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Stacy C. Davis
Oak Ridge National Laboratory

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Stacy C. Davis
Oak Ridge National Laboratory
P. 0. Box 2008
Building 3 156, MS-6073
Oak Ridge, Tennessee 3783 l-6073

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

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

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

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

FOREWORD

This edition has many new tables and graphs. I would like to draw your attention to several of them.

First, Table 1.1 and Figure 1.1 show an estimate of the total potential for fossil fuels. All the values are expressed in trillion of barrels of oil equivalent (tboe). The table shows that the world has consumed 0.8 1 tboe of conventional oil since oil was first discovered. The remaining conventional oil is more than double this amount. The potential for other fossil fuels are enormous. Remaining unconventional oil is about eight times that for conventional oil. The amount of conventional and unconventional natural gas is about four time that for conventional oil. The potential for coal and methane hydrates is even higher by a large amount. There is no shortage of fossil fuels, but the U.S. may need fuels that are renewable, domestic and low in carbon.

Second, in Chapter 6, the scrappage functions have been up-dated.

Third, safety information is provided in Tables 7.23 through 7.25. It is seen that occupant fatalities are down since 1975 and that single vehicle crashes are responsible for about 60 percent as many deaths as multiple vehicle crashes.

Fourth, the heavy truck information in Chapter 8 has been enhanced with the addition of 1997 data from the Vehicle Inventory and Use Survey.

I hope you find this edition useful.

Philip D. Patterson

ACKNOWLEDGMENTS

I would like to express my gratitude to the many individuals who assisted in the preparation of this document. First, I would like to thank Phil Patterson and the staff of the Office of Transportation Technologies (OTT) for their continued support of the Transportation Energy *Data Book* project. I would also like to thank Patricia Hu of Oak Ridge National Laboratory (ORNL) for her dedicated leadership of this project. This document benefits from the criticism and careful review of Phil Patterson, OTT, John Maples, Trancon, Inc., and Alicia Birky of the National Renewable Energy Laboratory. I would also like to thank Robert Gibson, University of Tennessee, for the emission standard tables; Jamie Payne, ORNL, who designed the cover; Sherry Campbell Gambrell, ORNL, who prepared the title index; and Bob Boundy, Q Systems, who assisted in a variety of ways. Finally, this book would not have been possible without the dedication of Debbie Bain, ORNL, who masterfully prepared the manuscript.

ABSTRACT

The *Transportation Energy Data Book: Edition* 20 is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Transportation Technologies in the Department of Energy (DOE). Designed for use as a desk-top reference, the data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use. The purpose of this document is to present relevant statistical data in the form of tables and graphs. The latest editions of the Data Book are available to a larger audience via the Internet (www-cta.ornl.gov/data/tedb.htm).

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

INTRODUCTION

In January 1976, the Transportation Energy Conservation (TEC) Division of the Energy Research and Development Administration contracted with Oak Ridge National Laboratory (ORNL) to prepare a Transportation Energy Conservation Data Book to be used by TEC staff in their evaluation of current and proposed conservation strategies. The major purposes of the data book were to draw together, under one cover, transportation data from diverse sources, to resolve data conflicts and inconsistencies, and to produce a comprehensive document. The first edition of the TEC Data Book was published in October 1976. With the passage of the Department of Energy (DOE) Organization Act, the work being conducted by the former Transportation Energy Conservation Division fell under the purview of the DOE's Office of Transportation Programs (now the Office of Transportation Technologies). DOE, through the Office of Transportation Technologies, has supported the compilation of Editions 3 through 20.

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 20 updates much of the same type of data that is found in previous editions.

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

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

Chapter 1
Petroleum

Summary Statistics from Tables/Figures in this Chapter

Source			
Table 1.2	World Oil Production, 1998		
	U.S. Oil Production (million barrels per day)		6.2
	U.S. Share		9.3%
Table 1.3	World Oil Consumption, 1997		
	U.S. Oil Consumption (million barrels per day)		*18.6*
	U.S. Share		*25.5%*
Figure 1.2	Refinery yield, 1999	OECD Europe	North America
	Gasoline	*21.3%*	*40.8%*
	Diesel fuel	*34.9%*	*22.0%*
	Residual fuel	*17.0%*	**7.6%**
	Kerosene	**6.7%**	**8.9%**
	Other	*20.1%*	**20.7%**
Table 1.9	U.S. transportation oil use as a percent of U.S. oil production, 1999		**146%**
Table 1.9	Net imports as a percentage of U.S. oil consumption, 1999		**50%**
Table 1.10	Transportation share of oil consumption, 1999		**67%**

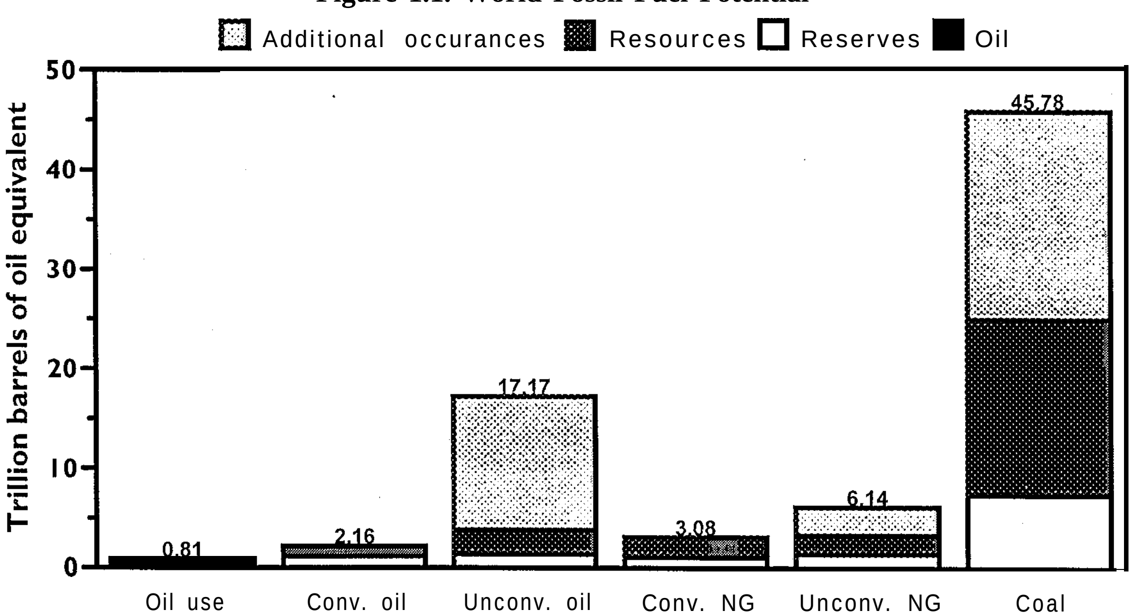
Although the world has consumed about one-third of estimated conventional oil resources, the total fossil fuel potential is huge. Methane hydrates-u potential source of natural gas-are not shown in the graph below, but constitute the largest resource at 137.5 *trillion barrels of oil equivalent.*

Table 1.1
World Fossil Fuel Potential
(trillion barrels of oil equivalent)

	Oil	Reserves	Resources	Additional occurrences
Oil				
Use to Date	0.81			
Conventional		1.10	1.06	0.00
Unconventional		1.34	2.46	13.37
Natural Gas				
Conventional		1.03	2.05	0.00
Unconventional		1.41	1.89	2.84
Methane hydrates		0.00	0.00	137.50
Coal		7.35	17.57	20.86

Source:
H.H. Rogner, "An Assessment of World Hydrocarbon Resources," *Annual Review of Energy and Environment, 1997,* p. *249.*

Figure 1.1. World Fossil Fuel Potential



Source:
See Table 1.1.

Table 1.2
World Crude Oil Production, 1960-98[a]
(million barrels per day)

Year	United States	U.S. Share	Total OPEC”	OPEC Share	OPEC +[c]	OPEC +[c] Share	Total Non-OPEC	Persian Gulf nations[d]	World
1960	7.04	33.5%	8.70	41.4%	12.25	58.3%	12.29	5.27	20.99
1965	7.80	25.7%	14.35	47.3%	19.83	65.4%	15.98	8.37	30.33
1970	9.64	21.0%	23.30	50.8%	31.16	67.9%	22.59	13.39	45.89
1971	9.46	19.5%	25.21	52.0%	33.58	69.2%	23.31	15.77	48.52
1972	9.44	18.5%	26.89	52.6%	35.69	69.8%	24.25	17.54	51.14
1973	9.21	16.5%	30.63	55.0%	39.82	71.5%	25.05	20.67	55.68
1974	8.77	15.7%	30.35	54.5%	40.24	72.2%	25.37	21.28	55.72
1975	8.37	15.8%	26.77	50.7%	37.56	71.1%	26.06	18.93	52.83
1976	8.13	14.2%	30.33	52.9%	41.87	73.0%	27.01	21.51	57.34
1977	8.24	13.8%	30.89	51.7%	43.09	72.2%	28.82	21.73	59.71
1978	8.71	14.5%	29.46	49.0%	42.46	70.6%	30.70	20.61	60.16
1979	8.55	13.6%	30.58	48.8%	44.12	70.4%	32.09	21.07	62.67
1980	8.60	14.4%	26.61	44.6%	41.07	68.9%	32.99	17.96	59.60
1981	8.57	15.3%	22.48	40.1%	37.46	66.8%	33.60	15.25	56.08
1982	8.65	16.2%	18.78	35.1%	34.28	64.1%	34.70	12.16	53.48
1983	8.69	16.3%	17.50	32.9%	33.15	62.2%	35.76	11.08	53.26
1984	8.88	16.3%	17.44	32.0%	33.19	60.9%	37.05	10.78	54.49
1985	8.97	16.6%	16.18	30.0%	31.81	58.9%	37.80	9.63	53.98
1986	8.68	15.4%	18.28	32.5%	34.05	60.6%	37.95	11.70	56.23
1987	8.35	14.7%	18.52	32.7%	34.72	61.3%	38.15	12.10	56.67
1988	8.14	13.9%	20.32	34.6%	36.66	62.4%	38.42	13.46	58.74
1989	7.61	12.7%	22.07	36.9%	38.50	64.3%	37.79	14.84	59.86
1990	7.36	12.2%	23.20	38.3%	39.12	64.6%	37.37	15.28	60.57
1991	7.42	12.3%	23.27	38.6%	38.53	64.0%	36.94	14.74	60.21
1992	7.17	11.9%	24.40	40.5%	37.67	62.6%	35.81	15.97	60.21
1993	6.85	11.4%	25.12	41.7%	37.65	62.5%	35.12	16.71	60.24
1994	6.66	10.9%	25.51	41.8%	37.67	61.8%	35.48	16.96	60.99
1995	6.56	10.5%	26.00	41.7%	38.24	61.4%	36.33	17.21	62.33
1996	6.46	10.1%	26.76	41.8%	39.45	61.6%	37.29	17.37	64.05
1997	6.45	9.7%	28.36	42.8%	41.31	62.3%	37.96	18.50	66.32
1998	6.24	9.3%	28.76	43.0%	41.69	62.3%	38.11	19.33	66.87
				Average annual percentage change					
1960-98	-0.3%		3.2%		3.3%		3.0%	3.5%	3.1%
1970-98	-1.5%		0.8%		1.0%		1.9%	1.3%	1.4%
1988-98	-2.6%		3.5%		1.3%		-0.1%	3.7%	1.3%

Source:

U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 1998,* Washington, DC, July 1999, Table 11.4.

“Includes lease condensate. Excludes natural gas plant liquids.

“Organization of Petroleum Exporting Countries. See Glossary for membership.

“OPEC includes all OPEC nations plus Russia, Mexico, Norway and Oman.

[d]See Glossary for Persian Gulf nations.

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

Table 1.3
World Oil Consumption, 1960-97
(million barrels per day)

Year	United States	U.S. Share	Total OECD[a]	Total Non-OECD	World
1960	9.80	45.9%	15.78	5.56	21.34
1965	11.51	37.0%	22.81	8.33	31.14
1970	14.70	31.4%	34.49	12.32	46.81
1971	15.21	30.8%	36.07	13.35	49.42
1972	16.37	30.8%	38.74	14.35	53.09
1973	17.31	30.2%	41.53	15.71	57.24
1974	16.65	29.4%	40.12	16.56	56.68
1975	16.32	29.0%	38.82	17.38	56.20
1976	17.46	29.3%	41.39	18.28	59.67
1977	18.43	29.8%	42.43	19.40	61.83
1978	18.85	29.4%	43.62	20.54	64.16
1979	18.51	28.4%	44.01	21.21	65.22
1980	17.06	27.0%	41.41	21.66	63.07
1981	16.06	26.4%	39.14	21.76	60.90
1982	15.30	25.7%	37.45	22.05	59.50
1983	15.23	25.9%	36.59	22.15	58.74
1984	15.73	26.3%	37.43	22.41	59.84
1985	15.73	26.2%	37.23	22.87	60.10
1986	16.28	26.4%	38.28	23.48	61.76
1987	16.67	26.5%	38.96	24.04	63.00
1988	17.28	26.7%	40.24	24.58	64.82
1989	17.33	26.3%	40.88	25.04	65.92
1990	16.99	25.8%	40.92	25.06	65.98
1991	16.71	25.1%	41.40	25.17	66.57
1992	17.03	25.5%	42.41	24.33	66.74
1993	17.24	25.7%	42.98	24.01	66.99
1994	17.72	25.9%	44.17	24.13	68.30
1995	17.72	25.4%	44.95	24.94	69.89
1996	18.31	25.7%	46.07	25.25	71.32
1997	18.62	25.5%	46.67	26.34	73.01
			Average annual percentage change		
1960-97	1.7%		3.0%	4.3%	3.4%
1970-97	0.9%		1.1%	2.9%	1.7%
1987-97	1.1%		1.8%	0.9%	1.5%

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 1998*, Washington, DC, July 1999, Table 11.9.

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

The United States has increased its petroleum stocks by 55% from 1973 to 1984; there has been no significant change in the stocks since 1984. Petroleum demand, however, has increased 87% in that same time period (see Table 1.3). The Strategic Petroleum Reserve accountedfor 35% of total U.S. stocks at the end of 1998.

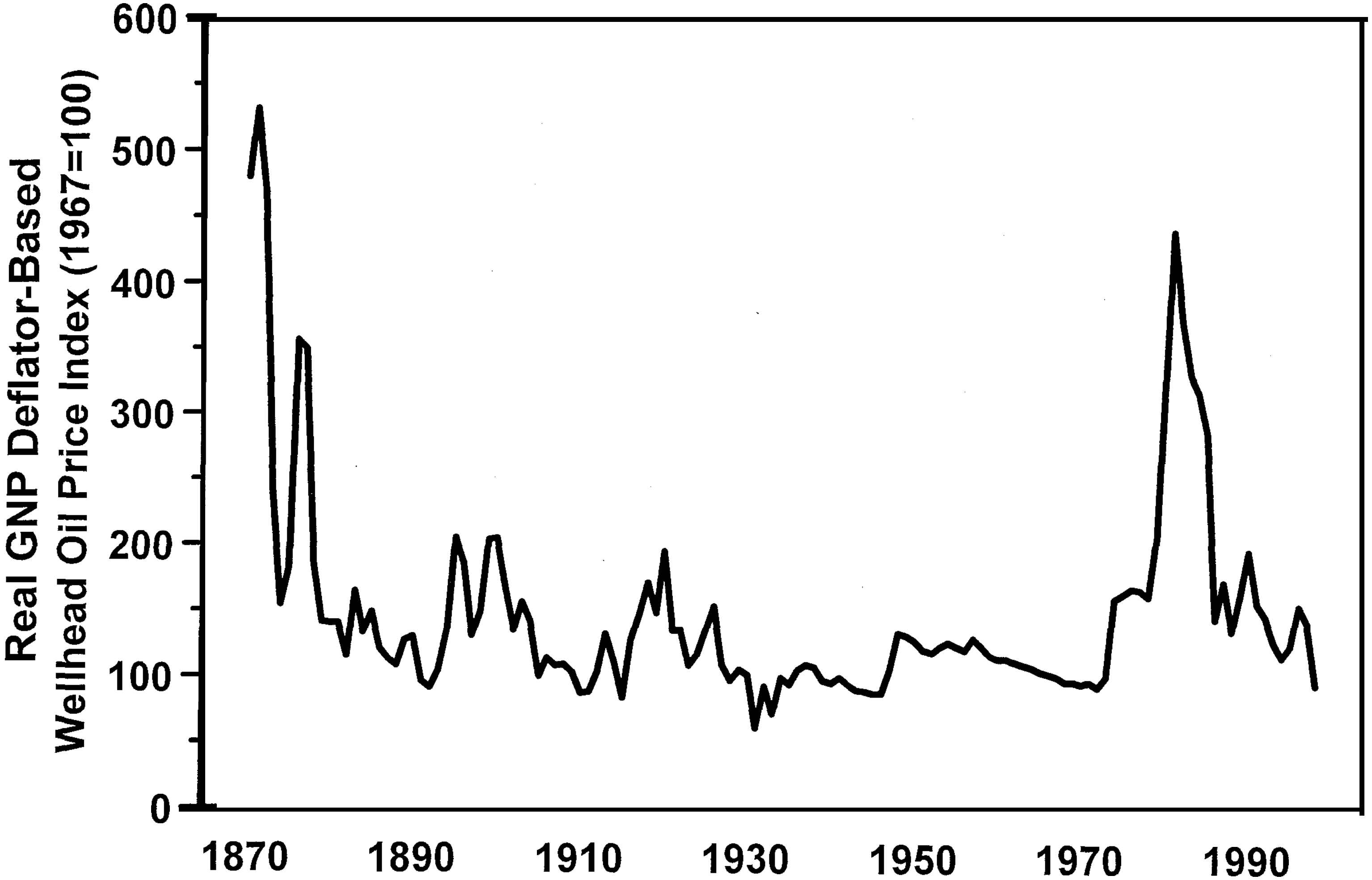
Table 1.4
Petroleum Stocks in OECD Countries, End of Year 1973-98”
(million barrels)

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	152 143	156 165	434 380	1,070	140 174	303 375	e e	1,008	67	2,588
		187										
1975 1980	225 243	319	170	168	564	1,464	164	495	108	1,392	72	2,903 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		116	538	560		71	3,440
1989	138	271	164	118	442	1,118 1,133	114	577	580	1,597 1,581	71	3,476
1990	140	265	172	112	474	1,163	121	590	586	1,621	73	3,568
1991	153 146	288 310	160 174	119 113	461 476	1,181	119 107	606 603	569 575	1,617	65 67	3,588
1992						1,219				1,592		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
				107	499		109	630	592		71	
1995 1996	159 158	301 300	162 152	108	538	1,228 1,256	103	651	566	1,563 1,507	74	3,601 3,591
1997	164	298	147	105	542	1,256	115	685	563	1,560	74	3,689
1998	161	321	153	108	561	1,304	118	649	571	1,647	66	3,784
						Average annual percentage change						
1973–98	-0.9%	2.3%	0.0%	-1.5%	1.6%	0.8%	-0.7%	3.1%	e	2.0%	-0.1%	1.5%
1988-98	1.4%	1.9%	-0.1%	-0.4%	2.3%	1.6%	0.2%	1.9%	0.2%	0.3%	-0.7%	1.0%

Source:
Country stocks - U.S. Department of Energy, Energy Information Administration, *International Petroleum Statistics Report*, Washington, DC, January 2000, Table 4.5.
U.S. Strategic Petroleum Reserve - U.S. Department of Energy, Energy Information Administration, *Annual Energy Review*, 1998, Washington, DC, July 1999, Table 5.15.

[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 199 1, 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.

Figure 1.2. Crude Oil Prices, 1870-98



Source:
Santini, Danilo J., "An Assessment of Oil Supply and Its Implications for Future Prices," *Nonrenewable Resources*, Vol. 7, No. 2, 1998, pp. 101-121, and 1994-98 data update.

The share ofpetroleum imported to the U.S. can be calculated using total imports or net imports. Net imports, which is the preferred data, rose to 50% of U.S. petroleum consumption for the first time in 1998 (see Table 1.9), while total imports reached 50% for the first time in 1993. OPEC share of net imports has been around 50-60% for the last ten years.

Table 1.5
U.S. Petroleum Net Imports by World Region of Origin, 1960–98
(thousand barrels per day)

Year	Net imports	Total OPEC[a]	OPEC share	Persian Gulf nations[b]	Persian Gulf share
1960	1,613	1,311	81.3%	c	c
1965	2,281	1,475	64.7%	c	c
1970	3,161	1,343	42.5%	c	c
1971	3,701	1,671	45.2%	c	c
1972	4,519	2,061	45.6%	c	c
1973	6,025	2,991	49.6%	c	c
1974	5,892	3,277	55.6%	c	c
1975	5,846	3,599	61.6%	c	c
1976	7,090	5,063	71.4%	c	c
1977	8,565	6,190	72.3%	c	c
1978	8,002	5,747	71.8%	c	c
1979	7,985	5,633	70.5%	c	c
1980	6,365	4,293	67.5%	c	c
1981	5,401	3,315	61.4%	1,215	22.5%
1982	4,298	2,136	49.7%	692	16.1%
1983	4,312	1,843	42.7%	439	10.2%
1984	4,715	2,037	43.2%	502	10.6%
1985	4,286	1,821	42.5%	309	7.2%
1986	5,439	2,828	52.0%	909	16.7%
1987	5,914	3,055	51.7%	1,074	18.2%
1988	6,587	3,513	53.3%	1,529	23.2%
1989	7,202	4,124	57.3%	1,858	25.8%
1990	7,161	4,285	59.8%	1,962	27.4%
1991	6,626	4,065	61.3%	1,833	27.7%
1992	6,938	4,071	58.7%	1,773	25.6%
1993	7,618	4,253	55.8%	1,774	23.3%
1994	8,054	4,233	52.6%	1,723	21.4%
1995	7,886	3,980	50.5%	1,563	19.8%
1996	8,498	4,193	49.3%	1,596	18.8%
1997	9,158	4,542	49.6%	1,747	19.1%
1998	9,452	4,789	50.7%	2,091	22.1%
		Average annual percentage change			
1960-98	4.8%	3.5%		c	
1970-98	4.0%	4.6%		c	
1988-98	3.7%	3.1%		3.2%	

Source:
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review* 1998, Washington, DC, July 1999, Table 5.7.

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

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

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

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

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

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

[3] Greene, D.L., and P. Leiby, *The Social Costs to the U.S. of Monopolization of the World Oil Market,* 1972- 199 1, ORNL-6744, Oak Ridge National Laboratory, Oak Ridge, TN, March 1993.

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

[5] Kaufmann, W.W., and J.D. Steinbruner, *Decisions for Defense: Prospects for a New Orcler,* The Brookings Institution, Washington, DC, 199 1.

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

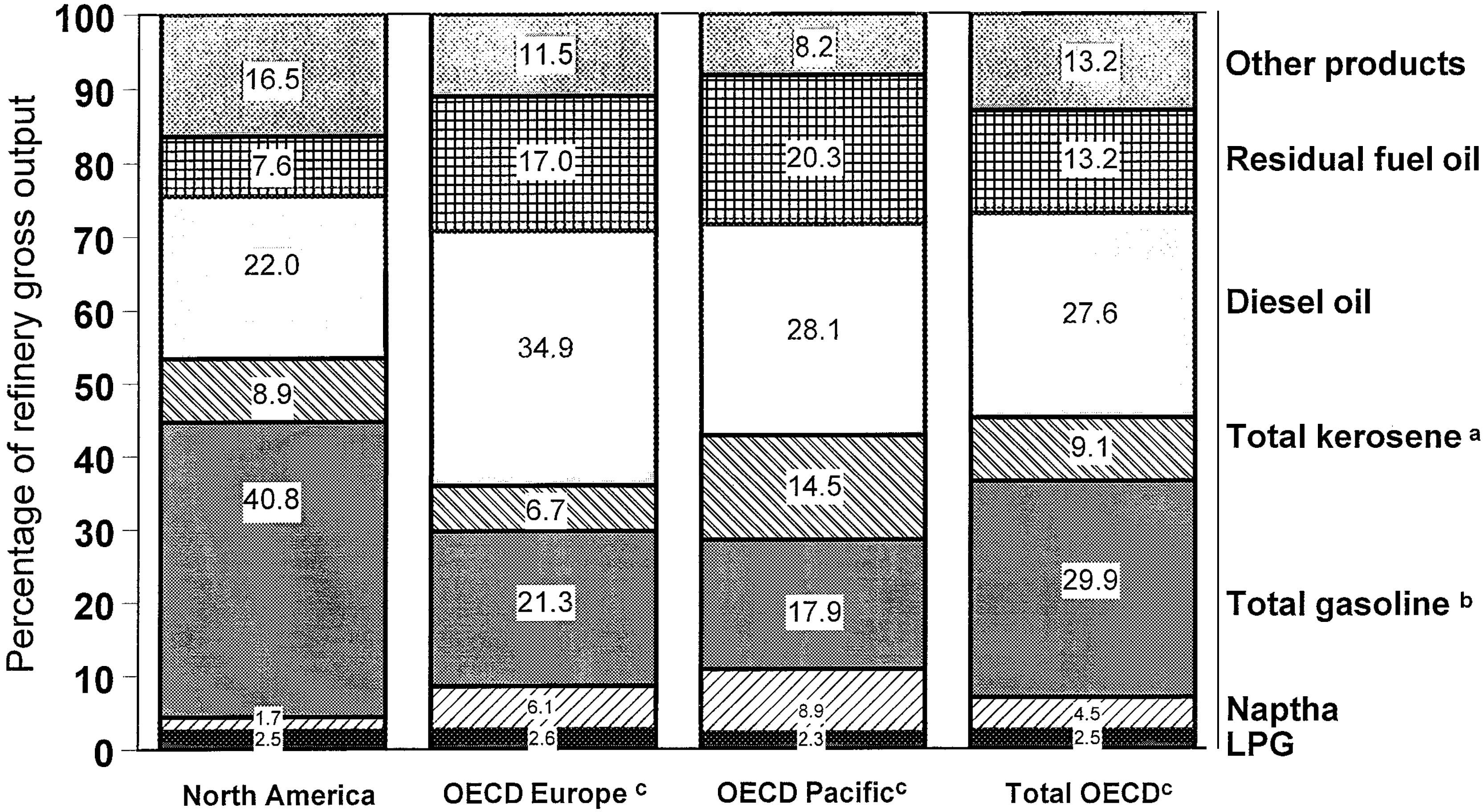
Source:
Hu, P.S., “Estimates of 1996 U.S. Military Expenditures on Defending Oil Supplies from the Middle East: A Literature Review,” Oak Ridge National Laboratory, Oak Ridge, TN, March 1996.

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

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

“Annual cost to defend all U.S. interests in the Persian Gulf.

Figure 1.3. Refinery Gross Output by World Region, 1999



Source:
International Energy Agency, *Monthly* Oil *Survey*, January 2000, Paris, France, Table 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 1.7
U.S. Refinery Input of Crude Oil and Petroleum Products, 1987-98
(thousand barrels)

			Oxygenates						
Year	Crude oil	Natural gas liquids	Fuel ethanol	Methanol	MTBE[a]	Other oxygenates[b]	Other hydrocarbons[c]	Other liquids	Total input to refineries
1987	4,691,783	280,889	[d]	[d]	[d]	[d]	23,304	220,296	5,105,392
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
1998	5,434,383	146,921	11,722	675	89,362	3,363	22,759	183,376	5,892,561
				Average annual percentage change					
1988-98	1.3%	-5.7%	[e]	[e]	[e]	[e]	-0.2%	-1.7%	1.3%
1993-98	1.8%	-3.9%	28.5%	-2.9%	12.6%	25.4%	7.9%	-7.1%	1.5%

Source:
U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual,* 1998, Vol. 1, June 1999, Table 16, and annual.
(Additional resources: www.eia.doe.gov)

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

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

Table 1.8
Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978-98
(percentage)

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

Source:
Department of Energy, Energy Information Administration, *Petroleum Supply Annual 1998,* Vol. 1, June 1999, Table 19 and annual. (Additional resources: www.eia.doe.gov)

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

Table 1.9
United States Petroleum Production and Consumption, 1973-99
(million barrels per day)

Year	Domestic crude oil production	Net imports			Exports		U.S. petroleum consumption[a]	World petroleum consumption	Net imports as a percentage of U.S. petroleum consumption	U.S. petroleum consumption as a percentage of world consumption	Transportation petroleum use as a percentage of domestic production[b]
		Crude oil	Petroleum products	Total	Crude oil	Petroleum products					
1973	9.21	3.24	2.78	6.03	0.00	0.23	17.31	56.39	34.8%	30.7%	76.7%
1974	8.77	3.47	2.42	5.89	0.00	0.22	16.65	55.91	35.4%	29.8%	78.3%
1975	8.37	4.10	1.75	5.85	0.00	0.20	16.32	55.48	35.8%	29.4%	82.8%
1976	8.13	5.28	1.81	7.09	0.00	0.22	17.46	58.74	40.6%	29.7%	89.5%
1977	8.25	6.57	2.00	8.57	0.05	0.19	18.43	61.63	46.5%	29.9%	91.7%
1978	8.71	6.20	1.80	8.00	0.16	0.20	18.85	63.30	42.5%	29.8%	91.7%
1979	8.55	6.28	1.70	7.99	0.24	0.24	18.51	65.17	43.1%	28.4%	92.0%
1980	8.60	4.98	1.39	6.37	0.29	0.26	17.06	63.07	37.3%	27.0%	87.9%
1981	8.57	4.17	1.23	5.40	0.23	0.37	16.06	60.87	33.6%	26.4%	86.9%
1982	8.65	3.25	1.05	4.30	0.24	0.58	15.30	59.50	28.1%	25.7%	84.9%
1983	8.69	3.17	1.15	4.31	0.16	0.58	15.23	58.74	28.3%	25.9%	85.3%
1984	8.88	3.25	1.47	4.72	0.18	0.54	15.73	59.84	30.0%	26.3%	86.0%
1985	8.97	3.00	1.29	4.29	0.20	0.58	15.73	60.10	27.3%	26.2%	86.6%
1986	8.68	4.02	1.41	5.44	0.15	0.63	16.28	61.76	33.4%	26.4%	93.1%
1988 1987	8.35	4.52	1.39	5.91	0.15	0.61	16.67	63.00	35.5%	26.5%	98.5%
	8.14	4.95	1.63	6.59	0.16	0.66	17.28	64.82	38.1%	26.7%	104.1%
1989	7.61	5.70	1.50	7.20	0.14	0.72	17.33	65.92	41.6%	26.3%	112.1%
	7.36	4.79	1.38	7.16	0.11	0.75	16.99	65.98	42.2%	25.8%	114.5%
1990 1991	7.42	5.67	0.96	6.63	0.12	0.89	16.71	66.57	39.6%	25.1%	110.6%
1992	7.17	5.99	0.94	6.94	0.09	0.86	17.03	66.76	40.7%	25.5%	114.5%
1993	6.85	6.69	0.93	7.62	0.10	0.90	17.24	67.00	44.2%	25.7%	118.7%
1994	6.66	6.96	1.09	8.05	0.10	0.84	17.72	68.30	45.5%	25.9%	124.4%
1995	6.56	7.14	0.75	7.89	0.10	0.86	17.73	69.87	44.5%	25.4%	127.0%
1996	6.47	7.40	1.10	8.50	0.11	0.87	18.31	71.40	46.4%	25.6%	130.3%
1997	6.45	8.12	1.04	9.16	0.11	0.90	18.62	73.13	49.2%	25.5%	131.7%
1998	6.25	8.60	1.17	9.76	0.11	0.84	18.92	73.64	51.6%	25.7%	138.7%
1999	5.95	8.47	1.14	9.61	0.11	0.82	19.39		49.6%		146.2%
						Average annual percentage change					
1973-99	-1.7%	3.8%	-3.4%	1.8%	[c]	5.0%	0.4%	1 1%[d]			
1989-99	-2.4%	4.0%	-2.7%	2.9%	-2.4%	1.3%	1.1%	1.2%[d]			

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2000,* Washington, DC, 2000, pp. 42–47.
World petroleum consumption - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1998,* January 2000, Tablel. 1.
(Additional resources: www.eia.doe.gov)

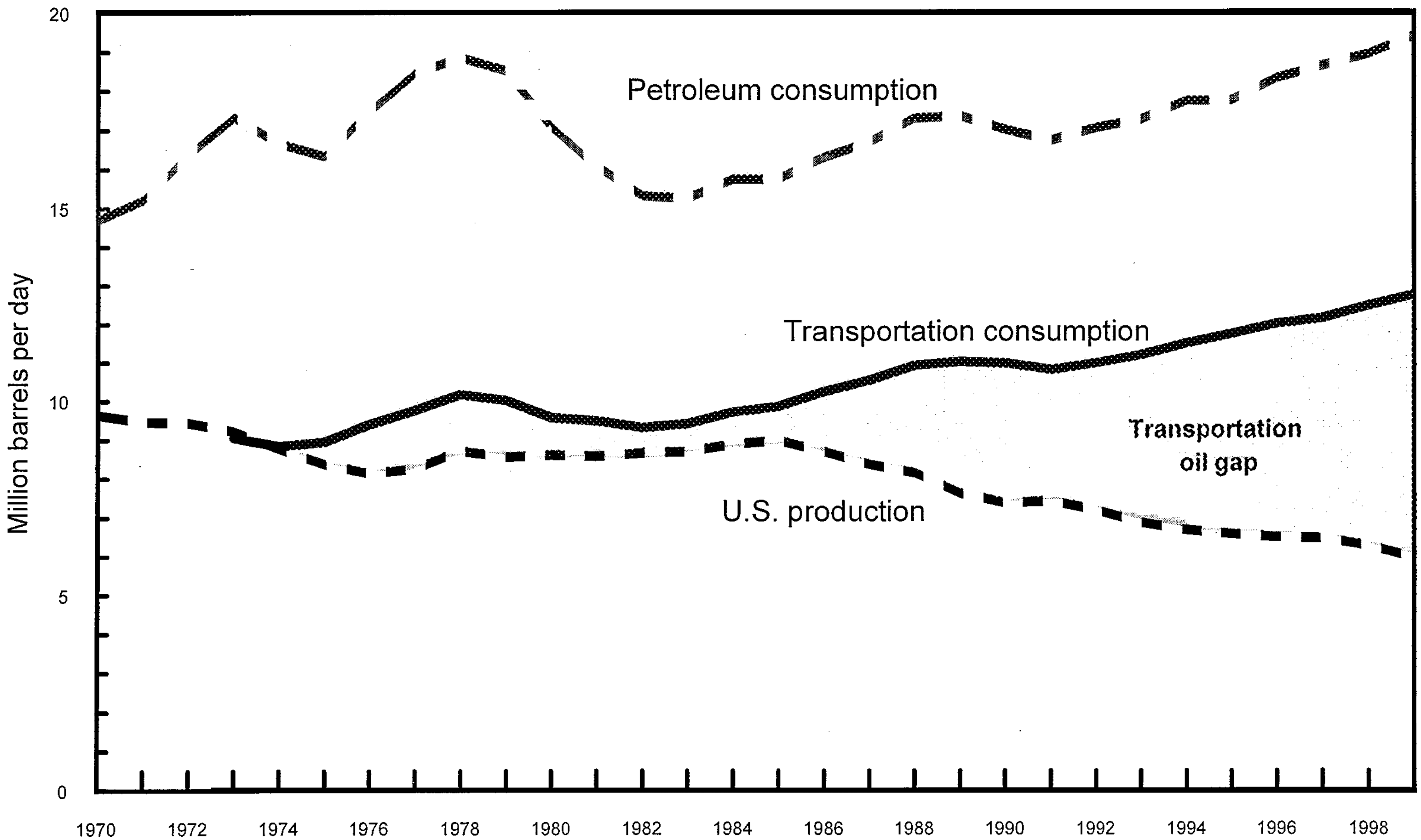
[a] Best estimate for U.S. petroleum consumption is the amount of petroleum products supplied to the U.S. in a given year. This is not the sum of crude oil production and net imports due to processing gain and stock changes.

[b] Transportation petroleum use can be found on Table 1 .10. This column has been revised to include domestic production of crude oil, natural gas plant liquids, and other hydrocarbons/hydrogen/oxygenates as shown in the *Monthly Energy Review,* Table 3.1 a.

[c] Data are not available.

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

Figure 1.4. United States Petroleum Production and Consumption, 1973–99



Source: See Tables 1.9 and 1.10.

Table 1.10
Consumption of Petroleum by End-Use Sector, 1973-99
(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	16.66
1975	17.61	53.8%	3.81	11.6%	8.15	24.9%	3.17	9.7%	32.74	16.33
1976	18.51	52.6%	4.18	11.9%	9.01	25.6%	3.48	9.9%	35.18	17.51
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	18.52
1980	19.01	55.6%	3.04	8.9%	9.53	27.9%	2.63	7.7%	34.21	17.11
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	15.29
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	15.77
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	17.33
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	16.72
1992	21.81	65.0%	2.13	6.4%	8.64	25.8%	0.95	2.8%	33.53	17.08
1993	22.20	65.6%	2.14	6.3%	8.45	25.0%	1.05	3.1%	33.84	17.24
1994	22.76	65.6%	2.09	6.0%	8.85	25.5%	0.97	2.8%	34.67	17.72
1995	23.20	67.1%	2.08	6.0%	8.62	24.9%	0.66	1.9%	34.56	17.73
1996	23.74	66.4%	2.20	6.2%	9.10	25.4%	0.73	2.0%	35.77	18.37
1997	24.00	66.2%	2.14	5.9%	9.31	25.7%	0.82	2.3%	36.27	18.62
1998	24.64	66.7%	1.97	5.3%	9.15	24.8%	1.17	3.2%	36.93	18.92
1999	25.21	66.9%	2.07	5.5%	9.45	25.1%	0.97	2.6%	37.70	19.39
				Average annual percentage change						
1973-99	1.3%		-2.9%		0.1%		-4.8%		0.3%	0.4%
1989-99	1.4%		-2.0%		1.5%		-5.4%		1.0%	1.1%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2000*, pp. 27, 29, 31, 33.
(Additional resources: 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 2000.

Table 1.11
Transportation of Petroleum and Petroleum Products in the U.S. by Mode, 1975-98

Year	Pipelines[a] (billion ton-miles)	Pipelines (percent)	Water carriers (billion ton-miles)	Water carriers (percent)	Motor carriers[b] (billion ton-miles)	Motor carriers (percent)	Railroads (billion ton-miles)	Railroads (percent)	Total (billion ton-miles)
1975	507.0	59.88%	298.0	35.20%	27.4	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	44.5 1%	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.X
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
1996	619.2	60.58%	356.5	34.88%	29.7	2.90%	16.8	1.64%	1,022.2
1997	616.5	64.45%	295.6	30.90%	27.7	2.90%	16.7	1.75%	956.5
1998	619.8	66.66%	265.0	28.50%	28.3	3.04%	16.7	1.80%	929.8
				Average annual percentage change					
1975-98	0.9%		-0.5%		0.1%		0.7%		0.4%
1988–98	0.1%		3.1%		0.3%		1.2%		1.1%

Source:
Association of Oil Pipelines, *Shifts in Petroleum Transportation,* Washington, DC, April 2000, Table 1.

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

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

Chapter 2
Energy

Summary Statistics from Tables in this Chapter

Source			
Table 2.3	Transportation share of U.S. energy consumption, 1999	28.0%	
Table 2.4	Petroleum share of transportation energy consumption, 1999	97.4%	
Table 2.6	Transportation energy use by mode, 1998	(trillion Btu)	(share)
	Automobiles	*9,078*	*35.3%*
	Light trucks	6,324	*24.6%*
	Heavy trucks	*4,218*	*16.4%*
	Buses	*195*	*0.8%*
	Air	*2,351*	*9.2%*
	Water	*1,295*	*5.0%*
	Pipeline	*901*	*3.5%*
	Rail	586	*2.3%*
Table 2.9	Alternative vehicle fuel and oxygenate consumption, 1999		
		(thousand gasoline equivalent gallons)	(share)
	Liquified petroleum gas	*243,648*	*5.6%*
	Compressed natural gas	*86,073*	*2.0%*
	Liquified natural gas	*6,062*	*0.1%*
	M85/M100	*1,557*	*0.0%*
	E85/E100	*2,548*	*0.0%*
	Electricity	*1,458*	*0.0%*
	MTBE	*3,097,800*	*71.6%*
	Ethanol in gasohol	*890,200*	*20.6%*

Table 2.1
World Production of Primary Energy by Selected Country Groups, 1989-98
(quadrillion Btu)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[a]	1998 Share
Petroleum											
World total	**134.66**	**136.35**	**135.90**	**136.50**	**136.52**	**138.30**	**141.47**	**144.93**	**149.01**	**151.96**	39.8%
OECD[b]	38.07	38.20	39.20	**39.70**	**39.57**	40.94	41.66	43.14	43.59	43.21	11.3%
Non OECD	96.58	98.15	96.70	96.81	96.95	97.36	99.81	101.79	105.42	108.75	28.5%
Natural gas											
World total	74.24	75.91	76.68	76.84	78.35	79.16	80.23	83.97	84.00	85.49	22.4%
OECD[b]	30.61	31.44	32.18	33.02	34.18	35.67	36.14	38.05	37.94	38.19	10.0%
Non OECD	43.63	44.47	44.50	43.82	44.17	43.49	44.09	45.92	46.06	47.30	12.4%
Coal											
World total	**91.05**	92.28	87.65	88.35	85.72	87.53	89.67	90.78	90.64	88.61	23.2%
OECD[b]	42.12	42.00	39.96	39.16	38.19	39.58	39.37	40.25	40.55	40.47	10.6%
Non OECD	48.93	50.28	47.69	49.19	47.53	47.95	50.31	50.53	50.09	48.14	12.4%
Hydroelectric power											
World total	**21.74**	22.56	22.98	22.96	24.31	24.48	25.73	26.11	26.74	26.63	7.0%
OECD[b]	11.84	12.22	12.33	12.18	12.91	12.43	13.31	13.71	13.96	13.63	3.6%
Non OECD	9.90	10.33	10.65	10.78	11.40	12.06	12.42	12.40	12.78	13.01	3.4%
Nuclear electric power											
World total	**19.82**	20.37	21.29	**21.36**	22.07	22.50	23.35	24.17	23.95	24.48	6.4%
OECD[b]	16.38	16.99	17.93	18.15	18.99	19.61	20.35	20.84	20.59	21.20	5.5%
Non OECD	3.44	3.38	3.36	3.21	3.08	2.89	3.01	3.33	3.36	3.27	0.9%
Total energy[c]											
World total	345.76	351.39	348.48	350.29	351.33	356.54	365.18	374.87	379.22	382.18	**100.0%**
OECD[b]	143.05	144.54	145.33	146.23	147.94	152.51	155.25	160.56	161.14	161.33	42.2%
Non OECD	202.71	206.85	203.15	204.06	203.39	204.04	209.93	214.31	218.08	220.85	57.8%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual* 1998, Washington, DC, January 2000, Table 2.9. (Additional resources: www.eia.doe.gov)

[a] Preliminary.
[b] Organization for Economic Cooperation and Development (OECD). See Glossary for membership.
[c] Geothermal, solar, and wind electric power are included in the total though not shown separately on this table.

Table 2.2
World Consumption of Primary Energy by Selected Country Groups, 1989-98
(quadrillion Btu)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[a]	1998 Share
					Petroleum						
World total	**134.82**	**134.87**	**136.11**	**136.62**	**136.61**	**139.10**	**142.39**	**145.51**	**148.62**	**149.73**	39.6%
OECD[b]	82.63	82.70	83.63	85.72	86.56	88.92	**90.45**	92.70	94.01	94.39	25.0%
Non OECD	52.19	52.17	52.48	50.90	50.05	50.18	51.94	52.82	54.61	55.34	14.7%
					Natural gas						
World total	73.93	74.78	76.02	76.23	78.40	78.34	**80.01**	84.01	83.77	84.40	22.3%
OECD[b]	35.85	36.26	37.69	38.58	40.20	41.33	43.22	45.70	45.64	45.62	12.1%
Non OECD	38.08	38.52	38.33	37.64	38.21	37.01	36.79	38.31	38.13	38.78	10.3%
					Coal						
World total	90.33	90.41	87.15	87.05	87.54	88.33	89.63	91.64	90.19	87.53	23.2%
OECD[b]	42.76	41.82	40.77	39.45	41.05	40.85	40.55	41.99	41.50	41.13	10.9%
Non OECD	47.57	48.59	46.39	47.60	46.49	47.48	49.07	49.64	48.69	46.40	12.3%
					Hydroelectric power						
World total	**21.89**	22.65	23.18	23.20	24.57	24.77	26.00	26.44	26.96	26.84	**7.1%**
OECD[b]	11.99	12.31	12.53	12.42	13.16	12.71	13.58	14.03	14.18	13.83	3.7%
Non- OECD	9.90	10.33	10.65	10.78	11.40	12.06	12.42	12.40	12.78	13.01	3.4%
					Nuclear electric power						
World total	**19.82**	20.37	21.29	**21.36**	22.07	22.50	23.35	24.17	23.95	24.48	6.5%
OECD[b]	16.38	16.99	17.93	18.15	18.99	19.61	20.35	20.84	20.59	21.20	5.6%
Non OECD	3.44	3.38	3.36	3.21	3.08	2.89	3.01	3.33	3.36	3.27	0.9%
					Total energy[c]						
World total	344.83	346.83	347.51	348.46	353.21	357.25	365.72	376.25	378.04	377.72	**100.0%**
OECD[b]	193.67	193.76	196.20	198.11	203.78	207.38	212.22	219.47	220.15	220.59	58.4%
Non OECD	151.16	153.07	151.31	150.35	149.43	149.87	153.50	156.78	157.89	157.13	41.6%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1998* Washington, DC, January 2000, Table 1.8. (Additional resources: www.eia.doe.gov)

[a] Preliminary.
[b] Organization for Economic Cooperation and Development (OECD). See Glossary for membership.
[c] Geothermal, solar, and wind electric power are included in the total though not shown separately on this table.

Total energy use in the U.S. has grown to 92 quads in 1999. The transportation sector accounts for 28% of total energy use.

Table 2.3
U. S. Consumption of Total Energy by End-Use Sector, 1970-99”
(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%	23.72	30.69	72.54
1975	18.24	25.9%	23.90	28.40	70.55
1976	19.10	25.7%	25.02	30.24	74.36
1977	19.82	26.0%	25.38	31.08	76.29
1978	20.62	26.4%	26.08	31.39	78.09
1979	20.47	25.9%	25.81	32.62	78.90
1980	19.70	25.9%	25.65	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	19.14	27.1%	25.62	25.76	70.52
1984	19.81	26.7%	26.47	27.87	74.14
1985	20.07	27.1%	26.70	27.21	73.98
1986	20.82	28.0%	26.85	26.63	74.30
1987	21.46	27.9%	27.61	27.83	76.89
1988	22.31	27.8%	28.92	28.99	80.22
1989	22.57	27.7%	29.42	29.37	81.36
1990	22.54	27.7%	28.80	29.95	81.30
1991	22.13	27.3%	29.42	29.57	81.12
1992	22.47	27.3%	29.27	30.68	82.42
1993	22.90	27.2%	30.45	30.88	84.22
1994	23.52	27.4%	30.70	31.76	85.99
1995	23.97	27.4%	31.54	32.04	87.56
1996	24.52	27.1%	32.94	32.95	90.42
1997	24.82	27.3%	33.09	33.07	90.98
1998	25.36	27.8%	33.17	32.73	91.26
1999	25.92	28.0%	33.63	33.16	92.72
		Average annualpercentage change			
1970-99	1.7%		1.5%	0.5%	1.2%
1989-99	1.4%		1.3%	1.2%	1.3%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 2000,* Washington, DC, Table 2.2. (Additional resources: www.eia.doe.gov)

“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. Additional detailed data about oxygenates and other fuel types for the Transportation sector are found on Table 2.9.

Table 2.4
Distribution of Energy Consumption by Source, 1973, 1980, and 1999
(percentage)

	Transportation			Residential & Commercial			Industrial			Electric utilities		
Energy source	1973	1980	1999	1973	1980	1999	1973	1980	1999	1973	1980	1999
Petroleum	95.8	96.5	97.4	18.2	11.8	11.7	28.9	31.1	36.9	17.7	10.7	2.8
Natural gas[a]	4.0	3.3	2.6	31.6	29.4	45.2	32.9	27.4	39.9	18.9	15.5	9.2
Coal	0.0	0.0	0.0	1.1	0.6	0.6	12.8	10.3	9.0	43.6	49.5	55.8
Hydroelectric	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	15.0	12.6	9.6
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	11.2	22.3
Electricity[b]	0.2	0.2	0.1	49.2	58.2	42.5	25.2	31.1	14.0	0.0	0.0	0.0
Other"	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.2
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* 2000, Washington, DC, pp. 27, 29, 31, 33. (Additional resources: www.eia.doe.gov)

"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 2.5
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1998”
(trillion Btu)

	Gasoline	Diesel fuel	Liquified petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity
HIGHWAY	**15,544.9**	**4,266.4**	**23.7**			**4.8**	**0.9**
Automobiles	**8,952.3[b]**	**126.0**				**0.1**	
Motorcycles	**25.7**						
Buses	**12.5**	**176.4**	**0.5**			**4.3**	**0.9**
Transit	**4.8**	**76.8**	**0.5**			**4.3**	**0.9**
Intercity”		**22.6**					
School”	**7.7**	**77.0**					
Trucks	**6,554.4**	**3,694.0**	**23.2**			**0.4**	
Light trucks[d]	6,076.4	**238.1**	**9.2**			**0.4**	
Other trucks	**478.0**	**3,726.0**	**14.0**			**0.0**	
OFF-HIGHWAY	**142.6**	**570.1[e]**					
Construction	**29.3**	**178.5[e]**					
Agriculture	**113.3**	**391.6[e]**					
NONHIGHWAY	**343.3**	**817.2**		**2,313.7**	**694.6**	**655.2**	**309.9**
Air	**37.4**			**2,313.7**			
General aviation	**37.4**			110.0			
Domestic air carriers				1,857.3			
International air carriers’				**346.4**			
Water	**305.9**	**294.8**			**694.6**		
Freight		**294.8**			**694.6**		
Recreational	**305.9**						
Pipeline						**655.2**	**246.0**
Rail		**522.4**					**63.9**
Freight (Class I)		**502.0**					
Passenger		**20.4**					**61.0**
Transit							**42.6**
Commuter		10.8					**15.1**
Intercity”		**9.8**					**3.3**
TOTAL	**16,030.8**	**5,653.7**	**23.7**	**2,313.7**	**694.6**	**660.0**	**310.8**

Source:
See Appendix A for Table 2.5.

[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] One half of fuel used by domestic carriers in international operation.

The 1997 data have been revised to include the latest data available.

Table 2.6
Transportation Energy Use by Mode, 1997-98”

	Trillion Btu		Thousand barrels per day crude oil equivalent [b]		Percentage of total	
	1997	1998	1997	1998	1997	1998
HIGHWAY	**19,244.3**	**19,840.7**	**9,681.2**	**9,981.3**	**76.6%**	**77.2%**
Automobiles	**8,746.3**	**9,078.4**	**4,400.0**	**4,567.1**	**34.8%**	**35.3%**
Motorcycles	**25.2**	**25.7**	**12.7**	**12.9**	**0.1%**	**0.1%**
Buses	**199.1**	**194.6**	**100.1**	**97.9**	**0.8%**	**0.8%**
Transit	**93.0**	**87.3**	**46.8**	**43.9**	**0.4%**	**0.3%**
Intercity	**22.2"**	**22.6**	**11.2"**	11.4	0.1%	0.1%
School	**83.9”**	**84.7**	**42.2"**	**42.6**	**0.3%**	**0.3%**
Trucks	**10,273.7**	**10,542.0**	**5,168.4**	**5,303.4**	**40.9%**	**41.0%**
Light trucks [d]	6,187.5	6,324.1	3,112.8	3,181.5	**24.6%**	**24.6%**
Other trucks	4,086.2	4,217.9	2,055.6	2,121.9	**16.3%**	**16.4%**
OFF-HIGHWAY	**730.8**	**712.7**	**367.6**	**358.5**	**2.9%**	**2.8%**
Construction	**216.1**	**207.8**	**108.7**	**104.5**	**0.9%**	*0.8%*
Agriculture	**514.7**	**504.9**	**258.9**	**254.0**	**2.0%**	**2.0%**
NONHIGHWAY	**5,158.4**	**5,133.9**	**2,595.0**	**2,582.7**	**20.5%**	**20.0%**
Air	**2,383.9**	**2,351.1**	**1,149.0**	**1,182.8**	**9.1%**	**9.2%**
General aviation	121.1	**147.4**	**60.9**	**74.2**	**0.5%**	**0.6%**
Domestic air carriers	1,831.0	1,857.3	921.1	**934.4**	**7.3%**	**7.2%**
International air	**331.8**	**346.4**	166.9	**174.3**	**1.3%**	**1.3%**
Water	**1,309.0**	**1,295.3**	**658.5**	**651.6**	**5.2%**	**5.0%**
Freight	1,009.3	**989.4**	**507.7**	*497.7*	**4.0%**	**3.9%**
Recreational	**299.7**	**305.9**	**150.8**	**153.9**	**1.2%**	**1.2%**
Pipeline	**987.0**	**901.2**	**496.5**	**453.4**	**3.9%**	**3.5%**
Rail	**578.9**	**586.3**	**291.0**	**295.0**	**2.3%**	**2.3%**
Freight	**499.7**	**502.0**	**251.4**	**252.5**	**2.0%**	**2.0%**
Passenger	**78.8**	**84.3**	**39.6**	**42.4**	**0.3%**	**0.3%**
Transit	**42.5**	**43.1**	**21.4**	**21.7**	**0.2%**	**0.2%**
Commuter	**23.7**	**28.2**	**11.9**	**14.2**	*0.1%*	0.1%
Intercity	**12.6"**	**13.0**	**6.3'**	**6.5**	0.1%	0.1%
TOTAL	**25,133.5**	**25,687.3**	**12,643.9**	**12922.5**	**100.0**	**100%**

Source: See Appendix A for Table 2.5 (detailed breakdown).

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

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

Table 2.7
Transportation Energy Consumption by Mode, 1970-98
(trillion Btu)

Year	Autos	Light trucks	Light vehicles subtotal	Motor-cycles	Buses[a]	Heavy trucks	Highway subtotal	Air	Water	Pipeline	Rail	Nonhighway subtotal	Total transportation[b]
	8,527	1,540	10,067	7	109	1,503	11,686	1,307	753	**985**	558	3,603	15,289
1970 1975	9,321	2,386	11,707	14	119	1,939	13,779	1,274	851	835	563	3,523	17,302
1976	9,844	2,605	12,449	15	129	2,046	14,639	1,333	1,001	803	585	3,722	18,361
	9,940	2,799	12,739	16	132	2,268	15,155	1,411	1,103	781	595	3,890	19,045
1977 1978	10,140	3,022	13,162	18	135	2,539	15,854	1,467	1,311	781	589	4,148	20,002
1979	9,629	3,057	12,686	22	137	2,644	15,489	1,568	1,539	856	613	4,576	20,065
	8,798	2,976	11,774	26	139	2,651	14,590	1,528	1,677	889	596	4,690	19,280
1980 1981	8,695	2,964	11,659	27	143	2,706	14,535	1,455	1,562	899	565	4,481	19,016
1982	8,695	2,839	11,534	25	146	2,707	14,412	1,468	1,290	853	488	4,099	18,511
1983	8,814	2,995	11,809	22	145	2,757	14,733	1,505	1,187	738	482	3,912	18,645
	8,857	3,202	12,059	22	154	2,846	15,081	1,633	1,251	780	523	4,187	19,268
1984 1985	8,954	3,422	12,376	23	161	2,842	15,402	1,678	1,311	758	487	4,234	19,636
1986	9,162	3,636	12,798	23	154	2,903	15,878	1,823	1,295	738	423	4,279	20,157
1987	9,179	3,827	13,006	24	157	2,990	16,177	1,894	1,326	775	485	4,480	20,657
	9,180	4,096	13,276	25	159	3,117	16,577	1,978	1,338	878	498	4,692	21,269
1988 1989	9,251	4,173	13,424	26	163	3,196	16,809	1,981	1,376	895	501	4,753	21,562
1990	8,707	4,467	13,174	24	163	3,329	16,690	2,059	1,487	928	492	4,966	21,656
1991	8,048	4,793	12,841	23	174	3,396	16,434	1,926	1,567	864	463	4,820	21,254
	8,188	5,134	13,322	24	182	3,460	16,988	1,971	1,641	849	476	4,937	21,925
1992 1993	8,389	5,375	13,764	25	192	3,567	17,548	1,996	1,473	889	513	4,871	22,419
1994	8,494	5,530	14,024	26	202	3,772	18,024	2,056	1,414	955	546	4,971	22,995
1995	8,519	5,717	14,236	25	179	3,950	18,390	2,117	1,522	971	565	5,175	23,565
1996	8,622	5,936	14,558	25	194	4,033	18,850	2,196	1,460	984	578	5,218	24,068
1997	8,746	6,188	14,934	25	199	4,086	19,244	2,284	1,309	987	579	5,159	24,403
1998	9,078	6,324	15,402	26	195	4,218	19,841	2,351	1,295	901	586	5,133	24,974
						Average annual percentage change							
1970-98	0.2%	5.2%	1.5%	4.7%	2.1%	3.8%	1.9%	2.2%	2.0%	-0.3%	0.2%	1.3%	1.8%
1988-98	-0.1%	4.4%	1.5%	0.4%	2.1%	3.1%	1.8%	1.7%	1.3%	0.3%	1.6%	0.9%	1.6%

Source:
See Appendix A for Table 2.7.

[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 reportingprocedures 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 ofgasoline and at least IO%, byvolume, alcohol. Effective January I, 1993, three types ofgasohol were defined: 10% gasohol—containing at least 10% alcohol; 7.7% gasohol—containing 7.7% alcohol but less than 10%; and 5.7% gasohol-containing at least 5.7% alcohol but less than 7.7%. See Table 2.9 for details on oxygenate usage.

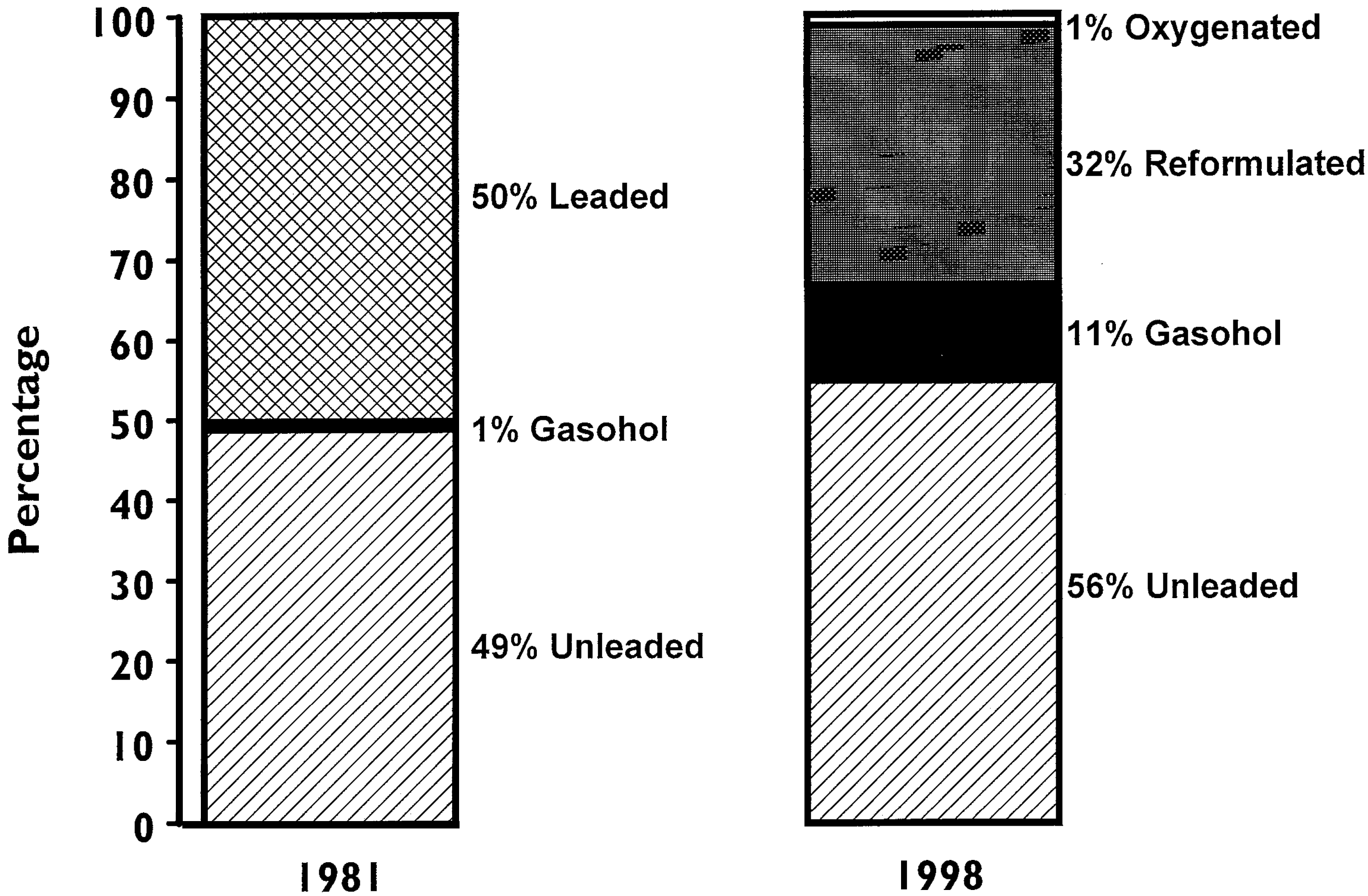
Table 2.8
Highway Usage of Gasoline and Special Fuels, 1973-98
(million gallons)

Year	Gasoline	Gasohol	Ethanol used in gasohol[a]	Total gasoline and gasohol	Diesel[b]	Percent diesel	Total highway fuel use
1973	[c]	[c]	[c]	100,636	9,837	8.9%	110,473
1975	[c]	[c]	[c]	99,354	9,631	8.8%	108,985
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
1997	106,237	14,701	1,328.9	120,938	29,394	196%	150,332
1998	110,715	13,979	1,296.8	124,694	30,190	19.5%	154,884
				Average annualpercentage change			
1973-98	[d]	[d]	[d]	0.9%	4.6%		1.4%
1988-98	0.9%	5.6%	4.8%	1.3%	4.2%		1.8%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* 1998, Washington, DC, 1999, Tables MF-21 and MF-33E, and annual.
(Additional resources: www.fhwa.dot.gov)

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

Figure 2.1. Motor Gasoline Quantities by Type, 1981 and 1998



Source:

U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual 1998*, 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 1998*, Washington, DC, Table MF-33E, and annual.

Table 2.9
Alternative Vehicle Fuel Consumption, 1992-2000
(thousand gasoline equivalent gallons)

Alternative fuel	1992	1993	1994	1995	1996	1997	1998	1999	2000”	2000 Percentage
Liquified petroleum	208,142	264,655	248,467	232,701	239,158	238,356	241,583	243,648	249,550	5.7%
Compressed natural gas	16,823	21,603	24,160	35,162	46,923	65,192	73,251	86,073	104,501	2.4%
Liquified natural gas	585	1,901	2,345	2,759	3,247	3,714	5,343	6,062	7,460	0.2%
M85[b]	1,069	1,593	2,340	2,023	1,775	1,554	1,212	1,108	1,062	0.0%
M100	2,547	3,166	3,190	2,150	347	347	449	449	449	0.0%
E85[b]	21	48	80	190	694	1,280	1,727	2,489	3,283	0.1%
E95[b]	85	80	140	995	2,699	1,136	59	59	59	0.0%
Electricity	359	288	430	663	773	1,010	1,202	1,458	1,712	0.0%
Subtotal	**229,631**	293,334	**281,152**	276,643	295,616	312,589	324,826	341,346	368,076	8.4%
Oxygenates										
MTBE[c]	1,175,000	2,069,200	2,018,800	2,691,200	2,749,700	3,104,200	2,915,600	3,097,800	3,111,500	70.9%
Ethanol in gasohol	701,000	760,000	845,900	910,700	660,200	830,700	916,000	890,200	908,700	20.7%
Total	**2,105,631**	**3,122,534**	**3,145,852**	**3,878,543**	**3,705,516**	**4,247,489**	**4,156,426**	**4,311,346**	**4,388,276**	**100.0%**

Source:
U.S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels*, 1998, Washington, DC, 1999, web site www.eia.doe.gov/cneaf/solar.renewables/alt_trans_fuel98/atf1-13_99.html. (Additional resources: www.eia.doe.gov)

[a]Based on plans or projections.
Consumption includes gasoline portion of the mixture.
[c]Methyl Tertiary Butyl Ether. This category includes a very small amount of other ethers, primarily Tertiary Amy1 Methyl Ether (TAME) and Ethyl Tertiary Butyl Ether (ETBE).

Table 2.10
U.S. Production and Imports of MTBE” and Fuel Ethanol, 1978-99
(million gallons)

	Production		Imports	
Year	Fuel ethanol	MTBE”	Fuel ethanol	MTBE”
1978	20	b	b	b
1979	40	b	b	b
1980	80	b	b	b
1981	85	122	b	b
1982	234	132	b	b
1983	443	134	b	b
1984	567	235	b	b
1985	793	302	b	b
1986	798	359	b	b
1987	825	b	b	b
1988	800	b	b	b
1989	750	b	b	b
1990	756	b	b	b
1991	875	b	b	b
1992	1,080	1,542	b	b
1993	1,156	2,081	10	306
1994	1,280	2,205	12	595
1995	1,355	2,506	16	692
1996	974	2,846	13	733
1997	1,274	3,011	4	918
1998	1,387	3,151	3	1,040
1999	1,472	3,315	b	b
		Aver-age annual percentage change		
1978-99	22.7%	b	b	b
1989-99	7.0%	b	b	b

Source:

Production - 1992-99 Ethanol and MTBE: U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Monthly*, Washington, DC, January 1999, Table D1. 1978-90 Ethanol: lnformation Resources, Inc., Washington, DC, 199 1. 198 l-86 MTBE: EA-Mueller,Inc., Baltimore, MD, 1992.

Imports - U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual*, 1998, *Volume* I, Washington, DC, 1999, Table 20, and annual.

“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 2.11
Passenger Travel and Energy Use in the United States, 1998

	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	**131,838.5**	**1,545,830**	**2,473,328**	**1.6**	**5,873**	**3,671**	**9,078.4**
Personal trucks	**55,231.7**	**626,343**	**1,002,149**	**1.6**	**7,166**	**4,478**	**4,488.1**
Motorcycles	**3,879.5**	**10,260**	**12,312**	**1.2**	**2,505**	**2,087**	**25.7**
Buses	**658.2**	**7,957**	a	a	**243,457**	a	**194.6**
Transit	**74.6**	2,291	**20,602**	**9.0**	**38,106**	**4,238**	**87.3**
Intercity	19.2	1,366	31,700	**23.2**	**16,545**	**713**	**22.6**
School	**582.4**	**4,300**	a	a	**19,698**	a	**84.7**
Air	a	a	**477,695**	a	a	**41,966**	**2,004.7**
Certificated route	a	5,031	464,395	**92.3**	369,171	3,999	1,857.3
General aviation	**204.7**	a	**13,300**	a	a	11,083	147.4
Recreational boats	**12,565.9**	a	a	a	a	a	**305.9**
Intercity[b]	17.7 1.3'	1,316[d]	26,765 5,325"	23.1 16.9	71,684 41,139	3,150 2,441	84.3 13.0'
Transit"	11.5	609	**13,402**	**22.0**	**70,772**	**3,216**	**43.1**
Commuter	4.9	251	**8,038**	**32.0**	**112,351**	**3,508**	**28.2**

Source:
See Appendix A for Table 2.11.

"Data are not available.
"Amtrak only.
'Passenger train cars.
"Passenger train car-miles.
'Revenue passenger-miles.
'Estimated using vehicle travel data
[g]Light and heavy rail.

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

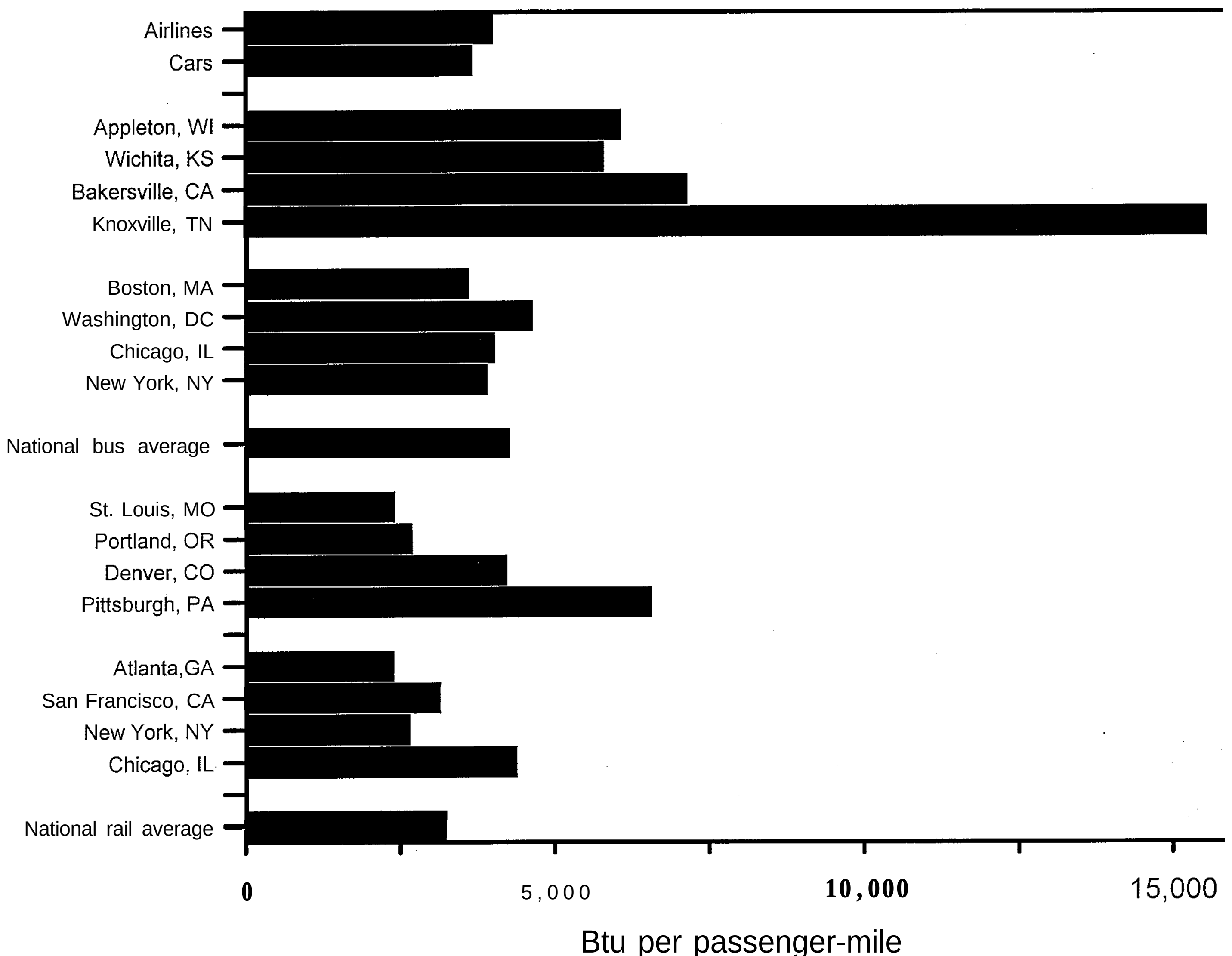
Table 2.12
Energy Intensities of Passenger Modes, 1970-98

Year	Automobiles (Btu per vehicle-mile)	Automobiles (Btu per passenger-mile)	Light truck[a] (Btu per vehicle-mile)	Buses: Transit[b] (Btu per vehicle-mile)	Buses: Transit[b] (Btu per passenger-mile)	Buses: Intercity (Btu per passenger-mile)	Buses: School (Btu per vehicle-mile)	Air: Certificated air carriers (Btu per passenger-mile)	Air: General aviation (Btu per passenger-mile)	Rail: Intercity Amtrak (Btu per passenger-mile)	Rail: Rail transit (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	37,145	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	31,962	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	804	13,680	4,236	10,152	2,314	3,818
1996	5,874	3,671	7,247	39,307	4,512	785	13,680	4,081	10,481	2,389	3,444
1997	5,822	3,639	6,981	38,101	4,318	726	16,432	4,047	9,688	2,458	3,253
1998	5,873	3,671	7,166	38,106	4,238	713	19,698	3,999	11,083	2,460	3,216
						Average annual percentage change					
1970-98	-1.6%	-1.0%	-2.0%	0.6%	1.9%	-1.4%	-0.3%	-3.3%	-0.2%	-1.5%[d]	1.0%
1988-98	-1.3%	-0.1%	-1.3%	-0.3%	2.2%	-3.0%	2.4%	-1.9%	-0.6%	0.0%	-1.1%

Source:
See Appendix A for Table 2.12.

[a] All two-axle, four-tire trucks.
[b] Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA)
[c] Data are not available.
[d] Average annual percentage change is from earliest year possible.

Figure 2.2. Energy Intensity for Transit in the U.S., 1998



Source:

U.S. Department of Transportation, Federal Transit Administration, 1998 National Transit Database, Washington, DC. (Additional resources: www.fta.dot.gov/ntl)

Great care should be taken when comparing modal energy intensity data among modes. Because of the inherent differences between-the transportation modes in the nature ofservices, routes available, and many additionalfactors, it is notpossible to obtain truly comparable national energy intensities among modes.

Table 2.13
Intercity Freight Movement and Energy Use in the United States, 1998

	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]	**2,388**	**133,890**	**1,027,000**	**3,952**	**701[b]**	**2,990**	**3,070.6**
Waterborne commerce[c]	**42**	d	**672,795**	**1,087**	**619**	**436**	**293.1**
Coastwise	d	d	**3 14,864**	**250**	**1,261**	d	d
Lakewise	d	d	**61,654**	**122**	**504**	d	d
Internal and local	d	d	294,896	715	**416**	d	d
Pipeline	d	d	d	d	d	d	**847.5**
Natural gas	d	d	d	d	d	d	689.1
Crude oil and products	d	d	**620,000**	1,116	d	**256**	**158.4**
Class I railroads[e]	**576**	**32,657**	**1,376,802**	**1,649**	**835**	**365**	**502.0**

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]701 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 285 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 ojthe inherent differences between the transportation modes in the nature of services, routes available, and many additional factors, it is not possible to obtain truly comparable national energy intensities among modes.

Table 2.14
Energy Intensities of Freight Modes, 1970–98

Year	Heavy single-unit and combination trucks (Btu per vehicle-mile)	Class I freight railroad (Btu per freight car-mile)	Class I freight railroad (Btu per ton-mile)	Domestic waterborne commerce (Btu per ton-mile)
1970	24,154	17,668	691	545
1971	23,694	18,814	717	506
1972	23,871	18,292	714	522
1973	23,977	18,468	677	576
1974	23,983	18,852	681	483
1975	23,836	18,741	687	549
1976	23,773	18,938	680	468
1977	23,873	19,225	669	458
197s	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	5,834	391	386
1992	22,559	16,044	393	398
1993	22,308	16,055	389	389
1994	22,159	16,338	388	369
1995	22,172	15,993	372	374
1996	21,964	15,747	368	412
1997	21,340	15,783	370	415
1998	21,514	15,372	365	436
		Average annualpercentage change		
1970-9s	-0.4%	-0.5%	-2.3%	*-0.8%*
1988-98	-0.5%	-0.9%	-1.9%	1.9%

Source:
See Appendix A for Table 2.14.

Chapter 3
Greenhouse Gas Emissions

Summary Statistics from Tables in this Chapter

Source			
Table 3.1	Greenhouse gas emissions (million metric tonnes)	1990	1997
	France	*554*	*550*
	Germany	*1,201*	*1,036*
	United Kingdom	*727*	*657*
	Japan	*1,175*	*1,280*
	United States	*5,903*	*6,514*
Table 3.5	Transportation share of U.S. carbon dioxide emissions from fossil fuel consumption		
	1984		*30.5%*
	1990		*32.2%*
	1998		*32.6%*
Table 3.6	Carbon dioxide emissions from U.S. transportation energy use, 1998		
	Motor gasoline		*60.8%*
	Liquified petroleum gas		*0.0%*
	Jet fuel		*13.2%*
	Distillate fuel		*20.0%*
	Residual fuel		*3.1%*
	Lubricants		*0.4%*
	Aviation gas		*0.2%*
	Natural gas		*2.2%*
	Electricity		*0.1%*

Table 3.1
International Man-Made Emissions of Greenhouse Gases, 1990-97”
(CO, equivalent)

	1990 (million metric tonnes)	1991	1992	1993	1994	1995	1996	1997
		(percentage relative to 1990, 1990=100)						
Australia	410.80	100	101	102	103	106	108	b
Austria	73.73	106	98	97	99	101	103	105
Canada	590.55	99	102	103	106	109	112	114
Denmark	71.66	115	108	110	115	110	129	117
France	553.58	104	102	98	97	99	101	99
Germany	1,201.12	96	91	89	88	88	89	86
Greece	103.80	100	101	102	103	105	107	b
Ireland	56.86	99	100	100	103	104	105	b
Italy	532.89	b	b	b	97	102	b	b
Japan	1,175.02	102	103	102	108	108	109	109
Netherlands	208.31	103	102	103	103	107	111	b
New Zealand	71.89	100	101	101	101	101	103	105
Norway	47.13	97	97	102	106	107	113	114
Poland	459.05	b	96	b	96	b	95	93
Portugal	68.44	103	109	105	106	b	b	b
Russian Federation	2,998.77	b	b	b	70	b	b	b
Spain	301.43	100	103	100	104	108	b	b
Sweden	69.47	93	94	94	98	97	111	100
Switzerland	53.75	103	101	98	97	98	99	96
United Kingdom	726.64	100	97	93	93	91	94	90
United States	5,902.99	99	101	103	105	106	109	110

Source:
United Nations Framework Convention on Climate Change, Greenhouse Gas Inventory Database, www.unfccc.de/resource, April 2000, October 1998. (Additional resources: www.unfccc.de)

“Includes National totals of C02, CH4, and N20, excluding land-use change and forestry.
“Data are not available.

Table 3.2
International Man-Made Emissions of Carbon Dioxide, 1990-97[a]

	1990 (million metric tonnes)	1991	1992	1993	1994	1995	1996	1997
		(percentage relative to 1990, 1990=100)						
Australia	275.34	101	102	103	104	108	112	[b]
Austria	62.04	107	98	96	98	101	103	106
Canada	461.25	98	101	101	104	107	110	113
Denmark	52.28	120	110	114	121	114	140	123
France	395.51	106	104	99	98	100	103	102
Germany	1,014.50	96	91	90	89	89	91	88
Greece	85.35	100	102	102	104	106	108	[b]
Ireland	30.72	103	105	104	108	111	113	[b]
Italy	432.61	[b]	[b]	[b]	96	101	[b]	[b]
Japan	1,124.53	102	103	102	108	108	110	109
Netherlands	40.40	103	106	110	107	110	113	0
New Zealand	25.24	102	110	107	107	107	115	120
Norway	35.20	95	97	102	108	109	117	118
Poland	380.70	[b]	98	[b]	98	[b]	98	95
Portugal	47.12	104	112	107	108	[b]	[b]	[b]
Russian Federation	2,372.30	[b]	[b]	[b]	70	[b]	[b]	[b]
Spain	226.42	100	104	100	105	109	[b]	[b]
Sweden	55.44	100	101	101	106	105	114	102
Switzerland	45.07	104	101	98	96	98	100	96
United Kingdom	584.17	101	98	96	95	94	97	93
United States	4,928.90	99	100	103	104	106	109	111

Source:
United Nations Framework Convention on Climate Change, Greenhouse Gas Inventory Database, www.unfccc.de/resource, April 2000. (Additional resources: www.unfccc.de)

[a] Includes National totals of CO_2, excluding land-use change and forestry.
[b] Data are not available.

Table 3.3
International Man-Made Emissions of Carbon Dioxide by Source Category, 1990 and 1997[a]

	Energy (excl transport)				Transport				Industrial processes				Total	
	1990		1997		1990		1997		1990		1997		1990	1997
	(MMT)	%	(MMT)	%	(MMT)	%	(MMT)	%	(MMT)	%	(MMT)	%	(MMT)	(MMT)
Australia[b]	209	75.9	234	75.9	60	21.6	67	21.8	7	2.4	7	2.3	275	308
Austria	35	56.2	38	57.7	14	22.4	16	23.9	13	20.5	12	17.6	62	66
Canada	275	59.6	306	58.9	147	31.9	174	33.5	32	6.9	38	7.3	461	519
Denmark	41	77.8	51	78.7	10	20.0	12	18.8	1	1.9	2	2.4	52	64
France	241	61.8	241	59.8	123	31.5	138	34.3	21	5.4	18	4.4	391	402
Germany	824	81.3	694	77.6	162	16.0	175	19.6	28	2.7	25	2.8	1,014	894
Greece[b]	62	72.7	66	72.1	15	17.8	17	18.8	8	9.1	8	8.8	85	92
Ireland[b]	24	78.6	26	76.1	5	15.9	7	18.8	2	5.3	2	5.0	31	35
Italy[b]	307	70.9	303	69.1	96	22.1	110	25.1	28	6.4	23	5.2	433	438
Japan	846	75.2	899	73.1	207	18.4	251	20.4	59	5.2	60	4.8	1,125	1,231
Netherlands[b]	129	80.2	149	80.3	29	17.7	33	18.1	2	1.2	2	0.9	161	185
New Zealand	14	56.3	16	51.9	9	34.2	11	37.1	2	9.5	1	2.3	25	30
Norway	15	41.5	18	43.9	14	39.2	15	36.9	7	18.9	8	18.7	35	41
Poland	342	89.9	324	89.7	29	7.6	27	7.4	9	2.4	11	2.9	381	362
Portugal	29	62.3	30	59.6	14	29.8	17	33.1	3	7.3	3	6.7	47	51
Russian Federation[b]	2,326	98.0	1,619	97.5	–	0.0	–	0.0	46	2.0	24	1.4	2,372	1,660
Spain[b]	150	66.1	166	66.9	58	25.7	64	25.9	18	7.8	17	7.0	226	248
Sweden	33	59.0	33	58.8	19	33.6	20	34.6	4	6.8	4	6.6	55	56
Switzerland	26	57.1	24	56.5	15	32.5	15	35.2	3	7.5	2	5.1	45	43
United Kingdom	453	77.6	405	74.9	116	19.9	124	22.9	14	2.4	12	2.2	583	541
United States	3,390	68.6	3,756	68.8	1,499	30.3	1,635	30.0	55	1.1	65	1.2	4,943	5,456

Source:
United Nations Framework Convention on Climate Change, Greenhouse Gas Inventory Database, www.unfccc.de/resource, April 2000.
(Additional resources: www.unfccc.de)

[a]National totals excluding land-use change and forestry.

[b]1997 data were not available. Australia, Greece, Ireland, and the Netherlands data are 1996; Italy and Spain data are 1995; and Russian Federation data are 1994.

Table 3.4
Estimated U.S. Emissions of Greenhouse Gases, 1990–98

Greenhouse gas	Unit of measure[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998
Carbon dioxide	million metric tons of gas	4,939.0	4,886.0	4,972.9	5,109.5	5,169.7	5,220.5	5,395.6	5,464.9	5,483.4
	million metric tons of carbon	1,347.0	1,333.0	1,356.0	1,389.0	1,410.0	1,424.0	1,472.0	1,490.0	1,495.0
Methane	million metric tons of gas	30.2	30.5	30.6	29.9	30.0	30.2	29.3	29.3	28.8
	million metric tons of carbon (gwp)[b]	173.0	174.0	175.0	171.0	172.0	173.0	168.0	168.0	165.0
Nitrous oxide	million metric tons of gas	1.2	1.2	1.2	1.2	1.3	1.3	1.2	1.2	1.2
	million metric tons of carbon (gwp)[b]	99.0	101.0	103.0	103.0	111.0	106.0	105.0	104.0	103.0
Carbon monoxide	million metric tons of gas	86.8	88.6	85.5	85.6	89.5	80.7	82.3	79.2	c
Nitrogen oxide	million metric tons of gas	21.2	21.3	21.6	21.8	22.1	21.5	21.3	21.4	c
Nonmethane VOCs[d]	million metric tons of gas	18.9	19.0	18.6	18.8	19.4	18.6	17.4	17.3	c
CFC-11,12,113[d]	million metric tons of gas	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0
HCFC-22[d]	million metric tons of gas	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
HCFC-23 and PFCs[d]	million metric tons of carbon (gwp)”	22.0	22.0	23.0	24.0	26.0	32.0	36.0	38.0	40.0

Source:

U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States*, 1998, Washington, DC, October 1999, p. ix, x. (Additional resources: www.eia.doe.gov)

Criteria pollutants (CO, NO,, VOC) -U.S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1997*, 1998, pp. A-6, A-l 1, A- 18. (Additional resources: www.epa.gov/oar/oaqps)

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[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.

‘Data are not available.

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

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, 1984-98”
(million metric tons of carbon)

End use	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy consumption sectors															
Residential	241.1	245.8	244.0	251.0	264.8	267.5	253.1	257.1	255.9	271.7	268.3	270.3	285.9	284.8	284.5
Commercial	188.8	189.6	190.4	197.2	207.6	210.1	206.7	206.4	205.4	211.3	213.8	217.9	226.0	238.0	238.4
Industrial	434.4	424.1	409.0	422.7	444.1	450.4	453.7	442.2	459.8	458.9	467.1	466.0	480.0	483.7	477.7
Transportation	379.0	384.4	399.1	411.1	427.5	432.7	432.8	424.3	431.1	436.4	449.1	457.6	468.7	473.4	484.9
Percentage	30.5%	30.9%	32.1%	32.1%	31.8%	31.8%	32.2%	31.9%	31.9%	31.7%	32.1%	32.4%	32.1%	32.0%	32.6%
Total energy	**1,243.3**	**1,243.9**	**1,242.5**	**1,282.0**	**1,344.0**	**1,360.9**	**1,345.2**	**1,330.0**	**1,351.3**	**1,378.2**	**1,398.3**	**1,411.7**	**1,460.5**	**1,478.0**	**1,485.4**
Electric utility sector															
Electric utility[b]	427.9	438.9	435.4	452.6	475.9	484.0	476.7	473.3	472.8	490.5	494.0	495.2	513.0	532.8	549.8

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1998,* Washington, DC, October 1999, p. 22, and annual. (Additional resources: www.eia.doe.gov)

“Includes energy from petroleum, coal, and natural gas. Electric utility emissions are distributed across consumption sectors.
[b]Does not include estimates of carbon dioxide emissions from the use of flue gas desulfurization.

Table 3.6
U.S. Carbon Dioxide Emissions from Energy Use in the Transportation Sector, 1980–98
(million metric tons of carbon)

	1980		1985		1990		1995		1998	
Fuel	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%	279.9	61.1%	294.6	60.8%
LPG[a]	0.3	0.1%	0.5	0.1%	0.4	0.1%	0.3	0.1%	0.2	0.0%
Jet fuel	42.0	11.1%	48.0	12.5%	60.1	13.9%	60.0	13.1%	64.2	13.2%
Distillate fuel	55.3	14.6%	63.3	16.5%	75.7	17.5%	85.1	18.6%	96.9	20.0%
Residual fuel	30.0	7.9%	16.7	4.3%	21.9	5.1%	19.7	4.3%	14.9	3.1%
Lubricants	1.8	0.5%	1.6	0.4%	1.8	0.4%	1.7	0.4%	1.8	0.4%
Aviation gas	1.2	0.3%	0.9	0.2%	0.8	0.2%	0.7	0.2%	0.7	0.2%
Total	368.7	97.4%	376.1	97.8%	421.5	97.5%	447.4	97.6%	473.4	97.6%
Other energy										
Natural gas	9.4	2.5%	7.5	2.0%	9.8	2.3%	10.4	2.3%	10.8	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%	484.9	100.0%

Source:
U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1998,* Washington, DC, October 1999, p. 24, and annual. (Additional resources: 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 1998,* Washington, DC, October 1999, p. 8. Original source: Intergovernmental Panel on Climate Change. (Additional resources: www.eia.doe.gov, www.ipcc.ch)

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

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

The energy in greenhouse gas estimates of the most recent version (Version 1.5a) of the GREET model are displayed in the next two tables. The model estimates the full fuel-cycle emissions and energy use associated withvarious transportation fuels and advanced transportation technologies for light-duty vehicles. It calculates fuel-cycle emissions of **three greenhouse gases** (carbon dioxide, methane, and nitrous oxide) and five criteria pollutants (volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter measuring 10 microns or less). **See Chapter 4 for the criteria pollutant data from GREET.** The model also calculates the total fuel-cycle energy consumption, fossil fuel consumption, and petroleum consumption using various transportation fuels. The fuel cycles that are included in the GREET model are:

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

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 20 10 model-year cars.

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

Michael Q. Wang
Argonne National Laboratory
9700 South Cass Avenue, ES/362
Argonne, IL 60439-48 15
phone: 630-252-2819
fax: 630-252-3443
email: mqwang@anl.gov

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

Acronyms Used on Tables 3.8 and 3.9

Emissions acronyms

CO_2	carbon dioxide
GHGs	greenhouse gases

Geographical acronyms

CA	California
NE	northeast
US	United States

Technologies acronyms

BD20	mixture of 20% biodiesel and 80% conventional diesel (by volume)
CARFG2	California Phase 2 reformulated gasoline
CD	conventional diesel
CIDI	compression ignition, direct injection
CNG	compressed natural gas
CNGV	compressed natural gas vehicle
Dedi.	dedicated
DME	dimethyl ether
E10	mixture of 10% ethanol and 90% gasoline (by volume)
E85	mixture of 85% ethanol and 15% gasoline (by volume)
E90	mixture of 90% ethanol and 10% gasoline (by volume)
ETBE	ethyl tertiary butyl ether
EtOH	ethanol
EtOHV	ethanol vehicle
EV	electric vehicle
FCV	fuel-cell vehicle
FFV	flexible fuel vehicle
FRFG2	Federal Phase 2 reformulated gasoline
FG	flared gas
FT50	mixture of 50% Fischer-Tropsch diesel and 50% conventional diesel (by volume)
FT100	100% Fischer-Tropsch diesel
GC	grid-connected
GI	grid-independent
GHGs	greenhouse gases
GV	gasoline vehicle
H_2	hydrogen
HB	herbaceous biomass
HEV	hybrid electric vehicle
LFG	land-fill gas
LNG	liquefied natural gas
LNGV	liquefied natural gas vehicle
LPG	liquefied petroleum gas
LPGV	liquefied petroleum gas vehicle
M85	mixture of 85% methanol and 15% gasoline by volume
M90	mixture of 90% methanol and 10% gasoline by volume
MeOH	methanol
MeOHV	methanol vehicle
MTBE	methyl tertiary butyl ether
NG	natural gas
RFD	reformulated diesel
SI	spark ignition
SIDI	spark-ignition, direct-injection
WB	woody biomass

Table 3.8

NEAR-TERM Technology (for MY 2000 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to conventional gasoline vehicles fueled with conventional gasoline)

	GV: FRFG2, MTBE	GV: FRFG2, EtOH	CIDI: CD	Bi-Fuel CNGV on CNG	Dedi. CNGV	Dedi. LPGV: NG	Dedi. LPGV: Crude	M85 FFV: NG	E85 FFV: Corn
Total Emissions:									
Total Energy	0.0%	0.4%	**-29.7%**	8.6%	5.1%	-9.6%	-8.6%	15.3%	17.8%
Fossil fuels	0.0%	-3.5%	-29.6%	6.9%	3.4%	-9.2%	-8.6%	16.0%	-41.9%
Petroleum	-11.0%	-3.6%	-26.7%	-99.3%	-99.4%	-98.2%	-3.4%	-72.6%	-74.3%
CO_2	1.8%	-5.0%	-23.5%	-9.9%	-12.8%	-11.6%	-9.8%	-1.9%	-36.3%
GHGs	2.2%	-4.2%	-24.3%	-4.1%	-6.7%	-11.0%	-9.6%	-1.7%	-25.8%

	E10 GV: Corn	EV: US Mix	EV: NE US Mix	EV: CA Mix	GC SIDI HEV: CARFG2, EtOH, CA Mix	GI SIDI HEV: FRFG2, MTBE	GI SIDI HEV: FRFG2, EtOH	GI CIDI HEV: CD
Total Emissions:								
Total Energy	2.0%	-13.7%	-14.2%	-17.0%	-35.8%	-47.4%	-47.2%	-52.5%
Fossil fuels	-3.4%	-39.1%	-46.4%	-69.0%	-52.6%	-47.4%	-49.2%	-52.5%
Petroleum	-6.3%	-98.2%	-96.8%	-99.6%	-61.7%	-53.2%	-49.3%	-50.6%
CO_2	-2.9%	-25.5%	-41.5%	-70.3%	-54.0%	-46.5%	-50.0%	-48.4%
GHGs	-1.9%	-26.7%	-41.9%	-70.1%	-53.1%	-45.2%	-48.6%	-48.5%

Source:

Wang, Michael Q., GREET 1.5a Model Results, Argonne National Laboratory, Argonne, IL, April 2000.

Note: See page preceding Table 3.8 for acronym definitions.

Table 3.9

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	Dedi. CNGV	Dedi. LNGV: NG	Dedi. LNGV: FG	Dedi. LPGV: NG	Dedi. LPGV: Crude	Dedi. MeOHV: M90, NG	Dedi. MeOHV: M90, FG	Dedi. EtOHV: E90, Corn	Dedi. EtOHV: E90, WB
Total Emissions:									
Total Energy	-8.5%	-5.7%	-89.8%	-17.8%	-16.9%	10.5%	-77.5%	10.1%	90.7%
Fossil fuels	-9.4%	-5.2%	-90.0%	-17.5%	-16.9%	11.1%	-77.7%	-52.0%	-88.7%
Petroleum	-99.4%	-97.8%	-95.9%	-98.2%	-1.3%	-78.1%	-78.1%	-80.1%	-76.1%
CO_2	-25.0%	-24.5%	-93.3%	-21.0%	-19.5%	-8.1%	-77.1%	-49.8%	-122.8%
GHGs	-22.0%	-21.5%	-90.0%	-20.7%	-19.4%	-8.2%	-75.5%	-40.3%	-115.4%

	Dedi. EtOHV: E90. HB	SIDI: FRFG2, EtOH	Dedi. MeOH SIDI: M90, NG	Dedi. MeOH SIDI: M90, FG	Dedi. EtOH SIDI: E90, corn	Dedi. EtOH SIDI: E90, WB	Dedi. EtOH SIDI: E90, HB	GI SIDI HEV: FRFG2, EtOH	GI SI HEV: CNG
Total Emissions:									
Total Energy	77.6%	-20.0%	-5.2%	-82.7%	-3.1%	67.8%	56.3%	-47.4%	-43.5%
Fossil fuels	-80.5%	-20.0%	-4.7%	-135.5%	-57.8%	-90.1%	-82.8%	-47.4%	-44.0%
Petroleum	-78.5%	-20.0%	-82.1%	-82.1%	-82.5%	-78.9%	-81.1%	-47.4%	-99.6%
CO_2	-94.9%	-20.0%	-21.4%	-82.1%	-55.8%	-120.1%	-95.5%	-47.4%	-53.7%
GHGs	-80.7%	-19.5%	-21.2%	-80.5%	-47.2%	-113.3%	-82.8%	-46.3%	-51.0%

Table continued on next page. See page preceding Table 3.8 for acronym definitions.

Table 3.9 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GI SI HEV: LNG, NG	GI SI HEV: LNG, FG	GI SI HEV: LPG, NG	GI SI HEV: LPG, Crude	GI SIDI HEV: M90, NG	GI SIDI HEV: M90, FG	GI SIDI HEV: E90, corn	GI SIDI HEV: E90, WB	GI SIDI HEV: E90, HB
Total Emissions:									
Total Energy	-41.8%	-93.7%	-46.8%	-46.2%	-54.0%	-54.1%	-36.3%	10.4%	2.8%
Fossil fuels	-4 1.4%	-93.8%	-46.6%	-46.3%	-35.7%	-121.7%	-72.2%	-93.5%	-88.7%
Petroleum	-98.7%	-97.5%	-98.8%	-36.1%	-87.3%	-87.3%	-88.5%	-86.1%	-87.5%
c o 2	-53.4%	-95.9%	-48.9%	-47.9%	-46.8%	-86.8%	-71.0%	-113.3%	-97.1%
GHGs	-50.7%	-93.0%	-47.9%	-47.1%	-46.0%	-85.0%	-64.5%	-107.9%	-87.9%

	GC SIDI HEV: RFG2, EtOH. US Mix	GC SIDI HEV: RFG2, EtOH, NE US Mix	GC SIDI HEV: RFG2, EtOH, CA Mix	GC SI HEV: CNG, US Mix	GC SI HEV: CNG, NE US Mix	GC SI HEV: CNG, CA Mix	GC SI HEV: LNG, NG, US Mix	GC SI HEV: LNG, FG, US Mix	GC SI HEV: LNG, NG, NE US Mix
Total Emissions:									
Total Energy	-43.9%	-44.4%	-44.1%	-40.9%	-41.5%	-41.2%	-39.7%	-77.2%	-40.2%
Fossil fuels	-47.5%	-48.8%	-55.3%	-45.9%	-47.3%	-54.0%	-44.0%	-81.8%	-45.2%
Petroleum	-61.4%	-61.3%	-61.7%	-99.3%	-99.2%	-99.7%	-98.7%	-97.8%	-98.5%
c o 2	-44.5%	-48.1%	-55.6%	-50.2%	-53.9%	-61.6%	-50.0%	-80.7%	-53.2%
GHGs	-44.1%	-47.5%	-54.9%	-48.6%	-52.0%	-59.6%	-48.4%	-78.9%	-51.3%

Table continued on next page. See page preceding Table 3.8 for acronym definitions.

Table 3.9 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies
(percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC SI HEV: LNG, FG, NE US Mix	GC SI HEV: LNG, NG, CA Mix	GC SI HEV: LNG, FG, CA Mix	GC SI HEV: LPG, NG, US. Mix	GC SI HEV: LPG, Crude, U.S. Mix	GC SI HEV: LPG, NG, NE US Mix	GC SI HEV: LPG, Crude, NE US Mix	GC SI HEV: LPG, NG, CA Mix	GC SI HEV: LPG, Crude, CA Mix
Total Emissions:									
Total Energy	-77.7%	-40.0%	-77.4%	-43.3%	-42.9%	-43.9%	-43.5%	-43.6%	-43.2%
Fossil fuels	-83.1%	-51.0%	-89.4%	-47.7%	-47.5%	-49.0%	-48.8%	-55.0%	-55.0%
Petroleum	-97.6%	-98.9%	-98.1%	-98.8%	-53.6%	-98.6%	-53.4%	-99.1%	-53.8%
CO_2	-84.0%	-59.9%	-91.2%	-46.7%	-46.0%	-50.0%	-49.3%	-56.8%	-56.3%
GHGs	-82.1%	-57.9%	-89.1%	-46.4%	-45.8%	-49.4%	-48.9%	-56.1%	-55.8%

	GC SIDI HEV: M90, NG, US Mix	GC SIDI HEV: M90, FG, US Mix	GC SIDI HEV: M90, NG, NE US Mix	GC SIDI HEV: M90, FG, NE US Mix	GC SIDI HEV: M90, NG, CA Mix	GC SIDI HEV: M90, FG, CA Mix	GC SIDI HEV: E90, Corn, US Mix	GC SIDI HEV: E90, WB, US Mix	GC SIDI HEV: E90, HB, US Mix
Total Emissions:									
Total Energy	-35.7%	-72.3%	-36.2%	-72.9%	-35.9%	-72.6%	-35.9%	-2.3%	-7.8%
Fossil fuels	-40.0%	-101.8%	-41.2%	-103.2%	-47.1%	-109.7%	-66.2%	-81.5%	-78.1%
Petroleum	-90.5%	-90.5%	-90.3%	-90.3%	-90.8%	-90.8%	-91.3%	-89.7%	-90.7%
CO_2	-45.3%	-74.1%	-48.5%	-77.4%	-55.2%	-84.5%	-62.7%	-93.1%	-81.5%
GHGs	-45.1%	-73.1%	-48.1%	-76.3%	-54.6%	-83.2%	-58.4%	-89.6%	-75.2%

Table continued on next page. See page preceding Table 3.8 for acronym definitions.

Table 3.9 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC SIDI HEV: E90, Corn, NE US Mix	GC SIDI HEV: E90, WB, NE US Mix	GC SIDI HEV: E90, HB, NE US Mix	GC SIDI HEV: E90, Corn, CA Mix	GC SIDI HEV: E90, WB, CA Mix	GC SIDI HEV: E90, HB, CA Mix	CIDI: RFD	CIDI: DME, NG	CIDI: DME, FG
Total Emissions:									
Total Energy	-36.4%	-2.6%	-8.2%	-36.1%	-2.5%	-8.0%	-35.1%	-17.1%	-94.8%
Fossil fuels	-67.5%	-82.4%	-79.2%	-73.7%	-86.6%	-84.6%	-35.1%	-16.6%	-148.4%
Petroleum	-91.2%	-89.5%	-90.5%	-91.6%	-89.8%	-90.9%	-25.0%	-97.9%	-97.9%
CO_2	-66.0%	-95.4%	-84.4%	-73.0%	-100.4%	-90.6%	-30.7%	-33.5%	-94.5%
GHGs	-61.5%	-91.8%	-77.9%	-68.3%	-96.6%	-83.9%	-31.6%	-34.3%	-93.4%

	CIDI: FT100, NG	CIDI: FT100, FG	CIDI: BD20	GI CIDI HEV: RFD	GI CIDI HEV: DME, NG	GI CIDI HEV: DME, FG	GI CIDI HEV: FT100, NG	GI CIDI HEV: FT100, FG	GI CIDI HEV: BD20
Total Emissions:									
Total Energy	4.0%	-92.0%	-31.5%	-57.7%	-45.9%	-96.6%	-32.2%	-94.8%	-55.3%
Fossil fuels	4.7%	-145.6%	-31.7%	-57.7%	-45.6%	-131.6%	-31.7%	-129.8%	-55.5%
Petroleum	-97.5%	-97.5%	-36.7%	-51.1%	-98.6%	-98.6%	-98.4%	-98.4%	-58.7%
CO_2	-20.9%	-87.7%	-38.9%	-54.8%	-56.7%	-96.5%	-48.4%	-92.0%	-60.2%
GHGs	-22.3%	-87.3%	-39.3%	-55.0%	-56.7%	-95.3%	-48.9%	-91.3%	-60.0%

Table continued on next page. See page preceding Table 3.8 for acronym definitions.

Table 3.9 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC CIDI HEV: RFD, US Mix	GC CIDI HEV: RFD, NE US Mix	GC CIDI HEV: RFD, CA Mix	GC CIDI HEV: DME, NG, US Mix	GC CIDI HEV: DME, FG, US Mix	GC CIDI HEV: DME, NG, NE US Mix	GC CIDI HEV: DME, FG, NE US Mix	GC CIDI HEV: DME, NG, CA Mix	GC CIDI HEV: DME, FG, CA Mix
Total Emissions:									
Total Energy	-50.7%	-51.3%	-51.0%	-42.1%	-79.2%	-42.7%	-79.8%	-42.4%	-79.5%
Fossil fuels	-55.2%	-56.6%	-62.7%	-46.4%	-109.3%	-47.7%	-110.7%	-53.5%	-117.3%
Petroleum	-63.8%	-63.6%	-64.1%	-98.6%	-98.6%	-98.5%	-98.5%	-98.9%	-98.9%
CO_2	-50.5%	-53.8%	-60.7%	-51.9%	-81.0%	-55.0%	-84.3%	-61.7%	-91.4%
GHGs	-51.0%	-54.1%	-60.9%	-52.3%	-80.5%	-55.2%	-83.7%	-61.8%	-90.6%

	GC CIDI HEV: FT100, NG, US Mix	GC CIDI HEV: FT100, FG, US Mix	GC CIDI HEV: FT100, NG, NE US Mix	GC CIDI HEV: FT100, FG, NE US Mix	GC CIDI HEV: FT100, NG, CA Mix	GC CIDI HEV: FT100, FG, CA Mix	GC CIDI HEV: BD20, US Mix	GC CIDI HEV: BD20, NE US Mix	GC CIDI HEV: BD20, CA Mix
Total Emissions:									
Total Energy	-32.1%	-77.9%	-32.6%	-78.5%	-32.3%	-78.2%	-49.0%	-49.6%	-49.3%
Fossil fuels	-36.2%	-108.0%	-37.5%	-109.4%	-43.2%	-115.9%	-53.6%	-55.0%	-61.3%
Petroleum	-98.4%	-98.4%	-98.2%	-98.3%	-98.7%	-98.7%	-69.4%	-69.2%	-69.7%
CO_2	-45.8%	-77.7%	-48.9%	-81.0%	-55.5%	-88.1%	-54.4%	-57.8%	-65.0%
GHGs	-46.6%	-77.6%	-49.5%	-80.7%	-56.0%	-87.6%	-54.7%	-57.9%	-64.9%

Table continued on next page. See page preceding Table 3.8 for acronym definitions.

Table 3.9 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	Electric Vehicle, US Mix	Electric Vehicle, NE US Mix	Electric Vehicle, CA Mix	FCV: Gaseous H_2, NG, Central	FCV: Gaseous H_2, NG, Refueling Station	FCV: Gaseous H_2, Solar	FCV: Liquid H_2, NG	FCV: Liquid H_2, FG	FCV: Liquid H_2, Solar
Total Emissions:									
Total Energy	-39.0%	-40.9%	-39.9%	-53.8%	-48.3%	-62.6%	-38.9%	-86.9%	-71.9%
Fossil fuels	-54.0%	-58.4%	-79.0%	-55.8%	-49.8%	-91.4%	-39.4%	-87.1%	-71.7%
Petroleum	-98.7%	-98.2%	-99.6%	-99.6%	-96.5%	-99.8%	-99.1%	-99.2%	-98.5%
c o 2	-45.3%	-56.3%	-79.7%	-62.3%	-58.3%	-90.5%	-5 1.4%	-90.1%	-99.1%
GHGs	-46.3%	-56.7%	-79.8%	-63 .0%	-58.5%	-90.6%	-52.8%	-91.1%	-99.2%

	FCV: MeOH, NG	FCV: MeOH, FG	FCV: RFG2, EtOH	FCV: RFD	EtOH FCVs: Corn	EtOH FCVs: WB	EtOH FCVs: HB	NG FCV: CNG	FCV: LNG, NG
Total Emissions:									
Total Energy	-45.1%	-96.4%	-50.0%	-51.4%	-37.7%	13.9%	5.5%	-51.9%	-50.5%
Fossil fuels	-44.8%	-131.4%	-50.0%	-51.3%	-77.5%	-101.0%	-95.7%	-52.4%	-50.2%
Petroleum	-98.4%	-98.4%	-50.0%	-43.7%	-96.5%	-93.9%	-95.5%	-99.7%	-98.9%
c o 2	-56.0%	-96.2%	-50.0%	-48.0%	-76.1%	-122.8%	-104.9%	-60.5%	-60.3%
GHGs	-56.5%	-95.8%	-50.7%	-49.5%	-70.8%	-118.9%	-96.7%	-59.6%	-59.3%

Table continued on next page. See page preceding Table 3.8 for acronym definitions.

Table 3.9 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasolide)

	FCV: LNG, FG	FCV: LPG, NG	FCV: LPG, Crude
Total Emissions:			
Total Energy	-94.7%	-54.8%	-54.3%
Fossil fuels	-94.7%	-54.6%	-54.3%
Petroleum	-97.9%	-99.0%	-96.9%
CO_2	-96.4%	-56.5%	-55.7%
GHGs	-95.3%	-57.2%	-56.5%

Source:
Wang, Michael Q., GREET 1.5a Model Results, Argonne National Laboratory, Argonne, IL, April 2000.

Note: See page preceding Table 3.8 for acronym definitions.

Chapter 4
Criteria Pollutants

Summary Statistics from Tables in this Chapter

Source		
Table 4.1	Transportation's share of U.S. emissions, 1998	
	CO	*78.6%*
	NO_X	*53.4%*
	VOC	*43.5%*
	PM-10	*2.1%*
	PM-2.5	*7.2%*
	SO_2	*7.2%*
	NH_3	*5.2%*
Table 4.10	Transportation's share of lead emissions	
	1970	*82.3%*
	1998	*13.1%*

Table 4.1
Total National Emissions of the Criteria Air Pollutants by Sector, 1998
(millions of short tons/percentage)

Sector	c o	NO_x	v o c	PM-10	PM-2.5	SO,	NH,
Highway vehicles	50.39	7.77	5.33	0.26	0.20	0.33	0.25
	56.3%	31.8%	29.7%	0.7%	2.4%	1.7%	5.1%
Aircraft	0.96	0.16	0.18	0.04	0.03	0.01	0.00
	1.1%	0.7%	1.0%	0.1%	0.3%	0.1%	0.1%
Railroads	0.12	0.95	0.05	0.03	0.03	0.11	0.00
	0.1%	3.9%	0.3%	0.1%	0.4%	0.6%	0.0%
Vessels	0.14	1.00	0.04	0.04	0.04	0.26	0.00
	0.2%	4.1%	0.2%	0.1%	0.5%	1.3%	0.0%
Other off-highway	18.71	3.17	2.19	0.35	0.31	0.70	0.00
	20.9%	13.0%	12.2%	1.0%	3.7%	3.6%	0.0%
Transportation total	70.30	13.05	7.79	0.72	0.61	1.41	0.26
	78.6%	53.4%	43.5%	2.1%	7.2%	7.2%	5.2%
Stationary source fuel combustion	5.37	10.19	0.89	1.09	0.79	16.72	0.06
	6.0%	41.7%	5.0%	3.1%	9.4%	85.1%	1.2%
Industrial processes	3.71	0.80	8.02	0.71	0.39	1.46	0.25
	4.1%	3.3%	44.8%	2.0%	4.7%	7.4%	5.1%
Waste disposal and recycling total	1.15	0.10	0.43	0.31	0.24	0.04	0.09
	1.3%	0.4%	2.4%	0.9%	2.8%	0.2%	1.7%
Miscellaneous	8.92	0.33	0.79	31.92	6.35	0.01	4.28
	10.0%	1.3%	4.4%	91.9%	75.8%	0.1%	86.6%
Total of all sources	89.45	24.45	17.92	34.74	8.38	19.65	4.94
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source:
All other-U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1998, 2000,* Appendix A. (Additional resources: www.epa.gov/oar/oaqps)

Note:
CO = Carbon monoxide. NO, = Nitrogen oxides. PM-10 = Particulate matter less than 10 microns. PM-2.5 = Particulate matter less than 2.5 microns. SO, = Sulfur dioxide. VOC = Volatile organic compounds. NH, = Ammonia.

The transportation sector accountedfor more than three-fourths of the nation's carbon monoxide (CO) emissions in 1998. Highway vehicles are by far the source of the greatest amount of CO. For details on the highway emissions of CO, see Table 4.3.

Table 4.2
Total National Emissions of Carbon Monoxide, 1970–98[a]
(million short tons)

Source category	1970	1980	1990	1995	1997	1998	Percent of total, 1998
Highway vehicles	88.03	78.05	57.85	54.11	51.67	50.39	56.3%
Aircraft	0.51	0.74	0.90	0.94	0.96	0.96	1.1%
Railroads	0.07	0.10	0.12	0.11	0.12	0.12	0.1%
Vessels”	0.02	0.06	0.13	0.13	0.14	0.14	0.2%
Other off-highway	11.38	13.59	17.04	19.04	18.71	18.71	20.9%
Transportation total	100.00	92.54	76.04	74.33	70.30	70.30	78.6%
Stationary fuel combustion total	4.63	7.30	5.51	5.93	5.37	5.37	6.0%
Industrial processes total	9.84	6.95	4.77	4.61	3.71	3.71	4.1%
Waste disposal and recycling total	7.06	2.30	1.08	1.19	1.15	1.15	1.3%
Miscellaneous total	7.91	8.34	11.21	7.05	8.92	8.92	10.0%
Total of all sources	129.44	117.43	98.53	93.35	89.45	89.45	*100.0%*

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1998, 2000,* pp. A-l-A-5, and annual. (Additional resources: www.epa/oar/oaqps)

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

“The sums of subcategories may not equal total due to rounding.
“Recreational marine vessels.

Table 4.3
Emissions of Carbon Monoxide from Highway Vehicles, 1970–98[a]
(million short tons)

Source category	1970	1975	1980	1985	1990	1992	1993	1994	1995	1996	1997	1998	Percent of total, 1998
Gasoline powered													
Light vehicles &motorcycles	64.03	59.28	53.56	49.45	37.41	39.37	39.16	37.51	33.70	28.73	27.04	27.04	53.7%
Light trucks[b]	16.57	15.77	16.14	18.96	13.82	14.57	15.20	17.35	14.83	19.27	18.36	18.73	37.2%
Heavy vehicles	6.71	7.14	7.19	7.72	5.36	4.57	4.48	5.53	4.12	3.77	3.35	3.07	6.1%
Total	87.31	82.19	76.89	76.13	56.58	58.51	58.84	60.38	52.65	51.77	48.75	48.83	96.9%
Diesel powered													
Light vehicles	c	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.1%
Light trucks[b]	c	c	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0%
Heavy vehicles	0.72	0.92	1.14	1.24	1.23	1.32	1.33	1.41	1.41	1.45	1.47	1.51	3.0%
Total	0.72	0.95	1.16	1.26	1.27	1.35	1.37	1.45	1.45	1.49	1.51	1.55	3.1%
Total													
Highway vehicle total	**88.03**	83.13	78.05	77.39	57.85	59.86	60.20	61.83	54.11	53.26	50.26	50.39	100.0%
Percent diesel	0.8%	1.1%	1.5%	1.6%	2.2%	2.3%	2.3%	2.3%	2.7%	2.8%	3.0%	3.1%	

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1998*, 2000, p. A-3 and annual. (Additional resources: www.epa.gov/oar/oaqps)

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

The transportation sector accounted for over half of the nation's nitrogen oxide (NOx) emissions in 1998, with the majority coming from highway vehicles. For details on the highway emissions of NOx, see Table 4.5.

Table 4.4
Total National Emissions of Nitrogen Oxides, 1970–98[a]
(million short tons)

Source category	1970	1980	1990	1995	1997	1998	Percent of total, 1998
Highway vehicles	7.39	8.62	7.09	7.83	7.88	7.77	31.8%
Railroads	0.50	0.73	0.93	0.99	0.95	0.95	3.9%
Other off-highway	1.44	2.80	3.88	4.14	4.30	4.33	17.7%
Transportation total	9.32	12.15	11.89	12.95	13.13	13.05	53.3%
Stationary fuel combustion total	10.06	11.32	10.89	10.83	10.40	10.19	41.7%
Industrial processes total	0.78	0.56	0.80	0.77	0.79	0.80	3.3%
Waste disposal and recycling total	0.44	0.11	0.09	0.10	0.10	0.10	0.4%
Miscellaneous total	0.33	0.25	0.37	0.27	0.41	0.33	1.3%
Total of all sources	20.93	24.38	24.05	24.92	24.82	24.45	**100.0%**

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1998*, 2000, pp. A-6-A-10, and annual. (Additional resources: 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 4.5
Emissions of Nitrogen Oxides from Highway Vehicles, 1970–98[a]
(million short tons)

Source category	1970	1975	1980	1985	1990	1992	1993	1994	1995	1996	1997	1998	Percent of total, 1998
Gasoline powered													
Light vehicles & motorcycles	4.16	4.73	4.42	3.81	3.22	3.61	3.68	3.57	3.44	2.98	2.93	2.85	36.7%
Light trucks[b]	1.28	1.46	1.41	1.53	1.26	1.36	1.42	1.66	1.52	1.95	1.96	1.95	24.7%
Heavy vehicles	0.28	0.32	0.30	0.33	0.33	0.31	0.32	0.35	0.33	0.33	0.33	0.32	4.2%
Total	5.71	6.51	6.13	5.67	4.80	5.28	5.42	5.58	5.30	5.26	5.22	5.09	65.5%
Diesel powered													
Light vehicles	c	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.4%
Light trucks[b]	c	c	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.2%
Heavy vehicles	1.68	2.12	2.46	2.39	2.24	2.30	2.34	2.45	2.48	2.54	2.61	2.63	33.9%
Total	1.68	2.14	2.49	2.42	2.29	2.35	2.39	2.49	2.53	2.59	2.66	2.68	34.5%
Total													
Highway vehicle total	7.39	8.65	8.62	8.09	7.09	7.62	7.81	8.08	7.83	7.85	7.87	7.77	**100.0%**
Percent diesel	22.7%	24.8%	28.9%	30.0%	32.3%	30.8%	30.6%	30.9%	32.3%	33.0%	33.7%	34.5%	

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1998,* 2000, p. A-9 and annual.
(Additional resources: www.epa.gov/oar/oaqps)

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

The transportation sector accounted for over 40% of the nation's volatile organic compound (VOC) emissions in 1998, with the majority coming from highway vehicles. For details on the highway emissions of VOC, see Table 4.7.

Table 4.6
Total National Emissions of Volatile Organic Compounds, 1970–98[a]
(million short tons)

Source category	1970	1980	1990	1995	1997	1998	Percent of total, 1998
Highway vehicles	12.97	8.98	6.31	5.70	5.33	5.33	29.7%
Off-highway	1.71	2.14	2.55	2.70	2.46	2.46	13.7%
Transportation total	14.69	11.12	8.86	8.40	7.79	7.79	43.5%
Stationary fuel combustion total	0.72	1.05	1.01	1.07	0.89	0.89	5.0%
Industrial processes total	12.33	12.10	9.01	9.71	8.02	8.02	44.8%
Waste disposal and recycling total	1.98	0.76	0.99	1.07	0.43	0.43	2.4%
Miscellaneous total	1.10	1.13	1.07	0.57	1.26	0.79	4.4%
Total of all sources	30.82	26.17	20.94	20.82	18.88	17.92	100.0%

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1998*, 2000, pp. A-l 1-A-17, and annual. (Additional resources: www.epa.gov/oar/oaqps)

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

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

Table 4.7
Emissions of Volatile Organic Compounds from Highway Vehicles, 1970-98[a]
(thousand short tons)

Source category	1970	1975	1980	1985	1990	1992	1993	1994	1995	1996	1997	1998	Percent of total, 1998
Gasoline powered													
Light vehicles & motorcycles	9,193	7,248	5,907	5,864	3,947	3,832	3,812	3,748	3,426	2,875	2,796	2,832	47.6%
Light trucks[b]	2,770	2,289	2,059	2,425	1,622	1,588	1,647	1,909	1,629	2,060	2,017	2,015	33.9%
Heavy vehicles	1,206	1,038	830	988	662	739	772	906	735	917	889	877	14.7%
Total	13,169	10,575	8,796	9,277	6,231	6,159	6,231	6,563	5,790	5,852	5,702	5,724	96.3%
Diesel powered													
Light vehicles	c	15	8	8	13	13	13	13	14	12	12	12	0.2%
Light trucks[b]	c	c	2	2	3	3	3	4	4	5	5	5	0.1%
Heavy vehicles	266	335	392	360	297	302	301	313	302	245	227	205	3.4%
Total	266	350	402	370	313	318	317	330	320	262	244	222	3.7%
Total													
Highway vehicle total	13,435	10,925	9,198	9,647	6,544	6,477	6,548	6,893	6,110	6,114	5,946	5,946	100.0%
Percent diesel	2.0%	3.2%	4.4%	3.8%	4.8%	4.9%	4.8%	4.8%	5.2%	4.3%	4.1%	3.7%	

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1998,* 2000, p. A-16 and annual.
(Additional resources: www.epa.gov/oar/oaqps)

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

*The transportation sector accountedfor only 2% **of** the nation 's particulate matter (PM-l 0) emissions in 1998. For details on the highway emissions **of** PM-1 0, see Table 4.9.*

Table 4.8
Total National Emissions of Particulate Matter (PM-10), 1970-98”
(million short tons)

Source category	1970	1980	1990	1995	1996	1997	1998	Percent of total, 1998
Highway vehicles	0.44	0.40	0.34	0.29	0.28	0.27	0.26	0.7%
Off-highway	0.22	0.40	0.49	0.46	0.46	0.46	0.46	1.3%
Transportation total	0.66	0.80	0.83	0.75	0.74	0.73	0.72	2.1%
Stationary fuel combustion total	2.87	2.45	1.20	1.18	1.17	1.09	1.09	3.1%
Industrial processes total	7.67	2.75	1.04	0.95	0.68	0.70	0.71	2.0%
Waste disposal and recycling total	1.00	0.27	0.27	0.29	0.30	0.31	0.31	0.9%
Miscellaneous total	0.84	0.85	26.63	23.91	30.14	31.40	31.40	91.9%
Total of all sources	**13.04**	**7.12**	29.96	27.07	33.04	34.23	34.74	**100.0%**

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1998*, 2000, pp. A-22-A-26, 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.

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

Table 4.9
Emissions of Particulate Matter (PM-10) from Highway Vehicles, 1970-98[a]
(thousand short tons)

Source category	1970	1975	1980	1985	1990	1992	1993	1994	1995	1996	1997	1998	Percent of total, 1998
Gasoline powered													
Light vehicles & motorcycles	225	207	120	77	61	64	65	62	62	55	56	56	21.8%
Light trucks[b]	70	72	55	43	30	31	31	35	32	41	41	40	15.6%
Heavy vehicles	13	15	15	14	10	9	10	10	9	9	9	8	3.1%
Total	308	294	190	134	101	104	106	107	103	105	106	104	40.5%
Diesel powered													
Light vehicles	c	10	12	8	9	9	8	8	8	7	6	6	2.3%
Light trucks[b]	c	c	2	1	1	2	2	2	2	2	2	2	0.8%
Heavy vehicles	136	166	194	219	224	228	205	204	181	168	158	144	56.0%
Total	136	177	209	228	235	239	215	213	190	177	167	152	59.1%
Total													
Highway vehicle total	443	471	397	363	336	343	321	**320**	293	282	272	257	**100.0%**
Percent diesel	30.7%	37.6%	52.6%	62.8%	69.9%	69.7%	67.0%	66.6%	64.8%	62.8%	61.4%	59.1%	

Source:
U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1998, 2000,* p. A-25 and annual.
(Additional resources: www.epa.gov/oar/oaqps)

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

The transportation sector accounted for only 7% of the nation's particulate matter (PM-2.5) emissions in 1998. For details on the highway emissions of PM-2.5, see Table 4.11.

Table 4.10
Total National Emissions of Particulate Matter (PM-2.5), 1990–98
(million short tons)

Source category	1990	1991	1992	1993	1994	1995	1996	1997	1998	Percent of total, 1998
Highway vehicles	0.28	0.29	0.28	0.26	0.26	0.23	0.22	0.21	0.20	2.4%
Off-highway	0.44	0.43	0.43	0.43	0.42	0.40	0.41	0.41	0.41	4.9%
Transportation total	0.71	0.72	0.71	0.68	0.68	0.63	0.63	0.62	0.61	7.3%
Stationary fuel combustion total	0.91	0.89	0.93	0.85	0.84	0.90	0.86	0.79	0.79	9.4%
Industrial processes total	0.56	0.57	0.58	0.50	0.50	0.50	0.38	0.39	0.39	4.7%
Waste disposal and recycling total	0.23	0.24	0.24	0.29	0.27	0.25	0.23	0.24	0.24	2.8%
Miscellaneous total	5.55	5.31	5.19	5.00	5.68	4.90	6.09	6.45	6.35	75.7%
Total of all sources	7.96	7.74	7.65	7.33	7.98	**7.18**	8.20	8.48	8.38	**100.0%**

Source:
U.S. Environmental Protection Agency, *National Air Pollutant Emission Trends*, 1900-1998, 2000, pp. A-27-A-31, and annual.
(Additional resources: www.epa.gov/oar/oaqps)

Diesel vehicles are responsiblefor the majority of highway vehicle PM-2.5 emissions. Nearly two-thirds of the PM-2.5 emissions are from heavy diesel trucks.

Table 4.11
Emissions of Particulate Matter (PM-2.5) from Highway Vehicles, 1990–98[a]
(thousand short tons)

Source category	1990	1991	1992	1993	1994	1995	1996	1997	1998	Percent of total, 1998
Gasoline powered										
Light vehicles & motorcycles	37	38	38	38	36	36	32	32	33	16.8%
Light trucks[b]	19	21	20	20	23	20	25	25	25	12.7%
Heavy vehicles	7	6	6	7	7	6	6	6	5	2.5%
Total	63	65	64	65	66	62	63	63	63	32.0%
Diesel powered										
Light vehicles	8	8	8	7	7	7	6	6	5	2.5%
Light trucks[b]	1	1	2	1	2	2	2	2	2	1.0%
Heavy vehicles	203	212	206	183	182	161	149	140	127	64.5%
Total	212	221	216	192	190	169	157	147	134	68.0%
Total										
Highway vehicle total	275	286	280	257	256	231	221	**211**	**197**	**100.0%**
Percent diesel	77.1%	77.3%	77.1%	74.7%	74.2%	73.2%	71.0%	69.7%	68.0%	

Source:
U.S. Environmental Protection Agency, *National Air Pollutant Emission Trends*, 1900-1998, 2000, p. A-30 and annual.
(Additional resources: www.epa.gov/oar/oaqps)

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

*Historically the transportation sector, highway vehicles in particular, have been a **major source of** lead emissions in the U.S. Regulatory action in 1978 required a gradual reduction **of** the lead content **of** all gasoline over a period **of** many years. The transportation sector accounts **for** only 13% **of** lead emissions in 1998.*

Table 4.12
National Lead Emission Estimates, 1970–98[a]
(thousand short tons per year)

Source category	1970	1975	1980	1985	1990	1995	1996	1997	1998	Percent of total, 1998
Highway vehicles	171.96	130.21	60.50	18.05	0.42	0.02	0.02	0.02	0.02	0.5%
Off-highway	9.74	6.13	4.21	0.92	0.78	0.54	0.51	0.50	0.50	12.7%
Transportation total	181.70	136.34	64.71	18.97	1.20	0.56	0.52	0.52	0.52	13.1%
Stationary source fuel combustion	10.62	10.35	4.30	0.52	0.50	0.49	0.49	0.49	0.50	12.7%
Industrial processes	26.36	11.38	3.94	2.53	2.47	2.27	2.27	2.32	2.33	58.6%
Waste disposal and recycling total	2.20	1.60	1.21	0.87	4.98 0.80	3.93 0.60	3.90 0.61	3.95 0.62	3.97 0.62	100.0% 15.6%
Total of all sources	220.87	159.66	74.15	22.89						

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

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

Table 4.13
State-level Emissions for Criteria Pollutants, 1998
(thousand short tons)

State	Carbon monoxide	Nitrogen oxides”	Volatile organic compounds”	Sulfur dioxide	Particulate matter (PM- 10)	Particulate matter (PM-2.5)
Alabama	2,361	619	419	764	619	184
Alaska	2,249	99	457	12	274	155
Arizona	1,370	450	281	225	336	145
Arkansas	1,147	267	223	125	529	132
California	8,072	1,456	1,215	182	1,973	535
Colorado	1,200	400	274	137	518	126
Connecticut	793	153	156	66	119	30
District of Columbia	100	23	22	11	6	2
Delaware	216	77	51	96	39	14
Florida	5,203	1,059	891	1,008	822	260
Georgia	3,998	730	576	660	1,103	320
Hawaii	321	59	53	35	35	11
Idaho	956	116	115	39	678	161
Illinois	2,890	1,076	748	1,153	1,028	261
Indiana	2,526	848	518	1,164	641	154
Iowa	1,045	343	239	283	GO2	130
Kansas	1,230	479	257	163	1,570	299
Kentucky	1,389	682	330	753	345	103
Louisiana	2,184	825	425	405	441	149
Maine	488	94	109	53	158	102
Maryland	1,107	344	183	339	227	57
Massachusetts	1,188	304	264	264	290	72
Michigan	3,309	880	765	628	569	153
Minnesota	1,552	476	381	162	1,011	222
Mississippi	1,414	353	304	305	458	130
Missouri	1,816	546	360	482	1,286	252
Montana	703	176	105	GO	1,137	216
Nebraska	681	239	154	94	632	125
Nevada	520	157	98	66	143	39
New Hampshire	355	82	74	148	54	17
New Jersey	1,454	466	408	257	313	96
New Mexico	855	279	140	199	4,987	781
New York	3,337	723	753	688	767	222
N. Carolina	2,773	745	605	729	501	172
N. Dakota	380	235	105	327	430	92
Ohio	3,934	1,198	706	1,921	658	195
Oklahoma	1,518	440	295	157	1,033	193
Oregon	1,988	271	272	58	686	224
Pennsylvania	2,909	840	575	1,221	547	156
Rhode Island	221	35	49	12	25	8
S. Carolina	1,638	367	334	290	410	112
S. Dakota	333	119	78	53	349	73
Tennessee	2,037	761	528	789	375	130
Texas	5,644	2,140	1,388	1,096	3,655	733
Utah	942	233	161	79	238	69
Vermont	240	46	44	16	75	18
Virginia	2,149	532	471	373	409	118
Washington	2,035	364	347	155	430	149
W. Virginia	721	500	141	787	152	50
Wisconsin	1,600	480	400	378	391	112
Wyoming	361	270	68	179	663	122
Total	89,454	24,454	**17,917**	**19,647**	**34,741**	8,379

Source:
U.S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900–1998*, *2000,* p. 2-8.
(Additional resources: www.epa.gov/oar/oaqps)

Note:
The sums of the States may not equal national totals due to rounding.

[a] Excluding biogenics.

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

The energy and criteria pollutant estimates of the most recent version (Version 1 .5a) 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 vehicles. It calculates fuel-cycle emissions of **five criteria pollutants** (volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter measuring 10 microns or less) and three greenhouse gases (carbon dioxide, methane, and nitrous oxide). **See Chapter 3 for the greenhouse gas data from GREET.** The model also calculates the total fuel-cycle energy consumption, fossil fuel consumption, and petroleum consumption using various transportation fuels. The fuel cycles that are included in the GREET model are:

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

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 20 10 model-year cars.

For additional information about the GREET model, *see GREET 1. 5 – Transportation Fuel- Cycle Model, Volume 1: Methodology, Development, Use and Results*, ANL/ESD-39, Vol. 1, August 1999, or contact:

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

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

Acronyms Used on Tables 4.14 and 4.15

Emissions acronyms

CO	carbon monoxide
NOx	nitrogen oxides
PM10	particulate matter measuring 10 microns or less
SOx	sulfur oxides
VOC	volatile organic compounds

Geographical acronyms

CA	California
NE	northeast
US	United States

Technologies acronyms

BD20	mixture of 20% biodiesel and 80% conventional diesel (by volume)
CARFG2	California Phase 2 reformulated gasoline
CD	conventional diesel
CIDI	compression ignition, direct injection
CNG	compressed natural gas
CNGV	compressed natural gas vehicle
Dedi.	dedicated
DME	dimethyl ether
E10	mixture of 10% ethanol and 90% gasoline (by volume)
E85	mixture of 85% ethanol and 15% gasoline (by volume)
E90	mixture of 90% ethanol and 10% gasoline (by volume)
ETBE	ethyl tertiary butyl ether
EtOH	ethanol
EtOHV	ethanol vehicle
EV	electric vehicle
FCV	fuel-cell vehicle
FFV	flexible fuel vehicle
FRFG2	federal Phase 2 reformulated gasoline
FG	flared gas
FT50	mixture of 50% Fischer-Tropsch diesel and 50% conventional diesel (by volume)
FT100	100% Fischer-Tropsch diesel
GC	grid-connected
GI	grid-independent
GHGs	greenhouse gases
GV	gasoline vehicle
H_2	hydrogen
HB	herbaceous biomass
HEV	hybrid electric vehicle
LFG	land-fill gas
LNG	liquefied natural gas
LNGV	liquefied natural gas vehicle
LPG	liquefied petroleum gas
LPGV	liquefied petroleum gas vehicle
M85	mixture of 85% methanol and 15% gasoline by volume
M90	mixture of 90% methanol and 10% gasoline by volume
MeOH	methanol
MeOHV	methanol vehicle
MTBE	methyl tertiary butyl ether
NG	natural gas
RFD	reformulated diesel
SI	spark ignition
SIDI	spark-ignition, direct-injection
WB	woody biomass

Table 4.14
NEAR-TERM Technology (for MY 2000 vehicles)
Fuel-Cycle Energy and Criteria Pollutant Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to conventional gasoline vehicles fueled with conventional gasoline)

	GV: FRFG2, MTBE	GV: FRFG2, EtOH	CIDI: CD	Bi-Fuel CNGV on CNG	Dedi. CNGV	Dedi. LPGV: NG	Dedi. LPGV: Crude	M85 FFV: NG	E85 FFV: corn
Total Emissions:									
Total Energy	0.0%	0.4%	-29.7%	8.6%	5.1%	-9.6%	-8.6%	15.3%	17.8%
Fossil fuels	0.0%	-3.5%	-29.6%	6.9%	3.4%	-9.2%	-8.6%	16.0%	-41.9%
Petroleum	-11.0%	-3.6%	-26.7%	-99.3%	-99.4%	-98.2%	-3.4%	-72.6%	-74.3%
VOC	-15.6%	-11.1%	-61.5%	-52.0%	-75.0%	-64.2%	-59.3%	-19.3%	55.6%
CO	-19.1%	-19.5%	-79.4%	-19.0%	-19.0%	-25.0%	-24.6%	-22.7%	-37.4%
NOx	0.7%	2.8%	55.8%	35.0%	26.6%	-20.5%	-15.4%	1.4%	103.3%
PM10	-1.6%	38.9%	158.8%	-33.0%	-34.9%	-42.2%	-32.8%	-26.5%	619.9%
SOx	-28.8%	-16.2%	-31.3%	-28.3%	-30.6%	-77.3%	-57.3%	-58.7%	168.7%
Urban Emissions:									
VOC	-19.7%	-20.2%	-62.8%	-47.7%	-76.6%	-60.3%	-63.2%	-20.2%	-19.1%
CO	-20.0%	-20.0%	-80.5%	-19.5%	-19.5%	-24.9%	-24.9%	-25.0%	-39.9%
NOx	-4.2%	-4.6%	111.5%	29.8%	19.1%	-9.3%	-9.1%	-12.0%	-7.6%
PM10	-1.4%	-1.7%	258.6%	-29.8%	-31.7%	-31.3%	-31.3%	-22.8%	-20.7%
SOx	-82.7%	-82.9%	-4.0%	-96.0%	-96.1%	-98.1%	-98.0%	-73.7%	-79.0%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.14 (continued)

NEAR-TERM Technology (for MY 2000 vehicles)

Fuel-Cycle Energy and Criteria Pollutant Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to conventional gasoline vehicles fueled with conventional gasoline)

	El0 GV: corn	EV: US Mix	EV: NE US Mix	EV: CA Mix	GC SIDI HEV: CARFG2, EtOH, CA Mix	GI SIDI HEV: FRFG2, MTBE	GI SIDI HEV: FRFG2, EtOH	GI CIDI HEV: CD
Total Emissions:								
Total Energy	2.0%	-13.7%	-14.2%	-17.0%	-35.8%	-47.4%	-47.2%	-52.5%
Fossil fuels	-3.4%	-39.1%	-46.4%	-69.0%	-52.6%	-47.4%	-49.2%	-52.5%
Petroleum	-6.3%	-98.2%	-96.8%	-99.6%	-61.7%	-53.2%	-49.3%	-50.6%
v o c	14.7%	-88.7%	-91.5%	-96.1%	-50.6%	-34.1%	-31.7%	-65.2%
c o	-42.8%	-98.1%	-98.0%	-98.7%	-44.0%	-20.4%	-20.6%	-80.0%
NOx	10.1%	64.3%	14.3%	-50.5%	-24.5%	-17.2%	-16.1%	47.4%
PM10	57.7%	48.9%	12.3%	-30.3%	-3.0%	-12.2%	9.1%	151.8%
s o x	15.7%	464.9%	242.4%	-5.9%	-40.1%	-62.6%	-55.9%	-53.7%
Urban Emissions:								
v o c	10.5%	-99.8%	-99.5%	-99.6%	-51.1%	-30.4%	-30.6%	-63.7%
c o	-43.9%	-99.9%	-99.9%	-99.9%	-44.0%	-20.0%	-20.0%	-80.6%
NOx	0.2%	-95.8%	-90.8%	-93.2%	-29.3%	-1.8%	-2.0%	110.6%
PM10	0.1%	-35.9%	-33.3%	-34.7%	-6.3%	6.0%	5.8%	258.0%
SOx	-6.7%	-96.2%	-90.4%	-99.1%	-93.2%	-90.9%	-91.0%	-35.2%

Source:

Wang, Michael Q., GREET 1.5a Model Results, Argonne National Laboratory, Argonne, IL, April 2000.

Note: See page preceding Table 4.14 for acronym definitions.

Table 4.15

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	Dedi. CNGV	Dedi. LNGV: NG	Dedi. LNGV: FG	Dedi. LPGV: NG	Dedi. LPGV: Crude	Dedi. MeOHV: M90, NG	Dedi. MeOHV: M90, FG	Dedi. EtOHV: E90, Corn	Dedi. EtOHV: E90, WE3
Total Emissions:									
Total Energy	-8.5%	-5.7%	-89.8%	-17.8%	-16.9%	10.5%	-77.5%	10.1%	90.7%
Fossil fuels	-9.4%	-5.2%	-90.0%	-17.5%	-16.9%	11.1%	-77.7%	-52.0%	-88.7%
Petroleum	-99.4%	-97.8%	-95.9%	-98.2%	-1.3%	-78.1%	-78.1%	-80.1%	-76.1%
VOC	-63.3%	-54.1%	-59.8%	-56.8%	-50.8%	-13.8%	-20.0%	87.4%	20.2%
CO	-38.8%	-36.7%	-40.8%	-40.1%	-39.5%	2.4%	-2.2%	1.7%	15.1%
NOx	31.0%	77.6%	-23.3%	-38.4%	-29.8%	4.5%	-115.6%	156.9%	287.7%
PM10	-33.4%	-29.5%	-68.5%	-38.4%	-30.1%	-22.4%	-62.5%	601.2%	147.6%
SOx	-32.6%	-76.9%	-77.1%	-71.8%	-48.4%	-59.1%	-60.6%	140.8%	-159.8%
Urban Emissions:									
VOC	-57.1%	-58.2%	-58.6%	-47.4%	-51.1%	-11.1%	-11.1%	-9.4%	-9.4%
CO	-39.3%	-39.9%	-40.0%	-39.9%	-39.9%	-0.2%	-0.2%	0.0%	-0.1%
NOx	106.3%	-8.3%	-11.0%	-3.7%	-2.8%	-17.2%	-17.2%	7.4%	0.4%
PM10	-24.5%	-25.9%	-26.1%	-25.2%	-25.1%	-14.5%	-14.5%	-12.4%	-12.9%
SOx	-80.6%	-98.1%	-98.3%	-91.5%	-91.3%	-77.9%	-77.9%	-83.0%	-85.4%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	Dedi. EtOHV: E90, HB	SIDI: FRFG2, EtOH	Dedi. MeOH SIDI: M90, NG	Dedi. MeOH SIDI: M90, FG	Dedi. EtOH SIDI: E90, Corn	Dedi. EtOH SIDI: E90, WB	Dedi. EtOH SIDI: E90, HB	GI SIDI HEV: FRFG2, EtOH	GI SI HEV: CNG
Total Emissions:									
Total Energy	77.6%	-20.0%	-5.2%	-82.7%	-3.1%	67.8%	56.3%	-47.4%	-43.5%
Fossil fuels	-80.5%	-20.0%	-4.7%	-135.5%	-57.8%	-90.1%	-82.8%	-47.4%	-44.0%
Petroleum	-78.5%	-20.0%	-82.1%	-82.1%	-82.5%	-78.9%	-81.1%	-47.4%	-99.6%
VOC	13.9%	-11.4%	-22.8%	-28.3%	69.1%	10.0%	4.5%	-28.7%	-66.3%
CO	12.4%	-0.8%	1.2%	-2.9%	0.9%	12.7%	10.4%	-2.0%	-40.4%
NOx	307.8%	-16.6%	-14.0%	-119.6%	128.2%	243.2%	261.0%	-39.2%	-12.4%
PM10	129.9%	-4.2%	-20.2%	-55.4%	532.5%	133.3%	117.7%	-21.5%	-33.7%
SOx	-97.5%	-20.0%	-75.6%	-76.8%	111.9%	-152.6%	-97.8%	-47.4%	-58.3%
Urban Emissions:									
VOC	-9.5%	-7.3%	-15.8%	-15.8%	-14.4%	-14.4%	-14.5%	-32.1%	-58.3%
CO	0.0%	-0.1%	-0.2%	-0.2%	0.0%	-0.1%.	-0.1%	-0.1%	-39.6%
NOx	3.3%	-4.9%	-18.3%	-18.3%	3.4%	-2.8%	-0.2%	-11.7%	55.7%
PM10	-12.7%	12.0%	-2.1%	-2.1%	-0.3%	-0.7%	-0.5%	5.0%	-16.5%
SOx	-84.0%	-20.0%	-80.6%	-80.6%	-85.0%	-87.1%	-85.9%	-47.4%	-88.0%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GI SI HEV: LNG, NG	GI SI HEV: LNG, FG	GI SI HEV: LPG, NG	GI SI HEV: LPG, Crude	GI SIDI HEV: M90, NG	GI SIDI HEV: M90, FG	GI SIDI HEV: E90, Corn	GI SIDI HEV: E90, WB	GI SIDI HEV: E90, HB
Total Emissions:									
Total Energy	-41.8%	-93.7%	-46.8%	-46.2%	-54.0%	-54.1%	-36.3%	10.4%	2.8%
Fossil fuels	-41.4%	-93.8%	-46.6%	-46.3%	-35.7%	-121.7%	-72.2%	-93.5%	-88.7%
Petroleum	-98.7%	-97.5%	-98.8%	-36.1%	-87.3%	-87.3%	-88.5%	-86.1%	-87.5%
VOC	-60.6%	-64.1%	-60.5%	-56.6%	-33.5%	-37.1%	25.0%	-13.9%	-17.6%
CO	-39.1%	-41.6%	-41.1%	-40.7%	-0.7%	-3.3%	-1.1%	6.7%	5.1%
NOx	16.3%	-46.0%	-54.0%	-48.4%	-32.2%	-101.7%	56.1%	131.8%	143.5%
PM10	-31.3%	-55.4%	-36.5%	-31.1%	-25.6%	-48.7%	335.5%	72.9%	62.6%
SOx	-85.8%	-85.9%	-81.7%	-66.6%	-76.3%	-77.2%	39.4%	-134.6%	-98.6%
Urban Emissions:									
VOC	-58.9%	-59.2%	-50.0%	-52.4%	-25.7%	-25.7%	-24.7%	-24.7%	-24.8%
CO	-40.0%	-40.1%	-40.0%	-40.0%	-0.2%	-0.2%	-0.1%	-0.2%	-0.1%
NOx	-15.2%	-16.8%	-11.6%	-11.1%	-21.0%	-21.0%	-6.7%	-10.8%	-9.1%
PM10	-17.3%	-17.5%	-16.8%	-16.8%	-7.1%	-7.1%	-5.9%	-6.2%	-6.0%
SOx	-98.8%	-98.9%	-94.5%	-94.4%	-87.2%	-87.2%	-90.1%	-91.5%	-90.7%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC SIDI HEV: RFG2, EtOH, US Mix	GC SIDI HEV: RFG2, EtOH, NE US Mix	GC SIDI HEV: RFG2, EtOH, CA Mix	GC SI HEV: CNG, US Mix	GC SI HEV: CNG, NE US Mix	GC SI HEV: CNG, CA Mix	GC SI HEV: LNG, NG, US Mix	GC SI HEV: LNG, FG, US Mix	GC SI HEV: LNG, NG, NE US Mix
Total Emissions:									
Total Energy	-43.9%	-44.4%	-44.1%	-40.9%	-41.5%	-41.2%	-39.7%	-77.2%	-40.2%
Fossil fuels	-47.5%	-48.8%	-55.3%	-45.9%	-47.3%	-54.0%	-44.0%	-81.8%	-45.2%
Petroleum	-61.4%	-61.3%	-61.7%	-99.3%	-99.2%	-99.7%	-98.7%	-97.8%	-98.5%
v o c	-46.7%	-47.6%	-48.8%	-72.0%	-73.1%	-74.5%	-67.9%	-70.5%	-68.8%
c o	-30.6%	-30.6%	-30.9%	-44.2%	-44.1%	-44.5%	-43.2%	-45 .0%	-43.2%
NOx	4.9%	-12.3%	-37.0%	25.1%	6.9%	-19.5%	45.8%	0.9%	31.2%
PM10	-18.7%	-24.2%	-30.3%	-17.8%	-26.1%	-35.3%	-16.1%	-33.5%	-23.2%
s o x	68.1%	11.4%	-40.4%	73.3%	5.1%	-61.3%	53.5%	53.4%	-6.2%
Urban Emissions:									
v o c	-43.7%’	-43.6%	-43.7%	-69.2%	-69.1%	-69.2%	-69.7%	-69.8%	-69.6%
c o	-30.1%	-30.0%	-30.0%	-43.7%	-43.7%	-43.7%	-44.0%	-44.0%	-44.0%
NOx	-32.2%	-26.4%	-30.8%	16.3%	21.9%	17.7%	-34.8%	-36.0%	-29.4%
PM10	-6.1%	-5.6%	-6.0%	-21.2%	-20.6%	-21.1%	-21.8%	-21.9%	-21.3%
s o x	-59.2%	-55.9%	-61.4%	-88.1%	-84.4%	-90.7%	-95.9%	-96.0%	-92.7%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC SI HEV: LNG, FG, NE US Mix	GC SI HEV: LNG, NG, CA Mix	GC SI HEV: LNG, FG, CA Mix	GC SI HEV: LPG, NG, U.S. Mix	GC SI HEV: LPG, Crude, U.S. Mix	GC SI HEV: LPG, NG, NE US Mix	GC SI HEV: LPG, Crude, NE US Mix	GC SI HEV: LPG, NG, CA Mix	GC SI HEV: LPG, Crude, CA Mix
Total Emissions:									
Total Energy	-77.7%	-40.0%	-77.4%	-43.3%	-42.9%	-43.9%	-43.5%	-43.6%	-43.2%
Fossil fuels	-83.1%	-51.0%	-89.4%	-47.7%	-47.5%	-49.0%	-48.8%	-55.0%	-55.0%
Petroleum	-97.6%	-98.9%	-98.1%	-98.8%	-53.6%	-98.6%	-53.4%	-99.1%	-53.8%
v o c	-71.4%	-70.1%	-72.7%	-68.2%	-65.3%	-69.1%	-66.3%	-70.4%	-67.6%
c o	-45.0%	-43.5%	-45.3%	-44.7%	-44.4%	-44.6%	-44.3%	-45.0%	-44.7%
NOx	-15.5%	10.0%	-39.3%	-4.9%	-0.9%	-21.9%	-18.2%	-46.5%	-43.5%
PM10	-40.9%	-31.1%	-49.1%	-19.8%	-15.9%	-27.1%	-23.4%	-35.3%	-31.7%
s o x	-6.5%	-64.3%	-65.0%	56.4%	67.3%	-4.6%	5.8%	-64.0%	-54.1%
Urban Emissions:									
v o c	-69.8%	-69.6%	-69.8%	-63.6%	-65.3%	-63.5%	-65.2%	-63.6%	-65.3%
c o	-44.0%	-44.0%	-44.0%	-44.0%	-44.0%	-44.0%	-44.0%	-44.0%	-44.0%
NOx	-30.6%	-33.5%	-34.7%	-32.3%	-3 1.9%	-26.8%	-26.2%	-30.9%	-30.4%
PM10	-21.4%	-21.7%	-21.8%	-21.5%	-21.4%	-20.9%	-20.9%	-21.3%	-21.3%
s o x	-92.7%	-98.2%	-98.3%	-92.8%	-92.7%	-89.5%	-89.3%	-95.1%	-95.1%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies
(percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC SIDI HEV: M90, NG, US Mix	GC SIDI HEV: M90, FG, US Mix	GC SIDI HEV: M90, NG, NE US Mix	GC SIDI HEV: M90, FG, NE US Mix	GC SIDI HEV: M90, NG, CA Mix	GC SIDI HEV: M90, FG, CA Mix	GC SIDI HEV: E90, Corn, US Mix	GC SIDI HEV: E90, WB, US Mix	GC SIDI HEV: E90, HB, US Mix
Total Emissions:									
Total Energy	-35.7%	-72.3%	-36.2%	-72.9%	-35.9%	-72.6%	-35.9%	-2.3%	-7.8%
Fossil fuels	-40.0%	-101.8%	-41.2%	-103.2%	-47.1%	-109.7%	-66.2%	-81.5%	-78.1%
Petroleum	-90.5%	-90.5%	-90.3%	-90.3%	-90.8%	-90.8%	-91.3%	-89.7%	-90.7%
VOC	-50.0%	-52.6%	-50.9%	-53.5%	-52.1%	-54.7%	-7.9%	-35.9%	-38.5%
CO	-29.7%	-31.6%	-29.6%	-31.5%	-29.9%	-31.8%	-30.0%	-24.4%	-25.5%
NOx	10.7%	-39.2%	-5.5%	-57.3%	-29.0%	-83.6%	74.2%	128.6%	137.0%
PM10	-12.1%	-28.8%	-19.2%	-36.2%	-27.1%	-44.4%	247.5%	58.7%	51.3%
SOx	60.2%	59.6%	0.7%	0.0%	-57.3%	-58.2%	143.4%	18.3%	44.3%
Urban Emissions:									
VOC	-47.9%	-47.9%	-47.8%	-47.8%	-47.8%	-47.8%	-47.2%	-47.2%	-47.2%
CO	-30.1%	-30.1%	-30.1%	-30.1%	-30.1%	-30.1%	-30.1%	-30.1%	-30.1%
NOx	-39.0%	-39.0%	-33.5%	-33.5%	-37.7%	-37.7%	-28.8%	-31.7%	-30.5%
PM10	-14.7%	-14.7%	-14.2%	-14.2%	-14.6%	-14.6%	-13.8%	-14.0%	-13.9%
SOx	-87.6%	-87.6%	-84.3%	-84.3%	-89.8%	-89.8%	-89.7%	-90.7%	-90.1%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC SIDI HEV: E90, Corn, NE US Mix	GC SIDI HEV: E90, WB, NE US Mix	GC SIDI HEV: E90, HB, NE US Mix	GC SIDI HEV: E90, Corn, CA Mix	GC SIDI HEV: E90, WB, CA Mix	GC SIDI HEV: E90, HB, CA Mix	CIDI: RFD	CIDI: DME, NG	CIDI: DME, FG
Total Emissions:									
Total Energy	-36.4%	-2.6%	-8.2%	-36.1%	-2.5%	-8.0%	-35.1%	-17.1%	-94.8%
Fossil fuels	-67.5%	-82.4%	-79.2%	-73.7%	-86.6%	-84.6%	-35.1%	-16.6%	-148.4%
Petroleum	-91.2%	-89.5%	-90.5%	-91.6%	-89.8%	-90.9%	-25.0%	-97.9%	-97.9%
VOC	-8.7%	-36.4%	-39.3%	-9.9%	-37.2%	-40.3%	-62.4%	-73.5%	-83.9%
CO	-29.9%	-24.3%	-25.4%	-30.2%	-24.5%	-25.7%	-2.2%	-0.1%	-4.1%
NOx	60.4%	123.6%	128.5%	40.4%	116.4%	116.1%	-22.1%	-18.3%	-124.2%
PM10	244.5%	55.5%	46.4%	241.1%	51.9%	40.9%	-12.7%	-34.5%	-69.7%
SOx	97.1%	-19.9%	-6.0%	52.0%	-57.2%	-55.0%	-34.1%	-81.9%	-83.4%
Urban Emissions:									
VOC	-47.1%	-47.1%	-47.1%	-47.2%	-47.2%	-47.2%	-63.4%	-76.0%	-76.0%
CO	-30.0%	-30.1%	-30.0%	-30.0%	-30.1%	-30.1%	-0.1%	-0.3%	-0.3%
NOx	-23.4%	-28.3%	-25.9%	-27.4%	-30.9%	-29.3%	43.1%	32.7%	32.7%
PM10	-13.3%	-13.7%	-13.5%	-13.7%	-14.0%	-13.8%	-1.4%	-12.0%	-12.0%
SOx	-86.4%	-88.5%	-87.3%	-92.0%	-92.2%	-92.1%	6.8%	-95.7%	-95.7%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	CIDI: FT100, NG	CIDI: FTlOO, FG	CIDI: BD20	GI CIDI HEV: RFD	GI CIDI HEV: DME, NG	GI CIDI HEV: DME, FG	GI CIDI HEV: FTlOO, NG	GI CIDI HEV: FT100, FG	GI CIDI HEV: BD20
Total Emissions:									
Total Energy	4.0%	-92.0%	-31.5%	-57.7%	-45.9%	-96.6%	-32.2%	-94.8%	-55.3%
Fossil fuels	4.7%	-145.6%	-31.7%	-57.7%	-45.6%	-131.6%	-3 1.7%	-129.8%	-55.5%
Petroleum	-97.5%	-97.5%	-36.7%	-51.1%	-98.6%	-98.6%	-98.4%	-98.4%	-58.7%
v o c	-71.5%	-77.8%	-37.8%	-67.1%	-76.9%	-83.7%	-73.1%	-77.2%	-51.1%
c o	-0.2%	-4.9%	0.0%	-3.1%	-1.7%	-4.4%	-1.8%	-4.9%	-1.7%
NOx	-24.4%	-145.8%	20.9%	-38.6%	-36.1%	-105.2%	-40.1%	-119.3%	-10.6%
PM10	-34.3%	-74.9%	-5.9%	-20.1%	-36.5%	-59.5%	-35.7%	-62.2%	-16.4%
s o x	-82.6%	-83.5%	-32.6%	-57.0%	-88.2%	-89.2%	-88.6%	-89.3%	-56.1%
Urban Emissions:									
v o c	-66.7%	-66.7%	-61.3%	-64.6%	-76.3%	-76.3%	-66.8%	-66.8%	-63.2%
c o	-0.3%	-0.3%	0.5%	-0.2%	-0.3%	-0.3%	-0.3%	-0.3%	0.2%
NOx	33.0%	33.0%	78.6%	38.3%	31.5%	31.5%	31.7%	31.7%	61.4%
PM10	-8.9%	-8.9%	-0.8%	-2.0%	-12.1%	-12.1%	-9.0%	-9.0%	-2.7%
s o x	-94.9%	-94.9%	-9.6%	-30.4%	-97.2%	-97.2%	-96.7%	-96.7%	-41.1%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC CIDI HEV: RFD, US Mix	GC CIDI HEV: RFD, NE US Mix	GC CIDI HEV: RFD, CA Mix	GC CIDI HEV: DME, NG, US Mix	GC CIDI HEV: DME, FG, US Mix	GC CIDI HEV: DME, NG, NE US Mix	GC CIDI HEV: DME, FG, NE US Mix	GC CIDI HEV: DME, NG, CA Mix	GC CIDI HEV: DME, FG, CA Mix
Total Emissions:									
Total Energy	-50.7%	-51.3%	-51.0%	-42.1%	-79.2%	-42.7%	-79.8%	-42.4%	-79.5%
Fossil fuels	-55.2%	-56.6%	-62.7%	-46.4%	-109.3%	-47.7%	-110.7%	-53.5%	-117.3%
Petroleum	-63.8%	-63.6%	-64.1%	-98.6%	-98.6%	-98.5%	-98.5%	-98.9%	-98.9%
v o c	-73.5%	-74.5%	-75.8%	-80.5%	-85.4%	-81.4%	-86.3%	-82.7%	-87.6%
c o	-3 1.4%	-31.3%	-31.7%	-30.4%	-32.3%	-30.3%	-32.3%	-30.6%	-32.6%
NOx	6.3%	-10.4%	-34.7%	8.1%	-42.5%	-7.9%	-60.4%	-31.1%	-86.4%
PM10	-8.0%	-15.2%	-23.3%	-19.9%	-36.7%	-27.0%	-44.1%	-34.9%	-52.3%
s o x	74.7%	16.0%	-41.3%	51.9%	51.2%	-7.7%	-8.5%	-65.8%	-66.7%
Urban Emissions:									
v o c	-75.1%	-75.0%	-75.0%	-83.3%	-83.3%	-83.2%	-83.2%	-83.3%	-83.3%
c o	-30.2%	-30.1%	-30.2%	-30.2%	-30.2%	-30.1%	-30.1%	-30.1%	-30.1%
NOx	-3.8%	1.2%	-2.6%	-2.4%	-2.4%	2.6%	2.6%	-1.1%	-1.1%
PM10	-11.8%	-11.3%	-11.7%	-18.2%	-18.2%	-17.7%	-17.7%	-18.1%	-18.1%
SOx	-48.3%	-45.3%	-50.4%	-94.7%	-94.7%	-91.5%	-91.5%	-97.0%	-97.0%

Table continued on next page. See page preceding Table 4.14 for acronym definitions..

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	GC CIDI HEV: FT100, NG, US Mix	GC CIDI HEV: FT100, FG, US Mix	GC CIDI HEV: FT100, NG, NE US Mix	GC CIDI HEV: FT100, FG, NE US Mix	GC CIDI HEV: FT100, NG, CA Mix	GC CIDI HEV: FT100, FG, CA Mix	GC CIDI HEV: BD20, US Mix	GC CIDI HEV: BD20, NE US Mix	GC CIDI HEV: BD20, CA Mix
Total Emissions:									
Total Energy	-32.1%	-77.9%	-32.6%	-78.5%	-32.3%	-78.2%	-49.0%	-49.6%	-49.3%
Fossil fuels	-36.2%	-108.0%	-37.5%	-109.4%	-43.2%	-115.9%	-53.6%	-55.0%	-61.3%
Petroleum	-98.4%	-98.4%	-98.2%	-98.3%	-98.7%	-98.7%	-69.4%	-69.2%	-69.7%
VOC	-77.9%	-80.9%	-78.8%	-81.8%	-80.1%	-83.1%	-61.8%	-62.7%	-64.0%
CO	-30.4%	-32.7%	-30.4%	-32.6%	-30.7%	-32.9%	-30.3%	-30.3%	-30.6%
NOx	5.2%	-52.8%	-10.8%	-71.0%	-34.1%	-97.5%	26.8%	10.3%	-13.6%
PM10	-19.3%	-38.7%	-26.4%	-46.1%	-34.3%	-54.3%	-5.3%	-12.7%	-20.9%
SOx	51.5%	51.1%	-7.9%	-8.5%	-65.8%	-66.5%	75.4%	14.5%	-44.7%
Urban Emissions:									
VOC	-76.6%	-76.6%	-76.6%	-76.6%	-76.6%	-76.6%	-74.1%	-74.0%	-74.0%
CO	-30.2%	-30.2%	-30.1%	-30.1%	-30.1%	-30.1%	-29.8%	-29.8%	-29.8%
NOx	-2.2%	-2.2%	2.8%	2.8%	-0.9%	-0.9%	19.6%	24.6%	20.8%
PM10	-16.0%	-16.0%	-15.5%	-15.5%	-15.9%	-15.9%	-11.5%	-11.0%	-11.4%
SOx	-94.4%	-94.4%	-91.1%	-91.1%	-96.6%	-96.6%	-53.7%	-50.5%	-55.9%

Table continued on next page. See page preceding Table 4. 4 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	Electric Vehicle, US Mix	Electric Vehicle, NE US Mix	Electric Vehicle, CA Mix	FCV: Gaseous H_2, NG, Central	FCV: Gaseous H_2, NG, Refueling Station	FCV: Gaseous H_2, Solar	FCV: Liquid H_2, NG	FCV: Liquid H_2, FG	FCV: Liquid H_2, Solar
Total Emissions:									
Total Energy	-39.0%	-40.9%	-39.9%	-53.8%	-48.3%	-62.6%	-38.9%	-86.9%	-71.9%
Fossil fuels	-54.0%	-58.4%	-79.0%	-55.8%	-49.8%	-91.4%	-39.4%	-87.1%	-71.7%
Petroleum	-98.7%	-98.2%	-99.6%	-99.6%	-96.5%	-99.8%	-99.1%	-99.2%	-98.5%
v o c	-89.4%	-92.5%	-96.9%	-95.4%	-92.8%	-96.4%	-94.3%	-99.9%	-96.2%
c o	-97.6%	-97.4%	-98.5%	-96.9%	-95.6%	-98.8%	-96.3%	-99.8%	-99.4%
NOx	107.7%	49.7%	-34.4%	-30.8%	0.8%	-39.3%	-32.5%	-109.3%	-85.7%
PM10	18.6%	-7.0%	-35.5%	-39.7%	-37.2%	-42.0%	-37.4%	-62.8%	-49.4%
s o x	377.4%	178.8%	-14.6%	-22.6%	-33.6%	-28.4%	-87.6%	-93.1%	-98.8%
Urban Emissions:									
v o c	-99.7%	-99.5%	-99.7%	-99.7%	-94.7%	-99.4%	-99.5%	-99.5%	-99.0%
c o	-99.9%	-99.8%	-99.9%	-99.9%	-97.1%	-99.8%	-100.0%	-100.0%	-99.9%
NOx	-81.5%	-61.6%	-76.5%	-85.4%	102.7%	-72.7%	-94.5%	-94.6%	-88.2%
PM10	-32.5%	-30.6%	-32.0%	-33.7%	-26.1%	-33.4%	-33.5%	-33.5%	-32.6%
s o x	-89.3%	-78.5%	-96.7%	-98.3%	-98.0%	-98.3%	-99.4%	-99.4%	-98.7%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies (percentage relative to gasoline vehicles fueled with reformulated gasoline)

	FCV: MeOH, NG	FCV: MeOH, FG	FCV: RFG2, EtOH	FCV: RFD	EtOH FCVs: Corn	EtOH FCVs: WB	EtOH FCVs: HB	NG FCV: CNG	FCV: LNG, NG
Total Emissions:									
Total Energy	-45.1%	-96.4%	-50.0%	-51.4%	-37.7%	13.9%	5.5%	-51.9%	-50.5%
Fossil fuels	-44.8%	-131.4%	-50.0%	-51.3%	-77.5%	-101.0%	-95.7%	-52.4%	-50.2%
Petroleum	-98.4%	-98.4%	-50.0%	-43.7%	-96.5%	-93.9%	-95.5%	-99.7%	-98.9%
VOC	-70.7%	-74.3%	-52.8%	-85.0%	-4.0%	-47.0%	-51.1%	-88.3%	-83.4%
CO	-77.2%	-79.9%	-78.7%	-79.0%	-77.2%	-68.6%	-70.3%	-78.8%	-77.7%
NOx	-53.6%	-123.6%	-55.2%	-58.3%	50.1%	133.8%	146.7%	-36.9%	-12.4%
PM10	-46.8%	-70.2%	-41.5%	-39.3%	354.1%	63.7%	52.3%	-46.0%	-44.0%
SOx	-85.7%	-86.5%	-53.7%	-55.6%	45.9%	-146.5%	-106.6%	-65.4%	-87.9%
Urban Emissions:									
VOC	-73.5%	-73.5%	-54.1%	-90.8%	-72.0%	-72.0%	-72.0%	-87.9%	-88.5%
CO	-80.0%	-80.0%	-79.9%	-79.9%	-79.8%	-79.9%	-79.9%	-79.6%	-79.9%
NOx	-82.5%	-82.5%	-72.6%	-63.7%	-55.1%	-62.1%	-59.2%	-15.7%	-75.9%
PM10	-34.0%	-34.0%	-32.7%	-33.1%	-31.6%	-32.0%	-31.8%	-32.4%	-33.2%
SOx	-96.6%	-96.6%	-95.6%	-75.7%	-95.8%	-98.2%	-96.8%	-99.1%	-99.0%

Table continued on next page. See page preceding Table 4.14 for acronym definitions.

Table 4.15 (continued)

LONG-TERM Technology (for MY 2010 vehicles)

Fuel-Cycle Energy and Greenhouse Gas Emission Changes of Alternative Transportation Fuels and Advanced Vehicle Technologies
(percentage relative to gasoline vehicles fueled with reformulated gasoline)

	FCV: LNG, FG	FCV: LPG, NG	FCV: LPG, Crude
Total Emissions:			
Total Energy	-94.7%	-54.8%	-54.3%
Fossil fuels	-94.7%	-54.6%	-54.3%
Petroleum	-97.9%	-99.0%	-96.9%
v o c	-86.5%	-86.2%	-82.9%
c o	-79.9%	-79.4%	-79.1%
NOx	-65.4%	-72.2%	-67.5%
PM10	-64.5%	-48.3%	-43.8%
s o x	-88.0%	-84.5%	-71.6%
Urban Emissions:			
v o c	-88.7%	-84.8%	-86.8%
c o	-80.0%	-79.9%	-79.9%
NOx	-77.3%	-72.9%	-72.4%
PM10	-33.3%	-32.7%	-32.7%
s o x	-99.1%	-95.3%	-95.2%

Source:
Wang, Michael Q., GREET 1.5a Model Results, Argonne National Laboratory, Argonne, IL, April 2000.

Note: See page preceding Table 4.14 for acronym definitions.

The average light truck pollutes 40 percent more than the average car, according to the American Councilfor an Energy-Efficient Economy. One reason for the difference is that cars and light trucks have not been held to the same emissions standards. However, that is beginning to change.

Early in 2000, the Environmental Protection Agency issued a final rule for more stringent tailpipe emission standards for all new passenger vehicles, including sport utility vehicles (SUVs), minivans, vans, andpick-up trucks. This is thefirst time that SUVs and other light-duty trucks are subjected to the same national pollution standards as passenger cars.

Table 4.16
Pollution from a Typical New Car and Light Truck, 2000 Model Year
(pounds of pollutant per 15,000 miles of travel)

	Car	Light truck
Carbon dioxide	15,200	21,200
Carbon monoxide	420	547
Nitrogen oxide	50	83
Hydrocarbons	55	74
Particulate matter	2.7	3.3

Source:
DeCicco, John, and Martin Thomas, *Green Guide to Cars and Trucks: Model Year* 2000, American Council for an Energy-Efficient Economy, Washington, DC, 2000, p. 113. (Additional resources: www.aceee.org)

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

Table 4.17
Tier 2 Federal Emission Standards

Vehicle types	Standard	Time frame
Light-duty vehicles and light light-duty trucks (less than 6,000 lbs. GVW)	0.07 grams per mile NO,	Phased in 2004-2007
Heavy light-duty trucks (6,000–8,500 lbs. GVW) and medium-duty passenger vehicles (8,500–10,000 lbs. GVW)	0.07 grams per mile NO,	Phased in 2004-2009

Source:
U.S. Environmental Protection Agency, Office of Mobile Sources, Regulatory Announcement, *"EPA's Program for Cleaner Vehicles and Cleaner Gasoline,"* EPA420-F-99-051, December 1999. *(Federal Register,* Vol. 65, No. 28, Thursday, February 10, 2000.) (Additional resources: www.epa.gov/oms/tr2home.htm)

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

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

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

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

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

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

[d]No estimate available.

[e]No standard set.

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

Table 4.19

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

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

Source:

40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86.090-g; 40 CFR 86.091-g; 40 CFR 86,094-g; 40 CFR 86.096-2; 40 CFR 86.096-g; 40 CFR 86,099-g; 40 CFR 86.000-g; 40 CFR 86.001-g; 40 CFR 86.004-g. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication.

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

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

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

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

[e]No estimate available.

[f]No standard set.

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

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

Table 4.20
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT2) *a,b,c*
(grams per mile)

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

Source:
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86,090-g; 40 CFR 86.091-g; 40 CFR 86.094-g; 40 CFR 86.096-2; 40 CFR 86.096-g; 40 CFR 86,099-g; 40 CFR 86.000-g; 40 CFR 86.001-9; 40 CFR 86.004-g. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

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

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

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

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

[e]No estimate available.

[f]No standard set.

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

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

Table 4.21
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT3) *a,b,c*
(grams per mile)

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

Source:
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86.090-g; 40 CFR 86.091-g; 40 CFR 86.094-g; 40 CFR 86.096-2; 40 CFR 86.096-g; 40 CFR 86,099-g; 40 CFR 86.000-g; 40 CFR 86,001-g; 40 CFR 86.004-g. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

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

[b]The test procedure for measuring exhaust emissions has changed several times over the course of vehicle emissions regulation. The 7-mode procedure was used through model year 197 1 and was replaced by the CVS-72 procedure beginning in model year 1972. The CVS-75 became the test procedure as of model year 1975. While it may appear that the total hydrocarbon and carbon monoxide standards were relaxed in 1972-74, these standards were actually more stringent due to the more stringent nature of the CVS-72 test procedure. Additional standards for carbon monoxide and composite standards for non-methane hydrocarbons and nitrogen oxides tested over the new Supplemental Federal Test Procedure will be phased-in during model years 2002-04; these standards are not shown in this table.

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

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

[e]No estimate available.

[f]No standard set.

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

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

Table 4.22
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Light Trucks (Category LDT4) ***a,b,c***
(grams per mile)

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

Source:
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.090-2; 40 CFR 86.090-g; 40 CFR 86.091-g; 40 CFR 86.094-g; 40 CFR 86.096-2; 40 CFR 86.096-g; 40 CFR 86.099-g; 40 CFR 86,000-g; 40 CFR 86,001-g; 40 CFR 86.004-g. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

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

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

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

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

[e]No estimate available.

[f]No standard set.

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

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

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

Engine Type & Pollutant	1970-73	1974-78	1979-83	1984	1985-86	1987	1988-89	1990	1991-93	1994-97	1998-2003	2004+
Gasoline												
Hydrocarbons + nitrogen oxides (HC + NOx)	*a*	16	10		*a*							
Hydrocarbons (HC)	*b*	*a*	1.5		1.9	1.1						
Nitrogen oxides (NOx)	*a*				110.6			6.0	15.0		14.0	
Carbon Monoxide (CO)	*b*	(40	25		137.1	114.4						
Diesel												
Hydrocarbons + nitrogen oxides (HC + NOx)	*a*	16	10	*a*								
Hydrocarbons (HC)	*b*	*a*	1.5	1.3								
Nitrogen oxides (NOx)	*a*			10.7				6.0	5.0		4.0	
Non-methane hydrocarbons + nitrogen oxides	*a*											2.4*c*
Carbon Monoxide (CO)	*b*	40	(2 5	115.5								
Particulates	*a*						0.60		0.25	(0.10		
Smoke Opacity (acceleration/lugging/peak) d	40/20/*a*	20/15/50										
Weight Criteria for Light Heavy Trucks *e*	GVWR over 6,000 lbs		GVWR over 8,500 lbs			GVWR 8,501 through 14,000 Ibs						
Test Procedure (gasoline)*f*	9-mode steady-state				MVMA transient							
(diesel) *f*	13-mode steady-state			EPA transient								
Useful Life (gasoline) *g*	5 years/50,000 miles				8 years/l 10,000 miies							

Sources:
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.088-10; 40 CFR 86.090-2; 40 CFR 86.090-10; 40 CFR 86,090-l 1; 40 CFR 86.091-10; 40 CFR 86.091-l 1; 40 CFR 86.093-I 1; 40 CFR 86.094-I 1; 40 CFR 86.096-2; 40 CFR 86.096-10; 40 CFR 86,096-l 1; 40 CFR 86.098-10; 40 CFR 86,098-l 1; 40 CFR 86.099-10; 40 CFR 86,099-l 1; 40 CFR 86,004-l 1; 40 CFR 86.004-15. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999. Rob French, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

[a]No standard set.

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

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

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

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

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

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

Table 4.24
Federal Exhaust Emission Certification Standards for Gasoline- and Diesel-Powered Heavy Heavy Trucks
(Grams per brake horsepower-hour)

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

Sources:
40 CFR 86.082-2; 40 CFR 86.085-2; 40 CFR 86.088-10; 40 CFR 86.090-2; 40 CFR 86.090-10; 40 CFR 86.090-l 1; 40 CFR 86.091-10; 40 CFR 86.091-11; 40 CFR 86,093-l 1; 40 CFR 86,094-l 1; 40 CFR 86.096-2; 40 CFR 86.096-10; 40 CFR 86.096-l 1; 40 CFR 86.098-10; 40 CFR 86,098-l 1; 40 CFR 86.099-10; 40 CFR 86,099-l 1; 40 CFR 86.004-I 1; 40 CFR 86.004-15. Lisa Snapp, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999. Rob French, Office of Air and Radiation, Environmental Protection Agency, Personal communication, April 1999.

[a]No standard set

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

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

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

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

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

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

Table 4.25
***California* Passenger Cars and Light Trucks Emission Certification Standards**
(grams/mile)

Vehicle Type	Emission Category	Vehicle Useful Life: 5 Years / 50,000 Miles							10 Years / 100,000 Miles						
		THC	NMHC[b]	NMOG[c]	CO	NO_X	PM	HCHO	THC"	NMHC[b]	NMOG[c]	CO	NO,	PM	HCHO
Passenger car	Tier 0	–	0.39	–	7.0	0.4	0.08[d]	0.015"							
	Tier 1	–	0.25	–	3.4	0.4	0.08[d]	0.015"	–	0.31	–	4.2	0.6	–	–
	TLEV	–	–	0.125	'3.4	0.4	–	0.015	–	–	0.156	4.2	0.6	0.08[d]	0.018
	LEV	–	–	0.075	3.4	0.2	=	0.015	– –	_ –	0.090	4.2	0.3	0.08[d]	0.018
	ULEV			0.040	1.7	0.2		0.008			0.055	2.1	0.3	0.04[d]	0.011
	ZEV	0.0	0.00	0.000	0.0	0.0	0.00	0.000				0.00000	0.0	0.00	0.000
LDT1	Tier 0	–	0.39	–	9.0	0.4	0.08[d]	0.015"							
	Tier 1	–	0.25	–	3.4	0.4	0.08[d]	0.015"	–	0.31	–	4.2	0.6	–	–
	TLEV	–	–	0.125	3.4	0.4	–	0.015	–	–	0.156	4.2	0.6	0.08[d]	0.018
	LEV	–	–	0.075	3.4	0.2	–	0.015	–	–	0.090	4.2	0.3	0.08[d]	0.018
	ULEV	–	–	0.040	1.7	0.2	–	0.008	–	–	0.055	2.1	0.3	0.04[d]	0.011
	ZEV	0.0	0.00	0.000	0.0	0.0	0.00	0.000	0.00	0.00	0.000	0.0	0.0	0.00	0.000
LDT2	Tier 0	–	0.50	–	9.0	1.0	0.08[d]	0.018"							
	Tier 1	–	0.32	–	4.4	0.7	0.08[d]	0.018'	–	0.40	–	5.5	0.97	–	–
	TLEV	–	–	0.160	4.4	0.7	–	0.018	–	–	0.200	5.5	0.9	0.10[d]	0.023
	LEV	–	–	0.100	4.4	0.4	–	0.018	–	–	0.130	5.5	0.5	0.10[d]	0.023
	ULEV	–	–	0.050	2.2	0.4	–	0.009	–	–	0.070	2.8	0.5	0.05[d]	0.013

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

Note:
LDT1 = light truck up through 3,750 lbs. loaded vehicle weight; LDT2 = light truck greater than 3,750 lbs. loaded vehicle weight.

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

California's Low-Emission Vehicle regulations provide for reduced emission vehicles to be available to consumers. Vehicles meeting these stanclards 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 4.26
California Vehicle Emission Reduction for Passenger Cars and Light 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, www.arb.ca.gov/msprog/ccbg/ccbg.htm (Additional resources: www.arb.ca.gov)

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

[a] See Table 4.23.

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 4.27
California Air Resources Board Requirements for Meeting Emission Standards

Year	Conventional vehicles	Transitional low-emission vehicles	Low-emission vehicles	Ultra-low-emission vehicles	Zero emission vehicles
1993	100%				
1994	90%	10%			
1995	85%	15%			
1996	80%	20%			
1997	73%		25%	2%	
1998	48%		48%	2%	
1999	25%		73%	2%	
2000			90%	2%	
2001			90%	5%	
2002			85%	10%	
2003			75%	15%	10%

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

Chapter 5

Transportation and the Economy

Summary Statistics from Tables/Figures in this Chapter

Source		
Figure 5.1	Share of gasoline cost attributed to taxes, 1998	
	Canada	*47%*
	France	*80%*
	Germany	*74%*
	Japan	*60%*
	United Kingdom	*76%*
	United States	36%
Table 5.4	Retail prices for motor fuel in the U.S., 1999 (current cents per gallon)	
	Gasoline, average for all types	*122.1*
	Diesel fuel	97.0
Table 5.10	Average price of a new car, 1999 (current dollars)	21,022
	Domestic	*18,725*
	Import	30,350
Table 5.12	Automobile operating costs, 1999	
	Variable costs (constant 1998 dollars per 10,000 miles)	*1,039*
	Fixed costs (constant 1998 dollars per 10,000 miles)	4,635
Table 5.18	Transportation share of total employment	
	1960	*13.5%*
	1980	*11.3%*
	1998	*10.5%*

Table 5.1
Gasoline Prices for Selected Countries, 1978-99

	Current dollars per gallon									Average annual percentage change	
	1978"	1982"	1986[a]	1990[b]	1994[b]	1996[b]	1997[b]	1998[b]	1999[b]	1978-99	1990-99
China	d	d	d	d	d	0.93[b]	d	d	1.05	d	d
India	d	d	d	1.92	2.28	2.25"	2.65'	2.32 [c]	d	d	d
Japan	2.00'	2.60"	2.79'	3.05'	4.14	3.77	3.28'	2.94	3.13"	2.2%	0.3%
France	2.15	2.56	2.58	3.40	3.31	4.41	4.22	3.82	3.79	2.7%	1.2%
United Kingdom	1.22	2.42	2.07	2.55	2.86	3.47	4.25	3.90	3.97	5.8%	5.0%
Germany	1.75	2.17	1.88	2.72	3.34	4.32	3.87	3.33	3.36	3.2%	2.4%
UnitedCanadaStates[d]	0.69 0.66'	1.37" 1.32"	0.93' 1.31"	1.92" 1.04"	1.57 1.24	1.80 1.28	1.92 1.42	1.55 1.27	1.54 1.13	3.9% 2.6%	-2.4% 0.9%

	Constant 1998 dollars" per gallon									Average annual percentage change	
	1978"	1982"	1986"	1990[b]	1994[b]	1996[b]	1997[b]	1998[b]	1999[b]	1978-99	1990-99
China	d	d	d	d	d	**0.97**	d	d	**1.03**	d	d
India	d	d	d	2.40	2.51	2.34	2.69"	2.32"	d	d	d
Japan	5.00"	4.39'	4.15'	3.81"	4.55	3.92	3.33"	2.94	3.06"	-2.3%	-2.4%
France	5.37	4.32	3.84	4.24	3.64	4.58	4.29	3.82	3.71	-1.7%	-1.5%
United Kingdom	3.05	4.09	3.08	3.18	3.15	3.61	4.32	3.90	3.88	1.2%	2.2%
Germany	4.37	3.67	2.80	3.39	3.67	4.49	3.93	3.33	3.29	-1.3%	-0.2%
Canada	1.72"	2.31"	1.95"	2.40'	1.73	1.87	1.95	1.55	1.51	-0.6%	-5.0%
United States[e]	1.65"	2.23'	1.38'	1.30	1.36	1.33	1.44	1.27	1.11	-1.9%	-1.7%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual I998* Washington, DC, January 2000, Table 7.2 and annual.
(Additional resources: ww.eia.doe.gov)

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

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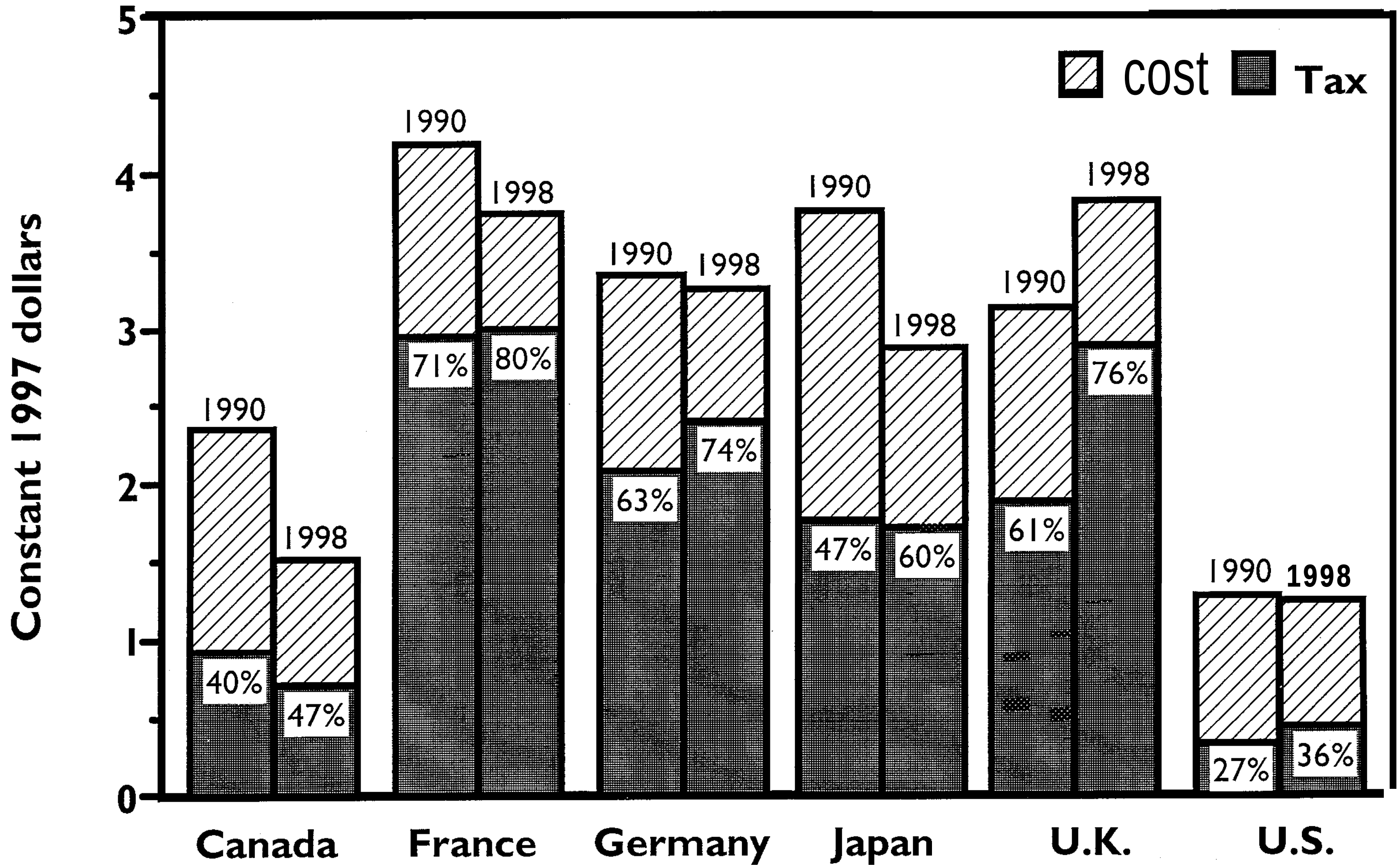
[a] Prices represent the retail prices (including taxes) for premium leaded gasoline. Prices are representative for each country based on quarterly data averaged for the year
[b] Regular gasoline.
[c] Data are not available.
[d] These estimates are for international comparisons only and do not necessarily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

Figure 5.1. Gasoline Prices for Selected Countries, 1990 and 1998



Source:
Table 5.1 and International Energy Agency, *Energy Prices and Taxes,* **Fourth** *Quarter 1998,* Paris, France, 1999.
(Additional resources: www.iea.org)

Table 5.2
Diesel Fuel Prices for Selected Countries, 1978-99

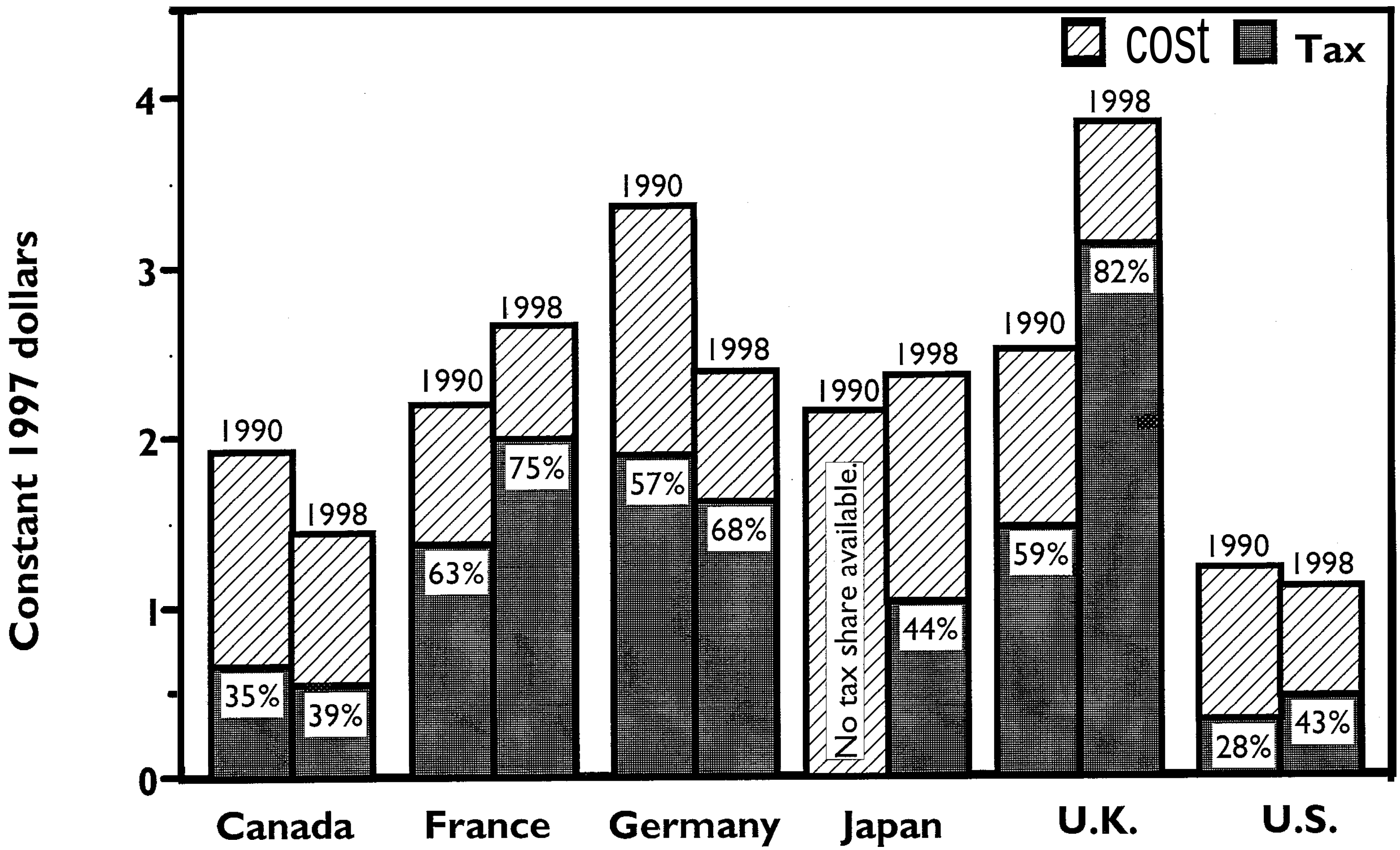
	Current dollars per gallon									Average annual percentage change	
	1978”	1982”	1986”	1990[b]	1994[b]	1996[b]	1997[b]	1998[b]	1999[b]	1978-99	1990-99
China	b	c	c	c	c	0.88	c	c	2.73	c	c
India	c	c	c	0.78	0.74	0.92	1.11	1.01	c	c	c
Japan	c	1.78	1.90	1.75	2.48	2.51	2.34	2.40	1.95	c	1.2%
France	1.30	1.88	1.69	1.78	2.10	3.10	3.08	2.71	2.23	2.6%	2.5%
United Kingdom	1.24	2.05	1.71	2.04	2.46	3.26	3.78	3.92	3.47	5.0%	6.1%
Germany	1.48	1.81	1.51	2.72	2.16	3.02	2.91	2.43	2.03	1.5%	-3.2%
Canada	c	1.27	1.27	1.55	1.47	1.43	1.56	1.46	1.32	c	-1.8%
United States[c]	0.54	1.16	0.94	0.99	0.96	1.15	1.29	1.12	0.97	2.8%	-0.2%
	Constant 1998 dollars[d] per gallon									Average annual percentage change	
	1978”	1982”	1986”	1990[b]	1994[b]	1996[b]	1997[b]	1998[b]	1999[b]	1978-99	1990-99
China	c	c	c	c	c	0.91	c	c	2.67	c	c
India	c	c	c	0.97	0.81	0.96	1.13	1.01	c	c	c
Japan	c	3.01	2.83	2.18	2.73	2.61	2.38	2.40	1.91	c	1.5%
France	3.25	3.18	2.51	2.22	2.31	3.22	3.13	2.71	2.18	-1.9%	-0.2%
United Kingdom	3.10	3.46	2.54	2.55	2.71	3.39	3.84	3.92	3.40	0.4%	3.2%
Germany	3.70	3.06	2.25	3.39	2.38	3.14	2.96	2.43	1.99	-2.9%	-5.7%
Canada	c	2.15	1.89	1.93	1.62	1.49	1.58	1.46	1.29	c	-4.4%
United States[d]	1.35	1.96	1.40	1.24	1.06	1.20	1.31	1.12	0.95	-1.7%	-2.9%

Source:
U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1998,* Washington, DC, January 2000, Table 7.2 and annual.
(Additional resources: www.eia.doe.gov)

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

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

Figure 5.2. Diesel Prices for Selected Countries, 1990 and 1998



Source:
Table 5.2 and International Energy Agency, *Energy Prices and Taxes, Fourth Quarter 1998*, Paris, France, 1999.
(Additional resources: www.iea.org)

Though the cost of crude oil certainly influences the price of gasoline, it is not the only factor which determines the price at the pump. Processing cost, transportation cost, and taxes also play a major part of the cost of a gallon of gasoline. The average price of a barrel of crude oil (in constant 1990 dollars) declined by 38% from I990 to 1999, while the average price of a gallon of gasoline declined 22% in this same time period.

Table 5.3
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978-99

Year	Crude oil” (dollars per barrel) Current	Crude oil” (dollars per barrel) Constant 1998”	Gasoline” (cents per gallon) Current	Gasoline” (cents per gallon) Constant 1998”	Ratio of gasoline to crude oil
1978	12.5	31.1	65.2	162.9	219.8
1979	17.7	39.8	88.2	198.1	209.1
1980	28.1	55.5	122.1	241.6	182.7
1981	35.2	63.2	135.3	242.5	161.3
1982	31.9	53.8	128.1	216.4	168.8
1983	29.0	47.4	122.5	200.5	177.5
1984	28.6	44.9	119.8	188.0	175.7
1985	26.8	40.5	119.6	181.3	187.8
1986	14.6	21.6	93.1	138.4	268.7
1987	17.9	25.7	95.7	137.3	224.5
1988	14.7	20.2	96.3	132.7	275.7
1989	18.0	23.6	106.0	139.4	247.7
1990	22.2	27.7	121.7	151.8	230.0
1991	19.1	22.8	119.6	143.1	263.5
1992	18.4	21.4	119.0	138.3	271.2
1993	16.4	18.5	117.3	132.4	300.2
1994	15.6	17.2	117.4	129.1	316.3
1995	17.2	18.4	120.5	128.9	293.7
1996	20.7	21.5	128.8	133.8	261.2
1997	19.0	19.3	129.1	131.1	284.8
1998	12.5	12.6	111.5	111.5	372.6
1999	17.5	17.1	122.1	118.5	291.3
		Average annual percentage change			
1978-99	1.6%	-2.8%	3.0%	-1.5%	
1989-99	-0.3%	-3.2%	1.3%	-1.6%	

Sources:
Crude oil - U.S. Department of Energy, Energy Infoimation Administration, *Monthly Energy Review, March* 2000, Washington, DC, Table 9.1.
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March* 2000, Washington, DC, Table 9.4.
(Additional resources: www.eia.doe.gov)

“Refiner acquisition cost of composite (domestic and imported) crude oil.
“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.
“Adjusted by the Consumer Price Inflation Index.

Table 5.4
Retail Prices for Motor Fuel, 1978-99
(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 1998”	Current	Constant 1998”	Current	Constant 1998”	Current	Constant 1998”
1978	d	d	67.0	167.4	d	*0.0*	65.2	162.9
1979		d	*90.3*	202.8	d	*0.0*	88.2	198.1
1980	101	200	124.5	246.3		*0.0*	122.1	241.6
1981	118	212	137.8	247.0	147.0	263.5	135.3	242.5
1982	116	196	129.6	218.9	141.5	239.0	128.1	216.4
1983	120	196	124.1	203.1	138.3	226.3	122.5	200.5
1984	122	191	121.2	190.2	136.6	214.4	119.8	188.0
1985	122	185	120.2	182.2	134.0	203.1	119.6	181.3
1986	94	0	92.7	137.8	108.5	161.3	93.1	138.4
1987	96	138	94.8	136.0	109.3	156.8	95.7	137.3
1988	95	131	94.6	130.4	110.7	152.6	96.3	132.7
1989	102	134	102.1	134.3	119.7	157.4	106.0	139.4
1990	107	0	116.4	145.2	134.9	168.3	121.7	151.8
1991	91	109	114.0	136.4	132.1	158.1	119.6	143.1
1992	106	123	112.7	130.9	131.6	152.9	119.0	138.3
1993	98	111	110.8	125.0	130.2	146.9	117.3	132.4
1994	96	0	111.2	122.3	130.5	143.5	117.4	129.1
1995	97	0	114.7	122.7	133.6	142.9	120.5	128.9
1996	115	120	123.1	127.9	141.3	146.8	128.8	133.8
1997	129	131	123.4	125.3	141.6	143.8	129.1	131.1
1998	112	112	105.9	105.9	125.0	125.0	111.5	111.5
1999	97	95	116.5	114.0	135.7	132.8	122.1	119.5
				Average annualpercentage change				
1978-99	-0.2%”	-3.8%’	2.7%	-1.8%	-0.4%’	-3.7%’	3.0%	-1.5%
1989-99	-0.5%	-3.4%	1.3%	-1.6%	1.3%	-1.7%	1.4%	-1.5%

Source:
Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, 2000, Washington, DC, Table 9.4.
Diesel - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1998*, Washington, DC, January 2000, Table 7.2.
(Additional resources: www.eia.doe.gov)

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.
‘Adjusted by the Consumer Price Inflation Index.
[d]Data are not available.
‘Average annual percentage change is from the earliest year possible to 1999.

Thefielprices shown here are refiner ***salesprices*** *of transportation fuels to end users, excluding tax. Sales to end users are those made directly to the ultimate consumer, including bulkconsumers. Bulksales to utility, industrial, and commercial accountspreviously included in the wholesale category are now counted as sales to end users.*

Table 5.5
Prices for Selected Transportation Fuels, 1978-99
(cents per gallon, excluding tax)

	Propane[a]		Finished aviation gasoline		Kerosene-type jet fuel		No. 2 diesel fuel	
Year	Current	Constant 1998[b]	Current	Constant 1998[b]	Current	Constant 1998[b]	Current	Constant 1998[b]
1978	33.5	83.7	51.6	128.9	38.7	*96.7*	37.7	*94.2*
1979	35.7	80.2	d8.9	154.8	54.7	122.9	58.5	131.4
1980	48.2	95.4	108.4	214.5	86.6	171.3	81.8	161.8
1981	56.5	101.3	130.3	233.6	102.4	183.6	99.5	178.4
1982	59.2	100.0	131.2	221.6	96.3	162.7	94.2	159.1
1983	70.9	116.0	125.5	205.4	87.8	143.7	82.6	135.2
1984	73.7	115.7	123.4	193.7	84.2	132.2	82.3	129.2
	71.7	108.7	120.1	182.0	79.6	120.6	78.9	119.6
1985 1986	74.5	110.8	101.1	150.3	52.9	78.7	47.8	71.1
1987	70.1	100.6	90.7	130.1	54.3	77.9	55.1	79.0
	71.4	98.4	89.1	122.8	51.3	70.7	50.0	68.9
1988 1989	61.5	80.9	99.5	130.9	59.2	77.9	58.5	76.9
1990	74.5	92.9	112.0	139.7	76.6	95.6	72.5	90.4
1991	73.0	87.4	104.7	125.3	65.2	78.0	64.8	77.6
1993 1992	64.3	74.7	102.7	119.3	61.0	70.9	61.9	71.9
	67.3	75.9	99.0	111.7	58.0	65.5	60.2	67.9
1994	53.0	58.3	95.7	105.2	53.4	58.7	55.4	GO.9
1995	49.2	52.6	100.5	107.5	54.0	57.7	56.0	59.9
1996	60.5	62.9	111.6	116.0	65.1	67.6	68.1	70.8
1997	55.2	56.1	112.8	114.6	61.3	62.3	64.2	65.2
1998	40.5	40.5	97.5	97.5	45.2	45.2	49.4	49.4
1999	45.7	44.7	105.9	103.6	53.8	52.6	57.9	56.7
				Aver-age annual percentage change				
1978-99	1.5%	*-2.9%*	3.5%	-1.0%	1.6%	*-2.9%*	2.1%	-2.4%
1989-99	-2.9%	-5.8%	0.6%	-2.3%	-1.0%	-3.9%	-0.1%	-3.0%

Source:
U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March* 2000, Washington, DC, Table 9.7.
(Additional resources: www.eia.doe.gov)

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

Table 5.6
State Taxes on Motor Fuels, 1999
(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”	0.16”
Alaska	0.08	0.08	0.08”	0.08	0.00	0.08”	0.08”
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"	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"	0.37"
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"	0.04"
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"	0.181	0.25"	0.25"
Illinois	0.19	0.215	0.19	0.19	0.19	0.19”	0.19”
Indiana	0.15	0.16	0.15	a	a	0.15	0.15
Iowa	0.20	0.225	0.19	0.16"	0.20	0.19"	0.19"
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'	0.16'	0.20"	0.20"
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	0.0	0.097	0.21	0.21
Michigan	0.15	0.15	0.18	0.0	0.15	0.15”	0.025"
Minnesota	0.20	0.20	0.20	0.001739[j]	0.15	NA	0.20"
Mississippi	0.18	0.18	0.18	0.18”	0.17	0.18”	0.18”
Missouri	0.17	0.17	0.17	a	a	0.17[b]	0.17”
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"
Nevada	0.23	0.27	0.23	0.23"	0.23"	0.23	0.23
New Hampshire	0.18	0.18	0.18	0.18	0.18	0.18”	0.18”
New Jersey	0.105	0.135	0.105	0.0525	0.0525	0.105"	0.105"
New Mexico	0.22	0.18	0.22	0.06'	0.06'	0.22[b]	0.22"
New York	0.08'	0.10’	0.08'	0.08'	0.08'	0.08[l]	0.08'
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"	0.20"
Ohio	0.22	0.22	0.22	0.22	0.22	0.22"	0.22"

Table 5.6 (continued)
State Taxes on Motor Fuels, 1999
(dollars per gallon or gasoline equivalent gallon)

State	Gasoline	Diesel fuel	Gasohol	CNG	Propane	Methanol	Ethanol
Oklahoma	0.16	0.13	0.16	a	0.16	0.16”	0.16[b]
Oregon	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Pennsylvania	0.12”’	0.12”’	0.12”’	0.12”	0.12”	0.12”	0.12”’
Rhode Island	0.28	0.28	0.28	0.0	0.28	0.28	0.28
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”
Utah	0.19	0.19	0.19	0.19[m]	0.19”	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”	0.175”
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	0.254	0.254	0.254	0.203	0.186	0.254	0.254
Wyoming	0.08	0.08	0.00	0.00	0.00	0.08[b]	0.08”

Source:
Energy Futures, Inc., *The Clean Fuels and Electric Vehicles Report,* Boulder, CO, February 1999, pp. 150-151.

[a]Annual flat fee.
[b]Blends with gasoline only.
‘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, 200 1.
“For County of Honolulu; for County of Maui LPG tax is $0.20/gal. and all other fuels are taxed at $0.1 8/gal.; other counties have all fuels taxed at $0.26/gal.
“Per therm.
‘Optional: flat fee may be paid instead.
[j]Per cubic foot; LNG is taxed at $0.12/gal.
[k]Per 120 ft^3.
‘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 2000, only five states offered tax exemptions to encourage the use of gasohol for transportation purposes. This list is quite short compared to the 30 states which offered gasohol tax exemptions fifteen years ago. Still, the Federal Government encourages gasohol use via a difference in the Federal tax rates of gasoline and gasohol.

Table 5.7
State Tax Exemptions for Gasohol, January 1, 2000

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, October 1999," February 2000, Washington, DC, Table MF-121T. (Additional resources: www.fhwa.dat.gov)

Table 5.8
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:
Energy Futures, Inc., *The Clean Fuels and Electric Vehicles Report,* Boulder, CO, February 1999, pp. 150-151.

[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 5.9
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	$0.2 1 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 Incentives and Laws*, 2nd edition, Washington, DC, November 1996.
(Additional resources: www.ccities.doe.gov)

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

Table 5.10
Average Price of a New Car, 1970-99

	Domestic[a]		Import		Total	
Year	Current dollars	Constant 1998 dollars[b]	Current dollars	Constant 1998 dollars[b]	Current dollars	Constant 1998 dollars[b]
1970	3,708	15,568	2,648	11,118	3,542	14,872
1971	3,919	15,776	2,769	11,147	3,742	15,064
1972	4,034	15,721	2,994	11,668	3,879	15,117
1973	4,181	15,339	3,344	12,268	4,052	14,865
1974	4,524	14,956	4,206	13,310	4,440	14,679
1975	5,084	15,400	4,384	13,280	4,950	14,994
1976	5,506	15,769	4,923	14,099	5,418	15,517
1977	5,985	16,102	5,072	13,645	5,814	15,642
1978	6,478	16,188	5,934	14,829	6,379	15,941
1979	6,889	15,473	6,704	15,058	6,847	15,379
1980	7,609	15,055	7,482	14,803	7,574	14,985
1981	8,912	15,976	8,896	15,947	8,910	15,972
1982	9,865	16,662	9,957	16,818	9,890	16,727
1983	10,516	17,208	10,868	17,784	10,606	17,356
1984	11,079	17,390	12,336	19,362	11,375	17,854
1985	11,589	17,563	12,853	19,479	11,838	17,941
1986	12,319	18,317	13,670	20,326	12,652	18,812
1987	12,922	18,536	14,470	20,757	13,386	19,202
1988	13,418	18,493	15,221	20,978	13,932	19,201
1989	13,936	18,327	15,510	20,397	14,371	18,899
1990	14,489	18,076	16,640	20,760	15,042	18,766
1991	15,192	18,182	16,327	19,540	15,475	18,521
1992	15,644	18,175	18,593	21,601	16,336	18,979
1993	15,976	18,029	20,261	22,864	16,871	19,039
1994	16,930	18,619	21,989	24,183	17,903	19,689
1995	16,864	18,035	23,202	24,813	17,959	19,206
1996	17,468	18,152	26,205	27,231	18,777	19,512
1997	17,838	18,116	28,193	28,633	19,551	19,856
1998	18,579	18,579	31,986	31,986	20,849	20,849
1999	18,725	18,323	30,350	29,699	21,022	20,571
			Average annualpercentage change			
1970-99	5.7%	0.6%	8.8%	3.4%	6.3%	1.1%
1989-99	3.0%	0.0%	6.9%	3.6%	3.9%	0.9%

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

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

Table 5.11
Average Price of a New Car by Sector, 1970-99

	Consumer		Business		Government	
Year	Current dollars	Constant 1998 dollars”	Current dollars	Constant 1998 dollars”	Current dollars	Constant 1998 dollars”
1970	3,507	14,725	3,676	15,434	2,976	12,495
1971	3,705	14,915	3,878	15,611	3,150	12,681
1972	3,840	14,965	4,036	15,728	3,249	12,662
1973	4,035	14,803	4,137	15,177	3,231	11,853
1974	4,459	14,742	4,448	14,705	3,351	11,078
1975	4,960	15,025	4,994	15,128	3,604	10,917
1976	5,424	15,534	5,482	15,700	3,739	10,708
1977	5,801	15,607	5,887	15,838	4,813	12,949
1978	6,433	16,076	6,319	15,791	5,180	12,945
1979	6,871	15,433	6,858	15,404	5,518	12,394
1980	7,619	15,074	7,537	14,912	6,164	12,196
1981	9,028	16,183	8,743	15,673	7,217	12,937
1982	10,070	17,009	9,598	16,211	7,932	13,397
1983	10,901	17,838	10,108	16,541	8,152	13,340
1984	11,705	18,372	10,867	17,057	9,034	14,180
1985	12,163	18,433	11,493	17,418	9,546	14,467
1986	13,047	19,400	12,078	17,959	10,188	15,149
1987	13,777	19,763	12,723	18,251	10,946	15,702
1988	14,337	19,759	13,238	18,245	12,585	17,345
1989	14,783	19,441	13,599	17,884	14,497	19,065
1990	15,820	19,737	13,816	17,236	14,279	17,814
1991	16,337	19,552	14,413	17,250	16,103	19,272
1992	17,089	19,854	15,321	17,800	17,551	20,391
1993	17,608	19,871	15,918	17,963	18,171	20,506
1994	18,806	20,682	16,917	18,605	18,398	20,234
1995	18,895	20,207	17,020	18,202	17,048	18,232
1996	20,098	20,885	17,718	18,412	14,099	14,651
1997	21,177	21,507	18,201	18,485	15,027	15,261
1998	22,715	22,715	19,218	19,218	15,105	15,105
1999	23,040	22,546	19,166	18,755	14,984	14,663
			Average annual percentage change			
1970-99	6.7%	1.5%	5.9%	0.7%	5.7%	0.6%
1989-99	4.5%	1.5%	3.5%	0.5%	0.3%	-2.6%

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

‘Adjusted by the Consumer Price Inflation Index.

The total cost of operating an automobile is the sum of the fixed cost (depreciation, insurance, finance charge, and license fee) and the variable cost, which is related to the amount of travel. The cost of operating a car in 1999 (constant 1998 cents) was approximately 57 cents per mile. Gas and oil accountedfor only 9.7% of total cost per mile in 1999, which is the lowest in the series history.

Table 5.12
Automobile Operating Cost per Mile, 1975-99

Model year[c]	Variable costs (constant 1998 cents per mile")				Constant 1998 dollars per 10,000 miles[a]			Total cost per mile[b] (constant 1998 cents[a])
	Gas and oil	Percentage gas and oil of total cost	Maintenance	Tires	Variable cost	Fixed cost	Total cost	
1975	14.60	26.3%	2.94	2.00	1,954	3,593	5,546	55.46
1977	11.06	20.4%	2.77	1.78	1,560	3,871	5,432	54.32
1979	9.23	17.1%	2.47	1.46	1,316	4,068	5,384	53.84
1980	11.59	21.0%	2.22	1.27	1,508	4,022	5,530	55.30
1981	11.24	19.6%	2.12	1.29	1,465	4,257	5,722	57.22
1982	11.38	20.8%	1.69	1.06	1,414	4,050	5,464	54.64
1983	10.87	19.9%	1.70	1.11	1,368	4,101	5,469	54.69
1984	9.72	19.8%	1.63	0.99	1,234	3,682	4,916	49.16
1985[d]	9.34	22.6%	1.86	0.99	1,218	2,904	4,122	41.22
1986	6.66	15.1%	2.04	1.00	969	3,430	4,400	44.00
1987	6.89	14.7%	2.30	1.15	1,033	3,649	4,682	46.82
1988	7.17	13.6%	2.21	1.10	1,089	4,176	5,265	52.65
1989	6.84	13.6%	2.50	1.05	1,039	3,985	5,024	50.24
1990	6.74	13.2%	2.62	1.12	1,048	4,062	5,110	51.10
1991	8.02	15.4%	2.63	1.08	1,173	4,050	5,223	52.23
1992	6.97	13.1%	2.56	1.05	1,057	4,260	5,318	53.18
1993	6.77	13.3%	2.71	1.02	1,050	4,045	5,094	50.94
1994	6.16	12.0%	2.75	1.21	1,012	4,119	5,130	51.30
1995	6.42	12.3%	2.78	1.50	1,069	4,161	5,231	52.31
1996	6.13	11.5%	2.91	1.45	1,050	4,295	5,344	53.44
1997	6.70	12.4%	2.84	1.42	1,097	4,294	5,391	53.91
1998	6.30	11.5%	3.10	1.40	1,080	4,403	5,483	54.83
1999	5.49'	9.7%	3.23	1.67	1,039	4,635	5,674	56.74
	Average annual percentage change							
1975-84	-4.4%		-6.3%	-7.5%	-4.9%	0.3%	-1.3%	-1.3%
1985-99	-3.5%		4.0%	3.8%	-1.1%	3.4%	2.3%	2.3%

Source:
American Automobile Association, *Your Driving Costs*, 1999 Edition, Heathrow, FL, and annual. (Additional resources: www.aaa.com, www.runzheimer.com)

[a] Adjusted by the Consumer Price Inflation Index.
[b] Based on 10,000 miles per year.
[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.
[e] Fuel cost data used in this calculation was 1.098/gallon, which is much lower than most 1999 averages. This calculation was done early in 1999 when prices were much lower.

Table 5.13
Fixed Automobile Operating Costs per Year, 1975–99
(constant 1998 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	161	427	573	91	2,342	[e]	3,593	9.84
1977	215	506	673	199	2,279	[e]	3,871	10.60
1978	142	345	572	185	2,234	[e]	3,479	9.52
1979	166	377	541	202	2,116	665	4,068	11.14
1980	138	340	491	162	2,054	837	4,022	11.02
1981	136	323	455	158	2,307	878	4,257	11.67
1982	90	258	410	91	2,290	910	4,050	11.10
1983	131	329	363	167	2,198	913	4,101	11.24
1984	126	314	353	166	1,894	829	3,682	10.09
1985	139	300	323	174	1,899	864	3,699	10.14
1986	128	284	345	193	1,963	947	3,860	10.57
1987	125	281	361	201	2,160	862	3,991	10.93
1988	119	280	391	192	2,459	779	4,219	11.56
1989	143	322	406	199	2,754	823	4,648	12.73
1990	137	308	397	206	2,941	848	4,837	13.25
1991	138	309	422	202	3,043	932	5,047	13.82
1992	131	303	433	208	3,230	967	5,272	14.44
1993	121	262	434	207	3,253	785	5,062	13.87
1994	100	227	440	224	3,286	764	5,041	13.81
1995	102	226	438	226	3,314	780	5,085	13.93
1996	113	257	443	238	3,334	808	5,193	14.23
1997	108	307	407	223	3,319	805	5,169	14.17
1998	115	262	479	223	3,294	802	5,175	14.18
1999	159	318	474	221	3,367	811	5,351	14.66
			Average annual percentage change					
1975-99	-0.1%	-1.2%	-0.8%	3.8%	1.5%	[e]	1.7%	1.7%
1989-99	1.1%	-0.1%	1.6%	1.1%	2.0%	-0.1%	1.4%	1.4%

Source:
American Automobile Association, "Your Driving Costs," 1999 Edition, Heathrow, FL, and annual. (Additional resources: www.aaa.com, www.runzheimer.com)

Note:
The data in this table are costs *per year*, while the data on the previous table are costs *per mile*.

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

Table 5.14
Economic Indicators, 1970-99
(billion dollars)

Year	Gross National Product		Total transportation outlays		Transportation as a percent of GNP
	Current	Constant 1998”	Current	Constant 1998”	
1970	1,015.5	4,194.0	192.8	809.5	19.0%
1980	2,732.0	5,327.4	533.0	1,054.6	19.5%
1990	5,567.8	6,848.4	951.0	1,186.4	17.1%
1997	8,102.9	8,102.9	1,317.2	1,337.7	16.3%
1998	8,750.0	8,750.0	1,378.1	1,378.1	15.7%
	Personal Consumption Expenditures		Transportation Personal Consumption Expenditures”		Transportation PCE as a percent of total PCE
1970	640.0	2,687.1	81.5	342.2	12.7%
1980	1,732.6	3,428.0	238.5	471.9	13.8%
1990	3,761.2	4,692.4	453.9	566.3	12.1%
1999	6,257.3	6,123.1	694.6	679.7	11.1%

Sources:
GNP - U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business,* April 2000, Table 1.9, p. D-4, and annual. (Additional resources: www.bea.doc.gov)
Transportation outlays - Eno Transportation Foundation, *Transportation in America* 1999, Seventeenth Edition, Lansdowne, VA, 2000, p. 38.
PCE - U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business,* March 2000, Table 2.2 and annual. (Additional resources: www.bea.doc.gov/bea/scbinf.html)

Table 5.15
Consumer Price Indices, 1970-99
(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
1999	4.291	3.581	2.696	4.872	9.217

Source:
Bureau of Labor Statistics, Consumer Price Index Table 1A for 1999, and annual. [GNP-see above.] (Additional resources: stats.bls.gov/cpihome.htm)

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

Table 5.16
Motor Vehicle Manufacturing Employment Statistics, 1972-98

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 car	Total domestic vehicle expenditures[c] (millions)	Employees per million dollar expenditure (current)	Employees per million dollar expenditure (constant 1998[d])
1972	415	9,327	2,096	3.6	$4,034	$46,080	9.0	29.9
1973	462	9,676	2,512	3.8	$4,181	$50,958	9.1	28.5
1974	416	7,454	2,163	4.3	$4,524	$43,507	9.6	27.6
1975	375	7,053	2,053	4.1	$5,084	$46,295	8.1	21.4
1976	416	8,611	2,720	3.7	$5,506	$62,388	6.7	16.7
1977	442	9,109	3,108	3.6	$5,985	$73,119	6.0	14.3
1978	470	9,312	3,473	3.7	$6,478	$82,821	5.7	12.5
1979	463	8,341	2,844	4.1	$6,889	$77,053	6.0	12.2
1980	368	6,581	1,959	4.3	$7,609	$64,981	5.7	10.5
1981	359	6,209	1,745	4.5	$8,912	$70,886	5.1	8.6
1982	318	5,759	2,062	4.1	$9,865	$77,154	4.1	6.6
1983	349	6,795	2,518	3.7	$10,516	$97,936	3.6	5.5
1984	392	7,952	3,257	3.5	$11,079	$124,185	3.2	4.7
1985	409	8,205	3,691	3.4	$11,589	$137,863	3.0	4.3
1986	400	8,215	3,671	3.4	$12,319	$ 146,424	2.7	3.8
1987	381	7,081	3,785	3.5	$12,922	$140,410	2.7	3.7
1988	357	7,526	4,195	3.0	$13,418	$157,272	2.3	3.0
1989	350	7,073	4,108	3.1	$13,936	$155,818	2.2	2.8
1990	329	6,897	3,948	3.0	$14,489	$157,133	2.1	2.6
1991	316	6,137	3,595	3.2	$15,192	$147,849	2.1	2.5
1992	314	6,277	4,233	3.0	$15,644	$164,418	1.9	2.2
1993	319	6,742	4,987	2.7	$15,976	$187,383	1.7	1.9
1994	340	7,255	5,638	2.6	$16,930	$218,278	1.6	1.7
1995	355	7,129	5,663	2.8	$16,864	$215,724	1.6	1.7
1996	342	7,254	6,088	2.6	$17,468	$233,058	1.5	1.5
1997	352	6,917	6,226	2.7	$17,838	$234,440	1.5	1.5
1998	344	6,761	6,683	2.6	$18,579	$249,776	1.4	1.4
				Average annual percentage change				
1972-98	-0.7%	-1.2%	4.6%	-1.2%	6.1%	6.7%	-6.9%	-11.1%
1988-98	-0.4%	-1.1%	4.8%	-1.4%	3.3%	4.7%	-4.8%	-7.3%

Source:
Employees - U.S. Department of Labor, Bureau of Labor Statistics, Covered Employment and Wages, SIC 3711, www.bls.gov, April 2000.
Sales - See Table 6.4. Expenditures - See Table 5.10.

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

Employees of motor vehicle and related industries comprise 7.6% of the laborforce. For employment in the entire transportation industry, see the next table.

Table 5.17
Employees of Motor Vehicle and Related Industries, 1990 and 1997

	1990			1997			
Industry	Employees	Percent of total motor vehicle	Percent of total U.S. employment[a]	Employees	Percent of total motor vehicle	Percent of total U.S. employment[a]	Percent change 1990-95
Motor vehicle and equipment manufacturing	1,055,595	15.0%	1.1%	1,192,105	14.8%	1.1%	12.9%
Motor vehicles and equipment	707,160	10.0%	0.8%	815,513	10.1%	0.8%	15.3%
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%	60,739	0.8%	0.1%	251.8%
Automotive stampings	111,548	1.6%	0.1%	126,712	1.6%	0.1%	13.6%
Carburetors, pistons, piston rings, and valves	19,674	0.3%	0.0%	18,290	0.2%	0.0%	-7.0%
Vehicular lighting equipment	15,586	0.2%	0.0%	16,689	0.2%	0.0%	7.1%
Storage batteries	23,518	0.3%	0.0%	23,131	0.3%	0.0%	-1.6%
Electrical equipmentfor internal combustion engines	61,675	0.9%	0.1%	52,885	0.7%	0.1%	-14.3%
Tires and inner tubes	68,505	1.0%	0.1%	63,699	0.8%	0.1%	-7.0%
Cold-rolled steel sheet, strip, and bars	16,365	0.2%	0.0%	14,447	0.2%	0.0%	-11.7%
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%	2,056,223	25.5%	2.0%	23.7%
Trucking and courier services, except by air or by the U.S. Postal Service	1,458,847	20.7%	1.6%	1,811,597	22.5%	1.7%	24.2%
Petroleum refining and wholesale distribution	264,820	3.8%	0.3%	238,298	3.0%	0.2%	-10.0%
Passenger transportation	672,271	9.5%	0.7%	907,395	11.3%	0.9%	35.0%
Automotive sales and servicing	3,135,783	44.5%	3.4%	3,656,899	45.4%	3.5%	16.6%
Total of motor vehicle and related industries	7,052,766	100.0%	7.5%	8,050,920	100.0%	7.6%	14.2%
U.S. Total[a]	93,476,087		100.0%	105,299,123		100.0%	12.6%

Source:
U.S. Department of Commerce, Bureau of the Census, County Business Patterns web site: tier2.census.gov/cbp/, February 2000. (Additional resources: www.census.gov)

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

[b]Data are not available.

Table 5.18
Employment in Transportation and Related Industries, 1960–98
(persons in thousands)

	1960	1965	1970	1975	1980	1985	1990	1995	1998
Transportation Service									
Air transport	191	229	351	362	453	537	789	920	1,008
Bus, intercity	41	42	43	39	38	36	20	24	26
Local transport	101	83	77	69	79	90	136	203	235
Railroads	885	735	627	538	532	346	285	238	231
Oil pipeline	23	20	18	17	21	19	20	15	14
Taxi	121	110	107	83	53	38	33	31	31
Trucking & truck materials	770	882	998	996	1,189	1,285	1,534	1,587	1,745
Water	232	230	215	190	213	214	173	175	180
Total	2,364	2,331	2,436	2,294	2,578	2,565	2,990	3,192	3,470
Transportation Equipment Manufacturing									
Aircraft & parts	646	624	669	514	652	647	709	451	524
Motor vehicles, equipment, tires	829	945	914	892	904	964	886	1,112	1,130
Railroad equipment	43	56	51	52	71	34	34	38	37
Ship & boat building & repair	141	160	170	194	221	193	189	160	164
Other transportation equipment	33	57	111	115	149	130	46	53	55
Total	**1,692**	1,842	**1,915**	1,767	1,997	1,968	1,864	1,812	1,910
Transportation Related Industries									
Automotive/accessory retail dealers	807	902	996	1,076	1,048	1,185	1,292	1,388	1,356
Automotive wholesalers	215	255	320	367	418	433	451	492	518
Automotive service & garages	251	324	384	400	571	730	926	981	1,249
Gasoline service stations	461	522	614	616	561	61 I	641	649	689
Highway & street construction	294	324	331	297	268	264	245	228	253
Petroleum[a]	311	292	333	390	533	568	521	429	442
Other industries									
Truck drivers & deliverymen	1,477	1,521	1,565	1,796	1,931	2,050	2,148	2,861	2,601
Freight handlers	365	411	456	613	622	574	504	536	628
Total	**4,181**	4,551	4,999	5,545	5,952	6,415	6,728	7,564	7,737
Government Transportation Employees									
U.S. Department of Transportation	38	45	66	75	72	61	65	64	65
Highways, state & local	499	550	568	569	532	549	569	543	530
US. Postal Service”	83	83	103	98	92	104	115	118	122
Other’	18	16	12	13	13	11	11	11	12
Total	638	694	749	755	709	725	760	736	729
Total transportation employment	8,875	9,418	10,099	**10,361**	11,236	11,673	12,342	13,304	13,845
Total employed civilians	65,778	71,088	78,627	85,783	99,303	107,150	117,914	125,136	131,463
Transportation percent of total	13.5%	13.2%	12.8%	12.1%	11.3%	10.9%	10.5%	10.6%	10.5%

Source:
Eno Transportation Foundation, *Transportation in America* 1999, Seventeenth Edition, Lansdowne, VA, 2000, p. 6 1

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

Chapter 6

Highway Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 6.1	U.S. share of world automobile registrations, 1996	26.7%
Table 6.2	U.S. share of world truck & bus registrations, 1996	41.3%
Table 6.3	Number of automobiles, 1998 (Polk - in thousands)	125,966
Table 6.3	Number of trucks, 1998 (Polk - in thousands)	79,077
Table 6.5	Vehicle miles traveled, 1997	(million miles)
	Automobiles	*1,545,830*
	Motorcycles	*10,260*
	Two-axle, four-tire trucks	866,228
	Other single-unit trucks	67,894
	Combination trucks	*128,159*
	Buses	6,996
Table 6.8	Average age of vehicles, 1998	(years)
	Automobiles	8.8
	Trucks	8.3
	Median lifetime of vehicles	(years)
Table 6.9	*Automobiles*	*14.0*
Table 6.10	*Light trucks*	*15.2*

Table 6.1
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		*4.9%*
1970-96	e	e	6.7%	3.0%	2.9%	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: www.aama.com)

[a] Data for 199 1 and prior include West Germany only. Kraftwagen are included with automobiles.

[b] Data from 199 1 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 6.2
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	World total[d]
1950	[e]	[e]	183	[e]	1,060		643	8,823	*50.9%*	17,349
1955	[e]	[e]	318	[e]	1,244		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: www.aama.com)

[a] Data for 199 1 and prior include West Germany only. Kraftwagen are included with automobiles (Table 1.1).
[b] Data from 199 1 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 US. data.
[e] Data are not available.

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 1 ½ percent. Assuming that percentage is correct, the number of passenger cars in use would have declined from 1991 to 1992 under the previous Polk method. The growing popularity of light trucks being used as passenger vehicles could also have had an impact on these figures.

Table 6.3
Automobiles and Trucks in Use, 1970–98
(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%
1997	129,749	124,673	4.1%	77,307	76,398	1.2%	207,056	201,071	3.0%
1998	131,839	125,966	4.7%	79,062	79,077	0.0%	210,901	205,043	2.9%

Source:
FHWA - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* 1998, Washington, DC, 1999, Table VM-1, p. V-47, and annual. (Additional resources: www.fhwa.dot.gov)
Polk - The Polk Company, Detroit, Michigan. **FURTHER REPRODUCTION PROHIBITED.** (Additional resources: 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 1997 Vehicle Inventory and Use Survey (latest available survey).

Table 6.4
Vehicle Stock and New Sales in United States, 1998 Calendar Year

	Vehicle stock		New sales		
	Thousands	Percentage	Domestic (thousands)	Import[b] (thousands)	Total (thousands)
Autos	125,966	**100.0%**	6,761 (83.1%)	1,378 (16.9%)	8,139 **(100.0%)**
Two seaters	2,129	1.7%	**0 (0.0%)**	12 (100.0%)	12 (100.0%)
Minicompact	1,297	1.0%	1,278 (85.0%)	226 (15.0%)	1,504 (100.0%)
Subcompact	27,817	22.1%	1,863 (80.0%)	465 (20.0%)	2,328 (100.0%)
Compact	40,759	32.4%	2,524 (80.6%)	608 (19.4%)	3,132 (100.0%)
Midsize	36,499	29.0%	1,043 (98.3%)	19 (1.7%)	1,062 (100.0%)
Large	17,464	13.9%	54 (52.8%)	48 (47.2%)	101 (100.0%)
Autos	**125,966**	**100.0%**	c	c	c
Business fleet autos”	9,550	7.6%	c	c	c
Personal autos	116.416	92.4%	c	c	c
Motorcycles	3,879’	**100.0%**	c	c	c
Recreational vehicles	c	c	441 **(100.0%)**	**0 (0.0%)**	**441 (100.0%)**
Trucks	79,077	**100.0%**	c	c	7,826 (100.0%)
Light (O-10,000 lbs)	73,971	93.5%	6,683 (91.5%)	616 (8.4%)	7,300 (100.0%)
Medium (lO,OOl-26,000 lbs)	2,351	3.0%	c	c	203 (100.0%)
Heavy-heavy (26,001 lbs and over)	2,754	3.5%	c	c	324 (100.0%)
Trucks	79,077	**100.0%**	c	c	c
Business fleet trucks ≤ 19,500 lbs[d]	7,329	9.3%	c	c	c
Personal trucks ≤ 19,500 lbs	68,202	86.2%	c	c	c
Trucks > 19,500 lbs.	3,546	4.5%	c	c	c

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

[a] Total auto and truck vehicle stock as of July 1 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 6.5
Highway Vehicle Miles Traveled by Vehicle Type, 1970–98
(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	1,469,854	9,920	816,540	64,072	118,899	6,563	2,485,848
1997	1,502,556	10,081	850,739	66,893	124,584	6,842	2,561,695
1998	1,545,830	10,260	866,228	67,894	128,159	6,996	2,625,367
			Average annual percentage change				
1970-98	1.9%	4.5%	7.2%	3.3%	4.7%	1.6%	3.1%
1988-98	1.2%	0.2%	5.6%	3.2%	3.8%	2.5%	2.6%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1998*, Washington, DC, 1999, Table VM-1, p. V-47, and annual.
(Additional resources: www.fhwa.dot.gov)

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

Table 6.6
Automobiles in Operation and Vehicle Travel by Age, 1970 and 1998

Age (years)	1970 Vehicles (thousands)	1970 Percentage	1970 Cumulative percentage	1998 Vehicles (thousands)	1998 Percentage	1998 Cumulative percentage	1998 Estimated vehicle travel Percentage	1998 Estimated vehicle travel Cumulative percentage	Average annual miles per vehicle
Under 1"	6,288	7.8%	7.8%	5,619	4.5%	4.5%	6.1%	6.1%	15,600
1	9,299	11.6%	19.4%	8,049	6.4%	10.9%	6.3%	12.4%	11,200
2	8,816	11.0%	30.3%	7,564	6.0%	16.9%	5.9%	18.3%	11,300
3	7,878	9.8%	40.1%	8,926	7.1%	23.9%	7.2%	25.5%	11,600
4	8,538	10.6%	50.8%	7,878	6.3%	30.2%	6.8%	32.3%	12,400
5	8,506	10.6%	61.3%	7,953	6.3%	36.5%	7.0%	39.3%	12,700
6	7,116	8.8%	70.2%	7,320	5.8%	42.3%	6.6%	45.9%	12,900
7	6,268	7.8%	78.0%	7,536	6.0%	48.3%	7.2%	53.1%	13,800
8	5,058	6.3%	84.3%	7,620	6.0%	54.4%	7.8%	60.9%	14,800
9		4.1%	88.3%	8,187	6.5%	60.9%	8.2%	69.2%	14,500
10	3,277 2,766	3.5%	91.8%	8,008	6.4%	67.2%	5.0%	74.2%	9,000
11		2.1%	93.9%	7,439	5.9%	73.1%	4.7%	78.8%	9,000
12	1,692 799	1.0%	94.9%	6,870	5.5%	78.6%	4.3%	83.1%	9,000
13	996	1.2%	96.1%	5,774	4.6%	83.2%	3.6%	86.7%	9,000
14	794	1.0%	97.1%	4,636	3.7%	86.8%	2.9%	89.6%	9,000
15 and older	2.336	2.9%	100.0%	16,587	13.2%	100.0%	10.4%	100.0%	9,000
Subtotal	80,427	**100.0%**		125,966					
Age not given	22			0					
Total	80,449			125,966					
Average age		5.6			8.8				
Median age									

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

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

Table 6.7
Trucks in Operation and Vehicle Travel by Age, 1970 and 1998

Age (years)	1970 Vehicles (thousands)	1970 Percentage	1970 Cumulative percentage	1998 Vehicles (thousands)	1998 Percentage	1998 Cumulative percentage	1998 Estimated vehicle travel Percentage	1998 Estimated vehicle travel Cumulative percentage	Average annual miles per vehicle
Under 1"	1,262	7.1%	7.1%	5,030	6.4%	6.4%	7.9%	7.9%	17,500
1	1,881	10.6%	17.8%	6,550	8.3%	14.6%	11.3%	19.1%	19,200
2	1,536	8.7%	26.5%	5,545	7.0%	21.7%	9.8%	29.0%	19,800
3	1,428	8.1%	34.6%	6,165	7.8%	29.5%	9.9%	38.9%	17,900
4	1,483	8.4%	43.0%	5,593	7.1%	36.5%	8.8%	47.6%	17,500
5	1,339	7.6%	50.5%	4,711	6.0%	42.5%	7.2%	54.8%	17,000
6	1,154	6.5%	57.1%	3,870	4.9%	47.4%	5.4%	60.2%	15,600
7	975	5.5%	62.6%	3,800	4.8%	52.2%	5.2%	65.4%	15,400
8	826	4.7%	67.3%	3,647	4.6%	56.8%	4.9%	70.3%	15,100
9	621	3.5%	70.8%	4,171	5.3%	62.1%	4.9%	75.3%	13,200
10	658	3.7%	74.5%	3,979	5.0%	67.1%	3.3%	78.6%	9,200
11	583	3.3%	77.8%	3,418	4.3%	71.4%	2.8%	81.4%	9,200
12	383	2.2%	80.0%	3,448	4.4%	75.8%	2.8%	84.2%	9,200
13	417	2.4%	82.3%	2,855	3.6%	79.4%	2.4%	86.6%	9,200
14	414	2.3%	84.7%	2,367	3.0%	82.4%	2.0%	88.5%	9,200
15 and older	2,710	15.3%	100.0%	13,928	17.6%	100.0%	11.5%	100.0%	9,200
Subtotal	**17,670**	**100.0%**		79,077			**100.0%**		
Age not given	15			0					
Total	**17,685**			79,077					
Average age		7.3			8.3				
Median age									

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

"Trucks sold as of July 1 of each year.

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

Table 6.8
Average Age of Automobiles and Trucks in Use, 1970–98
(years)

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

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

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

Using current registration data and a scrappage model by Greenspan and Cohen, [1996 paper: http://www.bog.frb.fed.us/pubs/feds/1996/199640/199640pap.pdf], *ORNL calculated new automobile scrappage rates. The expected median lifetime for a 1990 model year automobile is 14 years. These data are fitted model values which assume constant economic conditions.*

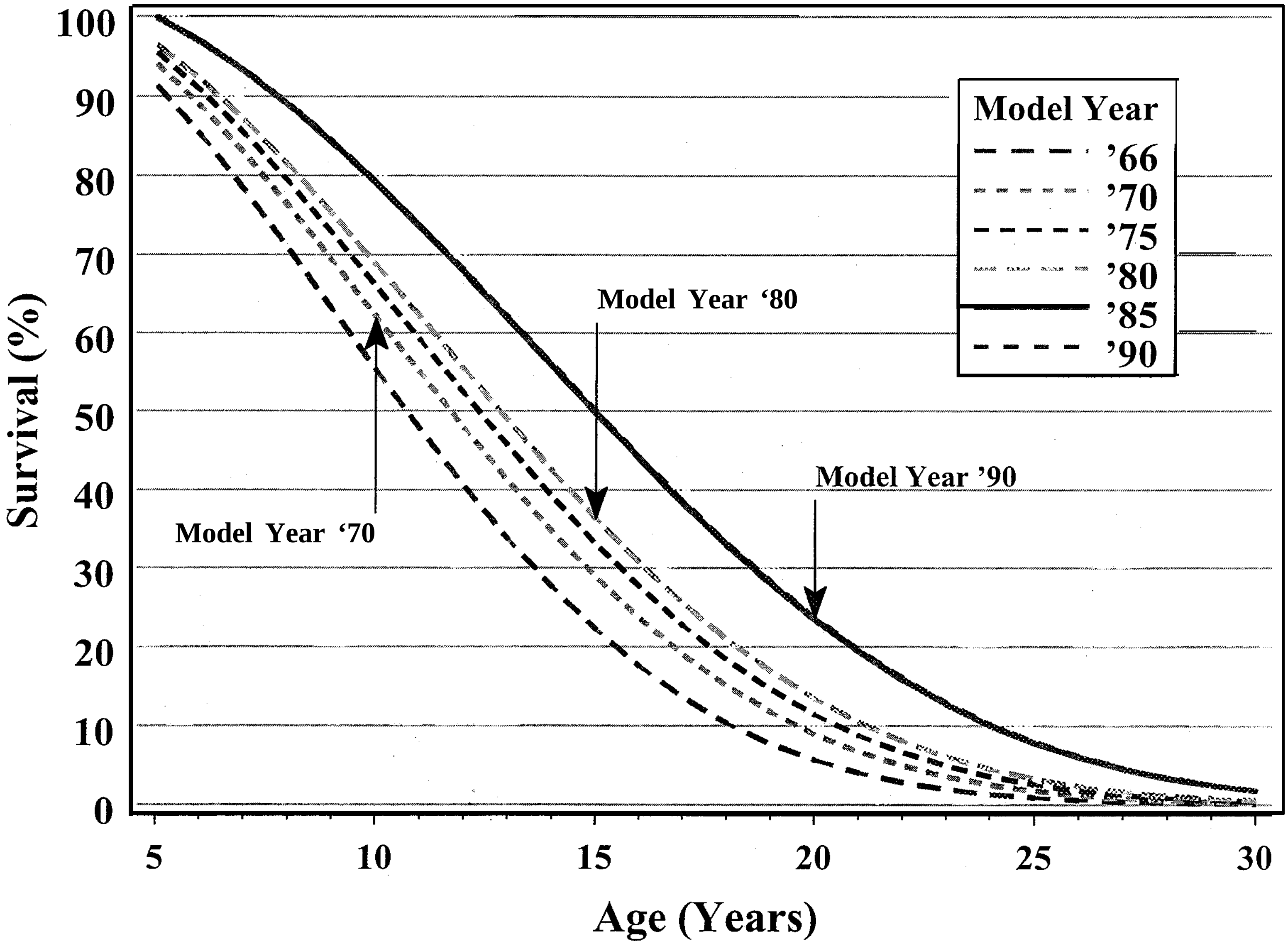
Table 6.9
Automobile Scrappage and Survival Rates
1970, 1980 and 1990 Model Years

Vehicle age[a] (years)	1970 model year		1980 model year		1990 model year	
	Survival rate[b]	Scrappage rate[c]	Survival rate[b]	Scrappage rate[c]	Survival rate[b]	Scrappage rate[c]
4	98.5	3.5	100.0	2.8	100.0	1.8
5	94.0	4.5	96.4	3.7	99.9	2.4
6	88.7	5.6	92.0	4.6	96.8	3.1
7	82.7	6.8	86.9	5.5	93.2	3.8
8	76.1	7.9	81.2	6.5	89.0	4.5
9	69.1	9.1	75.1	7.5	84.3	5.3
10	62.0	10.4	68.6	8.6	79.1	6.1
11	54.8	11.6	62.0	9.7	73.6	7.0
12	47.7	12.9	55.3	10.8	67.8	7.8
13	41.0	14.2	48.7	12.0	61.9	8.8
14	34.6	15.5	42.3	13.1	55.9	9.7
15	28.8	16.8	36.2	14.3	49.9	10.7
16	23.6	18.2	30.6	15.5	44.0	11.7
17	19.0	19.5	25.5	16.8	38.4	12.8
18	15.0	20.9	20.9	18.0	33.1	13.9
19	11.6	22.3	16.8	19.3	28.1	15.0
20	8.9	23.7	13.4	20.6	23.6	16.1
21	6.6	25.1	10.4	21.9	19.5	17.3
22	4.9	26.6	8.0	23.3	15.9	18.4
23	3.5	28.0	6.0	24.6	12.8	19.6
24	2.5	29.4	4.5	26.0	10.1	20.9
25	1.7	30.9	3.2	27.3	7.9	22.1
26	1.2	32.3	2.3	28.7	6.1	23.3
27	0.8	33.8	1.6	30.1	4.6	24.6
28	0.5	35.2	1.1	31.5	3.4	25.9
29	0.3	36.7	0.7	32.9	2.5	27.2
30	0.2	38.1	0.5	34.3	1.8	28.5
Median lifetime	11.3 years		12.2 years		14.0 years	

Source:
Schmoyer, Richard L., unpublished study on scrappage rates, Oak Ridge National Laboratory, Oak Ridge, TN, 2000.

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

Figure 6.1. Automobile Survival Rates



Source: See Table 6.9.

Using current registration data and a scrappage model by Greenspan and Cohen [1996 paper: http://www.bog.frb.fed.us/pubs/feds/1996/199640/199640pap.pdf], *ORNL calculated new light truck scrappage rates. The expected median lifetime for a 1990 model year light truck is 15.2 years. These data are fitted model values which assume constant economic conditions.*

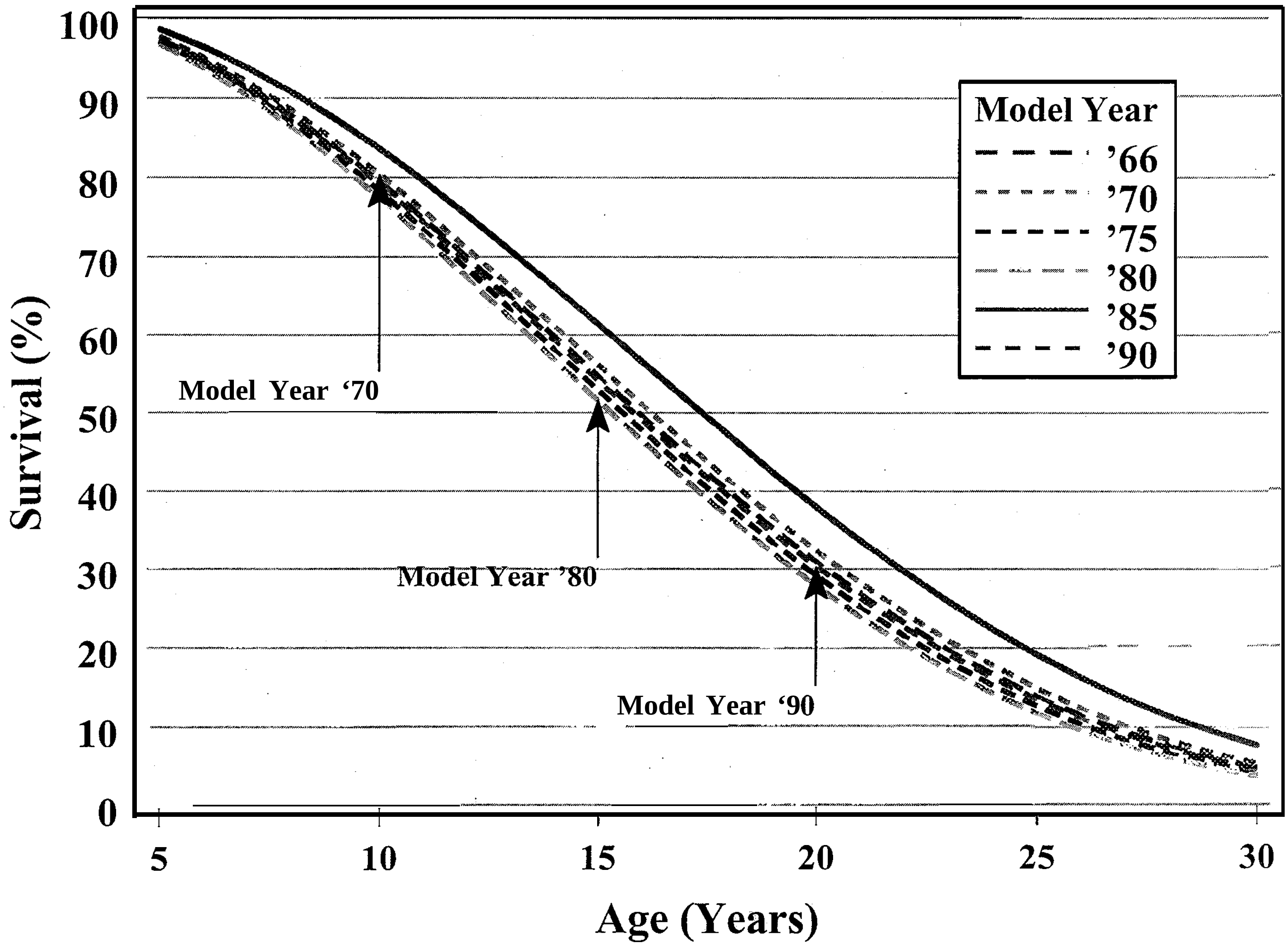
Table 6.10
Scrappage and Survival Rates for Light Trucks

Vehicle age[a] (years)	1970 model year		1980 model year		1990 model year	
	Survival rate[b]	Scrappage rate[c]	Survival rate[b]	Scrappage rate[c]	Survival rate[b]	Scrappage rate[c]
4	99.8	1.6	99.2	1.9	99.6	1.8
5	97.7	2.2	96.8	2.5	97.3	2.3
6	95.1	2.7	93.8	3.1	94.5	2.9
7	92.0	3.2	90.3	3.7	91.3	3.4
8	88.5	3.8	86.4	4.4	87.6	4.0
9	84.6	4.4	82.0	5.0	83.5	4.7
10	80.4	5.0	77.4	5.7	79.1	5.3
11	75.8	5.6	72.5	6.4	74.4	5.9
12	71.1	6.3	67.3	7.1	69.5	6.6
13	66.2	6.9	62.1	7.8	64.4	7.3
14	61.1	7.6	56.8	8.5	59.3	8.0
15	56.1	8.3	51.5	9.3	54.1	8.7
16	51.0	9.0	46.3	10.0	49.0	9.4
17	46.1	9.7	41.3	10.8	44.0	10.2
18	41.3	10.4	36.5	11.6	39.2	10.9
19	36.7	11.2	32.0	12.4	34.6	11.7
20	32.3	11.9	27.8	13.2	30.3	12.5
21	28.2	12.7	23.9	14.1	26.3	13.3
22	24.4	13.5	20.3	14.9	22.6	14.1
23	20.9	14.3	17.1	15.7	19.2	14.9
24	17.7	15.1	14.3	16.6	16.2	15.7
25	14.9	15.9	11.8	17.5	13.5	16.6
26	12.4	16.8	9.6	18.3	11.1	17.4
27	10.2	17.6	7.8	19.2	9.1	18.3
28	8.3	18.5	6.2	20.1	7.4	19.2
29	6.7	19.3	4.9	21.0	5.9	20.0
30	5.4	20.2	3.8	21.9	4.7	20.9
Median lifetime	16.8 years		15.7 years		15.2 years	

Source:
Schmoyer, Richard L., unpublished study on scrappage rates, Oak Ridge National Laboratory, Oak Ridge, TN, 2000.

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

Figure 6.2. Light Truck Survival Rates



Source: See Table 6.9.

Chapter 7
Light Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 7.1	Passenger cars, 1998	
	Registrations (thousands)	*131,839*
	Vehicle miles (million miles)	*1,545,830*
	Fuel economy (miles per gallon)	*21.4*
Table 7.2	Two-axle, four tire trucks, 1998	
	Registrations (thousands)	*71,818*
	Vehicle miles (million miles)	*866,228*
	Fuel economy (miles per gallon)	*17.1*
Table 7.5	Automobile sales, 1999 sales period	
	Minicompact	*12,903*
	Subcompact	*1,622,483*
	Compact	*2,367,048*
	Midsize	*3,359,492*
	Large	*1,180,739*
	Two-seater	*103,248*
Table 7.7	Light truck share of total light vehicle sales	
	1976	*19.8%*
	1999	*48.1%*
Table 7.6	Light truck sales, 1999 sales period	
	Small pickup	*302,426*
	Large pickup	*2,830,271*
	Small van	*1,319,398*
	Large van	*416,813*
	Small utility	*942,298*
	Large utility	*2,190,549*
Table 7.16	Corporate average fuel economy	(mpg)
	Automobile standard, MY 1999	*27.5*
	Automobile fuel economy, MY 1999	*28.3*
	Light truck standard, MY 1999	*20.7*
	Light truck fuel economy, MY 1999	*20.7*
Table 7.21	Average fuel economy loss from 55 to 70 mph	17.1%

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

Table 7.1
Summary Statistics for Passenger Cars, 1970-98

Year	Registrations” (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy” (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	1,469,854	69,221	21.2
1997	129,749	1,502,556	69,892	21.5
1998	131,839	1,545,830	72,209	21.4
		Average annual percentage change		
1970-98	1.4%	1.9%	0.2%	1.7%
1988-98	-0.2%	1.2%	-0.2%	1.4%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* 1998, Washington, DC, 1999, Table VM-1, p. V-74, and annual.
(Additional resources: www.fhwa.dot.gov)

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

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

Table 7.2
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970–98

Year	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	14,211	123,286	12,313	10.0
1971	15,181	137,870	13,484	10.2
1972	16,428	156,622	15,150	10.3
1973	18,083	176,833	16,828	10.5
1974	19,335	182,757	16,657	11.0
1975	20,418	200,700	19,081	10.5
1976	22,301	225,834	20,828	10.8
1977	23,624	250,591	22,383	11.2
1978	25,476	279,414	24,162	11.6
1979	27,022	291,905	24,445	11.9
1980	27,876	290,935	23,796	12.2
1981	28,928	296,343	23,697	12.5
1982	29,792	306,141	22,702	13.5
1983	31,214	327,643	23,945	13.7
1984	32,106	358,006	25,604	14.0
1985[a]	37,214	390,961	27,363	14.3
1986	39,382	423,915	29,074	14.6
1987	41,107	456,870	30,598	14.9
1988	43,805	502,207	32,653	15.4
1989	45,945	536,475	33,271	16.1
1990	48,275	574,571	35,611	16.1
1991	53,033	649,394	38,217	17.0
1992	57,091	706,863	40,929	17.3
1993	59,994	745,750	42,851	17.4
1994	62,904	764,634	44,112	17.3
1995	65,738	790,029	45,605	17.3
1996	69,134	816,540	47,354	17.2
1997	70,224	850,739	49,389	17.2
1998	71,818	866,228	50,579	17.1
		Average annualpercentage change		
1970-98	6.0%	7.2%	5.2%	1.9%
1988-98	5.1%	5.6%	4.5%	1.1%

Source:
U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1998,* Washington, DC, 1999, Table VM-1, p. V-74, and annual.
(Additional resources: www.fhwa.dot.gov)

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

Table 7.3
New Retail Automobile Sales in the United States, 1970–98

Calendar year	Domestic”	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	164%	d	d	0.09%
1998	6,761	1,378	8,139	16.9%	d	d	0.13%
				Average annual percentage change			
1970-98	-0.2%	0.2%	-0.1%				
1988-98	-1.1%	-7.8%	-2.6%				

Source:

Domestic and import data - 1970-97: American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures 1998,* Detroit, MI, 1998, p. 15, and annual. 1997 data from *Economic Indicators, 4th Quarter 1997.* 1998: Ward's Communication, *Ward's Automotive Yearbook*, Detroit, MI, 1999, p. 243.

Diesel data - Ward's Communications, *Ward's Automotive Yearbook,* Detroit, MI, 1999, p. 64, and annual.

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

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[a] North American built.

[b] Does not include import tourist deliveries.

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

[d] Data are not available.

Table 7.4
New Retail Sales of Trucks 10,000 Pounds GVW and Less in the United States, 1970–98

Calendar year	Light truck sales” (thousands)	Percentages					
		Import[b]	Transplants”	Diesel[d]	Four-wheel drive of domestic light trucks[d]	Light trucks of light-duty vehicle sales[e]	Light trucks of total truck sales
1970	1,463	4.5%	f	g		14.8%	80.4%
1971	1,757	4.8%	f	g		14.6%	83.4%
1972	2,239	6.4%	f	g		17.0%	83.3%
1973	2,745	8.5%	f	g		19.4%	84.2%
1974	2,338	7.5%	f	g	18.0%	20.9%	84.2%
1975	2,281	10.0%	f	g	23.4%	20.9%	87.9%
1976	2,956	8.0%	0.0%	g	23.8%	22.6%	89.8%
1977	3,430	9.4%	0.0%	g	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%	1.2%	29.4%	23.7%	88.7%
1980	2,440	19.7%	0.9%	3.6%	20.7%	21.4%	88.9%
1981	2,189	20.3%	0.0%	3.1%	18.6%	20.4%	89.8%
1982	2,470	16.5%	0.0%	8.5%	16.8%	23.6%	92.8%
1983	2,984	15.6%	0.0%	6.7%	28.5%	24.5%	93.6%
1984	3,863	15.7%	2.0%	4.8%	27.0%	27.1%	93.0%
1985	4,458	17.2%	2.6%	3.8%	29.1%	28.8%	93.6%
1986	4,594	20.1%	2.3%	3.7%	27.0%	28.6%	94.3%
1987	4,610	17.9%	1.7%	2.3%	32.0%	31.0%	93.9%
1988	4,800	12.6%	2.4%	2.3%	32.1%	31.1%	93.2%
1989	4,610	10.9%	2.6%	2.9%	3 1.4%	31.8%	93.3%
1990	4,548	13.2%	3.4%	3.1%	31.6%	32.8%	93.9%
1991	4,123	12.8%	4.5%	3.2%	34.4%	33.5%	94.5%
1992	4,629	8.6%	5.5%	3.3%	31.6%	36.0%	94.4%
1993	5,351	6.8%	7.1%	3.7%	32.6%	38.6%	94.2%
1994	6,033	6.5%	8.1%	3.9%	34.4%	40.2%	94.0%
1995	6,053	6.5%	7.5%	4.1%	39.1%	41.2%	93.4%
1996	6,519	6.6%	f	3.7%	35.7%	43.3%	94.1%
1997	6,797	8.4%	f	4.8%	39.6%	466%	94.1%
1998	7,299	8.9%	f	1.7%	43.8%	47.3%	93.3%
		Average annual percentage change					
1970--98	5.9%						
1988-98	4.3%						

Source:

Four-wheel drive - 1970-88: Ward’s Communications, *Ward’s Automotive Yearbook,* Detroit, MI, 1989, p. 168, and annual. 1989-97: Ward’s Communications, *Ward’s Automotive Yearbook,* Factory Installation Reports, Detroit, MI, 1998, p. 300, and annual.

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

All other - 1970-97: American Automobile Manufacturers Association, *Motor Vehicle Facts and Figures* 1998, Detroit, MI; 1998, pp. 8, 15, 24, and annual. 1998: Ward’s Communications, *Ward’s Automotive Yearbook,* Detroit, MI (Additional resources: www.aama.com, www.wardsauto.com)

[a] Includes all trucks of 10,000 pounds gross vehicle weight and less sold in the U.S.

[b] Excluding transplants.

[c] Based on mode1 year data. A transplant is a light truck which was built in the U.S. by a foreign firm. Also included are joint ventures built in the U.S.

[d] Based on mode1 year factory installations. Column was revised.

[e] Light-duty vehicles include automobiles and light trucks.

[f] Data are not available.

[g] Indicates less than 1 percent.

Table 7.5
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Automobiles, Selected Sales Periods” 1976-99

Sales Period	1976	1980	1984	1988	1990	1993	1994	1995	1996	1997	1998	1999
MINICOMPACT												
Total sales, units		428,346	41,368	84,186	76,698	84,345	57,198	44,752	34,234	39,519	12,159	12,903
Market share, %		4.7	0.4	0.8	0.8	1.0	0.6	0.5	0.4	0.5	0.2	0.1
Fuel economy, mpg	–	29.4	29.0	37.8	26.4	29.9	27.8	27.0	27.2	26.3	23.9	24.8
SUBCOMPACT												
Total sales, units	2,625,929	3,441,480	2,5 10,929	1,983,353	2,030,226	1,944,892	2,015,280	1,518,209	1,315,281	1,510,050	1,491,233	1,622,483
Market share, %	27.1	37.8	24.6	19.1	22.0	23.2	22.6	17.4	15.2	18.3	18.5	18.8
Fuel economy, mpg	23.5	27.3	30.5	31.7	31.3	31.9	31.3	31.7	32.1	32.6	31.3	31.0
COMPACT												
Total sales, units	2,839,603	599,423	2,768,056	4,199,638	3,156,481	2,655,378	3,077,203	3,289,735	3,492,957	2,937,064	2,309,330	2,367,048
Market share, %	29.3	6.6	27.1	40.5	34.2	31.7	34.5	37.7	40.4	35.6	28.6	27.4
Fuel economy, mpg	17.1	22.3	30.6	29.8	28.9	29.3	29.8	30.2	30.4	30.0	30.8	30.2
MIDSIZE												
Total sales, units	1,815,505	3,073,103	3,059,647	2,550,964	2,511,503	2,445,842	2,359,898	2,498,521	2,487,880	2,531,196	3,106,787	3,359,492
Market share, %	18.7	33.8	30.0	24.6	27.2	29.2	26.5	28.6	28.8	30.6	38.5	38.9
Fuel economy, mpg	15.3	21.3	24.1	26.9	25.9	25.7	25.6	25.9	26.4	26.3	26.9	26.9
LARGE												
Total sales, units	2,206,102	1,336,190	1,502,097	1,368,717	1,279,092	1,186,991	1,339,863	1,320,608	1,259,266	1,162,290	1,050,405	1,180,739
Market share, %	22.8	14.7	14.7	13.2	13.9	14.2	15.0	15.1	14.6	14.1	13.0	13.7
Fuel economy, mpg	13.9	19.3	20.2	24.2	23.5	24.0	24.2	24.1	24.2	24.5	24.6	24.4
TWO SEATER												
Total sales, units	199,716	215,964	328,968	186,127	170,465	70,480	67,020	53,045	62,231	80,921	101,023	103,248
Market share, %	2.1	2.4	3.2	1.8	1.8	0.8	0.8	0.6	0.7	1.0	1.3	1.2
Fuel economy, mpg	20.1	21.0	26.5	27.3	28.0	24.8	23.9	24.7	25.4	26.3	25.4	25.3
TOTAL												
Total sales, units	9,686,855	9,094,506	10,211,06	10,372,98	9,224,465	8,387,928	8,9 16,462	8,724,870	8,65 1,849	8,261,040	8,070,937	8,645,913
Market share, %	100	100	100	100	100	100	100	100	100	100	100	100
Fuel economy, mpg	17.2	23.2	26.3	28.5	27.6	27.8	27.8	28.0	28.3	28.3	28.3	**28.0**

Source:
Oak Ridge National Laboratoiy, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2000. (Additional resources: www-cta.ornl.gov)

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

Table 7.6
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Light Trucks, Selected Sales Periods[a] 1976-99

Sales Period	1976	1980	1984	1988	1990	1993	1994	1995	1996	1997	1998	1999
SMALL PICKUP												
Total sales, units	170,351	516,412	1,012,298	1,026,551	678,488	332,470	365,322	356,856	574,930[b]	520,834	460,097	302,426
Market share, %	7.1	23.3	28.0	21.6	15.0	6.6	6.4	6.0	9.2	8.0	6.4	3.8
Fuel economy, mpg	23.9	25.5	27.2	26.1	25.2	24.9	25.3	25.6	25.6	24.6	24.5	24.8
LARGE PICKUP												
Total sales, units	1,586,020	1,115,248	1,218,972	1,453,255	1,573,729	1,877,806	2,199,224	2,183,793	2,042,179	2,051,144	2,377,916	2,830,271
Market share, %	66.4	50.3	33.7	30.6	34.9	37.1	38.4	36.8	32.7	31.4	33.3	35.4
Fuel economy, mpg	15.1	17	17.5	18.5	18.9	19.6	20.1	19.4	18.9	19.4	19.1	19.3
SMALL VAN												
Total sales, units	18,651	13,649	222,798	851,384	932,693	1,129,459	1,263,933	1,257,116	1,229,650	1,215,776	1,223,670	1,319,398
Market share, %	0.8	0.6	6.2	18.0	20.7	22.3	22.1	21.2	19.7	18.6	17.1	16.5
Fuel economy, mpg	19.5	19.6	25.0	22.9	23.1	22.9	22.1	22.8	22.8	22.9	23.3	23.0
LARGE VAN												
Total sales, units	574,745	328,065	545,595	486,981	398,877	**388,435**	407,737	401,056	370,126	386,563	380,829	416,813
Market share, %	24.1	14.8	15.1	10.3	8.8	7.7	7.1	6.8	5.9	5.9	5.3	5.2
Fuel economy, mpg	15.4	16.3	16.3	17.0	16.9	17.3	17.4	17.1	17.2	17.8	18.2	17.8
SMALL SUV												
Total sales, units	16,632	85,286	442,062	671,497	553,286	**733,253**	816,409	902,921	637,287	782,104	762,490	942,298
Market share, %	0.7	3.8	12.2	14.2	12.3	14.5	14.3	15.2	10.2	12.0	10.7	11.8
Fuel economy, mpg	15.5	16.6	21.7	22.3	21.5	21.0	20.4	20.4	21.7	21.5	22.9	23.0
LARGE SUV												
Total sales, units	20,511	157,877	168,727	253,332	377,552	594,254	671,776	832,124	1,382,689	1,570,295	1,932,648	2,190,549
Market share, %	0.9	7.1	4.7	5.3	8.4	11.8	11.7	14.0	22.2	24.1	27.1	27.4
Fuel economy, mpg	14.3	14.6	16.0	16.8	18.9	18.9	19.0	18.8	19.5	18.3	18.9	18.8
TOTAL												
Total sales, units	2,386,910	2,216,537	3,612,934	4,743,000	4,514,625	5,055,677	5,724,401	5,933,866	6,236,861	6,526,716	7,137,650	8,001,755
Market share, %	100.0	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	20.5	20.4	20.2	20.4	20.1	20.3	20.1

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2000. (Additional resources: www-cta.ornl.gov)

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

[b] Some four-wheel drive pickups previously classified as large pickups were correctly reclassified as small pickups.

Table 7.7
Light Vehicle Market Shares by Size Class, Sales Periods” 1976-99

Sales period[a]	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Minicomnact	0.0%	6.5%	6.7%	4.3%	3.8%	3.9%	2.7%	2.1%	0.3%	0.3%	1.2%	1.0%
Subcompact	21.7%	15.5%	15.0%	24.4%	30.4%	31.2%	26.6%	23.2%	18.2%	15.7%	15.9%	13.6%
Compact	23.5%	21.8%	12.0%	6.7%	5.3%	5.4%	10.8%	12.6%	20.0%	23.2%	23.6%	27.1%
Midsize	15.0%	15.6%	26.1%	26.9%	27.2%	27.9%	28.3%	24.5%	22.1%	20.5%	19.1%	16.9%
Large	18.3%	20.0%	17.6%	15.4%	11.8%	12.1%	10.1%	9.6%	10.9%	10.0%	9.4%	9.3%
Two seater	1.7%	1.7%	1.5%	1.7%	1.9%	2.0%	2.2%	2.0%	2.4%	2.5%	1.8%	1.6%
Small pickup	1.4%	2.1%	2.2%	3.3%	4.6%	4.3%	5.3%	8.6%	7.3%	7.5%	7.8%	7.7%
Large pickup	13.1%	13.2%	13.4%	12.0%	9.9%	8.8%	9.1%	9.3%	8.8%	9.3%	8.5%	8.8%
Small van	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	1.6%	2.9%	4.1%	4.9%
Large van	4.8%	3.2%	4.8%	4.3%	2.9%	3.0%	3.4%	4.7%	3.9%	3.5%	3.3%	3.2%
Small utility	0.1%	0.1%	0.1%	0.0%	0.8%	0.4%	0.3%	1.6%	3.2%	2.9%	3.8%	4.6%
Large utility	0.2%	0.2%	0.3%	0.8%	1.4%	1.1%	1.2%	1.6%	1.2%	1.8%	1.5%	1.4%
Total light vehicles sold	12,073,765	13,045,310	14,037,378	13,589,420	11,311,043	11,029,922	11,012,704	10,345,470	13,823,999	15,203,880	15,633,934	15,014,173
Cars	80.2%	81.0%	79.0%	79.4%	80.4%	82.5%	80.6%	74.0%	73.9%	72.1%	71.0%	69.5%
Light trucks	19.8%	19.0%	21.0%	20.6%	19.6%	17.5%	19.4%	26.0%	26.1%	27.9%	29.0%	30.5%

Sales period	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Minicompact	0.6%	0.1%	0.6%	0.6%	0.9%	0.6%	0.4%	0.3%	0.2%	0.3%	0.1%	0.1%
Subcompact	13.1%	13.1%	14.8%	17.5%	16.6%	14.5%	13.8%	10.4%	8.8%	10.2%	9.8%	9.7%
Compact	27.8%	24.7%	23.0%	19.8%	19.6%	19.8%	21.0%	22.4%	23.5%	19.9%	15.2%	14.2%
Midsize	16.9%	19.7%	18.3%	18.8%	18.0%	18.2%	16.1%	17.0%	16.7%	17.1%	20.4%	20.2%
Large	9.1%	9.4%	9.3%	9.4%	9.1%	8.8%	9.2%	9.0%	8.5%	7.9%	6.9%	7.1%
Two seater	1.2%	1.1%	1.2%	1.1%	0.7%	0.5%	0.5%	0.4%	0.4%	0.5%	0.7%	0.6%
Small pickup	6.8%	5.9%	4.9%	4.9%	4.7%	2.5%	2.5%	2.4%	3.9%	3.5%	3.0%	1.8%
Large pickup	9.6%	10.6%	11.5%	11.0%	11.6%	14.0%	15.0%	14.9%	13.7%	13.9%	15.6%	17.0%
Small van	5.6%	5.8%	6.8%	7.1%	7.7%	8.4%	8.6%	8.6%	8.3%	8.2%	8.0%	7.9%
Large van	3.2%	3.2%	2.9%	2.5%	2.8%	2.9%	2.8%	2.7%	2.5%	2.6%	2.5%	2.5%
Small utility	4.4%	3.5%	4.0%	5.1%	5.5%	5.5%	5.6%	6.2%	4.3%	5.3%	5.0%	5.7%
Large utility	1.7%	3.1%	2.7%	2.2%	2.8%	4.4%	4.6%	5.7%	9.3%	10.6%	12.7%	13.2%
Total light vehicles sold	15,115,985	14,939,837	13,739,090	12,422,881	12,499,454	13,443,605	14,640,863	14,658,736	14,888,710	14,787,756	15,208,587	16,647,668
Cars	68.6%	68.1%	67.1%	67.1%	64.9%	62.4%	60.9%	59.5%	58.1%	55.9%	53.1%	51.9%
Light trucks	31.4%	31.9%	32.9%	32.9%	35.1%	37.6%	39.1%	40.5%	41.9%	44.1%	46.9%	48.1%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2000. (Additional resources: www-cta.ornl.gov)

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

Table 7.8
Sales-Weighted Engine Size of New Domestic and Import Automobiles by Size Class, Sales Periods” 1976-99
(liters”)

Sales period”	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	Fleet
1976	c	2.67	5.00	5.85	6.79	2.89	4.89
1977	1.98	2.73	4.79	5.47	6.02	2.81	4.56
1978	2.06	2.67	3.95	4.89	6.17	3.01	4.33
1979	1.86	2.39	3.74	4.41	5.56	2.77	3.78
1980	1.90	2.10	3.03	3.90	5.12	2.79	3.22
1981	1.57	2.04	2.20	3.63	5.00	2.49	2.98
1982	1.53	2.08	2.12	3.47	4.73	2.41	2.89
1983	1.60	2.19	2.20	3.45	4.95	2.52	2.98
1984	2.17	2.22	2.21	3.40	4.87	2.50	2.97
1985	1.95	2.29	2.27	3.37	4.65	2.47	2.92
1986	1.45	2.19	2.21	3.19	4.38	2.83	2.76
1987	1.48	2.19	2.20	2.99	4.36	2.57	2.68
1988	1.52	2.05	2.21	3.00	4.32	2.75	2.66
1989	2.54	2.08	2.11	3.01	4.31	2.81	2.68
1990	2.42	1.96	2.25	3.13	4.33	2.57	2.72
1991	2.17	1.97	2.23	3.16	4.40	2.67	2.72
1992	1.89	2.01	2.33	3.16	4.34	3.01	2.76
1993	1.96	2.07	2.28	3.16	4.27	3.47	2.78
1994	2.21	2.27	2.23	3.15	4.17	3.82	2.79
1995	2.42	2.26	2.23	3.12	4.12	3.76	2.79
1996	2.49	2.23	2.19	2.98	4.09	3.67	2.71
1997	2.62	2.13	2.28	3.02	4.03	3.08	2.74
1998	3.15	2.29	2.17	2.94	3.98	3.51	2.75
1999	2.86	2.31	2.25	2.91	3.91	3.62	2.76
			Average annualpercentage change				
1976-99	1.7%[d]	-0.6%	-3.4%	-3.0%	-2.4%	1.0%	-2.5%
1989-99	1.2%	1.1%	0.6%	-0.3%	-1.0%	2.6%	0.3%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2000. (Additional resources: www-cta.ornl.gov)

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

Table 7.9
Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class
Sales Periods” 1976-99
(liters”)

Sales period”	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
1998	2.84	4.64	3.37	5.02	2.83	4.74	4.16
1999	2.92	4.94	3.44	4.99	2.84	4.73	4.15
			Average annualpercentage change				
1976-99	1.9%	-0.5%	2.5%	-0.3%	-2.7%	-0.2%	-1.0%
1989-99	1.0%	0.5%	1.0%	-0.4%	-2.1%	-1.4%	0.5%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2000. (Additional resources: www-cta.ornl.gov)

[a] “Sales period” is October 1 of the current year through September 30 of the next year.
[a] 1 liter = 6 1.02 cubic inches.

Table 7.10
Sales-Weighted Curb Weight of New Domestic and Import Automobiles by Size Class, Sales Periods” 1976-99
(pounds)

Sales period”	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	Fleet
1976	[b]	2,577	3,609	4,046	4,562	2,624	3,608
1977	2,228	2,586	3,550	3,900	4,026	2,608	3,424
1978	2,200	2,444	3,138	3,427	3,956	2,763	3,197
1979	2,120	2,367	3,048	3,287	3,763	2,699	3,000
1980	2,154	2,270	2,813	3,081	3,667	2,790	2,790
1981	1,920	2,370	2,382	2,996	3,672	2,744	2,744
1982	2,002	2,302	2,422	2,992	3,703	2,525	2,730
1983	2,072	2,334	2,441	3,027	3,779	2,663	2,788
1984	2,376	2,380	2,454	2,990	3,734	2,559	2,788
1985	2,211	2,392	2,464	2,954	3,575	2,539	2,743
1986	2,120	2,415	2,432	2,857	3,451	2,575	2,675
1987	1,960	2,423	2,474	2,857	3,483	2,602	2,689
1988	1,933	2,346	2,558	2,880	3,487	2,693	2,717
1989	2,576	2,357	2,517	2,985	3,496	2,735	2,760
1990	2,651	2,368	2,637	3,065	3,594	2,656	2,828
1991	2,584	2,406	2,652	3,085	3,650	2,707	2,848
1992	2,395	2,444	2,674	3,131	3,670	2,770	2,879
1993	2,449	2,478	2,659	3,142	3,615	2,967	2,894
1994	2,719	2,571	2,639	3,171	3,657	3,035	2,921
1995	2,831	2,552	2,647	3,179	3,648	2,947	2,937
1996	2,847	2,533	2,667	3,203	3,671	2,985	2,950
1997	2,997	2,489	2,737	3,241	3,653	2,863	2,977
1998	3,004	2,584	2,703	3,198	3,675	2,956	3,002
1999	2,835	2,626	2,755	3,198	3,689	3,007	3,034
			Average annual percentage change				
1976-99	1.1%”	0.1%	-1.2%	-1.0%	-0.9%	0.6%	-0.8%
1989-99	1.0%	1.1%	0.9%	0.7%	0.5%	1.0%	1.0%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2000. (Additional resources: www-cta.ornl.gov)

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

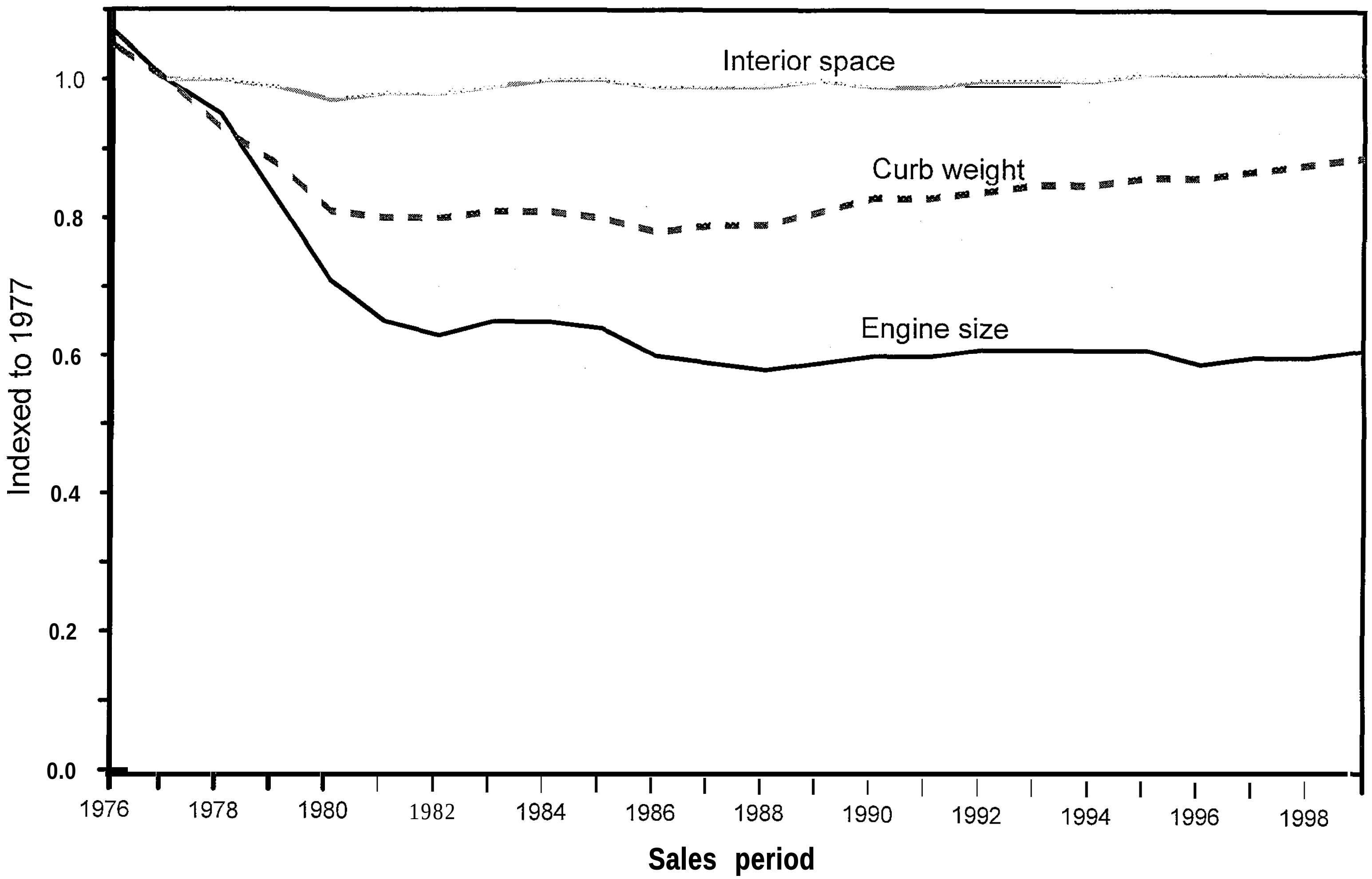
Table 7.11
Sales-Weighted Interior Space of New Domestic and Import Automobiles by Size Class, Sales Periods” 1976-99
(cubic feet)

Sales period”	Minicompact (< 85)	Subcompact (85-99)	Compact (100-109)	Midsize (110-119)	Large (> 120)	Fleet”
1977	78.8	**89.8**	107.1	113.0	128.0	107.9
1978	79.4	**89.8**	105.3	112.9	128.5	107.9
1979	80.0	**90.2**	105.8	113.4	130.1	106.9
1980	82.4	**89.9**	105.4	113.5	130.8	104.9
1981	83.3	90.2	103.6	113.7	130.6	105.5
1982	83.1	91.3	102.9	113.9	130.4	106.0
1983	82.7	93.3	103.0	113.1	131.3	107.3
1984	77.0	93.8	103.0	113.3	130.4	108.0
1985	77.8	94.1	103.1	113.5	129.7	107.9
1986	80.1	94.5	102.8	113.8	127.6	107.0
1987	81.6	93.1	103.0	113.9	127.5	106.9
1988	81.0	93.5	103.3	113.6	127.2	107.0
1989	75.0	93.3	102.7	113.8	127.4	107.5
1990	79.9	93.9	103.2	113.8	127.8	107.3
1991	79.6	94.4	103.2	113.8	128.3	107.1
1992	79.1	94.0	104.2	114.0	129.2	107.5
1993	79.2	94.5	104.0	114.0	128.9	108.0
1994	79.4	94.4	103.8	113.8	128.8	108.0
1995	78.5	93.8	103.9	114.3	128.1	108.7
1996	76.7	94.9	103.4	114.2	128.0	108.8
1997	77.2	95.6	103.2	114.6	128.0	108.7
1998	66.9	97.0	102.2	114.4	127.7	109.2
1999	76.3	96.7	103.3	114.1	127.1	109.5
			Average annual percentage change			
1977-99	-0.1%	0.3%	-0.2%	0.0%	0.0%	0.1%
1989-99	0.2%	0.4%	0.1%	0.0%	0.0%	0.2%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2000. (Additional resources: www-cta.ornl.gov)

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

Figure 7.1. Engine Size, Curb Weight, and Interior Space of New Domestic and Import Automobiles, 1976-99



Source: See Tables 7.8, 7.10, and 7.11.

Table 7.12
Sales-Weighted Wheelbase of New
Automobiles and Light Trucks, Sales Periods” 1976-99
(inches)

Sales period”	Automobiles	Light trucks	Automobiles and light trucks combined
1976	110.78	118.87	112.03
1977	109.75	117.79	111.05
1978	107.67	116.23	108.65
1979	105.77	116.27	107.93
1980	103.61	114.54	105.76
1981	102.97	114.86	105.10
1982	103.01	114.87	105.60
1983	103.76	113.73	106.10
1984	103.50	113.87	106.21
1985	102.96	113.98	106.02
1986	102.27	113.40	105.48
1987	102.11	113.27	105.52
1988	102.21	111.79	105.21
1989	102.66	112.23	105.71
1990	103.13	111.41	105.85
1991	103.27	111.09	105.82
1992	103.60	112.68	106.78
1993	104.03	112.57	107.21
1994	104.31	113.23	107.75
1995	104.95	113.37	108.31
1996	105.04	113.36	108.53
1997	105.36	113.36	108.89
1998	105.55	114.53	109.76
1999	105.77	114.70	110.06
	Average annual percentage change		
1976-99	-0.2%	-0.2%	-0.1%
1989-99	0.3%	0.2%	0.4%

Source:
Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2000.
(Additional resources: www-cta.ornl.gov)

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

The average auto lost over 300 pounds from 1978 to 1985, but gained a few pounds back since then. Much of the weight reduction was due to the declining use of conventional steel and iron and the increasing use of aluminum and plastics. Conventional steel, however, remained the predominant component of automobiles in 1999 with a 43% share of total materials. As conventional steel use has been decreasing, use of high-strength steel has increased.

Table 7.13
Average Material Consumption for a Domestic Automobile, 1978, 1985, and 1999

	1978		1985		1999	
Material	Pounds	Percentage	Pounds	Percentage	Pounds	Percentage
Conventional steel[a]	1,880.0	53.8%	1,481.5	46.5%	1,399.0	42.7%
High-strength steel	127.5	3.6%	217.5	6.8%	328.0	10.0%
Stainless steel	25.0	0.7%	29.0	0.9%	50.5	1.5%
Other steels	56.0	1.6%	54.5	1.7%	25.0	0.8%
Iron	503.0	14.4%	468.0	14.7%	355.0	10.8%
Aluminum	112.0	3.2%	138.0	4.3%	236.0	7.2%
Rubber	141.5	4.1%	136.0	4.3%	142.0	4.3%
Plastics/composites	176.0	5.0%	211.5	6.6%	245.0	7.5%
Glass	88.0	2.5%	85.0	2.7%	97.0	3.0%
Copper	39.5	1.1%	44.0	1.4%	45.5	1.4%
Zinc die castings	28.0	0.8%	18.0	0.5%	12.0	0.4%
Powder metal parts	16.0	0.5%	19.0	0.6%	35.0	1.1%
Fluids & lubricants	189.0	5.4%	184.0	5.8%	194.0	5.9%
Other materials	112.5	3.2%	101.5	3.2%	110.0	3.4%
Total	**3,494.0**	100.0%	3,187.5	100.0%	3,274.0	100.0%

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

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

The number of franchised dealerships which sell new light-duty vehicles (cars and light trucks) has declined 27% since 1970, though new vehicle sales have increased. The average number of vehicles sold per dealer in 1998 was 683 vehicles per dealer – more than double the 1970 number.

Table 7.14
New Light Vehicle Dealerships and Sales, 1970–98

Calendar year	Number of franchised new light vehicle dealerships[a]	New light vehicle sales (thousands)	Light vehicle sales per dealer
1970	30,800	9,867	320
1971	30,300	12,006	396
1972	30,100	13,189	438
1973	30,100	14,184	471
1974	30,000	11,191	373
1975	29,600	10,905	368
1976	29,300	13,066	446
1977	29,100	14,613	502
1978	29,000	15,122	521
1979	28,500	13,984	491
1980	27,900	11,419	409
1981	26,350	10,725	407
1982	25,700	10,452	407
1983	24,725	12,166	492
1984	24,725	14,254	577
1985	24,725	15,501	627
1986	24,825	16,047	646
1987	25,150	14,888	592
1988	25,025	15,426	616
1989	25,000	14,508	580
1990	24,825	13,849	558
1991	24,200	12,298	508
1992	23,500	12,842	546
1993	22,950	13,869	604
1994	22,850	15,023	657
1995	22,800	14,688	644
1996	22,750	15,046	661
1997	22,700	15,069	664
1998	22,600	15,438	683
	Average annual percentage change		
1970-98	-1.1%	1.6%	2.7%
1988-98	-1.0%	0.0%	1.0%

Source:

Number of dealers - National Automobile Dealers Association, *Automotive Executive Magazine,* 1999. (Additional resources: www.nada.org/)

Light-duty vehicle sales - See tables 7.3 and 7.4.

[a] As of the beginning of the year.

The number of conventional refuelingstations has declinedsince 1970 while the number of vehicle fueling at those stations continues to rise. In 1996, there were less than 0.5 conventionalfueling stations per thousand vehicles. Data for alternativefuel vehicles in 1999 indicate that there was an average of 15 stationsper thousand vehicles.

Table 7.15
Conventional and Alternative Fuel Refueling Stations

Calendar year	Refueling stations[a]	Vehicles in operation (thousands)	Stations per thousand vehicles
		Conventional fuels	
1970	146,616	98,136	1.49
1975	147,576	120,054	1.23
1980	116,900	139,832	0.84
1985	105,787	157,048	0.67
1988	108,107	171,741	0.63
1989	105,767	175,960	0.60
1990	104,801	179,299	0.58
1991	101,894	181,438	0.56
1992	100,078	181,519	0.55
1993	101,383	186,315	0.54
1994	99,250	188,714	0.53
1995	97,448	193,441	0.50
1996	96,236	198,294	0.49
1997	95,847	201,071	0.48
		Alternative fuels, 1999[b]	
LPG	4,153	268	1,549.63
CNG	1,267	90	14.08
Electricity	490	6	84.13
M85/M100	51	20	2.55
LNG	46	1	33.87
E85/E95	49	22	2.23
Total	6,056	407	14.87

Source:

Refueling stations - Conventional: U.S. Department of Commerce, Bureau of the Census, County Business Patterns for the United States, www.census.gov/epcd/cbp/view/cbpview.html and electronic communication with the County Business Pattern Office, 1998. Alternative Fuel: Alternative Fuels Data Center, www.afdc.doe.gov.

Vehicles - Conventional: The Polk Company, Detroit, MI. FURTHER REPRODUCTION PROHIBITED. Alternative Fuel: Alternative Fuels Data Center, www.afdc.doe.gov.

[a] Includes convenience stores/refueling stations and truck stops which have gasoline sales of at least 50% of total establishment sales.

[b] Additional data on alternative fuel vehicles and refueling stations are in Chapter 9.

Table 7.16
Corporate Average Fuel Economy (CAFE) Standards versus Sales-Weighted Fuel Economy Estimates for Automobiles and Light Trucks, 1978-99”
(miles per gallon)

	Automobiles				Light trucks[c]				CAFE estimates
		CAFE estimates[d]				CAFE estimates[d]			
Model year[b]	CAFE standards	Domestic	Import	Combined	CAFE standards	Domestic	Import	Combined	Autos and light trucks combined
1978	18.0	18.7	27.3	19.9	e	f	f		19.9
1979	19.0	19.3	26.1	20.3	e	17.7	20.8	18.2	20.1
1980	20.0	22.6	29.6	24.3	e	16.8	24.3	18.5	23.1
1981	22.0	24.2	31.5	25.9	e	18.3	27.4	20.1	24.6
1982	24.0	25.0	31.1	26.6	17.5	19.2	27.0	20.5	25.1
1983	26.0	24.4	32.4	26.4	19.0	19.6	27.1	20.7	24.8
1984	27.0	25.5	32.0	26.9	20.0	19.3	26.7	20.6	25.0
198.5	27.5	26.3	31.5	27.6	19.5	19.6	26.5	20.7	25.4
1986	26.0	26.9	31.6	28.2	20.0	20.0	25.9	21.5	25.9
1987	26.0	27.0	31.2	28.4	20.5	20.5	25.2	21.7	26.2
1988	26.0	27.4	31.5	28.0	20.5	20.6	24.6	21.3	26.0
1989	26.5	27.2	30.8	28.4	20.5	20.4	23.5	21.0	25.6
1990	27.5	26.9	29.9	27.9	20.0	20.3	23.0	20.8	25.4
1991	27.5	27.3	30.1	28.4	20.2	20.9	23.0	21.3	25.6
1992	27.5	27.0	29.2	27.9	20.2	20.5	22.7	20.8	25.1
1993	27.5	27.8	29.6	28.4	20.4	20.7	22.8	21.0	25.2
1994	27.5	27.5	29.7	28.3	20.5	20.5	22.0	20.8	24.7
1995	27.5	27.7	30.3	28.6	20.6	20.3	21.5	20.5	24.9
1996	27.5	28.1	29.6	28.5	20.7	20.5	22.1	20.8	24.9
1997	27.5	27.8	30.1	28.7	20.7	20.1	22.1	20.6	24.6
1998	27.5	28.1	30.0	28.7	20.7	20.4	23.0	20.9	24.6
1999	27.5	28.2	28.4	28.3	20.7	f	f	20.7	24.5

Source:
U.S. Department of Transportation, NHTSA, “Summary of Fuel Economy Performance,” Washington, DC, October 1999. (Additional resources: www.nhtsa.dot.gov)

“Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer.
[b]Model year as determined by the manufacturer on a vehicle by vehicle basis.
‘Represents two- and four-wheel drive trucks combined. Gross vehicle weight of 0–6,000 pounds for model year 1978-1979 and 0–8,500 pounds for subsequent years.
[d]All CAFE calculations are sales-weighted.
“Standards were set for two-wheel drive and four-wheel drive light trucks separately, but no combined standard was set in this year.
[f]Data are not available.

Table 7.17
Corporate Average Fuel Economy (CAFE) Fines Collected, 1983-98”
(thousands)

Model year	Current dollars	1998 constant dollars[b]
1983	58	95
1984	5,958	9,352
1985	15,565	23,589
1986	29,872	44,417
1987	31,261	44,844
1988	44,519	61,357
1989	47,381	62,311
1990	48,449	60,444
1991	42,243	50,557
1992	38,287	44,481
1993	28,688	32,374
1994	31,478	34,619
1995	40,788	43,620
1996	19,302	20,058
1997	36,204	36,769
1998	17,677	17,677

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, March, 2000.
(Additional resources: www.nhtsa.dot.gov)

Table 7.18
Tax Receipts from the Sale of Gas Guzzlers, 1980–98
(thousands1

Fiscal year	Current dollars	1998 constant dollars[b]
1980	740	1,464
1981	780	1,398
1982	1,720	2,905
1983	4,020	6,578
1984	8,820	13,844
1985	39,790	60,302
1986	147,660	219,557
1987	145,900	209,292
1988	116,780	160,947
1989	109,640	144,189
1990	103,200	128,750
1991	118,400	141,703
1992	144,200	167,530
1993	111,600	125,940
1994	64,100	70,496
1995	73,500	78,603
1996	52,600	54,660
1997	48,200	48,952
1998	47,700	47,700

Source:
Internal Revenue Service, Statistics of Income Bulletin, Summer 1999, Washington, DC, 1999, p. 220. (Additional resources: www.irs.gov/tax_stats).

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

[b] Adjusted using the Consumer Price Inflation Index.

Consumers mustpay the Gas Guzzler Tax whenpurchasingan automobile thnthas an EnvironmentalProtection Agency (EPA) fuel economy rating less than that stipulated in the table below.. The Gas Guzzler Tax doubled in 1991 after remaining constantfrom 1986 to 1990. The tax has not changedsince 1991.

Table 7.19
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 .O	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	1,00	1,300	2,600
17.0-17.5	0	0	350	500	750	1,00	1,500	3,000
16.5-17.0	0	200	350	650	750	1,20	1,500	3,000
16.0-16.5	0	200	450	650	950	1,20	1,850	3,700
15.5-16.0	0	350	450	800	950	1,50	1,850	3,700
15.0-15.5	0	350	600	800	1,150	1,50	2,250	4,500
14.5-15.0	200	450	600	1,000	1,150	1,80	2,250	4,500
14.0-14.5	200	450	750	1,000	1,450	1,80	2,700	5,400
13.5-14.0	300	550	750	1,250	1,450	2,20	2,700	5,400
13.0-13.5	300	550	950	1,250	1,750	2,20	3,200	6,400
12.5–13.0	550	650	950	1,550	1,750	2,65	3,200	6,400
Under 12.5	550	650	1,200	1,550	2,150	2,65	3,850	7,700

Source:
Internal Revenue Service, Form 6197, (Rev. 1-9 1), “Gas Guzzler Tax.”
(Additional resources: www.irs.ustreas.gov)

Fuel Economy by Vehicle Speed

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

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

For further information regarding this study please contact:

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

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

Table 7.20
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 .O 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 14	PFI	L4	27	34

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

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

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

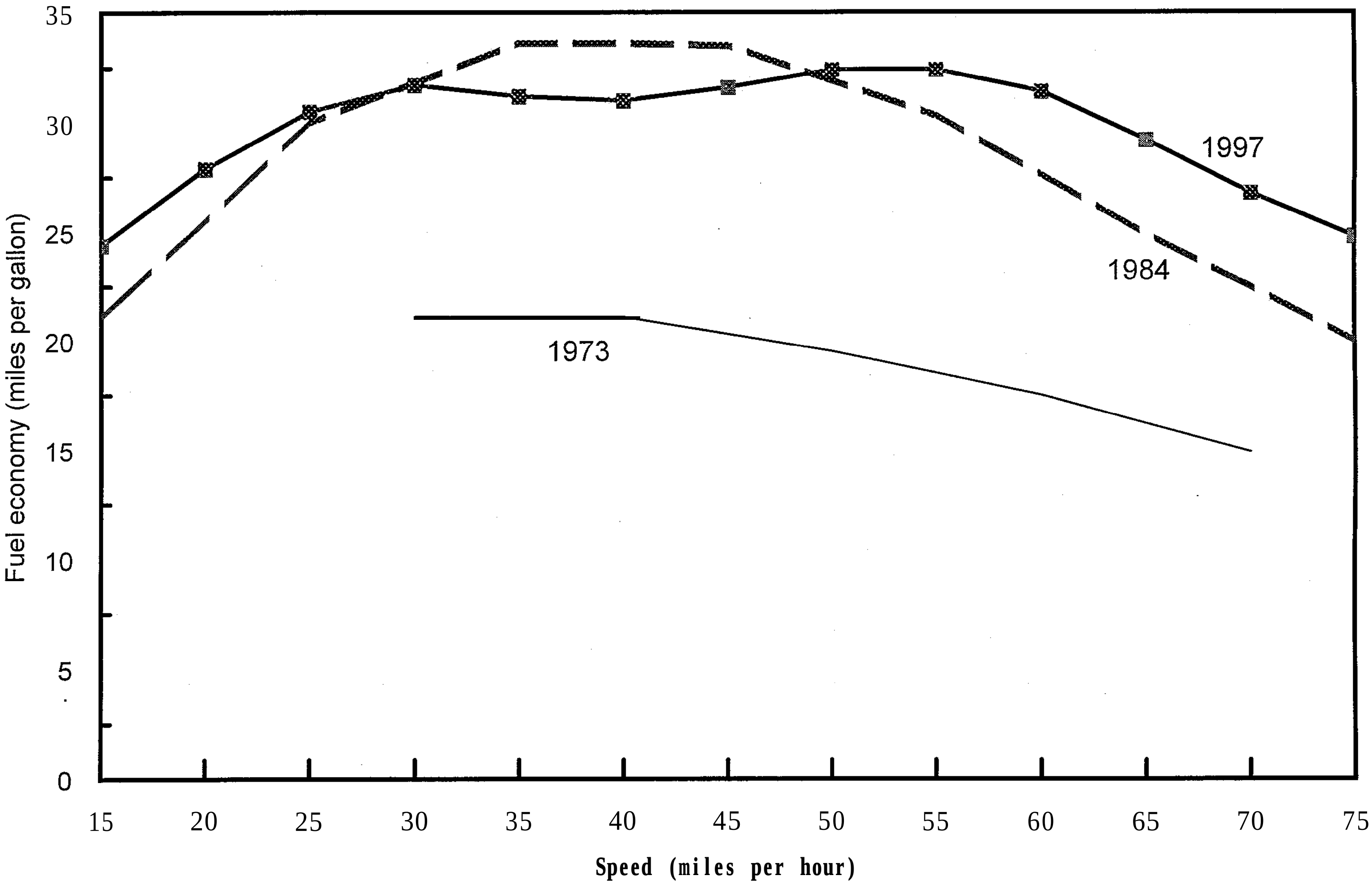
Table 7.21
Fuel Economy by Speed, 1973, 1984, and 1997
(miles per gallon)

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

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

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

Figure 7.2. Fuel Economy by Speed, 1973, 1984, and 1997



Source: See Table 7.21.

Table 7.22
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%	-2.4%
65-75 mph	17.4%	13.8%	20.0%	13.6%	17.0%	10.3%	11.5%	17.0%	15.4%
55-75 mph	18.6%	23.6%	30.6%	25.8%	27.9%	20.4%	29.3%	24.9%	13.4%

Source:

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

Note:

For specifications of the tested vehicles, please see Table 7.20.

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

Figure 7.3. Urban Driving Cycle

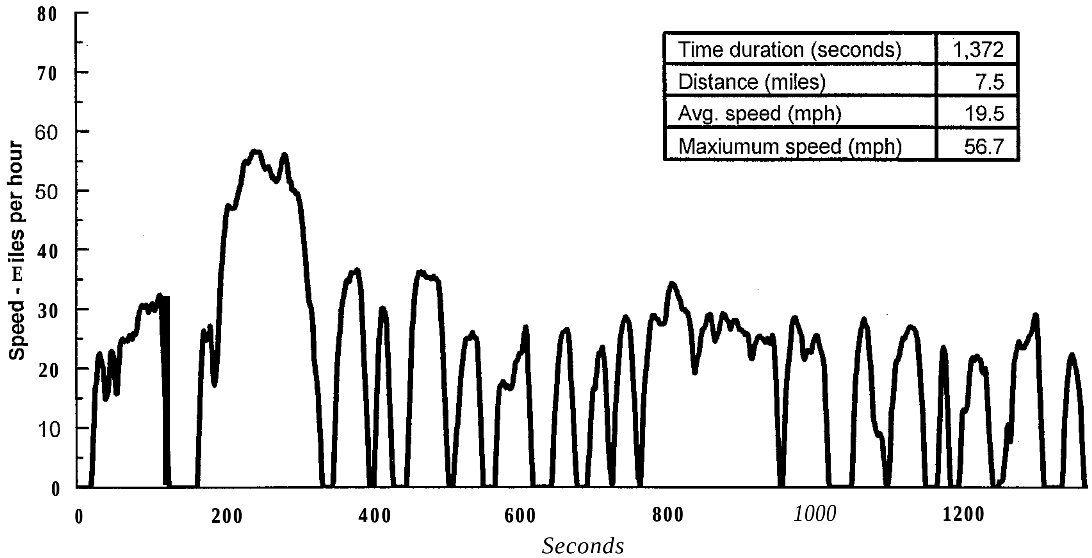
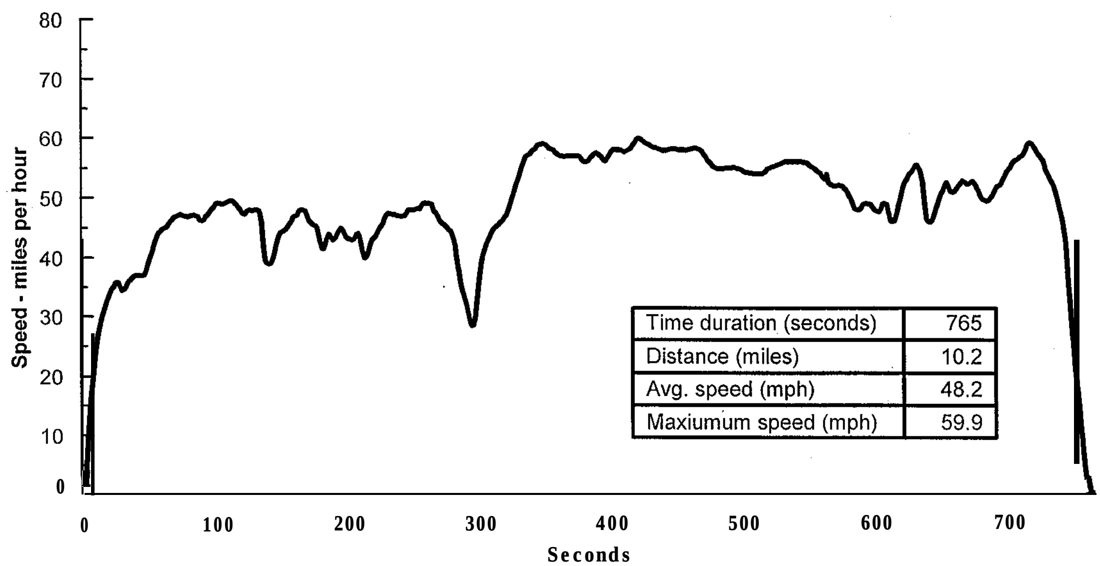


Figure 7.4. Highway Driving Cycle

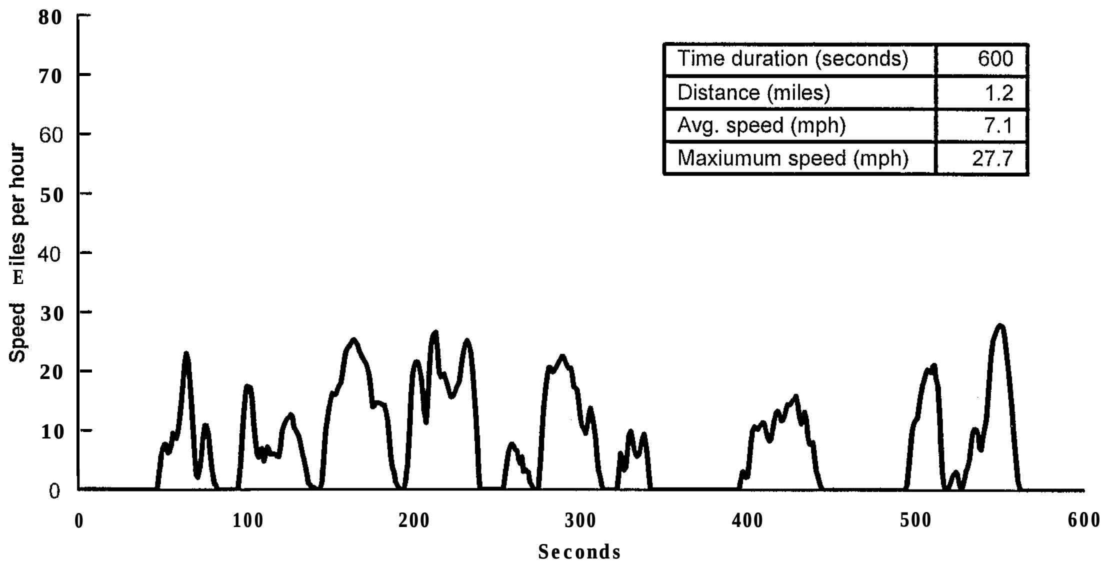


Source:

Code of Federal Regulations, 40CFR, "Subpart B - Fuel Economy Regulations for 1978 and Later Model Year Automobiles - Test Procedures," July 1, 1988 edition, p. 676.

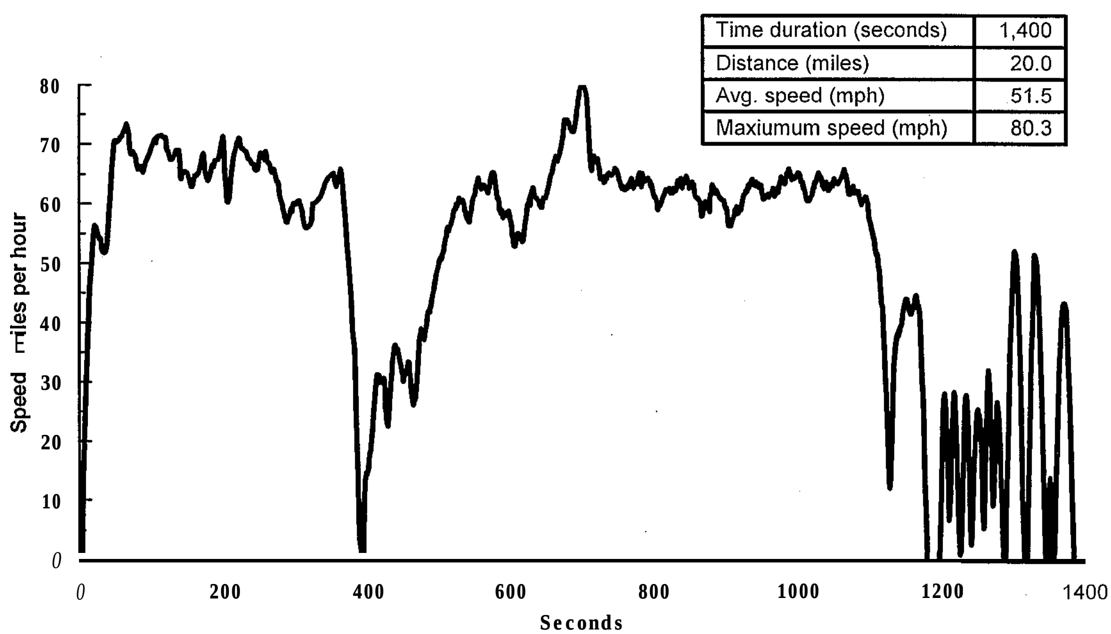
The New York Test Cycle was developed in the 1970's in order to simulate driving in downtown congested areas. The Representative Number Five Test Cycle was developed recently to better represent actual on-road driving by combining modern urban andfreeway driving.

Figure 7.5. New York City Driving Cycle



Time duration (seconds)	600
Distance (miles)	1.2
Avg. speed (mph)	7.1
Maxiumum speed (mph)	27.7

Figure 7.6. Representative Number Five Driving Cycle



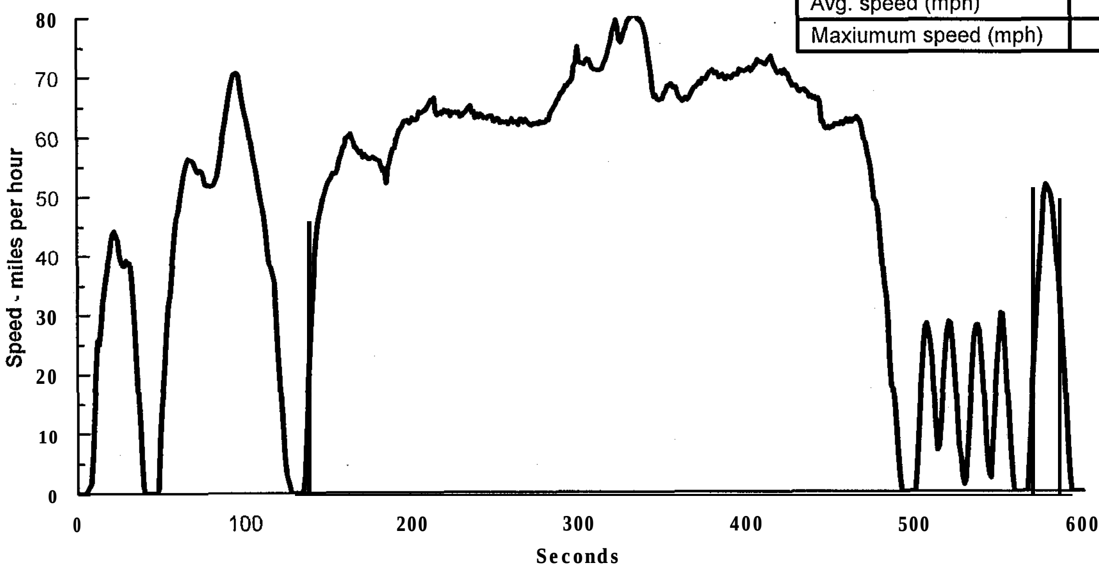
Time duration (seconds)	1,400
Distance (miles)	20.0
Avg. speed (mph)	51.5
Maxiumum speed (mph)	80.3

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

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

Figure 7.7. US06 Driving Cycle

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



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

Table 7.23
Occupant Fatalities by Vehicle Type and Nonoccupant Fatalities, 1975-98

	1975	1980	1985	1990	1995	1996	1997	1998
Vehicle occupant fatalities by vehicle type								
Passenger car								
Subcompact	3,834	7,299	7,993	8,309	6,791	6,618	6,220	[a]
Compact	614	927	2,635	5,310	6,899	7,288	7,195	[a]
Intermediate	1,869	3,878	4,391	4,849	4,666	4,670	4,794	[a]
Full	10,800	11,580	6,586	4,635	3,413	3,417	3,481	[a]
Unknown	8,812	3,765	1,607	989	654	512	509	[a]
Total	25,929	27,449	23,212	24,092	22,423	22,505	22,199	**21,164**
Truck								
Light	4,856	7,486	6.689	8,601	9,568	9,932	10,249	10,647
Large	961	1,262	977	705	648	621	723	728
Total	**5,817**	8,748	7,666	9,306	10,216	10,553	10,972	11,375
Other Vehicles								
Motorcycle	3,189	5,144	4,564	3,244	2,227	2,161	2,116	2,284
Bus	53	46	57	32	33	21	18	36
Other/unknown vehicle type	[R]937	540	544	460	392	455	420	500
Total	**[R]4,179**	5,730	5,165	3,736	2,652	2,637	2,554	2,820
TOTAL vehicle occupant fatalities	35,925	41,927	36,043	37,134	35,291	35,695	34,725	35,369
Nonoccupant fatalities								
Pedestrian	7,516	8,070	6,808	6,482	5,584	5,449	5,321	5,220
Pedalcyclist	1,003	965	890	859	833	765	814	761
Other	81	129	84	124	109	154	153	131
Total	8,600	9,164	7,782	7,465	6,526	6,368	6,288	6,112
TOTAL traffic fatalities	44,525	51,091	43,825	44,599	41,817	42,065[b]	42,013	41,471

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics* 1999, Washington, DC 1999, p. 232. [Original source: U.S. DOT, National Highway Traffic Safety Administration, Fatal Accident Reporting System.] (Additional resources: www.nhtsa.dot.gov)

[a] Data are not available.
[b] Includes 2 fatalities that could not be assigned to a category above.

Table 7.24
Light Vehicle Occupant Safety Data, 1975-98

	1975	1980	1985	1990	1995	1996	1997	1998
				Passenger cars				
Fatalities	25,929	27,449	23,212	24,092	22,423	22,505	22,199	21,164
Injuries	[a]	[a]	[a]	2,376,000	2,469,000	2,458,000	2,341,000	2,201,000
Crashes	[a]	[a]	[a]	5,560,000	5,523,000	5,599,000	5,537,000	[a]
Vehicle-miles (billions)[b]	1,030	1,107	1,249	1,427	1,478	1,499	1,528	[a]
Rates per 100 million vehicle miles								
Fatalities	2.5	2.5	1.9	1.7	1.5	1.5	1.4	[a]
Injuries	[a]	[a]	[a]	167	167	164	[R]153	[a]
Crashes	[a]	[a]	[a]	390	374	374	[R]355	[a]
				Light trucks (10,000 lbs. or less)				
Fatalities	4,856	7,486	6,689	8,601	9,568	9,932	10,249	10,647
Injuries	[a]	[a]	[a]	505,000	722,000	761,000	755,000	763,000
Crashes	[a]	[a]	[a]	2,152,000	2,709,000	2,881,000	2,901,000	[a]
Vehicle-miles (billions)[b]	204	295	389	556	750	787	824	[a]
Rates per 100 million vehicle-miles								
Fatalities	2.4	2.5	1.7	1.5	1.3	1.3	1.2	[a]
Injuries	[a]	[a]	[a]	91	96	98	93	[a]
Crashes	[a]	[a]	[a]	387	361	366	352	[a]

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 1999,* Washington, DC 1999, pp. 233, 235. [Original source: U.S. DOT, National Highway Traffic Safety Administration, Fatal Accident Reporting System.] (Additional resources: www.nhtsa.dot.gov)

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

In 1998, nearly 40% of all passenger car and light truckfatal crashes were single-vehicle crashes. Because there are so many passenger cars on the roads compared to the other vehicle types, total passenger car crashes are nearly double all other vehicle types combined.

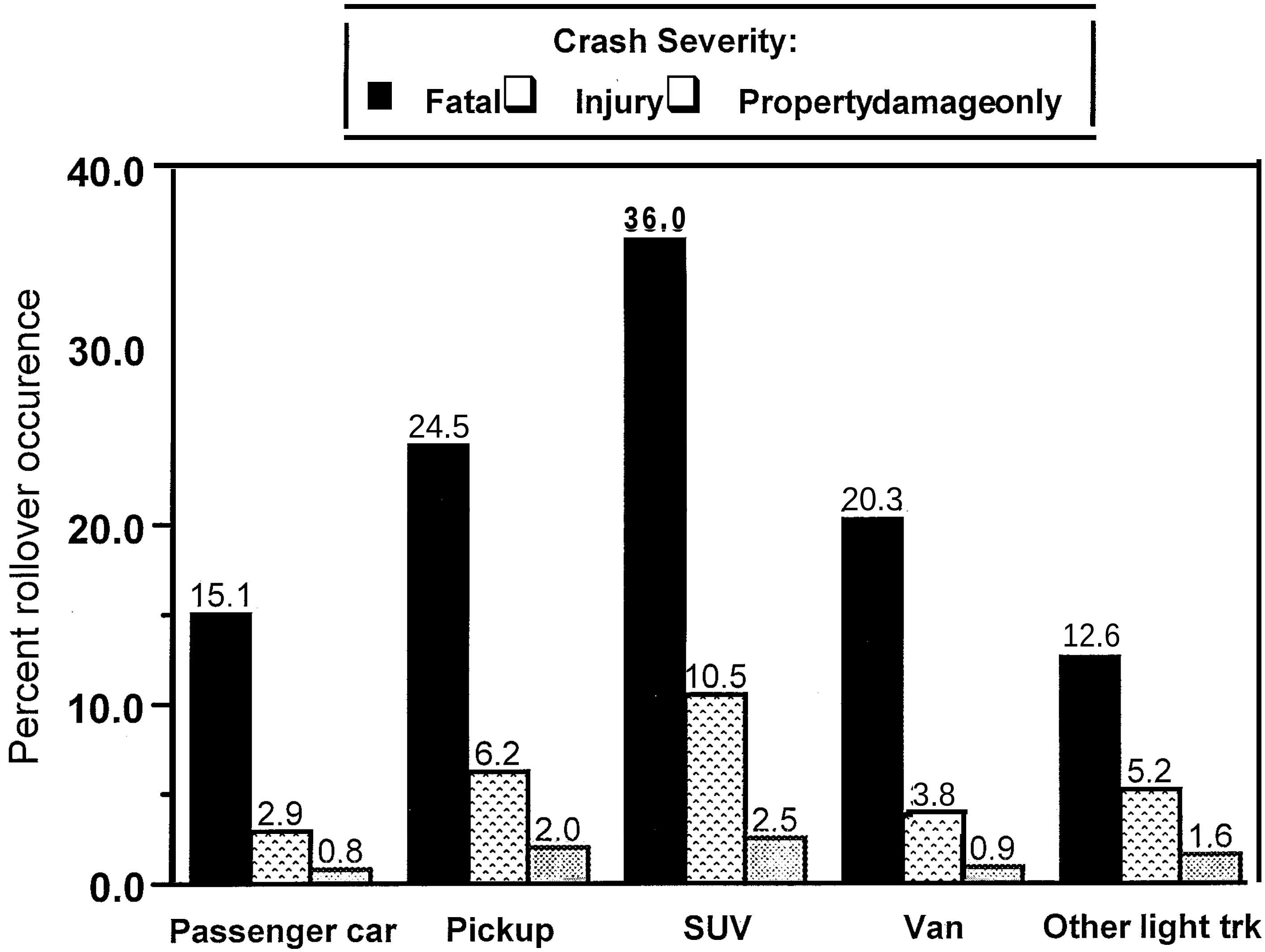
Table 7.25
Crashes by Crash Severity, Crash Type, and Vehicle Type, 1998

	Fatal		Inj m-y		Property damage only		
Vehicle type	Single-vehicle crash	Multiple-vehicle crash	Single-vehicle crash	Multiple-vehicle crash	Single-vehicle crash	Multiple-vehicle crash	Total crashes
Passenger cars	10,785	18,207	362,000	725,000	725,000	4,171,000	7,470,000
Light trucks	7,540	11,677	163,000	896,000	365,000	1,950,000	3,393,000
Large trucks	808	4,127	14,000	75,000	73,000	245,000	412,000
Buses	106	179	2,000	11,000	8,000	32,000	53,000
Motorcycles	1,045	1,279	22,000	23,000	2,000	6,000	55,000

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts* 1998, Washington, DC, October 1999, pp. 72, 74, 76, 80, 82.

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

Figure 7.8. Percent Rollover Occurrence by Vehicle Type and Crash Severity



Source:

U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts* 1998, Washington, DC, October 1999, p. 64.

Chapter 8

Heavy Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 8.1	Heavy single-unit trucks, 1998	
	Registration (thousands)	*5,414*
	Vehicle miles (millions)	*67,894*
	Fuel economy (miles per gallon)	*7.0*
Table 8.1	Combination trucks, 1998	
	Registration (thousands)	*1,831*
	Vehicle miles (millions)	*128,159*
	Fuel economy (miles per gallon)	*6.1*
Table 8.7	Trucks by size, 1997 Truck Inventory & Use Survey	
	Light (O-l 0,000 lbs)	*93.5%*
	Medium (10,001–26,000 lbs)	*3.0%*
	Heavy (26,001 lbs and over)	*3.5%*
Table 8.12	Freight Shipments, 1997 Commodity Flow Survey	
	Value (billion dollars)	*8,567*
	Tons (millions)	*14,800*
	Ton-miles (billions)	*3,851*
Table 8.13	Bus passenger miles, 1998	(millions)
	Transit	*20,602*
	In tercity	*31,700*

Table 8.1
Summary Statistics for Other Single-Unit and Combination Trucks, 1970–98[a]

	Other single-unit trucks[b]				Combination trucks’			
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
	4,313	45,637	7,386	6.2	1,408	81,038	14,475	5.6
1986 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	5,266	64,072	9,409	6.8	1,747	118,899	20,192	5.9
1997	5,293	66,893	9,576	7.0	1,790	124,584	20,302	6.1
1998	5,414	67,894	9,741	7.0	1,831	128,159	21,100	6.1
				Average annual percentage change				
1970-98	1.4%	3.3%	3.3%	0.1%	2.5%	4.7%	3.8%	**0.9%**
1988-98	1.9%	3.2%	2.4%	0.9%	1.6%	3.8%	3.3%	0.5%

Source:
U. S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1998,* Washington, DC, 1999, Table VM1 and annual.
(Additional resources: 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 8.5.

Table 8.2
New Retail Truck Sales by Gross Vehicle Weight, 1970–98[a]
(thousands)

Calendar year	Class 1 6,000 lbs. or less	Class 2 6,001–10,000 lbs.	Class 3 10,001–14,000 lbs.	Class 4 14,001-16,000 lbs.	Class 5 16,001-19,500 lbs.	Class 6 19,501–26,000 lbs.	Class 7 26,001-33,000 lbs.	Class 8 33,001 lbs. and over	Total
Domestic sales (import data are not available)									
1970[b]	1,049	408	6	12	58	133	36	89	1,791
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
1997	5,085	1,712	53	57	9	18	114	178	7,226
1998	5,263	2,036	102	43	25	32	115	209	7,825
Average annual percentage change									
1970-85	5.7%	7.9%	4.1%		-15.1%	-6.6%	6.8%	2.8%	5.5%
1986-98	3.8%	4.4%	19.5%		12.6%	-2.8%	1.1%	5.3%	4.0%

Source:
1970-97: American Automobile Manufacturers Association, Motor *Vehicle Facts and Figures 1998,* Detroit, MI, 1998, p. 24, and annual. 1998: Ward's Communications, *Ward's Automotive Yearbook,* Southfield, MI, p. 260. (Additional resources: www.wardsauto.com)

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

Vehicle Inventory and Use Survey

The Vehicle Inventory and Use Survey (VIUS), which was formerly the Truck Inventory and Use Survey, provides data on the physical and operational characteristics of the Nation's truck population. It is based on a probability sample of private and commercial trucks registered (or licensed) in each state. The name of the 1997 survey was changed to the Vehicle Inventory and Use Survey due to future possibilities of including additional vehicle types. Data for 1997 have been released in a report, as well as on CD-ROM. Copies may be obtained by contacting the U.S. Bureau of the Census, Transportation Characteristics Surveys Branch (301) 457-2797. Internet site **www. census.gov/svsd/www/tiusview.html** is the location of the VIUS on-line.

Since 1987 the survey has includedminivans, vans, station wagons on truck chassis, and sport utility vehicles in addition to the bigger trucks. The 1977 and 1982 surveys did not include those vehicle types. The estimated number of trucks that were within the scope of the 1997 VIUS and registered in the U.S. as of July 1, 1997, was 72.8 million. These trucks were estimated to have been driven a total of 1,044 billion miles during 1997, an increase of 32.8% from 1992. The average annual miles traveled per truck was estimated at 14,300 miles.

In the 1997 VIUS, there are several ways to classify a truck by weight. The survey respondent was asked the average weight of the vehicle or vehicle-trailer combination when carrying a typical payload; the empty weight (truck minus cargo) of the vehicle as it was usually operated; and the maximum gross weight at which the vehicle or vehicle-trailer combination was operated. The Census Bureau also collected information on the Gross Vehicle Weight Class of the vehicles (decoded from the vehicle identification number) and the registered weight of the vehicles from the State registration files. Some of these weights are only provided in categories, while others are exact weights. Since all these weights could be quite different for a single truck, the tabulations by weight can be quite confusing. For illustration of this, see Tables 8.3 and 8.4. The first set of data are based on the Gross Vehicle Weight Class of the vehicle when it was manufactured; the data on Table 8.5 are based on the average weight as reported by the respondent. There is a 24% difference in the number of Class 1 trucks (6,000 lbs. and less). In most tables, the Gross Vehicle Weight Class was used. However, on the tables comparing different survey estimates, average weight must be used, as the older surveys did not include data on the Gross Vehicle Weight rating.

These tables illustrate the difference between two weight variables in the Vehicle Inventory and Use Survey. The manufacturer's gross vehicle weight class is likely to be more accurate than the average weightprovided by the respondent.

Table 8.3
Truck Statistics by Gross Vehicle Weight Class, 1997

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

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

Table 8.4
Percentage of Trucks by Size Class, 1977, 1982, 1987, 1992, and 1997
(percentage)

Average weight as reported by respondent	1977 TIUS	1982 TIUS	1987 TIUS	1992 TIUS	1997 VIUS
6,000 lbs and less	66.0%	77.8%	85.4%	85.4%	86.3%
6,001–10,000 lbs	17.9%	11.6%	6.5%	7.9%	7.3%
10,000-14,000 lbs	3.1%	1.6%	1.2%	1.2%	1.1%
14,001–16,000 lbs	1.3%	0.9%	0.5%	0.5%	0.4%
16,001–19,500 lbs	2.1%	1.0%	0.6%	0.5%	0.4%
19,501–26,000 lbs	3.4%	2.4%	1.7%	1.2%	1.0%
26,001–33,000 lbs	1.5%	1.0%	0.8%	0.7%	0.6%
33,001 lbs and over	4.6%	3.8%	3.3%	2.8%	2.9%

Source:
Estimates are based on data provided on the following public use files: U.S. Department of Commerce, Bureau of the Census, Census of Transportation, Washington, DC, 1977 *Truck Inventory and Use Survey,* 1980; 1982 *Truck Inventory and Use Survey*, 1985; 1987 *Truck Inventory and Use Survey*, 1990; *1992 Truck Inventory and Use Survey*, 1995; 1997 *Vehicle Inventory and Use Survey, 2000.*
(Additional resources: 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 8.5
Truck Fuel Economy by Fuel Type and Size Class, 1997
(miles per gallon)

Average weight as reported by the respondent	Gasoline trucks	Diesel trucks
6,000 lbs and less	16.8	16.6
6,001–10,000 lbs	13.7	13.7
10,001–14,000 lbs	10.4	11.8
14,001–16,000 lbs	8.9	10.3
16,001–19,500 lbs	8.6	9.3
19,501–26,000 lbs	7.5	8.3
26,001–33,000 lbs	7.0	7.5
33,001 lbs and up	6.5	5.9
Weighted average	16.4	10.3

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

Table 8.6
Truck Fuel Economy by Size Class, 1977, 1982, 1987, 1992, and 1997
(miles per gallon)

Average weight as reported by respondent	1977 TIUS	1982 TIUS	1987 TIUS	1992 TIUS	1997 VIUS
6,000 lbs and less	13.2	14.2	15.0	16.1	16.8
6,001–10,000 lbs	11.5	11.1	10.9	12.2	13.6
lO,OOO-14,000 lbs	9.4	8.1	8.1	9.2	10.8
14,001–16,000 lbs	6.9	7.5	7.5	8.5	9.5
16,001–19,500 lbs	7.6	7.2	7.1	8.1	8.9
19,501–26,000 lbs	6.1	6.9	6.4	7.2	7.9
26,001–33,000 lbs	5.3	6.2	6.1	6.8	7.4
33,001 lbs and over	4.8	5.2	5.3	5.5	6.0

Source:
Estimates are based on data provided on the following public use files: U.S. Department of Commerce, Bureau of the Census, Census of Transportation, Washington, DC, *1977 Truck Inventory and Use Survey,* 1980; *1982 Truck Inventory and Use Survey*, 1985; *1987 Truck Inventory and Use Survey*, 1990; *1992 Truck Inventory and Use Survey,* 1995; 1997 *Vehicle Inventory and Use Survey, 2000.*
(Additional resources: www.census.gov/svsd/www/tiusview.html)

Table 8.7
Truck Statistics by Size, 1997

	Manufacturer's gross vehicle weight class			
	Light (< 10,000 lbs)	Medium (10,001–26,000 lbs)	Heavy (> 26,000 lbs)	Total
Trucks	68,099,912	2,164,791	2,535,549	72,800,252
Trucks (%)	93.54%	2.97%	3.48%	100%
Miles per truck	13,165	13,837	46,513	14,347
Total miles (%)	85.84%	2.87%	11.29%	100%
Fuel use (%)	71.61%	3.99%	24.40%	100%
Fuel economy (mpg)	16.55	9.37	6.20	16.02
	Range of operation			
Under 50 miles	75.15%	62.50%	39.55%	73.53%
51-100 miles	12.84%	16.60%	16.73%	13.09%
10 l-200 miles	3.85%	5.60%	10.82%	4.15%
201-500 miles	2.05%	5.74%	12.18%	2.52%
Over 500 miles	2.28%	20.04%	16.00%	2.75%
Off-road	3.83%	7.52%	4.74%	3.97%
Total	100%	100%	100%	100%
	Primary refueling facility			
Central company-owned	14.55%	24.68%	39.13%	29.20%
Single off-site contract	4.27%	6.11%	6.89%	6.08%
Pubic station	77.71%	64.62%	49.83%	60.56%
Other	3.47%	4.59%	4.16%	4.16%
Total	100%	100%	100%	100%

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

Table 8.8
Percentage of Trucks by Size Ranked by Major Use, 1997

Rank	Light (< 10,000 lbs)	Medium (10,001 – 26,000 lbs)	Heavy (> 26,000 lbs)
1	**Personal**	**Agriculture**	**For Hire**
	74.56%	19.54%	31.48%
2	**Construction**	**Construction**	**Construction**
	7.56%	20.19%	17.56%
3	**Services**[a]	**Services**[a]	**Agriculture**
	5.57%	11.64%	14.01%
4	**Agriculture**	**Retail**	**Wholesale**
	3.82%	9.28%	7.81%
5	**Retail**	**Utilities**	**Retail**
	2.79%	4.40%	5.67%
6	**Not in Use**	**Wholesale**	**Personal**
	1.61%	7.31%	0.31%
7	**Wholesale**	**For Hire**	**Services**[a]
	1.33%	5.47%	7.39%
8	**Manufacturing**	**Personal**	**Manufacturing**
	0.74%	7.00%	5.61%
9	**Utilities**	**Manufacturing**	**Not in Use**
	0.75%	3.72%	1.11%
10	**Daily Rental**	**Not in Use**	**Utilities**
	0.53%	3.21%	2.18%
11	**Forestry**	**Daily Rental**	**Forestry**
	0.26%	4.21%	2.56%
12	**Mining**	**Forestry**	**Daily Rental**
	0.25%	1.64%	2.11%
13	**For Hire**	**Mining**	**Mining**
	0.21%	1.14%	2.18%
14	**One-Way Rental**	**One-Way Rental**	**One-Way Rental**
	0.01%	1.24%	0.01%
15	**Other**	**Other**	**Other**
	0.00%	**0.00%**	**0.00%**

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

[a] Business and personal services.

Nearly GO% of all truck fleets use public fueling stations as their primary refueling facility. As expected, larger fleets use central company-ownedfacilities more than smaller fleets. Mid-size fleets (lo-500 vehicles) use off-site contractfacilities more than the smaller or larger fleets.

Table 8.9
Percentage of Trucks by Fleet Size and Primary Refueling Facility, 1997

	Primary refueling facility				
Truck fleet size	Central company-owned fueling facility	Single contract fueling facility located off-site	Public fueling stations	Other	Total
1	5.94%	2.70%	87.26%	4.09%	100%
2-5	13.80%	4.56%	76.12%	5.52%	100%
6-9	25.77%	7.32%	62.02%	4.88%	100%
1 O-24	37.08%	10.43%	49.70%	2.79%	100%
25-99	48.48%	9.65%	39.29%	2.59%	100%
100499	48.76%	10.62%	38.40%	2.22%	100%
500-999	46.39%	7.46%	44.38%	1.77%	100%
1 ,ooo-4,999	45.24%	4.93%	45.94%	3.89%	100%
5,000–9,999	35.77%	6.01%	53.36%	4.87%	100%
10,000 & up	71.72%	2.56%'	19.27%	6.45%	100%
Total	30.08%	6.39%	59.37%	4.16%	**100%**

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

Table 8.10
Percentage of Trucks by Major Use and Primary Refueling Facility, 1997

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

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

Commodity Flow Survey

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

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

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

Table 8.11
Growth of Freight Activity in the United States: Comparison of the 1997 and 1993 Commodity Flow Surveys
(Detail may not add to total because of rounding)

Mode of Transportation	Value			Tons			Ton-miles			Average miles per shipment		
	1997 (billion 1997 dollars)	1993 (billion 1997 dollars)	Percent change	1997 (millions)	1993 (millions)	Percent change	1997 (billions)	1993 (billions)	Percent change	1997	1993	Percent change
All modes	6,944.0	6,360.8	**9.2%**	11,089.7	9,688.5	14.5%	2,661.4	2,420.9	**9.9%**	472	424	11.4%
Single modes	5,719.6	5,376.3	6.4%	10,436.5	8,922.3	17.0%	2,383.5	2,136.9	11.5%	184	197	-6.4%
Truck	4981.5	4791.0	4.0%	7700.7	**6385.9**	20.6%	1023.5	869.5	17.7%	144	144	-0.1%
For-hire truck	2901.3	2856.1	1.6%	3402.6	2808.3	21.2%	741.1	629.0	17.8%	485	472	2.9%
Private truck	2036.5	1910.4	6.6%	4137.3	3543.5	16.8%	268.6	235.9	13.9%	53	52	2.1%
Rail	319.6	269.2	18.7%	1,549.8	1,544.1	0.4%	1,022.5	942.6	8.5%	769	766	3.0%
Water	75.8	67.1	13.1%	563.4	505.4	11.5%	261.7	272.0	-3.8%	482	c	c
Shallow draft	53.9	44.3	21.7%	414.8	362.5	14.4%	189.3	164.4	15.2%	177	c	c
Great Lakes	1.5	c	c	38.4	33.0	c	13.4	12.4	8.2%	204	534	-61.8%
Deep draft	20.4	21.5	-4.9%	110.2	109.9	0.2%	59.0	95.2	-38.0%	1,024	1,861	-45.0%
Air (includes truck and air)	229.1	151.3	51.4%	4.5	3.1	42.6%	6.2	4.0	55.5%	1,380	1,415	-2.5%
Pipeline[b]	113.5	97.8	16.1%	618.2	483.6	27.8%	c	c	c	c	c	c
Multiple modes	945.9	720.9	31.2%	216.7	225.7	-4.0%	204.5	191.5	6.8%	813	736	10.5%
Parcel, U.S. Postal Service or courier	855.9	612.8	39.7%	23.7	18.9	25.4%	18.0	13.2	36.8%	813	734	10.7%
Truck and rail	75.7	90.4	-16.3%	54.2	40.6	33.5%	55.6	37.7	47.5%	1,347	1,403	-3.9%
Truck and water	8.2	10.2	-19.4%	33.2	68.0	-51.2%	34.8	40.6	-14.4%	1,265	1,417	-10.7%
Rail and water	1.8	4.0	-55.2%	79.3	79.2	0.1%	77.6	70.2	10.5%	1,092	627	74.1%
Other multiple modes	4.3	3.5	22.0%	26.2	18.9	38.6%	18.6	c	c	c	1,082	c
Other and unknown modes	278.6	263.6	5.7%	436.5	540.5	-19.2%	73.4	92.6	-20.7%	122	229	-46.9%

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

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

Some freight activities, such as pipeline shipments, were not within the scope of the Commodity Flow Survey (CFS). Data for the out-of-scope freight activities are estimated here and added to the CFS data to give a more complete picture of total freight activity.

Table 8.12
Commodity Flow Survey Freight Activity, 1997

Mode	Value (billion dollars)	Tons (millions)	Ton miles (billions)	Value (percent)	Tons (percent)	Ton miles (percent)	Value per ton (dollars)	Value per pound (dollars)	Ton miles per ton [a]
CFS 1997:									
Parcel, postal, courier service	$856	24	18	*10.0*	0.2	0.5	35,667	$17.83	750
Truck (for-hire, private, both)	$4,982	7,701	1,024	58.2	52.0	26.6	647	$0.32	133
Air (including truck and air)	$229	4	6	2.7	0.0	0.2	57,250	$28.63	1,500
Rail	$320	1,550	1,023	3.7	10.5	26.6	206	$0.10	660
Water	$76	563	262	0.9	3.8	6.8	135	$0.07	465
Pipeline [b]	$113	618	244	1.3	4.2	6.3	183	$0.09	395
Truck and rail	$76	54	56	0.9	0.4	1.5	1,407	$0.70	1,037
Other intermodal combinations’	$14	139	131	0.2	0.9	3.4	101	$0.05	942
Other and unknown modes	**$279**	437	73	3.3	3.0	1.9	638	$0.32	167
CFS 1997 Subtotal	**$6,945**	11,090	2,837	**81.1**	74.9	73.7	626	$0.31	256
Estimates of Out-of-scope Components:									
Truck									
Farm based truck shipments	$197	1,050	39	2.3	7.1	1.0	188	$0.09	37
Imports from Canada	$100	67	32	1.2	0.5	0.8	1,493	$0.75	478
Imports from Mexico	$57	18	14	0.7	0.1	0.4	3,167	$1.58	778
Pipeline									
Crude oil	$81	740	377	0.9	5.0	9.8	109	$0.05	509
Petroleum products [d]	$37	90	35	0.4	0.6	0.9	411	$0.21	389
Water [e]									
Imports	$403	765	58	4.7	5.2	1.5	527	$0.26	76
Exports	$222	411	48	2.6	2.8	1.2	540	$0.27	117
Other	$61	481	358	0.7	3.3	9.3	127	$0.06	744
Rail									
Imports from Canada and Mexico	$40	62	43	0.5	0.4	1.1	645	$0.32	694
Non-commodity		10	10		0.1	0.3			1,000
Air									
Imports	$213	3		2.5	0.0		71,000	$35.50	
Exports	$211	3		2.5	0.0		70,333	$35.17	
US Mail [f]		10			0.1				
Out-of-scope Estimates Subtotal	**$1,622**	3,710	**1,014**	18.9	**25.1**	26.3	437	$0.22	273
CFS + Out-of-scope Estimates:	$8,567	14,800	3,851	**100.0**	**100.0**	**100.0**	580	$0.29	272
Intermodal Total (excluding air)”	$946	217	205	**11.0**	**1.5**	5.3	4,359	$2.18	945
Intermodal Total (including air)	**$1,175**	**221**	211	13.7	1.5	5.5	5,317	$2.66	1,047

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

[a] Tonnage for CFS pipeline and U.S. Mail was not included in the total tonnage for the calculation of ton-miles/ton.
[b] The pipeline ton-miles shown here are not a CFS estimate, but were calculated using data from the Assn. of Oil Pipe Lines.
[c] This includes truck and water, rail and water, and other combinations.
[d] These numbers are the differences between the FERC totals and CFS estimates.
[e] Ton-miles for water imports & exports include only the portion of ton-miles within the U.S. Waterways to or from the U.S. **port.**
[f] U.S. Mail tonnage includes all mail except class B standard mail, and international parcel post for surface and air mail.
[g] Intermodal total is a combination of parcel, postal, courier; truck and rail; truclc and water; rail and water; and other intermodal. It excludes truck and air which is added to air transportation.

Table 8.13
Summary Statistics on Buses by Type, 1970–98

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
1995	67,107	20,138	560,447
1996	71,678	20,649	569,395
1997	72,770	20,910	568,113
1998	74,641	19,173	582,470
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
1995	2,184	1,194	5,000
1996	2,221	1,220	5,000
1997	2,245	1,319	4,400
1998	2,291	1,366	4,300
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
1995	18,818	28,100	95,000
1996	19,096	28,800	99,000
1997	19,604	30,600	82,900
1998	20,602	31,700	[b]
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	64.8[d]
1995	87.5[c]	22.6	83.9
1996	89.3	22.6	84.7
1997	93.0	22.2	83.9
1998	87.3	22.6	84.7

Source:
See Appendix A for Table 8.13.
(Additional resources: www.apta.com, www.fhwa.dot.gov, 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 A for details.

Chapter 9
Alternative Fuel Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 9.1	Light alternative fuel vehicles, 1998	313,258
	LPG	*212,000*
	CNG	*63,739*
	LNG	*118*
	M85	*19,627*
	E85	*12,778*
	Electric	*4,996*
Table 9.2’	Heavy alternative fuel vehicles, 1998	*70,589*
	LPG	*54,000*
	CNG	*15,043*
	LNG	*1,054*
	M85/M100	*221*
	E85/E95	*24*
	Electric	*247*
Table 9.5	Number of alternative fuel refuel sites, 1999	6,058
	LPG	*4,153*
	CNG	*1,267*
	LNG	*490*
	M85	*51*
	E85	*49*
	Electric	*46*

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

Alternative Fuels

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

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

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

The purposes of the AFDC are:

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

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

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

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

There are more LPG vehicles in use than any other alternative fuel vehicle. The population of E8.5 vehicles, however, has grown the most since 1992. For details on alternative fuel use by fuel type, see Table 2.10

Table 9.1
Estimates of Alternative Fuel Vehicles in Use, 1992-2000

Fuel type	1992	1993	1994	1995	1996	1997	1998	1999"	2000"	Average annual percentage change 1992-2000
LPG	22 1,000	269,000	264,000	259,000	263,000	263,000	266,000	268,000	270,000	2.5%
CNG	23,191	32,714	41,227	50,218	60,144	68,571	78,782	89,633	101,991	20.3%
LNG	90	299	484	603	663	813	1,172	1,422	1,682	44.2%
M85	4,850	10,263	15,484	18,319	20,265	21,040	19,648	19,497	18,725	18.4%
M100	404	414	415	386	172	172	200	200	200	-8.4%
E85[b]	172	441	605	1,527	4,536	9,130	12,788	22,359	30,017	90.6%
E95	38	27	33	136	361	347	14	14	14	-11.7%
Electricity	1,607	1,690	2,224	2,860	3,280	4,453	5,243	6,417	7,590	21.4%
Total	**251,352**	**314,848**	324,472	333,049	352,421	369,526	383,847	407,542	430,219	6.9%

Source:
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels,1998*, Washington, DC, 1999, web site www.eia.doe.gov/cneaf/solar.renewables/alt_trans_fuel98/table1.html. (Additional resources: www.eia.doe.gov)

"Based on plans or projections.
[b]Does not include flex-fuel vehicles.

Table 9.2
Estimates of Light Alternative Fuel Vehicles, 1996, 1998, and 2000

	Private			State and local government			Federal Government		
Fuel type	1996	1998	2000[a]	1996	1998	2000[a]	1996	1998	2000[a]
LPG	167,000	170,000	170,000	43,000	42,000	42,000	193	159	839
CNG	25,020	35,357	47,400	11,305	15,913	21,415	13,945	12,469	13,569
LNG	10	75	75	45	43	43	72	0	0
M-85	6,633	10,773	10,111	5,958	8,313	8,252	7,668	541	341
M-100	0	0	0	0	0	0	0	0	0
E-85	793	2,595	4,944	1,995	5,906	8,786	1,748	4,277	16,277
E-95	0	0	0	0	0	0	0	0	0
Electricity	2,451	8,219	4,307	487	1,432	2,083	188	146	846
Total	201,907	222,218	236,837	62,790	73,607	82,579	23,814	17,592	31,872

Source:
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 1998,* Washington, DC, 1999, web site www.eia.doe.gov/cneaf/solar.renewables/alt_trans_fuel98/atf1-13_99.html. (Additional resources: www.eia.doe.gov)

Note: Light vehicles are less than or equal to 8,500 lbs. gross vehicle weight

[a]Based on plans or projections.

Table 9.3
Estimates of Heavy Alternative Fuel Vehicles, 1996, 1998, and 2000

	Private			State and local government			Federal government		
Fuel type	1996	1998	2000[a]	1996	1998	2000[a]	1996	1998	2000[a]
LPG	43,000	43,000	45,000	10,000	11,000	12,000	2	16	16
CNG	5,485	7,972	10,396	4,389	6,378	8,318	0	693	893
LNG	77	204	280	453	836	1,144	6	14	140
M85	0	0	0	6	19	19	0	2	2
M100	0	0	0	172	200	200	0	0	0
E85	0	0	0	0	0	0	0	10	10
E95	4	0	0	357	14	14	0	0	0
Electricity	32	43	43	113	189	296	9	15	15
Total	48,598	**51,219**	**55,719**	**15,490**	**18,636**	**21,991**	**17**	734	1,076

Source:
U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels, 1998*, Washington, DC, 1999, web site www.eia.doe.gov/cneaf/solar.renewables/alt_trans_fuel98/atf1-13_99.html. (Additional resources: www.eia.doe.gov)

Note: Heavy vehicles are above 8,500 lbs. gross vehicle weight.

[a]Based on plans or projections.

Table 9.4
Alternative Fuel Vehicles Available by Manufacturer, Model Year 2000

Model	Fuel	Type	Emission class
Daimler Chrysler: 1-800-999-FLEET			
EPIC (CA, NY-lease only)	Electric-lead acid or NiMH	Minivan	ZEV
Minivan	E-85	Minivan	N/A
Ram Wagon	CNG dedicated	Large van	ULEVIILEVISULEV
Ram Van	CNG dedicated	Large van	ULEV/ILEV/SULEV
Ford: 1-877-ALT-FUEL			
Ranger	Electric-lead acid	Standard pickup	ZEV
Ranger	E-85 flex-fuel	Standard pickup	TLEV
Contour (QVM)	CNG bi-fuel	Compact	TLEV
Crown Victoria	CNG dedicated	Large car	ULEV/ILEV
Econoline	CNG dedicated	Full-size van	ULEV/ILEV/SULEV
F-Series	CNG dedicated or CNG/LPG bi-fuel	Standard pickup	LEV/ULEV/ILEV/ SULEV
Taurus	E-85 flex-fuel	Large car	TLEV
Th!nk (select markets)	Electric-NiCd	Two-seater	ZEV
General Motors: 1-800-25Electric, 313-556-7723 or 1-888-GM-AFT-4U (CNG)			
EV1 (CA and AZ only)	Electric-lead acid or NiMH	Two-seater	ZEV
Chevrolet S-l 0	Electric-lead acid or NiMH	Small pickup	ILEV/ZEV
Chevrolet S-10	E85 flex-fuel	Small pickup	LEV
Chevrolet Cavalier	CNG bi-fuel	Subcompact	LEV
Honda: 1-888-CCHonda			
Insight	Hybrid EV-NiMH	Two-seater	LEV/ULEV
Civic GX (CA, NY fleets only)	CNG dedicated	Subcompact	ILEV/ULEV
Mazda: l-800-222-5500			
B3000	E85 flex fuel	Standard pickup	LEV/TLEV
Nissan: l-310-771-3422			
Altra EV (CA fleets only)	Electric lithium-ion	Mid-size wagon	ZEV
Solectria Corporation: l-508-658-2231			
Flash	Electric-lead acid	Small pickup truck	ZEV
Force	Electric-lead acid, NiMH, NiCd	Compact	ZEV
Toyota: l-800-331-4331 (Press 3 for Alternative Fuel Information) (Fleet sales only)			
RAV4-EV (select markets)	Electric-lead acid, NiMH	Sports utility vehicle	ZEV
Camry	CNG dedicated	Compact	N/A
Prius (Summer 2000)	Hybrid EV	Compact	SULEV

Source:
U.S. Department of Energy, National Alternative Fuels Data Center, web site, www.afdc.doe.gov/pdfs/my00.pdf, November 1999.
(Additional resources: www.afdc.nrel.gov)

Note:
LEV=low emission vehicle. ILEV=inherently low emission vehicle. ULEV=ultra low emission vehicle. ZEV=zero emission vehicle. TLEV=transitional low emission vehicle.

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

Table 9.5
Number of Alternative Refuel Sites by State and Fuel Type, 1999

State	M85 sites	CNG sites	E85 sites	LPG sites	LNG sites	Electric sites	Total
Alabama	0	16	0	151	2	0	169
Alaska	0	0	0	12	0	0	12
Arizona	1	28	0	81	3	46	1.59
Arkansas	0	6	0	133	0	0	139
California	36	208	0	517	9	336	1106
Colorado	0	44	1	93	2	0	140
Connecticut	0	27	0	48	0	1	76
Delaware	0	6	0	2	0	0	8
District of Columbia	0	4	0	0	0	1	5
Florida	1	43	0	109	1	5	159
Georgia	0	70	0	80	2	29	181
Hawaii	0	0	0	24	0	3	28
Idaho	0	7	1	29	0	1	38
Illinois	0	24	5	65	0	2	96
Indiana	0	38	1	46	3	1	89
Iowa	0	5	5	69	0	1	80
Kansas	0	6	1	123	1	0	131
Kentucky	0	9	2	24	0	0	35
Louisiana	0	15	0	25	0	0	40
Maine	0	1	0	57	0	0	58
Maryland	0	27	0	18	2	1	48
Massachusetts	0	17	0	69	0	4	90
Michigan	0	32	2	267	1	7	309
Minnesota	0	15	11	82	1	0	109
Mississippi	0	3	0	63	0	0	66
Missouri	0	10	4	295	0	0	309
Montana	0	11	1	56	1	0	69
Nebraska	0	6	6	44	0	0	57
Nevada	0	18	0	56	0	0	74
New Hampshire	0	2	0	68	0	1	71
New Jersey	0	22	0	25	0	0	47
New Mexico	0	14	0	243	1	0	258
New York	12	57	0	98	0	6	173
N. Carolina	0	9	0	94	0	7	110
N. Dakota	0	4	2	14	0	0	20
Ohio	0	49	0	57	1	1	108
Oklahoma	0	61	0	34	0	0	95
Oregon	0	9	0	30	1	0	40
Pennsylvania	0	59	0	100	1	1	161
Rhode Island	0	4	0	9	0	0	13
S. Carolina	0	4	0	74	0	1	79
S. Dakota	0	4	6	29	0	0	39
Tennessee	0	5	0	36	0	2	43
Texas	0	73	0	231	8	2	314
Utah	0	62	0	22	1	0	85
Vermont	0	1	0	62	0	7	70
Virginia	0	27	0	40	3	18	88
Washington	1	28	0	88	1	6	124
W. Virginia	0	39	0	14	0	0	53
Wisconsin	0	20	1	112	0	0	133
Wyoming	0	18	0	35	1	0	54
Total	51	1,267	49	4,153	46	490	6,058

Source:
U.S. Department of Energy, Alternative Fuels Data Center web site, www.afdc.doe.gov/refuel/state_tot.shtml, January 2000.

Clean Cities is a locally-based government/industry partnership, coordinated by the U.S. Department of Energy to expand the use of alternatives to gasoline and diesel fuel. By combining the decision-making with voluntary action by partners, the "grass-roots" approach of Clean Cities departs from traditional "top-down" Federal programs. It establishes a plan, carried out at the local level, for creating a sustainable, nationwide alternative fuels market.

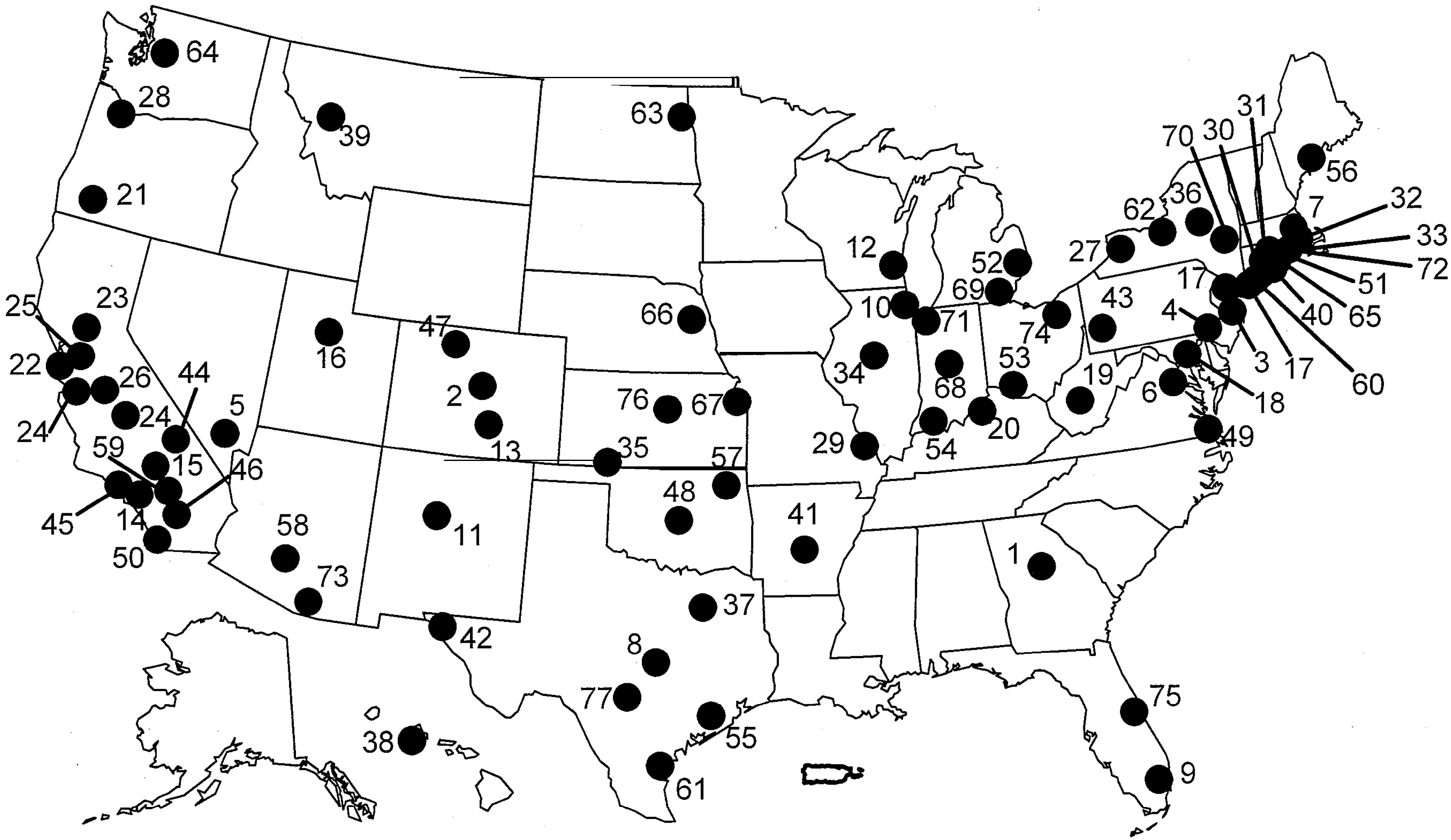
Table 9.6
List of Clean Cities as of 12/1/99 by Designation

1. Atlanta, GA - 9/8/93
2. Denver, CO - 9/13/93
3. Philadelphia, PA - 9/22/93
4. State of Delaware - 10/12/93
5. Las Vegas, NV - 10/18/93
6. Washington, DC - 10/21/93
7. Boston, MA - 3/18/94
8. Austin, TX - 4/18/94
9. Florida Gold Coast - 5/3/94
10. Chicago, IL - 5/13/94
11. Land of Enchantment, NM - 6/1/94
12. Wisconsin - SE Area - 6/30/94
13. Colorado Springs, CO - 7/13/94
14. Long Beach, CA - 8/31/94
15. Lancaster, CA - 9/22/94
16. Salt Lake City, UT - 10/3/94
17. White Plains, NY - 10/4/94
18. Baltimore, MD - 10/7/94
19. State of WV - 10/18/94
20. Commonwealth CC Partnership, KY - 10/18/94
21. Rogue Valley, OR - 11/10/94
22. San Francisco, CA - 10/21/94
23. Sacramento, CA - 10/21/94
24. South Bay (San Jose), CA - 10/21/94
25. East Bay, CA - 10/21/94
26. San Joaquin Valley, CA - 10/21/94
27. Western New York - 11/4/94
28. Columbia-Willamette, OR - 11/10/94
29. St. Louis, MO - 11/18/94
30. Waterbury, CT - 11/21/94
31. Connecticut Southwestern Area, - 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. San Diego, CA 12/12/96
51. Long Island, NY - 10/18/96
52. Detroit, MI/Toronto, ON - 12/18/96
53. Cincinnati, OH - 1/29/97
54. Evansville, IN - 1/30/97
55. Houston-Galveston, TX - 9/4/97
56. Portland, ME - 9/4/97
57. Tulsa, OK - 9/22/97
58. Maricopa Assn. of Govts. - 10/8/97
59. Riverside, CA - 10/24/97
60. North Jersey, NJ - 10/31/97
61. Texas Coastal (Corpus Christi), TX - 3/30/98
62. Genesee Region (Rochester), NY - 5/28/98
63. Red River Valley/Grand Forks, ND - 8/10/98
64. Puget Sound, WA - 8/13/98
65. RI - Ocean States - 9/14/98
66. Omaha, NE - 9/18/98
67. Kansas City, KS/MO - 11/18/98
68. Central Indiana CC Alliance, IN - 3/4/99
69. Ann Arbor, MI - 4/19/99
70. Capital District (Albany), NY - 4/26/99
71. South Shore, IN - 6/15/99
72. Capital Clean Cities of CT - 6/21/99
73. Tuscon, AX - 8/24/99
74. NE Clean Fuels Coalition (Cleveland) - 9/14/99
75. Florida Space Coast - 10/1/99
76. Manhattan Area, KS - 10/4//99
77. The Alamo Area (San Antonio) - 11/10/99

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, February 2000. (Additional resources: www.ccities.doe.gov)

Figure 9.1 Map of Clean Cities as of 12/1/99



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, February 2000. (Additional resources: www.ccities.doe.gov)

Electric and hybrid-electric vehicles are required to be sold in California under the California Low-Emission Vehicle (LEV) program. Other states, such as New York, Texas, and Massachusetts, have indicated that they will also enforce the LEV program. The 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 (Daimler-Chrysler, Ford, General Motors), the Electric Power Research Institute, and the U.S. Department of Energy.

Table 9.7
U.S. Advanced Battery Consortium Goals for Electric Vehicle Batteries

Primary criteria	Long-term goals” (2000)
Power density” W/L	460
Specific power” W/kg (80% DOD/30 sec)	300
Energy density” Wh/L (C/3 discharge rate)	230
Specific energy” Wh/kg (C/3 discharge rate)	150
Life (years)	10
Cycle life” (cycles) (80% DOD)	1000 1800 (@ 50% DOD) 2670 (@ 30% DOD)
Power and capacity degradation[b] (% of rated spec)	20%
Ultimate price[c] ($/kWh) (10,000 units @ 40 kWh)	< $150 (desired to75)
Operating environment	-30 to 65°C
Recharge time”	< 6 hours
Continuous discharge in 1 hour (no failure)	75% (of rated energy capacity)
Secondarv criteria	
Efficiency (C/3 discharge & C/3 charge)”	80%
Self discharge[b]	< 20% in 12 days
Maintenance	No maintenance. Service by qualified personnel only.
Thermal loss[b]	Covered by self discharge
Abuse resistance”	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=dcpth of discharge; Wh=watt-hour; kWh=kilowatt-hour.
Additional information about USABC is available at: www.uscar.org/techno/store.htm.

“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.
‘Cost to the Original Equipment Manufacturers.
[d]Roundtrip charge/discharge efficiency.

The Partnership for a New Generation of Vehicles (PNGV) is an historic public/private partnership between the U.S.-federal government (led by the Technology Administration at the Department of Commerce, and including 7 agencies and 19 federal laboratories) and DaimlerChrysler, Ford, and General Motors that aims to strengthen America? competitiveness by developing technologies for a new generation of vehicles.

PNGV's long term goal is to develop an environmentally friendly car with up to triple the fuel efficiency of today's midsize cars-- without sacrificing affordability, performance, or safety. Two other PNGV goals are to significantly improve national competitiveness in automotive manufacturing and to apply commercially viable innovation to conventional vehicles.

Table 9. 8
PNGV Goals and Specifications of Hybrid-Electric Vehicles

		PNGV Concept Vehicles				
Parameter	PNGV Goals	Dodge ESX3	Ford Prodigy	GM Precept	Toyota Prius	Honda Insight
Fuel economy	up to 80 mpg (3x current mpg)	72 mpg gas equiv. 80 mpg diesel	72 mpg gas equiv. 80 mpg diesel[a]	80 mpg gas equiv. 90 mpg diesel	56 mpg gas	64 mpg gas
Range	380 miles	400 miles	660 miles	3 80 miles	550 miles	600 miles
Acceleration (O-60 mph)	12.0 seconds	11 .O seconds	12.0 seconds	11.5 seconds	14.1 seconds	12.0 seconds
Emissions	Default Tier 2	Target is Tier 2	Target is Tier 2	Target is Tier 2	SULEV	ULEV
Areodynamics	0.20 Cd	0.22 Cd	0.199 Cd	0.163 Cd	0.30 Cd	0.25 Cd
Curb weight	1,980 lbs.	2,250 lbs.	2,387 lbs.	2,592 lbs.	2,734 lbs.	1,856 lbs.
Passenger capacity	Up to 6	5	5	5	5	2
Dimensions: Length Width		192.8 in. 74.2 in.	186.9 in. 69.1 in.	193.2 in. 67.9 in.	168.3 in. 66.7 in.	155.1 in. 66.7 in.
Cargo Capacity	16.8 ft^3	16.0 ft^3	14.6 ft^3	4.4 ft^3	10.0 ft^3	7.0 ft^3
Safety	Meet FMVSS[b]	Meet FMVSS[b]	Meet FMVSS[b]	Meet FMVSS[b]	Meet FMVSS[b]	Meet FMVSS[b]

Source:
Partnership for a New Generation of Vehicles, Media Information, 2000. (Additional resources: www.ta.doc.gov/pngv/cover/pngvcover.htm)

"Fuel economy for Dodge using "Designer" diesel (0 ppm sulfur); Ford using Swedish clean diesel (<10 ppm sulfur); GM using California low-sulfur diesel (<30 ppm sulfur).

[b]Federal Motor Vehicle Safety Standards.

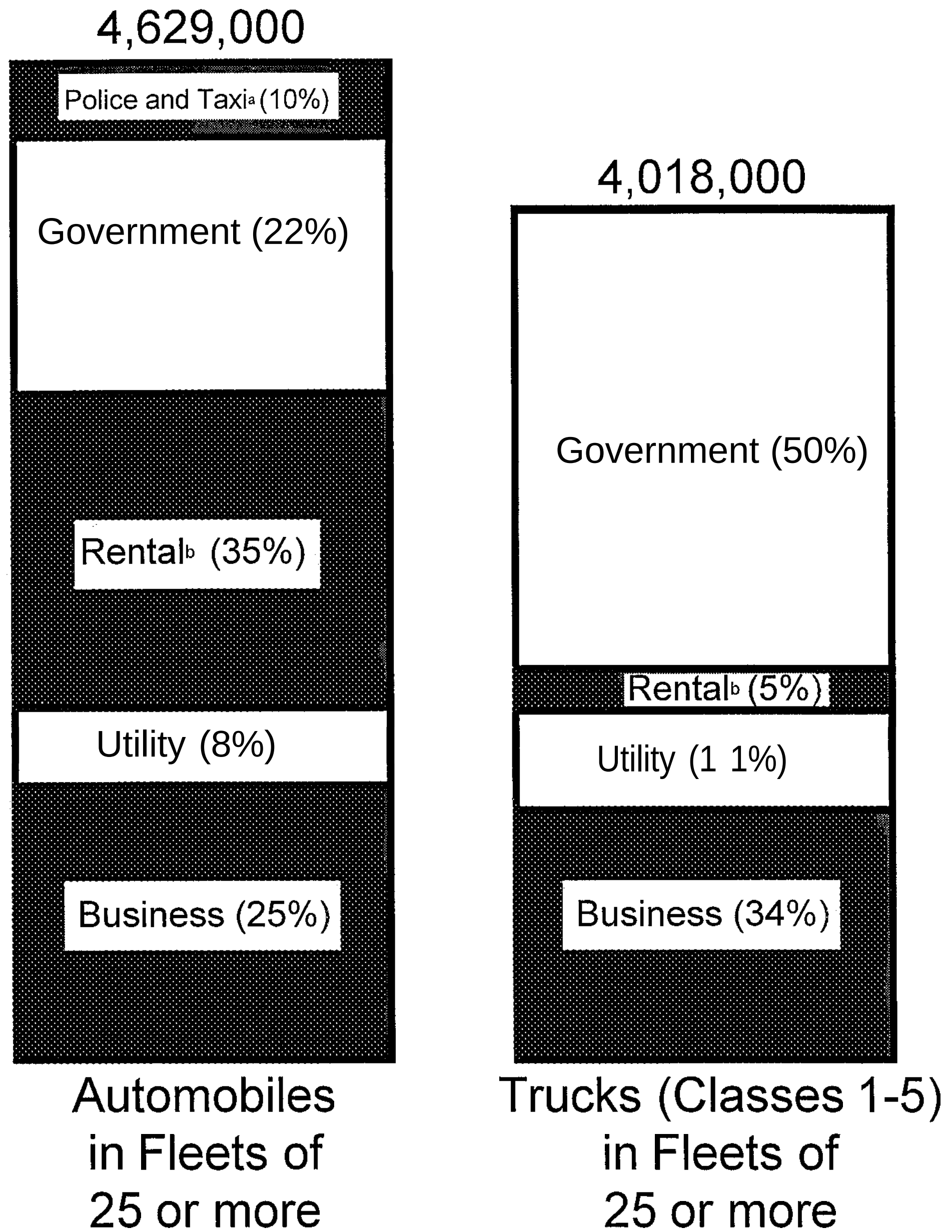
Chapter 10
Fleet Vehicles and Characteristics

Summary Statistics from Tables/Figures in this Chapter

Source		
Figure 10.1	Fleet automobiles, 1999	4,629,000
Figure 10.1	Fleet Class l-5 Trucks, 1999	4,018,000
Table 10.4	Average annual miles per automobile	
	Business fleets	*29,200*
	Utility fleets	*14,500*
	Government fleets	*13,700*
Table 10.5	Federal Government vehicles, FY 1997	548,978
	Automobiles	*113,460*
	Buses	*6,048*
	Light trucks	*381,674*
	Medium trucks	*29,817*
	Heavy trucks	*17,979*

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 1999 data arepresented here.

Figure 10.1. Fleet Vehicles in Service as of January 1, 1999



Source:
Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 1999,* Redondo Beach, CA, 1999. (Additional resources: www.fleet-central.com)

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

Taxi category includes vans.

“Rental category includes vans and sports utility vehicles under **automobiles,** not trucks.

These are the top ten states in terms of fleets and fleet vehicles, according to Dwight's Energydata, Denver, CO. Autos and light trucks make up the largest share of fleet vehicles in each of the states. The average number of vehicles per fleet is the highest in Florida and California.

Table 10.1
Top Ten States with Fleets of Ten Vehicles or More, 1999

States	Fleets of ten vehicles or more	Fleet vehicles					Average vehicles per fleet'
		Autos	Trucks (class 1-2)	Trucks (class 3-5)	Trucks (class 6-8)	Total	
California	12,005	474,627	443,869	205,883	321,332	1,457,716	121
Texas	8,851	260,885	262,270	107,599	247,960	887,565	100
New York	6,706	227,144	191,415	78,215	182,015	685,495	102
Pennsylvania	5,973	166,880	148,086	52,840	179,086	552,865	93
Florida	5,986	233,209	208,919	88,230	199,408	735,752	123
Illinois	5,653	178,939	149,886	76,441	179,770	590,689	104
Ohio	5,418	177,830	130,846	60,350	163,627	538,071	99
Michigan	3,945	149,536	103,684	53,670	104,373	415,208	105
New Jersey	3,919	139,327	121,717	35,172	119,839	419,974	107
North Carolina	3,821	102,047	109,667	38,342	142,354	396,231	104

Source:
Bobit Publishing Company, Automotive Fleet Industry Statistics web site: www.fleet-central.com /AF/Resources/Stats/chart3.htm. Original data source: Dwight's Energydata, Denver, CO. (Additional resources: www.fleet-central.com/AF)

These fleet data, which were generated from a 1991-92 ORNL study, are still the latest available data of this kind.

Table 10.2
Fleet Vehicle Composition by Vehicle Type, 1991
(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 10.3
Average Length of Time Fleet Vehicles are Kept Before Sold to Others, 1991
(months)

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

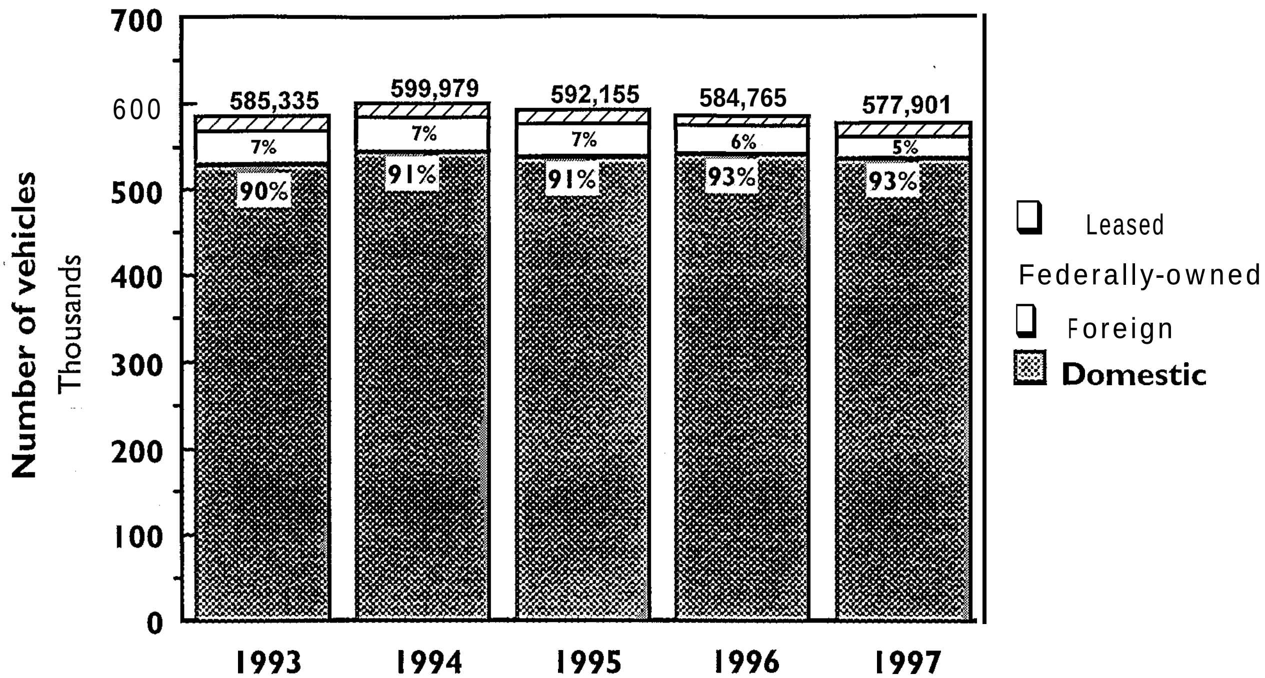
Table 10.4
Average Annual and Daily Vehicle-Miles of Travel for Fleet Vehicles, 1991

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

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

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

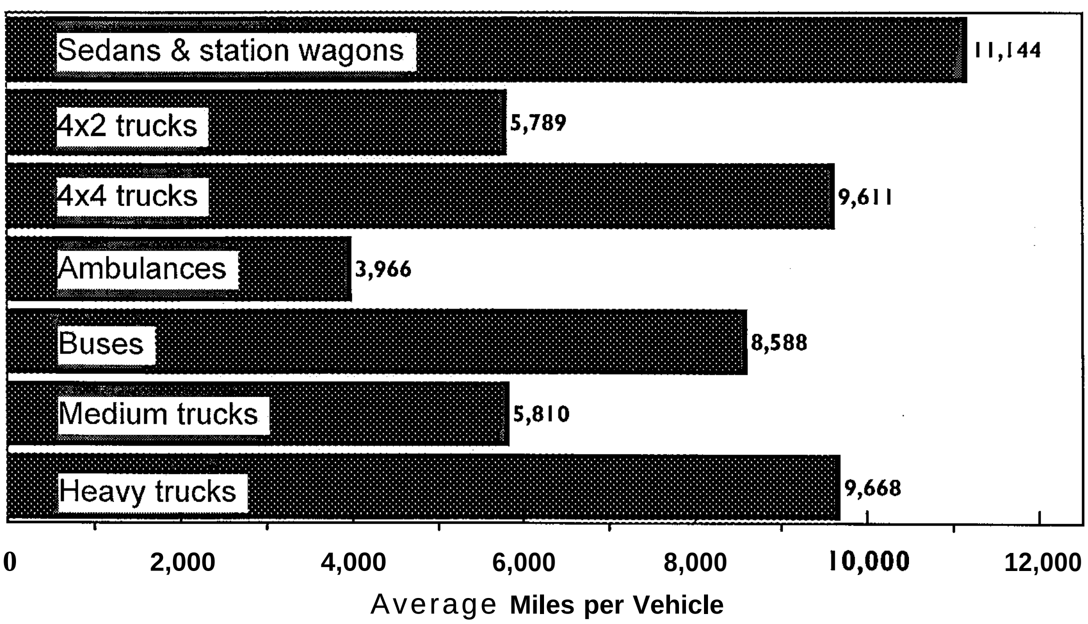
Figure 10.2. Worldwide Federal Inventory, 1992-97



Source:

U.S. General Services Administration, Federal Vehicle Policy Division, *FY 1997 Federal Fleet Report* , Washington, DC, 1999, Tables 1 and 12.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

Figure 10.3. Average Miles per Federal Vehicle by Vehicle Type, 1997



Source:

U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 1997 Federal Fleet Report,* Washington, DC, 1999, Table 5.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

Table 10.5
Federal Government Vehicles by Agency, Fiscal Year 1997

Department or Agency	Autos	Buses	Light trucks[b]	Medium trucks[c]	Heavy trucks[d]	Total
Department of Agriculture	3,273	42	24,614	5,247	602	33,778
Department of Commerce	144	2	416	228	12	802
Department of Education	1	0	2	0	0	3
Department of Energy	784	164	3,606	919	794	6,267
Department of Health & Human	89	7	326	147	58	627
Department of Housing & Urban Dev.	3	0	1	0	0	4
Department of Justice	25,190	314	12,742	976	271	39,493
Department of Labor	19	1	144	14	3	181
Department of State	103	0	84	0	11	198
Department of Interior	1,374	80	9,160	3,506	1,420	15,540
Department of Treasury	10,960	18	3,760	307	96	15,141
Department of Transportation	30	16	411	96	67	620
Department of Veterans Affairs	470	120	1,036	243	115	1,984
Environmental Protection Agency	57	0	233	70	15	375
Federal Communications Comm	55	0	63	2	0	120
Federal Emergency Mgmt Agency	28	6	253	25	0	312
General Services Administration[e]	54,263	2,932	88,808	3,636	3,707	153,346
Natl Aeronautics & Space Admin.	103	43	806	326	75	1,353
Small Business Administration	115	0	0	0	0	115
Tennessee Valley Authority	427	0	1,012	999	226	2,664
Others	94	19	396	37	50	596
CIVILIAN AGENCIES	97,582	3,764	147,873	16,778	7,522	273,519
U.S. POSTAL SERVICE	9,342	6	180,346	9,293	4,927	203,914
Department of the Air Force	2,591	1,191	22,679	970	2,348	29,779
Department of the Army	124	26	247	163	122	682
Department of the Navy	2,845	677	22,756	1,379	2,340	29,997
Other Defense Agencies	283	25	1,988	110	116	2,522
Corps of Engineers	223	4	2,410	575	311	3,523
U.S. Marine Corps	470	355	3,375	549	293	5,042
MILITARY AGENCIES	6,536	2,278	53,455	3,746	5,530	71,545
TOTAL	113,460	6,048	381,674	29,817	17,979	548,978

Source:
U.S. General Services Administration, Federal Supply Service, *FY* 1997 *Federal Fleet Report,* Washington, DC, 1999, Table 14. (Additional resources: 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.
[e] GSA Fleet vehicles.

Table 10.6
Federal Fleet Vehicle Acquisitions
by Fuel Type, FY 1997”

	Vehicle acquisitions
Gasoline	14,097
Diesel	489
Natural gas	172
E-85	160
Electricity	139
Other	12
M-85	9
LPG	1
Biodiesel	0
Hydrogen	0
Total	15,079”

Source:
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY* 1997 *Federal Fleet Report,* Washington, DC, 1999, Table 18.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

Table 10.7
Fuel Consumed by Federal Government Fleets, FY 1997”

	Thousand gasoline equivalent gallons
Gasoline	280,051
Diesel	64,834
NG	4,076
Electricity	287
Biodiesel	186
Methanol	151
M-85	137
LPG	37
Ethanol	19
Total	349.780”

Source:
U.S. General Services Administrations, Federal Vehicle Policy Division, *FY 1997 Federal Fleet Report,* Washington, DC, 1999, Table 6.
(Additional resources: policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

“These data are reported under new requirements for FY 1997. Data for some agencies may be missing or incomplete.

The Energy Policy Act of 1992 (EPACT) set alternative fuel vehicle acquisition 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 began in 1997.

Table 10.8
Energy Policy Act Purchase Requirements of Light Alternative Fuel Vehicles

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

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

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

“The Department of Energy is presently considering implementation of private and municipal fleet rule making.

Chapter 11
Household Vehicles and Characteristics

Summary Statistics from Tables/Figures in this Chapter

Source		
Table 11.1	Vehicles per licensed driver, 1998	1.11
Table 11.2	Average household transportation expense, 1998	18.2%
Table 11.8	Share of households owning 3 or more vehicles	
	1960	*2.5%*
	1970	*5.5%*
	1980	*17.5%*
	1990	*17.3%*
Table 11.12	Average annual miles per household vehicle, 1995	11,800
Figure 11.1	Average occupancy rates by vehicle type, 1995	
	Automobile	*1.6*
	Pickup truck	*1.4*
	Sports Utility	*1.7*
	Van	*2.1*
Table 11.13	Share of workers who car pooled, 1990	13.4%
Figure 11.3	Long-distance trips in the U.S., 1995	
	Trips	*1,001 million*
	Person-miles	*82 7 billion*

Table 11.1
Population and Vehicle Profile, 1950–98

Year	Resident population” (thousands)	Total households (thousands)	Number of vehicles in operation (thousands)	Total vehicle-miles (millions)	Number of licensed drivers (thousands)	Number of civilian employed persons (thousands)	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	458,246	62,194	58,918	0.28	3,029	1.43	0.70	0.73
1955	165,069	47,874	55,804	605,646	74,686	62,170	0.34	3,656	1.56	0.75	0.90
1960	179,979	52,799	66,582	718,762	87,253	65,778	0.37	3,994	1.65	0.76	1.01
1965	193,526	57,251	82,067	887,812	98,502	71,088	0.42	4,587	1.72	0.83	1.15
1970	203,984	63,401	98,136	1,109,724	111,543	78,678	0.48	5,440	1.76	0.88	1.25
1975	215,465	71,120	120,054	1,327,664	129,791	85,846	0.56	6,162	1.82	0.92	1.40
1980	227,225	80,776	139,832	1,527,295	145,295	99,303	0.62	6,722	1.80	0.96	1.41
1981	229,466	82,368	141,908	1,555,308	147,075	100,397	0.62	6,778	1.79	0.96	1.41
1982	231,664	83,527	143,854	1,595,010	150,234	99,526	0.62	6,885	1.80	0.96	1.45
1983	233,792	83,918	147,104	1,652,788	154,389	100,834	0.63	7,069	1.84	0.95	1.46
1984	235,825	85,407	152,162	1,720,269	155,424	105,005	0.65	7,295	1.82	0.98	1.45
1985	237,924	86,789	157,048	1,774,826	156,868	107,150	0.66	7,460	1.81	1.00	1.47
1986	240,133	88,458	162,094	1,834,872	159,487	109,597	0.68	7,641	1.80	1.02	1.48
1987	242,289	89,479	167,193	1,921,204	161,975	112,440	0.69	7,929	1.81	1.03	1.49
1988	244,499	91,061	171,741	2,025,962	162,853	114,968	0.70	8,286	1.79	1.05	1.49
1989	246,819	92,830	175,960	2,096,487	165,555	117,342	0.71	8,494	1.78	1.06	1.50
1990	249,439	93,347	179,299	2,144,362	167,015	118,793	0.72	8,597	1.79	1.07	1.51
1991	252,127	94,312	181,438	2,172,050	168,995	117,718	0.72	8,615	1.79	1.07	1.54
1992	254,995	95,689	181,519	2,247,151	173,125	118,492	0.71	8,782	1.81	1.05	1.53
1993	257,746	96,391	186,315	2,296,378	173,149	120,259	0.72	8,909	1.80	1.08	1.55
1994	260,289	97,107	188,714	2,357,588	175,403	123,060[b]	0.73	9,057	1.81	1.08	1.53
1995	262,765	98,990	193,441	2,422,696	176,628	124,900[b]	0.74	9,220	1.78	1.10	1.55
1996	265,190	99,627	198,294	2,485,848	179,539	126,708”	0.75	9,374	1.80	1.10	1.56
1997	267,744	101,018	201,071	2,561,695	182,709	129,558[b]	0.75	9,567	1.81	1.10	1.55
1998	270,299	102,528	205,043	2,625,367	184,980	131,463	0.76	9,713	1.80	1.11	1.56
					Average annual percentage change						
1950-98	1.2%	1.8%	3.3%	3.7%	2.3%	1.7%	2.1%	2.5%	0.5%	1.0%	1.6%
1988-98	1.0%	1.2%	1.8%	2.6%	1.3%	1.3%	0.8%	1.6%	0.1%	0.6%	0.5%

Source:
Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, Statistical *Abstract of the United* States-1999, 119th edition, Washington, DC, 1999, pp. 8, 60,412, and annual. (Additional resources: www.census.gov)
Vehicles in operation - The Polk Company. **FURTHER REPRODUCTION PROHIBITED.** (Additional resources: www.polk.com)
Licensed drivers and vehicle-miles - U.S. Department of Transportation, Federal Highway Administration, Highway *Statistics* 1998, Tables DL-20 and VM-1, and annual. (Additional resources: www.fhwa.dot.gov)

“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 (31.8%) as the largest expenditure for the average household. In 1998, approximately 15% of transportation expenditures were for purchasing gasoline and motor oil. There is an average of two vehicles per household.

Table 11.2
Average Annual Expenditures of Households by Income, 1998[a]

	All households	Income before taxes								
		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	$37,260	$17,502	$14,838	$19,958	$22,810	$27,941	$33,616	$39,934	$49,376	$73,786
	Percentage of total expenditures[b]									
Food[c]	14.4%	18.1%	18.5%	15.4%	16.3%	15.5%	15.3%	14.8%	14.0%	12.5%
Housing	31.8%	34.8%	39.0%	36.8%	34.8%	33.3%	32.2%	30.0%	29.4%	30.6%
Apparel and services	4.7%	6.4%	4.7%	4.1%	4.0%	4.8%	5.2%	5.1%	4.3%	4.7%
Transportation	18.2%	16.4%	13.7%	17.9%	18.4%	19.1%	18.6%	18.8%	19.9%	17.4%
Vehicle purchases (net outlay)	8.2%	6.8%	5.6%	8.6%	8.2%	8.6%	7.7%	8.2%	9.4%	7.8%
Gasoline and motor oil	2.8%	3.2%	2.9%	3.0%	3.2%	3.2%	3.1%	3.1%	2.8%	2.2%
Other vehicle expenditures	6.1%	5.2%	4.1%	5.3%	5.9%	6.2%	6.7%	6.5%	6.7%	5.9%
Public transportation	**1.1%**	**1.2%**	**1.1%**	**1.0%**	**1.0%**	**1.0%**	**1.0%**	**1.0%**	0.9%	**1.5%**
Health care	5.3%	4.9%	7.9%	8.3%	9.4%	6.6%	5.5%	5.2%	4.4%	3.9%
Entertainment	4.9%	5.2%	3.8%	4.5%	3.9%	4.3%	4.3%	4.9%	5.3%	5.4%
Personal Insurance & pensions	11.0%	2.7%	2.1%	3.0%	4.4%	6.5%	9.3%	11.7%	13.2%	15.8%
Others[d]	9.7%	11.6%	10.3%	10.1%	8.9%	9.9%	9.7%	9.5%	9.4%	9.8%
Households (thousands)	84,115	4,259	8,143	8,469	7,352	12,621	10,123	7,654	11,300	14,193
Percentage of households	100%	5.1%	9.7%	10.1%	8.7%	15.0%	12.0%	9.1%	13.4%	16.9%
Average number of vehicles in HH	2.0	1.0	0.9	1.3	1.5	1.9	2.1	2.3	2.6	2.9

Source:
U.S. Department of Labor, Bureau of Labor Statistics, web site: www.bls.gov/csx/1998/Standard/income.pdf., February 2000. (Additional resources: www.bls.gov)

[a] Public assistance monies are included in reported income. Data for those reporting income.
[b] Percentages may not sum to totals due to rounding.
[c] Includes alcoholic beverages.
[d] Includes personal care, reading, education, tobacco and smoking supplies, cash contributions, and miscellaneous items.

Household vehicle ownership shows a dramatic increase from 1960 to 1990. In 1960, nearly 79% of households owned less than two vehicles; by 1990, it declined to 45%. Census data prior to 1990 indicated that the majority of households owned one vehicle; in 1990 that changed to two vehicles.

Table 11.3
Household Vehicle Ownership, 1960-90 Census
(percentage)

	No vehicles	One vehicle	Two vehicles	Three or more vehicles	Total vehicles”
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: www.census.gov)

“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 walling." 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 shouldonly be compared to the adjusted 1990 trip data, and the original trip 1990 data should be compared with previous surveys. Additional analyses can be done on the 1995 NPTS data through the Internet site: **www-cta.ornl.gov/npts.**

Table 11.4
Demographic Statistics
1969, 1977, 1983, 1990, and 1995 NPTS

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

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

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

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

Table 11.5
Average Annual Vehicle-Miles, Vehicle Trips and Trip Length per Household
1969, 1977, 1983, 1990, and 1995 NPTS

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

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

"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 allprevious surveys; however, comparisons should always be made with caution because of differing survey methodologies.

Table 11.6
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”	Shopping	Social and recreational	All purposes”
	Average annual PMT per household			
1983	4,586	2,567	8,964	22,802
1990 original	5,637	2,674	8,567	24,803
1990 adjusted	5,637	3,343	11,308	30,316
1995	7,740	4,659	10,571	34.459
	Average annual person trips per household			
1983	537	474	728	2,628
1990 original	539	504	662	2,673
1990 adjusted	539	630	874	3,262
1995	676	775	953	3,828
	Average person trip length (miles)			
1983	8.5	5.4	12.3	8.7
1990 original	10.7	5.4	13.2	9.5
1990 adjusted	10.7	5.4	13.2	9.5
1995	11.6	6.1	11.3	9.1

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

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

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

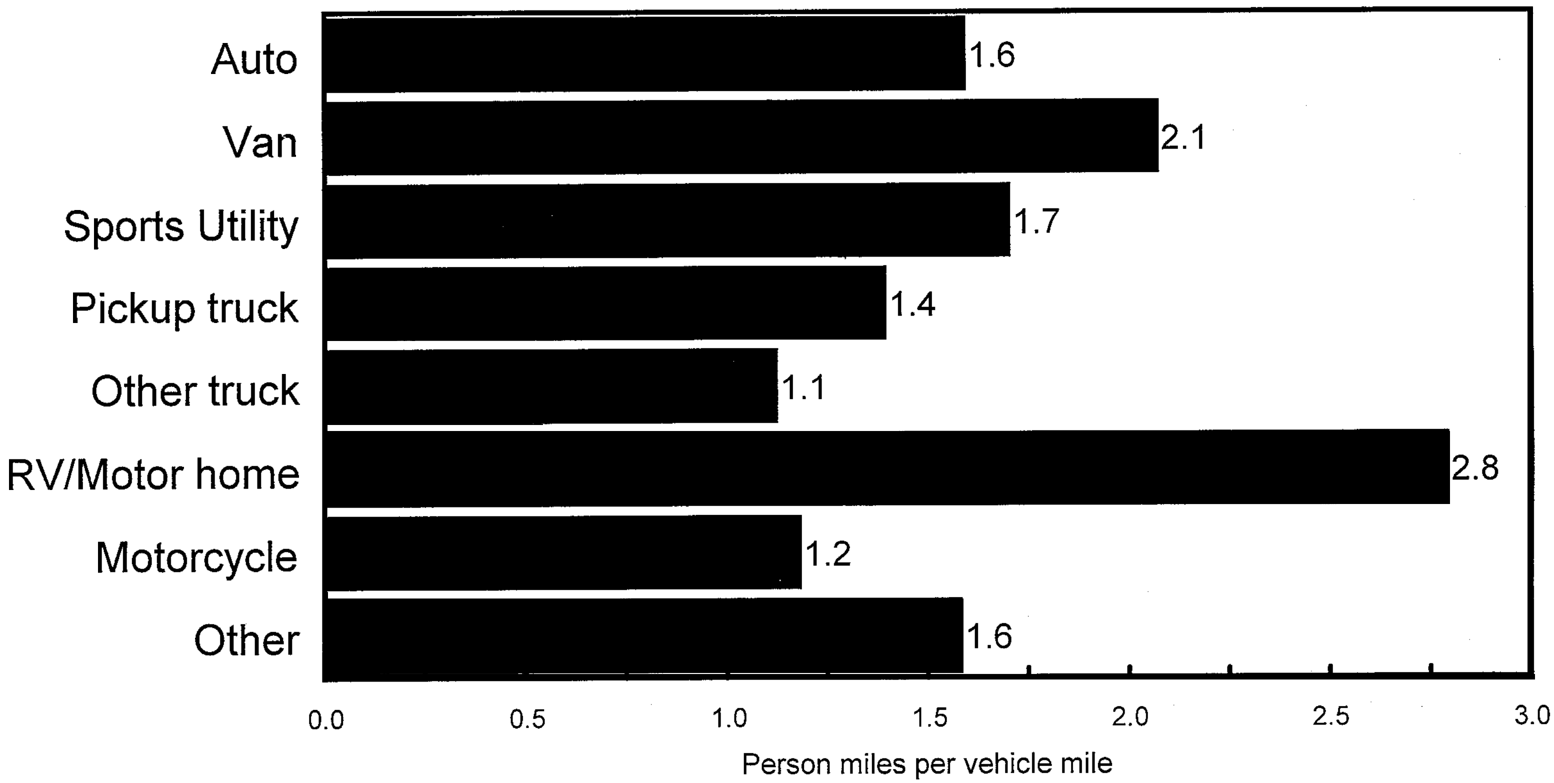
“Includes trip purposes not shown on this table.

Table 11.7
Average Number of Vehicles and Vehicle Travel per Household, 1990 and 1995 NPTS

	Average number of vehicles per household		Average vehicle-miles traveled per household	
Number of Drivers	**1990**	**1995**	**1990**	**1995**
1	1.5	1.2	15,200	11,000
2	2.1	2.1	22,900	22,600
3	2.9	2.8	29,400	30,100
4 or more	3.8	3.6	40,500	39,600
Household size				
1 person	1.2	1.2	11,400	10,800
2 persons	1.9	1.9	19,300	19,400
3 persons	2.2	2.2	23,700	24,800
4 persons	2.4	2.3	25,300	25,600
5 persons	2.4	2.3	24,900	27,200
6 or more persons	2.7	2.5	29,200	27,900
Household urban status				
Urban	1.9	1.6	19,000	16,500
Rural	2.1	2.0	22,200	22,600
Household composition				
With children	2.2	2.2	24,100	25,000
Without children	1.8	1.8	17,600	17,100
Total	**1.8**	**1.8**	**18,300**	**18,700**

Source:
Generated from the Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 2000. (Additional resources: www-cta.ornl.gov/npts)

Figure 11.1. Average Vehicle Occupancy by Vehicle Type, 1995 NPTS

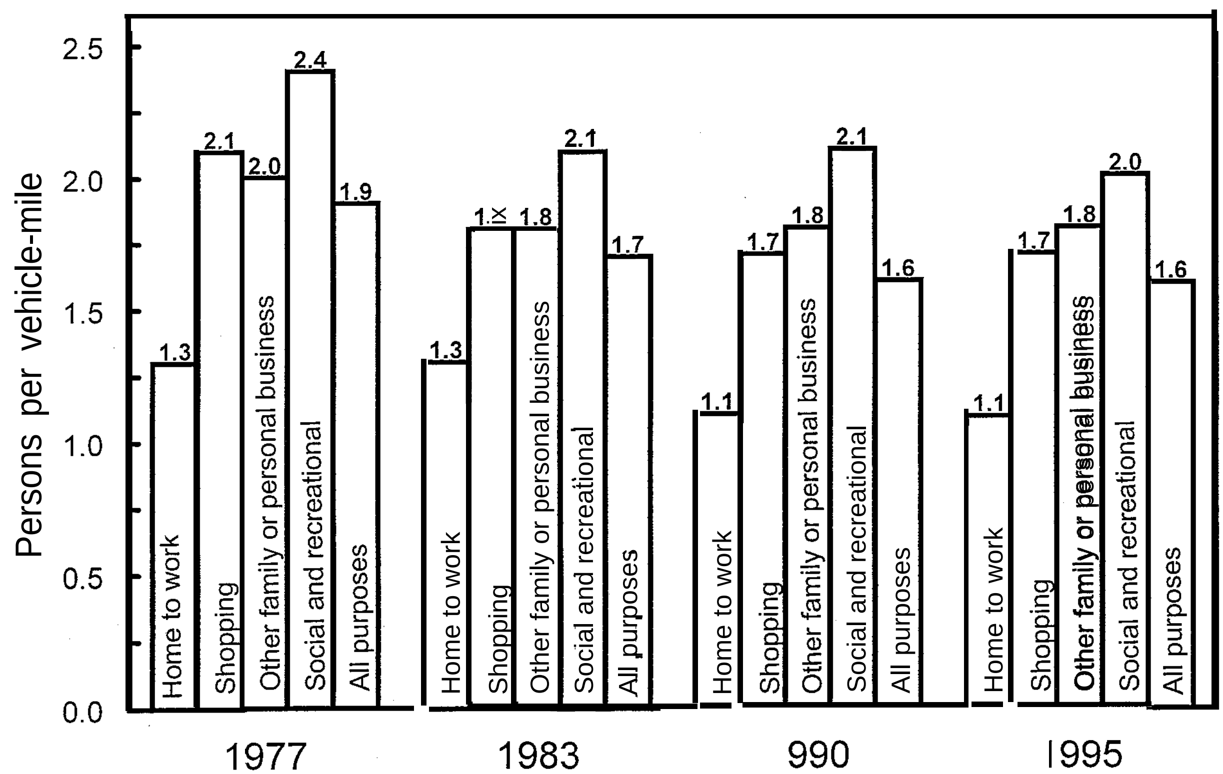


Source:

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

The average vehicle occupancy, calculated as person-miles per vehicle-mile, 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 11.2. 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: www.fhwa.dot.gov, www-cta.ornl.gov/npts)

Less than 27% of all household vehicle-miles are trips to or from work. Errands such as family andpersonal business and shopping (combined) make up a third of vehicle travel. One quarter of all trips 75 miles or longer (one way) were for the purpose of visiting friends or relatives.

Table 11.8
Vehicle-Miles by Trip Purpose, 1995 NPTS

Purpose of trip	Daily trip vehicle-miles (millions)	Daily trip vehicle-miles (percent)	Long trip vehicle-miles[a] (millions)	Long trip vehicle-miles[a] (percent)	Total trip vehicle-miles (millions)	Total trip vehicle-miles (percent)
To or from work	642,610	31.1%	16,032	4.2%	658,642	26.8%
Work-related business	137,867	6.7%	56,613	14.7%	194,480	7.9%
Shopping	277,860	13.4%	13,377	3.5%	291,237	11.9%
Other family or personal business	426,330	20.6%	54,722	14.2%	481,052	19.6%
School/church	78,313	3.8%	11,874	3.1%	90,187	3.7%
Doctor/dentist	30,613	1.5%	5,016	1.3%	35,629	1.5%
Vacation	20,318	1.0%	38,765	10.0%	59,083	2.4%
Visit friends or relatives	195,068	9.4%	99,308	25.7%	294,376	12.0%
Other social or recreational	256,169	12.4%	85,989	22.3%	342,158	13.9%
Other	2,797	0.1%	4,281	1.1%	7,078	0.3%
Not ascertained	422	0.0%	20	0.0%	442	0.0%
All	2,068,368	100.0%	385,997	100.0%	2,454,365	100.0%

Source:

U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey web site: www-cta.ornl.gov/npts.

[a] Defined as a trip which is 75 miles or longer one way.

As households owned more vehicles, the average annual miles for the most frequently driven vehicle increased. For example, the mostfrequently driven vehicle in five-vehicle households was driven 26% more per year than the one in two-vehicle households (21,177 miles vs. 16,804 miles).

Table 11.9
Average Annual Miles per Vehicle by Household Vehicle Ownership, 1995 NPTS

Vehicle [a]	One-vehicle household	Two-vehicle household	Three-vehicle household	Four-vehicle household	Five-vehicle household
#1	12,379	16,804	18,853	20,724	21,177
#2		8,322	9,806	11,311	12,880
#3			4,555	6,395	7,319
#4				3,218	4,177
#5					2,321
Average	**12,379**	**12,855**	**11,604**	**11,100**	**10,372**

Source:
Generated from the Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 1998. (Additional resources: www-cta.oml.gov/npts)

Table 11.10
Average Age of Vehicles by Household Vehicle Ownership, 1995 NPTS

Vehicle"	One-vehicle household	Two-vehicle household	Three-vehicle household	Four-vehicle household	Five-vehicle household
#1	7.48	6.45	6.74	7.01	7.35
#2		8.54	8.55	8.68	9.54
#3			12.25	11.36	11.89
#4				14.52	14.60
#5					17.81
Average	7.48	7.42	8.93	10.03	**11.62**

Source:
Generated from the Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey Public Use Files, Washington, DC, 1998. (Additional resources: www-cta.ornl.gov/npts)

"Vehicles are ranked by descending annual miles driven.

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. These data indicate that respondents may overestimate the number of miles driven in a year.

Table 11.11
Average Annual Miles Per Household Vehicle by Vehicle Age

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

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

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

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

Table 11.12
Journey-to-Work Statistics
1983, 1990, and 1995 NPTS”

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

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

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

“Includes airplane, Amtrak, taxi, bicycle, school bus, moped, walk and other.

‘Does not include time spent waiting for transportation.

*Does not include segmented trips.

According to the U.S. Census data, the percentage ofworkers who car pooled has droppedfrom 19.7% in 1980 to 13.4% in 1990. Thepercent of workers usingpublic transit declinedfrom 6.4% to 5.3% during the same time period. The average travel time increased by 0.7 minutes from 1980 to 1990.

Table 11.13
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”	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: www.census.gov)

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

Table 11.14
National and Metropolitan Area Comparisons of Journey-to-Work Statistics, 1990 Census

	National	Metropolitan areas”
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%
3 O-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: www.census.gov)

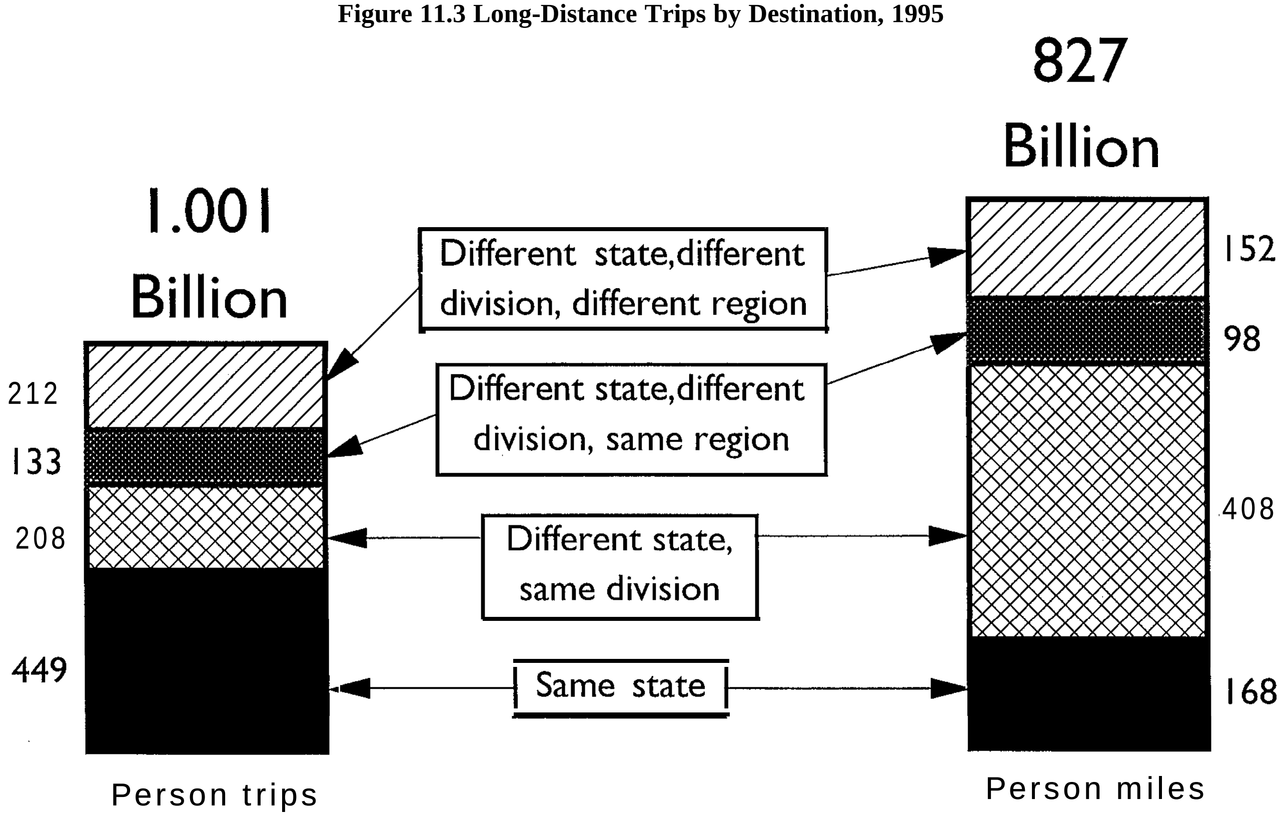
“Metropolitan areas over 1 million population. There were 39 such areas in the 1990 Census.

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: www.bts.gov/ats

Figure 11.3 Long-Distance Trips by Destination, 1995



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

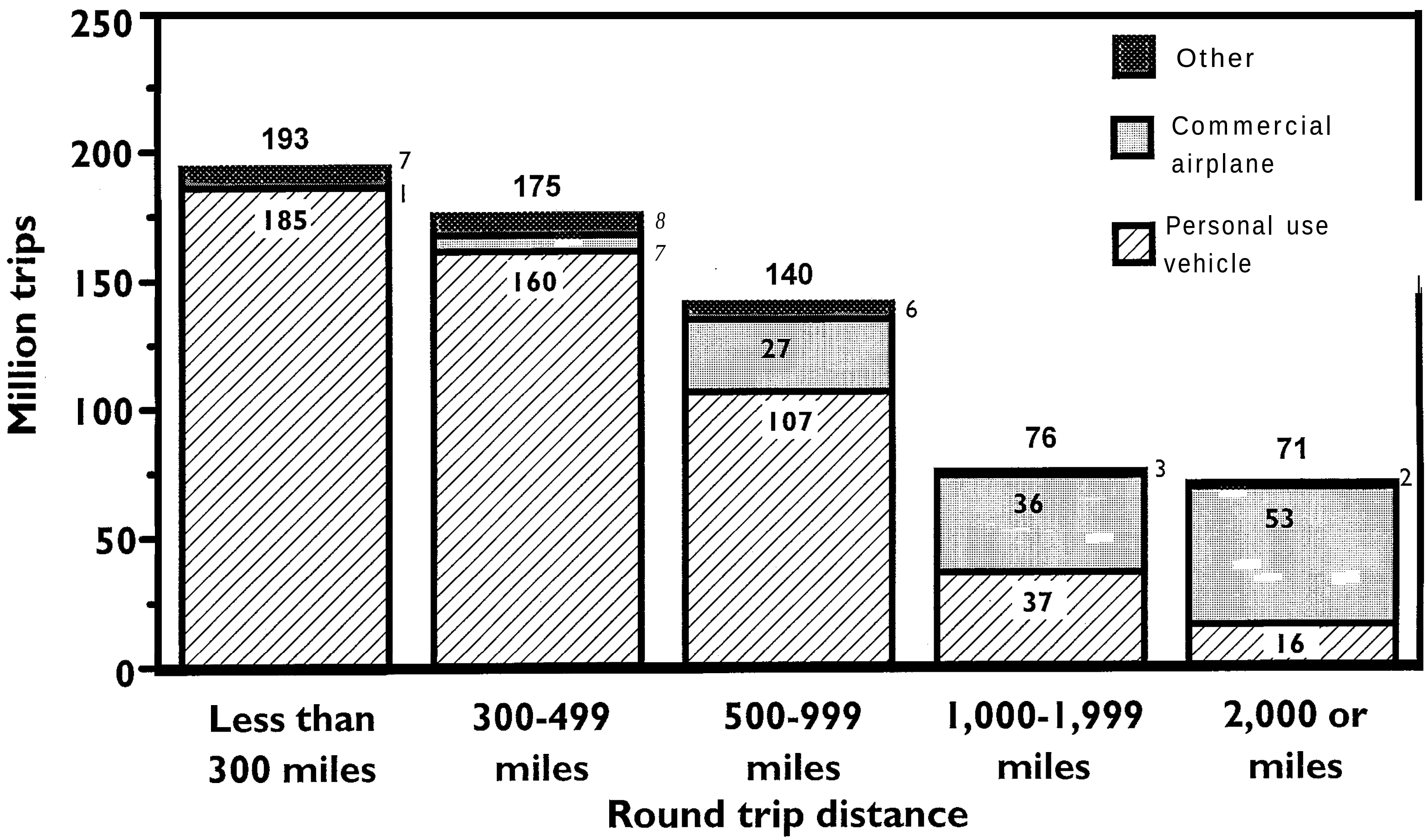
Table 11.15
Long-Distance Trips[a] by Mode and Purpose, 1995

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

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

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

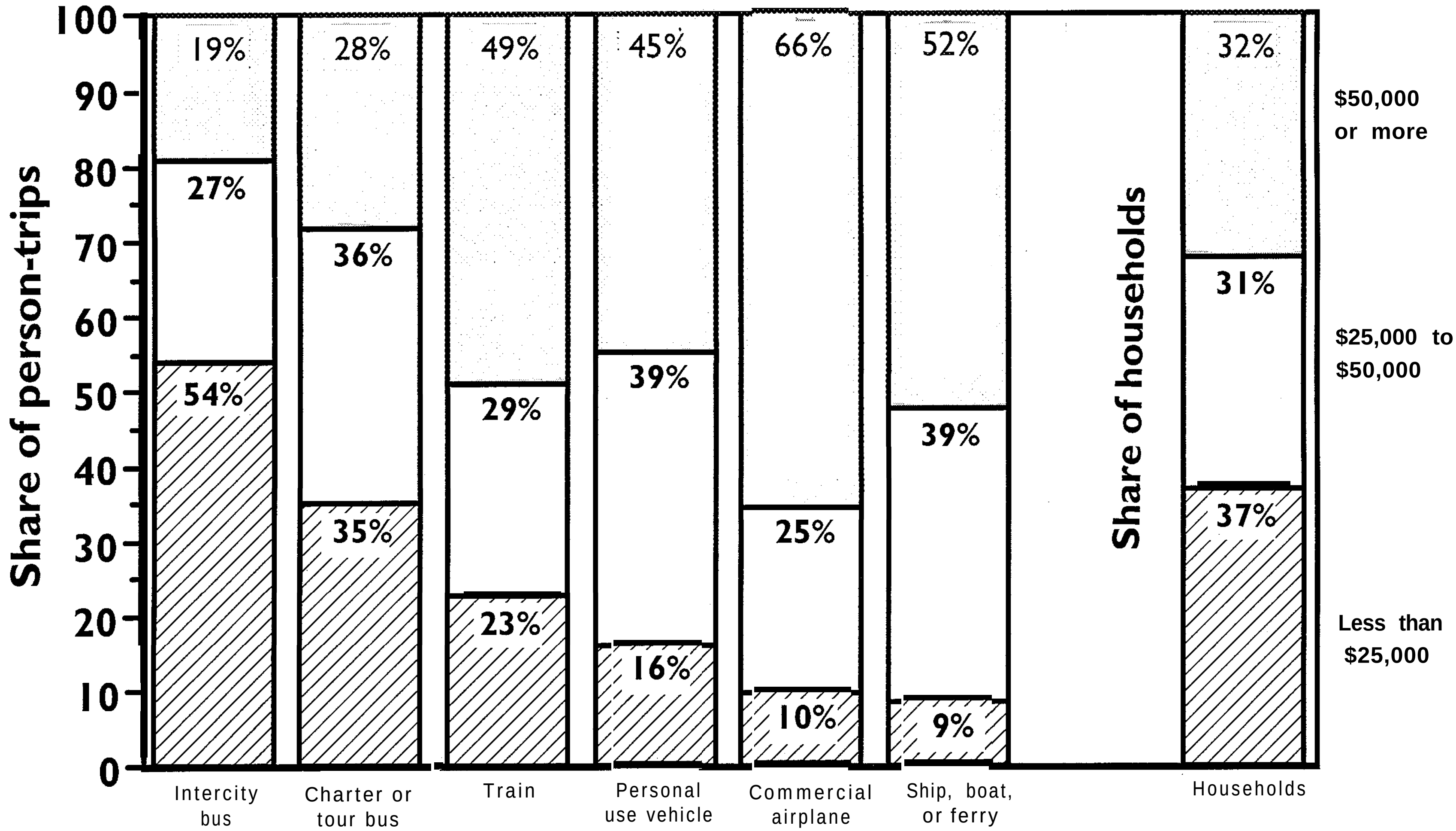
Figure 11.4. Long-Distance Household Trips by Mode and Trip Distance, 1995



Source:

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

Figure 11.5. 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*, 117" Edition, Washington, DC, 1997, p. 465.

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

Chapter 12
Nonhighway Modes

Summary Statistics from Tables in this Chapter

Source		
	Passenger-miles, 1998	(millions)
Table 12.1	*Domestic and international air carrier*	*636,410*
Table 12.2	*General aviation*	*13,300*
Table 12.10	*Amtrak*	*5,325*
Table 12.11	*Transit rail*	*13,402*
	Freight ton-miles, 1998	(millions)
Table 12.4	*Domestic waterborne commerce*	*673,000*
Table 12.7	*Class I railroad*	*1,376,802*
	Passenger energy use, 1998	(trillion Btus)
Table 12.1	*Domestic and international air carrier*	*2,550.1*
Table 12.2	*General aviation*	*147.4*
Table 12.10	*Amtrak energy use*	*13.1*
Table 12.11	*Transit rail*	*43.1*
	Freight energy use, 1998	(trillion Btus)
Table 12.4	*Domestic waterborne commerce*	*293.1*
Table 12.7	*Class I railroad*	*502.0*

Table 12.1
Summary Statistics for U.S. Domestic and International Certificated Route Air Carriers (Combined Totals), 1970-98”

Year	Revenue aircraft-miles (millions)	Average passenger trip length” (miles)	Revenue passenger-miles (millions)	Available seat-miles (millions)	Available seats per aircraft’	Passenger load factor (percentage)[d]	Revenue cargo ton-miles (millions)	Energy use (trillion Btu)	Percent domestic of total energy use (percentage)
1970	2,383	678	131,719 [f]	264,904 [f]	111	49.7%’	4,994	1,363.4	[g]
1975	2,241	698	173,324	315,823	135	54.9%	5,944	1,283.4	[g]
1976	2,320	704	191,823	338,349	139	56.7%	6,222	1,324.1	[g]
1977	2,418	704	206,082	361,172	143	57.1%	6,587	1,386.2	[g]
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	[g]
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	3 19,504	534,104	164	59.8%	9,328	1,607.4	[g]
1985	3,462	758	351,073	565,677	163	62.1%	9,048	1,701.5	[g]
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	5,855	802	596,164	859,720	147	69.3%	24,892	2,396.6	74.0%
1997	6,025	814	619,969	880,607	146	70.4%	27,610	2,494.5	73.4%
1998	6,222	813	636,410	899,115	145	70.8%	28,015	2,550.1	72.8%
				Average *annual* percentage change					
1970-98	3.5%	0.7%	5.8%	4.5%	1.0%		6.4%	2.3%	
1988-98	3.6%	0.3%	3.8%	2.6%	-1.0%		6.7%	2.2%	

Source:
U.S. Department of Transportation, Bureau of Transportation Statistics, Air Carrier *Traffic* Statistics Monthly, December 19980997, Washington, DC, pp. l-2, and annual.
1970-81 Energy Use - Department of Transportation, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, DC, 1981, and annual.
1982-98 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: www.bts.gov, www.faa.gov)

[a]Data are for all U.S. air carriers reporting on Form 41.
‘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.
‘Available seats per aircraft is calculated as the ratio of available seat-miles to revenue aircraft-miles.
[d]Passenger load factor is calculated as the ratio of revenue passenger-miles to available seat-miles for scheduled and nonscheduled services.
‘Energy use includes fuel purchased abroad for international flights.
Scheduled services only.
‘Data are not available.

Table 12.2
Summary Statistics for General Aviation, 1970–98

Calendar year	Total number of aircraft	Hours flown (thousands)	Intercity passenger travel (billion passenger-miles)	Energy use (trillion btu)
1970	131,700”	26,030”	9.1	94.4
1971	131,100”	25,512”	9.2	91.6
1972	145,000”	26,974”	10.0	103.4
1973	148,000”	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	30,490	12.1	120.4
1992	185,650	27,471	10.8	104.7
1993	177,120	24,455	9.9	97.5
1994	172,935	24,092	9.8	95.3
1995	188,089	26,612	10.4	106.6
1996	191,129	26,909	10.6	111.1
1997	192,414	27,713	12.5	121.1
1998	204,710	28,100	13.3	147.4
		Average annual percentage change		
1970-98	1.6%	0.3%	1.4%	1.6%
1988-98	0.4%	-1.0%	0.5%	-0.1%

Sources:

Intercity passenger-miles - Eno Foundation for Transportation, *Transportation in America 1999,* Sixteenth edition, Lansdowne, VA, 2000, p. 47, and annual.

All other- U.S. Department of Transportation, Federal Aviation Administration, *General Aviation Activity and Avionics Survey: Calendar Year* 1998, pp. 1-7, 1-16, 5-2, 5-3, 5-4, and annual. (Additional resources: www.faa.gov)

‘Active fixed-wing general aviation aircraft only.

[b]Include rotocraft.

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

Table 12.3
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970–98
(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	48.2%
1997	2,334	1,221	1,113	47.7%
1998	2,339	1,245	1,094	46.8%
Average annual percentage change				
1970-98	1.5%	2.8%	0.5%	
1988-98	1.1%	2.5%	-0.2%	

Source:
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year* 1998, Part 5: National Summaries, New Orleans, Louisiana, 2000, Table l-l, p. 1-3, and annual. (Additional resources: www.wrc-ndc.usace.army.mil/ndc)

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

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

Table 12.4
Summary Statistics for Domestic Waterborne Commerce, 1970–98

Year	Number of vessels"	Ton-miles (billions)	Tons shipped" (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
1997	41,419	707	1,106	639.5	415	293.2
1998	42,032	673	1,087	619.0	436	293.1
			Average annual percentage change			
1970-98	1.8%	0.4%	0.5%	-0.1%	-0.8%	-0.4%
1988-98	0.7%	-2.8%	-0.2%	-2.6%	1.9%	-0.9%

Source:
Number of vessels -

1970-92, 1995-98 - U.S. Department of the Army, Corps of Engineers, "Summary of U.S. Flag Passenger and cargo vessels, 1998," New Orleans, LA, 2000, 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 1998* Part 5: National Summaries, New Orleans, LA, 2000, Table 1-4, pp. 1-6, 1-7, and annual.

Energy use - See Appendix A for Table 2.5.

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

"Grand total for self-propelled and non-self-propelled.

"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-six percent of all domestic marine cargo in 1998 were energy-related products (petroleum, coal, coke). The majority of the energy-related products were shipped internally and locally (64%). Barge traffic accountedfor 96% of all internal and local waterborne commerce.

Table 12.5
Breakdown of Domestic Marine Cargo by Commodity Class, 1998

	Coastwise		Lakewise		Internal and local		Total domestic?		
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	177	1,300	2	291	196	200	376	34.6%	720
Chemicals and related products	15	2,064	c	322	62	492	78	7.1%	800
Crude materials	19	618	94	511	133	34%	246	22.6%	431
Coal and coke	15	659	22	5 2 5	192	365	229	21.1%	400
Primary manufactured goods	7	680	3	295	30	865	41	3.8%	784
Food and farm products	7	1,696	c	929	84	993	92	8.4%	1,047
Manufactured equipment	9	1,655	c	c	12	93	21	1.9%	738
Waste and scrap	c	667	0	0	5	68		0.5%	68
Unknown		2,133		c		c		0.0%	1,684
Total	250	1,261	122	504	715	416	1,087	100.0%	620
Barge traffic (million tons)	115		14		684		813		
Percentage by barge	46.0%		11.1%		95.7%		74.8%		

Source:
U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1998,* Part 5: National Summaries, New Orleans, Louisiana, 2000, Tables 2-1, 2-2, and 2-3, pp. 2-l-2-8, and annual.
(Additional resources: www.wrc-ndc.usace.army.mil/ndc)

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

“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 1998, nine railroads were given this classification.

Table 12.6
Class I Railroad Freight Systems in the United States Ranked by Revenue Ton-Miles, 1998

Railroad	Revenue ton-miles (billions)	Percent
Burlington Northern and Sante Fe Railway Company	469	34.1%
Union Pacific Railroad Company	432	31.4%
CSX Transportation	166	12.1%
Norfolk Southern Corporation	133	9.7%
Consolidated Rail Corporation (Conrail)	101	7.3%
Illinois Central Railroad Company	23	1.7%
Kansas City Southern Railway Company	22	1.6%
Soo Line Railroad Company	20	1.5%
Grand Trunk Western Railroad Inc.	9	0.7%
Total	**1,375**	**100.0%**

Source:
Association of American Railroads, *Railroad Facts*, 1999 Edition, Washington, DC, October 1999, p. 66. (Additional resources: www.aar.org)

Table 12.7
Summary Statistics for Class I Freight Railroads, 1970–98

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
1997	19,684	568	475	31,660	1,585	851	1,348,926	370	499.7
1998	20,261	576	475	32,657	1,649	835	1,376,802	365	502.0
					Average annual percentage change				
1970-98	-1.0%	-3.2%	0.4%	0.3%	0.4%	1.7%	2.1%	-2.3%	-0.2%
1988-98	0.5%	-2.3%	2.3%	2.2%	1.4%	1.8%	3.3%	-1.9%	1.3%

Source:
Association of American Railroads, *Railroad Facts,* 1999 Edition, Washington, DC, October 1999, pp. 27, 28, 33, 34, 36, 48, 50, 60.
(Additional resources: www.aar.org)

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

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

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

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

The "other" category, which consists primarily of intermodal traffic, has grown 126% in carloads from 1974 to 1998. Coal now accounts for one quarter of all carloacls.

Table 12.8
Railroad Revenue Carloads by Commodity Group, 1974 and 1998

Commodity group	Carloads (thousands) 1974	Carloads (thousands) 1998	Percent distribution 1974	Percent distribution 1998	Percentage change 1974198
Coal	4,544	7,027	17.0%	27.3%	54.6%
Farm products	3,021	1,404	11.3%	5.5%	-53.5%
Chemicals and allied products	1,464	1,680	5.5%	6.5%	14.8%
Nonmetallic minerals	821	1,256	3.1%	4.9%	53.0%
Food and kindred products	1,777	1,282	6.6%	5.0%	-27.9%
Lumber and wood products	1,930	645	7.2%	2.5%	-66.6%
Metallic ores	1,910	311	7.1%	1.2%	-83.7%
Stone, clay and glass	2,428	475	9.1%	1.8%	-80.4%
Pulp, paper, and allied products	1,180	547	4.4%	2.1%	-53.6%
Petroleum products	877	483	3.3%	1.9%	-44.9%
Primary metal products	1,366	671	5.1%	2.6%	-50.9%
Waste and scrap material	889	581	3.3%	2.3%	-34.6%
Transportation equipment	1,126	1,546	4.2%	6.0%	37.3%
Others	3,451	7,797	12.9%	30.3%	125.9%
Total	26,784	25,705	100.0%	100.0%	-4.0%

Source:
1974 - Association of American Railroads, *Railroad Facts*, 1976 Edition, Washington, DC, 1975, p. 26.
1997 - Association of American Railroads, *Railroad Facts,* 1999 Edition, Washington, DC, October 1999, p. 25.
(Additional resources: www.aar.org)

The number of trailers and containers moved by railroads has increased more than four-fold from 1965 to 1998. Containerization has increased in recent years, evidenced by the 135% increase in the number of containers from 1988 to 1997. According to the 1997 Commodity Flow Survey, 5% of all freight ton-miles are rail intermodal shipments (truck/rail or rail/water). See Table 8. 11 for details.

Table 12.9
Intermodal Rail Traffic, 1965-98

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	4,090,07X	[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
1997[b]	8,695,860	3,453,081	5,242,779
1998[b]	8,772,663	3,353,032	5,419,631
Average annual percentage change			
1965-98	5.2%	[a]	[a]
1988-98	4.3%	-0.4%	9.0%

Source:
Association of American Railroads, *Railroad Facts,* 1999 edition, Washington, DC, October 1999 p.26. (Additional resources: www.aar.org)

[a] Data are not available.

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

Table 12.10
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971-98

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		1,165	16,537	140,147	1,993	188		
1972	285	1,571	26,302	213,261	3,039	183		[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	3 1,000	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	3 1,579	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]
1997	292	1,572	32,000	287,760	5,166	255	2,458	12.7[c]
1998	362	1.347	32.926	315,823	5,325	251	2,460	13.0[c]
				Average annual percentage change				
1971-98	0.9%[d]	0.5%	2.6%	3.1%	3.7%	1.1%	-1.7%[d]	-0.3%[d]
1988-98	-0.8%	-3.1%	0.9%	1.3%	-0.7%	-0.5%	0.0%	-0.7%

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.
1994–98- Number of locomotives in service, number of passenger cars, train-miles, car-miles, revenue passenger-miles, and average trip length - Association of American Railroads, *Railroad Facts,* 1999 Edition, Washington, DC, 1999, p. 77.
Energy use - Personal communication with the Amtrak, Washington, DC, and estimates thereafter based on train-miles.
(Additional resources: www.amtrak.com, www.aar.org)

[a] Data are not available.
[b] Energy use for 1994 on is not directly comparable to earlier years. Some commuter rail energy use may have been inadvertently included in earlier years.
[c] Estimated using train-miles.
[d] Average annual percentage change is from earliest year available to 1998.

Table 12.11
Summary Statistics for Rail Transit Operations, 1970–98[a]

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)[b]	Estimated passenger-miles (millions)	Average trip length (miles)[d]	Energy-intensity (Btu/passenger-mile)	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	580.7	2,417	12,484	5.2	3,444	43.0
1997	11,471	598.9	2,692	13,091	4.9	3,253	42.6
1998	11,506	609.1	2,668	13,402	5.0	3,216	43.1
				Average annual percentage change			
1970–98	0.3%	1.2%	0.8%	0.3%	-0.7%[g]	1.0%	1.3%
1988-98	0.1%	1.2%	0.8%	1.3%	0.4%	-1.0%	0.2%

Source:

American Public Transit Association, 2000 Transit Fact Book, Washington, DC, March 2000, pp. 69, 70, 78, 83. (Additional resources: www.apta.com)

Energy use - See Appendix A for Table 2.5.

[a] Heavy rail and light rail. Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

[b] 1970–79 data represents total passenger rides; after 1979, data represents unlinked passenger trips.

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

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

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

[f] Data are not available.

[g] Average annual percentage change is calculated for years 1977-98.

APPENDIX A

SOURCES

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

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

List of Abbreviations Used in Appendix A

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

Table 2.5
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1998

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

Highway

Automobiles

Total gallons of fuel taken from DOT, FHWA, *Highway Statistics* 1998, 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* 1998, 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* 1998, Washington, DC, 1999, Table 12.

Motorcycles

DOT, FHWA, *Highway Statistics* 1998, Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:

APTA, *2000 Transit Fact Book*, 2000, Washington, DC.
Non-diesel fossil fuel consumption was assumed to be used by motor buses,

Intercity:

Eno Transportation Foundation, *Transportation in America* 1999, Seventeenth Edition, 2000, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

School:

Gasoline and Diesel - Eno Transportation Foundation, *Transportation in America 1999*, Seventeenth Edition, 2000, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

Trucks

Total:

Sum of light trucks and other trucks.

Light Trucks:

DOT, FHWA, *Highway Statistics* 1998, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.3% of fuel assumed to be gasoline, 3.4% diesel, 0.2% lpg; percentages were generated from the 1997 VIUS Public Use CD. Natural gas data are from the DOE, EIA *Natural Gas Annual* 1998, 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* 1998, Table VM- 1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These gallons were distributed as follows based on data from the 1997 VIUS Public Use CD: 12.4% of fuel assumed to be gasoline, 87.1% diesel, and 0.5% lpg.

Off-Highway

Diesel:

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

Gasoline:

DOT, FHWA, *Highway Statistics 1999,* Table MF-24. Agriculture and Construction totals.

Nonhighwav

Air

General Aviation:

DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report Calendar Year 1998,* 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 1998,* 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 calculatedusing the following equation: Total = 0.95 (Gal/boat) (number ofboats). 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 1998*, Table 1. Cubic feet were converted to Btu using 1,03 1 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, 198 1. (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,* 1999 Edition, Washington, DC, 1999.

Passenger:

Transit and Commuter **-** APTA, 2000 *Transit Fact Book*, Washington, DC, 2000. Transit was defined as the sum of “heavy rail,” “light rail,” and “other.”

Intercity **-** Personal communication with Amtrak, Washington, DC. (1998 data were estimated using train-mile information.)

Table 2.7
Transportation Energy Consumption by Mode, 1970–98

Highway

Automobiles

Total gallons of fuel for automobiles was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-20 1 A; and Table VM- 1 in the 1996-l 998 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

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

1981-82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January I981 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.

1994-98 - 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.

1993-98 - Natural gas data are from the DOE, EIA *Natural Gas Annual 1998*, 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 1996-98 annual editions. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Sum of transit, intercity and school.

Transit:

APTA, *2000 Transit Fact Book, 2000,* Washington, DC, and annual.

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

Intercity:

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

1985–98- Eno Transportation Foundation, *Transportation in America 1999,* Seventeenth Edition, 2000, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

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.

1987–98- Eno Transportation Foundation, *Transportation in America 1999* , Seventeenth Edition, 1999, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

Trucks

Light Trucks:

Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995,* Table VM-201A, and Table VM-1 of the 1996-98 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-87 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994-97 was distributed based on the 1992 TIUS: 96.4% gasoline; 3.3% diesel; 0.3% lpg. Fuel use for 1998 was based on the 1997 VIUS: 96.3% gasoline, 3.4% diesel, 0.2% lpg. Natural gas data are from the DOE, EIA *Natural Gas Annual* 1998, 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 1996-98 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-87 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994-96 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg. Fuel use for 1997-98 was distributed as follows based on data from the 1997 VIUS Public Use CD: 12.4% of fuel assumed to be gasoline, 87.1% diesel, and 0.5% lpg.

Total Highway

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

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, 198 1.

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

1985-97 - DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report, Calendar Year* 1998, 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.

1982–98- DOT, Bureau of Transportation Statistics, “Fuel Cost and Consumption Tables;” annual figures were obtained by summing monthly totals. These data are for domestic carriers, but include the international operations of those domestic carriers. The international operations total was divided in half to estimate domestic fuel use for international flights.

Water

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

Freight:

Total - DOE, EIA, *Fuel Oil and Kerosene Sales* 1998, Table 23. Adjusted sales of distillateandresidual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Recreational Boating:

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

1985-98 - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

Pipeline

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

Natural Gas.

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1998,* 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-l 10 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 0.0 15. 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, 198 1. (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,* 1999 Edition, Washington, DC.

Passenger:

Transit and Commuter - APTA, *2000 Transit Fact Book*, 2000, Washington, DC , annual. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Intercity - Personal communication with Amtrak, Washington, DC. (1995-98 data were estimated using train-mile information.)

Table 2.11
Passenger Travel and Energy Use in the United States, 1998

Highway

Automobiles

Number of Vehicles - DOT, FHWA, *Highway Statistics 1998* Table VM- 1.
Vmt - DOT, FHWA, *Highway Statistics* 1998, Table VM- 1.
Pmt - Calculated by ORNL (load factor times vmt).
Load Factor - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.
Energy Use - Total gallons of fuel taken from DOT, FHWA, *Highway Statistics* 1998, Table VM-1. These were distributed as follows: 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* 1998, 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.

Personal Trucks

Number of Vehicles - Based on the 1997 TIUS, 75.2% of total 2-axle, 4-tire trucks and 16.9% of total other trucks were for personal use. Therefore, 75.2% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics* 1998, Table VM- 1) and 16.9% of total other trucks were estimated to be for personal use.
Vmt - 70.7% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics* 1998, Table VM- 1) and 7.1% of total vehicle miles traveled by other trucks were for personal use. The percentages were derived by ORNL from the 1997 VIUS Micro Data File on CD.
Pmt - Calculated by ORNL as vmt multiplied by load factor.
Load Factor - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.
Energy Use- Assuming that there is no difference in fuel economy (measured in miles per gallon) between personal-use trucks and non-personal use trucks, 68.5% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics* 1998, Table VM- 1) and 3.7% of total other truck fuel consumption was for personal use. These percentages were derived by ORNL from the 1997 VIUS Public Use tape. Total truck energy use was the sum of light truck and other truck energy use.

Light Trucks: DOT, FHWA, *Highway Statistics* 1998, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.3% of fuel assumed to be gasoline, 3.4% diesel, 0.2% lpg; percentages were generated from the 1997 VIUS Public Use CD. Natural gas data are from the DOE, EIA *Natural Gas Annual 1998,* 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 1998,* Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These gallons were distributed as follows based on data from the 1997 VIUS Public Use CD: 12.4% of fuel assumed to be gasoline, 87.1% diesel, and 0.5% lpg.

Motorcycles

Number of Vehicles and Vmt - DOT, FHWA, *Highway Statistics 1998,* 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* 1998, 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, *2000 Transit Fact Book, 2000,* Washington, DC.

Load Factor - Calculated by ORNL as pmt/vmt.

Intercity:

Number of Vehicles - Estimatedby ORNL as 18% of commercial bus registrations, DOT, FHWA, *Highway Statistics* 1998, Table MV- 10.

Pmt - Eno Transportation Foundation, *Transportation in America, 1999,* Seventeenth Edition, Lansdowne, VA, 2000, 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 1999,* Seventeenth Edition, 2000, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

School:

Number of Vehicles - School and other nonrevenue as reported in DOT, FHWA, *Highway Statistics 1998,* Table MV-10.

Vmt, Pmt - National Safety Council, *Accident Facts,* 1999Edition, Chicago, IL.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - Eno Transportation Foundation, *Transportation in America* 1999, Sixteenth Edition, 2000, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

Nonhighway

Air

Large Certified Route Air Carriers:

Vmt, Pmt - DOT, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1998/1999, 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 1998*, pp. l-7, 3-l 1, 5-3.

Pmt - Eno Transportation Foundation, *Transportation in America 1999*, Seventeenth Edition, Lansdowne, VA, 2000, 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, May *2000*.

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*, 1999 Edition, Washington, DC, p. 78.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - Personal communication with Amtrak, Washington, DC. (1998 data estimated using train-mile information.)

Transit and Commuter:

Number of Vehicles, Vmt and Pmt - APTA, *2000 Transit Fact Book*, Washington, DC, *2000*.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - APTA, *2000 Transit Fact Book*, 2000,Washington, DC. 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, 1998

Highway

Trucks

Vehicles - 0.4% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1998*, Table VM-1) and 29% of total other trucks were engaged in intercity freight movement. These percentages were derived by ORNL from the 1997 VIUS Micro Data File on CD. Intercity freight trucks were defined as any truck whose:
- greatest share of miles were traveled more than 50 miles away from the vehicle's home base; **and**
- principal use was not personal or passenger transportation; **and**
- body type was not pickup, minivan, or utility vehicle.

Vmt - 0.7% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1998*, Table VM-1) and 65.2% of total vehicle miles traveled by other trucks were used in intercity freight movement. These percentages were derived by ORNL from the 1997 VIUS Micro Data File on CD.

Ton Miles, Tons Shipped and Average Length of Haul - Eno Transportation Foundation, *Transportation in America* 1999, Seventeenth Edition, Lansdowne, VA, 2000, pp. 44, 46, 71.

Energy Intensity - Energy use divided by ton-miles.

Energy Use - 1.0% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1998*, Table VM-1) and 71.3% of total other truck fuel consumption were used in intercity freight movement. These percentages were derived by ORNL from the 1997 VIUS Micro Data File on CD.

Nonhighway

Waterborne Commerce

Vehicles - U.S. Department of the Army, Army Corps of Engineers, "Summary of U.S. Flag Passenger and Cargo Vessels, 1998," New Orleans, LA, 2000.

Ton Miles, Tons Shipped, and Average Length of Haul - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1998, Part 5: National Summaries,* New Orleans, LA, 2000, pp. l-6, l-7.

Energy Intensity - Energy use divided by ton miles.

Energy Use - DOE, EIA, *Fuel Oil and Kerosene Sales 1998* 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.

Pipeline

Natural Gas:

Tons shipped - DOE, EIA, *Natural Gas Annual* 1998, Washington, DC, 1999, 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* 1998, Table 1. Cubic feet were converted to Btu using 1,03 1 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* 1999, Seventeenth Edition, Lansdowne, VA, 2000, 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, Tons, Ton Miles, Average Length of Haul and Energy Use - AAR, Railroad Facts, 1999 Edition, Washington, DC, 1999.

Table 2.12
Energy Intensities of Passenger Modes, 1970–98

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 1996-98 editions.
Pmt - vmt multiplied by the load factor.
Energy Use - Total gallons of fuel for automobiles was taken from DOT, FHWA, *Highway Statistics Summary to* 1995, Table VM-201A; and Table VM-1 in the 1996-98 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

1970-80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980*, p. 10.
1981-82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981*, pp. 11, 13.
1983-84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983,* Jan., 1985, pp. 7, 9.
1985-87 - 98.5% gasoline, 1.5% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Transportation Energy Consumption Survey. Consumption Patterns of Household Vehicles 1985,* April 1987, pp. 25, 27.
1988-90 - 98.8% gasoline and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1988,* March 1990, p. 65.
1991-93 - 97.8% gasoline, 1 .O% gasohol, and I .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.
1994-98 - 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.
1993-98 - Methanol use was estimated using data from DOE, EIA, Alternatives to *Traditional Transportation Fuels 1999*, Washington, DC, 1998, Table 12.
1993-98 - Natural gas data are from the DOE, EIA *Natural Gas Annual* 1998, 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-20 1 A, and Table VM- 1 of the 1996-98 editions. Light trucks were defined as 2-axle, 4-tire trucks.

Energy Use - Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to* 1995, Table VM-20 1 A, and Table VM- 1 of the 1996-98 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-87 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994-96 was distributed based on the 1992 TIUS: 96.4% gasoline; 3.3% diesel; 0.3% Ipg. Fuel use for 1997-98 was based on the 1997 VIUS: 96.3% gasoline, 3.4% diesel, 0.2% lpg. Natural gas data are from the DOE, EIA *Natural Gas Annual 1998*, 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.

Buses

Transit:

Vmt, Pmt, Energy Use - APTA, *2000 Transit Fact Book*, Washington, DC, 2000, 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.

1985-98 - Eno Transportation Foundation, *Transportation in America 1999*, Seventeenth Edition, Lansdowne, VA, 2000, p. 47.

Vmt - 1990-98 - Estimated using passenger travel and an average load factor of 23.2.

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

1985-98 - Eno Transportation Foundation, *Transportation in America 1999*, Seventeenth Edition, Lansdowne, VA, p. 56, and annual. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

School:

Vmt - 1970-84 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, p. 175, and annual.

1985-87 - DOT, TSC, *National Transportation Statistics*, 1989, Figure 2, p. 7, and annual.

1988-98- National Safety Council, *Accident Facts*, 1999 Edition, Chicago, IL, and annual.

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.

1987-98 - Eno Transportation Foundation, *Transportation in America 1999*, Seventeenth Edition, Lansdowne, VA, p. 56, and annual. For conversion purposes, fuel for school buses was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

Nonhighway

Air

Certificated Air Carriers:

Pmt - DOT, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly,* December 1998/99, Washington, DC, p. 2.

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

1982-98 - 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 1999,* Seventeenth Edition, Washington, DC, 1999, p.47.

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

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

1985-98 - DOT, FAA, *General Aviation Activity and Avionics Survey: Calendar Year* 1998, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Rail

Passenger (Am trak):

Pmt - 1971-83 - AAR, *Statistics of Class I Railroads*, Washington, DC, annual.

1984-88, 1995-96 - AAR, *Railroad Facts*, 1987 Edition, Washington, DC, December 1987, p. 78, and annual.

1989-94 - Personal communication with Amtrak.

1995-98 - AAR, *Railroad Facts,* 1999 Edition, Washington, DC, 1999, p. 77, and annual.

Energy Use - Personal communication with Amtrak. (1995-98 were estimated using train-mile information.)

Transit:

Pmt and Energy Use - APTA, *2000 Transit Fact Book*, Washington, DC, 2000.
Transit was defined as the sum of "heavy rail," "light rail."

Table 2.14
Energy Intensities of Freight Modes, 1970–98

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 1996-98 editions. Heavy single-unit and combination trucks were defined as the difference between total trucks and 2-axle, 4-tire trucks.

Energy Use - Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996-98 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-87 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994-96 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg. Fuel use for 1997-98 was distributed as follows based on data from the 1997 VIUS Public Use CD: 12.4% of fuel assumed to be gasoline, 87.1% diesel, and 0.5% lpg.

Nonhighway

Water

Ton Miles - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1999, Part 5: National Summaries*, New Orleans, LA, 2000, p. l-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* 1998, Table 23. Adjusted sales of distillateandresidual 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*, 1999 Edition, Washington, DC, 1999, and annual.

Table 6.4
Vehicle Stock and New Sales in the United States, 1998 Calendar Year

Highway

Automobiles

Stock -The number of vehicles in use by EPA size class were derived as follows: Market Shares by EPA size class for new car sales from 1970-75 were taken from the DOT, NHTSA, *Automotive Characteristics Historical DataBase*, Washington, DC. Market shares for the years 1976-90 were found in Linda S. Williams and Patricia S. Hu, *Highway Vehicle MPG and Market Shares Report: Model Year* 1990, ORNL-6672, April 1991, and Table 7 and the ORNL MPG and Market Shares Database, thereafter. These data were assumed to represent the number of cars registered in each size class for each year. These percentages were applied to the automobiles in operation for that year as reported by The Polk Company (FURTHER REPRODUCTION PROHIBITED) and summed to calculate the total mix. This method assumed that all vehicles, large and small, were scrapped at the same rate.

Sales - Domestic, import, and total sales were from *Ward's Motor Vehicle Facts and Figures* 1999, p. 15. The domestic sales were distributed by size class according to the following percentages: Two seater, 0.0%; Minicompact, 18.9%; Subcompact, 27.6%; Compact 37.3%; Midsize, 15.4%; and Large, 0.8%. The import sales were distributed by size class according to the following percentages: Two-seater, 0.9%; Minicompact, 16.4%; Subcompact, 33.7%; Compact, 44.2%; Midsize, 1.3%; and Large, 3.5%. 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* 1999, Redondo Beach, CA, 1999.

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* 1998, Table VM- 1, 1999.

Recreational Vehicles

Sales - *Ward's Automotive Yearbook 1999,* U.S. Recreation Vehicle Shipments by Type, "Total," p. 242.

Trucks

Stock - Vehicles in use by weight class were determined by applying the percentage in use by weight class as reported in DOC, Bureau of the Census, 1997 VIUS, (O-10,000 lbs, 93.5%; 10,001–19,500 lbs, 2.0%; 19,501–26,000 lbs, 1.0%; 26,001 lbs and over, 3.5%) to the total number of trucks in use as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED).

Sales -*Ward's Motor Vehicle Facts and Figures 1999*, p. 25.

Business fleet trucks - Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 1998*, Redondo Beach, CA, 1998.

Personal trucks - Difference between total stock and business fleet trucks.

Table 8.13
Summary Statistics on Buses by Type, 1970–98

Number in Operation

Transit buses:

American Public Transit Association, *2000 Transit Fact Book*, Washington, DC, 2000, 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.

1990–98 - Estimated as 3 8% of commercial buses (less transit motor buses). Commercial bus total found in *Highway Statistics* 1998, Table MV-10, and annual.

School buses:

U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* 1998, Washington, DC, 1999, Table MV- 1 ,0 and annual.

Vehicle-miles and Passenger-miles

Transit buses:

American Public Transit Association, *2000 Transit Fact Book*, Washington, DC, 2000, pp. 70, 78, and annual.

In tercity buses :

1970-80 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985–98 - Eno Transportation Foundation, *Transportation in America* 1999, Seventeenth edition, Lansdowne, VA, 2000, p. 47.

1990-98 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.

198.5 - U.S. Department of Transportation, Research and Special Programs Administration, *National Transportation Statistics*, 1989, Figure 2, p. 7, and annual.

1990-98 - National Safety Council, *Accident Facts,* 1999 Edition, Chicago, IL, pp. 94, and annual. Note: In the 1999 Edition the National Safety Council discontinued publishing the passenger-miles data. There is currently no other known source for these data.

Energy Use

Transit buses:

American Public Transit Association, *2000 Transit Fact Book*, Washington, DC, 2000, pp. 112-l 14. Gasoline 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.

1985-98 - Eno Transportation Foundation, *Transportation in America 1999,* Seventeenth edition, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

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.

1987–98- Eno Transportation Foundation, *Transportation in America 1999*,Seventeenth edition, Lansdowne, VA, p. 56. For conversion purposes, fuel for school was assumed to be 90% diesel fuel and 10% gasoline based on estimates from the National Association of State Directors of Pupil Transportation Services.

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.l
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 exajoulelyear
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
	= 2 1.29 quadrillion Btu/year
	= 20.73 trillion ft^3 natural gas/year
	= 22.46 exajoulelyear
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
	= 19.3 1 quadrillion btu/year
	= 18.80 trillion ft^3 natural gas/year
	= 20.37 exajoules/year
1 trillion ft^3 natural gas/year	= 0.485 1 million bbl crude oil/day
	= 0.177 1 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 x 10^{6} ft-lb
	= 1055 J		= 3.671 x 10^{5} kg-m
	= 39.30 x 10^{-5} hp-h		= 3.600 x 10^{6} J
	= 39.85 x 10^{-5} metric hp-h		= 1.341 hp-h
	= 29.31 x 10^{-5} kWhr		= 1.360 metric hp-h
1 kg-m	= 92.95 x 10^{-4} Btu	1 Joule	= 94.78 x 10^{-5} Btu
	= 7.233 ft-lb		= 0.7376 ft-lb
	= 9.806 J		= 0.1020 kg-m
	= 36.53 x 10^{-7} hp-h		= 37.25 x 10^{-8} hp-h
	= 37.04 x 10^{-7} metric hp-h		= 37.77 x 10^{-8} metric hp-h
	= 27.24 x 10^{-7} kWhr		= 27.78 x 10^{-8} kWhr
1 hp-h	= 2544 Btu	1 metric hp-h	= 2510 Btu
	= 1.98 x 10^{6} ft-lb		= 1.953 x 10^{6} ft-lb
	= 2.738 x 10^{6} kgm		= 27.00 x 10^{4} kg-m
	= 2.685 x 10^{6} J		= 2.648 x 10” J
	= 1 .O 14 metric hp-h		= 0.9863 hp-h
	= 0.7475 kWhr		= 0.7355 kWhr

“This figure does not take into account the fact that electricity generation and distribution efficiency is approximately 29%. If generation and distribution efficiency are taken into account, 1 kWhr = 11,765 Btu.

Table B.4
International Energy Conversions

To:	TJ	Gcal	Mtoe	Mbtu	GWh
From:	*multiply by:*				
TJ	1	238.8	2.388 x 10^{-5}	947.8	0.2778
Gcal	4.1868 x 10^{-3}	1	10^{-7}	3.968	1.163 x 10^{-3}
Mtoe	4.1868 x 10^{4}	10^{7}	1	3.968 x 10^{7}	11,630
Mbtu	1.0551 x 10^{-3}	0.252	2.52 X 10^{-8}	1	2.931 x 10^{-4}
Gwh	3.6	860	8.6 x 10^{-5}	3412	1

Table B.5
Distance and Velocity Conversions

1 in.	= 83.33 x 10” ft	1 ft	= 12.0 in.
	= 27.78 x 10” yd		= 0.33 yd
	= 15.78 x 10^{-6} mile		= 189.4 x 10^{-3} mile
	= 25.40 x 10^{-3} m		= 0.3048 m
	= 0.2540 x 10^{-6} km		= 0.3048 x 10” km
1 mile	= 63360 in.	1 km	= 39370 in.
	= 5280 ft		= 3281 ft
	= 1760 yd		= 1093.6 yd
	= 1609 m		= 0.6214 mile
	= 1.609 km		= 1000 m

1 ft/sec = 0.3048 m/s = 0.6818 mph = 1.0972 km/h
1 m/sec = 3.281 ft/s = 2.237 mph = 3.600 km/h
1 km/h = 0.9114 ft/s = 0.2778 m/s = 0.6214 mph
1 mph = 1.467 ft/s = 0.4469 m/s = 1.609 km/h

Table B.6
Alternative Measures of Greenhouse Gases

1 pound methane, measured in carbon units (CH_4)	=	1.333 pounds methane, measured at full molecular weight (CH_4)
1 pound carbon dioxide, measured in carbon units (CO,-C)	=	3.6667 pounds carbon dioxide, measured at full molecular weight (CO,)
1 pound carbon monoxide, measured in carbon units (CO-C)	=	2.333 pounds carbon monoxide, measured at full molecular weight (CO)
1 pound nitrous oxide, measured in nitrogen units (N_2O-N)	=	1.571 pounds nitrous oxide, measured at full molecular weight (N_2O)

Table B.7
Volume and Flow Rate Conversions”

1 U.S. gal	= 231 in.^{3}	1 liter	= 61.02 in.^{3}
	= 0.1337 ft^3		= 3.531 x 10^{-2} ft^3
	= 3.785 liters		= 0.2624 U.S. gal
	= 0.8321 imperial gal		= 0.2200 imperial gal
	= 0.0238 bbl		= 6.29 x 10” 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		= 33 157 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
	= 0.15 10 bbl/day		= 55.10 bbl/year
1 bbl/hr	= 137.8 ft^3/year		= 49 187 ft^3 year
	= 1008 U.S. gal/day		= 3.679 x 10^5 U.S. gal/year
	= 839.3 imperial gal/day		= 3.063 x 10^5 imperial gal/year
	= 3 8 15 liter/day		= 1.393 x 10^6 liter/day

“The conversions for flow rates are identical to those for volume measures, if the time units are identical.

Table B.8
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 x 10”	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.9
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 x 10”	9.8425×10^{-4}	1.0 x 10”
Short ton	2000	907.2	1	0.8929	0.9072
Long ton	2240	1016	1.12	1	1.016
Metric ton	2205	1000	1.102	0.9842	1

Table B.10
Fuel Efficiency Conversions”

MPG	Miles/liter	Kilometers/L	L/l 00 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	59.5 1	1.68
145	38.30	61.64	1.62
150	39.62	63.76	1.57

“To convert fuel efficiency from miles per gallon (mpg) to liters per hundred kilometers, divide mpg into 235.24.

Table B.11
SI Prefixes and Their Values

	Value	Prefix	Symbol
One million million millionth	10^{-18}	atto	a
One thousand million millionth	10^{-15}	femto	f
One million millionth	10^{-12}	pico	p
One thousand millionth	10^{-9}	nano	n
One millionth	10^{-6}	micro	µ
One thousandth	10^{-3}	milli	m
One hundredth	10^{-2}	centi	c
One tenth	10^{-1}	deci	
One	10^{0}		
Ten	10’	deca	
One hundred	10^{2}	hecto	
One thousand	10^{3}	kilo	k
One million	10^{6}	mega	M
One billion”	10^{9}	giga	G
One trillion”	10^{12}	tera	T
One quadrillion”	10^{15}	peta	P
One quintillion”	10^{18}	exa	E

“Care should be exercised in the use of this nomenclature, especially in foreign correspondence, as it is either unknown or carries a different value in other countries. A “billion,” for example, signifies a value of 10^{12} in most other countries.

Table B.12
Metric Units and Abbreviations

Quantity	Unit name	Symbol
Energy	joule	J
Specific energy	joule/kilogram	J/kg
Specific energy consumption	joule/kilogram•kilometer	J/(kg•km)
Energy consumption	joule/kilometer	J/km
Energy economy	kilometer/kilojoule	km/kJ
Power	kilowatt	Kw
Specific power	watt/kilogram	W/kg
Power density	watt/meter^3	W/m^3
Speed	kilometer/hour	km/h
Acceleration	meter/second*	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/l 00 km

Conversion of Constant Dollar Values

Many types of information in this data book are expressed in dollars.. Generally, constant dollars are used--that is, dollars of a fixed value for a specific year, such as 1990 dollars. Converting current dollars to constant dollars, or converting constant dollars for one year to constant dollars for another year, requires conversion factors (Table B. 13 and B. 14). Table B. 13 shows conversion factors for the Consumer Price Index inflation factors. Table B. 14 shows conversion factors using the Gross National Product inflation factors.

Due to the size of the tables, the data in Tables B. 13 and B. 14 were changed to two decimal places starting with Edition 17. However, three decimal places were used to calculate all constant dollar values.

Table B.13
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	1998	1999
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	4.20	4.29
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	4.03	4.11
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	3.90	3.98
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	3.67	3.75
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	3.31	3.38
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	3.03	3.10
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	2.86	2.93
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	2.69	2.75
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	2.50	2.55
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	2.25	2.30
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	1.98	2.02
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	1.79	1.83
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	1.69	1.73
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	1.64	1.67
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	1.57	1.60
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	1.52	1.55
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	1.49	1.52
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	1.43	1.47
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	1.38	1.41
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	1.32	1.34
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	1.25	1.27
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	1.20	1.22
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	1.16	1.19
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	1.13	1.15
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	1.10	1.12
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	1.07	1.09
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	1.04	1.06
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	1.02	1.04
1998	0.24	0.25	0.26	0.27	0.30	0.33	0.35	0.37	0.40	0.45	0.51	0.56	0.59	0.61	0.64	0.66	0.67	0.70	0.73	0.76	0.80	0.84	0.86	0.89	0.91	0.94	0.96	0.98	1.00	1.02
1999	0.23	0.24	0.25	0.27	0.30	0.32	0.34	0.36	0.39	0.44	0.49	0.55	0.58	0.60	0.62	0.65	0.66	0.68	0.71	0.74	0.78	0.82	0.84	0.87	0.89	0.92	0.94	0.96	0.98	1.00

Source:

Personal contact with the Bureau of Labor Statistics.

Table B.14
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	1998	1999
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	3.64	3.71
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	3.46	3.53
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	3.32	3.39
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	3.14	3.20
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	2.89	2.95
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	2.64	2.69
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	2.51	2.56
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	2.37	2.42
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	2.21	2.25
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	2.03	2.07
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	1.86	1.90
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	1.70	1.74
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	1.60	1.64
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	1.54	1.57
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	1.48	1.51
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	1.44	1.47
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	1.40	1.43
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	1.36	1.39
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	1.32	1.34
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	1.27	1.29
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	1.22	1.24
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	1.17	1.19
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	1.13	1.15
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	1.10	1.13
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	1.08	1.10
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	1.05	1.07
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	1.03	1.05
1997	0.26	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	1.00	1.02
1998	0.27	0.29	0.30	0.32	0.35	0.38	0.40	0.42	0.45	0.49	0.54	0.59	0.62	0.65	0.68	0.70	0.71	0.73	0.76	0.79	0.82	0.86	0.89	0.91	0.92	0.95	0.97	1.00	1.00	1.02
1999	0.27	0.28	0.30	0.31	0.34	0.37	0.39	0.41	0.44	0.48	0.53	0.58	0.61	0.64	0.66	0.68	0.70	0.72	0.74	0.77	0.80	0.84	0.87	0.89	0.91	0.94	0.96	0.98	0.98	1.00

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.l
Census Divisions and Regions

Division	Region	States
Northeast Division	Mid-Atlantic region	New Jersey, New York, Pennsylvania
Northeast Division	New England region	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
South Division	West South Central region	Arkansas, Louisiana, Oklahoma, Texas
South Division	East South Central region	Alabama, Kentucky, Mississippi, Tennessee
South Division	South Atlantic region	Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, Washington, DC, West Virginia
West Division	Pacific region	Alaska, California, Hawaii, Oregon, Washington
West Division	Mountain region	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming
Midwest Division	West North Central region	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
Midwest Division	East North Central region	Illinois, Indiana, Michigan, Ohio, Wisconsin

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.*

Anthropogenic - Human made. Usually used in the context of emissions that are produced as the result of human activities.

Automobile size classifications - Size classifications of automobiles are established by the Environmental Protection Agency (EPA) as follows:

Minicompact - less than 85 cubic feet of passenger and luggage volume.
Subcompact - between 85 to 100 cubic feet of passenger and luggage volume.
Compact - between 100 to 110 cubic feet of passenger and luggage volume.
Midsize - between 110 to 120 cubic feet of passenger and luggage volume.
Large - more than 120 cubic feet of passenger and luggage volume.
Two seater - automobiles designed primarily to seat only two adults.

Station wagons are included with the size class for the sedan of the same name.

Aviation - *See General aviation.*

Aviation gasoline - All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) Specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range which will be used for blending or compounding into aviation gasoline.

Barges - Shallow, nonself-propelled vessels used to carry bulk commodities on the rivers and the Great Lakes.

Battery efficiency - Measured in percentage. Net DC energy delivered on discharge, as a percentage of the total DC energy required to restore the initial state-of-charge. The efficiency value must include energy losses resulting from self-discharge, cell equalization, thermal loss compensation, and all battery-specific auxiliary equipment.

Btu - 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,) - 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 classzjications.*

Model year - In this publication, model year is referring to the "sales" model year, the period from October 1 to the next September 3 1.

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,) - 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.

TITLE INDEX

INTERNAL DISTRIBUTION

1. V. D. Baxter
2. T. J. Blasing
3. R. Boundy
4. J. E. Christian
5. G. E. Courville
6. T. R. Curlee
7. S. Das
8. S . C. Davis
9. D. L. Greene
10. E. T. Grostick
11. L. D. Han
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13. R. B. Honea
14. P. S. Hu
15. C. R. Hudson
16. P. J. Hughes
17. D. W. Jones
18. P. N. Leiby
19. G. Marland
20. L. N. McCold
21. C. I. Moser
22. W. N. Naegeli
23. R. D. Perlack
24. B. E. Peterson
25. C. G. Rizy
26. A. C. Schaffhauser
27. R. B. Shelton
28. S. Singh
29. J. E. Sorensen
30. F. Southworth
31. J. W. Terry
32. L. F. Truett
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EXTERNAL DISTRIBUTION

39. L. A. Abron, President, PEER Consultants, P.C., 1460 Gulf Blvd., 11th Floor, Clearwater, Florida 34630

40. S. L. Cutter, Director, Hazards Research Lab, Department of Geography, University of South Carolina, Columbia, South Carolina 29208

41. S. G. Hildebrand, Director, Environmental Sciences Division, Oak Ridge National Laboratory, Post Office Box 2008, Oak Ridge, Tennessee 3783 l-6037

42. P. R. Rittelmann, FAIA, Executive Vice President, Burt Hill Kosar Rittelmann Associates, 400 Morgan Center, Butler, Pennsylvania 1600 1-5977

43. S. F. Tierney, The Economic Resource Group, Inc., One Mifflin Place, Cambridge, Massachusetts 02 13 8

44. C. M. Walton, Ernest H. Cockrell Centennial Chair in Engineering and Chairman, Department of Civil Engineering, University of Texas at Austin,E Cockrell, Jr. Hall I, Suite 4210, Austin, Texas 78712-1075

45-1200. Center for Transportation Analysis, Energy Division, Building 3 156, Room 102.