doe.gov

Chapter 9

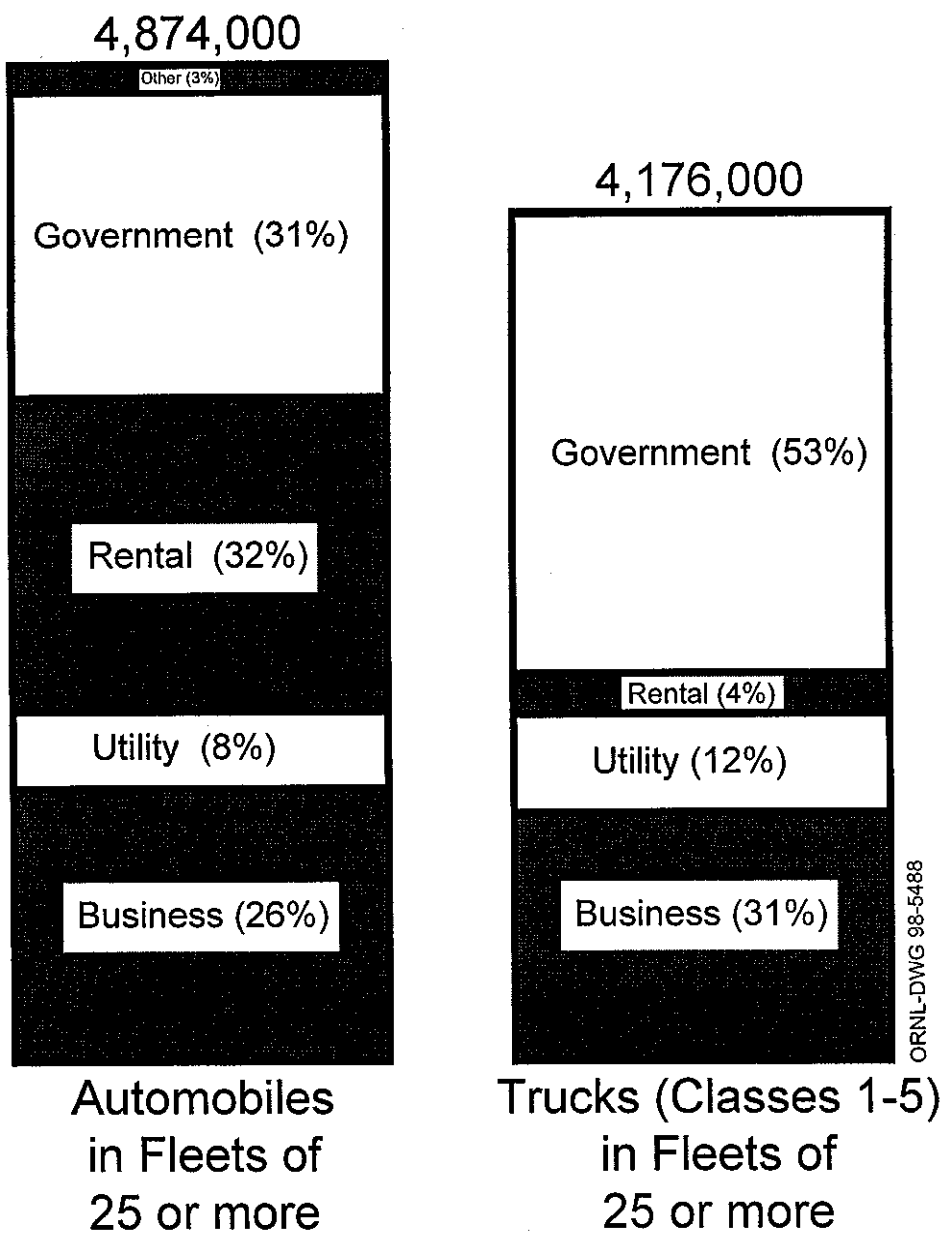
Fleet Vehicles and Characteristics

Summary Statistics

Table/Figure		
F 9.1	Fleet automobiles, 1997	4,874,000
F 9.1	Fleet Class 1-5 Trucks, 1997	4,176,000
T 9.3	Average annual miles per automobile	
	Business fleets	*29,200*
	Utility fleets	*14,500*
	Government fleets	*13,700*
T 9.4	Federal Government vehicles, FY 1996	550,373
	Automobiles	*113,366*
	Buses	*6,376*
	Light trucks	*381,525*
	Medium trucks	*32,281*
	Heavy trucks	*16,825*

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 1997 data are presented here.

Figure 9.1. Fleet Vehicles in Service as of January 1, 1997



Source:
Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 1997*, Redondo Beach, CA, 1997. (Additional resources: http://www.fleet-central.com)

Note:
Truck classes 1-5 are 19,500 lbs. and less.

Table 9.1
Fleet Vehicle Composition by Vehicle Type
(percent)

Fleet type	Cars	Light trucks[a] and vans	Medium trucks[b]	Heavy trucks[c]	Total
Business	24.2%	21.1%	45.8%	8.9%	100%
Utility	22.6%	39.0%	15.0%	23.4%	100%
Government	48.5%	42.8%	6.8%	1.8%	100%

Table 9.2
Average Length of Time Fleet Vehicles are Kept Before Sold to Others
(months)

	Business	Utility	Government
Cars	35	68	81
Light trucks[a]	56	60	82
Medium trucks[b]	83	86	96
Heavy trucks[c]	103	132	117

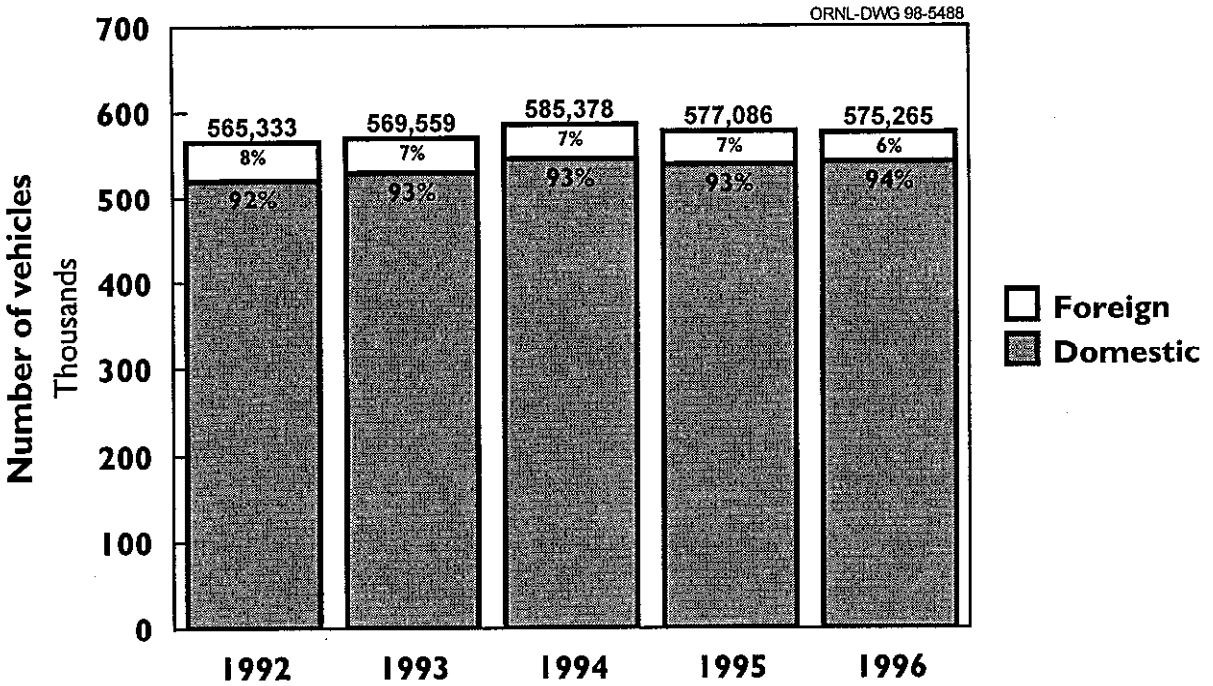
Table 9.3
Average Annual and Daily Vehicle-Miles of Travel for Fleet Vehicles

	Business		Utility		Government	
Vehicle type	Miles/year (thousands)	Miles/day @250 days/year	Miles/year (thousands)	Miles/day @250 days/year	Miles/year (thousands)	Miles/day @250 days/year
Cars	29.2	117	14.5	58	13.7	55
Light trucks[a]	26.6	106	17.5	70	13.9	56
Medium trucks[b]	17.5	70	11.8	47	11.9	48
Heavy trucks[c]	64.4	258	13.8	55	10.7	43

Source:
Miaou, S. P., et. al., *Fleet Vehicles in the United States: Composition, Operating Characteristics, and Fueling Practices,* (ORNL-6717), Oak Ridge National Laboratory, Oak Ridge, TN, May 1992. (Additional resources: http://www-cta.ornl.gov)

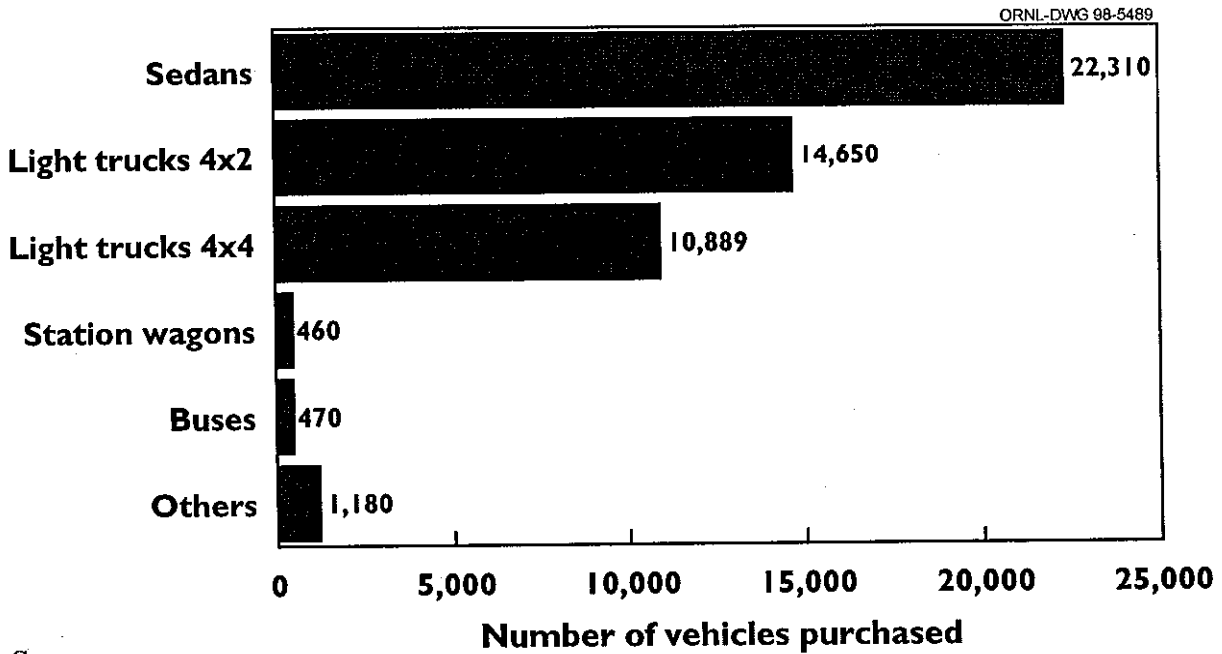
[a]In this study, light trucks are <8,500 lbs gross vehicle weight.
[b]In this study, medium trucks are between 8,500–26,000 lbs gross vehicle weight.
[c]In this study, heavy trucks are >26,000 lbs gross vehicle weight.

Figure 9.2. Worldwide Federal Inventory, 1991–96



Source:
U.S. General Services Administrations, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1998. (Additional resources: http://policyworks.gov/main/mt/homepage/mtv/mtvhp.htm)

Figure 9.3. Federal Vehicle Purchases by Vehicle Type, 1996



Source:
U.S. General Services Administrations, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1998. (Additional resources: http://policyworks.gov/main/mt/homepage/mtv/mtvhp.htm)

Table 9.4
Federal Government Vehicles by Agency, Fiscal Year 1996[a]

Department or Agency	Autos	Buses	Light trucks[b]	Medium trucks[c]	Heavy trucks[d]	Total
Department of Agriculture	3,292	91	24,477	5,280	601	33,741
Department of Commerce	133	2	399	205	29	768
Department of Education	1	0	1	0	0	2
Department of Energy	807	209	3,447	1,001	402	5,866
Department of Health & Human	84	8	300	113	54	559
Department of Housing & Urban Dev.	3	0	1	0	0	4
Department of Justice	19,473	294	10,152	1,239	0	31,158
Department of Labor	19	1	151	14	3	188
Department of State	112	0	63	3	8	186
Department of Interior	1,553	126	9,605	4,283	1,911	17,478
Department of Treasury	11,148	21	3,661	388	26	15,244
Department of Transportation	42	17	385	80	38	562
Department of Veterans Affairs	452	122	1,152	223	102	2,051
Environmental Protection Agency	108	0	262	193	2	565
Federal Communications Comm	62	0	62	2	0	126
Federal Emergency Mgmt Agency	28	5	261	25	0	319
General Services Administration	53,127	2,856	87,983	3,635	3,745	151,346
Natl Aeronautics & Space Admin.	92	18	636	237	52	1,035
Small Business Administration	137	0	0	0	0	137
Tennessee Valley Authority	1,535	2	1,125	1,067	232	3,961
Others	91	17	540	79	38	765
CIVILIAN AGENCIES	**92,299**	**3,789**	**144,663**	**18,067**	**7,243**	**266,061**
U.S. POSTAL SERVICE	**10,708**	**11**	**176,888**	**8,179**	**4,874**	**200,660**
Department of the Air Force	3,582	1,342	25,896	2,242	1,688	34,750
Department of the Army	414	102	1,209	418	255	2,398
Department of the Navy	3,424	733	24,393	1,999	2,124	32,673
Other Defense Agencies	2,056	3	639	78	98	2,874
Corps of Engineers	268	4	3,342	697	221	4,532
U.S. Marine Corps	615	392	4,495	601	322	6,425
MILITARY AGENCIES	**10,359**	**2,576**	**59,974**	**6,035**	**4,708**	**83,652**
TOTAL	**113,366**	**6,376**	**381,525**	**32,281**	**16,825**	**550,373**

Source:
U.S. General Services Administration, Federal Supply Service, *Federal Motor Fleet Report*, Washington, DC, 1998.
(Additional resources: http://policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

[a] Federally-owned and commercially-leased vehicles.
[b] Less than 8,500 lbs GVWR. Includes ambulances.
[c] 8,501–23,999 lbs GVWR.
[d] 24,000 lbs. Or more GVWR.

Table 9.5
Operating and Cost Data for Large Domestic Federal Fleets, 1986–96[a]

Fiscal year	Number of vehicles	Miles operated (thousands)	Average annual miles per vehicle	Fleet average cost per mile (dollars)
		Sedans		
1986	86,069	1,130,843	13,139	$0.21
1987	89,894	1,069,124	11,893	$0.20
1988	85,928	1,119,343	13,027	$0.19
1989	90,254	1,170,370	12,968	$0.20
1990	93,510	1,226,674	13,118	$0.22
1991	98,259	1,297,651	13,206	$0.23
1992	97,680	1,261,954	12,940	$0.20
1993	98,144	1,251,348	12,750	$0.23
1994	96,386	1,216,385	12,620	$0.18
1995	97,777	1,214,877	12,425	$0.21
1996	97,588	1,214,579	12,446	$0.23
		Trucks		
1986	292,256	2,095,079	7,168	$0.43
1987	303,275	2,195,017	8,238	$0.45
1988	316,443	2,242,075	7,085	$0.44
1989	336,617	2,292,593	6,811	$0.43
1990	354,392	2,423,131	6,837	$0.44
1991	366,471	2,498,190	6,818	$0.45
1992	381,721	2,645,979	6,932	$0.40
1993	392,796	2,627,759	6,690	$0.41
1994	400,564	2,659,631	6,640	$0.40
1995	413,328	2,754,750	6,665	$0.37
1996	413,704	2,713,467	6,566	$0.44
		All Vehicles[b]		
1986	403,855	3,477,730	8,611	$0.36
1987	414,575	3,461,332	8,349	$0.37
1988	424,286	3,576,421	8,429	$0.36
1989	448,836	3,681,314	8,202	$0.35
1990	467,678	3,855,984	8,245	$0.38
1991	484,552	3,984,175	8,222	$0.38
1992	495,257	4,061,255	8,200	$0.35
1993	504,877	4,010,354	7,943	$0.36
1994	509,483	3,995,161	7,842	$0.34
1995	522,959	4,076,990	7,796	$0.34
1996	523,600	4,032,247	7,701	$0.38

Source:
U.S. General Services Administrations, Federal Supply Service, *Federal Motor Fleet Report*, Washington, DC, 1998. (Additional resources: http://policyworks.gov/main/mt/homepage/mtv/mtvhp.htm)

[a]Agencies or bureaus with 2,000 or more vehicles.
[b]Includes sedans, station wagons, ambulances, buses, and all trucks.

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

Table 9.6
Energy Policy Act Purchase Requirements of Light-Duty Alternative Fuel Vehicles

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

Source:
Final rule for the alternative fuels transportation programs, *Federal Register*, Vol. 61, p. 10622, March 14, 1996.
Private alternative fueled vehicle acquisition requirements for private and local government fleets, *Federal Register*, vol. 62, p. 19701, April 23, 1997.

Note:
The Department of Energy has provided an Alternative Fuel Vehicles Acquisitions and Credits Database on the Internet to provide fleet managers with a convenient way to report their compliance with this mandate. (http://www.ott.doe.gov/credits)

[a]Additional rule making is required by January 1, 2000, for private AFV requirements to take effect.

"Section 501 of the Energy Policy Act mandates that certain percentages of new light-duty vehicles acquired by alternative fuel providers be alternative fuel vehicles (AFV). The first step in estimating the effects of these mandates entails identifying affected fleets that are covered by the Act. This assessment concludes that a limited number of companies in the methanol, ethanol, propane, and hydrogen industries are likely to be covered by this mandate. On the other hand, many of the large crude oil producers, petroleum refiners, natural gas producers and transporters, and natural gas and electric utilities are likely to be subject to this mandate."

Table 9.7
Summary of EPACT Section 501 Coverage by Industry, 1994

Fuel	Percentage of companies likely to be "covered"	Estimated number of light-duty vehicles "covered"	Current AFV percentage of total "covered" light-duty vehicles
Methanol	10%	60	0%
Ethanol	0%	0	0%
Natural gas	23%	73,000[a]	20%
Propane[b]	8%	420	78%
Electricity	5%	59,000	2%
Petroleum[c]	30%	11,000	0.4%
Hydrogen	0%	0	0%

Source:
P. Hu, M. Wang, A. Vyas, M. Mintz, and S. Davis, *Transportation Research Record No. 1520*, Washington, DC, 1996, p. 155.

[a]Among these vehicles, 30,000 are owned/operated by gas-only companies, 33,000 by dual utilities and 10,000 by gas producers and transporters.
[b]Of the top 35 propane providers only.
[c]Those with production capability of at least 50,000 barrels per day.

Chapter 10

Household Vehicles and Characteristics

Summary Statistics

Table/Figure		
T 10.1	Vehicles per licensed driver, 1996	1.10
T 10.2	Average household transportation expense, 1995	18.2%
T 10.8	Share of households owning 3 or more vehicles	
	1960	*2.5%*
	1970	*5.5%*
	1980	*17.5%*
	1990	*17.3%*
T 10.12	Average annual miles per household vehicle, 1995	11,800
F 10.1	Average occupancy rates by vehicle type, 1995	
	Automobile	*1.6*
	Pickup truck	*1.4*
	Sports Utility	*1.7*
	Van	*2.1*
T 10.14	Share of workers who car pooled, 1990	13.4%
F 10.3	Long-distance trips in the U.S., 1995	
	Trips	*1,001 million*
	Person-miles	*827 billion*

Table 10.1
Population and Vehicle Profile, 1950–96

Year	Resident population[a] (thousands)	Total households (thousands)	Number of vehicles in operation (thousands)	Number of licensed drivers (thousands)	Number of civilian employed persons (thousands)	Vehicles per capita	Vehicle-miles per capita	Licensed drivers per household	Vehicles per licensed driver	Vehicles per civilian employed persons
1950	151,868	43,554	43,256	62,194	58,918	0.29	3,029	1.43	0.70	0.73
1955	165,069	47,874	55,804	74,686	62,170	0.34	3,656	1.56	0.75	0.90
1960	179,979	52,799	66,582	87,253	65,778	0.36	3,994	1.65	0.76	1.01
1965	193,526	57,251	82,067	98,502	71,088	0.42	4,587	1.72	0.83	1.15
1970	203,984	63,401	98,136	111,543	78,678	0.48	5,440	1.76	0.88	1.25
1975	215,465	71,120	120,054	129,791	85,846	0.56	6,162	1.82	0.92	1.40
1980	227,225	80,776	139,832	145,295	99,303	0.62	6,722	1.80	0.96	1.41
1981	229,466	82,368	141,908	147,075	100,397	0.62	6,767	1.79	0.96	1.41
1982	231,664	83,527	143,854	150,234	99,526	0.62	6,885	1.80	0.96	1.45
1983	233,792	83,918	147,104	154,389	100,834	0.63	7,069	1.83	0.95	1.46
1984	235,825	85,407	152,162	155,424	105,005	0.65	7,295	1.82	0.98	1.45
1985	237,924	86,789	157,048	156,868	107,150	0.66	7,457	1.81	1.00	1.47
1986	240,133	88,458	162,094	159,487	109,597	0.68	7,655	1.80	1.02	1.48
1987	242,289	89,479	167,193	161,975	112,440	0.69	7,929	1.81	1.03	1.49
1988	244,499	91,061	171,741	162,853	114,968	0.70	8,286	1.79	1.05	1.49
1989	246,819	92,830	175,960	165,555	117,342	0.71	8,494	1.78	1.06	1.50
1990	249,398	93,347	179,299	167,015	118,793	0.72	8,598	1.79	1.07	1.51
1991	252,106	94,312	181,438	168,995	117,718	0.72	8,614	1.79	1.07	1.54
1992	255,011	95,689	181,519	173,125	118,492	0.71	8,781	1.81	1.05	1.53
1993	257,795	96,391	186,315	173,149	120,259	0.72	8,909	1.80	1.08	1.55
1994	260,372	97,107	188,714	175,403	123,060[b]	0.72	9,055	1.81	1.08	1.53
1995	262,890	98,990	193,441	176,628	124,900[b]	0.74	9,216	1.78	1.10	1.55
1996	265,284	99,627	198,294	179,539	126,708[b]	0.75	9,357	1.80	1.10	1.56
					Average annual percentage change					
1950–96	1.2%	1.8%	3.4%	2.3%	1.7%	2.1%	2.5%	0.5%	1.0%	1.7%
1986–96	1.0%	1.2%	2.0%	1.2%	1.5%	1.0%	2.0%	0.0%	0.8%	0.5%

Source:
Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, 117th edition, Washington, DC, 1997, pp. 8, 59, 397, and annual. (Additional resources: http://www.census.gov)
Vehicles in operation - The Polk Company. **FURTHER REPRODUCTION PROHIBITED.** (Additional resources: http://www.polk.com)
Licensed drivers and vehicle-miles - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Tables DL-1C and VM-1, and annual. (Additional resources: http://www.fhwa.dot.gov)

[a]Estimates as of July 1. Includes Armed Forces stationed in the United States.
[b]Data are not comparable to earlier years due to changes in definitions and methodology. See original source for more details.

Transportation (18.2%) is second only to housing (31.5%) as the largest expenditure for the average household. In 1995, approximately 17% of transportation expenditures were for purchasing gasoline and motor oil. There is an average of two vehicles per household.

Table 10.2
Average Annual Expenditures of Households by Income, 1995[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	$33,610	$14,718	$14,156	$18,911	$22,619	$26,732	$33,324	$38,496	$48,844	$69,303
	Percentage of total expenditures[b]									
Food[c]	14.9%	17.6%	17.6%	17.3%	17.9%	16.0%	14.9%	15.3%	13.7%	12.6%
Housing	31.5%	38.6%	38.5%	35.7%	32.8%	31.5%	31.4%	29.2%	29.6%	30.6%
Apparel and services	5.3%	4.6%	5.3%	4.9%	5.2%	5.5%	5.0%	5.4%	5.0%	5.5%
Transportation	18.2%	13.3%	14.3%	17.6%	17.8%	19.8%	19.2%	19.5%	19.7%	17.0%
Vehicle purchases (net outlay)	**8.0%**	**3.6%**	**5.2%**	**7.5%**	**7.5%**	**9.3%**	**8.4%**	**9.0%**	**8.8%**	**7.4%**
Gasoline and motor oil	**3.0%**	**3.2%**	**3.2%**	**3.3%**	**3.3%**	**3.4%**	**3.4%**	**3.2%**	**3.1%**	**2.4%**
Other vehicle expenditures	**6.1%**	**5.6%**	**4.9%**	**5.8%**	**6.1%**	**6.2%**	**6.4%**	**6.4%**	**6.8%**	**5.8%**
Public transportation	**1.1%**	**1.0%**	**1.0%**	**1.0%**	**0.9%**	**0.9%**	**1.0%**	**0.8%**	**1.0%**	**1.5%**
Health care	5.2%	5.7%	8.5%	7.9%	7.1%	6.5%	5.0%	5.1%	4.4%	3.6%
Entertainment	5.0%	4.9%	4.7%	4.7%	4.0%	4.5%	5.3%	5.0%	5.1%	5.4%
Personal Insurance & pensions	1.3%	1.3%	1.3%	1.4%	1.3%	1.4%	1.4%	1.4 %	1.2%	1.1%
Others[d]	18.7%	14.0%	9.9%	10.6%	13.9%	14.9%	17.9%	19.2%	21.3%	24.1%
Households (thousands)	83,364	4,687	9,787	8,725	7,724	12,643	10,648	8,191	10,378	10,582
Percentage of households	100%	5.6%	11.6%	11.5%	9.2%	15.0%	12.6%	9.7%	12.3%	12.5%
Average number of vehicles in HH	2.0	1.0	0.9	1.3	1.6	1.9	2.3	2.5	2.7	2.8

Source:
U.S. Department of Labor, Bureau of Labor Statistics, *Consumer Expenditure Survey: Interview Survey, 1995*. Washington, DC, 1997. (Additional resources: http://www.bls.gov)

[a] Public assistance monies are included in reported 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.

Table 10.3
Average Number of Vehicles and Vehicle Travel per Household, 1991 and 1994 RTECS

	Average number of vehicles per household		Average vehicle-miles traveled per household	
Number of Drivers	**1991**	**1994**	**1991**	**1994**
1	1.2	1.2	10,900	12,300
2	2.0	2.0	21,400	23,200
3	2.6	2.8	30,700	33,100
4 or more	3.1	3.4	36,700	43,000
Household size				
1 person	1.2	1.2	10,600	11,600
2 persons	1.8	1.8	17,700	20,000
3 persons	2.0	2.1	22,300	25,200
4 persons	2.2	2.2	26,200	26,600
5 persons	2.1	2.2	23,600	26,300
6 or more persons	1.9	2.3	22,600	30,900
Household urban status				
Urban	1.8	1.8	18,800	20,700
Central city	1.6	1.7	15,900	18,000
Suburban	1.9	1.9	20,400	22,300
Rural	1.9	1.9	19,500	22,500
Household composition				
With children	2.0	2.0	22,800	24,800
Without children	1.7	1.7	16,500	18,900
Total	**1.8**	**1.8**	**18,900**	**21,100**

Source:
1991-U.S. Department of Energy, Energy Information Administration, *Household Vehicles Energy Consumption 1994*, Washington, DC, 1996, pp. 48, 49.
1994-Personal Communication, U.S. Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division. (Additional resources: http://www.eia.doe.gov)

Table 10.4
Statistics for Household Vehicles by Vehicle Type, 1985, 1988, 1991, and 1994 RTECS

Type of vehicle	Number of vehicles[a] (millions)				Average annual miles per vehicle (thousands)				Average fuel economy (mpg)			
	1985	1988	1991	1994	1985	1988	1991	1994	1985[b]	1988	1991	1994
Passenger car	106.6	109.3	108.3	106.4	9.9	10.4	10.6	11.3	17.2	19.7	21.1	21.9
Pickup truck	21.2	25.9	25.9	28.8	9.4	9.4	10.0	11.1	13.5	15.3	15.8	16.3
Mini van	[c]	2.2	5.1	8.1	[c]	12.7	12.7	13.4	[c]	19.4	19.6	19.7
Large van	4.7	4.7	2.6	3.4	10.5	9.8	10.1	11.7	13.2	13.1	13.7	13.8
Utility vehicle	3.7	4.8	7.3	9.5	10.6	11.8	11.6	12.7	12.7	15.4	16.2	16.3
Other[d]	1.1	0.7	[c]	[c]	6.0	4.9	[c]	[c]	9.6	8.3	[c]	[c]

Source:
1985 and 1988 estimates are based on data provided on the following public use tapes: U.S. Department of Energy, Energy Information Administration, *1985 Residential Transportation Energy Consumption Survey*, and *1988 Residential Transportation Energy Consumption Survey*, Washington, DC, 1987 and 1990.
1991 estimates: U.S. Department of Energy, Energy Information Administration, *Household Vehicles Energy Consumption 1991*, Washington, DC, 1993, pp. 29, 46, 52.
1994 estimates: Personal Communication, U.S. Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division.
(Additional resources: http://www.eia.doe.gov)

[a]These data are survey estimates; data are not the same as R. L. Polk estimates of the number of vehicles.
[b]Fuel economy data from the 1985 RTECS is not **directly** comparable to data from later years because of a change in methodology.
[c]Data are not available.
[d]Includes motor homes.

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 9% more per year than the one in two-vehicle households (16,542 miles vs. 15,172 miles).

Table 10.5
Average Annual Miles per Vehicle by Household Vehicle Ownership, 1994 RTECS

Vehicle [a]	One-vehicle household	Two-vehicle household	Three-vehicle household	Four-vehicle household	Five-vehicle household
#1	11,284	15,172	15,599	17,410	16,542
#2	-	7,694	9,057	10,270	10,160
#3	-	-	5,188	6,693	7,620
#4	-	-	-	5,036	5,219
#5	-	-	-	-	3,609
Average	**11,284**	**12,014**	**11,329**	**11,728**	**11,144**

Source:
Generated from the Department of Energy, Energy Information Administration, 1994 Residential Transportation Energy Consumption Survey Public Use Files, Washington, DC, May 1997.
(Additional resources: http://www.eia.doe.gov)

Table 10.6
Average Age of Vehicles by Household Vehicle Ownership, 1994 RTECS

Vehicle[a]	One-vehicle household	Two-vehicle household	Three-vehicle household	Four-vehicle household	Five-vehicle household
#1	7.63	6.67	7.16	6.33	6.76
#2	-	8.75	8.52	7.76	7.92
#3	-	-	10.80	10.61	10.68
#4	-	-	-	11.68	15.86
#5	-	-	-	-	24.64
Average	**7.63**	**7.55**	**8.29**	**8.15**	**9.29**

Source:
Generated from the Department of Energy, Energy Information Administration, 1994 Residential Transportation Energy Consumption Survey Public Use Files, Washington, DC, May 1997.
(Additional resources: http://www.eia.doe.gov)

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

Table 10.7
Distribution of Vehicles by Vehicle Age and Household Vehicle Ownership, 1994 RTECS

Vehicle age	One-vehicle households	Two-vehicle households	Three-vehicle households	Four-vehicle households	Five-vehicle households	Total households
			Vehicle 1			
New	1.45%	2.28%	0.76%	0.56%	0.14%	5.23%
2–5	5.81%	8.18%	3.97%	1.34%	0.56%	20.10%
6–10	7.02%	8.49%	4.06%	1.69%	0.44%	21.84%
11–15	2.54%	2.58%	1.46%	0.42%	0.12%	7.17%
16–20	1.20%	0.98%	0.57%	0.17%	0.14%	3.09%
21+	0.46%	0.35%	0.16%	0.03%	0.02%	1.05%
			Vehicle 2			
New		1.11%	0.35%	0.25%	0.05%	1.84%
2–5		4.45%	2.88%	1.05%	0.26%	8.80%
6–10		6.29%	3.72%	1.79%	0.61%	12.46%
11–15		2.55%	1.59%	0.51%	0.19%	4.96%
16–20		1.28%	0.62%	0.20%	0.08%	2.19%
21+		1.02%	0.42%	0.10%	0.00%	1.60%
			Vehicle 3			
New			0.13%	0.06%	0.02%	0.21%
2–5			1.06%	0.47%	0.21%	1.82%
6–10			1.00%	0.97%	0.34%	2.45%
11–15			0.85%	0.49%	0.10%	1.47%
16–20			0.66%	0.21%	0.14%	1.01%
21+			0.40%	0.26%	0.10%	0.85%
			Vehicle 4			
New				0.02%	0.00%	0.02%
2–5				0.28%	0.02%	0.36%
6–10				0.14%	0.05%	0.29%
11–15				0.15%	0.23%	0.42%
16–20				0.12%	0.12%	0.30%
21+				0.15%	0.08%	0.27%
			Vehicle 5			
New					0.00%	0.03%
6–10					0.02%	0.05%
11–15					0.00%	0.05%
21+					0.03%	0.07%
Total	**18.47%**	**39.57%**	**24.65%**	**11.44%**	**4.07%**	**100.00%**

Source:
Generated from the Department of Energy, Energy Information Administration, 1994 Residential Transportation Energy Consumption Survey Public Use Files, Washington, DC, May 1997.
(Additional resources: http://www.eia.doe.gov)

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 10.8
Household Vehicle Ownership, 1960–90 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

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. (Additional resources: http://www.census.gov)

[a]Compiled by the Census Bureau, these data on the total number of vehicles do not match the figures on Table 4.1. The figures on Table 4.1, from R.L. Polk and Company, are the preferred data.

1995 Nationwide Personal Travel Survey

The 1995 Nationwide Personal Travel Survey (NPTS) is a national survey designed to collect data on the nature and characteristics of personal travel. The definition of a trip in the NPTS is "any one-way travel from one address to another by private motor vehicle, public transportation, bicycle, or walking." Excluded from the survey are jogging and walking for exercise, as is all bicycling and walking for individuals under 5 years of age. The survey collects detailed data on household trips, their purposes and the transportation modes used. The NPTS is sponsored by several agencies of the U.S. Department of Transportation and is conducted approximately every seven years. Since each of the surveys differ somewhat in terminology, survey procedure, and target population, one should be cautious when comparing statistics from one survey to the next. Improved methodologies used in the collection of the trip information in the 1995 NPTS make it impossible to compare these data with past NPTS survey data. Thus, the 1990 NPTS trip data have been adjusted to make it comparable with the latest survey. Both the original 1990 data and the adjusted 1990 data are shown in tables comparing trip information. The 1995 trip data should only be compared to the adjusted 1990 trip data, and the original trip 1990 data should be compared with previous surveys. Additional analyses can be done on the 1995 NPTS data through the Internet site: **http://www-cta.ornl.gov/npts**.

Table 10.9
Demographic Statistics
1969, 1977, 1983, 1990, and 1995 NPTS

	1969	1977	1983	1990	1995	Percent change 1969–95
Persons per household	3.16	2.83	2.69	2.56	2.63	-17%
Vehicles per household	1.16	1.59	1.68	1.77	1.78	53%
Workers per household	1.21	1.23	1.21	1.27	1.33	10%
Vehicles per worker	0.96	1.29	1.39	1.40	1.34	40%
Average vehicle trip length (miles)	8.89	8.34	7.90	8.98	9.06	2%

Source:
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92-027, Washington, DC, March 1992, Table 2. Data for 1995 were generated from the Internet site *http://www-cta.ornl.gov/npts*.
(Additional resources: http://www.fhwa.dot.gov)

Note:
Average vehicle trip length for 1990 and 1995 is calculated using only those records with trip mileage information present. The 1969 survey does not include pickups and other light trucks as household vehicles.

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

Table 10.10
Average Annual Vehicle-Miles, Vehicle Trips and Trip Length per Household
1969, 1977, 1983, 1990, and 1995 NPTS

	Journey-to-work[a]	All trips
Average annual vehicle-miles per household		
1969	4,183	12,423
1977	3,815	12,036
1983	3,538	11,739
1990 original	4,853	15,100
1990 adjusted	4,853	18,161
1995	6,492	20,895
Average annual vehicle trips per household		
1969	445	1,396
1977	423	1,442
1983	414	1,486
1990 original	448	1,702
1990 adjusted	448	2,077
1995	553	2,321
Average vehicle trip length (miles)		
1969	9.4	8.9
1977	9.0	8.4
1983	8.5	7.9
1990 original	11.0	9.0
1990 adjusted	11.0	8.9
1995	11.8	9.1

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

[a]It is believed that the methodology changes in the 1995 NPTS did not affect journey-to-work trips; therefore, no adjustment is necessary.

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

Table 10.11
Average Annual Person-Miles Traveled (PMT), Person Trips and Trip Length per Household by Selected Trip Purposes
1983, 1990, and 1995 NPTS

	Journey-to-work[a]	Shopping	Social and recreational	All purposes[b]
	Average annual PMT per household			
1983	4,586	2,567	8,964	22,802
1990 original	5,637	2,674	8,567	24,803
1990 adjusted	5,637	3,343	11,308	30,316
1995	7,740	4,659	10,571	34,459
	Average annual person trips per household			
1983	537	474	728	2,628
1990 original	539	504	662	2,673
1990 adjusted	539	630	874	3,262
1995	676	775	953	3,828
	Average person trip length (miles)			
1983	8.5	5.4	12.3	8.7
1990 original	10.7	5.4	13.2	9.5
1990 adjusted	10.7	5.4	13.2	9.5
1995	11.6	6.1	11.3	9.1

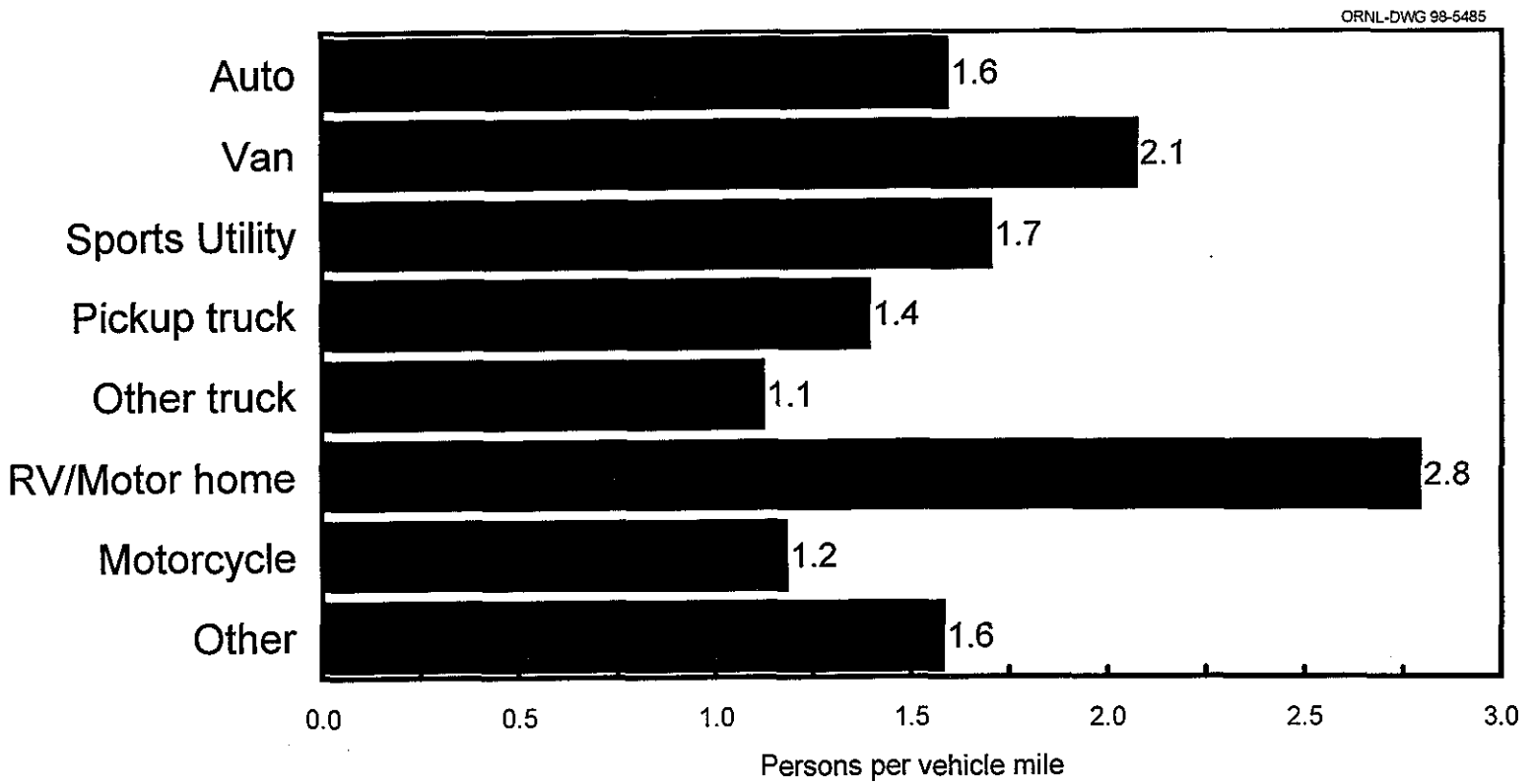
Source:
U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Study, Public Use Tapes, Washington, DC. Data for 1995 were generated from the Internet site *http://www-cta.ornl.gov/npts*. 1990 adjusted data - Oak Ridge National Laboratory, Oak Ridge, TN,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

Figure 10.1. Average Vehicle Occupancy by Vehicle Type, 1995 NPTS

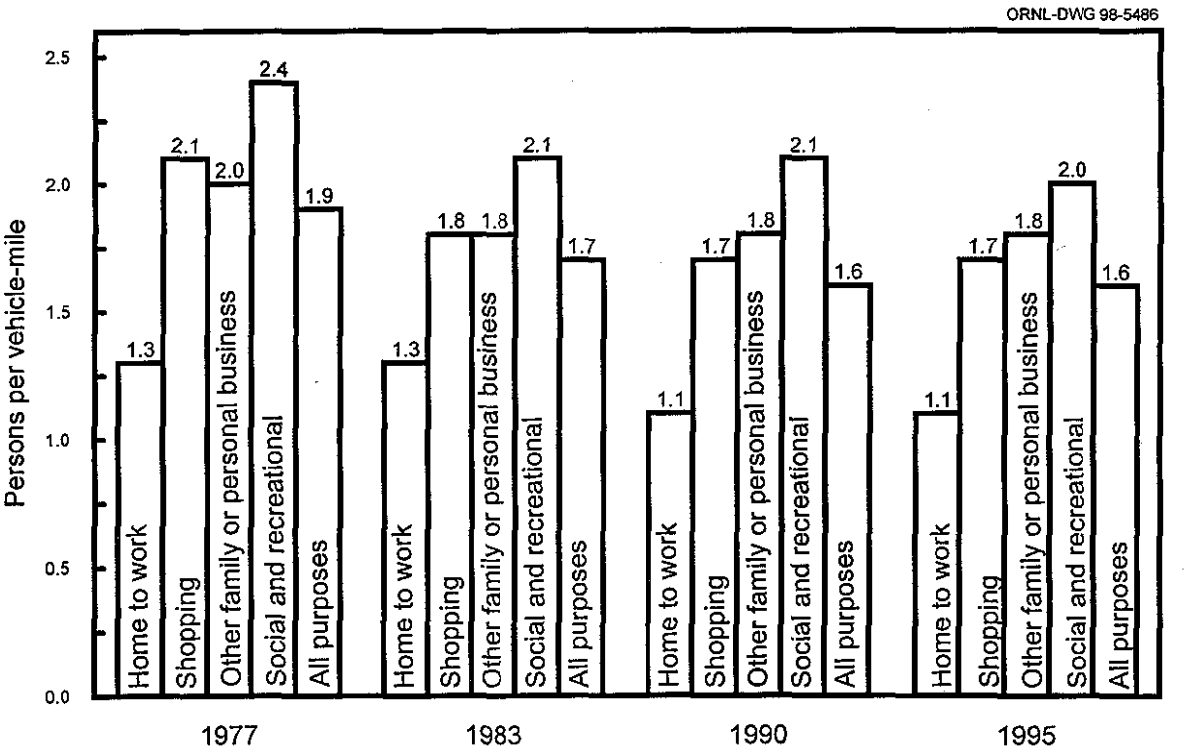


Source:

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

The average vehicle occupancy, calculated as person-miles per vehicle-mile, was nearly identical in 1990 and 1995 for every trip purpose. The highest vehicle occupancy levels were in 1977. The increased number of vehicles per household and the decrease in average household size could have contributed to the decline since then.

Figure 10.2. Average Vehicle Occupancy by Trip Purpose 1977, 1983, 1990, and 1995 NPTS



Source:

U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, FHWA-PL-92027, Washington, DC, March 1992, Figure 6. Data from 1995 were generated from the public use file.
(Additional resources: http://www.fhwa.dot.gov, http://www-cta.ornl.gov/npts)

Historically, the data from the Nationwide Personal Transportation Study (NPTS) are based on estimates reported by survey respondents. For the 1995 survey, odometer data was also collected. The Residential Transportation Energy Consumption Survey (RTECS) data has always been collected from odometer readings. These data indicate that respondents may overestimate the number of miles driven in a year.

Table 10.12
Average Annual Miles Per Household Vehicle by Vehicle Age

	National Personal Transportation Study				Residential Transportation Energy Consumption Survey				
Vehicle age (years)	1983 self-reported	1990 self-reported	1995 self-reported	1995 odometer	1983 odometer	1985 odometer	1988 odometer	1991 odometer	1994 odometer
Under 1	8,200	19,600	15,900	15,600	13,400	12,700	12,900	13,400	15,220
1	15,200	16,800	12,200	11,200	13,000	13,000	13,400	14,100	14,250
2	16,800	16,600	12,200	11,300	12,700	12,600	12,600	12,600	13,740
3	14,500	14,700	12,800	11,600	12,100	12,400	12,100	13,200	13,080
4	13,000	13,600	13,200	12,400	11,300	11,100	11,500	13,300	12,500
5	12,100	12,900	13,500	12,700	9,700	10,600	10,600	12,200	12,560
6	11,300	13,200	14,100	12,900	9,700	10,000	10,800	11,200	12,290
7	10,000	12,400	14,400	13,800	9,500	9,700	10,000	10,700	12,030
8	9,800	12,600	15,500	14,800	8,700	8,900	10,300	11,400	10,915
9	9,000	11,500	16,800	14,500	8,400	8,600	8,900	10,000	10,950
10 and older	7,300	9,200	8,900	9,000	8,700	8,400	7,500	7,200	9,780
All vehicles	**10,400**	**12,500**	**12,200**	**11,800**	**9,400**	**9,900**	**10,200**	**10,600**	**11,400**

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: http://www-cta.ornl.gov/npts.
Residential Transportation Energy Consumption Survey—Personal communication with Energy Information Agency, Office of Markets and End Use, Energy End Use Division.
(Additional resources: http://www.fhwa.dot.gov, http://www.eia.doe.gov)
Note:
Data include all household vehicles. Data have been rounded to the nearest hundredth.

In 1995 the average journey-to-work was faster (miles per hour increased to 34.6), but the travel time still increased, probably due to an increase in the average travel distance. Journeys-to-work using public transportation continued to take twice as long as private transportation, though there is only a slight difference in travel distance.

Table 10.13
Journey-to-Work Statistics
1983, 1990, and 1995 NPTS[a]

Year	Private transportation	Public transportation	Other	Total
		Average travel time (minutes)[b]		
1983	17.6	39.8	10.6	18.2
1990	19.1	41.1	12.4	19.6
1995	20.1	42.0	18.8	20.7
		Average trip length (miles)		
1983	8.9	11.8	1.4	8.5
1990	11.0	12.8	2.2	10.7
1995	11.8	12.9	8.2	11.6
		Average speed (miles per hour)		
1983	30.2	17.8	7.6	28.2
1990[c]	34.7	18.2	7.6	33.3
1995[c]	35.4	19.3	25.9	34.6

Source:
U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Study, Public Use Tapes, Washington, DC. Data for 1995 were generated from the Internet site *http://www-cta.ornl.gov/npts*. (Additional resources: http://www.fhwa.dot.gov, http://www-cta.ornl.gov/npts)

[a]It is believed that the methodology changes in the 1995 NPTS did not affect journey-to-work trips; therefore, no adjustment is necessary.
[b]Does not include time spent waiting for transportation.
[c]Does not include segmented trips.

According to the U.S. Census data, the percentage of workers who car pooled has dropped from 19.7% in 1980 to 13.4% in 1990. The percent of workers using public transit declined from 6.4% to 5.3% during the same time period. The average travel time increased by 0.7 minutes from 1980 to 1990.

Table 10.14
Means of Transportation to Work, 1980 and 1990 Census

	1980 Census		1990 Census	
Means of transportation	Number of workers	Percentage	Number of workers	Percentage
Private vehicle	81,258,496	84.1%	99,592,932	86.5%
Drove alone	62,193,449	64.4%	84,215,298	73.2%
Car pooled	19,065,047	19.7%	15,377,634	13.4%
Public transportation	6,175,061	6.4%	6,069,589	5.3%
Bus or trolley bus[a]	3,924,787	4.1%	3,445,000	3.0%
Streetcar or trolley car[a]	[b]	[b]	78,130	0.1%
Subway or elevated	1,528,852	1.6%	1,755,476	1.5%
Railroad	554,089	0.6%	574,052	0.5%
Ferryboat	[b]	[b]	37,497	0.0%
Taxicab	167,133	0.2%	179,434	0.2%
Other means	703,273	0.7%	808,582	0.7%
Motorcycle	419,007	0.4%	237,404	0.2%
Bicycle	468,348	0.5%	466,856	0.4%
Walked only	5,413,248	5.6%	4,488,886	3.9%
Worked at home	2,179,863	2.3%	3,406,025	3.0%
Total workers	96,617,296	100.0%	115,070,274	100.0%
Average travel time (minutes)	21.7		22.4	

Source:
Data provided by the Journey-to-Work and Migration Statistics Branch, Population Division, U.S. Bureau of the Census. (Additional resources: http://www.census.gov)

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

Table 10.15
National and Metropolitan Area Comparisons of Journey-to-Work Statistics, 1990 Census

	National	Metropolitan areas[a]
Workers per household	1.25	1.31
Workers per vehicle	0.76	0.82
Average travel time (minutes)	22.38	25.20
Commute length (percentage)		
Less than 15 minutes	15.87%	11.45%
15–29 minutes	51.64%	49.22%
30–39 minutes	14.66%	17.48%
40–59 minutes	9.01%	11.77%
60 minutes or more	5.86%	7.52%
Mode (percentage)		
Drive alone	73.19%	70.75%
Percentage car pooled	13.36%	12.69%
Public transit	5.27%	8.98%
Motorcycle	0.21%	0.21%
Walk	3.90%	3.76%
Bicycle	0.41%	0.43%
Other	0.70%	0.62%
Work at home	2.96%	2.57%
Time workers leave home (percentage)		
5:00 AM–6.59 AM	26.04%	25.49%
7:00 AM–8:29 AM	41.87%	42.44%
8:30 AM–9:59 AM	10.28%	11.57%
All other departures	18.85%	17.93%

Source:
U. S. Department of Transportation, Volpe National Transportation Systems Center, *Journey-to-Work Trends in theUnited States and its Major Metropolitan Area, 1960–1990*, FHWA-PL-94-012, Cambridge, MA, 1994, p. 2-6. (Additional resources: http://www.census.gov)

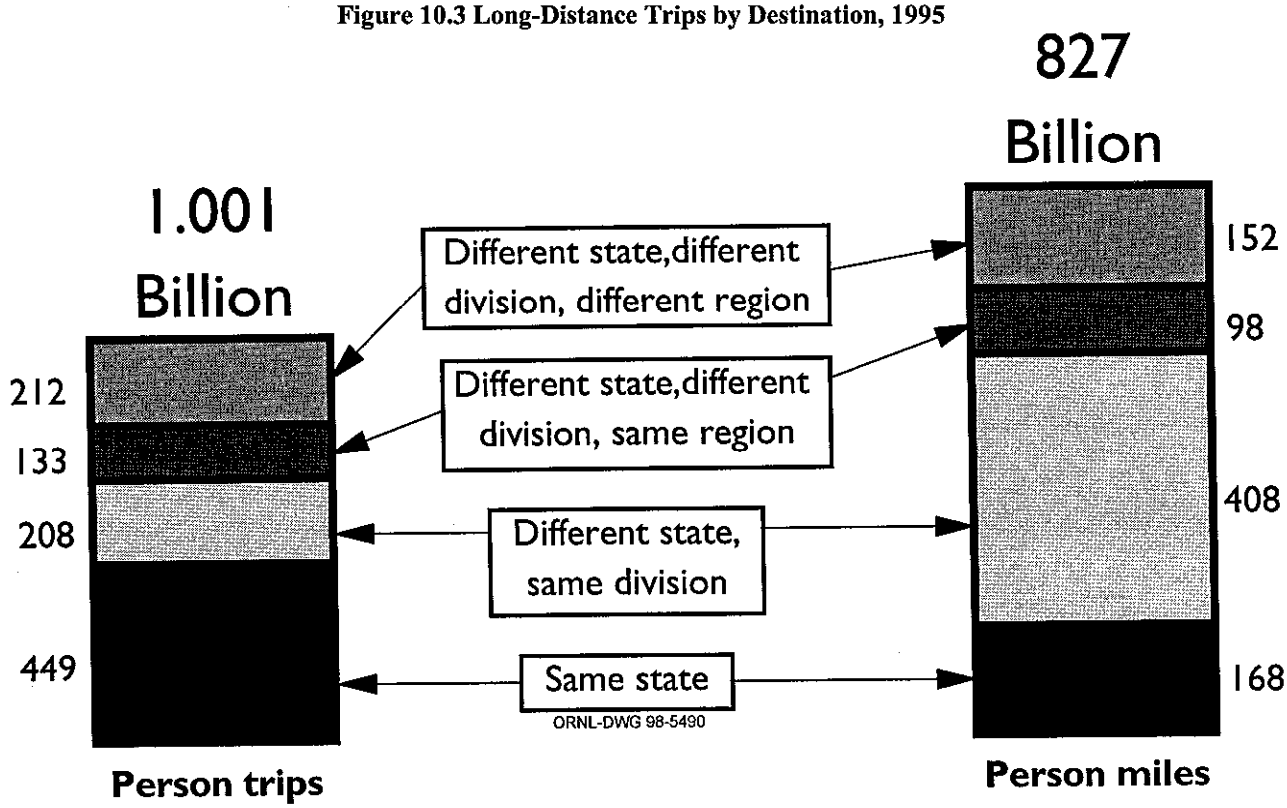
[a]Metropolitan areas over 1 million population. There were 39 such areas in the 1990 Census.

1995 American Travel Survey

The American Travel Survey (ATS) was conducted by the Bureau of Transportation Statistics 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: http://www.bts.gov/ats

Figure 10.3 Long-Distance Trips by Destination, 1995



Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *1995 American Travel Survey Profile*, Washington, DC, October 1997, p. 2. (Additional resources: http://www.bts.gov/ats)

Note:
Definitions of divisions and regions are in Appendix C.

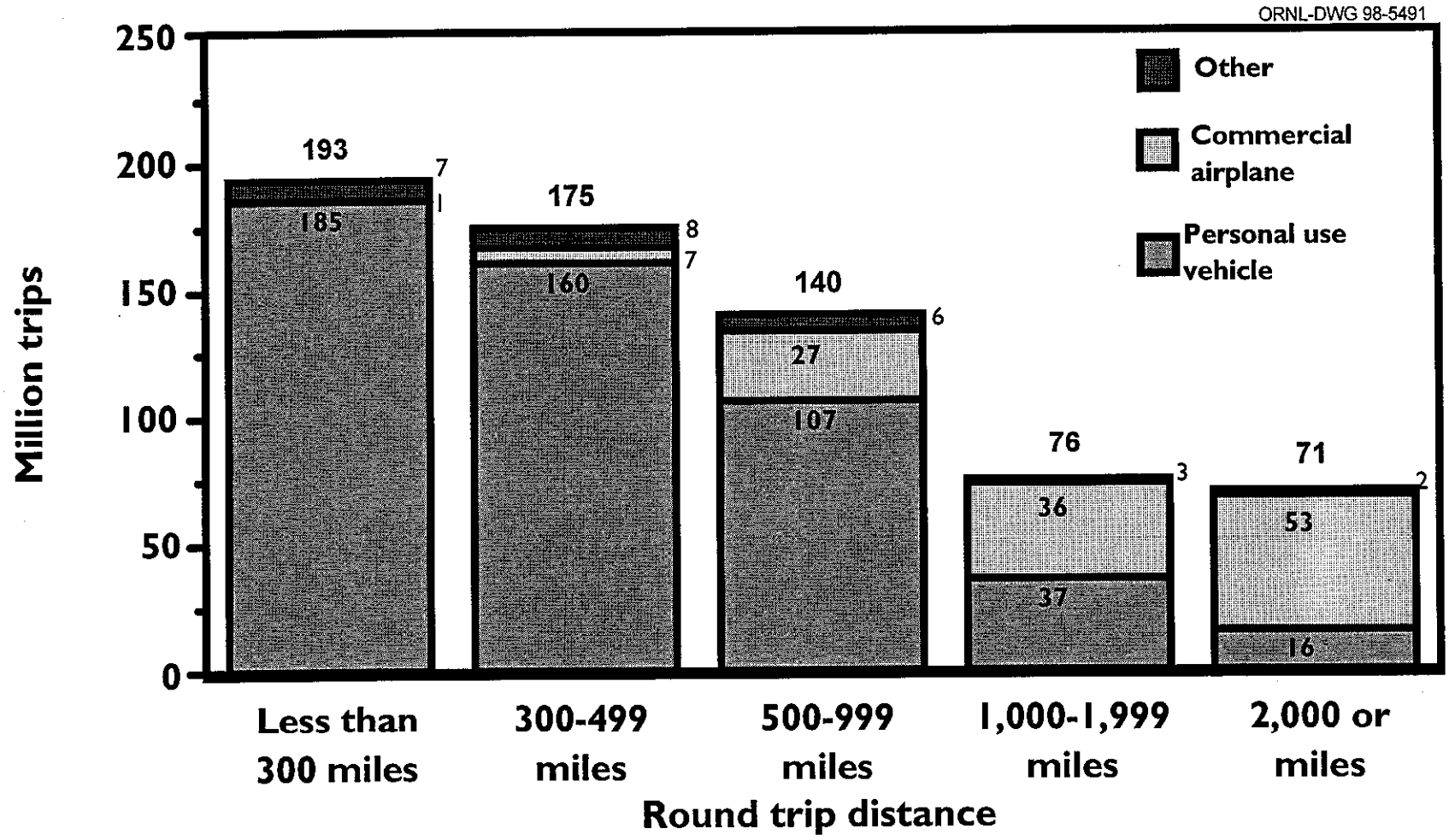
Table 10.16
Long-Distance Trips[a] by Mode and Purpose

Principal means of transportation	Main purpose of trip					
		Pleasure				
	Business	Visit friends or relatives	Leisure	Total	Personal business	Total
	Person trips (thousands)					
Personal use vehicle	151,697	283,153	254,186	537,339	124,791	813,858
Commercial airplane	67,083	41,881	31,581	73,462	15,386	155,936
Intercity bus	286	1,830	690	2,519	439	3,244
Charter or tour bus	1,281	1,198	9,253	10,451	2,514	14,247
Train	1,342	2,004	944	2,948	704	4,994
Ship, boat, or ferry	68	43	483	525	20	614
Total	**224,835**	**330,755**	**299,355**	**630,110**	**146,338**	**1,001,319**
	Percentage					
Personal use vehicle	18.6	34.8	31.2	66.0	15.3	100.0
Commercial airplane	43.0	26.9	20.3	47.1	9.9	100.0
Intercity bus	8.8	56.4	21.3	77.7	13.5	100.0
Charter or tour bus	9.0	8.4	64.9	73.4	17.6	100.0
Train	26.9	40.1	18.9	59.0	14.1	100.0
Ship, boat, or ferry	11.1	7.0	78.7	85.5	3.3	100.0
Total	**22.5**	**33.0**	**29.9**	**62.9**	**14.6**	**100.0**

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

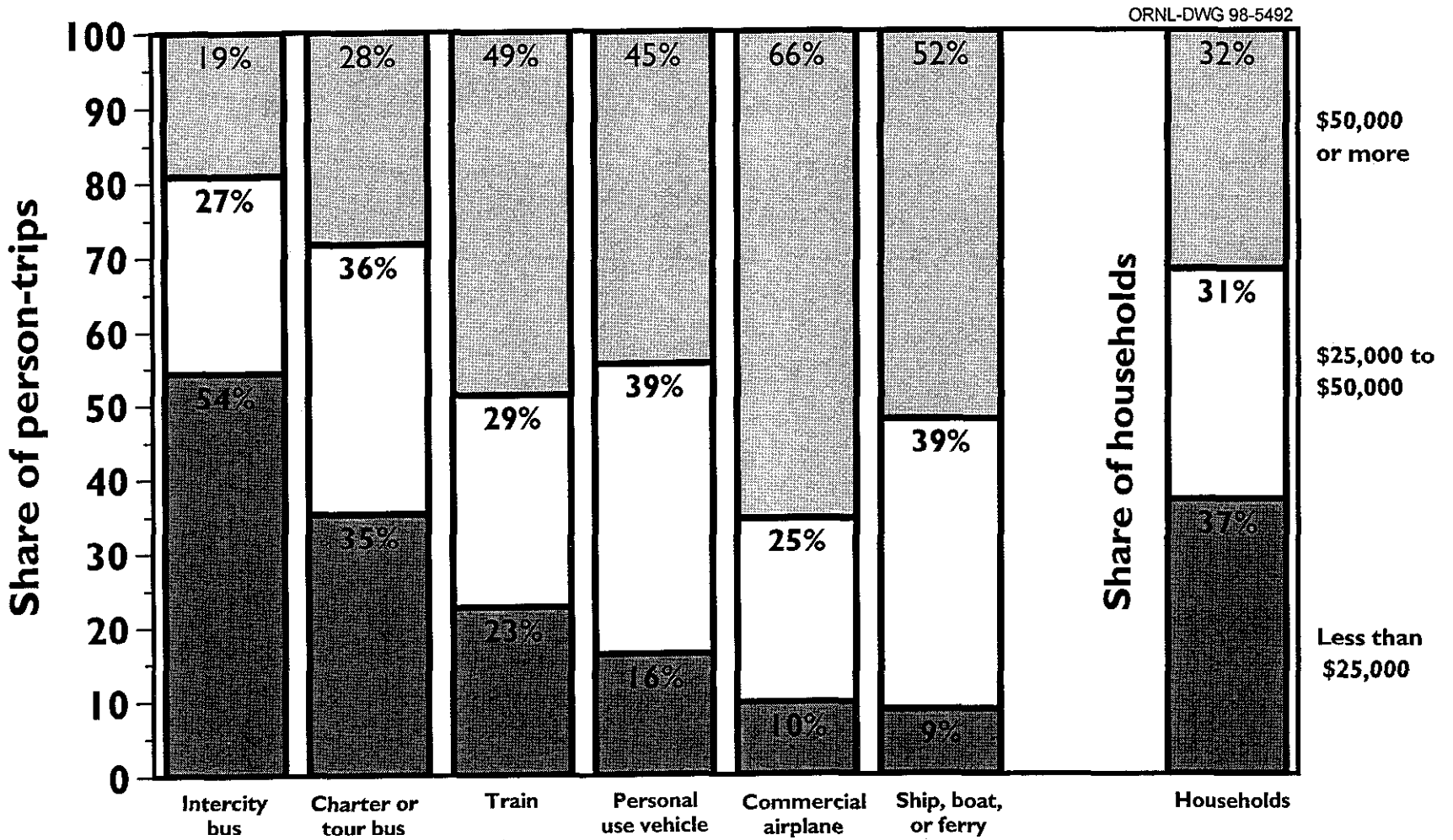
[a]A long-distance trip is any trip of 100 miles or more, one way.

Figure 10.4. Long-Distance Household Trips by Mode and Trip Distance, 1995



Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *1995 American Travel Survey Profile*, Washington, DC, October 1997, p. 3.
(Additional resources: http://www.bts.gov/ats)

Figure 10.5. 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: http://www.bts.gov/ats, http://www.census.gov)

Chapter 11
Nonhighway Modes

Summary Statistics

Table		
	Passenger-miles, 1996	(millions)
11.1	*Domestic and international air carrier*	*595,784*
11.2	*General aviation*	*10,600*
11.10	*Amtrak*	*5,066*
11.11	*Transit rail*	*12,484*
	Freight ton-miles, 1996	(millions)
11.4	*Domestic waterborne commerce*	*765,000*
11.7	*Class I railroad*	*1,355,975*
	Passenger energy use, 1996	(trillion Btus)
11.1	*Domestic and international air carrier*	*2,396.6*
11.2	*General aviation*	*111.1*
11.10	*Amtrak energy use*	*43.0*
11.11	*Transit rail*	*12.1*
	Freight energy use, 1996	(trillion Btus)
11.4	*Domestic waterborne commerce*	*1,171.0*
11.7	*Class I railroad*	*499.4*

Table 11.1
Summary Statistics for Domestic and International Certificated Route Air Carriers (Combined Totals), 1970–96

Year	Revenue aircraft-miles (millions)	Average passenger trip length[a] (miles)	Revenue passenger-miles (millions)	Available seat-miles (millions)	Available seats per aircraft[b]	Passenger load factor (percentage)[c]	Revenue cargo ton-miles (millions)	Energy use (trillion Btu)[d]	Percent domestic of total energy use (percentage)
1970	2,383	678	131,719 [e]	264,904 [e]	111	49.7%[e]	4,994	1,363.4	[f]
1975	2,241	698	173,324	315,823	135	54.9%	5,944	1,283.4	[f]
1976	2,320	704	191,823	338,349	139	56.7%	6,222	1,324.1	[f]
1977	2,418	704	206,082	361,172	143	57.1%	6,587	1,386.2	[f]
1978	2,608	719	236,998	381,113	147	62.2%	7,395	1,436.3	82.0%
1979	2,859	714	269,719	425,411	146	63.4%	7,580	1,534.8	82.5%
1980	2,924	736	267,722	448,479	148	59.7%	7,515	1,489.6	82.4%
1981	2,703	749	260,063	438,778	157	59.3%	7,917	1,429.3	[f]
1982	2,804	766	272,435	455,938	157	59.8%	7,807	1,406.6	81.1%
1983	2,923	765	295,144	480,977	159	61.4%	8,497	1,439.2	84.4%
1984	3,264	759	319,504	534,104	164	59.8%	9,328	1,607.4	[f]
1985	3,462	758	351,073	565,677	163	62.1%	9,048	1,701.5	[f]
1986	3,873	767	378,923	623,073	161	60.8%	10,987	1,847.1	81.4%
1987	4,182	779	417,830	670,871	160	62.3%	13,130	1,945.4	80.4%
1988	4,355	786	437,649	696,337	160	62.9%	14,633	2,049.4	78.5%
1989	4,442	792	447,480	703,888	158	63.6%	16,347	2,087.4	77.0%
1990	4,724	803	472,236	753,211	159	62.7%	16,411	2,191.3	75.9%
1991	4,661	806	463,296	738,030	158	62.8%	16,149	2,069.2	74.5%
1992	4,899	806	493,715	772,869	158	63.9%	17,306	2,144.2	74.1%
1993	5,118	799	505,996	793,959	155	63.7%	19,083	2,168.8	74.4%
1994	5,360	787	537,506	809,240	151	66.4%	21,773	2,249.5	74.3%
1995	5,627	791	558,757	845,012	150	66.1%	23,375	2,310.4	74.0%
1996	5,850	802	595,784	859,077	147	69.4%	24,810	2,396.6	74.0%
				Average annual percentage change					
1970–96	3.5%	0.6%	6.0%	4.6%	1.1%		6.4%	2.2%	
1986–96	4.2%	0.4%	4.6%	3.3%	-0.9%		8.5%	2.6%	

Source:

U.S. Department of Transportation, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1996/1995, Washington, DC, pp. 1–2, and annual.

1970–81 Energy Use - Department of Transportation, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, 1981, and annual.

1982–96 Energy Use - Department of Transportation, Research and Special Programs Administration, "Fuel Cost and Consumption Tables," Washington, DC, monthly. Annual totals are derived by summing monthly totals for domestic and international air carriers. (Additional resources: http://www.bts.gov, http://www.faa.gov)

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[a]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.

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

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

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

[e]Scheduled services only.

[f]Data are not available.

Table 11.2
Summary Statistics for General Aviation, 1970–96

Calendar year	Total number of 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
1971	131,100[a]	25,512[b]	9.2	91.6
1972	145,000[a]	26,974[b]	10.0	103.4
1973	148,000[a]	28,599	10.7	90.4
1974	161,502	29,758	11.2	101.4
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	12.2	120.4
1992	185,650	26,747	10.7	104.7
1993	177,120	24,455	10.1	97.5
1994	172,935	24,092	10.4	95.3
1995	182,605	25,667	10.5	106.6
1996	187,312	26,100	10.6	111.1
		Average Annual Percentage Change		
1970–96	1.4%	0.0%	0.6%	0.6%
1986–96	-0.9%	-2.0%	-1.6%	-2.8%

Sources:

Intercity passenger-miles - Eno Foundation for Transportation, *Transportation in America 1997*, Fifteenth edition, Lansdowne, VA, 1998, p. 47, and annual.

All other- U.S. Department of Transportation, Federal Aviation Administration, *General Aviation Activity and Avionics Survey*: Calendar Year 1996, pp. 1-7, 1-14, 5-3, and annual. (Additional resources: http://www.faa.gov)

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

[b]Include rotocraft.

In the early seventies, domestic waterborne commerce accounted for over 60% of total tonnage, but by 1996 foreign tonnage grew to more than half of all waterborne tonnage.

Table 11.3
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970–96
(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%
1971	1,513	566	947	62.6%
1972	1,617	630	987	61.0%
1973	1,762	767	994	56.4%
1974	1,747	764	983	56.3%
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[c]	48.2%
	Average annual percentage change			
1970–96	1.5%	2.8%	0.6%	
1986–96	2.0%	3.5%	0.6%	

Source:
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996*, Part 5: National Summaries, New Orleans, Louisiana, 1997, Table 1-1, p. 1-3, and annual. (Additional resources: http://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.

[c]Beginning in 1996, fish was excluded for internal and intra port domestic traffic.

Table 11.4
Summary Statistics for Domestic Waterborne Commerce, 1970–96

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
1971	26,063	593	944	628.1	506	300.0
1972	27,347	604	985	612.8	522	315.1
1973	28,431	585	990	590.7	576	337.0
1974	29,328	586	979	599.1	483	283.3
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
			Average annual percentage change			
1970–96	1.7%	1.2%	0.5%	0.7%	-1.1%	-0.1%
1986–96	-0.5%	-1.0%	0.7%	-1.7%	-1.2%	-2.5%

Source:

Number of vessels -

1970–92, 1995–96 - U.S. Department of the Army, Corps of Engineers, "Summary of U.S. Flag Passenger and cargo vessels, 1996," New Orleans, LA, 1998, 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 1996*, Part 5: National Summaries, New Orleans, LA, 1997, Table 1-4, pp. 1-6, 1-7, and annual.

Energy use - See Appendix A for Table 2.7.

(Additional resources: http://www.wrc-ndc.usace.army.mil/ndc)

[a]Grand total for self-propelled and non-self-propelled.

[b]These figures are not consistent with the figures on Table 6.4 because intra-territory tons are not included in this table. Intra-territory traffic is traffic between ports in Puerto Rico and the Virgin Islands.

Fifty-seven percent of all domestic marine cargo in 1996 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% of all internal and local waterborne commerce.

Table 11.5
Breakdown of Domestic Marine Cargo by Commodity Class, 1996

	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	197	1,636	2	322	193	190	392	35.8%	918
Chemicals and related products	16	2,133	[c]	320	64	480	80	7.3%	815
Crude materials	18	566	88	509	127	352	233	21.3%	427
Coal and coke	14	662	21	546	195	388	230	21.0%	418
Primary manufactured goods	8	813	3	297	27	731	38	3.4%	710
Food and farm products	8	1,869	[c]	969	90	1,002	98	9.0%	1,072
Manufactured equipment	7	1,583	[c]	[c]	10	89	17	1.6%	695
Waste and scrap	[c]	1,000	0	0	6	54	6	0.5%	54
Unknown	[c]	2,239	[c]	[c]	[c]	[c]	[c]	0.0%	1,648
Total	267	1,526	115	508	711	419	1,093	100.0%	699
Barge traffic (million tons)	107		9		681		796		
Percentage by barge	39.9%		7.5%		95.8%		72.8%		

Source:
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996*, Part 5: National Summaries, New Orleans, Louisiana, 1997, Tables 2-1, 2-2, and 2-3, pp. 2-1—2-8, and annual.
(Additional resources: http://www.wrc-ndc.usace.army.mil/ndc)

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

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

The Interstate Commerce Commission designates Class I railroads on the basis of annual gross revenues. In 1996, ten railroads were given this classification (see note below).

Table 11.6
Class I Railroad Freight Systems in the United States
Ranked by Revenue Ton-Miles, 1996

Railroad	Revenue ton-miles (billions)	Percent
Burlington Northern and Sante Fe Railway Company	411	30.3%
Union Pacific Railroad Company	333	24.6%
CSX Transportation	157	11.6%
Southern Pacific Transportation Company	156	11.5%
Norfolk Southern Corporation	130	9.6%
Consolidated Rail Corporation (Conrail)	95	7.0%
Soo Line Railroad Company	25	1.8%
Illinois Central Railroad Company	22	1.6%
Kansas City Southern Railway Company	18	1.3%
Grand Trunk Western Railroad Inc.	9	0.7%
Total	**1,356**	**100.0%**

Source:
Association of American Railroads, *Railroad Facts*, 1997 Edition, Washington, DC, September 1997, p. 66. (Additional resources: http:/www.aar.org)

Note:
The Union Pacific Railroad Company merged with Southern Pacific Transportation on September 11, 1996. The two railroads reported separately for 1996.

Table 11.7
Summary Statistics for Class I Freight Railroads, 1970–96

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
1971	27,160[d]	1,422	430	29,181	1,391	507	739,723	717	530.2
1972	27,044	1,411	451	30,309	1,448	511	776,746	714	554.4
1973	27,438	1,395	469	31,248	1,532	531	851,809	677	577.1
1974	27,627	1,375	469	30,719	1,531	527	850,961	681	579.1
1975	27,855	1,359	403	27,656	1,395	541	754,252	687	518.3
1976	27,233	1,332	425	28,530	1,407	540	794,059	680	540.3
1977	27,298	1,287	428	28,749	1,395	549	826,292	669	552.7
1978	26,959	1,226	433	29,076	1,390	617	858,105	641	550.4
1979	27,660	1,217	438	29,436	1,502	611	913,669	618	564.8
1980	28,094	1,168	428	29,277	1,492	616	918,621	597	548.7
1981	27,421	1,111	408	27,968	1,453	626	910,169	572	521.0
1982	26,795	1,039	345	23,952	1,269	629	797,759	553	440.8
1983	25,448	1,007	346	24,358	1,293	641	828,275	525	435.1
1984	24,117	948	369	26,409	1,429	645	921,542	510	470.0
1985	22,548	867	347	24,920	1,320	664	876,984	497	436.1
1986	20,790	799	347	24,414	1,306	664	867,722	486	421.5
1987	19,647	749	361	25,627	1,372	688	943,747	456	430.3
1988	19,364	725	379	26,339	1,430	697	996,182	443	441.4
1989	19,015	682	383	26,196	1,403	723	1,013,841	437	442.6
1990	18,835	659	380	26,159	1,425	726	1,033,969	420	434.7
1991	18,344	633	375	25,628	1,383	751	1,038,875	391	405.8
1992	18,004	605	390	26,128	1,399	763	1,066,781	393	419.2
1993	18,161	587	405	26,883	1,397	794	1,109,309	389	431.6
1994	18,505	591	441	28,485	1,470	817	1,200,701	388	465.4
1995	18,812	583	458	30,383	1,550	843	1,305,688	372	485.9
1996	19,269	571	469	31,715	1,611	842	1,355,975	368	499.4
				Average annual percentage change					
1970–96	-1.3%	-3.5%	0.4%	0.2%	0.3%	1.9%	2.2%	-2.4%	-0.2%
1986–96	-0.8%	-3.3%	3.1%	2.7%	2.1%	2.4%	4.6%	-2.7%	1.7%

Source:

Association of American Railroads, *Railroad Facts*, 1997 Edition, Washington, DC, September 1997, pp. 27, 28, 33, 34, 36, 48, 50, 60.
(Additional resources: http://www.aar.org)

[a]Does not include self-powered units. From 1972 to 1979, the number of locomotives used in Amtrak passenger operations are subtracted from the total locomotives used in passenger and freight service to calculate the number of Class I locomotives in service.

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

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

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

The "other" category, which consists primarily of intermodal traffic, has grown 86% in carloads from 1974 to 1996. Coal continues to account for one quarter of all carloads.

Table 11.8
Railroad Revenue Carloads by Commodity Group, 1974 and 1996

Commodity group	Carloads (thousands)		Percent distribution		Percentage change
	1974	1996	1974	1996	1974–96
Coal	4,544	6,746	17.0%	25.9%	48.5%
Farm products	3,021	1,530	11.3%	6.3%	-49.4%
Chemicals and allied products	1,464	1,668	5.5%	6.9%	13.9%
Nonmetallic minerals	821	1,176	3.1%	4.9%	43.2%
Food and kindred products	1,777	1,302	6.6%	5.4%	-26.7%
Lumber and wood products	1,930	682	7.2%	2.8%	-64.7%
Metallic ores	1,910	443	7.1%	1.8%	-76.8%
Stone, clay and glass	2,428	491	9.1%	2.0%	-79.8%
Pulp, paper, and allied products	1,180	589	4.4%	2.4%	-50.1%
Petroleum products	877	538	3.3%	2.2%	-38.7%
Primary metal products	1,366	626	5.1%	2.6%	-54.2%
Waste and scrap material	889	605	3.3%	2.5%	-31.9%
Transportation equipment	1,126	1,341	4.2%	5.6%	19.1%
Others	3,451	6,421	12.9%	26.6%	86.1%
Total	26,784	24,158	100.0%	100.0%	-9.8%

Source:
1974 - Association of American Railroads, *Railroad Facts*, 1976 Edition, Washington, DC, 1975, p. 26.
1996 - Association of American Railroads, *Railroad Facts*, 1997 Edition, Washington, DC, September 1997, p. 25.
(Additional resources: http://www.aar.org)

The number of trailers and containers moved by railroads has increased more than four-fold from 1965 to 1996. Containerization has increased in recent years, evidenced by the 52% increase in the number of containers from 1988 to 1996.

Table 11.9
Intermodal Rail Traffic, 1965–96

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]
1981	3,150,522	[a]	[a]
1982	3,396,973	[a]	[a]
1983	4,090,078	[a]	[a]
1984	4,565,743	[a]	[a]
1985	4,590,952	[a]	[a]
1986	4,997,229	[a]	[a]
1987	5,503,819	[a]	[a]
1988	5,779,547	3,481,020	2,298,527
1989	5,987,355	3,496,262	2,491,093
1990	6,206,782	3,451,953	2,754,829
1991	6,246,134	3,201,560	3,044,574
1992	6,627,841	3,264,597	3,363,244
1993	7,156,628	3,464,126	3,692,502
1994	8,128,228	3,752,502	4,375,726
1995	8,070,309	3,519,664	4,550,645
1996[b]	8,153,942	3,320,312	4,833,630
Average annual percentage change			
1965–96	5.3%	[a]	[a]
1988–96	4.4%	-0.6%	9.7%

Source:
Association of American Railroads, *Railroad Facts*, 1997 edition, Washington, DC, September 1997 p.26. (Additional resources: http://www.aar.org)

[a] Data are not available.

[b] The Grand Trunk Western Railroad and the Soo Line Railroad Company data are excluded.

Table 11.10
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971–96

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]
1972	285	1,571	26,302	213,261	3,039	183	[a]	[a]
1973	352	1,777	27,151	239,775	3,807	224	3,756	14.3
1974	457	1,848	29,538	260,060	4,259	233	3,240	13.8
1975	355	1,913	30,166	253,898	3,753	224	3,677	13.8
1976	379	2,062	30,885	263,589	4,268	229	3,397	14.5
1977	369	2,154	33,200	261,325	4,204	221	3,568	15.0
1978	441	2,084	32,451	255,214	4,154	217	3,683	15.3
1979	437	2,026	31,379	255,129	4,867	226	3,472	16.9
1980	448	2,128	29,487	235,235	4,503	217	3,176	14.3
1981	398	1,830	30,380	222,753	4,397	226	2,979	13.1
1982	396	1,929	28,833	217,385	3,993	220	3,156	12.6
1983	388	1,880	28,805	223,509	4,227	223	2,957	12.5
1984	387	1,844	29,133	234,557	4,427	227	3,027	13.4
1985	382	1,818	30,038	250,642	4,785	238	2,800	13.4
1986	369	1,793	28,604	249,665	5,011	249	2,574	12.9
1987	381	1,850	29,515	261,054	5,361	259	2,537	13.6
1988	391	1,845	30,221	277,774	5,686	265	2,462	14.0
1989	312	1,742	31,000	285,255	5,859	274	2,731	16.0
1990	318	1,863	33,000	300,996	6,057	273	2,609	15.8
1991	316	1,786	34,000	312,484	6,273	285	2,503	15.7
1992	336	1,796	34,000	307,282	6,091	286	2,610	15.9
1993	360	1,853	34,936	302,739	6,199	280	2,646	16.4
1994	411	1,874	34,940	305,600	5,869	276	2,351	13.8[b]
1995	422	1,907	31,579	282,579	5,401	266	2,314	12.5[c]
1996	348	1,501	30,542	277,750	5,066	257	2,389	12.1[c]
				Average annual percentage change				
1971–96	0.8%[d]	1.0%	2.5%	2.8%	3.8%	1.3%	-1.9%[d]	-0.7%[d]
1986–96	-0.6%	-1.8%	0.7%	1.1%	0.1%	0.3%	-0.7%[d]	-0.6%[d]

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.

1994–96- 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*, 1997 Edition, Washington, DC, 1997, p. 78.

Energy use - Personal communication with the Amtrak, Washington, DC. (Additional resources: http://www.amtrak.com, http://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.

[c] Estimated using train-miles.

[d] Average annual percentage change is from earliest year available to 1996.

Table 11.11
Summary Statistics for Rail Transit Operations, 1970–96[a]

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)[b]	Estimated passenger-miles (millions)[c]	Average trip length (miles)[d]	Energy intensity (Btu/passenger-mile)[e]	Energy use (trillion Btu)
1970	10,548	440.8	2,116	12,273	[f]	2,453	30.1
1971	10,550	440.4	2,000	11,600	[f]	2,595	30.1
1972	10,599	417.8	1,942	11,264	[f]	2,540	28.6
1973	10,510	438.5	1,921	11,142	[f]	2,460	27.4
1974	10,471	458.8	1,876	10,881	[f]	2,840	30.9
1975	10,617	446.9	1,797	10,423	[f]	2,962	31.1
1976	10,625	428.1	1,744	10,115	[f]	2,971	30.3
1977	10,579	381.7	1,713	10,071	5.8	2,691	27.1
1978	10,459	383.0	1,810	10,722	5.9	2,210	23.7
1979	10,429	399.6	1,884	11,167	5.9	2,794	31.2
1980	10,654	402.2	2,241	10,939	4.9	3,008	32.9
1981	10,824	436.6	2,217	10,590	4.8	2,946	31.2
1982	10,831	445.2	2,201	10,428	4.6	3,069	32.0
1983	10,904	423.5	2,304	10,741	4.7	3,212	34.5
1984	10,848	452.7	2,388	10,531	4.4	3,732	39.3
1985	11,109	467.8	2,422	10,777	4.4	3,461	37.3
1986	11,083	492.8	2,467	11,018	4.5	3,531	38.9
1987	10,934	508.6	2,535	11,603	4.6	3,534	41.0
1988	11,370	538.3	2,462	11,836	4.8	3,565	42.2
1989	11,261	553.4	2,704	12,539	4.6	3,397	42.6
1990	11,332	560.9	2,521	12,046	4.8	3,453	41.6
1991	11,426	554.8	2,356	11,190	4.7	3,727	41.7
1992	11,303	554.1	2,396	11,441	4.8	3,575	40.9
1993	11,286	549.8	2,234	10,936	4.9	3,687	42.2
1994	11,192	565.8	2,453	11,501	4.8	3,828	44.0
1995	11,156	571.8	2,284	11,419	5.0	3,818	43.6
1996	11,341	580.6	2,417	12,484	5.2	3,444	43.0
				Average annual percentage change			
1970–96	0.3%	1.1%	0.5%	0.1%	-0.6%[g]	1.3%	1.4%
1986–96	0.2%	1.7%	-0.2%	1.3%	1.5%	-0.2%	1.0%

Source:
American Public Transit Association, *1998 Transit Fact Book*, Washington, DC, February 1998, pp. 69, 71, 78, 83. (Additional resources: http://www.apta.com)
Energy use - See Appendix A for Table 2.7.

[a]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 pasenger trips.

[c]Estimated for years 1970–76 based on an average trip length of 5.8 miles.

[d]Calculated as the ratio of passenger-miles to passenger trips.

[e]Large system-to-system variations exist within this category.

[f]Data are not available.

[g]Average annual percentage change is calculated for years 1977-96.

APPENDIX A

SOURCES

This appendix contains documentation of the estimation procedures used by ORNL. The reader can examine the methodology behind the estimates and form an opinion as to their utility.

The appendix is arranged by table number and subject heading. Only tables which contain ORNL estimations are documented in Appendix A; all other tables have sources listed at the bottom of the table. Since abbreviations are used throughout the appendix, a list of abbreviations is also included.

List of Abbreviations Used in Appendix A

AAMA	American Automobile Manufacturers Association
AAR	Association of American Railroads
APTA	American Public Transit Association
Amtrak	National Railroad Passenger Corporation
Btu	British thermal unit
DOC	Department of Commerce
DOE	Department of Energy
DOT	Department of Transportation
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
gvw	gross vehicle weight
lpg	liquefied petroleum gas
mpg	miles per gallon
NHTSA	National Highway Traffic Safety Administration
NPTS	Nationwide Personal Transportation Study
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
vmt	vehicle-miles traveled

Table 2.6
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1996

Most of the source data were given in gallons. It was converted to Btu by using the conversion factors in Appendix B.

Highway

Automobiles

Total gallons of fuel taken from DOT, FHWA, *Highway Statistics 1995*, Table VM-1. These were distributed as follows: 97.% gasoline, 1.0% gasohol, and 1.3% diesel. Percentages were derived from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1994*, August 1997, p. 46. Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Automobiles were assumed to use 25% of light vehicle natural gas use. Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996*, Washington, DC, December 1997, p.22.

Motorcycles

DOT, FHWA, *Highway Statistics 1996,* Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:

APTA, *1998 Transit Fact Book,* February 1998, Washington, DC, pp. 132–135. Non-diesel fossil fuel consumption was assumed to be used by motor buses.

Intercity:

Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997 Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School:

Gasoline and Diesel - Eno Transportation Foundation, *Transportation in America 1997,* Fifteenth Edition, 1996, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline.

Methanol - Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996,* Washington DC, December 1997, p. 22.

Trucks

Total:

Sum of light trucks and other trucks.

Light Trucks:

DOT, FHWA, *Highway Statistics 1996*, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.2% of fuel assumed to be gasoline, 3.3% diesel, 0.3% lpg; percentages were generated from the 1992 TIUS Public Use Tape. Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Light trucks were assumed to use 75% of light vehicle natural gas use.

Other Trucks:

DOT, FHWA, *Highway Statistics 1996*, Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These gallons were distributed as follows based on data from the 1992 TIUS Public Use Tape: 16.2% of fuel assumed to be gasoline, 83.3% diesel, and 0.5% lpg.

Off Highway

Diesel:

Data supplied by Marianne Mintz, Argonne National Laboratory, from the Public Use Data Base, *National Energy Accounts,* DOC, OBA-NEA-10, August 1988.

Gasoline:

DOT, FHWA, *Highway Statistics 1996,* Table MF-24. Agriculture and Construction totals.

Nonhighway

Air

General Aviation:

DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report Calendar Year 1996,* Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Domestic and International Air Carrier:

DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel use for international flights.

Water

Freight:

Total - DOE, EIA, *Fuel Oil and Kerosene Sales 1996*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Recreational Boating:

Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

Pipeline

The sum of natural gas, crude petroleum and petroleum product, and coal slurry and water.

Natural Gas:

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1996*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft^3. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., *End Use Energy Consumption DataBase: Transportation Sector*. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude petroleum and petroleum product:

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, TN, 1981. (Latest available data.)

Coal slurry and water:

W. F. Banks, Systems, Science and Software, *Energy Consumption in the Pipeline Industry*, LaJolla, CA, October 1977. (Latest available data.)

Rail

Total:

Sum of freight and passenger rail.

Freight:

AAR, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, p. 60.

Passenger:

Transit and Commuter - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, p. 102-104. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Intercity - Personal communication with Amtrak, Washington, DC. (1996 data were estimated using train-mile information.)

Table 2.8
Transportation Energy Consumption by Mode, 1970–96

Highway

Automobiles

Total gallons of fuel for automobiles was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996 annual edition. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

1970–80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980*, p. 10.

1981–82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981*, pp. 11, 13.

1983–84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983*, Jan., 1985, pp. 7, 9.

1985–87 - 98.5% gasoline, 1.5% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles 1985*, April 1987, pp. 25, 27.

1988–90 - 98.8% gasoline and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1988*, March 1990, p. 65.

1991–93 - 97.8% gasoline, 1.0% gasohol, and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1991*, December 1993, p. 46.

1994–96 - 97.7% gasoline, 1.0% gasohol, 1.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Household Vehicles Energy Consumption, 1994*, Washington, DC, August 1997, p. 46.

1993–96 - Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996*, Washington, DC, December 1997, p. 22.

1993–96 - Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Automobiles were assumed to use 25% of light vehicle natural gas use.

Motorcycles

Department of Transportation, Federal Highway Administration, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996 annual edition. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Sum of transit, intercity and school.

Transit:

APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 102–104, and annual.

Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988–92, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

Intercity:

1970–84 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985–96- Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School:

1970–84 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, and annual.

1985–86 - DOT, Research and Special Programs Administration, *National Transportation Statistics*, Figure 2, p. 5, and annual.

1987–96- Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline. (1996 data were estimated using vehicle travel information.)

Trucks

Light Trucks:

Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 annual edition. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970–87 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988–93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994–96 was distributed based on the 1992 TIUS: 96.4% gasoline; 3.3% diesel; 0.3% lpg. Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Light trucks were assumed to use 75% of light vehicle natural gas use.

Other Trucks:

Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970–87 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988–93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994–96 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg.

Total Highway

Sum of autos, motorcycles, buses, light trucks, and other trucks.

Nonhighway

Air

Sum of fuel use by General Aviation and Certificated Route Air Carrier.

General Aviation:

1970–74 - DOT, TSC, *National Transportation Statistics*, Cambridge, MA, 1981.

1975–85 - DOT, FAA, *FAA Aviation Forecasts*, Washington, DC, annual.

1985–96 - DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report, Calendar Year 1996*, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Certificated Route Air Carrier:

1970–81 - DOT, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, annual.

1982–96- DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel use for international flights.

Water

Sum of vessel bunkering fuel (i.e., freight) and fuel used by recreational boats.

Freight:

Total - DOE, EIA, *Fuel Oil and Kerosene Sales 1996*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering.(This may include some amounts of bunker fuels used for recreational purposes.)

Recreational Boating:

1970–84 - DOT, FHWA, *Highway Statistics*, Washington, DC, Table MF-24, annual.

1985–96 - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United*

States (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

Pipeline

The sum of natural gas, crude petroleum and petroleum product, and coal slurry and water.

Natural Gas:

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1996*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft^3. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., *End Use Energy Consumption DataBase: Transportation Sector*. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude petroleum and petroleum product:

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, Tennessee, 1981. (Latest available data.)

Coal slurry and water:

W. F. Banks, Systems, Science and Software, *Energy Consumption in the Pipeline Industry*, LaJolla, California, October 1977. (Latest available data.)

Rail

Total:

Sum of freight and passenger rail.

Freight:

AAR, *Railroad Facts*, 1997 Edition, Washington, DC, p. 60.

A–11

Passenger:

Transit and Commuter - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, p. 102–104, annual. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Intercity - Personal communication with Amtrak, Washington, DC. (1995 and 1996 data were estimated using train-mile information.)

Table 2.12
Passenger Travel and Energy Use in the United States, 1996

Highway

Automobiles

Number of Vehicles - DOT, FHWA, *Highway Statistics 1996*, Table VM-1.
Vmt - DOT, FHWA, *Highway Statistics 1996*, Table VM-1.
Pmt - Calculated by ORNL (load factor times vmt).
Load Factor - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.
Energy Use - Total gallons of fuel taken from DOT, FHWA, *Highway Statistics 1996*, Table VM-1. These were distributed as follows: 97.8% gasoline, 1.0% gasohol, and 1.2% diesel. Percentages were derived from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1991*, December 1993, p. 46. Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Automobiles were assumed to use 25% of light vehicle natural gas use. Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996* ,Washington, DC, December 1997, p. 22.

Personal Trucks

Number of Vehicles - Based on the 1992 TIUS, 73.9% of total 2-axle, 4-tire trucks and 15.5% of total other trucks were for personal use. Therefore, 73.9% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 15.5% of total other trucks were estimated to be for personal use.
Vmt - 68.8% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 7.1% of total vehicle miles traveled by other trucks were for personal use. The percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.
Pmt - Calculated by ORNL as vmt multiplied by load factor.
Load Factor - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.
Energy Use- Assuming that there is no difference in fuel economy (measured in miles per gallon) between personal-use trucks and non-personal use trucks, 66.0% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 3.5% of total other truck fuel consumption was for personal use. These percentages were derived by ORNL from the 1992 TIUS Public Use tape. Total truck energy use was the sum of light truck and other truck energy use.
Light Trucks: DOT, FHWA, *Highway Statistics 1996*, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.4% of fuel assumed to be gasoline, 3.3% diesel, 0.3% lpg; percentages were generated from the 1992 TIUS Micro Data File on CD. Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Light trucks were assumed to use 75% of light vehicle natural gas use.

Other Trucks: DOT, FHWA, *Highway Statistics 1996*, Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These values were distributed based on data from the 1992 TIUS Public Use Tape: 16.2% of fuel assumed to be gasoline, 83.3% diesel, and 0.5% lpg.

Motorcycles

Number of Vehicles and Vmt - DOT, FHWA, *Highway Statistics 1996*, Table VM-1.
Pmt - Calculated by ORNL as vmt multiplied by load factor.
Load Factor - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.
Energy Use - DOT, FHWA, *Highway Statistics 1996*, Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:

Number of Vehicles, Vmt, Pmt, and Energy Use - Motor bus only. APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 71, 78, 83, 102, 104.
Load Factor - Calculated by ORNL as pmt/vmt.

Intercity:

Number of Vehicles - Estimated by ORNL as 18% of commercial bus registrations, DOT, FHWA, *Highway Statistics 1996*, Table MV-10.
Pmt - Eno Transportation Foundation, *Transportation in America, 1997*, Fifteenth Edition, Lansdowne, VA, 1997, p. 47.
Vmt - Estimated using passenger travel and an average load factor of 23.2 persons/vehicle.
Load Factor -Estimated as 23.2 based on historical data.
Energy Use - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School:

Number of Vehicles - School and other nonrevenue as reported in DOT, FHWA, *Highway Statistics 1996*, Table MV-10.
Vmt, Pmt - National Safety Council, *Accident Facts*, 1997 Edition, Chicago, IL, pp. 94–95.
Load Factor - Calculated by ORNL as pmt/vmt.
Energy Use - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline. (1996 data were estimated using vehicle travel information.)

Nonhighway

Air

Large Certified Route Air Carriers:

Vmt, Pmt - DOT, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1996/1995, Washington, DC, p.2.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals for domestic only.

General Aviation:

Number of Vehicles, Vmt, Energy Use - DOT, FAA, *General Aviation Activity and Avionics, Survey: Calendar Year 1996*, pp. 1-7, 3-11, 5-3.

Pmt - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1997, p. 47.

Load Factor - Calculated by ORNL as pmt/vmt.

Recreational Boating

Number of Vehicles - U.S. Coast Guard, Office of Boating Safety, Washington, DC, March, 1997.

Energy Use - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

Rail

Intercity:

Number of Vehicles, Vmt and Pmt - AAR, *Railroad Facts*, 1997 Edition, Washington, DC, p. 78.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - Personal communication with Amtrak, Washington, DC. (1996 data estimated using train-mile information.)

Transit and Commuter:

Number of Vehicles, Vmt and Pmt - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 71, 78, 83.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 102-104. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Table 2.13
Intercity Freight Movement and Energy Use in the United States, 1996

Highway

Trucks

Vehicles - 0.3% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 24% of total other trucks were engaged in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS 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.

Vmt - 0.6% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 59.5% of total vehicle miles traveled by other trucks were used in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.

Ton Miles, Tons Shipped and Average Length of Haul - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1997, pp. 44, 46, 71.

Energy Intensity - Energy use divided by ton-miles.

Energy Use - 0.9% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 67.2% of total other truck fuel consumption were used in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.

Nonhighway

Waterborne Commerce

Vehicles - U.S. Department of the Army, Army Corps of Engineers, "Summary of U.S. Flag Passenger and Cargo Vessels, 1996," New Orleans, LA, 1998.

Ton Miles, Tons Shipped, and Average Length of Haul - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996, Part 5: National Summaries*, New Orleans, LA, 1997, pp. 1-6, 1-7.

Energy Intensity - Energy use divided by ton miles.

Energy Use - DOE, EIA, *Fuel Oil and Kerosene Sales 1996*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Domestic freight energy use was calculated as:

Distillate fuel - 77.5% domestic
Residual fuel - 9.3% domestic.

Percentages were derived from the DOC, U.S. Foreign Trade, *Bunker Fuels*, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988. This report was discontinued in 1989. No other source for these data has been located.

Pipeline

Natural Gas:

Tons shipped - DOE, EIA, *Natural Gas Annual 1996*, Washington, DC, 1997, Table 1. Total natural gas disposition divided by 44,870 ft^3/ton.

Energy use - The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1996*, 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 Oil and Petroleum Product:

Ton Miles and Tons Shipped - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1997 pp. 44, 46.

Energy Use - W. F. Banks, Systems, Science, and Software, Inc., *Energy Consumption in the Pipeline Industry*, LaJolla, CA, 1977.

Rail

Vehicles, Vmt, Ton Miles, Average Length of Haul - AAR, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, pp. 27, 34, 36, 50.

Tons shipped - AAR, *Analysis of Class I Railroads 1996*, 1997, p. 31.

Energy Use -AAR, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, p. 60.

Table 2.14
Energy Intensities of Passenger Modes, 1970–96

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each passenger mode using the following data sources:

Highway

Automobiles

Vmt - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 edition.

Pmt - vmt multiplied by the load factor.

Energy Use - Total gallons of fuel for automobiles was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996 annual edition. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

1970–80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980*, p. 10.

1981–82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981*, pp. 11, 13.

1983–84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983*, Jan., 1985, pp. 7, 9.

1985–87 - 98.5% gasoline, 1.5% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles 1985*, April 1987, pp. 25, 27.

1988–90 - 98.8% gasoline and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1988*, March 1990, p. 65.

1991–93 - 97.8% gasoline, 1.0% gasohol, and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1991*, December 1993, p. 46.

1994–96 - 97.7% gasoline, 1.0% gasohol, 1.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Household Vehicles Energy Consumption 1994*, Washington, DC, August 1997, p. 46.

1993–96 - Methanol use was estimated using data from DOE, EIA, Alternatives to *Traditional Transportation Fuels 1996*, Washington, DC, December 1997, p. 22.

1993–96 - Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Automobiles were assumed to use 25% of light vehicle natural gas use.

Light Trucks

Vmt - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 edition. Light trucks were defined as 2-axle, 4-tire trucks.

Energy Use - Light trucks were defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 annual edition. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970–87 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988–93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994–95 was distributed based on the 1992 TIUS: 96.2% gasoline; 3.3% diesel; 0.3% lpg; and 0.2% cng.

Buses

Transit:

Vmt, Pmt, Energy Use - APTA, 1998 *Transit Fact Book*, February 1998, Washington, DC, pp. 71, 78, 102–104, and annual.

Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988–94, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

Intercity:

Pmt - 1970–84 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985–95 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1997, p. 47.

Energy Use - 1970–84 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985–96 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, p. 56, and annual. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School:

Vmt - 1970–84 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, p. 175, and annual.

1985–87 - DOT, TSC, *National Transportation Statistics*, 1989, Figure 2, p. 7, and annual.

1988–95 - National Safety Council, *Accident Facts*, 1996 Edition , Chicago, IL, p. 95, and annual.

Energy Use - 1970–84 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, and annual.

1985–86 - DOT, TSC, *National Transportation Statistics*, Figure 2, p. 5, and annual.

1987–96 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, p. 56, and annual. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline. (1996 data were estimated using vehicle travel information.)

Nonhighway

Air

Certificated Air Carriers:

Pmt - DOT, Bureau of Transportation Statistics, *Air Carrier Traffic Statitistics Monthly*, December 1996/95, Washington, DC, p. 2.

Energy Use - 1970–81 - DOT, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, annual.

1982–96 - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals for domestic only.

General Aviation:

Pmt - Eno Transportation Foundation, *Transportation In America 1997*, Fifteenth Edition, Washington, DC, 1997, p.47.

Energy Use - 1970–74 - DOT, TSC, *National Transportation Statistics*, Cambridge, MA, 1981.

1975–85 - DOT, FAA, *FAA Aviation Forecasts*, Washington, DC, annual.

1985–96 - DOT, FAA, *General Aviation Activity and Avionics Survey: Calendar Year 1996*, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Rail

Passenger (Amtrak):

Pmt - 1971–83 - AAR, *Statistics of Class I Railroads*, Washington, DC, annual.

1984–88, 1995–96 - AAR, *Railroad Facts*, 1987 Edition, Washington, DC, December 1987, p. 78, and annual.

1989–94 - Personal communication with Amtrak.

Energy Use - Personal communication with Amtrak. (1995 and 1996 data were estimated using train-mile information.)

Transit:

Pmt and Energy Use - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 71, 102–104. Transit was defined as the sum of "heavy rail," "light rail,"and "other."

Table 2.15
Energy Intensities of Freight Modes, 1970–96

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each freight mode using the following data sources:

Highway

Heavy Single-Unit and Combination Trucks

Vmt - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 edition. Heavy single-unit and combination trucks were defined as the difference between total trucks and 2-axle, 4-tire trucks.

Energy Use - Heavy single-unit and combination trucks were defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 annual edition. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970–87 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988–93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994–96 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg.

Nonhighway

Water

Ton Miles - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996, Part 5: National Summaries*, New Orleans, LA, 1997, p. 1-6, and annual.

Energy Use - Calculated as the difference between total water freight energy use and foreign water freight energy use.

Total - DOE, EIA, *Fuel Oil and Kerosene Sales 1996*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering.(This may include some amounts of bunker fuels used for recreational purposes.)

Rail

Freight Car Miles, Ton Miles and Energy Use - AAR, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, pp. 27, 36, 60, and annual.

Table 5.4
Vehicle Stock and New Sales in the United States, 1996 Calendar Year

Highway

Automobiles

Stock - The number of vehicles in use by EPA size class were derived as follows: Market Shares by EPA size class for new car sales from 1970–75 were taken from the DOT, NHTSA, *Automotive Characteristics Historical DataBase*, Washington, DC. Market shares for the years 1976–90 were found in Linda S. Williams and Patricia S. Hu, *Highway Vehicle MPG and Market Shares Report: Model Year 1990*, ORNL-6672, April 1991, and Table 7 and the ORNL MPG and Market Shares Database, thereafter. These data were assumed to represent the number of cars registered in each size class for each year. These percentages were applied to the automobiles in operation for that year as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED) and summed to calculate the total mix. This method assumed that all vehicles, large and small, were scrapped at the same rate.

Sales - Domestic, import, and total sales were from AAMA, *Facts and Figures 1997* , p. 19. The domestic sales were distributed by size class according to the following percentages: Two seater, 0.3%; Minicompact, 0%; Subcompact, 13.5%; Compact 38.8%; Midsize, 29.4%; and Large, 18.0%. The import sales were distributed by size class according to the following percentages: Two-seater, 2.1%; Minicompact, 2.9%; Subcompact, 35.5%; Compact, 32.7%; Midsize, 25.3%; and Large, 1.5%. These percentages were derived from the ORNL MPG and Market Shares Database. Domestic-sponsored imports (captive imports) were included in the import figure only.

Business fleet autos - Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 1997*, Redondo Beach, CA, 1997.

Personal autos - Difference between total vehicle stock and business fleet autos.

See Glossary for definition of Automobile Size Classifications.

Motorcycles

Stock - DOT, FHWA, *Highway Statistics 1996*, Table VM-1, 1997.

Recreational Vehicles

Sales - *Ward's Automotive Yearbook 1997*, U.S. Recreation Vehicle Shipments by Type, "Total," p. 205.

Trucks

Stock - Vehicles in use by weight class were determined by applying the percentage in use by weight class as reported in DOC, Bureau of the Census, 1992 TIUS, (0–10,000 lbs, 93.3%; 10,001–19,500 lbs, 2.1%; 19,501–26,000 lbs, 1.2%; 26,001 lbs and over, 3.4%) to the total number of trucks in use as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED).

Sales - AAMA, *Facts and Figures 1997*, p. 20.

Business fleet trucks - Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 1997*, Redondo Beach, CA, 1997.

Personal trucks - Difference between total stock and business fleet trucks.

Table 7.13
Summary Statistics on Buses by Type, 1970–96

Number in Operation

***Transit buses*:**

American Public Transit Association, *1998 Transit Fact Book*, Washington, DC, February 1998, p. 83, and annual.

Intercity buses:

1970–80 - American Bus Association, *1984 Annual Report*, Washington, DC, and annual.

1985 - U.S. Department of Transportation, Transportation Systems Center, *National Transportation Statistics*, Cambridge, MA, August 1990, Figure 5, p. 8, and annual.

1990–96 - Estimated as 38% of commercial buses (less transit motor buses). Commercial bus total found in *Highway Statistics 1996*, Table MV-10, and annual.

***School buses*:**

U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, 1997, Table MV-10, p. II-6, and annual.

Vehicle-miles and Passenger-miles

Transit buses:

American Public Transit Association, *1998 Transit Fact Book*, Washington, DC, February 1998, pp. 71, 78, and annual.

***Intercity buses*:**

1970–80 - American Bus Association, *Annual Report,* Washington, DC, annual.

1985–95 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth edition, Lansdowne, VA, 1997, p. 47.

1990–96 vehicle travel - Estimated using passenger travel and an average load factor of 23.2.

School buses:

1970–80 - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1984*, Washington, DC, Table VM-1, p. 175, and annual.

1985 - U.S. Department of Transportation, Research and Special Programs Administration, *National Transportation Statistics,* 1989, Figure 2, p. 7, and annual.

1990–96 - National Safety Council, *Accident Facts*, 1997 Edition, Chicago, IL, pp. 94–95, and annual.

Energy Use

Transit buses:

American Public Transit Association, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 102–104. Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988–92, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

Intercity buses:

1970–80 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985–95 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth edition, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School buses:

1970–80 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, and annual.

1985–86 - DOT, Research and Special Programs Administration, *National Transportation Statistics*, Figure 2, p. 5, and annual.

1987–96- Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth edition, Lansdowne, VA, p. 56. For conversion purposes, fuel for school was assumed to be 60% diesel fuel and 40% gasoline. (1996 data were estimated using vehicle travel information.)

APPENDIX B
CONVERSIONS

A Note About Heating Values

The heat content of a fuel is the quantity of energy released by burning a unit amount of that fuel. However, this value is not absolute and can vary according to several factors. For example, empirical formulae for determining the heating value of liquid fuels depend on the fuels' American Petroleum Institute (API) gravity. The API gravity varies depending on the percent by weight of the chemical constituents and impurities in the fuel, both of which are affected by the combination of raw materials used to produce the fuel and by the type of manufacturing process. Temperature and climatic conditions are also factors.

Because of these variations, the heating values in Table B.1 may differ from values in other publications. The figures in this report are representative or average values, not absolute ones. The gross heating values used here agree with those used by the Energy Information Administration (EIA).

Heating values fall into two categories, gross and net. If the products of fuel combustion are cooled back to the initial fuel-air or fuel-oxidizer mixture temperature and the water formed during combustion is condensed, the energy released by the process is the higher (gross) heating value. If the products of combustion are cooled to the initial fuel-air temperature, but the water is considered to remain as a vapor, the energy released by the process is lower (net) heating value. Usually the difference between the gross and net heating values for fuels used in transportation is around 5 to 8 percent; however, it is important to be consistent in their use.

Table B.1
Approximate Heat Content for Various Fuels

Automotive gasoline		125,000 Btu/gal(gross) = 115,400 Btu/gal(net)
Diesel motor fuel		138,700 Btu/gal (gross) = 128,700 Btu/gal (net)
Methanol		64,600 Btu/gal (gross) = 56,560 Btu/gal (net)
Ethanol		84,600 Btu/gal (gross) = 75,670 Btu/gal (net)
Gasohol		120,900 Btu/gal (gross) = 112,417 Btu/gal (net)
Aviation gasoline		120,200 Btu/gal (gross) = 112,000 Btu/gal (net)
Propane		91,300 Btu/gal (gross) = 83,500 Btu/gal (net)
Butane		103,000 Btu/gal (gross) = 93,000 Btu/gal (net)
Jet fuel (naphtha)		127,500 Btu/gal (gross) = 118,700 Btu/gal (net)
Jet fuel (kerosene)		135,000 Btu/gal (gross) = 128,100 Btu/gal (net)
Lubricants		144,400 Btu/gal (gross) = 130,900 Btu/gal (net)
Waxes		131,800 Btu/gal (gross) = 120,200 Btu/gal (net)
Asphalt and road oil		158,000 Btu/gal (gross) = 157,700 Btu/gal (net)
Petroleum coke		143,400 Btu/gal (gross) = 168,300 Btu/gal (net)
Natural gas		
	Wet	1,109 Btu/ft^3
	Dry	1,027 Btu/ft^3
	Compressed	20,551 Btu/pound
		960 Btu/cubic foot
	Liquid	90,800 Btu/gal (gross) = 87,600 Btu/gal (net)
Crude petroleum		138,100 Btu/gal (gross) = 131,800 Btu/gal (net)
Fuel Oils		
	Residual	149,700 Btu/gal (gross) = 138,400 Btu/gal (net)
	Distillate	138,700 Btu/gal (gross) = 131,800 Btu/gal (net)
Coal		
	Anthracite - Consumption	21.711 x 10^6 Btu/short ton
	Bituminous and lignite - Consumption	21.012 x 10^6 Btu/short ton
	Production average	21.352 x 10^6 Btu/short ton
	Consumption average	21.015 x 10^6 Btu/short ton

Table B.2
Fuel Equivalents

1 million bbl crude oil/day	= 0.3650 billion bbl crude oil/year = 2.117 quadrillion Btu/year = 99.45 million short tons coal/year = 90.22 million metric tons coal/year = 2.061 trillion ft^3 natural gas/year = 2.233 exajoule/year
1 billion bbl crude oil/year	= 2.740 million bbl crude oil/day = 5.800 quadrillion Btu/year = 272.5 million short tons coal/year = 247.2 million metric tons coal/year = 5.648 trillion ft^3 natural gas/year = 6.119 exajoule/year
1 quadrillion Btu/year	= 0.4724 million bbl crude oil/day = 172.4 million bbl crude oil/year = 46.98 million short tons coal/year = 42.62 million metric tons coal/year = 973.7 billion ft^3 natural gas/year = 1.055×10^{-3} exajoule/year
1 billion short tons coal/year	= 0.9072 billion metric tons coal/year = 10.06 million bbl crude oil/day = 3.670 billion bbl crude oil/year = 21.29 quadrillion Btu/year = 20.73 trillion ft^3 natural gas/year = 22.46 exajoule/year
1 billion metric tons coal/year	= 1.102 billion short tons coal/year = 9.122 million bbl crude oi l/day = 3.330 billion bbl crude oil/year = 19.31 quadrillion btu/year = 18.80 trillion ft^3 natural gas/year = 20.37 exajoules/year
1 trillion ft^3 natural gas/year	= 0.4851 million bbl crude oil/day = 0.1771 billion bbl crude oil/year = 1.027 quadrillion Btu/year = 48.25 million short tons coal/year = 43.77 million metric tons coal/year = 1.083×10^{-3} exajoules/year
1 exajoule/year	= 0.4477 million bbl crude oil/day = 0.1634 billion bbl crude oil/year = 947.9 trillion Btu/year = 44.53 million short tons coal/year = 40.40 million metric tons coal/year = 0.9229 trillion ft^3 natural gas/year

Table B.3
Energy Unit Conversions

1 Btu	= 778.2 ft-lb	1 kWhr	= 3412 Btu[a]
	= 107.6 kg-m		= 2.655×10^{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.4
Distance and Velocity Conversions

1 in.	$= 83.33 \times 10^{-3}$ ft	1 ft	= 12.0 in.
	$= 27.78 \times 10^{-3}$ yd		= 0.33 yd
	$= 15.78 \times 10^{-6}$ mile		$= 189.4 \times 10^{-3}$ mile
	$= 25.40 \times 10^{-3}$ m		= 0.3048 m
	$= 0.2540 \times 10^{-6}$ km		$= 0.3048 \times 10^{-3}$ 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.5
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.6
Volume and Flow Rate Conversions[a]

1 U.S. gal	= 231 $in.^3$	1 liter	= 61.02 $in.^3$
	= 0.1337 ft^3		= 3.531×10^{-2} ft^3
	= 3.785 liters		= 0.2624 U.S. gal
	= 0.8321 imperial gal		= 0.2200 imperial gal
	= 0.0238 bbl		= 6.29×10^{-3} bbl
	= 0.003785 m^3		= 0.001 m^3
	A U.S. gallon of gasoline weighs 6.2 pounds		
1 imperial gal	= 277.4 $in.^3$	1 bbl	= 9702 $in.^3$
	= 0.1606 ft^3		= 5.615 ft^3
	= 4.545 liters		= 158.97 liters
	= 1.201 U.S. gal		= 42 U.S. gal
	= 0.0286 bbl		= 34.97 imperial gal
	= 0.004546 m^3		= 0.15897 m^3
1 U.S. gal/hr	= 3.209 ft^3/day		= 1171 ft^3/year
	= 90.84 liter/day		= 33157 liter/year
	= 19.97 imperial gal/day		= 7289 imperial gal/year
	= 0.5712 bbl/day		= 207.92 bbl/year
	For Imperial gallons, multiply above values by 1.201		
1 liter/hr	= 0.8474 ft^3/day		= 309.3 ft^3/year
	= 6.298 U.S. gal/day		= 2299 U.S. gal/year
	= 5.28 imperial gal/day		= 1927 imperial gal/year
	= 0.1510 bbl/day		= 55.10 bbl/year
1 bbl/hr	= 137.8 ft^3/year		= 49187 ft^3 year
	= 1008 U.S. gal/day		= 3.679×10^5 U.S. gal/year
	= 839.3 imperial gal/day		= 3.063×10^5 imperial gal/year
	= 3815 liter/day		= 1.393×10^6 liter/day

[a]The conversions for flow rates are identical to those for volume measures, if the time units are identical.

Table B.7
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.8
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.9
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

[a]To convert fuel efficiency from miles per gallon (mpg) to liters per hundred kilometers, divide mpg into 235.24.

Table B.10
SI Prefixes and Their Values

	Value	Prefix	Symbol
One million million millionth	10^{-18}	atto	a
One thousand million millionth	10^{-15}	femto	f
One million millionth	10^{-12}	pico	p
One thousand millionth	10^{-9}	nano	n
One millionth	10^{-6}	micro	μ
One thousandth	10^{-3}	milli	m
One hundredth	10^{-2}	centi	c
One tenth	10^{-1}	deci	
One	10^{0}		
Ten	10^{1}	deca	
One hundred	10^{2}	hecto	
One thousand	10^{3}	kilo	k
One million	10^{6}	mega	M
One billion[a]	10^{9}	giga	G
One trillion[a]	10^{12}	tera	T
One quadrillion[a]	10^{15}	peta	P
One quintillion[a]	10^{18}	exa	E

[a]Care should be exercised in the use of this nomenclature, especially in foreign correspondence, as it is either unknown or carries a different value in other countries. A "billion," for example, signifies a value of 10^{12} in most other countries.

Table B.11
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.12 and B.13). Table B.12 shows conversion factors for the Consumer Price Index inflation factors. Table B.13 shows conversion factors using the Gross National Product inflation factors.

Due to the size of the tables, the data in Tables B.12 and B.13 were changed to two decimal places starting with Edition 17. However, three decimal places were used to calculate all constant dollar values.

Table B.12
Consumer Price Inflation (CPI) Index

From	To																											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1970	1.00	1.04	1.08	1.14	1.27	1.39	1.47	1.56	1.68	1.87	2.12	2.34	2.49	2.57	2.68	2.77	2.82	2.93	3.05	3.19	3.37	3.51	3.61	3.72	3.82	3.93	4.04	4.13
1971	0.96	1.00	1.03	1.10	1.22	1.33	1.41	1.50	1.61	1.79	2.04	2.25	2.38	2.46	2.56	2.65	2.71	2.81	2.92	3.06	3.23	3.36	3.47	3.57	3.66	3.76	3.87	3.96
1972	0.93	0.97	1.00	1.06	1.18	1.29	1.36	1.45	1.56	1.74	1.97	2.17	2.31	2.38	2.48	2.57	2.62	2.72	2.83	2.96	3.12	3.26	3.35	3.45	3.54	3.64	3.75	3.84
1973	0.87	0.91	0.94	1.00	1.11	1.21	1.28	1.36	1.47	1.63	1.86	2.05	2.17	2.24	2.34	2.42	2.47	2.56	2.66	2.79	2.94	3.07	3.16	3.25	3.34	3.43	3.53	3.61
1974	0.79	0.82	0.85	0.90	1.00	1.09	1.15	1.23	1.32	1.47	1.67	1.84	1.96	2.02	2.11	2.18	2.22	2.31	2.40	2.51	2.65	2.76	2.85	2.93	3.01	3.09	3.18	3.26
1975	0.72	0.75	0.78	0.83	0.92	1.00	1.06	1.13	1.21	1.35	1.53	1.69	1.79	1.85	1.93	2.00	2.04	2.11	2.20	2.30	2.43	2.53	2.61	2.68	2.75	2.83	2.92	2.98
1976	0.68	0.71	0.74	0.78	0.87	0.95	1.00	1.07	1.15	1.28	1.45	1.60	1.70	1.75	1.82	1.89	1.93	2.00	2.08	2.18	2.30	2.39	2.47	2.54	2.60	2.68	2.76	2.82
1977	0.64	0.67	0.69	0.73	0.81	0.89	0.94	1.00	1.08	1.20	1.36	1.50	1.59	1.65	1.72	1.78	1.81	1.88	1.95	2.05	2.16	2.25	2.32	2.38	2.45	2.52	2.59	2.65
1978	0.60	0.62	0.64	0.68	0.76	0.83	0.87	0.93	1.00	1.11	1.27	1.40	1.48	1.53	1.59	1.65	1.68	1.74	1.81	1.90	2.00	2.09	2.15	2.21	2.27	2.34	2.40	2.46
1979	0.54	0.56	0.58	0.61	0.68	0.74	0.78	0.84	0.90	1.00	1.14	1.25	1.33	1.37	1.43	1.48	1.51	1.57	1.63	1.71	1.80	1.88	1.93	1.99	2.04	2.10	2.16	2.21
1980	0.47	0.49	0.51	0.54	0.60	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
1981	0.43	0.45	0.46	0.49	0.54	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
1982	0.40	0.42	0.43	0.46	0.51	0.56	0.59	0.63	0.68	0.75	0.85	0.94	1.00	1.03	1.08	1.11	1.14	1.18	1.23	1.28	1.35	1.41	1.45	1.50	1.54	1.58	1.63	1.66
1983	0.39	0.41	0.42	0.45	0.50	0.54	0.57	0.61	0.66	0.73	0.83	0.91	0.97	1.00	1.04	1.08	1.10	1.14	1.19	1.24	1.31	1.37	1.41	1.45	1.49	1.53	1.57	1.61
1984	0.37	0.39	0.40	0.43	0.48	0.52	0.55	0.58	0.63	0.70	0.79	0.88	0.93	0.96	1.00	1.04	1.06	1.09	1.14	1.19	1.26	1.31	1.35	1.39	1.43	1.47	1.51	1.55
1985	0.36	0.38	0.39	0.41	0.46	0.50	0.53	0.56	0.61	0.68	0.77	0.85	0.90	0.93	0.97	1.00	1.02	1.06	1.10	1.15	1.22	1.27	1.30	1.34	1.38	1.42	1.46	1.49
1986	0.35	0.37	0.38	0.41	0.45	0.49	0.52	0.55	0.60	0.66	0.75	0.83	0.88	0.91	0.95	0.98	1.00	1.04	1.08	1.13	1.19	1.24	1.28	1.32	1.35	1.39	1.43	1.46
1987	0.34	0.36	0.37	0.39	0.43	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
1988	0.33	0.34	0.35	0.38	0.42	0.46	0.48	0.51	0.55	0.61	0.70	0.77	0.82	0.84	0.88	0.91	0.93	0.96	1.00	1.05	1.11	1.15	1.19	1.22	1.25	1.29	1.33	1.36
1989	0.31	0.33	0.34	0.36	0.40	0.43	0.46	0.49	0.53	0.59	0.67	0.73	0.78	0.80	0.84	0.87	0.88	0.92	0.95	1.00	1.05	1.10	1.13	1.17	1.20	1.23	1.27	1.29
1990	0.30	0.31	0.32	0.34	0.38	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
1991	0.29	0.30	0.31	0.33	0.36	0.40	0.42	0.45	0.48	0.53	0.61	0.67	0.71	0.73	0.76	0.79	0.81	0.83	0.87	0.91	0.96	1.00	1.03	1.06	1.09	1.12	1.15	1.18
1992	0.28	0.29	0.30	0.32	0.35	0.38	0.41	0.43	0.47	0.52	0.59	0.65	0.69	0.71	0.74	0.77	0.78	0.81	0.84	0.88	0.93	0.97	1.00	1.03	1.06	1.09	1.12	1.14
1993	0.27	0.28	0.29	0.31	0.34	0.37	0.39	0.42	0.45	0.50	0.57	0.63	0.67	0.69	0.72	0.75	0.76	0.79	0.82	0.86	0.91	0.94	0.97	1.00	1.03	1.06	1.09	1.11
1994	0.26	0.27	0.28	0.30	0.33	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
1995	0.26	0.27	0.27	0.29	0.32	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
1996	0.25	0.26	0.27	0.28	0.31	0.34	0.36	0.39	0.42	0.46	0.53	0.58	0.62	0.64	0.66	0.69	0.70	0.72	0.75	0.79	0.83	0.87	0.89	0.92	0.94	0.97	1.00	1.02
1997	0.24	0.25	0.26	0.28	0.31	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

Source:
Personal contact with the Bureau of Labor Statistics.

Table B.13
Gross National Product (GNP) Implicit Price Deflator

From	To																											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1970	1.00	1.05	1.10	1.16	1.26	1.38	1.45	1.53	1.65	1.79	1.95	2.14	2.27	2.36	2.45	2.53	2.60	2.67	2.76	2.87	2.99	3.12	3.23	3.29	3.36	3.47	3.54	3.63
1971	0.95	1.00	1.04	1.10	1.20	1.31	1.38	1.46	1.57	1.70	1.86	2.04	2.16	2.24	2.33	2.41	2.48	2.54	2.63	2.72	2.84	2.97	3.07	3.13	3.19	3.30	3.37	3.45
1972	0.91	0.96	1.00	1.06	1.15	1.26	1.32	1.40	1.50	1.63	1.79	1.96	2.07	2.15	2.24	2.32	2.38	2.44	2.52	2.62	2.73	2.85	2.95	3.01	3.07	3.17	3.24	3.31
1973	0.86	0.91	0.95	1.00	1.09	1.19	1.25	1.32	1.42	1.54	1.69	1.85	1.96	2.03	2.12	2.19	2.24	2.30	2.38	2.47	2.58	2.69	2.79	2.84	2.90	3.00	3.06	3.13
1974	0.79	0.83	0.87	0.92	1.00	1.09	1.15	1.22	1.31	1.42	1.55	1.70	1.80	1.87	1.95	2.01	2.06	2.12	2.19	2.28	2.37	2.48	2.56	2.61	2.67	2.76	2.81	2.88
1975	0.73	0.76	0.80	0.84	0.92	1.00	1.05	1.11	1.20	1.30	1.42	1.55	1.65	1.71	1.78	1.84	1.89	1.94	2.01	2.08	2.17	2.27	2.34	2.39	2.44	2.52	2.57	2.63
1976	0.69	0.73	0.76	0.80	0.87	0.95	1.00	1.06	1.14	1.24	1.35	1.48	1.57	1.63	1.70	1.75	1.80	1.84	1.91	1.98	2.06	2.15	2.23	2.27	2.32	2.40	2.44	2.50
1977	0.65	0.69	0.71	0.76	0.82	0.90	0.95	1.00	1.07	1.17	1.27	1.40	1.48	1.54	1.60	1.65	1.70	1.74	1.80	1.87	1.95	2.03	2.11	2.15	2.19	2.26	2.31	2.37
1978	0.61	0.64	0.67	0.70	0.77	0.84	0.88	0.93	1.00	1.09	1.19	1.30	1.38	1.43	1.49	1.54	1.58	1.62	1.68	1.74	1.81	1.89	1.96	2.00	2.04	2.11	2.15	2.20
1979	0.56	0.59	0.61	0.65	0.70	0.77	0.81	0.86	0.92	1.00	1.09	1.20	1.27	1.32	1.37	1.42	1.45	1.49	1.54	1.60	1.67	1.74	1.80	1.84	1.88	1.94	1.98	2.03
1980	0.51	0.54	0.56	0.59	0.65	0.71	0.74	0.78	0.84	0.92	1.00	1.10	1.16	1.21	1.26	1.30	1.33	1.36	1.41	1.47	1.53	1.60	1.65	1.68	1.72	1.78	1.81	1.86
1981	0.47	0.49	0.51	0.54	0.59	0.64	0.68	0.72	0.77	0.84	0.91	1.00	1.06	1.10	1.15	1.18	1.21	1.25	1.29	1.34	1.40	1.46	1.51	1.54	1.57	1.62	1.66	1.70
1982	0.44	0.46	0.48	0.51	0.56	0.61	0.64	0.68	0.73	0.79	0.86	0.94	1.00	1.04	1.08	1.12	1.15	1.18	1.22	1.26	1.32	1.38	1.42	1.45	1.48	1.53	1.56	1.60
1983	0.42	0.45	0.46	0.49	0.53	0.58	0.61	0.65	0.70	0.76	0.83	0.91	0.96	1.00	1.04	1.08	1.10	1.13	1.17	1.22	1.27	1.32	1.37	1.40	1.42	1.47	1.50	1.54
1984	0.41	0.43	0.45	0.47	0.51	0.56	0.59	0.62	0.67	0.73	0.80	0.87	0.92	0.96	1.00	1.04	1.06	1.08	1.12	1.16	1.21	1.27	1.31	1.34	1.37	1.41	1.44	1.47
1985	0.40	0.42	0.43	0.46	0.50	0.54	0.57	0.61	0.65	0.71	0.77	0.85	0.90	0.93	0.94	1.00	1.03	1.05	1.09	1.13	1.18	1.23	1.28	1.30	1.33	1.37	1.40	1.43
1986	0.39	0.40	0.42	0.45	0.49	0.53	0.56	0.59	0.63	0.69	0.75	0.82	0.87	0.91	0.94	0.97	1.00	1.03	1.06	1.10	1.15	1.20	1.24	1.27	1.29	1.34	1.36	1.40
1987	0.38	0.40	0.41	0.44	0.47	0.52	0.54	0.58	0.62	0.67	0.73	0.80	0.85	0.89	0.92	0.95	0.98	1.00	1.04	1.08	1.12	1.17	1.21	1.24	1.26	1.30	1.33	1.36
1988	0.36	0.38	0.40	0.42	0.46	0.50	0.53	0.56	0.60	0.65	0.71	0.77	0.82	0.85	0.89	0.92	0.94	0.97	1.00	1.04	1.08	1.13	1.17	1.19	1.22	1.26	1.28	1.31
1989	0.35	0.37	0.38	0.40	0.44	0.48	0.51	0.54	0.58	0.62	0.68	0.75	0.79	0.82	0.86	0.88	0.91	0.93	0.96	1.00	1.04	1.09	1.13	1.15	1.17	1.21	1.24	1.27
1990	0.34	0.35	0.37	0.39	0.42	0.46	0.49	0.51	0.55	0.60	0.66	0.72	0.76	0.79	0.83	0.85	0.87	0.89	0.93	0.96	1.00	1.05	1.08	1.10	1.13	1.16	1.19	1.22
1991	0.32	0.34	0.35	0.37	0.40	0.44	0.47	0.49	0.53	0.57	0.63	0.69	0.73	0.76	0.79	0.81	0.83	0.86	0.89	0.92	0.96	1.00	1.04	1.06	1.08	1.11	1.14	1.16
1992	0.31	0.33	0.34	0.36	0.39	0.43	0.45	0.48	0.51	0.55	0.61	0.66	0.70	0.73	0.76	0.78	0.81	0.83	0.86	0.89	0.92	0.97	1.00	1.02	1.04	1.08	1.10	1.12
1993	0.30	0.32	0.33	0.35	0.38	0.42	0.44	0.47	0.50	0.54	0.59	0.65	0.69	0.72	0.75	0.77	0.79	0.81	0.84	0.87	0.91	0.95	0.98	1.00	1.02	1.05	1.08	1.10
1994	0.30	0.31	0.33	0.35	0.38	0.41	0.43	0.46	0.49	0.53	0.58	0.64	0.68	0.70	0.73	0.75	0.77	0.79	0.82	0.85	0.89	0.93	0.96	0.98	1.00	1.03	1.05	1.08
1995	0.29	0.30	0.32	0.33	0.36	0.40	0.42	0.44	0.47	0.52	0.56	0.62	0.65	0.68	0.71	0.73	0.75	0.77	0.80	0.83	0.86	0.90	0.93	0.95	0.97	1.00	1.02	1.05
1996	0.28	0.30	0.31	0.33	0.36	0.39	0.41	0.43	0.46	0.51	0.55	0.60	0.64	0.67	0.69	0.71	0.73	0.75	0.78	0.81	0.84	0.88	0.91	0.93	0.95	0.98	1.00	1.02
1997	0.28	0.29	0.30	0.32	0.35	0.38	0.40	0.42	0.45	0.49	0.54	0.59	0.63	0.65	0.68	0.70	0.72	0.74	0.76	0.79	0.82	0.86	0.89	0.91	0.93	0.96	0.98	1.00

Source:
U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Washington, DC, monthly.

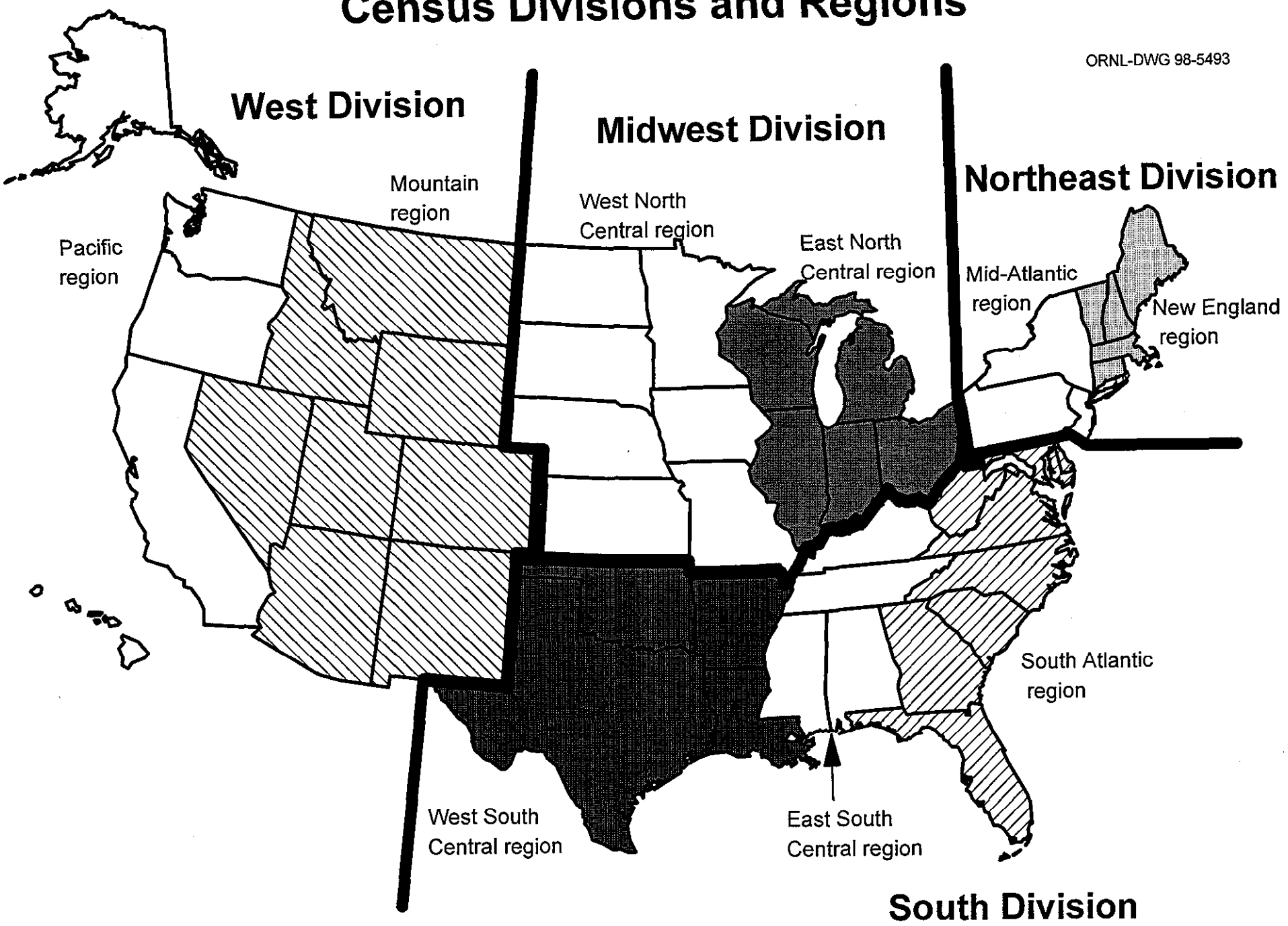
APPENDIX C

CENSUS DIVISIONS AND REGIONS

Table C.1
Census Divisions and Regions

Northeast Division			
Mid-Atlantic region		New England region	
New Jersey	Pennsylvania	Connecticut	New Hampshire
New York		Maine	Rhode Island
		Massachusetts	Vermont
South Division			
West South Central region	East South Central region	South Atlantic region	
Arkansas	Alabama	Delaware	South Carolina
Louisiana	Kentucky	Florida	Virginia
Oklahoma	Mississippi	Georgia	Washington, DC
Texas	Tennessee	Maryland	West Virginia
		North Carolina	
West Division			
Pacific region		Mountain region	
Alaska	Oregon	Arizona	Nevada
California	Washington	Colorado	New Mexico
Hawaii		Idaho	Utah
		Montana	Wyoming
Midwest Division			
West North Central region		East North Central region	
Iowa	Nebraska	Illinois	Ohio
Kansas	North Dakota	Indiana	Wisconsin
Minnesota	South Dakota	Michigan	
Missouri			

Census Divisions and Regions



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*.

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 - 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. Includes motor bus and trolley coach.

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 normal 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*.

Clean Fuel Vehicle - Vehicle meeting the clean fuel vehicle exhaust emissions standards with no restriction on fuel type.

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 - See *Residential and Commercial sector.*

Commuter railroad - See *Rail.*

Compact car - See *Automobile size classifications.*

Constant dollars - A series of figures is expressed in constant dollars when the effect of change 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".

Disposable personal income - See *Income*.

Distillate fuel oil - The lighter fuel oils distilled off during the refining process. Included are products known as ASTM grades numbers 1 and 2 heating oils, diesel fuels, and number 4 fuel oil. The major uses of distillate fuel oils include heating, fuel for on-and off-highway diesel engines, and railroad diesel fuel.

Domestic air operator - See *Air carrier*.

Domestic water transportation - See *Internal water transportation*.

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), blended with gasoline (E85), or as a gaoline octane enhancer and oxygenate (10% concentration).

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 (GSA), 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. 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 vehicle plus the maximum anticipated load weight.

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 - A term relating the potential capacity of a system relative to its actual performance. Is often calculated as total passenger miles divided by total vehicle miles.

Low-emission vehicle - A clean fuel vehicle meeting the low-emission vehicle standards.

Medium truck - See *Truck size classifications*.

Methanol (CH_3OH) - A colorless poisonous 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.

Naphtha-type jet fuel - See *Jet fuel*.

National income - See *Income*.

Nationwide Personal Transportation Study (NPTS) - A nationwide home interview 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 and 1990 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 Plant Liquids - Products obtained from processing natural gas at natural gas processing plants, including natural gasoline plants, cycling plants, and fractionators. Products obtained include ethane, liquefied petroleum gases, (propanes, butane, propane-butane mixtures, and ethane-propane mixtures), isopentane, natural gasoline, unfractionated streams, plant condensate, and other minor quantities of finished products, such as motor gasoline, special naphthas, jet fuel, kerosene, and distillate fuel oil.

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 and Commercial sector - Consists of housing units, non-manufacturing business establishments (e.g., wholesale and retail businesses), health and educational institutions, and government offices.

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. The 1992 data have not yet been released.

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 - A clean fuel vehicle meeting the more stringent Ultra-low emission standards.

Urban - Usually refers to areas with population of 5,000 or greater.

Variable operating cost - See *Operating cost*.

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 - A clean fuel vehicle meeting even more stringent zero-emission vehicle standards.