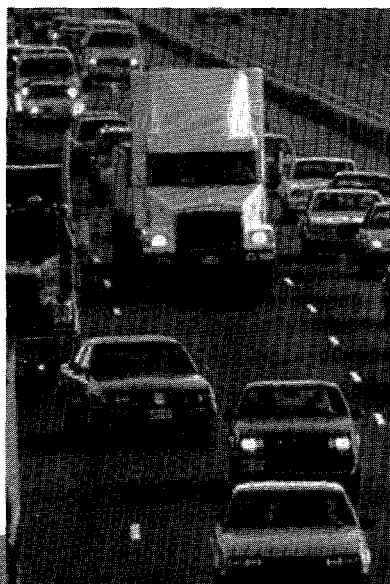


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Stacy C. Davis

Center for Transportation Analysis

Oak Ridge National Laboratory

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EDITION 18**

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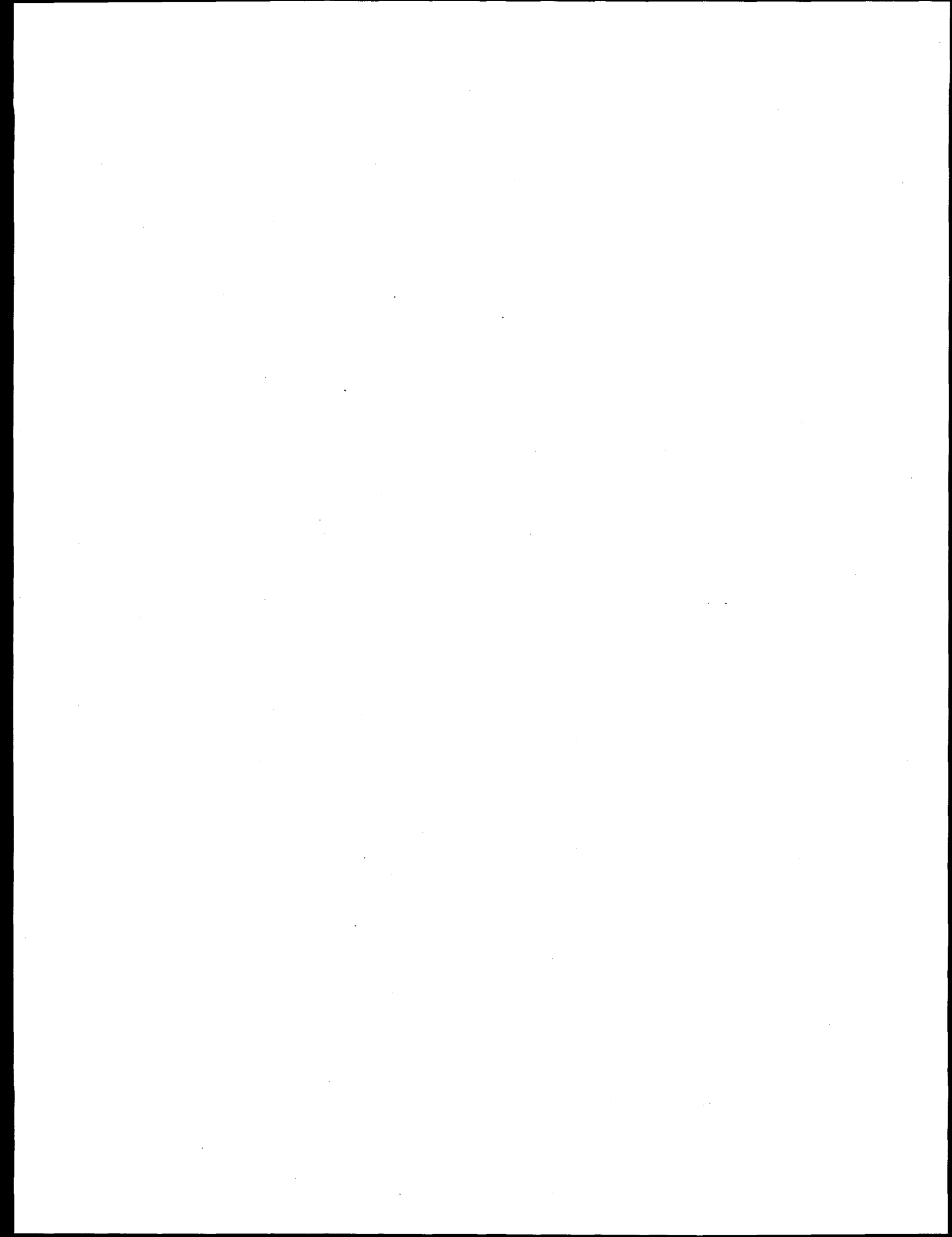
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FOREWORD

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

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

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

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

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

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

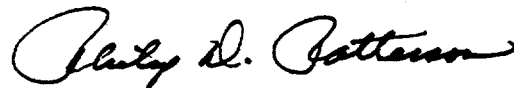
The characteristics of light vehicles (autos and light trucks) are presented in Chapter 6. More detail is provided on vehicle sales, fuel economy, engine size, curb weight, and interior volume. Data is also provided for vehicle occupancy, fuel economy standards, and the test cycles used for emission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

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

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

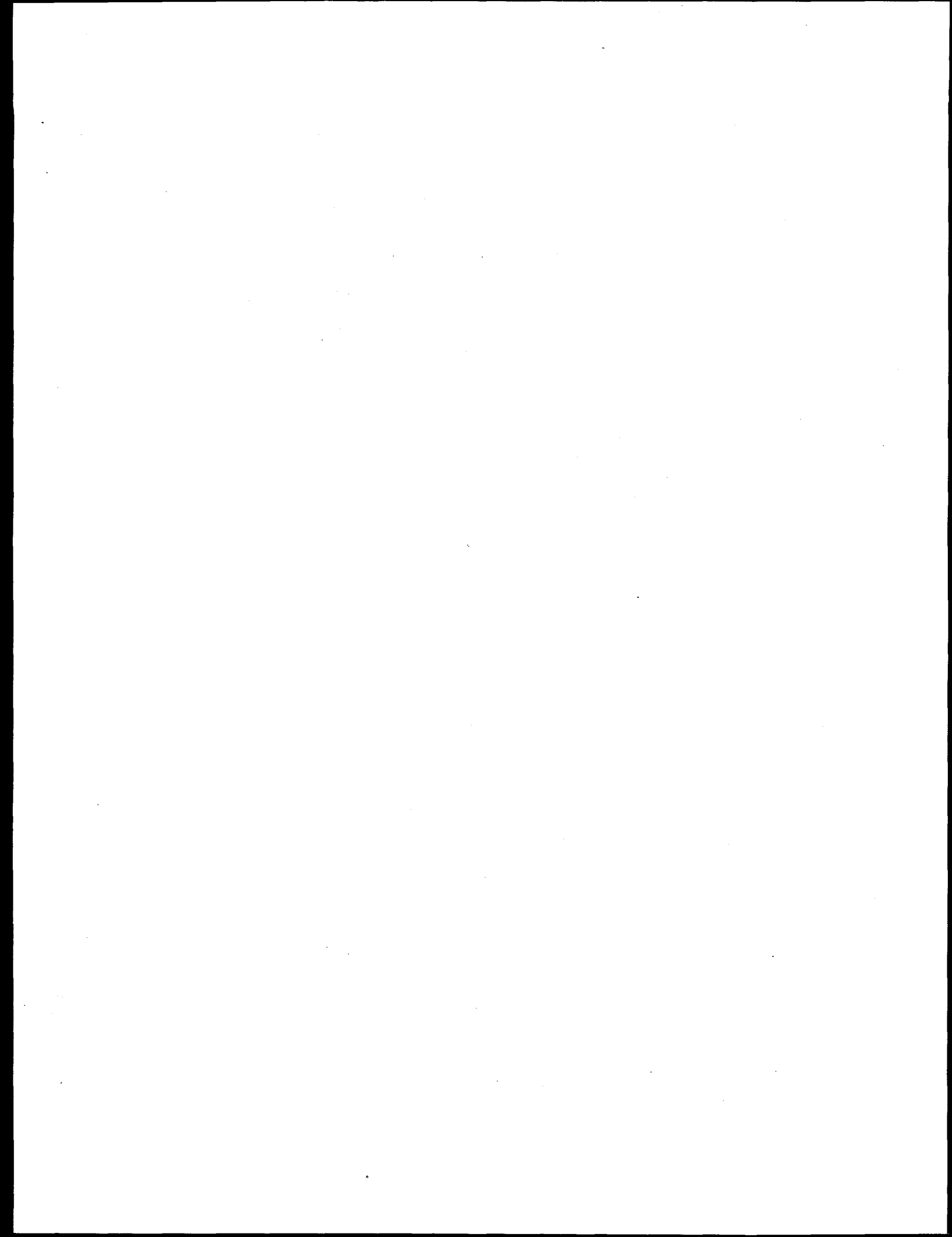
Chapter 11 contains information on activity levels and energy use by aircraft, ships, railroads, and rail transit. Appendix A provides the documentation used by ORNL Appendix B contains conversion tables. The data book concludes with a glossary and an index.

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



ACKNOWLEDGMENTS

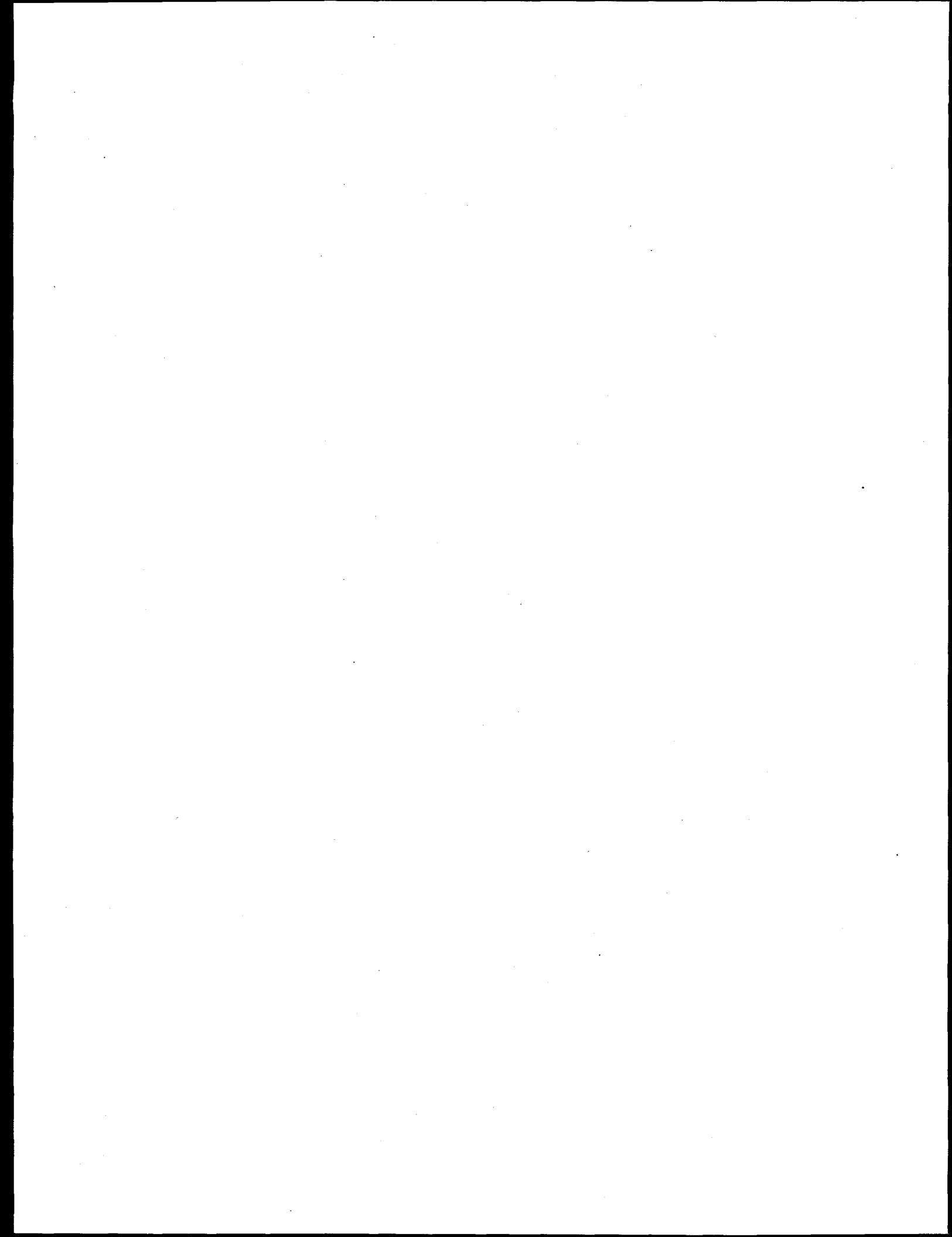
I would like to express my gratitude to the many individuals who assisted in the preparation of this document. First, I would like to thank Phil Patterson and the staff of the Office of Transportation Technologies for their continued support of the *Transportation Energy Data Book* project. I would also like to thank Patricia Hu of Oak Ridge National Laboratory (ORNL) for her dedicated leadership of this project. This document benefits from the criticism and careful review of Phil Patterson of the U.S. Department of Energy, David Greene of ORNL, and John Maples of the University of Tennessee (UT). I would also like to thank Bob Boundy, UT, who assisted with the icons for each chapter; Jamie Payne, ORNL, who designed the new cover of the book; and Sherry Campbell Gambrell, ORNL, who prepared the title index. Finally, this book would not have been possible without the dedication of Debbie Bain who masterfully prepared the manuscript.



ABSTRACT

The *Transportation Energy Data Book: Edition 18* is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Transportation Technologies in the Department of Energy (DOE). Designed for use as a desk-top reference, the data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use. The purpose of this document is to present relevant statistical data in the form of tables and graphs.

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



INTRODUCTION

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

Policymakers and analysts need to be well-informed about activity in the transportation sector. The organization and scope of the data book reflect the need for different kinds of information. For this reason, Edition 18 updates much of the same type of data that is found in previous editions.

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

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

Chapter 1

Petroleum

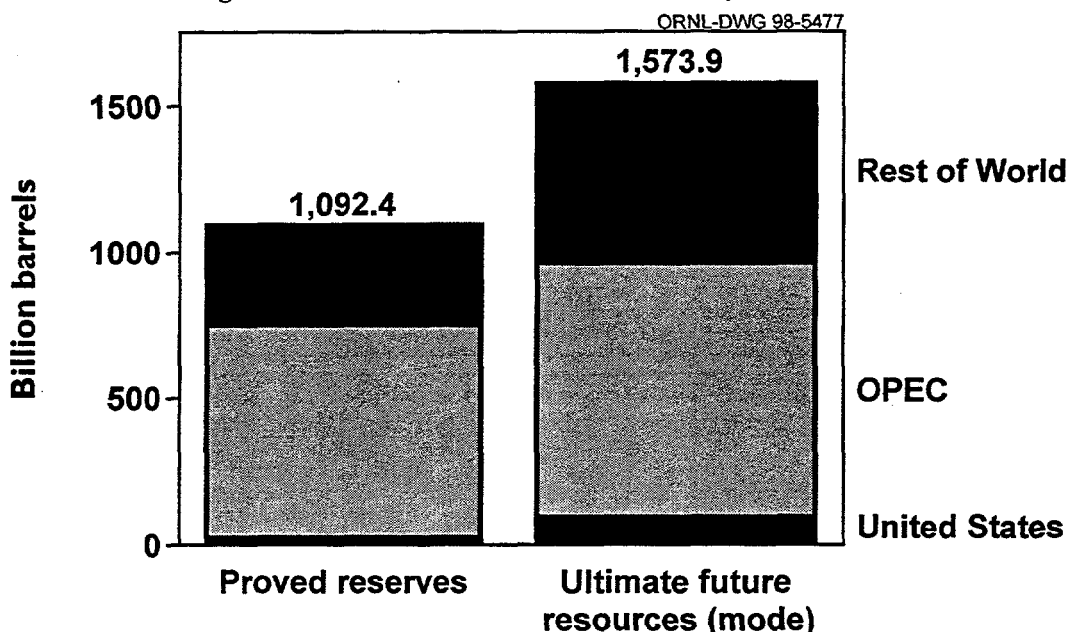
Summary Statistics

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



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

Figure 1.1. World Oil Resource Estimates, 1993



Source:

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

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

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

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

Source:

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



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

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

Source:

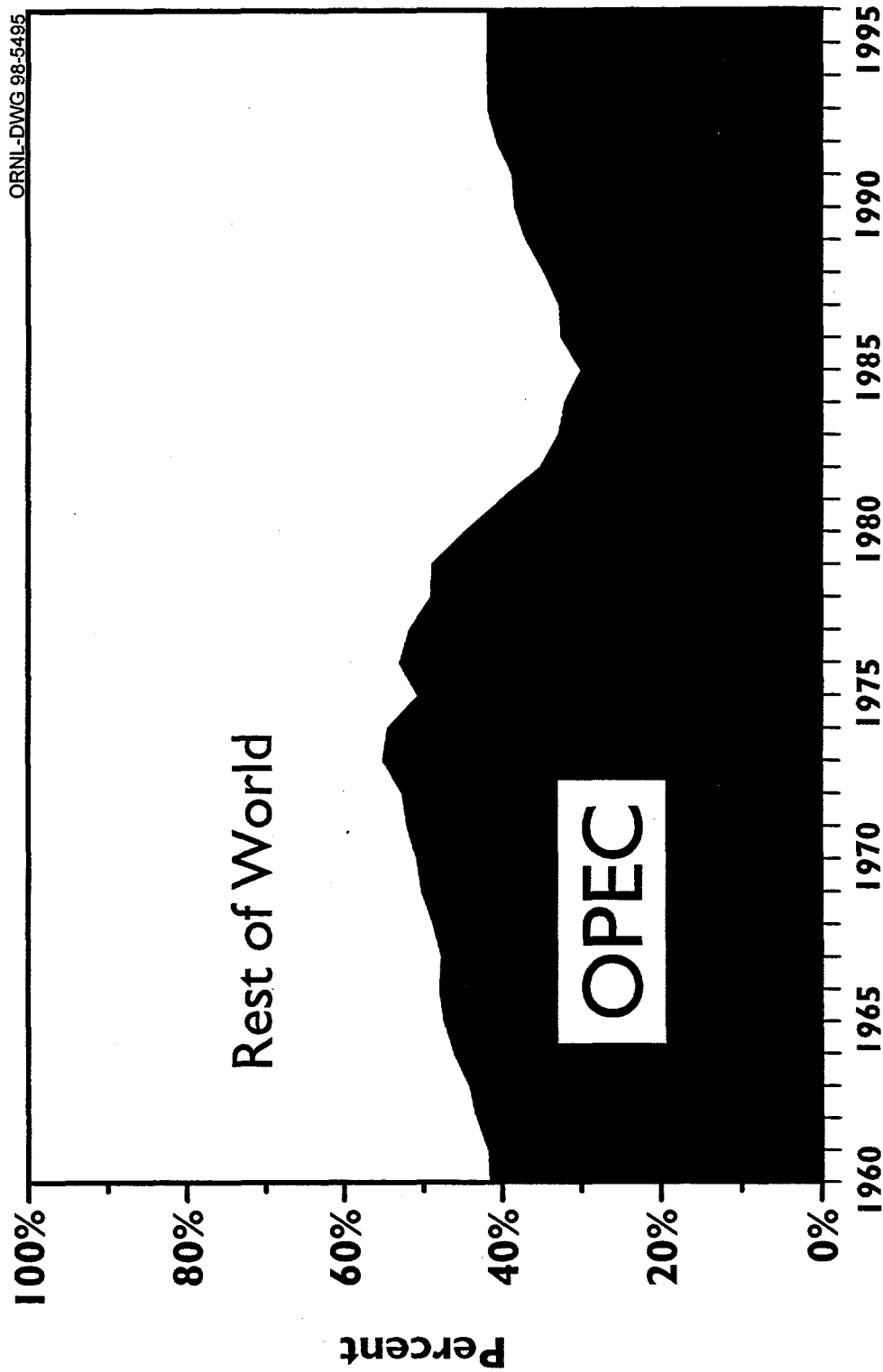
U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 1996*,
 Washington, DC, July 1997, pp. 299-301.

^aOrganization of Petroleum Exporting Countries. See Glossary for membership.

^bSee Glossary for Persian Gulf nations.



Figure 1.2. OPEC Market Share, 1960-96



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



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

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

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

Source:

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

^a Organization for Economic Cooperation and Development. See Glossary for membership.



Table 1.4
Petroleum Stocks in OECD Countries, End of Year 1973-96^a
(million barrels)

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

Source:

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

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

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

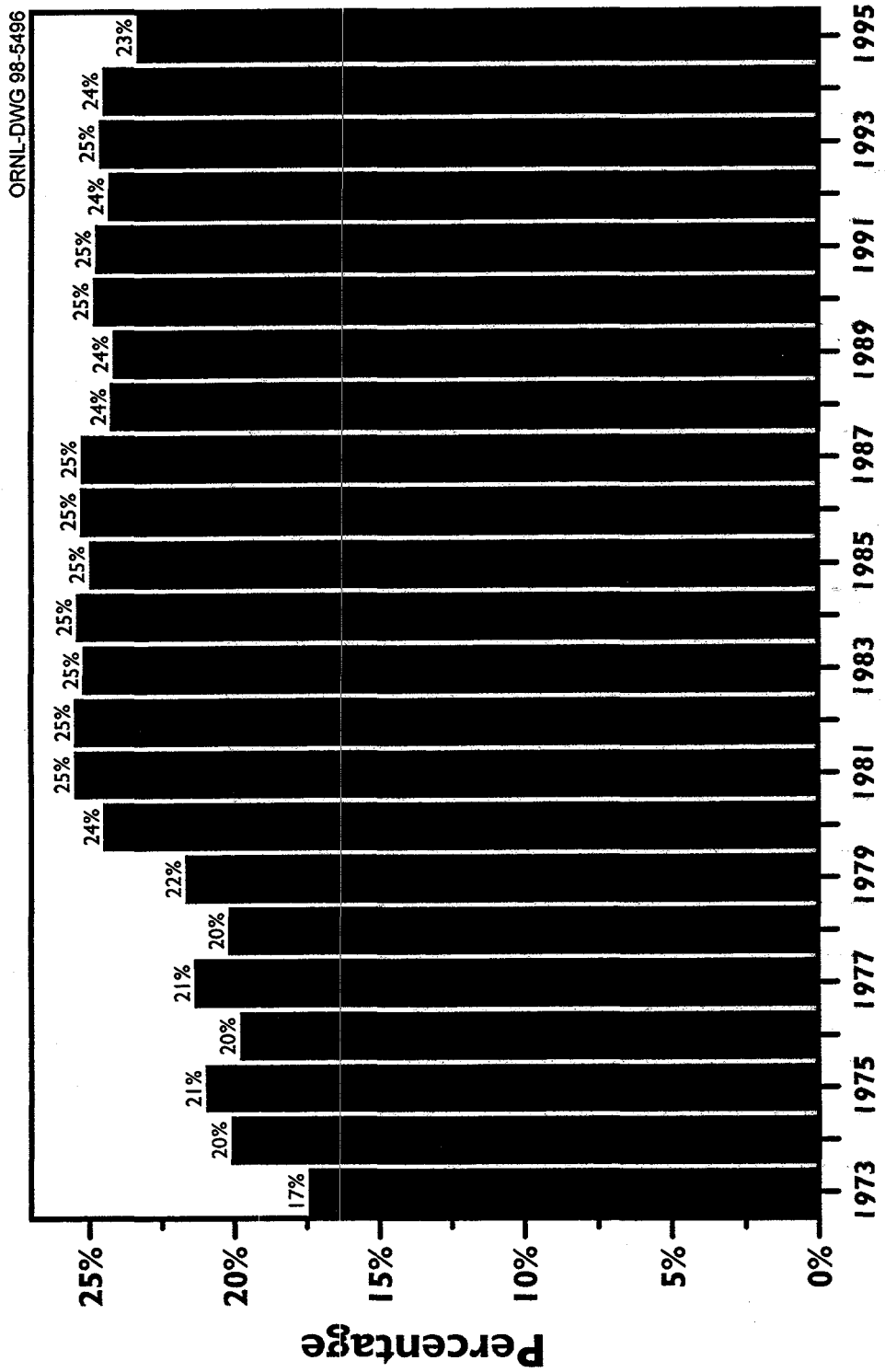
^c Organization for Economic Cooperation and Development (OECD). See Glossary for membership.

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

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

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

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

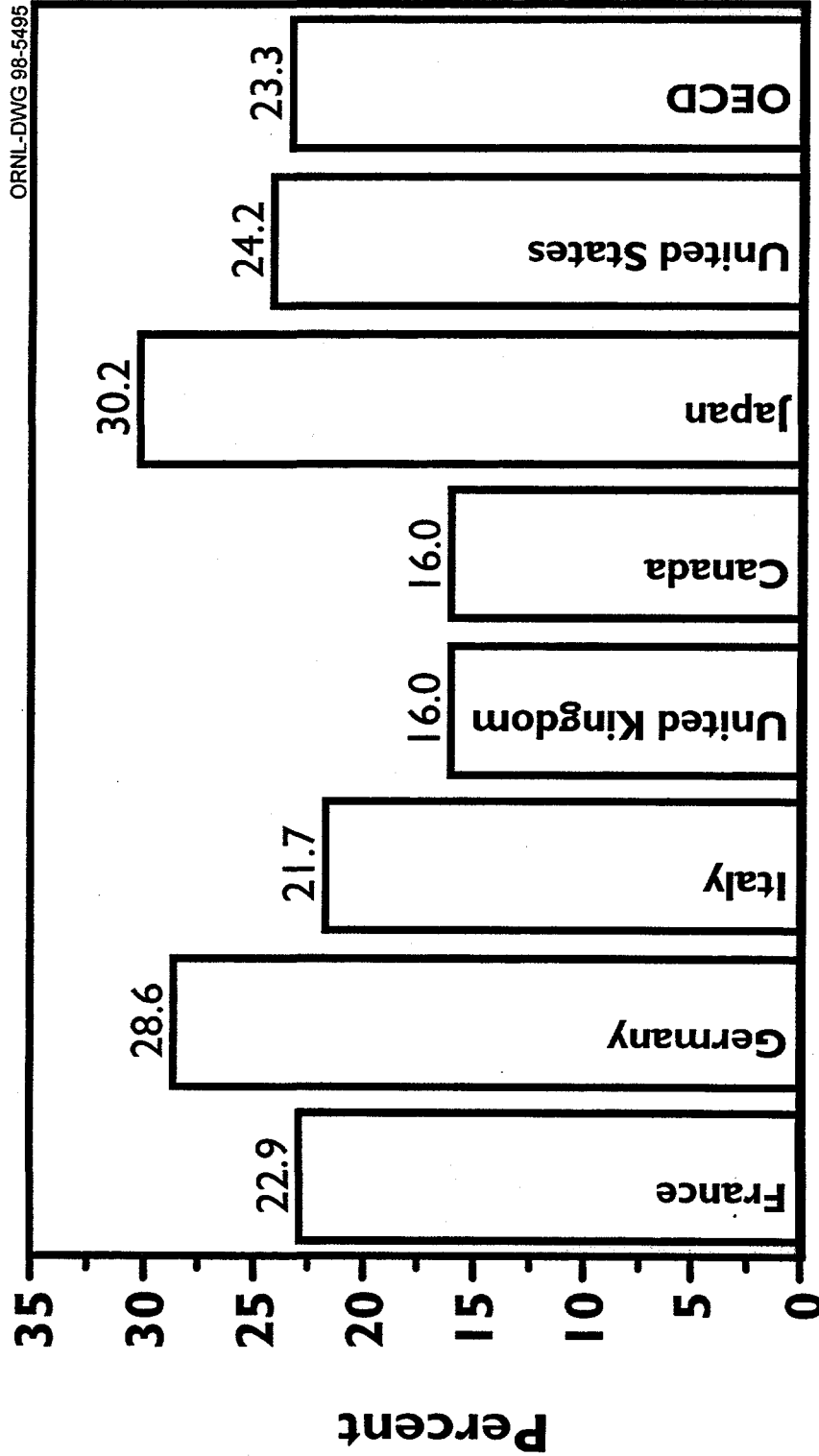


Source: See Tables 1.3 and 1.4.



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

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

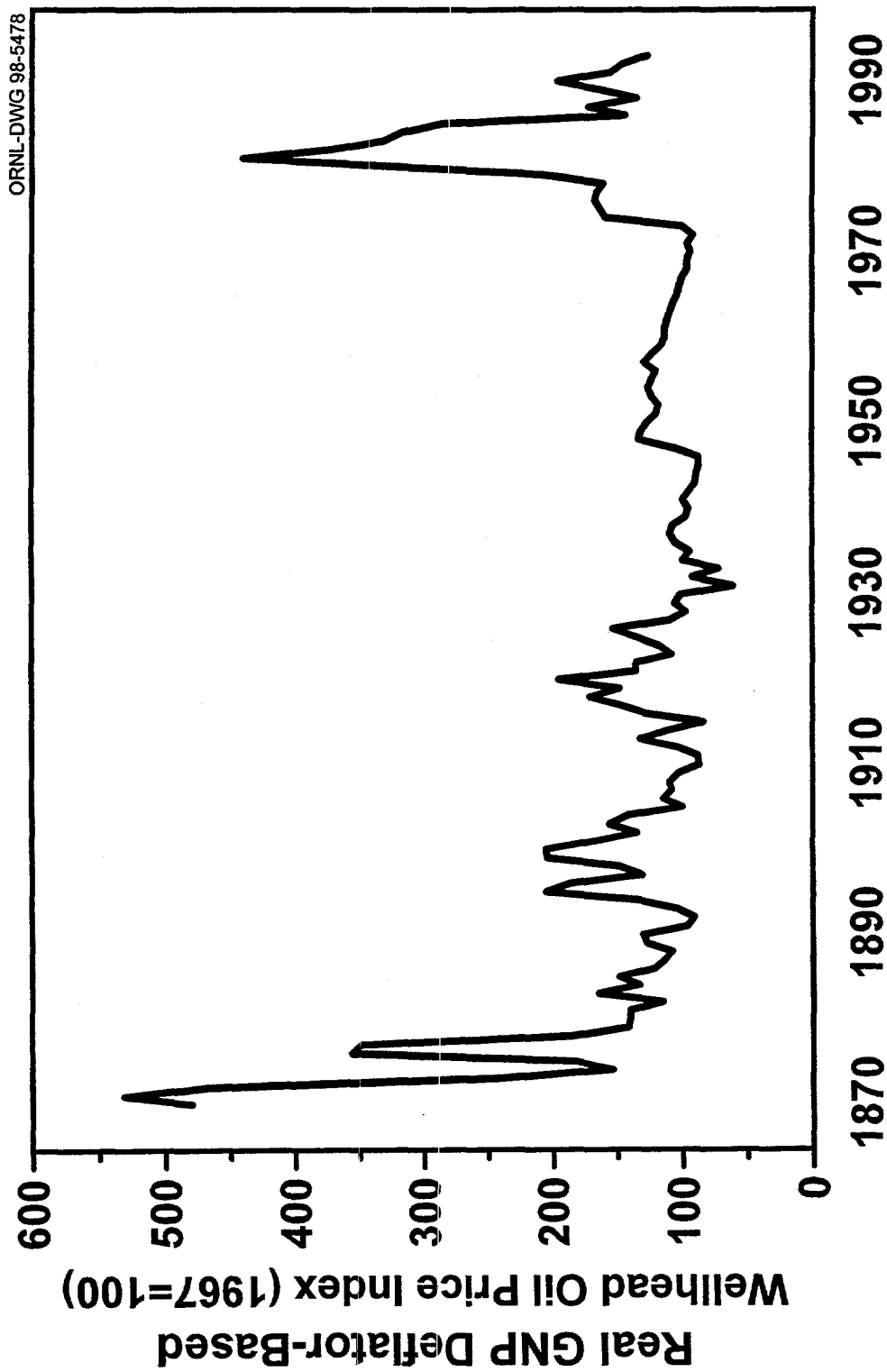


ORNL-DWG 98-5495

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



Figure 1.5. Crude Oil Prices, 1870-93



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



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

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

Source:

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

^a Organization of Petroleum Exporting Countries. See Glossary for membership.

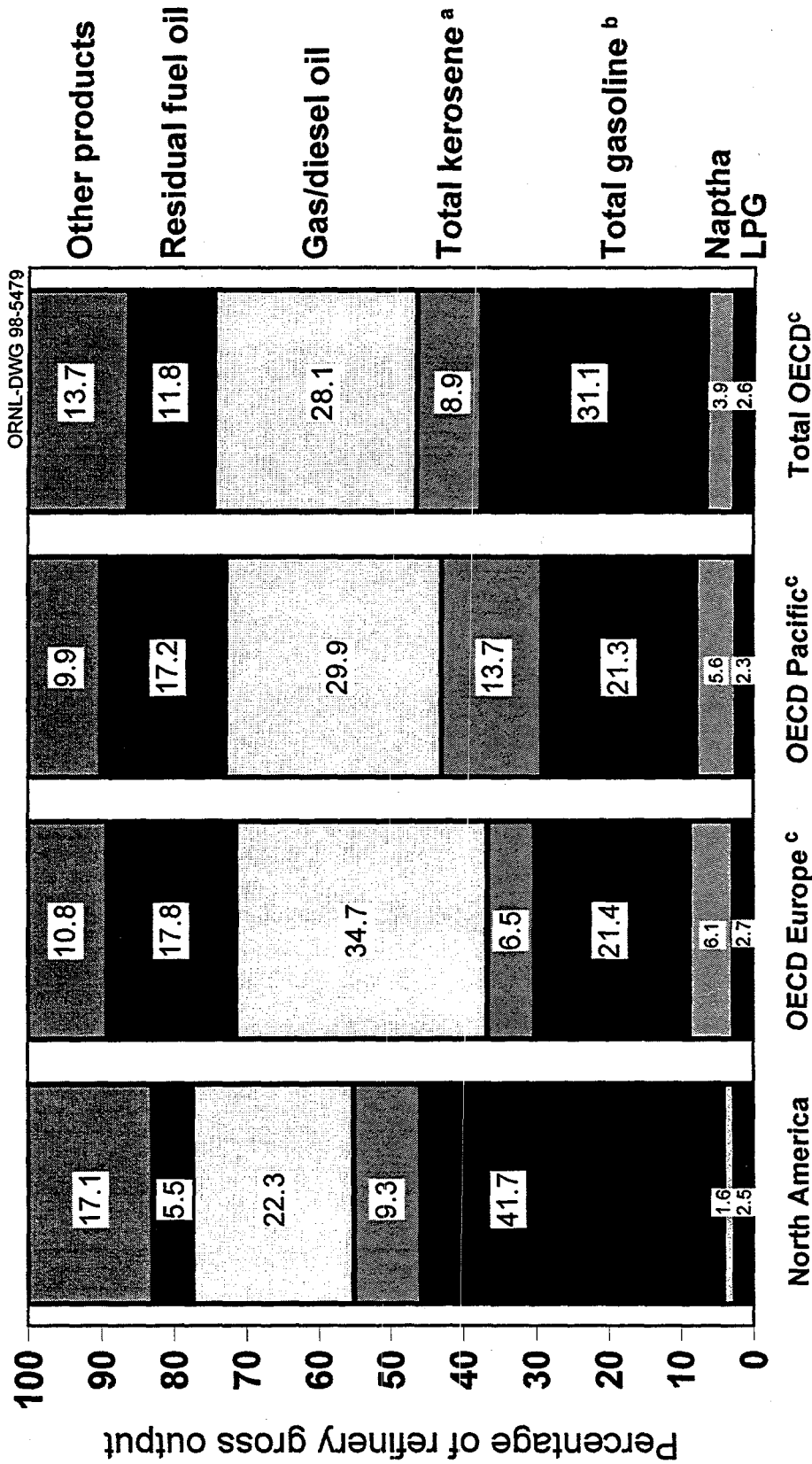
^b See Glossary for Persian Gulf nations.

^c See Table 1.7 for U.S. petroleum consumption.

^d Data are not available.



Figure 1.6. Refinery Gross Output by World Region, 1997



Source:

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

^a Includes jet kerosene and other kerosene.

^b Includes motor gasoline, jet gasoline, and aviation gasoline.

^c Organization for Economic Cooperation and Development. See Glossary for membership.



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

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

Year	Oxygenates							Total input to refineries	
	Crude oil	Natural gas liquids	Fuel ethanol	Methanol	MTBE ^a	Other oxygenates ^b	Other hydrocarbons ^c		Other liquids
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
1987-97	1.3%	-6.0%	e	e	e	e	-0.1%	-2.1%	1.3%
1993-97	1.9%	-4.1%	37.0%	-10.8%	15.0%	36.4%	10.3%	-9.4%	1.4%
Average annual percentage change									

Source:

U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual, 1997*, Vol. 1, June 1998, Table 16, p. 49, and annual. (Additional resources: <http://www.eia.doe.gov>)

^aMethyl tertiary butyl ether (MTBE).

^bIncludes 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.

^cFor 1987-92, includes other hydrocarbons/hydrogen/oxygenates. For 1993-on, includes other hydrocarbons/hydrogen.

^dReported in "Other hydrocarbons" category in this year.

^eData are not available.

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

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

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

Source:

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

^a Includes aviation gasoline, kerosene, naphtha and other oils for petrochemical feedstock use, special naphthas, lubricants, waxes, petroleum coke, asphalt and road oil, still gas, and miscellaneous products.

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



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

Year	Domestic crude oil production		Net imports		Exports		U.S. petroleum consumption ^a	World petroleum consumption	Net imports as a percentage of U.S. petroleum consumption	U.S. petroleum consumption as a percentage of world consumption	Transportation petroleum use as a percentage of domestic production ^b
	Crude oil	Petroleum products	Crude oil	Petroleum products	Crude oil	Petroleum products					
1973	9.21	3.24	2.78	6.03	0.00	0.23	17.31	56.39	34.8%	30.7%	98.3%
1974	8.77	3.47	2.42	5.89	0.00	0.22	16.65	55.91	35.4%	29.8%	100.8%
1975	8.37	4.10	1.75	5.85	0.00	0.20	16.32	55.48	35.8%	29.4%	106.9%
1976	8.13	5.28	1.81	7.09	0.00	0.22	17.46	58.74	40.6%	29.7%	115.6%
1977	8.25	6.57	2.00	8.57	0.05	0.19	18.43	61.63	46.5%	29.9%	118.3%
1978	8.71	6.20	1.80	8.00	0.16	0.20	18.85	63.30	42.5%	29.8%	116.6%
1979	8.55	6.28	1.70	7.99	0.24	0.24	18.51	63.17	43.1%	28.4%	117.1%
1980	8.60	4.98	1.39	6.37	0.29	0.26	17.06	63.07	37.3%	27.0%	111.3%
1981	8.57	4.17	1.23	5.40	0.23	0.37	16.06	60.87	33.6%	26.4%	110.7%
1982	8.65	3.25	1.05	4.30	0.24	0.58	15.30	59.50	28.1%	25.7%	107.6%
1983	8.69	3.17	1.15	4.31	0.16	0.58	15.23	58.74	28.3%	25.9%	108.2%
1984	8.88	3.25	1.47	4.72	0.18	0.54	15.73	59.84	30.0%	26.3%	109.4%
1985	8.97	3.00	1.29	4.29	0.20	0.58	15.73	60.10	27.3%	26.2%	109.8%
1986	8.68	4.02	1.41	5.44	0.15	0.63	16.28	61.76	33.4%	26.4%	117.9%
1987	8.35	4.52	1.39	5.91	0.15	0.61	16.67	63.00	35.5%	26.5%	126.1%
1988	8.14	4.95	1.63	6.59	0.16	0.66	17.28	64.82	38.1%	26.7%	134.0%
1989	7.61	5.70	1.50	7.20	0.14	0.72	17.33	65.92	41.6%	26.3%	144.7%
1990	7.36	4.79	1.38	7.16	0.11	0.75	16.99	65.99	42.2%	25.7%	149.1%
1991	7.42	5.67	0.96	6.63	0.12	0.89	16.71	66.58	39.6%	25.1%	145.6%
1992	7.17	5.99	0.94	6.94	0.09	0.86	17.03	66.74	40.7%	25.5%	153.1%
1993	6.85	6.69	0.93	7.62	0.10	0.90	17.24	67.04	44.2%	25.7%	163.3%
1994	6.66	6.96	1.09	8.05	0.10	0.84	17.72	68.31	45.5%	25.9%	172.5%
1995	6.56	7.14	0.75	7.89	0.10	0.86	17.73	69.93	44.5%	25.4%	178.8%
1996	6.47	7.40	1.10	8.50	0.11	0.87	18.30	71.52	46.2%	25.6%	185.8%
1997	6.41	7.89	1.02	8.90	0.11	0.90	18.58		47.9%		188.8%
1973-97	-1.5%	3.8%	-4.1%	1.6%	c				1.0% ^d		
1987-97	-2.6%	5.7%	-3.0%	4.2%	-3.1%	4.0%			1.4% ^d		

Source:

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

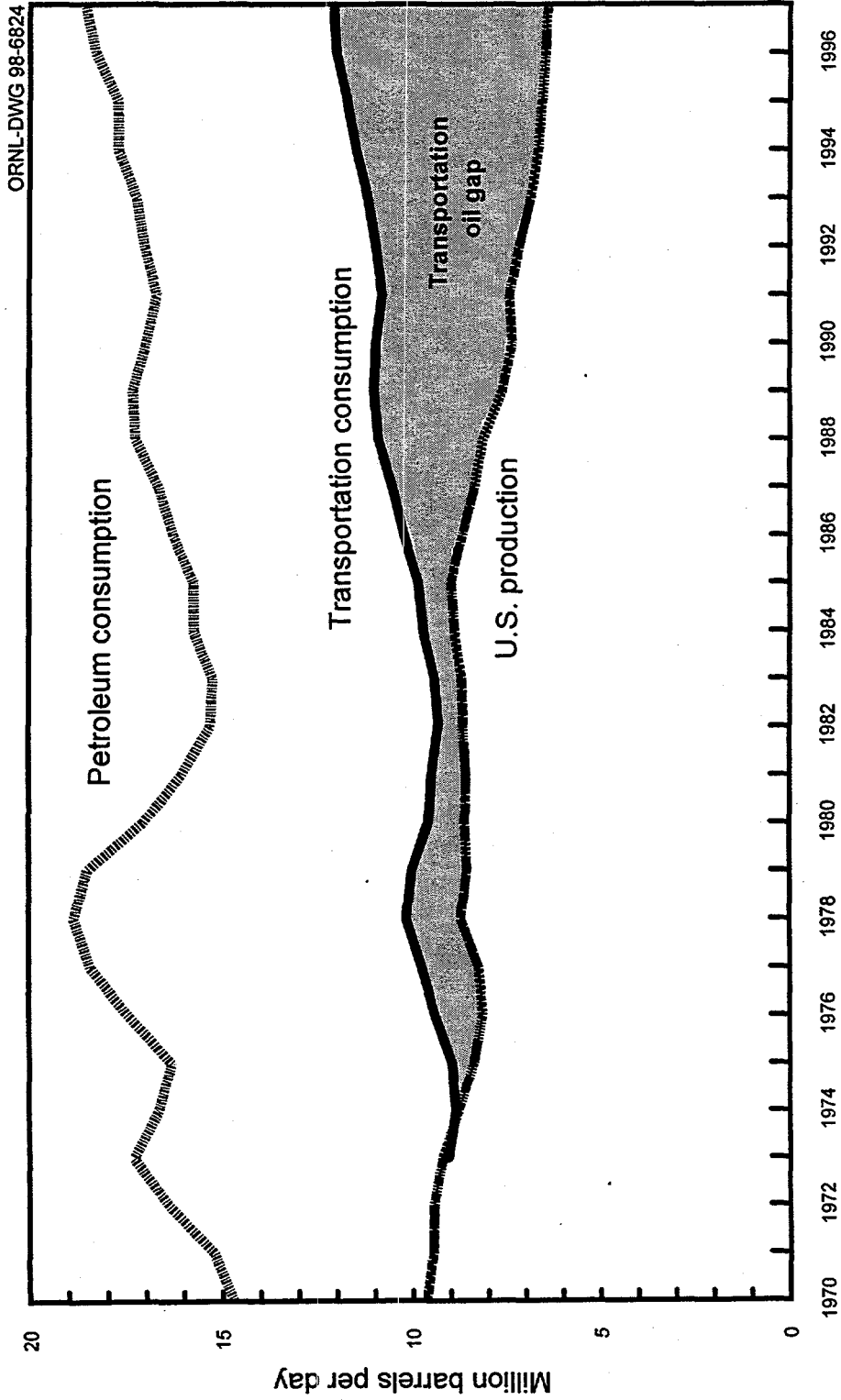
^a Best estimate for U.S. petroleum consumption is the amount of petroleum products supplied to the U.S. in a given year. This is not the sum of crude oil production and net imports due to processing gain and stock changes.

^b Transportation petroleum use can be found on Table 1.9.

^c Data are not available.

^d Average annual percentage change is to latest year possible.

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

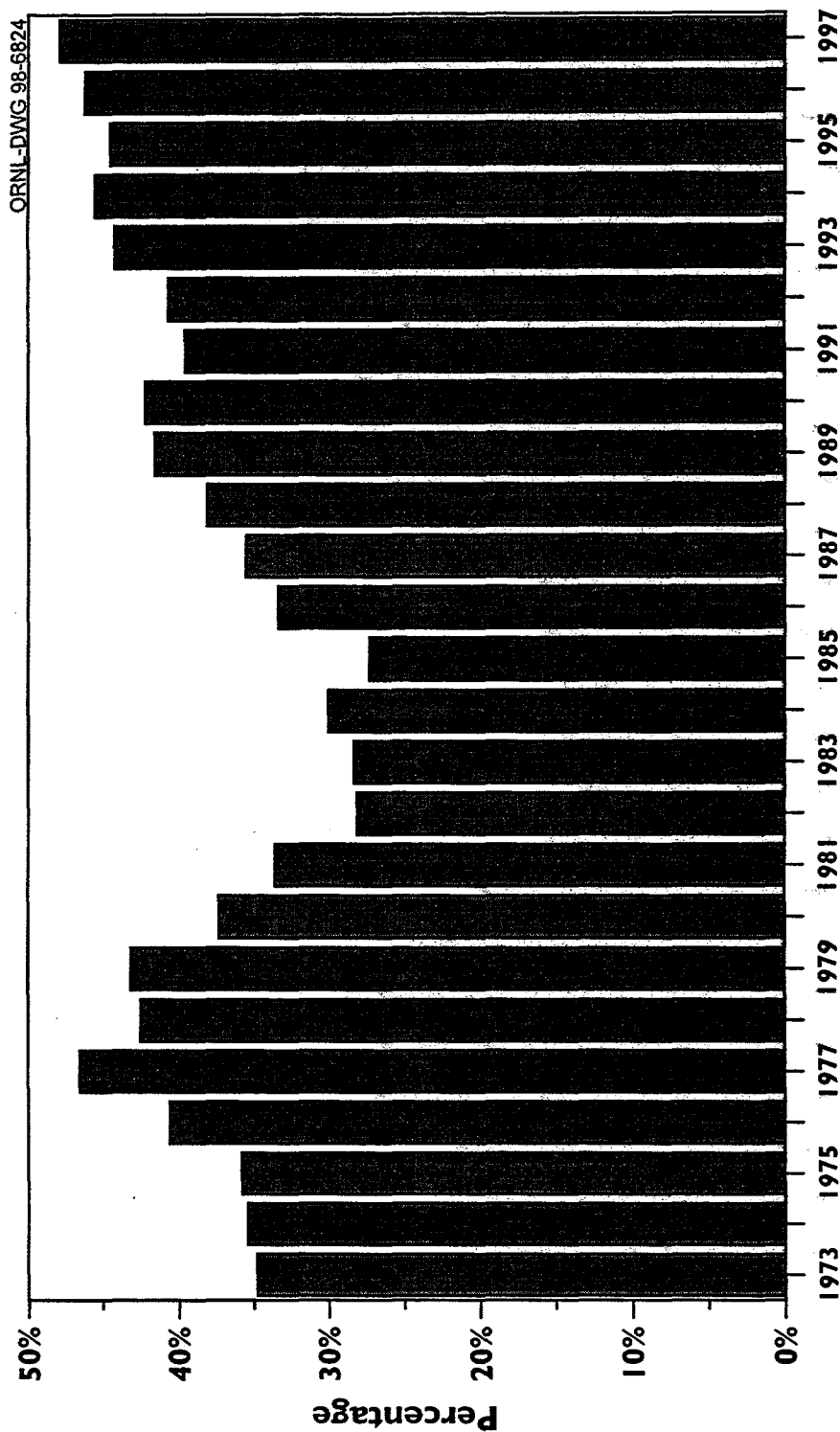


Source: See Tables 1.8 and 1.9.



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

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



Source: See Table 1.8.



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

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

Source:

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

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



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

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

Source:

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

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

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



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

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

Source:

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

^a Preliminary.

^b Data include the production of crude oil, natural gas plant liquids, refinery gain, and other liquid fuels.

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

^d Includes biofuels electric power generation for United States and Brazil.



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

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

Source:

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

^a Preliminary.

^b Organization for Economic Cooperation and Development (OECD). See Glossary for membership.

^c Includes the consumption of biofuels electric power for United States and Brazil.



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

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

Source:

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

^a Preliminary.

^b Organization for Economic Cooperation and Development (OECD). See Glossary for membership.

^c Electricity generation and distribution were not taken into account when converting kWhr to Btu.

^d Includes the consumption of biofuels electric power for United States and Brazil.



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

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

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

Source:

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

^aElectrical energy losses have been distributed among the sectors.



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

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

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

Source:

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

^a Includes supplemental gaseous fuels. Transportation sector includes pipeline fuel and natural gas vehicle use.

^b Includes electrical system energy losses.

^c Energy generated from geothermal, wood, waste, wind, photovoltaic, and solar thermal energy sources.



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

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

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

Source:

See Appendix A for Table 2.6

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

^b Includes gasohol.

^c Estimated using vehicle travel information.

^d Two-axle, four-tire trucks.

^e 1985 data.

^f Represents an estimate of energy purchased in the U.S. for international air carrier consumption.



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

Table 2.7
Transportation Energy Use by Mode, 1995-96^a

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

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

^aCivilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).

^bThousand barrels per day crude oil equivalents based average on the EIA weighted average of heat content of petroleum products used in transportation.

^cEstimated using vehicle travel information.

^dTwo-axle, four-tire trucks.



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

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

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

Source:

See Appendix A for Table 2.8.

^a Beginning in 1992 data became available on alternative fuel use by transit buses.

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



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

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

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

Source:

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

^a Estimated for 1980-92 as 10% of gasohol consumption.

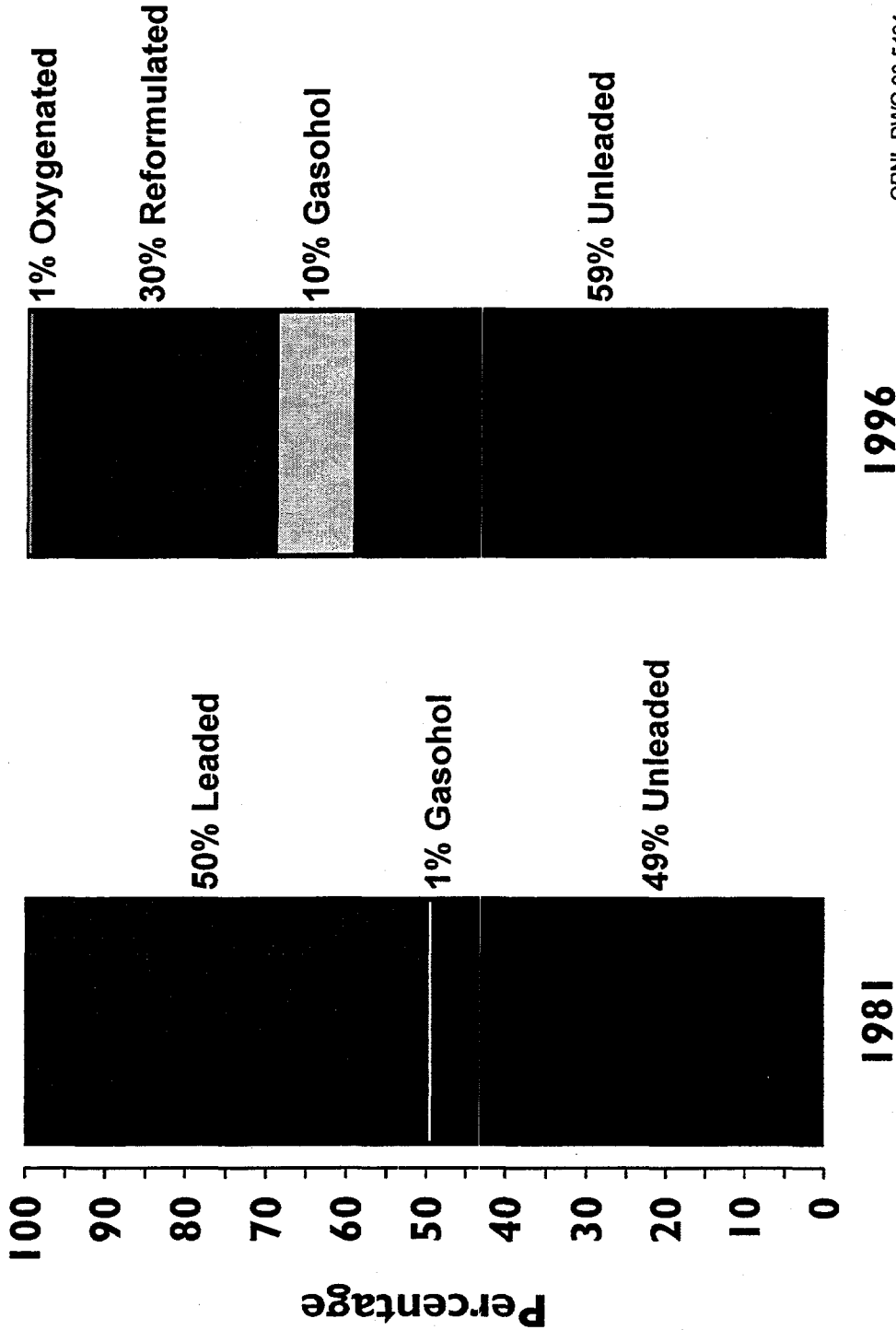
^b Special fuels consist primarily of diesel fuel, with small quantities of liquefied petroleum gas.

^c Data for gasoline and gasohol cannot be separated in this year.

^d Data are not available.



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



Source: ORNL-DWG 98-5494
 U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Annual 1996*, Washington, DC, Tables 17 and 20.
 U.S. Department of Energy, Energy Information Administration, *The Motor Gasoline Industry: Past, Present and Future*, Washington, DC, Table 5.
 U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, Tables MF-21 and MF-33E, and annual.



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

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

Source:

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

^aBased on plans or projections.

^bConsumption includes gasoline portion of the mixture.

^cMethyl Tertiary Butyl Ether. This category includes a very small amount of other ethers, primarily Tertiary Amyl Methyl Ether (TAME) and Ethyl Tertiary Butyl Ether (ETBE).



Table 2.11
U.S. Production of MTBE^a and Fuel Ethanol, 1978-97
(million gallons)

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

Source:

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

^aMethyl tertiary-butyl ether.

^bData are not available.



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

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

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

Source:

See Appendix A for Table 2.12.

^aEstimated using vehicle travel data.

^bData are not available.

^cNautical miles.

^dAmtrak only.

^eSum of passenger train cars and locomotive units.

^fPassenger train car-miles.

^gRevenue passenger miles.

^hLight and heavy rail.



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

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

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

Source:

See Appendix A for Table 2.13.

^aThe definition of intercity truck was "tightened" to exclude smaller trucks. See Appendix A for details.

^b668 miles is for general freight (less than truckload). Based on data from the Eno Transportation Foundation, the average length of haul for specialized freight (truckload) was 301 miles.

^cIncludes commerce by foreign and domestic carriers in the U.S.

^dData are not available.

^eRailroad measures are: number vehicles = number freight cars, vehicle-miles = car-miles, ton-miles = revenue ton-miles.



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

Table 2.14
Energy Intensities of Passenger Modes, 1970-96

Year	Automobiles		Light truck ^a (Btu per vehicle-mile)	Buses		Air		Rail		
	(Btu per vehicle-mile)	(Btu per passenger-mile)		Transit ^b (Btu per vehicle-mile)	(Btu per passenger-mile)	Intercity (Btu per passenger-mile)	School (Btu per vehicle-mile)	Certificated air carriers (Btu per passenger-mile)	General aviation (Btu per passenger-mile)	Intercity Amtrak (Btu per passenger-mile)
1970	9,301	4,896	12,492	31,796	2,472	1,051	17,857	10,351	10,374	2,453
1975	9,015	4,745	11,890	33,748	2,814	976	17,040	7,883	10,658	2,962
1976	9,130	4,805	11,535	34,598	2,896	996	17,051	7,481	10,769	2,971
1977	8,961	4,716	11,171	35,120	2,889	961	16,983	7,174	11,695	2,691
1978	8,844	4,655	10,815	36,603	2,883	953	17,018	6,333	11,305	2,210
1979	8,647	4,551	10,473	36,597	2,795	963	16,980	5,858	10,787	2,794
1980	7,915	4,166	10,230	36,553	2,813	1,069	16,379	5,837	11,497	3,008
1981	7,672	4,038	10,001	37,745	3,027	1,155	16,385	5,743	11,123	2,957
1982	7,485	3,959	9,275	38,766	3,237	1,149	16,296	5,147	13,015	3,069
1983	7,376	4,098	9,141	37,962	3,177	1,174	16,236	5,107	11,331	3,212
1984	7,218	4,010	8,945	37,507	3,204	1,247	14,912	5,031	11,454	3,732
1985	7,182	3,990	8,754	38,862	2,421	1,324	16,531	5,679	11,707	3,461
1986	7,213	4,007	8,578	39,869	3,512	869	15,622	5,447	11,935	3,531
1987	6,975	3,875	8,376	38,557	3,542	939	15,615	4,753	11,496	3,534
1988	6,700	3,722	8,155	39,121	3,415	965	15,585	4,814	11,794	3,585
1989	6,602	3,668	7,779	36,583	3,711	963	15,575	4,796	10,229	3,397
1990	6,183	3,864	7,774	36,647	3,735	944	16,368	4,811	10,146	3,453
1991	5,925	3,703	7,381	36,939	3,811	978	16,419	4,560	9,869	3,710
1992	5,970	3,731	7,263	40,472	4,303	978	16,386	4,482	9,785	3,575
1993	6,103	3,814	7,208	39,005	4,257	972	19,093	4,304	9,653	3,687
1994	6,041	3,775	7,232	40,102	4,604	876	20,591	4,455	9,163	3,828
1995	5,923	3,702	7,237	40,175	4,650	816	13,680	4,236	10,152	3,818
1996	5,874	3,671	7,247	39,307	4,512	816	13,680	4,081	10,481	3,444
1970-96	-1.8%	-1.1%	-2.1%	0.8%	2.3%	-1.0%	-1.0%	-3.5%	0.0%	-2.0% ^d
1986-96	-2.0%	-0.9%	-1.7%	-0.1%	2.5%	-0.6%	-1.3%	-2.8%	-1.3%	-0.7%

Source:

See Appendix A for Table 2.14.

^aAll two-axle, four-tire trucks.

^bSeries not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA).

^cData are not available.

^dAverage annual percentage change is for years 1973-95.

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

Table 2.15
Energy Intensities of Freight Modes, 1970-96

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

Source:

See Appendix A for Table 2.15.



Chapter 3

Emissions and Transportation

Summary Statistics

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



Table 3.1
International Anthropogenic Emissions of All Greenhouse Gases, 1990-94^a

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

Source:

United Nations Framework Convention on Climate Change, FCCC/CP/1996/12/Add.1, June 1996.

(Additional resources: <http://www.unfccc.de>)

^aExcluding land-use change and forestry.

^bData are not available.

^cSome parties with economies in transition have chosen different base years than 1990.

^dAll figures are adjusted for electricity trade.

^eAll figures are adjusted for temperature.



Table 3.2
International Anthropogenic Emissions of Carbon Dioxide, 1990-94*

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

Source:

United Nations Framework Convention on Climate Change, FCCC/CP/1996/12/Add.1, June 1996.

(Additional resources: <http://www.unfccc.de>)

*Excluding land-use change and forestry.

^bData are not available.

^cSome parties with economies in transition have chosen different base years than 1990.

^dAll figures are adjusted for electricity trade.

^eAll figures are adjusted for temperature.



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

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

Source:

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

^aData are not available.

^bSome parties with economies in transition have chosen different base years than 1990.



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

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

Source:

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

Criteria pollutants (CO, NO_x, VOC) - U.S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1990-1996*, 1997, pp. A-6, A-11, A-18. (Additional resources: <http://www.epa.gov/oar/oaqps>)

^aGases 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.

^bBased on global warming potential.

^cVOC=volatile organic compounds. CFC=chlorofluorocarbons. HCFC=hydrochlorofluorocarbons. HFC=hydrofluorocarbons. PFC=perfluorocarbons.

^dData are not available.



Gases which contain carbon can be measured in terms of the full molecular weight of the gas or just in terms of their carbon content. This table presents carbon content. The ratio of the weight of carbon to carbon dioxide is 0.2727.

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

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

Source:

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

^aIncludes energy from petroleum, coal, and natural gas. Electric utility emissions are distributed across consumption sectors.



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

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

Source:

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

^aLiquefied petroleum gas.



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

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

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

Source:

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

Note:

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



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

Sector	CO	NO _x	VOC	PM-10	SO ₂
Highway vehicles	52.94	7.17	5.50	0.27	0.31
	59.6%	30.7%	28.8%	0.9%	1.6%
Aircraft	0.95	0.17	0.18	0.04	0.01
	1.1%	0.7%	0.9%	0.1%	0.1%
Railroads	0.11	0.92	0.05	0.03	0.24
	0.1%	3.9%	0.3%	0.1%	1.2%
Vessels	0.08	0.23	0.05	0.03	0.11
	0.1%	1.0%	0.3%	0.1%	0.6%
Other off-highway	15.86	3.29	2.15	0.49	0.01
	17.9%	14.1%	11.3%	1.6%	0.0%
Transportation total	69.95	11.78	7.93	0.87	0.68
	78.7%	50.4%	41.5%	2.8%	3.5%
Stationary source fuel combustion	5.96	10.49	1.08	1.19	16.79
	6.7%	44.9%	5.6%	3.8%	87.8%
Industrial processes	4.62	0.78	9.05	0.94	1.60
	5.2%	3.3%	47.4%	3.0%	8.4%
Waste disposal and recycling total	1.20	0.10	0.43	0.29	0.05
	1.4%	0.4%	2.3%	0.9%	0.3%
Miscellaneous	7.10	0.24	0.60	28.02	0.01
	8.0%	1.0%	3.1%	89.5%	0.0%
Total of all sources	88.83	23.29	19.08	31.30	19.11
	100.0%	100.0%	100.0%	100.0%	100.0%

Source:

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

Note:

CO = Carbon monoxide. NO_x = Nitrogen oxides. PM-10 = Particulate matter less than 10 microns.
SO₂ = Sulfur dioxide. VOC = Volatile organic compounds.



Table 3.9
Total National Emissions of Carbon Monoxide, 1940-96^a
(million short tons)

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

Source:

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

Note:

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

^aThe sums of subcategories may not equal total due to rounding.

^bRecreational marine vessels.



Table 3.10
Total National Emissions of Nitrogen Oxides, 1940-96^a
 (million short tons)

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

Source:

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

Note:

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

^aThe sums of subcategories may not equal total due to rounding.



Table 3.11
Emissions of Nitrogen Oxides from Highway Vehicles, 1970-96^a
(million short tons)

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

Source:

U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1996*, p. A-10 and annual.
 (Additional resources: <http://www.epa.gov/oar/oaqps>)

^aThe sums of subcategories may not equal total due to rounding.

^bLess than 8,500 pounds.

^cData are not available.



Table 3.12
Total National Emissions of Volatile Organic Compounds, 1940-96^a
 (million short tons)

Source category	1940	1950	1960	1970	1980	1990	1994	1995	1996	Percent of total, 1996
Highway vehicles	4.82	7.25	10.51	12.97	8.98	6.31	6.40	5.70	5.50	28.8%
Off-highway	0.78	1.21	1.22	1.71	2.14	2.50	2.62	2.43	2.43	12.7%
Transportation total	5.60	8.46	11.73	14.69	11.12	8.82	9.02	8.13	7.93	41.5%
Stationary fuel combustion total	1.98	1.44	0.88	0.72	1.05	1.01	0.99	1.07	1.08	5.6%
Industrial processes total	4.52	7.40	8.73	12.33	12.10	9.01	9.69	9.71	9.05	47.4%
Waste disposal and recycling total	0.99	1.10	1.55	1.98	0.76	0.99	1.05	1.07	0.43	2.3%
Miscellaneous total	4.08	2.53	1.57	1.10	1.13	1.16	0.80	0.60	0.60	3.1%
Total of all sources	17.16	20.94	24.46	30.82	26.17	20.98	21.55	20.59	19.08	100.0%

Source:

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

Note:

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

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



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

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

Source:

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

Note:

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

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



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

Source category	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	Percent of total, 1996
Gasoline powered												
Light-duty vehicles & motorcycles	225	207	120	77	61	63	64	65	62	62	63	23.0%
Light-duty trucks ^b	70	72	55	43	30	32	31	31	35	32	31	11.3%
Heavy-duty vehicles	13	15	15	14	10	10	9	10	10	9	9	3.3%
Total	308	294	190	134	101	105	104	106	107	103	103	37.6%
Diesel powered												
Light-duty vehicles	0	10	12	8	9	9	9	8	8	8	8	2.9%
Light-duty trucks ^b	0	0	2	1	1	2	2	2	2	2	2	0.7%
Heavy-duty vehicles	136	166	194	219	224	234	228	205	204	181	162	59.1%
Total	136	176	208	228	234	245	239	215	214	191	172	62.8%
Total												
Highway vehicle total	443	471	397	363	336	349	343	321	320	293	274	100.0%
Percent diesel	30.7%	37.4%	52.4%	62.8%	69.6%	70.2%	69.7%	67.0%	66.9%	65.2%	62.8%	

Source:
 U. S. Environmental Protection Agency, *National Air Pollutant Emission Trends, 1900-1996*, 1997, p. A-26 and annual.
 (Additional resources: <http://www.epa.gov/oar/oaqps>)

^aThe sums of subcategories may not equal total due to rounding.
^bLess than 8,500 pounds.
^cData are not available.



Table 3.15
Estimates of Particulate Matter, 1990
PM_{2.5} versus PM₁₀ (tons)

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

Source:

E. H. Pechan & Associates, *National PM Study: OPPE Particulate Programs Implementation Evaluation System*, Final Report to EPA, September 1994; and E.H. Pechan & Associates, *Updates to Fugitive Emission Components of the National Particulate Inventory*, January 1996.

(Additional resources: <http://www.pechan.com>)

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

^aOther Industrial Processes includes the wood, pulp and paper industry, and mineral products industries, and other categories.

^bWaste Disposal and Recycling includes incineration and open burning.

^cOther Combustion includes wildfires and prescribed burning.



Table 3.16
National Lead Emission Estimates, 1970-96^a
 (thousand short tons per year)

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

Source:

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

^aThe sums of subcategories may not equal due to rounding.



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

The results of the most recent version (Version 1.4) of the GREET model are displayed in the next two tables. The model estimates the full fuel-cycle emissions and energy use associated with various transportation fuels and advanced transportation technologies for light-duty vehicles. It calculates fuel-cycle emissions of five criteria pollutants (volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter measuring 10 microns or less) and three greenhouse gases (carbon dioxide, methane, and nitrous oxide). The model also calculates the total fuel-cycle energy consumption, fossil fuel consumption, and petroleum consumption using various transportation fuels. The fuel cycles that are included in the GREET model are:

- petroleum to conventional gasoline, reformulated gasoline, conventional diesel, reformulated diesel, liquefied petroleum gas, and electricity via residual oil;
- natural gas to compressed natural gas, liquefied natural gas, liquefied petroleum gas, methanol, Fischer-Tropsch diesel, dimethyl ether, hydrogen, and electricity;
- coal to electricity;
- uranium to 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 2010 model-year cars.

For additional information about the GREET model, contact:

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Acronyms Used on Tables 3.17 and 3.18

Emissions acronyms (both tables)

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

Near-term technology acronyms (Table 3.17)

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



Long-term technology acronyms (Table 3.18)

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



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

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

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



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

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

Source:

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

Note:

See previous pages for acronym definitions.



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

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

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



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

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

Source:

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

Note:

See previous pages for acronym definitions.



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

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

Model Year	Automobiles				Light trucks ^b			
	Hydro- carbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO _x)	Particulates ^c	Hydro- carbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO _x)	Particulates ^c
1968-71	4.10	34.0	d	d	8.0	102.0	3.6	d
1972-74	3.00	28.0	3.1	d	8.0	102.0	3.6	d
1975-76	1.50	15.0	3.1	d	2.0	20.0	3.1	d
1977-78	1.50	15.0	2.0	d	2.0	20.0	3.1	d
1979	1.50	15.0	2.0	d	1.7	18.0	2.3	d
1980	0.41	7.0	2.0	d	1.7	18.0	2.3	d
1981	0.41	3.4	1.0	d	1.7	18.0	2.3	d
1982-83	0.41	3.4	1.0	0.60	1.7	18.0	2.3	0.60
1984-86	0.41	3.4	1.0	0.60	0.8	10.0	2.3	0.60
1987	0.41	3.4	1.0	0.20	0.8	10.0	2.3	0.26
1988-93	0.41	3.4	1.0	0.20	0.8	10.0	1.2 ^e	0.26
1994	0.25	3.4	0.4	0.08	0.25	3.4 ^e	1.2 ^e	0.26
1995-on	0.25	3.4	0.4	0.08	0.25	3.4 ^e	0.4 ^f	0.08

Source:

1968-75: Motor Vehicle Manufacturers Association, *Motor Vehicle Facts & Figures '85*, 1985, p. 88.

1976-93: *Code of Federal Regulations 40CFR86*, "Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines: Certification and Testing Procedures," July 1, 1987 edition, p. 264.

1994-on: Clean Air Act Amendments of 1990.

^a California standards not included.

^b Applies to trucks under 6,000 pounds gross vehicle weight rating (GVWR) until model year 1978 and under 8,500 pounds GVWR beginning in model year 1979.

^c Applies to diesel engines only.

^d No standard was set for this year.

^e Applies to light trucks up to and including 3,750 pounds loaded vehicle weight (LVW).

^f Applies to light trucks up to and including 3,750 pounds LVW. Does not apply to diesel-fueled light trucks.



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

Model Year	Hydrocarbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO _x)	Hydrocarbons + nitrogen oxides (HC + NO _x)
1974-78	^b	40.0	^b	16.0
1979-83	1.5	25.0	^b	10.0
1984	1.3	15.5	10.7	^b
1985-86	2.5	40.0	10.7	^b
1987-89	1.9	37.1	10.6	^b
1990	1.9	37.1	6.0	^b
1991-93	1.9	37.1	5.0	^b
1994	1.9 ^c	37.1	5.0 ^c	^b
1995-97	1.9 ^c	37.1 ^c	5.0 ^c	^b
1998-on	1.9 ^c	37.1 ^c	4.0 ^c	^b

Source:1974-75: MVMA, *Motor Vehicle Facts & Figures '85*, 1985, p. 88.1976-93: *Code of Federal Regulations*, 40CFR86, "Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines: Certification and Testing Procedures," July 1, 1987, p. 264.

1994-on: Clean Air Act Amendments of 1990.

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

Model Year	Hydrocarbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO _x)	Hydrocarbons + nitrogen oxides (HC + NO _x)	Particulates
1976-78	^b	40.0	^b	16.0	^b
1979-83	1.5	25.0	^b	10.0	^b
1984	1.3	15.5	10.7	5.0	^b
1985-87	1.3	15.5	10.7	^b	^b
1988-89	1.3	15.5	10.7	^b	0.60
1990	1.3	15.5	6.0	^b	0.60
1991-93	1.3	15.5	5.0	^b	0.25
1994-97	1.3 ^c	15.5	5.0	^b	0.10
1998-on	1.3 ^c	15.5 ^c	4.0 ^c	^b	0.10 ^c

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

1994-on: Clean Air Act Amendments of 1990.

^aApplies to trucks greater than 6,000 pounds gross vehicle weight until model year 1978, greater than 8,500 pounds gross vehicle weight for model years 1979-1986, and greater than 14,000 pounds gross vehicle weight starting in 1987.

^bNo standard was set for this year.

^cHeavy-duty trucks must meet these standards or standards which reflect the greatest degree of emission reduction achievable through the application of the technology available.

^dApplies to trucks greater than 6,000 pounds gross vehicle weight through model year 1978 and to trucks greater than 8,500 pounds gross vehicle weight beginning in model year 1979.



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

Vehicle Type	Emission Category	Vehicle Useful Life											
		5 Years / 50,000 Miles					10 Years / 100,000 Miles						
		THC ^a	NMHC ^b	NMOG ^c	CO	NO _x	PM	THC ^a	NMHC ^b	NMOG ^c	CO	NO _x	PM
LDV	Tier 0	0.41	0.34 ^d	-	3.4	1.0	0.20 ^e	-	0.31	-	4.2	0.6 ^g	0.10
	Tier 1	0.41	0.25	-	3.4	0.4 ^f	0.08	0.80	0.67 ^d	-	10	1.2	0.26 ^e
	Tier 0	-	0.25	-	3.4	0.4 ^f	0.08	0.80 ^h	0.31	-	4.2	0.6 ^g	0.10
LDT1	Tier 1	-	0.25	-	3.4	0.4 ^f	0.08	0.80	0.67 ^d	-	10	1.7	0.13 ^e
	Tier 0	-	0.32	-	4.4	0.7 ⁱ	0.08	0.80 ^h	0.40	-	5.5	0.97	0.10
LDT2	Tier 1	-	0.32	-	4.4	0.7 ⁱ	0.08	0.80 ^h	0.40	-	5.5	0.97	0.10
	Tier 0	-	0.32	-	4.4	0.7 ⁱ	0.08	0.80 ^h	0.40	-	5.5	0.97	0.10
	Tier 1	-	0.32	-	4.4	0.7 ⁱ	0.08	0.80 ^h	0.40	-	5.5	0.97	0.10
LDT3	Tier 0	-	0.32	-	4.4	0.7 ⁱ	0.08	0.80 ^h	0.40	-	5.5	0.97	0.10
	Tier 1	-	0.32	-	4.4	0.7 ⁱ	0.08	0.80 ^h	0.40	-	5.5	0.97	0.10
	Tier 0	-	0.32	-	4.4	0.7 ⁱ	0.08	0.80 ^h	0.40	-	5.5	0.97	0.10
LDT4	Tier 1	-	0.39	-	5.0	1.1 ⁱ	-	0.80	0.56	-	7.3	1.53	0.12
	Tier 0	-	0.39	-	5.0	1.1 ⁱ	-	0.80	0.56	-	7.3	1.53	0.12
	Tier 1	-	0.39	-	5.0	1.1 ⁱ	-	0.80	0.56	-	7.3	1.53	0.12

Source:

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

Note:

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

^a THCE for methanol vehicles. Does not apply to CNG vehicles.

^b THCE for tier 0 methanol vehicles. NMHC for other alcohol vehicles.

^c NMHC for diesel-fueled vehicles.

^d CNG vehicles only.

^e Applies to diesel-fueled vehicles only.

^f 1.0 for diesel-fueled vehicles through 2003 model year.

^g 1.25 for diesel-fueled vehicles through 2003 model year.

^h Standards apply at a useful life of 11 years / 120,000 miles.

ⁱ Does not apply to diesel-fueled vehicles.



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

Table 3.23
California Vehicle Emission Reduction for
Passenger Cars and Light-Duty Trucks

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

Source:

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

Note:

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

^aCalifornia standards can be found on the Internet: <http://www.epa.gov/OMSWWW/stds-ld.htm>



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

Table 3.24
California Air Resources Board Requirements for Meeting Emission Standards

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

Source:

California Air Resources Board, Mobile Sources Division, El Monte, CA, 1996.

(Additional resources: <http://www.arb.ca.gov>)

- ^aCV = Conventional vehicles
^tTLEV = Transitional low-emission vehicles
^lLEV = Low-emission vehicles
^uULEV = Ultra-low-emission vehicles
^zZEV = Zero emission vehicles

^bAccording to revised regulations, the marketplace is to determine the amount of ZEVs that are offered for sale.

^cFleet average of non-methane organic gases = 0.062 in 2003.



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

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

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

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

Source:

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



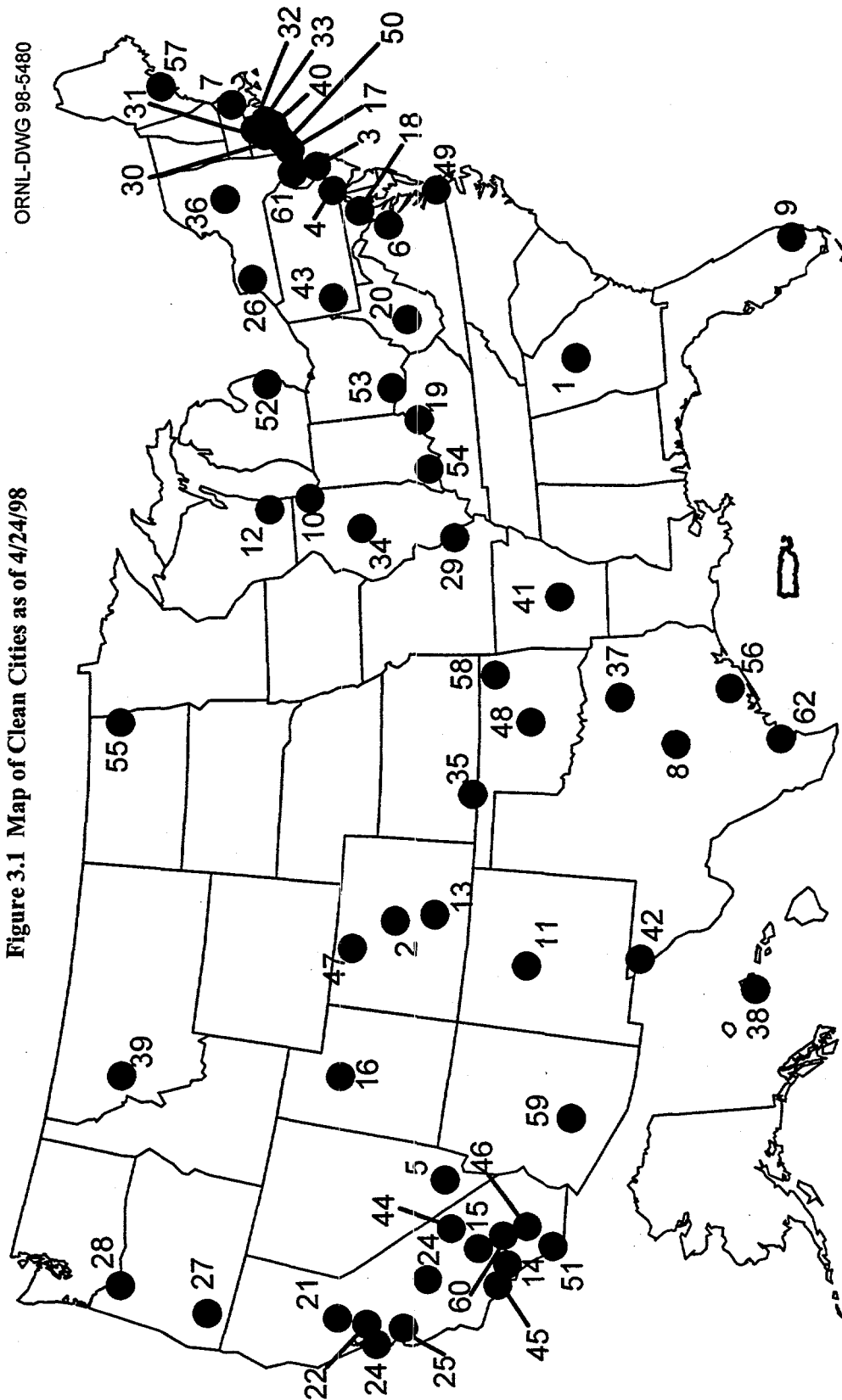


Figure 3.1 Map of Clean Cities as of 4/24/98

ORNL-DWG 98-5480

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



Chapter 4

Transportation and the Economy

Summary Statistics

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



Table 4.1
Gasoline Prices for Selected Countries, 1978-97

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

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

Source:

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

Note:

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

^a Prices represent the retail prices (including taxes) for premium leaded gasoline. Prices are representative for each country based on quarterly data averaged for the year.

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

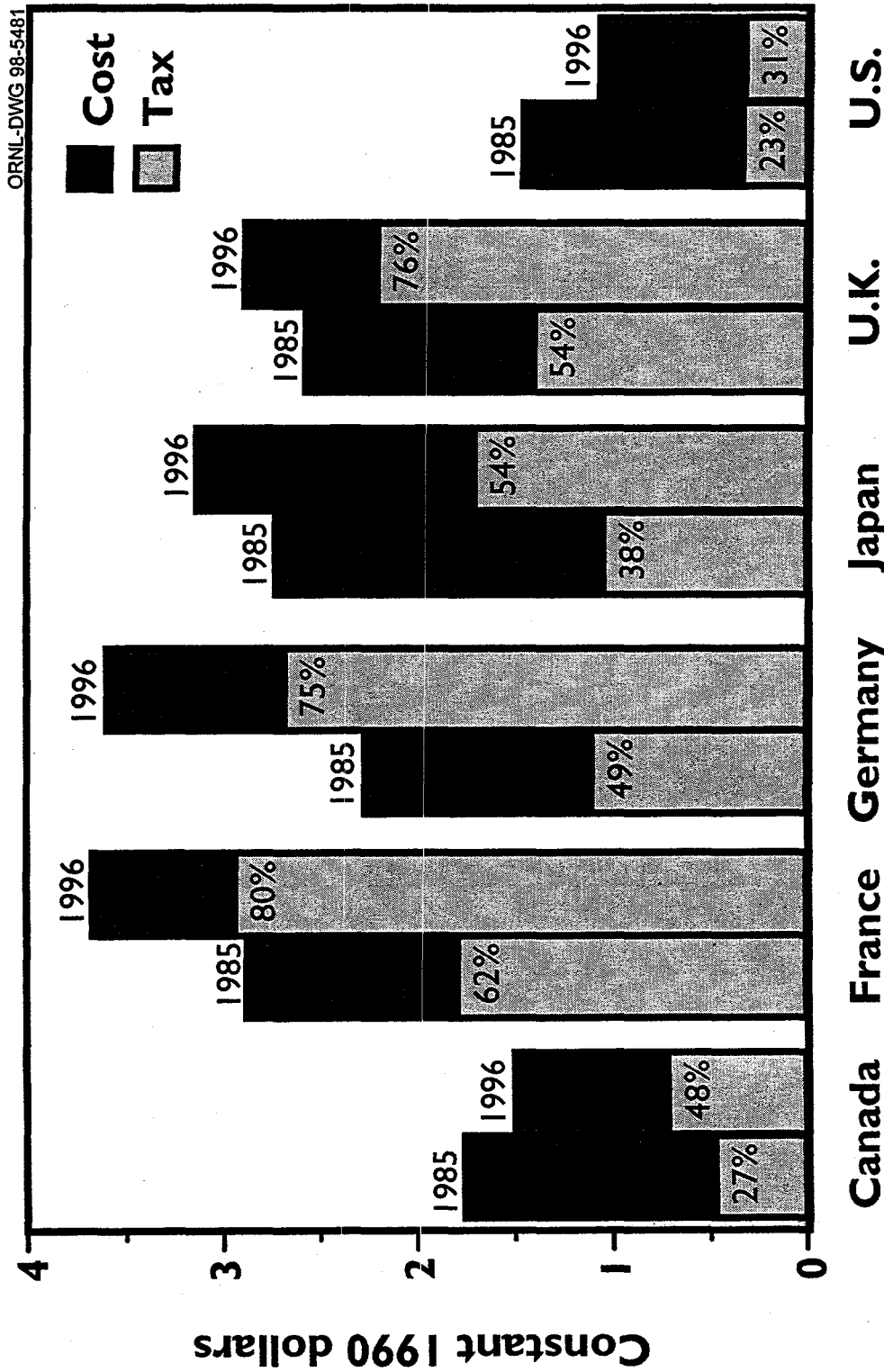
^c Regular gasoline.

^d Data are not available.

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

^f Adjusted by the U.S. Consumer Price Inflation Index.

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



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



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

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

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

Source:

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

Note:

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

^a Prices represent the retail prices (including taxes) for diesel fuel. Prices are representative for each country based on quarterly data averaged for the year.

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

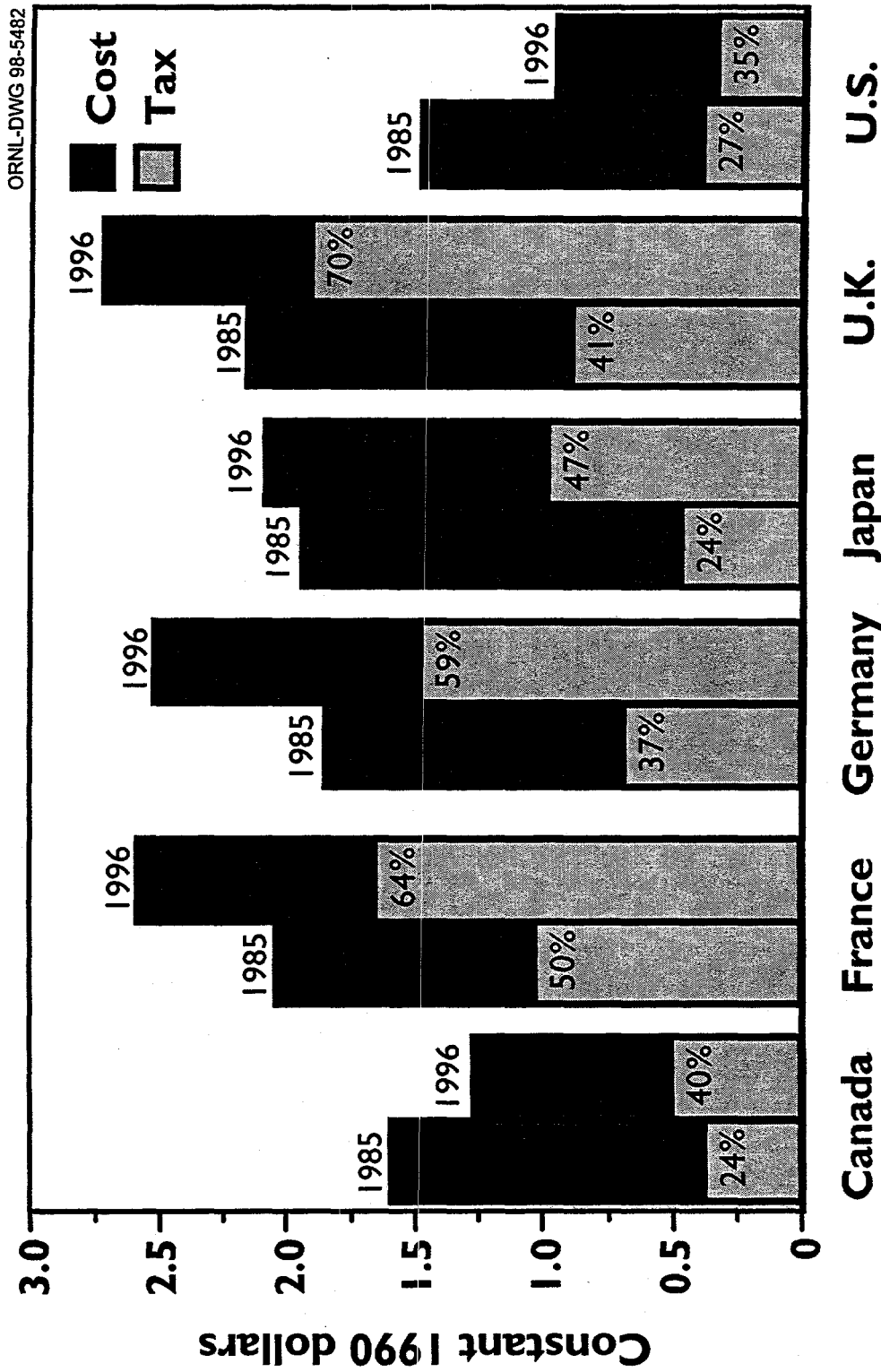
^c Data are not available.

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

^e Adjusted by the U.S. Consumer Price Inflation Index.



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



Source:
 Table 4.2 and International Energy Agency, *Energy Prices and Taxes, Fourth Quarter 1996*, Paris, France, 1998.
 (Additional resources: <http://www.iea.org>)



Though the cost of crude oil certainly influences the price of gasoline, it is not the only factor which determines the price at the pump. Processing cost, transportation cost, and taxes also play a major part of the cost of a gallon of gasoline. The average price of a barrel of crude oil (in constant 1990 dollars) declined by 30% from 1990 to 1997, while the average price of a gallon of gasoline declined 14% in this same time period.

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

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

Sources:

Crude oil - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 1998, Washington, DC, Table 9.1, p. 111.

Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 1998, Washington, DC, Table 9.4, p. 114.

(Additional resources: <http://www.eia.doe.gov>)

^aRefiner acquisition cost of composite (domestic and imported) crude oil.

^bAverage 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.

^cAdjusted by the Consumer Price Inflation Index.



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

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

Source:

Gasoline - U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 1998*, Washington, DC, Table 9.4, p. 114.
Diesel - U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1996*, Washington, DC, February 1998, p. 102
(Additional resources: <http://www.eia.doe.gov>)

^aCollected from a survey of prices on January 1 of the current year.

^bThese 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.

^cAdjusted by the Consumer Price Inflation Index.

^dData are not available.

^eAverage annual percentage change is from the earliest year possible to 1997.



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

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

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

U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review, March 1998*, Washington, DC, Table 9.7, p. 117.

(Additional resources: <http://www.eia.doe.gov>)

^aConsumer grade.

^bAdjusted by the Consumer Price Inflation Index.



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

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

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

Source:

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

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



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

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



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

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

Source:

J. E. Sinor Consultants, Inc., Niwot, CO, March 1998.

(Additional resources: <http://phidias.colorado.edu/sinor>)

^aAnnual flat fee.

^bBlends with gasoline only.

^cNovember-February tax rate is \$0.02.

^dPer 1.25 therm.

^ePer 100 ft³.

^fCNG, LNG, and LPG are exempt from motor fuel taxes when used as vehicle fuel until July 1, 2001.

^gFor County of Honolulu; for County of Maui LPG tax is \$0.20/gal. and all other fuels are taxed at \$0.18/gal.; other counties have all fuels taxed at \$0.26/gal.

^hPer therm.

ⁱOptional: flat fee may be paid instead.

^jPer cubic foot; LNG is taxed at \$0.12/gal.

^kPer 120 ft³.

^lPlus a petroleum business tax; the amount varies but is usually in the ballpark of \$0.12-\$0.14.

^mPlus 0.1035 oil franchise tax.

