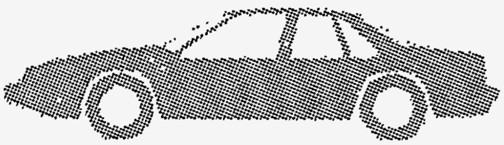
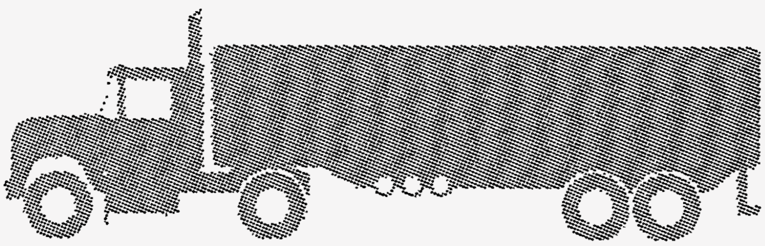
U.S. Department of Energy



Transportation Energy Data Book: Edition 16



Oak Ridge National Laboratory*

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David N. McFarlin

MASTER

*Managed by Lockheed Martin Energy Research Corp.
for the United States Department of Energy

ORNL-6898

FREQUENTLY USED TABLES

COMMON CONVERSIONS

1 Quad	=	84,997.9 Gigawatthours[a]		
	=	0.4724 million barrels per day of oil (mbpd), or		
	=	8 billion gallons of gasoline		
1 Gigawatthour	=	1.1765×10^{-5} Quads[a]		
1 Mbpd	=	2.117 Quads per year		
1 Barrel	=	42 gallons		
1 Btu	=	1055 Joules		
1 Gallon of Gasoline	=	125,000 Btu (gross)	=	115,400 Btu (net)
1 Gallon of Ethanol	=	84,600 Btu (gross)	=	75,670 Btu (net)
1 Gallon of Methanol	=	64,600 Btu (gross)	=	56,560 Btu (net)
1 Gallon of Diesel	=	138,700 Btu (gross)	=	128,700 Btu (net)
1 Gallon of Gasoline	=	6.2 pounds		
1 U.S. Gallon	=	0.8321 Imperial Gallons	=	3.785 Liters
1 Liter	=	61.026 Cubic inches		
Inertia Weight	=	Curb Weight + 300 Pounds		
1 Mph	=	1.609 Kph		
1 Horsepower	=	0.7457 Kilowatts		
1 Mile	=	1.609 Kilometers		

[a]Electricity generation and distribution have been taken into account. Without electricity generation and distribution, 1 Gigawatthour = 0.3412×10^{-5} Quads and 1 Quad = 293,083.2 Gigawatthours.

ORNL-6898
(Edition 16 of ORNL-5198)

Center for Transportation Analysis
Energy Division

TRANSPORTATION ENERGY DATA BOOK: EDITION 16

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July 1996

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

Prepared by
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U.S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-96OR22464

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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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FOREWORD

This edition of the data book continues the tradition of adding new material. Some of this new data has been requested by my office, while some has been suggested by others. Some examples of new data are:

- International freight energy use for selected countries (Table 1.11)
- More truck data (Tables 3.26, 3.27, 3.28, 3.29, and 3.30)
- 1996 data for auto fuel economy as a function of speed (Table 3.46)
- Employment in motor vehicle related industries (Table 2.33)
- Fleet vehicles operated by fuel providers (Tables 5.4, 5.5, and 5.6)
- A map and list of clean cities (Figure 7.1)
- Intermodel rail traffic (Table 6.11)
- States with ethanol tax incentives (Table 5.19)

Take a look at this new data, and make suggestions of what you would like to see in future editions.

Phil Patterson

ACKNOWLEDGEMENTS

We would like to express our gratitude to the many individuals who assisted in the preparation of this document. First, we would like to thank Philip D. Patterson and the staff of the Office of Transportation Technologies for their continued support of the Transportation Energy Data Book. This document also benefits from the criticism and careful review of Phil Patterson of the U.S. Department of Energy, John Maples, Robert Gibson, and Jenny Young of the University of Tennessee, Lee Schipper of Lawrence Berkeley Laboratory and Jerry Hadder of Oak Ridge National Laboratory (ORNL). We would also like to thank An Lu of the University of Tennessee for generating statistics from the ORNL MPG and Market Shares Data Base and David Greene (ORNL) for providing the Transportation Energy Trends Analysis.

In addition, we would like to acknowledge the contributions of Sherry Campbell of the ORNL Health Sciences Research Division for the preparation of the title index.

ABSTRACT

The Transportation Energy Data Book: Edition 16 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 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 16.

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 16 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 orher own opinions as to their utility. Clearly, the accuracy ofthe 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

This chapter includes statistics related to the transportation sector of selected countries. Countries were included based on data availability, geographical distribution, and transportation fuel use as a percentage of total refined petroleum consumption. The statistics presented for the United States in this chapter are from international sources and are only for use in international comparisons. The numbers may differ slightly from data presented in other chapters of the book.

Data from the Lawrence Berkeley Laboratory (LBL) are contained in Tables 1.5 through 1.13. These data are generated by LBL using sources from various countries; a listing of these sources, along with a brief explanation, can be found in Appendix C. Often, additional data from the country will result in changes for the entire data series; such changes are noted in Appendix C. Details on the methodology for compiling these data can be found in "Energy Efficiency and Human Activity," by Lee Schipper, Steve Meyers, et. al., Cambridge University Press, Cambridge, MA, 1992, the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect," and "New Car Test and Actual Fuel Economy: Yet Another Gap?" by Lee Schipper and Wienke Tax, 1993.

LBL has recently generated a new series of freight data for the various countries. Freight energy use data for truck, ship, and rail modes are displayed in Table 1.11.

Using national travel surveys, LBL compiled vehicle-mile and passenger-mile data by trip purpose for seven countries. As with most international data, caution should be used when comparing between countries because of differences in survey methodologies, definitions, etc.

Table 1.1
Automobile Registrations for Selected Countries, 1950-94
(thousands)

Year	Japan	France	Italy	Sweden	United Kingdom	West Germany	Canada	United States	U.S. percentage of world	All other countries[a]	World total
1950	43	b	342	b	2,307	b	1,913	40,339	76.0%	8,107	53,051
1955	153	b	861	b	3,609	1,821	2,961	52,145	71.4%	11,486	73,036
1960	457	4,950	1,976	b	5,650	4,559	4,104	61,671	62.7%	14,938	98,305
1965	2,181	8,320	5,473	b	9,131	9,043	5,279	75,258	53.8%	25,091	139,776
1970	8,779	11,860	10,181	b	11,802	13,299	6,602	89,244	46.1%	41,712	193,479
1975	17,236	15,180	15,060	2,760	14,061	16,764	8,870	106,706	41.0%	63,564	260,201
1980	23,660	18,440	17,686	2,883	15,438	21,455	10,256	121,601	38.0%	88,971	320,390
1981	24,612	19,130	18,603	2,893	15,633	21,812	10,199	123,098	37.2%	94,819	330,799
1982	25,539	19,750	19,616	2,936	17,644	22,086	10,530	123,702	36.4%	98,463	340,266
1983	26,385	20,300	20,389	3,007	18,108	22,624	10,732	126,444	35.9%	104,043	352,032
1984	27,114	20,600	20,888	3,081	18,532	23,193	10,781	128,158	35.1%	112,758	365,105
1985	27,845	20,800	22,495	3,151	18,953	23,777	11,118	131,864	35.2%	115,480	374,483
1986	28,654	21,090	23,495	3,253	19,415	24,700	11,586	135,431	35.1%	118,726	386,350
1987	29,478	21,500	24,320	3,367	20,108	25,558	11,686	137,324	34.9%	120,689	394,030
1988	30,776	21,970	25,290	3,483	20,977	26,228	12,086	141,252	34.2%	130,845	412,907
1989	32,621	22,520	26,267	3,578	21,919	26,914	12,380	143,081	33.7%	135,086	424,366
1990	34,924	23,010	27,416	3,601	22,528	27,218	12,622	143,550	32.3%	150,031	444,900
1991	37,076	23,550	28,435	3,619	22,744	27,484	13,061	142,956	31.3%	157,108	456,033
1992	38,963	24,020	29,450	3,587	23,008	28,092	13,298	144,213	30.7%	165,312	469,943
1993	40,772	24,385	29,600	3,566	23,402	28,250	13,478	146,314	31.2%	159,693	469,460
1994	42,678	24,900	29,800	3,594	23,832	28,695	13,700	147,171	30.7%	165,163	479,533
					Average annual percentage change						
1950-94	17.0%	4.9%[c]	10.7%	b	5.5%	7.3%[d]	4.6%	3.0%		7.1%	5.1%
1970-94	6.8%	3.1%	4.6%	1.4%[e]	3.0%	3.3%	3.1%	2.1%		5.9%	3.9%
1984-94	4.6%	1.9%	3.6%	1.6%	2.5%	2.2%	2.4%	1.4%		3.9%	2.8%

Source:
Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1996 Edition, Detroit, MI, 1996, pp. 15, 58, 108, 126, 148, 188, 211, 256, 286 and annual.

[a]Automobile registrations for all other countries were calculated by subtracting listed countries' registrations from the world total.
[b]Data not available.
[c]Average annual percentage change is for 1960-94.
[d]Average annual percentage change is for 1955-94.
[e]Average annual percentage change is for 1975-94.

Table 1.2
Truck and Bus Registrations for Selected Countries, 1950-94
(thousands)

Year	Japan[a]	France	Italy	Sweden	United Kingdom	West Germany	Canada	United States	U.S. percentage of world	All other countries[b]	World total
1950	183	c	235	c	1,060	c	643	8,823	50.9%	6,405	17,349
1955	318	c	335	c	1,244	760	952	10,544	46.1%	8,707	22,860
1960	896	1,540	455	c	1,534	1,079	1,056	12,186	42.6%	9,837	28,583
1965	4,119	1,770	664	c	1,748	1,690	1,232	15,100	39.6%	11,795	38,118
1970	8,803	1,850	929	c	1,769	2,298	1,481	19,175	36.2%	16,594	52,899
1975	10,854	2,210	1,193	171	1,934	2,725	2,158	26,243	38.8%	20,210	67,698
1980	14,197	2,550	1,429	194	1,920	3,385	2,955	34,195	37.7%	29,767	90,592
1981	15,009	2,575	1,547	199	1,890	3,501	3,192	35,188	36.5%	33,304	96,405
1982	15,797	2,716	1,642	207	3,022	3,584	3,293	35,941	36.4%	32,585	98,787
1983	16,546	2,890	1,764	215	3,106	3,725	3,363	37,306	35.9%	34,973	103,888
1984	17,380	3,230	1,792	224	3,230	3,878	3,099	38,091	35.3%	37,001	107,925
1985	18,313	3,310	1,910	231	3,278	4,032	3,149	39,790	35.2%	39,011	113,024
1986	19,319	3,980	2,008	244	3,336	4,270	3,213	40,760	35.9%	36,306	113,436
1987	20,424	4,200	2,069	260	3,452	4,534	3,576	41,714	34.4%	40,947	121,176
1988	21,674	4,370	2,191	281	3,621	4,795	3,766	43,145	34.0%	43,039	126,882
1989	22,472	4,570	2,311	309	3,754	5,140	3,889	44,179	33.3%	45,942	132,566
1990	22,773	4,748	3,427	324	3,774	5,453	3,931	45,106	32.7%	48,546	138,082
1991	22,839	4,910	2,598	324	3,685	5,926	3,744	45,416	32.6%	49,832	139,274
1992	22,694	5,040	2,684	319	3,643	6,403	3,688	46,149	32.1%	52,967	143,587
1993	22,490	5,065	2,727	316	3,604	6,755	3,712	47,749	32.3%	55,209	147,627
1994	22,333	5,140	2,778	318	3,605	7,222	3,740	48,298	32.3%	56,111	149,545
					Average annual percentage change						
1950-94	11.5%	3.6%[d]	5.8%	c	2.8%	5.9%[e]	4.1%	3.9%		5.1%	5.0%
1970-94	4.0%	4.3%	4.7%	3.3%[f]	3.0%	4.9%	3.9%	3.9%		5.2%	4.4%
1984-94	2.5%	4.8%	4.5%	3.6%	1.1%	6.4%	1.9%	2.4%		4.3%	3.3%

Source:
Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1996 Edition, Detroit, MI, 1996, pp. 15, 58, 108, 126, 148, 188, 211, 256, and 286.

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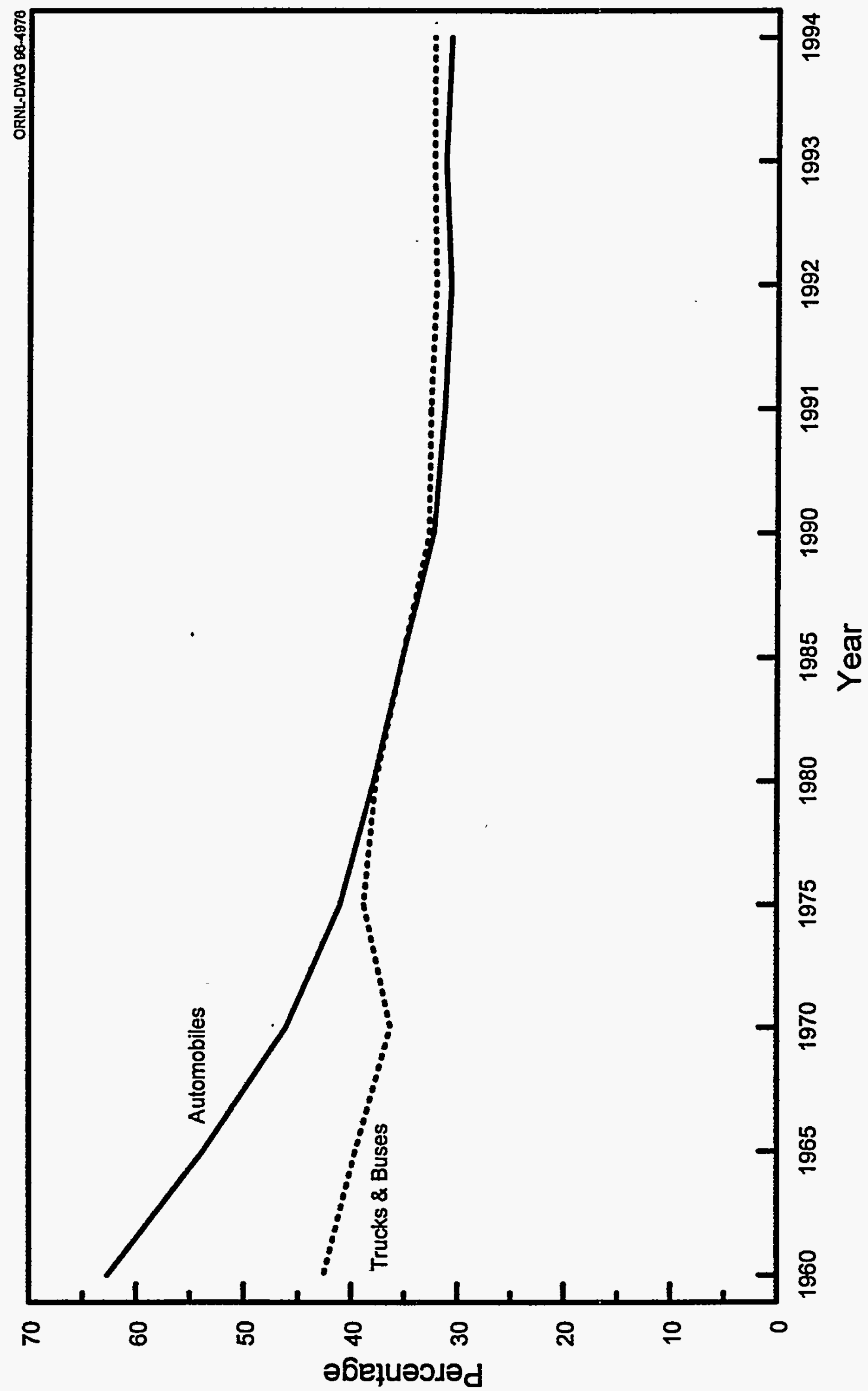
[a]Data revised to include special purpose vehicles for consistency with other countries' data.
[b]Truck and bus registrations for all other countries were calculated by subtracting listed countries' registrations from the world total.
[c]Data are not available.
[d]Average annual percentage change is for 1960-94.
[e]Average annual percentage change is for 1955-94.
[f]Average annual percentage change is for 1975-94.

Figure 1.1. United States Automobile and Truck & Bus Registrations as a Percent of World Registrations, 1960-94



Source: See Tables 1.1 and 1.2.

Table 1.3
Gasoline Prices for Selected Countries, 1978-94

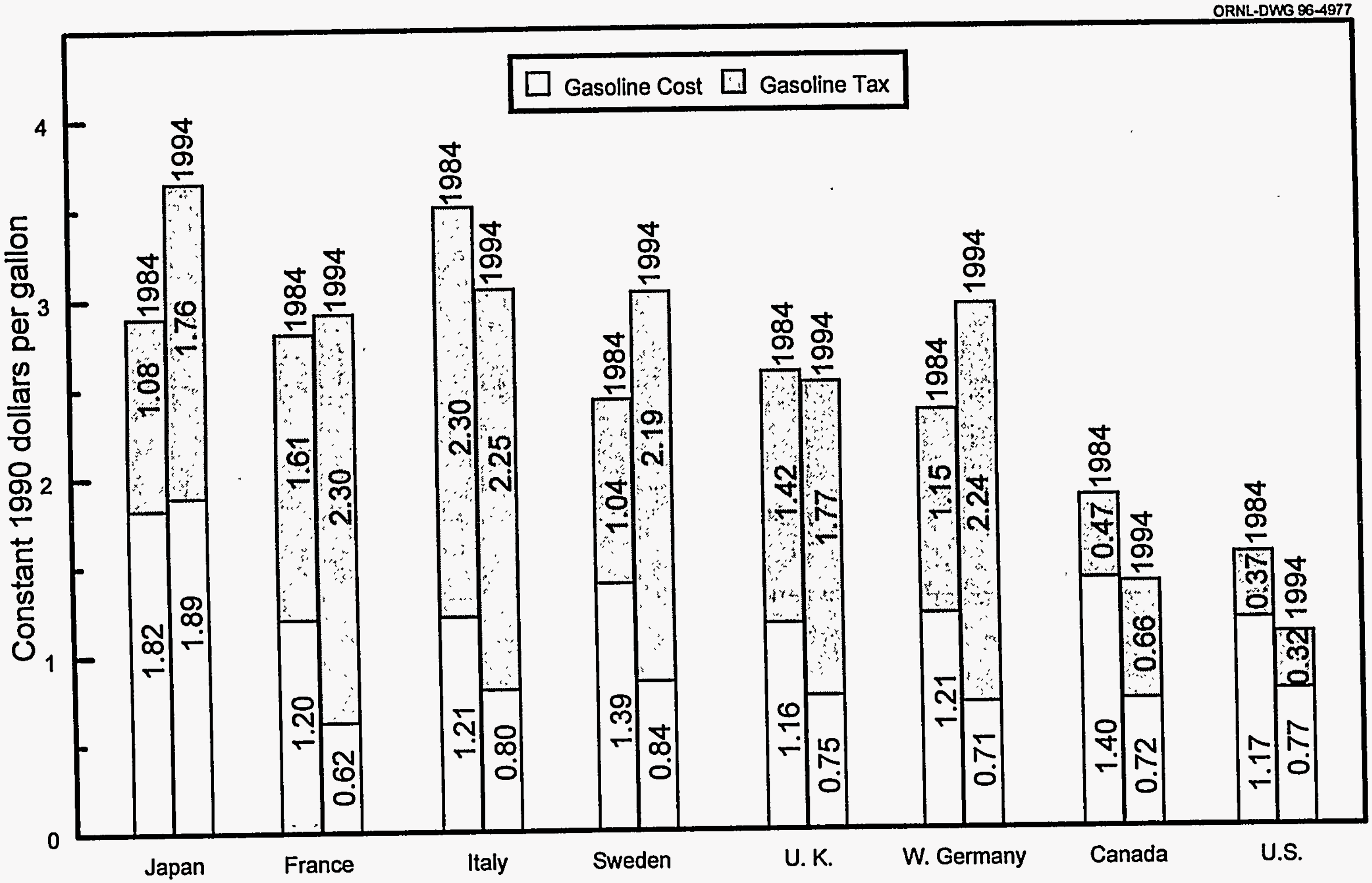
	Current dollars per gallon								Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1991[b]	1992[b]	1993[b]	1994[b]	1978-94	1982-94
Japan	2.00[c]	2.60[c]	2.79[c]	3.05[c]	3.90[c]	3.78[c]	4.55	4.14	4.7%	4.0%
France	2.15	2.56	2.58	3.40	3.86	3.69	3.41	3.31	2.7%	2.2%
Italy	2.23	2.88	3.26	4.27	5.10	4.81	3.77	3.46	2.8%	1.5%
Sweden	1.56	2.40	2.20	3.23	4.45	4.28	4.20	3.44	5.1%	3.0%
United Kingdom	1.22	2.42	2.07	2.55	2.55	3.28	2.77	2.86	5.5%	1.4%
West Germany	1.75	2.17	1.88	2.72	2.87	3.84	3.25	3.34	4.1%	3.7%
Canada	0.69[c]	1.37[c]	1.31[c]	1.92[c]	2.06[c]	2.11[c]	1.85	1.57	5.3%	1.1%
United States[d]	0.66[c]	1.32[c]	0.93[c]	1.04[c]	1.43[c]	1.07[c]	1.31	1.24	4.0%	-0.5%

	Constant 1990 dollars[e] per gallon								Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1991[b]	1992[b]	1993[b]	1994[b]	1978-94	1982-94
Japan	4.01[c]	3.52[c]	3.33[c]	3.05[c]	3.74[c]	3.52[c]	4.12	3.65	-0.6%	0.3%
France	4.31	3.47	3.07	3.40	3.70	3.44	3.09	2.92	-2.4%	-1.4%
Italy	4.47	3.90	3.89	4.27	4.89	4.48	3.42	3.05	-2.4%	-2.0%
Sweden	3.12	3.25	2.62	3.23	4.27	3.98	3.81	3.03	-0.2%	-0.6%
United Kingdom	2.44	3.28	2.47	2.55	2.45	3.05	2.51	2.52	0.2%	-2.2%
West Germany	3.51	2.94	2.24	2.72	2.75	3.58	2.94	2.95	-1.1%	0.0%
Canada	1.38[c]	1.85[c]	1.56[c]	1.92[c]	1.98[c]	1.96[c]	1.68	1.38	0.0%	-2.4%
United States[d]	1.32[c]	1.79[c]	1.11[c]	1.04[c]	1.37[c]	1.00[c]	1.19	1.09	-1.2%	-4.0%

Source:
U.S. Department of Energy, Energy Information Administration, International Energy Annual 1993, Washington, DC, May 1995, pp. 93, 94, and annual.

[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 leaded gasoline on January 1 of the year.
[c]Unleaded regular gasoline.
[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. Gasoline Prices for Selected Countries, 1984 and 1994



Source:
International Energy Agency, Energy Prices and Taxes, Fourth Quarter, 1994 Edition, Paris, France, 1995, and Table 1.3.

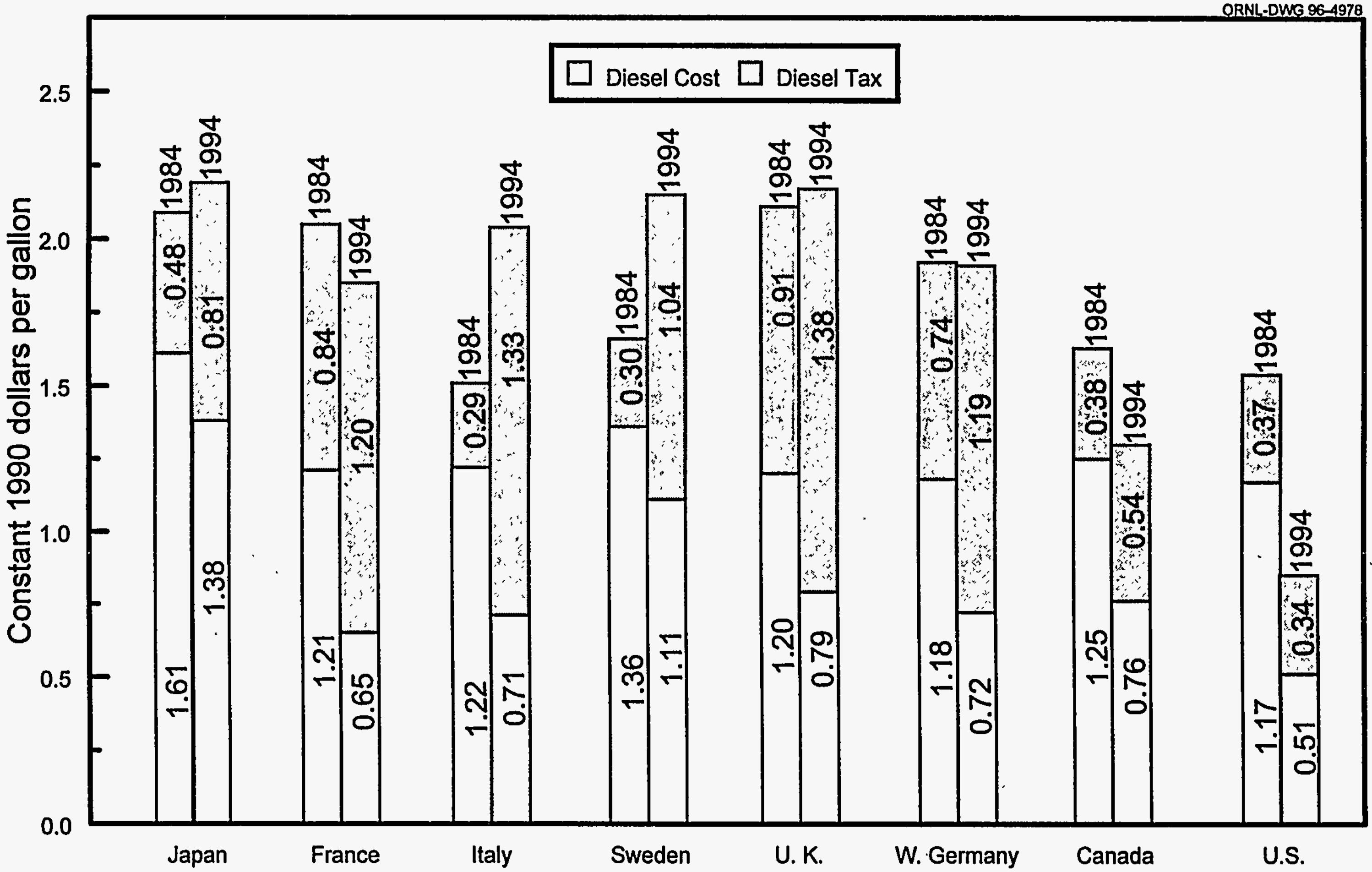
Table 1.4
Diesel Fuel Prices for Selected Countries, 1978-94

	Current dollars per gallon								Average annual percentage change	
	1978[a]	1982[a]	1986[a]	1990[b]	1991[b]	1992[b]	1993[b]	1994[b]	1978-94	1982-94
Japan	[c]	1.78	1.90	1.75	2.4	[c]	2.45	2.48	[c]	2.8%
France	1.30	1.88	1.69	1.78	[c]	[c]	2.05	2.10	3.0%	0.9%
Italy	0.64	1.19	1.31	2.34	3.77	[c]	2.52	2.31	8.4%	5.7%
Sweden	0.62	1.41	1.24	2.30	3.58	[c]	2.05	2.44	8.9%	4.7%
United Kingdom	1.24	2.05	1.71	2.04	[c]	[c]	2.36	2.46	4.4%	1.5%
West Germany	1.48	1.81	1.51	2.72	2.69	2.81	2.20	2.16	2.4%	1.5%
Canada	[c]	1.27	1.27	1.55	1.98	1.78	1.55	1.47	[c]	1.2%
United States[d]	0.54	1.16	0.94	0.99	0.91	1.06	0.98	0.96	3.7%	-1.6%
	Constant 1990 dollars[e] per gallon								**Average annual percentage change**	
	1978[a]	1982[a]	1986[a]	1990[b]	1991[b]	1992[b]	1993[b]	1994[b]	1978-94	1982-94
Japan	[c]	2.41	2.26	1.75	2.30	[c]	2.22	2.19	[c]	-0.8%
France	2.60	2.55	2.01	1.78	[c]	[c]	1.86	1.85	-2.1%	-2.6%
Italy	1.28	1.61	1.56	2.34	3.62	[c]	2.28	2.04	3.0%	2.0%
Sweden	1.24	1.91	1.48	2.30	3.43	[c]	1.86	2.15	3.5%	1.0%
United Kingdom	2.48	2.78	2.04	2.04	[c]	[c]	2.14	2.17	-0.8%	-2.0%
West Germany	2.96	2.45	1.80	2.72	2.58	2.62	1.81	1.91	-2.7%	-2.1%
Canada	[c]	1.72	1.51	1.55	1.90	1.66	1.40	1.30	[c]	-2.3%
United States[d]	1.08	1.57	1.12	0.99	0.87	0.99	0.89	0.85	-1.5%	-5.0%

Source:
U.S. Department of Energy, Energy Information Administration, International Energy Annual 1993, Washington, DC, May 1995, pp. 94, 95, and annual.

[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.
[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 1.3. Diesel Fuel Prices for Selected Countries, 1984 and 1994



Source:
International Energy Agency, Energy Prices and Taxes, 1994 Edition, Paris, France, 1994, and Table 1.4.

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, 1973-93
(miles per gallon)

Year	Japan	France	Italy	Sweden	Norway	Denmark	West Germany	United States
1973	22.6	b	b	b	b	b	22.8	13.0
1974	22.1	b	b	b	b	b	b	13.8
1975	21.2	27.5	b	b	24.8	28.1	b	15.3
1976	22.6	28.0	b	b	25.3	b	b	16.7
1977	24.9	28.3	b	b	25.6	30.2	b	17.7
1978	26.6	28.5	b	25.3	25.9	b	24.9	18.6
1979	27.3	29.0	b	25.6	26.1	30.7	25.3	18.7
1980	28.2	30.2	28.2	26.1	26.7	b	26.6	22.5
1981	28.9	31.8	28.7	27.0	27.4	31.5	28.0	24.1
1982	30.6	33.0	29.4	27.4	28.3	b	29.0	24.7
1983	30.1	33.6	31.8	27.4	29.0	33.6	29.2	24.6
1984	30.1	34.3	32.7	27.7	30.2	b	31.2	24.6
1985	29.2	34.9	32.7	27.7	30.3	35.1	31.8	25.0
1986	28.2	35.1	33.7	28.0	31.1	b	32.6	25.7
1987	27.8	35.5	34.1	28.7	31.2	34.5	31.6	25.9
1988	27.3	35.9	34.1	28.3	32.3	b	30.4	25.9
1989	26.8	36.1	b	28.3	30.6	35.6	29.8	25.4
1990	27.1	36.1	b	28.3	31.8	35.5	29.8	25.1
1991	30.8	36.1	b	25.3	31.8	30.7	29.5	25.3
1992	b	31.3	b	22.8	31.8	32.7	30.4	24.5
1993	b	27.6	b	20.8	b	32.2	30.7	25.7
				Average annual percentage change				
1973-93	b	0.0%[c]	b	-1.3%[d]	b	0.8%[d]	1.5%	3.5%
1983-93	b	-1.9%	b	-2.7%	b	-0.4%	0.5%	0.4%

Sources:
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 1975-93.
[d]Average annual percentage change is for years 1978-93.

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, 1970-93
(miles per gallon)

Year	Japan	France	Italy	Sweden	Finland	Norway	Denmark	United Kingdom	West Germany	United States	Holland	Australia
1970	21.7	27.7	27.6	22.7	24.6	22.8	b	b	24.5	13.2	24.6	b
1971	20.7	27.7	b	22.5	24.9	22.8	b	b	23.5	13.3	24.6	19.2
1972	21.9	27.7	b	22.3	25.5	22.8	23.2	b	22.8	13.1	24.6	19.1
1973	21.3	26.8	27.8	22.1	26.2	22.8	b	b	23.5	13.0	24.6	19.0
1974	21.0	27.7	27.8	22.7	26.6	23.1	b	b	23.8	13.2	24.6	19.0
1975	21.4	27.2	27.8	22.2	26.7	23.1	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	20.8	26.1	27.8	21.6	28.3	23.1	27.7	b	22.8	13.8	26.3	18.8
1979	20.4	26.5	27.8	21.6	27.1	23.3	28.6	b	23.3	14.1	26.3	18.7
1980	20.4	25.7	27.8	21.6	27.6	23.3	29.0	b	23.1	15.0	25.6	18.8
1981	20.8	25.5	28.0	21.6	27.8	23.5	29.3	b	23.1	15.5	25.6	19.0
1982	21.1	25.2	28.0	21.7	27.8	23.8	29.3	b	23.1	16.1	25.9	19.3
1983	21.1	25.3	28.2	21.8	27.4	24.3	29.3	23.5	23.1	16.6	26.1	19.6
1984	21.5	25.6	28.7	21.8	27.4	24.8	30.7	24.3	23.1	17.0	26.6	19.8
1985	21.9	25.8	28.9	22.0	27.4	25.3	30.0	24.7	23.1	17.4	26.8	20.3
1986	22.0	25.9	29.4	22.4	26.6	25.9	30.2	24.0	23.1	17.4	27.3	20.6
1987	22.4	26.1	29.9	22.8	27.0	25.9	31.1	24.8	23.3	18.1	27.5	20.8
1988	22.5	26.1	30.1	23.1	27.9	25.9	31.0	25.3	23.5	18.8	27.8	20.8
1989	22.5	26.5	30.6	23.3	28.0	25.9	31.2	25.9	24.0	19.2	28.0	20.8
1990	22.3	26.5	31.1	23.5	28.3	26.1	30.1	25.3	24.3	19.6	28.5	20.9
1991	21.8	26.5	31.3	23.8	28.0	26.1	30.0	25.0	24.5	20.1	28.5	20.8
1992	22.0	26.5	31.3	24.0	27.9	26.1	29.9	25.3	24.5	20.1	28.5	21.0
1993	22.5	26.5	b	24.1	28.0	26.4	30.3	b	24.5	20.0	28.5	21.4
						Average annual percentage change						
1970-93	0.2%	-0.2%	b	0.3%	0.6%	0.6%	b	b	0.0%	1.8%	0.6%	0.5%[c]
1983-93	0.6%	0.5%	b	1.0%	0.2%	0.8%	0.3%	b	0.6%	1.9%	0.9%	0.9%

Sources:

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 1971-93.

> *"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
(liters per 100 kilometers)

Country	Year	Test	Actual	Average Gap	Percent Gap	Comments
Canada	1988	8.0	10.0	2.0	20	Actual fuel efficiency from driver surveys. Test from laboratory test.
Individual car models	1985	8.6	10.7	2.1	19.6	
France	1988	6.5	8.4	1.9	23	Travel diaries compared to 1/3 city, 1/3 highway, 1/3 road test values.
Germany	1987	7.7	9.8	2.1	21.4	DIN (test) vs. DIW (actual)
Sweden	1987	8.2	8.5	0.3	3.5	KOV compared with consumer reported survey data.
U.S.	1985					
Cars		9.7	11.9	2.2	18.5	RTECS survey vs. EPA fleet average from dynamometer test.
Trucks		11.6	14.5	2.9	20	
U.K.	1989	7.2	9.3	2.1	22.6	Test value for registration-weighted average.

Sources:
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 per Vehicle Traveled by Personal Vehicles[a] for Selected Countries, 1970-93

Year	Japan	France	Italy	Sweden	Finland	Norway	Denmark	United Kingdom	West Germany	United States	Holland
1970	9,290	8,415	7,394	8,912	12,231	7,782	9,464	9,110	9,484	11,173	9,665
1971	8,864	8,397	6,931	8,974	12,261	7,781	9,661	9,265	9,403	11,402	9,734
1972	7,948	8,415	6,780	9,172	12,853	7,781	10,250	9,303	9,100	11,606	9,324
1973	7,845	8,639	6,965	9,310	13,000	7,721	9,807	9,190	8,961	11,465	9,307
1974	6,973	8,129	6,401	8,638	11,800	7,724	9,156	8,853	8,672	10,732	9,023
1975	6,906	8,204	6,666	8,910	12,797	8,343	10,061	8,499	9,044	10,749	9,316
1976	6,748	8,135	6,467	8,805	12,619	8,590	10,051	8,466	8,925	10,923	9,438
1977	6,896	8,067	6,316	8,830	12,323	8,653	10,059	8,606	8,789	11,046	9,333
1978	6,828	8,036	6,619	8,985	12,143	8,468	10,125	8,705	8,705	11,115	9,706
1979	6,820	7,906	6,961	8,987	11,915	8,596	10,009	8,336	8,546	10,660	9,303
1980	6,714	8,092	6,898	9,147	11,521	8,288	9,660	8,600	8,423	10,605	8,988
1981	6,599	8,247	6,873	9,052	11,243	8,108	9,614	8,654	7,832	10,625	8,784
1982	6,589	7,850	6,934	9,109	11,100	8,049	9,690	8,729	8,047	10,825	8,991
1983	6,454	7,843	6,827	9,088	10,936	8,052	9,837	8,656	8,155	10,924	9,185
1984	6,403	7,980	6,902	9,159	10,866	8,241	10,017	8,971	8,196	10,966	9,381
1985	6,451	7,937	7,077	9,021	10,886	8,426	9,723	8,996	7,995	10,997	9,162
1986	6,481	8,160	7,235	9,321	10,897	8,551	10,022	9,228	8,301	11,108	9,501
1987	6,469	8,247	7,443	9,484	11,133	8,637	10,110	9,564	8,546	11,351	9,670
1988	6,505	8,378	7,636	9,444	11,413	8,733	10,248	9,804	8,732	11,775	9,540
1989	6,442	8,254	7,753	9,439	11,502	8,845	10,399	10,138	8,677	12,029	9,441
1990	6,464	8,451	7,878	9,030	11,340	8,953	10,547	9,874	8,740	12,243	9,204
1991	6,447	8,499	7,958	9,077	11,122	8,786	10,668	9,828	7,789	12,381	9,254
1992	6,439	8,667	8,173	9,205	11,129	8,664	10,726	9,648	7,796	13,091	9,398
1993	6,286	8,749	[b]	9,332	11,087	8,675	10,772	9,687	7,892	13,186	9,329
					Average annual percentage change						
1970-93	-1.7%	0.2%	[b]	0.2%	-0.4%	0.5%	0.6%	0.3%	-0.8%	0.7%	-0.2%
1983-93	-0.3%	1.1%	[b]	0.3%	0.1%	0.7%	0.9%	1.1%	-0.3%	1.9%	0.2%

Sources:
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.

Table 1.9
Passenger Travel by Personal Vehicles[a] for Selected Countries, 1970-93
(billion passenger-miles)

Year	Japan	France	Italy	Sweden	Finland	Norway	Denmark	United Kingdom	West Germany	United States	Holland	Australia
1970	127	189	146	38	15	11	23	180	228	2,123	41	[a]
1971	149	199	169	40	15	13	24	191	244	2,209	46	107
1972	156	211	186	41	17	14	26	200	247	2,305	47	111
1973	159	237	189	42	18	15	26	209	256	2,334	50	115
1974	160	224	176	40	17	15	24	203	250	2,219	50	123
1975	172	233	190	44	19	17	27	201	271	2,248	55	130
1976	179	239	196	46	20	17	25	211	279	2,318	58	134
1977	179	248	203	45	20	18	28	218	289	2,359	61	140
1978	198	258	221	44	21	19	28	231	299	2,425	66	145
1979	212	264	220	45	21	18	27	232	310	2,343	66	148
1980	213	281	218	44	22	19	26	245	310	2,304	67	149
1981	217	291	226	43	22	19	25	249	293	2,309	67	151
1982	228	291	241	43	23	19	25	252	303	2,347	68	159
1983	237	297	227	44	24	20	26	255	311	2,390	70	159
1984	240	306	242	45	26	20	27	269	317	2,445	74	166
1985	251	307	254	44	27	23	27	274	316	2,496	73	174
1986	259	321	268	46	28	23	28	289	337	2,556	77	179
1987	268	332	291	48	29	26	29	311	353	2,645	79	182
1988	280	345	317	48	30	26	29	333	370	2,767	82	189
1989	298	355	328	50	31	26	29	361	375	2,836	85	196
1990	320	364	362	49	32	26	29	365	393	2,882	85	200
1991	339	372	370	49	31	26	30	364	397	2,891	85	197
1992	355	384	387	49	31	26	30	361	400	2,993	86	199
1993	458	392	[b]	50	31	26	30	359	400	3,055	88	204
						Average annual percentage change						
1970-93	5.0%	3.2%	[b]	1.2%	3.2%	3.8%	1.2%	3.0%	2.5%	1.6%	3.4%	3.0%[c]
1983-93	6.0%	2.8%	[b]	1.3%	2.6%	2.7%	1.4%	3.5%	2.6%	2.5%	2.3%	2.5%

Sources:
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 1971-93.

Table 1.10
Energy Use by Personal Vehicles[a] for Selected Countries, 1970-93
(trillion Btu)

Year	Japan	France	Italy	Sweden	Finland	Norway	Denmark	United Kingdom	West Germany	United States	Holland	Australia
1970	491	431	304	99	40	30	52	501	626	9,230	111	[b]
1971	589	454	316	104	42	32	55	531	698	9,777	122	244
1972	594	480	341	111	46	34	60	600	737	10,509	126	255
1973	676	534	379	117	49	36	[b]	640	750	10,927	133	266
1974	672	511	362	110	47	35	[b]	622	733	10,474	135	285
1975	706	540	393	122	54	40	59	609	796	10,732	146	304
1976	747	573	395	126	54	45	62	635	838	11,291	146	318
1977	825	593	399	130	54	49	62	653	881	11,499	153	335
1978	887	627	434	133	55	49	65	692	932	11,806	165	349
1979	959	636	473	133	59	51	63	705	956	11,314	167	361
1980	982	688	493	133	59	51	58	719	979	10,570	174	361
1981	984	704	512	132	59	51	56	705	929	10,478	172	365
1982	1,005	720	536	134	61	53	56	725	965	10,386	176	381
1983	1,017	733	538	135	65	54	58	752	997	10,459	182	379
1984	1,015	743	550	140	67	56	58	793	1,026	10,485	186	394
1985	1,035	739	574	140	70	59	60	801	1,022	10,629	183	410
1986	1,062	766	594	146	75	62	63	845	1,097	10,971	187	419
1987	1,077	780	620	151	80	63	64	896	1,155	11,067	194	426
1988	1,118	808	655	154	84	64	66	944	1,211	11,260	195	445
1989	1,189	818	649	157	89	64	66	978	1,220	11,427	199	466
1990	1,286	831	673	153	90	65	69	1,005	1,262	11,477	193	480
1991	1,391	842	698	151	89	63	70	1,018	1,264	11,377	195	483
1992	1,446	863	775	153	89	63	71	1,013	1,269	11,863	201	489
1993	1,442	879	[b]	154	87	63	70	1,012	1,273	12,197	203	497
						Average annual percentage change						
1970-93	4.8%	3.1%	[b]	1.9%	3.4%	3.3%	1.3%	3.1%	3.1%	1.0%	2.0%	3.0%[c]
1983-93	3.6%	1.8%	[b]	1.3%	3.0%	1.6%	1.9%	3.0%	2.5%	1.0%	1.0%	2.0%

Sources:
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 1971-93.

Table 1.11
Freight Energy Use 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			Holland			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

Sources:
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
Vehicle Travel per Automobile
for Selected Countries by Trip Purpose

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

Sources:

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.

Notes:

The U. S. NPTS survey excludes people under 5 years old (7.6% of the U. S. population for 1990); German Kontiv excludes children under 6 years (5% of total Pop. by 1989); Dutch NTS excludes children 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 VMT values by mode and purpose.

[a]Data are not available.

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

	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	0.34	0.03	0.37	1.94	0.76	2.70	1.71	4.77
Germany	0.30	0.05	0.35	0.51	0.10	0.61	1.15	2.12
Sweden	0.37	0.11	0.48	0.84	0.05	0.89	2.04	3.41
United Kingdom	0.46	0.08	0.53	1.83	0.29	2.12	1.66	4.31
Holland	0.35	0.14	0.49	0.70	0.07	0.77	2.03	3.29
Norway	0.27	0.05	0.31	0.79	0.05	0.85	1.48	2.64
Denmark	0.41	0.00	0.42	0.48	0.00	0.48	1.11	2.02
				Weekly miles traveled per automobile passenger				
United States	9.93	2.40	12.33	48.49	9.80	58.29	100.63	171.24
Germany	7.46	1.75	9.21	8.60	1.68	10.28	42.10	61.59
Sweden	6.55	6.69	13.24	14.55	1.08	15.63	64.30	93.17
United Kingdom	8.32	3.98	12.30	29.48	2.74	32.22	56.42	100.94
Holland	11.60	5.52	17.12	10.03	2.25	12.28	65.68	95.08
Norway	a	a	a	a	a	a	a	a
Denmark	11.50	0.41	11.91	9.28	0.00	9.28	40.32	61.51

Sources:
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.

Notes:
The U. S. NPTS survey excludes people under 5 years old (7.6% of the U. S. population for 1990); German Kontiv excludes children under 6 years (5% of total Pop. by 1989); Dutch NTS excludes children 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 VMT values by mode and purpose.

[a]Data are not available.

CHAPTER 2

TRANSPORTATION ENERGY CHARACTERISTICS

The U.S. is responsible for more than one-quarter of the world's petroleum consumption. Domestic crude oil production is at the lowest level in the last 25 years. While domestic crude oil production has declined 27% from 1985 to 1995, the amount of crude oil imported has more than doubled in that time period to meet the domestic demand. Net imports of crude oil and petroleum products in 1995 accounted for 45% of U.S. petroleum consumption (Table 2.2). Most of the petroleum consumed in the U.S. was in the transportation sector, 67% (Table 2.5). This accounted for 27.5% of total energy use in 1995 (Table 2.9).

The fuels used in the transportation sector include gasoline, distillate fuel oil (diesel fuel), jet fuel, residual fuel oil, natural gas, electricity, and methanol. Gasoline, however, accounted for the majority of transportation energy consumption in 1994. Of total transportation energy use in 1994, 76% was consumed by the highway mode while the nonhighway mode (which includes water, air, pipeline, and rail transportation) accounted for 21%. The remaining 3% of transportation energy use was consumed by the off-highway mode (Table 2.11).

The results of a study sponsored by the Office of Energy Demand Policy, U.S. Department of Energy, are presented in Tables 2.18-2.20. The study of Transportation Energy Trends Analysis uses a mathematical technique known as Divisia analysis to decompose energy use trends. Further discussion of this study is found on page 2-19.

The average price of a new car in 1994 reached $19,676. The average price for an import car has been more than the average price for a domestic car since 1982. Before then, imports were priced less than domestics, on average (Table 2.30). The cost of operating a car (in 1990 dollars) was 41.5 cents per mile in 1994. Gas and oil, once as much as one-quarter of the total cost to operate a car, accounted for only 12% of the total cost in 1994 (Table 2.30).

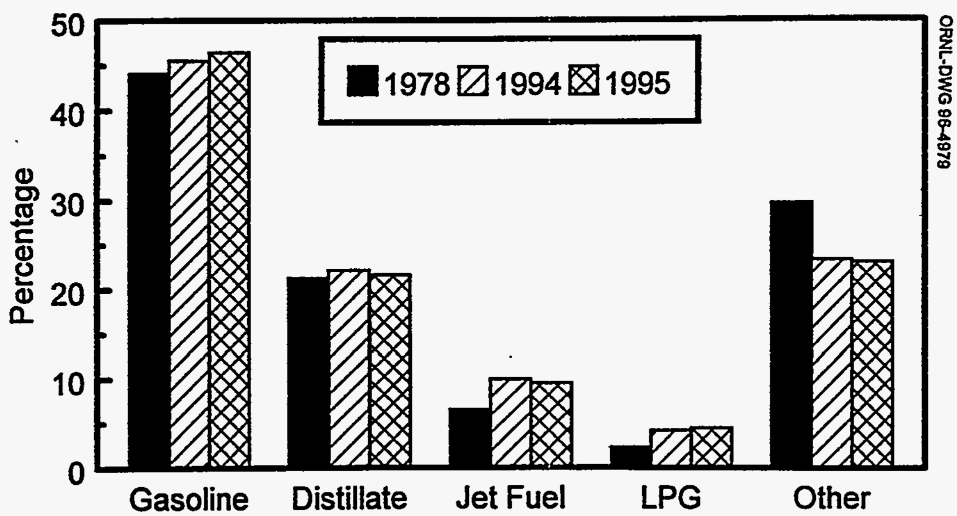
There were 2.6 motor vehicle manufacturing employees per hundred vehicles sold in 1994, which is the lowest ratio in the 23 year series. In 1981, there were 4.5 employees per hundred vehicles sold (Table 2.32). Employees of motor vehicle and related industries declined 2.1% from 1990 to 1992 (Table 2.33).

Table 2.1
Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978-95[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

Source:
Department of Energy, Energy Information Administration, Petroleum Supply Annual 1995, Vol. 1, May 1996, Table 19, p. 54, and annual.

Figure 2.1. Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978, 1994, and 1995



Source: See Table 2.1.

[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.

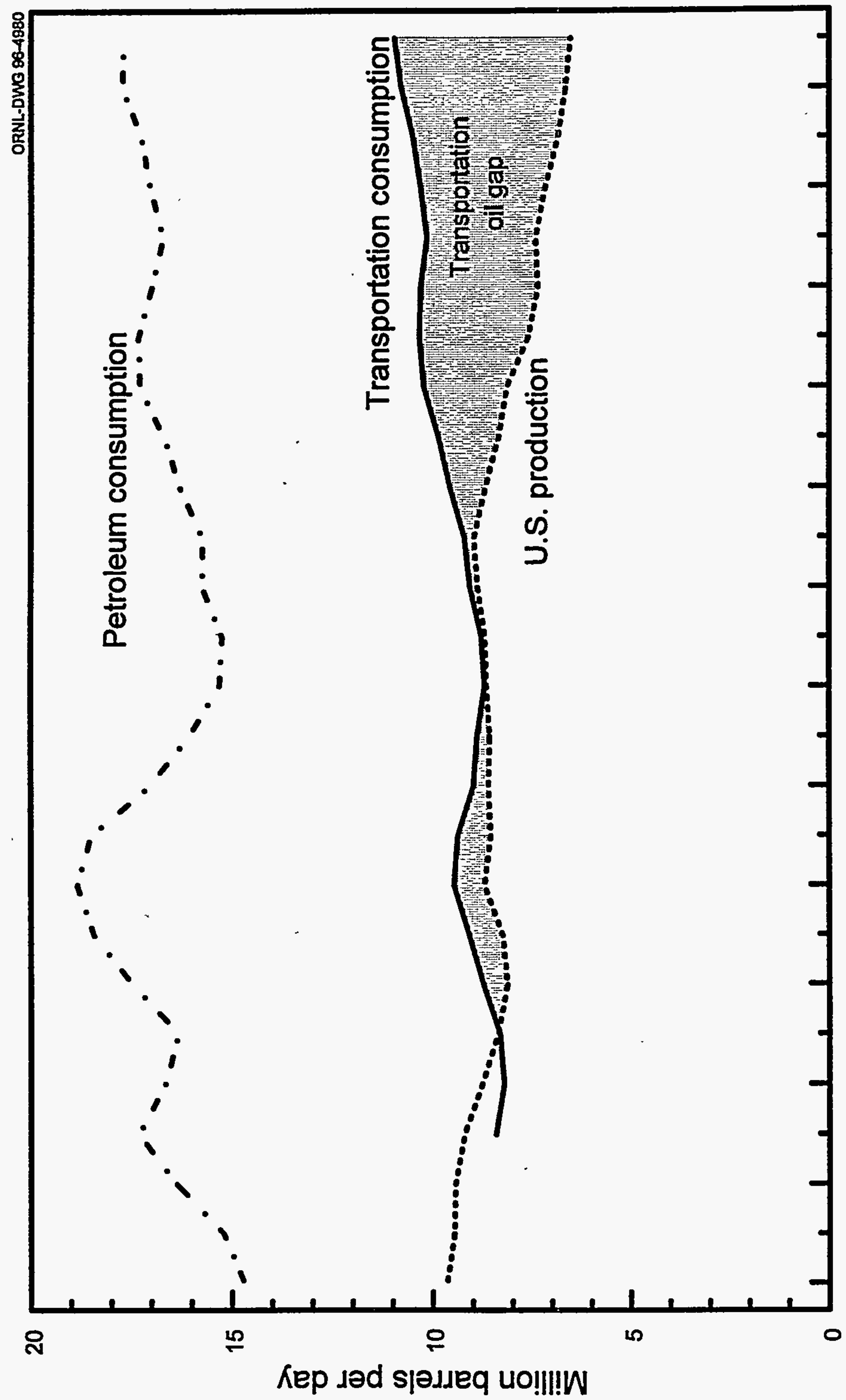
Table 2.2
United States Petroleum Production and Consumption, 1973-95
(million barrels per day)

Year	Domestic crude oil production	Net imports: Crude oil	Net imports: Petroleum products	Net imports: Total	Exports: Crude oil	Exports: Petroleum products	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]
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	63.01	35.5%	26.5%	118.1%
1988	8.14	4.95	1.63	6.59	0.16	0.66	17.28	64.83	38.1%	26.7%	125.4%
1989	7.61	5.70	1.50	7.20	0.14	0.72	17.33	66.03	41.5%	26.2%	135.7%
1990	7.36	4.79	1.38	7.16	0.11	0.75	16.99	66.16	42.1%	25.7%	140.0%
1991	7.42	5.67	0.96	6.63	0.12	0.89	16.71	66.72	39.7%	25.0%	136.6%
1992	7.17	5.99	0.94	6.94	0.09	0.86	17.03	66.57	40.8%	25.6%	143.7%
1993	6.85	6.69	0.93	7.62	0.10	0.90	17.24	66.72	44.2%	25.8%	153.1%
1994	6.66	6.96	1.09	8.05	0.10	0.84	17.72	c	45.4%	c	161.9%
1995	6.53	7.15	0.74	7.88	0.10	0.86	17.70	c	44.5%	c	167.7%
						Average annual percentage change					
1973-95	-1.6%	3.7%	-5.8%	1.2%	19.5%	6.2%	0.1%	0.8%[d]			
1985-95	-3.1%	9.1%	-5.4%	6.3%	-6.7%	4.0%	1.2%	1.3%[d]			

Sources:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, April 1996, pp. 42-47.
World petroleum consumption - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1993, May 1995, p. 27.

[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 2.2. United States Petroleum Production and Consumption, 1973-95



Source: See Tables 2.2 and 2.5.

Table 2.3
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**	**121,429**	**753,470**	**131,550**	**28.6%**	**22.5%**	**25.1%**	**-10.3%**
Ecuador	13,886	3,845	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]
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%
NonOPEC	**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%**

Source:
Energy Information Administration, Petroleum Supply Annual 1995, Volume 1, May 1996, p. 56, and annual.

[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 NonOPEC countries.

Table 2.4
World Crude Oil Production by Country of Origin, 1980-94
(thousand barrels per day)

Country	1980	1985	1987	1990	1991	1992	1993	Percent of total 1993	Percent change 1980-93
Arab OPEC	**17,357**	**8,375**	**10,811**	**13,323**	**12,621**	**13,718**	**14,382**	**23.7%**	**-17.1%**
Algeria	1,106	1,037	1,048	1,175	1,230	1,214	1,190	2.0%	7.6%
Iraq	2,514	1,433	2,079	2,040	305	425	512	0.8%	-79.6%
Kuwait	1,656	1,023	1,585	1,175	190	1,058	1,872	3.1%	13.0%
Qatar	472	301	293	406	395	423	419	0.7%	-11.2%
Saudi Arabia	9,900	3,388	4,265	6,410	8,115	8,332	8,198	13.5%	-17.2%
United Arab Emirates	1,709	1,193	1,541	2,117	2,386	2,266	2,191	3.6%	28.2%
Other OPEC	**7,841**	**7,200**	**7,063**	**9,052**	**9,764**	**9,866**	**10,336**	**17.0%**	**31.8%**
Ecuador	204	281	174	285	299	321	346	0.6%	69.6%
Gabon	175	172	155	270	294	298	312	0.5%	78.3%
Indonesia	1,577	1,325	1,343	1,462	1,592	1,504	1,528	2.5%	-3.1%
Iran	1,662	2,250	2,298	3,088	3,312	3,429	3,650	6.0%	119.6%
Nigeria	2,055	1,495	1,341	1,810	1,892	1,943	2,050	3.4%	-0.2%
Venezuela	2,168	1,677	1,752	2,137	2,375	2,371	2,450	4.0%	13.0%
North America	**11,968**	**13,187**	**12,432**	**11,461**	**11,644**	**11,446**	**11,198**	**18.5%**	**-6.4%**
All other	**22,433**	**25,219**	**26,369**	**26,730**	**26,178**	**25,183**	**24,724**	**40.8%**	**10.2%**
Total	**59,599**	**53,981**	**56,666**	**60,566**	**60,207**	**60,213**	**60,640**	**100.0%**	**1.7%**

Source:
Energy Information Administration, International Energy Annual, May 1995, p. 22-23.

Each year since 1990, the transportation sector has consumed at least 65% of the petroleum used in the U.S.

Table 2.5
Consumption of Petroleum by End-Use Sector, 1973-95
(quadrillion Btu)

Year	Transportation	Percentage transportation of total	Residential and commercial	Industrial	Electric utilities	Total	Total in million barrels per day[a]
1973	17.83	51.2%	4.39	9.10	3.52	34.84	16.46
1974	17.40	52.0%	4.00	8.69	3.37	33.46	15.81
1975	17.61	53.8%	3.81	8.15	3.17	32.74	15.47
1976	18.51	52.6%	4.18	9.01	3.48	35.18	16.62
1977	19.24	51.8%	4.21	9.77	3.90	37.12	17.53
1978	20.04	52.8%	4.07	9.87	3.99	37.97	17.94
1979	19.83	53.4%	3.45	10.57	3.28	37.13	17.54
1980	19.01	55.6%	3.04	9.53	2.63	34.21	16.16
1981	18.81	58.9%	2.63	8.29	2.20	31.93	15.08
1982	18.42	60.9%	2.45	7.79	1.57	30.23	14.28
1983	18.59	61.9%	2.50	7.42	1.54	30.05	14.19
1984	19.22	61.9%	2.54	8.01	1.29	31.06	14.67
1985	19.50	63.1%	2.52	7.81	1.09	30.92	14.61
1986	20.27	63.0%	2.56	7.92	1.45	32.20	15.21
1987	20.87	63.5%	2.59	8.15	1.26	32.87	15.53
1988	21.63	62.2%	2.60	8.43	1.56	34.22	16.16
1989	21.87	63.9%	2.53	8.13	1.69	34.22	16.16
1990	21.81	65.0%	2.17	8.32	1.25	33.55	15.85
1991	21.46	65.3%	2.15	8.06	1.18	32.85	15.52
1992	21.81	65.0%	2.13	8.64	0.95	33.53	15.84
1993	22.20	65.6%	2.14	8.45	1.05	33.84	15.98
1994	22.82	65.7%	2.09	8.85	0.97	34.73	16.41
1995	23.18	66.9%	2.12	8.67	0.66	34.63	16.36
		Average annual percentage change					
1973-95	1.2%		-3.3%	-0.2%	-7.3%	0.0%	0.0%
1985-95	1.7%		-1.7%	1.1%	-4.9%	1.1%	1.1%

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, April 1996, pp. 27, 29, 31, 33.

[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 2.6% from 1983-94. Natural gas vehicle fuel consumption was first reported in 1990 and has shown some growth.

Table 2.6 Natural Gas Consumption in the United States, 1970-94
(quadrillion Btu)

			Delivered to consumers						
Year	Lease and plant fuel	Pipeline fuel	Residential	Commercial	Industrial	Vehicle fuel	Electric utilities	Total	Total consumption
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	1.185	0.700	4.950	2.956	8.350	0.002	3.050	19.307	21.191
				Average annual percentage change					
1970-94	-0.8%	-0.2%	0.0%	0.8%	0.2%	[a]	-1.1%	0.0%	-0.1%
1984-94	0.8%	2.6%	0.6%	1.4%	2.9%	[a]	-0.4%	1.5%	1.5%

Source:
U. S. Department of Energy, Energy Information Administration, Natural Gas Annual 1994, Washington, DC, Table 101, p. 207.

Note: All volumes are for standard conditions of atmospheric pressure and 60 degrees Fahrenheit.

[a]Data are not available.

Table 2.7
Distribution of Energy Consumption by Source, 1973 and 1995
(percentage)

Energy source	Transportation		Residential & Commercial		Industrial		Electric utilities	
	1973	1995	1973	1995	1973	1995	1973	1995
Petroleum	95.8	96.7	18.2	6.7	28.9	27.2	17.7	2.1
Natural gas[a]	4.0	3.1	31.6	26.2	32.9	31.5	18.9	10.3
Coal	0.0	0.0	1.1	0.4	12.8	7.8	43.6	53.7
Hydroelectric	0.0	0.0	0.0	0.0	0.1	0.1	15.0	10.8
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	4.6	22.7
Electricity[b]	0.2	0.2	49.2	66.7	25.2	33.4	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, April 1996, Washington, DC, pp. 27, 29, 31, 33.

Table 2.8
Alternative Vehicle Fuel Consumption 1992-93
(thousand gasoline equivalent gallons)

Alternative fuel	1992	1993
Liquified petroleum gas[d]	208,142	264,655
Compressed natual gas	16,823	21,603
Liquified natural gas	585	1,900
M85[e] (85% methanol, 15% gasoline)	1,069	1,593
M100	2,547	3,166
E85[e] (85% ethanol, 15% gasoline)	21	48
E95[e] (95% ethanol, 5% gasoline)	85	80
Electricity	374	309
Total	**231,638**	**295,347**

Source:
U.S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels, 1993, p. 18.

[a]Includes supplemental gaseous fuels. Transportation sector includes pipeline fuel only.
[b]Includes electrical system energy losses.
[c]Energy generated from geothermal, wood, waste, wind, photovoltaic, and solar thermal energy sources.
[d]Values represent lower bound estimates.
[e]Consumption includes gasoline portion of the mixture.

Total energy use was over 87 quads in 1995. The transportation sector continues to account for more than 27% of total energy use.

Table 2.9
Consumption of Total Energy by End-Use Sector, 1970-95[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	31.63	85.64
1995	23.96	27.5%	31.40	31.88	87.25
		Average annual percentage change			
1970-95	1.6%		1.5%	0.4%	1.1%
1985-95	1.8%		1.6%	1.6%	1.7%

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, April 1996, Washington, DC, Table 2.2, p. 25.

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

Although the automobile energy use for 1994 is lower than in 1993 [Edition 15], 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. New LPG shares from the 1992 Truck Inventory and Use Survey indicate an increase in truck LPG use.

Table 2.10
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1994[a]
(trillion Btu)

	Gasoline	Diesel fuel	Liquified petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity	Methanol
HIGHWAY	**14,263.0**	**3,625.1**	**22.9**			**1.8**	**1.2**	**0.8**
Automobiles	**9,114.4[b]**	**122.9**				**1.3**		**0.0**
Motorcycles	**25.6**							
Buses	**49.2**	**144.3**	**0.2**			**0.5**	**1.2**	**0.8**
Transit	6.0	81.4	0.2			0.5	1.2	0.8
Intercity[c]		24.0						
School[e]	43.2	38.9						0.0
Trucks	**5,073.8**	**3,357.9**	**22.7**			**0.0**		**0.0**
Light trucks[d]	4,515.4	171.9	10.2			0.0		0.0
Other trucks	558.4	3,186.0	12.5			0.0		0.0
OFF-HIGHWAY	**146.3**	**570.1[e]**						
Construction	**33.3**	**178.5[e]**						
Agriculture	**113.0**	**391.6[e]**						
NONHIGHWAY	**274.4**	**765.1**		**2,024.3**	**890.0**	**706.6**	**310.9**	
Air	**31.7**			**2,024.3**				
General aviation	31.7			63.6				
Domestic air carriers				1,671.9				
International air carriers[f]				288.8				
Water	**242.7**	**281.1**			**890.0**			
Freight		281.1			890.0			
Recreational	242.7							
Pipeline						**706.6**	**248.6**	
Rail		**484.0**					**62.3**	
Freight (Class I)		465.4						
Passenger		18.6					62.3	
Transit							44.0	
Commuter		8.4					14.7	
Intercity		10.2					3.6	
TOTAL	**14,683.7**	**4,960.3**	**22.9**	**2,024.3**	**890.0**	**708.4**	**312.1**	**0.8**

Source:
See Appendix A for Table 2.10.

[a]Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g. snowmobiles).
[b]Includes gasohol.
[c]1993 data; 1994 data are not yet available.
[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.

Table 2.11
Transportation Energy Use by Mode, 1993-94[a]

	Trillion Btu		Thousand barrels per day crude oil equivalent[b]		Percentage of total	
	1993	1994	1993	1994	1993	1994
HIGHWAY	**17,527.9**	**17,914.7**	**8,279.6**	**8,462.3**	**75.9%**	**75.9%**
Automobiles	**9,204.2[c]**	**9,238.6**	**4,347.8**	**4,364.0**	**39.8%**	**39.1%**
Motorcycles	**24.8**	**25.6**	**11.7**	**12.1**	**0.1%**	**0.1%**
Buses	193.9	196.2	91.6	92.7	0.8%	0.8%
Transit	87.8	90.1	41.5	42.5	0.4%	0.4%
Intercity	24.0	24.0[d]	11.3	11.3	0.1%	0.1%
School	82.1	82.1[d]	38.8	38.8	0.4%	0.3%
Trucks	**8,104.9**	**8,454.4**	**3,828.5**	**3,993.6**	**35.1%**	**35.8%**
Light trucks[e]	4,563.1[c]	4,697.5	2,155.5	2,218.9	19.7%	19.9%
Other trucks	3,541.8	3,756.9	1,673.0	1,774.6	15.3%	15.9%
OFF-HIGHWAY	**706.5**	**716.4**	**333.7**	**338.4**	**3.1%**	**3.0%**
Construction	**209.2**	**211.8**	**98.8**	**100.0**	**0.9%**	**0.9%**
Agriculture	**497.3**	**504.6**	**234.9**	**238.4**	**2.2%**	**2.1%**
NONHIGHWAY	**4,870.8**	**4,971.3**	**2,300.8**	**2,348.3**	**21.1%**	**21.1%**
Air	**1,995.9**	**2,056.0**	**942.8**	**971.2**	**8.6%**	**8.7%**
General aviation	104.7	95.3	49.5	45.0	0.5%	0.4%
Domestic air carriers	1,613.6	1,671.9	762.2	789.7	7.0%	7.1%
International air carriers[f]	277.6	288.8	131.1	136.4	1.2%	1.2%
Water	**1,472.8**	**1,413.8**	**695.7**	**667.8**	**6.4%**	**6.0%**
Freight	1,222.1	1,171.1	577.3	553.2	5.3%	5.0%
Recreational	250.7	242.7	118.4	114.6	1.1%	1.0%
Pipeline	**889.1**	**955.2**	**420.0**	**451.2**	**3.8%**	**4.0%**
Rail	**513.0**	**546.3**	**242.3**	**258.1**	**2.2%**	**2.3%**
Freight	431.6	465.4	203.9	219.8	1.9%	2.0%
Passenger	81.4	80.9	38.5	38.2	0.4%	0.3%
Transit	42.2	44.0	19.9	20.8	0.2%	0.2%
Commuter	21.4	23.1	10.1	10.9	0.1%	0.1%
Intercity	17.8	13.8	8.4	6.5	0.1%	0.1%
TOTAL	**23,105.2**	**23,602.5**	**10,914.1**	**11,149.0**	**100.0%**	**100.0%**

Source: See Appendix A for Table 2.10.

[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]These 1993 data have been revised so that they are comparable with the 1994 data. See Table 2.10 for details.
[d]1993 data; 1994 data are not yet available.
[e]Two-axle, four-tire trucks.
[f]This figure is an estimate of the energy purchased in the U.S. for international air carrier consumption.

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 2.12
Transportation Energy Consumption by Mode, 1970-94
(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	174	4,155	3,381	16,971	1,971	1,641	849	476	4,937	21,908
1993	9,204	25	194	4,563	3,542	17,527	1,996	1,473	889	513	4,871	22,399
1994	9,239	26	196	4,698	3,757	17,915	2,056	1,414	955	546	4,971	22,886
					Average annual percentage change							
1970-94	0.3%	5.6%	2.5%	4.8%	3.9%	1.8%	1.9%	2.7%	-0.1%	-0.1%	1.4%	1.7%
1984-94	0.7%	1.7%	2.4%	3.1%	2.8%	1.7%	2.3%	1.2%	2.0%	0.4%	1.7%	1.7%

Source:
See Appendix A for Table 2.12.

[a]Beginning in 1993, data became available on alternative fuel use by transit buses.
[b]Light trucks include only those trucks which have 2-axles and 4-tires. Starting in 1993, this category includes minivans and sport utility vehicles.
[c]These 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 1993 and 1994 data may not be directly comparable to eariler years. Some states have improved reporting procedures in recent years, and the estimation procedures were revised for 1994.

Table 2.13
Highway Usage of Gasoline and Special Fuels, 1973-94
(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
			Average annual percentage change			
1973-94	-	-	1.1%	4.0%		1.1%
1984-94	0.8%	7.3%	2.5%	3.8%		1.7%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1995, pp. I-3, I-6, and annual.
Total highway fuel use - calculated as the sum of gasoline and special fuels.

[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 2.14
Passenger Travel and Energy Use in the United States, 1994

	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	**133,929.7**	**1,585,618**	**2,536,989**	**1.6**	**5,827**	**3,642**	**9,238.6**
Personal trucks	**43,204.9**	**416,164**	**624,245**	**1.5**	**7,781**	**5,187**	**3,238.0**
Motorcycles	**37,718.1**	**10,251**	**14,351**	**1.4**	**2,497**	**1,784**	**25.6**
Buses	**634.3**	**7,653**	**130,538**	**17.1**	**25,637**	**1,503**	**196.2**
Transit	67.5	2,163	20,238	9.4	41,655	4,452	90.1
Intercity	19.1	1,090	25,300	23.2	22,018[a]	949[a]	24.0[a]
School	547.7	4,400	85,000	19.3	18,659[a]	966[a]	82.1[a]
Air	[b]	**7,074**	**398,132**	**56.3**	**290,642**	**5,164**	**2,056.0**
Certificated route	[b]	4,157	388,432	93.4	471,662	5,048	1,960.7
General aviation	170.6	2,917[c]	9,700	3.3	32,671	9,825	95.3
Recreational boats	**9,971.0**	[b]	[b]	[b]	[b]	[b]	**242.7**
Rail	**18.0**	**1,103**	**25,367**	**23.0**	**73,345**	**3,189**	**80.9**
Intercity[d]	2.3[e]	306[f]	5,869[g]	19.2	45,098	2,351	13.8
Transit[h]	11.2	566	11,502	20.3	77,739	3,825	44.0
Commuter	4.5	231	7,996	34.6	100,000	2,889	23.1

Source:
See Appendix A for Table 2.14.

[a]1993 energy use data; 1994 data are not yet available.
[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 2.15
Intercity Freight Movement and Energy Use in the United States, 1994

	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]	**1,684**	**105,028**	**908,000**	**3,285**	**611[b]**	**2,827**	**2,567.0**
Waterborne commerce[c]	**39**	[d]	**814,919**	**1,099**	**746**	**369**	**300.7**
Coastal	[d]	[d]	457,601	277	1,652	[d]	[d]
Lakewise	[d]	[d]	58,263	115	508	[d]	[d]
Internal and local	[d]	[d]	299,055	707	423	[d]	[d]
Pipeline	[d]	[d]	[d]	**1,653**	[d]	[d]	**901.5**
Natural gas	[d]	[d]	[d]	541	[d]	[d]	743.1
Crude oil and products	[d]	[d]	608,000	1,112	[d]	261	158.4
Class I Railroads[e]	**591**	**28,485**	**1,200,701**	**2,185**	**817**	**388**	**465.4**

Source:
See Appendix A for Table 2.15.

[a]The definition of intercity truck was "tightened" to exclude smaller trucks. See Appendix A for details.
[b]1992 data are the latest available. 611 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 283 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 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 2.16
Energy Intensities of Passenger Modes, 1970-94

	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
1971	9,283	5,461	30,255	2,475	1,039	17,857	10,103	9,957	[b]	2,595
1972	9,383	5,519	30,352	2,454	1,016	16,956	9,017	10,340	[b]	2,540
1973	9,456	5,562	30,657	2,597	981	16,957	8,919	8,449	3,756	2,460
1974	9,372	5,513	31,516	2,518	949	16,980	7,917	9,054	3,240	2,840
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	37,071	3,970	978	16,767	4,482	8,582	2,610	3,575
1993	5,948	3,418	39,081[c]	4,374[c]	980	18,659	5,427	9,343	2,646	3,687
1994	5,827	3,642	41,655	4,452	[b]	[b]	5,048	9,825	2,351	3,825
					Average annual percentage change					
1970-94	-1.9%	-1.7%	1.1%	2.5%	-0.3%[d]	0.2%[d]	-2.9%	-0.2%	-2.2%[e]	1.9%
1984-94	-1.9%	-1.3%	1.1%	3.3%	-2.6%[d]	2.5%[d]	0.0%	-1.9%	-2.5%	0.2%

Source:
See Appendix A for Table 2.16.

[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 1993 data became available on alternative fuel use by transit buses.
[d]Average annual percentage change is for years 1970-93 and 1984-93.
[e]Average annual percentage change is for years 1973-94.

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 2.17
Energy Intensities of Freight Modes, 1970-94

Year	Trucks			Class I freight railroad[a]		Domestic waterborne commerce (Btu per ton-mile)
	Light truck[b] (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[c]	22,150	11,054	16,055	389	389
1994	7,999[c]	22,046	11,158	16,338	388	369
			Average annual percentage change			
1970-94	-1.8%	-0.4%	-1.6%	-0.3%	-2.4%	-1.6%
1984-94	-1.9%	-0.4%	-1.6%	-0.9%	-2.7%	0.6%

Source:
See Appendix A for Table 2.17.

[a]These data have changed from previous editions due to a change in source for energy use data. Previous estimates were based on sales.
[b]All two-axle, four-tire trucks (which would include trucks which may not carry freight).
[c]These data include minivans and sport utility vehicles which were not previously included in this category.

Transportation Energy Trends Analysis

Since the first oil price shock in October of 1973, important changes have occurred in the way energy is used in the U.S. transportation system. Knowing how and how much transportation energy use has changed is important to understanding how the system responds to energy challenges and how it is evolving as a result of long-term social, economic, and technological trends. As a first level of analysis, changes in transportation energy use can be decomposed into changes due to: 1) growth in transportation activity, 2) changes in the distribution of activity across modes, and 3) changes in the energy intensiveness of transport modes. A mathematical technique known as Divisia analysis can be used to rigorously decompose energy use trends (see, e.g., Greene and Fan, 1994). This technique is used here to look at the sector as a whole, at a high level of generality, and to look in increasing detail at passenger and freight movements.

For each analysis a table and figure are displayed. The tables show actual energy use by year in the first column, followed by the level of energy use that would have been required for that year if the actual level of transportation activity had taken place at 1972 average energy intensity (the "trended energy use"). Next comes the total change in energy use from the previous year, followed by the components of change. The components will add up to the total change, except for rounding. Note that the components will tend to increase in absolute value over time, all else equal, as activity levels increase. Finally, the level of activity is shown. In the figures, trended energy use and actual energy use are plotted as dashed and solid lines, respectively. Below are bars showing the individual components, factors tending to increase energy use projected above zero, those tending to decrease it projected below zero. The sum of the bars in each year exactly equals the difference between the trended and actual energy use.

This work was performed by Oak Ridge National Laboratory for the U.S. Department of Energy, Office of Energy Demand Policy.

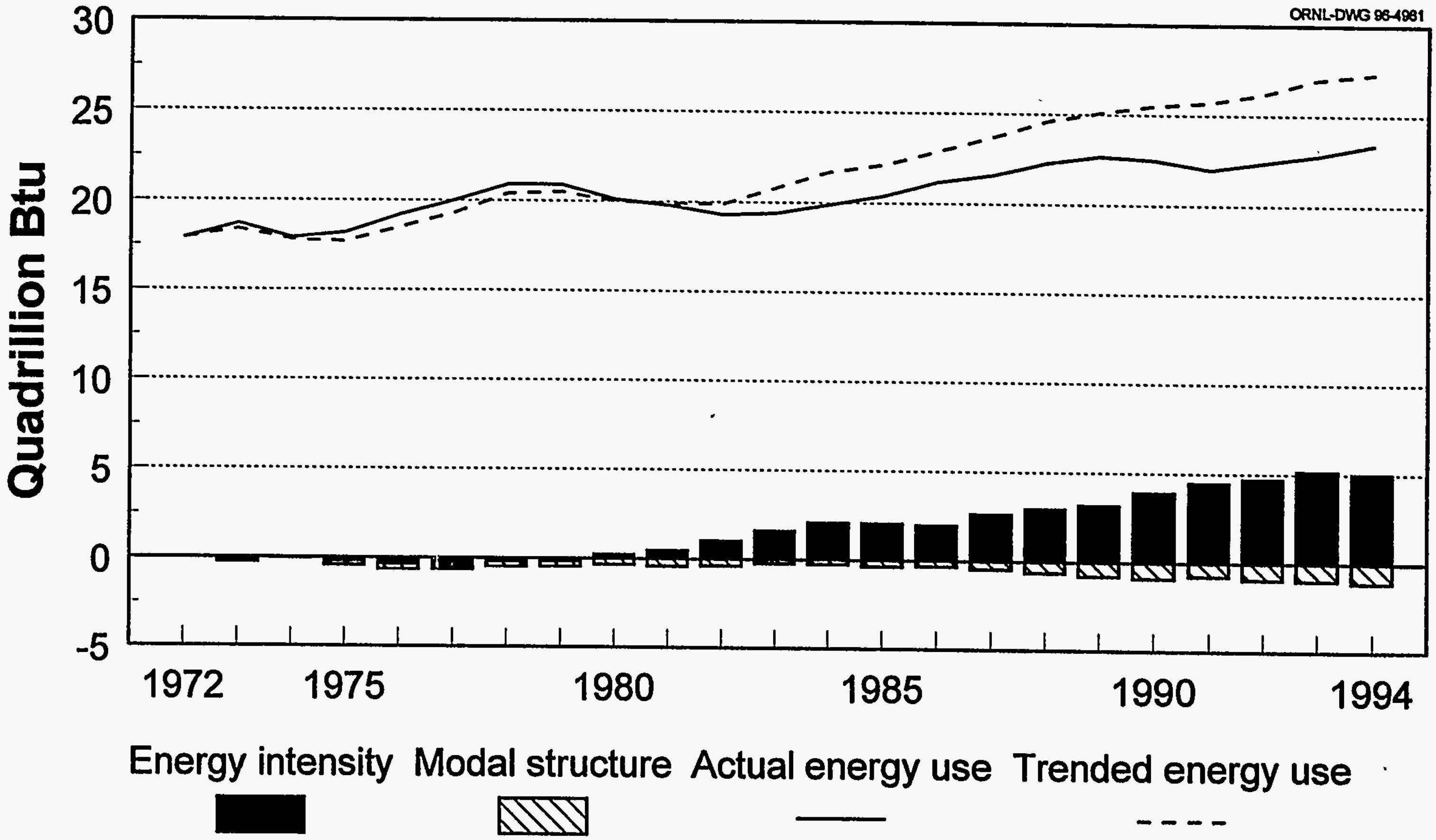
Overall transportation energy use increased by five quads from 1972 to 1994, from 17.9 to 23.4 quads. Energy use would have been 4 quads (17%) higher, had energy intensiveness not been reduced. Note that there is little difference between actual and trended energy use in the first decade from 1972 to 1982, and that the two curves diverge thereafter. This implies that the energy intensity of transportation changed very little during the first decade following the initial oil price shock of 1973-74. The changes in transportation energy use during that period were due primarily to changes in the amount of transportation activity. In other words, response to the initial price shock came largely in the form of traveling less and shipping less. The fact that energy efficiency improvements did not come until after the second price shock in 1979-80 is largely due to the fact that it takes a long time to change the energy using technology embodied in transportation equipment. Not only do transportation vehicles last a decade and often considerably more, but it takes additional time for manufacturers to redesign and retool to produce more efficient vehicles.

Table 2.18
Changes in Transportation Energy Use, 1972-94
Modal Energy Intensity and Modal Structure Effects

Year	Actual energy use (quadrillion Btu)	Trended energy use (quadrillion Btu)	Components of energy savings (quadrillion Btu) Total	Modal energy intensity	Modal structure	Activity (billion 1987 dollars)
1972	17.9	17.9	0.00	0.00	0.00	679
1973	18.7	18.4	-0.27	-0.13	-0.14	697
1974	17.9	17.8	-0.06	-0.02	-0.04	674
1975	18.2	17.7	-0.45	-0.23	-0.22	670
1976	19.2	18.5	-0.65	-0.41	-0.24	701
1977	20.0	19.3	-0.65	-0.48	-0.16	731
1978	20.9	20.4	-0.48	-0.24	-0.24	771
1979	20.9	20.5	-0.45	-0.20	-0.25	775
1980	20.1	20.0	-0.12	0.23	-0.34	756
1981	19.8	19.9	0.05	0.46	-0.41	751
1982	19.3	19.9	0.64	1.02	-0.38	754
1983	19.4	20.8	1.36	1.59	-0.24	785
1984	19.9	21.7	1.83	2.08	-0.25	822
1985	20.4	22.1	1.71	2.06	-0.35	835
1986	21.2	22.9	1.67	1.98	-0.31	864
1987	21.6	23.7	2.18	2.62	-0.45	898
1988	22.3	24.6	2.34	2.95	-0.62	931
1989	22.7	25.1	2.38	3.17	-0.79	948
1990	22.5	25.5	3.00	3.90	-0.90	963
1991	22.0	25.7	3.71	4.46	-0.76	973
1992	22.4	26.2	3.77	4.69	-0.92	992
1993	22.8	27.0	4.17	5.15	-0.98	1,020
1994	23.4	27.3	3.92	5.02	-1.10	1,034

Source:
Methodology found in Greene, David L. and Yuehui Fan, Transportation Energy Efficiency Trends, 1972-1992, Oak Ridge National Laboratory, Oak Ridge, TN, December 1994.

Figure 2.3. Changes in Transportation Energy Use, 1972-94
Modal Energy Intensity and Modal Structure Effects



Source: See Table 2.18.

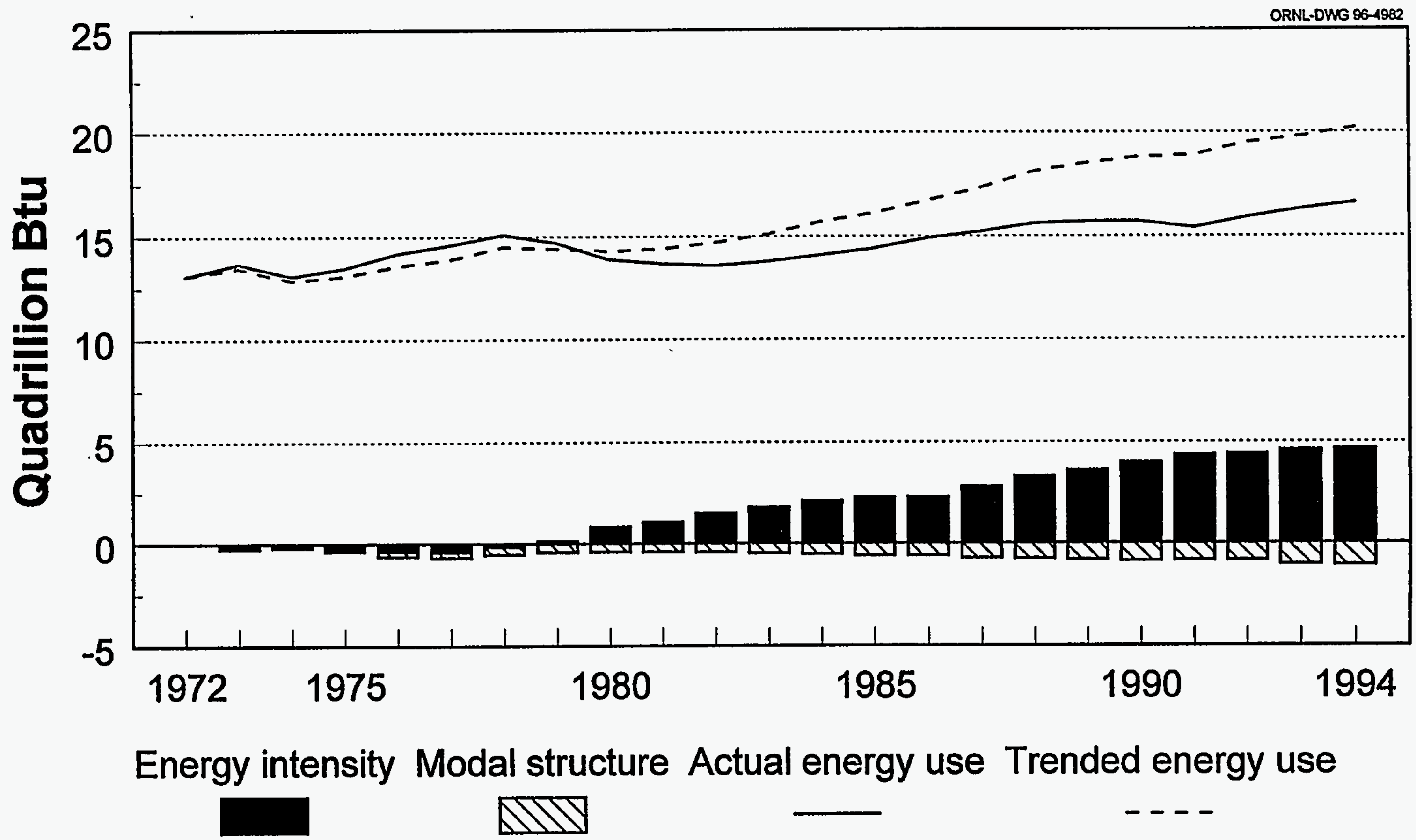
The decomposition of energy use in passenger travel looks very similar to that of total transportation. This is because, 1) passenger travel accounts for 70% of total transportation energy use, and 2) there appears to have been little overall change in freight energy intensity, as is shown in the following material. Energy use for passenger travel is 3.6 quads (22%) less than it would have been at 1972 energy intensities.

Table 2.19
Changes in Passenger Transportation Energy Use, 1972-94
Modal Energy Intensity and Modal Structure Effects

Year	Actual energy use (quadrillion Btu)	Trended energy use (quadrillion Btu)	Components of energy savings (quadrillion Btu): Total	Modal energy intensity	Modal structure	Activity (billion passenger-miles)
1972	13.1	13.1	0.00	0.00	0.00	2,717
1973	13.7	13.5	-0.25	-0.14	-0.11	2,784
1974	13.1	12.9	-0.19	-0.06	-0.13	2,671
1975	13.5	13.1	-0.38	-0.21	-0.16	2,704
1976	14.2	13.6	-0.61	-0.40	-0.21	2,810
1977	14.6	13.9	-0.69	-0.42	-0.27	2,875
1978	15.1	14.5	-0.54	-0.17	-0.37	3,007
1979	14.7	14.4	-0.30	0.12	-0.42	2,986
1980	13.9	14.3	0.43	0.83	-0.41	2,958
1981	13.7	14.4	0.65	1.05	-0.40	2,970
1982	13.6	14.7	1.05	1.48	-0.42	3,031
1983	13.8	15.1	1.31	1.79	-0.48	3,119
1984	14.1	15.7	1.58	2.09	-0.52	3,238
1985	14.4	16.1	1.67	2.26	-0.59	3,324
1986	14.9	16.7	1.70	2.29	-0.59	3,444
1987	15.2	17.3	2.08	2.80	-0.73	3,577
1988	15.6	18.1	2.53	3.30	-0.76	3,746
1989	15.7	18.5	2.80	3.60	-0.81	3,833
1990	15.7	18.8	3.11	3.98	-0.87	3,897
1991	15.4	18.9	3.52	4.37	-0.85	3,911
1992	15.9	19.5	3.57	4.42	-0.85	4,031
1993	16.3	19.8	3.56	4.59	-1.03	4,097
1994	16.6	20.2	3.57	4.65	-1.08	4,171

Source:
Methodology found in Greene, David L. and Yuehui Fan, Transportation Energy Efficiency Trends, 1972-1992, Oak Ridge National Laboratory, Oak Ridge, TN, December 1994.

Figure 2.4. Changes in Passenger Transportation Energy Use, 1972-94
Modal Energy Intensity and Modal Structure Effects



Source: See Table 2.19.

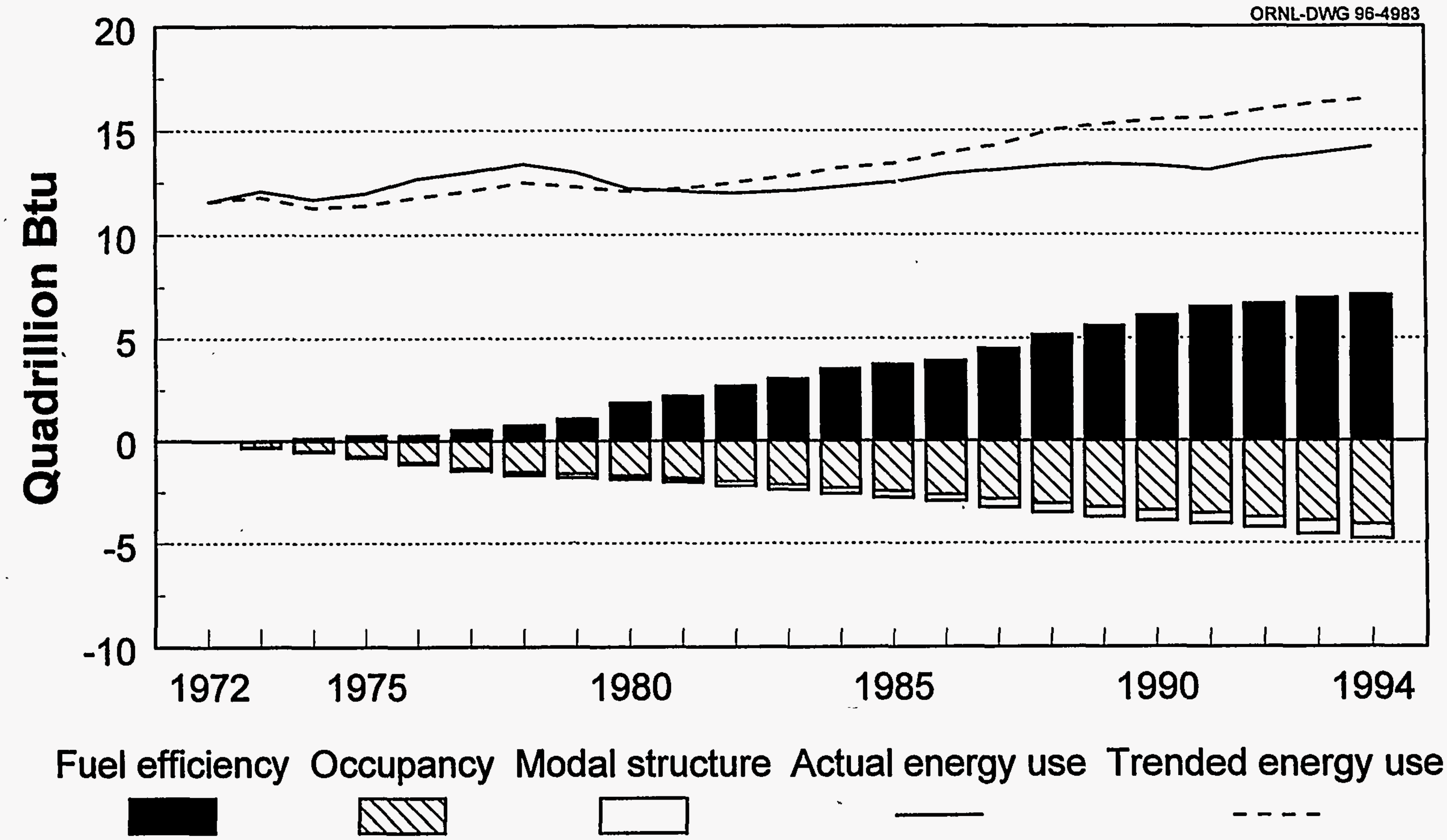
The most interesting aspect of trends in highway passenger energy use is the fact that very large potential gains due to vehicle fuel economy have been cut more than in half by decreasing vehicle occupancy rates. Highway passenger energy use would have been 50% higher had there been no improvement in vehicle miles per gallon. A persistent, gradual trend of fewer passengers per vehicle offset 4.0 quads (58%) of the potential energy savings due to vehicle fuel economy. The vehicle occupancy data come from the Nationwide Personal Transportation Survey conducted approximately every five years. Thus, true year-to-year changes cannot be captured. Nonetheless, the trend of steadily declining vehicle occupancy rates is clearly reflected in every survey. Changes in the distribution of travel among vehicle types has also tended to increase energy intensiveness, though by less than 5%; increasing popularity of light trucks is largely responsible.

Table 2.20
Changes in Highway Passenger Transportation Energy Use, 1972-94
Efficiency, Occupancy and Vehicle Type Effects

Year	Actual energy use (quadrillion Btu)	Trended energy use (quadrillion Btu)	Components of energy savings (quadrillion Btu): Total	Fuel efficiency	Occupancy	Modal structure	Activity (billion passenger-miles)
1972	11.6	11.6	0.00	0.00	0.00	0.00	2,534
1973	12.1	11.8	-0.32	-0.04	-0.24	-0.04	2,577
1974	11.7	11.3	-0.38	0.14	-0.48	-0.04	2,463
1975	12.0	11.4	-0.55	0.26	-0.74	-0.07	2,497
1976	12.7	11.8	-0.86	0.27	-1.04	-0.09	2,584
1977	13.0	12.1	-0.94	0.53	-1.35	-0.12	2,635
1978	13.4	12.5	-0.92	0.77	-1.52	-0.17	2,734
1979	13.0	12.3	-0.72	1.07	-1.60	-0.19	2,677
1980	12.2	12.1	-0.02	1.86	-1.70	-0.18	2,652
1981	12.1	12.2	0.18	2.18	-1.83	-0.18	2,674
1982	12.0	12.5	0.51	2.69	-1.98	-0.20	2,725
1983	12.1	12.8	0.64	3.03	-2.14	-0.24	2,790
1984	12.3	13.2	0.95	3.51	-2.30	-0.26	2,884
1985	12.5	13.4	0.96	3.74	-2.45	-0.33	2,938
1986	12.9	13.9	0.98	3.91	-2.62	-0.31	3,029
1987	13.1	14.3	1.24	4.49	-2.83	-0.42	3,123
1988	13.3	15.0	1.67	5.17	-3.06	-0.44	3,272
1989	13.4	15.3	1.88	5.60	-3.24	-0.48	3,347
1990	13.3	15.5	2.17	6.09	-3.40	-0.52	3,387
1991	13.1	15.6	2.48	6.52	-3.53	-0.51	3,410
1992	13.6	16.0	2.43	6.67	-3.73	-0.51	3,501
1993	13.9	16.3	2.38	6.94	-3.89	-0.67	3,557
1994	14.2	16.5	2.30	7.10	-4.08	-0.71	3,598

Source:
Methodology found in Greene, David L. and Yuehui Fan, Transportation Energy Efficiency Trends, 1972-1992, Oak Ridge National Laboratory, Oak Ridge, TN, December 1994.

Figure 2.5. Changes in Highway Passenger Transportation Energy Use, 1972-94
Efficiency, Occupancy and Vehicle Type Effects



Source: See Table 2.20.

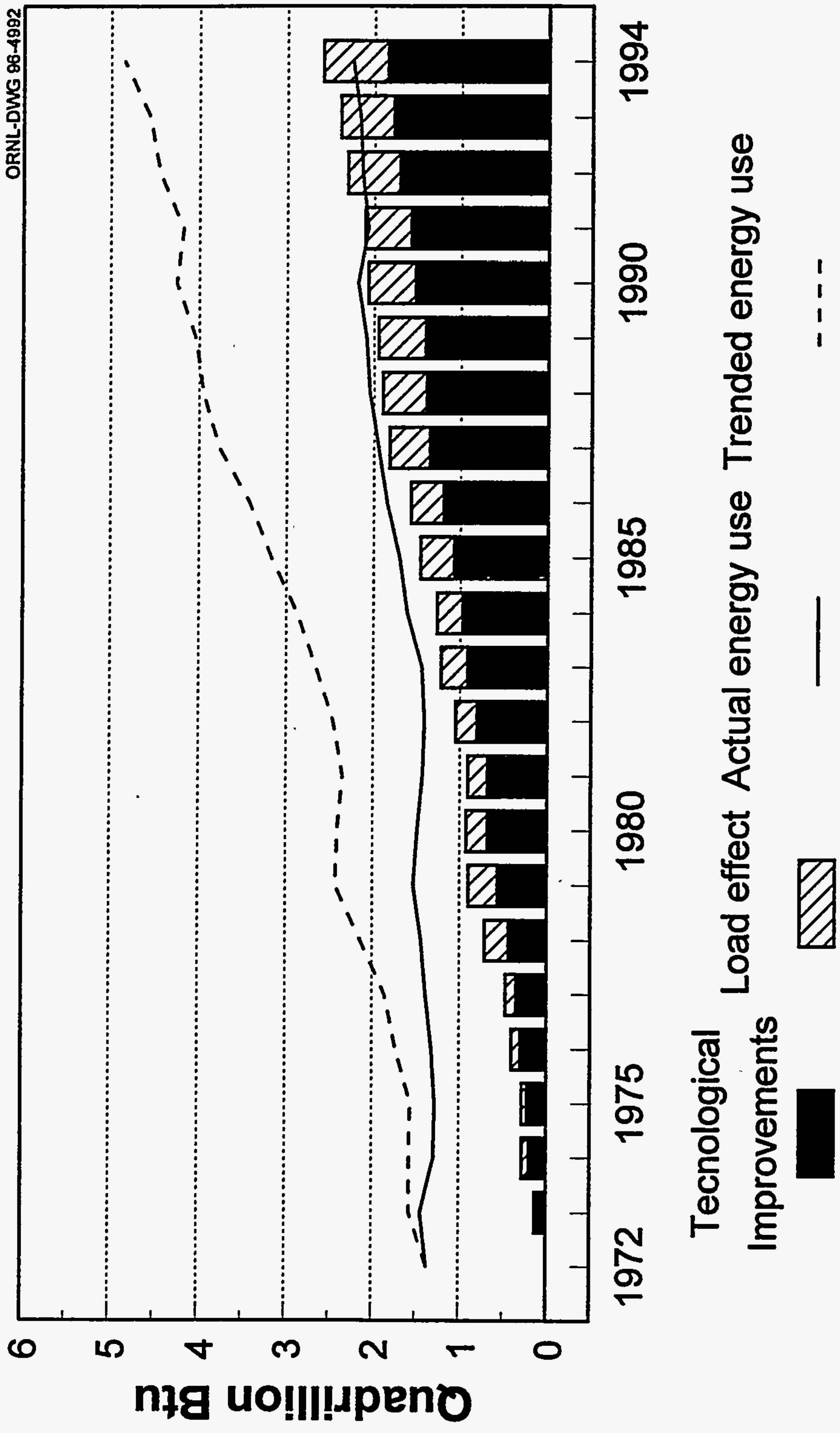
Had there been no reduction in the energy intensity of air travel since 1972, commercial airlines would be using over twice as much jet fuel as they are today: 4.9 instead of 2.3 quads. This remarkable increase in the energy efficiency of air travel was achieved through a combination of aircraft and load factor improvements. Reduced energy use per seat-mile, accomplished by simultaneously reducing energy use per aircraft mile and increasing aircraft size (average number of seats per aircraft), accounted for nearly three quarters of the reduction in energy use per passenger. Higher load factors (average seat occupancy rates) provided the rest of the savings.

Table 2.21
Changes in Air Passenger Transportation Energy Use, 1972-94
Seat-Miles Efficiency and Load Factor Effects

Year	Actual energy use (quadrillion Btu)	Trended energy use (quadrillion Btu)	Components of energy savings (quadrillion Btu): Total	Technological improvements	Load effect	Activity (billion passenger-miles)
1972	1.37	1.37	0.00	0.00	0.00	152
1973	1.44	1.57	0.13	0.10	0.03	174
1974	1.29	1.57	0.28	0.20	0.08	174
1975	1.28	1.56	0.28	0.23	0.05	173
1976	1.32	1.73	0.41	0.30	0.10	192
1977	1.39	1.86	0.47	0.35	0.12	206
1978	1.44	2.14	0.70	0.44	0.27	237
1979	1.53	2.43	0.90	0.57	0.33	270
1980	1.49	2.41	0.92	0.69	0.24	268
1981	1.43	2.35	0.92	0.69	0.22	260
1982	1.41	2.46	1.05	0.81	0.24	272
1983	1.44	2.66	1.22	0.92	0.30	295
1984	1.61	2.88	1.27	0.98	0.29	320
1985	1.70	3.17	1.46	1.08	0.38	351
1986	1.85	3.42	1.57	1.20	0.37	379
1987	1.95	3.77	1.82	1.36	0.46	418
1988	2.05	3.95	1.90	1.40	0.50	438
1989	2.09	4.04	1.95	1.41	0.54	447
1990	2.19	4.26	2.07	1.53	0.54	472
1991	2.07	4.18	2.11	1.58	0.53	463
1992	2.14	4.45	2.31	1.71	0.60	494
1993	2.17	4.56	2.39	1.78	0.61	506
1994	2.25	4.85	2.60	1.85	0.74	537

Source:
Methodology found in Greene, David L. and Yuehui Fan, Transportation Energy Efficiency Trends, 1972-1992, Oak Ridge National Laboratory, Oak Ridge, TN, December 1994.

Figure 2.6. Changes in Air Passenger Transportation Energy Use, 1972-94
Seat-Miles Efficiency and Load Factor Effects



Source: See Table 2.21.

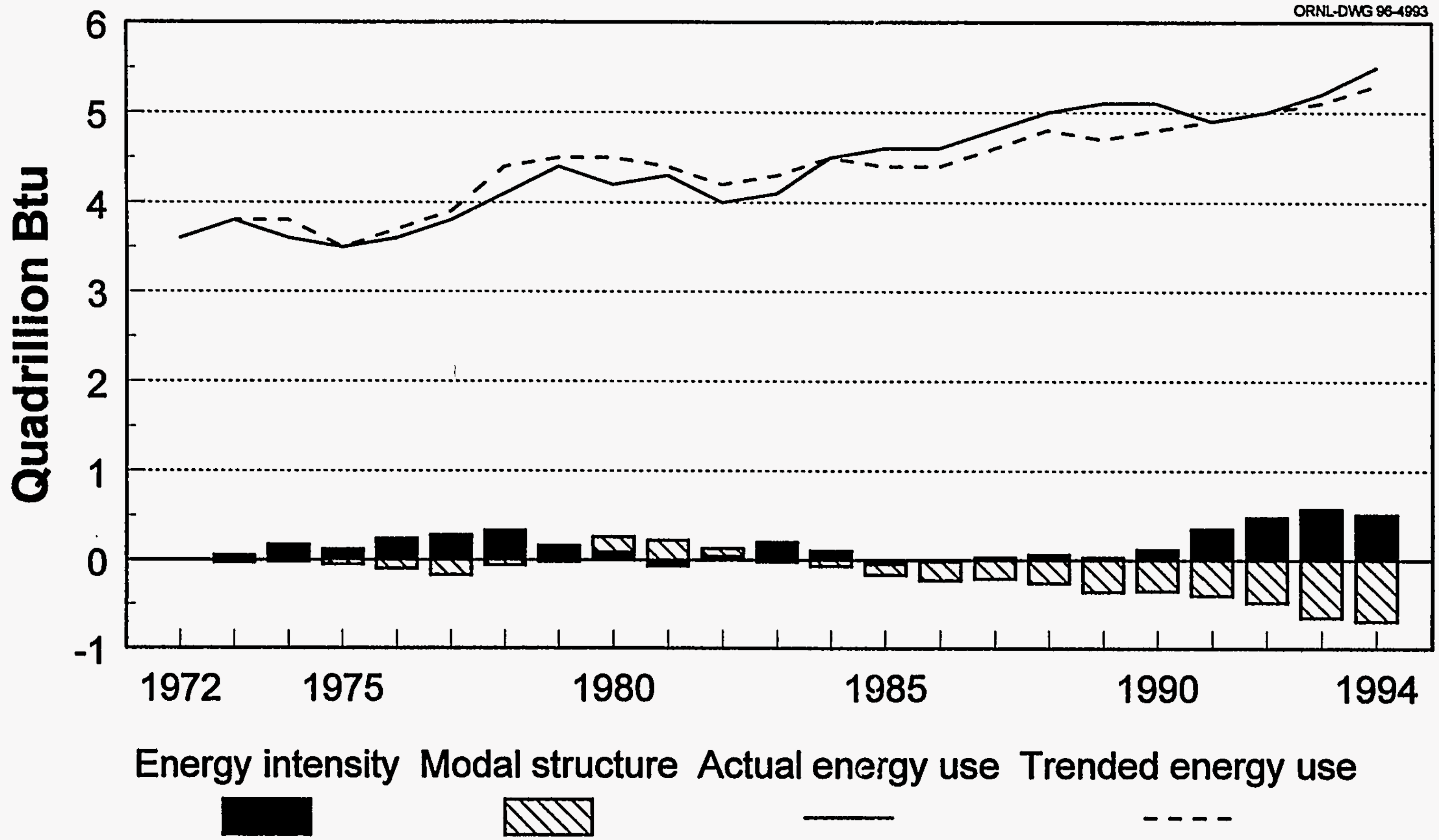
Before reviewing the freight transportation energy decomposition, we note that the quality of estimates of freight ton-miles tends to be poor, especially for the highway mode which is by far the largest energy user. Since energy use per ton-mile is the basic measure of energy intensity, this argues for caution in drawing firm conclusions about the freight sector Divisia analysis. With that in mind, the data indicate that at 1972 energy intensities, 1994 freight movements would have required almost the same amount of energy as was actually used in 1994. That is, not much improvement in energy intensity is indicated. An improvement in energy use per ton-mile within individual modes appears to have been wiped out by a gradual shift in traffic to the more energy intensive modes (highway and air).

Table 2.22
Changes in Freight Transportation Energy Use, 1972-94
Modal Energy Intensity and Modal Structure Effects

	Actual energy use	Trended energy use	Components of energy savings (quadrillion Btu)			Activity (billion ton-miles)
Year	(quadrillion Btu)		Total	Modal energy intensity	Modal structure	
1972	3.6	3.6	0.00	0.00	0.00	2,871
1973	3.8	3.8	0.02	0.05	-0.03	3,019
1974	3.6	3.8	0.15	0.17	-0.02	2,986
1975	3.5	3.5	0.07	0.12	-0.05	2,812
1976	3.6	3.7	0.14	0.24	-0.10	2,968
1977	3.8	3.9	0.11	0.28	-0.17	3,099
1978	4.1	4.4	0.27	0.33	-0.06	3,471
1979	4.4	4.5	0.13	0.16	-0.02	3,571
1980	4.2	4.5	0.25	0.09	0.17	3,568
1981	4.3	4.4	0.15	-0.07	0.22	3,507
1982	4.0	4.2	0.13	0.04	0.09	3,312
1983	4.1	4.3	0.18	0.20	-0.02	3,412
1984	4.5	4.5	0.03	0.10	-0.07	3,563
1985	4.6	4.4	-0.17	-0.05	-0.12	3,511
1986	4.6	4.4	-0.23	-0.02	-0.21	3,511
1987	4.8	4.6	-0.18	0.03	-0.21	3,670
1988	5.0	4.8	-0.20	0.06	-0.26	3,795
1989	5.1	4.7	-0.33	0.03	-0.36	3,764
1990	5.1	4.8	-0.23	0.12	-0.35	3,850
1991	4.9	4.9	-0.05	0.35	-0.40	3,873
1992	5.0	5.0	0.00	0.48	-0.48	3,986
1993	5.2	5.1	-0.08	0.57	-0.65	4,054
1994	5.5	5.3	-0.17	0.51	-0.69	4,226

Source:
Methodology found in Greene, David L. and Yuehui Fan, Transportation Energy Efficiency Trends, 1972-1992, Oak Ridge National Laboratory, Oak Ridge, TN, December 1994.

Figure 2.7. Changes in Freight Transportation Energy Use, 1972-94
Modal Energy Intensity and Modal Structure Effects



Source: See Table 2.22.

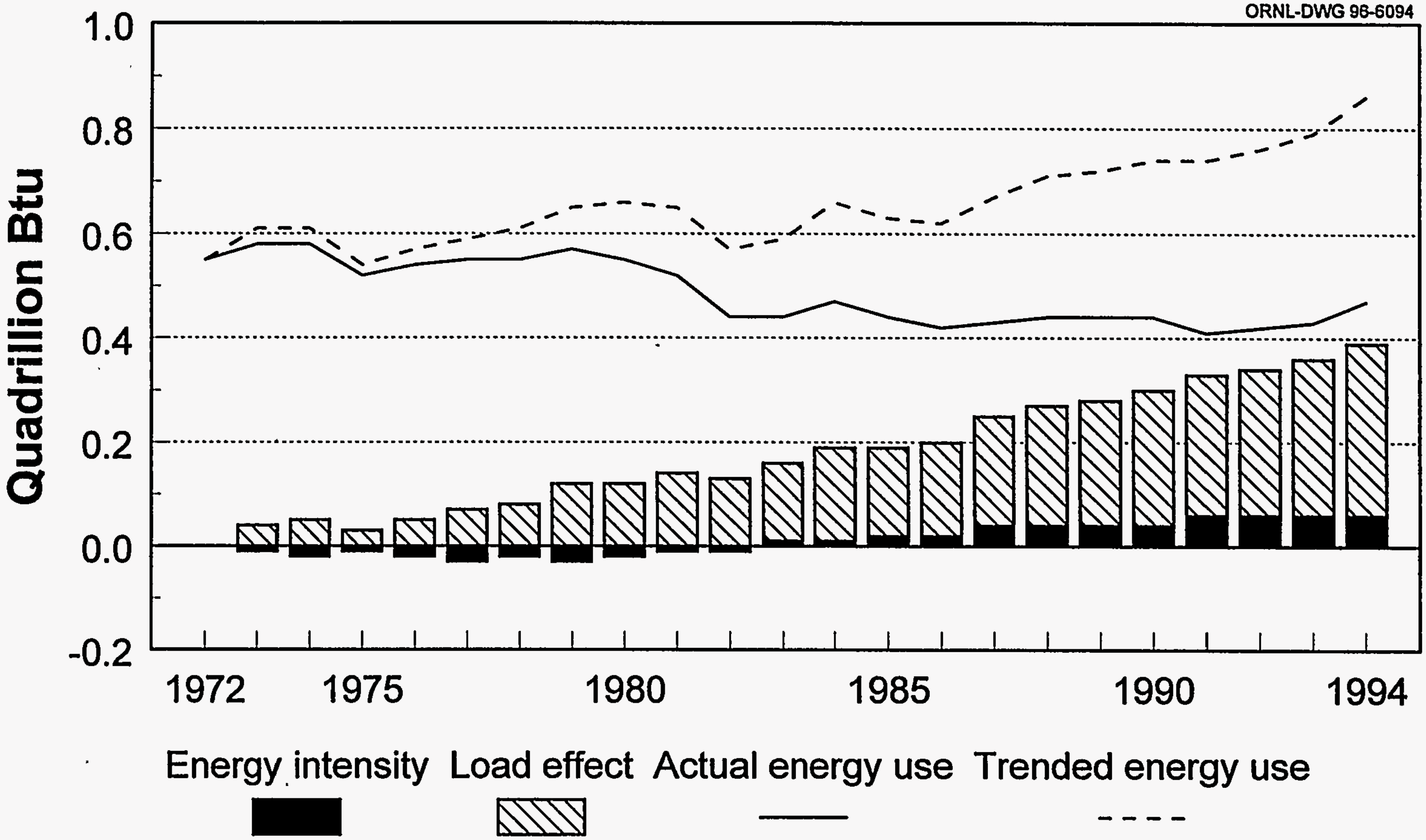
In sharp contrast to overall freight energy trends, rail energy use per ton-mile has been dramatically improved. At 1972 energy intensity per ton-mile, 1994 rail freight movements would have required nearly twice as much energy (0.86 quads versus 0.47 quads actually used). Higher car-loadings are primarily responsible. More than any other mode, rail freight appears to have increased its energy efficiency by improving the efficiency of operations. Energy use per car-mile was also reduced, however, despite the increase in ton-miles per car-mile.

Table 2.23
Changes in Rail Freight Transportation Energy Use, 1972-94
Efficiency and Load Factor Effects

Year	Actual energy use (quadrillion Btu)	Trended energy use (quadrillion Btu)	Components of energy savings (quadrillion Btu): Total	Modal energy intensity	Load effect	Activity (billion ton-miles)
1972	0.55	0.55	0.00	0.00	0.00	777
1973	0.58	0.61	0.03	-0.01	0.04	852
1974	0.58	0.61	0.03	-0.02	0.05	851
1975	0.52	0.54	0.02	-0.01	0.03	754
1976	0.54	0.57	0.03	-0.02	0.05	794
1977	0.55	0.59	0.04	-0.03	0.07	826
1978	0.55	0.61	0.06	-0.02	0.08	858
1979	0.57	0.65	0.09	-0.03	0.12	914
1980	0.55	0.66	0.11	-0.02	0.12	919
1981	0.52	0.65	0.13	-0.01	0.14	910
1982	0.44	0.57	0.13	-0.01	0.13	798
1983	0.44	0.59	0.16	0.01	0.15	828
1984	0.47	0.66	0.19	0.01	0.18	922
1985	0.44	0.63	0.19	0.02	0.17	877
1986	0.42	0.62	0.20	0.02	0.18	868
1987	0.43	0.67	0.24	0.04	0.21	944
1988	0.44	0.71	0.27	0.04	0.23	996
1989	0.44	0.72	0.28	0.04	0.24	1,014
1990	0.44	0.74	0.30	0.04	0.26	1,034
1991	0.41	0.74	0.33	0.06	0.27	1,039
1992	0.42	0.76	0.34	0.06	0.28	1,067
1993	0.43	0.79	0.36	0.06	0.30	1,109
1994	0.47	0.86	0.39	0.06	0.33	1,201

Source:
Methodology found in Greene, David L. and Yuehui Fan, Transportation Energy Efficiency Trends, 1972-1992, Oak Ridge National Laboratory, Oak Ridge, TN, December 1994.

Figure 2.8. Changes in Rail Freight Transportation Energy Use, 1972-94
Efficiency and Load Factor Effects



Source: See Table 2.23.

Prices for alternative fuels can be found in Chapter 5.

Table 2.24
Retail Prices for Motor Fuel, 1978-95
(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	[d]	[d]	114.7	98.3	133.6	114.5	120.5	103.3
			Average annual percentage change					
1978-95	-0.4%[e]	-4.5%[e]	3.2%	-1.8%	-0.7%[f]	-4.3%[f]	3.7%	-1.4%
1985-95	-2.6%[e]	-6.0%[e]	-0.5%	-3.9%	0.0%	-3.5%	0.1%	-3.4%

Sources:
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review April 1996, Washington, DC, Table 9.4, p. 114.
Diesel - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1993, Washington, DC, May 1995, pp. 94.

[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 2.25
Prices for Selected Transportation Fuels, 1978-95
(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
				Average annual percentage change				
1978-95	2.3%	-2.7%	4.0%	-1.1%	2.0%	-3.0%	2.4%	-2.6%
1985-95	-3.7%	-7.0%	-1.8%	-5.1%	-3.8%	-7.1%	-3.4%	-6.7%

Sources:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, April 1996, Washington, DC, Table 9.7, p. 117.

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

The average price of a barrel of crude oil (in constant 1990 dollars) declined by 33.5% from 1990 to 1995, while the average price of a gallon of gasoline declined only 15.1% in this same time period. There could be many reasons for this difference—for example, Federal and State gasoline tax increases and differences in crude oil processing cost.

Table 2.26
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978-95

	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
		Average annual percentage change			
1978-95	1.9%	-3.0%	3.7%	-1.4%	
1985-95	-4.3%	-7.6%	0.1%	-3.4%	

Sources:
Crude Oil - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, April 1996, Washington, DC, Table 9.1, p. 111.
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, April 1996, Washington, DC, Table 9.4, p. 114.

[a]Refiner acquisition cost of composite (domestic and import) 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 2.27
Gross National Product as Related to Transportation, 1970-94

Year	Gross National Product (billion dollars) Current	Gross National Product (billion dollars) Constant 1990[a]	Total transportation outlays (billion dollars) Current	Total transportation outlays (billion dollars) Constant 1990[a]	Transportation as a percent of GNP
1970	1,015.5	3,031.3	195.2	583	19.2%
1971	1,102.7	3,127.8	222.0	630	20.1%
1972	1,212.8	3,304.5	242.3	660	20.0%
1973	1,359.3	3,499.9	266.5	686	19.6%
1974	1,472.8	3,490.0	282.6	670	19.2%
1975	1,598.4	3,463.9	298.9	648	18.7%
1976	1,782.8	3,671.3	351.1	723	19.7%
1977	1,990.5	3,871.3	400.9	780	20.1%
1978	2,249.7	4,076.6	453.4	822	20.2%
1979	2,508.2	4,182.2	503.0	839	20.1%
1980	2,732.0	4,167.4	542.9	828	19.8%
1981	3,052.6	4,259.0	592.5	827	19.3%
1982	3,166.0	4,163.3	591.4	778	18.6%
1983	3,405.7	4,308.3	643.2	814	18.7%
1984	3,772.2	4,573.5	715.6	867	18.8%
1985	4,010.3	4,730.4	753.1	888	18.6%
1986	4,235.0	4,861.8	760.9	874	17.8%
1987	4,515.6	5,053.2	807.5	904	17.8%
1988	4,873.7	5,268.1	869.0	939	17.7%
1989	5,200.8	5,416.5	915.2	953	17.4%
1990	5,567.8	5,567.8	964.6	965	17.3%
1991	5,740.8	5,488.2	943.4	902	16.4%
1992	6,025.8	5,567.8	999.0	923	16.6%
1993	6,347.8	5,751.1	1,068.0	968	16.8%
1994	6,738.4	5,943.3	1,139.1	1,005	16.9%
		Average annual percentage change			
1970-94	8.2%	2.8%	7.6%	2.3%	
1984-94	6.0%	2.7%	4.8%	1.5%	

Sources:

1970-86 GNP - U.S. Department of Commerce, Bureau of Census, Statistical Abstract of the United States 1988, p. 410.

1987-94 GNP - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July 1995, Table 1.9, p. 57, and annual.

Transportation outlays - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, 1995, p. 38.

[a]Adjusted by the implicit GNP price deflator.

Personal consumption expenditures (PCE) have more than doubled from 1970 to 1994. Transportation PCE have grown 96% in that same time period. Transportation expenditures accounted for 11.6% of total PCE in 1994.

Table 2.28
Personal Consumption Expenditures as Related to Transportation, 1970-94

	Personal Consumption Expenditures (billion dollars)		Transportation Personal Consumption Expenditures[a] (billion dollars)		
Year	Current	Constant 1990[b]	Current	Constant 1990[b]	Transportation PCE as a percent of total PCE
1970	640.0	1,910.4	81.5	243.3	12.7%
1971	691.6	1,961.7	95.2	270.0	13.8%
1972	757.6	2,064.2	105.8	288.3	14.0%
1973	837.2	2,155.6	116.0	298.7	13.9%
1974	916.5	2,171.8	119.8	283.9	13.1%
1975	1,012.8	2,194.9	131.2	284.3	13.0%
1976	1,129.3	2,325.6	157.1	323.5	13.9%
1977	1,257.2	2,445.1	181.5	353.0	14.4%
1978	1,403.5	2,543.2	199.9	362.2	14.2%
1979	1,566.8	2,612.5	222.0	370.2	14.2%
1980	1,732.6	2,642.9	238.5	363.8	13.8%
1981	1,915.1	2,672.0	261.5	364.8	13.7%
1982	2,050.7	2,696.7	267.6	351.9	13.0%
1983	2,234.5	2,826.7	295.4	373.7	13.2%
1984	2,430.5	2,946.8	329.5	399.5	13.6%
1985	2,629.0	3,101.1	359.5	424.1	13.7%
1986	2,797.4	3,211.4	366.3	420.5	13.0%
1987	3,009.4	3,367.7	379.7	424.9	12.6%
1988	3,296.1	3,562.9	413.2	446.6	12.5%
1989	3,523.1	3,669.2	437.3	455.4	12.4%
1990	3,761.2	3,761.2	453.9	453.7	12.1%
1991	3,902.4	3,730.7	433.6	414.5	11.1%
1992	4,136.9	3,822.5	466.3	430.9	11.3%
1993	4,378.2	3,966.6	504.2	456.8	11.5%
1994	4,628.4	4,110.0	538.0	477.7	11.6%
		Average annual percentage change			
1970-94	8.6%	3.2%	8.2%	2.9%	
1984-94	6.7%	3.4%	5.0%	1.8%	

Sources:

1970-86 data - U.S. Department of Commerce, Bureau of Census, Statistical Abstract of the United States 1988, p. 412.

1987-94 data - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July 1995, Table 2.2, p. 12, and annual.

[a]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, tires, tubes and other parts, insurance premiums); purchased intercity transportation; and purchased local transportation.

[b]Adjusted by the implicit GNP price deflator.

The Consumer Price Index (CPI) for transportation has almost quadrupled from 1970 to 1995; and the Used Car CPI continued to grow at a much faster rate than did the New Car CPI. This means that while consumers paid for a new automobile in 1995 more than double what they did in 1970, they paid over five times more to buy a used car in 1995 than in 1970.

Table 2.29
Statistical Indices as Related to Transportation, 1970-94
(1970 = 1.000)

Year	Consumer Price Index	Transportation Consumer Price Index[a]	New car Consumer Price Index	Used car Consumer Price Index	Gross National Product
1970	1.000	1.000	1.000	1.000	1.000
1971	1.043	1.052	1.041	1.057	1.086
1972	1.077	1.064	1.032	1.059	1.194
1973	1.144	1.098	1.033	1.128	1.339
1974	1.270	1.222	1.092	1.175	1.450
1975	1.386	1.336	1.186	1.404	1.574
1976	1.466	1.469	1.261	1.610	1.756
1977	1.561	1.572	1.328	1.753	1.960
1978	1.680	1.646	1.429	1.788	2.215
1979	1.869	1.881	1.543	1.927	2.470
1980	2.122	2.216	1.667	1.995	2.690
1981	2.342	2.484	1.768	2.463	3.006
1982	2.486	2.587	1.836	2.842	3.118
1983	2.566	2.648	1.883	3.161	3.354
1984	2.675	2.766	1.938	3.602	3.715
1985	2.770	2.838	2.000	3.640	3.954
1986	2.824	2.728	2.087	3.487	4.176
1987	2.927	2.811	2.162	3.625	4.447
1988	3.046	2.899	2.206	3.782	4.799
1989	3.193	3.043	2.249	3.859	5.121
1990	3.365	3.213	2.283	3.769	5.483
1991	3.508	3.301	2.364	3.785	5.653
1992	3.614	3.373	2.423	3.949	5.934
1993	3.721	3.477	2.481	4.292	6.251
1994	3.818	3.581	2.566	4.542	6.624
1995	3.926	3.709	2.623	5.016	[b]

Sources:
1970-93 U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Washington, DC, March 1994, p. S-6, and annual.
1994-95 Bureau of Labor Statistics, Consumer Price Index Table 1A for 1994-95.
Gross National Product - Indexed to 1970 from Table 2.27.

[a]Transportation Consumer Price Index includes new and used cars, gasoline, auto insurance rates, intracity mass transit, intracity bus fare, and airline fares.
[b]Data are not available.

After adjusting for inflation, the average price of domestic new cars declined from 1992 to 1993, but rose to an even higher level in 1994. Average domestic car prices in 1970 were $3,567 ***more*** *than imports (in constant 1990 dollars), but in 1994, domestic car prices were $5,499* ***less*** *than imports.*

Table 2.30
Average Price of a New Car, 1970-94

	Domestic		Import		Total		Estimated Average New Car Price for a 1967 "Comparable Car"	
Year	Current dollars	Constant 1990 dollars[a]	Current dollars	Constant 1990 dollars[a]	Current dollars	Constant 1990 dollars[a]	With added safety & emissions equipment[b]	Without added safety & emissions equipment[c]
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	10,559	13,850	10,873	14,262	10,640	13,956	8,387	6,544
1984	11,172	14,056	12,354	15,543	11,450	14,405	8,685	6,742
1985	11,733	14,253	12,875	15,640	12,022	14,604	8,984	6,958
1986	12,526	14,929	13,815	16,465	12,894	15,368	9,395	7,259
1987	13,239	15,223	14,602	16,790	13,657	15,703	9,743	7,518
1988	14,029	15,498	15,537	17,164	14,468	15,983	9,995	7,668
1989	14,947	15,746	16,126	16,999	15,272	16,105	10,248	7,825
1990	15,638	15,638	17,538	17,538	16,157	16,157	10,581	7,938
1991	16,487	15,811	17,795	17,065	16,838	16,148	11,152	8,224
1992	17,339	16,143	20,542	19,125	18,141	16,889	11,458	8,424
1993	17,549	15,882	22,724	20,565	18,716	16,938	11,806	8,631
1994	18,361	16,194	24,595	21,693	19,676	17,354	12,427	8,925
				Average annual percentage change				
1970-94	6.9%	1.1%	9.7%	3.8%	7.4%	1.6%	5.3%	4.0%
1984-94	5.1%	1.4%	7.1%	3.4%	5.6%	1.9%	3.6%	2.8%

Source: American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '95, Detroit, MI, 1995, p.60.

[a]Adjusted by the Consumer Price Inflation Index.

[b]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.

[c]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 1995 (constant 1990 cents) was approximately 42 cents per mile. From 1985 to 1995 the fixed costs have risen an average of 3.7% per year while the variable costs have declined at an average annual rate of 1.3%. Gas and oil accounted for only 12% of total cost per mile in 1994, the lowest percentage in the 18 year series.

Table 2.31
Automobile Operating Costs, 1975-95

	Variable costs (Constant 1990 cents per mile[a])				Constant 1990 dollars per 10,000 miles[a]			
Year[c]	Gas and oil	Percentage gas and oil of total cost	Maintenance	Tires	Variable cost	Fixed cost	Total cost	Total cost per mile[b] (Constant 1990 cents[a])
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]
			Average annual percentage change					
1975-84	-4.4%		-6.3%	-7.5%	-5.0%	0.3%	-1.3%	-1.3%
1985-95	-3.7%		4.1%	4.3%	-1.3%	3.7%	2.4%	2.4%

Source:
American Automobile Association, "Your Driving Costs," 1995 Edition, Falls Church, VA, and annual.

[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 preceeding 1985 are not comparable with figures after 1985. 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 2.32
Motor Vehicle Manufacturing Employment Statistics, 1972-94

Year	Motor vehicle manufacturing employees (thousands)	Domestic automobile sales (thousands)	Domestic light truck[a] sales (thousands)	Employees per hundred vehicles sold	Expenditure per new domestic vehicle	Total domestic vehicle expenditures (millions)	Employees per million dollar expenditure (current)	Employees per million dollar expenditure (constant 1990[b])
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	$10,559	$98,336	3.5	2.8
1984	392	7,952	3,257	3.5	$11,172	$125,227	3.1	2.6
1985	409	8,205	3,691	3.4	$11,733	$139,576	2.9	2.5
1986	400	8,215	3,671	3.4	$12,526	$148,884	2.7	2.3
1987	381	7,081	3,785	3.5	$13,239	$143,855	2.6	2.4
1988	357	7,526	4,195	3.0	$14,029	$164,434	2.2	2.0
1989	350	7,073	4,108	3.1	$14,947	$167,122	2.1	2.0
1990	329	6,897	3,948	3.0	$15,638	$169,594	1.9	1.9
1991	316	6,137	3,595	3.2	$16,487	$160,451	2.0	2.1
1992	314	6,277	4,233	3.0	$17,339	$182,233	1.7	1.9
1993	319	6,742	4,987	2.7	$17,549	$205,832	1.5	1.7
1994	340	7,255	5,638	2.6	$18,361	$236,728	1.4	1.6
				Average annual percentage change				
1972-94	-0.9%	-1.1%	4.6%	-1.5%	7.1%	7.7%	-8.1%	-3.2%
1984-94	-1.4%	-0.9%	5.6%	-2.9%	5.1%	6.6%	-7.6%	-4.7%

Sources:

Employees - American Automobile Manufacturers Association, Economic Indicators, Second Quarter,1995, Detroit, MI, 1995, p. 16.

Sales and expenditures - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '95, Detroit, MI, 1995, pp. 20, 21, 60, and annual.

[a]Less than 10,000 pounds gross vehicle weight.
[b]Adjusted by the implicit Gross National Product price deflator.

Table 2.33
Employees of Motor Vehicle and Related Industries, 1990 and 1992

	1990			1992			
Industry	Employees	Percent of total motor vehicle	Percent of total U.S. employment[a]	Employees	Percent of total motor vehicle	Percent of total U.S. employment[a]	Percent change 1990-92
Motor vehicle and equipment manufacturing	1,055,595	15.0%	1.1%	1,004,551	14.8%	1.1%	-4.8%
Motor vehicles and equipment	*707,160*	*10.0%*	*0.8%*	*678,363*	*10.0%*	*0.7%*	*-4.1%*
Travel trailers and campers	*14,301*	*0.2%*	*0.0%*	*13,893*	*0.2%*	*0.0%*	*-2.9%*
Transportation equipment, not elsewhere classified	*17,263*	*0.2%*	*0.0%*	*17,173*	*0.3%*	*0.0%*	*-0.5%*
Automotive stampings	*111,548*	*1.6%*	*0.1%*	*102,017*	*1.5%*	*0.1%*	*-8.5%*
Carburetors, pistons, piston rings, and valves	*19,674*	*0.3%*	*0.0%*	*18,633*	*0.3%*	*0.0%*	*-5.3%*
Vehicular lighting equipment	*15,586*	*0.2%*	*0.0%*	*14,532*	*0.2%*	*0.0%*	*-6.8%*
Storage batteries	*23,518*	*0.3%*	*0.0%*	*21,760*	*0.3%*	*0.0%*	*-7.5%*
Electrical equipment for internal combustion engines	*61,675*	*0.9%*	*0.1%*	*57,789*	*0.9%*	*0.1%*	*-6.3%*
Tires and inner tubes	*68,505*	*1.0%*	*0.1%*	*63,653*	*0.9%*	*0.1%*	*-7.1%*
Cold-rolled steel sheet, strip, and bars	*16,365*	*0.2%*	*0.0%*	*16,738*	*0.2%*	*0.0%*	*2.3%*
Road construction and maintenance	261,461	3.7%	0.3%	190,407	2.8%	0.2%	-27.2%
Motor freight transportation and related services	1,662,836	23.6%	1.8%	1,619,307	23.9%	1.7%	-2.6%
Trucking and courier services, except by air or by the US Postal Service	*1,458,847*	*20.7%*	*1.6%*	*1,423,209*	*21.0%*	*1.5%*	*-2.4%*
Petroleum refining and wholesale distribution	264,820	3.8%	0.3%	255,334	3.8%	0.3%	-3.6%
Passenger transportation	672,271	9.5%	0.7%	698,136	10.3%	0.8%	3.8%
Automotive sales and servicing	3,135,783	44.5%	3.4%	3,000,518	44.3%	3.2%	-4.3%
Total of motor vehicle and related industries	7,052,766	100.0%	7.5%	6,768,253	100.0%	7.3%	-4.0%
U.S. Total[a]	93,476,087		100.0%	92,800,870		100.0%	-0.7%

Source:
American Automobile Manufactures Association, Motor Vehicle Facts and Figures '95, Detroit, MI, 1995, p. 71, and annual.

[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.

CHAPTER 3

HIGHWAY MODE

Highway energy use represented 75.9% of transportation energy use in 1994. Of the highway modes, automobiles had the greatest share of energy use, 39.2% (Table 3.1). The automobiles were also responsible for the majority of vehicle miles traveled in 1994. Light trucks with two axles and four tires have experienced the largest increase in vehicle miles traveled, an average of 6.7% annually from 1970 to 1994 (Table 3.2).

The number of automobiles and trucks in use are reported by both the Federal Highway Administration and R. L. Polk and Company (Table 3.4). According to R. L. Polk, the number of automobiles in the U. S. declined from 1991 to 1992. A discussion of this decline and of differences between the two sets of estimates can be found on page 3-5.

Automobile sales have been on the increase since 1992, mainly due to domestic sales. Import sales have declined each year since 1985; Transplants, however, have increased by 7.9% in that time period. Fuel economy for the automobile population has increased from 13.5 miles per gallon in 1970 to 21.5 miles per gallon in 1994 (Table 3.10). As the older autos are scrapped, they are replaced with newer, more fuel efficient autos which help to raise the population fuel economy. The sales-weighted fuel economy for new automobiles was at 27.9 mpg for the 1994 sales period (Table 3.16).

Truck travel data are based mainly on the Truck Inventory and Use Survey (TIUS) conducted by the U.S. Bureau of the Census. As part of the nation's economic surveys, TIUS is required by law to be conducted every 5 years for the years ending in 2 and 7 to provide data on the physical and operational characteristics of the nation's truck population. The survey is based on a probability sample of private and commercial trucks registered (or licensed) in eachstate. The most recent survey for which results are available was conducted in 1992. In addition to trucks, the following types of vehicles were also included in the 1987 and 1992 surveys: minivans, vans, station wagons, 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 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.

Although the **average** Corporate Average Fuel Economy (CAFE) of automobiles and light trucks has met the CAFE standard most years (there are two exceptions), there are still manufactures who fall short of meeting the standard. Since 1986 the Gas Guzzler tax has been assessed on automobiles with a fuel economy rating of less than22.5 miles per gallon. These tax rates, which remained constant from 1986 to 1990, doubled in 1991 (Table 3.44).

Table 3.1
Highway Energy Use by Mode, 1970-94

Year	Autos[a]	Light trucks	Other trucks	Buses	Total highway	Transportation energy use[b] (trillion Btu)
	(percentage of total)					
1970	55.8%	10.1%	9.8%	0.7%	76.4%	**15,291**
1971	56.4%	10.6%	9.9%	0.7%	77.6%	**15,912**
1972	56.7%	11.2%	10.0%	0.6%	78.5%	**16,918**
1973	55.7%	11.8%	10.4%	0.6%	78.5%	**17,781**
1974	55.4%	12.2%	10.5%	0.7%	78.9%	**17,055**
1975	55.7%	12.9%	10.3%	0.7%	79.6%	**17,295**
1976	54.7%	13.7%	10.6%	0.7%	79.7%	**18,357**
1977	53.2%	14.4%	11.3%	0.7%	79.6%	**19,041**
1978	51.5%	15.1%	12.0%	0.7%	79.3%	**19,985**
1979	48.6%	15.4%	12.5%	0.7%	77.2%	**20,059**
1980	47.0%	15.3%	12.6%	0.7%	75.6%	**19,268**
1981	47.1%	15.6%	13.0%	0.8%	76.5%	**19,003**
1982	47.8%	16.1%	13.1%	0.8%	77.9%	**18,493**
1983	47.1%	17.2%	13.9%	0.8%	79.0%	**18,635**
1984	44.8%	18.0%	14.7%	0.8%	78.3%	**19,276**
1985	44.3%	18.5%	14.9%	0.8%	78.4%	**19,645**
1986	44.2%	18.7%	14.9%	0.8%	78.6%	**20,214**
1987	42.9%	19.5%	15.2%	0.8%	78.3%	**20,665**
1988	42.4%	19.3%	15.6%	0.7%	78.0%	**21,310**
1989	42.3%	19.2%	15.7%	0.8%	78.0%	**21,573**
1990	41.7%	19.1%	15.5%	0.8%	77.1%	**21,659**
1991	41.7%	19.2%	15.5%	0.8%	77.3%	**21,244**
1992	42.3%	19.0%	15.4%	0.8%	77.5%	**21,908**
1993	41.2%	20.4%	15.8%	0.8%	78.2%	**22,399**
1994	40.5%	20.5%	16.4%	0.8%	78.3%	**22,886**

Source:
See Appendix A for Table 2.10.

[a]Includes motorcycles.
[b]Does not include off-highway and military transportation energy use.

Although automobiles continued to be responsible for the majority of highway travel, two-axle, four-tire trucks had the fastest average growth in vehicle miles from 1970-94 and 1982-94.

Table 3.2
Highway Vehicle Miles Traveled by Mode, 1970-94
(million miles)

Year	Automobiles[a]	Two-axle, four-tire trucks	Other single-unit trucks	Combination trucks	Buses[b]	Total
1970	919,679	123,286	27,081	35,134	4,544	1,109,724
1971	969,947	137,870	28,985	37,217	4,792	1,178,811
1972	1,025,696	156,622	31,414	40,706	5,348	1,259,786
1973	1,051,175	176,833	33,661	45,649	5,792	1,313,110
1974	1,012,696	182,757	33,441	45,966	5,684	1,280,544
1975	1,039,579	200,700	34,606	46,724	6,055	1,327,664
1976	1,084,218	225,834	36,390	49,680	6,258	1,402,380
1977	1,115,592	250,591	39,339	55,682	5,823	1,467,027
1978	1,153,666	279,414	42,747	62,992	5,885	1,544,704
1979	1,122,277	291,905	42,012	66,992	5,947	1,529,133
1980	1,121,810	290,935	39,813	68,678	6,059	1,527,295
1981	1,141,517	296,343	39,568	69,134	6,241	1,552,803
1982	1,176,166	306,141	40,212	66,668	5,823	1,595,010
1983	1,206,783	327,643	43,409	69,754	5,199	1,652,788
1984	1,233,703	357,999	46,560	77,367	4,640	1,720,269
1985	1,269,651	373,072	46,980	79,600	4,876	1,774,179
1986	1,310,611	389,047	48,308	81,833	5,073	1,834,872
1987	1,364,836	415,449	49,537	86,064	5,318	1,921,204
1988	1,439,603	439,496	51,239	90,158	5,466	2,025,962
1989	1,488,140	454,339	52,969	95,349	5,659	2,096,456
1990	1,522,741	466,092	53,443	96,367	5,719	2,144,362
1991	1,542,730	472,848	53,787	96,942	5,743	2,172,050
1992	1,610,396	478,193	53,691	99,112	5,759	2,247,151
1993	1,557,272[c]	573,398[c]	56,781	103,123	6,126	2,296,700
1994	1,595,879[c]	587,284[c]	61,350	109,065	6,416	2,359,984
		Average annual percentage change				
1970-94	2.3%	6.7%	3.5%	4.8%	3.3%	3.2%
1984-94	2.6%	5.1%	2.8%	3.5%	1.4%	3.2%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1995, Table VM-1, p. V-115, and annual.

[a]Includes motorcycles.
[b]The data do not correspond with vehicle miles of travel presented in the Bus section of this chapter due to differing data sources.
[c]Some minivans and sport utility/vehicles are included in 2-axle, 4-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 3.3
Vehicle Stock and New Sales in United States, 1994 Calendar Year

	Vehicle stock[a] (thousands)	New sales Domestic (thousands)	New sales Import[b] (thousands)	New sales Total (thousands)
Autos	**121,997**	**7,255 (80.7%)**	**1,736 (19.3%)**	**8,991 (100.0%)**
Two seaters	2,512	29 (37.2%)	49 (62.8%)	78 (100.0%)
Minicompact	2,179	0 (0.0%)	75 (100.0%)	75 (100.0%)
Subcompact	29,801	1,241 (62.6%)	743 (37.4%)	1,984 (100.0%)
Compact	34,452	2,394 (82.3%)	514 (17.7%)	2,908 (100.0%)
Midsize	35,389	2,314 (87.5%)	331 (12.5%)	2,646 (100.0%)
Large	17,664	1,277 (98.2%)	24 (1.8%)	1,301 (100.0%)
Motorcycles	**3,877[c]**	[c]	[c]	**306 (100.0%)**
Recreational vehicles	[c]	**519 (100.0%)**	**0 (0.0%)**	**519 (100.0%)**
Trucks	**66,717**	**5,995 (93.4%)**	**426 (6.6%)**	**6,421 (100.0%)**
Light (0-10,000 lbs)	62,201	5,638 (93.5%)	395 (6.5%)	6,033 (100.0%)
Medium (10,001-19,500 lbs)	1,418	60 (71.2%)	24 (28.8%)	84 (100.0%)
Light-heavy (19,501-26,000 lbs)	825	16 (79.8%)	4 (20.2%)	20 (100.0%)
Heavy-heavy (26,001 lbs and over)	2,273	281 (99.1%)	3 (0.9%)	284 (100.0%)

Source:
See Appendix A for Table 3.3

[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, such as:

- 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 chassis, 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 Adminstration 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, it's 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 3.4
Automobiles and Trucks in Use, 1970-94
(thousands)

Years	Automobiles			Trucks			Total		
	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%

Sources:

FHWA - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1995, Table VM-1, p. V-115, and annual.

R. L. Polk - R. L. Polk and Company, Detroit, Michigan. **FURTHER REPRODUCTION PROHIBITED.**

[a]Some minivans and sport/utility vehicles are included in with the trucks that were previously included in with the automobiles.

In 1994 the average and median ages of automobiles and trucks were the same. Truck ages, which have always averaged higher than automobiles, dropped slightly from 1993 to 1994, while automobile ages increased slightly.

Table 3.5
Average Age of Automobiles and Trucks in Use, 1970-94
(years)

Calendar Year	Automobile		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

Source:
R. L. Polk and Co., Detroit, MI. **FURTHER REPRODUCTION PROHIBITED.**

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 3.6
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.

[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 3.7
Scrappage and Survival Rates for Trucks

	All trucks						Light trucks	
	(1966-73)[a]		(1973-78)[a]		(1978-89)[a]		(1978-89)[a]	
Vehicle age (years)	Scrappage rate	Survival rate	Scrappage rate	Survival rate	Scrappage rate	Survival rate	Scrappage rate	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.

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

Although the transplant share of new automobile sales has been growing, the import share has been declining since 1990. Domestic automobile sales have been rising since 1991, while import sales have been decreasing.

Table 3.8
New Retail Automobile Sales in the United States, 1970-94

Calendar year	Domestic	Import[a]	Total	Percentage imports	Percentage transplants[b] on model year basis	Percentage imports and transplants	Percentage diesel
	(thousands)						
1970	7,119	1,285	8,404	15.3%	c	c	c
1971	8,681	1,568	10,249	15.3%	c	c	0.06%
1972	9,327	1,623	10,950	14.8%	c	c	0.05%
1973	9,676	1,763	11,439	15.4%	c	c	0.06%
1974	7,454	1,399	8,853	15.8%	c	c	0.20%
1975	7,053	1,571	8,624	18.2%	c	c	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%
				Average annual percentage change			
1970-94	0.1%	1.3%	0.3%				
1984-94	-0.9%	-3.3%	-1.4%				

Sources:

Domestic and import data - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '94, Detroit, MI, 1995, p. 16, and annual.

Diesel data - H. A. Stark (ed), Ward's Communications, Inc., Ward's Automotive Yearbook, Detroit, MI, 1995, p. 44, and annual.

Transplant data - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares Data System, Oak Ridge, TN, 1995.

[a]Does not include import tourist deliveries.

[b]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.

[c]Data are not available.

Table 3.9
Automobiles in Operation and Vehicle Travel by Age, 1970 and 1994

	1970			1994			1994 Estimated vehicle travel	
Age (years)	Vehicles (thousands)	Percentage	Cumulative percentage	Vehicles (thousands)	Percentage	Cumulative percentage	Percentage	Cumulative percentage
Under 1[a]	6,288	7.8%	7.8%	5,636	4.6%	4.6%	6.0%	6.0%
1	9,299	11.6%	19.4%	8,201	6.7%	11.3%	8.2%	14.2%
2	8,816	11.0%	30.3%	7,718	6.3%	17.7%	7.4%	21.6%
3	7,878	9.8%	40.1%	7,995	6.6%	24.2%	7.3%	28.9%
4	8,538	10.6%	50.8%	8,225	6.7%	31.0%	7.2%	36.1%
5	8,506	10.6%	61.3%	9,126	7.5%	38.5%	8.0%	44.1%
6	7,116	8.8%	70.2%	9,410	7.7%	46.2%	8.1%	52.2%
7	6,268	7.8%	78.0%	9,205	7.5%	53.7%	7.7%	60.0%
8	5,058	6.3%	84.3%	9,134	7.5%	61.2%	7.0%	66.9%
9	3,267	4.1%	88.3%	8,419	6.9%	68.1%	6.4%	73.4%
10	2,776	3.5%	91.8%	7,510	6.2%	74.3%	5.1%	78.5%
11	1,692	2.1%	93.9%	5,082	4.2%	78.4%	3.5%	82.0%
12	799	1.0%	94.9%	3,988	3.3%	81.7%	2.7%	84.7%
13	996	1.2%	96.1%	3,613	3.0%	84.7%	2.5%	87.2%
14	794	1.0%	97.1%	3,138	2.6%	87.2%	2.1%	89.3%
15 and older	2,336	2.9%	100.0%	15,572	12.8%	100.0%	10.7%	100.0%
Subtotal	**80,427**	**100.0%**		**121,972**	**100.0%**		**100.0%**	
Age not given	22			25				
Total	**80,449**			**121,997**				
Average age		5.6			8.4			
Median age		4.9			7.5			

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.

[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 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 consistant trend.[a] The FHWA plans to release revised historical data for each of these categories in the Spring of 1997.

Table 3.10
Summary Statistics for Passenger Cars, 1970-94

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	1,588,618	73,825	21.5
		Average annual percentage change		
1970-94	1.7%	2.3%	0.4%	2.0%
1984-94	0.4%	2.6%	0.7%	1.9%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1995, Table VM-1, p. V-115, and annual.

[a]See Table 3.22 for truck data.
[b]This number differs from R. L. Polk's estimates of "number of automobiles in use." See Table 3.4.
[c]Fuel economy for automobile population.
[d]Some minivans and sport/utility vehicles are included with 2-axle, 4-tire trucks that were previously included with passenger cars.

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 3.11
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**

Sources:

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.

[a]Includes only auto 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, pick-up trucks, vans, and utility vehicles.

The average weight of the domestic automobile has been reduced nearly 290 pounds from 1978 to 1995, but increased slightly from 1985 to 1995. 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 1995 with a 43.6% share of total materials. As conventional steel use has been decreasing, use of high-strength steel has increased.

Table 3.12
Average Material Consumption for a Domestic Automobile, 1978, 1985, and 1995

	1978		1985		1995	
Material	Pounds	Percentage	Pounds	Percentage	Pounds	Percentage
Conventional steel[a]	1,880.0	53.8%	1,481.5	46.5%	1,398.0	43.6%
High-strength steel	127.5	3.6%	217.5	6.8%	279.5	8.7%
Stainless steel	25.0	0.7%	29.0	0.9%	46.0	1.4%
Other steels	56.0	1.6%	54.5	1.7%	43.5	1.4%
Iron	503.0	14.4%	468.0	14.7%	398.5	12.4%
Aluminum	112.0	3.2%	138.0	4.3%	187.5	5.8%
Rubber	141.5	4.1%	136.0	4.3%	136.0	4.2%
Plastics/Composite	176.0	5.0%	211.5	6.6%	246.5	7.7%
Glass	88.0	2.5%	85.0	2.7%	91.5	2.9%
Copper	39.5	1.1%	44.0	1.4%	43.5	1.4%
Zinc die castings	28.0	0.8%	18.0	0.5%	16.0	0.5%
Power metal parts	16.0	0.5%	19.0	0.6%	28.0	0.9%
Fluids & lubricants	189.0	5.4%	184.0	5.8%	190.0	5.9%
Other materials	112.5	3.2%	101.5	3.2%	103.5	3.2%
Total	3,494.0	100.0%	3,187.5	100.0%	3,208.0	100.0%

Source:
H. A. Stark (ed), Ward's Communications, Inc., Wards Automotive Yearbook, Detroit, MI, 1995, p. 27, and annual.

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

Table 3.13
Sales-Weighted Engine Size of New Domestic and Import Automobiles by Size Class, Sales Periods 1976-95
(cubic inches -- 1 liter = 61.02 cubic inches)

Model year	Minicompact	Subcompact	Compact	Midsize	Large	Two seater	Fleet
1976	[a]	163.1	304.9	357.0	414.2	176.2	298.5
1977	120.8	166.4	292.4	333.5	367.2	171.6	278.3
1978	125.5	162.8	241.0	298.6	376.3	183.8	264.4
1979	113.2	146.0	228.5	268.9	339.4	168.8	230.8
1980	115.8	128.2	184.8	237.9	312.3	170.0	196.5
1981	96.1	124.6	134.2	221.2	304.8	151.7	182.0
1982	93.5	127.2	129.3	212.0	288.4	147.2	176.1
1983	97.8	133.6	134.3	210.3	302.0	153.8	182.1
1984	132.7	135.3	135.1	207.3	297.1	152.4	181.2
1985	118.8	139.8	138.8	205.5	283.6	150.9	178.3
1986	88.4	133.6	134.6	194.9	267.3	172.5	168.3
1987	90.2	133.4	134.4	182.4	266.3	157.1	163.5
1988	92.5	125.0	135.1	183.1	263.4	167.9	162.2
1989	155.2	127.0	128.8	183.5	263.1	171.3	163.5
1990	147.7	119.6	137.5	190.7	264.3	157.0	166.1
1991	132.6	120.2	135.8	192.9	268.3	163.1	166.2
1992[b]	115.3	122.5	142.2	192.9	264.7	183.5	168.5
1993[b]	119.7	126.6	139.1	192.6	260.3	211.8	169.4
1994[b]	134.7	138.5	136.2	192.5	254.2	233.1	170.1
1995	147.7	138.0	136.0	190.5	251.1	229.2	170.0
			Average annual percentage change				
1976-95	1.6%[c]	-0.9%	-4.2%	-3.3%	-2.6%	1.4%	-2.9%
1985-95	2.2%	-0.1%	-0.2%	-0.8%	-1.2%	4.3%	-0.5%

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

[a]There were no minicompact automobiles sold in 1976.
[b]Revised.
[c]Average annual percentage change is for years 1977-95.

Table 3.14
Sales-Weighted Curb Weight of New Domestic and Import Automobiles by Size Class, Sales Periods 1976-95
(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[b]	2,395	2,444	2,674	3,131	3,670	2,770	2,879
1993[b]	2,449	2,478	2,659	3,142	3,615	2,967	2,894
1994[b]	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
			Average annual percentage change				
1976-95	1.3%[c]	-0.1%	-1.6%	-1.3%	-1.2%	0.6%	-1.1%
1985-95	2.5%	0.6%	0.7%	0.7%	0.2%	1.5%	0.7%

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

[a]There were no minicompact automobiles sold in 1976.
[b]Revised.
[c]Average annual percentage change is for years 1977-95

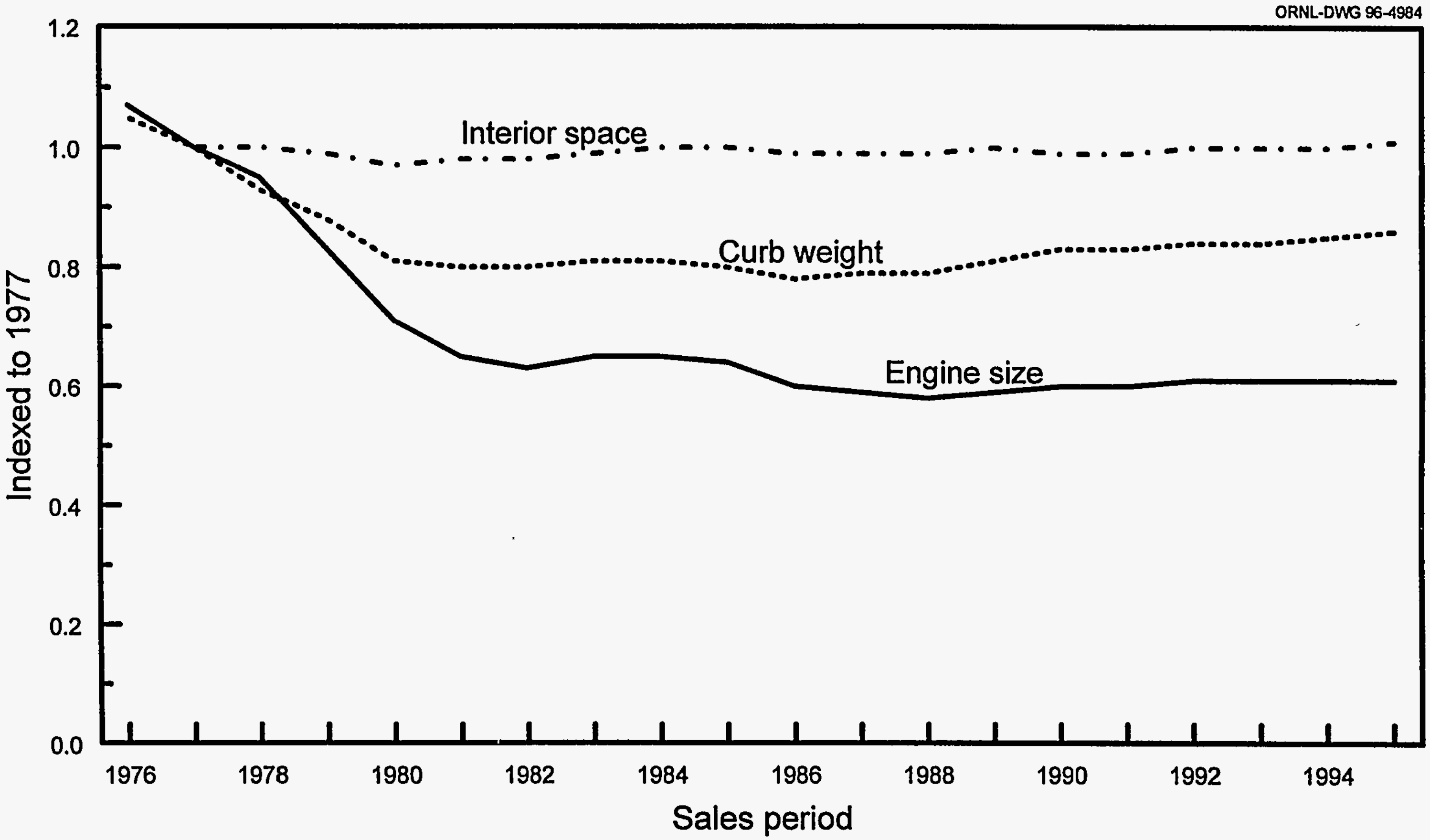
Table 3.15
Sales-Weighted Interior Space of New Domestic and Import Automobiles by Size Class, Sales Periods 1976-95
(cubic feet)

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[b]	79.1	94.0	104.2	114.0	129.2	107.5
1993[b]	79.2	94.5	104.0	114.0	128.9	108.0
1994[b]	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
			Average annual percentage change			
1977-95	0.0%	0.2%	-0.2%	0.1%	0.0%	0.0%
1984-95	0.1%	0.0%	0.1%	0.1%	-0.1%	0.1%

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

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

Figure 3.1. Engine Size, Curb Weight, and Interior Space of New Domestic and Import Automobiles, 1976-95



Source: See Tables 3.13, 3.14, and 3.15.

Table 3.16
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Automobiles, Selected Sales Periods 1976-95[a]

	1976	1980	1982	1984	1986	1988	1990	1993[b]	1994[b]	1995
MINICOMPACT										
Total sales, units	c	428,346	221,699	41,368	191,490	84,186	76,698	84,345	57,198	44,752
Market share, %	c	4.7	2.9	0.4	1.7	0.8	0.8	1.0	0.6	0.5
Fuel economy, mpg	c	29.4	36.5	29.0	31.9	37.8	26.4	29.9	27.8	27.0
SUBCOMPACT										
Total sales, units	2,625,929	3,441,480	2,404,489	2,510,929	2,350,081	1,983,353	2,030,226	1,944,892	2,015,280	1,518,209
Market share, %	27.1	37.8	31.4	24.6	21.2	19.1	22.0	23.2	22.6	17.4
Fuel economy, mpg	23.5	27.3	30.2	30.5	30.7	31.7	31.3	31.9	31.3	31.7
COMPACT										
Total sales, units	2,839,603	599,423	1,300,372	2,768,056	3,829,093	4,199,638	3,156,481	2,655,378	3,077,203	3,289,735
Market share, %	29.3	6.6	17.0	27.1	34.5	40.5	34.2	31.7	28.0	37.7
Fuel economy, mpg	17.1	22.3	30.1	30.6	30.0	29.8	28.9	29.3	29.8	30.2
MIDSIZE										
Total sales, units	1,815,505	3,073,103	2,533,121	3,059,647	2,985,835	2,550,964	2,511,503	2,445,842	2,359,898	2,498,521
Market share, %	18.7	33.8	33.1	30.0	26.9	24.6	27.2	29.2	26.5	28.6
Fuel economy, mpg	15.3	21.3	24.1	24.1	25.6	26.9	25.9	25.7	25.6	25.9
LARGE										
Total sales, units	2,206,102	1,336,190	995,561	1,502,097	1,467,077	1,368,717	1,279,092	1,186,991	1,339,863	1,320,608
Market share, %	22.8	14.7	13.0	14.7	13.2	13.2	13.9	14.2	15.0	15.1
Fuel economy, mpg	13.9	19.3	20.6	20.2	23.8	24.2	23.5	24.0	24.2	24.1
TWO SEATER										
Total sales, units	199,716	215,964	202,929	328,968	275,470	186,127	170,465	70,480	67,020	53,045
Market share, %	2.1	2.4	2.6	3.2	2.5	1.8	1.8	0.8	0.8	0.6
Fuel economy, mpg	20.1	21.0	25.1	26.5	28.4	27.3	28.0	24.8	23.9	24.7
FLEET										
Total sales, units	9,686,855	9,094,506	7,658,171	10,211,065	11,099,046	10,372,985	9,224,465	8,387,928	8,916,462	8,724,870
Market share, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fuel economy, mpg	17.2	23.2	26.3	26.3	27.9	28.5	27.6	27.8	27.8	28.0

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

[a]These figures represent only those sales that could be matched to corresponding EPA fuel economy values.
[b]Revised.
[c]There were no minicompact automobiles sold in 1976.

Light truck sales exceeded 6 million in 1994. The import share of light truck sales has been declining since 1990, but the transplant share has been increasing during those years.

Table 3.17
New Retail Sales of Trucks 10,000 pounds GVW and less in the United States, 1970-94

		Percentages					
Calendar year	Light truck sales[a] (thousands)	Import[b]	Transplants[c]	Diesel	Four-wheel drive on 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%
			Average annual percentage change				
1970-94	6.1%						
1984-94	4.1%						

Sources:

Four-wheel drive - 1970-88: H. A. Stark (ed.), Ward's Communication, Inc., Ward's Automotive Yearbook, Detroit, MI, 1989, p. 168, and annual. 1989-94: H. A. Stark (ed.), Ward's Communications, Inc., Ward's Automotive Yearbook, Factory Installation Reports, Detroit, MI, 1995.

Transplants - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1995.

All other - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '95, Detroit, MI, 1995, pp. 8, 19, 20, 21, and annual.

[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 3.18
New Retail Truck Sales by Gross Vehicle Weight, 1970-94[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[b]
				Domestic Sales (Import data are not available)					
1970[c]	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	[d]	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	[d]	2	90	58	117	2,231
1981	896	850	1	[d]	2	72	51	100	1,972
1982	1,102	961	1	[d]	1	44	62	76	2,248
1983	1,314	1,207	[d]	[d]	1	47	59	82	2,710
1984	2,031	1,224	6	[d]	5	55	78	138	3,538
1985	2,408	1,280	11	[d]	5	48	97	134	3,983
				Domestic and Import Sales					
1986	3,380	1,214	12	[d]	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
				Average annual percentage change					
1970-85	5.7%	7.9%	4.1%	-	-15.1%	-6.6%	6.8%	2.8%	5.5%
1986-94	3.7%	2.7%	14.3%	-	-4.9%	-9.6%	-0.4%	6.4%	3.5%

Source:
American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '95, Detroit, MI, 1995, p. 21, and annual.

[a]Sales include domestic-sponsored imports.
[b]Totals may not equal Motor Vehicle Manufacturers Association totals due to rounding.
[c]Data for 1970 is based on new truck registrations.
[d]Less than 500 trucks.

Table 3.19
Trucks in Operation and Vehicle Travel by Age, 1970 and 1994

Age (years)	1970 Vehicles (thousands)	1970 Percentage	1970 Cumulative percentage	1994 Vehicles (thousands)	1994 Percentage	1994 Cumulative percentage	1994 Estimated vehicle travel Percentage	1994 Estimated vehicle travel Cumulative percentage	Average annual miles per vehicle
Under 1[a]	1,262	7.1%	7.1%	3,925	5.9%	5.9%	6.5%	6.5%	14,288
1	1,881	10.6%	17.8%	5,181	7.8%	13.7%	9.9%	16.4%	16,439
2	1,536	8.7%	26.5%	4,323	6.5%	20.1%	9.2%	25.7%	18,388
3	1,428	8.1%	34.6%	4,223	6.3%	26.5%	8.6%	34.3%	17,601
4	1,483	8.4%	43.0%	4,109	6.2%	32.6%	8.0%	42.3%	16,775
5	1,339	7.6%	50.5%	4,753	7.1%	39.8%	8.9%	51.2%	16,020
6	1,154	6.5%	57.1%	4,682	7.0%	46.8%	7.9%	59.1%	14,574
7	975	5.5%	62.6%	4,160	6.2%	53.0%	6.6%	65.8%	13,710
8	826	4.7%	67.3%	4,346	6.5%	59.5%	6.7%	72.5%	13,255
9	621	3.5%	70.8%	3,712	5.6%	65.1%	5.3%	77.7%	12,237
10	658	3.7%	74.5%	3,207	4.8%	69.9%	3.1%	80.8%	8,224
11	583	3.3%	77.8%	1,996	3.0%	72.9%	1.9%	82.7%	8,224
12	383	2.2%	80.0%	1,632	2.4%	75.4%	1.6%	84.3%	8,224
13	417	2.4%	82.3%	1,447	2.2%	77.5%	1.4%	85.7%	8,224
14	414	2.3%	84.7%	1,327	2.0%	79.5%	1.3%	86.9%	8,224
15 and older	2,710	15.3%	100.0%	13,652	20.5%	100.0%	13.1%	100.0%	8,224
Subtotal	**17,670**	**100.0%**		**66,674**	**100.0%**		**100.0%**		
Age not given	15			43					
Total	**17,685**			**66,717**					
Average age		7.3			8.4				
Median age		5.9			7.5				

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.

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

Table 3.20
Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class
Sales Periods 1976-95
(cubic inches -- 1 liter = 61.02 cubic inches)

Model year	Small pickup	Large pickup	Small van	Large van	Small utility	Large utility	Fleet
1976	116.7	339.6	120.0	328.8	329.1	303.1	318.9
1977	122.8	334.4	120.0	324.7	333.4	302.1	306.7
1978	123.9	332.6	120.0	322.7	310.8	329.7	306.5
1979	125.3	314.1	120.0	313.3	275.7	323.3	281.7
1980	125.0	308.4	120.0	306.7	261.6	329.0	264.2
1981	130.4	294.1	120.0	295.5	240.6	314.3	253.4
1982	142.7	304.4	109.4	300.5	237.0	321.3	258.8
1983	143.7	303.5	114.3	308.6	186.0	326.1	244.2
1984	145.0	301.8	136.2	308.7	171.2	329.0	235.9
1985	145.5	290.8	161.9	312.6	172.7	327.5	229.8
1986	148.0	285.6	169.8	313.1	169.4	338.6	222.6
1987	149.0	286.0	180.8	317.8	171.1	331.0	222.6
1988	156.5	285.7	192.2	318.2	191.7	336.3	232.8
1989	160.8	286.9	189.5	318.3	213.6	332.8	239.9
1990	177.0	274.0	200.8	318.0	206.1	334.1	239.6
1991	177.6	278.9	201.0	319.3	220.9	329.6	240.4
1992[a]	187.1	279.1	202.3	322.3	225.0	333.8	243.8
1993[a]	198.2	263.9	201.4	317.7	231.8	340.4	245.5
1994[a]	189.4	271.8	212.4	324.1	229.8	338.0	250.2
1995	179.9	271.0	207.6	314.1	229.1	335.1	247.5
				Average annual percentage change			
1976-95	2.3%	-1.2%	2.9%	-0.2%	-1.9%	0.5%	-1.3%
1985-95	2.1%	-0.7%	2.5%	0.0%	2.9%	0.2%	0.7%

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

[a]Revised.

Table 3.21
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Light Trucks, Selected Sales Periods 1976-94[a]

	1976	1980	1982	1984	1986	1988	1990	1993	1994
SMALL PICKUP									
Total sales, units	170,351	516,412	579,263	1,012,2988	1,225,5700	1,026,5511	678,488	332,470	376,111
Market share, %	7.1	23.3	27.2	28.0	27.0	21.6	15.0	6.6	6.6
Fuel economy, mpg	23.9	25.5	28.1	27.2	26.1	26.1	25.2	24.9	24.7
LARGE PICKUP									
Total sales, units	1,586,020	1,115,248	1,000,772	1,218,972	1,325,547	1,453,255	1,573,729	1,877,806	2,188,435
Market share, %	66.4	50.3	46.9	33.7	29.2	30.6	34.9	37.2	38.3
Fuel economy, mpg	15.1	17	18.6	17.5	18.4	18.5	18.9	19.6	20.3
SMALL VAN									
Total sales, units	18,651	13,649	11,964	222,798	640,936	851,384	932,693	1,121,786	1,259,732
Market share, %	0.8	0.6	0.6	6.2	14.1	18.0	20.7	22.2	22.0
Fuel economy, mpg	19.5	19.6	22.5	25.0	23.8	22.9	23.1	22.8	22.2
LARGE VAN									
Total sales, units	574,745	328,065	379,110	545,595	510,558	486,981	398,877	388,435	407,737
Market share, %	24.1	14.8	17.8	15.1	11.3	10.3	8.8	7.7	7.1
Fuel economy, mpg	15.4	16.3	17.0	16.3	17.3	17.0	16.9	17.3	17.4
SMALL UTILITY									
Total sales, units	4,716	75,875	28,376	398,000	598,652	701,005	738,294	938,514	1,032,283
Market share, %	0.2	3.4	1.3	11.0	13.2	14.8	16.4	18.6	18.0
Fuel economy, mpg	15.5	16.9	20.9	23.0	21.5	22.4	21.9	21.3	20.7
LARGE UTILITY									
Total sales, units	32,427	167,288	133,355	215,271	233,625	223,824	192,544	388,993	455,902
Market share, %	1.4	7.5	6.3	6.0	5.2	4.7	4.3	7.7	8.0
Fuel economy, mpg	14.7	14.6	16.9	15.7	15.9	16.2	16.1	17.6	18.0
FLEET									
Total sales, units	2,386,910	2,216,537	2,132,840	3,612,934	4,534,888	4,743,000	4,514,625	5,048,004	5,720,200
Market share, %	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	20.0	20.8	20.7	20.5	20.5	20.5

Source:
Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1995.

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

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 consistant trend. (See Table 3.10 for car data.) The FHWA plans to release revised historical data for each of these categories in the Spring of 1997.

Table 3.22
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970-94

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]	57,141	587,284	37,550	15.6
		Average annual percentage change		
1970-94	6.0%	6.7%	4.8%	1.9%
1984-94	5.9%	5.1%	3.1%	1.9%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1995, Table VM-1, p. V-115, and annual.

[a]Some minivans and sport/utility vehicles are included with these trucks that were previously included with automobiles.

Table 3.23
Summary Statistics for Other Single-Unit and Combination Trucks, 1970-94[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	4,678	61,350	8,996	6.8	1,625	109,065	18,580	5.9
				Average annual percentage change				
1970-94	1.0%	3.5%	3.5%	-0.4%	2.5%	4.8%	3.9%	0.9%
1984-94	1.4%	2.8%	3.2%	0.0%	1.9%	3.5%	2.3%	1.3%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1995, Table VM-1, p. V-115, and annual.

[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 recently 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.

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 is 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 on 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 between surveys average weight must be used, as the older surveys did not include data on the Gross Vehicle Weight Rating.

Table 3.24
Truck Fuel Economy by Size Class, 1977, 1982, 1987, and 1992
(miles per gallon)

Size class	Average weight	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.

Table 3.25
Percentage of Trucks by Size Class, 1977, 1982, 1987, and 1992
(percentage)

Size class	Average weight	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.

Table 3.26
Truck Statistics by Gross Vehicle Weight Class, 1992

Gross vehicle weight class	Number of trucks	Percentage of trucks	Average annual miles per truck	Average fuel economy	Gallons of fuel use (millions)	Percentage of fuel use
0 - 6,000 lbs	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.

Table 3.27
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.

Table 3.28
Truck Statistics by Size, 1992

	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.

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.

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.

[a]Business and personal services.

Table 3.31
Summary Statistics on Buses by Type, 1970-94

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
1991	60,377	21,158	513,227
1992	63,080	19,904	525,838
1993	64,850	19,119	534,872
1994	67,492	19,146	547,718
		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
1991	2,167	996	4,300
1992	2,178	974	4,400
1993	2,210	1,056	4,300
1994	2,163	1,091	4,400
		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
1991	21,090	23,100	83,300
1992	20,336	22,600	90,000
1993	20,247	24,500	94,200
1994	20,238	25,300	85,000
		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
1991	80.6	22.6	70.6
1992	81.0	22.1	72.1
1993	86.2[c]	24.0	82.1
1994	90.0	[b]	[b]

Source:
See Appendix A for Table 3.31.

[a]Data for Transit buses after 1983 is not comparable with prior data. Data for prior years were provided voluntarily and statistically expanded, but in 1984 reporting became mandatory.
[b]Data are not available.
[c]Beginning in 1993 data became available on alternative fuel use by transit buses.

Automobile fleet data are difficult to estimate, but progress is made each year in compiling fleet estimates. In the mid-eighties it was discovered that daily rental fleets from 1970 to 1983 had been grossly underestimated. Now, newly available data dictate changes in the number of business fleets, individually leased fleets, government fleets, and utility fleets in 1993. Since these data are not historically consistent, please use caution when comparing 1993-94 data to earlier years.

Table 3.32
Automobile Fleets by Use, 1982-94
(thousands)

	Cars in fleets of 10 or more								
Year	Business fleets[a]	Individual leased	Government	Utilities	Police	Taxi	Daily rental	Total cars	Cars in fleets of 4 or more
1982	3,324	1,645	500	530	223	141	[b]	6,923	10,076
1983	3,383	1,653	500	533	221	139	[b]	7,001	10,400
1984	3,422	1,657	528	540	228	140	755	7,380	10,475
1985	3,484	1,800	528	540	233	140	760	7,600	10,508
1986	3,530	1,975	535	545	238	143	790	7,868	10,560
1987	3,564	2,098	538	550	240	144	800	8,046	10,578
1988	3,689	2,160	543	553	242	144	870	8,314	10,597
1989	3,787	2,140	543	553	244	144	907	8,431	10,592
1990	3,823	2,020	538	551	249	141	990	8,427	10,607
1991	3,466	2,008	504	544	250	141	1,160	8,188	10,514
1992	3,460	2,126	516	548	264	140	1,448	8,502	10,468
1993[c]	2,607	2,400	401	386	264	140	1,501	7,699	10,359
1994	2,565	3,150	428	382	266	141	1,473	8,405	10,346

Source:
Bobit Publishing Company, Automotive Fleet Research Department, 1995 Automotive Fleet Fact Book, Redondo Beach, CA, 1995, pp. 12, 18, and annual.

[a]Includes driver schools.
[b]Data are not available.
[c]Newly available data resulted in changes for the 1993 data.

Table 3.33
Federal Government Vehicles by Agency, Fiscal Year 1993

Department or Agency	Autos	Buses	Light trucks[a]	Medium trucks[b]	Heavy trucks[c]	Total
CIVILIAN AGENCIES	**93,574**	**3,680**	**135,435**	**19,490**	**7,520**	**259,699**
Department of Agriculture	3,528	59	25,615	5,412	582	35,196
Department of Commerce	88	3	404	220	13	728
Department of Energy	1,770	238	6,711	1,917	704	11,340
Department of Health & Human	112	8	264	111	47	542
Department of Interior	1,990	235	9,805	3,940	1,823	17,793
Department of Justice	17,571	228	7,894	723	143	26,559
Department of Labor	24	5	117	9	2	157
Department of State	1,247	0	1,204	1,061	80	3,592
Department of Transportation	23	15	350	162	41	591
Department of Treasury	11,401	14	3,192	127	22	14,756
Department of Veterans Affairs	342	116	624	95	56	1,233
American Battle Monuments Comm.	18	0	38	11	0	67
Environmental Protection Agency	24	0	230	234	6	494
Federal Communications Comm	70	0	49	2	0	121
Federal Emergency Mgmt Agency	29	9	91	25	0	154
General Services Administration	52,544	2,659	75,563	3,764	3,556	138,086
Government Printing Office	4	0	45	0	0	49
International. Boundary & Water	0	0	22	16	26	64
Merit System Protection Board	0	0	1	0	0	1
Natl Aeronautics & Space Admin.	109	15	571	211	45	951
National Science Foundation	22	8	129	24	2	185
Panama Canal Commission	184	13	437	157	59	850
Pension Benefit Guaranty Corp.	1	0	0	0	0	1
Small Business Administration	1	0	0	0	0	1
Smithsonian Institute	65	4	232	57	17	375
Tennessee Valley Authority	1,677	4	1,073	1,129	271	4,154
U.S. Agency for International Develop.	283	23	453	56	12	837
U.S. Information Agency	426	16	297	21	3	763
U.S. Soldiers' & Airmen's Home	11	8	24	6	10	59
U.S. POSTAL SERVICE	**7,852**	**13**	**166,856**	**12,081**	**5,094**	**191,896**
MILITARY AGENCIES	**14,673**	**4,413**	**82,320**	**9,394**	**7,164**	**117,964**
Air Force	4,685	1,977	35,025	3,275	2,885	47,847
Army	2,556	965	11,391	1,801	1,144	17,857
Corps of Engineers	560	7	4,457	932	270	6,226
Marine	615	400	4,730	802	392	6,939
Navy	3,260	1,026	25,357	2,473	2,409	34,525
Other	2,997	38	1,360	111	64	4,570
TOTAL	**116,099**	**8,106**	**384,611**	**40,965**	**19,778**	**569,559**

Source:
U.S. General Services Administration, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1995, p. 25.

[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
Federal Government Vehicles by Agency, Fiscal Year 1994

Department or Agency	Autos	Buses	Light trucks[a]	Medium trucks[b]	Heavy trucks[c]	Total
CIVILIAN AGENCIES	**93,344**	**3,628**	**141,295**	**19,576**	**7,773**	**204,894**
Department of Agriculture	3,451	56	25,171	5,428	563	34,669
Department of Commerce	89	2	404	223	12	730
Department of Energy	958	192	4,071	1,144	420	6,785
Department of Health & Human Services	115	9	261	115	65	565
Department of Interior	1,978	130	10,069	4,421	1,977	18,575
Department of Justice	17,803	237	8,507	803	189	27,539
Department of Labor	23	4	125	17	3	172
Department of State	1,217	0	1,232	1,156	81	3,686
Department of Transportation	29	16	343	124	42	554
Department of Treasury	11,183	20	3,186	254	32	14,675
Department of Veterans Affairs	262	93	671	75	42	1,143
American Battle Monuments Comm.	18	0	40	11	0	69
Environmental Protection Agency	38	0	264	160	6	468
Equal Employment Opportunity Comm.	0	0	1	0	0	1
Federal Communications Comm	69	0	58	4	0	131
Federal Emergency Mgmt Agency	26	9	99	26	0	160
General Services Administration	53,383	2,785	83,595	3,881	3,924	147,568
Government Printing Office	3	0	46	0	0	49
International. Boundary & Water Comm.	0	0	19	17	25	61
Merit System Protection Board	0	0	1	0	0	1
Natl Aeronautics & Space Admin.	110	15	514	220	48	907
National Gallery of Art	0	0	5	3	1	9
National Science Foundation	18	6	128	29	3	184
Panama Canal Commission	184	13	405	189	59	850
Pension Benefit Guaranty Corp.	1	0	0	0	0	1
Small Business Administration	1	0	1	0	0	2
Smithsonian Institute	62	4	225	54	14	359
Tennessee Valley Authority	1,671	4	1,018	1,149	243	4,085
U.S. Agency for International Develop.	238	15	471	51	9	784
U.S. Information Agency	408	12	342	16	6	784
U.S. Soldiers' & Airmen's Home	6	6	23	6	9	50
U.S. POSTAL SERVICE	**7,825**	**11**	**180,157**	**11,995**	**4,906**	**204,894**
MILITARY AGENCIES	**113,916**	**4,301**	**82,460**	**8,787**	**6,573**	**114,868**
Air Force	4,380	2,102	35,509	3,129	2,892	48,012
Army	1,345	711	10,058	1,599	559	14,272
Corps of Engineers	490	3	4,130	804	251	5,678
Marine	576	410	4,793	730	382	6,891
Navy	3,126	1,037	26,547	2,392	2,404	35,506
Other	2,830	38	1,423	133	85	4,509
TOTAL	**113,916**	**7,940**	**403,912**	**40,358**	**19,252**	**585,378**

Source:
U.S. General Services Administration, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1996, p. 25.

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[a]Less than 8,500 lbs GVWR. Includes ambulances.

[b]8,501-23,999 lbs GVWR.

[c]24,000 lbs. Or more GVWR.

The average cost per mile for the operation of sedans, trucks, and all vehicles decreased in FY 1994. On average, sedans were driven nearly twice the miles that trucks were driven.

Table 3.35
Operating and Cost Data for Large Domestic Federal Fleets, 1986-94[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
		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
		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

Source:
U.S. General Services Administrations, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1996, pp. 30-32, 36, 40-42.

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

Table 3.36
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 3.37
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 3.38
Average Annual/Daily Vehicle Miles of Travel for Fleet Vehicles

	Business		Utility		Government	
Vehicle type	Miles/Yr (thousands)	Miles/Day @250 Days/Year	Miles/Yr (thousands)	Miles/Day @250 Days/Year	Miles/Yr (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, 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.

[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 Motor-Vehicle Fleets in Atlanta 1994

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. A 1994 survey conducted in metropolitan Atlanta was designed to draw a profile of private company and local government fleets in a major metropolitan area.

The survey area was the Atlanta nonattainment area, as defined by the 1990 Clean Air Act Amendments. In 1990, about one percent of the U.S. population resided in the Atlanta nonattainment area. The area represents the Atlanta Metropolitan Statistical Area (MSA), excluding five counties, with relatively small populations, which are on the outer ring of the MSA.

Out of the estimated 102,146 vehicles operated by private companies and local governments, one percent were fueled by an alternative fuel such as ethanol, methanol, natural gas, propane, or electricity. The majority of the vehicles in the survey were gasoline and diesel vehicles operated in private company fleets. Selected data from the report, for these vehicles, are presented in Tables 3.38-3.40.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-890, *Profile of Motor-Vehicle Fleets in Atlanta 1994*, DOE/EIA-0601, November 1995, (http://www.eia.doe.gov).

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 3.39
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 Codes	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 (number 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).

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 percent, 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 5 fleets.

[c] No case reported.

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 3.40
Number of Gasoline Vehicles in Private Company Fleets in Atlanta by Vehicle Type and Selected Characteristics

Selected characteristics	Cars (≤ 8,500 GVWR)	Small/ compact pickups (≤ 8,500 GVWR)	Large/ full-size pickups (≤ 8,500 GVWR)	Minivans (≤ 8,500 GVWR)	Full-size vans (≤ 8,500 GVWR)	Sport/ utility 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]
Yearly mileage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
0 to 5,000	2%	4%	3%	[b]	19%	[c]	0%	[b]	13%	4%
5,001 to 10,000	[b]	1%	6%	1%	4%	[b]	[b]	19%	[b]	[b]
10,001 to 20,000	[b]	23%	31%	[b]	[b]	[b]	32%	51%	27%	[b]
20,001 to 50,000	27%	40%	41%	[b]	32%	24%	20%	17%	[b]	35%
50,001 to 100,000	4%	[b]	4%	[b]	10%	[c]	12%	[b]	[c]	5%
100,001 or more	[b]	[b]	[b]	[b]	[b]	[c]	[c]	[c]	[c]	1%
No answer	4%	27%	14%	3%	[b]	[b]	17%	8%	[b]	[b]
Fuel economy (miles per gallon)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1 to 10	[b]	3%	6%	0%	10%	[b]	42%	51%	27%	3%
11 to 20	[b]	[b]	60%	[b]	69%	[b]	30%	[b]	[b]	40%
21 to 30	[b]	[b]	4%	9%	3%	[b]	[b]	[c]	[c]	[b]
31 to 50	[b]	[b]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[b]
No answer	[b]	16%	29%	[b]	[b]	8%	28%	28%	[b]	[b]
Total vehicles	[b]	[b]	8,053	[b]	7,967	[b]	2,159	1,002	[b]	58,527

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. 17, (http://www.eia.doe.gov).

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

[b]Withheld because Relative Standard Error is equal to or greater than 50 percent, 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 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 3.41
Number of 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]
Annual miles traveled	100%	100%	100%	100%	100%
0 to 5,000	[b]	[b]	17%	[b]	4%
5,001 to 10,000	[b]	[b]	[b]	[b]	0%
10,001 to 20,000	14%	28%	26%	10%	17%
20,001 to 50,000	58%	42%	26%	17%	24%
50,001 to 100,000	[b]	[b]	8%	32%	26%
100,001 or more	[b]	[c]	[b]	23%	15%
No answer	[b]	10%	[b]	11%	13%
Fuel economy (miles per gallon)	100%	100%	100%	100%	100%
1 to 10	6%	34%	60%	89%	71%
11 to 20	55%	46%	21%	1%	13%
21 to 30	7%	[b]	[b]	[c]	1%
31 to 50	[b]	[c]	[c]	[c]	[c]
No answer	31%	[b]	19%	9%	15%
Total vehicles	**1,102**	**3,098**	**3,950**	**14,921**	**24,086**

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. 17, (http://www.eia.doe.gov).

[a]Buses are included in totals but are not shown because the relative standard error is equal to or greater than 50 percent, or data were reported for fewer than five fleets.

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

[c]No case reported.

With a few exceptions, the sales-weighted fuel economies of automobiles and light trucks have, on average, met the fuel economy standards set by the federal government. This does not mean, however, that each manufacturer has met the standards each year. Some manufacturers still fall short, while others exceed the standards. In 1994 the light truck (combined) fuel economy estimate fell 0.2 mpg short of the standard.

Table 3.42
Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates
for Automobiles and Light Trucks, 1978-95[a]
(miles per gallon)

	Automobiles				Light Trucks[b]			
		CAFE Estimates[c]				CAFE Estimates[c]		
Model Year	CAFE Standards	Domestic	Import	Combined	CAFE Standards	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	17.2	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	19.9	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	21.0
1990	27.5	26.9	29.9	28.0	20.0	20.3	23.0	20.8
1991	27.5	27.3	30.0	28.3	20.2	20.9	23.0	21.3
1992	27.5	27.0	29.1	27.8	20.2	20.5	22.7	20.8
1993	27.5	27.8	29.5	28.4	20.2	20.7	22.8	21.0
1994	27.5	27.3	29.6	28.2	20.5	20.4	22.0	20.6
1995	27.5	27.5	29.7	28.2	20.6	20.1	21.6	20.4

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, September 1995.

[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 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 3.43
Corporate Average Fuel Economy (CAFE) Fines Collected, 1983-94
(thousands)

Model year	Current dollars	1990 constant dollars[a]
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[b]	11,234	10,133
Total	343,515	357,856

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, January 1996.

Table 3.44
Tax Receipts from the Sale of Gas Guzzlers, 1980-93
(thousands)

Fiscal year	Current dollars	1990 constant dollars[a]
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	152,000	137,560
Total	1,093,650	1,146,214

Source:
Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '94, Detroit, MI, 1995, p. 85.

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[a]Adjusted using the Consumer Price Inflation Index.

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

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 3.45
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, "Gas Guzzler Tax" and annual.

New Data by Vehicle Speed

ORNL is presently conducting a project for the Federal Highway Administration to develop vehicle fuel consumption and emissions models and databases for use in FHWA's TRAF-NETSIM model. In the project, 15 to 20 light-duty vehicles will be thoroughly characterized for their fuel consumption and emissions over most of their operating ranges. The vehicle characterizations will be represented in tables of fuel consumption and emissions as functions of vehicle speed and acceleration. To acquire the data, each vehicle will be instrumented and tested on-road and on a chassis dynamometer. Emissions and fuel consumption measurements will be made while driving the vehicles on the dynamometer, and these data will be married with actual on-road speed and acceleration measurements.

Tests of four vehicles have been completed thus far, including a 1994 Oldsmobile Cutlass, 1994 Oldsmobile Eighty-Eight, 1994 Mercury Villager minivan, and a 1994 Geo Prizm. Other vehicles to be tested include more light trucks and some smaller cars. Preliminary results of steady-speed fuel consumption tests indicate that peak fuel economy occurs at higher speeds than in older vehicles tested in previous studies.

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

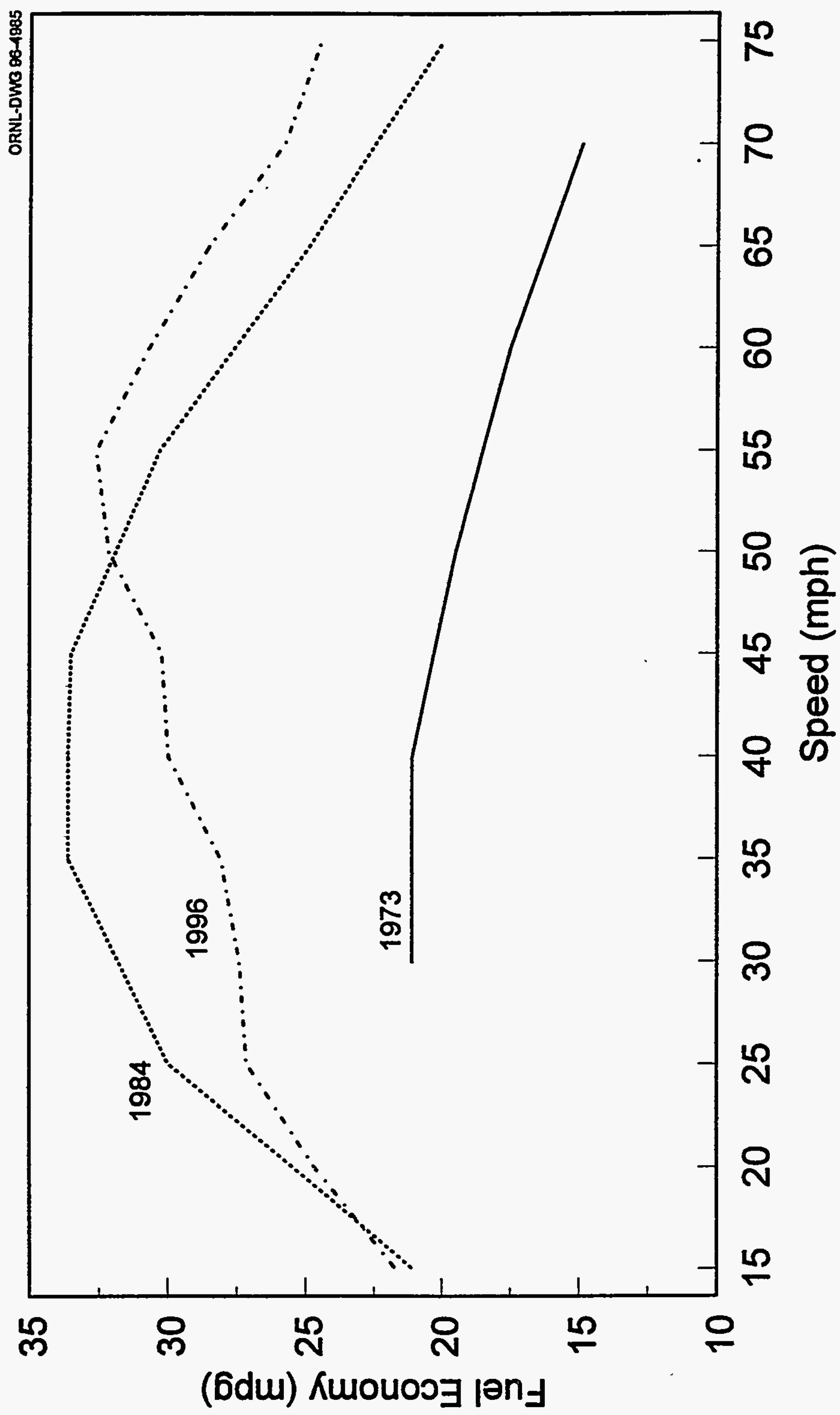
Table 3.46
Fuel Economy by Speed, 1973, 1984, and 1996
(miles per gallon)

Speed (miles per hour)	1973[a] (13 vehicles)	1984[b] (15 vehicles)	1996[c] (4 vehicles)
15	[d]	21.1	21.73
20	[d]	25.5	24.70
25	[d]	30.0	27.15
30	21.1	31.8	27.40
35	21.1	33.6	28.08
40	21.1	33.6	29.98
45	20.3	33.5	30.23
50	19.5	31.9	32.15
55	18.5	30.3	32.60
60	17.5	27.6	30.70
65	16.2	24.9	28.53
70	14.9	22.5	25.80
75	[d]	20.0	24.48
	Fuel economy loss		
55-65 mph	12.4%	17.8%	11.3%
65-70 mph	8.0%	9.6%	14.2%
55-70 mph	19.5%	25.7%	23.9%

Sources:
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.
1996 - Produced for the Federal Highway Administration by Oak Ridge National Laboratory, preliminary data, March 1996.

[a]Model years 1970 and earlier automobiles.
[b]Model years 1981-84 automobiles and light trucks.
[c]Model years 1988-94 automobiles and light trucks. Preliminary data for four vehicles.
[d]Data are not available.

Figure 3.2. Fuel Economy by Speed, 1973, 1984, and 1996



Source: See Table 3.46.

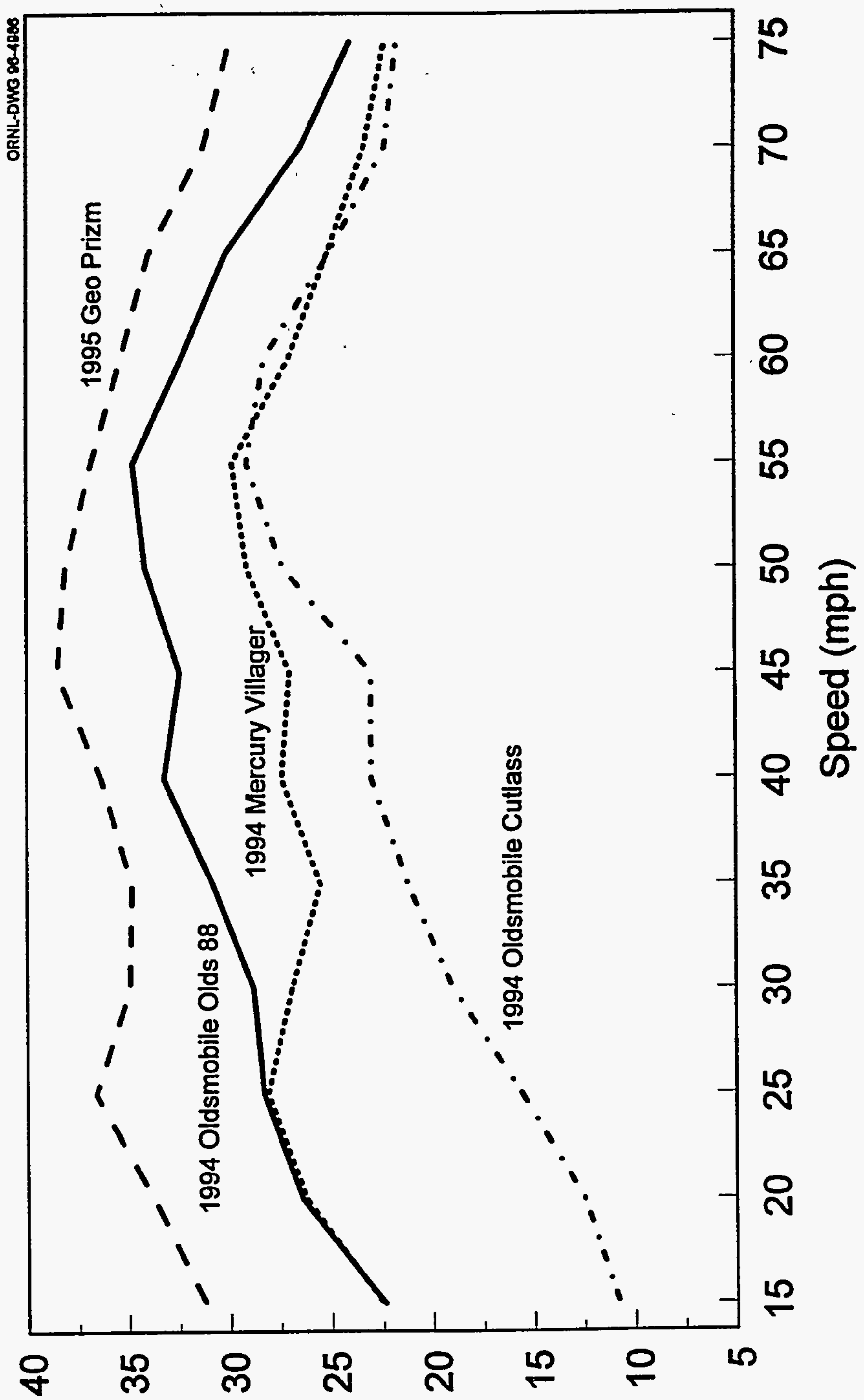
All of the tested vehicles showed over 20% fuel economy loss from 55 to 75 miles per hour (mph). From 65 to 75 mph, the Olds 88 indicated a 20% decline in fuel economy, nearly double the loss of the Villager or the Prizm. *Please see Page 3-45 for details on this study.*

Table 3.47
Fuel Economy by Speed for Selected Vehicles, 1996
Preliminary Test Data

Speed (mph)	1994 Oldsmobile Olds 88	1994 Mercury Villager	1994 Oldsmobile Cutlass	1995 Geo Prizm
	3800 V6	3.0 Liter V6	3.4 Liter V6	1.6 Liter I4
	L4	L4	L4	L3
	(miles per gallon)			
15	22.4	22.5	10.8	31.2
20	26.4	26.2	12.5	33.7
25	28.3	28.1	15.6	36.6
30	28.8	26.9	19.0	34.9
35	30.8	25.5	21.2	34.8
40	33.2	27.4	23.0	36.3
45	32.4	27.0	23.0	38.5
50	34.1	29.1	27.3	38.1
55	34.7	29.8	29.1	36.8
60	32.3	27.0	28.2	35.3
65	30.1	25.1	25.0	33.9
70	26.4	23.3	22.3	31.2
75	24.0	22.3	21.7	29.9
	Fuel economy loss			
55-65 mph	11.7%	13.7%	8.4%	11.0%
65-75 mph	20.3%	11.2%	13.2%	11.8%
55-75 mph	29.6%	23.4%	20.5%	21.5%

Source:
1996 - Produced for the Federal Highway Administration by Oak Ridge National Laboratory, preliminary data, March 1996.

Figure 3.3. Fuel Economy by Speed for Selected Vehicles, 1996 Preliminary Data



Source: See Table 3.47.

There will be no updated data on Interstate speeds. The Federal Highway Administration no longer publishes this information due to budget constraints.

Table 3.48
Average Urban and Rural Interstate Speeds, 1970-93[a]
(miles per hour)

Year	Urban Interstate	Rural Interstate
1970	b	59.2
1971	b	60.6
1972	b	60.3
1973	b	60.3
1974	b	55.3
1975	b	55.8
1976	56.1	58.2
1977	56.5	58.8
1978	56.7	58.8
1979	56.4	58.3
1980	55.4	57.5
1981	55.5	57.9
1982	56.3	59.0
1983	56.8	59.1
1984	57.2	59.3
1985	57.2	59.5
1986	57.4	59.7
1987	58.0	59.7
1988	58.6	59.5
1989	58.9	60.3
1990	58.6	60.4
1991	58.8	59.9
1992	57.7	61.2
1993	58.5	60.8

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1993, Washington, DC, 1994, Table VS-1, p. V-137, and annual.

[a]Data from 1970-79 represent only free-moving traffic, on level, straight, uncongested sections of Interstate. Beginning with fiscal year 1980, the data show the speeds of all vehicular traffic.
[b]Data are not available.

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

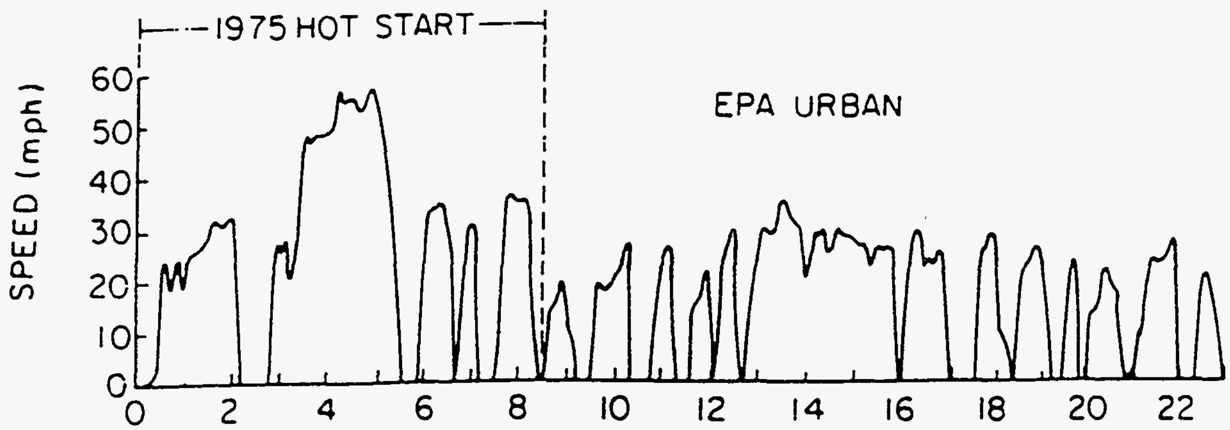
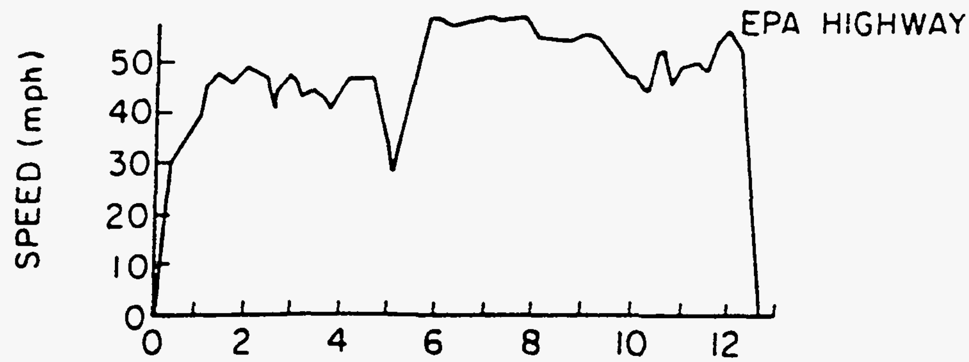


Figure 3.4. Urban Driving Cycle
Length of cycle: 1870 seconds, including idle time.
Average speed: 21.3 mph with idle; 26.5 mph without idle.



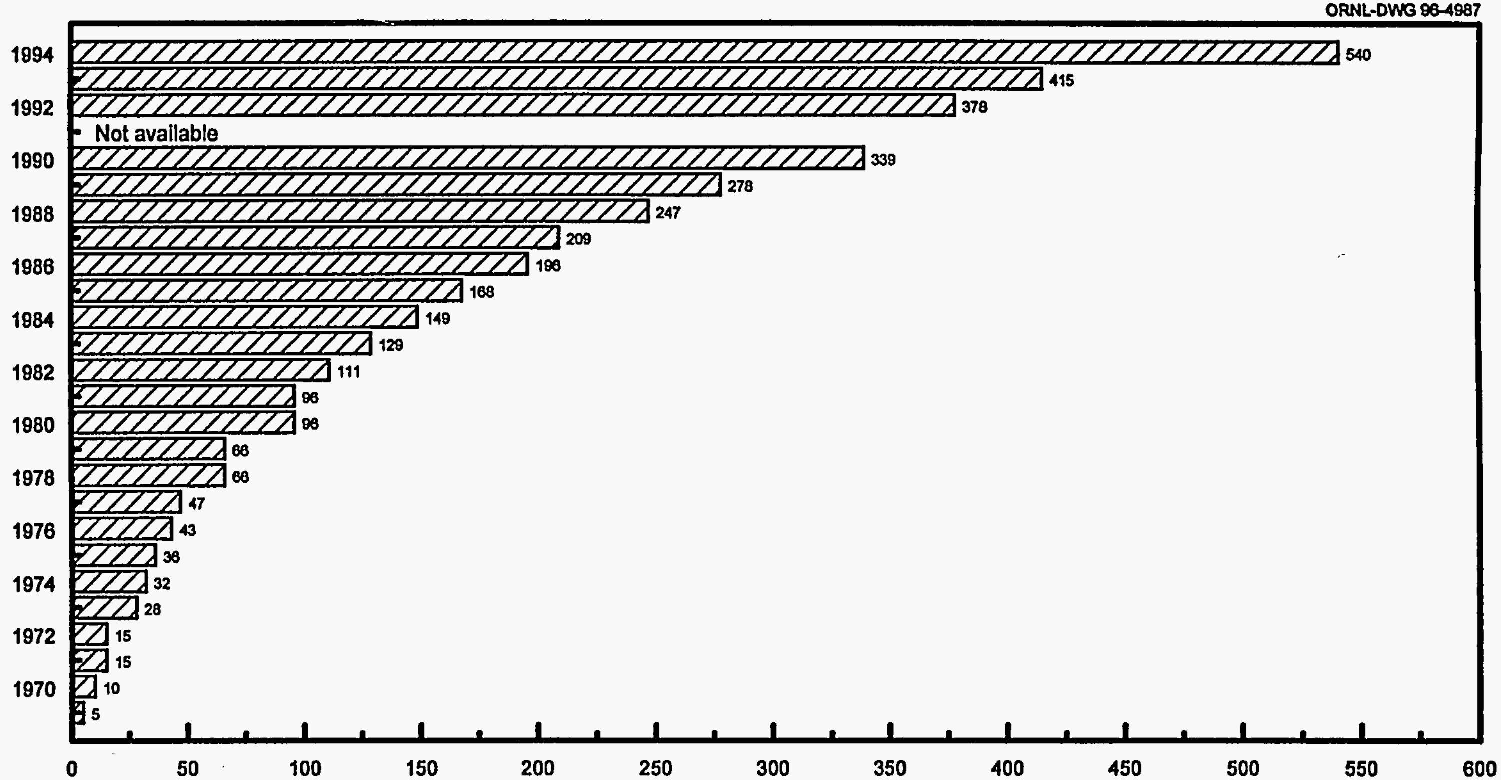
Time (minutes)

Figure 3.5. Highway Driving Cycle
Length of cycle: 765 seconds.
Average speed: 48.5 mph.

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

High-occupancy vehicle (HOV) lanes are special highway lanes meant for the exclusive use of vehicles with a specified 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 3.6. Miles of High-Occupancy Vehicle Lanes, 1969-94



Source:
Texas Transportation Institute, College Station, TX, February 1996.

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

CHAPTER 4
PERSONAL TRAVEL STATISTICS

From 1950 to 1994, the average annual rate of increase in the number of vehicles surpassed the increases in population, households, licensed drivers, and employed persons. Since 1986 there has been more than one vehicle for every licensed driver in the U.S. (Table 4.1). An average household spent 18.5% of total expenditures on transportation in 1994 (Table 4.2).

Results from the Residential Transportation Energy Consumption Survey (RTECS) are found in Tables 4.3-4.7. The RTECS has been conducted six times since 1978 by the Department of Energy's Energy Information Administration. The survey focuses on vehicle miles traveled, energy end-use consumption and expenditures by households for personal transportation. Vehicle travel information is collected by actual odometer readings instead of survey respondents estimates. There were no major changes in survey methodology between the 1988, 1991 and 1994 surveys, but the 1985 and previous RTECS had different estimation procedures for vehicle fuel economy and fuel prices. Therefore, caution should be used when comparing the 1988 and later RTECS to previous years. The 1994 RTECS data were recently released and some of the more detailed data were not yet available to update Tables 4.5-4.7.

Information on household trips by trip purpose is found in the Nationwide Personal Transportation Survey (NPTS) (Table 4.9). The NPTS is a national survey designed to collect data on the nature and characteristics of personal travel. The definition of a trip in the NPTS is "any one-way travel from one address to another by private motor vehicle, public transportation, bicycle, or walking." Excluded from the survey are jogging and walking for exercise, as well as all bicycling and walking for individuals under 5 years of age. The survey collects detailed data on household trips, their purposes and the transportation modes used. The NPTS is sponsored by several agencies of the U.S. Department of Transportation and is conducted approximately every seven years. Since each of the surveys differ somewhat in terminology, survey procedure, and target population, one should be cautious when comparing statistics from one survey to the next. The last NPTS was conducted in 1995; survey results have not yet been released.

The NPTS and the Decennial Census of the population both provide information on the "journey-to-work." In 1990, 73% of U.S. workers commuted to work alone in a private vehicle, which is 9% more than in 1980 (Table 4.12).

Table 4.1
Population and Vehicle Profile, 1950-94

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	249,402	93,347	179,299	167,015	117,914	0.72	8,598	1.79	1.07	1.52
1991	252,131	94,312	181,438	168,995	116,877	0.72	8,614	1.79	1.07	1.55
1992	255,028	95,689	181,519	173,125	117,598	0.71	8,781	1.81	1.05	1.54
1993	257,783	96,391	186,315	173,149	119,306	0.72	8,909	1.80	1.08	1.56
1994	260,341	97,107	188,714	175,403	123,060[b]	0.72	9,065	1.81	1.08	1.53
					Average annual percentage change					
1950-94	1.2%	1.8%	3.4%	2.4%	1.7%	2.1%	2.5%	0.5%	1.0%	1.7%
1984-94	1.0%	1.3%	2.2%	1.2%	1.6%	1.0%	2.2%	-0.1%	1.0%	0.5%

Sources:
Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 115th edition, 1995, Washington, DC, pp. 8, 57, 399, and annual.
Vehicles in operation - R. L. Polk and Company. **FURTHER REPRODUCTION PROHIBITED.**
Licensed drivers and vehicle miles - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Table DL-1A, VM-1, and annual.

[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 source for more details.

Transportation (18.5%) is second only to housing (31.1%) as the largest expenditure for the average household. In 1994, approximately 16% of transportation expenditures were for purchasing gasoline and motor oil.

Table 4.2
Average Annual Expenditures of Households by Income, 1994[a]

		Income before taxes								
	All households	Less than $5000	$5,000-$9999	$10,000-$14999	$15,000-$19,999	$20,000-$29,999	$30,000-$39,999	$40,000-$49999	$50,000-$69,999	$70,000 and over
Total expenditures	$32,763	$15,201	$13,010	$17,798	$22,139	$27,042	$32,476	$40,299	$48,177	$69,505
	Percentage of total expenditures[b]									
Food[c]	14.7%	18.4%	18.8%	17.9%	16.9%	15.6%	15.4%	14.2%	14.3%	12.3%
Housing	31.1%	34.8%	37.4%	36.2%	32.7%	31.4%	31.0%	29.5%	29.0%	30.0%
Apparel and services	5.2%	5.6%	4.6%	4.4%	4.9%	5.4%	5.2%	4.7%	5.1%	5.7%
Transportation	18.5%	16.5%	14.2%	15.5%	19.5%	20.7%	18.5%	22.1%	19.0%	16.8%
Vehicle purchases (net outlay)	**8.3%**	**6.7%**	**5.1%**	**5.5%**	**8.7%**	**9.9%**	**7.9%**	**11.4%**	**8.6%**	**7.1%**
Gasoline and motor oil	**3.0%**	**3.3%**	**3.5%**	**3.4%**	**3.4%**	**3.5%**	**3.5%**	**3.2%**	**2.8%**	**2.3%**
Other vehicle expenditures	**6.1%**	**5.2%**	**4.6%**	**5.4%**	**6.1%**	**6.3%**	**6.2%**	**6.5%**	**6.5%**	**5.9%**
Public transportation	**1.2%**	**1.4%**	**1.0%**	**1.1%**	**1.3%**	**0.9%**	**1.0%**	**1.0%**	**1.1%**	**1.6%**
Health care	5.4%	5.9%	8.7%	8.3%	7.5%	5.8%	5.4%	5.0%	4.6%	3.9%
Entertainment	4.9%	5.0%	4.2%	4.1%	4.3%	4.8%	4.8%	4.8%	5.3%	5.4%
Personal Insurance & pensions	10.4%	1.5%	2.3%	3.9%	5.0%	7.3%	9.9%	11.2%	13.0%	15.3%
Others[d]	9.8%	12.2%	9.7%	9.7%	9.2%	8.9%	9.9%	8.7%	9.7%	10.6%

Source:
U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey: Interview Survey, 1994, detailed computer printout, 1995.

[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.

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]

Sources:

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.

[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 18% more than per year than the one in two-vehicle households (15,110 miles vs. 12,803 miles).

Table 4.5
Average Annual Miles per Vehicle by Household Vehicle Ownership, 1991 RTECS

Vehicle[a]	One-vehicle household	Two-vehicle household	Three-vehicle household	Four-vehicle household	Five-vehicle household
#1	9,245	12,803	13,756	14,837	15,110
#2	-	6,405	8,629	9,416	9,969
#3	-	-	4,200	5,839	6,966
#4	-	-	-	2,661	4,828
#5	-	-	-	-	2,469
Average	**9,245**	**9,604**	**8,862**	**8,188**	**7,868**

Source:
Generated from the Department of Energy, Energy Information Administration, "1991 Residential Transportation Energy Consumption Survey Public Use diskettes," Washington, DC, December 1993.

Table 4.6
Average Age of Vehicles by Household Vehicle Ownership, 1991 RTECS

Vehicle[a]	One-vehicle household	Two-vehicle household	Three-vehicle household	Four-vehicle household	Five-vehicle household
#1	7.64	6.05	6.33	5.58	5.52
#2	-	8.48	7.40	6.43	7.81
#3	-	-	9.45	9.15	11.09
#4	-	-	-	9.60	9.20
#5	-	-	-	-	10.70
Average	**7.64**	**7.27**	**7.73**	**7.69**	**8.87**

Source:
Generated from the Department of Energy, Energy Information Administration, "1991 Residential Transportation Energy Consumption Survey Public Use diskettes," Washington, DC, December 1993.

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

Table 4.7
Distribution of Vehicles by Vehicle Age and Household Vehicle Ownership, 1991 RTECS

Vehicle age	One-vehicle households	Two-vehicle households	Three-vehicle households	Four-vehicle households	Five-vehicle households	Total households
Vehicle 1						
New	2.94%	4.36%	2.42%	1.20%	0.29%	11.22%
2-5	3.94%	5.83%	2.63%	0.89%	0.37%	13.66%
6-10	4.95%	4.90%	2.31%	1.17%	0.21%	13.54%
11-15	2.90%	1.92%	1.19%	0.42%	0.14%	6.58%
16-20	1.01%	0.60%	0.29%	0.06%	0.04%	2.00%
21+	0.50%	0.32%	0.29%	0.07%	0.00%	1.18%
Vehicle 2						
New		2.26%	1.82%	0.95%	0.11%	5.14%
2-5		4.33%	2.26%	1.02%	0.27%	7.88%
6-10		5.58%	2.83%	1.12%	0.30%	9.84%
11-15		3.69%	1.39%	0.45%	.0.30%	5.83%
16-20		1.26%	0.46%	0.17%	0.06%	1.95%
21+		0.80%	0.37%	0.09%	0.02%	1.28%
Vehicle 3						
New			1.47%	0.68%	0.08%	2.23%
2-5			1.50%	0.74%	0.15%	2.39%
6-10			2.58%	0.79%	0.29%	3.66%
11-15			2.04%	0.97%	0.36%	3.37%
16-20			0.84%	0.34%	0.08%	1.26%
21+			0.70%	0.29%	0.10%	1.09%
Vehicle 4						
New				0.61%	0.27%	0.88%
2-5				0.78%	0.14%	0.92%
6-10				0.89%	0.22%	1.11%
11-15				0.87%	0.21%	1.08%
16-20				0.34%	0.09%	0.43%
21+				0.32%	0.12%	0.44%
Vehicle 5						
New					0.18%	0.18%
2-5					0.19%	0.19%
6-10					0.12%	0.12%
11-15					0.27%	0.27%
16-20					0.20%	0.20%
21+					0.09%	0.09%
Total	**16.25%**	**35.85%**	**27.38%**	**15.23%**	**5.29%**	**100.00%**

Source:
Generated from the Department of Energy, Energy Information Administration, "1991 Residential Transportation Energy Consumption Survey Public Use diskettes," Washington,DC, December 1993.

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.

[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, Table 7, FHWA-PL-92-027, Washington, DC, March 1992.

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

Two-vehicle households accounted for 42% of all households, but 46% of vehicle trips in 1990. Over 20% of all vehicle trips were taken in vehicles 10 years or older, regardless of the number of vehicles available to the household.

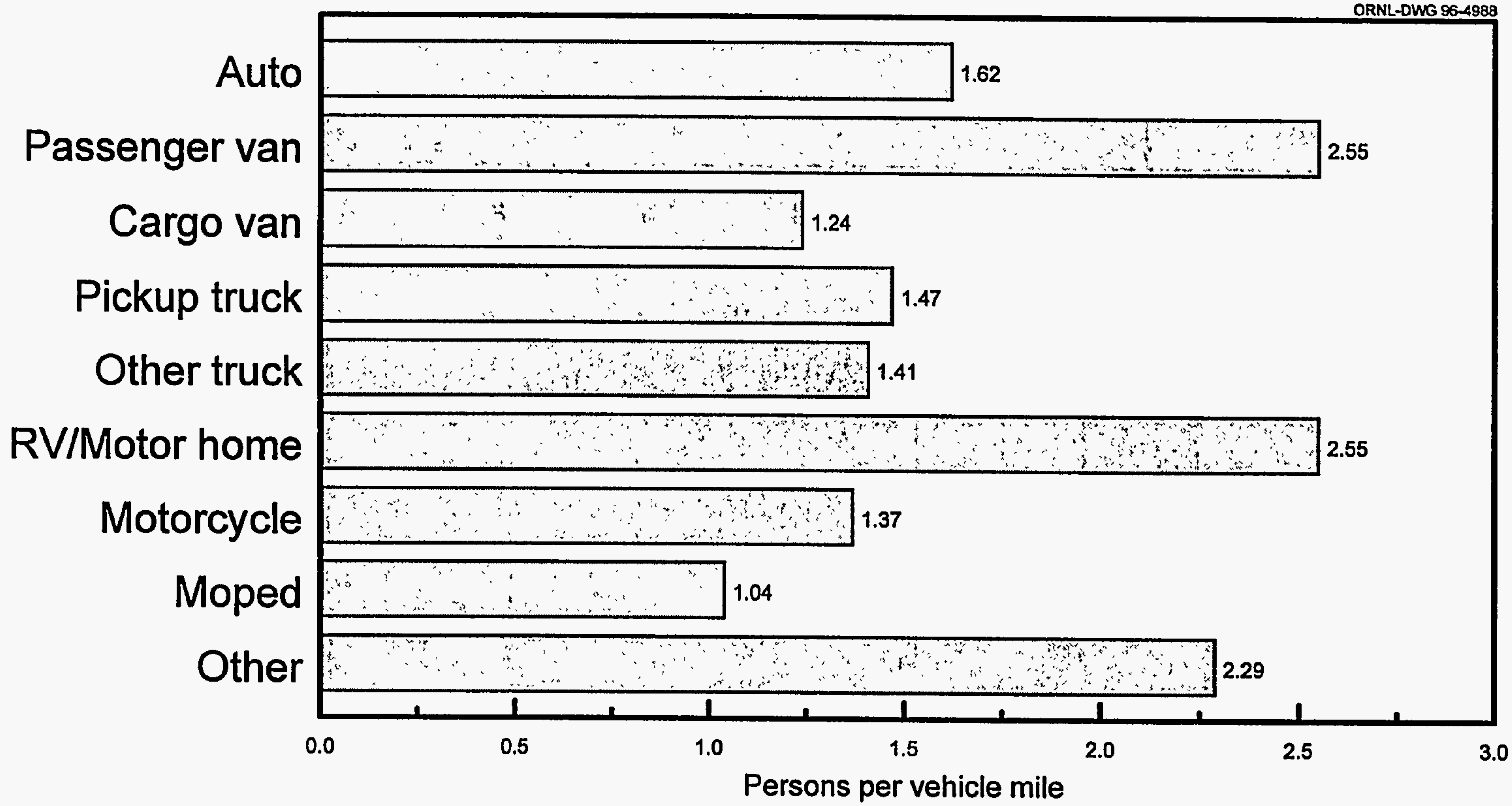
Table 4.10
Annual Vehicle Trips by Number of Household-based Vehicles[a] and Age of Vehicle, 1990 NPTS (millions)

Vehicle Age	1 Vehicle	2 Vehicles	3 or More Vehicles	TOTAL
1 Year or Less	2,334	5,876	3,716	**11,926**
2 Years	3,399	8,608	4,755	**16,762**
3 Years	3,227	8,064	4,532	**15,823**
4 Years	4,021	7,490	4,067	**15,578**
5 Years	3,806	7,600	4,559	**15,965**
6 Years	3,222	6,451	4,074	**13,747**
7 Years	2,913	5,600	3,860	**12,373**
8 Years	1,813	3,274	2,463	**7,550**
9 Years	1,433	2,710	1,983	**6,126**
10 or More Years	9,267	14,600	11,500	**35,367**
TOTAL	**36,966**	**73,144**	**48,274**	**158,927[b]**
ALL AGES	***23%***	***46%***	***30%***	***100%***
TOTAL HOUSEHOLDS	***36.3%***	***42.3%***	***21.5%***	***100.0%***

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. 5-43.

[a]Includes all vehicles owned by or available on a regular basis to the household.
[b]Includes trips where age of vehicle was unreported.

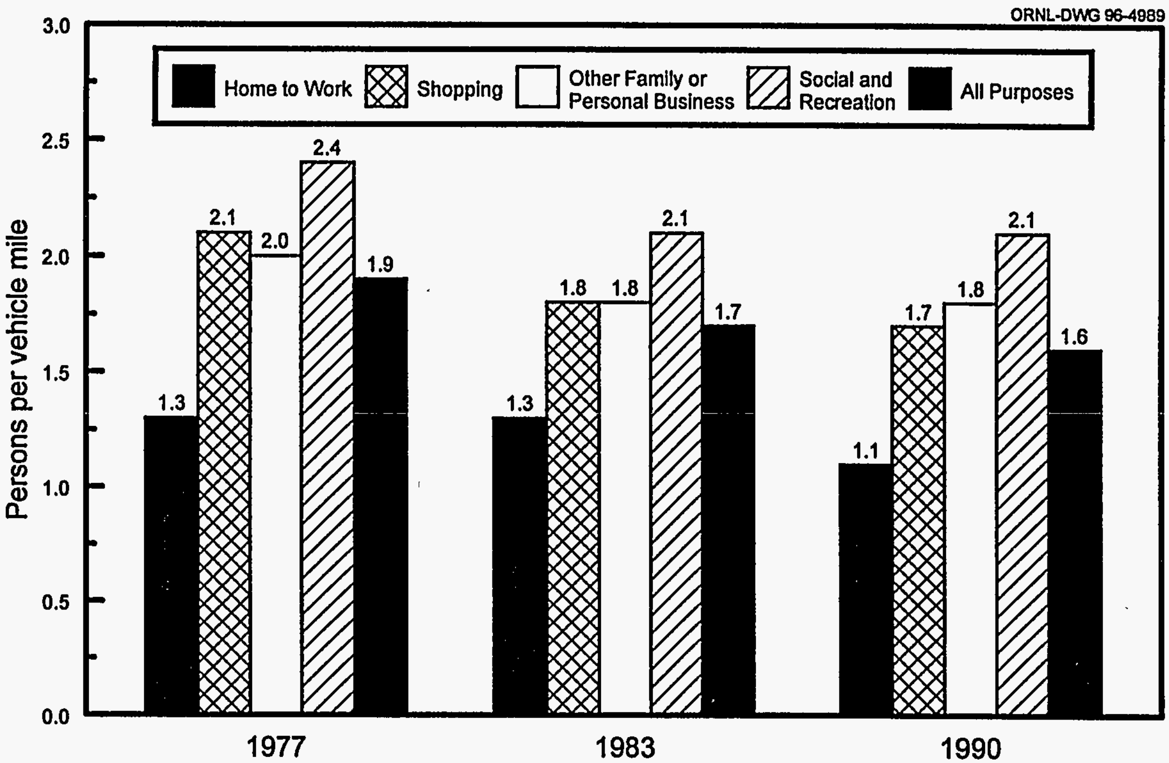
Figure 4.1 Average Vehicle Occupancy by Vehicle Type, 1990 NPTS



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.

The average vehicle occupancy, calculated as person miles per vehicle mile, was at its lowest level since 1977 for everytrip 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, Figure 6, Washington, DC, March 1992.

Less than 10% of vehicle trips to work were multi-occupant. Single-occupant automobile trips accounted for nearly 70% of all journey-to-work vehicle trips.

Table 4.11
Number of Journey-to-Work Vehicle Trips by Number of Occupants and Vehicle Type, 1990 NPTS

	Number of Persons on the Trip				
	1	2	3	4+	Total
Auto	29,143,140	2,245,724	524,413	179,100	32,092,377
	90.8%	7.0%	1.6%	0.6%	100.0%
Passenger Van	1,365,401	135,338	30,063	47,930	1,578,732
	86.5%	8.6%	1.9%	3.0%	100.0%
Pickup Truck	6,601,584	547,596	107,032	22,757	7,278,968
	90.7%	7.5%	1.5%	0.3%	100.0%
Motorcycle and Moped	137,546	[a]	[a]	[a]	137,546
	100.0%	[a]	[a]	[a]	100.0%
Other[b]	619,870	64,058	9,784	1,648	695,360
	89.1%	9.2%	1.4%	0.2%	100.0%
Total [c]	**37,876,690**	**2,992,716**	**671,291**	**251,435**	**41,792,133**
	90.6%	**7.2%**	**1.6%**	**0.6%**	**100.0%**

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. 7-34.

[a]Indicates no data reported.
[b]Includes cargo van, other truck, RV/motor home, and any other private vehicles not corresponding to the above classifications.
[c]Includes trips where vehicle type was unreported.

According to the U.S. Census data, the percentage of workers who carpooled 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 4.12
Means of Transportation to Work for the United States, 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%
Carpooled	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	1.1%	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.

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

Table 4.13
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 carpooled	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 the United States and its Major Metropolitan Area, 1960-1990, FHWA-PL-94-012, Cambridge, MA, 1994, p. 2-6.

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

CHAPTER 5
ALTERNATIVE FUELS STATISTICS

In 1994, the transportation sector alone used 22.7 quads of petroleum fuels, accounting for 65.4% of total petroleum consumed in the United States. With decreasing domestic oil production and rising demand, the amount of imported crude oil and petroleum products has increased at an average rate of 5.1% per year since 1984. In 1994, 50% of the petroleum consumed in the U.S. was imported. These statistics suggest that reducing the transportation sector's dependence on petroleum fuels will be the key to reducing the nation's dependence on imported petroleum.

In 1988 the Alternative Motor Fuels Act (AMFA) was established to encourage the use of alternative fuels in the U.S. transportation sector. As a result of the AMFA, the Alternative Fuels Data Center (AFDC) was established by the Department of Energy. The AFDC distributes information about alternative fuel vehicles as well as data on refueling sites around the nation. Information about the AFDC, and statistics and maps generated by the AFDC, are presented in this chapter.

The Energy Policy Act (EPACT) of 1992 included alternative fuel mandates. Purchase requirements were set from 1993 forward for the federal and state governments, fuel providers (e.g., natural gas and electric utilities), and the private sector. The federal fleet purchase requirements have already been updated by Executive Order 12844 (see Figure 5.1). Additional rulemaking is required for the private sector alternative fuel vehicle mandates to take effect. The Energy Information Administration, in an effort to learn more about fuel provider fleets which may be impacted by EPACT Section 501, conducted surveys of three fuel provider industries - propane, electricity, and natural gas (Tables 5.4-5.7). An estimate of fuel provider vehicles (all industries) which are potentially covered under EPACT Section 501 is included in Table 5.8.

Since the AMFA, government and industry have made major efforts to advance our knowledge of alternative fuels and alternative fuel vehicles. The U.S. Advanced Battery Consortium (USABC) was established in January 1991 to concentrate efforts on battery development for electric vehicles. The goals of the USABC are presented in Table 5.9.

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 chaper 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 **www.afdc.nrel.gov**.

Table 5.1
Estimates of Non-Federal Alternative Fuel Vehicles by Ownership and Vehicle Size, 1993 and 1995

	Private		State and local government		Total	
Fuel type	1993	1995	1993	1995	1993	1995
			Light-duty vehicles			
LPG[a]	192,000	213,000	10,000	11,000	202,000	224,000
CNG	16,932	41,124	8,692	32,576	25,624	73,700
M-85	2,737	7,647	1,900	2,720	4,637	10,367
E-85	52	54	273	451	325	505
Electricity	1,657	1,857	135	273	1,792	2,130
M-100	0	0	0	0	0	0
E-95	4	4	1	1	5	5
LNG	2	2	29	50	31	52
Total	**213,384**	**263,688**	**21,030**	**47,071**	**234,414**	**310,759**
			Heavy-duty vehicles			
LPG[a]	64,000	71,000	3,000	4,000	67,000	75,000
CNG	1,719	4,991	2,281	6,010	4,000	11,001
M-85	0	0	108	109	108	109
E-85	0	0	2	2	2	2
Electricity	0	0	19	67	19	67
M-100	2	1	412	412	414	416
E-95	4	4	18	24	22	28
LNG	3	6	265	381	268	387
Total	**65,728**	**76,002**	**6,105**	**11,005**	**71,833**	**87,119**

Source:
U. S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels: An Overview, Washington, DC, January 1995, p. 11, 12.

[a]These figures represent the lower boundary for the number of LPG vehicles.

In 1993 the Federal Fleet had 8,790 alternative fuel vehicles (AFV). Estimated acquisitions for 1995 indicate that the number of AFVs would more than double. The plans called for the purchase of mostly methanol and compressed natural gas vehicles in 1995.

Table 5.2
Federal Government
Alternative Fuel Vehicles by Fuel Type, 1992, 1993, and 1995

Fuel type	1992	1993	Estimated purchases, 1995
Propane	19	32	331
Compressed natural gas	691	3,090	8,485
M-85	2,590	5,518	9,564
E-85	25	114	321
Electricity	35	36	53
Total	**3,360**	**8,790**	**18,754**

Source:
U. S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels: An Overview, Washington, DC, January 1995, pp. 10, 11, 12.

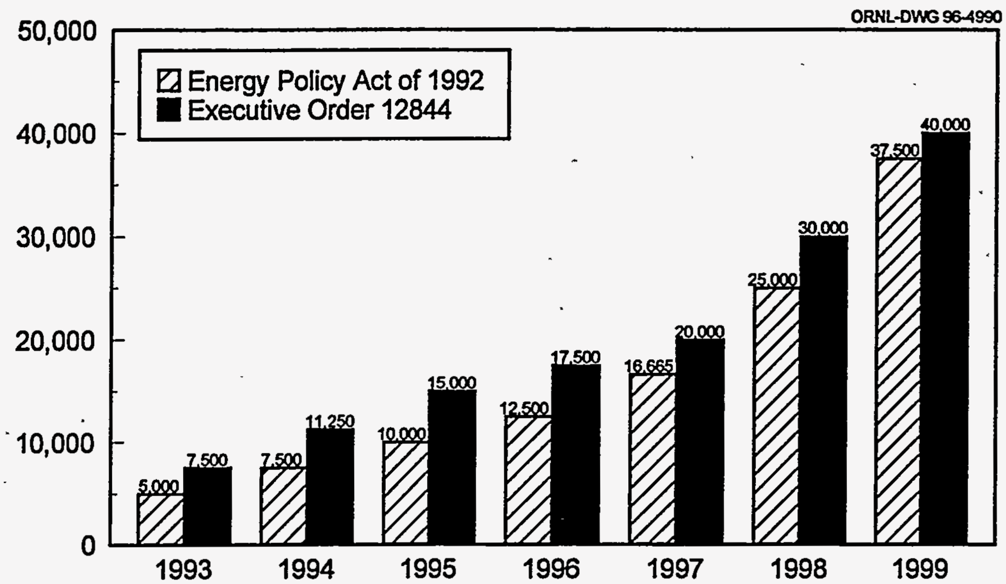
Although the Energy Policy Act of 1992 (EPACT) set alternative fuel vehicle purchase requirements for Federal and State Governments, fuel providers and the private sector, the Federal fleet requirements have since been increased by Executive Order 12844. A comparison of the two requirements is shown in the graph below.

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%	10%	30%	-
1997	33%	15%	50%	-
1998	50%	25%	70%	-
1999	75%	50%	90%	20%
2000	75%	75%	90%	20%
2001	75%	75%	90%	20%
2002	75%	75%	90%	30%
2003	75%	75%	90%	40%
2004	75%	75%	90%	50%
2005	75%	75%	90%	60%
2006-on	75%	75%	90%	70%

Source:
National Alternative Fuels Hotline for Transportation Technologies, 1993.

Figure 5.1. Federal Fleet Alternative Fuel Vehicle Purchase Requirements[b]



[a]Under the early rulemaking scenario. Additional rulemaking is required by December 15, 1996 for private AFV requirements to take effect.
[b]Based on 50,000 vehicle acquisitions per year.

The propane provider fleet data were collected on the Propane Provider Fleet Survey (EIA-885), a national-level survey of propane providers. The survey collected information concerning the fleets and fleet vehicles operated by propane providers in the U.S. as of the end of 1993. The information collected included vehicle stock, vehicle acquisition plans, and fleet vehicle operating characteristics.

Table 5.4
Fleet Vehicles Operated by Propane Providers as of December 31, 1993
(number of vehicles)

	Passenger cars			Light-duty vans/trucks (≤8,500 lbs. GVW)					Medium-/heavy-duty trucks			
Fuel type	Sub-compact/ compact	Mid-size	Large	Mini-van	Full-size van	Small pickup	Large pickup	Sport/ utility	8,501 to 26,000 lbs. GVW	>26,000 lbs. GVW	Total	Percentage of total
Conventional-fuel vehicles	**279**	**1,801**	[a]	[b]	**1,571**	**585**	**8,040**	**575**	**10,128**	**17,512**	**43,699**	**53.3%**
Gasoline	279	1,801	[b]	[b]	1,545	584	6,360	571	7,686	2,255	24,288	29.6%
Diesel	[b]	[a]	[b]	[a]	[b]	[b]	[b]	[b]	2,443	15,257	19,412	23.7%
Alternative-fuel vehicles[c]	**131**	**41**	**65**	**14**	[b]	**1,282**	**9,786**	[b]	**15,078**	**11,462**	**38,267**	**46.7%**
Propane												
Dedicated	124	6	[b]	[b]	[b]	1,082	7,080	[b]	14,383	10,719	33,800	41.2%
Multifuel	6	35	39	6	[b]	182	2,659	[a]	691	743	4,374	5.3%
Total	409	1,842	[b]	[b]	1,934	1,867	17,826	732	25,300	28,974	81,967	100.0%

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.

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).

[a] No cases in sample.
[b] Data withheld because Relative Standard Errors are greater than 50 percent or fewer than three companies are represented.
[c] Data on compressed natural gas vehicles were collected, however, much of the data were withheld (see footnote b) or there were no cases in the sample.

The electric utility fleet data were collected on the Electric Utility Fleet Survey (EIA-861 Schedule VII), a national-level census survey of electric utilities. The survey collected vehicle stock and vehicle acquisitions plans for fleets operated by electric utilities in the U.S. as of the end of 1993.

Table 5.5
Fleet Vehicles Operated by Electric Utilities as of December 31, 1993
(number of vehicles)

	Passenger cars			Light-duty vans/trucks (≤8,500 lbs. GVW)					Medium/ heavy-duty trucks		
Fuel type	Sub-compact/ compact	Mid-size	Large	Mini-van	Full-size van	Small pickup	Large pickup	Sport/ utility		Total	Percentage of total
Conventional-fuel vehicles	**19,589**	**14,965**	**3,248**	**7,011**	**11,567**	**22,091**	**37,137**	**11,134**	**69,499**	**196,241**	**97.2%**
Gasoline	19,588	14,949	3,238	6,997	11,003	21,870	34,480	10,358	32,587	155,070	76.8%
Diesel	1	16	10	14	564	221	2,657	776	36,912	41,171	20.4%
Alternative-fuel vehicles	**244**	**342**	**55**	**193**	**853**	**593**	**1,831**	**535**	**949**	**5,595**	**2.8%**
Compressed natural gas											
Dedicated	0	4	3	5	516	13	212	42	26	821	0.4%
Multifuel	92	233	16	128	206	360	1,047	452	401	2,935	1.5%
Propane											
Dedicated	1	0	0	0	21	52	91	6	318	489	0.2%
Multifuel	1	0	0	3	3	12	120	11	19	169	0.1%
Methanol/ethanol blends											
Dedicated	11	47	26	15	20	47	222	13	122	523	0.3%
Multifuel	79	52	9	11	30	62	136	7	26	412	0.2%
Electricity											
Dedicated	60	6	1	31	50	46	3	4	36	237	0.1%
Multifuel	0	0	0	0	0	0	0	0	0	0	0.0%
Other alternative fuels											
Dedicated	0	0	0	0	7	1	0	0	1	9	0.0%
Multifuel	0	0	0	0	0	0	0	0	0	0	0.0%
Total	**19,833**	**15,307**	**3,303**	**7,204**	**12,420**	**22,684**	**38,968**	**11,669**	**70,448**	**201,836**	**100.0%**

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.

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).

The natural gas supplier fleet data were collected on the Natural Gas Suppliers Fleet Survey (EIA-176 Schedule B), a national-level census survey of natural gas suppliers. The survey collected information regarding the fleets and fleet vehicles operated by natural gas suppliers in the U.S. as of the end of 1993. The information collected included vehicle stock, vehicle acquisition plans, and fleet vehicle operating characteristics.

Table 5.6
Fleet Vehicles Operated By Natural Gas Suppliers as of December 31, 1993
(number of vehicles)

	Passenger cars			Light-duty vans/trucks (≤8,500 lbs. GVW)							
Fuel type	Sub-compact/ compact	Mid-size	Large	Mini-van	Full-size van	Small pickup	Large pickup	Sport/ utility	Medium/ heavy-duty trucks	Total	Percentage of total
Conventional-fuel vehicles	**10,416**	**11,626**	**3,652**	**5,141**	**11,806**	**13,688**	**26,144**	**5,731**	**34,072**	**122,276**	**88.4%**
Gasoline	10,416	11,609	3,649	5,134	11,465	13,629	25,070	5,440	18,022	104,434	75.5%
Diesel	0	17	3	7	341	59	1,074	291	16,050	17,842	12.9%
Alternative-fuel vehicles	**585**	**791**	**335**	**495**	**3,610**	**1,839**	**5,347**	**638**	**2,408**	**16,048**	**11.6%**
Compressed natural gas											
Dedicated	7	19	31	21	965	118	935	31	96	2,223	1.6%
Multifuel	567	756	291	447	2,505	1,612	3,464	602	1,565	11,809	8.5%
Propane											
Dedicated	2	13	8	17	99	87	185	3	591	1,005	0.7%
Multifuel	0	3	5	2	16	19	763	2	138	948	0.7%
Electricity											
Dedicated	8	0	0	7	18	3	0	0	1	37	0.0%
Multifuel	0	0	0	0	0	0	0	0	0	0	0.0%
Other alternative fuels											
Dedicated	1	0	0	1	7	0	0	0	17	26	0.0%
Multifuel	0	0	0	0	0	0	0	0	0	0	0.0%
Total	**11,001**	**12,417**	**3,987**	**5,636**	**15,416**	**15,527**	**31,491**	**6,369**	**36,480**	**138,324**	**100.0%**

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.

Note:
"Multifuel" refers to all alternative-fuel vehicles 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 5.7
Natural Gas Supplier Fleet Vehicle Daily Miles Traveled Range, 1993
(number of vehicles)

	Passenger cars			Light-duty vans/trucks (≤8,500 lbs. GVW)							
Fuel type	Sub-compact/ compact	Mid-size	Large	Mini-van	Full-size van	Small pickup	Large pickup	Sport/ utility	Medium/ heavy-duty trucks	Total	Percentage of total
0 to 50	6,168	6,006	1,376	2,924	7,473	8,382	12,849	3,678	26,286	75,142	54.3%
51 to 100	4,631	5,550	1,671	2,224	7,023	6,280	13,456	2,098	8,579	51,512	37.2%
101 to 150	166	655	509	345	754	582	3,339	457	1,095	7,902	5.7%
151 to 200	21	104	90	130	130	247	1,057	100	300	2,179	1.6%
201 to 300	10	89	310	8	32	34	530	32	72	1,117	0.8%
More than 300	5	13	31	5	4	2	260	4	148	472	0.3%
Total vehicles	**11,001**	**12,417**	**3,987**	**5,636**	**15,416**	**15,527**	**31,491**	**6,369**	**36,480**	**138,324**	**100.0%**

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.

"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 5.8
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, submitted and accepted February 1996 (not yet published).

[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 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 have indicated that they will also enforce the LEV program. One of the greatest advantages in using electric vehicles is that there are no vehicle 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 5.9
U.S. Advanced Battery Consortium Research Agreements

Battery type	Organization
	Research contracts
Nickel-metal hydride	Ovonic Battery Corporation, Troy, MI
Sodium-sulfur	Silent Power, Salt Lake City, UT
Nickel-metal hydride	Saft America, Cockeysville, MD
Lithium-iron disulfide	Saft America, Cockeysville, MD
Lithium-polymer	W. R. Grace, Boca Raton, FL 3M, St. Paul, MN
Nickel electrode	Yardney Technical Products, Pawcatuck, CT
	CRADAs
Lithium-polymer	Lawrence Berkeley Laboratory, Berkeley, CA
Sodium Sulfer thermal enclosure	National Renewable Energy Laboratory, Golden, CO
Nickel-metal hydride	Argonne National Laboratory, Argonne, IL
Sodium-sulfur	Idaho National Energy Laboratory, Idaho Falls, ID Sandia National Laboratory, Albuquerque, NM
Lithium-iron disulfide	Argonne National Laboratory, Argonne, IL National Renewable Energy Laboratory, Golden, CO
Sodium-beta sulfur	Argonne National Laboratory, Argonne, IL
Lithium-polymer	Sandia National Laboratory, Albuquerque, NM Idaho National Energy Laboratory, Idaho Falls, ID

Source: U.S. Adanced Battery Consortium.

Today's lead acid batteries provide 30-40 watt hours per kilogram, cost betwen $50-150 per kilowatt hour and have a two- to three-year lifetime. However, current batteries do not have energy or performance sufficient to provide vehicles which are 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 5.10
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.

Alternative fuel vehicles are already in the marketplace with these cars and trucks which are model years 1995 and 1996.

Table 5.11
Alternative Fuel Vehicles Available by Manufacturer

Manufacturer	Model	Body style	Design fuel	Secondary fuel
		1995 model year		
Chrysler - Dodge	Intrepid	Full-size sedan	85% methanol	Gasoline
Chrysler - Dodge	Ram Van/Wagon	Full-size van	Compressed natural gas	
Chrysler - Dodge	Ram Pickup	Full-size pickup	Compressed natural gas	
Chrysler	Caravan/Voyager	Minivan	Compressed natural gas	
Ford	Taurus	Mid-size sedan	85% methanol or 85% ethanol	Gasoline
Ford	F150/250	Full-size pickup	Compressed natural gas	Gasoline
Ford	Econoline	Full-size van	Compressed natural gas	Gasoline
Ford	F500/F700	Heavy-duty truck	Liquified petrolem gas	
		1996 model year		
Chrysler - Dodge	Ram Van/Wagon	Full-size van	Compressed natural gas	Gasoline
Chrysler - Dodge	Ram pickup	Full-size pickup	Compressed natural gas	
Chrysler - Dodge	Caravan/Voyager	Minivan	Compressed natural gas	
Ford	Taurus	Mid-size sedan	85% methanol or 85% ethanol	Gasoline
Ford	Crown Victoria	Full-size sedan	Compressed natural gas	
Ford	F150/250	Full-size pickup	Compressed natural gas	Gasoline
Ford	Econoline	Full-size van	Compressed natural gas	Gasoline
Ford	F500/F700	Heavy-duty truck	Liquified petrolem gas	

Source:
National Alternative Fuels Hotline for Transportation Technologies, 1996.

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 5.12
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	M85	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	22.8	15	31
	Gasoline	1993	24.0	21	32
Ford Econoline[c]	M85	1992, 1993	14.2	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

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

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

[a]Reformulated gasoline was used for all emissions tests.
[b]Average fuel economy measurements during emissions tests.
[c]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 5.13
Number of Alternative Refuel Sites by State and Fuel Type, 1995

State	M85 sites	E85 sites	CNG sites	Propane sites	Electric sites	Total
Alabama	0	0	16	85	0	101
Alaska	0	0	0	8	0	8
Arizona	1	0	20	45	4	66
Arkansas	0	0	7	104	0	111
California	59	0	117	214	103	390
Colorado	2	0	42	48	0	92
Connecticut	0	0	11	19	1	30
Delaware	0	0	5	6	0	11
District of Columbia	1	1	7	0	1	9
Florida	3	0	38	222	4	263
Georgia	1	0	47	80	2	128
Hawaii	0	0	0	0	3	0
Idaho	0	0	6	20	1	26
Illinois	2	10	23	163	2	198
Indiana	0	1	39	124	1	164
Iowa	0	6	4	108	1	118
Kansas	0	2	19	38	0	59
Kentucky	0	0	9	35	0	44
Louisiana	0	0	14	44	0	58
Maine	0	0	0	12	0	12
Maryland	2	0	24	21	3	47
Massachusetts	0	0	11	41	4	52
Michigan	2	1	29	182	10	214
Minnesota	0	1	16	125	0	142
Mississippi	0	0	0	75	0	75
Missouri	0	1	10	83	0	94
Montana	0	0	11	48	0	59
Nebraska	0	5	10	47	0	62
Nevada	0	0	8	20	0	28
New Hampshire	0	0	1	31	1	32
New Jersey	0	0	23	36	0	59
New Mexico	0	0	15	46	0	61
New York	7	0	42	100	5	149
N. Carolina	0	0	8	72	1	80
N. Dakota	0	0	5	17	0	22
Ohio	2	0	53	98	1	153
Oklahoma	0	0	47	56	0	103
Oregon	0	0	4	21	0	25
Pennsylvania	1	0	49	133	1	183
Rhode Island	0	0	2	5	0	7
S. Carolina	0	0	3	43	1	46
S. Dakota	0	7	5	25	0	36
Tennessee	2	0	6	80	1	88
Texas	0	0	77	202	2	279
Utah	0	0	48	20	0	68
Vermont	0	0	1	33	9	34
Virginia	0	0	25	39	19	64
Washington	2	0	30	37	6	69
W. Virginia	1	0	37	16	1	54
Wisconsin	0	2	22	139	0	163
Wyoming	0	0	19	33	0	52
Total	**88**	**37**	**1,065**	**3,298**	**188**	**4,488**

Source:
National Alternative Fuels Hotline, 1995.
Electric sites - Electric Vehicle Association of the Americas, "Market Brief," February 1996.

Table 5.14
U.S. Production of MTBE[a] and Fuel Ethanol, 1978-95
(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
Average annual percentage change		
1978-95	28.1%	[b]
1985-95	5.5%	23.6%

Sources:
1992-95 Ethanol and MTBE - U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Monthly*, January 1995, 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 5.15
Gasohol Consumption by Reporting States, 1980-94[a]
(thousands of gallons)

	1980	1990	1993	1994	Total ethanol used in gasohol,1994	% ethanol used in gasohol, 1994
Alabama		197,856	140,774	143,850	14,385	10.00%
Alaska				260	26	10.00%
Arizona	2,798		32,062	80,708	7,073	8.76%
Arkansas	8,250	62,004	16,152	2,783	278	9.99%
California	147,795	479,716	360,112	482,396	27,497	5.70%
Colorado	3	97,263	251,889	234,571	19,998	8.53%
Connecticut	15,849		58,359	37,590	3,729	9.92%
Delaware	1,512					
District of Columbia	124					
Florida	14,359	77,558	46,671	35,950	3,595	10.00%
Georgia	11,063	88,672	40,391	10,926	1,093	10.00%
Hawaii	1,095					
Idaho		70,199	6,536	5,514	551	9.99%
Illinois	15,088	1,341,148	1,472,573	1,747,412	174,741	10.00%
Indiana		638,337	638,673	597,625	59,762	10.00%
Iowa	155,947	374,897	575,515	627,730	62,773	10.00%
Kansas	37,786	73,971	51,939	46,546	4,655	10.00%
Kentucky	4,763	355,987	218,231	87,546	8,755	10.00%
Louisiana		38,760	78,727	105,626	10,563	10.00%
Maine	2,634					
Maryland	18,549					
Massachusetts	16,209		8			
Michigan	29,924	510,447	574,747	631,188	63,119	10.00%
Minnesota	11,776	244,336	1,293,107	1,431,263	125,280	8.75%
Mississippi			49,747	33,428	3,343	10.00%
Missouri		267,408	274,217	292,398	29,240	10.00%
Montana	158	1,423	5,491			
Nebraska	30,067	300,632	288,206	184,894	18,489	10.00%
Nevada	641	49,167	94,880			
New Hampshire	3,642					
New Jersey	6,567		11,743	40,125	3,215	8.01%
New Mexico		156,935	22,406	55,525	5,192	9.35%
New York			33,806	79,284	6,956	8.77%
N. Carolina	10,688		29,422	107,993	10,114	9.37%
N. Dakota	13,491	35,821	52,331	58,935	5,893	10.00%
Ohio	16,726	1,072,040	1,675,801	1,866,896	186,690	10.00%
Oklahoma	28,910					
Oregon			339,128			
Pennsylvania			82,460	192,703	18,882	9.80%
Rhode Island	1,763					
S. Carolina	11,608	62,549				
S. Dakota	10,507	60,000	168,193	183,326	18,333	10.00%
Tennessee		246,713	211,883	285,603	28,560	10.00%
Texas		247,384	53,829	126,969	12,605	9.93%
Utah		485	7,137			
Virginia	1,991	161,202	19,273	100,403	9,400	9.36%
Washington	14,063	86,847	804,150	882,104	76,215	8.64%
W. Virginia	692		23,114	16,287	1,629	10.00%
Wisconsin		82,961	127,117	133,124	13,312	10.00%
Wyoming	611	9,513	55,717	60,113	6,011	10.00%
Total	497,222	7,492,231	10,286,567	11,009,594	1,041,952	9.46%

Sources:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1995, 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 1996 showed in most areas CNG is less expensive than unleaded gasoline, as much as 47% less in Billings, MT. The only surveyed location which sold CNG at a higher price than gasoline was Atlanta, GA.

Table 5.16
Comparison of Station Prices: Compressed Natural Gas and Regular Unleaded Gasoline, December 1995

Region	Station	CNG	Unleaded gasoline	Percentage CNG to gasoline
	Dollars per gallon or equivalent gallons			
1	Amoco/Minneapolis, MN	$0.969	$1.199	80.8%
	Exxon/Billings, MT	$0.689	$1.299	53.0%
2	UnocalVista, CA	$0.889	$1.199	74.1%
	Total/Denver, CO	$0.809	$1.129	71.7%
	Sinclair/Salt Lake City, UT	$0.589	$1.109	53.1%
3	Mobile/Garland, TX	$0.799	$1.019	78.4%
	Shell/Houston, TX	$0.999	$1.079	92.6%
	Chevron/Houston, TX	$0.799	$1.019	78.4%
	Phillips 66/Oklahoma City, OK	$0.799	$0.999	80.0%
	Amoco/Topeka. KS	$0.859	$0.999	86.0%
4	Conoco/Mobile, AL	$0.799	$0.999	80.0%
	Shell/Palm Beach Gardens, FL	$0.999	$1.149	86.9%
	Amoco/Atlanta, GA	$0.839	$0.819	102.4%
	Amoco/Tucker, GA	$0.839	$0.859	97.7%
5	Amoco/Naperville, IL	$0.959	$1.189	80.7%
	Texaco/Hartford, CT	$0.899	$1.299	69.2%
	Mobile/Brooklyn, NY	$1.049	$1.299	80.8%
	Canadian dollars per liter or equivalent liters			
Canada	Petro-Canada/Van., BC	$0.328	$0.579	56.6%
	Shell/Etobicoke, Ont.	$0.348	$0.515	67.6%

Source:
"Natural Gas Fuels," January 1996, p. 13.

Table 5.17
Federal and State Taxes on Motor Fuels, 1994[a]
(dollars per gallon or gallon equivalent)

State	Gasoline	Diesel fuel	Gasohol	Propane	CNG	Methanol	Ethanol
Alabama	0.160	0.170	0.160	[b]	[b]	0.160	0.160
Alaska	0.080	0.080	0.000	0.080		0.080	0.080
Arizona	0.180	0.180	0.180	0.180	0.010[c]	0.180	0.180
Arkansas	0.185	0.185	0.185	0.165	0.050[d]	0.185	0.185
California	0.180	0.180	0.180	0.060	0.070	0.090	0.090
Colorado	0.220	0.205	0.220	0.205	0.205	0.205	0.205
Connecticut	0.320	0.180	0.310	0.180	0.180	0.310	0.310
Delaware	0.230	0.220	0.220	0.220[e]	0.220	0.220	0.220
District of Columbia	0.200	0.200	0.200	0.200	0.200	0.200	0.200
Florida	0.123	0.123	0.123	[b]	[b]	0.123	0.123
Georgia	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Hawaii	0.160	0.160	0.160				
Idaho	0.210	0.210	0.210	0.152	0.165[f]	0.210	0.210
Illinois	0.190	0.215	0.190	0.190	0.190	0.190	0.190
Indiana	0.150	0.160	0.150	[b]	[b]	0.150	0.150
Iowa	0.200	0.225	0.190	0.200	0.160[d]	0.190	0.190
Kansas	0.180	0.200	0.180	0.170	0.170	0.200	0.200
Kentucky	0.150	0.120	0.150	0.150	0.120	0.150	0.150
Louisiana	0.200	0.200	0.200	0.160	0.160	0.200	0.200
Maine	0.190	0.200	0.190	0.180	0.180	0.190	0.190
Maryland	0.235	0.2425	0.235	0.235	0.235	0.235	0.235
Massachusetts	0.210	0.210	0.210	0.083		0.210	0.210
Michigan	0.150	0.150	0.150	0.150	0.000	0.150	0.166
Minnesota	0.200	0.200	0.180	0.200	0.200		0.200
Mississippi	0.180	0.180	0.180	0.170	0.170	0.180	0.180
Missouri	0.150	0.150	0.150	[b]	[b]	0.150	0.150
Montana	0.270	0.2775	0.270	[b]	0.070	0.270	0.270
Nebraska	0.240	0.240	0.240	[b]	[b]	0.240	0.240
Nevada	0.230	0.270	0.230	0.230	0.230	0.230	0.230
New Hampshire	0.180	0.180	0.180	0.180	0.180	0.180	0.180
New Jersey	0.105	0.135	0.105	0.0525	0.0525	0.1050	0.1050
New Mexico	0.200	0.180	0.180	0.180[g]	0.180[g]	0.180	0.180
New York	0.2187	0.2387	0.2187	0.080	0.2187	0.2187	0.2187
N. Carolina	0.217	0.217	0.217	0.217	0.217	0.217	0.217
N. Dakota	0.180	0.180	0.180	0.180	0.180	0.180	0.180
Ohio	0.220	0.220	0.220	0.220		0.220	0.220
Oklahoma	0.160	0.130	0.160	0.160	[b]	0.160	0.160
Oregon	0.240	0.240	0.240	0.240	0.240	0.240	0.240
Pennsylvania	0.2235	0.2235	0.2235	0.2235	0.2235	0.2235	0.2235
Rhode Island	0.280	0.280	0.280	0.280	0.000	0.280	0.280
S. Carolina	0.160	0.160	0.160	0.160	0.160	0.160	0.160
S. Dakota	0.180	0.180	0.160	0.160	0.060	0.060	0.060
Tennessee	0.200	0.170	0.170	0.170	0.130	0.170	0.170
Texas	0.200	0.200	0.200	0.150	0.150	0.200	0.200
Utah	0.190	0.190	0.190	0.190	0.190	0.190	0.190
Vermont	0.160	0.170	0.160	[b]	0.160		
Virginia	0.175	0.160	0.175	0.100	0.100	0.100	0.100
Washington	0.230	0.230	0.230	[b]	[b]	0.230	0.230
W. Virginia	0.2535	0.2535	0.2535	0.2535	0.2535	0.2535	0.2535
Wisconsin	0.234	0.234	0.234	0.234	0.234	0.234	0.234
Wyoming	0.080	0.080	0.080	0.000	0.000	0.080	0.080
Federal	**0.184**	**0.244**	**0.130**	**0.183**	**0.4854[h]**	**0.130**	**0.1235**

Source:
Hawaii: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1994, p. IV-50.
All else: J. E. Sinor Consultants, Inc., "The Clean Fuels Report," November 1995, pp. 41, 42.

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[a]All prices are per gallon or gallon equivalent.
[b]Annual flat fee.
[c]Per 1.25 therm.
[d]Per 100 ft^3
[e]AFV's are exempt from paying ,otor fuels tax until Jan. 1, 1996; for any taxpayer, the number of vehicles subject to thisexemption cannot exceed the greater of 10 vehicles or 10% of the taxpayer's vehicles propelled by a fuel subject to the state motor fuel tax.
[f]Per therm.
[g]Optional flat fee may be paid instead.
[h]Given in million cubic feet.

As of July 1995, 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 (see Table 5.17).

Table 5.18
State Tax Exemptions for Gasohol
July 1995

State	Exemption (cents/gallon of gasohol)
Alaska	8.0
Connecticut	1.0
Idaho	2.1
Iowa	1.0
South Dakota	2.0

Source:
U.S. Department of Transportation, Federal Highway Administration, "Monthly Motor Fuel Reported by the States, July 1995," October 1995, Washington, DC, Table MF-121T.

Table 5.19
States With Ethanol Tax Incentives

State	Ethanol Tax Incentives
AL	Federal Tax credits can also apply to state liability
AK	$0.08/ethanol gallon (blender)
CA	E85 and M85 excise tax is half the gasoline tax
CT	$0.01/ethanol gallon (blender)
FL	County governments receive waste reduction credits for using yard trash, wood, or paper waste as feedstocks for fuel.
HI	4% ethanol sales tax exemption
ID	$0.21 excise tax exemption for ethanol or biodiesel
IL	2% average sales tax exemption
IA	$0.01 (blender)
KS	$0.20 (producer)
MN	$0.02 (blender), $0.25 (producer)
MO	$0.02 (blender), $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)
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, National Renewable Energy Laboratory, "Biofuels Update," Fall 1995.

Table 5.20
Federal Excise Tax Exemption for Ethanol-Blended Fuels[a]

Ethanol Volume	Oxygen Content	Tax Exemption (cents/gal)
5.7%	2.0%	3
7.7%	2.7%	4
10.0%	3.5%	5

Source:
U.S. Department of Energy, National Renewable Energy Laboratory, "Biofuels Update," Fall 1995.

Note: There is a $0.10/gallon tax credit for ethanol producers with a total capacity of no more than 30 million gallons/year.

[a]Through September 30, 2000.

CHAPTER 6

NONHIGHWAY MODES

This chapter presents statistics for three major nonhighway transportation modes: air, water, and rail. The combined energy use for these three modes accounted for 17% of the total energy use in the transportation sector in 1994 (Table 6.1). Air transportation accounted for the largest share (8.7%) of nonhighway transportation energy consumption.

Air transportation activities can be categorized into two types: air carrier and general aviation. General aviation aircraft serve a variety of purposes, such as business travel and flight instruction, and include all aircraft which do not belong to the air carrier fleet. Since most of the aircraft in this category are used for personal activities, they do not provide commercial passenger or freight services. Although general aviation aircraft account for the majority of the number of aircraft in operation and fly almost five times as many hours as their counterparts in the air carrier category, the lower speeds and the smaller loads of general aviation aircraft result in a significantly smaller share of total aircraft energy use than that of the air carrier fleet.

Domestic marine traffic includes all movements between points in the United States, Puerto Rico, and the Virgin Islands. All movements between the United States and foreign countries are classified as foreign traffic. Foreign trade has been growing faster than domestic. In 1994 foreign trade accounted for just over 50% of the total waterborne trade, while in 1970 it accounted for only 38%.

Twelve railroad systems in 1994 were designated by the Interstate Commerce Commission (ICC) as Class I freight railroads (Table 6.8). This designation was assigned on the basis of the annual gross revenue of the railroad. A railroad whose revenues were 255.9 million dollars or more in 1993 was designated as a Class I railroad in 1994. The Class I designation is dropped if the railroad fails to meet the annual earnings threshold for three consecutive years. Data for the National Railroad Passenger Corporation (Amtrak) and transit rail are also presented in this chapter.

Table 6.1
Nonhighway Energy Use by Mode, 1970-94

Year	Air	Water	Pipeline	Rail	Nonhighway transportation energy use	Transportation energy use[a] (trillion Btu)
	(percent of total transportation)					
1970	8.5%	4.9%	6.4%	3.7%	23.6%	15,291
1971	8.2%	4.4%	6.3%	3.5%	22.4%	15,912
1972	7.8%	4.2%	6.1%	3.4%	21.5%	16,918
1973	7.7%	4.7%	5.6%	3.5%	21.5%	17,781
1974	7.4%	4.7%	5.5%	3.7%	21.2%	17,055
1975	7.4%	4.9%	4.8%	3.3%	20.4%	17,295
1976	7.3%	5.5%	4.4%	3.2%	20.3%	18,357
1977	7.4%	5.8%	4.1%	3.1%	20.4%	19,041
1978	7.3%	6.6%	3.9%	2.9%	20.8%	19,985
1979	7.8%	7.7%	4.3%	3.1%	22.8%	20,059
1980	7.9%	8.7%	4.6%	3.1%	24.3%	19,268
1981	7.7%	8.2%	4.7%	3.0%	23.6%	19,003
1982	7.9%	7.0%	4.6%	2.6%	22.2%	18,493
1983	8.1%	6.4%	3.9%	2.6%	21.0%	18,635
1984	8.5%	6.5%	4.0%	2.7%	21.7%	19,276
1985	8.5%	6.7%	3.9%	2.5%	21.6%	19,645
1986	9.0%	6.4%	3.6%	2.3%	21.4%	20,214
1987	9.2%	6.4%	3.7%	2.3%	21.7%	20,665
1988	9.3%	6.3%	4.1%	2.3%	22.0%	21,310
1989	9.2%	6.4%	4.1%	2.3%	22.0%	21,573
1990	9.5%	6.9%	4.3%	2.3%	22.9%	21,659
1991	9.1%	7.4%	4.1%	2.2%	22.7%	21,244
1992	9.0%	7.5%	3.9%	2.2%	22.5%	21,908
1993	8.9%	6.6%	4.0%	2.3%	21.8%	22,399
1994	9.0%	6.2%	4.2%	2.4%	21.2%	22,886

Source:
See Appendix A for Table 2.11.

[a]Does not include off-highway and military transportation energy use.

Table 6.2
Summary Statistics for Domestic and International Certificated Route Air Carriers (Combined Totals), 1970-94

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]
1971	2,344	681	135,658[e]	279,823	119	48.5%[e]	5,120	1,370.5	[f]
1972	2,337	685	152,406[e]	287,411	122	53.0%[e]	5,506	1,374.3	[f]
1973	2,402	689	174,352	322,992	129	54.0%	6,046	1,444.5	[f]
1974	2,351	684	174,052	310,130	126	56.1%	6,133	1,289.8	[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	5,345	787	537,401	808,796	151	66.4%	21,485	2,249.5	74.3%
				Average annual percentage change					
1970-94	3.4%	0.6%	6.0%	4.8%	1.3%		6.3%	2.1%	
1984-94	5.1%	0.4%	5.3%	4.2%	-0.8%		8.7%	3.4%	

Sources:

U.S. Department of Transportation, Federal Aviation Administration, FAA Statistical Handbook of Aviation, 1993 Edition, Washington, DC, 1995, pp. 5-3, 6-4, 6-7, and annual (1994 preliminary).

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

1982-94 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.

[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 6.3
Summary Statistics for General Aviation, 1970-94

Calendar year	Percentage of total aircraft					Total number of aircraft	Hours flown (thousands)	Intercity passenger travel (billion passenger-miles)	Energy use (trillion btu)
	Piston	Turboprop	Turbojet	Rotary wing	Other				
1970	[a]	[a]	[a]	[a]	[a]	131,700[b]	26,030[c]	9.1	94.4
1971	[a]	[a]	[a]	[a]	[a]	131,100[b]	25,512[c]	9.2	91.6
1972	[a]	[a]	[a]	[a]	[a]	145,000[b]	26,974[c]	10.0	103.4
1973	[a]	[a]	[a]	[a]	[a]	148,000[b]	28,599	10.7	90.4
1974	93.9%	1.3%	1.0%	2.2%	1.6%	161,502	29,758	11.2	101.4
1975	93.4%	1.5%	1.1%	2.4%	1.7%	168,475	30,298	11.4	121.5
1976	93.3%	1.4%	1.1%	2.5%	1.8%	177,964	31,950	12.1	130.3
1977	92.7%	1.6%	1.2%	2.6%	2.0%	184,294	33,679	12.8	149.7
1978	92.5%	1.6%	1.2%	2.7%	2.0%	199,178	36,844	14.1	159.4
1979	92.0%	1.7%	1.3%	2.8%	2.3%	210,339	40,432	15.5	167.2
1980	91.5%	1.9%	1.4%	2.8%	2.3%	211,045	41,016	14.7	169.0
1981	90.7%	2.2%	1.5%	3.3%	2.4%	213,226	40,704	14.6	162.4
1982	90.2%	2.5%	1.9%	2.9%	2.5%	209,779	36,457	13.1	170.5
1983	89.8%	2.6%	1.8%	3.1%	2.8%	213,293	35,249	12.7	143.9
1984	89.4%	2.6%	2.0%	3.2%	2.8%	220,943	36,119	13.0	148.9
1985	89.4%	2.5%	2.1%	3.1%	3.0%	196,500[d]	31,456[d]	12.3	144.0
1986	88.9%	2.7%	2.0%	3.2%	3.2%	205,300[d]	31,782[d]	12.4	148.0
1987	89.5%	2.4%	2.0%	2.9%	3.1%	202,700[d]	30,883[d]	12.1	139.1
1988	89.2%	2.5%	2.0%	3.1%	3.3%	196,200[d]	31,114[d]	12.6	148.6
1989	88.2%	2.9%	2.0%	3.4%	3.5%	205,000[d]	32,332[d]	13.1	134.0
1990	88.5%	2.7%	2.1%	3.5%	3.3%	198,000[d]	32,096[d]	13.0	131.9
1991	88.3%	2.5%	2.2%	3.2%	3.8%	198,475	30,067	12.6	120.4
1992	87.9%	2.6%	2.2%	3.1%	4.2%	184,434	26,493	10.7	104.7
1993	83.6%	2.5%	2.2%	2.6%	9.2%[e]	176,006	24,340	10.2	97.5
1994	81.4%	2.5%	2.4%	2.6%	11.1%[e]	170,600	23,866	9.7	95.3
						Average Annual Percentage Change			
1970-94						1.1%	-0.4%	0.3%	0.0%
1984-94						-2.6%	-4.1%	-2.9%	-4.4%

Sources:
Aircraft and hours flown - U.S. Department of Transportation, Federal Aviation Administration, FAA Statistical Handbook of Aviation, Calendar Year 1994, Washington, DC, 1996, pp. 8-2, 8-6, and annual.
Intercity passenger miles - Eno Foundation for Transportation, Transportation in America, 13th edition, Washington, DC, 1993, p.47, and annual.
Energy use - U.S. Department of Transportation, Federal Aviation Administration, General Aviation Activity and Avionics Survey: Calendar Year 1994, Table 5.1, p. 5-7, and annual.

[a]Data are not available.
[b]Active fixed-wing general aviation aircraft only.
[c]Include rotocraft.
[d]Revised to correct for nonresponse bias.
[e]New data were added for "other" aircraft which were not previously available. These include gliders, lighter than air, and experimental aircraft.

In the early seventies, domestic waterborne commerce accounted for over 60% of total tonnage, but by 1994 foreign tonnage grew to more than half of all waterborne tonnage.

Table 6.4
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970-94
(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%
	Average annual percentage change			
1970-94	1.5%	2.8%	0.6%	
1984-94	1.9%	3.3%	0.6%	

Source:
U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1994, Part 5: National Summaries, New Orleans, Louisiana, 1996, Table 1-1, p. 1-3 and annual.

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[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 6.5
Summary Statistics for Domestic Waterborne Commerce, 1970-94

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	1,099	745.5	369	300.7
			Average annual percentage change			
1970-94	1.7%	1.3%	0.6%	0.7%	-1.6%	-0.2%
1984-94	-0.7%	-0.9%	0.3%	-1.4%	0.6%	-0.3%

Sources:

Number of Vessels -

1970-92 - U.S. Department of the Army, Corps of Engineers, "Summary of U.S. Flag Passenger and Cargo Vessels, 1992," New Orleans, LA, 1993, 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 1994, Part 5: National Summaries, New Orleans, LA, 1996, Table 1-4, pp. 1-6,1-7, and annual.

Energy Use - See Appendix A for Table 2.7.

[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-nine percent of all domestic marine cargo in 1993 were energy-related products (petroleum, coal, coke). The majority of the energy-related products were shipped internal and local (62%). Barge traffic accounted for 95% of all internal and local waterborne commerce.

Table 6.6
Breakdown of Domestic Marine Cargo by Commodity Class, 1993

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	209	1,747	2	660	205	181	417	38.2%	968
Chemicals and related products	15	2,175	[b]	409	58	521	73	6.7%	856
Crude materials	12	718	84	523	128	287	224	20.5%	398
Coal and coke	12	684	19	514	192	420	224	20.5%	443
Primary manufactured goods	7	875	3	318	17	786	27	2.5%	748
Food and farm products	8	1,810	1	985	96	894	105	9.6%	968
Manufactured equipment	8	1,571	4	-	3	165	15	1.3%	868
Waste and scrap	[b]	1,941	[b]	-	6	49	6	0.6%	59
Unknown	[b]	565	[b]	-	[b]	49	1	0.1%	480
Total	272	1,650	110	495	687	404	1,068	100.0%	724
Barge traffic (million tons)	93.9		8.6		650.8		753.3		
Percentage by barge	34.6%		7.8%		94.7%		70.5%		

Source:
U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1993, Part 5: National Summaries, New Orleans, Louisiana, 1995, Tables 2-1, 2-2, and 2-3, pp. 2-1, 2-2, 2-3, 2-6, 2-11, 2-12, 2-15 and annual.

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

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

Table 6.7
Breakdown of Domestic Marine Cargo by Commodity Class, 1994

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	209	1,787	2	660	210	185	421	38.3%	982
Chemicals and related	16	1,900	[b]	381	62	520	79	7.1%	802
Crude materials	16	631	85	519	119	359	221	20.1%	441
Coal and coke	12	653	23	508	196	422	231	21.0%	443
Primary manufactured goods	7	887	4	297	26	820	36	3.3%	781
Food and farm products	9	1,903	[b]	983	84	957	93	8.5%	1,047
Manufactured equipment	8	1,548	[b]	-	5	150	13	1.1%	1,013
Waste and scrap	[b]	500	[b]	-	6	55	6	0.5%	55
Unknown	[b]	1,892	[b]	-	[b]	-	[b]	0.0%	916
Total	277	1,652	115	508	707	423	1,099	100.0%	741
Barge traffic (million tons)	95.2		8.6		678.2		782.0		
Percentage by barge	34.4%		7.5%		95.9%		71.0%		

Source:
U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1994, Part 5: National Summaries, New Orleans, Louisiana, 1996, Tables 2-1, 2-2, and 2-3, pp. 2-1 through 2-15 and annual.

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

[a]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 1994, twelve railroads were given this classification.

Table 6.8
Class I Railroad Freight Systems in the United States
Ranked by Revenue Ton-Miles, 1994

Railroad	Revenue ton-miles (billions)	Percent
Burlington Northern Railroad Company	261	21.7%
Union Pacific Railroad	236	19.7%
CSX Transportation, Incorporation	154	12.8%
Norfolk Southern Corporation	122	10.2%
Southern Pacific Transportation Company	133	11.1%
Atchison, Topeka and Santa Fe Railway	100	8.3%
Consolidated Rail Corporation (Conrail)	94	7.8%
Chicago and North Western Transportation Company	37	3.1%
Soo Line Railroad	21	1.7%
Illinois Central Railroad	21	1.7%
Kansas City Southern Railway	16	1.3%
Grand Trunk Corporation	6	0.5%
Total	**1,201**	**100.0%**

Source:
Association of American Railroads, Railroad Facts, 1995 Edition, Washington, DC, September 1995, p. 64.

Table 6.9
Summary Statistics for Class I Freight Railroads, 1970-94

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
				Average annual percentage change					
1970-94	-1.6%	-3.6%	0.1%	-0.2%	-1.0%	1.9%	1.9%	-2.4%	-0.5%
1984-94	-2.6%	-4.6%	1.8%	0.8%	-0.3%	2.4%	2.7%	-2.7%	-0.1%

Sources:
Association of American Railroads, Railroad Facts, 1995 Edition, Washington, DC, September 1995, pp. 27, 33, 34, 36, 48, 50, 60.
Revenue tons - Association of American Railroads, Analysis of Class I Railroads 1994, 1995, p. 31, and annual.

[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 previouseditions 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 carloadings in 1994. The fastest growing commodity group from 1974 to 1994 was the "other" category (81.8%).

Table 6.10
Railroad Revenue Carloadings by Commodity Group, 1974 and 1994

Commodity group	Carloadings (thousands) 1974	Carloadings (thousands) 1994	Percent distribution 1974	Percent distribution 1994	Percentage change 1974-94
Coal	4,544	5,681	17.0%	24.5%	25.0%
Farm products	3,021	1,459	11.3%	6.3%	-51.7%
Chemicals and allied products	1,464	1,719	5.5%	7.4%	17.4%
Nonmetallic minerals	821	1,138	3.1%	4.9%	38.6%
Food and kindred products	1,777	1,381	6.6%	6.0%	-22.3%
Lumber and wood products	1,930	771	7.2%	3.3%	-60.1%
Metallic ores	1,910	440	7.1%	1.9%	-77.0%
Stone, clay and glass	2,428	512	9.1%	2.2%	-78.9%
Pulp, paper, and allied products	1,180	651	4.4%	2.8%	-44.8%
Petroleum products	877	577	3.3%	2.5%	-34.2%
Primary metal products	1,366	616	5.1%	2.7%	-54.9%
Waste and scrap material	889	604	3.3%	2.6%	-32.1%
Transportation equipment	1,126	1,354	4.2%	5.8%	20.2%
Others	3,451	6,274	12.9%	27.1%	81.8%
Total	26,784	23,179	100.0%	100.0%	-13.5%

Sources:

1974 - Association of American Railroads, Railroad Facts, 1976 Edition, Washington, DC, 1975, p. 26.

1994 - Association of American Railroads, Railroad Facts, 1995 Edition, Washington, DC, September 1995, p. 25.

The number of trailers and containers moved by railroads has increased nearly four-fold from 1965 to 1994. Since 1988, the growth in containers moved by the railroad has increased by an average of 11.2% per year.

Table 6.11
Intermodal Rail Traffic, 1965-94

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	8,167,166	3,816,363	4,350,803
Average annual percentage change			
1965-94	5.6%	[a]	[a]
1984-94	6.0%	1.5%[b]	11.2%[b]

Source:
Association of American Railroads, Railroad Facts, 1995 edition, Washington, DC, p.26.

[a]Data are not available.
[b]Average annual percentage change is for years 1988-94.

Table 6.12
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971-94

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]
				Average annual percentage change				
1971-94	1.7%[c]	2.1%	3.3%	3.4%	4.8%	1.7%	-2.2%[d]	-0.2%[d]
1984-94	0.6%	0.2%	1.8%	2.7%	2.9%	2.0%	-2.5%	0.3%

Sources:

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 - 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, 1995 Edition, Washington, DC, 1996, p. 78.

Energy use - Personal communication with the Amtrak, Washington, DC.

[a]Data are not available.
[b]Energy use for 1994 is not directly comparable to earlier years. Some commuter rail energy use may have been inadvertently included in earlier years.
[c]Average annual percentage change is for years 1972-93.
[d]Average annual percentage change is for years 1973-93.

Table 6.13
Summary Statistics for Rail Transit Operations, 1970-94[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	565.7	2,409	11,502	4.8	3,828	44.0
				Average annual percentage change			
1970-94	0.2%	1.0%	0.5%	-0.3%	-1.1%[g]	1.9%	1.6%
1984-94	0.3%	2.3%	0.1%	0.9%	0.9%	0.3%	1.1%

Sources:
American Public Transit Association, 1996 Transit Fact Book, Washington, DC, February 1996, pp. 24-28.
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 1977-94.

CHAPTER 7
EMISSIONS AND TRANSPORTATION

The combustion of fossil fuels in transportation vehicles contributes significantly to air pollution. In 1994 the transportation sector was responsible for 78% of carbon monoxide (CO) emissions and over 32% of nitrogen oxide (NO_x), lead, and volatile organic compound (VOC) emissions (Table 7.1). Highway vehicles, which are responsible for the majority of transportation CO emissions, have reduced their emissions by 31% from 1970 to 1994 (Table 7.2) despite a 113% increase in vehicle travel during that time period. Some of the emission reduction can be attributed to the Federal Motor Vehicle Control Program. This program has resulted in the widespread use of catalytic converters on automobiles to reduce not only CO emissions but also NO_x and VOC emissions.

Transportation and stationary fuel combustion account for the majority of NO_x emissions (Table 7.3). Light-duty gasoline-powered vehicles and heavy-duty diesel-powered vehicles were responsible for over three-fourths of the transportation sector's NO_x emissions in 1994 (Table 7.4). Transportation does not play a major role in the emissions of particulate matter (Table 7.6) or sulfur dioxide.

National lead emissions have declined by 98% from 1970 to 1994, mostly due to the 99% decline in transportation lead emissions (Table 7.7). This is mainly due to the fact that almost all highway vehicles are now made to use unleaded gasoline (another result of the Federal Motor Vehicle Control Program).

The estimated U.S. emissions of greenhouse gases in 1993 are presented in Table 7.8. Greenhouse gases block the outward flow of radiation more effectively than they block incoming solar radiation, causing the earth to be warmer than it would be otherwise. More than half of the carbon dioxide (CO_2) emitted from transportation sources in the U.S. comes from motor gasoline (Table 7.10).

In order to reduce the amount of emissions from mobile sources, the government has imposed standards for hydrocarbons, carbon monoxide, nitrogen oxide and particulate emissions. The Clean Air Act Amendments of 1990 set stricter standards nationwide beginning in 1994 (Tables 7.11-7.13). A discussion of the Clean Cities program concludes this chapter.

Table 7.1
Total National Emissions by Sector, 1994
(millions of short tons)

Sector	CO	NO_x	VOC	PM-10	SO_2	Lead[a]
Transportation						
Highway vehicles	61.07	7.53	6.30	0.31	0.30	1.40
	62.3%	31.9%	27.2%	0.7%	1.4%	28.2%
Aircraft	1.06	0.15	0.21	0.05	0.00	[b]
	1.1%	0.6%	0.9%	0.1%	0.0%	[b]
Railroads	0.12	0.95	0.04	0.05	0.07	[b]
	0.1%	4.0%	0.2%	0.1%	0.3%	[b]
Vessels	0.06	0.19	0.04	0.03	0.21	[b]
	0.1%	0.8%	0.2%	0.1%	1.0%	[b]
Other off-highway	14.41	1.81	1.96	0.29	0	0.19[c]
	14.7%	7.7%	8.5%	0.6%	0.0%	3.8%
Transportation total	**76.73**	**10.63**	**8.55**	**0.72**	**0.58**	**1.6**
	78.3%	**45.0%**	**36.9%**	**1.6%**	**2.7%**	**32.3%**
Stationary source fuel combustion	4.88	11.73	0.89	1.03	18.5	0.49
	5.0%	49.7%	3.8%	2.3%	87.6%	9.9%
Industrial processes	5.42	0.80	10.78	0.68	1.99	2.02
	5.5%	3.4%	46.5%	1.5%	9.4%	40.7%
Waste disposal and recycling total	1.75	0.09	2.27	0.25	0.04	0.85
	1.8%	0.4%	9.8%	0.6%	0.2%	17.1%
Miscellaneous	9.25	0.37	0.69	42.74	0.01	0.00
	9.4%	1.6%	3.0%	94.1%	0.0%	0.0%
Total of all sources	**98.02**	**23.62**	**23.17**	**45.43**	**21.12**	**4.96**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Estimates, 1900-1994, 1995, Appendix A.

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

[a] Thousands of short tons.
[b] Data are not available.
[c] Includes all off-highway and nonhighway vehicles.

Table 7.2
Total National Emissions of Carbon Monoxide, 1940-94[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1993	1994[b]	Percent of total, 1994
Transportation									
Highway vehicles	30.12	45.20	64.27	88.03	78.05	62.86	60.20	61.07	62.3%
Aircraft	0.00	0.93	1.76	0.51	0.74	0.97	1.02	1.06	1.1%
Railroads	4.08	3.08	0.33	0.07	0.10	0.12	0.12	0.12	0.1%
Vessels[c]	0.06	0.12	0.52	0.98	1.10	1.21	1.25	0.06	0.1%
Other off-highway	3.91	7.48	8.96	9.06	10.74	12.35	12.88	14.41	14.7%
Transportation total	38.17	56.81	69.87	98.64	90.73	77.5	75.47	76.73	78.3%
Stationary fuel combustion total	15.33	11.32	7.02	4.63	7.30	5.06	4.95	4.88	5.0%
Industrial processes total	7.28	11.64	10.28	9.84	6.95	5.23	5.28	5.42	5.1%
Waste disposal and recycling total	3.63	4.72	5.60	7.06	2.3	1.69	1.73	1.75	1.8%
Miscellaneous total	29.21	18.14	11.01	7.91	8.34	11.17	6.70	9.25	9.4%
Total of all sources	**93.62**	**102.61**	**109.75**	**128.08**	**115.63**	**100.65**	**94.13**	**98.02**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Estimates, 1900-1994, 1995, p. 3-11.

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]Preliminary.
[c]Recreational marine vessels.

Table 7.3
Total National Emissions of Nitrogen Oxides, 1940-94[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1993	1994[b]	Percent of total, 1994
Transportation									
Highway vehicles	1.33	2.14	3.98	7.39	8.62	7.49	7.51	7.53	31.9%
Railroads	0.66	0.99	0.77	0.50	0.73	0.93	0.95	0.95	4.0%
Other off-highway	0.33	0.55	0.67	1.13	1.69	1.91	2.04	2.15	9.1%
Transportation total	2.32	3.68	5.43	9.02	11.04	10.33	10.50	10.63	45.0%
Stationary fuel combustion total	3.73	5.16	7.37	10.06	11.32	11.48	11.70	11.73	49.7%
Industrial processes total	0.22	0.38	0.57	0.78	0.56	0.77	0.78	0.80	3.4%
Waste disposal and recycling total	0.11	0.22	0.33	0.44	0.11	0.08	0.08	0.09	0.4%
Miscellaneous total	0.99	0.67	0.44	0.33	0.25	0.38	0.22	0.37	1.6%
Total of all sources	**7.37**	**10.09**	**14.14**	**20.63**	**23.28**	**23.04**	**23.30**	**23.62**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Estimates, 1900-1994, 1995, p. 3-12.

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]Preliminary.

Table 7.4
Emissions of Nitrogen Oxides from Highway Vehicles, 1970-94[a]
(million short tons)

Source category	1970	1980	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Percent of total, 1994
Gasoline powered														
Light-duty vehicles & motorcycles	4.16	4.42	3.99	3.81	3.60	3.50	3.50	3.49	3.44	3.46	3.61	3.68	3.75	49.8%
Light-duty trucks[b]	1.28	1.41	1.58	1.53	1.46	1.44	1.42	1.39	1.34	1.34	1.36	1.42	1.43	19.0%
Heavy-duty vehicles	0.28	0.30	0.33	0.33	0.33	0.33	0.34	0.34	0.34	0.33	0.31	0.32	0.33	4.4%
Total	5.72	6.13	5.90	5.67	5.39	5.27	5.26	5.22	5.12	5.13	5.28	5.42	5.51	73.2%
Diesel powered														
Light-duty vehicles	[c]	0.03	0.03	0.03	0.03	0.03	0.03	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	2.45	2.39	2.35	2.35	2.37	2.42	2.33	2.20	2.12	2.01	1.97	26.2%
Total	1.68	2.50	2.49	2.43	2.39	2.39	2.41	2.47	2.38	2.25	2.17	2.06	2.02	26.8%
Total														
Highway vehicle total	**7.39**	**8.62**	**8.39**	**8.09**	**7.77**	**7.65**	**7.66**	**7.68**	**7.49**	**7.37**	**7.44**	**7.51**	**7.53**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Estimates, 1900-1994, 1995, p. A-8.

[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, 1940-94[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1993	1994[b]	Percent of total, 1994
Transportation									
Highway vehicles	4.82	7.25	10.51	12.97	8.98	6.85	6.10	6.30	27.2%
Off-highway	0.78	1.21	1.22	1.54	1.87	2.12	2.21	2.25	9.7%
Transportation total	5.60	8.46	11.73	14.51	10.85	8.97	8.31	8.55	36.9%
Stationary fuel combustion total	1.98	1.44	0.88	0.72	1.05	0.92	0.90	0.89	3.8%
Industrial processes total	4.52	7.40	8.73	12.33	12.10	10.38	10.58	10.78	46.5%
Waste disposal and recycling total	0.99	1.10	1.55	1.98	0.76	2.26	2.27	2.27	9.8%
Miscellaneous total	4.08	2.53	1.57	1.10	1.13	1.07	0.52	0.69	3.0%
Total of all sources	**17.16**	**20.94**	**24.46**	**30.65**	**25.89**	**23.60**	**22.58**	**23.17**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Estimates, 1900-1994, 1995, p. 3-13.

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. The EPA's definition of volatile organic compounds excludes methane, ethane, and certain other nonphotochemically reactive organic compounds.
[b]Preliminary.

Table 7.6
Total National Emissions of Particulate Matter (PM-10), 1940-94[a]
(million short tons)

Source category	1940	1950	1960	1970	1980	1990	1993	1994[b]	Percent of total, 1994
Transportation									
Highway vehicles	0.21	0.31	0.55	0.44	0.40	0.36	0.32	0.31	0.7%
Off-highway	2.48	1.79	0.20	0.22	0.33	0.37	0.40	0.49	1.1%
Transportation total	2.69	2.10	0.76	0.66	0.73	0.73	0.72	0.72	1.6%
Stationary fuel combustion total	4.01	3.75	3.56	2.87	2.45	1.08	1.04	1.03	2.3%
Industrial processes total	5.90	8.85	9.24	7.67	2.75	0.66	0.66	0.68	1.5%
Waste disposal and recycling total	0.39	0.51	0.76	1.00	0.27	0.24	0.25	0.25	0.6%
Miscellaneous total	2.97	1.93	1.24	0.84	0.85	40.63[c]	39.88[c]	42.74[c]	94.1%
Total of all sources	**15.96**	**17.13**	**15.56**	**13.04**	**7.05**	**49.33**	**45.49**	**45.43**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Estimates, 1900-1994, 1995, p. 3-15.

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

Table 7.7
National Lead Emission Estimates, 1970-94
(thousand short tons per year)

Source category	1970	1975	1980	1985	1990	1993	1994	Percent of total, 1994
Transportation								
Highway vehicles	171.96	130.21	62.19	15.98	1.69	1.40	1.40	28.2%
Off-highway	8.34	5.01	3.32	0.23	0.20	0.18	0.19	3.8%
Transportation total	180.30	135.22	65.51	16.21	1.89	1.58	1.60	32.3%
Stationary source fuel combustion	10.62	10.35	4.30	0.52	0.50	0.49	0.49	9.9%
Industrial processes	26.36	11.38	3.94	2.53	2.47	2.04	2.02	40.7%
Waste disposal and recycling total	2.20	1.60	1.21	0.87	0.80	0.83	0.85	17.1%
Total of all sources	**219.47**	**158.54**	**74.96**	**20.12**	**5.67**	**4.94**	**4.96**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Estimates, 1900-1994, 1995, p. 3-16.

Table 7.8
Estimated U.S. Emissions of Greenhouse Gases, 1993

Greenhouse gas	Unit of measure[a]	
Carbon dioxide	million metric tons of gas	5,156.0
	million metric tons of carbon	1,406.0
Methane	million metric tons of gas	26.6
	million metric tons of carbon (gwp)[b]	178.0
Nitrous oxide	million metric tons of gas	0.5
	million metric tons of carbon (gwp)[b]	40.0
Carbon monoxide	million metric tons of gas	88.1
Nitrogen oxide	million metric tons of gas	21.2
Nonmethane VOCs[c]	million metric tons of gas	21.1
CFC-11,12,113[c]	million metric tons of gas	0.2
HCFC-22[c]	million metric tons of gas	0.1
HCFC-23 and PFCs[c]	million metric tons of gas	[d]
	million metric tons of carbon (gwp)[b]	20.0
Methyl Chloroform	million metric tons of gas	0.2

Source:
U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1987-1994, Washington, DC, October 1995, pp. ix, xi.

Table 7.9
U.S. Carbon Dioxide Emissions from Fossil Energy Consumption by End-Use Sector, 1985-94[e]
(million metric tons of carbon)

End use	1987	1988	1989	1990	1991	1992	1993	1994[f]
Energy consumption sectors								
Residential	251.0	264.8	267.5	253.0	257.1	255.9	271.6	271.6
Commercial	197.2	207.6	210.0	206.7	206.4	205.5	212.1	216.9
Industrial	422.7	444.1	445.6	452.4	436.6	453.6	454.0	461.4
Transportation	411.1	427.5	432.7	432.1	424.5	431.4	436.7	446.3
Total energy	**1,282.0**	**1,344.0**	**1,355.8**	**1,344.2**	**1,324.6**	**1,346.3**	**1,372.5**	**1,396.2**
Electric utility sector								
Electric utility	452.6	475.9	483.5	476.9	473.5	472.9	490.9	494.9

Source:
U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1987-1994, Washington, DC, October 1995, p. 12.

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[a]Gases that contain carbon can be measured either in terms of the full molecular weight of the gas or just in terms of their carbon content. See Appendix B for details.

[b]Based on global warming potential.

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

[d]Less than 50,000 tons of gas.

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

[f]Preliminary.

Table 7.10
U.S. Carbon Dioxide Emissions from Energy Use in the Transportation Sector, 1980-94
(million metric tons of carbon)

Fuel	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994[a]
								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	269.3	273.5
LPG[b]	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	0.4
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
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	80.3
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	19.2
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
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
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**	**426.8**	**436.2**
								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	9.4
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
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**	**436.7**	**446.3**

Source:
U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1987-1994, Washington, DC, October 1995, p. 92.

[a]Preliminary
[b]Liquified petroleum gas.

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 7.11
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

Sources:
1968-1975: 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 7.12
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]

Sources:
1974-1975: 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 edition, p. 264.
1994-on: Clean Air Act Amendments of 1990.

Table 7.13
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]

Sources:
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.

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[a]Applies to trucks greater than 6,000 pounds gross vehicle weight until model year 1978; greater than 8,500 pounds gross vehicle weight from model year 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 until model year 1978; greater than 8,500 pounds gross vehicle weight beginning in model year 1979.

Table 7.14
Exhaust Emission Standards for Clean-Fuel Vehicles in the California Pilot Test Program
(50,000-mile standards in grams per mile)

	LDV & LDT ≤6,000 GVWR ≤3,750 LVW	LDT ≤6,000 GVWR >3,750 LVW ≤5,750 LVW	LDT[a] >6,000 GVWR ≤3,750 TW	LDT[a] >6,000 GVWR >3,750 TW ≤5,750 TW	LDT[a] >6,000 GVWR >5,750 TW ≤8,500 TW	LDT[a] >6,000 GVWR >8,500 TW ≤10,000 TW	LDT[a] >6,000 GVWR >10,000TW ≤14,000 TW
Conventional vehicles							
Non-methane	0.250	0.320	0.250	0.320	0.390	0.460	0.600
Carbon monoxide	3.400	4.400	3.400	4.400	5.000	5.500	7.000
Nitrogen oxides	0.400	0.700	0.400	0.700	1.100	1.300	2.000
Formaldehyde	0.015	0.018	0.015	0.018	0.022	0.028	0.036
Transitional low-emission vehicles (TLEVs)							
Non-methane	0.125	0.160	[b]	[b]	[b]	[b]	[b]
Carbon monoxide	3.400	4.400	[b]	[b]	[b]	[b]	[b]
Nitrogen oxides	0.400	0.700	[b]	[b]	[b]	[b]	[b]
Formaldehyde	0.015	0.018	[b]	[b]	[b]	[b]	[b]
Low-emission vehicles (LEVs)							
Non-methane	0.075	0.100	0.125	0.160	0.195	0.230	0.300
Carbon monoxide	3.400	4.400	3.400	4.400	5.000	5.500	7.000
Nitrogen oxides	0.200	0.400	0.400	0.700	1.100	1.300	2.000
Formaldehyde	0.015	0.018	0.015	0.018	0.022	0.028	0.036
Ultra-low-emission vehicles (ULEVs)							
Non-methane	0.040	0.050	0.075	0.100	0.117	0.138	0.180
Carbon monoxide	1.700	2.200	1.700	2.200	2.500	2.800	3.500
Nitrogen oxides	0.200	0.400	0.200	0.400	0.600	0.700	1.000
Formaldehyde	0.008	0.009	0.008	0.009	0.011	0.014	0.026
Zero-emission vehicles (ZEVs)							
Non-methane	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Carbon monoxide	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrogen oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Formaldehyde	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source:
California Environmental Protection Agency, Air Resources Board, Mobile Source Division, "Mobile Source Emission Standards Summary; A summary of Mobile Source Emission Standards Adopted as of March 1994," CA, 1994.

LDT = light-duty truck
GVWR = gross vehicle weight rating
LVW = loaded vehicle weight
TW = tare weight

[a]The clean-fuel vehicle standards are not effective until the 1998 model year.
[b]There is no TLEV category for this vehicle class.

The California Air Resources Board has proposed these figures for fleet mixture in order to meet the emission standards. By the year 2001, it is proposed that 90% of the vehicle manufacturers' fleet be low-emission vehicles.

Table 7.15
California Air Resources Board Proposal 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, 1990.

[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 recently 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.

Four fuels are projected as capable of meeting the requirements for the transitional low-emission vehicles, low-emission vehicles, ultra-low-emission vehicles, and zero-emission vehicles. Gasoline, alcohol, compressed natural gas, and liquified petroleum gas, with fuel and vehicle improvements, are projected as capable of meeting the first three levels. Electric vehicles are phased in as ultra-low-emission vehicles and are the only vehicle type expected to be zero-emission vehicles.

Table 7.16
Possible Fuel/Vehicles for Clean-Fuel Vehicles

TRANSITIONAL LOW-EMISSION VEHICLES (TLEVs)

- ***Gasoline*** - small/medium displacement engines, heated fuel preparation system, close-coupled catalyst
- ***Alcohol*** - improved close-coupled catalyst
- ***Compressed natural gas*** - underfloor catalyst
- ***Liquified petroleum gas*** - close-coupled catalyst

LOW-EMISSION VEHICLES (LEVs)

- ***Gasoline*** - electrically heated catalyst, phase 2 gasoline
- ***Alcohol*** - heated fuel preparation system, close-coupled catalyst
- ***Compressed natural gas*** - electronic fuel injection, close-coupled catalyst
- ***Liquified petroleum gas*** - electronic fuel injection, close-coupled catalyst

ULTRA-LOW-EMISSION VEHICLES (ULEVs)

- ***Gasoline*** - heated fuel preparation system, electrically heated catalyst, phase 2 gasoline
- ***Alcohol*** - heated fuel preparation system, electrically heated catalyst
- ***Compressed natural gas*** - electronic fuel injection, electrically heated catalyst
- ***Electricity*** - range-extended hybrid vehicles, battery powered vehicles with auxiliary combustion heaters

HYBRID-ELECTRIC VEHICLES (HEVs)

- Use an electric drive system at least part of the time

EQUIVALENT ZERO-EMISSION VEHICLES (EZEVs)

- Vehicles having exhaust, evaporative and refueling emissions equivalent to the power plant emissions associated with electric vehicles

ZERO-EMISSION VEHICLES (ZEVs)

- ***Electricity*** - battery-powered vehicles

Source:
U.S. Department of Energy, Office of Transportation Technologies, "Electric Vehicle Progress," Washington, DC, January 1991, p.3.
Additional data from the California Air Resources Board web site (http://arbis.arb.ca.gov/).

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 creates an effective plan, carried out at the local level, for creating a sustainable, nationwide alternative fuels market.

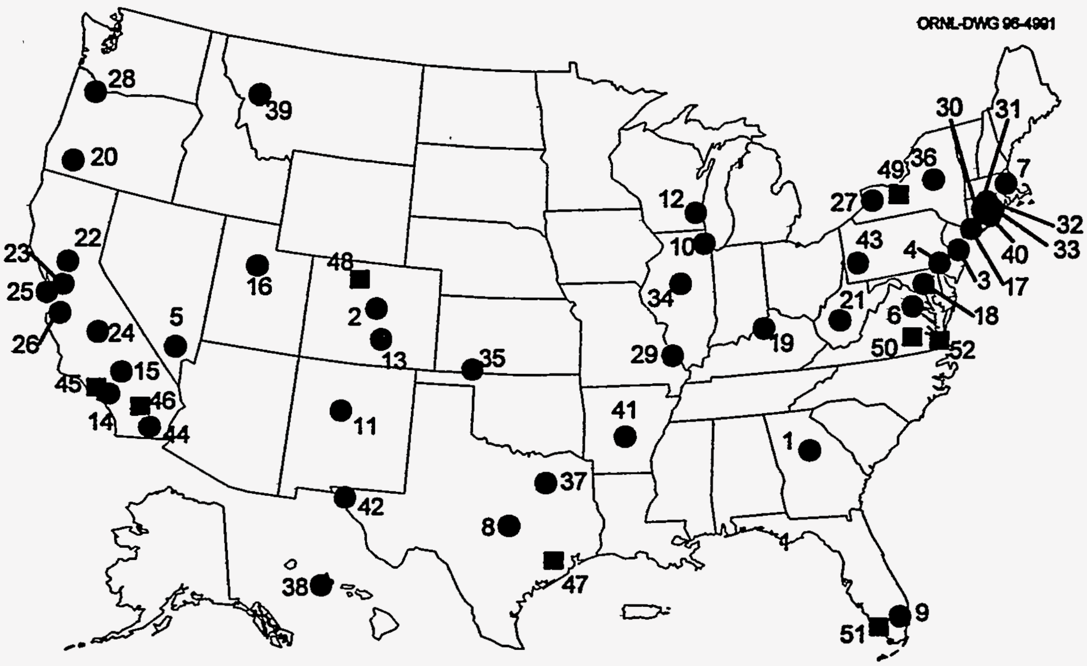

Figure 7.1 List of Clean Cities as of 3/8/96

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

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. The Clean Cities Home Page can be accessed through the Energy Efficiency and Renewable Energy Network at: www.eren.doe.gov/transportation/transportation.html.

Source:

U.S. Department of Energy, Alternative Fuel Information, Clean Cities: Guide to Alternative Fuel Vehicle Incentives & Laws, Washington, DC, November 1995, pp. 1-3.

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
MIC	Motorcycle Industry Council
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 2.10
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1994

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 1994, 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 per personal communication with the California Energy Commission. Natural gas comes from the Natural Gas Annual, Table 1; transit bus and truck natural gas were subtracted from total and the remainder was assumed to be automobile use.

Motorcycles

DOT, FHWA, Highway Statistics 1994, Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:
APTA, 1994-95 Transit Fact Book, February 1995, 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, Thirteenth Edition, 1996, Washington, DC, p. 56. Data for 1994 are not yet available. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

School:
Gasoline and Diesel - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, 1996, Washington, DC, p. 56. Data for 1994 are not yet available. For conversion purposes, fuel for school buses was assumed to be half diesel fuel and half gasoline.
Methanol - Methanol use was estimated per personal communication with the California Energy Commission.

Trucks

Total:

Sum of light trucks and other trucks.

Light Trucks:

DOT, FHWA, Highway Statistics 1994, 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 1994, 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 1994, 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 1994, 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, 1994, 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 was found in Boating Industry Magazine, Annual Report, "The Boating Business 1994" (Communication Channels, Inc., Chicago, IL). The total was the sum of inboard, outboard and inboard/outdrive 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 1994, 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, 1995 Edition, Washington, DC, p. 60.

Passenger:

Transit and Commuter - APTA, 1994-95 Transit Fact Book, February 1995, Washington, DC, p. 132-135. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Intercity - Personal communication with Amtrak, Washington, DC.

Table 2.12
Transportation Energy Consumption by Mode, 1970-94

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.

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

1993- 94 - Methanol use was estimated per personal communication with the California Energy Commission.

Motorcycles

Department of Transportation, Federal Highway Administration, Highway Statistics Summary to 1985, Table VM-201A; and Table VM-1 in the 1986-94 annual editions. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Sum of transit, intercity and school.

Transit:

APTA, 1994-95 Transit Fact Book, February 1995, Washington, DC, pp. 132-135, 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.

1985-93 - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, 1995, Washington, DC, p. 56. Data for 1994 are not yet available. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

School:

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

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

1987-93 - Eno Transportation Foundation, Transportation in America, Twelfth Edition, 1995, Washington, DC, p. 56. Data for 1994 are not yet available. For conversion purposes, fuel for school buses was assumed to be half diesel fuel and half gasoline.

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 1986-94 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 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 1986-94 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 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 1994, 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.
1982-94 - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel use for international flights.

Water

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

Freight:

Total - DOE, EIA, Fuel Oil and Kerosene Sales, 1994, 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.
1985-94 - 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 was found in Boating Industry Magazine, Annual Report, "The Boating Business 1994" (Communication Channels, Inc., Chicago, IL) and annual. The total was the sum of inboard, outboard and inboard/outdrive 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 1994, 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, 1995 Edition, Washington, DC, p. 60.

Passenger:

Transit and Commuter - APTA, 1994-95 Transit Fact Book, February 1995, Washington, DC, p. 132-135, annual. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Intercity - Personal communication with Amtrak, Washington, DC.

Table 2.14
Passenger Travel and Energy Use in the United States, 1994

Highway

Automobiles

Number of Vehicles - DOT, FHWA, Highway Statistics 1994, Table VM-1.
Vmt - DOT, FHWA, Highway Statistics 1994, 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 1994, 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 per personal communication with the California Energy Commission.

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 1993, 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 1994, 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 1994, 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 1994, 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 1994, 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 1994, 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 1994, 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, 1994-95 Transit Fact Book, February 1995, Washington, DC, pp. 106, 107, 110, 132-135.
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 1994, Table MV-10.
Pmt - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, 1995, 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, Thirteenth Edition, 1995, Washington, DC, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

School:
Number of Vehicles - School and other nonrevenue as reported in DOT, FHWA, Highway Statistics 1994, Table MV-10.
Vmt, Pmt - National Safety Council, Accident Facts, 1995 Edition, Chicago, IL, pp. 70-71.
Load Factor - Calculated by ORNL as pmt/vmt.
Energy Use - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, 1995, Washington, DC, p. 56. For conversion purposes, fuel for school buses was assumed to be half diesel fuel and half gasoline.

Non-Highway

Air

Large Certified Route Air Carriers:

Vmt - Revenue aircraft miles flown, DOT, FAA, FAA Statistical Handbook of Aviation Calendar Year 1993, p. 6-4. (1994 - personal communication.)

Pmt - Revenue pmt of domestic operations, scheduled and nonscheduled, DOT, FAA, FAA Statistical Handbook of Aviation Calendar Year 1993, p. 6-4. (1994 - personal communication.)

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. Because the data for international included fuel purchased abroad, the international total was divided by two to estimate domestic fuel use for international flights.

General Aviation:

Number of Vehicles, Vmt, Energy Use - DOT, FAA, General Aviation Activity and Avionics, Survey: Calendar Year 1994, pp. 1-7, 3-11, 5-3.

Pmt - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, 1994, p. 47.

Load Factor - Calculated by ORNL as pmt/vmt.

Recreational Boating

Number of Vehicles - Whitney Communications, Boating Industry Magazine, Annual Report, "The Boating Business 1994." The total was the sum of inboard, outboard, and inboard/outdrive boats.

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 was found in Boating Industry Magazine, Annual Report, "The Boating Business 1994" (Communication Channels, Inc., Chicago, IL). The total was the sum of inboard, outboard and inboard/outdrive boats.

Rail

Intercity:

Number of Vehicles, Vmt and Pmt -AAR, Railroad Facts, 1995 Edition, Washington, DC, p. 78.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - Personal communication with Amtrak, Washington, DC.

Transit and Commuter:

Number of Vehicles, Vmt and Pmt - APTA, 1994-95 Transit Fact Book, February 1995, Washington, DC, pp. 106, 107, 110.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - APTA, 1994-95 Transit Fact Book, February 1995, Washington, DC, pp. 132-135. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Table 2.15
Intercity Freight Movement and Energy Use in the United States, 1994

Highway

Trucks

Vehicles - 0.3% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1994, 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 1994, 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, Thirteenth Edition, Washington, DC, 1995, 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 1994, Table VM-1) and 67.2% of total other truck fuel consumption were used in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.

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, 1993.

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 1994, Part 5: National Summaries, New Orleans, LA, 1996, pp. 1-6, 1-7.

Energy Intensity - Energy use divided by ton miles.

Energy Use - DOE, EIA, Fuel Oil and Kerosene Sales, 1994, 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 1994, Washington, DC, 1995, 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 1994, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft^3. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., End Use Energy Consumption DataBase: Transportation Sector. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude Oil and Petroleum Product:

Ton Miles and Tons Shipped - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, 1995, 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, 1995 Edition, Washington, DC, 1995, pp. 27, 34, 36, 50.

Tons shipped - AAR, Analysis of Class I Railroads 1994, 1995, p. 31.

Energy Use -AAR, Railroad Facts, 1995 Edition, Washington, DC, p. 60.

Table 2.16
Energy Intensities of Passenger Modes, 1970-94

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 1987-94 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, Office of Markets and End Use, Energy End Use Division, Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983, Jan., 1985, pp. 7, 9.

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

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

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

1993-94 - Methanol use was estimated per personal communication with the California Energy Commission.

Buses

Transit:

Vmt, Pmt, Energy Use - APTA, 1994-95 Transit Fact Book, February 1995, Washington, DC, pp. 106, 107, 132-135, 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.

1985-94 - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, 1995, p. 47.

Energy Use - 1970-1984 - American Bus Association, Annual Report, Washington, DC, annual.

1985-94 - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, p. 56, and annual. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

School:

Vmt - 1970-84 - DOT, FHWA, Highway Statistics 1984, Washington, DC, Table VM-1, p. 175, and annual.

1985-87 - DOT, TSC, National Transportation Statistics, 1989, Figure 2, p. 7, and annual.

1988-94 - National Safety Council, Accident Facts, 1995 Edition , Chicago, IL, p. 71, 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.

1987-94 - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, p. 56, and annual. For conversion purposes, fuel for school buses was assumed to be half diesel fuel and half gasoline.

Non-Highway

Air

Certificated Air Carriers:

Pmt - DOT, FAA, FAA Statistical Handbook of Aviation, Calendar Year 1993, Washington, DC, 1995, p. 6-4, and annual. (1994 - Personal communication.)

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

1982-94 - 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.

General Aviation:

Pmt - Eno Transportation Foundation, Transportation In America, Thirteenth Edition, Washington, DC, 1995, p.47.

Energy Use - 1970-74 - DOT, TSC, National Transportation Statistics, Cambridge, MA, 1981.

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

1985-94 - DOT, FAA, General Aviation Activity and Avionics Survey: Calendar Year 1994, 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 - 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.

Transit:

Pmt and Energy Use - APTA, 1994-95 Transit Fact Book, February 1995, Washington, DC, pp. 106, 132-135. Transit was defined as the sum of "heavy rail," "light rail,"and "other."

Table 2.17
Energy Intensities of Freight Modes, 1970-94

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 1987-94 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 1986-94 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 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 1986-94 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 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 1994, Part 5: National Summaries, New Orleans, LA, 1996, 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, 1994, 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, 1995 Edition, Washington, DC, 1995, pp. 27, 36, 60, and annual.

Table 3.3
Vehicle Stock, New Sales and New Registrations
in the United States, 1994 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 '95, p. 16. The domestic sales were distributed by size class according to the following percentages: Two seater, 0.4%; Minicompact, 0%; Subcompact, 18.4%; Compact 35.0%; Midsize, 27.4%; and Large, 18.4%. The import sales were distributed by size class according to the following percentages: Two-seater, 2.5%; Minicompact, 2.4%; Subcompact, 37.3%; Compact, 33.8%; Midsize, 22.6%; and Large, 1.3%. 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 -MIC, 1995 Motorcycle Statistical Annual, p. 14, registrations.

Sales - MIC, 1995 Motorcycle Statistical Annual, pp. 10 and 16. Sales included motorcycles, scooters, and all-terrain vehicles for on- and off-highway use.

Recreational Vehicles

Sales - Ward's Automotive Yearbook, 1995 U.S. Recreation Vehicle Shipments by Type, "Total," p. 92.

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, 93.2%; 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 '95, p. 21.

Table 3.27
Summary Statistics on Buses by Type, 1970-94

Number in Operation

Transit buses:

American Public Transit Association, 1994-95 Transit Fact Book, Washington, DC, February 1995, p. 110, 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.

1990-94 - Estimated as 38% of commercial buses (less transit motor buses). Commercial bus total found in Highway Statistics 1994, Table MV-10, and annual.

School buses:

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1994, Washington, DC, 1994, Table MV-10, p. 20, and annual.

Vehicle-miles and Passenger-miles

Transit buses:

American Public Transit Association, 1994-95 Transit Fact Book, Washington, DC, February 1995, pp. 106, 107, and annual.

Intercity buses:

1970-80 - American Bus Association, Annual Report, Washington, DC, annual.

1985-94 - Eno Transportation Foundation, Transportation in America, Thirteenth edition, Washington, DC, 1995, p. 47.

1990-94 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.

1990-94- National Safety Council, Accident Facts, 1994 Edition, Chicago, IL, pp. 74-75, and annual.

Energy Use

Transit buses:

APTA, 1994-95 Transit Fact Book, February 1995, Washington, DC, pp. 132-135. 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.

1985-93 - Eno Transportation Foundation, Transportation in America, Thirteenth edition, Washington, DC, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel.

School buses:

1970-80- DOT, FHWA, Highway Statistics 1984, Washington, DC, Table VM-1, and annual.

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

1986-93 - Eno Transportation Foundation, Transportation in America, Thirteenth edition, Washington, DC, p. 56. For conversion purposes, fuel for school was assumed to be half diesel fuel and half gasoline.

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.

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 gross heating value (higher 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 the net heating value (lower heating value). Usually the difference between the gross and net heating values for fuels used in transportation is 5 to 8 percent; however, it is important to be consistent in their use.

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). Gross heating values were used for all energy conversions in this report.

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.	$= 83.33 \times 10^{-3}$ ft	1 ft	= 12.0 in.
	$= 27.78 \times 10^{-3}$ yd		= 0.33 yd
	$= 15.78 \times 10^{-6}$ mile		$= 189.4 \times 10^{-3}$ mile
	$= 25.40 \times 10^{-3}$ m		= 0.3048 m
	$= 0.2540 \times 10^{-6}$ km		$= 0.3048 \times 10^{-3}$ km
1 mile	= 63360 in.	1 km	= 39370 in.
	= 5280 ft		= 3281 ft
	= 1760 yd		= 1093.6 yd
	= 1609 m		= 0.6214 mile
	= 1.609 km		= 1000 m

1 ft/sec = 0.3048 m/s = 0.6818 mph = 1.0972 km/h
1 m/sec = 3.281 ft/s = 2.237 mph = 3.600 km/h
1 km/h = 0.9114 ft/s = 0.2778 m/s = 0.6214 mph
1 mph = 1.467 ft/s = 0.4469 m/s = 1.609 km/h

Table B.5
Alternative Measures of Greenhouse Gases

1 pound methane, measured in carbon units (CH_4)	=	1.333 pounds methane, measured at full molecular weight (CH_4)
1 pound carbon dioxide, measured in carbon units (CO_2-C)	=	3.6667 pounds carbon dioxide, measured at full molecular weight (CO_2)
1 pound carbon monoxide, measured in carbon units (CO-C)	=	2.333 pounds carbon monoxide, measured at full molecular weight (CO)
1 pound nitrous oxide, measured in nitrogen units (N_2O-N)	=	1.571 pounds nitrous oxide, measured at full molecular weight (N_2O)

Table B.6
Volume and Flow Rate Conversions[a]

1 U.S. gal	= 231 in.^{3}	1 liter	= 61.02 in.^{3}
	= 0.1337 ft^3		= 3.531 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	Miles/ kilowatt-hours[b] (gasoline-equivalent)	Kilowatt-hours/ mile[b] (gasoline-equivalent)
10	2.64	4.25	23.52	0.27	3.66
15	3.96	6.38	15.68	0.41	2.44
20	5.28	8.50	11.76	0.55	1.83
25	6.60	10.63	9.41	0.68	1.47
30	7.92	12.75	7.84	0.82	1.22
35	9.25	14.88	6.72	0.96	1.05
40	10.57	17.00	5.88	1.09	0.92
45	11.89	19.13	5.23	1.23	0.81
50	13.21	21.25	4.70	1.36	0.73
55	14.53	23.38	4.28	1.50	0.67
60	15.85	25.51	3.92	1.64	0.61
65	17.17	27.63	3.62	1.77	0.56
70	18.49	29.76	3.36	1.91	0.52
75	19.81	31.88	3.14	2.05	0.49
80	21.13	34.01	2.94	2.18	0.46
85	22.45	36.13	2.77	2.32	0.43
90	23.77	38.26	2.61	2.46	0.41
95	25.09	40.38	2.48	2.59	0.39
100	26.42	42.51	2.35	2.73	0.37
105	27.74	44.64	2.24	2.87	0.35
110	29.06	46.76	2.14	3.00	0.33
115	30.38	48.89	2.05	3.14	0.32
120	31.70	51.01	1.96	3.28	0.31
125	33.02	53.14	1.88	3.41	0.29
130	34.34	55.26	1.81	3.55	0.28
135	35.66	57.39	1.74	3.69	0.27
140	36.98	59.51	1.68	3.82	0.26
145	38.30	61.64	1.62	3.96	0.25
150	39.62	63.76	1.57	4.09	0.24

[a]To convert fuel efficiency from miles per gallon to liters per hundred kilometers, divide mpg into 235.24.
[b]Based on gasoline Btu content of 125,000 Btu/gallon and 3,412 Btu/kWhr.

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
SI (Metric) Units and Symbols

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
Air pressure		

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

	To																									
From	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
1970	1.000	1.043	1.078	1.144	1.270	1.386	1.466	1.561	1.680	1.869	2.122	2.342	2.486	2.566	2.675	2.770	2.824	2.927	3.046	3.193	3.365	3.508	3.614	3.721	3.818	3.926
1971	0.958	1.000	1.033	1.097	1.217	1.328	1.405	1.496	1.609	1.791	2.035	2.245	2.382	2.458	2.563	2.654	2.708	2.806	2.921	3.061	3.227	3.364	3.465	3.567	3.660	3.764
1972	0.928	0.968	1.000	1.062	1.179	1.286	1.361	1.448	1.559	1.735	1.971	2.174	2.307	2.381	2.482	2.571	2.620	2.717	2.828	2.963	3.124	3.256	3.354	3.453	3.543	3.644
1973	0.874	0.911	0.941	1.000	1.110	1.211	1.281	1.364	1.467	1.633	1.856	2.047	2.173	2.243	2.338	2.421	2.469	2.558	2.662	2.790	2.941	3.065	3.158	3.251	3.336	3.431
1974	0.787	0.821	0.848	0.901	1.000	1.091	1.154	1.229	1.322	1.472	1.672	1.844	1.956	2.019	2.105	2.180	2.224	2.305	2.399	2.514	2.650	2.762	2.846	2.930	3.006	3.091
1975	0.721	0.752	0.777	0.826	0.916	1.000	1.058	1.126	1.212	1.349	1.532	1.690	1.792	1.850	1.929	1.997	2.038	2.112	2.198	2.303	2.428	2.531	2.607	2.684	2.754	2.833
1976	0.682	0.712	0.736	0.781	0.866	0.945	1.000	1.065	1.145	1.275	1.449	1.598	1.696	1.750	1.824	1.889	1.926	1.997	2.078	2.178	2.296	2.393	2.465	2.538	2.604	2.678
1977	0.641	0.668	0.690	0.733	0.814	0.888	0.939	1.000	1.076	1.198	1.361	1.501	1.594	1.645	1.715	1.776	1.809	1.876	1.952	2.046	2.156	2.248	2.316	2.384	2.446	2.516
1978	0.595	0.621	0.642	0.682	0.756	0.825	0.873	0.929	1.000	1.113	1.265	1.395	1.479	1.527	1.592	1.648	1.681	1.742	1.813	1.900	2.003	2.088	2.151	2.214	2.272	2.337
1979	0.535	0.558	0.576	0.612	0.679	0.741	0.784	0.835	0.898	1.000	1.135	1.253	1.330	1.373	1.431	1.482	1.511	1.566	1.630	1.708	1.800	1.877	1.933	1.990	2.042	2.100
1980	0.471	0.491	0.508	0.539	0.598	0.653	0.690	0.735	0.791	0.881	1.000	1.103	1.171	1.209	1.260	1.305	1.331	1.379	1.436	1.504	1.586	1.653	1.703	1.753	1.799	1.850
1981	0.427	0.445	0.460	0.489	0.542	0.592	0.626	0.666	0.717	0.798	0.907	1.000	1.062	1.096	1.142	1.183	1.206	1.250	1.301	1.363	1.437	1.498	1.543	1.588	1.630	1.676
1982	0.402	0.420	0.434	0.460	0.511	0.558	0.590	0.628	0.676	0.752	0.853	0.942	1.000	1.032	1.075	1.114	1.136	1.178	1.226	1.284	1.354	1.411	1.454	1.497	1.536	1.579
1983	0.390	0.406	0.420	0.446	0.495	0.540	0.571	0.608	0.655	0.728	0.827	0.913	0.970	1.000	1.043	1.080	1.100	1.141	1.187	1.244	1.312	1.367	1.409	1.450	1.488	1.530
1984	0.374	0.390	0.403	0.428	0.475	0.518	0.548	0.584	0.628	0.699	0.793	0.876	0.930	0.960	1.000	1.036	1.056	1.094	1.139	1.194	1.258	1.311	1.351	1.391	1.427	1.468
1985	0.361	0.376	0.389	0.413	0.458	0.500	0.529	0.564	0.606	0.675	0.766	0.846	0.898	0.926	0.966	1.000	1.019	1.057	1.100	1.152	1.215	1.266	1.304	1.343	1.378	1.417
1986	0.354	0.369	0.382	0.405	0.450	0.491	0.519	0.553	0.595	0.662	0.751	0.829	0.880	0.909	0.947	0.981	1.000	1.037	1.079	1.131	1.192	1.242	1.280	1.318	1.352	1.390
1987	0.342	0.356	0.368	0.391	0.434	0.474	0.501	0.533	0.574	0.639	0.725	0.800	0.849	0.876	0.914	0.946	0.964	1.000	1.041	1.091	1.150	1.199	1.235	1.271	1.304	1.341
1988	0.328	0.342	0.354	0.376	0.417	0.455	0.481	0.512	0.552	0.614	0.697	0.769	0.816	0.842	0.878	0.909	0.927	0.961	1.000	1.048	1.105	1.152	1.186	1.221	1.253	1.289
1989	0.313	0.327	0.337	0.358	0.398	0.434	0.459	0.489	0.526	0.586	0.665	0.734	0.779	0.804	0.838	0.868	0.884	0.917	0.954	1.000	1.054	1.099	1.132	1.165	1.196	1.230
1990	0.297	0.310	0.320	0.340	0.377	0.412	0.436	0.464	0.499	0.555	0.631	0.696	0.739	0.762	0.795	0.823	0.839	0.870	0.905	0.949	1.000	1.042	1.074	1.106	1.134	1.167
1991	0.285	0.297	0.307	0.326	0.362	0.395	0.418	0.445	0.479	0.533	0.605	0.668	0.709	0.731	0.762	0.790	0.805	0.834	0.868	0.910	0.959	1.000	1.030	1.061	1.088	1.119
1992	0.277	0.289	0.298	0.317	0.351	0.384	0.406	0.432	0.465	0.517	0.587	0.648	0.688	0.710	0.740	0.767	0.781	0.810	0.843	0.883	0.931	0.971	1.000	1.030	1.056	1.086
1993	0.269	0.280	0.290	0.308	0.341	0.373	0.394	0.419	0.452	0.502	0.570	0.630	0.668	0.690	0.719	0.745	0.759	0.787	0.819	0.858	0.905	0.943	0.971	1.000	1.026	1.055
1994	0.262	0.273	0.282	0.300	0.333	0.363	0.384	0.409	0.440	0.490	0.556	0.614	0.651	0.672	0.701	0.726	0.740	0.767	0.798	0.836	0.882	0.919	0.947	0.975	1.000	1.028
1995	0.255	0.266	0.274	0.292	0.323	0.353	0.373	0.398	0.428	0.476	0.541	0.597	0.633	0.654	0.681	0.706	0.719	0.746	0.776	0.813	0.857	0.894	0.920	0.948	0.972	1.000

Source:
Personal communication 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
1970	1.000	1.051	1.095	1.159	1.260	1.377	1.448	1.534	1.646	1.789	1.953	2.141	2.270	2.356	2.454	2.531	2.600	2.667	2.763	2.867	2.985	3.120	3.230	3.294	3.360	3.472
1971	0.951	1.000	1.041	1.101	1.198	1.310	1.377	1.457	1.566	1.701	1.859	2.035	2.157	2.241	2.334	2.412	2.475	2.535	2.625	2.724	2.836	2.966	3.070	3.131	3.194	3.300
1972	0.913	0.960	1.000	1.058	1.150	1.257	1.323	1.400	1.504	1.634	1.786	1.955	2.072	2.151	2.240	2.315	2.375	2.435	2.522	2.617	2.725	2.849	2.949	3.007	3.068	3.170
1973	0.863	0.908	0.945	1.000	1.087	1.188	1.250	1.323	1.421	1.544	1.688	1.848	1.958	2.033	2.118	2.189	2.242	2.301	2.383	2.473	2.575	2.692	2.787	2.842	2.899	2.996
1974	0.794	0.834	0.869	0.920	1.000	1.094	1.150	1.218	1.307	1.421	1.551	1.700	1.802	1.871	1.948	2.014	2.062	2.117	2.193	2.276	2.370	2.477	2.564	2.614	2.667	2.756
1975	0.726	0.763	0.795	0.841	0.915	1.000	1.051	1.114	1.195	1.299	1.418	1.554	1.648	1.711	1.782	1.841	1.887	1.936	2.006	2.081	2.167	2.265	2.344	2.391	2.439	2.520
1976	0.691	0.726	0.756	0.800	0.871	0.952	1.000	1.058	1.137	1.235	1.350	1.478	1.566	1.628	1.696	1.752	1.795	1.840	1.906	1.978	2.059	2.153	2.228	2.272	2.318	2.395
1977	0.652	0.686	0.714	0.756	0.822	0.898	0.945	1.000	1.074	1.167	1.273	1.396	1.479	1.536	1.600	1.654	1.695	1.738	1.800	1.868	1.945	2.033	2.105	2.146	2.190	2.263
1978	0.608	0.639	0.665	0.704	0.766	0.837	0.880	0.931	1.000	1.087	1.187	1.300	1.378	1.432	1.492	1.542	1.580	1.619	1.677	1.740	1.812	1.894	1.961	1.999	2.040	2.108
1979	0.559	0.588	0.612	0.648	0.704	0.770	0.810	0.857	0.920	1.000	1.092	1.196	1.268	1.317	1.372	1.418	1.453	1.490	1.543	1.601	1.667	1.743	1.804	1.840	1.877	1.939
1980	0.512	0.539	0.560	0.592	0.645	0.705	0.741	0.784	0.842	0.915	1.000	1.095	1.160	1.206	1.256	1.298	1.332	1.363	1.412	1.465	1.525	1.595	1.651	1.683	1.717	1.775
1981	0.467	0.491	0.512	0.541	0.588	0.643	0.677	0.717	0.770	0.837	0.912	1.000	1.061	1.100	1.146	1.184	1.214	1.247	1.291	1.340	1.395	1.459	1.510	1.540	1.571	1.623
1982	0.441	0.464	0.483	0.511	0.556	0.607	0.639	0.676	0.726	0.789	0.861	0.944	1.000	1.040	1.082	1.118	1.145	1.175	1.217	1.263	1.315	1.375	1.423	1.451	1.481	1.530
1983	0.424	0.446	0.464	0.491	0.534	0.584	0.614	0.651	0.698	0.759	0.828	0.907	0.962	1.000	1.040	1.075	1.104	1.130	1.171	1.215	1.265	1.322	1.368	1.396	1.424	1.471
1984	0.408	0.428	0.445	0.471	0.514	0.562	0.589	0.624	0.670	0.728	0.797	0.870	0.922	0.961	1.000	1.035	1.059	1.083	1.122	1.164	1.212	1.267	1.312	1.338	1.365	1.410
1985	0.395	0.415	0.433	0.458	0.498	0.544	0.572	0.606	0.645	0.707	0.772	0.846	0.897	0.931	0.944	1.000	1.027	1.054	1.092	1.133	1.180	1.233	1.276	1.302	1.328	1.372
1986	0.385	0.404	0.421	0.446	0.485	0.530	0.557	0.590	0.633	0.688	0.751	0.824	0.873	0.906	0.944	0.974	1.000	1.026	1.062	1.103	1.148	1.200	1.242	1.267	1.293	1.335
1987	0.375	0.395	0.411	0.435	0.472	0.517	0.544	0.575	0.618	0.671	0.734	0.802	0.851	0.885	0.923	0.949	0.975	1.000	1.036	1.075	1.119	1.170	1.211	1.235	1.260	1.302
1988	0.362	0.381	0.397	0.420	0.456	0.499	0.525	0.556	0.596	0.648	0.708	0.774	0.822	0.854	0.891	0.916	0.941	0.966	1.000	1.038	1.081	1.130	1.170	1.193	1.217	1.258
1989	0.349	0.367	0.382	0.404	0.439	0.480	0.506	0.535	0.575	0.624	0.683	0.746	0.792	0.823	0.859	0.883	0.907	0.930	0.963	1.000	1.041	1.088	1.126	1.149	1.172	1.210
1990	0.335	0.353	0.367	0.388	0.422	0.461	0.486	0.514	0.552	0.600	0.656	0.717	0.760	0.790	0.825	0.848	0.871	0.894	0.925	0.960	1.000	1.046	1.083	1.104	1.126	1.164
1991	0.320	0.337	0.351	0.371	0.404	0.441	0.465	0.492	0.528	0.574	0.627	0.685	0.727	0.756	0.789	0.811	0.833	0.855	0.885	0.919	0.956	1.000	1.035	1.056	1.077	1.113
1992	0.310	0.326	0.339	0.359	0.390	0.427	0.449	0.475	0.510	0.554	0.606	0.662	0.703	0.731	0.762	0.783	0.805	0.826	0.855	0.888	0.924	0.966	1.000	1.020	1.041	1.075
1993	0.304	0.319	0.333	0.352	0.382	0.418	0.440	0.466	0.500	0.543	0.594	0.649	0.689	0.717	0.748	0.768	0.789	0.810	0.838	0.871	0.906	0.947	0.980	1.000	1.021	1.054
1994	0.298	0.313	0.326	0.345	0.375	0.410	0.431	0.457	0.490	0.533	0.582	0.636	0.675	0.702	0.733	0.753	0.774	0.794	0.822	0.853	0.888	0.928	0.961	0.980	1.000	1.033
1995	0.288	0.303	0.315	0.334	0.363	0.397	0.418	0.442	0.474	0.516	0.563	0.616	0.654	0.680	0.709	0.729	0.749	0.768	0.795	0.826	0.859	0.899	0.930	0.949	0.968	1.000

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 LBL ANALYSES OF OECD COUNTRIES.

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1. BRIEF REVIEW OF SOURCES AND EXPLANATION.

Generic Comments.

This note explains the most recent LBL collection and analysis of data covering the structure of travel and freight energy use in twelve OECD countries. In general the LBL 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 travel surveys to check modal distributions with the aggregate sources.

[1] This update was produced with assistance from Jacco Farla (on leave from the Univ. of Utrecht), Maria Josefine Figueroa, Todd Goldman, Roger Gorham, Henrik Gudmunsson (Danish Environmental Laboratory), Marta Khrushsh, Katrin Millock, and Michael Ting.

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 LBL 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 LBL 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, which we 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 the information 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 and using 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 passenger use (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 Institute of 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 Lawrence Berkeley Laboratory (LBL). 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; since 1987, 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 of these small vehicles. We assume a load factor of 1.5. The Japanese sources show a significant increase in all 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 automobility 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 2.2 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 mid-size 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

2. RECENT 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. In this edition our data from Italy, Denmark, United Kingdom, Sweden, and Japan have been significantly revised as new historical material appeared.

- The Danish Road Authority published its first own comprehensive road statistics in 1994, which covered data (much revised) through 1992. this book still assumes a constant load factor for automobile use throughout the entire 1970s and 1980s but acknowledges that the national travel surveys give different results. We have used these sources to derive our own estimates of passenger km traveled in cars and personal light trucks; The authority, along with the Danish Energy Agency and Ministry of Transport, also revised their estimates of fuel used, particular that of road diesel. The Ministry of Transport provided its revised figures for energy use by mode and fuel through 1993. These revisions reflect both best estimates of diesel used by foreign vehicles and use of diesel for space heating. Significant numbers of diesel users obtain their fuel almost tax free and it is believed some of this is used as heating oil, which is heavily taxed.

- For France, the long-standing yearly Tableaux des Consummations d'Energie, one of our two main data sources for France, again did not appear in 1995. We have relied on the Les Comptes des Transports as published by INSEE, and these appear to be consistent with both earlier years and with the data published by our earlier source. This source will replace all others in the future.

- Data for Western Germany come from the same source each year and show no revisions. In future work we will try to incorporate figures for Eastern Germany, where car ownership has almost reached the level of western Germany.

- For Italy, we received for 1992 new estimates of fuel use from AGIP, the Italian State Oil Company, as well as the latest National Accounts for Transportation. AGIP estimates the contribution of local traffic (intra city use of cars and trucks) to totals. We have estimated energy use by mode for 1975-1978 using interpolation. However, we have not received enough information to work out trends for 1993.

- For Japan, we have prepared a separate analysis of trends in transportation activity and energy use in Japan from 1965 to 1993 (Kiang and Schipper, to appear in **Energy Policy**). As with last year, our key modifications include estimates of activity of small mini-cars and mini-trucks, including our estimate of the passenger travel in mini-cars back to 1965 (based on load factors from 1987 onward). We cannot explain the jump in automobile load factor for "normal" cars that appeared in 1987. This load factor is obtained by comparing time series for vehicle-km and passenger-km for automobiles from the same source.

- We revised our travel data and energy use (for cars) for Netherlands through 1993. Car use data now reflect travel by Dutch within the borders of the Netherlands.

- For Norway, we continue to lack figures on fuel use for domestic aviation, as these fail to distinguish domestic from international traffic. Fuel use figures for domestic shipping reflect some revisions as the Bureau of Statistics provides more detailed data in their yearly Energy Balances. Fuel-use figures for road traffic are still provided by Esso, who has made small revisions from time to time.

- For Sweden, SIKA was supposed to assume the responsibility for quarterly publications previously available from the Swedish Road Institute in Linköping (VTI Transportstatistik). Unfortunately, these include almost no information on automobile use, but do reflect data obtained from the Bureau of Statistics for other modes. SIKA provide us with the data they also submit to the European Council of Ministers of Transport in Paris, also based on Bureau of Statistics data. These data entail slight revisions in freight activity. For automobile activity, there are still no widely-accepted figures for either vehicle-km or passenger-km. We used extrapolated last year's estimates developed by the Road Institute (H. Jönsson, priv. comm.) as the basis for our activity estimates, and a load factor of 1.5 to get passenger-km. Our estimate of fuel use per km for automobiles is higher than theirs and is documented in an appendix to

Schipper et al. 1993. Fuel use for domestic air travel is no longer available now that SAS is not the only carrier. Unfortunately, a domestic fuel carbon tax is calculated indirectly, and not on actual fuel consumed. In all the figures presented for energy use in Sweden and for vehicle activity of cars for both 1992 and 1993 should be considered preliminary.

- The U.K. Ministry of Transport carefully reviewed all trends in road vehicle activity and fuel use from 1982. The update results, were once again communicated to us by Bruce Oelman, and used to revise our figures from that year on.

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 on board the vehicle. Motor bus types include intercity, school, and transit.

School and other nonrevenue bus: Bus services for which passengers are not directly charged for transportation, either on a per passenger or per vehicle basis.

Transit bus: A bus designed for frequent stop service with front and center doors, normally with a rear-mounted diesel engine, low-back seating, and without luggage storage compartments or restroom facilities. Includes motor bus and trolley coach.

Trolley coach: Rubber-tired electric transit vehicle, manually-steered, propelled by a motor drawing current, normally through overhead wires, from a central power source not on board the vehicle.

Calendar year - The period of time between January 1 and December 31 of any given year.

Captive imports - Products produced overseas specifically for domestic manufacturers.

Carbon dioxide (CO_2) - A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion.

Carbon monoxide (CO) - A colorless, odorless, highly toxic gas that is a normal by-product of incomplete fossil fuel combustion. Carbon monoxide, one of the major air pollutants, can be harmful in small amounts if breathed over a certain period of time.

Car-mile (railroad) - A single railroad car moved a distance of one mile.

Cargo ton-mile - See *Ton-mile*.

Certificated route air carriers - See *Air carriers*.

Class I freight railroad - See *Rail.*

Clean Fuel Vehicle - Vehicle meeting the clean fuel vheicle 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.

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 form that process; for example, gallons of fuel per passenger-mile or Btu per ton-mile.

Ethanol (C_2H_5OH) - Otherwise known as ethyl alcohol, alcohol, or grain-spirit. A clear, colorless, flammable oxygenated hydrocarbon with a boiling point of 78.5 degrees Celsius in the anhydrous state. In transportation, ethanol is used as a vehicle fuel by itself (E100), blended with gasoline (E85), or as a gaoline octane enhancer and oxygenate (10% concentration).

Fixed operating cost - See *Operating cost*.

Fleet vehicles -

Private fleet vehicles: Ideally, a vehicle could be classified as a member of a fleet if it is:

a) operated in mass by a corporation or institution,
b) operated under unified control, or
c) used for non-personal activities.

However, the definition of a fleet is not consistent throughout the fleet industry. Some companies make a distinction between cars that were bought in bulk rather than singularly, or whether they are operated in bulk, as well as the minimum number of vehicles that constitute a fleet (i.e. 4 or 10).

Government fleet vehicles: Includes vehicles owned by all federal (GSA), state, county, city, and metro units of government, including toll road operations.

Foreign freight - Movements between the United States and foreign countries and between Puerto Rico, the Virgin Islands, and foreign countries. Trade between U.S. territories and possessions (e.g. Guam, Wake, American Samoa) and foreign countries is excluded. Traffic to or from the Panama Canal Zone is included.

Gas Guzzler Tax - Originates from the 1978 Energy Tax Act (Public Law 95-618). A new car purchaser is required to pay the tax if the car purchased has a combined city/highway fuel economy rating that is below the standard for that year. For model years 1986 and later, the standard is 22.5 mpg.

Gasohol - A mixture of 10% anhydrous ethanol and 90% gasoline by volume. There are other fuels that contain methanol and gasoline, but these fuels are not referred to as gasohol.

Gasoline - See *Motor gasoline.*

General aviation - That portion of civil aviation which encompasses all facets of aviation except air carriers. It includes any air taxis, commuter air carriers, and air travel clubs which do not hold Certificates of Public Convenience and Necessity.

Gross National Product - A measure of monetary value of the goods and services becoming available to the nation from economic activity. Total value at market prices of all goods and services produced by the nation's economy. Calculated quarterly by the Department of Commerce, the Gross National Product is the broadest available measure of the level of economic activity.

Gross vehicle weight (gvw) - The weight of the empty vehicle plus the maximum anticipated load weight.

Heavy-heavy truck - See *Truck size classifications.*

Household - Consists of all persons who occupy a housing unit, including the related family members and all unrelated persons, if any, who share the housing unit.

Housing unit - A house, apartment, a group of rooms, or a single room occupied or intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants do not live and eat with any other persons in the structure and which have either (1) direct access from the outside of the building or through a common hallway intended to be used by the occupants of another unit or by the general public, or (2) complete kitchen facilities for the exclusive use of the occupants. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements.

Hydrocarbon (HC) - A compound that contains only hydrogen and carbon. The simplest and lightest forms of hydrocarbon are gaseous. With greater molecular weights they are liquid, while the heaviest are solids.

Income -

Disposable personal income: Personal income less personal tax and non-tax payments.

National income - The aggregate earnings of labor and property which arise in the current production of goods and services by the nation's economy.

Personal income: The current income received by persons from all sources, net of contributions for social insurance.

Industrial sector - Construction, manufacturing, agricultural and mining establishments.

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 and 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-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.

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Notations:

- * indicates the end of the title
- () indicates the page number

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