ORNL-6919
(Edition 17 of ORNL-5198)

Center for Transportation Analysis
Energy Division

TRANSPORTATION ENERGY DATA BOOK: EDITION 17

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August 1997

Prepared for
Office of Transportation Technologies
U.S. Department of Energy

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6073
managed by
LOCKHEED MARTIN ENERGY RESEARCH CORP.
for the
U.S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-96OR22464

Users of the Transportation Energy Data Book are encouraged to comment on errors, omissions, emphases, and organization of this report to one of the persons listed below. Requests for additional complementary copies of this report, additional data, or information on an existing table should be referred to Ms. Stacy Davis, Oak Ridge National Laboratory.

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This edition of the Transportation Energy Data Book can be found on the web at:
http://www-cta.ornl.gov/data/tedb.htm

TABLE OF CONTENTS

FOREWORD

This twentieth anniversary edition of the Data Book breaks new ground by providing the Internet addresses for many of the sources used to supply the data for this book. Of course, this book itself is available at www.cta.ornl.gov/data/tedb.htm which also be found through the analytic homepage for the Office of Transportation Technologies (www.ott.doe.gov/fact.html). This issue drops the commentary at the beginning of each chapter.

As shown in Table 2.2, the transportation sector in 1996 consumed 72.7% more petroleum than the U.S. produced. One reason this figure keeps rising is that the cost to fuel the average car in the U.S. keeps falling (Table 2.23) due to low fuel process (Table 2.19) and increasing overall fleet fuel economy (Table 3.9).

Vehicles are now being built in such a way that the fuel economy losses resulting from traveling over 55 mph are less than for vehicles from the 80's and the 70's (Table 3.43). A lot of changes have occurred in the transportation sector over the last 20 years. This data book allows you to see many of these changes. Unfortunately, the transportation sector's dependence on oil has not changed. That is the challenge that faces us.

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, and John Maples and Robert Gibson of the University of Tennessee, Knoxville, TN. Rene' Moskol (Temp Systems, Inc.) creatively produced the new page design which includes new icons for each chapter. Sherry Campbell of the ORNL Life Sciences Division prepared the title index. Finally, I am indebted to Nancy Jett and Rene' Moskol for their diligent preparation of the manuscript.

ABSTRACT

The Transportation Energy Data Book: Edition 17 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. Each of the major transportation modes is treated in separate chapters or sections. Chapter 1 compares U.S. transportation data with data from other countries. Aggregate energy use and energy supply data for all modes are presented in Chapter 2. The highway mode, which accounts for over three-fourths of total transportation energy consumption, is dealt with in Chapter 3. Topics in this chapter include automobiles, trucks, buses, fleet vehicles, federal standards, fuel economies, and high-occupancy vehicle lane data. Household travel behavior characteristics are displayed in Chapter 4. Chapter 5 contains information on alternative fuels and alternative fuel vehicles. Chapter 6 covers the major nonhighway modes: air, water, and rail. The last chapter, Chapter 7, presents data on environmental issues relating to transportation.

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 17.

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

Chapter 1 contains information which compares U.S. transportation data with data from selected countries in Asia, Europe, and North America. Chapter 2, Transportation Energy Characteristics, presents aggregate energy use data for each of the major transportation modes (i.e., highway, air, water, pipeline, and rail), as well as related statistics on the price and supply of transportation fuels. Chapter 3 covers detailed statistics on three major highway modes: automobiles, trucks, and buses. Also contained in this chapter is information on fleets, federal standards, fuel economies of highway vehicles, and high-occupancy vehicle lanes. Household travel behavior characteristics are displayed in Chapter 4. Chapter 5 presents data on alternative fuels and alternative fuel vehicles, and Chapter 6 consists of data for the major nonhighway modes: air, water, and rail. Chapter 7 contains information

on environmental issues which are pertinent to the transportation industry. Sources used represent the latest available data.

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

INTERNATIONAL TRANSPORTATION STATISTICS

Table 1.1
Automobile Registrations for Selected Countries, 1950–95
(thousands)

Year	China	India	Japan	France	United Kingdom	Germany[a]	Canada[b]	United States[c]	U.S. percentage of world[c]	World total
1950	[d]	[d]	43	[d]	2,307	[d]	1,913	40,339	76.0%	53,051
1955	[d]	[d]	153	[d]	360	[d]	2,961	52,145	71.4%	73,036
1960	[d]	[d]	457	4,950	5,650	4,856	4,104	61,671	62.7%	98,305
1965	[d]	[d]	2,181	8,320	9,131	9,719	5,279	75,258	53.8%	139,776
1970	[d]	550	8,779	11,860	11,802	14,376	6,602	89,244	46.1%	193,479
1975	[d]	674	17,236	15,180	14,061	18,161	8,870	106,706	41.0%	260,201
1980	351	928	23,660	18,440	15,438	23,236	10,256	121,601	38.0%	320,390
1981	400	998	24,612	19,130	15,633	23,681	10,199	123,098	37.2%	330,799
1982	450	1,066	25,539	19,750	17,644	24,036	10,530	123,702	36.4%	340,266
1983	478	1,197	26,385	20,300	18,108	24,689	10,732	126,444	35.9%	352,032
1984	563	1,218	27,114	20,600	18,532	25,378	10,781	128,158	35.1%	365,105
1985	795	1,339	27,845	20,800	18,953	26,099	11,118	131,864	35.2%	374,483
1986	966	1,522	28,654	21,090	19,415	27,224	11,586	135,431	35.1%	386,350
1987	1,112	1,628	29,478	21,500	20,108	28,304	11,686	137,324	34.9%	394,030
1988	1,304	1,869	30,776	21,970	20,977	29,190	12,086	141,252	34.2%	412,907
1989	1,464	2,086	32,621	22,520	21,919	30,152	12,380	143,081	33.7%	424,366
1990	1,622	2,300	34,924	23,010	22,528	30,695	12,622	143,550	32.3%	444,900
1991	1,852	2,491	37,076	23,550	22,744	31,309	12,578	142,956	31.3%	456,033
1992	2,262	2,807	38,963	24,020	23,008	37,579	12,781	144,213	30.7%	469,943
1993	2,860	3,100	40,772	24,385	23,402	39,202	12,927	146,314	31.2%	469,460
1994	3,497	3,300	42,678	24,900	23,832	39,918	13,122	133,929	27.9%	479,533
1995	4,179	3,500	44,680	25,100	24,307	40,499	13,183	134,981	28.3%	477,010
					Average annual percentage change					
1950–95	[d]	[d]	16.7%	4.9%[e]	5.4%	[d]	[d]	[d]		5.0%
1970–95	18.0%[e]	7.7%	6.7%	3.0%	2.9%	[d]	[d]	[d]		3.7%
1985–95	18.1%	10.1%	4.8%	1.9%	2.5%	[d]	[d]	[d]		2.4%

Source:
Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1997 Edition, Detroit, MI, 1997, pp. 8, 23, 28, 42, 87, 100, 173, 209, 234 and annual.
(Additional resources: http://www.aama.com)

[a] Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles.
[b] Data from 1991 and later are not comparable to prior data.
[c] Data from 1994 and later are not comparable to prior data.
[d] Data are not available.
[e] Average annual percentage change is from earliest year possible to 1995.

Table 1.2
Truck and Bus Registrations for Selected Countries, 1950–95
(thousands)

Year	China	India	Japan	France	United Kingdom	Germany[a]	Canada[b]	United States[c]	U.S. percentage of world[c]	World total
1950	[d]	[d]	183	[d]	1,060	[d]	643	8,823	50.9%	17,349
1955	[d]	[d]	318	[d]	1,244	[d]	952	10,544	46.1%	22,860
1960	[d]	[d]	896	1,540	1,534	786	1,056	12,186	42.6%	28,583
1965	[d]	[d]	4,119	1,770	1,748	1,021	1,232	15,100	39.6%	38,118
1970	[d]	492	8,803	1,850	1,769	1,228	1,481	19,175	36.2%	52,899
1975	811	542	10,854	2,210	1,934	1,337	2,158	26,243	38.8%	67,698
1980	1,480	739	14,197	2,550	1,920	1,617	2,955	34,195	37.7%	90,592
1981	1,630	799	15,009	2,575	1,890	1,646	3,192	35,188	36.5%	96,405
1982	1,767	892	15,797	2,716	3,022	1,648	3,293	35,941	36.4%	98,787
1983	1,908	980	16,546	2,890	3,106	1,674	3,363	37,306	35.9%	103,888
1984	2,070	1,035	17,380	3,230	3,230	1,693	3,099	38,091	35.3%	107,925
1985	2,402	1,198	18,313	3,310	3,278	1,723	3,149	39,790	35.2%	113,024
1986	2,884	1,294	19,319	3,980	3,336	1,760	3,213	40,760	35.9%	113,436
1987	3,247	1,480	20,424	4,200	3,452	1,801	3,576	41,714	34.4%	121,176
1988	3,716	1,705	21,674	4,370	3,621	1,846	3,766	43,145	34.0%	126,882
1989	4,118	1,885	22,472	4,570	3,754	1,914	3,889	44,179	33.3%	132,566
1990	4,496	2,020	22,773	4,748	3,774	1,989	3,931	45,106	32.7%	138,082
1991	4,721	2,177	22,839	4,910	3,685	2,114	3,402	45,416	32.6%	139,274
1992	5,177	2,397	22,694	5,040	3,643	2,672	3,413	46,149	32.1%	143,587
1993	5,316	2,600	22,490	5,065	3,604	2,842	3,409	47,749	32.3%	147,627
1994	5,922	2,875	22,333	5,140	3,605	2,960	3,466	64,116	42.9%	149,545
1995	6,221	3,050	22,173	5,195	3,635	3,062	3,485	65,465	38.6%	169,749
					Average annual percentage change					
1950–95	[d]	[d]	11.2%	3.5%[e]	2.8%	[d]	[d]	[d]		5.2%
1970–95	10.0%[e]	9.8%	3.8%	4.2%	2.9%	[d]	[d]	[d]		4.8%
1985–95	12.0%	10.8%	1.9%	4.6%	1.0%	[d]	[d]	[d]		4.2%

Source:
Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1997 Edition, Detroit, MI, 1997, pp. 8, 23, 28, 42, 87, 100, 173, 209, and 234. (Additional resources: http://www.aama.com)

[a] Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles (Table 1.1).
[b] Data from 1991 and later are not comparable to prior data.
[c] Data from 1994 and later are not comparable to prior data.
[d] Data are not available.
[e] Average annual percentage change is from earliest year possible to 1995.

Table 1.3
Gasoline Prices for Selected Countries, 1978–96

	Current dollars per gallon								Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1992[b]	1994[b]	1995[b]	1996[b]	1978–96	1986–96
China	[d]	[d]	[d]	[d]	[d]	[d]	1.08	0.93[c]	[d]	[d]
India	[d]	[d]	[d]	1.92	2.59	2.28	2.32	2.25[c]	[d]	[d]
Japan	2.00[c]	2.60[c]	2.79[c]	3.05[c]	3.78[c]	4.14	4.56	3.77	3.6%	3.1%
France	2.15	2.56	2.58	3.40	3.69	3.31	4.02	4.41	4.1%	5.5%
United Kingdom	1.22	2.42	2.07	2.55	3.28	2.86	3.21	3.47	6.0%	5.3%
Germany	1.75	2.17	1.88	2.72	3.84	3.34	3.91	4.32	5.1%	8.7%
Canada	0.69[c]	1.37[c]	1.31[c]	1.92[c]	2.11[c]	1.57	1.68	1.80	5.5%	3.2%
United States[e]	0.66[c]	1.32[c]	0.93[c]	1.04[c]	1.07[c]	1.24	1.32	1.28	3.7%	3.2%

	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]	1978–96	1986–96
China	[d]	[d]	[d]	[d]	[d]	[d]	0.93	0.77	[d]	[d]
India	[d]	[d]	[d]	1.92	2.41	2.01	1.99	1.87	[d]	[d]
Japan	4.01[c]	3.52[c]	3.33[c]	3.05[c]	3.52[c]	3.65	3.91	3.14	-1.3%	-0.6%
France	4.31	3.47	3.07	3.40	3.44	2.92	3.45	3.67	-0.9%	1.8%
United Kingdom	2.44	3.28	2.47	2.55	3.05	2.52	2.75	2.89	0.9%	1.6%
Germany	3.51	2.94	2.24	2.72	3.58	2.95	3.35	3.60	0.1%	4.9%
Canada	1.38[c]	1.85[c]	1.56[c]	1.92[c]	1.96[c]	1.38	1.44	1.50	0.5%	-0.4%
United States[e]	1.32[c]	1.79[c]	1.11[c]	1.04[c]	1.00[c]	1.09	1.13	1.07	-1.0%	-0.4%

Source:

U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, Washington, DC, December 1996, 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.

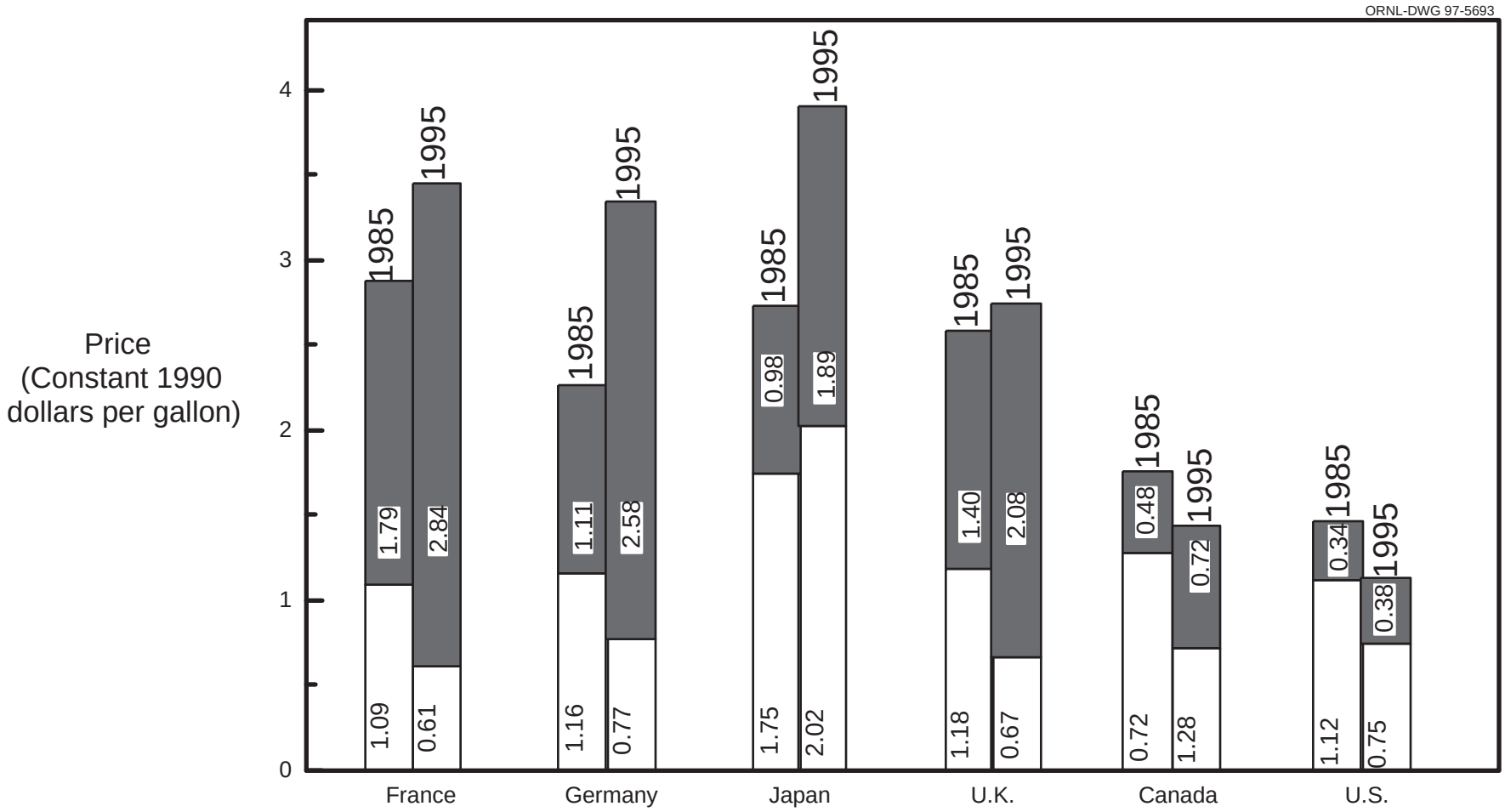
[c] Regular gasoline.

[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 1.1 Gasoline Prices for Selected Countries, 1985 and 1995



Source:

Table 1.3, and International Energy Agency, Energy Prices and Taxes, Fourth Quarter, 1995 Edition, Paris, France, 1996. (Additional resources: http:www.iea.org)

Table 1.4
Diesel Fuel Prices for Selected Countries, 1978–96

	Current dollars per gallon								Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1992[b]	1994[b]	1995 [b]	1996[b]	1978–96	1982–96
China	[c]	[c]	[c]	[c]	[c]	[c]	0.94	0.88	[c]	[c]
India	[c]	[c]	[c]	0.78	0.73	0.74	0.84	0.92	[c]	[c]
Japan	[c]	1.78	1.90	1.75	[c]	2.48	3.00	2.51	[c]	2.5%
France	1.30	1.88	1.69	1.78	[c]	2.10	2.37	3.10	4.9%	3.6%
United Kingdom	1.24	2.05	1.71	2.04	[c]	2.46	2.75	3.26	5.5%	3.4%
Germany	1.48	1.81	1.51	2.72	2.81	2.16	2.48	3.02	4.0%	3.7%
Canada	[c]	1.27	1.27	1.55	1.78	1.47	1.38	1.43	[c]	0.9%
United States[d]	0.54	1.16	0.94	0.99	1.06	0.96	0.97	1.15	4.3%	-0.1%

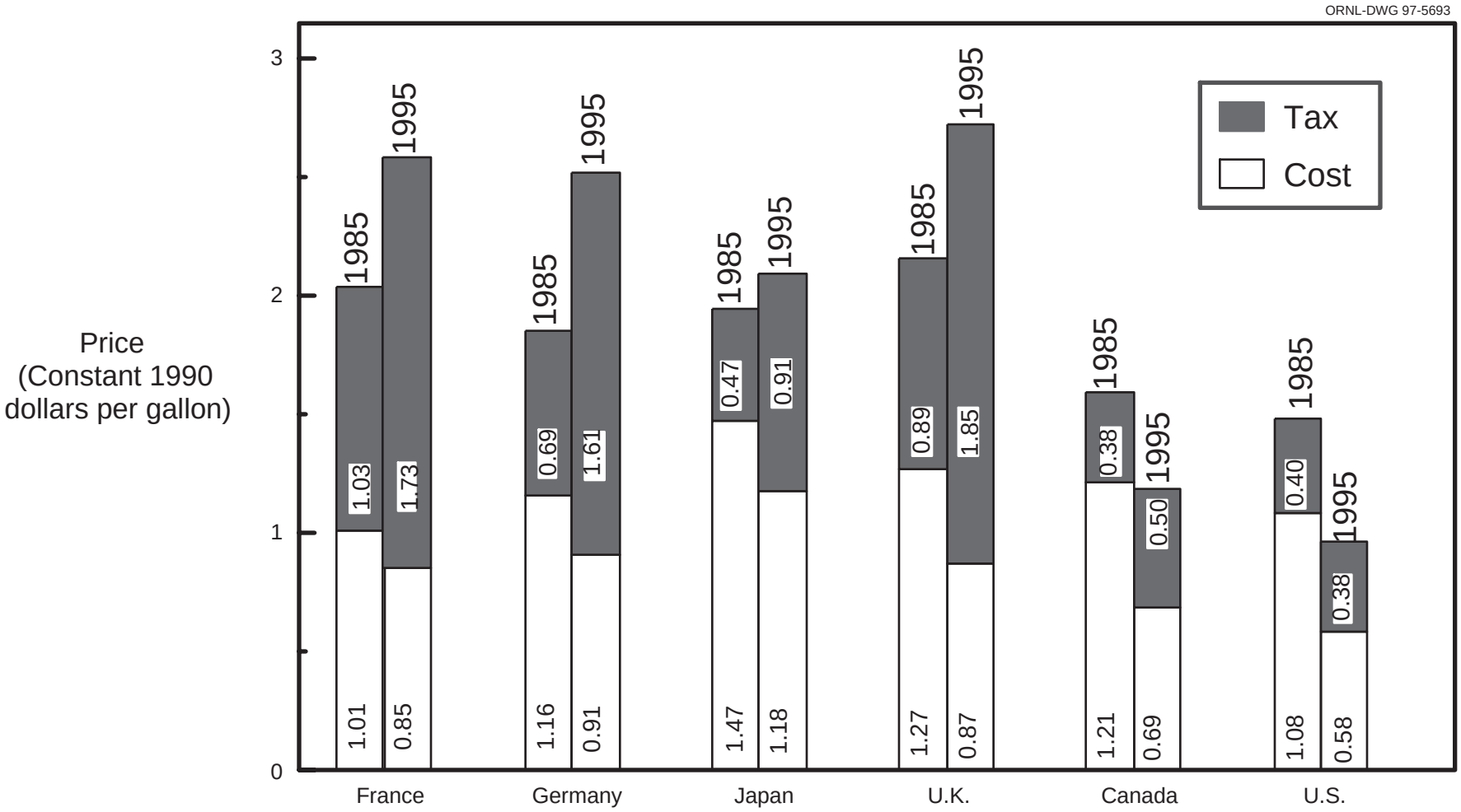
	Constant 1990 dollars[e] per gallon								Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1992[b]	1994[b]	1995	1996	1978–96	1986–96
China	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
India	[c]	[c]	[c]	0.78	0.68	0.65	0.72	0.77	[c]	[c]
Japan	[c]	2.41	2.26	1.75	[c]	2.19	2.57	2.09	[c]	-1.0%
France	2.60	2.55	2.01	1.78	[c]	1.85	2.03	2.58	0.0%	0.1%
United Kingdom	2.48	2.78	2.04	2.04	[c]	2.17	2.36	2.72	0.5%	-0.2%
Germany	2.96	2.45	1.80	2.72	2.62	1.91	2.13	2.52	0.9%	0.2%
Canada	[c]	1.72	1.51	1.55	1.66	1.30	1.18	1.19	[c]	-2.6%
United States[d]	1.08	1.57	1.12	0.99	0.99	0.85	0.83	0.96	0.7%	-3.5%

Source:
U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, Washington, DC, December 1996, 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 1.2. Diesel Prices for Selected Countries, 1985 and 1995



Source:

Table 1.4, and International Energy Agency, Energy Prices and Taxes, Fourth Quarter, 1995 Edition, Paris, France, 1996. (Additional resources: http:www.iea.org)

*According to the best available data, new cars in Denmark have the highest fuel economy of the listed countries. Caution should be used, however, when comparing fuel economy data between countries because each country may use different methods of calculating new car fuel economy. The data, therefore, may not be **directly** comparable.*

Table 1.5
New Gasoline Personal Vehicle[a] Fuel Economy for Selected Countries, 1975–95
(miles per gallon)

Year	Japan	France	Italy	Sweden	Norway	Denmark	West Germany	United States	United Kingdom
1975	21.2	27.5	[b]	[b]	25.0	28.1	[b]	15.3	[b]
1980	28.2	30.2	30.6	26.1	26.7	29.0	26.4	22.5	27.1
1981	28.9	31.8	31.4	27.0	27.4	29.0	27.6	24.1	27.7
1982	30.6	32.9	32.7	27.4	28.3	29.0	28.5	24.7	29.0
1983	30.1	33.6	34.1	27.4	29.0	29.6	28.8	24.6	29.8
1984	30.1	34.4	35.6	27.7	30.2	30.9	30.8	24.6	31.0
1985	29.2	34.9	36.2	27.7	30.6	31.0	31.1	25.0	31.2
1986	28.2	35.1	36.8	28.0	31.4	31.7	31.7	25.7	31.5
1987	27.5	35.5	36.8	28.7	31.8	31.9	31.0	25.9	31.8
1988	27.1	35.9	36.8	28.3	31.8	32.4	30.1	25.9	31.6
1989	26.6	36.1	36.8	28.3	31.8	32.3	29.4	25.4	31.0
1990	26.6	36.1	35.1	28.3	31.8	32.8	29.4	25.1	30.7
1991	26.1	36.4	35.1	28.3	31.8	33.1	29.1	25.4	30.7
1992	25.7	36.1	34.6	28.7	31.8	33.7	29.9	24.5	30.6
1993	25.7	35.5	34.1	28.3	32.2	33.1	30.2	25.3	30.4
1994	26.1	35.9	[b]	28.0	32.2	32.2	30.8	25.0	30.6
1995	25.9	36.1	[b]	28.3	31.8	[b]	[b]	24.9	31.2
				Average annual percentage change					
1975–95	1.0%	1.4%	[b]	[b]	1.2%	0.7%[c]	[b]	2.5%	[b]
1985–95	-1.2%	0.3%	[b]	0.2%	0.4%	0.4%[c]	-0.1%[c]	0.0%	0.0%

Source:
International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

Note:
Revisions in the data series are the result of newly available data.

[a] Includes automobiles and light trucks.
[b] Data are not available
[c] Average annual percentage change is for years 1975–94 and 1985–94.

Because each country may use different methods of calculating fuel economies, caution should be used when comparing fuel economy data among countries. The data for the United States were generated specifically for international comparisons and should be used only for that purpose; they are not consistent with other domestic fuel economy figures.

Table 1.6
Fuel Economy of the Gasoline Personal Vehicle[a] Population for Selected Countries, 1970–95
(miles per gallon)

Year	Japan	France	Italy	Sweden	Finland	Norway	Denmark	United Kingdom	West Germany	United States	Nether-lands	Australia
1970	26.0	27.7	27.6	22.8	24.6	22.8	[b]	[b]	24.5	13.2	24.6	[b]
1975	24.8	27.2	27.7	22.2	26.6	22.1	27.8	[b]	23.5	13.3	24.6	19.0
1976	21.2	26.3	27.8	22.0	28.0	23.1	27.5	[b]	23.3	13.3	26.1	18.8
1977	21.0	26.4	27.8	21.8	27.9	23.1	28.0	[b]	23.1	13.6	26.1	18.8
1978	23.1	26.1	27.6	21.6	28.3	22.6	27.7	[b]	22.8	13.8	26.3	18.8
1979	22.5	26.5	27.6	21.6	27.1	22.5	28.6	[b]	23.3	14.1	26.3	18.7
1980	22.3	25.0	27.6	21.6	27.6	22.5	29.0	[b]	23.1	15.0	25.6	18.8
1981	22.7	25.1	27.8	21.6	27.8	22.8	29.3	[b]	23.1	15.5	25.6	19.0
1982	22.9	24.9	27.8	21.7	27.8	22.9	29.3	[b]	23.1	16.1	25.9	19.3
1983	22.9	24.9	28.1	21.8	27.4	23.7	29.3	23.5	23.1	16.6	26.1	19.6
1984	23.3	25.2	28.7	21.8	27.4	23.9	30.7	24.3	23.1	17.1	26.6	19.8
1985	23.6	25.7	29.1	22.0	27.4	24.5	30.0	24.7	23.1	17.4	26.8	20.3
1986	23.6	26.1	29.8	22.4	26.6	25.1	30.2	24.0	23.1	17.4	27.3	20.6
1987	23.4	26.3	30.4	22.8	27.0	25.6	31.1	24.8	23.3	18.1	27.5	20.8
1988	23.5	26.3	30.5	23.1	27.9	25.9	31.0	25.3	23.5	18.7	27.8	20.8
1989	23.4	26.7	30.7	23.3	28.0	25.6	31.2	25.9	24.0	19.1	28.0	20.8
1990	23.2	27.0	31.1	23.5	28.3	25.8	30.1	25.3	24.3	19.7	28.5	20.9
1991	23.0	27.2	31.3	23.8	28.0	25.9	30.0	25.0	24.5	19.9	28.5	20.8
1992	22.8	27.3	31.4	24.0	27.9	26.1	29.9	25.3	24.5	19.9	28.5	21.0
1993	22.7	27.4	31.4	24.1	29.5	26.3	30.4	[b]	24.5	20.2	28.5	21.4
1994	22.6	27.7	[b]	[b]	29.6	26.3	[b]	[b]	25.0	20.0	28.5	[b]
1995	22.6	27.7	[b]	[b]	30.2	26.5	[b]	[b]	[b]	20.3	28.2	[b]
						Average annual percentage change						
1970–95	-0.6%	0.0%	[b]	[b]	0.8%	0.6%	[b]	[b]	0.1%[c]	1.7%	0.5%	[b]
1985–95	-0.4%	0.8%	[b]	[b]	1.0%	0.8%	[b]	[b]	0.9%[c]	1.6%	0.5%	[b]

Source:
International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

Note:
Revisions in the data series are the result of newly available data.

[a] Includes automobiles and light trucks.
[b] Data are not available.
[c] Average annual percentage change is for years 1970–94 and 1985–94.

"There is a relatively consistent shortfall or gap between tested fuel economy and that actually achieved by consumers on the road ... a gap which changes over time." The International Energy Studies Program at Lawrence Berkeley Laboratory (LBL) has studied this gap and discovered that "despite differences in test measurement methods and data collection and analysis techniques, significant similarities exist between countries on the gap problem." [a] The gap arises for several reasons, including driver behavior, seasonal differences, and city to highway driving proportion.

Table 1.7
Fuel Economy Gap for Selected Countries
(miles per gallon)

Country	Year	Test	Actual	Average gap	Percent gap	Comments
Canada	1988	29.4	23.5	5.9	20.0	Actual fuel efficiency from driver surveys. Test from laboratory tests.
Individual car models	1985	27.4	22.0	5.4	19.6	
France	1988	36.2	28.0	8.2	23.0	Travel diaries compared to 1/3 city, 1/3 highway, 1/3 road test values.
Germany	1987	30.6	24.0	6.5	21.4	DIN (test) vs. DIW (actual)
Sweden	1987	28.7	27.7	1.0	3.5	KOV compared with consumer reported survey data.
U.S.	1985					
Cars		24.3	19.8	4.5	18.5	RTECS survey vs. EPA fleet average
Trucks		20.3	16.2	4.1	20.0	from dynamometer test.
U.K.	1989	32.7	25.3	7.4	22.6	Test value for registration-weighted average.

Source:
Schipper, Lee, and Wienke Tax, "New Car Test and Actual Fuel Economy: Yet Another Gap?" Transport Policy, 1994.

Note:
DIN = Deutsches Institut fur Normug
DIW = Deutsches Institut fur Wirtschaftsforschung
KOV = Kosumentverket
RTECS = Residential Transportation Consumption Survey
EPA = Environmental Protection Agency

[a]Schipper, Lee, and Wienke Tax, "New Car Test and Actual Fuel Economy: Yet Another Gap?" Lawrence Berkeley Laboratory, Berkeley, CA, Fall 1993.

Table 1.8
Annual Vehicle-Miles Traveled per Vehicle by Personal Vehicles[a]
for Selected Countries, 1970–95

Year	Japan	France	Italy	Sweden	Finland	Norway	Denmark	United Kingdom	West Germany	United States	Nether-lands
1970	10,34	8,415	8,525	8,912	12,231	7,782	9,464	9,110	9,484	11,173	9,665
1975	7,515	8,204	6,375	8,910	12,797	8,280	10,061	8,499	9,044	10,749	9,316
1980	7,088	8,092	6,051	9,147	11,521	8,048	9,660	8,600	8,423	10,605	8,988
1981	6,947	8,247	5,851	9,052	11,243	7,850	9,614	8,654	7,832	10,625	8,784
1982	6,922	7,850	5,716	9,109	11,100	7,790	9,690	8,729	8,047	10,825	8,991
1983	6,775	7,843	5,598	9,088	10,936	7,808	9,837	8,457	8,155	10,924	9,185
1984	6,711	7,980	5,810	9,159	10,866	7,956	10,017	8,660	8,196	10,966	9,381
1985	6,741	7,937	5,664	9,021	10,886	8,284	9,723	8,715	7,995	10,997	9,162
1986	6,750	8,160	5,909	9,321	10,897	8,449	10,022	8,918	8,301	11,108	9,501
1987	6,742	8,247	6,089	9,484	11,133	8,571	10,110	9,283	8,546	11,351	9,670
1988	6,765	8,378	6,166	9,444	11,413	8,535	10,248	9,493	8,732	11,775	9,540
1989	6,687	8,254	6,274	9,439	11,502	8,704	10,399	9,821	8,677	12,029	9,441
1990	6,733	8,479	6,533	9,030	11,340	8,784	10,547	9,593	8,740	12,243	9,204
1991	6,791	8,504	6,604	9,100	11,122	8,720	10,668	9,612	8,677	12,159	9,254
1992	6,845	8,699	6,790	9,239	11,129	8,686	10,726	9,445	8,557	12,860	9,398
1993	6,700	8,736	6,947	9,075	11,087	8,744	10,789	9,467	8,401	13,213	9,329
1994	6,648	8,878	7,009	[b]	11,442	8,771	[b]	9,476	8,047	12,809	9,410
1995	[b]	8,914	7,067	[b]	11,473	8,667	[b]	[b]	[b]	12,957	9,494
					Average annual percentage change						
1970–95	-1.8%[c]	0.2%	-0.7%	[b]	-0.3%	0.4%	[b]	0.2%[c]	-0.7%[c]	0.6%	-0.1%
1985–95	-0.2%[c]	1.2%	2.2%	[b]	0.5%	0.5%	[b]	0.9%[c]	0.1%[c]	1.7%	0.4%

Source:
International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

Note:
Revisions in the data series are the result of newly available data.

[a] Calculated as total vehicle-miles of travel divided by the number of vehicles in use. Includes privately owned automobiles and light trucks.

[b] Data are not available.

[c] Average annual percentage change is for years 1970–94 and 1985–94.

Table 1.9
Personal Vehicles[a] Passenger Travel for Selected Countries, 1970–95
(billion passenger-miles)

Year	Japan	France	Italy	Sweden	Finland	Norway	Denmark	United Kingdom	West Germany	United States	Nether-lands	Australia
1970	141	189	132	38	15	11	28	180	228	2,110	38	[b]
1975	200	233	179	44	19	17	34	201	271	2,227	52	130
1980	286	281	201	44	22	19	34	245	310	2,275	62	149
1981	292	291	209	43	22	19	33	249	293	2,280	62	151
1982	302	291	223	43	23	19	33	252	303	2,317	63	159
1983	306	297	208	44	24	20	34	255	311	2,357	65	159
1984	315	306	221	45	26	20	35	269	317	2,419	68	166
1985	325	307	232	44	27	23	36	274	316	2,479	68	174
1986	335	321	256	46	28	25	37	289	337	2,548	71	179
1987	346	332	275	48	29	26	38	311	353	2,648	74	182
1988	369	345	289	48	30	26	38	333	370	2,783	78	189
1989	388	355	306	50	31	26	39	361	375	2,865	82	196
1990	415	364	330	49	32	26	39	365	393	2,926	81	200
1991	439	372	343	49	31	26	39	363	397	2,949	82	197
1992	460	384	365	50	31	26	39	365	400	3,050	82	199
1993	468	392	375	48	31	26	40	364	400	3,139	84	204
1994	482	405	[b]	[b]	31	27	41	370	493	3,091	86	[b]
1995	526	413	[b]	[b]	31	27	42	[b]	[b]	3,155	[b]	[b]
						Average annual percentage change						
1970–95	5.4%	3.2%	[b]	[b]	2.9%	3.7%	1.6%	3.0%[c]	3.3%[c]	1.6%	3.5%[c]	[b]
1985–95	4.9%	3.0%	[b]	[b]	3.2%	1.6%	1.6%	3.4%[c]	5.1%[c]	2.4%	2.6%[c]	[b]

Source:
International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

Note:
Revisions in the data series are the result of newly available data.

[a] Includes privately owned automobiles and light trucks.
[b] Data are not available.
[c] Average annual percentage change is for years 1970–94 and 1985–94.

Table 1.10
Personal Vehicles[a] Energy Use for Selected Countries, 1970–95
(trillion Btu)

Year	Japan	France	Italy	Sweden	Finland	Norway	Denmark	United Kingdom	West Germany	United States	Nether-lands	Australia
1970	452	431	366	99	40	30	52	500	626	9,230	111	[b]
1975	663	540	404	122	54	40	59	609	796	10,73	146	304
1980	946	651	458	133	59	51	58	719	979	10,57	174	361
1981	949	704	458	132	59	51	56	705	929	10,47	172	365
1982	970	720	481	134	61	53	56	725	965	10,38	176	381
1983	982	733	490	135	65	54	58	752	997	10,45	182	379
1984	981	744	516	140	67	56	58	793	1,026	10,48	186	394
1985	1,002	735	544	140	70	59	60	801	1,022	10,62	183	410
1986	1,031	763	586	146	75	62	63	845	1,097	10,97	187	419
1987	1,077	776	619	151	80	63	64	896	1,155	11,04	194	426
1988	1,118	804	649	154	84	64	66	944	1,211	11,29	195	445
1989	1,189	815	679	157	89	65	66	978	1,220	11,45	199	466
1990	1,286	821	723	153	87	64	69	1,005	1,262	11,42	193	480
1991	1,391	828	748	151	87	63	70	1,018	1,264	11,47	195	483
1992	1,487	848	793	154	87	62	71	1,013	1,269	11,98	201	489
1993	1,532	857	808	149	82	62	70	1,001	1,273	12,21	203	497
1994	1,593	876	[b]	[b]	82	62	[b]	1,001	1,216	12,22	[b]	[b]
1995	1,688	888	[b]	[b]	81	62	[b]	[b]	[b]	12,39	[b]	[b]
						Average annual percentage change						
1970–95	5.4%	2.9%	[b]	[b]	2.9%	2.9%	[b]	2.9%[c]	2.8%[c]	1.2%	[b]	[b]
1985–95	5.4%	1.9%	[b]	[b]	1.5%	0.5%	[b]	2.5%[c]	1.9%[c]	1.6%	[b]	[b]

Source:
International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

Note:
Revisions in the data series are the result of newly available data.

[a] Includes privately owned automobiles and light trucks.
[b] Data are not available.
[c] Average annual percentage change is for years 1970–94 and 1985–94.

Table 1.11
Freight Energy Use by Mode for Selected Countries by Mode, 1970–93
(trillion Btu)

	Truck	Ship	Rail	Truck	Ship	Rail	Truck	Ship	Rail	Truck	Ship	Rail
	Japan			France			Italy			Sweden		
1970	652	136	15.2	262	6.2	[a]	175	9.3	8.0	36	5.4	4.2
1975	707	208	12.6	344	5.2	17.4	221	11.9	5.2	41	2.8	4.0
1980	952	166	10.2	397	5.0	17.8	285	14.8	5.8	49	3.1	3.8
1985	1,066	100	6.2	373	3.1	14.4	368	14.6	6.9	56	3.3	4.6
1990	1,331	117	5.2	541	2.7	13.2	484	15.5	6.9	63	2.7	4.4
1991	1,403	118	5.3	562	2.5	13.5	479	15.8	6.9	61	2.5	4.3
1992	1,439	117	5.3	575	2.5	13.1	[a]	16.3	7.7	60	2.4	4.4
1993	1,452	112	5.3	575	2.7	12.2	[a]	[a]	[a]	[a]	[a]	[a]
	Finland			Norway			Denmark			United Kingdom		
1970	27	1.1	2.7	17	21.0	1.2	[a]	[a]	[a]	275	50.5	20.2
1975	30	1.0	2.8	18	22.3	1.1	23	4.1	1.3	295	51.9	14.8
1980	35	2.4	2.9	21	23.0	1.5	34	3.0	1.5	318	50.1	9.8
1985	37	2.2	2.8	27	23.7	1.4	45	3.0	1.4	325	49.8	6.9
1990	44	1.5	2.4	31	21.2	1.3	47	3.5	0.9	420	54.1	8.2
1991	42	1.3	2.2	31	22.4	1.3	48	3.6	0.9	418	56.5	8.4
1992	41	1.3	2.2	31	22.9	1.4	49	3.5	0.9	418	54.6	8.7
1993	41	2.9	2.5	32	28.5	1.4	48	3.2	0.9	415	53.8	8.1
	West Germany			United States			Netherlands			Australia		
1970	218	35.1	52.4	2,338	325	501	[a]	[a]	[a]	[a]	[a]	[a]
1975	224	36.0	24.4	2,908	311	515	[a]	[a]	[a]	119	38.0	17.8
1980	320	34.1	20.5	3,843	330	544	73	16.0	0.9	164	45.8	22.2
1985	299	28.4	19.3	4,598	399	427	76	15.0	1.0	196	29.1	23.7
1990	336	25.6	18.0	5,133	323	425	98	18.0	0.9	212	22.3	22.4
1991	412	25.6	17.6	4,970	328	399	100	[a]	[a]	197	17.9	22.3
1992	413	27.5	19.4	5,034	341	425	105	[a]	[a]	207	20.9	22.8
1993	387	27.5	19.7	5,243	307	382	[a]	[a]	[a]	216	20.9	24.0

Source:
International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

Note:
Revisions in the data series are the result of newly available data.

[a]Data are not available.

Table 1.12
Automobile Travel Statistics
by Trip Purpose for Selected Countries

	Work	Work-related	Total work	Family & personal	Civic & educational	Total family & civic	Social & recreational	Total
Number of weekly vehicle trips per automobile								
United States (1990)	3.49	0.24	3.73	6.01	0.70	6.72	2.71	13.15
Germany (1989)	2.81	0.61	3.41	1.83	0.19	2.02	2.26	7.69
Sweden (1984/85)	2.32	0.83	3.15	2.56	0.07	2.62	4.29	10.06
U.K. (1989/91)	1.71	0.56	2.27	2.79	0.24	3.03	1.59	6.88
Netherlands (1990)	2.03	1.05	3.08	1.82	0.14	1.96	3.85	8.89
Norway (1992)	2.29	0.62	2.91	5.06	0.11	5.17	3.54	11.62
Denmark (1992/93)	3.01	0.08	3.09	3.66	0.00	3.66	3.35	10.10
Weekly vehicle-miles traveled per automobile								
United States (1990)	98.22	11.27	109.49	104.02	13.71	117.73	119.49	346.70
Germany (1989)	72.03	48.09	120.12	22.59	5.69	28.28	66.20	214.60
Sweden (1984/85)	45.20	40.79	86.00	32.82	1.72	34.54	108.28	228.82
U.K. (1989/91)	39.64	26.49	66.13	38.74	2.74	41.48	46.01	153.62
Netherlands (1990)	56.78	33.01	89.79	18.70	4.73	23.43	89.11	202.33
Norway (1992)	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]
Denmark (1992/93)	82.17	2.86	85.02	46.36	0.00	46.36	115.27	246.65

Source:
Compiled by Lawrence Berkeley Lab from: U. S. National Personal Transportation Survey (NPTS) for year 1990; United Kingdom National Travel Survey 1989/91; Swedish Travel Patterns Survey, Resvaneundersokningen, 1984; The German Kontiv, 1987; Dutch National Mobility Survey, De Mobiliteit van de Nederlandse bevolking, 1992 RVU Denmark. See Appendix C.

Note:
The U. S. NPTS survey excludes persons under 5 years old (7.6% of the U. S. population for 1990); German Kontiv excludes persons under 6 years (5% of total pop. by 1989); Dutch NTS excludes persons under 12 years (19% of Dutch pop. by 1990); Danish NTS excludes persons under 15 years of age (17% of pop. by 1992); Swedish NTS excludes persons under 15 years of age (18% of pop. by 1984).

Special Note:
The way in which the Norwegian Travel Survey data was arranged in its final report did not report vehicle-miles by mode and purpose.

[a]Data are not available.

Table 1.13
Automobile Passenger Travel Statistics
by Trip Purpose for Selected Countries

	Work	Work-related	Total work	Family & personal	Civic & educational	Total family & civic	Social & recreational	Total
Number of weekly trips by automobile as a passenger								
United States (1990)	0.34	0.03	0.37	1.94	0.76	2.70	1.71	4.77
Germany (1989)	0.30	0.05	0.35	0.51	0.10	0.61	1.15	2.12
Sweden (1984/85)	0.37	0.11	0.48	0.84	0.05	0.89	2.04	3.41
U.K. (1989/91)	0.46	0.08	0.53	1.83	0.29	2.12	1.66	4.31
Netherlands (1990)	0.35	0.14	0.49	0.70	0.07	0.77	2.03	3.29
Norway (1992)	0.27	0.05	0.31	0.79	0.05	0.85	1.48	2.64
Denmark (1992/93)	0.41	0.00	0.42	0.48	0.00	0.48	1.11	2.02
Weekly miles traveled per automobile passenger								
United States (1990)	9.93	2.40	12.33	48.49	9.80	58.29	100.63	171.24
Germany (1989)	7.46	1.75	9.21	8.60	1.68	10.28	42.10	61.59
Sweden (1984/85)	6.55	6.69	13.24	14.55	1.08	15.63	64.30	93.17
U.K. (1989/91)	8.32	3.98	12.30	29.48	2.74	32.22	56.42	100.94
Netherlands (1990)	11.60	5.52	17.12	10.03	2.25	12.28	65.68	95.08
Denmark (1992/93)	11.50	0.41	11.91	9.28	0.00	9.28	40.32	61.51

Source:
Compiled by Lawrence Berkeley Lab from: U. S. National Personal Transportation Survey (NPTS) for year 1990; United Kingdom National Travel Survey 1989/91; Swedish Travel Patterns Survey, Resvaneundersokningen, 1984; The German Kontiv, 1987; Dutch National Mobility Survey, De Mobiliteit van de Nederlandse bevolking, 1992 RVU Denmark. See Appendix C.

Note:
The U. S. NPTS survey excludes persons under 5 years old (7.6% of the U. S. population for 1990); German Kontiv excludes persons under 6 years (5% of total pop. by 1989); Dutch NTS excludes persons under 12 years (19% of Dutch pop. by 1990); Danish NTS excludes persons under 15 years of age (17% of pop. by 1992); Swedish NTS excludes persons under 15 years of age (18% of pop. by 1984.)

Special Note:
The way in which the Norwegian Travel Survey data was arranged in its final report did not report vehicle-miles by mode and purpose.

CHAPTER 2

TRANSPORTATION ENERGY CHARACTERISTICS

Due to gains during the processing of crude oil, the product yield from a barrel of crude oil is more than 100%.

Table 2.1
Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978–96[a]
(percentage)

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

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

Table 2.2
United States Petroleum Production and Consumption, 1973–96
(million barrels per day)

Year	Domestic crude oil production	Net imports			Exports		U.S. petroleum consumption[a]	World petroleum consumption	Net imports as a percentage of U.S. petroleum consumption	U.S. petroleum consumption as a percentage of world consumption	Transportation petroleum use as a percentage of domestic production[b]
		Crude oil	Petroleum products	Total	Crude oil	Petroleum products					
1973	9.21	3.24	2.78	6.03	0.00	0.23	17.31	56.39	34.8%	30.7%	91.5%
1974	8.77	3.47	2.42	5.89	0.00	0.22	16.65	55.91	35.4%	29.8%	93.7%
1975	8.37	4.10	1.75	5.85	0.00	0.20	16.32	55.48	35.8%	29.4%	99.4%
1976	8.13	5.28	1.81	7.09	0.00	0.22	17.46	58.74	40.6%	29.7%	107.6%
1977	8.25	6.57	2.00	8.57	0.05	0.19	18.43	61.63	46.5%	29.9%	110.2%
1978	8.71	6.20	1.80	8.00	0.16	0.20	18.85	63.30	42.4%	29.8%	108.7%
1979	8.55	6.28	1.70	7.99	0.24	0.24	18.51	65.17	43.2%	28.4%	109.6%
1980	8.60	4.98	1.39	6.37	0.29	0.26	17.06	63.07	37.3%	27.0%	104.4%
1981	8.57	4.17	1.23	5.40	0.23	0.37	16.06	60.87	33.6%	26.4%	103.7%
1982	8.65	3.25	1.05	4.30	0.24	0.58	15.30	59.50	28.1%	25.7%	100.6%
1983	8.69	3.17	1.15	4.31	0.16	0.58	15.23	58.74	28.3%	25.9%	101.1%
1984	8.88	3.25	1.47	4.72	0.18	0.54	15.73	59.84	30.0%	26.3%	102.3%
1985	8.97	3.00	1.29	4.29	0.20	0.58	15.73	60.10	27.3%	26.2%	102.6%
1986	8.68	4.02	1.41	5.44	0.15	0.63	16.28	61.76	33.4%	26.4%	110.3%
1987	8.35	4.52	1.39	5.91	0.15	0.61	16.67	63.00	35.5%	26.5%	118.1%
1988	8.14	4.95	1.63	6.59	0.16	0.66	17.28	64.82	38.1%	26.7%	125.4%
1989	7.61	5.70	1.50	7.20	0.14	0.72	17.33	65.92	41.5%	26.3%	135.7%
1990	7.36	4.79	1.38	6.17	0.11	0.75	16.99	65.99	42.1%	25.7%	140.0%
1991	7.42	5.67	0.96	6.63	0.12	0.89	16.71	66.58	39.7%	25.1%	136.6%
1992	7.17	5.99	0.94	6.94	0.09	0.86	17.03	66.74	40.8%	25.5%	143.7%
1993	6.85	6.69	0.93	7.62	0.10	0.90	17.24	67.04	44.2%	25.7%	153.1%
1994	6.66	6.96	1.09	8.05	0.10	0.84	17.72	68.31	45.4%	25.9%	161.9%
1995	6.56	7.13	0.75	7.88	0.10	0.86	17.73	69.38	44.4%	25.6%	167.1%
1996	6.47	7.37	1.05	8.42	0.11	0.87	18.23	[c]	46.2%	[c]	172.7%
						Average annual percentage change					
1973–96	-1.5%	3.6%	-4.1%	1.5%	-	6.0%	0.2%	0.9%[d]			
1986–96	-2.9%	6.2%	-2.9%	4.5%	-3.1%	3.3%	1.1%	1.3%[d]			

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, February 97, pp. 42–47.
World petroleum consumption - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, December1996, p. 7.
(Additional resources: http://www.eia.doe.gov)

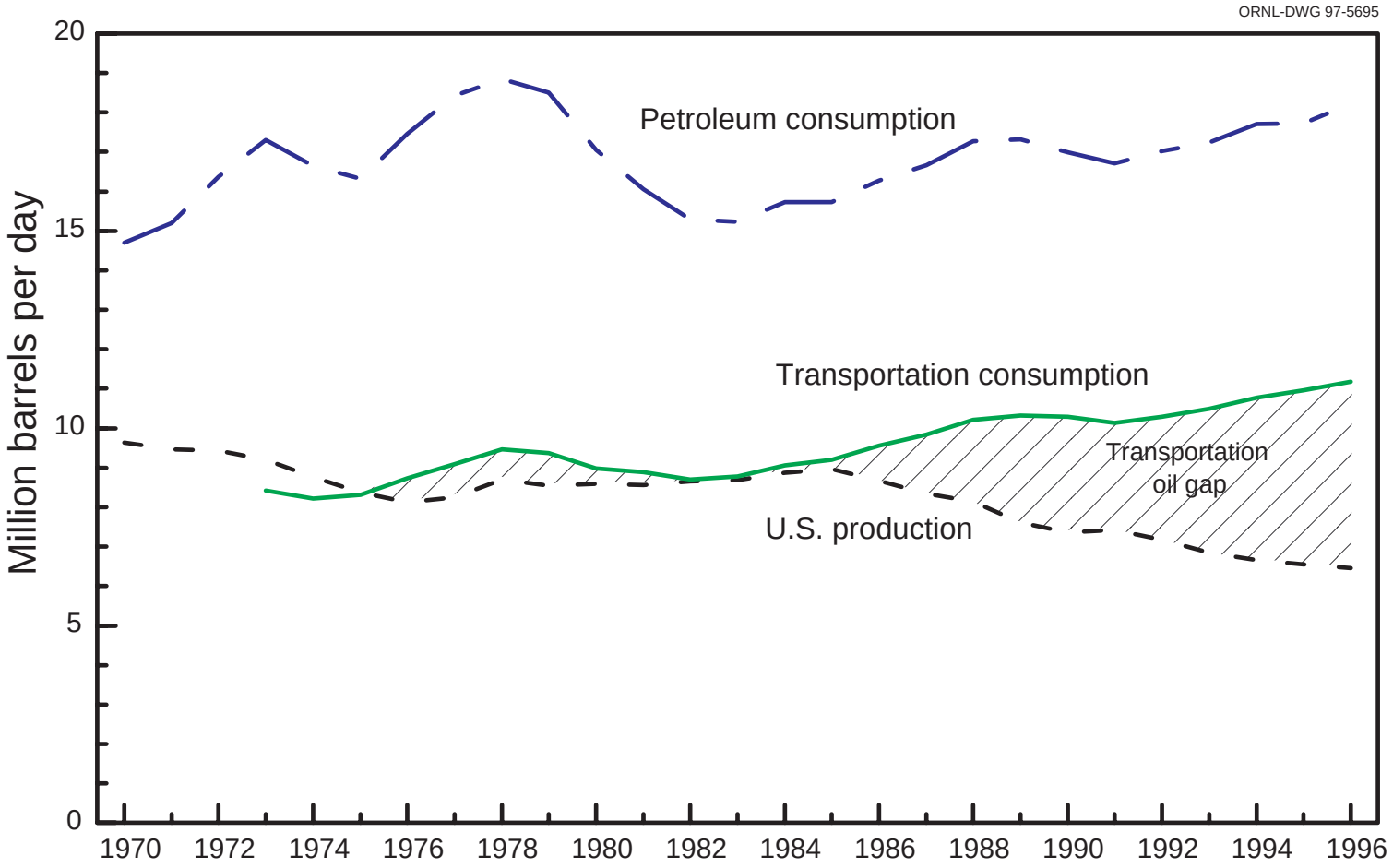
[a] Best estimate for U.S. petroleum consumption is the amount of petroleum products supplied to the U.S. in a given year. This is not the sum of crude oil production and net imports due to processing gain and stock changes.

[b] Transportation petroleum use can be found on Table 2.5.

[c] Data are not available.

[d] Average annual percentage change is for years 1973–93 and 1985–93.

Figure 2.1. United States Petroleum Production and Consumption, 1973-96



Source:
See Tables 2.2 and 2.5

Table 2.3
U. S. Imported Crude Oil and Petroleum Products by Country of Origin, 1990–95
(thousand barrels)

	1990		1994		1995		Percent of total 1995		Percent change 1990–95	
Country	Crude oil	Petroleum products	Crude oil	Petroleum products	Crude oil	Petroleum products	Crude oil	Petroleum products	Crude oil	Petroleum products
Arab OPEC	**680,248**	**138,964**	**597,174**	**122,055**	**549,471**	**109,741**	**20.8%**	**18.7%**	**-19.2%**	**-21.0%**
Algeria	23,035	79,280	7,714	81,030	9,789	75,686	0.4%	12.9%	-57.5%	-4.5%
Iraq	187,485	1,620	0	0	0	0	0.0%	0.0%	-100.0%	-100.0%
Kuwait	28,942	2,576	112,073	1,891	77,903	1,765	3.0%	0.3%	169.2%	-31.5%
Qatar	1,293	0	0	0	0	0	0.0%	0.0%	-100.0%	0.0%
Saudi Arabia	436,193	52,625	473,356	38,555	459,826	30,661	17.4%	5.2%	5.4%	-41.7%
United Arab Emirates	3,300	2,863	4,031	579	1,953	1,629	0.1%	0.3%	-40.8%	-43.1%
Other OPEC	**602,183**	**146,698**	**709,495** [a]	**121,429** [a]	**753,470** [a]	**131,550** [a]	**28.6%** [a]	**22.5%** [a]	**25.1%** [a]	**-10.3%** [a]
Ecuador	13,886	3,845								
Gabon	23,349	105	70,806	111	83,642	0	3.2%	0.0%	258.2%	-100.0%
Indonesia	35,912	5,836	33,526	7,033	23,258	8,840	0.9%	1.5%	-35.2%	51.5%
Iran	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%
Nigeria	286,126	5,833	227,638	5,002	226,574	2,410	8.6%	0.4%	-20.8%	-58.7%
Venezuela	242,910	131,079	377,525	109,283	419,996	120,300	15.9%	20.5%	72.9%	-8.2%
Non-OPEC	**868,956**	**489,346**	**1,271,403**	**462,065**	**1,335,869**	**344,652**	**50.6%**	**58.8%**	**53.7%**	**-29.6%**
Total	**2,151,387**	**775,008**	**2,578,072**	**705,549**	**2,638,810**	**585,943**	**100.0%**	**100.0%**	**22.7%**	**-24.4%**
Persian Gulf[b]	**657,213**	**59,684**	**589,460**	**41,271**	**539,682**	**34,350**	**20.5%**	**5.9%**	**-17.9%**	**-42.4%**

Source:
Energy Information Administration, Petroleum Supply Annual 1995, Volume 1, May 1996, p. 56, and annual.
(Additional resources: http://www.eia.doe.gov)

[a] On December 31, 1992, Ecuador withdrew as a member of OPEC. As of January 1, 1994, imports of petroleum from Ecuador are included with Non-OPEC countries.

[b] Includes Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.

Table 2.4
World Crude Oil Production by Country of Origin, 1980–95
(thousand barrels per day)

Country	1980	1985	1987	1990	1991	1993	1994	1995	Percent of total 1995	Percent change 1990–95
Arab OPEC	**17,357**	**8,375**	**10,811**	**13,323**	**12,621**	**14,296**	**14,486**	**14,812**	**23.7%**	**-11.2%**
Algeria	1,106	1,037	1,048	1,175	1,230	1,162	1,180	1,202	1.9%	2.3%
Iraq	2,514	1,433	2,079	2,040	305	512	553	560	0.9%	-72.5%
Kuwait	1,656	1,023	1,585	1,175	190	1,852	2,025	2,057	3.3%	75.1%
Qatar	472	301	293	406	395	413	415	483	0.8%	19.0%
Saudi Arabia	9,900	3,388	4,265	6,410	8,115	8,198	8,120	8,231	13.2%	28.4%
United Arab Emirates	1,709	1,193	1,541	2,117	2,386	2,159	2,193	2,279	3.6%	7.7%
Other OPEC[a]	**7,666**	**7,028**	**6,908**	**8,782**	**9,470**	**9,807**	**10,012**	**10,281**	**16.5%**	**17.1%**
Ecuador	204	281	174	285	299	346	365	392	0.6%	37.5%
Indonesia	1,577	1,325	1,343	1,462	1,592	1,511	1,510	1,503	2.4%	2.8%
Iran	1,662	2,250	2,298	3,088	3,312	3,540	3,618	3,643	5.8%	18.0%
Nigeria	2,055	1,495	1,341	1,810	1,892	1,960	1,931	1,993	3.2%	10.1%
Venezuela	2,168	1,677	1,752	2,137	2,375	2,450	2,588	2,750	4.4%	28.7%
North America	**11,968**	**13,187**	**12,432**	**11,461**	**11,644**	**11,199**	**11,093**	**10,982**	**17.6%**	**4.2%**
All others	**22,608**	**25,391**	**26,515**	**27,000**	**26,472**	**24,945**	**25,412**	**26,371**	**42.2%**	**-2.3%**
Total	**59,599**	**53,981**	**56,666**	**60,566**	**60,207**	**60,247**	**61,003**	**62,446**	**100.0%**	**3.1%**
Persian Gulf[b]	**16,299**	**7,380**	**9,805**	**12,190**	**11,429**	**13,233**	**13,347**	**13,651**	**21.9%**	**12.0%**

Source:
U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, December 1996, pp. 25–26.
(Additional resources: http://www.eia.doe.gov)

[a] Gabon withdrew from OPEC effective December 31, 1994. For consistency, Gabon is not included in the historical OPEC data.
[b] Includes Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.

Table 2.5
Consumption of Petroleum by End-Use Sector, 1973–96
(quadrillion Btu)

Year	Transportation	Percentage	Residential and commercial	Percentage	Industrial	Percentage	Electric utilities	Percentage	Total	Total in million barrels per day[a]
1973	17.83	51.2%	4.39	12.6%	9.10	26.1%	3.52	10.1%	34.84	16.46
1974	17.40	52.0%	4.00	12.0%	8.69	26.0%	3.37	10.1%	33.46	15.81
1975	17.61	53.8%	3.81	11.6%	8.15	24.9%	3.17	9.7%	32.74	15.47
1976	18.51	52.6%	4.18	11.9%	9.01	25.6%	3.48	9.9%	35.18	16.62
1977	19.24	51.8%	4.21	11.3%	9.77	26.3%	3.90	10.5%	37.12	17.53
1978	20.04	52.8%	4.07	10.7%	9.87	26.0%	3.99	10.5%	37.97	17.94
1979	19.83	53.4%	3.45	9.3%	10.57	28.5%	3.28	8.8%	37.13	17.54
1980	19.01	55.6%	3.04	8.9%	9.53	27.9%	2.63	7.7%	34.21	16.16
1981	18.81	58.9%	2.63	8.2%	8.29	26.0%	2.20	6.9%	31.93	15.08
1982	18.42	60.9%	2.45	8.1%	7.79	25.8%	1.57	5.2%	30.23	14.28
1983	18.59	61.9%	2.50	8.3%	7.42	24.7%	1.54	5.1%	30.05	14.19
1984	19.22	61.9%	2.54	8.2%	8.01	25.8%	1.29	4.2%	31.06	14.67
1985	19.50	63.1%	2.52	8.2%	7.81	25.3%	1.09	3.5%	30.92	14.61
1986	20.27	63.0%	2.56	8.0%	7.92	24.6%	1.45	4.5%	32.20	15.21
1987	20.87	63.5%	2.59	7.9%	8.15	24.8%	1.26	3.8%	32.87	15.53
1988	21.63	63.2%	2.60	7.6%	8.43	24.6%	1.56	4.6%	34.22	16.16
1989	21.87	63.9%	2.53	7.4%	8.13	23.8%	1.69	4.9%	34.22	16.16
1990	21.81	65.0%	2.17	6.5%	8.32	24.8%	1.25	3.7%	33.55	15.85
1991	21.46	65.3%	2.15	6.5%	8.06	24.5%	1.18	3.6%	32.85	15.52
1992	21.81	65.0%	2.13	6.4%	8.64	25.8%	0.95	2.8%	33.53	15.84
1993	22.20	65.6%	2.14	6.3%	8.45	25.0%	1.05	3.1%	33.84	15.98
1994	22.82	65.7%	2.09	6.0%	8.85	25.5%	0.97	2.8%	34.73	16.41
1995	23.20	66.9%	2.12	6.1%	8.69	25.1%	0.66	1.9%	34.67	16.38
1996	23.66	66.2%	2.22	6.2%	9.11	25.5%	0.73	2.0%	35.72	16.87
				Average annual percentage change						
1973–96	1.2%		-3.1%		0.0%		-6.6%		0.1%	0.1%
1986–96	1.6%		-1.4%		1.4%		-6.6%		1.0%	1.0%

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, pp. 27, 29, 31, 33.
(Additional resources: http://www.eia.doe.gov)

[a] Calculated from Total column. One million barrels per day of petroleum is approximately 2.117 quadrillion Btu per year.

Pipeline fuel, which is included in the transportation sector energy use, has grown at an annual rate of 3.4% from 1985–95. Natural gas vehicle fuel consumption was first reported in 1990 and has shown growth in recent years.

Table 2.6 Natural Gas Consumption in the United States, 1970–95
(quadrillion Btu)

Year	Lease and plant fuel	Pipeline fuel	Delivered to consumers						Total consumption
			Residential	Commercial	Industrial	Vehicle fuel	Electric utilities	Total	
1970	1.428	0.737	4.939	2.449	8.016	[a]	4.014	19.418	21.583
1975	1.426	0.595	5.028	2.561	7.115	[a]	3.224	17.927	19.948
1980	1.048	0.648	4.852	2.666	7.322	[a]	3.759	18.599	20.295
1981	0.947	0.656	4.642	2.573	7.277	[a]	3.717	18.208	19.811
1982	1.133	0.609	4.730	2.660	5.954	[a]	3.293	16.637	18.379
1983	0.999	0.500	4.473	2.484	5.761	[a]	2.972	15.689	17.188
1984	1.099	0.540	4.651	2.577	6.283	[a]	3.177	16.688	18.327
1985	0.986	0.514	4.526	2.483	6.025	[a]	3.108	16.143	17.644
1986	0.942	0.495	4.405	2.367	5.696	[a]	2.657	15.125	16.562
1987	1.174	0.530	4.405	2.481	6.078	[a]	2.904	15.869	17.572
1988	1.119	0.627	4.728	2.727	6.517	[a]	2.691	16.663	18.408
1989	1.092	0.643	4.881	2.775	6.959	[a]	2.846	17.461	19.196
1990	1.262	0.674	4.484	2.678	7.166	0.000	2.845	17.172	19.108
1991	1.153	0.614	4.651	2.786	7.383	0.000	2.848	17.668	19.435
1992	1.195	0.600	4.789	2.862	7.685	0.001	2.824	18.159	19.955
1993	1.197	0.637	5.061	2.922	8.149	0.001	2.739	18.871	20.705
1994	1.147	0.700	4.950	2.956	8.339	0.002	3.050	19.269	21.143
1995	1.246	0.715	4.952	3.095	8.760	0.003	3.264	20.073	22.034
			Average annual percentage change						
1970–95	-0.5%	-0.1%	0.0%	0.9%	0.4%	[a]	-0.8%	0.1%	0.1%
1985–95	2.4%	3.4%	0.9%	2.2%	3.8%	[a]	0.5%	1.5%	2.2%

Source:
U. S. Department of Energy, Energy Information Administration, Natural Gas Annual 1995, Washington, DC, Table 101, p. 205.
(Additional resources: http://www.eia.doe.gov)

Note:
All volumes are for standard conditions of atmospheric pressure and 60 degrees Fahrenheit converted to Btu using 1,021 Btu/cubic foot.

[a] Data are not available.

Details on alternative vehicle fuel use are found in Chapter 5.

Table 2.7
Distribution of Energy Consumption by Source, 1973 and 1996
(percentage)

Energy source	Transportation		Residential & Commercial		Industrial		Electric utilities	
	1973	1996	1973	1996	1973	1996	1973	1995
Petroleum	95.8	96.8	18.2	6.8	28.9	28.0	17.7	2.3
Natural gas[a]	4.0	3.0	31.6	26.6	32.9	31.6	18.9	8.6
Coal	0.0	0.0	1.1	0.4	12.8	7.4	43.6	55.1
Hydroelectric	0.0	0.0	0.0	0.0	0.1	0.1	15.0	11.6
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	4.6	22.0
Electricity[b]	0.2	0.2	49.2	66.2	25.2	32.9	0.0	0.0
Other[c]	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
Total	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 1997, 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.

Total energy use was nearly 90 quads in 1996. The transportation sector continues to account for more than 27% of total energy use.

Table 2.8
Consumption of Total Energy by End-Use Sector, 1970–96[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%	29.10	30.58	82.14
1993	22.88	27.3%	30.23	30.75	83.86
1994	23.57	27.5%	30.43	31.58	85.59
1995	23.96	27.5%	31.31	31.92	87.19
1996	24.44	27.2%	32.84	32.58	89.89
		Average annual percentage change			
1970–96	1.6%		1.6%	0.5%	1.2%
1986–96	1.6%		2.0%	2.0%	1.9%

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 2.2, p. 25. (Additional resources: http://www.eia.doe.gov)

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

Although the automobile energy use for 1995 is lower than in 1994 [Edition 16], it is due to a reclassification of minivans and sport utility vehicles by the Federal Highway Administration rather than a real usage decline. The sum of automobiles and light trucks will still produce a consistent trend. LPG shares from the 1992 Truck Inventory and Use Survey indicate an increase in truck LPG use.

Table 2.9
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1995[a]
(trillion Btu)

	Gasoline	Diesel fuel	Liquified petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity	Methanol
HIGHWAY	**14,492.0**	**3,820.3**	**25.5**			**3.0**	**1.2**	**0.7**
Automobiles	**8,434.3**[b]	**113.7**				**1.9**		**0.0**
Motorcycles	**24.5**							
Buses	**44.0**	**168.8**	**0.2**			**1.0**	**1.2**	**0.7**
Transit	5.4	79.0	0.2			1.0	1.2	0.7
Intercity[c]		25.4						
School[c]	38.6	64.4						0.0
Trucks	**5,989.2**	**3,537.8**	**25.3**			**0.1**		**0.0**
Light trucks[d]	5,405.2	205.7	12.2			0.1		0.0
Other trucks	584.0	3,332.1	13.1			0.0		0.0
OFF-HIGHWAY	**150.8**	**570.1**[e]						
Construction	**35.0**	**178.5**[e]						
Agriculture	**115.8**	**391.6**[e]						
NONHIGHWAY	**318.0**	**778.1**		**2,084.0**	**962.7**	**722.1**	**310.0**	
Air	**33.2**			**2,084.0**				
General aviation	33.2			73.4				
Domestic air carriers				1,710.7				
International air carriers[f]				299.9				
Water	**284.8**	**274.3**			**962.7**			
Freight		274.3			962.7			
Recreational	284.8							
Pipeline						**722.1**	**248.4**	
Rail		**503.8**					**61.6**	
Freight (Class I)		485.9						
Passenger		17.9					61.6	
Transit							43.6	
Commuter		8.7					14.7	
Intercity[c]		9.2					3.3	
TOTAL	**14,960.8**	**5,168.5**	**25.5**	**2,084.0**	**962.7**	**725.1**	**311.2**	**0.7**

Source:
See Appendix A for Table 2.9.

[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 1994 data have been revised to include the latest data available.

Table 2.10
Transportation Energy Use by Mode, 1994–95[a]

	Trillion Btu		Thousand barrels per day crude oil equivalent [b]		Percentage of total	
	1994	1995	1994	1995	1994	1995
HIGHWAY	**18,010.3**	**18,342.7**	**8,507.5**	**8,664.5**	**76.0%**	**75.7%**
Automobiles	**8,449.3**	**8,549.9**	**3,991.2**	**4,038.7**	**35.7%**	**35.3%**
Motorcycles	**25.6**	**24.5**	**12.1**	**11.6**	**0.1%**	**0.1%**
Buses	202.1	215.9	95.5	102.0	0.9%	0.9%
Transit	86.7	87.5	41.0	41.3	0.4%	0.4%
Intercity	24.7	25.4[c]	11.7	12.0	0.1%	0.1%
School	90.7	103.0[c]	42.8	48.7	0.4%	0.4%
Trucks	**9,333.3**	**9,552.4**	**4,408.7**	**4,512.2**	**39.4%**	**39.4%**
Light trucks [d]	5,557.4[c]	5,623.2	2,625.1	2,656.2	23.5%	23.2%
Other trucks	3,775.9	3,929.2	1,783.6	1,856.0	15.9%	16.2%
OFF-HIGHWAY	**716.4**	**720.9**	**338.4**	**340.5**	**3.0%**	**3.0%**
Construction	**211.8**	**213.5**	**100.0**	**100.9**	**0.9%**	**0.9%**
Agriculture	**504.6**	**507.4**	**238.4**	**239.7**	**2.1%**	**2.1%**
NONHIGHWAY	**4,971.3**	**5,174.9**	**2,348.3**	**2,444.4**	**21.0%**	**21.3%**
Air	**2,056.0**	**2,117.2**	**971.2**	**1,000.1**	**8.7%**	**8.7%**
General aviation	95.3	106.6	45.0	50.4	0.4%	0.4%
Domestic air carriers	1,671.9	1,710.7	789.7	808.1	7.1%	7.1%
International air carriers	288.8	299.9	136.4	141.7	1.2%	1.2%
Water	**1,413.8**	**1,521.8**	**667.8**	**718.8**	**6.0%**	**6.3%**
Freight	1,171.1	1,237.0	553.2	584.3	4.9%	5.1%
Recreational	242.7	284.8	114.6	134.5	1.0%	1.2%
Pipeline	**955.2**	**970.5**	**451.2**	**458.4**	**4.0%**	**4.0%**
Rail	**546.3**	**565.4**	**258.1**	**267.1**	**2.3%**	**2.3%**
Freight	465.4	485.9	219.8	229.5	2.0%	2.0%
Passenger	80.9	79.5	38.2	37.6	0.3%	0.3%
Transit	43.9	43.6	20.7	20.6	0.2%	0.2%
Commuter	23.2	23.4	11.0	11.1	0.1%	0.1%
Intercity	13.8	12.5[c]	6.5	5.9	0.1%	0.1%
TOTAL	**23,698.0**	**24,238.5**	**11,194.1**	**11,449.5**	**100.0%**	**100.0%**

Source: See Appendix A for Table 2.9.

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

Starting with the 1993 data, the automobile and light truck categories were redefined to include minivans and sport utility vehicles in the light truck category. The sum of these categories will still produce a consistent trend.

Table 2.11
Transportation Energy Consumption by Mode, 1970–95
(trillion Btu)

Year	Automobiles	Motorcycles	Buses[a]	Light trucks[b]	Other trucks	Total highway	Air	Water	Pipeline	Rail[c]	Total nonhighway	Total transportation[d]
1970	8,527	7	109	1,540	1,503	11,688	1,307	753	985	558	3,603	15,291
1971	8,971	9	108	1,687	1,568	12,343	1,304	698	1,007	560	3,569	15,912
1972	9,583	11	106	1,895	1,684	13,279	1,314	703	1,039	583	3,639	16,918
1973	9,891	13	109	2,105	1,844	13,962	1,377	827	996	619	3,819	17,781
1974	9,440	14	113	2,083	1,791	13,441	1,254	804	932	624	3,614	17,055
1975	9,611	14	119	2,239	1,789	13,772	1,274	851	835	563	3,523	17,295
1976	10,020	15	129	2,522	1,949	14,635	1,333	1,001	803	585	3,722	18,357
1977	10,108	16	132	2,739	2,156	15,151	1,411	1,103	781	595	3,890	19,041
1978	10,267	18	135	3,009	2,408	15,837	1,467	1,311	781	589	4,148	19,985
1979	9,719	22	137	3,095	2,510	15,483	1,568	1,539	856	613	4,576	20,059
1980	9,037	26	139	2,951	2,425	14,578	1,528	1,677	889	596	4,690	19,268
1981	8,927	27	143	2,964	2,461	14,522	1,455	1,562	899	565	4,481	19,003
1982	8,814	25	146	2,982	2,430	14,397	1,468	1,290	853	488	4,096	18,493
1983	8,762	22	145	3,196	2,598	14,723	1,505	1,187	738	482	3,912	18,635
1984	8,613	22	154	3,463	2,837	15,089	1,633	1,251	780	523	4,187	19,276
1985	8,673	23	161	3,630	2,924	15,411	1,678	1,311	758	487	4,234	19,645
1986	8,917	23	154	3,785	3,007	15,885	1,823	1,295	738	423	4,329	20,214
1987	8,836	24	157	4,036	3,132	16,185	1,894	1,326	775	485	4,480	20,665
1988	9,005	25	159	4,114	3,315	16,618	1,978	1,338	878	498	4,692	21,310
1989	9,106	26	163	4,139	3,386	16,820	1,981	1,376	895	501	4,753	21,573
1990	9,010	24	163	4,130	3,366	16,693	2,059	1,487	928	492	4,966	21,659
1991	8,845	23	174	4,080	3,302	16,424	1,926	1,567	864	463	4,820	21,244
1992	9,237	24	182	4,155	3,381	16,971	1,971	1,641	849	476	4,937	21,908
1993	9,204	25	192	4,563	3,542	17,527	1,996	1,473	889	513	4,871	22,399
1994	8,449	26	202	5,557	3,776	18,010	2,056	1,414	955	546	4,971	22,981
1995	8,550	25	216	5,623	3,929	18,343	2,117	1,522	971	565	5,174	23,517
					Average annual percentage change							
1970–95	0.0%	5.2%	2.8%	5.3%	3.9%	1.8%	1.9%	2.9%	-0.1%	0.0%	1.5%	1.7%
1985–95	-0.1%	0.8%	3.0%	4.5%	3.0%	1.8%	2.4%	1.5%	2.5%	1.5%	2.0%	1.8%

Source:
See Appendix A for Table 2.11.

[a]Beginning in 1992 data became available on alternative fuel use by transit buses.
[b]Light trucks include only those trucks which have two-axles **and** four-tires. Starting in 1993, this category includes minivans and sport utility vehicles.
[c]This data have changed from previous editions due to a change in source for Class I freight railroad energy use. Previous estimates were based on sales.
[d]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.

Table 2.12
Highway Usage of Gasoline and Special Fuels, 1973–95
(million gallons)

Year	Gasoline	Gasohol	Total gasoline and gasohol	Special fuels[a]	Percent special fuels	Total highway fuel use
1973	[b]	[b]	100,636	9,837	8.9%	110,473
1974	[b]	[b]	96,505	9,796	9.2%	106,301
1975	[b]	[b]	99,354	9,631	8.8%	108,985
1976	[b]	[b]	104,978	10,721	9.3%	115,699
1977	[b]	[b]	107,978	11,646	9.7%	119,624
1978	[b]	[b]	112,239	12,828	10.3%	125,067
1979	[b]	[b]	108,126	13,989	11.5%	122,115
1980	100,686	497	101,183	13,777	12.0%	114,960
1981	98,884	713	99,597	14,856	13.0%	114,453
1982	96,220	2,259	98,479	14,905	13.1%	113,384
1983	95,852	4,254	100,106	15,975	13.8%	116,081
1984	95,996	5,420	101,416	17,320	14.6%	118,736
1985	95,567	8,004	103,571	17,751	14.6%	121,322
1986	98,618	8,138	106,756	18,427	14.7%	125,183
1987	101,790	6,912	108,702	19,046	14.9%	127,748
1988	101,678	8,138	109,816	20,070	15.5%	129,886
1989	103,691	6,941	110,632	21,232	16.1%	131,864
1990	102,645	7,539	110,184	21,399	16.3%	131,583
1991	99,304	8,644	107,948	20,676	16.1%	128,624
1992	102,119	8,831	110,950	21,988	16.5%	132,938
1993	103,417	10,287	113,704	23,490	17.1%	137,194
1994	103,997	11,010	115,007	25,124	17.9%	140,131
1995	103,968	13,093	117,061	26,206	18.3%	143,267
			Average annual percentage change			
1973-95			0.7%	4.6%		1.2%
1985-95	0.8%	5.0%	1.2%	4.0%		1.7%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, pp. I-3, I-6, and annual. (Additional resources: http://www.fhwa.dot.gov)

[a]Special fuels consist primarily of diesel fuel, with small quantities of liquified petroleum gas.
[b]Data for gasoline and gasohol cannot be separated in this year.

Comparing energy intensity data between modes should be done with caution. These national estimates are generated from the best available data, but individual circumstances play a major role in energy intensity. Influences such as locality and equipment can significantly change energy intensity.

Table 2.13
Passenger Travel and Energy Use in the United States, 1995

	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger-miles (millions)	Load factor (persons/vehicle)	Energy intensities (Btu per vehicle-mile)	Energy intensities (Btu per passenger-mile)	Energy use (trillion Btu)
Automobiles	**136,066.0**	**1,541,458**	**2,466,333**	**1.6**	**5,547**	**3,467**	**8,549.9**
Personal trucks	**43,592.8**	**477,092**	**715,638**	**1.5**	**8,067**	**5,378**	**3,848.8**
Motorcycles	**3,767.0**	**9,797**	**13,716**	**1.4**	**2,501**	**1,786**	**24.5**
Buses	**647.6**	**8,428**	**142,818**	**16.9**	**24,063**	**1,420**	**202.8**
Transit	67.1	2,178	18,818	8.6	40,175	4,650	87.5
Intercity	20.1	1,250	29,000	23.2	20,320[a]	876[a]	25.4[a]
School	560.4	5,000	95,000	19.0	18,120[a]	954[a]	103.0[a]
Air	[b]	**7,927**	**415,188**	**52.4**	**229,254**	**4,377**	**1,817.3**
Certificated route	[b]	4,629	403,888	87.3	369,562	4,236	1,710.7
General aviation	181.3	3,298[c]	11,300	3.4	32,323	9,434	106.6
Recreational boats	**11,700.0**	[b]	[b]	[b]	[b]	[b]	**284.8**
Rail	**18.1**	**1,193**	**25,067**	**21.0**	**66,639**	**3,172**	**79.5**
Intercity[d]	2.3[e]	283[f]	5,401[g]	19.1	44,170	2,315	12.5[a]
Transit[h]	11.2	572	11,419	20.0	76,224	3,818	43.6
Commuter	4.6	238	8,247	34.7	98,319	2,837	23.4

Source:
See Appendix A for Table 2.13.

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

Comparing energy intensity data between modes should be done with caution. These national estimates are generated from the best available data, but individual circumstances play a major role in energy intensity. Influences such as locality, equipment, and commodity can significantly change energy intensity.

Table 2.14
Intercity Freight Movement and Energy Use in the United States, 1995

	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]	**1,825**	**110,127**	**921,000**	**3,373**	**646[b]**	**2,922**	**2,691.0**
Waterborne commerce[c]	**40**	**[d]**	**807,728**	**1,086**	**744**	**374**	**302.2**
Coastwise	[d]	[d]	440,345	267	1,652	[d]	[d]
Lakewise	[d]	[d]	59,704	116	514	[d]	[d]
Internal and local	[d]	[d]	307,679	703	437	[d]	[d]
Pipeline	**[d]**	**[d]**	**[d]**	**1,672**	**[d]**	**[d]**	**917.8**
Natural gas	[d]	[d]	[d]	554	[d]	[d]	759.4
Crude oil and products	[d]	[d]	599,000	1,118	[d]	264	158.4
Class I railroads[e]	**583**	**30,383**	**1,305,688**	**2,322**	**843**	**372**	**485.9**

Source:
See Appendix A for Table 2.14.

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

[b]646 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 274 miles.

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

[d]Data are not available.

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

Comparing energy intensity data among modes should be done with caution. These national estimates are generated from the best available data, but individual circumstances play a major role in energy intensity. Influences such as locality and equipment can significantly change energy intensity.

Table 2.15
Energy Intensities of Passenger Modes, 1970–95

	Automobiles		Buses				Air		Rail	
			Transit[a]		Intercity	School	Certificated air carriers	General aviation	Intercity Amtrak	Rail transit
Year	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)	(Btu per vehicle-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)	(Btu per passenger-mile)
1970	9,302	5,472	31,796	2,472	1,051	17,857	10,351	10,374	[b]	2,453
1975	9,295	5,468	33,748	2,814	976	17,040	7,883	10,658	3,677	2,962
1976	9,293	5,467	34,598	2,896	996	17,051	7,481	10,769	3,397	2,971
1977	9,113	5,360	35,120	2,889	961	16,983	7,174	11,695	3,568	2,691
1978	8,955	5,268	36,603	2,883	953	17,018	6,333	11,305	3,683	2,210
1979	8,727	5,134	36,597	2,795	963	16,980	5,858	10,787	3,472	2,794
1980	8,130	4,782	36,553	2,813	1,069	16,379	5,837	11,497	3,176	3,008
1981	7,894	4,644	37,745	3,027	1,155	16,385	5,743	11,123	2,957	2,946
1982	7,558	4,446	38,766	3,237	1,149	16,296	5,147	13,015	3,156	3,069
1983	7,314	4,302	37,962	3,177	1,174	16,236	5,107	11,331	2,957	3,212
1984	7,031	4,136	37,507	3,204	1,247	14,912	5,031	11,912	3,027	3,732
1985	6,880	4,047	38,862	2,421	1,324	16,531	5,679	11,339	2,800	3,461
1986	6,853	4,031	39,869	3,512	869	15,622	5,447	11,935	2,574	3,531
1987	6,519	3,835	38,557	3,542	939	15,615	4,753	11,218	2,537	3,534
1988	6,299	3,705	39,121	3,415	965	15,585	4,814	11,966	2,462	3,585
1989	6,162	3,851	36,583	3,711	963	15,575	4,796	10,984	2,731	3,397
1990	5,954	3,721	36,647	3,735	944	16,368	4,811	10,146	2,609	3,453
1991	5,768	3,605	36,939	3,811	978	16,419	4,560	9,556	2,503	3,710
1992	5,770	3,606	40,472[c]	4,303[c]	978	16,386	4,482	8,582	2,610	3,575
1993	5,948	3,418	39,005	4,257	972	19,093	4,304	9,343	2,646	3,687
1994	5,628	3,517	40,102	4,604	876	20,591	4,455	9,825	2,351	3,828
1995	5,547	3,467	40,175	4,650	876	20,600	4,236	9,434	2,341	3,818
					Average annual percentage change					
1970–95	-2.0%	-1.8%	0.9%	2.6%	-0.7%	0.6%	-3.5%	-0.4%	-2.1%[d]	1.8%
1985–95	-2.1%	-1.5%	0.3%	6.7%	-4.0%	2.2%	-2.9%	-1.8%	-1.8%	1.0%

Source:
See Appendix A for Table 2.15.

[a]Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA).
[b]Data are not available.
[c]Beginning in 1992 data became available on alternative fuel use by transit buses.
[d]Average annual percentage change is for years 1973–95.

Comparing energy intensity data among modes should be done with caution. These national estimates are generated from the best available data, but individual circumstances play a major role in energy intensity. Influences such as locality, equipment, and commodity can significantly change energy intensity.

Table 2.16
Energy Intensities of Freight Modes, 1970–95

Year	Trucks			Class I freight railroad		Domestic waterborne commerce (Btu per ton-mile)
	Light truck[a] (Btu per vehicle-mile)	Other trucks (Btu per vehicle-mile)	Total trucks (Btu per vehicle-mile)	(Btu per freight car-mile)	(Btu per ton-mile)	
1970	12,491	24,158	16,404	17,668	691	545
1971	12,236	23,685	15,950	18,814	717	506
1972	12,099	23,350	15,646	18,292	714	522
1973	11,904	23,251	15,417	18,468	677	576
1974	11,398	22,555	14,777	18,852	681	483
1975	11,156	21,997	14,282	18,741	687	549
1976	11,167	22,644	14,334	18,938	680	468
1977	10,930	22,690	14,163	19,225	669	458
1978	10,769	22,773	14,064	18,930	641	383
1979	10,603	23,027	13,981	19,187	618	457
1980	10,143	22,352	13,459	18,742	597	358
1981	10,002	22,640	13,394	18,628	572	360
1982	9,741	22,736	13,103	18,403	553	310
1983	9,755	22,958	13,144	17,863	525	319
1984	9,673	22,893	13,073	17,797	510	346
1985	9,730	23,100	13,117	17,500	497	446
1986	9,729	23,106	13,082	17,265	486	463
1987	9,715	23,097	13,008	16,791	456	402
1988	9,361	23,445	12,789	16,758	443	361
1989	9,110	22,829	12,486	16,896	437	403
1990	8,861	22,468	12,171	16,618	420	388
1991	8,629	21,907	11,838	15,834	391	386
1992	8,689	22,127	11,943	16,044	393	398
1993	7,960[b]	22,150	11,054	16,055	389	389
1994	8,303[b]	22,183	11,117	16,338	388	369
1995	8,185[b]	22,054	11,042	15,993	372	374
	Average annual percentage change					
1970–95	-1.7%	-0.4%	-1.6%	-0.4%	-2.4%	-1.5%
1985–95	-1.7%	-0.5%	-1.7%	-0.9%	-2.9%	-1.7%

Source:
See Appendix A for Table 2.16.

[a]All two-axle, four-tire trucks (which would include trucks which may not carry freight).
[b]These data include minivans and sport utility vehicles, which were not previously included in this category.

Prices for alternative fuels can be found in Chapter 5. The prices of all motor fuels (in current dollars) rose by at least 8 cents in 1996.

Table 2.17
Retail Prices for Motor Fuel, 1978–96
(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
			Average annual percentage change					
1978–96	0.8%[e]	-3.2%[e]	3.4%	-1.5%	-0.3%[f]	-3.8%[f]	3.9%	-1.1%
1986–96	2.0%[e]	-1.6%[e]	2.9%	-0.7%	2.7%	-0.9%	3.3%	-0.3%

Source:
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.4, p. 114.
Diesel - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, Washington, DC, December 1996, p.102
(Additional resources: http://www.eia.doe.gov)

[a]Collected from a survey of prices on January 1 of the current year.

[b]These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.

[c]Adjusted by the Consumer Price Inflation Index.

[d]Data are not available.

[e]Average annual percentage change is for years 1980–94 and 1985–94.

[f]Average annual percentage change is for years 1981–95.

*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. Prices for alternative fuels are found in Chapter 5.*

Table 2.18
Prices for Selected Transportation Fuels, 1978–96
(cents per gallon, excluding tax)

	Propane[a]		Finished aviation gasoline		Kerosene-type jet fuel		No. 2 diesel fuel	
Year	Current	Constant 1990[b]	Current	Constant 1990	Current	Constant 1990[b]	Current	Constant 1990[b]
1978	33.5	67.1	51.6	103.4	38.7	77.5	37.7	75.5
1979	35.7	64.3	68.9	124.0	54.7	98.5	58.5	105.3
1980	48.2	76.4	108.4	171.9	86.6	137.3	81.8	129.7
1981	56.5	81.2	130.3	187.2	102.4	147.1	99.5	143.0
1982	59.2	80.1	131.2	177.6	96.3	130.4	94.2	127.5
1983	70.9	93.0	125.5	164.6	87.8	115.2	82.6	108.4
1984	73.7	92.7	123.4	155.3	84.2	105.9	82.3	103.5
1985	71.7	87.1	120.1	145.9	79.6	96.7	78.9	95.9
1986	74.5	88.8	101.1	120.5	52.9	63.0	47.8	57.0
1987	70.1	80.6	90.7	104.3	54.3	62.4	55.1	63.4
1988	71.4	78.9	89.1	98.4	51.3	56.7	50.0	55.3
1989	61.5	64.8	99.5	104.9	59.2	62.4	58.5	61.7
1990	74.5	74.5	112.0	112.0	76.6	76.6	72.5	72.5
1991	73.0	70.0	104.7	100.4	65.2	62.6	64.8	62.1
1992	64.3	59.9	102.7	95.6	61.0	58.3	61.9	57.6
1993	67.3	60.9	99.0	89.6	58.0	52.5	60.2	54.5
1994	53.0	46.7	95.7	84.3	53.4	47.1	55.4	48.9
1995	49.2	42.2	100.5	86.1	54.0	46.2	56.0	48.0
1996	62.1	51.7	111.1	92.5	65.1	54.2	68.1	56.7
				Average annual percentage change				
1978–96	3.5%	-1.4%	4.4%	-0.6%	2.9%	-2.0%	3.3%	-1.6%
1986–96	-1.8%	-5.3%	0.9%	-2.6%	2.1%	-1.5%	3.6%	-0.1%

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.7, p. 117.
(Additional resources: http://www.eia.doe.gov)

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

Though the average price of a barrel of crude oil (in constant 1990 dollars) declined by 7% from 1990 to 1996, the average price of a gallon of gasoline declined 12% in this same time period. There could be many reasons for this difference—for example, changes in Federal and State gasoline taxes and differences in crude oil processing cost.

Table 2.19
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978–96

	Crude oil[a] (dollars per barrel)		Gasoline[b] (cents per gallon)		Ratio of gasoline to crude oil
Year	Current	Constant 1990[c]	Current	Constant 1990[c]	
1978	12.46	24.96	65.2	130.6	0.22
1979	17.72	31.90	88.2	158.8	0.21
1980	28.07	44.52	122.1	193.6	0.18
1981	35.24	50.63	135.3	194.4	0.16
1982	31.87	43.15	128.1	173.4	0.17
1983	28.99	38.03	122.5	160.7	0.18
1984	28.63	36.02	119.8	150.7	0.18
1985	26.75	32.50	119.6	145.3	0.19
1986	14.55	17.34	93.1	111.0	0.27
1987	17.90	20.58	95.7	110.0	0.23
1988	14.67	16.21	96.3	106.4	0.28
1989	17.97	18.94	106.0	111.7	0.25
1990	22.22	22.22	121.7	121.7	0.23
1991	19.06	18.28	119.6	114.7	0.26
1992	18.43	17.16	119.0	110.8	0.27
1993	16.41	14.85	117.3	106.2	0.30
1994	15.59	13.75	117.4	103.6	0.32
1995	17.24	14.77	120.5	103.3	0.34
1996	20.65	17.20	128.8	107.3	0.38
		Average annual percentage change			
1978–96	2.8%	-2.0%	3.9%	-1.1%	
1986–96	3.6%	-0.1%	3.3%	-0.3%	

Sources:
Crude oil - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.1, p. 111.
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.4, p. 114.
(Additional resources: http://www.eia.doe.gov)

[a]Refiner acquisition cost of composite (domestic and imported) crude oil.

[b]Average for all types. These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.

[c]Adjusted by the Consumer Price Inflation Index.

Table 2.20
Economic Indicators, 1970–96
(billion dollars)

Year	Gross National Product		Total transportation outlays		
	Current	Constant 1990[a]	Current	Constant 1990[a]	Transportation as a percent of GNP
1970	1,015.5	3,031.3	195.2	583	19.2%
1980	2,732.0	4,167.4	542.9	828	19.8%
1990	5,567.8	5,567.8	964.6	965	17.3%
1995	7,246.7	6,224.9	1,150.5	988	15.9%
	Personal Consumption Expenditures		Transportation Personal Consumption Expenditures[b]		Transportation PCE as a percent of total PCE
1970	640.0	1,910.4	81.5	243.3	12.7%
1980	1,732.6	2,642.9	238.5	363.8	13.8%
1990	3,761.2	3,761.2	453.9	453.7	12.1%
1996	5,152.0	4,291.6	578.3	481.7	11.2%

Sources:
GNP - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, April 1997, Table 1.9, p. D-4, and annual. (Additional resources: http://www.bea.doc.gov)
Transportation outlays - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, 1995, p. 38.
PCE - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July 1995, Table 2.2, p. 12, and annual. (Additional resources: http://www.bea.doc.gov/bea/scbinf.html)

Table 2.21
Consumer Price Indices, 1970–96
(1970 = 1.000)

Year	Consumer Price Index	Transportation Consumer Price Index[c]	New car Consumer Price Index	Used car Consumer Price Index	Gross National Product
1970	1.000	1.000	1.000	1.000	1.000
1980	2.122	2.216	1.667	1.995	2.690
1990	3.365	3.213	2.283	3.769	5.483
1996	4.040	3.813	2.668	5.032	7.452

Source:
Bureau of Labor Statistics, Consumer Price Index Table 1A for 1996, and annual.
(Additional resources: http://stats.bls.gov/cpihome.htm)

[a] Adjusted by the implicit GNP price deflator.

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

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

Table 2.22
Average Price of a New Car, 1970–95

Year	Domestic[a]		Import		Total		Estimated Average New Car Price for a 1967 "Comparable Car"	
	Current dollars	Constant 1990 dollars[b]	Current dollars	Constant 1990 dollars[b]	Current dollars	Constant 1990 dollars[b]	With added safety & emissions equipment[c]	Without added safety & emissions equipment[d]
1970	3,708	12,479	2,648	8,912	3,542	11,920	3,601	3,459
1971	3,919	12,645	2,769	8,935	3,742	12,074	3,777	3,601
1972	4,034	12,601	2,994	9,352	3,879	12,117	3,789	3,570
1973	4,181	12,295	3,344	9,834	4,052	11,915	3,903	3,572
1974	4,524	11,988	4,206	11,146	4,440	11,766	4,237	3,779
1975	5,084	12,344	4,384	10,645	4,950	12,019	4,686	4,103
1976	5,506	12,640	4,923	11,301	5,418	12,438	4,988	4,362
1977	5,985	12,906	5,072	10,938	5,814	12,538	5,272	4,593
1978	6,478	12,976	5,934	11,886	6,379	12,778	5,687	4,944
1979	6,889	12,403	6,704	12,070	6,847	12,327	6,176	5,337
1980	7,609	12,067	7,482	11,886	7,574	12,012	6,863	5,764
1981	8,912	12,805	8,896	12,782	8,910	12,802	7,700	6,115
1982	9,865	13,356	9,957	13,480	9,890	13,390	8,078	6,350
1983	10,516	13,797	10,868	14,259	10,606	13,915	8,387	6,544
1984	11,172	14,054	12,354	15,541	11,450	14,404	8,685	6,742
1985	11,589	14,081	12,853	15,616	11,902	14,461	8,984	6,958
1986	12,526	14,931	13,815	16,467	12,894	15,370	9,395	7,259
1987	12,922	14,860	14,470	16,641	13,386	15,394	9,743	7,518
1988	13,542	14,964	15,378	16,993	14,065	15,542	9,995	7,668
1989	14,193	14,959	15,829	16,684	14,645	15,436	10,248	7,825
1990	14,886	14,886	17,164	17,164	15,472	15,472	10,581	7,938
1991	15,773	15,126	17,019	16,321	16,083	15,424	11,152	8,224
1992	16,389	15,258	19,601	18,249	18,141	16,889	11,458	8,424
1993	16,673	15,089	21,477	19,437	17,678	15,999	11,806	8,631
1994	17,575	15,501	23,211	20,472	18,657	16,455	12,427	8,925
1995	17,174	14,718	23,995	20,564	18,360	15,735	12,857	9,115
1996	16,998	14,159	27,427	22,847	18,563	15,463	13,196	9,281
				Average annual percentage change				
1970–96	6.0%	0.5%	9.4%	3.7%	6.6%	1.0%	5.1%	3.9%
1986–96	3.1%	-0.5%	7.1%	3.3%	3.7%	0.1%	3.5%	2.5%

Source:
American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p.60.
1996 Data: American Automobile Manufacturers Association, Economic Indicators, Fourth Quarter 1996 Detroit, MI, February 1997, p.24.
(Additional resources: http://www.aama.com)

[a] Includes transplants.

[b] Adjusted by the Consumer Price Inflation Index.

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

[d] 1967 "Average Transaction Price" inflated to current dollars.

The total cost of operating an automobile is the sum of the fixed cost (depreciation, insurance, finance charge, and license fee) and the variable cost, which is related to the amount of travel. The cost of operating a car in 1996 (constant 1990 cents) was approximately 43 cents per mile. Gas and oil accounted for less than 12% of total cost per mile in 1996, the lowest percentage in the 20-year series.

Table 2.23
Automobile Operating Cost per Mile, 1975–96

Model year [c]	Variable costs (constant 1990 cents per mile [a])				Constant 1990 dollars per 10,000 miles [a]			Total cost per mile [b] (constant 1990 cents [a])
	Gas and oil	Percentage gas and oil of total cost	Maintenance	Tires	Variable cost	Fixed cost	Total cost	
1975	11.70	26.3%	2.36	1.60	1,566	2,880	4,446	44.46
1977	8.86	20.3%	2.22	1.42	1,251	3,103	4,354	43.54
1979	7.40	17.1%	1.98	1.17	1,055	3,260	4,315	43.15
1980	9.29	21.0%	1.78	1.01	1,208	3,224	4,433	44.33
1981	9.01	19.6%	1.70	1.03	1,174	3,413	4,586	45.86
1982	9.12	21.5%	1.35	0.97	1,133	3,145	4,243	42.43
1983	8.71	19.9%	1.36	0.89	1,097	3,287	4,384	43.84
1984	7.79	19.8%	1.31	0.79	989	2,952	3,940	39.40
1985	7.48	22.6%	1.49	0.79	977	2,328 [d]	3,304 [d]	33.04 [d]
1986	5.34	15.1%	1.63	0.80	777	2,750 [d]	3,577 [d]	35.27 [d]
1987	5.52	14.7%	1.84	0.92	828	2,925 [d]	3,753 [d]	37.53 [d]
1988	5.74	15.6%	1.77	0.88	840	2,851 [d]	3,691 [d]	36.91 [d]
1989	5.48	13.6%	2.00	0.84	833	3,194 [d]	4,027 [d]	40.27 [d]
1990	5.40	13.2%	2.10	0.90	840	3,256 [d]	4,096 [d]	40.96 [d]
1991	6.43	15.4%	2.11	0.86	940	3,245 [d]	4,185 [d]	41.85 [d]
1992	5.59	13.1%	2.05	0.84	847	3,414 [d]	4,261 [d]	42.61 [d]
1993	5.43	13.3%	2.17	0.81	842	3,244 [d]	4,085 [d]	40.85 [d]
1994	4.94	12.0%	2.21	0.97	811	3,303 [d]	4,115 [d]	41.15 [d]
1995	5.14	12.3%	2.23	1.20	857	3,335 [d]	4,192 [d]	41.92 [d]
1996	4.91	11.5%	2.33	1.17	841	3,443 [d]	4,284	42.84 [d]
			Average annual percentage change					
1975–84	-4.4%		-6.3%	-7.5%	-5.0%	0.3%	-1.3%	-1.3%
1986–96	-0.8%		3.6%	3.9%	0.8%	2.3%	1.8%	1.8%

Source:
American Automobile Association, "Your Driving Costs," 1996 Edition, Heathrow, FL, and annual. (Additional resources: http://www.aaa.com, http://www.runzheimer.com)

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

Table 2.24
Fixed Automobile Operating Costs per Year, 1975–96
(constant 1990 dollars)

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

Source:
American Automobile Association, "Your Driving Costs," 1996 Edition, Heathrow, FL, and annual. (Additional resources: http://www.aaa.com, http://www.runzheimer.com)

[a] $50 deductible 1975 through 1977; $100 deductible 1978 through 1992; $250 deductible for 1993 through 1996.
[b] $100 deductible through 1977; $250 deductible 1978 through 1992; $500 deductible for 1993 through 1996.
[c] Coverage: $100,000/$300,000.

Table 2.25
Motor Vehicle Manufacturing Employment Statistics, 1972–95

Year	Motor vehicle manufacturing employees (thousands)	Sales of domestic automobiles[a] (thousands)	Sales of domestic light trucks[a] (thousands)	Employees per hundred vehicles sold	Expenditure per new domestic vehicle	Total domestic vehicle expenditures[b] (millions)	Employees per million dollar expenditure (current)	Employees per million dollar expenditure (constant 1990[c])
1972	415	9,327	2,096	3.6	$4,034	$46,080	9.0	3.3
1973	462	9,676	2,512	3.8	$4,181	$50,958	9.1	3.5
1974	416	7,454	2,163	4.3	$4,524	$43,507	9.6	4.0
1975	375	7,053	2,053	4.1	$5,084	$46,295	8.1	3.7
1976	416	8,611	2,720	3.7	$5,506	$62,388	6.7	3.2
1977	442	9,109	3,108	3.6	$5,985	$73,119	6.0	3.1
1978	470	9,312	3,473	3.7	$6,478	$82,821	5.7	3.1
1979	463	8,341	2,844	4.1	$6,889	$77,053	6.0	3.6
1980	368	6,581	1,959	4.3	$7,609	$64,981	5.7	3.7
1981	359	6,209	1,745	4.5	$8,912	$70,886	5.1	3.6
1982	318	5,759	2,062	4.1	$9,865	$77,154	4.1	3.1
1983	349	6,795	2,518	3.7	$10,516	$97,936	3.6	2.7
1984	392	7,952	3,257	3.5	$11,172	$125,227	3.1	2.5
1985	409	8,205	3,691	3.4	$11,589	$137,863	3.0	2.4
1986	400	8,215	3,671	3.4	$12,526	$148,884	2.7	2.3
1987	381	7,081	3,785	3.5	$12,922	$140,410	2.7	2.4
1988	357	7,526	4,195	3.0	$13,542	$158,725	2.2	2.0
1989	350	7,073	4,108	3.1	$14,193	$158,692	2.2	2.1
1990	329	6,897	3,948	3.0	$14,886	$161,439	2.0	2.0
1991	316	6,137	3,595	3.2	$15,773	$153,503	2.1	2.1
1992	314	6,277	4,233	3.0	$16,389	$172,248	1.8	2.0
1993	319	6,742	4,987	2.7	$16,673	$195,558	1.6	1.8
1994	340	7,255	5,638	2.6	$17,575	$226,594	1.5	1.7
1995	355	7,129	5,663	2.8	$17,174	$219,690	1.6	1.9
				Average annual percentage change				
1972–95	-0.7%	-1.2%	4.4%	-1.1%	6.5%	7.0%	-7.2%	-2.4%
1985–95	-1.4%	-1.4%	4.4%	-1.9%	5.1%	4.8%	-6.1%	-2.3%

Source:

Employees - American Automobile Manufacturers Association, Economic Indicators, Second Quarter,1995, Detroit, MI, 1996, p. 18.

Sales and expenditures - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, pp. 20, 21, 60, and annual.

[a] Vehicles produced in North America.

[b] Less than 10,000 pounds gross vehicle weight.

[c] Estimated as vehicle sales multiplied by average expenditure. Adjusted by the implicit Gross National Product price deflator, estimated as vehicle sales multiplied by average expenditure.

Table 2.26
Employees of Motor Vehicle and Related Industries, 1990 and 1993

Industry	1990 Employees	1990 Percent of total motor vehicle	1990 Percent of total U.S. employment[a]	1993 Employees	1993 Percent of total motor vehicle	1993 Percent of total U.S. employment[a]	Percent change 1990–93
Motor vehicle and equipment manufacturing	1,055,595	15.0%	1.1%	1,055,968	15.1%	1.1%	0.0%
Motor vehicles and equipment	*707,160*	*10.0%*	*0.8%*	*722,563*	*10.3%*	*0.8%*	*-2.2%*
Travel trailers and campers	*14,301*	*0.2%*	*0.0%*	*16,613*	*0.2%*	*0.0%*	*16.2%*
Transportation equipment not elsewhere classified	*17,263*	*0.2%*	*0.0%*	*21,510*	*0.3%*	*0.0%*	*24.6%*
Automotive stampings	*111,548*	*1.6%*	*0.1%*	*107,161*	*1.5%*	*0.1%*	*-3.9%*
Carburetors, pistons, piston rings, and valves	*19,674*	*0.3%*	*0.0%*	*17,615*	*0.3%*	*0.0%*	*-10.5%*
Vehicular lighting equipment	*15,586*	*0.2%*	*0.0%*	*15,830*	*0.2%*	*0.0%*	*-1.6%*
Storage batteries	*23,518*	*0.3%*	*0.0%*	*21,805*	*0.3%*	*0.0%*	*-7.3%*
Electrical equipment for internal combustion engines	*61,675*	*0.9%*	*0.1%*	*49,947*	*0.7%*	*0.1%*	*-19.0%*
Tires and inner tubes	*68,505*	*1.0%*	*0.1%*	*65,281*	*0.9%*	*0.1%*	*-4.7%*
Cold-rolled steel sheet, strip, and bars	*16,365*	*0.2%*	*0.0%*	*17,643*	*0.3%*	*0.0%*	*7.8%*
Road construction and maintenance	261,461	3.7%	0.3%	[b]	[b]	[b]	[b]
Motor freight transportation and related services	1,662,836	23.6%	1.8%	1,629,611	23.3%	1.7%	-2.0%
Trucking and courier services, except by air or by the U.S. Postal Service	*1,458,847*	*20.7%*	*1.6%*	*1,529,227*	*21.8%*	*1.6%*	*4.8%*
Petroleum refining and wholesale distribution	264,820	3.8%	0.3%	259,620	3.7%	0.3%	-2.0%
Passenger transportation	672,271	9.5%	0.7%	754,477	10.8%	0.8%	12.2%
Automotive sales and servicing	3,135,783	44.5%	3.4%	3,300,096	47.1%	3.5%	5.2%
Total of motor vehicle and related industries	7,052,766	100.0%	7.5%	6,999,772	100.0%	7.4%	-0.8%
U.S. Total[a]	93,476,087		100.0%	94,789,444		100.0%	1.4%

Source:
American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p. 71, and annual.
(Additional resources: http://www.aama.com)

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

Table 2.27
Employees of Class I Railroads, 1975–95

				Percent change	
	1975	1985	1995	1975–95	1985–95
Executive, officials & staff assistants	16,704	13,619	10,708	-35.9%	-21.4%
Professional & administrative	102,645	56,901	26,904	-73.8%	-52.7%
Maintenance of way & structures	81,507	62,508	40,033	-50.9%	-35.5%
Maintenance of equipment & stores	104,578	56,104	37,106	-64.5%	-33.9%
Transportation, other than train & engine	35,790	19,796	9,597	-73.2%	-51.5%
Transportation, train & engine	146,565	93,401	63,831	-56.4%	-31.7%
Total	487,789	301,879	188,215	-61.4%	-37.7%
Number of Class I Railroads	52	22	11	-78.8%	-50.0%

Source:
Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, September 1996, p. 56, and annual.
(Additional resources: http://www.aar.org)

CHAPTER 3

HIGHWAY MODE

Table 3.1
Highway Vehicle Miles Traveled by Mode, 1970–95
(million miles)

Year	Automobiles	Motorcycles	Two-axle, four-tire trucks	Other single-unit trucks	Combination trucks	Buses[a]	Total
1970	916,700	2,979	123,286	27,081	35,134	4,544	1,109,724
1971	966,340	3,607	137,870	28,985	37,217	4,792	1,178,811
1972	1,021,365	4,331	156,622	31,414	40,706	5,348	1,259,786
1973	1,045,981	5,194	176,833	33,661	45,649	5,792	1,313,110
1974	1,007,251	5,445	182,757	33,441	45,966	5,684	1,280,544
1975	1,033,950	5,629	200,700	34,606	46,724	6,055	1,327,664
1976	1,078,215	6,003	225,834	36,390	49,680	6,258	1,402,380
1977	1,109,243	6,349	250,591	39,339	55,682	5,823	1,467,027
1978	1,146,508	7,158	279,414	42,747	62,992	5,885	1,544,704
1979	1,113,640	8,637	291,905	42,012	66,992	5,947	1,529,133
1980	1,111,596	10,214	290,935	39,813	68,678	6,059	1,527,295
1981	1,130,827	10,690	296,343	39,568	69,134	6,241	1,552,803
1982	1,166,256	9,910	306,141	40,212	66,668	5,823	1,595,010
1983	1,198,023	8,760	327,643	43,409	69,754	5,199	1,652,788
1984	1,224,919	8,784	357,999	46,560	77,367	4,640	1,720,269
1985	1,260,565	9,086	373,072	46,980	79,600	4,876	1,774,179
1986	1,301,214	9,397	389,047	48,308	81,833	5,073	1,834,872
1987	1,355,330	9,506	415,449	49,537	86,064	5,318	1,921,204
1988	1,429,579	10,024	439,496	51,239	90,158	5,466	2,025,962
1989	1,477,769	10,371	454,339	52,969	95,349	5,659	2,096,456
1990	1,513,184	9,557	466,092	53,443	96,367	5,719	2,144,362
1991	1,533,552	9,178	472,848	53,787	96,942	5,743	2,172,050
1992	1,600,839	9,557	478,193	53,691	99,112	5,759	2,247,151
1993	1,547,366	9,906	573,398[b]	56,781	103,123	6,126	2,296,700
1994	1,501,402	10,240	669,321[b]	61,284	108,932	6,409	2,357,588
1995	1,541,458	9,797	686,977[b]	62,706	115,454	6,383	2,422,775
			Average annual percentage change				
1970–95	2.1%	4.9%	7.1%	3.4%	4.9%	1.4%	3.2%
1985–95	2.0%	0.8%	6.3%	2.9%	3.8%	2.7%	3.2%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, Table VM-1, p. V-115, and annual.
(Additional resources: http://www.fhwa.dot.gov)

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

[b]Some minivans and sport utility vehicles are included in two-axle, four-tire trucks that were previously included with the automobiles.

The data on automobile stock by size class are estimations based on historical sales data. This method assumes a constant scrappage rate for all size classes.

Table 3.2
Vehicle Stock and New Sales in United States, 1995 Calendar Year

	Vehicle stock[a] (thousands)	New sales		
		Domestic (thousands)	Import[b] (thousands)	Total (thousands)
Autos	**123,242**	**7,129 (82.6%)**	**1,506 (17.4%)**	**8,635 (100.0%)**
Two seaters	2,414	21 (40.3%)	32 (59.7%)	53 (100.0%)
Minicompact	1,888	0 (0.0%)	44 (100.0%)	44 (100.0%)
Subcompact	30,301	962 (64.3%)	535 (35.7%)	1,497 (100.0%)
Compact	35,956	2,766 (84.9%)	492 (15.1%)	3,259 (100.0%)
Midsize	35,486	2,096 (84.6%)	381 (15.4%)	2,477 (100.0%)
Large	17,197	1,283 (98.3%)	23 (1.7%)	1,306 (100.0%)
Motorcycles	**3,767**[c]	[c]	[c]	[c]
Recreational vehicles	[c]	**475 (100.0%)**	**0 (0.0%)**	**475 (100.0%)**
Trucks	**70,199**	**6064 (93.6%)**	**417 (6.4%)**	**6,482 (100.0%)**
Light (0–10,000 lbs)	65,496	5,663 (93.5%)	390 (6.5%)	6,054 (100.0%)
Medium (10,001–19,500 lbs)	1,474	76 (78.4%)	21 (21.6%)	97 (100.0%)
Light-heavy (19,501–26,000 lbs)	842	20 (83.3%)	4 (16.7%)	24 (100.0%)
Heavy-heavy (26,001 lbs and over)	2,387	305 (99.3%)	2 (0.7%)	307 (100.0%)

Source:
See Appendix A for Table 3.3. (Additional resources: http://www.aama.com, http://www.polk.com)

[a]Vehicle stock as of July 1.
[b]Includes domestic-sponsored imports.
[c]Includes mostly on-highway motorcycles. Many states do not require registration for off-highway vehicles.

VEHICLES IN USE

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

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

According to the R. L. Polk statistics, the number of passenger cars in use in the U.S. declined from 1991 to 1992. This is the first decline in vehicle stock since the figures were first reported in 1924. However, the data should be viewed with caution. A redesign of Polk's approach in 1992 allowed a national check for duplicate registrations, which was not possible in earlier years. Polk estimates that, due to processing limitations, its vehicle population counts may have been inflated by as much as 1½ percent. Assuming that percentage is correct, the number of passenger cars in use would have declined from 1991 to 1992 under the previous Polk method. Meanwhile, the FHWA estimates indicated growth in both the number of passenger cars and trucks from 1991 to 1992.

Table 3.3
Automobiles and Trucks in Use, 1970–95
(thousands)

	Automobiles			Trucks			Total		
Year	FHWA	R.L. Polk	Percentage difference	FHWA	R.L. Polk	Percentage difference	FHWA	R.L. Polk	Percentage difference
1970	89,244	80,448	11.0%	18,797	17,688	6.3%	108,041	98,136	10.1%
1971	92,718	83,138	11.5%	19,871	18,462	7.6%	112,589	101,600	10.8%
1972	97,082	86,439	12.3%	21,308	19,773	7.8%	118,390	106,212	11.5%
1973	101,985	89,805	13.6%	23,244	21,412	8.6%	125,229	111,217	12.6%
1974	104,856	92,608	13.2%	24,630	23,312	5.7%	129,486	115,920	11.7%
1975	106,704	95,241	12.0%	25,781	24,813	3.9%	132,485	120,054	10.4%
1976	110,189	97,818	12.6%	27,876	26,560	5.0%	138,065	124,378	11.0%
1977	112,288	99,904	12.4%	29,314	28,222	3.7%	141,602	128,126	10.5%
1978	116,573	102,957	13.2%	31,336	30,565	2.5%	147,909	133,522	10.8%
1979	118,429	104,677	13.1%	32,914	32,583	1.0%	151,343	137,260	10.3%
1980	121,601	104,564	16.3%	33,667	35,268	-4.5%	155,268	139,832	11.0%
1981	123,098	105,839	16.3%	34,644	36,069	-4.0%	157,742	141,908	11.2%
1982	123,902	106,867	15.9%	35,382	36,987	-4.3%	159,284	143,854	10.7%
1983	126,444	108,961	16.0%	36,723	38,143	-3.7%	163,167	147,104	10.9%
1984	128,158	112,019	14.4%	37,507	40,143	-6.6%	165,665	152,162	8.9%
1985	131,864	114,662	15.0%	39,196	42,387	-7.5%	171,060	157,049	8.9%
1986	135,431	117,268	15.5%	40,069	44,826	-10.6%	175,500	162,094	8.3%
1987	137,208	119,849	14.5%	41,144	47,344	-13.1%	178,352	167,193	6.7%
1988	141,252	121,519	16.2%	42,529	50,221	-15.3%	183,781	171,740	7.0%
1989	143,026	122,758	16.5%	43,609	53,202	-18.0%	186,635	175,960	6.1%
1990	143,453	123,276	16.4%	44,717	56,023	-20.2%	188,170	179,299	4.9%
1991	142,569	123,268	15.7%	44,936	58,179	-22.8%	187,505	181,438	3.3%
1992	144,213	120,347	19.8%	45,504	61,172	-25.6%	189,717	181,519	4.5%
1993	131,581[a]	121,055	8.7%	61,828[a]	65,260	-5.3%	193,409	186,315	3.8%
1994	133,930[a]	121,997	9.8%	63,445[a]	66,717	-4.9%	197,375	188,714	4.6%
1995	136,066	123,242	9.4%	64,778	70,199	-8.4%	200,844	193,441	3.7%

Source:

FHWA - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, Table VM-1, p. V-92, and annual. (Additional resources: http://www.fhwa.dot.gov)

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

[a]Some minivans and sport utility vehicles that were previously classified as automobiles are classified as trucks.

The average age of automobiles in 1995 is greater than that of trucks for the first time in the 25-year series. Most likely, it is the high sales of light-duty trucks in recent years that has influenced the average age of the truck population.

Table 3.4
Average Age of Automobiles and Trucks in Use, 1970–95
(years)

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

Source:
R. L. Polk and Co., Detroit, MI.
(Additional resources: http://www.polk.com)

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

Table 3.5
Scrappage and Survival Rates for Automobiles
1970, 1980 and 1990 Model Years

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

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

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

Table 3.6
Scrappage and Survival Rates for Trucks

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

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

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

Table 3.7
New Retail Automobile Sales in the United States, 1970–96

Calendar year	Domestic[a]	Import[b]	Total	Percentage imports	Percentage transplants[c] on model year basis	Percentage imports and transplants	Percentage diesel
	(thousands)						
1970	7,119	1,285	8,404	15.3%	[d]	[d]	[d]
1971	8,681	1,568	10,249	15.3%	[d]	[d]	0.06%
1972	9,327	1,623	10,950	14.8%	[d]	[d]	0.05%
1973	9,676	1,763	11,439	15.4%	[d]	[d]	0.06%
1974	7,454	1,399	8,853	15.8%	[d]	[d]	0.20%
1975	7,053	1,571	8,624	18.2%	[d]	[d]	0.31%
1976	8,611	1,499	10,110	14.8%	0.0%	14.8%	0.22%
1977	9,109	2,074	11,183	18.5%	0.0%	18.5%	0.34%
1978	9,312	2,002	11,314	17.7%	0.0%	17.7%	1.02%
1979	8,341	2,332	10,673	21.8%	1.3%	23.1%	2.54%
1980	6,581	2,398	8,979	26.7%	2.1%	28.8%	4.31%
1981	6,209	2,327	8,536	27.3%	1.8%	29.1%	6.10%
1982	5,759	2,223	7,982	27.9%	1.4%	29.3%	4.44%
1983	6,795	2,387	9,182	26.0%	1.3%	27.3%	2.09%
1984	7,952	2,439	10,391	23.5%	2.0%	25.5%	1.45%
1985	8,205	2,838	11,043	25.7%	2.2%	27.9%	0.82%
1986	8,215	3,238	11,453	28.3%	2.8%	31.1%	0.37%
1987	7,081	3,197	10,278	31.1%	5.2%	36.3%	0.16%
1988	7,526	3,099	10,626	29.2%	5.8%	35.0%	0.02%
1989	7,073	2,825	9,898	28.5%	7.3%	35.8%	0.13%
1990	6,897	2,404	9,301	25.8%	11.2%	37.0%	0.08%
1991	6,137	2,038	8,175	24.9%	13.7%	38.6%	0.10%
1992	6,277	1,937	8,213	23.6%	14.1%	37.7%	0.06%
1993	6,742	1,776	8,518	20.9%	14.9%	35.8%	0.03%
1994	7,255	1,735	8,990	19.3%	16.5%	35.8%	0.04%
1995	7,129	1,506	8,635	17.4%	18.9%	36.3%	0.04%
1996	7,254	1,273	8,527	14.9%	[d]	[d]	[d]
			Average annual percentage change				
1970–96	0.1%	1.3%	0.3%				
1986–96	-0.9%	-3.3%	-1.4%				

Source:

Domestic and import data - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p. 16, and annual. 1996 data from "Economic Indicators, 4th Quarter 1996."

Diesel data - H. A. Stark (ed), Ward's Communications, Inc., Ward's Automotive Yearbook, Detroit, MI, 1996, p. 49, and annual.

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

[a] North American built.

[b] Does not include import tourist deliveries.

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

[d] Data are not available.

Table 3.8
Automobiles in Operation and Vehicle Travel by Age, 1970 and 1995

Age (years)	1970 Vehicles (thousands)	1970 Percentage	1970 Cumulative percentage	1995 Vehicles (thousands)	1995 Percentage	1995 Cumulative percentage	1995 Estimated vehicle travel Percentage	1995 Estimated vehicle travel Cumulative percentage
Under 1[a]	6,288	7.8%	7.8%	6,038	4.9%	4.9%	6.4%	6.4%
1	9,299	11.6%	19.4%	8,150	6.6%	11.5%	8.1%	14.5%
2	8,816	11.0%	30.3%	8,219	6.7%	18.2%	7.8%	22.3%
3	7,878	9.8%	40.1%	7,651	6.2%	24.4%	7.0%	29.2%
4	8,538	10.6%	50.8%	7,942	6.4%	30.8%	6.9%	36.1%
5	8,506	10.6%	61.3%	8,151	6.6%	37.5%	7.1%	43.3%
6	7,116	8.8%	70.2%	8,957	7.3%	44.7%	7.6%	50.9%
7	6,268	7.8%	78.0%	9,146	7.4%	52.2%	7.6%	58.5%
8	5,058	6.3%	84.3%	8,839	7.2%	59.3%	6.7%	65.3%
9	3,267	4.1%	88.3%	8,665	7.0%	66.4%	6.6%	71.8%
10	2,776	3.5%	91.8%	7,823	6.3%	72.7%	5.3%	77.2%
11	1,692	2.1%	93.9%	6,843	5.6%	78.3%	4.6%	81.8%
12	799	1.0%	94.9%	4,527	3.7%	81.9%	3.1%	84.9%
13	996	1.2%	96.1%	3,430	2.8%	84.7%	2.3%	87.2%
14	794	1.0%	97.1%	3,024	2.5%	87.2%	2.1%	89.3%
15 and older	2,336	2.9%	100.0%	15,796	12.8%	100.0%	10.7%	100.0%
Subtotal	**80,427**	**100.0%**		**123,201**	**100.0%**		**100.0%**	
Age not given	**22**			**41**				
Total	**80,449**			**123,242**				
Average age		5.6			8.5			
Median age		4.9			7.7			

Source:
R. L. Polk and Co., Detroit, MI. FURTHER REPRODUCTION PROHIBITED.
Vehicle travel - Average annual miles per auto by age were multiplied by the number of vehicles in operation by age to estimate the vehicle travel.
Average annual miles per auto by age - generated by ORNL from the Household Vehicle Energy Consumption, 1994, provided by the U.S. Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division, 1996.
(Additional resources: http://www.polk.com, http://www.eia.doe.gov)

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

Starting in 1993, the Federal Highway Administration (FHWA) revised their definitions of passenger cars and two-axle, four-tire trucks. The result was a dramatic decrease in cars and an increase in two-axle, four-tire trucks. The sum of these two categories will still produce a consistent trend.[a] The FHWA plans to release revised historical data for each of these categories in 1997.

Table 3.9
Summary Statistics for Passenger Cars, 1970–95

Year	Registrations[b] (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy[c] (miles per gallon)
1970	89,244	916,700	67,820	13.5
1971	92,718	966,340	71,351	13.5
1972	97,082	1,021,365	76,222	13.4
1973	101,985	1,045,981	78,668	13.3
1974	104,856	1,007,251	75,083	13.4
1975	106,704	1,033,950	76,447	13.5
1976	110,189	1,078,215	79,693	13.5
1977	112,288	1,109,243	80,397	13.8
1978	116,573	1,146,508	81,661	14.0
1979	118,429	1,113,640	77,304	14.4
1980	121,601	1,111,596	71,883	15.5
1981	123,098	1,130,827	70,954	15.9
1982	123,902	1,166,256	70,062	16.7
1983	126,444	1,198,023	69,906	17.1
1984	128,158	1,224,919	68,717	17.8
1985	131,864	1,260,565	69,268	18.2
1986	135,431	1,301,214	71,216	18.3
1987	137,208	1,355,330	70,573	19.2
1988	141,252	1,429,579	71,949	19.9
1989	143,026	1,477,769	72,749	20.3
1990	143,453	1,513,184	71,989	21.0
1991	142,569	1,533,552	70,692	21.7
1992	144,213	1,600,839	73,823	21.7
1993[d]	131,581	1,547,366	73,553	21.0
1994[d]	133,930	1,501,402	67,517	22.2
1995[d]	136,066	1,541,458	68,318	22.6
		Average annual percentage change		
1970–95	1.7%	2.1%	0.0%	2.1%
1985–95	0.3%	2.0%	0.1%	2.2%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, Table VM-1, p. V-92, and annual.
(Additional resources: http://www.fhwa.dot.gov)

[a]See Table 3.21 for truck data.
[b]This number differs from R. L. Polk's estimates of "number of automobiles in use." See Table 3.3.
[c] Fuel economy for automobile population.
[d] Some minivans and sport utility vehicles that were previously classified as passenger cars are classified as two-axle, four-tire trucks.

The data from the Nationwide Personal Transportation Study (NPTS) is based on estimates by survey respondents. The Residential Transportation Energy Consumption Survey (RTECS) data, which represents actual odometer readings of automobiles, has little bias from respondent estimations and, therefore, is the preferred data.

Table 3.10
Average Annual Miles Per Automobile by Automobile Age

Vehicle age (years)	National Personal Transportation Study[a]		Residential Transportation Energy Consumption Survey[b]				
	1983	1990	1983	1985	1988	1991	1994
Under 1	14,200	19,800	13,400	12,700	12,900	13,400	15,220
1	17,000	16,900	13,000	13,000	13,400	14,100	14,250
2	14,000	16,300	12,700	12,600	12,600	12,600	13,740
3	12,500	14,400	12,100	12,400	12,100	13,200	13,080
4	11,400	13,800	11,300	11,100	11,500	13,300	12,500
5	11,000	12,600	9,700	10,600	10,600	12,200	12,560
6	9,900	12,900	9,700	10,000	10,800	11,200	12,290
7	9,400	12,400	9,500	9,700	10,000	10,700	12,030
8	8,700	12,300	8,700	8,900	10,300	11,400	10,915
9	8,100	11,200	8,400	8,600	8,900	10,000	10,950
10 and older	6,900	9,300	8,700	8,400	7,500	7,200	9,780
All vehicles	**10,400**	**12,600**	**9,400**	**9,900**	**10,200**	**10,600**	**11,400**

Source:

Nationwide Personal Transportation Study—1983: D. Klinger and J. Richard Kuzmyak, COMSIS Corporation, Personal Travel in the United States, Volume 1: 1983–84 Nationwide Personal Travel Study, prepared for the U.S. Department of Transportation, Washington, DC, August 1986, Table 4-22, p.4-21.

1990: Generated from the 1990 Nationwide Personal Transportation Study Public Use Tape, March 1992.

Residential Transportation Energy Consumption Survey—Personnal communication with Energy Information Agency, Office of Markets and End Use, Energy End Use Division.

(Additional resources: http://www.fhwa.dot.gov, http://www.eia.doe.gov)

[a]Includes only passenger vehicles (standard auto, station wagon, taxi, and van-bus/minibus) owned by or available to the household on a regular basis.

[b]Includes all household vehicles—automobiles, station wagons, pickup trucks, vans, and utility vehicles.

The average auto lost over 300 pounds from 1978 to 1985, but gained a few pounds back since then. Much of the weight reduction was due to the declining use of conventional steel and iron and the increasing use of aluminum and plastics. Conventional steel, however, remained the predominant component of automobiles in 1996 with a 43.5% share of total materials. As conventional steel use has been decreasing, use of high-strength steel has increased.

Table 3.11
Average Material Consumption for a Domestic Automobile, 1978, 1985, and 1996

	1978		1985		1996	
Material	Pounds	Percentage	Pounds	Percentage	Pounds	Percentage
Conventional steel[a]	1,880.0	53.8%	1,481.5	46.5%	1,409.0	43.5%
High-strength steel	127.5	3.6%	217.5	6.8%	287.0	8.9%
Stainless steel	25.0	0.7%	29.0	0.9%	46.5	1.4%
Other steels	56.0	1.6%	54.5	1.7%	38.5	1.2%
Iron	503.0	14.4%	468.0	14.7%	389.0	12.0%
Aluminum	112.0	3.2%	138.0	4.3%	195.5	6.0%
Rubber	141.5	4.1%	136.0	4.3%	139.0	4.3%
Plastics/composites	176.0	5.0%	211.5	6.6%	245.0	7.6%
Glass	88.0	2.5%	85.0	2.7%	94.0	2.9%
Copper	39.5	1.1%	44.0	1.4%	45.0	1.4%
Zinc die castings	28.0	0.8%	18.0	0.5%	15.5	0.5%
Power metal parts	16.0	0.5%	19.0	0.6%	29.5	0.9%
Fluids & lubricants	189.0	5.4%	184.0	5.8%	197.5	6.1%
Other materials	112.5	3.2%	101.5	3.2%	105.0	3.2%
Total	3,494.0	100.0%	3,187.5	100.0%	3,236.0	100.0%

Source:
H. A. Stark (ed.), Ward's Communications, Inc., Wards Automotive Yearbook, Detroit, MI, 1996, p. 24, and annual. (Additional resources: http://www.wardsauto.com)

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

Table 3.12
Sales-Weighted Engine Size of New Domestic and Import Automobiles by Size Class, Sales Periods 1976–96
(liters[a])

Model year	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	Fleet
1976	[b]	2.67	5.00	5.85	6.79	2.89	4.89
1977	1.98	2.73	4.79	5.47	6.02	2.81	4.56
1978	2.06	2.67	3.95	4.89	6.17	3.01	4.33
1979	1.86	2.39	3.74	4.41	5.56	2.77	3.78
1980	1.90	2.10	3.03	3.90	5.12	2.79	3.22
1981	1.57	2.04	2.20	3.63	5.00	2.49	2.98
1982	1.53	2.08	2.12	3.47	4.73	2.41	2.89
1983	1.60	2.19	2.20	3.45	4.95	2.52	2.98
1984	2.17	2.22	2.21	3.40	4.87	2.50	2.97
1985	1.95	2.29	2.27	3.37	4.65	2.47	2.92
1986	1.45	2.19	2.21	3.19	4.38	2.83	2.76
1987	1.48	2.19	2.20	2.99	4.36	2.57	2.68
1988	1.52	2.05	2.21	3.00	4.32	2.75	2.66
1989	2.54	2.08	2.11	3.01	4.31	2.81	2.68
1990	2.42	1.96	2.25	3.13	4.33	2.57	2.72
1991	2.17	1.97	2.23	3.16	4.40	2.67	2.72
1992	1.89	2.01	2.33	3.16	4.34	3.01	2.76
1993	1.96	2.07	2.28	3.16	4.27	3.47	2.78
1994	2.21	2.27	2.23	3.15	4.17	3.82	2.79
1995	2.42	2.26	2.23	3.12	4.12	3.76	2.79
1996[c]	2.61	2.23	2.19	2.99	4.09	3.69	2.72
			Average annual percentage change				
1976–96	1.5%[d]	-0.9%	-4.0%	-3.3%	-2.5%	1.2%	-2.9%
1986–96	6.1%	0.2%	-0.1%	-0.6%	-0.7%	2.7%	-0.1%

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1996.
(Additional resources: http://www-cta.ornl.gov)

[a] 1 liter = 61.02. cubic inches.
[b] There were no minicompact automobiles sold in 1976.
[c] Preliminary.
[d] Average annual percentage change is for years 1977–95.

Table 3.13
Sales-Weighted Curb Weight of New Domestic and Import Automobiles by Size Class, Sales Periods 1976–96
(pounds)

Model year	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	Fleet
1976	[a]	2,577	3,609	4,046	4,562	2,624	3,608
1977	2,228	2,586	3,550	3,900	4,026	2,608	3,424
1978	2,200	2,444	3,138	3,427	3,956	2,763	3,197
1979	2,120	2,367	3,048	3,287	3,763	2,699	3,000
1980	2,154	2,270	2,813	3,081	3,667	2,790	2,790
1981	1,920	2,370	2,382	2,996	3,672	2,744	2,744
1982	2,002	2,302	2,422	2,992	3,703	2,525	2,730
1983	2,072	2,334	2,441	3,027	3,779	2,663	2,788
1984	2,376	2,380	2,454	2,990	3,734	2,559	2,788
1985	2,211	2,392	2,464	2,954	3,575	2,539	2,743
1986	2,120	2,415	2,432	2,857	3,451	2,575	2,675
1987	1,960	2,423	2,474	2,857	3,483	2,602	2,689
1988	1,933	2,346	2,558	2,880	3,487	2,693	2,717
1989	2,576	2,357	2,517	2,985	3,496	2,735	2,760
1990	2,651	2,368	2,637	3,065	3,594	2,656	2,828
1991	2,584	2,406	2,652	3,085	3,650	2,707	2,848
1992	2,395	2,444	2,674	3,131	3,670	2,770	2,879
1993	2,449	2,478	2,659	3,142	3,615	2,967	2,894
1994	2,719	2,571	2,639	3,171	3,657	3,035	2,921
1995	2,831	2,552	2,647	3,179	3,648	2,947	2,937
1996[b]	2,951	2,530	2,667	3,203	3,671	2,981	2,950
			Average annual percentage change				
1976–9	1.5%[c]	-0.1%	-1.5%	-1.2%	-1.1%	0.6%	-1.0%
1986–9	3.4%	0.5%	0.9%	1.1%	0.6%	1.5%	1.0%

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1997.
(Additional resources: http://www-cta.ornl.gov)

[a] There were no minicompact automobiles sold in 1976.
[b] Preliminary.
[c] Average annual percentage change is for years 1977–96.

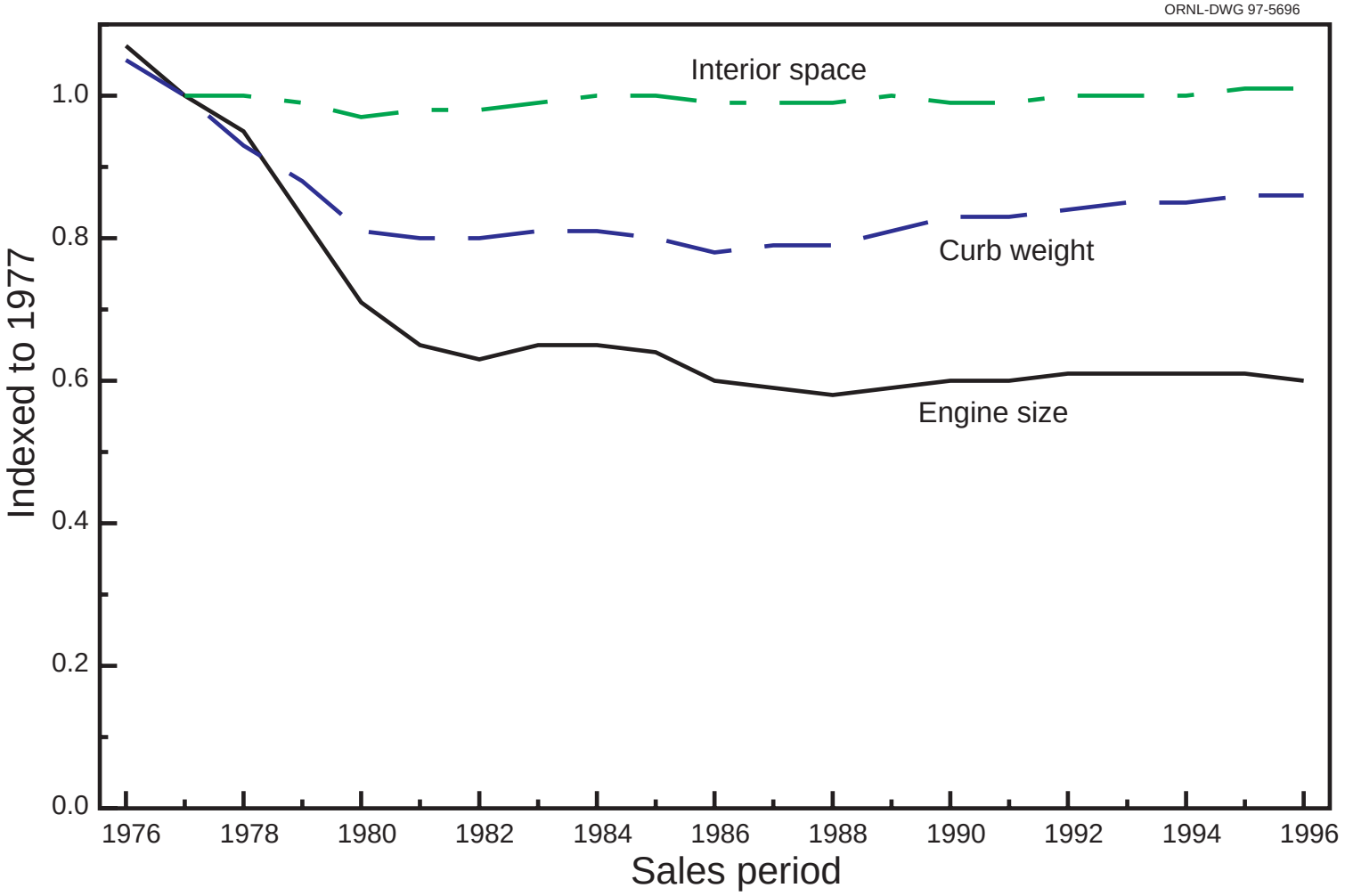
Table 3.14
Sales-Weighted Interior Space of New Domestic and Import Automobiles by Size Class, Sales Periods 1976–96
(cubic feet)

Model year	Minicompact (< 85)	Subcompact (85–99)	Compact (100–109)	Midsize (110–119)	Large (> 120)	Fleet[a]
1977	78.8	89.8	107.1	113.0	128.0	107.9
1978	79.4	89.8	105.3	112.9	128.5	107.9
1979	80.0	90.2	105.8	113.4	130.1	106.9
1980	82.4	89.9	105.4	113.5	130.8	104.9
1981	83.3	90.2	103.6	113.7	130.6	105.5
1982	83.1	91.3	102.9	113.9	130.4	106.0
1983	82.7	93.3	103.0	113.1	131.3	107.3
1984	77.0	93.8	103.0	113.3	130.4	108.0
1985	77.8	94.1	103.1	113.5	129.7	107.9
1986	80.1	94.5	102.8	113.8	127.6	107.0
1987	81.6	93.1	103.0	113.9	127.5	106.9
1988	81.0	93.5	103.3	113.6	127.2	107.0
1989	75.0	93.3	102.7	113.8	127.4	107.5
1990	79.9	93.9	103.2	113.8	127.8	107.3
1991	79.6	94.4	103.2	113.8	128.3	107.1
1992	79.1	94.0	104.2	114.0	129.2	107.5
1993	79.2	94.5	104.0	114.0	128.9	108.0
1994	79.4	94.4	103.8	113.8	128.8	108.0
1995	78.5	93.8	103.9	114.3	128.1	108.7
1996[b]	77.0	94.9	103.4	114.2	128.0	108.7
			Average annual percentage change			
1977–96	-0.1%	0.3%	-0.2%	0.1%	0.0%	0.0%
1986–96	-0.4%	0.0%	0.1%	0.0%	0.0%	0.2%

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1997. (Additional resources: http://www-cta.ornl.gov)

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

Figure 3.1. Engine Size, Curb Weight, and Interior Space of New Domestic and Import Automobiles, 1976-96



Source: See Tables 3.12, 3.13, and 3.14.

Table 3.15
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Automobiles, Selected Sales Periods 1976–96[a]

	1976	1980	1984	1988	1990	1991	1992	1993	1994	1995	1996[b]
MINICOMPACT											
Total sales, units		428,346	41,368	84,186	76,698	96,290	107,634	84,345	57,198	44,752	37,580
Market share, %		4.7	0.4	0.8	0.8	1.1	1.3	1.0	0.6	0.5	0.4
Fuel economy, mpg		29.4	29	37.8	26.4	29.3	30.6	29.9	27.8	27.0	26.8
SUBCOMPACT											
Total sales, units	2,625,929	3,441,480	2,510,929	1,983,353	2,030,22	2,256,293	2,074,35	1,944,892	2,015,280	1,518,209	1,312,741
Market share, %	27.1	37.8	24.6	19.1	22	26.9	25.6	23.2	22.6	17.4	15.2
Fuel economy, mpg	23.5	27.3	30.5	31.7	31.3	31.6	31.8	31.9	31.3	31.7	32.3
COMPACT											
Total sales, units	2,839,603	599,423	2,768,056	4,199,638	3,156,48	2,425,398	2,451,49	2,655,378	3,077,203	3,289,735	3,489,048
Market share, %	29.3	6.6	27.1	40.5	34.2	28.9	30.2	31.7	34.5	37.7	40.3
Fuel economy, mpg	17.1	22.3	30.6	29.8	28.9	28.8	28.7	29.3	29.8	30.2	30.4
MIDSIZE											
Total sales, units	1,815,505	3,073,103	3,059,647	2,550,964	2,511,50	2,305,773	2,249,55	2,445,842	2,359,898	2,498,521	2,491,734
Market share, %	18.7	33.8	30	24.6	27.2	27.5	27.7	29.2	26.5	28.6	28.8
Fuel economy, mpg	15.3	21.3	24.1	26.9	25.9	25.9	25.8	25.7	25.6	25.9	26.4
LARGE											
Total sales, units	2,206,102	1,336,190	1,502,097	1,368,717	1,279,09	1,161,319	1,140,77	1,186,991	1,339,863	1,320,608	1,258,996
Market share, %	22.8	14.7	14.7	13.2	13.9	13.9	14.1	14.2	15.0	15.1	14.6
Fuel economy, mpg	13.9	19.3	20.2	24.2	23.5	23.3	23.7	24.0	24.2	24.1	24.2
TWO SEATER											
Total sales, units	199,716	215,964	328,968	186,127	170,465	134,890	83,192	70,480	67,020	53,045	61,479
Market share, %	2.1	2.4	3.2	1.8	1.8	1.6	1.0	0.8	0.8	0.6	0.7
Fuel economy, mpg	20.1	21	26.5	27.3	28	27.3	25.9	24.8	23.9	24.7	25.5
FLEET											
Total sales, units	9,686,855	9,094,506	10,211,06	10,372,98	9,224,46	8,379,963	8,107,00	8,387,928	8,916,462	8,724,870	8,651,578
Market share, %	100	100	100	100	100	100	100	100	100	100	100
Fuel economy, mpg	17.2	23.2	26.3	28.5	27.6	27.7	27.7	27.8	27.8	28.0	28.3

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1997. (Additional resources: http://www-cta.ornl.gov)

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

Table 3.16
New Retail Sales of Trucks 10,000 Pounds GVW and Less in the United States, 1970–95

Calendar year	Light truck sales[a] (thousands)	Percentages					
		Import[b]	Transplants[c]	Diesel	Four-wheel drive of domestic light trucks	Light trucks of light-duty vehicle sales[d]	Light trucks of total truck sales
1970	1,463	4.5%	[e]	[f]	[e]	14.8%	80.4%
1971	1,757	4.8%	[e]	[f]	[e]	14.6%	83.4%
1972	2,239	6.4%	[e]	[f]	[e]	17.0%	83.3%
1973	2,745	8.5%	[e]	[f]	[e]	19.4%	84.2%
1974	2,338	7.5%	[e]	[f]	18.0%	20.9%	84.2%
1975	2,281	10.0%	[e]	[f]	23.4%	20.9%	87.9%
1976	2,956	8.0%	0.0%	[f]	23.8%	22.6%	89.8%
1977	3,430	9.4%	0.0%	[f]	24.6%	23.5%	89.7%
1978	3,808	8.8%	0.0%	1.0%	28.5%	25.2%	89.2%
1979	3,311	14.1%	0.0%	1.0%	29.4%	23.7%	88.7%
1980	2,440	19.7%	0.9%	3.2%	20.7%	21.4%	88.9%
1981	2,189	20.3%	0.0%	3.3%	18.6%	20.4%	89.8%
1982	2,470	16.5%	0.0%	5.0%	16.8%	23.6%	92.8%
1983	2,984	15.6%	0.0%	4.0%	28.5%	24.5%	93.6%
1984	3,863	15.7%	2.0%	3.8%	27.0%	27.1%	93.0%
1985	4,458	17.2%	2.6%	3.3%	29.1%	28.8%	93.6%
1986	4,594	20.1%	2.3%	2.6%	27.0%	28.6%	94.3%
1987	4,610	17.9%	1.7%	2.3%	32.0%	31.0%	93.9%
1988	4,800	12.6%	2.4%	2.0%	32.1%	31.1%	93.2%
1989	4,610	10.9%	2.6%	2.1%	31.4%[g]	31.8%	93.3%
1990	4,548	13.2%	3.4%	2.2%[g]	31.6%[g]	32.8%	93.9%
1991	4,123	12.8%	4.5%	2.2%[g]	34.4%[g]	33.5%	94.5%
1992	4,629	8.6%	5.5%	2.5%[g]	31.6%[g]	36.0%	94.4%
1993	5,351	6.8%	7.1%	2.3%[g]	32.6%[g]	38.6%	94.2%
1994	6,033	6.5%	8.1%	2.7%[g]	34.4%[g]	40.2%	94.0%
1995	6,053	6.5%	7.5%	3.8%[g]	39.1%[g]	41.2%	93.4%
		Average annual percentage change					
1970–95	5.8%						
1985–95	3.1%						

Source:

Four-wheel drive - 1970–88: H. A. Stark (ed.), Ward's Communications, Inc., Ward's Automotive Yearbook, Detroit, MI, 1989, p. 168, and annual. 1989–95: H. A. Stark (ed.), Ward's Communications, Inc., Ward's Automotive Yearbook, Factory Installation Reports, Detroit, MI, 1996.

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

All other - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, pp. 8, 20, 21, and annual. (Additional resources: http:/www.aama.com, http://www.wardsauto.com)

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

[b]Excluding transplants.

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

[d]Light-duty vehicles include cars and light trucks.

[e]Data are not available.

[f]Indicates less than 1 percent.

[g]Based on factory installations or factory sales.

Table 3.17
New Retail Truck Sales by Gross Vehicle Weight, 1970–95[a]
(thousands)

Calendar year	Class 1 6,000 lbs. or less	Class 2 6,001– 10,000 lbs.	Class 3 10,001– 14,000 lbs.	Class 4 14,001– 16,000 lbs.	Class 5 16,001– 19,500 lbs.	Class 6 19,501– 26000 lbs.	Class 7 26,001– 33,000 lbs.	Class 8 33,001 lbs. and over	Total
Domestic sales (import data are not available)									
1970[b]	1,049	408	6	12	58	133	36	89	1,791
1971	1,185	488	6	15	46	140	34	99	2,013
1972	1,498	599	55	11	29	182	35	126	2,535
1973	1,754	758	50	3	16	236	37	155	3,009
1974	1,467	696	21	3	14	207	31	148	2,587
1975	1,101	952	23	1	9	159	23	83	2,351
1976	1,318	1,401	43	[c]	9	153	22	97	3,043
1977	1,306	1,803	36	3	5	163	28	141	3,485
1978	1,334	2,140	73	6	3	156	41	162	3,915
1979	1,271	1,574	15	3	3	146	50	174	3,236
1980	985	975	4	[c]	2	90	58	117	2,231
1981	896	850	1	[c]	2	72	51	100	1,972
1982	1,102	961	1	[c]	1	44	62	76	2,248
1983	1,314	1,207	[c]	[c]	1	47	59	82	2,710
1984	2,031	1,224	6	[c]	5	55	78	138	3,538
1985	2,408	1,280	11	[c]	5	48	97	134	3,983
Domestic and import sales									
1986	3,380	1,214	12	[c]	6	45	101	113	4,870
1987	3,435	1,175	14	2	8	44	103	131	4,912
1988	3,467	1,333	14	21	8	54	103	148	5,149
1989	3,313	1,297	19	27	7	39	93	145	4,942
1990	3,451	1,097	21	27	5	38	85	121	4,846
1991	3,246	876	21	24	3	22	73	99	4,365
1992	3,608	1,021	26	26	4	28	73	119	4,903
1993	4,119	1,232	27	33	4	27	81	158	5,681
1994	4,527	1,506	35	44	4	20	98	186	6,421
1995	4,422	1,631	40	53	4	23	106	201	6,481
				Average annual percentage change					
1970–85	5.7%	7.9%	4.1%	-	-15.1%	-6.6%	6.8%	2.8%	5.5%
1986–95	3.0%	3.3%	14.3%	-	-4.4%	-7.2%	0.5%	6.6%	3.2%

Source:
American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p. 21, and annual. (Additional resources: http://www.aama.com)

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

Table 3.18
Trucks in Operation and Vehicle Travel by Age, 1970 and 1995

Age (years)	1970 Vehicles (thousands)	1970 Percentage	1970 Cumulative percentage	1995 Vehicles (thousands)	1995 Percentage	1995 Cumulative percentage	1995 Estimated vehicle travel Percentage	1995 Estimated vehicle travel Cumulative percentage	Average annual miles per vehicle
Under 1[a]	1,262	7.1%	7.1%	4,094	5.8%	5.8%	6.5%	6.5%	14,288
1	1,881	10.6%	17.8%	6,096	8.7%	14.5%	11.1%	17.6%	16,439
2	1,536	8.7%	26.5%	5,176	7.4%	21.9%	10.6%	28.2%	18,388
3	1,428	8.1%	34.6%	4,228	6.0%	27.9%	8.3%	36.4%	17,601
4	1,483	8.4%	43.0%	4,136	5.9%	33.8%	7.7%	44.1%	16,775
5	1,339	7.6%	50.5%	4,033	5.7%	39.6%	7.2%	51.3%	16,020
6	1,154	6.5%	57.1%	4,620	6.6%	46.2%	7.5%	58.7%	14,574
7	975	5.5%	62.6%	4,523	6.4%	52.6%	6.9%	65.6%	13,710
8	826	4.7%	67.3%	3,972	5.7%	58.3%	5.8%	71.4%	13,255
9	621	3.5%	70.8%	4,134	5.9%	64.2%	5.6%	77.1%	12,237
10	658	3.7%	74.5%	3,509	5.0%	69.2%	3.2%	80.3%	8,224
11	583	3.3%	77.8%	3,030	4.3%	73.5%	2.8%	83.0%	8,224
12	383	2.2%	80.0%	1,873	2.7%	76.1%	1.7%	84.7%	8,224
13	417	2.4%	82.3%	1,528	2.2%	78.3%	1.4%	86.1%	8,224
14	414	2.3%	84.7%	1,344	1.9%	80.2%	1.2%	87.4%	8,224
15 and older	2,710	15.3%	100.0%	13,869	19.8%	100.0%	12.6%	100.0%	8,224
Subtotal	**17,670**	**100.0%**		**70,167**	**100.0%**		**100.0%**		
Age not given	15			32					
Total	**17,685**			**70,199**					
Average age		7.3			8.4				
Median age		5.9			7.6				

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

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

Table 3.19
Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class
Sales Periods 1976–96
(liters[a])

Model year	Small pickup	Large pickup	Small van	Large van	Small utility	Large utility	Fleet
1976	1.91	5.57	1.97	5.39	5.39	4.97	5.23
1977	2.01	5.48	1.97	5.32	5.46	4.95	5.03
1978	2.03	5.45	1.97	5.29	5.09	5.40	5.02
1979	2.05	5.15	1.97	5.13	4.52	5.30	4.62
1980	2.05	5.05	1.97	5.03	4.29	5.39	4.33
1981	2.14	4.82	1.97	4.84	3.94	5.15	4.15
1982	2.34	4.99	1.79	4.92	3.88	5.27	4.24
1983	2.35	4.97	1.87	5.06	3.05	5.34	4.00
1984	2.38	4.95	2.23	5.06	2.81	5.39	3.87
1985	2.38	4.77	2.65	5.12	2.83	5.37	3.77
1986	2.43	4.68	2.78	5.13	2.78	5.55	3.65
1987	2.44	4.69	2.96	5.21	2.80	5.42	3.65
1988	2.56	4.68	3.15	5.21	3.14	5.51	3.82
1989	2.64	4.70	3.11	5.22	3.50	5.45	3.93
1990	2.90	4.49	3.29	5.21	3.38	5.48	3.93
1991	2.91	4.57	3.29	5.23	3.62	5.40	3.94
1992	3.07	4.57	3.32	5.28	3.69	5.47	4.00
1993	3.25	4.32	3.30	5.21	3.80	5.58	4.02
1994	3.10	4.45	3.48	5.31	3.77	5.54	4.10
1995	2.95	4.44	3.40	5.15	3.75	5.49	4.06
1996[b]	2.90	4.64	3.43	5.19	3.65	5.12	4.15
			Average annual percentage change				
1976–96	2.1%	-0.9%	2.8%	-0.2%	-1.9%	0.1%	-1.1%
1986–96	1.8%	-0.1%	2.1%	0.1%	2.8%	-0.8%	1.3%

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge,TN, 1996. (Additional resources: http://www-cta.ornl.gov)

[a] 1 liter = 61.02 cubic inches.
[b] Preliminary.

Table 3.20
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Light Trucks, Selected Sales Periods 1976–96[a]

	1976	1980	1984	1988	1990	1991[b]	1992[b]	1993[b]	1994[b]	1995[b]	1996[c]
SMALL PICKUP											
Total sales, units	170,351	516,412	1,012,298	1,026,551	678,488	628,098	586,752	332,470	365,322	356,856	390,792
Market share, %	7.1	23.3	28.0	21.6	15.0	15.5	13.4	6.6	6.4	6.0	6.3
Fuel economy, mpg	23.9	25.5	27.2	26.1	25.2	25.7	25.0	24.9	25.3	25.6	26.3
LARGE PICKUP											
Total sales, units	1,586,02	1,115,248	1,218,972	1,453,255	1,573,729	1,309,283	1,452,192	1,877,806	2,199,224	2,183,793	2,202,455
Market share, %	66.4	50.3	33.7	30.6	34.9	32.3	33.1	37.1	38.4	36.8	35.4
Fuel economy, mpg	15.1	17	17.5	18.5	18.9	18.8	18.9	19.6	20.1	19.4	19.0
SMALL VAN											
Total sales, units	18,651	13,649	222,798	851,384	932,693	888,165	968,361	1,129,459	1,263,933	1,257,116	1,229,648
Market share, %	0.8	0.6	6.2	18.0	20.7	21.9	22.0	22.3	22.1	21.2	19.8
Fuel economy, mpg	19.5	19.6	25.0	22.9	23.1	22.6	22.5	22.9	22.1	22.8	22.7
LARGE VAN											
Total sales, units	574,745	328,065	545,595	486,981	398,877	308,317	350,013	388,435	407,737	401,056	370,126
Market share, %	24.1	14.8	15.1	10.3	8.8	7.6	8.0	7.7	7.1	6.8	6.0
Fuel economy, mpg	15.4	16.3	16.3	17.0	16.9	17.4	16.9	17.3	17.4	17.1	17.2
SMALL UTILITY											
Total sales, units	4,716	75,875	398,000	701,005	738,294	782,588	867,934	948,797	1,042,584	1,225,131	1,378,715
Market share, %	0.2	3.4	11.0	14.8	16.4	19.3	19.8	18.8	18.2	20.6	22.2
Fuel economy, mpg	15.5	16.9	23.0	22.4	21.9	21.1	20.9	21.3	20.7	20.8	21.3
LARGE UTILITY											
Total sales, units	32,427	167,288	215,271	223,824	192,544	131,740	167,199	378,710	445,601	509,914	641,252
Market share, %	1.4	7.5	6.0	4.7	4.3	3.3	3.8	7.5	7.8	8.6	10.3
Fuel economy, mpg	14.7	14.6	15.7	16.2	16.1	16.4	16.9	17.5	17.8	17.4	18.1
FLEET											
Total sales, units	2,386,91	2,216,537	3,612,934	4,743,000	4,514,625	4,048,191	4,392,451	5,055,677	5,724,401	5,933,866	6,212,988
Market share, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fuel economy, mpg	15.6	18.1	20.0	20.7	20.5	20.6	20.4	20.5	20.4	20.2	20.3

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1997. (Additional resources: http://www-cta.ornl.gov)

[a] These figures represent only those sales that could be matched to corresponding EPA fuel economy values.
[b] Estimates from 1991 through 1995 were revised on EPA truck classification.
[c] Preliminary.

Starting in 1993, the Federal Highway Administration (FHWA) revised their definitions of passenger cars and 2-axle, 4-tire trucks. The result was a dramatic decrease in cars and increase in 2-axle, 4-tire trucks. The sum of these two categories will still produce a consistent trend. (See Table 3.9 for car data.) The FHWA plans to release revised historical data for each of these categories in 1997.

Table 3.21
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970–95

Year	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	14,211	123,286	12,313	10.0
1971	15,181	137,870	13,484	10.2
1972	16,428	156,622	15,150	10.3
1973	18,083	176,833	16,828	10.5
1974	19,335	182,757	16,657	11.0
1975	20,418	200,700	17,903	11.2
1976	22,301	225,834	20,164	11.2
1977	23,624	250,591	21,895	11.4
1978	25,476	279,414	24,055	11.6
1979	27,022	291,905	24,742	11.8
1980	27,876	290,935	23,594	12.3
1981	28,928	296,343	23,697	12.5
1982	29,792	306,141	23,845	12.8
1983	31,214	327,643	25,556	12.8
1984	32,106	357,999	27,687	12.9
1985	33,865	373,072	29,021	12.9
1986	34,820	389,047	30,265	12.9
1987	35,841	415,449	32,266	12.9
1988	37,096	439,496	32,803	13.4
1989	37,918	454,339	33,005	13.8
1990	38,864	466,092	32,937	14.2
1991	39,067	472,848	32,531	14.5
1992	39,533	478,193	33,127	14.4
1993[a]	55,710	573,398	36,476	15.7
1994[a]	57,142	669,321	44,422	15.1
1995[a]	57,897	686,977	44,949	15.3
		Average annual percentage change		
1970–95	5.8%	7.1%	5.3%	1.7%
1985–95	5.5%	6.3%	4.5%	1.7%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, Table VM-1, p. V-92, and annual.
(Additional resources: http://www.fhwa.dot.gov)

[a] Some minivans and sport utility vehicles that were previously classified as automobiles are classified as trucks.

Table 3.22
Summary Statistics for Other Single-Unit and Combination Trucks, 1970–95[a]

	Other single-unit trucks[b]				Combination trucks[c]			
Year	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)	Registrations (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	3,681	27,081	3,968	6.8	905	35,134	7,348	4.8
1971	3,770	28,985	4,212	6.9	919	37,217	7,595	4.9
1972	3,918	31,414	4,560	6.9	961	40,706	8,120	5.0
1973	4,131	33,661	4,859	6.9	1,029	45,649	9,026	5.1
1974	4,211	33,441	4,687	7.1	1,085	45,966	8,800	5.2
1975	4,232	34,606	4,815	7.2	1,131	46,724	8,654	5.4
1976	4,350	36,390	5,140	7.1	1,225	49,680	9,536	5.2
1977	4,450	39,339	5,559	7.1	1,240	55,683	10,673	5.2
1978	4,518	42,727	6,106	7.0	1,342	62,992	12,113	5.2
1979	4,505	42,012	6,036	7.0	1,386	66,992	12,864	5.2
1980	4,374	39,813	5,557	7.2	1,417	68,678	12,703	5.4
1981	4,455	39,568	5,574	7.1	1,261	69,134	12,960	5.3
1982	4,325	40,212	5,661	7.1	1,265	66,668	12,636	5.3
1983	4,204	43,409	6,118	7.1	1,304	69,754	13,447	5.2
1984	4,061	46,560	6,582	7.1	1,340	77,367	14,781	5.2
1985	3,927	46,980	6,735	7.0	1,403	79,600	15,280	5.2
1986	3,850	48,308	6,929	7.0	1,399	81,833	15,716	5.2
1987	3,884	49,537	7,091	7.0	1,419	86,064	16,493	5.2
1988	3,957	51,239	7,260	7.1	1,476	90,158	17,123	5.3
1989	4,103	52,969	7,412	7.2	1,589	95,349	17,495	5.5
1990	4,243	53,443	7,294	7.3	1,611	96,367	17,469	5.5
1991	4,265	53,787	7,134	7.5	1,604	96,942	17,157	5.7
1992	4,316	53,691	7,179	7.5	1,655	99,112	17,691	5.6
1993	4,526	56,781	8,277	6.9	1,592	103,123	17,719	5.8
1994	4,725	61,284	9,041	6.8	1,579	108,932	18,674	5.8
1995	5,204	62,706	9,178	6.8	1,677	115,454	19,662	5.9
				Average annual percentage change				
1970–95	1.4%	3.4%	3.4%	0.0%	2.5%	4.9%	4.0%	0.8%
1985–95	2.9%	2.9%	3.1%	-0.3%	1.8%	3.8%	2.6%	1.3%

Source:
U. S. Department of Transportation, Federal Highway Adminstration, Highway Statistics 1995, Washington, DC, 1996, Table VM1, p. V-92 and annual.
(Additional resources: http://www.fhwa.dot.gov)

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

Truck Inventory and Use Survey

The Truck Inventory and Use Survey (TIUS) provides data on the physical and operational characteristics of the Nation's truck population. It is based on a probability sample of private and commercial trucks registered (or licensed) in each state. Data for 1992 have been released in a report, as well as on CD-ROM. Copies may be obtained by contacting the U.S. Bureau of the Census, Transportation Characteristics Surveys Branch (301)457-2797. Internet site http://www.census.gov/svsd/www/tius.view.html is the location of the TIUS on-line.

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

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

Table 3.23
Truck Fuel Economy by Size Class, 1977, 1982, 1987, and 1992
(miles per gallon)

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

Source:

Estimates are based on data provided on the following public use tapes: U.S. Department of Commerce, Bureau of the Census, 1977 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1980; U.S. Department of Commerce, Bureau of the Census, 1982 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1985; U.S. Department of Commerce, Bureau of the Census, 1987 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1990; and U.S. Department of Commerce, Bureau of the Census, 1992 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1995.

(Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 3.24
Percentage of Trucks by Fleet Size and Primary Refueling Facility, 1992

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

Source:

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

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

Table 3.25
Truck Statistics by Gross Vehicle Weight Class, 1992

Manufacturer's gross vehicle weight class	Number of trucks	Percentage of trucks	Average annual miles per truck	Average fuel economy	Gallons of fuel used (millions)	Percentage of fuel use
6,000 lbs and less	37,068,163	62.61%	12,739	17.23	27,397	44.76%
6,001 – 10,000 lbs	17,519,216	29.59%	11,610	13.00	15,646	25.56%
10,001 – 14,000 lbs	349,301	5.90%	15,814	9.48	583	0.95%
14,001 – 16,000 lbs	127,219	0.21%	14,420	9.19	200	0.33%
16,001 – 19,500 lbs	209,158	0.35%	4,876	8.21	124	0.20%
19,501 – 26,000 lbs	1,859,529	3.14%	11,746	7.26	3,008	4.91%
26,001 – 33,000 lbs	197,985	0.33%	30,074	6.64	897	1.46%
33,001 lbs and up	1,870,183	3.16%	39,832	5.58	13,353	21.82%
Total	**59,200,755**	**100.00%**	**13,281**	**12.85**	**61,206**	**100.00%**

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

Table 3.26
Percentage of Trucks by Size Class, 1977, 1982, 1987, and 1992
(percentage)

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

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

The fuel economies for "Total" gasoline and diesel trucks illustrate the great differences in the truck types by fuel. Gasoline trucks are mainly light-duty vehicles with high fuel economies, while diesel trucks are mainly heavy-duty.

Table 3.27
Truck Fuel Economy by Fuel Type and Size Class, 1992
(miles per gallon)

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

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

Table 3.28
Truck Statistics by Size, 1992

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

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

Table 3.29
Percentage of Trucks by Major Use and Primary Refueling Facility, 1992

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

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

Table 3.30
Percentage of Trucks by Size Ranked by Major Use, 1992

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

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

[a] Business and personal services.

1993 Commodity Flow Survey

The Commodity Flow Survey (CFS) is designed to provide data on the flow of goods and materials by mode of transport. The CFS is a continuation of statistics collected in the Commodity Transportation Survey from 1963 through 1977, and includes major improvements in methodology, sample size, and scope. A sample of 200,000 domestic establishments randomly selected from a universe of about 900,000 establishments engaged in mining, manufacturing, wholesale, auxiliary establishments (warehouses) of multi-establishment companies, and some selected activities in retail and service was used. Each selected establishment reported a sample of approximately 30 outbound shipments for a two-week period in each of the four calendar quarters of 1993. This will produce a total sample of about 20 million shipments. For each sampled shipment, zip codes of origin and destination, 5-digit Standard Transportation Commodity Classification (STCC) code, weight, value, and modes of transport, were provided. Establishments were also asked to indicate whether the shipment was containerized, a hazardous material, or an export were also obtained.

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

For more information about the Commodity Flow Survey, contact John L. Fowler of the Census Bureau at (301) 457-2805 or (301) 457-2114, or visit the following Internet site: **http://www.bts.gov/cfs/cfs.html**

Table 3.31
Shipment Characteristics by Mode of Transportation, 1993

Mode of transportation	Monetary value: Million dollars	Monetary value: Percentage	Weight: Thousand tons	Weight: Percentage	Ton-miles[a]: Millions	Ton-miles[a]: Percentage	Average miles per shipment[a]
Single modes							
Parcel, U.S. Postal Service, or courier	563,277	9.6%	18,892	0.2%	13,151	0.5%	734
Private truck	1,755,837	30.0%	3,543,513	36.6%	235,897	9.7%	52
For-hire truck	2,625,093	44.9%	2,808,279	29.0%	629,000	26.0%	472
Air	5,200	0.1%	148	[b]	139	[b]	1,180
Rail	247,394	4.2%	1,544,148	15.9%	942,561	38.9%	766
Inland water	40,707	0.7%	362,454	3.7%	164,371	6.8%	[c]
Great Lakes	1,173	[b]	33,041	0.3%	12,395	0.5%	534
Deep sea water	67	[b]	[c]	[b]	[c]	[b]	[c]
Pipeline[d]	89,849	1.5%	483,645	5.0%	[c]	[c]	[c]
Multiple modes							
Private truck and for-hire truck	22,565	0.4%	34,123	0.4%	4,639	0.2%	197
Truck and air	133,887	2.3%	2,991	[b]	3,870	0.2%	1,423
Truck and rail	83,082	1.4%	40,624	0.4%	37,675	1.6%	1,403
Truck and water	9,392	0.2%	67,995	0.7%	40,610	1.7%	1,417
Truck and pipeline[d]	349	[b]	[c]	[b]	[c]	[b]	[c]
Rail and water	3,636	0.1%	79,222	0.8%	70,219	2.9%	627
Inland water and Great Lakes	2,448	[b]	13,501	[b]	[c]	[c]	[c]
Inland water and deep sea	19,682	0.3%	109,916	1.1%	95,215	3.9%	1,903
Other modes							
Other and unknown modes	242,691	4.2%	544,335	5.6%	96,972	4.0%	229
All modes	**5,846,334**	**100.0**	**9,688,493**	**100.0**	**2,420,915**	**100.0**	**424**

Source:
U.S. Department of Commerce, Bureau of the Census, 1993 Commodity Flow Survey, Washington, DC, October 1996, p. 3.
(Additional resources: http://www.bts.gov/cfs/cfs.html)

[a] Average miles and ton-miles are based on the estimated distance traveled, not on Great Circle Distance.
[b] Represents zero or less than 1 unit of measure.
[c] Data do not meet publication standards due to high sampling variability or other reasons.
[d] CFS data for pipelines exclude most shipments of crude oil.

Table 3.32
Summary Statistics on Buses by Type, 1970–95

Year	Transit motor bus[a]	Intercity bus	School bus
Number in operation			
1970	49,700	22,000	288,700
1975	50,811	20,500	368,300
1980	59,411	21,400	418,255
1985	64,258	20,200	480,400
1990	58,714	20,680	508,261
1992	63,080	19,904	525,838
1993	64,850	19,119	534,872
1994	68,123	19,146	547,718
1995	67,086	20,138	560,447
Vehicle-miles (millions)			
1970	1,409	1,209	2,100
1975	1,526	1,126	2,500
1980	1,677	1,162	2,900
1985	1,863	933	3,448
1990	2,123	991	3,800
1992	2,178	974	4,400
1993	2,210	1,065	4,300
1994	2,162	1,216	4,400
1995	2,178	1,250	5,000
Passenger-miles (millions)			
1970	18,210	25,300	[b]
1975	18,300	25,400	[b]
1980	21,790	27,400	[b]
1985	21,161	23,800	[b]
1990	20,981	23,000	74,200
1992	20,336	22,600	90,000
1993	20,247	24,700	94,200
1994	18,832	28,200	85,000
1995	18,818	29,000	95,000
Energy use (trillion Btu)			
1970	44.8	26.6	37.5
1975	51.5	24.8	42.6
1980	61.3	29.3	47.5
1985	72.4	31.5	57.0
1990	78.9	21.7	62.2
1992	87.5[c]	22.1	72.1
1993	86.2	24.0	82.1
1994	86.7	24.7	90.6
1995	87.5	25.4[d]	103.0 [d]

Source:
See Appendix A for Table 3.31. (Additional resources: http://www.apta.com, http://www.fhwa.dot.gov, http://www.schoolbusfleet.com)

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

[b] Data are not available.

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

[d] Estimated using vehicle-miles.

Table 3.33
Federal Government Vehicles by Agency, Fiscal Year 1995

Department or Agency	Autos	Buses	Light trucks[a]	Medium trucks[b]	Heavy trucks[c]	Total
Department of Agriculture	3,375	72	25,174	5,231	577	34,429
Department of Commerce	260	2	445	214	15	936
Department of Energy	828	235	3,862	810	292	6,027
Department of Health & Human Services	94	9	277	133	70	583
Department of Justice	18,256	269	9,569	837	176	29,107
Department of Labor	22	2	129	13	3	169
Department of State	1,206	0	1,225	1,249	84	3,764
Department of Interior	1,724	130	9,781	4,316	1,971	17,922
Department of Treasury	11,138	16	3,200	351	31	14,736
Department of Transportation	30	17	328	113	40	528
Department of Veterans Affairs	317	114	866	102	65	1,464
American Battle Monuments Comm.	17	0	36	12	0	65
Environmental Protection Agency	36	0	245	193	2	476
Federal Communications Comm	66	0	53	3	0	122
Federal Emergency Mgmt Agency	27	7	255	26	0	315
General Services Administration	53,136	2,821	84,310	3,711	3,823	147,801
Government Printing Office	2	0	40	0	0	42
International Boundary & Water Comm.	2	0	17	14	27	60
Merit System Protection Board	0	0	1	0	0	1
Natl Aeronautics & Space Admin.	90	18	626	234	51	1,019
National Gallery of Art	0	0	5	3	2	10
National Science Foundation	25	6	116	21	2	170
Panama Canal Commission	186	13	370	217	64	850
Peace Corps	20	45	450	0	0	515
Smithsonian Institute	61	4	228	54	14	361
Tennessee Valley Authority	1,591	4	1,117	1,158	264	4,134
U.S. Agency for International Develop.	213	17	499	50	17	796
U.S. Soldiers' & Airmen's Home	5	5	23	6	9	48
U.S. Information Agency	402	9	357	20	8	796
CIVILIAN AGENCIES	**93,129**	**3,815**	**143,604**	**19,091**	**7,607**	**267,246**
U.S. POSTAL SERVICE	**7,786**	**11**	**187,043**	**6,496**	**4,827**	**206,163**
Department of the Navy	2,771	889	25,963	2,262	2,423	34,308
Department of the Army	1,422	585	8,922	1,288	1,131	13,348
Department of the Air Force	4,278	2,065	35,212	3,106	2,840	47,501
Other Defense Agencies	2,521	39	1,365	164	131	4,220
Corps of Engineers	358	4	3,760	722	235	5,079
U.S. Marine Corps	641	425	4,789	791	**381**	7,027
MILITARY AGENCIES	**11,991**	**4,007**	**80,011**	**8,333**	**7,141**	**111,483**
TOTAL	**112,906**	**7,833**	**410,658**	**33,920**	**19,575**	**584,892**

Source:
U.S. General Services Administration, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1997.
(Additional resources: http://policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

[a] Less than 8,500 lbs GVWR. Includes ambulances.
[b] 8,501–23,999 lbs GVWR.
[c] 24,000 lbs. Or more GVWR.

Table 3.34
Operating and Cost Data for Large Domestic Federal Fleets, 1986–95[a]

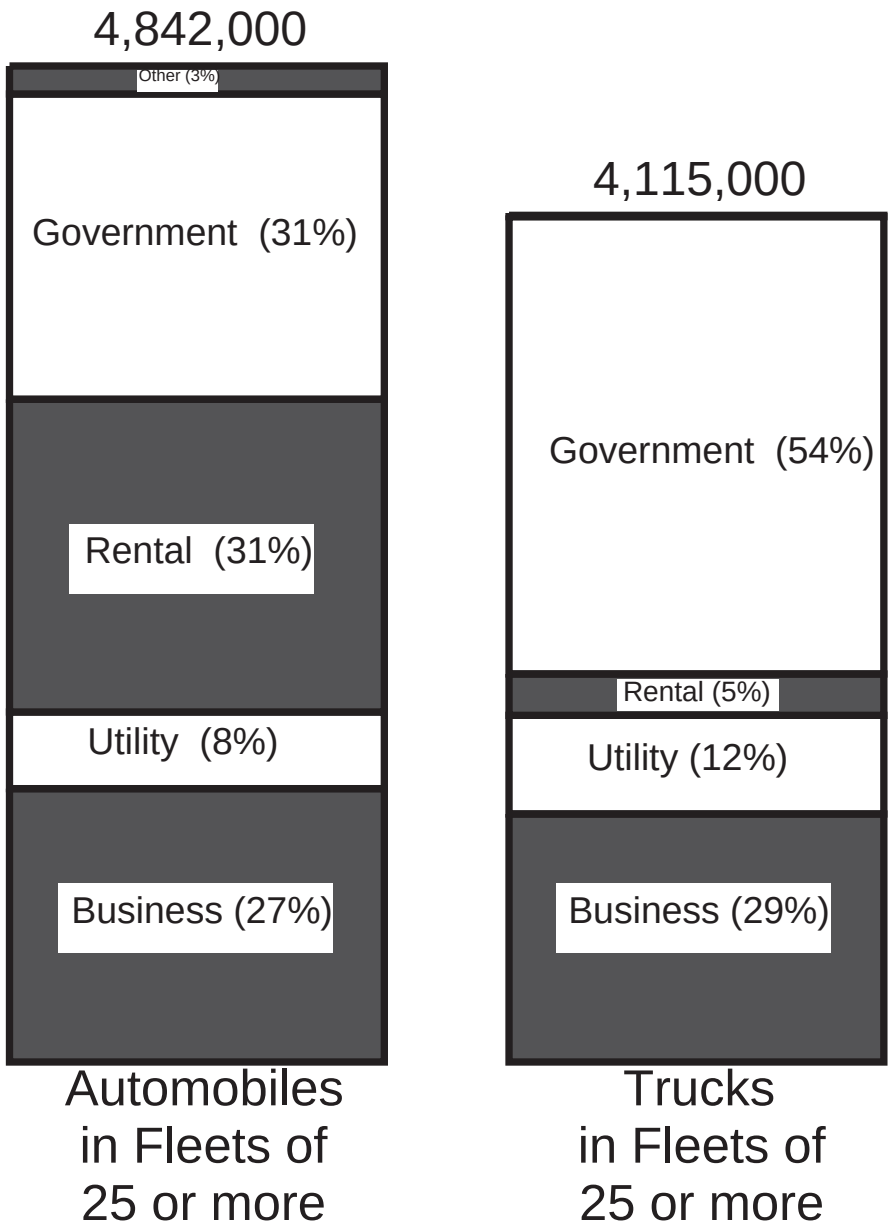
Fiscal year	Number of vehicles	Miles operated (thousands)	Average annual miles per vehicle	Fleet average cost per mile (dollars)
		Sedans		
1986	86,069	1,130,843	13,139	$0.21
1987	89,894	1,069,124	11,893	$0.20
1988	85,928	1,119,343	13,027	$0.19
1989	90,254	1,170,370	12,968	$0.20
1990	93,510	1,226,674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

Source:
U.S. General Services Administrations, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1997. (Additional resources: http://policyworks.gov/main/mt/homepage/mtv/mtvhp.htm)

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

Significant changes have been made in recent years, to fleet vehicle estimations. Newly available data improve the accuracy of fleet vehicles estimates but, at the same time, make it impossible to compare the data historically. Therefore, only the 1996 data are presented here.

Figure 3.2. Fleet Vehicles in Service as of January 1, 1996



Source:

Bobit Publishing Company, Automotive Fleet Research Department, Automotive Fleet Factbook 1996, Redondo Beach, CA, 1996, p. 12.

Table 3.35
Fleet Vehicle Composition by Vehicle Type
(percent)

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

Table 3.36
Average Length of Time Fleet Vehicles are Kept Before Sold to Others
(months)

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

Table 3.37
Average Annual and Daily Vehicle-Miles of Travel for Fleet Vehicles

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

Source:

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

[a]In this study, light trucks are <8,500 lbs gross vehicle weight.

[b]In this study, medium trucks are between 8,500–26,000 lbs gross vehicle weight.

[c]In this study, heavy trucks are >26,000 lbs gross vehicle weight.

Profile of Metropolitan Motor-Vehicle Fleets

Because of concerns about energy security and clean air, the Energy Policy Act of 1992 directed the Energy Information Administration (EIA) to collect data that would be useful in assessing the market for vehicles powered by alternatives to motor gasoline and diesel fuel. Two surveys were designed to draw a profile of private company and local government fleets in a major metropolitan area. The two metropolitan areas surveyed were the Atlanta Metropolitan Statistical Area (MSA) [1994] and the Denver MSA [1995].

The results of the Atlanta survey are published in *Profile of Motor-Vehicle Fleets in Atlanta 1994*, DOE/EIA-0601, November 1995; the results of the Denver survey can be found on the Internet at the following site: http://www.eia.doe.gov/emeu/eeuisd/htm/denver1.htm

Selected statistics from the surveys are presented in Tables 3.37 and 3.38.

A private company fleet for this survey was defined as any group of six or more vehicles owned or operated by private companies and operated out of a base location/locations in the 13-county nonattainment area of Atlanta. Employee-owned vehicles and short-term rental vehicles were excluded. Vehicle leasing companies were excluded to avoid double counting leased vehicles operated by private companies.

Table 3.38
Number of Gasoline and Diesel Vehicles in Private Company Fleets in Atlanta by Vehicle-Size Class and Selected Characteristics

Selected characteristics	Light-duty vehicles (≤ 8,500 GVWR)	Light trucks/ step vans (8,501–19,500 GVWR)	Medium trucks (19,501–26,000 GVWR)	Heavy trucks (> 26,000 GVWR)	Total[a]
SIC Code	**100%**	**100%**	**100%**	**100%**	**100%**
Ag./For./Fish.	[b]	12%	[b]	[b]	[b]
Mining	[b]	[b]	[c]	[b]	[b]
Construction	21%	23%	14%	8%	18%
Manufacturing	4%	10%	7%	6%	5%
Trans./Com./Utilities.	13%	15%	26%	51%	22%
Wholesale trade	14%	12%	23%	16%	15%
Retail trade	[b]	4%	6%	3%	[b]
Fin./Ins./Re.	[b]	[c]	[c]	[b]	[b]
Services	[b]	14%	3%	[b]	[b]
Not classified	12%	10%	6%	12%	11%
Fleet Size (# of vehicles)	**100%**	**100%**	**100%**	**100%**	**100%**
6 to 9	14%	20%	9%	12%	13%
10 to 19	17%	27%	14%	15%	17%
20 to 49	21%	17%	22%	31%	23%
50 or more	49%	37%	55%	42%	47%
Annual miles traveled	**100%**	**100%**	**100%**	**100%**	**100%**
0 to 10,000	7%	10%	22%	[b]	6%
10,001 to 20,000	[b]	33%	31%	11%	[b]
20,001 to 50,000	37%	32%	25%	18%	35%
50,001 or more	6%	[b]	8%	53%	16%
No answer	[b]	13%	[b]	11%	17%
Miles before replacement	**100%**	**100%**	**100%**	**100%**	**100%**
0 to 50,000	[b]	[b]	0%	[b]	[b]
50,001 to 100,000	[b]	13%	9%	4%	[b]
100,001 to 250,000	24%	42%	35%	12%	22%
250,001 or more	[b]	[b]	19%	65%	17%
No answer	[b]	23%	34%	19%	28%
Total vehicles	**55,794**	**5,257**	**4,951**	**15,400**	**82,613**
Percent vehicles by type	**68%**	**6%**	**6%**	**19%**	**100%**

Source:
Energy Information Administration, Office of Energy Markets and End Use, Profile of Motor-Vehicle Fleets in Atlanta, 1994, DOE/EIA-0601, Washington, DC, November 1995, p. 16, (http://www.eia.doe.gov/emeu/eeuisd/htm/atlanta1.htm).

Note: Ag./For./Fish. = Agriculture, Forestry, Fishing. Trans./Com./Utilities = Transportation, Communications, Electric, Gas, and Sanitary Services. Fin./Ins./Re. = Finance, Insurance, and Real Estate.

[a] Buses are included in totals but are not shown because the Relative Standard Error is equal to or greater than 50%, or data were reported for fewer than five fleets.

[b] Withheld because Relative Standard Error is equal to or greater than 50%, or data were reported for fewer than five fleets.

[c] No case reported.

*A private company fleet for this survey was defined as any group of **ten or more** vehicles owned or operated by private companies and operated out of a base location/locations in the 6-county nonattainment area of Denver. Employee-owned vehicles and short-term rental vehicles were excluded. Vehicle leasing companies were excluded to avoid double counting leased vehicles operated by private companies*.

Table 3.39
Number of Gasoline and Diesel Vehicles in Private Company Fleets in Denver by Vehicle-Size Class and Selected Characteristics

Selected characteristics	Light-duty vehicles (≤ 8,500 GVWR)	Light trucks/ step vans (8,501–19,500 GVWR)	Medium trucks (19,501–26,000 GVWR)	Heavy trucks (> 26,000 GVWR)	Total[a]
SIC Code	**100%**	**100%**	**100%**	**100%**	**100%**
Ag./For./Fish.	1%	1%	[b]	1%	1%
Mining	2%	[b]	[b]	[b]	2%
Construction	19%	6%	17%	5%	14%
Manufacturing	8%	4%	29%	7%	9%
Trans./Com./Utilities.	22%	27%	24%	72%	36%
Wholesale trade	10%	11%	16%	8%	10%
Retail trade	9%	32%	8%	4%	10%
Fin./Ins./Re.	1%	[b]	[b]	[b]	1%
Services	27%	12%	4%	2%	17%
Fleet Size (# of vehicles)	**100%**	**100%**	**100%**	**100%**	**100%**
10 to 19	28%	9%	22%	7%	19%
20 to 49	32%	55%	31%	11%	29%
50 or more	40%	36%	47%	82%	51%
Annual miles traveled	**100%**	**100%**	**100%**	**100%**	**100%**
0 to 10,000	8%	4%	26%	2%	5%
10,001 to 20,000	30%	38%	12%	9%	25%
20,001 to 50,000	32%	43%	44%	11%	29%
50,001 or more	6%	[b]	6%	[b]	[b]
No answer	25%	10%	12%	29%	27%
Miles before replacement	**100%**	**100%**	**100%**	**100%**	**100%**
0 to 50,000	12%	b	3%	5%	8%
50,001 to 100,000	24%	28%	16%	7%	17%
100,001 to 250,000	37%	54%	59%	14%	29%
250,001 or more	[c]	[c]	[c]	[c]	[c]
No answer	25%	15%	22%	75%	45%
Total vehicles	34,434	7,961	5,016	17,622	65,607
Percent vehicles by type	52%	12%	8%	27%	100%

Source:
Energy Information Administration, Office of Energy Markets and End Use, (http://www.eia.doe.gov/emeu/eeuisd/htm/denver1.htm).

Note: Ag./For./Fish. = Agriculture, Forestry, Fishing. Trans./Com./Utilities = Transportation, Communications, Electric, Gas, and Sanitary Services. Fin./Ins./Re. = Finance, Insurance, and Real Estate.

[a]Buses are included in totals but are not shown because the Relative Standard Error is equal to or greater than 50% or data were reported for fewer than five fleets.

[b]Withheld because Relative Standard Error is equal to or greater than 50%, or data were reported for fewer than five fleets.

[c]No case reported.

Table 3.40
Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates
for Automobiles and Light Trucks, 1978–97[a]
(miles per gallon)

Model Year	Automobiles				Light Trucks[b]			
	CAFE Standards	CAFE Estimates[c]			CAFE Standards	CAFE Estimates[c]		
		Domestic	Import	Combined		Domestic	Import	Combined
1978	18.0	18.7	27.3	19.9	[d]	[e]	[e]	[e]
1979	19.0	19.3	26.1	20.3	[d]	17.7	20.8	18.2
1980	20.0	22.6	29.6	24.3	[d]	16.8	24.3	18.5
1981	22.0	24.2	31.5	25.9	[d]	18.3	27.4	20.1
1982	24.0	25.0	31.1	26.6	17.5	19.2	27.0	20.5
1983	26.0	24.4	32.4	26.4	19.0	19.6	27.1	20.7
1984	27.0	25.5	32.0	26.9	20.0	19.3	26.7	20.6
1985	27.5	26.3	31.5	27.6	19.5	19.6	26.5	20.7
1986	26.0	26.9	31.6	28.2	20.0	20.0	25.9	21.5
1987	26.0	27.0	31.2	28.5	20.5	20.5	25.2	21.7
1988	26.0	27.4	31.5	28.8	20.5	20.6	24.6	21.3
1989	26.5	27.2	30.8	28.4	20.5	20.4	23.5	20.9
1990	27.5	26.9	29.9	28.0	20.0	20.3	23.0	20.8
1991	27.5	27.3	30.0	28.4	20.2	20.9	23.0	21.3
1992	27.5	27.0	29.2	27.9	20.2	20.5	22.7	20.8
1993	27.5	27.8	29.6	28.4	20.4	20.7	22.8	21.0
1994	27.5	27.5	29.6	28.3	20.5	20.5	22.0	20.7
1995	27.5	27.7	30.3	28.6	20.6	20.3	21.5	20.5
1996	27.5	28.3	29.7	28.7	20.7	20.5	22.1	20.7
1997	27.5	27.9	30.1	28.6	20.7	20.2	22.2	20.4

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, March 1997. (Additional resources: http://www.nhtsa.dot.gov)

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

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

[c]All CAFE calculations are sales-weighted.

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

[e]Data are not available.

Table 3.41
Corporate Average Fuel Economy (CAFE) Fines Collected, 1983–95[a]
(thousands)

Model year	Current dollars	1990 constant dollars[b]
1983	58	76
1984	5,958	7,496
1985	15,565	18,908
1986	29,872	35,603
1987	31,261	35,945
1988	44,519	49,181
1989	47,381	49,946
1990	48,449	48,449
1991	42,243	40,511
1992	38,287	35,645
1993	28,688	25,963
1994	31,474	27,760
1995	39,985	34,267
Total	403,740	409,750

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, March, 1997.
(Additional resources: http://www.nhtsa.dot.gov)

Table 3.42
Tax Receipts from the Sale of Gas Guzzlers, 1980–95
(thousands)

Fiscal year	Current dollars	1990 constant dollars[b]
1980	740	1,174
1981	780	1,121
1982	1,720	2,329
1983	4,020	5,273
1984	8,820	11,097
1985	39,790	48,336
1986	147,660	175,987
1987	145,900	167,759
1988	116,780	129,008
1989	109,640	115,575
1990	103,200	103,200
1991	118,400	113,546
1992	144,200	134,250
1993	111,600	100,998
1994	64,100	56,536
1995	74,600	63,932
Total	1,191,950	1,266,682

Source:
Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p. 87.
(Additional resources: http://www.aama.com)

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

[b] Adjusted using the Consumer Price Inflation Index.

Consumers must pay the Gas Guzzler Tax when purchasing an automobile that has an Environmental Protection Agency (EPA) fuel economy rating less than that stipulated in the table below. The Gas Guzzler Tax doubled in 1991 after remaining constant from 1986 to 1990.

Table 3.43
The Gas Guzzler Tax on New Cars
(dollars per vehicle)

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

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

New Data by Vehicle Speed

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

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

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Table 3.44
Vehicle Specifications for Tested Vehicles

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

Source:
West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values forTraffic Models, FHWA Report (in press), Washington, DC, April 1997.

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

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

Table 3.45
Fuel Economy by Speed, 1973, 1984, and 1997
(miles per gallon)

Speed (miles per hour)	1973[a] (13 vehicles)	1984[b] (15 vehicles)	1997[c] (8 vehicles)
15	[d]	21.1	22.3
20	[d]	25.5	25.5
25	[d]	30.0	27.5
30	21.1	31.8	29.0
35	21.1	33.6	28.8
40	21.1	33.6	30.0
45	20.3	33.5	29.9
50	19.5	31.9	30.2
55	18.5	30.3	30.4
60	17.5	27.6	28.8
65	16.2	24.9	27.4
70	14.9	22.5	25.3
75	[d]	20.0	23.3
		Fuel economy loss	
55–65 mph	12.4%	17.8%	9.9%
65–70 mph	8.0%	9.6%	7.7%
55–70 mph	19.5%	25.7%	16.8%

Source:

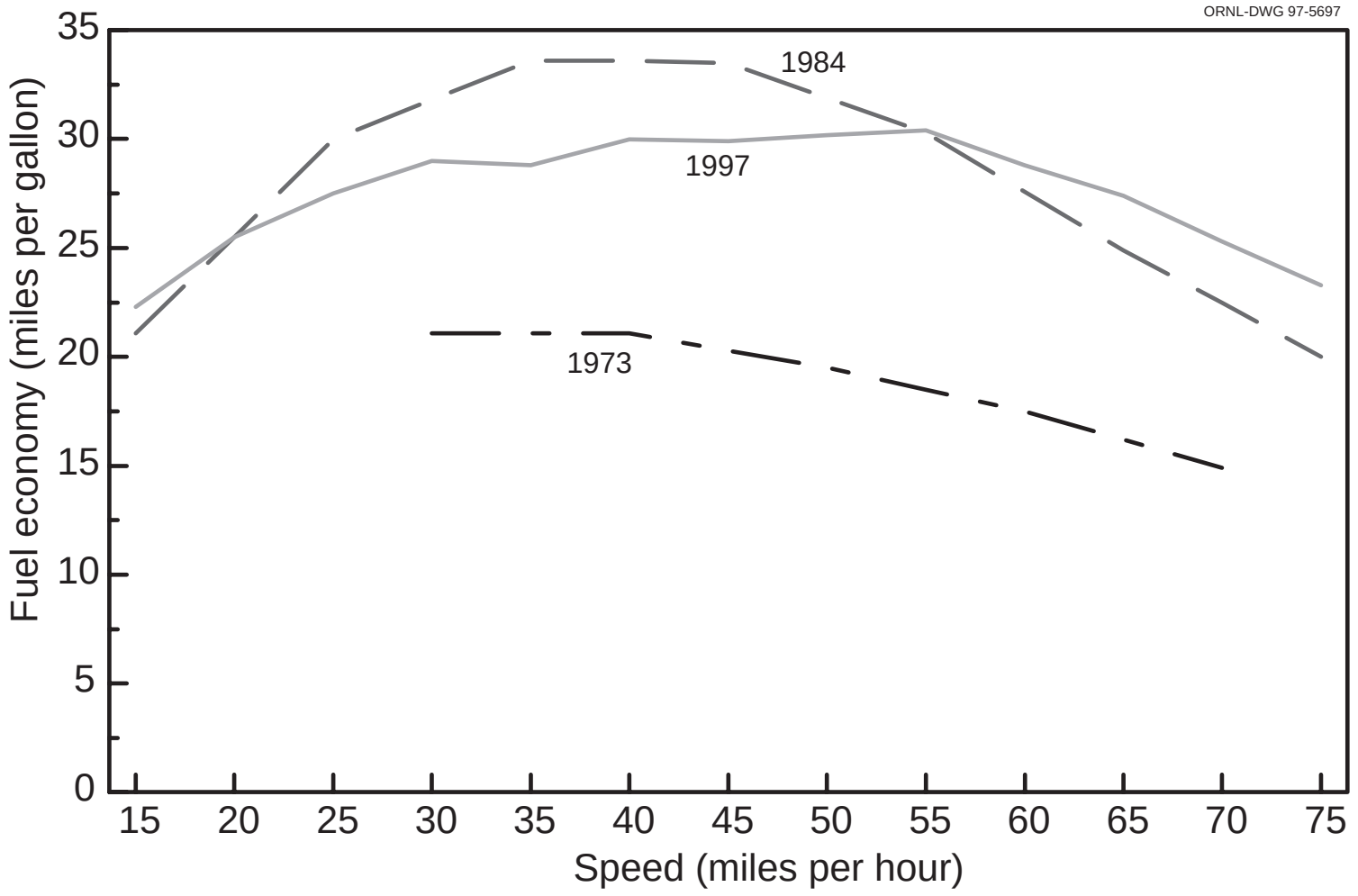
1973- U.S. Department of Transportation, Federal Highway Administration, Office of Highway Planning, The Effect of Speed on Automobile Gasoline Consumption Rates, Washington, DC, October 1973.

1984 - U.S. Department of Transportation, Federal Highway Administration, Fuel Consumption and Emission Values for Traffic Models, Washington, DC, May 1985.

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

[a]Model years 1970 and earlier automobiles.
[b]Model years 1981–84 automobiles and light trucks.
[c]Model years 1988–95 automobiles and light trucks.
[d]Data are not available.

Figure 3.3. Fuel Economy by Speed, 1973, 1984, and 1997



Source: See Table 3.43.

Table 3.46
Steady Speed Fuel Economy for Tested Vehicles
(miles per gallon)

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

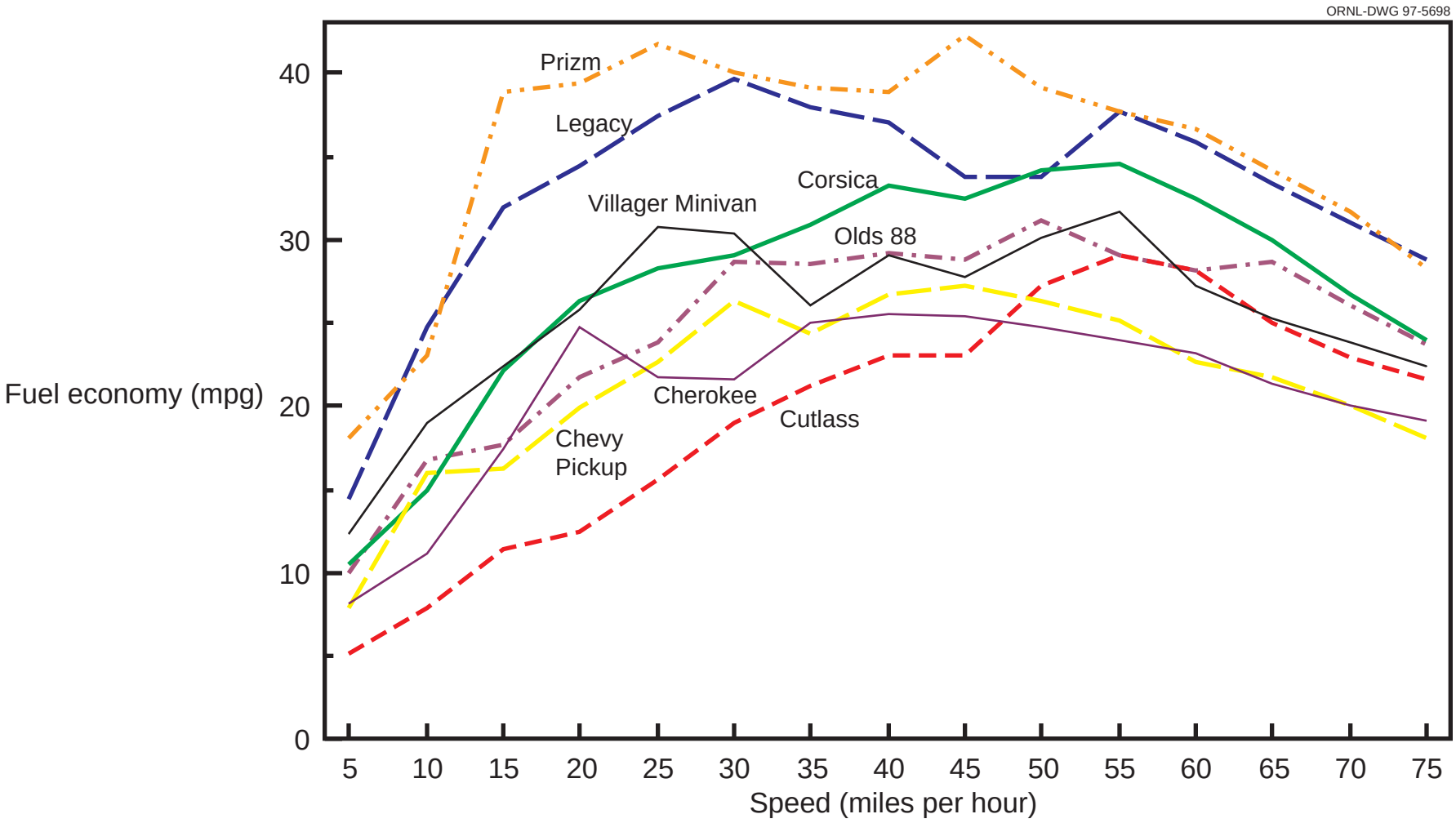
Source:

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

Note:

For specifications of the tested vehicles, please see page 3-49.

Figure 3.4. Fuel Economy by Speed for Selected Vehicles



Source: See Table 3.44.

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

Figure 3.5. Urban Driving Cycle

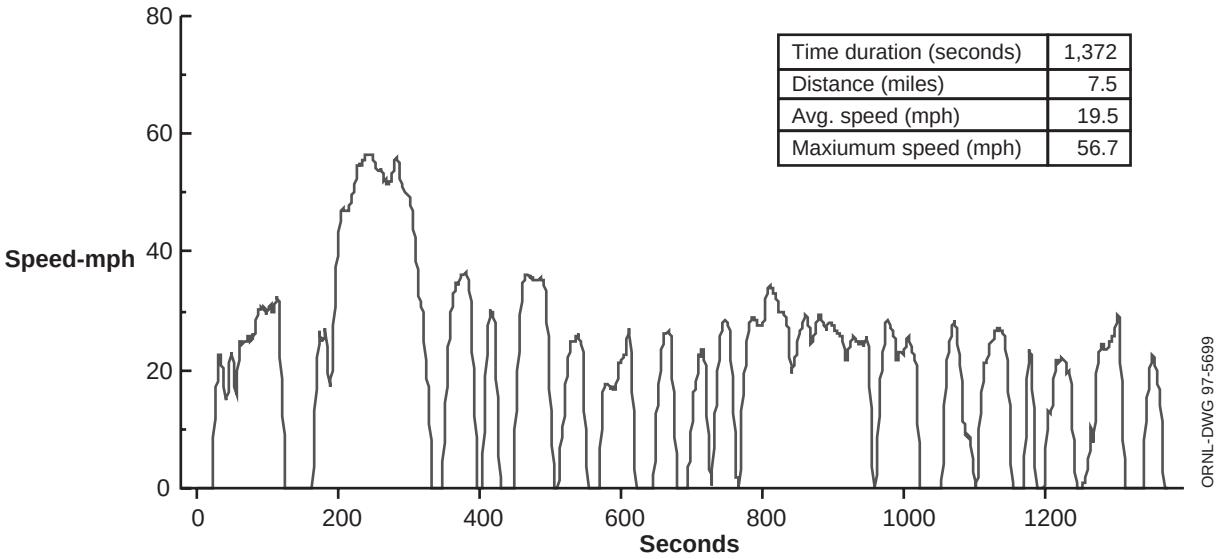
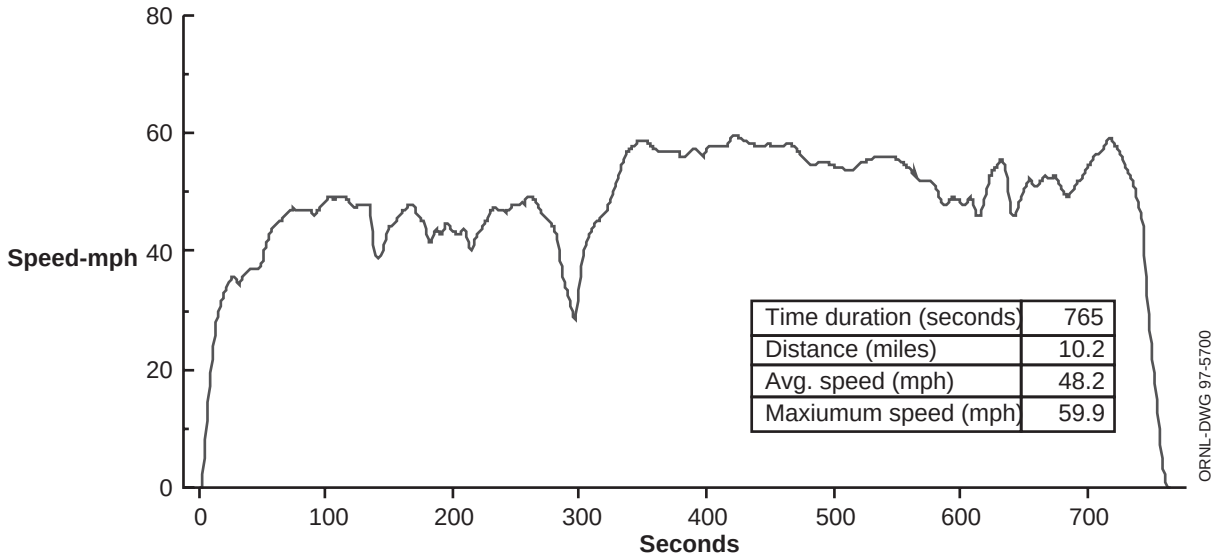


Figure 3.6. Highway Driving Cycle



Source:

Code of Federal Regulations, 40CFR, "Subpart B - Fuel Economy Regulations for 1978 and Later Model Year Automobiles - Test Procedures, " July 1, 1998 edition, p. 676.

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

Figure 3.7. New York City Driving Cycle

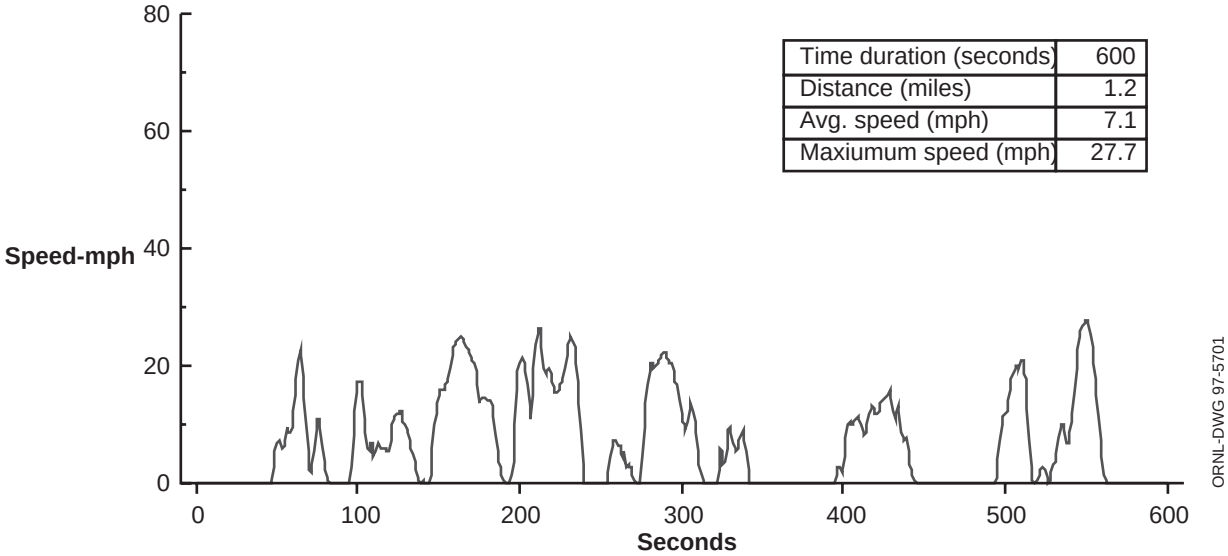
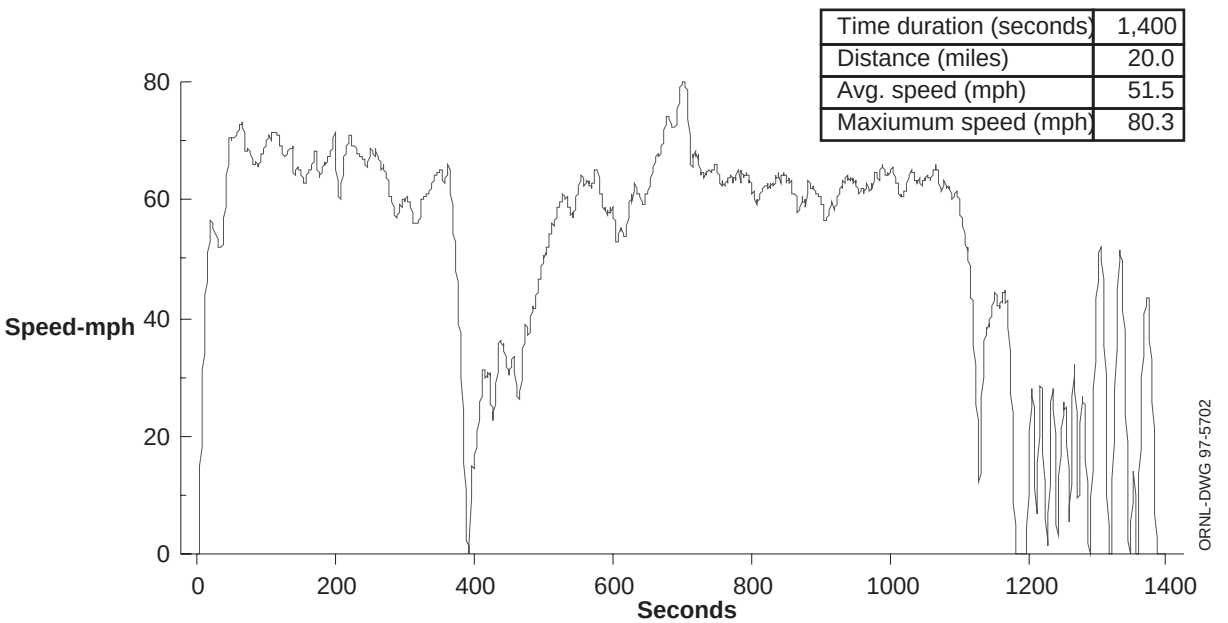


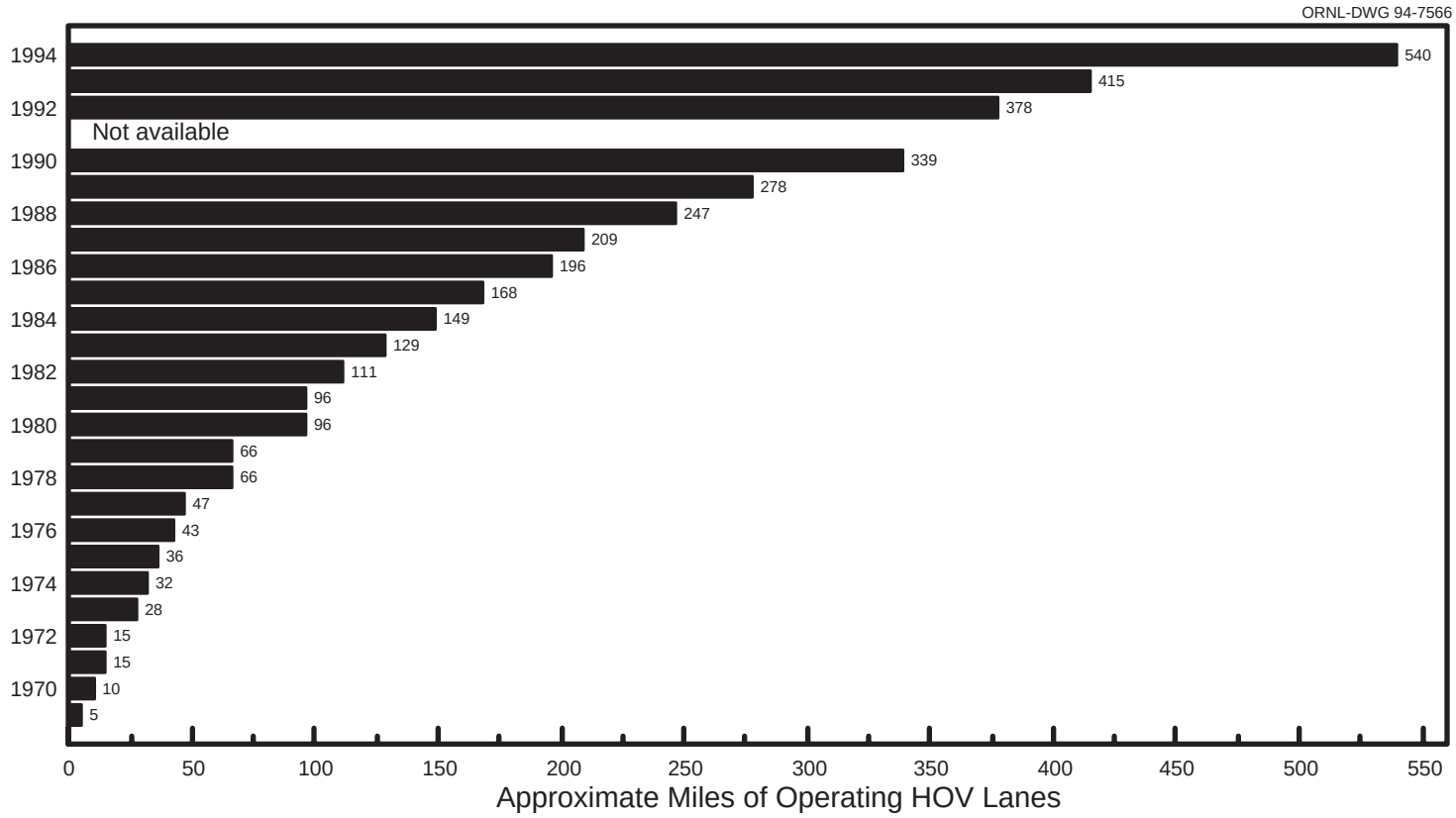
Figure 3.8. Representative Number Five Driving Cycle



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

High-occupancy vehicle (HOV) lanes are special highway lanes meant for the exclusive use of vehicles with a specified minimum number of passengers. Vehicles that use HOV lanes are usually guaranteed a shorter and less congested trip than those using regular traffic lanes. Twenty-five areas in the U.S. and Canada had HOV facilities in 1994, and 4 more areas had HOV facilities in development at that time.

Figure 3.9. Miles of High-Occupancy Vehicle Lanes, 1969-94



Source:
Texas Transportation Institute, College Station, TX, February 1996. (Additional resources: http://tti.tamu.edu)

Note:
1993-94 includes Canadian HOV lanes for three cities.

CHAPTER 4

PERSONAL TRAVEL STATISTICS

Table 4.1
Population and Vehicle Profile, 1950–95

Year	Resident population[a] (thousands)	Total households (thousands)	Number of vehicles in operation (thousands)	Number of licensed drivers (thousands)	Number of civilian employed persons (thousands)	Vehicles per capita	Vehicle miles per capita	Licensed drivers per household	Vehicles per licensed driver	Vehicles per civilian employed persons
1950	151,271	43,554	43,256	62,194	58,918	0.29	3,029	1.43	0.70	0.73
1955	165,069	47,874	55,804	74,686	62,170	0.34	3,656	1.56	0.75	0.90
1960	179,979	52,799	66,582	87,253	65,778	0.36	3,994	1.65	0.76	1.01
1965	193,526	57,251	82,067	98,502	71,088	0.42	4,587	1.72	0.83	1.15
1970	203,984	63,401	98,136	111,543	78,678	0.48	5,440	1.76	0.88	1.25
1975	215,465	71,120	120,054	129,791	85,846	0.56	6,162	1.82	0.92	1.40
1980	227,225	80,776	139,832	145,295	99,303	0.62	6,722	1.80	0.96	1.41
1981	229,466	82,368	141,908	147,075	100,397	0.62	6,767	1.79	0.96	1.41
1982	231,664	83,527	143,854	150,234	99,526	0.62	6,885	1.80	0.96	1.45
1983	233,792	83,918	147,104	154,389	100,834	0.63	7,069	1.83	0.95	1.46
1984	235,825	85,407	152,162	155,424	105,005	0.65	7,295	1.82	0.98	1.45
1985	237,924	86,789	157,048	156,868	107,150	0.66	7,457	1.81	1.00	1.47
1986	240,133	88,458	162,094	159,487	109,597	0.68	7,655	1.80	1.02	1.48
1987	242,289	89,479	167,193	161,975	112,440	0.69	7,929	1.81	1.03	1.49
1988	244,499	91,061	171,741	162,853	114,968	0.70	8,286	1.79	1.05	1.49
1989	246,819	92,830	175,960	165,555	117,342	0.71	8,494	1.78	1.06	1.50
1990	249,398	93,347	179,299	167,015	118,793	0.72	8,598	1.79	1.07	1.51
1991	252,131	94,312	181,438	168,995	117,718	0.72	8,614	1.79	1.07	1.54
1992	255,011	95,689	181,519	173,125	118,492	0.71	8,781	1.81	1.05	1.53
1993	257,783	96,391	186,315	173,149	120,259	0.72	8,909	1.80	1.08	1.55
1994	260,372	97,107	188,714	175,403	123,060[b]	0.72	9,055	1.81	1.08	1.53
1995	262,890	98,990	193,441	176,628	124,900[b]	0.74	9,216	1.78	1.10	1.55
					Average annual percentage change					
1950–95	1.2%	1.8%	3.4%	2.3%	1.7%	2.1%	2.5%	0.5%	1.0%	1.7%
1985–95	1.0%	1.3%	2.1%	1.2%	1.5%	1.2%	2.1%	-0.2%	1.0%	0.5%

Source:

Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 116th edition, Washington, DC, 1996, pp. 8, 58, 393, and annual. (Additional resources: http://www.census.gov)

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

Licensed drivers and vehicle-miles - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Tables DL-1C and VM-1, and annual. (Additional resources: http://www.fhwa.dot.gov)

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

[b]Data are not comparable to earlier years due to changes in definitions and methodology. See original source for more details.

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

Table 4.2
Average Annual Expenditures of Households by Income, 1995[a]

		Income before taxes								
	All households	Less than $5,000	$5,000–$9999	$10,000–$14999	$15,000–$19,999	$20,000–$29,999	$30,000–$39,999	$40,000–$49,999	$50,000–$69,999	$70,000 and over
Total expenditures	$36,948	$1,766	$7,543	$12,420	$17,341	$24,603	$34,606	$44,408	$58,363	$104,589
					Percentage of total expenditures[b]					
Food[c]	14.9%	17.6%	17.6%	17.3%	17.9%	16.0%	14.9%	15.3%	13.7%	12.6%
Housing	31.5%	38.6%	38.5%	35.7%	32.8%	31.5%	31.4%	29.2%	29.6%	30.6%
Apparel and services	5.3%	4.6%	5.3%	4.9%	5.2%	5.5%	5.0%	5.4%	5.0%	5.5%
Transportation	18.2%	13.3%	14.3%	17.6%	17.8%	19.8%	19.2%	19.5%	19.7%	17.0%
Vehicle purchases (net outlay)	**8.0%**	**3.6%**	**5.2%**	**7.5%**	**7.5%**	**9.3%**	**8.4%**	**9.0%**	**8.8%**	**7.4%**
Gasoline and motor oil	**3.0%**	**3.2%**	**3.2%**	**3.3%**	**3.3%**	**3.4%**	**3.4%**	**3.2%**	**3.1%**	**2.4%**
Other vehicle expenditures	**6.1%**	**5.6%**	**4.9%**	**5.8%**	**6.1%**	**6.2%**	**6.4%**	**6.4%**	**6.8%**	**5.8%**
Public transportation	**1.1%**	**1.0%**	**1.0%**	**1.0%**	**0.9%**	**0.9%**	**1.0%**	**0.8%**	**1.0%**	**1.5%**
Health care	5.2%	5.7%	8.5%	7.9%	7.1%	6.5%	5.0%	5.1%	4.4%	3.6%
Entertainment	5.0%	4.9%	4.7%	4.7%	4.0%	4.5%	5.3%	5.0%	5.1%	5.4%
Personal Insurance & pensions	1.3%	1.3%	1.3%	1.4%	1.3%	1.4%	1.4%	1.4 %	1.2%	1.1%
Others[d]	18.7%	14.0%	9.9%	10.6%	13.9%	14.9%	17.9%	19.2%	21.3%	24.1%
Households (thousands)	83,364	4,687	9,787	8,725	7,724	12,643	10,648	8,191	10,378	10,582
Percentage of households	100%	5.6%	11.6%	11.5%	9.2%	15.0%	12.6%	9.7%	12.3%	12.5%

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

[a] Public assistance monies are included in reported income.

[b] Percentages may not sum to totals due to rounding.

[c] Includes alcoholic beverages.

[d] Includes personal care, reading, education, tobacco and smoking supplies, cash contributions, and miscellaneous items.

Table 4.3
Average Number of Vehicles and Vehicle Travel per Household, 1991 and 1994 RTECS

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

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

Table 4.4
Statistics for Household Vehicles by Vehicle Type, 1985, 1988, 1991, and 1994 RTECS

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

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

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

As households owned more vehicles, the average annual miles for the most frequently driven vehicle increased. For example, the most frequently driven vehicle in five-vehicle households was driven 9% more per year than the one in two-vehicle households (16,542 miles vs. 15,172 miles).

Table 4.5
Average Annual Miles per Vehicle by Household Vehicle Ownership, 1994 RTECS

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

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

Table 4.6
Average Age of Vehicles by Household Vehicle Ownership, 1994 RTECS

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

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

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

Table 4.7
Distribution of Vehicles by Vehicle Age and Household Vehicle Ownership, 1994 RTECS

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

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

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

Table 4.8
Household Vehicle Ownership, 1960–90 Census
(percentage)

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

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

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

"Both annual VMT and annual vehicle trips per household increased by 22% between 1969 and 1990. Work trips continue to account for the largest proportion of household travel, both in terms of miles and in number of trips. Average vehicle trip lengths, which had been decreasing from 1969 to 1983, showed increases in 1990. The largest increase in trip length was in work trips." [a]

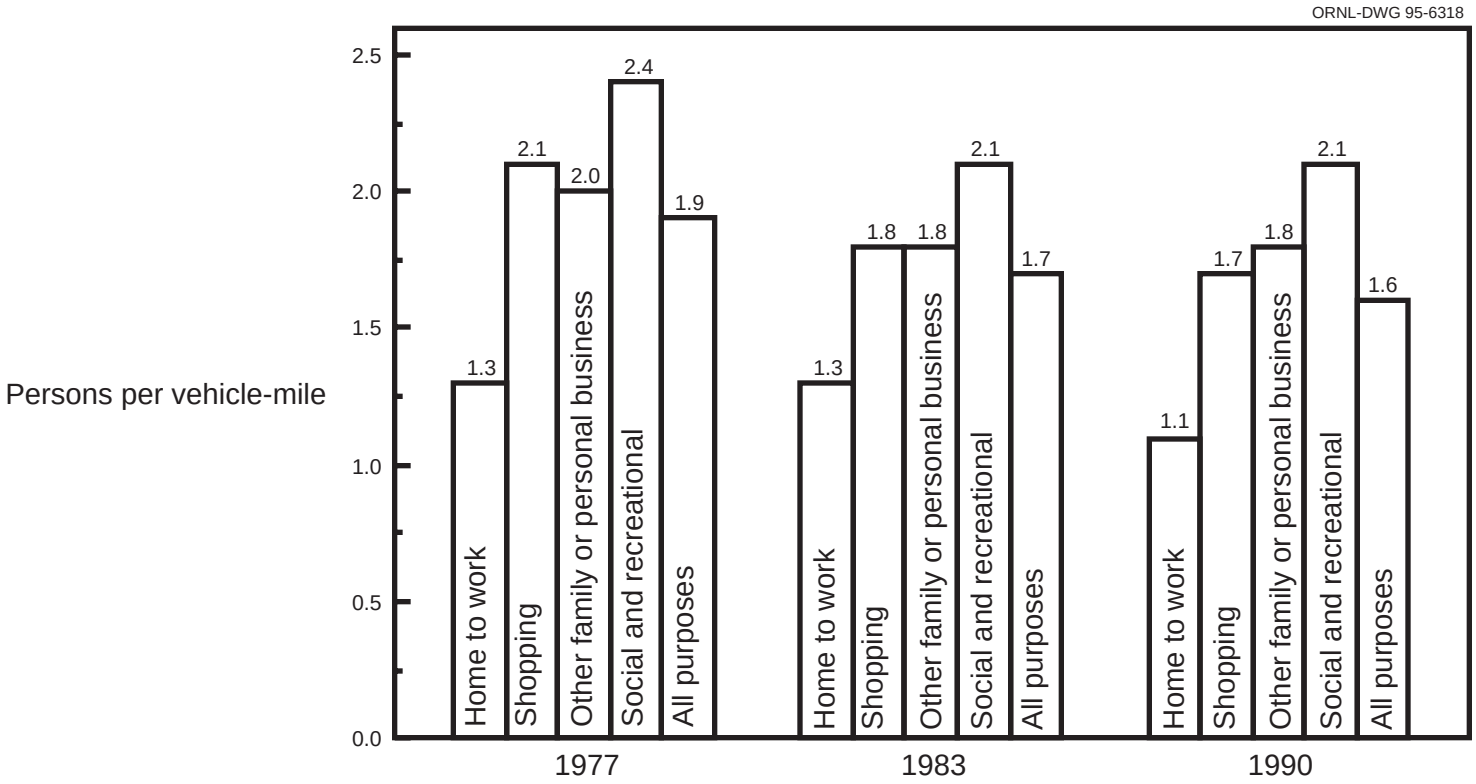
Table 4.9
Average Annual Vehicle-Miles, Vehicle Trips and Trip Length
Per Household for Selected Trip Purposes
1969, 1977, 1983, and 1990 NPTS

Trip purpose	1969	1977	1983	1990	Percent change 69–90
Average annual vehicle-miles per household					
Home to work	4,183	3,815	3,538	4,853	16%
Shopping	929	1,336	1,567	1,743	88%
Other family or personal business	1,270	1,444	1,816	3,014	137%
Social and recreation	4,094	3,286	3,534	4,060	-1%
All[b]	**12,423**	**12,036**	**11,739**	**15,100**	**22%**
Average annual vehicle trips per household					
Home to work	445	423	414	448	0.7%
Shopping	213	268	297	345	62%
Other family or personal business	195	215	272	411	111%
Social and recreation	312	320	335	349	12%
All[b]	**1,396**	**1,442**	**1,486**	**1,702**	**22%**
Average vehicle trip length (miles)					
Home to work	9.4	9.1	8.5	11	17%
Shopping	4.4	5	5.3	5.1	16%
Other family or personal business	6.5	6.8	6.7	7.4	14%
Social and recreation	13.1	10.3	10.5	11.8	-10%
All[b]	**8.9**	**8.4**	**7.9**	**9.0**	**1%**

Source:
U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, FHWA-PL-92-027, Washington, DC, March 1992, Table 7. (Additional resources: http://www.fhwa.dot.gov)

[a]Reference source document, p. 18.
[b]Includes trip purposes not shown above.

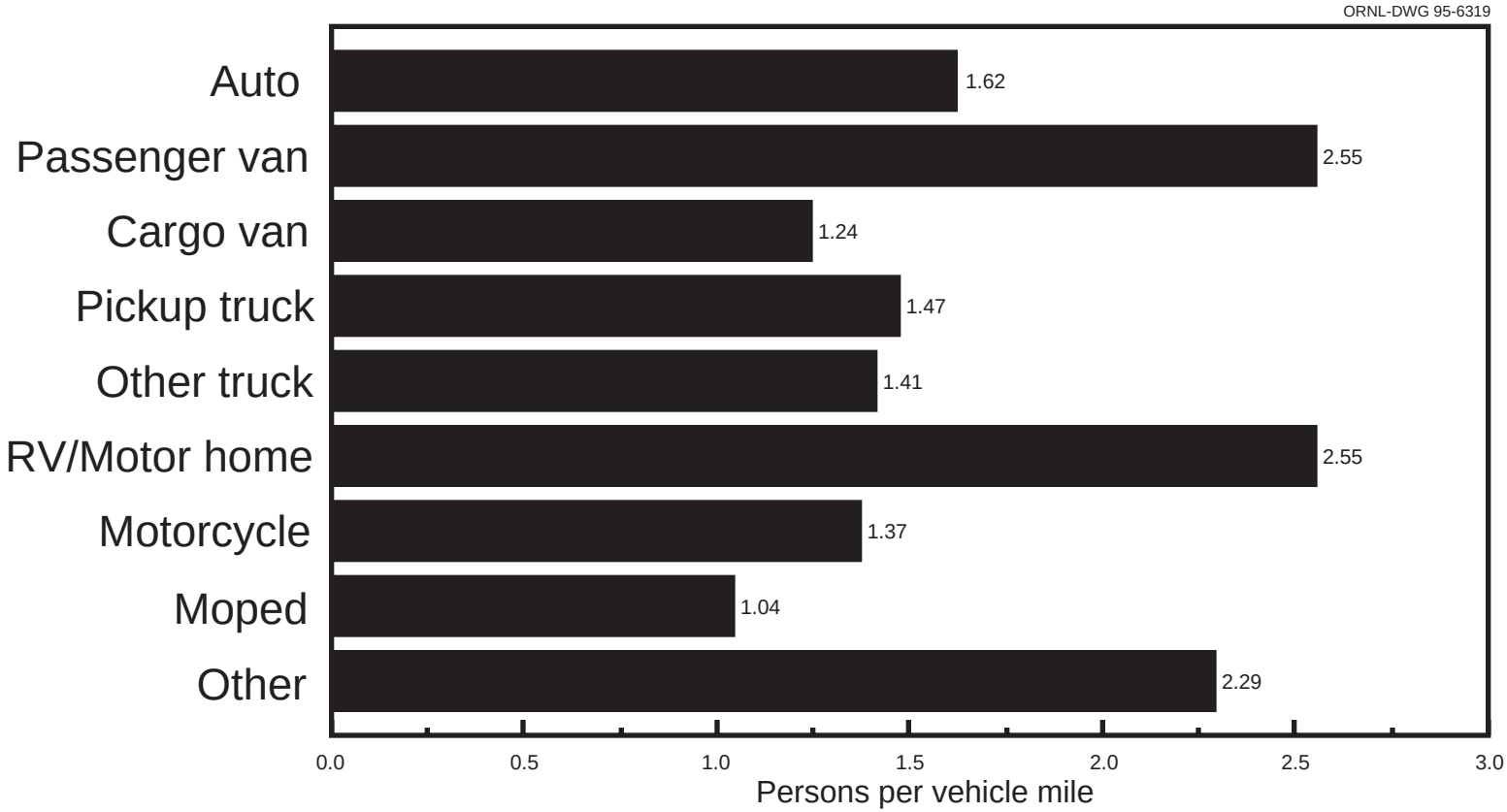
Figure 4.1. Average Vehicle Occupancy by Vehicle Type, 1990 NPTS



Source:
U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey, 1990 NPTS Databook, Volume II, FHWA-PL-94-010B, Washington, DC, November 1994, p. 7-6.
(Additional resources: http://www.fhwa.dot.gov)

The average vehicle occupancy, calculated as person-miles per vehicle-mile, was at its lowest level since 1977 for every trip purpose. The increased number of vehicles per household and the decrease in average household size could have contributed to the decline.

Figure 4.2. Average Vehicle Occupancy by Trip Purpose
1977, 1983, and 1990 NPTS



Source:

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, FHWA-PL-92-027, Washington, DC, March 1992, Figure 6. (Additional resources: http://www.fhwa.dot.gov)

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

Table 4.10
Means of Transportation to Work, 1980 and 1990 Census

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

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

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

Table 4.11
National and Metropolitan Area Comparisons of Journey-to-Work Statistics, 1990 Census

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

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

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

CHAPTER 5

ALTERNATIVE FUELS STATISTICS

Fuel type abbreviations are used throughout this chapter. LPG = liquified petroleum gas. CNG = compressed natural gas. M-85 = 85% methanol, 15% gasoline. E-85 = 85% ethanol, 15% gasoline. M-100 = 100% methanol. E-95 = 95% ethanol, 5% gasoline. LNG = liquified natural gas.

THE ALTERNATIVE FUELS DATA CENTER

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

The purposes of the AFDC are:

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

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

The data are collected for three specific vehicle types: (1) light-duty vehicles, including automobiles, light trucks, and mini-vans; (2) heavy-duty vehicles such as tractor-trailers and garbage trucks; and (3) urban transit buses. An Oracle Relational Database Management System is used to manage the data, along with a statistical software package capable of providing statistical, graphic, and textual information to users. Several tables and graphs in this chapter contain statistics which were generated by the AFDC. Future editions of the Transportation Energy Data Book will continue to present graphical and statistical information from the AFDC.

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

Table 5.1
Estimates of Light-Duty Alternative Fuel Vehicles, 1993, 1995, and 1997

	Private			State and local government			Federal Government		
Fuel type	1993	1995	1997	1993	1995	1997	1993	1995	1997
LPG	173,000	166,000	174,000	43,000	42,000	44,000	32	139	256
CNG	16,932	22,950	30,950	8,692	10,670	17,134	3,090	9,432	22,278
LNG	2	49	48	29	47	49	0	47	64
M-85	2,737	5,198	7,766	1,900	3,569	5,427	5,518	9,552	6,594
M-100	0	0	0	0	0	1	0	0	0
E-85	52	54	109	273	1,084	2,164	114	389	3,586
E-95	4	1	1	1	0	0	0	0	0
Electricity	1,657	2,400	2,966	14	160	257	0	191	519
Total	**194,384**	**196,652**	**215,840**	**53,909**	**57,530**	**69,032**	**8,754**	**19,750**	**33,297**

Source:
U. S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels, 1995, Washington, DC, December 1996, pp. 17–18.
(Additional resources: http://www.eia.doe.gov)

Table 5.2
Estimates of Heavy-Duty Alternative Fuel Vehicles, 1993, 1995, and 1997

	Private			State and local government			Federal government		
Fuel type	1993	1995	1997	1993	1995	1997	1993	1995	1997
LPG	43,000	41,000	44,000	10,000	10,000	11,000	0	2	2
CNG	1,719	3,981	6,001	2,281	3,185	5,384	0	0	0
LNG	3	34	61	265	426	727	0	0	6
M85	0	0	0	108	0	0	0	0	0
M100	2	0	0	412	386	129	0	0	0
E85	0	0	0	2	0	0	0	0	0
E95	4	1	1	18	134	339	0	0	0
Electricity	0	26	28	19	83	155	0	0	0
Total	**44,728**	**45,042**	**50,091**	**13,105**	**14,214**	**17,734**	**0**	**2**	**8**

Source:
U. S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels,1995, Washington, DC, December 1996, pp. 17–18.
(Additional resources: http://www.eia.doe.gov)

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

Table 5.3
Energy Policy Act Purchase Requirements of Light-Duty Alternative Fuel Vehicles

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

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

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

Table 5.4
Fleet Vehicles Operated by Propane, Electricity, and Natural Gas Providers, 1993

	Passenger cars	Light trucks	Medium/ heavy-duty truck	Total
		Propane providers		
Conventional fuel vehicles	2,080	10,771	27,640	43,699
Gasoline	2,080	9,060	9,941	24,288
Diesel	0	0	17,700	19,412
Alternative fuel vehicles	237	11,082	26,540	38,267
Propane-dedicated	130	8,162	25,102	33,800
Propane-multifuel	80	2,847	1,434	4,374
Total	**2,251**	**22,359**	**54,274**	**81,967**
		Electric utility providers		
Conventional fuel vehicles	37,802	88,940	69,499	196,241
Gasoline	37,775	84,708	32,587	155,070
Diesel	27	4,232	36,912	41,171
Alternative fuel vehicles	641	4,005	949	5,595
CNG-dedicated	7	788	26	821
CNG-multifuel	341	2,193	401	2,935
Propane-dedicated	1	170	318	489
Propane-multifuel	1	149	19	169
Methanol/ethanol blends-dedicated	84	317	122	523
Methanol/ethanol blends-multifuel	140	246	26	412
Electricity-dedicated	67	134	36	237
Electricity-multifuel	0	0	0	0
Other alternative fuels-dedicated	0	8	1	9
Other alternative fuels-multifuel	0	0	0	0
Total	**38,443**	**92,945**	**70,448**	**201,836**
		Natural gas providers		
Conventional fuel vehicles	25,694	62,510	5,731	34,072
Gasoline	25,674	60,738	5,440	18,022
Diesel	20	1,772	291	16,050
Alternative fuel vehicles	1,711	11,929	638	2,408
CNG-dedicated	57	2,070	31	96
CNG-multifuel	1,614	8,630	602	1,565
Propane-dedicated	23	391	3	591
Propane-multifuel	8	802	2	138
Electricity-dedicated	8	28	0	1
Electricity-multifuel	0	0	0	0
Other alternative fuels-dedicated	1	8	0	17
Other alternative fuels-multifuel	0	0	0	0
Total	**27,405**	**74,439**	**6,369**	**36,480**

Source:
Energy Information Administration, Office of Energy Markets and End Use, Describing Current and Potential Markets for Alternative-Fuel Vehicles, DOE/EIA-604, Washington, DC, 1996. (Additional resources: http://www.eia.gov)

Note:
"Multifuel" refers to all AFV's capable of operating on more than one fuel (i.e., bi-fuel, flex-fuel, hybrid, and dual-fuel vehicles).

These data, collected as a result of the Natural Gas Suppliers Fleet Survey (EIA-176 Schedule B), indicate that over 90% of the fleet vehicles travel less than 100 miles each day.

Table 5.5
Natural Gas Supplier Fleet Daily Vehicle-Miles Traveled Range, 1993
(number of vehicles)

	Passenger cars			Light-duty vans/trucks (≤8,500 lbs. GVW)					Medium/ heavy-duty trucks	Total
Daily miles traveled	Sub-compact/ compact	Mid-size	Large	Mini-van	Full-size van	Small pickup	Large pickup	Sport/ utility		
0 to 50	56.1%	48.4%	34.5%	51.9%	48.5%	54.0%	40.8%	57.7%	72.1%	54.3%
51 to 100	42.1%	44.7%	41.9%	39.5%	45.6%	40.4%	42.7%	32.9%	23.5%	37.2%
101 to 150	1.5%	5.3%	12.8%	6.1%	4.9%	3.7%	10.6%	7.2%	3.0%	5.7%
151 to 200	0.2%	0.8%	2.3%	2.3%	0.8%	1.6%	3.4%	1.6%	0.8%	1.6%
201 to 300	0.1%	0.7%	7.8%	0.1%	0.2%	0.2%	1.7%	0.5%	0.2%	0.8%
More than 300	0.0%	0.1%	0.8%	0.1%	0.0%	0.0%	0.8%	0.1%	0.4%	0.3%
Total vehicles	**11,001**	**12,417**	**3,987**	**5,636**	**15,416**	**15,527**	**31,491**	**6,369**	**36,480**	**138,324**

Source:
Energy Information Administration, Office of Energy Markets and End Use, Describing Current and Potential Markets for Alternative-Fuel Vehicles, DOE/EIA-604, Washington, DC, 1996.
(Additional resources: http://www.eia.doe.gov)

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

Table 5.6
Summary of EPACT Section 501 Coverage by Industry, 1994

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

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

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

U.S. ADVANCED BATTERY CONSORTIUM

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

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

Table 5.7
U.S. Advanced Battery Consortium Research Agreements, Phase II

Research contracts	
General Motors–Ovonic Joint Venture	Cost reduction program for nickel-metal hydride battery and testing of nickel-metal hydride pilot production modules
SAFT	Cost reduction program for nickel-metal hydride battery
3M Hydro-Quebec	Phase II development of lithium-polymer battery

CRADAs for advanced battery testing
Argonne National Laboratory, Argonne, IL
Sandia National Laboratory, Albuquerque, NM
Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID

Source:
U.S. Advanced Battery Consortium, April 1997.

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

Table 5.8
Advanced Battery Technology Goals of the U.S. Advanced Battery Consortium

	Mid-term goal (1995–1998)	Long-term goal[a]
Power density W/L	250	600
Specific power (charge) W/kg (80% DoD/30 sec)	150–200	400
Specific power (recharge) W/kg (20% DoD/10 sec)	75	
Energy density Wh/L (C/3 discharge rate)	135	300
Specific energy Wh/kg (C/3 discharge rate)	80–100	200
Power/energy ratio	1.5–2.5	
Life (years)	5	10
Cycle life (cycles) (80% DoD)	600	1000
Power and capacity degradation (% of rated spec)	20%	20%
Ultimate price ($/kWh) (10,000 units @ 40 kWh)	<$150	<$100
Operating environment	-30 to 65° C	-40 to 85° C
Normal recharge time	<6 hours	3 to 6 hours
Fast recharge time	50% of capacity in <30 minutes	
Continuous discharge in 1 hour (no failure) energy	75% (of rated energy capacity)	75% (of rated capacity)

Source:
U.S. Department of Energy, Office of Transportation Technologies, Washington, DC, 1995.

Note:
w=watt; kg=kilogram; L=liter; DoD=depth of discharge; wh=watt-hour; kwh=kilowatt-hour.

[a]Competitive with today's internal combustion engine vehicles.

Table 5.9
Alternative Fuel Vehicles Available by Manufacturer

Manufacturer	Model	Body style	Fuel	Emission class
		1997 model year		
Chrysler	EPIC	Minivan	Electric-lead acid	ZEV
Ford	Contour (QMV)	Compact sedan	CNG/gasoline bi-fuel	Gasoline equivalent
Ford	Crown Victoria	Full-size sedan	CNG	ULEV
Ford	Econoline	Full-size van	CNG	SULEV
Ford	F-Series	Light-duty truck	CNG	SULEV
Ford	F700	Mid-duty truck	LPG	California gasoline equivalent
Ford	Ranger	Light-duty truck	Electric-lead acid	ZEV
Ford	Taurus	Mid-size sedan	M85/gasoline or E85/gasoline	TLEV
GM	EV1	Sedan/two seater	Electric-lead acid	ZEV (target)
Chevrolet	S-10	Light-duty truck	Electric-lead acid	California ZEV
Honda	EV	Sedan	Electric-nickel metal hydride	ZEV
GMC	Sierra 2500	mid-duty truck	CNG/gasoline bi-fuel	LEV
		1998 model year		
GMC	Sierra 2500	Light-duty pickup	CNG/gasoline bi-fuel	California LEV (target)
Chevrolet	C 2500	Light-duty pickup	CNG/gasoline bi-fuel	California LEV (target)
Honda	Civic GX	Compact sedan	CNG	California ULEV, Federal ILEV
Nissan	Prairie EV	Minivan	Electric-lithium ion	ZEV
Toyota	RAV4-EV	Sports utility vehicle	Electric-lead acid/nickel metal hydride	ZEV
Chrysler	Minivan	Minivan	Ethanol	To be determined
		Model year to be determined		
Mazda	626 Wagon	Mid-size wagon	Hydrogen	ULEV
Mazda	Miata MX-5	Sedan/two seater	Electric-nickel cadmium	ZEV
Volvo	Volvo	Station wagon	CNG/gasoline bi-fuel	ULEV
Mazda	Titan	Light-duty truck	CNG	Gasoline-equivalent

Source:
U.S. Department of Energy, Light-Duty Vehicle Resource Guide, Washington, DC, March 31, 1997. (Additional resources: http://www.afdc.nrel.gov)

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

The Alternative Fuels Data Center collects data on alternative fuel vehicles around the country. The wide ranges of variability in fuel economy can be attributed in part to the variability in driving cycles and driving styles.

Table 5.10
Alternative Fuel Vehicle Fuel Economies
by Vehicle Type

Vehicle model	Fuel type[a]	Model years	Gasoline equivalent (GE) MPG[b]	In-use GE MPG	
				Low	High
Chevrolet Pickup	CNG	1992	12.0	7	14
	Gasoline	1993	14.0	10	16
Chevrolet Lumina	E85	1992, 1993	20.2	9	29
	M85	1993	19.5	14	30
	Gasoline	1993	19.1	14	28
Dodge Caravan	CNG	1994		8	13
Dodge Ram Van	CNG	1992, 1994	12.5	8	15
	Gasoline	1992, 1994	13.5	6	17
Dodge Spirit	M85	1993, 1994	22.3	15	31
	Gasoline	1993	24.0	21	32
Dodge Intrepid	M85	1995	21.6	[c]	[c]
	Gasoline	1995	20.1	[c]	[c]
Ford Econoline[d]	M85	1992, 1993	13.9	8	19
	Gasoline	1993	15.0	9	18
Ford Taurus	E85	1994	22.0	11	28
	M85	1993	20.7	18	31
	Gasoline	1993	21.4	21	34
Ford Taurus	M85	1995	22.2	[c]	[c]
	E85	1995	22.0	[c]	[c]
	Gasoline	1995	22.5	[c]	[c]

Source:
National Renewable Energy Laboratory, Alternative Fuels Data Center, April 1997.

Note: All alternative fuel values are in gasoline equivalent miles per gallon.

[a]Reformulated gasoline was used for all emissions tests.
[b]Average fuel economy measurements during emissions tests.
[c]Data not available.
[d]Not a production vehicle, part of a vehicle demonstration fleet.

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

Table 5.11
Number of Alternative Refuel Sites by State and Fuel Type, 1997

State	M85 sites	CNG sites	E85 sites	LPG sites	LNG sites	Electric sites	Total
Alabama	0	17	0	114	2	0	133
Alaska	0	0	0	9	0	0	9
Arizona	1	31	0	71	3	10	19
Arkansas	0	7	0	156	0	0	164
California	66	200	0	219	18	103	612
Colorado	2	45	1	48	3	0	99
Connecticut	0	22	0	18	0	1	40
Delaware	0	6	0	6	0	0	14
District of Columbia	1	8	1	0	0	1	10
Florida	3	60	0	222	0	4	285
Georgia	1	89	0	80	3	2	174
Hawaii	0	0	0	0	0	3	3
Idaho	0	7	0	20	1	1	28
Illinois	2	24	14	163	0	2	203
Indiana	0	47	2	125	4	1	178
Iowa	0	5	10	107	0	1	122
Kansas	0	18	2	38	1	0	64
Kentucky	0	13	3	35	0	0	51
Louisiana	0	21	0	44	2	0	68
Maine	0	0	0	12	0	0	12
Maryland	2	31	0	21	3	3	58
Massachusetts	0	18	0	42	0	4	60
Michigan	2	39	1	182	2	10	226
Minnesota	0	17	11	125	2	0	149
Mississippi	0	3	0	75	0	0	78
Missouri	0	11	3	83	0	0	97
Montana	0	13	0	48	1	0	62
Nebraska	0	11	6	47	1	0	66
Nevada	0	11	0	20	0	0	31
New Hampshire	0	1	0	31	0	1	32
New Jersey	0	24	0	37	0	0	62
New Mexico	0	18	0	46	1	0	65
New York	7	59	0	100	0	5	166
N. Carolina	0	11	0	72	0	1	83
N. Dakota	0	5	1	17	0	0	23
Ohio	2	70	0	98	1	1	171
Oklahoma	0	56	0	56	0	0	111
Oregon	0	9	0	21	1	0	31
Pennsylvania	1	61	0	141	1	1	195
Rhode Island	0	3	0	6	0	0	8
S. Carolina	0	3	0	67	0	1	47
S. Dakota	0	5	10	30	0	0	39
Tennessee	2	7	0	95	0	1	89
Texas	0	92	0	864	15	2	313
Utah	0	67	0	23	1	0	91
Vermont	0	1	0	40	0	9	34
Virginia	0	30	0	51	3	19	72
Washington	2	32	0	69	1	6	72
W. Virginia	1	42	0	21	0	1	59
Wisconsin	0	29	3	190	0	0	171
Wyoming	0	19	0	47	2	0	54
Total	**95**	**1,418**	**68**	**4,252**	**72**	**194**	**5,200**

Source:

U.S. Department of Energy's Alternative Fuels Data Center web site, http://www.afdc.nrel.gov/newrefuel/state_tot.cgi and the Electric Vehicle Association of the Americas web site, http://www.evaa.org/events_info/evdirectory.html, July 1997.

Table 5.12
U.S. Production of MTBE[a] and Fuel Ethanol, 1978–96
(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
Average annual percentage change		
1978–96	24.1%	[b]
1986–96	2.0%	23.0%

Source:
1992–96 Ethanol and MTBE - U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Monthly*, January 1996, Table D1.
1978–90 Ethanol - Information Resources, Inc., Washington, DC, 1991.
1981–86 MTBE - EA-Mueller,Inc., Baltimore, MD, 1992.

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

Table 5.13
Alternative Vehicle Fuel Consumption 1992–96
(thousand gasoline equivalent gallons)

Alternative fuel	1992	1993	1994	1995	1996
Liquified petroleum gas	208,142	264,655	248,467	232,701	238,681
Compressed natural gas	16,823	21,603	24,160	35,162	50,884
Liquified natural gas	585	1,900	2,345	2,759	3,233
M85[a] (85% methanol, 15% gasoline)	1,069	1,593	2,340	3,575	3,832
M100	2,547	3,166	3,190	2,150	360
E85[a] (85% ethanol, 15% gasoline)	21	48	80	190	436
E95 (85% ethanol, 5% gasoline)	85	80	140	709	1,803
Electricity	359	288	430	663	815
Total	**229,631**	**293,334**	**281,152**	**277,909**	**300,044**

Source:
U.S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels, 1995, Washington, DC, December 1996, p. 20.
(Additional resources: http://www.eia.doe.gov)

[a]Consumption includes gasoline portion of the mixture.

Table 5.14
Gasohol Consumption by Reporting States, 1980–95[a]
(thousands of gallons)

	1980	1990	1995 (10% ethanol)	1995 (<10% ethanol)	1995 Total	Total ethanol used in gasohol,1995
Alabama		197,856	241,205		214,205	21,421
Alaska			67,662	13,146	80,808	6,766
Arizona	2,798			313,688	313,688	24,154
Arkansas	8,250	62,004	3,356		3,356	336
California	147,795	479,716		1,632,197	1,632,197	93,035
Colorado	3	97,263	266,344	83,523	349,867	33,066
Connecticut	15,849		8,635	189	8,824	878
Delaware	1,512					
Dist of Columbia	124					
Florida	14,359	77,558	21,121		21,121	2,112
Georgia	11,063	88,672	1,108		1,108	111
Hawaii	1,095					
Idaho		70,199	3,918		3,918	392
Illinois	15,088	1,341,148	1,592,968		1,592,968	159,297
Indiana		638,337	819,217		819,217	81,922
Iowa	155,947	374,897	667,635		667,635	66,763
Kansas	37,786	73,971	40,625		40,625	4,063
Kentucky	4,763	355,987	47,766		47,766	4,777
Louisiana		38,760	68,507		68,507	6,851
Maine	2,634					
Maryland	18,549		22,745	7,064	29,809	2,818
Massachusetts	16,209					
Michigan	29,924	510,447	449,450		449,450	44,945
Minnesota	11,776	244,336	1,231,248	300,957	1,532,205	146,298
Mississippi			20,279		20,279	2,028
Missouri		267,408	212,387		212,387	21,239
Montana	158	1,423	6,170	109	6,279	625
Nebraska	30,067	300,632	238,587		238,587	23,859
Nevada	641	49,167	82,887	37,743	120,630	11,195
New Hampshire	3,642					
New Jersey	6,567		56,644	66,184	122,828	10,761
New Mexico		156,935	160,457	17,409	177,866	17,386
New York			178,326	81,624	259,950	24,118
N. Carolina	10,688		10,050	514	1,054	1,045
N. Dakota	13,491	35,821	60,503		60,503	6,050
Ohio	16,726	1,072,040	1,897,615		1,897,615	189,762
Oklahoma	28,910					
Oregon						
Pennsylvania			582,468	71,810	654,278	63,776
Rhode Island	1,763					
S. Carolina	11,608	62,549				
S. Dakota	10,507	60,000	186,665		186,665	18,666
Tennessee		246,713	132,142		132,142	13,124
Texas		247,384	447,139	1,164	448,303	44,804
Utah		485				
Virginia	1,991	161,202	282	31	313	31
Washington	14,063	86,847	222,737	64,631	287,098	27,229
W. Virginia	692		12,005		12,005	1,201
Wisconsin		82,961	317,418		317,418	31,742
Wyoming	611	9,513	49,601		49,601	4,960
Total	**497,222**	**7,492,231**	**10,400,872**	**2,691,713**	**13,092,585**	**1,213,696**

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, Table MF-33E, p. I-6, and annual.

[a]The data reflect gallons of gasohol reported by the distributors in each of the selected states. Blanks indicate data were not reported for the state that year.

The prices of CNG and unleaded gasoline vary from place to place. A comparison of fuel prices by "Natural Gas Fuels" in January 1997 showed that CNG is less expensive than unleaded gasoline, as much as 53% less in Salt Lake City, UT.

Table 5.15
Comparison of Station Prices: Compressed Natural Gas and Regular Unleaded Gasoline, January 1997

Region	Station	CNG	Unleaded gasoline	Percentage CNG to gasoline
	Dollars per gallon or equivalent gallon			
1	Amoco/Minneapolis, MN	$0.899	$1.279	70.3%
	Exxon/Billings, MT	$0.829	$1.399	59.3%
2	Unocal Vista, CA	$0.999	$1.239	80.6%
	Total/Denver, CO	$0.849	$1.379	61.6%
	Sinclair/Salt Lake City, UT	$0.577	$1.239	46.6%
3	Mobil/Garland, TX	$0.799	$1.179	67.8%
	Shell/Houston, TX	$0.899	$1.189	75.6%
	Chevron/Houston, TX	$0.799	$1.169	68.3%
	Sav-a-Stop/Oklahoma City,	$0.679	$0.159	58.6%
4	Conoco/Mobile, AL	$0.799	$1.189	67.2%
	Shell/Palm Beach Gardens,	$0.999	$1.379	72.4%
	Petroleum Source	$0.999	$1.149	86.9%
5	Texaco/Hartford, CT	$0.999	$1.539	64.9%
	Mobil/Brooklyn, NY	$1.299	$1.499	86.7%
	Canadian dollars per liter or equivalent liter			
Canada	Petro-Canada/Vancouver, BC	$0.348	$0.595	58.5%
	Shell/Etobicoke, Ontario	$0.361	$0.556	64.9%

Source:
R.P. Publishing, Inc., Natural Gas Fuels, February 1997, p. 10.

Table 5.16
State Taxes on Motor Fuels, 1997
(dollars per gallon or gasoline equivalent gallon)
(Footnotes for this table appear on page 5-19)

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	0.00	0.08	0.00	0.08[b]	0.08[b]
Arizona	0.18	0.18	0.00	0.10[c]	0.18	0.18	0.00
Arkansas	0.185	0.185	0.185	0.05[d]	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[e]	0.18[e]	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)[f]	0.325	0.325	0.325	0.325	0.22	0.325	0.325
Idaho	0.25	0.25	0.25	0.197[g]	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[d]	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[h]	0.16[h]	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[i]	0.15	NA	0.20[b]
Mississippi	0.18	0.18	0.18	0.18[d]	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[j]	[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[d]	0.23[d]	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[h]	0.03[h]	0.22[b]	0.22[b]
New York	0.08[k]	0.10[k]	0.08[k]	0.08[k]	0.08[k]	0.08[k]	0.08[k]
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[l]	0.12[l]	0.12[l]	0.12[l]	0.12[l]	0.12[l]	0.12[l]
Rhode Island	0.28	0.28	0.28	0.0	0.28	0.28	0.28
South Carolina	0.16	0.16	0.16	0.16	0.16	0.16	0.16
South Dakota	0.18	0.18	0.16	0.06	0.16	0.06	0.06

Table 5.16 (continued)
State Taxes on Motor Fuels, 1997
(dollars per gallon or gasoline equivalent gallon)

State	Gasoline	Diesel fuel	Gasohol	CNG	Propane	Methanol	Ethanol
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[l]	0.19[l]	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., The Clean Fuels Report, April 1997, pp. 47, 48.
(Additional resources: http://phidias,colorado.edu/sinor)

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

As of February 1997, only five states offered tax exemptions to encourage the use of gasohol for transportation purposes. This list is quite short compared to the 30 states which offered gasohol tax exemptions ten years ago. Still, the Federal Government encourages gasohol use via a difference in the Federal tax rates of gasoline and gasohol.

Table 5.17
State Tax Exemptions for Gasohol, February 1997

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

Source:
U.S. Department of Transportation, Federal Highway Administration, "Monthly Motor Fuel Reported by the States, November 1996," February 1996, Washington, DC, Table MF-121T.
(Additional resources: http://www.fhwa.dat.gov)

Table 5.18
Federal Excise Taxes on Motor Fuels

Fuel		Dollars per gallon
Gasoline		0.1830
Diesel[a]		0.2430
Gasohol	10% Ethanol	0.1290
	7.7% Ethanol	0.1414
	5.7% Ethanol	0.1522
Gasohol	10% Methanol	0.1230
	7.7% Methanol	0.1368
	5.7% Methanol	0.1488
Methanol	Qualified[b]	0.1290
	Partially Exempt[c]	0.1130
Ethanol	Qualified[b]	0.1290
	Partially Exempt[c]	0.11
CNG		0.4844/mcf[d]
LNG		0.1830
Propane		0.1830

Source:
J. E. Sinor Consultants, Inc., "The Clean Fuels Report," April 1997, p.48.
(Additional resources: http://phidias.colorado.edu/sinor)

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

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

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

[d]Thousand cubic feet.

Table 5.19
States With Ethanol Tax Incentives

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

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

CHAPTER 6

NON HIGHWAY MODES

Table 6.1
Summary Statistics for Domestic and International Certificated Route Air Carriers (Combined Totals), 1970–96

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

Source:

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

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

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

[a]Scheduled services of domestic operations only. The average passenger trip length for international operations is more than three and a half times longer than for domestic operations.

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

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

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

[e]Scheduled services only.

[f]Data are not available.

Table 6.2
Summary Statistics for General Aviation, 1970–95

Calendar year	Total number of aircraft	Hours flown (thousands)	Intercity passenger travel (billion passenger-miles)	Energy use (trillion btu)
1970	131,700[a]	26,030[b]	9.1	94.4
1971	131,100[a]	25,512[b]	9.2	91.6
1972	145,000[a]	26,974[b]	10.0	103.4
1973	148,000[a]	28,599	10.7	90.4
1974	161,502	29,758	11.2	101.4
1975	168,475	30,298	11.4	121.5
1976	177,964	31,950	12.1	130.3
1977	184,294	33,679	12.8	149.7
1978	199,178	36,844	14.1	159.4
1979	210,339	40,432	15.5	167.2
1980	211,045	41,016	14.7	169.0
1981	213,226	40,704	14.6	162.4
1982	209,779	36,457	13.1	170.5
1983	213,293	35,249	12.7	143.9
1984	220,943	36,119	13.0	148.9
1985	196,500	31,456	12.3	144.0
1986	205,300	31,782	12.4	148.0
1987	202,700	30,883	12.1	139.1
1988	196,200	31,114	12.6	148.6
1989	205,000	32,332	13.1	134.0
1990	198,000	32,096	13.0	131.9
1991	198,475	30,067	12.2	120.4
1992	184,434	26,493	10.7	104.7
1993	176,006	24,340	10.9	97.5
1994	170,600	23,866	11.1	95.3
1995	181,341	25,447	11.3	106.6
	Average Annual Percentage Change			
1970–95	1.3%	-0.1%	0.9%	0.5%
1985–95	-0.8%	2.1%	-0.8%	-3.0%

Sources:

Intercity passenger-miles - Eno Foundation for Transportation, Transportation in America, Fourteenth edition, Washington, DC, 1996, p. 47, and annual.

All other- U.S. Department of Transportation, Federal Aviation Administration, General Aviation Activity and Avionics Survey: Calendar Year 1995, pp. 1-7, 1-14, 5-3, and annual. (Additional resources: http://www.faa.gov)

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

[b]Include rotocraft.

In the early seventies, domestic waterborne commerce accounted for over 60% of total tonnage, but by 1995 foreign tonnage grew to more than half of all waterborne tonnage.

Table 6.3
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970–95
(million tons shipped)

Year	Foreign and domestic total	Foreign total[a]	Domestic total[b]	Percent domestic of total
1970	1,532	581	951	62.1%
1971	1,513	566	947	62.6%
1972	1,617	630	987	61.0%
1973	1,762	767	994	56.4%
1974	1,747	764	983	56.3%
1975	1,695	749	946	55.8%
1976	1,835	856	979	53.4%
1977	1,908	935	973	51.0%
1978	2,021	946	1,075	53.2%
1979	2,073	993	1,080	52.1%
1980	1,999	921	1,077	53.9%
1981	1,942	887	1,054	54.3%
1982	1,777	820	957	53.9%
1983	1,708	751	957	56.0%
1984	1,836	803	1,033	56.3%
1985	1,788	774	1,014	56.7%
1986	1,874	837	1,037	55.3%
1987	1,967	891	1,076	54.7%
1988	2,088	976	1,112	53.3%
1989	2,140	1,038	1,103	51.5%
1990	2,164	1,042	1,122	51.8%
1991	2,092	1,014	1,079	51.6%
1992	2,132	1,037	1,095	51.4%
1993	2,128	1,060	1,068	50.2%
1994	2,215	1,116	1,099	49.6%
1995	2,240	1,147	1,093	48.8%
	Average annual percentage change			
1970–95	1.5%	2.8%	0.6%	
1985–95	2.3%	4.0%	0.8%	

Source:
U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1995, Part 5: National Summaries, New Orleans, Louisiana, 1997, Table 1-1, p. 1-3, and annual. (Additional resources: http://www.wrc-ndc.usace.army.mil/ndc)

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

[b]All movements between U.S. ports, continental and noncontiguous, and on the inland rivers, canals, and connecting channels of the U.S., Puerto Rico, and the Virgin Islands, excluding the Panama Canal.

Table 6.4
Summary Statistics for Domestic Waterborne Commerce, 1970–95

Year	Number of vessels[a]	Ton-miles (billions)	Tons shipped[b] (millions)	Average length of haul (miles)	Energy intensity (Btu/ton-mile)	Energy use (trillion Btu)
1970	25,832	596	949	628.2	545	324.8
1971	26,063	593	944	628.1	506	300.0
1972	27,347	604	985	612.8	522	315.1
1973	28,431	585	990	590.7	576	337.0
1974	29,328	586	979	599.1	483	283.3
1975	31,666	566	944	599.9	549	311.0
1976	33,204	592	976	606.3	468	277.3
1977	35,333	599	969	618.0	458	274.3
1978	35,723	827	1,072	771.6	383	316.6
1979	36,264	829	1,076	770.0	457	378.7
1980	38,792	922	1,074	856.4	358	329.8
1981	42,079	929	1,051	884.0	360	334.5
1982	42,079	886	954	929.0	310	274.9
1983	41,784	920	953	964.6	319	293.7
1984	41,784	888	1,029	862.5	346	307.3
1985	41,672	893	1,011	883.5	446	398.6
1986	40,308	873	1,033	845.3	463	404.0
1987	40,000	895	1,072	835.0	402	370.7
1988	39,192	890	1,106	804.3	361	321.3
1989	39,209	816	1,097	743.2	403	328.6
1990	39,233	834	1,118	745.7	388	323.2
1991	39,233	848	1,074	789.9	386	327.5
1992	39,210	857	1,090	785.7	398	341.0
1993	39,064	790	1,063	742.7	389	307.0
1994	39,064	815	1,093	745.5	369	300.7
1995	39,641	808	1,086	743.6	374	302.2
			Average annual percentage change			
1970–95	1.7%	1.2%	0.5%	0.7%	-1.5%	-0.3%
1985–95	-0.5%	-1.0%	0.7%	-1.7%	-1.7%	-2.7%

Source:

Number of Vessels -

1970–92, 1995 - U.S. Department of the Army, Corps of Engineers, "Summary of U.S. Flag Passenger and Cargo Vessels, 1995," New Orleans, LA, 1997, and annual.

1993–94 - U.S. Dept of the Army, Corps of Engineers, The U.S. Waterway System-Facts, Navigation Data Center, New Orleans, Louisiana, January 1996.

Ton-miles, tons shipped, average length of haul - U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1995, Part 5: National Summaries, New Orleans, LA, 1997, Table 1-4, pp. 1-6, 1-7, and annual.

Energy Use - See Appendix A for Table 2.7.

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

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

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

Fifty-seven percent of all domestic marine cargo in 1995 were energy-related products (petroleum, coal, coke). The majority of the energy-related products were shipped internally and locally (62%). Barge traffic accounted for 97% of all internal and local waterborne commerce.

Table 6.5
Breakdown of Domestic Marine Cargo by Commodity Class, 1995

Commodity class	Coastwise		Lakewise		Internal and local		Total domestic		
	Tons shipped (millions)	Average haul[a] (miles)	Tons shipped (millions)	Average haul[a] (miles)	Tons shipped (millions)	Average haul[a] (miles)	Tons shipped (millions)	Percentage	Average haul[a] (miles)
Petroleum and products	201	1,812	2	660	194	193	397	36.6%	1,014
Chemicals and related products	15	1,790	0[b]	322	64	496	79	7.3%	739
Crude materials	17	605	89	521	121	350	226	20.8%	436
Coal and coke	12	659	21	535	191	408	224	20.6%	433
Primary manufactured goods	7	804	4	300	26	835	37	3.4%	775
Food and farm products	8	1,817	1	980	94	1,006	103	9.5%	1,071
Manufactured equipment	7	1,496	[b]	0	8	111	14	1.3%	762
Waste and scrap	[b]	2,826	0	0	5	55	5	0.5%	91
Unknown	[b]	2,185	[b]	[b]	[b]	[b]	[b]	0.0%	1,827
Total	267	1,652	116	514	704	437	1,086	100.0%	744
Barge traffic (million tons)	101		8		677				
Percentage by barge	37.8%								

Source:
U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1995, Part 5: National Summaries, New Orleans, Louisiana, 1997, Tables 2-1, 2-2, and 2-3, pp. 2-1, 2-2, 2-3, 2-6, 2-11, 2-12, and annual.
(Additional resources: http://www.wrc-ndc.usace.army.mil/ndc)

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

[a]Calculated as ton-miles divided by tons shipped.
[b]Negligible.

The Interstate Commerce Commission designates Class I railroads on the basis of annual gross revenues. In 1995, eleven railroads were given this classification (see note below).

Table 6.6
Class I Railroad Freight Systems in the United States
Ranked by Revenue Ton-Miles, 1995

Railroad	Revenue ton-miles (billions)	Percent
Union Pacific Railroad Company	307	23.5%
Burlington Northern Railroad Company	293	22.5%
CSX Transportation	160	12.3%
Southern Pacific Transportation Company	146	11.2%
Norfolk Southern Corporation	127	9.7%
Atchison, Topeka and Santa Fe Railway Company	104	8.0%
Consolidated Rail Corporation (Conrail)	93	7.1%
Soo Line Railroad Company	25	1.9%
Illinois Central Railroad Company	25	1.9%
Kansas City Southern Railway Company	19	1.5%
Grand Trunk Western Railroad Company	6	0.5%
Total	**1,305**	**100.0%**

Source:
Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, September 1996, p. 66. (Additional resources: http:/www.aar.org)

Note:
Union Pacific Railroad Company figures include revenue ton-miles for the Chicago and Northwestern Transportation Company for all of 1995, even though the acquisition was completed in early 1995. The Burlington Northern Railroad Company and the Atchison, Topeka, and Santa Fe Railway Company data are separate for 1995, even though they merged in September 1995 to create the Burlington Northern Santa Fe Corporation.

Table 6.7
Summary Statistics for Class I Freight Railroads, 1970–95

Year	Number of locomotives in service[a]	Number of freight cars (thousands)[b]	Train-miles (millions)	Car-miles (millions)	Revenue tons (millions)	Average length of haul (miles)	Revenue ton-miles (millions)	Energy intensity (Btu/ton-mile)[c]	Energy use (trillion Btu)[c]
1970	27,077[d]	1,424	427	29,890	2,616	515	764,809	691	528.1
1971	27,160[d]	1,422	430	29,181	2,458	507	739,723	717	530.2
1972	27,044	1,411	451	30,309	2,543	511	776,746	714	554.4
1973	27,438	1,395	469	31,248	2,701	531	851,809	677	577.1
1974	27,627	1,375	469	30,719	2,732	527	850,961	681	579.1
1975	27,855	1,359	403	27,656	2,437	541	754,252	687	518.3
1976	27,233	1,332	425	28,530	2,452	540	794,059	680	540.3
1977	27,298	1,287	428	28,749	2,439	549	826,292	669	552.7
1978	26,959	1,226	433	29,076	2,312	617	858,105	641	550.4
1979	27,660	1,217	438	29,436	2,463	611	913,669	618	564.8
1980	28,094	1,168	428	29,277	2,434	616	918,621	597	548.7
1981	27,421	1,111	408	27,968	2,386	626	910,169	572	521.0
1982	26,795	1,039	345	23,952	1,990	629	797,759	553	440.8
1983	25,448	1,007	346	24,358	1,936	641	828,275	525	435.1
1984	24,117	948	369	26,409	2,119	645	921,542	510	470.0
1985	22,548	867	347	24,920	1,985	664	876,984	497	436.1
1986	20,790	799	347	24,414	1,938	664	867,722	486	421.5
1987	19,647	749	361	25,627	1,926	688	943,747	456	430.3
1988	19,364	725	379	26,339	2,001	697	996,182	443	441.4
1989	19,015	682	383	26,196	1,988	723	1,013,841	437	442.6
1990	18,835	659	380	26,159	2,024	726	1,033,969	420	434.7
1991	18,344	633	375	25,628	1,987	751	1,038,875	391	405.8
1992	18,004	605	390	26,128	2,016	763	1,066,781	393	419.2
1993	18,161	587	405	26,883	2,047	794	1,109,309	389	431.6
1994	18,505	591	441	28,485	2,185	817	1,200,701	388	465.4
1995	18,812	583	458	30,383	2,322	843	1,305,688	372	485.9
					Average annual percentage change				
1970–95	-1.4%	-3.5%	0.3%	0.1%	-0.5%	2.0%	2.2%	-2.4%	-0.3%
1985–95	-1.8%	-3.9%	2.8%	2.0%	1.6%	2.4%	4.1%	-2.9%	1.1%

Source:

Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, September 1996, pp. 27, 33, 34, 36, 48, 50, 60.

Revenue tons - Association of American Railroads, Analysis of Class I Railroads 1995, 1996, p. 31, and annual.

(Additional resources: http://www.aar.org)

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

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

[c]These data have changed from previous editions due to a change in source. Previous estimates were based on sales.

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

Coal, which was the predominate commodity shipped by rail in 1974 (17%), accounted for 25% of car loadings in 1995. The fastest growing commodity group from 1974 to 1995 was the "other" category (81%).

Table 6.8
Railroad Revenue Car loadings by Commodity Group, 1974 and 1995

Commodity group	Car loadings (thousands)		Percent distribution		Percentage change 1974–95
	1974	1995	1974	1995	
Coal	4,544	6,095	17.0%	25.7%	34.1%
Farm products	3,021	1,692	11.3%	7.1%	-44.0%
Chemicals and allied products	1,464	1,667	5.5%	7.0%	13.9%
Nonmetallic minerals	821	1,159	3.1%	4.9%	41.2%
Food and kindred products	1,777	1,377	6.6%	5.8%	-22.5%
Lumber and wood products	1,930	719	7.2%	3.0%	-62.7%
Metallic ores	1,910	463	7.1%	2.0%	-75.8%
Stone, clay and glass	2,428	516	9.1%	2.2%	-78.7%
Pulp, paper, and allied products	1,180	628	4.4%	2.6%	-46.8%
Petroleum products	877	571	3.3%	2.4%	-34.9%
Primary metal products	1,366	607	5.1%	2.6%	-55.6%
Waste and scrap material	889	623	3.3%	2.6%	-29.9%
Transportation equipment	1,126	1,374	4.2%	5.8%	22.0%
Others	3,451	6,236	12.9%	26.3%	80.7%
Total	26,784	23,727	100.0%	100.0%	-11.4%

Source:
1974 - Association of American Railroads, Railroad Facts, 1976 Edition, Washington, DC, 1975, p. 26.
1995 - Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, September 1996, p. 25.
(Additional resources: http://www.aar.org)

The number of trailers and containers moved by railroads has increased more than four-fold from 1965 to 1995. Since 1988, the growth in containers moved by the railroad has increased by an average of 10.2% per year.

Table 6.9
Intermodal Rail Traffic, 1965–95

Year	Trailers & containers	Trailers	Containers
1965	1,664,929	[a]	[a]
1970	2,363,200	[a]	[a]
1975	2,238,117	[a]	[a]
1980	3,059,402	[a]	[a]
1981	3,150,522	[a]	[a]
1982	3,396,973	[a]	[a]
1983	4,090,078	[a]	[a]
1984	4,565,743	[a]	[a]
1985	4,590,952	[a]	[a]
1986	4,997,229	[a]	[a]
1987	5,503,819	[a]	[a]
1988	5,779,547	3,481,020	2,298,527
1989	5,987,355	3,496,262	2,491,093
1990	6,206,782	3,451,953	2,754,829
1991	6,246,134	3,201,560	3,044,574
1992	6,627,841	3,264,597	3,363,244
1993	7,156,628	3,464,126	3,692,502
1994	8,128,228	3,752,502	4,375,726
1995	8,070,309	3,519,664	4,550,645
Average annual percentage change			
1965–95	5.4%	[a]	[a]
1988–95	4.9%	0.2%	10.2%

Source:
Association of American Railroads, Railroad Facts, 1996 edition, Washington, DC, September 1996 p.26. (Additional resources: http://www.aar.org**)**

[a] Data are not available**.**

Table 6.10
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971–95

Year	Number of locomotives in service	Number of passenger cars	Train-miles (thousands)	Car-miles (thousands)	Revenue passenger-miles (millions)	Average trip length (miles)	Energy intensity (Btu per revenue passenger mile)	Energy use (trillion Btu)
1971	[a]	1,165	16,537	140,147	1,993	188	[a]	[a]
1972	285	1,571	26,302	213,261	3,039	183	[a]	[a]
1973	352	1,777	27,151	239,775	3,807	224	3,756	14.3
1974	457	1,848	29,538	260,060	4,259	233	3,240	13.8
1975	355	1,913	30,166	253,898	3,753	224	3,677	13.8
1976	379	2,062	30,885	263,589	4,268	229	3,397	14.5
1977	369	2,154	33,200	261,325	4,204	221	3,568	15.0
1978	441	2,084	32,451	255,214	4,154	217	3,683	15.3
1979	437	2,026	31,379	255,129	4,867	226	3,472	16.9
1980	448	2,128	29,487	235,235	4,503	217	3,176	14.3
1981	398	1,830	30,380	222,753	4,397	226	2,979	13.1
1982	396	1,929	28,833	217,385	3,993	220	3,156	12.6
1983	388	1,880	28,805	223,509	4,227	223	2,957	12.5
1984	387	1,844	29,133	234,557	4,427	227	3,027	13.4
1985	382	1,818	30,038	250,642	4,785	238	2,800	13.4
1986	369	1,793	28,604	249,665	5,011	249	2,574	12.9
1987	381	1,850	29,515	261,054	5,361	259	2,537	13.6
1988	391	1,845	30,221	277,774	5,686	265	2,462	14.0
1989	312	1,742	31,000	285,255	5,859	274	2,731	16.0
1990	318	1,863	33,000	300,996	6,057	273	2,609	15.8
1991	316	1,786	34,000	312,484	6,273	285	2,503	15.7
1992	336	1,796	34,000	307,282	6,091	286	2,610	15.9
1993	360	1,853	34,936	302,739	6,199	280	2,646	16.4
1994	411	1,874	34,940	305,600	5,869	276	2,351	13.8[b]
1995	422	1,907	31,579	282,579	5,401	266	2,314[c]	12.5[c]
				Average annual percentage change				
1971–95	1.7% [c]	2.1%	2.7%	3.0%	4.2%	1.5%	-2.2%[d]	-0.6%[d]
1985–95	1.0%	0.5%	0.5%	1.2%	1.2%	1.1%	-1.9%[d]	-0.7%[d]

Source:

1971–83- Association of American Railroads, Economics and Finance Department, Statistics of Class I Railroads, Washington, DC, and annual.

1984–88- Association of American Railroads, Railroad Facts, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.

1989–93- Personal communication with the Corporate Accounting Office of Amtrak, Washington, D.C.

1994–95- Number of locomotives in service, number of passenger cars, train-miles, car-miles, revenue passenger-miles, and average trip length - Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, 1996, p. 78.

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

[a] Data are not available.

[b] Energy use for 1994 on is not directly comparable to earlier years. Some commuter rail energy use may have been inadvertently included in earlier years.

[c] Estimated using train-miles.

[d] Average annual percentage change is from earliest year available to 1995.

Table 6.11
Summary Statistics for Rail Transit Operations, 1970–95[a]

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions)[b]	Estimated passenger-miles (millions)[c]	Average trip length (miles)[d]	Energy intensity (Btu/passenger-mile)[e]	Energy use (trillion Btu)
1970	10,548	440.8	2,116	12,273	[f]	2,453	30.1
1971	10,550	440.4	2,000	11,600	[f]	2,595	30.1
1972	10,599	417.8	1,942	11,264	[f]	2,540	28.6
1973	10,510	438.5	1,921	11,142	[f]	2,460	27.4
1974	10,471	458.8	1,876	10,881	[f]	2,840	30.9
1975	10,617	446.9	1,797	10,423	[f]	2,962	31.1
1976	10,625	428.1	1,744	10,115	[f]	2,971	30.3
1977	10,579	381.7	1,713	10,071	5.8	2,691	27.1
1978	10,459	383.0	1,810	10,722	5.9	2,210	23.7
1979	10,429	399.6	1,884	11,167	5.9	2,794	31.2
1980	10,654	402.2	2,241	10,939	4.9	3,008	32.9
1981	10,824	436.6	2,217	10,590	4.8	2,946	31.2
1982	10,831	445.2	2,201	10,428	4.6	3,069	32.0
1983	10,904	423.5	2,304	10,741	4.7	3,212	34.5
1984	10,848	452.7	2,388	10,531	4.4	3,732	39.3
1985	11,109	467.8	2,422	10,777	4.4	3,461	37.3
1986	11,083	492.8	2,467	11,018	4.5	3,531	38.9
1987	10,934	508.6	2,535	11,603	4.6	3,534	41.0
1988	11,370	538.3	2,462	11,836	4.8	3,565	42.2
1989	11,261	553.4	2,704	12,539	4.6	3,397	42.6
1990	11,332	560.9	2,521	12,046	4.8	3,453	41.6
1991	11,426	554.8	2,356	11,190	4.7	3,727	41.7
1992	11,303	554.1	2,396	11,441	4.8	3,575	40.9
1993	11,286	549.8	2,234	10,936	4.9	3,687	42.2
1994	11,192	565.8	2,453	11,501	4.8	3,828	44.0
1995	11,156	571.8	2,284	11,419	5.0	3,818	43.6
				Average annual percentage change			
1970–95	0.2%	1.0%	0.3%	-0.3%	-0.8%[g]	1.8%	1.5%
1985–95	0.0%	2.0%	-0.6%	0.6%	1.3%	1.0%	1.6%

Source:

American Public Transit Association, 1997 Transit Fact Book, Washington, DC, February 1997, pp. 69, 71, 78, 83. (Additional resources: http://www.apta.com)

Energy use - See Appendix A for Table 2.7.

[a]Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

[b]1970–79 data represents total passenger rides; after 1979, data represents unlinked pasenger trips.

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

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

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

[f]Data are not available.

[g]Average annual percentage change is calculated for years 1977-95.

CHAPTER 7
EMISSIONS AND TRANSPORTATION

Table 7.1
Total National Emissions by Sector, 1995
(millions of short tons/percentage)

Sector	CO	NO_x	VOC	PM-10	SO_2	CO_2
Highway vehicles	**58.62**	**7.61**	**6.10**	**0.10**	**0.30**	[a]
	63.6%	*34.9%*	*26.7%*	*0.7%*	*1.4%*	[a]
Aircraft	**1.05**	**0.15**	**0.21**	**0.05**	**0.00**	[a]
	1.1%	*0.7%*	*0.9%*	*0.1%*	*0.0%*	[a]
Railroads	**0.13**	**0.99**	**0.04**	**0.05**	**0.07**	[a]
	0.1%	*4.5%*	*0.2%*	*0.1%*	*0.3%*	[a]
Vessels	**0.07**	**0.19**	**0.04**	**0.03**	**0.21**	[a]
	0.1%	*0.9%*	*0.2%*	*0.1%*	*1.0%*	[a]
Other off-highway	**14.38**	**1.66**	**1.95**	**0.27**	**0.00**	[a]
	15.6%	*7.6%*	*8.5%*	*0.6%*	*0.0%*	[a]
Transportation total	**74.26**	**10.60**	**8.34**	**0.70**	**0.58**	**1,847.40**[b]
	80.6%	*48.6%*	*36.5%*	*1.6%*	*2.7%*	*35.4%*
Stationary source fuel combustion	**3.23**	**10.08**	**0.71**	**0.91**	**15.66**	[a]
	3.5%	*46.3%*	*3.1%*	*2.1%*	*87.6%*	[a]
Industrial processes	**5.67**	**0.79**	**10.94**	**0.69**	**2.02**	[a]
	6.2%	*3.6%*	*47.8%*	*1.6%*	*9.4%*	[a]
Waste disposal and recycling total	**1.77**	**0.09**	**2.41**	**0.25**	**0.04**	[a]
	1.9%	*0.4%*	*10.5%*	*0.6%*	*0.2%*	[a]
Miscellaneous	**6.45**	**0.23**	**0.45**	**37.93**	**0.01**	[a]
	7.0%	*1.1%*	*2.0%*	*94.0%*	*0.0%*	[a]
Total of all sources	**92.10**	**21.78**	**22.87**	**42.64**	**18.32**	**5,288.50**
	100.0%	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source:
All other–U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900–1995, 1996, Appendix A.
Carbon dioxide–U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1995, Washington, DC, October 1996, pp. 11, 12, 20.
(Additional resources: http://www.eia.doe.gov, www.epa.gov/oar/oaqps)

Note:
CO = Carbon monoxide. NO_x = Nitrogen oxides. PM-10 = Particulate matter less than 10 microns.
SO_2 = Sulfur dioxide. VOC = Volatile organic compounds. CO_2 = Carbon dioxide.

[a]Data are not available.

[b]Includes a small amount of electric utility emissions.

Table 7.2
Total National Emissions of Carbon Monoxide, 1940–95[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1993	1994	1995	Percent of total, 1995
Highway vehicles	30.12	45.20	64.27	88.03	78.05	62.86	60.20	61.83	58.62	63.6%
Aircraft	0.00	0.93	1.76	0.51	0.74	0.97	1.02	1.06	1.05	1.1%
Railroads	4.08	3.08	0.33	0.07	0.10	0.12	0.12	0.12	0.13	0.1%
Vessels[b]	0.06	0.12	0.52	0.98	1.10	1.21	1.25	0.06	0.07	0.1%
Other off-highway	3.91	7.48	8.96	9.06	10.74	12.35	12.88	14.41	14.38	15.6%
Transportation total	38.17	56.81	69.87	98.64	90.73	77.5	75.47	77.48	74.26	80.6%
Stationary fuel combustion total	15.33	11.32	7.02	4.63	7.30	5.06	4.95	4.88	3.23	3.5%
Industrial processes total	7.28	11.64	10.28	9.84	6.95	5.23	5.28	5.42	5.67	6.2%
Waste disposal and recycling total	3.63	4.72	5.60	7.06	2.3	1.69	1.73	1.75	1.77	1.9%
Miscellaneous total	29.21	18.14	11.01	7.91	8.34	11.17	6.70	9.25	6.45	7.0%
Total of all sources	**93.62**	**102.61**	**109.75**	**128.08**	**115.63**	**100.65**	**94.13**	**98.78**	**92.10**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900–1995, 1996, pp. A-6–A-9, and annual.
(Additional resources: http://www.epa/oar/oaqps)

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

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

[b]Recreational marine vessels.

Table 7.3
Total National Emissions of Nitrogen Oxides, 1940–95[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1993	1994	1995	Percent of total, 1995
Highway vehicles	1.33	2.14	3.98	7.39	8.62	7.49	7.51	7.67	7.61	34.9%
Railroads	0.66	0.99	0.77	0.50	0.73	0.93	0.95	0.95	0.99	4.5%
Other off-highway	0.33	0.55	0.67	1.13	1.69	1.91	2.04	2.15	2.00	9.2%
Transportation total	2.32	3.68	5.43	9.02	11.04	10.33	10.50	10.77	10.60	48.6%
Stationary fuel combustion total	3.73	5.16	7.37	10.06	11.32	11.48	11.70	11.63	10.08	46.3%
Industrial processes total	0.22	0.38	0.57	0.78	0.56	0.77	0.78	0.80	0.79	3.6%
Waste disposal and recycling total	0.11	0.22	0.33	0.44	0.11	0.08	0.08	0.09	0.09	0.4%
Miscellaneous total	0.99	0.67	0.44	0.33	0.25	0.38	0.22	0.37	0.23	1.1%
Total of all sources	**7.37**	**10.09**	**14.14**	**20.63**	**23.28**	**23.04**	**23.30**	**23.66**	**21.78**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900–1995, 1996, pp. A-6–A-9, and annual.
(Additional resources: http://www.epa/oar/oaqps)

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

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

Table 7.4
Emissions of Nitrogen Oxides from Highway Vehicles, 1970–95[a]
(million short tons)

Source category	1970	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Percent of total, 1995
Gasoline powered														
Light-duty vehicles & motorcycles	4.16	4.42	3.81	3.60	3.50	3.50	3.49	3.44	3.46	3.61	3.68	3.57	3.61	47.4%
Light-duty trucks[b]	1.28	1.41	1.53	1.46	1.44	1.42	1.39	1.34	1.34	1.36	1.42	1.66	1.62	21.3%
Heavy-duty vehicles	0.28	0.30	0.33	0.33	0.33	0.34	0.34	0.34	0.33	0.31	0.32	0.35	0.35	4.6%
Total	5.72	6.13	5.67	5.39	5.27	5.26	5.22	5.12	5.13	5.28	5.42	5.58	5.58	73.3%
Diesel powered														
Light-duty vehicles	[c]	0.03	0.03	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	0.01	0.01	0.1%
Heavy-duty vehicles	1.68	2.46	2.39	2.35	2.35	2.37	2.42	2.33	2.20	2.12	2.01	2.04	1.97	25.9%
Total	1.68	2.50	2.43	2.39	2.39	2.41	2.47	2.38	2.25	2.17	2.06	2.09	2.02	26.5%
Total														
Highway vehicle total	**7.39**	**8.62**	**8.09**	**7.77**	**7.65**	**7.66**	**7.68**	**7.49**	**7.37**	**7.44**	**7.51**	**7.67**	**7.61**	**100.0%**
Percent diesel	18.7%	29.0%	30.0%	30.8%	31.2%	31.5%	32.2%	31.8%	30.5%	29.2%	27.4%	27.2%	26.5%	

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900–1995, 1996, p. A-8 and annual.
(Additional resources: http://www.epa.gov/oar/oaqps)

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

[b]Less than 8,500 pounds.

[c]Data are not available.

Table 7.5
Total National Emissions of Volatile Organic Compounds, 1940–95[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1993	1994	1995	Percent of total, 1995
Highway vehicles	4.82	7.25	10. 51	12.97	8.98	6.85	6.10	6.40	6.10	26.7%
Off-highway	0.78	1.21	1.22	1.54	1.87	2.12	2.21	2.26	2.24	9.8%
Transportation total	5.60	8.46	11.73	14.51	10.85	8.97	8.31	8.66	8.34	36.5%
Stationary fuel combustion total	1.98	1.44	0.88	0.72	1.05	0.92	0.90	0.89	0.71	3.1%
Industrial processes total	4.52	7.40	8.73	12.33	12.10	10.38	10.58	10.78	10.94	47.8%
Waste disposal and recycling total	0.99	1.10	1.55	1.98	0.76	2.26	2.27	2.27	2.41	10.5%
Miscellaneous total	4.08	2.53	1.57	1.10	1.13	1.07	0.52	0.69	0.45	2.0%
Total of all sources	**17.16**	**20.94**	**24.46**	**30.65**	**25.89**	**23.60**	**22.58**	**23.28**	**22.87**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900–1995, 1996, pp. A-10–A-16, and annual.
(Additional resources: http://www.epa.gov/oar/oaqps)

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

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

Table 7.6
Total National Emissions of Particulate Matter (PM-10), 1940–95[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1993	1994	1995	Percent of total, 1995
Highway vehicles	0.21	0.31	0.55	0.44	0.40	0.36	0.32	0.32	0.30	0.7%
Off-highway	2.48	1.79	0.20	0.22	0.33	0.37	0.40	0.41	0.40	0.9%
Transportation total	2.69	2.10	0.76	0.66	0.73	0.73	0.72	0.73	0.70	1.6%
Stationary fuel combustion total	4.01	3.75	3.56	2.87	2.45	1.08	1.04	1.03	0.91	2.1%
Industrial processes total	5.90	8.85	9.24	7.67	2.75	0.66	0.66	0.69	0.69	1.6%
Waste disposal and recycling total	0.39	0.51	0.76	1.00	0.27	0.24	0.25	0.25	0.25	0.6%
Miscellaneous total	2.97	1.93	1.24	0.84	0.85	40.63[b]	39.88[b]	41.93[b]	40.09[b]	94.0%
Total of all sources	**15.96**	**17.13**	**15.56**	**13.04**	**7.05**	**43.34**	**42.55**	**44.62**	**42.64**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900–1995, 1996, pp. A-21–A-25, and annual. (Additional resources: http:/www.epa.gov/oar/oaqps)

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

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

[b]Includes fugitive dust estimates which were not available before 1990.

Table 7.7
Estimates of Particulate Matter, 1990
$PM_{2.5}$ versus PM_{10} (tons)

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

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

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

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

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

[c]Other Combustion includes wildfires and prescribed burning.

Table 7.8
National Lead Emission Estimates, 1970–95[a]
(thousand short tons per year)

Source category	1970	1975	1980	1985	1990	1993	1994	1995	Percent of total, 1995
Highway vehicles	171.96	130.21	62.19	15.98	1.69	1.40	1.39	1.39	27.9%
Off-highway	8.34	5.01	3.32	0.23	0.20	0.18	0.19	0.19	3.8%
Transportation total	180.30	135.22	65.51	16.21	1.89	1.58	1.58	1.58	31.7%
Stationary source fuel combustion	10.62	10.35	4.30	0.52	0.50	0.49	0.49	0.49	9.8%
Industrial processes	26.36	11.38	3.94	2.53	2.47	2.04	2.13	2.07	41.5%
Waste disposal and recycling total	2.20	1.60	1.21	0.87	0.80	0.83	0.83	0.84	16.8%
Total of all sources	**219.47**	**158.54**	**74.96**	**20.12**	**5.67**	**4.95**	**5.03**	**4.99**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1995, 1996, pp. A-26–A-27, and annual.
(Additional resources: http://www.epa.gov/oar/oaqps)

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

Table 7.9
U.S. Carbon Dioxide Emissions from Energy Use in the Transportation Sector, 1980–95
(million metric tons of carbon)

Fuel	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Petroleum																
Motor gasoline	238.1	238.1	236.6	239.9	241.6	245.1	252.8	259.0	264.9	264.2	260.9	259.5	263.4	270.1	274.7	280.7
LPG[a]	0.3	0.6	0.5	0.6	0.7	0.5	0.4	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.5	0.5
Jet fuel	42.0	39.7	40.4	41.2	46.5	48.0	51.6	54.6	57.3	58.8	60.1	58.1	57.6	58.1	60.4	60.0
Distillate fuel	55.3	57.4	55.1	57.4	62.1	63.3	65.3	66.9	72.9	75.8	75.7	72.6	75.3	77.3	82.5	83.8
Residual fuel	30.0	26.1	21.7	17.5	17.2	16.7	18.5	19.2	19.6	20.8	21.9	22.0	23.0	19.4	19.1	18.5
Lubricants	1.8	1.7	1.5	1.6	1.7	1.6	1.5	1.7	1.7	1.7	1.8	1.6	1.6	1.6	1.7	1.7
Aviation gas	1.2	1.1	0.9	0.9	0.8	0.9	1.1	0.9	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7
Total	**368.7**	**364.6**	**356.7**	**359.0**	**370.5**	**376.1**	**391.2**	**402.7**	**417.6**	**422.6**	**421.5**	**414.8**	**421.9**	**427.6**	**439.6**	**445.9**
Other energy																
Natural gas	9.4	9.5	8.8	7.3	7.8	7.5	7.2	7.7	9.1	9.4	9.8	8.9	8.8	9.3	10.2	10.6
Electricity	0.3	0.3	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6
Total	**378.4**	**374.4**	**366.2**	**366.9**	**379.0**	**384.4**	**399.1**	**411.1**	**427.5**	**432.7**	**432.1**	**424.5**	**431.4**	**437.5**	**450.4**	**457.2**

Source:
U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1995, Washington, DC, October 1996, p. 92, and annual.
(Additional resources: http://www.eia.doe.gov)

[a]Liquified petroleum gas.

Table 7.10
Estimated U.S. Emissions of Greenhouse Gases, 1994–95

Greenhouse gas	Unit of measure[a]	1994	1995
Carbon dioxide	million metric tons of gas	5248.6	5288.5
	million metric tons of carbon	[b]	1442.3
Methane	million metric tons of gas	31.0	[b]
	million metric tons of carbon (gwp)[c]	178.0	[b]
Nitrous oxide	million metric tons of gas	0.5	0.5
	million metric tons of carbon (gwp)[c]	40.0	39.0
Carbon monoxide	million metric tons of gas	88.9	[b]
Nitrogen oxide	million metric tons of gas	21.4	[b]
Nonmethane VOCs[d]	million metric tons of gas	21.0	[b]
CFC-11,12,113[d]	million metric tons of gas	0.1	0.1
HCFC-22[d]	million metric tons of gas	0.1	0.1
HCFC-23 and PFCs[d]	million metric tons of gas	[e]	[e]
	million metric tons of carbon (gwp)[c]	23	25

Source:
U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1995, Washington, DC, October 1996, pp. ix, xi.
(Additional resources: http://www.eia.doe.gov)

[a]Gases that contain carbon can be measured either in terms of the full molecular weight of the gas or just in terms of their carbon content. See Appendix B for details.
[b]Data are not available.
[c]Based on global warming potential.
[d]VOC=volatile organic compounds. CFC=chlorofluorocarbons. HCFC=hydrochlorofluorocarbons. HFC=hydrofluorocarbons. PFC=perfluorocarbons.
[e]Less than 50,000 tons of gas.

Table 7.11
U.S. Carbon Dioxide Emissions from Fossil Energy Consumption by End-Use Sector, 1984–95[a]
(million metric tons of carbon)

End use	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Energy consumption sectors												
Residential	241.1	245.8	244.0	251.0	264.8	267.5	253.0	257.1	255.9	271.6	268.6	270.9
Commercial	188.8	189.6	190.4	197.2	207.6	210.0	206.7	206.4	205.5	212.1	214.1	218.4
Industrial	434.4	424.1	409.0	422.7	444.1	445.6	452.4	436.6	453.6	453.7	463.3	462.9
Transportation	379.0	384.4	399.1	411.1	427.5	432.7	432.1	424.5	431.4	437.5	450.4	457.2
Total energy	**1,243.3**	**1,243.9**	**1,242.5**	**1,282.0**	**1,344.0**	**1,355.8**	**1,344.2**	**1,324.6**	**1,346.3**	**1,374.9**	**1,396.4**	**1,409.4**
Electric utility sector												
Electric utility	427.9	438.9	435.4	452.6	475.9	483.5	476.9	473.5	472.9	490.6	494.8	493.8

Source:
U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1995, Washington, DC, October 1996, p. 12, and annual.
(Additional resources: http://www.eia.doe.gov)

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

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 7.12
Federal Emission Control Requirements for Automobiles and Light Trucks, 1976–95[a]
(grams per mile)

	Automobiles				Light trucks[b]			
Model Year	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 7.13
Federal Emission Control Requirements for Heavy-Duty Gasoline Trucks, 1976–95[a]
(grams per brake horsepower hour)

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

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

Table 7.14
Federal Emission Control Requirements for Heavy-Duty Diesel Trucks, 1976–95[d]
(grams per brake horsepower hour)

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

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

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

[b]No standard was set for this year.

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

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

Table 7.15
Light-Duty Vehicles and Trucks Exhaust Emission Certification Standards, Federal and California Programs[a]
(grams per mile)

	Useful Life 5 years/50,000 miles					Useful Life 10 years/100,000 miles				
Effective Dates	**NMOG**	**NMHC[b, c]**	**CO**	**NOx**	**PM**	**NMOG**	**NMHC[b, c]**	**CO**	**NOx**	**PM**
Through 1993	[d]	[d]	3.4	1.0	0.2	---	---	---	---	---
Federal Tier 1 Standards (1994–2002)	[d]	[d]		[c]						[d]
Gasoline & Methanol	(0.257)	0.25	3.4	0.4	0.08	(0.319)	0.31	4.2	0.6	0.10
Diesel	(0.257)	0.25	3.4	1.0	0.08	(0.319)	0.31	4.2	1.25	0.10
Cold CO (all vehicles)	[d]	[d]	10	[e]	[f]				[f]	[f]
Federal Tier 2 Standards (2003+)[g]	---	---	---	---	---	(0.128)	0.125	1.7	0.2	0.10
California Tier 1 (1994–1999)	0.257	(0.25)	3.4	0.4	0.08	0.319	(0.31)	4.2	0.6	0.10
California TLEV (1994–1996)	0.125	(0.121)	3.4	0.4	---	0.156	(0.151)	4.2	0.6	0.08
California LEV (1997–2003)	0.075	(0.073)	3.4	0.2	---	0.09	(0.087)	4.2	0.3	0.08
California ULEV (1997–2003)	0.04	(0.039)	1.7	0.2	---	0.055	(0.053)	2.1	0.3	0.04
Federal Clean Fuel Fleet LEV (1998)	0.075	(0.073)	3.4	0.2	0.08	0.09	(0.087)	4.2	0.3	0.08
Federal Clean Fuel Fleet ULEV (1998)	0.04	(0.039)	1.7	0.2	0.08	0.055	(0.053)	2.1	0.3	0.04
Calif. Pilot Program TLEV (1994–1996)	0.125	(0.121)	3.4	0.4	0.08	0.156	(0.151)	4.2	0.6	0.08
California Pilot Program LEV (2001)	0.075	(0.073)	3.4	0.2	0.08	0.09	(0.087)	4.2	0.3	0.08
California Pilot Program ULEV (2001)	0.04	(0.039)	1.7	0.2	0.08	0.055	(0.053)	2.1	0.3	0.04

Source:
Http://www.epa.gov/OMSWWW/gopher/Cert/Veh-cert/stands95.pdf
Note:
Standards are reported for non-methane organic gas (NMOG), non-methane hydrocarbons (NMHC), carbon monoxide (CO), oxides of nitrogen (NOx), and particulate matter (PM),

[a] Light-duty vehicle- passenger car or passenger car derivative capable of seating 12 passengers or less. Light-duty truck - any motor vehicle rated at 8,500 lbs. GVWR or less with vehicle curb weight of 6,000 lbs. or less and a basic frontal area 45 sq. ft. or less, which is 1) designed primarily for purposes of transportation of property or is a derivation of such a vehicle, or 2) designed primarily for transportation of persons and has a capacity of more than 12 persons; or 3) available with special features enabling off-street or off-highway operation and use. Loaded Vehicle Weight (LVW) - vehicle curb weight plus 300 lbs. Gross Vehicle Weight Rating (GVWR) - minimum loaded weight for which the vehicle is designed, as specified by the manufacturer.

[b] California Tier 1 and LEV standards are for NMOG; Federal Tier 1 and Tier 2 standards are for NMHC. The figures indicated in parenthesis are for comparison purposes only; there are no California NHMC standards and there are no Federal NMOG standards for Tier 1 and Tier 2. Standards for Federal Clean Fuel vehicles (Fleet program and California Pilot Program) are in terms of NMOG. However, NMHC also applies as the Clean Air Act Amendments of 1990 did not delete NMHC requirements. California LEVs can be certified on California reformulated phase-2 gasoline, and California allows the use of reactivity adjustment factors. Although these effects are complex, an approximate conversion from NMOG to NMHC is obtained using the following conversion factor: $NMOG \times 10^6 (1/(1.0160 \times 10^4 * 1.0144)) = NMOG$ (memo from Richard Cox to Phil Lorang. "Procedure for generating MOBILE 4.1 Exhaust TOG Correction Factors," 6/18/91). There are two factors: 1.0160, which accounts for the additional aldehydes that are included in NMOG emissions on non-oxygenated gasoline; and 1.0144, which accounts for the additional aldehydes associated with the use of oxygenated fuel. The second factor is required since the California LEVs will be certified on oxygenated fuel.

[c] For methanol-fueled light-duty vehicles, organic gas standards are expressed on an organic material nonmethane hydrocarbon equivalent (OMNMHCE) basis. This standard controls carbon emissions from methanol vehicles to a level which is equivalent on a total carbon basis to that allowed from gasoline-fueled vehicles under their respective hydrocarbon standards.

[c] Total exhaust hydrocarbons not to exceed 0.41 gpm. For methanol-fueled light-duty vehicles, this standard is expressed on an organic material hydrocarbon equivalent (OMHCE) basis.

[e] The Federal Tier 1 diesel NOx standard will be eliminated after Model Year 2003. The 0.4 gpm standard will then apply to diesel vehicles.

[f] The Federal Tier 1 PM standard is effective beginning the Model Year 1994 for light-duty vehicles and Model Year 1995 for light-duty trucks.

[g] The promulgation of Federal Tier 2 standards is subject to the Administrator's discretion, both in terms of their levels and effective date.

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 stringent 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 7.16
California Vehicle Emissions Reduction for
Passenger Cars and Light-Duty Trucks

	Emission Reduction		
	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)

= equivalent emissions to vehicles meeting the basic California standard.

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. In March 1996, an amendment to the plan allows the marketplace to determine the number of zero emission vehicles from 1998 to 2002.

Table 7.17
California Air Resources Board Requirements for Meeting Emission Standards

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

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

[a]CV = Conventional vehicles
TLEV = Transitional low-emission vehicles
LEV = Low-emission vehicles
ULEV = Ultra-low-emission vehicles
ZEV = Zero emission vehicles

[b]According to revised regulations, the marketplace is to determine the amount of ZEVs that are offered for sale.

[c]Fleet average of non-methane organic gases = 0.062 in 2003.

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

Table 7.18
List of Clean Cities as of 2/24/97

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

Cities Nearing Designation

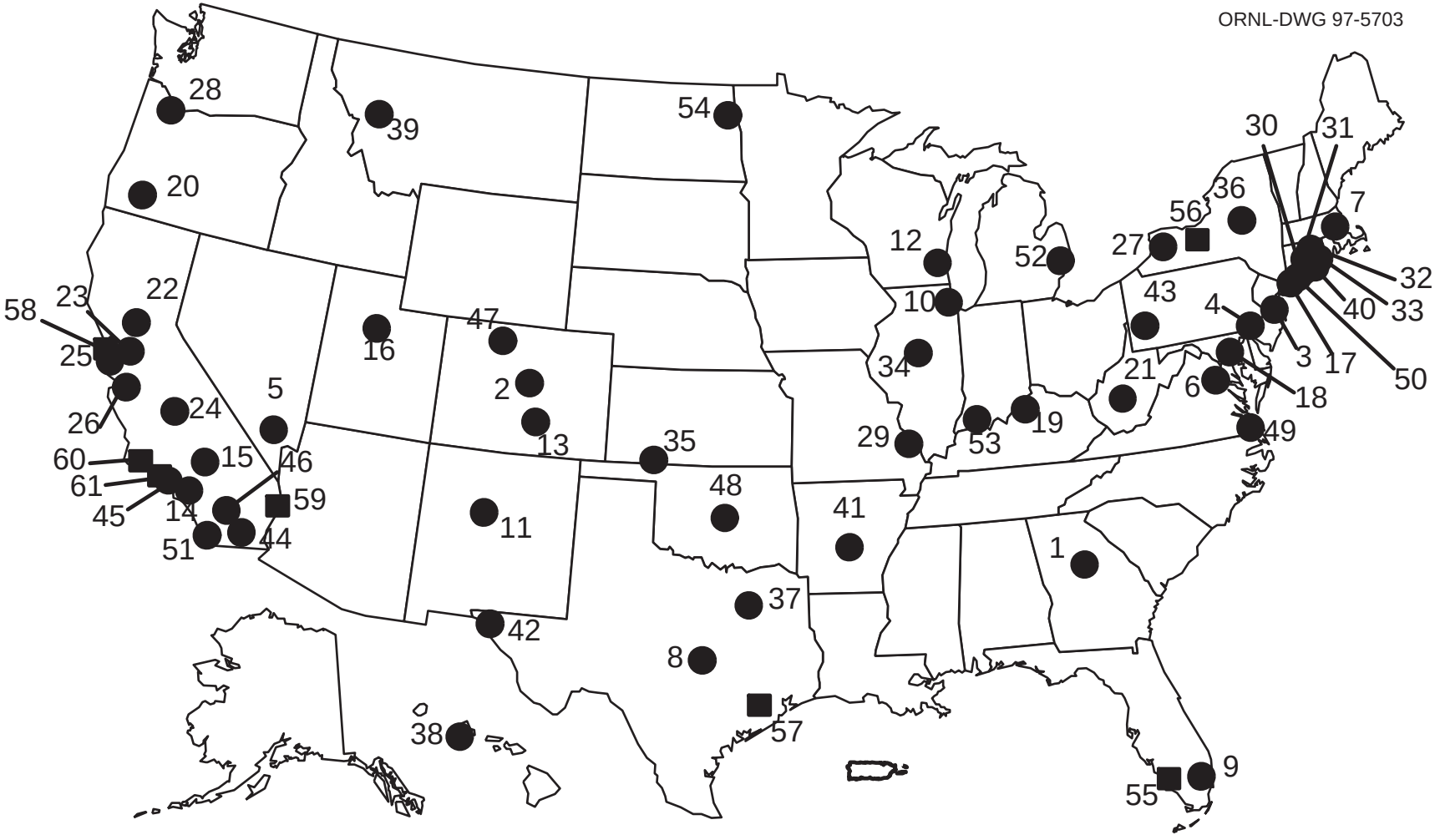
54. Florida Suncoast
55. Genesee Region, NY
56. Houston, TX
57. Redwood Empire/San Rosa, CA
58. Riverside, CA
59. Santa Barbara, CA
60. Santa Monica, CA

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. (Additional resources: http://www.ccities.doe.gov)

Figure 7.1. Map of Clean Cites as of 2/24/97



Source:

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

APPENDIX A

SOURCES

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

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

List of Abbreviations Used in Appendix A

AAMA	American Automobile Manufacturers Association
AAR	Association of American Railroads
APTA	American Public Transit Association
Amtrak	National Railroad Passenger Corporation
Btu	British thermal unit
DOC	Department of Commerce
DOE	Department of Energy
DOT	Department of Transportation
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
gvw	gross vehicle weight
lpg	liquefied petroleum gas
mpg	miles per gallon
NHTSA	National Highway Traffic Safety Administration
NPTS	Nationwide Personal Transportation Study
ORNL	Oak Ridge National Laboratory
pmt	passenger-miles traveled
RECS	Residential Energy Consumption Survey
RTECS	Residential Transportation Energy Consumption Survey
TIUS	Truck Inventory and Use Survey
TSC	Transportation Systems Center
vmt	vehicle-miles traveled

Table 2.9
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1995

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

Highway

Automobiles

Total gallons of fuel taken from DOT, FHWA, Highway Statistics 1995, Table VM-1. These were distributed as follows: 97.8% gasoline, 1.0% gasohol, and 1.2% diesel Percentages were derived from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Household Vehicles Energy Consumption 1991, December 1993, p. 46. Natural gas data are from the DOE, EIA Natural Gas Annual, 1995, Table 1; transit bus and truck natural gas were subtracted from total and the remainder was assumed to be automobile use. Methanol use was estimated using data from DOE, EIA, Alternatives to Traditional Transportation Fuels, Washington, DC, December 1996, p.23.

Motorcycles

DOT, FHWA, Highway Statistics 1995, Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:

APTA, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 132-135.
Non-diesel fossil fuel consumption was assumed to be used by motor buses.

Intercity:

Eno Transportation Foundation, Transportation in America, Fourteenth Edition, 1996, Washington, DC, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1995 data were estimated using vehicle travel information.)

School:

Gasoline and Diesel - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, 1996, Washington, DC, p. 56. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline.

Methanol - Methanol use was estimated using data from DOE, EIA, Alternatives to Traditional Transportation Fuels, Washington DC, December 1996, p. 23.

Trucks

Total:

Sum of light trucks and other trucks.

Light Trucks:

DOT, FHWA, Highway Statistics 1995, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.2% of fuel assumed to be gasoline, 3.3% diesel, 0.3% lpg, and 0.2% cng; percentages were generated from the 1992 TIUS Public Use Tape.

Other Trucks:

DOT, FHWA, Highway Statistics 1995, Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These gallons were distributed as follows based on data from the 1992 TIUS Public Use Tape: 16.2% of fuel assumed to be gasoline, 83.3% diesel, and 0.5% lpg.

Off Highway

Diesel:

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

Gasoline:

DOT, FHWA, Highway Statistics 1995, Table MF-24. Agriculture and Construction totals.

Non-Highway

Air

General Aviation:

DOT, FAA, General Aviation Activity and Avionics Survey: Annual Summary Report Calendar Year 1995, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Domestic and International Air Carrier:

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

Water

Freight:

Total - DOE, EIA, Fuel Oil and Kerosene Sales, 1995, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering.

Recreational Boating:

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

Pipeline

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

Natural Gas:

The amount of natural gas used to transport natural gas was defined as "pipeline fuel' as reported in DOE, EIA, Natural Gas Annual 1995, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft^3. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., End Use Energy Consumption DataBase: Transportation Sector. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude petroleum and petroleum product:

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

Coal slurry and water:

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

Rail

Total:

Sum of freight and passenger rail.

Freight:

AAR, Railroad Facts, 1996 Edition, Washington, DC, p. 60.

Passenger:

Transit and Commuter - APTA, 1997 Transit Fact Book, February 1997, Washington, DC, p. 102-104. Transit was defined as the sum of "heavy rail," "light rail," and "other."

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

Table 2.11
Transportation Energy Consumption by Mode, 1970-95

Highway

Automobiles

Total gallons of fuel for automobiles was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A; and Table VM-1 in the 1986-94 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

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

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

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

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

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

1991-95 - 97.8% gasoline, 1.0% gasohol, and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Household Vehicles Energy Consumption 1991, December 1993, p. 46.

1993-95 - Methanol use was estimated using data from DOE, EIA, Alternatives to Traditional Transportation Fuels, Washington, DC, December 1996, p. 23.

Motorcycles

Department of Transportation, Federal Highway Administration, Highway Statistics Summary to 1985, Table VM-201A; and Table VM-1 in the 1986-95 annual editions. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Sum of transit, intercity and school.

Transit:

APTA, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 102-104, and annual.

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

Intercity:

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

1985-95 - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, 1996, Washington, DC, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1995 data were estimated using vehicle travel information.)

School:

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

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

1987-95 - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, 1996, Washington, DC, p. 56. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline. (1995 data were estimated using vehicle travel information.)

Trucks

Light Trucks:

Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1986-95 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-1987 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988 - 1993 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994-95 was distributed based on the 1992 TIUS: 96.2% gasoline; 3.3% diesel; 0.3% lpg; and 0.2% cng.

Other Trucks:

Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1986-95 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-1987 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994-95 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg.

Total Highway

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

Non-Highway

Air

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

General Aviation:

1970-74 - DOT, TSC, National Transportation Statistics, Cambridge, MA, 1981.
1975-85 - DOT, FAA, FAA Aviation Forecasts, Washington, DC, annual.
1985-94 - DOT, FAA, General Aviation Activity and Avionics Survey: Annual Summary Report, Calendar Year 1995, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Certificated Route Air Carrier:

1970-81 - DOT, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, DC, annual.
1982-95 - DOT, Bureau of Transportation Statistics, "Fuel Costand Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel use for international flights.

Water

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

Freight:

Total - DOE, EIA, Fuel Oil and Kerosene Sales, 1995, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering.

Recreational Boating:

1970-84 - DOT, FHWA, Highway Statistics, Washington, DC, Table MF-24, annual.
1985-95 - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, Off-Highway Use of Gasoline in the United States (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard, Boating Statistics (numbered boats).

Pipeline

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

Natural Gas:

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, Natural Gas Annual 1995, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft^3. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., End Use Energy Consumption DataBase: Transportation Sector. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude petroleum and petroleum product:

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

Coal slurry and water:

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

Rail

Total:

Sum of freight and passenger rail.

Freight:

AAR, Railroad Facts, 1996 Edition, Washington, DC, p. 60.

Passenger:

Transit and Commuter - APTA, 1997 Transit Fact Book, February 1997, Washington, DC, p. 102-104, annual. Transit was defined as the sum of "heavy rail," "light rail," and "other."

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

Table 2.13
Passenger Travel and Energy Use in the United States, 1995

Highway

Automobiles

Number of Vehicles - DOT, FHWA, Highway Statistics 1995, Table VM-1.
Vmt - DOT, FHWA, Highway Statistics 1995, Table VM-1.
Pmt - Calculated by ORNL (load factor times vmt).
Load Factor - DOT, FHWA, Office of Highway Information Management, 1990 NPTS, Public Use Tape, 1992.
Energy Use - Total gallons of fuel taken from DOT, FHWA, Highway Statistics 1995, Table VM-1. These were distributed as follows: 97.8% gasoline, 1.0% gasohol, and 1.2% diesel. Percentages were derived from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Household Vehicles Energy Consumption 1991, December 1993, p. 46. Methanol use was estimated using data from DOE, EIA, Alternatives to Traditional Transportation Fuels, Washington, DC, December 1996, p.23.

Personal Trucks

Number of Vehicles - Based on the 1992 TIUS, 73.9% of total 2-axle, 4-tire trucks and 15.5% of total other trucks were for personal use. Therefore, 73.9% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1995, Table VM-1) and 15.5% of total other trucks were estimated to be for personal use.
Vmt - 68.8% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1995, Table VM-1) and 7.1% of total vehicle miles traveled by other trucks were for personal use. The percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.
Pmt - Calculated by ORNL as vmt multiplied by load factor.
Load Factor - DOT, FHWA, Office of Highway Information Management, 1990 NPTS, Public Use Tape, 1992.
Energy Use- Assuming that there is no difference in fuel economy (measured in miles per gallon) between personal-use trucks and non-personal use trucks, 66.0% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1995, Table VM-1) and 3.5% of total other truck fuel consumption was for personal use. These percentages were derived by ORNL from the 1992 TIUS Public Use tape. Total truck energy use was the sum of light truck and other truck energy use.
Light Trucks: DOT, FHWA, Highway Statistics 1995, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.2% of fuel assumed to be gasoline, 3.3% diesel, 0.3% lpg, and 0.2% cng; percentages were generated from the 1992 TIUS Micro Data File on CD.

Other Trucks: DOT, FHWA, Highway Statistics 1995, Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These values were distributed based on data from the 1992 TIUS Public Use Tape: 16.2% of fuel assumed to be gasoline, 83.3% diesel, and 0.5% lpg.

Motorcycles

Number of Vehicles and Vmt - DOT, FHWA, Highway Statistics 1995, Table VM-1.
Pmt - Calculated by ORNL as vmt multiplied by load factor.
Load Factor - DOT, FHWA, Office of Highway Information Management, 1990 NPTS, Public Use Tape, 1992.
Energy Use - DOT, FHWA, Highway Statistics 1995, Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:

Number of Vehicles, Vmt, Pmt, and Energy Use - Motor bus only. APTA, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 71, 78, 83, 102, 104.
Load Factor - Calculated by ORNL as pmt/vmt.

Intercity:

Number of Vehicles - Estimated by ORNL as 18% of commercial bus registrations, DOT, FHWA, Highway Statistics 1995, Table MV-10.
Pmt - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, Washington, DC, 1996, p. 47.
Vmt - Estimated using passenger travel and an average load factor of 23.2 persons/vehicle.
Load Factor -Estimated as 23.2 based on historical data.
Energy Use - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, 1996, Washington, DC, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1995 data were estimated using vehicle travel information.)

School:

Number of Vehicles - School and other nonrevenue as reported in DOT, FHWA, Highway Statistics 1995, Table MV-10.
Vmt, Pmt - National Safety Council, Accident Facts, 1996 Edition, Chicago, IL, pp. 94-95.
Load Factor - Calculated by ORNL as pmt/vmt.
Energy Use - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, 1996, Washington, DC, p. 56. For conversion purposes, fuel for schod buses was assumed to be 60% diesel fuel and 40% gasoline. (1995 data were estimated using vehicle travel information.)

Non-Highway

Air

Large Certified Route Air Carriers:

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

Load Factor - Calculated by ORNL as pmt/vmt.

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

General Aviation:

Number of Vehicles, Vmt, Energy Use - DOT, FAA, General Aviation Activity and Avionics, Survey: Calendar Year 1995, pp. 1-7, 3-11, 5-3.

Pmt - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, Washington, DC, 1996, p. 47.

Load Factor - Calculated by ORNL as pmt/vmt.

Recreational Boating

Number of Vehicles - U.S. Coast Guard, Boating Statistics 1995, Washington, DC, September, 1996.

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

Rail

Intercity:

Number of Vehicles, Vmt and Pmt -AAR, Railroad Facts, 1996 Edition, Washington, DC, p. 78.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - Personal communication with Amtrak, Washington, DC. (1995 data estimated using train-mile information.)

Transit and Commuter:

Number of Vehicles, Vmt and Pmt - APTA, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 71, 78, 83.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - APTA, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 102-104. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Table 2.14
Intercity Freight Movement and Energy Use in the United States, 1995

Highway

Trucks

Vehicles - 0.3% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1995, Table VM-1) and 24% of total other trucks were engaged in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD. Intercity freight trucks were defined as any truck whose:

- greatest share of miles were traveled more than 50 miles away from the vehicle's home base; **and**
- principal use was not personal or passenger transportation; **and**
- body type was not pickup, minivan, or utility vehicle.

Vmt - 0.6% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1995, Table VM-1) and 59.5% of total vehicle miles traveled by other trucks were used in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.

Ton Miles, Tons Shipped and Average Length of Haul - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, Washington, DC, 1996, pp. 44, 46, 71.

Energy Intensity - Energy use divided by ton-miles.

Energy Use - 0.9% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1995, Table VM-1) and 67.2% of total other truck fuel consumption were used in intercity freight movement. These percentages werederived by ORNL from the 1992 TIUS Micro Data File on CD.

Non-Highway

Waterborne Commerce

Vehicles - U.S. Department of the Army, Army Corps of Engineers, "Summary of U.S. Flag Passenger and Cargo Vessels, 1992," New Orleans, LA, 1997.

Ton Miles, Tons Shipped, and Average Length of Haul - U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1995, Part 5 National Summaries, New Orleans, LA, 1997, pp. 1-6, 1-7.

Energy Intensity - Energy use divided by ton miles.

Energy Use - DOE, EIA, Fuel Oil and Kerosene Sales, 1995, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering.

Domestic freight energy use was calculated as:

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

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

Pipeline

Natural Gas:

Tons shipped - DOE, EIA, Natural Gas Annual 1995, Washington, DC, 1996, Table 1. Total natural gas disposition divided by 44,870 ft^3/ton.

Energy use - The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, Natural Gas Annual 1995, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft^3. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., End Use Energy Consumption DataBase: Transportation Sector. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horsepower was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude Oil and Petroleum Product:

Ton Miles and Tons Shipped - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, Washington, DC, 1996, pp. 44, 46.

Energy Use - W. F. Banks, Systems, Science, and Software, Inc., Energy Consumption in the Pipeline Industry, LaJolla, CA, 1977.

Rail

Vehicles, Vmt, Ton Miles, Average Length of Haul - AAR, Railroad Facts, 1996 Edition, Washington, DC, 1996, pp. 27, 34, 36, 50.

Tons shipped - AAR, Analysis of Class I Railroads 1995, 1996, p. 31.

Energy Use -AAR, Railroad Facts, 1996 Edition, Washington, DC, 1996, p. 60.

Table 2.15
Energy Intensities of Passenger Modes, 1970-95

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each passenger mode using the following data sources:

Highway

Automobiles

Vmt - DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1987-95 editions.

Pmt - vmt multiplied by the load factor.

Energy Use - Total gallons of fuel for automobiles was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A; and Table VM-1 in the 1986-94 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

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

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

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

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

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

1991-95 - 97.8% gasoline, 1.0% gasohol, and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Household Vehicles Energy Consumption 1991, December 1993, p. 46.

1993-95 - Methanol use was estimated using data from DOE, EIA, Alternatives to Traditional Transportation Fuels, Washington, DC, December 1996, p. 23.

Buses

Transit:

Vmt, Pmt, Energy Use - APTA, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 71, 78, 102-104, and annual.

Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988-94, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

Intercity:

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

1985-95 - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, Washington, DC, 1996, p. 47.

Energy Use - 1970-1984 - American Bus Association, Annual Report, Washington, DC, annual.

1985-95 - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, Washington, DC, p. 56, and annual. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1995 data were estimated using vehicle travel information.)

School:

Vmt - 1970-84 - DOT, FHWA, Highway Statistics 1984, Washington, DC, Table VM-1, p. 175, and annual.

1985-87 - DOT, TSC, National Transportation Statistics, 1989, Figure 2, p. 7, and annual.

1988-95 - National Safety Council, Accident Facts, 1996 Edition , Chicago, IL, p. 95, and annual.

Energy Use - 1970-1984 - DOT, FHWA, Highway Statistics 1984, Washington, DC, Table VM-1, and annual.

1985-86 - DOT, TSC, National Transportation Statistics, Figure 2, p. 5, and annual.

1987-95 - Eno Transportation Foundation, Transportation in America, Fourteenth Edition, Washington, DC, p. 56, and annual. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline. (1995 data were estimated using vehicle travel information.)

Non-Highway

Air

Certificated Air Carriers:

Pmt - DOT, Bureau of Transportation Statistics, Air Carrier Traffic Statitistics Monthly, December 1996/95, Washington, DC, p. 2.

Energy Use - 1970-81 - DOT, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, DC, annual.
1982-95 - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals for domestic only.

General Aviation:

Pmt - Eno Transportation Foundation, Transportation In America, Fourteenth Edition, Washington, DC, 1996, p.47.

Energy Use - 1970-74 - DOT, TSC, National Transportation Statistics, Cambridge, MA, 1981.
1975-85 - DOT, FAA, FAA Aviation Forecasts, Washington, DC, annual.
1985-95 - DOT, FAA, General Aviation Activity and Avionics Survey: Calendar Year 1995, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Rail

Passenger (Amtrak):

Pmt - 1971-83 - AAR, Statistics of Class I Railroads, Washington, DC, annual.
1984-88, 1995 - AAR, Railroad Facts, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.
1989-94 - Personal communication with Amtrak.

Energy Use - Personal communication with Amtrak. (1995 data were estimated using train-mile information.)

Transit:

Pmt and Energy Use - APTA, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 71, 102-104. Transit was defined as the sum of "heavy rail," "light rail,"and "other."

Table 2.16
Energy Intensities of Freight Modes, 1970-95

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each freight mode using the following data sources:

Highway

Trucks

Vmt - DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1987-95 editions. Light trucks were defined as 2-axle, 4-tire trucks. Other trucks were defined as the difference between total trucks and 2-axle, 4-tire trucks.

Energy Use - Light Trucks - Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1986-95 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-1987 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994-95 was distributed based on the 1992 TIUS: 96.2% gasoline; 3.3% diesel; 0.3% lpg; and 0.2% cng.

Other Trucks - Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1986-95 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-1987 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994-95 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg.

Non-Highway

Water

Ton Miles - U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1995, Part 5: National Summaries, New Orleans, LA, 1997, p. 1-6, and annual.

Energy Use - Calculated as the difference between total water freight energy use and foreign water freight energy use.

Total - DOE, EIA, Fuel Oil and Kerosene Sales, 1995, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering.

Rail

Freight Car Miles, Ton Miles and Energy Use - AAR, Railroad Facts, 1996 Edition, Washington, DC, 1996, pp. 27, 36, 60, and annual.

Table 3.2
Vehicle Stock and New Sales in the
United States, 1995 Calendar Year

Highway

Automobiles

Vehicle Stock:

The number of vehicles in use by EPA size class were derived as follows: Market Shares by EPA size class for new car sales from 1970-1975 were taken from the DOT, NHTSA, Automotive Characteristics Historical DataBase, Washington, DC. Market shares for the years 1976-1990 were found in Linda S. Williams and Patricia S. Hu, Highway Vehicle MPG and Market Shares Report: Model Year 1990, ORNL-6672, April 1991, and Table 7 and the ORNL MPG and Market Shares Database, thereafter. These data were assumed to represent the number of cars registered in each size class for each year. These percentages were applied to the automobiles in operation for that year as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED) and summed to calculate the total mix. This method assumed that all vehicles, large and small, were scrapped at the same rate.

Sales:

Domestic, import, and total sales were from AAMA, Facts and Figures '96, p. 16. The domestic sales were distributed by size class according to the following percentages: Two seater, 0.3%; Minicompact, 0%; Subcompact, 13.5%; Compact 38.8%; Midsize, 29.4%; and Large, 18.0%. The import sales were distributed by size class according to the following percentages: Two-seater, 2.1%; Minicompact, 2.9%; Subcompact, 35.5%; Compact, 32.7%; Midsize, 25.3%; and Large, 1.5%. These percentages were derived from the ORNL MPG and Market Shares Database and were based on the sales period instead of the calendar year. Domestic-sponsored imports (captive imports) were included in the import figure only.

See Glossary for definition of Automobile Size Classifications.

Motorcycles

Stock - DOT, FHWA, Highway Statistics 1995, Table VM-1, 1996.

Recreational Vehicles

Sales - Ward's Automotive Yearbook 1996, U.S. Recreation Vehicle Shipments by Type, "Total," p. 204.

Trucks

Stock - Vehicles in use by weight class were determined by applying the percentage in use by weight class as reported in DOC, Bureau of the Census, 1992 TIUS, (0-10,000 lbs, 93.3%; 10,001-19,500 lbs, 2.1%; 19,501-26,000 lbs, 1.2%; 26,001 lbs and over, 3.4%) to the total number of trucks in use as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED).

Sales - AAMA, Facts and Figures '96, p. 21.

Table 3.32
Summary Statistics on Buses by Type, 1970-95

Number in Operation

***Transit buses*:**

American Public Transit Association, 1997 Transit Fact Book, Washington, DC, February 1997, p. 83, and annual.

Intercity buses:

1970-80 - American Bus Association, 1984 Annual Report, Washington, DC, and annual.

1985 - U.S. Department of Transportation, Transportation Systems Center, National Transportation Statistics, Cambridge, MA, August 1990, Figure 5, p. 8, and annual.

1990-95 - Estimated as 38% of commercial buses (less transit motor buses). Commercial bus total found in Highway Statistics 1995, Table MV-10, and annual.

***School buses*:**

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, Table MV-10, p. II-6, and annual.

Vehicle-miles and Passenger-miles

Transit buses:

American Public Transit Association, 1997 Transit Fact Book, Washington, DC, February 1997, pp. 71, 78, and annual.

***Intercity buses*:**

1970-80 - American Bus Association, Annual Report, Washington, DC, annual.

1985-95 - Eno Transportation Foundation, Transportation in America, Fourteenth edition, Washington, DC, 1996, p. 47.

1990-95 vehicle travel - Estimated using passenger travel and an average load factor of 23.2.

School buses:

1970-80 - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1984, Washington, DC, Table VM-1, p. 175, and annual.

1985 - U.S. Department of Transportation, Research and Special Programs Administration, National Transportation Statistics, 1989, Figure 2, p. 7, and annual.

1990-95 - National Safety Council, Accident Facts, 1996 Edition, Chicago, IL, pp. 94-95, and annual.

Energy Use

Transit buses:

American Public Transit Association, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 102-104. Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988-92, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

Intercity buses:

1970-80 - American Bus Association, Annual Report, Washington, DC, annual.

1985-95 - Eno Transportation Foundation, Transportation in America, Fourteenth edition, Washington, DC, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1995 data were estimated using vehicle travel information.)

School buses:

1970-80 - DOT, FHWA, Highway Statistics 1984, Washington, DC, Table VM-1, and annual.

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

1987-95- Eno Transportation Foundation, Transportation in America, Fourteenth edition, Washington, DC, p. 56. For conversion purposes, fuel for school was assumed to be 60% diesel fuel and 40% gasoline. (1995 data were estimated using vehicle travel information.)

APPENDIX B
CONVERSIONS

A Note About Heating Values

The heat content of a fuel is the quantity of energy released by burning a unit amount of that fuel. However, this value is not absolute and can vary according to several factors. For example, empirical formulae for determining the heating value of liquid fuels depend on the fuels' American Petroleum Institute (API) gravity. The API gravity varies depending on the percent by weight of the chemical constituents and impurities in the fuel, both of which are affected by the combination of raw materials used to produce the fuel and by the type of manufacturing process. Temperature and climatic conditions are also factors.

Because of these variations, the heating values in Table B.1 may differ from values in other publications. The figures in this report are representative or average values, not absolute ones. The gross heating values used here agree with those used by the Energy Information Administration (EIA).

Heating values fall into two categories, gross and net. If the products of fuel combustion are cooled back to the initial fuel-air or fuel-oxidizer mixture temperature and the water formed during combustion is condensed, the energy released by the process is the higher (gross) heating value. If the products of combustion are cooled to the initial fuel-air temperature, but the water is considered to remain as a vapor, the energy released by the process is lower (net) heating value. Usually the difference between the gross and net heating values for fuels used in transportation is around 5 to 8 percent; however, it is important to be consistent in their use.

Table B.1
Approximate Heat Content for Various Fuels

Automotive gasoline	125,000 Btu/gal(gross) = 115,400 Btu/gal(net)
Diesel motor fuel	138,700 Btu/gal (gross) = 128,700 Btu/gal (net)
Methanol	64,600 Btu/gal (gross) = 56,560 Btu/gal (net)
Ethanol	84,600 Btu/gal (gross) = 75,670 Btu/gal (net)
Gasohol	120,900 Btu/gal (gross) = 112,417 Btu/gal (net)
Aviation gasoline	120,200 Btu/gal (gross) = 112,000 Btu/gal (net)
Propane	91,300 Btu/gal (gross) = 83,500 Btu/gal (net)
Butane	103,000 Btu/gal (gross) = 93,000 Btu/gal (net)
Jet fuel (naphtha)	127,500 Btu/gal (gross) = 118,700 Btu/gal (net)
Jet fuel (kerosene)	135,000 Btu/gal (gross) = 128,100 Btu/gal (net)
Lubricants	144,400 Btu/gal (gross) = 130,900 Btu/gal (net)
Waxes	131,800 Btu/gal (gross) = 120,200 Btu/gal (net)
Asphalt and road oil	158,000 Btu/gal (gross) = 157,700 Btu/gal (net)
Petroleum coke	143,400 Btu/gal (gross) = 168,300 Btu/gal (net)
Natural gas	
Wet	1,112 Btu/ft^3
Dry	1,031 Btu/ft^3
Compressed	20,551 Btu/pound
Liquid	90,800 Btu/gal (gross) = 87,600 Btu/gal (net)
Crude petroleum	138,100 Btu/gal (gross) = 131,800 Btu/gal (net)
Fuel Oils	
Residual	149,700 Btu/gal (gross) = 138,400 Btu/gal (net)
Distillate	138,700 Btu/gal (gross) = 131,800 Btu/gal (net)
Coal	
Anthracite - Consumption	21.711 x 10^6 Btu/short ton
Bituminous and lignite - Consumption	21.012 x 10^6 Btu/short ton
Production average	21.352 x 10^6 Btu/short ton
Consumption average	21.015 x 10^6 Btu/short ton

Table B.2
Fuel Equivalents

1 million bbl/day crude oil	= 0.3650 billion bbl/year crude oil = 5.800 trillion Btu/day = 2.117 quadrillion Btu/year = 90.09 million short tons coal/year = 2.074 trillion ft^3 natural gas/year = 22.33 x 10^{11} MJ/year
1 billion bbl/year crude oil	= 2.740 million bbl/day crude oil = 15.89 trillion Btu/day = 5.800 quadrillion Btu/year = 246.8 million short ton coal/year = 5.68 trillion ft^3/year natural gas/day = 61.19 x 10^{11} MJ/year
1 trillion Btu/day	= 172.4 thousand bbl/day crude oil = 62.93 million bbl/year crude oil = 0.3650 quadrillion Btu/year = 15.53 million short tons coal/year = 357.5 billion ft^3 natural gas/year = 38.51 x 10^{10} MJ/year
1 quadrillion Btu/year	= 0.4724 million bbl/day crude oil = 172.4 million bbl/year crude oil = 2.740 trillion Btu/day = 42.55 million short tons coal/year = 979.4 billion ft^3 natural gas/year = 10.55 x 10^{11} MJ/year
1 billion short tons coal/year	= 11.10 million bbl/day crude oil = 4.052 billion bbl/year crude oil = 64.38 trillion Btu/day = 23.50 quadrillion Btu/year = 23.02 trillion ft^3 natural gas/year = 24.79 x 10^{12} MJ/year
1 trillion ft^3 natural gas/year	= 0.4823 million bbl/day crude oil = 0.1760 billion bbl/year crude oil = 2.797 trillion Btu/day = 1.021 quadrillion Btu/year = 43.45 million short tons coal/year = 10.77 x 10^{11} MJ/year
1 mega joule/year	= 44.78 x 10^{-8} bbl/day crude oil = 16.34 x 10^{-5} bbl/year crude oil = 2.597 Btu/day = 947.9 Btu/year = 4.034 x 10^{-5} short tons coal/year = 0.9285 ft^3 natural gas/year

Table B.3
Energy Unit Conversions

1 Btu	= 778.2 ft-lb	1 kWhr	= 3412 Btu[a]
	= 107.6 kg-m		= 2.655×10^{6} ft-lb
	= 1055 J		= 3.671×10^{5} kg-m
	= 39.30×10^{-5} hp-h		= 3.600×10^{6} J
	= 39.85×10^{-5} metric hp-h		= 1.341 hp-h
	= 29.31×10^{-5} kWhr		= 1.360 metric hp-h
1 kg-m	= 92.95×10^{-4} Btu	1 Joule	= 94.78×10^{-5} Btu
	= 7.233 ft-lb		= 0.7376 ft-lb
	= 9.806 J		= 0.1020 kg-m
	= 36.53×10^{-7} hp-h		= 37.25×10^{-8} hp-h
	= 37.04×10^{-7} metric hp-h		= 37.77×10^{-8} metric hp-h
	= 27.24×10^{-7} kWhr		= 27.78×10^{-8} kWhr
1 hp-h	= 2544 Btu	1 metric hp-h	= 2510 Btu
	= 1.98×10^{6} ft-lb		= 1.953×10^{6} ft-lb
	= 2.738×10^{6} kgm		= 27.00×10^{4} kg-m
	= 2.685×10^{6} J		= 2.648×10^{6} J
	= 1.014 metric hp-h		= 0.9863 hp-h
	= 0.7475 kWhr		= 0.7355 kWhr

[a]This figure does not take into account the fact that electricity generation and distribution efficiency is approximately 29%. If generation and distribution efficiency are taken into account, 1 kWhr = 11,765 Btu.

Table B.4
Distance and Velocity Conversions

1 in.	= 83.33 x 10^{-3} ft	1 ft	= 12.0 in.
	= 27.78 x 10^{-3} yd		= 0.33 yd
	= 15.78 x 10^{-6} mile		= 189.4 x 10^{-3} mile
	= 25.40 x 10^{-3} m		= 0.3048 m
	= 0.2540 x 10^{-6} km		= 0.3048 x 10^{-3} km
1 mile	= 63360 in.	1 km	= 39370 in.
	= 5280 ft		= 3281 ft
	= 1760 yd		= 1093.6 yd
	= 1609 m		= 0.6214 mile
	= 1.609 km		= 1000 m

1 ft/sec = 0.3048 m/s = 0.6818 mph = 1.0972 km/h
1 m/sec = 3.281 ft/s = 2.237 mph = 3.600 km/h
1 km/h = 0.9114 ft/s = 0.2778 m/s = 0.6214 mph
1 mph = 1.467 ft/s = 0.4469 m/s = 1.609 km/h

Table B.5
Alternative Measures of Greenhouse Gases

1 pound methane, measured in carbon units (CH_4)	= 1.333 pounds methane, measured at full molecular weight (CH_4)
1 pound carbon dioxide, measured in carbon units (CO_2-C)	= 3.6667 pounds carbon dioxide, measured at full molecular weight (CO_2)
1 pound carbon monoxide, measured in carbon units (CO-C)	= 2.333 pounds carbon monoxide, measured at full molecular weight (CO)
1 pound nitrous oxide, measured in nitrogen units (N_2O-N)	= 1.571 pounds nitrous oxide, measured at full molecular weight (N_2O)

Table B.6
Volume and Flow Rate Conversions[a]

1 U.S. gal	= 231 $in.^3$	1 liter	= 61.02 $in.^3$
	= 0.1337 ft^3		= 3.531 x 10^{-2} ft^3
	= 3.785 liters		= 0.2624 U.S. gal
	= 0.8321 imperial gal		= 0.2200 imperial gal
	= 0.0238 bbl		= 6.29 x 10^{-3} bbl
	= 0.003785 m^3		= 0.001 m^3
	A U.S. gallon of gasoline weighs 6.2 pounds		
1 imperial gal	= 277.4 $in.^3$	1 bbl	= 9702 $in.^3$
	= 0.1606 ft^3		= 5.615 ft^3
	= 4.545 liters		= 158.97 liters
	= 1.201 U.S. gal		= 42 U.S. gal
	= 0.0286 bbl		= 34.97 imperial gal
	= 0.004546 m^3		= 0.15897 m^3
1 U.S. gal/hr	= 3.209 ft^3/day		= 1171 ft^3/year
	= 90.84 liter/day		= 33157 liter/year
	= 19.97 imperial gal/day		= 7289 imperial gal/year
	= 0.5712 bbl/day		= 207.92 bbl/year
	For Imperial gallons, multiply above values by 1.201		
1 liter/hr	= 0.8474 ft^3/day		= 309.3 ft^3/year
	= 6.298 U.S. gal/day		= 2299 U.S. gal/year
	= 5.28 imperial gal/day		= 1927 imperial gal/year
	= 0.1510 bbl/day		= 55.10 bbl/year
1 bbl/hr	= 137.8 ft^3/year		= 49187 ft^3 year
	= 1008 U.S. gal/day		= 3.679 x 10^5 U.S. gal/year
	= 839.3 imperial gal/day		= 3.063 x 10^5 imperial gal/year
	= 3815 liter/day		= 1.393 x 10^6 liter/day

[a]The conversions for flow rates are identical to those for volume measures, if the time units are identical.

Table B.7
Power Conversions

FROM	TO					
	Horsepower	Kilowatts	Metric horsepower	Ft-lb per sec	Kilocalories per sec	Btu per sec
Horsepower	1	0.7457	1.014	550	0.1781	0.7068
Kilowatts	1.341	1	1.360	737.6	0.239	0.9478
Metric horsepower	0.9863	0.7355	1	542.5	0.1757	0.6971
Ft-lb per sec	1.36×10^{-3}	1.356×10^{-3}	1.84×10^{-3}	1	0.3238×10^{-3}	1.285×10^{-3}
Kilocalories per sec	5.615	4.184	5.692	3088	1	3.968
Btu per sec	1.415	1.055	1.434	778.2	0.2520	1

Table B.8
Mass Conversions

	TO				
FROM	Pound	Kilogram	Short ton	Long ton	Metric ton
Pound	1	0.4536	5.0×10^{-4}	4.4643×10^{-4}	4.5362×10^{-4}
Kilogram	2.205	1	1.1023×10^{-3}	9.8425×10^{-4}	1.0×10^{-3}
Short ton	2000	907.2	1	0.8929	0.9072
Long ton	2240	1016	1.12	1	1.016
Metric ton	2205	1000	1.102	0.9842	1

Table B.9
Fuel Efficiency Conversions[a]

MPG	Miles/liter	Kilometers/L	L/100 kilometers
10	2.64	4.25	23.52
15	3.96	6.38	15.68
20	5.28	8.50	11.76
25	6.60	10.63	9.41
30	7.92	12.75	7.84
35	9.25	14.88	6.72
40	10.57	17.00	5.88
45	11.89	19.13	5.23
50	13.21	21.25	4.70
55	14.53	23.38	4.28
60	15.85	25.51	3.92
65	17.17	27.63	3.62
70	18.49	29.76	3.36
75	19.81	31.88	3.14
80	21.13	34.01	2.94
85	22.45	36.13	2.77
90	23.77	38.26	2.61
95	25.09	40.38	2.48
100	26.42	42.51	2.35
105	27.74	44.64	2.24
110	29.06	46.76	2.14
115	30.38	48.89	2.05
120	31.70	51.01	1.96
125	33.02	53.14	1.88
130	34.34	55.26	1.81
135	35.66	57.39	1.74
140	36.98	59.51	1.68
145	38.30	61.64	1.62
150	39.62	63.76	1.57

[a]To convert fuel efficiency from miles per gallon (mpg) to liters per hundred kilometers, divide mpg into 235.24.

Table B.10
SI Prefixes and Their Values

	Value	Prefix	Symbol
One million million millionth	10^{-18}	atto	a
One thousand million millionth	10^{-15}	femto	f
One million millionth	10^{-12}	pico	p
One thousand millionth	10^{-9}	nano	n
One millionth	10^{-6}	micro	µ
One thousandth	10^{-3}	milli	m
One hundredth	10^{-2}	centi	c
One tenth	10^{-1}	deci	
One	10^{0}		
Ten	10^{1}	deca	
One hundred	10^{2}	hecto	
One thousand	10^{3}	kilo	k
One million	10^{6}	mega	M
One billion[a]	10^{9}	giga	G
One trillion[a]	10^{12}	tera	T
One quadrillion[a]	10^{15}	peta	P
One quintillion[a]	10^{18}	exa	E

[a]Care should be exercised in the use of this nomenclature, especially in foreign correspondence, as it is either unknown or carries a different value in other countries. A "billion," for example, signifies a value of 10^{12} in most other countries.

Table B.11
Metric Units and Abbreviations

Quantity	Unit name	Symbol
Energy	joule	J
Specific energy	joule/kilogram	J/kg
Specific energy consumption	joule/kilogram•kilometer	J/(kg•km)
Energy consumption	joule/kilometer	J/km
Energy economy	kilometer/kilojoule	km/kJ
Power	kilowatt	Kw
Specific power	watt/kilogram	W/kg
Power density	watt/meter^3	W/m^3
Speed	kilometer/hour	km/h
Acceleration	meter/second^2	m/s^2
Range (distance)	kilometer	km
Weight	kilogram	kg
Torque	newton•meter	N•m
Volume	meter^3	m^3
Mass; payload	kilogram	kg
Length; width	meter	m
Brake specific fuel consumption	kilogram/joule	kg/J
Fuel economy (heat engine)	liters/100 km	L/100 km

Conversion of Constant Dollar Values

Many types of information in this data book are expressed in dollars. Generally, constant dollars are used--that is, dollars of a fixed value for a specific year, such as 1990 dollars. Converting current dollars to constant dollars, or converting constant dollars for one year to constant dollars for another year, requires conversion factors (Table B.12 and B.13). Table B.12 shows conversion factors for the Consumer Price Index inflation factors. Table B.13 shows conversion factors using the Gross National Product inflation factors.

Table B.12
Consumer Price Inflation (CPI) Index

From	To																											
	1970	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
1970	1.00	1.04	1.08	1.14	1.27	1.39	1.47	1.56	1.68	1.87	2.12	2.34	2.49	2.57	2.68	2.77	2.82	2.93	3.05	3.19	3.37	3.51	3.61	3.72	3.82	3.93	4.04
1971	0.96	1.00	1.03	1.10	1.22	1.33	1.41	1.50	1.61	1.79	2.04	2.25	2.38	2.46	2.56	2.65	2.71	2.81	2.92	3.06	3.23	3.36	3.47	3.57	3.66	3.76	3.87
1972	0.93	0.97	1.00	1.06	1.18	1.29	1.36	1.45	1.56	1.74	1.97	2.17	2.31	2.38	2.48	2.57	2.62	2.72	2.83	2.96	3.12	3.26	3.35	3.45	3.54	3.64	3.75
1973	0.87	0.91	0.94	1.00	1.11	1.21	1.28	1.36	1.47	1.63	1.86	2.05	2.17	2.24	2.34	2.42	2.47	2.56	2.66	2.79	2.94	3.07	3.16	3.25	3.34	3.43	3.53
1974	0.79	0.82	0.85	0.90	1.00	1.09	1.15	1.23	1.32	1.47	1.67	1.84	1.96	2.02	2.11	2.18	2.22	2.31	2.40	2.51	2.65	2.76	2.85	2.93	3.01	3.09	3.18
1975	0.72	0.75	0.78	0.83	0.92	1.00	1.06	1.13	1.21	1.35	1.53	1.69	1.79	1.85	1.93	2.00	2.04	2.11	2.20	2.30	2.43	2.53	2.61	2.68	2.75	2.83	2.92
1976	0.68	0.71	0.74	0.78	0.87	0.95	1.00	1.07	1.15	1.28	1.45	1.60	1.70	1.75	1.82	1.89	1.93	2.00	2.08	2.18	2.30	2.39	2.47	2.54	2.60	2.68	2.76
1977	0.64	0.67	0.69	0.73	0.81	0.89	0.94	1.00	1.08	1.20	1.36	1.50	1.59	1.65	1.72	1.78	1.81	1.88	1.95	2.05	2.16	2.25	2.32	2.38	2.45	2.52	2.59
1978	0.60	0.62	0.64	0.68	0.76	0.83	0.87	0.93	1.00	1.11	1.27	1.40	1.48	1.53	1.59	1.65	1.68	1.74	1.81	1.90	2.00	2.09	2.15	2.21	2.27	2.34	2.40
1979	0.54	0.56	0.58	0.61	0.68	0.74	0.78	0.84	0.90	1.00	1.14	1.25	1.33	1.37	1.43	1.48	1.51	1.57	1.63	1.71	1.80	1.88	1.93	1.99	2.04	2.10	2.16
1980	0.47	0.49	0.51	0.54	0.60	0.65	0.69	0.74	0.79	0.88	1.00	1.10	1.17	1.21	1.26	1.31	1.33	1.38	1.44	1.50	1.59	1.65	1.70	1.75	1.80	1.85	1.90
1981	0.43	0.45	0.46	0.49	0.54	0.59	0.63	0.67	0.72	0.80	0.91	1.00	1.06	1.10	1.14	1.18	1.21	1.25	1.30	1.36	1.44	1.50	1.54	1.59	1.63	1.68	1.73
1982	0.40	0.42	0.43	0.46	0.51	0.56	0.59	0.63	0.68	0.75	0.85	0.94	1.00	1.03	1.08	1.11	1.14	1.18	1.23	1.28	1.35	1.41	1.45	1.50	1.54	1.58	1.63
1983	0.39	0.41	0.42	0.45	0.50	0.54	0.57	0.61	0.66	0.73	0.83	0.91	0.97	1.00	1.04	1.08	1.10	1.14	1.19	1.24	1.31	1.37	1.41	1.45	1.49	1.53	1.57
1984	0.37	0.39	0.40	0.43	0.48	0.52	0.55	0.58	0.63	0.70	0.79	0.88	0.93	0.96	1.00	1.04	1.06	1.09	1.14	1.19	1.26	1.31	1.35	1.39	1.43	1.47	1.51
1985	0.36	0.38	0.39	0.41	0.46	0.50	0.53	0.56	0.61	0.68	0.77	0.85	0.90	0.93	0.97	1.00	1.02	1.06	1.10	1.15	1.22	1.27	1.30	1.34	1.38	1.42	1.46
1986	0.35	0.37	0.38	0.41	0.45	0.49	0.52	0.55	0.60	0.66	0.75	0.83	0.88	0.91	0.95	0.98	1.00	1.04	1.08	1.13	1.19	1.24	1.28	1.32	1.35	1.39	1.43
1987	0.34	0.36	0.37	0.39	0.43	0.47	0.50	0.53	0.57	0.64	0.73	0.80	0.85	0.88	0.91	0.95	0.96	1.00	1.04	1.09	1.15	1.20	1.24	1.27	1.30	1.34	1.38
1988	0.33	0.34	0.35	0.38	0.42	0.46	0.48	0.51	0.55	0.61	0.70	0.77	0.82	0.84	0.88	0.91	0.93	0.96	1.00	1.05	1.11	1.15	1.19	1.22	1.25	1.29	1.33
1989	0.31	0.33	0.34	0.36	0.40	0.43	0.46	0.49	0.53	0.59	0.67	0.73	0.78	0.80	0.84	0.87	0.88	0.92	0.95	1.00	1.05	1.10	1.13	1.17	1.20	1.23	1.27
1990	0.30	0.31	0.32	0.34	0.38	0.41	0.44	0.46	0.50	0.56	0.63	0.70	0.74	0.76	0.80	0.82	0.84	0.87	0.91	0.95	1.00	1.04	1.07	1.11	1.13	1.17	1.20
1991	0.29	0.30	0.31	0.33	0.36	0.40	0.42	0.45	0.48	0.53	0.61	0.67	0.71	0.73	0.76	0.79	0.81	0.83	0.87	0.91	0.96	1.00	1.03	1.06	1.09	1.12	1.15
1992	0.28	0.29	0.30	0.32	0.35	0.38	0.41	0.43	0.47	0.52	0.59	0.65	0.69	0.71	0.74	0.77	0.78	0.81	0.84	0.88	0.93	0.97	1.00	1.03	1.06	1.09	1.12
1993	0.27	0.28	0.29	0.31	0.34	0.37	0.39	0.42	0.45	0.50	0.57	0.63	0.67	0.69	0.72	0.75	0.76	0.79	0.82	0.86	0.91	0.94	0.97	1.00	1.03	1.06	1.09
1994	0.26	0.27	0.28	0.30	0.33	0.36	0.38	0.41	0.44	0.49	0.56	0.61	0.65	0.67	0.70	0.73	0.74	0.77	0.80	0.84	0.88	0.92	0.95	0.98	1.00	1.03	1.06
1995	0.26	0.27	0.27	0.29	0.32	0.35	0.37	0.40	0.43	0.48	0.54	0.60	0.63	0.65	0.68	0.71	0.72	0.75	0.78	0.81	0.86	0.89	0.92	0.95	0.97	1.00	1.03
1996	0.25	0.26	0.27	0.28	0.31	0.34	0.36	0.39	0.42	0.46	0.53	0.58	0.62	0.64	0.66	0.69	0.70	0.72	0.75	0.79	0.83	0.87	0.89	0.92	0.94	0.97	1.00

Source:
Personal contact with the Bureau of Labor Statistics.

Table B.13
Gross National Product (GNP) Implicit Price Deflator

From	To																											
	1970	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
1970	1.00	1.05	1.10	1.16	1.26	1.38	1.45	1.53	1.65	1.79	1.95	2.14	2.27	2.36	2.45	2.53	2.60	2.67	2.76	2.87	2.99	3.12	3.23	3.29	3.36	3.47	3.54
1971	0.95	1.00	1.04	1.10	1.20	1.31	1.38	1.46	1.57	1.70	1.86	2.04	2.16	2.24	2.33	2.41	2.48	2.54	2.63	2.72	2.84	2.97	3.07	3.13	3.19	3.30	3.37
1972	0.91	0.96	1.00	1.06	1.15	1.26	1.32	1.40	1.50	1.63	1.79	1.96	2.07	2.15	2.24	2.32	2.38	2.44	2.52	2.62	2.73	2.85	2.95	3.01	3.07	3.17	3.24
1973	0.86	0.91	0.95	1.00	1.09	1.19	1.25	1.32	1.42	1.54	1.69	1.85	1.96	2.03	2.12	2.19	2.24	2.30	2.38	2.47	2.58	2.69	2.79	2.84	2.90	3.00	3.06
1974	0.79	0.83	0.87	0.92	1.00	1.09	1.15	1.22	1.31	1.42	1.55	1.70	1.80	1.87	1.95	2.01	2.06	2.12	2.19	2.28	2.37	2.48	2.56	2.61	2.67	2.76	2.81
1975	0.73	0.76	0.80	0.84	0.92	1.00	1.05	1.11	1.20	1.30	1.42	1.55	1.65	1.71	1.78	1.84	1.89	1.94	2.01	2.08	2.17	2.27	2.34	2.39	2.44	2.52	2.57
1976	0.69	0.73	0.76	0.80	0.87	0.95	1.00	1.06	1.14	1.24	1.35	1.48	1.57	1.63	1.70	1.75	1.80	1.84	1.91	1.98	2.06	2.15	2.23	2.27	2.32	2.40	2.44
1977	0.65	0.69	0.71	0.76	0.82	0.90	0.95	1.00	1.07	1.17	1.27	1.40	1.48	1.54	1.60	1.65	1.70	1.74	1.80	1.87	1.95	2.03	2.11	2.15	2.19	2.26	2.31
1978	0.61	0.64	0.67	0.70	0.77	0.84	0.88	0.93	1.00	1.09	1.19	1.30	1.38	1.43	1.49	1.54	1.58	1.62	1.68	1.74	1.81	1.89	1.96	2.00	2.04	2.11	2.15
1979	0.56	0.59	0.61	0.65	0.70	0.77	0.81	0.86	0.92	1.00	1.09	1.20	1.27	1.32	1.37	1.42	1.45	1.49	1.54	1.60	1.67	1.74	1.80	1.84	1.88	1.94	1.98
1980	0.51	0.54	0.56	0.59	0.65	0.71	0.74	0.78	0.84	0.92	1.00	1.10	1.16	1.21	1.26	1.30	1.33	1.36	1.41	1.47	1.53	1.60	1.65	1.68	1.72	1.78	1.81
1981	0.47	0.49	0.51	0.54	0.59	0.64	0.68	0.72	0.77	0.84	0.91	1.00	1.06	1.10	1.15	1.18	1.21	1.25	1.29	1.34	1.40	1.46	1.51	1.54	1.57	1.62	1.66
1982	0.44	0.46	0.48	0.51	0.56	0.61	0.64	0.68	0.73	0.79	0.86	0.94	1.00	1.04	1.08	1.12	1.15	1.18	1.22	1.26	1.32	1.38	1.42	1.45	1.48	1.53	1.56
1983	0.42	0.45	0.46	0.49	0.53	0.58	0.61	0.65	0.70	0.76	0.83	0.91	0.96	1.00	1.04	1.08	1.10	1.13	1.17	1.22	1.27	1.32	1.37	1.40	1.42	1.47	1.50
1984	0.41	0.43	0.45	0.47	0.51	0.56	0.59	0.62	0.67	0.73	0.80	0.87	0.92	0.96	1.00	1.04	1.06	1.08	1.12	1.16	1.21	1.27	1.31	1.34	1.37	1.41	1.44
1985	0.40	0.42	0.43	0.46	0.50	0.54	0.57	0.61	0.65	0.71	0.77	0.85	0.90	0.93	0.94	1.00	1.03	1.05	1.09	1.13	1.18	1.23	1.28	1.30	1.33	1.37	1.40
1986	0.39	0.40	0.42	0.45	0.49	0.53	0.56	0.59	0.63	0.69	0.75	0.82	0.87	0.91	0.94	0.97	1.00	1.03	1.06	1.10	1.15	1.20	1.24	1.27	1.29	1.34	1.36
1987	0.38	0.40	0.41	0.44	0.47	0.52	0.54	0.58	0.62	0.67	0.73	0.80	0.85	0.89	0.92	0.95	0.98	1.00	1.04	1.08	1.12	1.17	1.21	1.24	1.26	1.30	1.33
1988	0.36	0.38	0.40	0.42	0.46	0.50	0.53	0.56	0.60	0.65	0.71	0.77	0.82	0.85	0.89	0.92	0.94	0.97	1.00	1.04	1.08	1.13	1.17	1.19	1.22	1.26	1.28
1989	0.35	0.37	0.38	0.40	0.44	0.48	0.51	0.54	0.58	0.62	0.68	0.75	0.79	0.82	0.86	0.88	0.91	0.93	0.96	1.00	1.04	1.09	1.13	1.15	1.17	1.21	1.24
1990	0.34	0.35	0.37	0.39	0.42	0.46	0.49	0.51	0.55	0.60	0.66	0.72	0.76	0.79	0.83	0.85	0.87	0.89	0.93	0.96	1.00	1.05	1.08	1.10	1.13	1.16	1.19
1991	0.32	0.34	0.35	0.37	0.40	0.44	0.47	0.49	0.53	0.57	0.63	0.69	0.73	0.76	0.79	0.81	0.83	0.86	0.89	0.92	0.96	1.00	1.04	1.06	1.08	1.11	1.14
1992	0.31	0.33	0.34	0.36	0.39	0.43	0.45	0.48	0.51	0.55	0.61	0.66	0.70	0.73	0.76	0.78	0.81	0.83	0.86	0.89	0.92	0.97	1.00	1.02	1.04	1.08	1.10
1993	0.30	0.32	0.33	0.35	0.38	0.42	0.44	0.47	0.50	0.54	0.59	0.65	0.69	0.72	0.75	0.77	0.79	0.81	0.84	0.87	0.91	0.95	0.98	1.00	1.02	1.05	1.08
1994	0.30	0.31	0.33	0.35	0.38	0.41	0.43	0.46	0.49	0.53	0.58	0.64	0.68	0.70	0.73	0.75	0.77	0.79	0.82	0.85	0.89	0.93	0.96	0.98	1.00	1.03	1.05
1995	0.29	0.30	0.32	0.33	0.36	0.40	0.42	0.44	0.47	0.52	0.56	0.62	0.65	0.68	0.71	0.73	0.75	0.77	0.80	0.83	0.86	0.90	0.93	0.95	0.97	1.00	1.02
1996	0.28	0.30	0.31	0.33	0.36	0.39	0.41	0.43	0.46	0.51	0.55	0.60	0.64	0.67	0.69	0.71	0.73	0.75	0.78	0.81	0.84	0.88	0.91	0.93	0.95	0.98	1.00

Source:

U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Washington, DC, monthly.

APPENDIX C

ACTIVITY AND ENERGY USE IN TRANSPORTATION: DATA SOURCES FOR THE LBNL ANALYSES OF OECD COUNTRIES

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Lawrence Berkeley National Laboratory (LBNL) [1]

1. NOTES ON THE UPDATE

During 1995 and 1996, LBNL continued to analyze international trends in transportation. This brief note summarizes key new findings and revisions. Previous notes and references can be found in Section 3 of this Appendix. Country specific revisions can be found in Section 2. Details of methodology can be found in Indicators of Energy Use and Efficiency: Linking Energy Use to Human Activity, published by the International Energy Agency. It is hoped that freight data (including significant revisions for France and Japan) can be provided next year.

Several points made in earlier editions must be emphasized.

- Derivations of miles driven, fuel use per mile, and total fuel use are, in general, based on circularities that are resolved when occasional surveys record fuel use per mile and miles driven per vehicle independently, then aggregate up to national totals. At present, only the Dutch government carries out such surveys every year. Australia surveys approximately every three years; France has surveys for most of the last ten years; Japan surveys every year. For other countries, the general order of calculation is to start with gasoline use, subtract off what is believed used by trucks, buses and motorcycles, and allocate the rest to cars and light trucks. Using estimates of mileage driven by cars and light trucks, miles per gallon is derived. For diesel fuel, automobile fuel is usually removed by assumption, with average mileage relatively well

[1] This update was produced with assistance from Roger Gorham, LBNL, and Celine Marie, International Energy Agency.

known. Buses are removed by assumption and using data from local and intercity operators for mileage and even fuel consumption. The remaining fuel is allocated to trucks and "special vehicles," such as fire engines, cranes, etc. LBNL has tried to remove these from the data whenever possible, and will hopefully present revised freight data in the next edition.

- "Cars" are for every country cars in use, not total registrations. Data from The Polk Company is used for the U.S. This may reduce the number of cars by as much as 15%. Wherever possible, the mid-year averages are used as well. However, total distance driven is usually derived from either surveys (cars in use × distance per car per year) or from a combination of traffic counts and travel surveys. Therefore, for some countries, notably the U.S., distance per car per year may seem higher than what is customary. But fuel per distance is always measured or derived as such, and is independent of the number of cars counted.

- Gasoline and diesel fuel continue to be aggregated using the energy content of fuels. This gives an aggregate miles per gallon figure that is somewhat different than those published by many countries that count only volumes. Where possible, the fuel economies have been disaggregated into gasoline, diesel, and LPG.

- Measures of passenger travel for a number of countries (i.e. Sweden, Japan, Denmark, Italy) do not agree with national sources because load factors are interpolated between years of travel surveys or load factors are assumed for some vehicles for which none are published (i.e. light trucks for Denmark, mini-cars for Japan).

- With few exceptions, data on fuel use for domestic air travel are unreliable. Most countries continue to record purchases of fuel by domestic airlines for both travel within each country and departures abroad. Only Australia, Denmark, Italy (since the late 1980s), Japan, Norway (since 1993), and the U.S. report fuel use for domestic and foreign air traffic separately.

2. REVISIONS REFLECTED IN THE PRESENT DATA

From time to time our national sources revise data as better estimates of the components of energy use and transportation activity are made available. Information about these revisions follows.

- **Australia** - Data for 1994 and 1995 were not available at the time of publication.

- **Denmark**- No official Transport Statistics Volumes were published for 1994 or 1995. The few data we have included for these years should be considered provisional. Data on domestic airline fuel fluctuate significantly and cannot be considered reliable. New car fuel economy are taken from a newly-revised time series prepared by Danmarks Miljoeundersoegeise (H. Gudmunsson, private communication).

- **Finland**- VTT, the Technical Research Center of Espoo, Finland, provided a throughly revised set of mileage, car stocks, and fuel consumption data for all road vehicles. The recent dramatic improvements in the fuel economy of the stock may reflect inconsistencies with older data, particularly, the stated fuel economy of diesel cars which jumps in 1990.

- **France** - Data for 1994 and 1995 come from the same sources as previous data, with few revisions. However, a typographical error in the previous data provided listed the fuel economy of new vehicles incorrectly. This has been corrected.

- **Germany (West)** - With the publication of the traditional data sources, East and West Germany can no longer be separated. The data which do exist for West Germany alone for 1994 are included in the present revisions. It is hoped that data for united Germany can be presented in future editions with historical data to 1991. Distances traveled by cars have been significantly revised back to 1970. The drop in car miles driven in 1994 may be a result of the difficulties of splitting East and West Germany. Fuel economy has been revised as well, typically by five to seven percent. Fuel economy is used to determine distance traveled. Deutsches Institut fuer Wirtschaftsforschung (DIW) updated the firues on new car fuel economy as well as provided the revised car mileage and fuel use data for West Germany economy.

- **Italy** - New authoritative data on car stocks, car use, and fuel use for gasoline and diesel were provided by the Automobile Club of Italy (ACI) (L. Penissi, private communication) and by Fiat. These were used to recalculate all figures from 1980 onward. A load factor of 1.7 was used for cars for all years after 1988. (Official data from the yearly National Accounts of Transport include only intercity automobile use and travel.) Distance and assumed fuel use per kilometer are used to determine total fuel by type. New car fuel economy for recent years was provided by ACI as well.

- **Japan** - With assistance from the Ministry of Transport (H. Sasaki, private communication), the Japan Auto Research Institute (K. Minato, private communication), Energy Economic Institute, and Energy Data and Modeling Center publications, the estimates of automobile fuel use and kilometers traveled have been revised. Fuel economy is calculated as total fuel divided by total distance and cannot easily be broken down by fuel type. The Ministry of Transport has provided yearly car use surveys which will be explored in future editions of the data. New data on fuel economy averages reflect a new 15 mode consumption test (H. Sasaki, private communication) which were chained to previous years for compatibility.

- **Netherlands** - Data from the Bureau of Statistics, the Adviesdiesnt Verkeer en Vervoer, and the fuel consumption per car use surveys were used to revise all of the automobile data. Driving of Dutch drivers outside of Holland is excluded as is the fuel consumed on these trips. Driving done by foreign drivers visiting Holland is also excluded. Fuel data was received on bus and rail use from the University of Utrecht and from the Bureau of Statistics surveys, but we had to estimate these for the period 1980 to 1984. The car fleet data shown are for cars in use. Where known, these are shown by fuel type.

- **Norway** - Norsk Esso provided their reliable breakdown of road fuel use by vehicle type and fuel. Most of the other data for 1994 were provided by the Institutt for Energiteknik, near Oslo, as part of a project funded by the Norwegian Water and Energy Authority. The Institutt for Energiteknik revised information on fuel use for domestic air travel only.

- **Sweden** - As a complete revision of automobile fuel use and driving data is still not complete, we have not been able to update any information for Sweden on travel, vehicle use, or fuel use

However, we do include revised figures for the sales-weighted fuel economy of new cars, correcting a typographical error in the previous data.

- **United Kingdom** - A revised series of fuel use and car use from the U.K. Department of Transportation and updated information on sales-weighed fuel economy of new gasoline cars were received. It is noted that diesel cars have risen in popularity; however no data on these cars' new test fuel consumption are available. Information on rail energy use and on fuel for domestic air travel was incomplete.

- **United States** - The transportation data come from ORNL and from various U.S. Department of Transportation publications. The reader is reminded that for purposes of international comparisons, automobiles and personal light trucks are aggregated. The classification of some vans and sport utility vehicles was shifted by DOT in 1993 and are reflected in the 1994 and 1995 data. This makes comparisons involving numbers of vehicles, mileage, and fuel use in previous years slightly uncertain.

In addition, LBNL would like to acknowledge the assistance of these individuals:
Denmark - Bo Ekman, Danish Road Authority, Copenhagen
Finland - Antti Lehtila and Kari Makela, VTT, Espoo
France - Didier Bosseboef, ADEME, Paris
Germany - Drs. Heilweg Rielke and Uwe Kunert, DIW, Berlin
Italy - Lucia Penissi, Automobile Club of Italy, Roma
Japan - H. Sasaski, Ministry of Transport
Netherlands - Jan van der Waard, AVV, Rotterdam and Jacco Farla, University of Utrecht
Norway - Norsk Esso
United Kingdom - Deryck Jones, United Kingdom Department of Transport

3. BRIEF REVIEW OF SOURCES AND EXPLANATION

This note explains the most recent LBNL collection and analysis of data covering the structure of travel and freight energy use in twelve OECD countries. In general the LBNL analyses follow major sources from each country. Where these are incomplete, we proceed bottom-up using each country's main data sources on vehicle activity, as well as travel (passenger-kilometers) and freight (tonne-kilometers). Aggregate data on traffic, travel and freight by mode (including data for car travel derived usually from travel surveys) are split where possible by fuel, i.e., into activity for gasoline, diesel, and liquified petroleum gas (LPG). Fuel data are developed by each country source, typically by first parsing reported data (rail, bus, some trucking, domestic shipping, domestic air travel) and then splitting the remaining road fuels into modes. Usually we follow our sources, but important exceptions are Sweden, Denmark, and Italy, where we have tried to resolve often conflicting information from a number of experts and published sources. For rail energy use, we assume (unless data show otherwise) that electricity is used only for passenger travel (as well as for local rail transit) and split the diesel fuel according to a formula where two passenger-km traveled are equal to one tonne-km of freight hauled. (For air freight, we parse according to weight, approximately seven passengers (with baggage) equals one tonne. We usually do not analyze minor modes (motorcycles and mopeds, and waterborne travel in most countries) and omit pipelines for most countries because of a lack of data on volume (tonne-km) or energy consumed, or both. We omit international shipping and try to eliminate fuel use for international passenger and freight air transport because there are virtually no data on activity by country of traveler. We also use each country's travelsurveys to check modal distributions with the aggregate sources.

To insure comparability with the U.S. we have taken these precautions with "cars." First, we count U.S. personal light trucks (approximately 2/3 of all light trucks and light truck travel) with automobiles, since these are clearly used as household vehicles and now make up more than 20% of the household vehicle stock. Light trucks and vans in Australia, Denmark and Britain are also counted with automobiles, making up about 3-5% of the stock. Light trucks and vans in the other Nordic countries (roughly 2% of the household vehicle stock), however, cannot easily be separated from other trucks, so are not counted as "cars." Mini-cars in Japan are counted as cars. Light trucks or vans are not important as household vehicles in Italy, Germany, and France.

Australia

We present for the first time a complete set of data for Australian travel and energy use, covering the period 1971 to 1993. The figures were worked out by the Bureau of Transport and Communications Economics (BTCE) of the Australian Government, Canberra, and transmitted by Leo Dobes, David Gargett, and David Cosgrove. These officials provide some unpublished estimates to complement the data found in publications listed below. The original sources of the data were the Australian government's Survey of Motor Vehicle Use, taken every three years since 1976, with BTCE interpolating the missing years, and The Motor Vehicles Census, both published by the Australian Bureau of Statistics.

BTCE estimated traffic, travel or freight output, and energy use for each kind of road vehicle (cars by fuel, light trucks by fuel, heavy trucks by fuel and type, buses by fuel), for urban light rail and heavy rail and for interurban passenger and freight rail. Rail energy use data were published for 1976, 1985, 1988 and 1991, with other years interpolated. Electricity was given as final demand. Bus is estimated with constant vehicle intensities (MJ/vehicle-km) for urban and inter-urban buses and estimates of vkt for each type of travel. They also estimated travel and energy use for domestic air transport, for domestic air freight, for domestic (coastal) shipping, and estimated travel for ferries as well. We modified these figures only to split activity and energy use of light trucks into a component for travel (according to BTCE's unpublished estimates). We extrapolated the split of rail travel and freight activity and energy use by electric and diesel traction for 1971-1973 assuming constant shares of each energy source and constant intensities for those years at the 1974 levels.

Fuel prices were given by BTCE back to 1975 for LPG and diesel, and for gasoline back to 1971. We estimated diesel prices for 1971-1974 from a price index provided by BTCE, and assume LPG followed the same trends. Until the late 1970s gasoline totally dominated the mix of fuels for automobiles.

Denmark

Data come from a variety of government and automobile industry sources. Through an earlier contract with the Danish Energy Agency, an LBNL team helped authorities revise data for energy and transportation. Data for vehicle use and fuel consumption are provided for each type of vehicle by

fuel type: cars, light trucks (under one tonne), buses, various sizes of trucks. Data on passenger travel are provided by the Ministry of Transport publications, with one important exception. Official sources use a constant automobile load factor for the entire 1970-1993 period to convert vehicle-km to passenger-km. After reviewing a number of studies of travel and load factor, we concluded that this was incorrect. We start with a figure of 1.85 for 1970 and, using surveys for 1975, 1981, 1986, and 1992 and estimating the impact of including children and older people not counted in these surveys, arrive at a load factor close to 1.6 for 1992, using interpolation for years not surveyed. As a result, our data show lower total travel in Denmark than Danish data, and significantly less growth in travel. Light trucks ("vaerebiler") under 1 tonne capacity are counted with automobiles. Foreign (transit) truck traffic is excluded from both tonne-km and energy consumption calculations.

New car fuel economy data are tabulated from sales weighted data for the 20 best selling cars (through 1987), the ten best selling cars (1989), and all new cars (1991 and 1993). Comparison of results from only the ten or twenty best sellers of 1991 or 1993 show little deviation from the complete sample. The jump in fuel consumption in the 1993 new cars appears real, as it followed a significant decrease in fuel prices.

Published Sources - Denmark

Trafikministeriet (Danish Ministry of Transport). 1990. Transportstatistik 1980-1991 [Transport statistics 1980-1991] Copenhagen, Denmark: Trafikministeriet. Now Published Yearly

Automobil-importoerernes Sammenslutning (VIS), 1994. Vejtransporten i tal og tekst (Road transportation statistics) Hellerup: VIS. Editions from 1975 onward

Tofte, E., and Joergensen, J., 1992. Befolknings Rejsevaner (The Travel Habits of the Population). Copenhagen: Trafikministeriet

Trafik- og Kommunikationsministeriet (Danish Ministry of Transport and Communications). 1988. Persontrafik i 1975, 1981 og 1986 (Personal travel in 1975, 1981, and 1986) Copenhagen, Denmark: Trafik- og Kommunikationsministeriet

Vejdirektoratet, 1994. Tal om Vejtrafik (Data on road traffic). Copenhagen: Veijdirektorat Sektorplanafdelingen

For further information see L. Schipper et al. Energy Use in Denmark in an International Perspective, LBL 32362. Berkeley: Lawrence Berkeley Laboratory.

Finland

The figures were first worked out as part of an LBNL project undertaken for the Ministry of Trade and Industry. O. Koskonen of the Ministry of Transport provided the ministry's estimates of road vehicle activity and fuel use by mode, while almost all other data come from the annual: Transport and Communications Statistical Yearbook for Finland 1993 (and previous years) of the Finnish Bureau of Statistics.

Aviation. Energy consumption data for aviation come from statistics from Finnair (including Finnair, Finnaviation and Karair). Passenger-km and tonne-km of freight are from Civil Aviation Administration (Statistics of Finnish Civil Aviation 1970 - 1980 and 1980-1993). Domestic fuel use for 1989-1993 was provided by Finnair. For earlier years, we took the total fuel supplied to Finnish aircraft flying within Finland or leaving Finland (from the Transport Statistics) and related this to all domestic passenger travel and ½ of the passenger travel flown by the same Finnish airlines to give outbound traffic only and therefore corresponding to outbound fuel use. Using the ratio of total outbound energy use to total outbound traffic, we formed an energy intensity (in MJ/passenger-km) which we multiplied by domestic-only travel to get domestic fuel use. For the years after 1989 this result came very close to the intensity given by Finnair.

Rail. Almost all data for the rail traffic are derived from the yearbook of Valtion Rautatiet (State Railways). This includes passenger-km, tonne-km, train-km and consumption of both electricity and diesel. In addition to this we took the metro and trams in Helsinki into account. This information (both activity and energy data) refers to Helsingin Kaupungin Liikennelaitos (Helsingfors Trafikverket, Helsinki Transportation Company).

Road Traffic. Information about the vehicle stock comes from the Stat. Yearbook. Activity data are partly from a database maintained by the Ministry of Transport (O. Koskinen, priv. comm.), which includes vehicle-km for both travel and freight by vehicle type and fuel. To this data we added information on buses in Helsinki (Helsingfors Trafikverket). Vehicle-km for cars for the years 1970 - 1974 come from the Ministry database, but for the remaining years we used information from National Road Administration. The published statistics of the Road Administration use 12000 km as their length of street network in 1975 - 1991 and after that switch to 15000 km. To avoid this discrepancy

in the data set we used a continuous times series based on a 15000 km long street network recently processed by the Road Administration. Passenger -km for cars are from Road Administration Passenger-km for buses and motorcycles refer to the source "Transport and Communications Statistical Yearbook of Finland 1993." Passenger-km for the buses in Helsinki are from Helsingfors Trafikverket.

Activity for freight is derived from Tavaraliikenteen Tavarankuljetustilasto, Road Administration (Statistics of freight). No published data exist for tonne-km for vans, whichwe refer to as light trucks in our analyses. Therefore we had to use the estimate 0.33 tonne-km / vehicle-km.

Information on energy consumption for road traffic is based on the earlier mentioned database from the Ministry of Transport. We complemented these data with theinformation on specific consumption of new cars sold each year estimated by Harri Kallberg of Neste, the State Oil Company (priv. comm.) Fuel intensity for cars is derived; fuel economy for new cars was estimated by Kallberg through 1988 only.

Water traffic. For water traffic energy consumption data come from the Energy Statistics. Activity (both passenger-km and tonne-km) come from the Statistical Yearbook for the years 1971 - 1993. Data for 1970 are from Tie- ja Vesirakennus Hallitus (Road and Water Administration).

Published Sources - Finland

Central Bureau of Statistics, 1994. Transport and Communications Statistical Yearbook for Finland 1993. Helsinki.

For further information see L. Schipper, L Peraelae et al., 1995. Energy Use in Finland in an International Perspective, LBL 35XXX. Berkeley: Lawrence Berkeley Laboratory.

France

Energy use data are both derived from the following sources: **Tableaux des Consommations d'Energie en France** (Observatoire de l'Energie), **Les Comptes des Transports**, (INSEE, the National Statistical Office, in their series **Resultats),** and Didier Bosseboeuf of ADEME, l'Agence d''Environment et de la Maitrise de l'Energie.

Activity data are mainly from INSEE, complemented by a few other sources. Air passenger (passenger-km) and seat activity (seat-km) data refer to Air Inter, which handles approximately 95% of all domestic flights. Rail activity data for both intercity (passenger-km) travel and freight (tonne-km) refers to SNCF. Bus activity (passenger-km) assumes a load factor (LF) of 23 for years 1970-1980 (which is about the 1983-87 average). It is estimated by multiplying this LF with known vehicle-km numbers.

Vehicle use data are based on the following assumptions: (a) automobile use (km/car/yr) for years 1970, 1971, and 1973 is estimated assuming a load-factor (LF) of 1.85 andusing activity (passenger-km) and stock data; and (b) gasoline-powered automobile use was estimated, assuming that diesel cars in 1970 went 2.4 times as far as the average car, which narrowed to 2.0 times by 1988 (refer to Observatoire de l'Energie).

Automobile energy use includes liquid petroleum gas (LPG). The 1970-1972 data for both gasoline and diesel powered automobiles are estimated by multiplying toe/vehicle and stock of vehicles. Air energy use is fuel used for domestic flights by Air Inter. After 1985, a new means of accounting for diesel energy use for buses was adopted. Rail electricity use data of SNCF and RATP are converted from primary to delivered energy.

Assumptions for energy use include: (a) 1970-1972 data for gasoline-powered automobiles are based on the 1974 ratio of tons of oil equivalent (toe) and vehicle-kilometers; (b) for these same years, it is assumed that fuel economies (MJ/vehicle-km) were about constant for both diesel and gasoline cars in years 1970 and 1973. This assumption was made to approximate average fuel economy estimates supplied by Didier Bosseboeuf; (c) 95% of air energy use is for passengeruse (which is derived from Air Inter's energy intensity figures (MJ/passenger-km) for domestic flights; and (d) passenger share of rail transport assumes one passenger-kilometer (passenger-km) uses as much energy as 1.25 ton-

kilometers (tonne-km), which coincides with 1988 data. After 1988 there is a slight series break in the accounting for automotive diesel.

New car fuel economy for diesel and for gasoline are published in the Tableaux and in Les Comptes en Transports.

Didier Bosseboeuf of the Agence d'Environment et Maitrise d'Energie provided essential data, interpretation, and comments on the analysis.

Published Sources - France

INSEE and OEST (Institut National de la Statistique et des Etudes Economiques and Observatoire Economique et Statistique des Transport). 1987-1994. Les Comptes des Transports (Transport accounts) Paris, France: INSEE. (Published Yearly)

Ministry of Industry, 1975-1994. Tableaux des Consummation d'Energie en France (Tables of Energy Consumption in France). Paris: Ministry of Industry

Germany (West)

The primary source of data on transportation and energy use is: Deutsches Institut fuer Wirtschaftsforschung: **Verkehr in Zahlen** (various editions). This handbook contains a nearly complete set of data for traffic, travel and freight activity and energy use from 1950 to 1993. We had to assume, however, that 1/3 of air fuel was for domestic travel, and form our own split of rail energy into travel and freight components. Additional supporting data for rail and air travel are from Deutsches Institut fuer Wirtschaftsforschung: **Detaillierung des Energieverbrauchs in der BRD im HuK, Industrie und Verkehr nach Verwendungswecken**; and Deutsches Institut fuer Wirtschaftsforschung, **Der Endenergieverbrauch im Sektor Verkehr nach Subsektoren sowie nach Verwendungsarten und Verkehrsbereichen** (1984).

Estimates of new car fuel economy (using static tests and using road tests) are published by DIW in their Wochenblatt series. We show the static test values, for both gasoline and diesel. The latest data available were for 1991.

Published Sources - West Germany

Deutsches Institut fuer Wirtschaftsforschung (DIW) 1972-1994. Verkehr in Zahlen 1994. (Traffic in Figures). Bonn, Germany: Bundesministerium fuer Verkehr

Vergleichende Auswertungen von Haushaltsbefragungewn zum Personennahverkehr (KONTIV 1976, 1982, 1989). Berlin, West Germany: Deutsches Institut fuer Wirtschaftsforschung (DIW). Original is Emnid-Institut GMBH & Co. 1990. KONTIV 1989. (Four Volumes.) Bielefeld, West Germany

Italy

Major sources data include: ANFIA, **L'automobile in cifre,** 1988; AGIP Petroli; Ministero dei Trasporti, **Conto Nationale Trasporti** (**Anno 1988 e prime anticiazioni per il 1989** and subsequent years); Ministero dei Trasporti, Piano Generale Trasporti; ISTAT: **Sommario di Statistiche Storiche**; and International Road Federation (IRF), World Road Statistics.

Energy use data come from the following sources: AGIP Petroli; Unione Petrolifera; Ministero dei Trasporti, **Piano Generale Trasporti**; Ministero dell'Industria, Commerciol ed Artigianato, **Bilancio Energetico Nazionale.**

Automobile vehicle use data include average kilometers traveled by both gasoline, LPG, and diesel cars. Truck vehicle use data include 3-wheeled trucks. These are estimated for urban and intercity activity, the latter of which refers to freeways and trunk roads. Pipeline activity data include pipelines greater than 50 kilometers.

Intracity passenger and freight movement data exist only for rail. All other intracity movement (bus, car, truck) are estimates by AGIP Petroli.

Energy use from coal in rail transport applies the conversion factor of 7500 kcal/kg (except for 1970 and 1972, which applies 7410 and 6500 kcal/kg, respectively. Assumptions in energy use include: (a) diesel passenger share used in calculating total energy use in rail transport assumes transporting 1.25 persons is equivalent to 1 ton; (b) passenger share of jet fuel use is estimated at 97% which is

similarly used for other countries; and (c) jet fuel domestic share energy use is estimated at 18% for 1973 and grows at 1% per year. This assumption allows consistency with AGIP Petroli's modal intensity figures.

There are some inconsistencies in the energy use data: (a) the public sector diesel consumption drops significantly from 1978 and 1979, suggesting that the 1970-1978 time series may include diesel fuel consumption for heating purposes; (b) truck energy use data, which come from Ministry of Transport, are missing for a number of years (1970-1971, 1973-1977, 1979-1986, and 1988) and therefore have been interpolated. If one tries to calculate energy use, weighted by activity (vehicle-km), different numbers result. The question concerns how the Ministry of Transport arrived at their calculations; (c) data on energy consumption of jet fuel in air transport for years 1976-1978 were adjusted to correct for inconsistency; and (d) end-use energy data from the Ministry of Industry appear to be high. It is uncertain if the data include other uses, like heating or cooking.

Data on new car fuel intensity were provided by Agip Petroli (through 1988). No more recent data were available.

Allesandro Liberati 0of Agip Petroli and Romeo Dines of the Univ. of Trieste provided data and helpful comments.

Japan

Two sources publish data on transportation energy consumption in Japan: (1) the Ministry of Transport (MOT) and (2) the Ministry of International Trade and Industry (MITI) in cooperation with the Energy and Data Modeling Center (EDMC) of the Instituteof Energy Economics (IEE). However, only the MOT collects data through direct surveys, whereas MITI and IEE derive figures for energy consumption through indirect calculation. MITI assumes average fuel-intensity levels and derives energy consumption in a top-down fashion, a practice criticized as unreliable in an earlier study done at LBNL. In addition, of these agencies only the EDMC performs detailed energy analyses of the country's transportation sector, but few of these studies are published outside of Japan.

We use MOT data as the most accurate, bearing in mind the following changes in the data series: before 1981, road vehicle fuel consumption figures are based only on fuel sales data; since 1981, the

MOT has conducted surveys, with more modes included in a consistent manner; since1987, mini-car and mini-truck transport has been counted. We have extrapolated data on the use of mini-cars from after 1987 to prior years using a constant yearly driving distance and the known number ofthese small vehicles. We assume a load factor of 1.5. The Japanese sources show a significant increase in al automobile load factor after 1987, which boosts passenger travel in this mode by over 10% in one year. We can find no explanation for this rapid change. Although some uncertainties still remain, the characteristics of energy use in Japanese transportation are so striking, and the changes observed so large, compared with the uncertainties, that we feel any conclusions drawn from our data are robust.

New car fuel consumption according to the "10 Mode test" are provided in the EDMC yearly Energy Handbook.

Naoto Sagawa of the Institute for Energy Economics and K. Minato of the Japan Auto Research Institute provided helpful comments.

Published Sources - Japan

The Institute of Energy Economics. (1992). Energy Data and Demand of Transportation Sector in Japan, Tokyo: The Energy Data and Modeling Center, The Institute of Energy Economics.

The Institute of Energy Economics, yearly. Enerugii Keizai Toukei Youran (Energy Economics Statistical Survey). Tokyo: Energy Data and Modeling Center, IEE.

Institute of Energy Economics Energy Data Modeling Center. Annual Energy Statistics. (Also known as the "Red Book").

Ministry of Transport, 1993. Jidosha Unso Tokei Nenjo ("Automobile Transportation Statistical Yearbook"), various years.

Japan Automobile Association, Rikuun Tokei Yoran (Land Transport Statistical Handbook), various years.

Ministry of Transport, Statistics of Automobile Transportation, Energy Handbook on Transportation, various years.

Ministry of Transport, Unyu Kankei Enerugi Yoran ("Transportation Energy Statistics Handbook"), various years.

Netherlands

Principal source of data is the yearbook of the Ministry of Transport, Public Works, and Water Management, Zakboek verkeers en vervoersstatistieken. This contains traffic and energy use data by fuel type and mode and travel by mode from 1985. Earlier years are estimated from a variety of sources, with automobile fuel use data back to 1970. Many sources do not distinguish between travel on city trams/subway or bus, but tram/metro travel can be separated out using passenger travel statistics for bus. However, local and intercity rail services are both provided by NS, the National Railway, so these cannot be distinguished. Erna Schol of Energieunderzoek Centrum Nederlands (ECN) and Jacco Farla of the Univ. of Utrecht assisted in the analysis of a large number of data sources.

From the mid 1970s, CBS provides data on car ownership and vehicle-km by fuel type, and fuel consumption as well. We exclude the use of Dutch vehicles outside of Holland (since the energy use is not included) and we also exclude foreigner's driving and fuel use in Holland. Thus the figures given underestimate the auto-mobility and fuel use of the Dutch by about 5% (early 1970s) up to 10% (early 1990s). Bus and rail activity data, however include passengers of all nationalities and include the domestic portions of foreign trips. Accurate data on fuel use for rail and bus were not available for all years. No data are available for the small amount of domestic air travel or its fuel use.

For freight, the activity data include imports and exports but not freight carried by foreign trucks transiting Holland. Accurate splits of fuel use for all modes were not available for all years.

The sales-weighted new-car fuel economy was not available.

Published Sources - Netherlands

Ministry of Transport, 1992. Verkeer en Ciffers. (Transportation in Figures.) The Hague: Min. of Transport

Centraal Bureau voor de statistiek (CBS), 1991. De mobiliteit van de nederlandse bevolking 1990. (Mobility of the Dutch population in 1990.) (The Mobility of the Dutch Population. Every year from 1979.) The Netherlands: Voorburg/Heerlen

CBS, various years. Het bezit en gebruik van personauto's. (Ownership and Use of Private Cars.). Vorburg: CBS.

CBS, various years. Statistiek van de motovoertuigen. (Statistics of Motor Vehicles.) Voorburg: CBS

CBS, various years. Statistiek van het Personevervoer. (Statistics of Personal Travel.) Voorburg: CBS

CBS, various years. Zakboek verkeers en verfoersstatistieken. (Handbook of Transportation and Travel Statistics.) Voorburg: CBS.

Norway

Estimates of passenger- and tonne-km activity are published in Samferdsel Statistikk (Transportation Statistics) and in publications from Transport Oekonomisk Institute (TOI) in Oslo. Estimates of automobile use stem from surveys taken in 1967, 1973, 1981, and 1985-88, "Eie og Bruk av Bil." Numbers of vehicles are published in Samferdsel statistikk and in Bil og Vei, the publication of the Norwegian Road Authority (Veg Direktorat). "Cars" (biler) includes virtually all vehicles, but "person biler" represents automobiles for private and business use.

Energy use by mode is poorly documented in public literature. The Bureau of Statistics publishes "Road", "Rail", "Ship", and "Air" energy use by fuel in their yearly Energistatistikk and Energiregnskap. Data from 1976 to 1980 and 1980 to 1986 contain many detailed breakdowns of individual transportation mode's energy use (and activity). Esso (A. Kvamme, priv. comm.) has made their own research into the matter, breaking both the automobile and truck fuel markets into considerable detail. Because the Esso data cover the longest period (1970 to present) and make the

most detailed attempt to balance all the various liquid fuels markets, we use the data they kindly provided to match energy use, activity, and energy use per vehicle-km.

Transport Economics Institute has estimated the fuel economy of new cars by examining the most popular models sold and their test fuel consumption.

Published Sources - Norway

Central Bureau of Statistics (SSB), 1970-1994. Samferdsel Statistikk (Transport statistics) Kongsviner: SSB

OFV, 1994. Bil og Vei: Statistikk 1994 (Car and Road Statistics for 1994). Oslo: Opplysnings raadet for Veitraffikken.

Rideng, A., 1993. (Transport Oekeonomisk Institutt, various years). Transportytelser i Norge (Transport in Norway) 1946-1992. TOI Rapport 187/1993. Oslo: Transport Economic Institute

Transport Oekeonomisk Institutt. 1993. Norsk reisevaner. Dokumentasjonsrapport for den landsomfattande reisevaneundersoekelsen 1991-2 (National survey of travel habits 1991-2) Report 183. Oslo: Transport Economic Institute

Vibe, N., 1993. Vaare Daglige reiser. Endringer i Nordmenns reisevaner fra 1985 til 1992 (Our Daily Travel. Changes in Norwegians' Daily Travel 1985-1992). TOE rapport 171. Oslo: Transport Economics

Sweden

The data on energy use come from two sources: the National Energy Administration (STEP, now GNATHIC); and the Transportation Council (TAR, now taken over by the Highway Institute in Linköping). In 1977 SIND (the predecessor to STEP) prepared a forecast of energy use in Sweden that was based in part upon detailed breakdowns of energy use in the transportation sector provided by the predecessor of TAR. These were "updated" in subsequent energy studies published by STEP. TAR has continually published data on passenger- and tonne-km, as well as on vehicle-km. The Central Bureau of Statistics publishes data on the characteristics of the vehicle stock. The Swedish Automobile Association and AB Bilstatistik publish a yearbook with other details of the vehicle stock,

such as the number of cars by weight. New car fuel economy, based on tests, is weighted by sales by the car industry and provided by the Ministry of Trade.

In the 1980s J. Wajsmann of TAR began a systematic bottom-up analysis of energy use in the transportation sector. His unpublished analyses have been provided to STEP for their own yearly breakdowns of Swedish energy use. In these he examines the number of vehicles, km driven and consumption of fuel per km for four types of cars (gasoline private cars and taxis, and diesel private cars and taxis), buses, and trucks. He covers domestic air travel and inland shipping, as well as many smaller users of liquid fuels. Data on electricity use for the railways and local transit are published by the Central Bureau of Statistics' El och Fjaerrvaerme Försörjning (Electricity Supply Statistics). Wajsmann's analyses cover 1980, and 1983 to 1989. The match with the 1970-76 data is not perfect, but acceptable for our purposes. Using data on the stock of vehicles and modal activity, we have reconstructed 1978 and 1981-82 energy use patterns and interpolated remaining years between 1976 and 1983. We have also estimated automobile vehicle-km and fuel economy for 1970-1976, since the SIND data and their TAR source contain very little information on these two parameters. However, Energiprognosutredning (1974) provides a detailed breakdown of transportation energy use in 1970 and some information for 1973. Assembling these together we believe we have created a reasonable picture of the 1970-76 period that can be compared with the period from 1980 to the present. Finally a large number of smaller official and unofficial publications reviewed in Appendix 3 of Schipper L.J. and Johnson F., with Howarth R., Andersson B.E., Anderson B.G., and Price LK. 1993. Energy Use in Sweden: An International Perspective. Lawrence Berkeley Laboratory Report LBL-33819. Berkeley, CA: Lawrence Berkeley Laboratory. Published as Schipper and Price 1994 in **Nat. Res. Forum** (May)

Published Sources - Sweden

Bilindustriförening, 1994 (each year). Bilism i Sverige 1993. (Driving in Sweden 1993) Stockholm: AB Bilstatistik.

National Central Bureau of Statistics (Sweden). 1984/5 Resavanorundersökning. Statistiska meddelanden (1984/5 Survey of travel habits). Stockholm, Sweden: Statistics Sweden

VTI, 1993. VTI Transportstatistik. Swedish Road Institute Transport Statistics.) Appears Quarterly. Stockholm: DPU (Delegation för prognos och utvecklingsverksamhet inom transportsektorn, Dept. of Communications). These are now produced by SIKA (Statens Institut för Kommunikations Analyser).

United Kingdom (Great Britain)

Transportation activity and energy data are taken from the U.K. Digest of Transportation Statistics, published yearly by the Department of Transport. These contain data covering Great Britain (England, Wales, and Scotland), and, for a few tables, the United Kingdom (ie., including N. Ireland) as well. Most data are taken directly from this source. Fuel use for road vehicles from 1981 was re-analyzed by B.Oelman, Dept. of Transport (priv. comm.). Light trucks and small vans are counted with automobiles. Oelman also estimates fuel economy of new cars.

Published Sources - United Kingdom

Department of Transport (DOT). 1970-1994. Transport Statistics: Great Britain. London, UK: Her Majesty's Stationery Office

Transport Department, various years. National Travel Survey. (1972/3, 1982/3, 1985/6, 1990/91) London, UK: Her Majesty's Stationery Office

United States

The transportation data come from three major sources: Oak Ridge National Laboratory (ORNL) and the US Department of Transportation (DOT). Virtually all of the time-series data beginning from 1970 to the present are extracted from ORNL's Transportation Energy Data Book: Editions 11-14, 1991-1994. and subsequent editions, and FHWA Statistical Summary to 1985.

Energy use data are from ORNL's Data Books.

Assumptions for vehicle use (vehicle-km) and energy use include: (a) light trucks have the same mileage as automobiles, and the share used as personal vehicles is taken from the ORNL data book (for example Table 2.12 of Edition 12.); (b) all light freight vehicle use is assumed to be for intracity transport; (c) domestic air is estimated at 87% of total vehicle-km. Load factor (LF) estimates include the following: (a) automobile LF is estimated at 22 persons from 1960 to 1970. It then decreased to 1.87 by 1977, 1.7 by 1983, and 1.59 in 1990. (b) motorcycle LF (motorcycles are not shown in this work) is estimated at 1.1 persons; (c) personal truck LF is estimated at the same as that of the automobile LF; (d) intracity light truck LF is estimated at 0.25 tons/truck; (e) intracity midsize trucks is estimated at 5 tons/truck; and (f) school bus load is estimated at 20 persons.

Two areas of concern are: (a) a discrepancy exists between automobile stock cited in ORNL (Polk) and DOT FHWA. The former survey shows fewer cars than FHWA; and (b) there is a growing population of light trucks used solely for personal travel. TIUS survey data (reported in ORNL and used in the time-series data on stock and activity) show the share of trucks used for personal travel growing from approximately 25% in 1960 to 65% in 1988, which we extrapolate to 68% by 1993.

Published Sources - United States

Davis, S. C., 1994. Transportation Energy Data Book: Edition 15. Oak Ridge, TN: Oak Ridge National Laboratory, ORNL-6710 (and previous editions).

U.S. FHWA (Federal Highway Administration). 1994 (and previous years). Highway Statistics 1993. Washington, DC: U.S. Department of Transportation, Federal Highway Administration, FHWA-PL-93-023

U.S. Department of Transportation. 1992. U.S. Nationwide Personal Transportation Survey 1990. Washington, DC: U.S. Dept. of Transportation

GLOSSARY

Acceleration power - Measured in kilowatts. Pulse power obtainable from a battery used to accelerate a vehicle. This is based on a constant current pulse for 30 seconds at no less than 2/3 of the maximum open-circuit-voltage, at 80% depth-of-discharge relative to the battery's rated capacity and at 20° C ambient temperature.

Air Carrier - The commercial system of air transportation consisting of certificated air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

Certificated route air carrier: An air carrier holding a Certificate of Public Convenience and Necessity issued by the Department of Transportation to conduct scheduled interstate services. Nonscheduled or charter operations may also be conducted by these carriers. These carriers operate large aircraft (30 seats or more, or a maximum payload capacity of 7,500 pounds or more) in accordance with Federal Aviation Regulation part 121.

Domestic air operator: Commercial air transportation within and between the 50 States and the District of Columbia. Includes operations of certificated route air carriers, Pan American, local service, helicopter, intra-Alaska, intra-Hawaii, all-cargo carriers and other carriers. Also included are transborder operations conducted on the domestic route segments of U.S. air carriers. Domestic operators are classified based on their operating revenue as follows:

Majors - over $1 billion
Nationals - $100-1,000 million
Large Regionals - $10-99.9 million
Medium Regionals - $0-9.99 million

International air operator: Commercial air transportation outside the territory of the United States, including operations between the U.S. and foreign countries and between the U.S. and its territories and possessions.

Supplemental air carrier: A class of air carriers which hold certificates authorizing them to perform passenger and cargo charter services supplementing the scheduled service of the certificated route air carriers. Supplemental air carriers are often referred to as nonscheduled air carriers or "nonskeds".

Amtrak - See *Rail*.

Automobile size classifications - Size classifications of automobiles are established by the Environmental Protection Agency (EPA) as follows:

Minicompact - less than 85 cubic feet of passenger and luggage volume.
Subcompact - between 85 to 100 cubic feet of passenger and luggage volume.
Compact - between 100 to 110 cubic feet of passenger and luggage volume.
Midsize - between 110 to 120 cubic feet of passenger and luggage volume.
Large - more than 120 cubic feet of passenger and luggage volume.
Two seater - automobiles designed primarily to seat only two adults.

Station wagons are included with the size class for the sedan of the same name.

Aviation - See *General aviation*.

Aviation gasoline - All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) Specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range which will be used for blending or compounding into aviation gasoline.

Barges - Shallow, nonself-propelled vessels used to carry bulk commodities on the rivers and the Great Lakes.

Battery efficiency - Measured in percentage. Net DC energy delivered on discharge, as a percentage of the total DC energy required to restore the initial state-of-charge. The efficiency value must include energy losses resulting from self-discharge, cell equalization, thermal loss compensation, and all battery-specific auxiliary equipment.

Btu - The amount of energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit at or near 39.2 degrees Fahrenheit. An average Btu content of fuel is the heat value per quantity of fuel as determined from tests of fuel samples.

Bunker - A storage tank.

Bunkering fuels - Fuels stored in ship bunkers.

Bus -

Intercity bus: A standard size bus equipped with front doors only, high backed seats, luggage compartments separate from the passenger compartment and usually with restroom facilities, for high-speed long distance service.

Motor bus: Rubber-tired, self-propelled, manually-steered bus with fuel supply onboard the vehicle. Motor bus types include intercity, school, and transit.

School and other nonrevenue bus: Bus services for which passengers are not directly charged for transportation, either on a per passenger or per vehicle basis.

Transit bus: A bus designed for frequent stop service with front and center doors, normally with a rear-mounted diesel engine, low-back seating, and without luggage storage compartments or restroom facilities. Includes motor bus and trolley coach.

Trolley coach: Rubber-tired electric transit vehicle, manually-steered, propelled by a motor drawing current, normally through overhead wires, from a central powersource not on board the vehicle.

Calendar year - The period of time between January 1 and December 31 of any given year.

Captive imports - Products produced overseas specifically for domestic manufacturers.

Carbon dioxide (CO_2) - A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion.

Carbon monoxide (CO) - A colorless, odorless, highly toxic gas that is a normal by-product of incomplete fossil fuel combustion. Carbon monoxide, one of the major air pollutants, can be harmful in small amounts if breathed over a certain period of time.

Car-mile (railroad) - A single railroad car moved a distance of one mile.

Cargo ton-mile - See *Ton-mile*.

Certificated route air carriers - See *Air carriers*.

Class I freight railroad - See *Rail*.

Clean Fuel Vehicle - Vehicle meeting the clean fuel vehicle exhaust emissions standards with no restriction on fuel type.

Coal slurry - Finely crushed coal mixed with sufficient water to form a fluid.

Combination trucks - Consist of a power unit (a truck tractor) and one or more trailing units (a semi-trailer or trailer). The most frequently used combination is popularly referred to as a "tractor-semitrailer" or "tractor trailer".

Commercial sector - See *Residential and Commercial sector*.

Commuter railroad - See *Rail*.

Compact car - See *Automobile size classifications*.

Constant dollars - A series of figures is expressed in constant dollars when the effect of change in the purchasing power of the dollar has been removed. Usually the data are expressed in terms of dollars of a selected year or the average of a set of years.

Consumer Price Index (CPI) - An index issued by the U.S. Department of Labor, Bureau of Labor Statistics. The CPI is designed to measure changes in the prices of goods and services bought by wage earners and clerical workers in urban areas. It represents the cost of a typical consumption bundle at current prices as a ratio to its cost at a base year.

Continuous discharge capacity - Measured as percent of rated energy capacity. Energy delivered in a constant power discharge required by an electric vehicle for hill climbing and/or high-speed cruise, specified as the percent of its rated energy capacity delivered in a one hour constant-power discharge.

Corporate Average Fuel Economy (CAFE) standards - CAFE standards were originally established by Congress for new automobiles, and later for light trucks, in Title V of the Motor Vehicle Information and Cost Savings Act (15 U.S.C.1901, et seq.) with subsequent amendments. Under CAFE, automobile manufacturers are required by law to produce vehicle fleets with a composite sales-weighted fuel economy which cannot be lower than the CAFE standards in a given year, or for every vehicle which does not meet the standard, a fine of $5.00 is paid for every one-tenth of a mpg below the standard.

Crude oil - A mixture of hydrocarbons that exists in the liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities.

Crude oil imports - The volume of crude oil imported into the 50 States and the District of Columbia, including imports from U.S. territories, but excluding imports of crude oil into the Hawaiian Foreign Trade Zone.

Curb weight - The weight of a vehicle including all standard equipment, spare tire and wheel, all fluids and lubricants to capacity, full tank of fuel, and the weight of major optional accessories normally found on the vehicle.

Current dollars - Represents dollars current at the time designated or at the time of the transaction. In most contexts, the same meaning would be conveyed by the use of the term "dollars".

Disposable personal income - See *Income*.

Distillate fuel oil - The lighter fuel oils distilled off during the refining process. Included are products known as ASTM grades numbers 1 and 2 heating oils, diesel fuels, and number 4 fuel oil. The major uses of distillate fuel oils include heating, fuel for on-and off-highway diesel engines, and railroad diesel fuel.

Domestic air operator - See *Air carrier*.

Domestic water transportation - See *Internal water transportation*.

Electric utilities sector - Consists of privately and publicly owned establishments which generate electricity primarily for resale.

Emission standards - Standards for the levels of pollutants emitted from automobiles and trucks. Congress established the first standards in the Clean Air Act of 1963. Currently, standards are set for four vehicle classes - automobiles, light trucks, heavy-duty gasoline trucks, and heavy-duty diesel trucks.

Energy capacity - Measured in kilowatt hours. The energy delivered by the battery, when tested at C/3 discharge rate, up to termination of discharge specified by the battery manufacturer. The required acceleration power must be delivered by the battery at any point up to 80% of the battery's energy capacity rating.

Energy efficiency - In reference to transportation, the inverse of energy intensiveness: the ratio of outputs from a process to the energy inputs; for example, miles traveled per gallon of fuel (mpg).

Energy intensity - In reference to transportation, the ratio of energy inputs to a process to the useful outputs from that process; for example, gallons of fuel per passenger-mile or Btu per ton-mile.

Ethanol (C_2H_5OH) - Otherwise known as ethyl alcohol, alcohol, or grain-spirit. A clear, colorless, flammable oxygenated hydrocarbon with a boiling point of 78.5 degrees Celsius in the

anhydrous state. In transportation, ethanol is used as a vehicle fuel by itself (E100), blended with gasoline (E85), or as a gaoline octane enhancer and oxygenate (10% concentration).

Fixed operating cost - See *Operating cost*.

Fleet vehicles -

Private fleet vehicles: Ideally, a vehicle could be classified as a member of a fleet if it is:

a) operated in mass by a corporation or institution,
b) operated under unified control, or
c) used for non-personal activities.

However, the definition of a fleet is not consistent throughout the fleet industry. Some companies make a distinction between cars that were bought in bulk rather than singularly, or whether they are operated in bulk, as well as the minimum number of vehicles that constitute a fleet (i.e. 4 or 10).

Government fleet vehicles: Includes vehicles owned by all federal (GSA), state, county, city, and metro units of government, including toll road operations.

Foreign freight - Movements between the United States and foreign countries and between Puerto Rico, the Virgin Islands, and foreign countries. Trade between U.S. territories and possessions (e.g. Guam, Wake, American Samoa) and foreign countries is excluded. Traffic to or from the Panama Canal Zone is included.

Gas Guzzler Tax - Originates from the 1978 Energy Tax Act (Public Law 95-618). A new car purchaser is required to pay the tax if the car purchased has a combined city/highway fuel economy rating that is below the standard for that year. For model years 1986 and later, the standard is 22.5 mpg.

Gasohol - A mixture of 10% anhydrous ethanol and 90% gasoline by volume. There are other fuels that contain methanol and gasoline, but these fuels are not referred to as gasohol.

Gasoline - See *Motor gasoline*.

General aviation - That portion of civil aviation which encompasses all facets of aviation except air carriers. It includes any air taxis, commuter air carriers, and air travelclubs which do not hold Certificates of Public Convenience and Necessity.

Gross National Product - A measure of monetary value of the goods and services becoming available to the nation from economic activity. Total value at market prices of all goods and services produced by the nation's economy. Calculated quarterly by the Department of

Commerce, the Gross National Product is the broadest available measure of the level of economic activity.

Gross vehicle weight (gvw) - The weight of the empty vehicle plus the maximum anticipated load weight.

Heavy-heavy truck - See *Truck size classifications*.

Household - Consists of all persons who occupy a housing unit, including the related family members and all unrelated persons, if any, who share the housing unit.

Housing unit - A house, apartment, a group of rooms, or a single room occupied or intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants do not live and eat with any other persons in the structure and which have either (1) direct access from the outside of the building or through a common hallway intended to be used by the occupants of another unit or by the general public, or (2) complete kitchen facilities for the exclusive use of the occupants. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements.

Hydrocarbon (HC) - A compound that contains only hydrogen and carbon. The simplest and lightest forms of hydrocarbon are gaseous. With greater molecular weights they are liquid, while the heaviest are solids.

Income -

Disposable personal income: Personal income less personal tax and non-tax payments.

National income - The aggregate earnings of labor and property which arise in the current production of goods and services by the nation's economy.

Personal income: The current income received by persons from all sources, net of contributions for social insurance.

Industrial sector - Construction, manufacturing, agricultural and mining establishments.

Intercity bus - See *Bus*.

Internal water transportation - Includes all local (intraport) traffic and traffic between ports or landings wherein the entire movement takes place on inland waterways. Also termed internal

are movements involving carriage on both inland waterways and the water of the Great Lakes, and inland movements that cross short stretches of open water that link inland systems.

International air operator - See *Air carrier*.

International freight - See *Foreign freight*.

Jet fuel - Includes both naphtha-type and kerosene-type fuels meeting standards for use in aircraft turbine engines. Although most jet fuel is used in aircraft, some is used for other purposes such as generating electricity in gas turbines.

Kerosene-type jet fuel: A quality kerosene product with an average gravity of 40.7 degrees API and 10% to 90% distillation temperatures of 217 to 261 degrees centigrade. Used primarily as fuel for commercial turbojet and turboprop aircraft engines. It is a relatively low freezing point distillate of the kerosene type.

Naphtha-type jet fuel: A fuel in the heavy naphtha boiling range with an average gravity of 52.8 degrees API and 10% to 90% distillation temperatures of 117 to 233 degrees centigrade used for turbojet and turboprop aircraft engines, primarily by the military. Excludes ramjet and petroleum.

Kerosene - A petroleum distillate in the 300 to 500 degrees Fahrenheit boiling range and generally having a flash point higher than 100 degrees Fahrenheit by the American Society of Testing and Material (ASTM) Method D56, a gravity range from 40 to 46 degrees API, and a burning point in the range of 150 to 175 degrees Fahrenheit. It is a clean-burning product suitable for use as an illuminant when burned in wick lamps. Includes grades of kerosene called range oil having properties similar to Number 1 fuel oil, but with a gravity of about 43 degrees API and an end point of 625 degrees Fahrenheit. Used in space heaters, cooking stoves, and water heaters.

Kerosene-type jet fuel - See *Jet fuel*.

Large car - See *Automobile size classifications*.

Light duty vehicles - Automobiles and light trucks combined.

Light truck - Unless otherwise noted, light trucks are defined in this publication as two-axle, four-tire trucks. The U.S. Bureau of Census classifies all trucks with a gross vehicle weight less than 10,000 pounds as light trucks (See *Truck size classifications*).

Light-heavy truck - See *Truck size classifications*.

Liquified petroleum gas (lpg) - Consists of propane and butane and is usually derived from natural gas. In locations where there is no natural gas and the gasoline consumption is low, naphtha is converted to lpg by catalytic reforming.

Load factor - A term relating the potential capacity of a system relative to its actual performance. Is often calculated as total passenger miles divided by total vehicle miles.

Low-emission vehicle - A clean fuel vehicle meeting the low-emission vehicle standards.

Medium truck - See *Truck size classifications*.

Methanol (CH_3OH) - A colorless poisonous liquid with essentially no odor and very little taste. It is the simplest alcohol and boils at 64.7 degrees Celsius. In transportation, methanol is used as a vehicle fuel by itself (M100), or blended with gasoline (M85).

Midsize car - See *Automobile size classifications*.

Minicompact car - See *Automobile size classifications*.

Model year - In this publication, model year is referring to the "sales" model year, the period from October 1 to the next September 31.

Motor bus - See *Bus*.

Motor Gasoline - A mixture of volatile hydrocarbons suitable for operation of an internal combustion engine whose major components are hydrocarbons with boiling points ranging from 78 to 217 degrees centigrade and whose source is distillation of petroleum and cracking, polymerization, and other chemical reactions by which the naturally occurring petroleum hydrocarbons are converted into those that have superior fuel properties.

Naphtha-type jet fuel - See *Jet fuel*.

National income - See *Income*.

Nationwide Personal Transportation Study (NPTS) - A nationwide home interview survey of households that provides information on the characteristics and personal travel patterns of the U.S. population. Surveys were conducted in 1969, 1977, 1983 and 1990 by the U.S. Bureau of Census for the U.S. Department of Transportation.

Natural gas - A mixture of hydrocarbon compounds and small quantities of various non-hydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions.

Nitrogen Oxides (NO_x) - A product of combustion of fossil fuels whose production increases with the temperature of the process. It can become an air pollutant if concentrations are excessive.

Operating cost -

Fixed operating cost: In reference to passenger car operating cost, refers to those expenditures that are independent of the amount of use of the car, such as insurance costs, fees for license and registration, depreciation and finance charges.

Variable operating cost: In reference to passenger car operating cost, expenditures which are dependent on the amount of use of the car, such as the cost of gas and oil, tires, and other maintenance.

Organization for Petroleum Exporting Countries (OPEC) - Includes Saudi Arabia, Iran, Venezuela, Libya, Indonesia, United Arab Emirates, Algeria, Nigeria, Ecuador, Gabon, Iraq, Kuwait, and Qatar. Data for Saudi Arabia and Kuwait include their shares from the Partitioned Zone (formerly the Neutral Zone).

Other single-unit truck - See *Single-unit truck*.

Oxygenate - A substance which, when added to gasoline, increases the amount of oxygen in that gasoline blend. Includes fuel ethanol, methanol, and methyl tertiary butyl ether (MTBE).

Particulates - Carbon particles formed by partial oxidation and reduction of the hydrocarbon fuel. Also included are trace quantities of metal oxides and nitrides, originating from engine wear, component degradation, and inorganic fuel additives. In the transportation sector, particulates are emitted mainly from diesel engines.

Passenger-miles traveled (PMT) - One person traveling the distance of one mile. Total passenger-miles traveled, thus, give the total mileage traveled by all persons.

Passenger rail - See *Rail, "Amtrak" and "Transit Railroad"*.

Personal Consumption Expenditures (PCE) - As used in the national accounts, the market value of purchases of goods and services by individuals and nonprofit institutions and the value of food, clothing, housing, and financial services received by them as income in kind. It

includes the rental value of owner-occupied houses but excludes purchases of dwellings, which are classified as capital goods (investment).

Personal income - See *Income*.

Petroleum - A generic term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oil, refined petroleum products, natural gas plant liquids, and non-hydrocarbon compounds blended into finished petroleum products.

Petroleum consumption - A calculated demand for petroleum products obtained by summing domestic production, imports of crude petroleum and natural gas liquids, imports of petroleum products, and the primary stocks at the beginning of the period and then subtracting the exports and the primary stocks at the end of the period.

Petroleum exports - Shipments of petroleum products from the 50 States and the District of Columbia to foreign countries, Puerto Rico, the Virgin Islands, and other U.S. possessions and territories.

Petroleum imports - All imports of crude petroleum, natural gas liquids, and petroleum products from foreign countries and receipts from Guam, Puerto Rico, the Virgin Islands, and the Hawaiian Trade Zone. The commodities included are crude oil, unfinished oils, plant condensate, and refined petroleum products.

Petroleum inventories - The amounts of crude oil, unfinished oil, petroleum products, and natural gas liquids held at refineries, at natural gas processing plants, in pipelines, at bulk terminals operated by refining and pipeline companies, and at independent bulk terminals. Crude oil held in storage on leases is also included; these stocks are know as primary stocks. Secondary stocks - those held by jobbers dealers, service station operators, and consumers - are excluded. Prior to 1975, stock held at independent bulk terminals were classified as secondary stocks.

Petroleum products supplied - For each petroleum product, the amount supplied is calculated by summing production, crude oil burned directly, imports, and net withdrawals from primary stocks and subtracting exports.

Quad - Quadrillion, 10^{15}. In this publication, a Quad refers to Quadrillion Btu.

Rail -

Amtrak (American Railroad Tracks): Operated by the National Railroad Passenger Corporation of Washington, DC. This rail system was created by President Nixon in 1970, and was given the responsibility for the operation of intercity, as distinct from suburban, passenger trains between points designated by the Secretary of Transportation.

Class I freight railroad: Defined by the Interstate Commerce Commission each year based on annual operating revenue. A railroad is dropped from the Class I list if it fails to meet the annual earnings threshold for three consecutive years.

Commuter railroad: Those portions of mainline railroad (not electric railway) transportation operations which encompass urban passenger train service for local travel between a central city and adjacent suburbs. Commuter railroad service - using both locomotive-hauled and self-propelled railroad passenger cars - is characterized by multi-trip tickets, specific station-to-station fares, and usually only one or two stations in the central business district. Also known as suburban railroad.

Transit railroad: Includes "heavy" and "light" transit rail. **Heavy transit rail** is characterized by exclusive rights-of-way, multi-car trains, high speed rapid acceleration, sophisticated signaling, and high platform loading. Also known as subway, elevated railway, or metropolitan railway (metro). **Light transit rail** may be on exclusive or shared rights-of-way, high or low platform loading, multi-car trains or single cars, automated or manually operated. In generic usage, light rail includes streetcars, trolley cars, and tramways.

Residential and Commercial sector - Consists of housing units, non-manufacturing business establishments (e.g., wholesale and retail businesses), health and educational institutions, and government offices.

Residential Transportation Energy Consumption Survey (RTECS) - This survey was designed by the Energy Information Administration of the Department of Energy to provide information on how energy is used by households for personal vehicles. It has been conducted five times since 1979, the most recent being 1991.

Residual fuel oil - The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations. Included are products know as ASTM grade numbers 5 and 6 oil, heavy diesel oil, Navy Special Fuel Oil, Bunker C oil, and acid sludge and pitch used as refinery fuels. Residual fuel oil is used for the production of electric power, for heating, and for various industrial purposes.

Rural - Usually refers to areas with population less than 5,000.

Sales period - October 1 of the previous year to September 30 of the given year. Approximately the same as a model year.

Sales-weighted miles per gallon (mpg) - Calculation of a composite vehicle fuel economy based on the distribution of vehicle sales.

Scrappage rate - As applied to motor vehicles, it is usually expressed as the percentage of vehicles of a certain type in a given age class that are retired from use (lacking registration) in a given year.

School and other nonrevenue bus - See *Bus*.

Single unit truck - Includes two-axle, four-tire trucks and other single unit trucks.

Two-axle, four tire truck: A motor vehicle consisting primarily of a single motorized device with two axles and four tires.

Other single-unit truck: A motor vehicle consisting primarily of a single motorized device with more than two axles or more than four tires.

Special fuels - Consist primarily of diesel fuel with small amount of liquified petroleum gas, as defined by the Federal Highway Administration.

Specific acceleration power - Measured in watts per kilogram. Acceleration power divided by the battery system weight. Weight must include the total battery system.

Specific energy - Measured in watt hours per kilogram. The rated energy capacity of the battery divided by the total battery system weight.

Subcompact car - See *Automobile size classifications*.

Supplemental air carrier - See *Air carrier*.

Ton-mile - The movement of one ton of freight the distance of one mile. Ton-miles are computed by multiplying the weight in tons of each shipment transported by the distance hauled.

Transmission types -

A3 - Automatic three speed
A4 - Automatic four speed
A5 - Automatic five speed
L4 - Automatic lockup four speed
M5 - Manual five speed

Transit bus - See *Bus*.

Transit railroad - See *Rail*.

Transportation sector - Consists of both private and public passenger and freight transportation, as well as government transportation, including military operations.

Truck Inventory and Use Survey (TIUS) - Survey designed to collect data on the characteristics and operational use of the nation's truck population. It is conducted every five years by the U.S. Bureau of the Census. Surveys were conducted in 1963, 1967, 1972, 1977, 1982, 1987, and 1992. The 1992 data have not yet been released.

Trolley coach - See *Bus*.

Truck size classifications - U.S. Bureau of the Census has categorized trucks by gross vehicle weight (gvw) as follows:

Light - Less than 10,000 pounds gvw (Also see *Light Truck*.)
Medium - 10,001 to 20,000 pounds gvw
Light-heavy - 20,001 to 26,000 pounds gvw
Heavy-heavy - 26,001 pounds gvw or more.

Two-axle, four-tire truck - See *Single-unit truck*.

Two seater car - See *Automobile size classifications*.

Ultra-low emission vehicle - A clean fuel vehicle meeting the more stringent Ultra-low emission standards.

Urban - Usually refers to areas with population of 5,000 or greater.

Variable operating cost - See *Operating cost*.

Vehicle-miles traveled (vmt) - One vehicle traveling the distance of one mile. Total vehicle miles, thus, is the total mileage traveled by all vehicles.

Zero-emission vehicle - A clean fuel vehicle meeting even more stringent zero-emission vehicle standards.

TITLE INDEX

Notations:

* indicates the end of the title

( ) indicates the page number