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Transportation and Systems Research

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TRANSPORTATION ENERGY DATA BOOK:

EDITION 10

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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.

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FOREWORD

This printed edition of the Transportation Energy Data Book is dated over two years after the Edition 9 which was issued in April 1987. Due to funding limitations, a printed edition was not available in 1988. Oak Ridge National Laboratory did a fine job, however, in issuing a shortened computerized data book with a much smaller distribution.

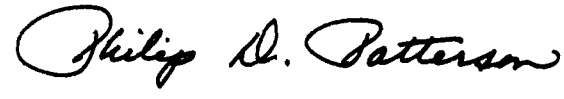
Edition 10 has several new features. Chapter 1 contains international data. Note that the fuel economy of new vehicles sold in the U.S., West Germany, and Japan was not that much different (p. 1-11) even though the price of gasoline was several times higher in West Germany and Japan than in the U.S. (p. 1-4).

Data in Chapter 2 show that U.S. transportation oil use has surpassed domestic oil production every year since 1976 (p. 2-4). U.S. gasohol use remained about constant from 1985 to 1987 even though some states showed large gains (for example, Illinois) while other states showed large losses (Florida) (p. 2-20). Energy intensity has improved since 1970 for all modes but transit (p. 2-26), and the largest gains have been made by air carrier.

Data on highway vehicles in Chapter 3 show that light trucks increased their share of highway fuel use (p. 3-3) since 1970. All trucks increased their share of the vehicle stock from 18 to 28 percent (p. 3-6). The average age of autos and trucks rose in the early 1980's (p. 3-8). This chapter also contains the Corporate Average Fuel Economy (CAFE) standards (p. 3-50), vehicle emission standards (p. 3-53 to 3-55) and the gas guzzler tax schedule (p. 3-56).

Chapter 4 contains data on the nonhighway modes. Appendix A provides a list of abbreviations and data sources. Appendix B provides conversion tables for energy, distance and velocity, volume and flow, power, fuel efficiency, and price deflators. Some of the most often used conversions are listed inside the front cover.

I welcome your suggestions on what additional information you would like to see in future editions of this data book.



ACKNOWLEDGEMENTS

We wish 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 Systems for their continued support of the Transportation Energy Data Book. This document also benefits from the criticism and careful review of Fred Westbrook of Camden Corporation, Phil Patterson of the U.S. Department of Energy, and David Greene, Bruce Janson, Bruce Peterson, Frank Southworth, and Jerry Hadder of Oak Ridge National Laboratory.

In addition, we would like to acknowledge the contributions of Sherry Daniels of the Health, Saftey, Environment, and Accountability Division for the preparation of the title index. Finally, we are indebted to Jonnie Sorensen for her skills in assisting with the preparation of the manuscript.

ABSTRACT

The Transportation Energy Data Book: Edition 10 is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Transportation Systems 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 - highway, air, water, rail, pipeline - is treated in separate chapters or sections. Chapter 1 compares U.S. transportation data with data from seven 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 automobiles, federal standards, fuel economies, and household data. The last chapter, Chapter 4, covers each of the nonhighway modes: air, water, pipeline, and rail, respectively.

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STATISTICAL SUMMARY

Vehicle stock (thousands)			Transportation movement (billions)		Energy use (trillion Btu)	
	New sales	In use	**Domestic passenger travel, 1987**		Total United States energy use, 1988	**79,940**
Automobiles, 1987	10,195	**119,849**	Vehicle-miles	1,623	Total U.S. petroleum use, 1988	**33,960**
Two seater	2.1%	2.3%	Automobiles	83.6%	Percentage of U.S. energy use	42.5%
Minicompact	1.0%	4.1%	Motorcycles	0.6%	Percentage used in transportation	62.6%
Subcompact	26.1%	23.2%	Personal trucks	15.1%	Percentage of transportation energy	97.3%
Compact	34.4%	20.8%	Buses[a]	0.1%		
Midsize	24.3%	28.4%	Air[b]	0.5%	Total transportation energy use, 1988	**21,860**
Large	12.0%	21.2%	Rail	0.1%		
					Percentage of U.S. energy use, 1988	27.3%
Trucks, 1987	4,911	**47,344**	Passenger-miles	3,193		
					Highway, 1987	**73.6%**
Light	93.9%	89.3%	Automobiles	72.3%		
Medium	0.5%	3.5%	Motorcycles	0.3%	Automobiles	40.3%
Light-heavy	0.9%	2.4%	Personal trucks	14.6%	Motorcycles	0.1%
Heavy-heavy	4.7%	4.8%	Buses[c]	1.3%	Trucks	32.6%
			Air[b]	10.7%	Buses	0.7%
Motorcycles, 1987	935	**4,886**	Rail	0.7%		
					Nonhighway, 1987	**20.4%**
Buses, 1987		**602**	**Domestic intercity freight movement, 1987**			
					Air	8.6%
Aircraft[d], 1987		**217**	Ton-miles	3,114	Water	6.0%
					Pipeline	3.5%
Commercial water vessels, 1987		**40**	Trucks	21.2%	Rail	2.2%
			Water	29.6%		
Recreational boats, 1987		**9,459**	Pipeline[e]	18.9%	**Off-highway, 1985**	**3.0%**
			Rail[f]	30.3%		
Railroad cars, 1987		**751**			**Military operations, 1987**	**2.9%**

[a]Transit bus only.
[b]Certificated route air carriers and general aviation.
[c]Transit and intercity bus only.
[d]General aviation aircraft only.
[e]Coal slurry and crude oil and products pipeline only.
[f]Class I rail only.

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 Data 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 Systems). DOE, through the Office of Transportation Systems, has supported the compilation of Editions 3 through 10.

The current role of the government in reducing transportation energy use is to supplement the efforts of private industry. To this end, the major thrust of the Office of Transportation Systems is toward the research and development of generic, high-risk technologies with a large potential for energy savings. 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 10 updates much of the same type of data that is found in previous editions.

Chapter 1 is a new chapter in the data book series, containing information which compares U.S. transportation data with data from seven selected countries in Asia, Europe, and North America. The U.S. data in this chapter are presented for comparison with other international data only and, therefore, should not match domestic data found in other chapters of the book. 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 federal standards and fuel economies of highway vehicles, and household travel patterns, although household travel is not entirely restricted to highway transportation. Chapter 4 consists of data for the nonhighway modes: air, water, pipeline, and rail. 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 in this edition for the first time to document the estimation procedures. The attempt is to provide sufficient information for the conscientious user to evaluate the estimates and to form his or her own opinions as to their utility. Clearly, the accuracy of the estimates cannot exceed the accuracy of the primary data, an accuracy which in most instances is unknown. In cases where data

accuracy is known or substantial errors are strongly suspected in the data, the reader will be 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 can endorse the validity of these data.

Edition 10 of the Transportation Energy Data Book includes over 150 pages of tables and figures. To facilitate use of this information, several aids in format and presentation techniques are included. Statistical highlights from the data book precede this introduction, and a synopsis of chapter contents is provided at the beginning of each chapter. Some of the average rates of change in the data book are calculated using 1982 as a base year. An oil embargo was affecting the economy in 1982, and the base year was chosen as a year of economic recession.

Table identifiers, a new feature in edition 10, can be found on the upper outside corner of each table and in the Table of Contents. The table identifiers are created to assist in the specific location of information, since many of the same tables are updated in each edition of the data book, but are not given the same table number or page number as the previous edition. Throughout future editions of the data book, the table identifiers will remain the same for each table which is published, and new identifiers will be created for new tables.

CHAPTER 1
INTERNATIONAL TRANSPORTATION STATISTICS

This chapter, a new chapter in the Data Book series, includes statistics related to the transportation sector of eight selected countries around the world. Countries were selected based on data availability, geographical distribution, and transportation fuel use as a percentage of total refined petroleum consumption. In 1986, all of the selected countries consumed at least 35% of their total petroleum consumption in the transportation sector. 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.

Table 1.1 shows the transportation sector's use of refined petroleum products in 1986 for selected countries. The United States consumed the largest share (67.1%) of its total petroleum consumption in the transportation sector. (Note that this share is different than the Energy Information Administration's estimate.) The United Kingdom and Canada closely followed, consuming 59.3% and 56.5% of total petroleum use in their transportation sectors, respectively. Motor gasoline accounted for more than 50% of the transportation sector's total petroleum consumption for all of the listed countries, except for Italy. Diesel fuel consumption took the lead in Italy.

Gasoline and diesel fuel prices in selected countries are presented in Tables 1.2 and 1.3 (in current and constant 1987 U.S. dollars). The United States experienced the greatest drops in both gasoline and diesel prices during the past six years. The U.S. gasoline price dropped at an average rate of 9.2% per year in constant 1987 U.S. dollars while diesel price declined at a rate of 6.4% per year. Italy was the only country that experienced increases in both gasoline and diesel prices; it also had the highest gasoline prices among all countries from 1982 to 1988. Figures 1.1 and 1.2 indicate the amount of tax that is included in the price of gasoline and diesel for each listed country.

Vehicle registration statistics for the selected countries are included in Tables 1.4 and 1.5. The total number of vehicle (car, truck and bus) registrations in the world has almost doubled in 16 years, from 246 million in 1970 to 500 million in 1986. Although vehicle registrations in the United States, compared to the world totals, declined steadily, approximately 35% of the world's vehicles were registered in the United States in 1986.

The enactment of the Corporate Average Fuel Economy Standards (CAFES) in the U.S. in 1978, along with increases in the price of fuel, contributed in part to the rapid increase in U.S. fuel economy from 1973 to 1986. Average new car fuel economies have continuted to improve in the United States and West Germany, while fuel economies in Japan actually began to decline in 1983 (Table 1.6).

Over half of the petroleum products consumed in the United States, the United Kingdom, and Canada was for transportation. Motor gasoline accounted for at least 50% of all transportation petroleum consumption for the listed countries, except Italy.

Table 1.1
Transportation Sector Use of Refined Petroleum Products for Selected Countries, 1986
(million gallons)

	Motor gasoline	Percent motor gasoline of transportation use	Aviation gasoline	Liquid petroleum gas	Jet fuel	Gas/Diesel oil	Residual fuel oil	Total transportation petroleum use[a]	Transportation as a percentage of total	Total petroleum use for country
Asia:										
Japan	8,468.0	50.0%	2.8	532.0	755.6	6,266.2	899.6	16,942.2	37.0%	45,750.8
Europe:										
France	5,676.9	53.6%	8.3	18.2	1,070.1	3,806.4	6.5	10,587.3	45.8%	23,119.7
Italy	3,532.7	42.1%	2.8	308.8	588.9	3,957.8	[b]	8,391.9	45.6%	18,389.1
Sweden	1,215.1	60.6%	2.8	1.2	195.2	543.1	46.8	2,004.2	41.3%	4,851.9
United Kingdom	6,609.8	58.6%	8.9	[b]	1,692.3	2,938.8	34.2	11,287.7	59.3%	19,020.2
West Germany	7,531.8	58.3%	6.5	3.4	1,158.2	4,227.2	[b]	12,927.4	39.0%	33,136.8
North America:										
Canada	7,433.9	67.7%	36.6	78.8	1,075.0	2,159.9	203.5	10,987.7	56.5%	19,447.5
United States[c]	89,408.4	67.0%	398.4	256.1	19,065.5	22,609.5	1,748.6	133,477.5	67.1%	198,990.5

Source:
Organization for Economic Cooperation and Development, International Energy Agency, Energy Statistics 1985-1986, Paris, France, 1988, pp. 41, 53, 57, 73, 77, 105, 117, 121.

[a]Total may not equal the sum of the components because of small quatities of kerosene which are included in the total, but not reported separately.
[b]Negligible.
[c]The United States petroleum use on this page should be used only in international comparisons. These data are not consistent with other domestic figures because they are partly estimated by the Secretariat and are not the same data published by the Energy Information Administration.

Gasoline prices, in constant 1987 U.S. dollars, have been decreasing since 1982 for most of the listed countries, with the greatest drop observed in the United States. U.S. gasoline prices have decreased at a substantial average annual rate of 9.2% since 1982. Over the past six years, the United States has reported the lowest gasoline prices among all listed countries while Italy has the highest.

Table 1.2
Gasoline Prices for Selected Countries,[a] 1978-88

	Current dollars per gallon											Average annual percentage change	
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[b]	1978-88	1982-88
Asia:													
Japan[c]	2.00	2.10	2.58	2.64	2.60	2.42	2.31	2.25	2.79	3.17	3.49	5.7	5.0
Europe:													
France	2.15	2.56	3.03	2.70	2.56	2.37	2.24	2.37	2.58	3.05	3.08	3.7	3.1
Italy	2.23	2.47	3.10	2.97	2.88	2.93	2.79	2.63	3.26	3.79	4.09	6.3	6.0
Sweden	1.56	1.94	2.64	2.64	2.40	2.07	1.93	2.06	2.20	2.50	2.68	5.6	1.9
United Kingdom	1.22	1.79	2.50	2.57	2.42	2.25	2.05	2.12	2.07	2.39	2.43	7.1	0.1
West Germany	1.75	2.06	2.43	2.38	2.17	2.04	1.87	1.87	1.88	2.20	2.18	2.2	0.1
North America:													
Canada[c]	0.69	0.73	0.85	1.13	1.37	1.47	1.48	1.45	1.31	1.41	1.52	8.2	1.7
United States[d]	0.66	0.87	1.23	1.37	1.32	1.25	1.22	1.20	0.93	0.93	0.91	3.3	-6.0
	Constant 1987 dollars[e] per gallon											Average annual percentage change	
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[b]	1978-88	1982-88
Asia:													
Japan[c]	3.48	3.29	3.56	3.30	3.06	2.76	2.53	2.38	2.89	3.17	3.35	-0.4	1.5
Europe:													
France	3.75	4.01	4.18	3.38	3.02	2.70	2.45	2.51	2.68	3.05	2.96	-2.3	-0.3
Italy	3.88	3.87	4.27	3.71	3.39	3.34	3.05	2.78	3.38	3.79	3.93	0.1	2.5
Sweden	2.72	3.04	3.64	3.30	2.83	2.36	2.11	2.18	2.28	2.50	2.58	-0.5	-1.5
United Kingdom	2.13	2.80	3.45	3.21	2.85	2.57	2.24	2.24	2.15	2.39	2.34	0.9	-3.2
West Germany	3.05	3.23	3.35	2.98	2.56	2.33	2.05	1.98	1.95	2.20	2.09	-3.7	-3.3
North America:													
Canada[c]	1.20	1.14	1.17	1.41	1.61	1.68	1.62	1.53	1.36	1.41	1.46	2.0	-1.6
United States[d]	1.15	1.36	1.70	1.71	1.55	1.43	1.33	1.27	0.96	0.93	0.87	-2.8	-9.2

Source:
U.S. Department of Energy, Energy Information Administration, International Energy Annual, Washington, DC, October 1988, p. 49-52, 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.

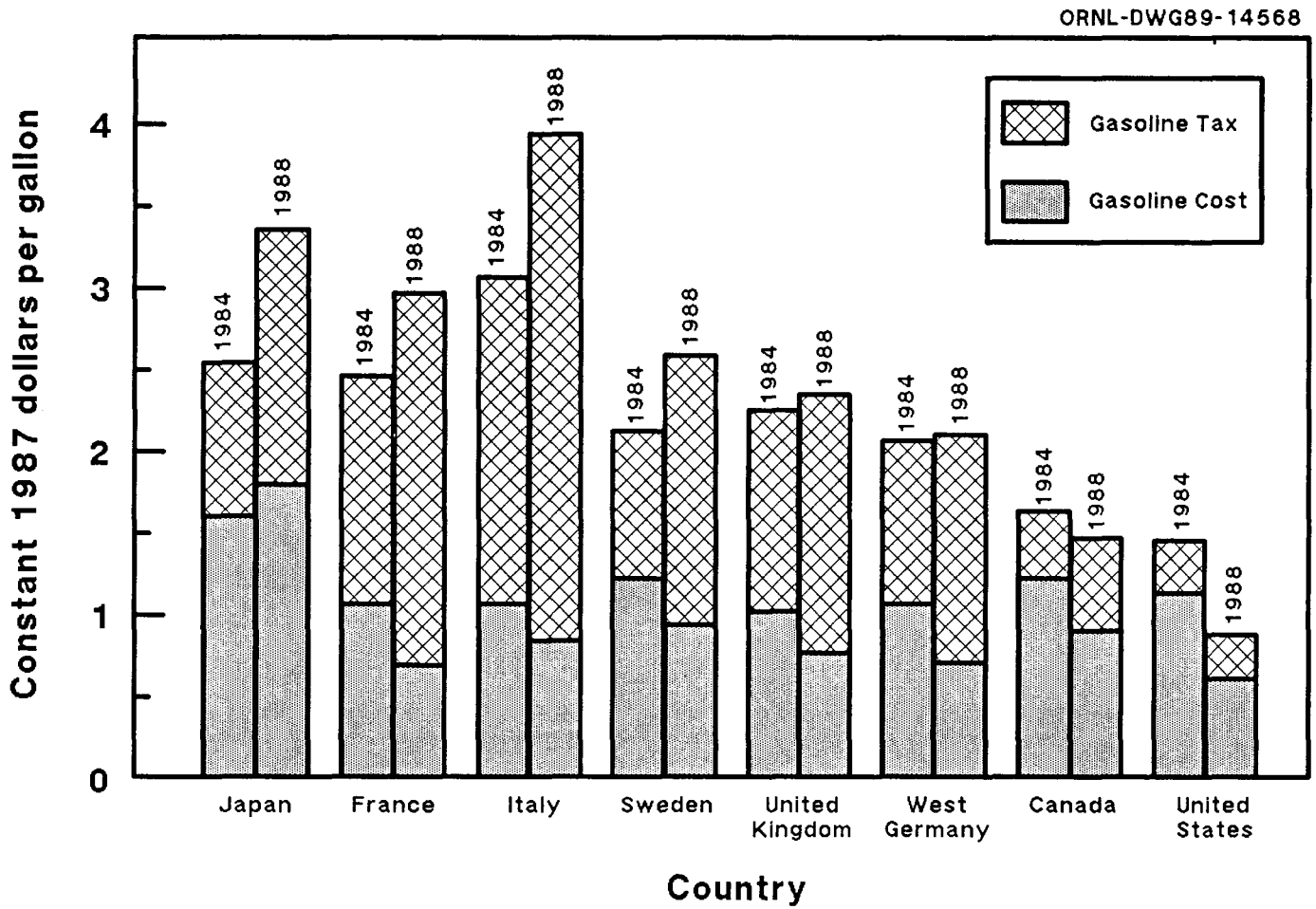
[b]1988 prices represent the retail prices (including taxes) for premium leaded gasoline on January 1.

[c]All prices for Japan and Canada are unleaded regular gasoline.

[d]All prices for the United States are unleaded regular gasoline. 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 1.1. Gasoline Prices for Selected Countries, 1984 and 1988



Source: Total prices - See Table 1.2.
Tax - International Energy Agency, Energy Prices and Taxes, Third Quarter 1988, 1988.

U.S. diesel fuel prices, in 1987 constant dollars, showed the greatest average annual decrease (6.4%) of all of the listed countries. Italy was the only country which did not experience an average annual decrease in 1987 constant dollar diesel fuel prices between 1982 and 1988.

Table 1.3
Diesel Fuel Prices for Selected Countries,[a] 1978-88

	Current dollars per gallon											Average annual percentage change	
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[b]	1978-88	1982-88
Asia:													
Japan	[c]	1.23	1.70	1.81	1.78	1.72	1.66	1.60	1.90	1.91	2.08	6.0[d]	2.6
Europe:													
France	1.30	1.65	2.11	1.98	1.88	1.76	1.63	1.68	1.69	1.92	1.93	4.0	0.4
Italy	0.64	0.80	1.21	1.11	1.19	1.26	1.20	1.21	1.31	1.62	1.77	10.7	6.8
Sweden	0.62	0.83	1.31	1.35	1.41	1.26	1.32	1.36	1.24	1.54	1.64	10.2	2.6
United Kingdom	1.24	1.70	2.19	2.23	2.05	1.87	1.68	1.78	1.71	1.89	1.95	4.6	-0.8
West Germany	1.48	1.77	2.10	1.90	1.81	1.66	1.53	1.52	1.51	1.72	1.75	1.7	-0.6
North America:													
Canada	[c]	[c]	[c]	1.27	1.27	1.33	1.30	1.31	1.27	1.33	1.43	[c]	2.0
United States[e]	0.54	0.73	1.01	1.18	1.16	1.20	1.22	1.22	0.94	0.96	0.96	5.9	-3.1
	Constant 1987 dollars[f] per gallon											Average annual percentage change	
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988[b]	1978-88	1982-88
Asia:													
Japan	[c]	1.93	2.34	2.26	2.10	1.96	1.82	1.69	1.97	1.91	2.00	0.4[d]	-0.8
Europe:													
France	2.26	2.58	2.91	2.48	2.21	2.01	1.78	1.78	1.75	1.92	1.85	-2.0	-2.9
Italy	1.11	1.25	1.67	1.39	1.40	1.44	1.31	1.28	1.36	1.62	1.70	4.4	3.3
Sweden	1.08	1.30	1.81	1.69	1.66	1.44	1.44	1.44	1.29	1.54	1.58	3.9	-0.8
United Kingdom	2.16	2.66	3.02	2.79	2.41	2.13	1.84	1.88	1.77	1.89	1.87	-1.4	-4.1
West Germany	2.58	2.77	2.90	2.38	2.13	1.89	1.67	1.61	1.57	1.72	1.68	-4.2	-3.9
North America:													
Canada	[c]	[c]	[c]	1.59	1.50	1.52	1.42	1.38	1.32	1.33	1.37	[c]	-1.5
United States[e]	0.94	1.14	1.39	1.48	1.37	1.37	1.33	1.29	0.97	0.96	0.92	-0.2	-6.4

Source:
U.S. Department of Energy, Energy Information Administration, International Energy Annual, Washington, DC, October 1988, p. 49-52, 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]1988 prices represent the retail prices (including taxes) for diesel fuel on January 1.

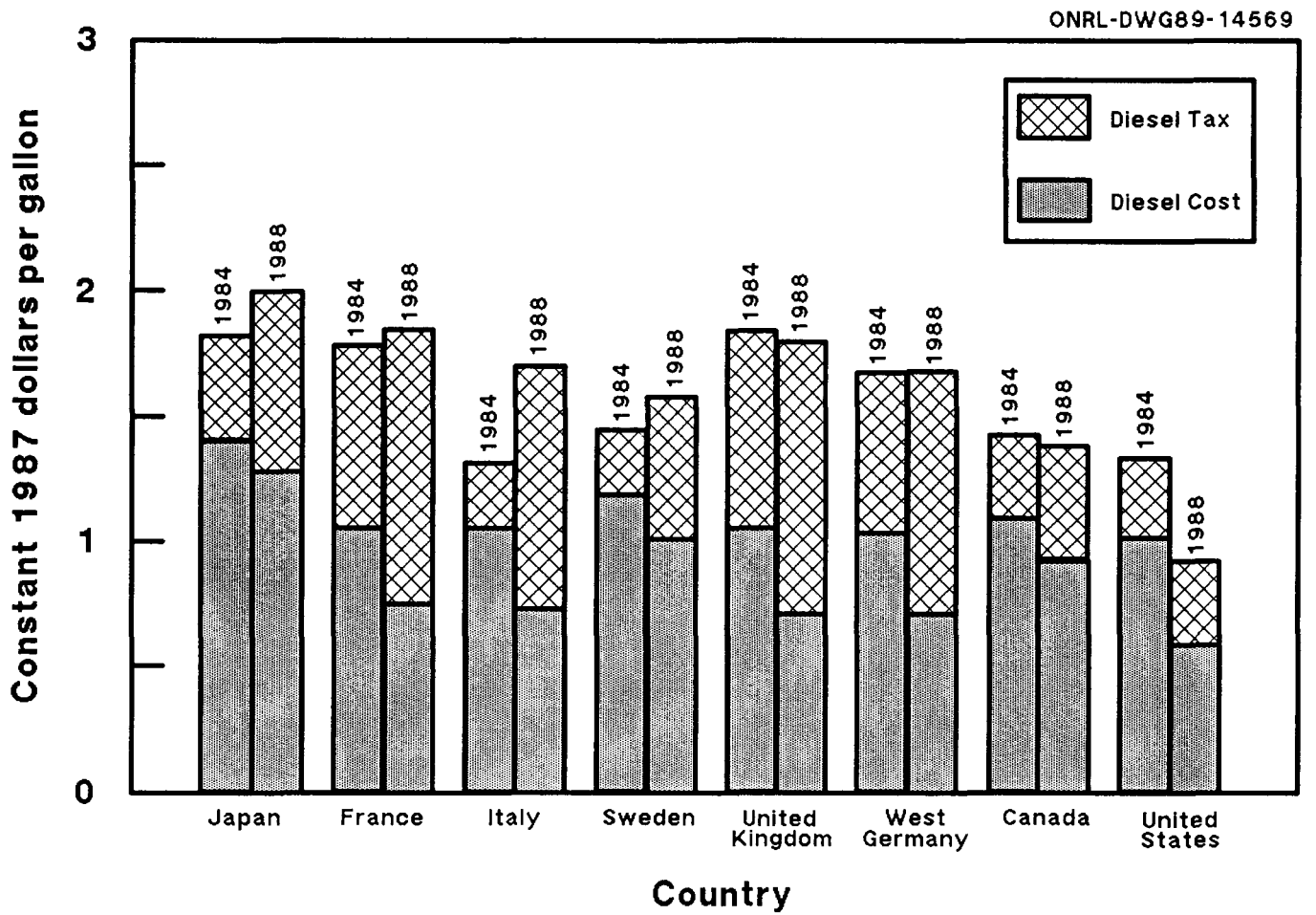
[c]Data are not available.

[d]Average annual percentage change is for years 1979-88.

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

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

Figure 1.2. Diesel Fuel Prices for Selected Countries, 1984 and 1988



Source: Total prices - See Table 1.3.
Tax - International Energy Agency, Energy Prices and Taxes, Third Quarter 1988, 1988.

The share of U.S. automobile registrations as a percentage of the world total has decreased since 1970, from 46.1% in 1970 to 35.1% in 1986. Among all listed countries, Japan has experienced the greatest average annual increase, 7.1%; and the number of automobile registrations in 1986 was 3.26 times that reported in 1970.

Table 1.4
Automobile Registrations for Selected Countries, 1970-86
(thousands)

	Asia	Europe					North America		Percentage		
Year	Japan	France	Italy	Sweden	United Kingdom	West Germany	Canada	United States	U.S. of world	All other countries[a]	World total
1970	8,779	12,280	10,191	[b]	11,802	13,299	6,602	89,244	46.1%	41,319	193,516
1971	10,572	12,995	11,294	[b]	12,356	14,301	6,967	92,718	44.8%	45,751	206,954
1972	12,531	13,800	12,484	2,443	13,023	15,064	7,407	97,082	44.1%	46,218	220,052
1973	14,474	14,550	13,425	2,503	13,815	15,724	7,866	101,985	43.2%	51,656	235,998
1974	15,854	15,100	14,304	2,639	13,948	16,010	8,472	104,856	42.2%	57,426	248,609
1975	17,236	15,555	15,060	2,760	14,061	16,764	8,870	106,706	41.0%	63,195	260,207
1976	18,476	16,250	15,925	2,881	14,372	17,722	9,016	110,189	40.9%	64,748	269,579
1977	19,826	17,000	16,466	2,857	[b]	18,853	9,554	112,287	39.3%	89,175	286,018
1978	21,280	17,780	16,241	2,856	14,417	20,007	9,745	116,573	39.2%	78,462	297,361
1979	22,667	18,525	17,073	2,868	14,927	20,910	9,985	118,429	38.2%	84,285	309,667
1980	23,660	19,150	17,686	2,663	14,438	21,455	10,256	121,601	37.9%	89,630	320,539
1981	24,612	19,725	18,603	2,893	15,633	21,812	10,199	123,098	38.4%	83,938	320,513
1982	25,539	20,420	19,616	2,936	16,075	22,086	10,530	123,702	36.4%	99,358	340,262
1983	26,385	20,950	20,389	3,007	16,612	22,624	10,732	126,444	35.9%	105,173	352,316
1984	27,144	21,175	20,888	3,081	17,313	23,193	10,781	128,158	35.1%	133,081	364,814
1985	27,845	21,325	21,500	3,151	18,575	23,777	11,118	131,864	35.2%	115,572	374,727
1986	28,654	21,575	22,000	3,253	19,176	24,700	11,477	135,431	35.1%	120,042	386,308
					Average annual percentage change						
1970-86	7.7%	3.6%	4.9%	2.1%[c]	3.1%	3.9%	3.5%	2.6%		6.9%	4.4%
1982-86	2.9%	1.4%	2.9%	2.6%	4.5%	2.8%	2.2%	2.3%		4.8%	3.2%

Sources:
Individual countries - Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1988 Edition, Detroit, Michigan, 1988, pp. 94, 152, 177, 198, 248, 274, 339, 372.
World total - Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '88, Detroit, Michigan, 1988, p. 37.

[a]Automobile registrations for all other countries were calculated by subtracting listed countries' registrations from the world total.
[b]Data are not available.
[c]Average annual percentage change is for 1972-86.

The total number of truck and bus registrations in the world has increased at an average annual rate of 4.9% since 1970. The U.S. share of the world's trucks and buses was 35.9% in 1986, which was slightly lower than 1970's share of 36.3%.

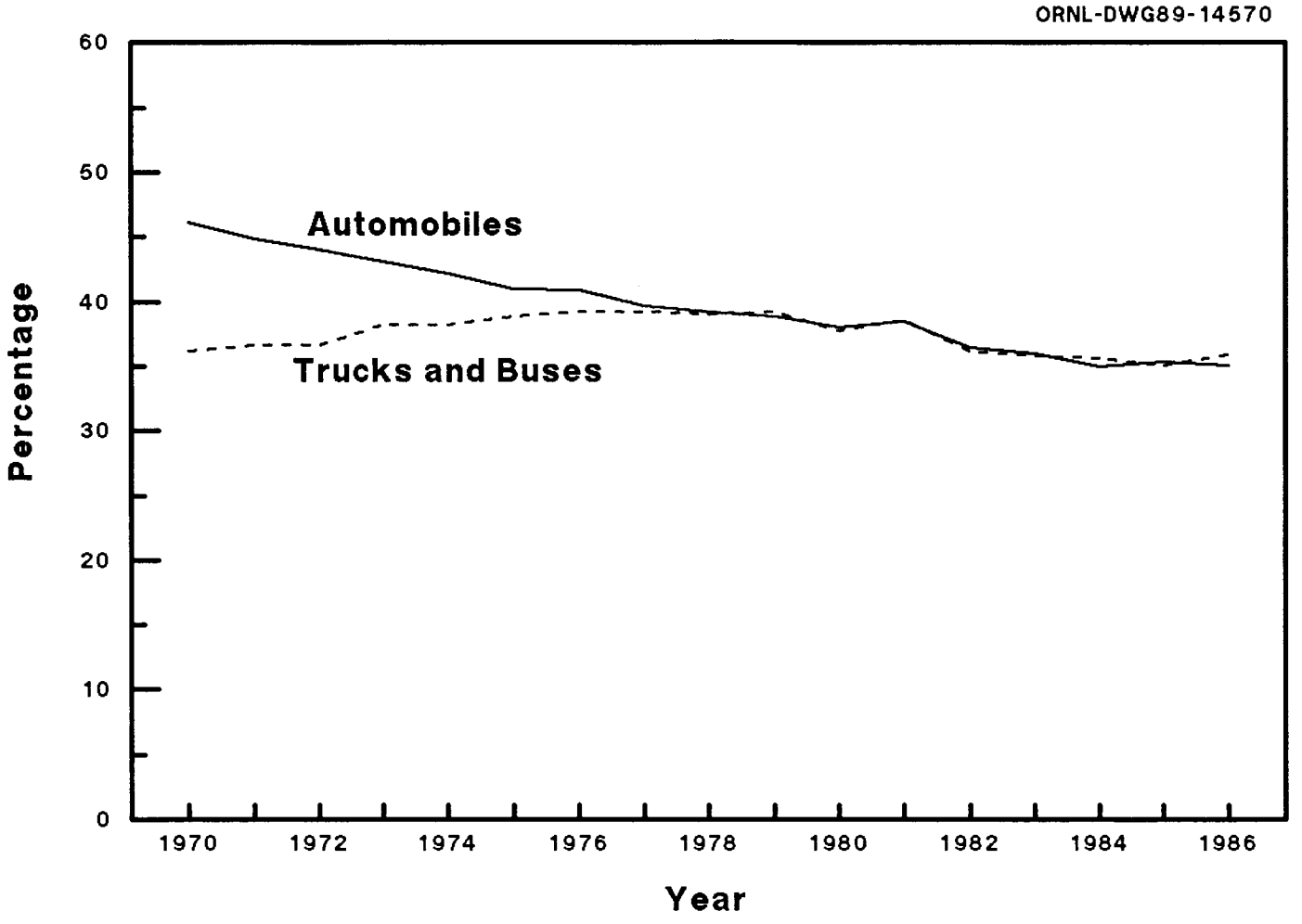
Table 1.5
Truck and Bus Registrations for Selected Countries, 1970-86
(thousands)

	Asia	Europe					North America		Percentage		
Year	Japan	France	Italy	Sweden	United Kingdom	West Germany	Canada	United States	U.S. of world	All other countries[a]	World total
1970	8,793	2,115	929	[b]	1,768	2,306	1,481	19,175	36.3%	16,285	52,852
1971	9,286	2,126	993	[b]	1,775	2,458	1,557	20,268	36.7%	16,758	55,221
1972	19,877	2,175	1,032	161	1,798	2,577	1,682	21,715	36.7%	8,161	59,178
1973	10,526	2,250	1,084	164	1,880	2,660	1,842	23,669	38.2%	17,883	61,958
1974	11,018	2,334	1,146	171	1,915	2,694	2,028	25,077	38.2%	19,343	65,726
1975	10,854	2,375	1,193	171	1,934	2,735	2,158	26,243	38.8%	20,030	67,693
1976	11,594	2,410	1,249	178	1,918	2,827	2,317	28,354	39.3%	21,285	72,132
1977	12,182	2,446	1,283	182	[b]	2,937	2,494	29,805	38.9%	25,291	76,620
1978	12,841	2,479	1,179	184	1,855	3,091	2,771	31,841	38.5%	26,418	82,659
1979	13,564	2,525	1,287	191	1,914	3,252	2,907	33,441	38.7%	27,263	86,344
1980	14,197	2,571	1,429	194	1,921	3,398	2,955	34,196	37.8%	29,712	90,573
1981	15,009	2,625	1,547	199	1,889	3,515	3,192	35,188	38.9%	27,399	90,563
1982	15,797	2,690	1,642	207	1,856	3,598	3,293	35,941	36.4%	33,633	98,657
1983	16,546	2,734	1,764	215	1,697	3,738	3,363	37,306	36.0%	36,353	103,716
1984	17,380	2,746	1,792	224	1,595	3,878	3,099	38,091	35.1%	39,659	108,464
1985	18,313	2,765	1,824	232	728[c]	4,045	3,148	39,789	35.3%	41,972	112,816
1986	18,342	2,828	1,856	244	741[c]	4,276	4,212	40,760	35.9%	40,164	113,423
					Average annual percentage change						
1970-86	4.7%	1.8%	4.4%	3.0%[d]	-5.3%[e]	3.9%	6.8%	4.8%		5.8%	4.9%
1982-86	3.8%	1.3%	3.1%	4.2%	-20.5%[e]	4.4%	6.3%	3.2%		4.5%	3.5%

Sources:
Individual countries - Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1988 Edition, Detroit, Michigan, 1988, pp 94, 152, 177, 198, 248, 274, 339, 372.
World total - Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '88, Detroit, Michigan, 1988, p. 37.

[a]Truck and bus registrations for all other countries were calculated by subtracting listed countries' registrations from the world total.
[b]Data are not available.
[c]Data are not comparable to earlier years because of a reclassification of trucks by the United Kingdom Department of Transport.
[d]Average annual percentage change is for 1972-86.
[e]Average annual percentage change is misleading due to the data changes in 1985.

Figure 1.3. United States Automobile, and Truck and Bus Registrations as a Percent of World Registrations, 1970-86



Source: See Table 1.4 and Table 1.5.

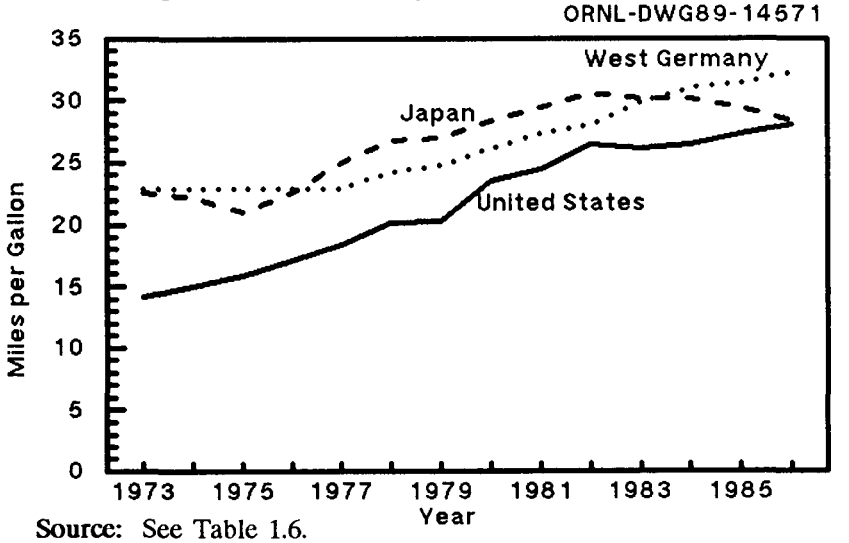
The automobile fuel economy in the United States increased by 98% from 14.17 mpg in 1973 to 28.00 mpg in 1986. This rapid increase in fuel economy can be attributed in part to the enactment of the Corporate Average Fuel Economy Standards in 1978 and the increase in fuel prices. The gap between Japanese and U.S. new car fuel economies has narrowed from 8.45 mpg in 1973 to 0.34 mpg in 1986.

Table 1.6
New Passenger Car Fuel Economies for Selected Countries, 1973-86
(miles per gallon)

Year	United States[a]	Japan	Germany
1973	14.17	22.62	22.84
1974	14.98	22.19	22.84
1975	15.89	21.00	22.84
1976	17.05	22.62	22.84
1977	18.38	25.03	22.84
1978	20.11	26.73	24.25
1979	20.28	27.04	24.76
1980	23.52	28.34	26.14
1981	24.50	29.41	27.35
1982	26.43	30.55	28.00
1983	26.14	30.16	29.77
1984	26.43	30.16	30.95
1985	27.35	29.41	31.37
1986	28.00	28.34	32.22
	Average annual percentage change		
1973-86	5.4%	1.7%	2.7%
1982-86	1.5%	-1.9%	3.6%

Source:
Personal communication with the International Energy Agency, Washington, DC, 1988.

Figure 1.4. Passenger Car Fuel Economy Trends for Selected Countries, 1973-86



Source: See Table 1.6.

[a]These estimates are for international comparisons only and do not necessarily correspond to fuel economies in other sections of the book.

CHAPTER 2
TRANSPORTATION ENERGY CHARACTERISTICS

Petroleum products supplied for U.S. consumption since 1970 have increased at a slower rate than has world petroleum consumption (0.9% annually versus 1.8% annually, respectively). Although its share has been declining slightly, the U.S. continues to account for more than one-quarter of world total petroleum consumption (Table 2.2). Gross imported crude oil and petroleum products as a percentage of total domestic petroleum supply reached its peak in 1977 (47.7%), reflecting the increased U.S. dependence on imported oil. This percentage dropped to 32.2% in 1985; however, it rose again to 41.8% in 1988 (Table 2.2). Imported oil's increasing share of the total supply was due in part to the increased petroleum use in transportation, from 9.23 million barrels per day in 1985 to 10.04 million barrels per day in 1988 (Table 2.3).

The transportation sector, as the largest end-user of refined petroleum products, was responsible for close to two-thirds (62.6%) of total domestic petroleum consumption (Table 2.3), and 27.3% of total energy use in 1988 (Table 2.5). Although transportation's share of total energy use is the smallest of all listed sectors, it is significant that most transportation energy use is from petroleum products, 97.3% in 1988 (Table 2.4). Neither the residential and commercial sector, nor the industrial sector consumes as much petroleum as the transportation sector does. Transportation petroleum use has increased at a rate of 2.4% per year since 1982, which is a faster rate than total petroleum use (Table 2.3).

Of total transportation energy use in 1987, 73.6% was consumed by the highway mode while the non-highway mode (which includes air, water, pipeline, and rail transportation) accounted for 20.4% (Table 2.8). The remaining 6% of transportation energy was consumed by the off-highway mode and military activities. Since 1982, highway energy use has increased 2.4% per year. This increase was the result of rapid increases in the number of trucks in operation (due potentially to the introduction of mini vans (Table 3.3)) and the increased amount of travel by individual trucks

(Tables 3.15-3.17). Total energy use by all trucks (light trucks and other trucks combined) increased by 33%, from 5.4 quadrillion Btu in 1982 to 7.2 quadrillion Btu in 1988 (Table 2.9).

On a per passenger-mile basis, almost all of the passenger modes have experienced improved energy efficiencies since 1982, with the greatest improvement in intercity rail transportation (Amtrak) (Table 2.14). The rail transit sector and transit buses were the only modes that did not show improvements in energy efficiency (Table 2.14).

Changes in transportation fuel prices affect all types of travel patterns. For example, the 4.6% decrease per year in gasoline price (all types combined) since 1982 (Table 2.17) contributed in part to a 2.4% increase per year in transportation petroleum use (Table 2.3). Both gasoline and diesel prices (either in current dollars or in 1987 constant dollars) dropped during the period from 1982 to 1988. The greatest drop in price was observed in unleaded gasoline--on the average 8.3% per year (constant 1987 dollars) since 1982 (Table 2.17).

The portion of Gross National Product (GNP) contributed by transportation has increased at a faster rate since 1982 than has total GNP, 5.1% and 4.0%, respectively, in constant 1987 dollars (Table 2.20). In 1987, approximately 300 billion dollars were spent on transportation-related products. Transportation's share of total GNP was the lowest to date in 1982 and started to increase in 1983. However, Personal Consumption Expenditures (PCE) on transportation increased at a slower rate than did the total PCE on all commodities, 3.8% and 4.6% per year, respectively (Table 2.21). On the average, 12.6% of the total personal consumption expenditures in 1987 were spent on transportation compared to 13% in 1982.

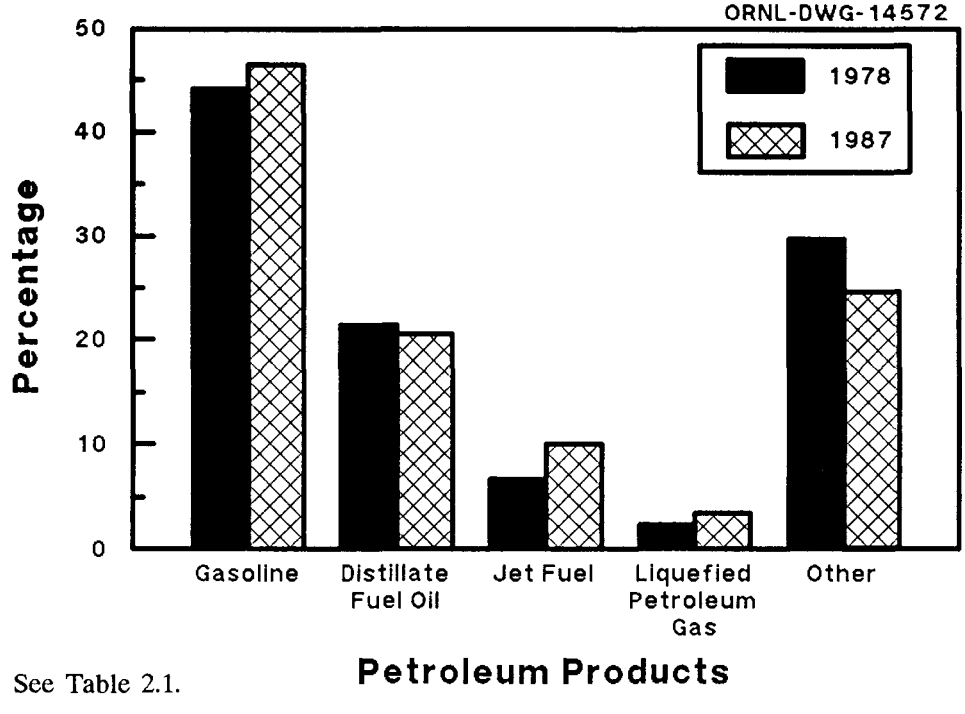
Section 2.1. Energy Consumption and Supply

Table 2.1
Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978-87[a]
(percentage)

Year	Gasoline	Distillate fuel oil	Jet fuel	Liquefied petroleum gas	Other
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

Source:
Department of Energy, Energy Information Administration, Petroleum Supply Annual 1987, Vol. 1, May 1988, Table 13, p. 35.

Figure 2.1. Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978 and 1987



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%.

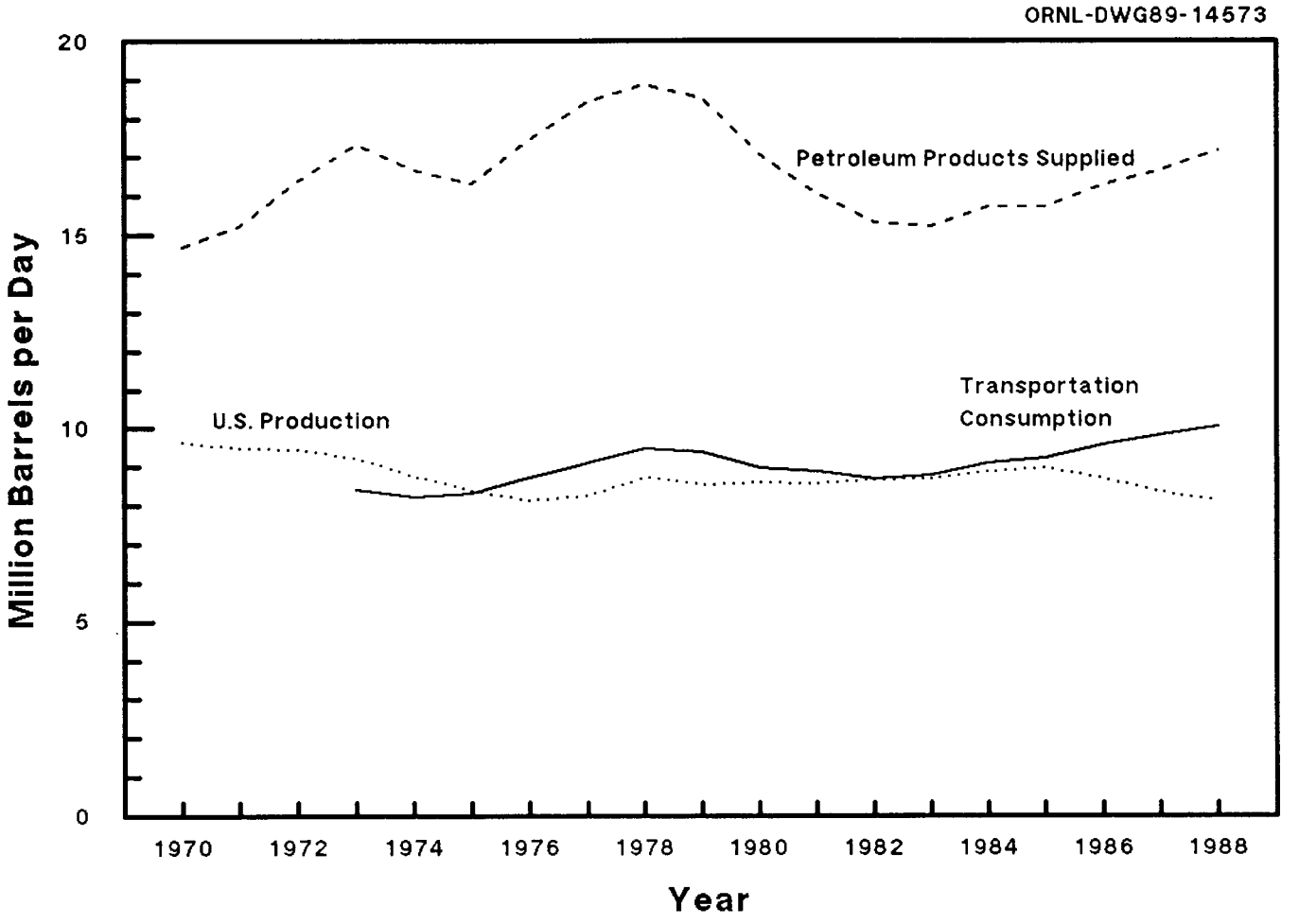
Table 2.2
United States Petroleum Production and Consumption, 1970-88
(million barrels per day)

Year	Domestic crude oil production	Gross imports			Petroleum products supplied	World petroleum consumption	Imports as a percentage of petroleum products supplied	Petroleum products as a percentage of imports	U.S. petroleum products supplied as a percentage of world consumption	Transportation petroleum use as a percentage of domestic production[a]
		Crude oil	Petroleum products	Total						
1970	9.64	1.32	2.10	3.42	14.70	46.38	23.3	61.4	31.7	[b]
1971	9.46	1.68	2.25	3.93	15.21	50.00	25.8	57.3	30.4	[b]
1972	9.44	2.22	2.53	4.75	16.37	52.42	29.0	53.3	31.2	[b]
1973	9.21	3.24	3.01	6.25	17.31	56.39	36.1	48.2	30.7	91.5
1974	8.77	3.48	2.64	6.12	16.65	55.91	36.8	43.1	29.8	93.7
1975	8.37	4.10	1.95	6.05	16.32	55.48	37.1	32.2	29.4	99.4
1976	8.13	5.29	2.03	7.32	17.46	58.74	41.9	27.7	29.7	107.6
1977	8.25	6.61	2.19	8.80	18.43	61.63	47.7	24.9	29.9	110.2
1978	8.71	6.36	2.01	8.37	18.85	63.30	44.4	24.0	29.8	108.7
1979	8.55	6.52	1.94	8.46	18.51	65.17	45.7	22.9	28.4	109.6
1980	8.60	5.26	1.65	6.91	17.06	63.20	40.5	23.9	27.0	104.4
1981	8.57	4.40	1.60	6.00	16.06	61.00	37.4	26.7	26.3	103.7
1982	8.65	3.49	1.63	5.12	15.30	59.62	33.5	31.8	25.7	100.6
1983	8.69	3.33	1.72	5.05	15.23	58.95	33.2	34.1	25.8	101.1
1984	8.88	3.43	2.01	5.44	15.73	60.00	34.6	36.9	26.2	102.6
1985	8.97	3.20	1.87	5.07	15.73	59.82	32.2	36.9	26.3	102.9
1986	8.68	4.18	2.05	6.23	16.28	61.36	38.3	32.9	26.5	110.1
1987	8.35	4.67	2.00	6.68	16.67	[b]	40.0	30.0	[b]	117.7
1988	8.13	5.05	2.13	7.17	17.17	[b]	41.8	29.7	[b]	123.5
					Average annual percentage change					
1970-88	-0.9%	7.7	0.1%	4.2%	0.9%	1.8%[c]				
1982-88	-1.0%	6.4%	4.6%	5.8%	1.9%	0.7%[c]				

Sources:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, December 1988, March 1989, Table 2.5, 3.1a, 3.1b, pp. 35, 46-47.
World petroleum consumption - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1987, October 1988, Table 7, p. 28.

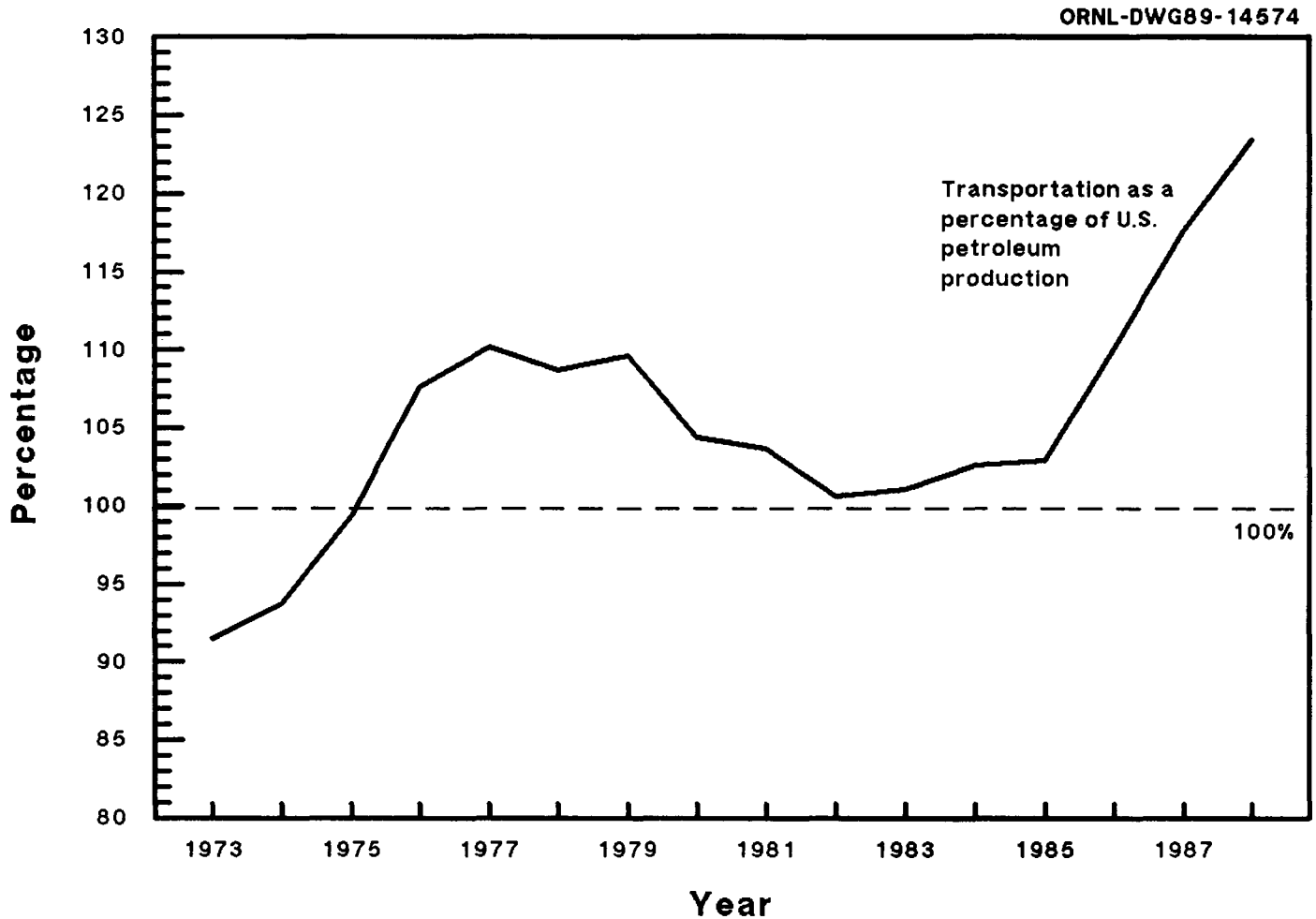
[a]Transportation petroleum use can be found on Table 2.3.
[b]Data are not available.
[c]Average annual percentage change for years 1970-86 and 1982-86.

Figure 2.2. United States Petroleum Production and Consumption, 1970-88



Source: See Tables 2.2 and 2.3.

Figure 2.3. Transportation Petroleum Consumption as a Percentage of Total United States Petroleum Production, 1973-88



Source: See Table 2.3.

Since 1982, petroleum consumption in the transportation sector has increased at an average annual rate of 2.4% which was higher than for any of the other sectors. Transportation's share of total petroleum consumption increased from 51.2% in 1973 to 62.6% in 1988.

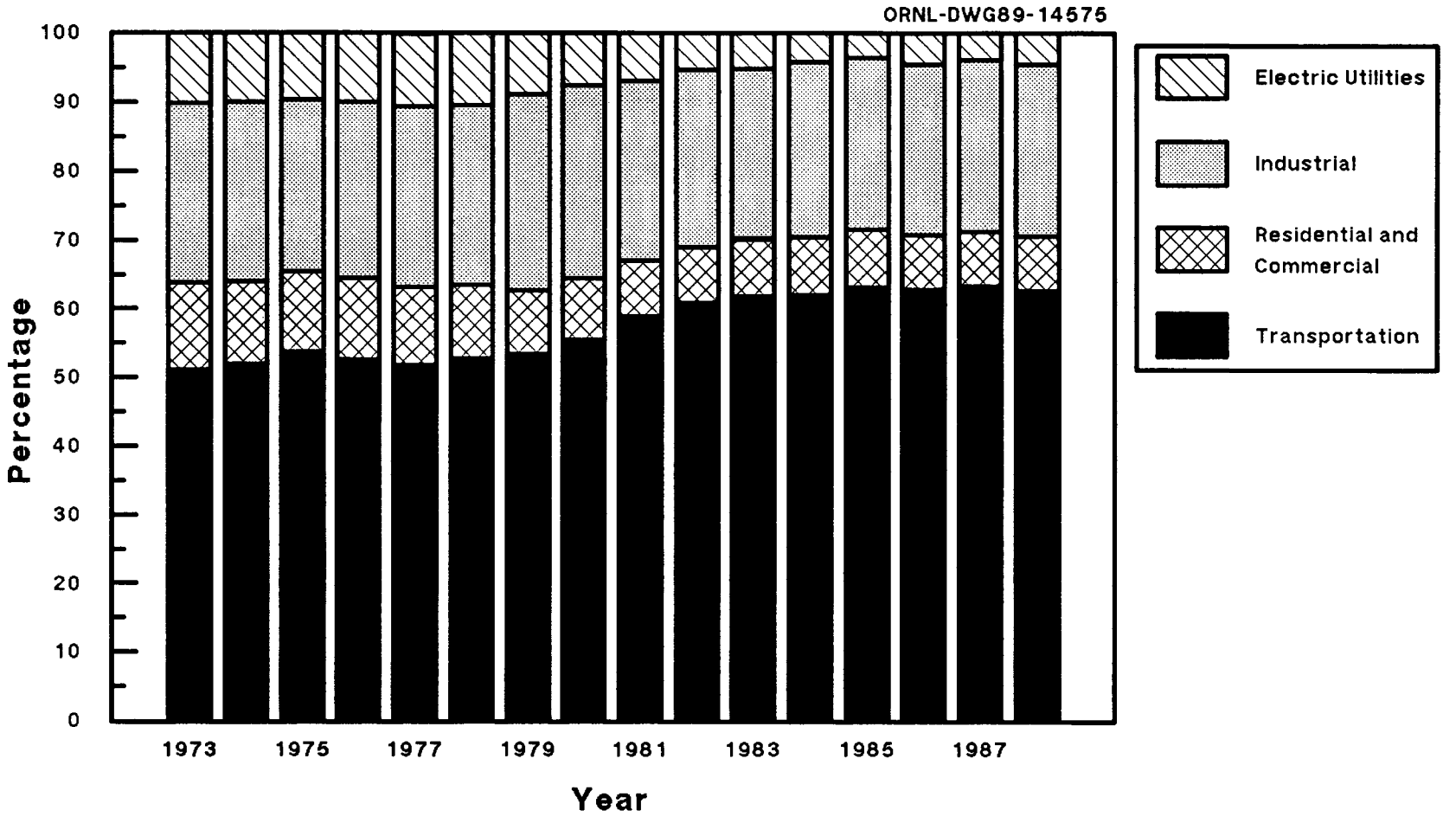
Table 2.3
Consumption of Petroleum by End-Use Sector, 1973-88
(quadrillion Btu)

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	7.80	1.57	30.24	14.28
1983	18.59	61.9%	2.50	7.42	1.54	30.05	14.19
1984	19.28	62.1%	2.59	7.90	1.29	31.06	14.67
1985	19.54	63.2%	2.57	7.72	1.09	30.92	14.61
1986	20.23	62.8%	2.58	7.94	1.45	32.20	15.21
1987	20.80	63.3%	2.62	8.19	1.26	32.87	15.53
1988	21.25	62.6%	2.70	8.44	1.56	33.96	16.04
			Average annual percentage change				
1973-88	1.2%		-3.2%	-0.5%	-5.3%	-0.2%	
1982-88	2.4%		1.6%	1.3%	-0.1%	2.0%	

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, December 1988, March 1989, p. 29, 31, 33, 35.

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

Figure 2.4. Petroleum Use by End-Use Sector, 1973-88



Source: See Table 2.3.

Petroleum was the major source of transportation energy use, with only 2.8 percent coming from other sources in 1988. The residential and commercial sector, which depended heavily on natural gas and petroleum as energy sources in 1978, used electricty as the primary energy source in 1988. From 1978 to 1988 the industrial sector also moved away from using petroleum, natural gas, and coal as energy sources in favor of electricity.

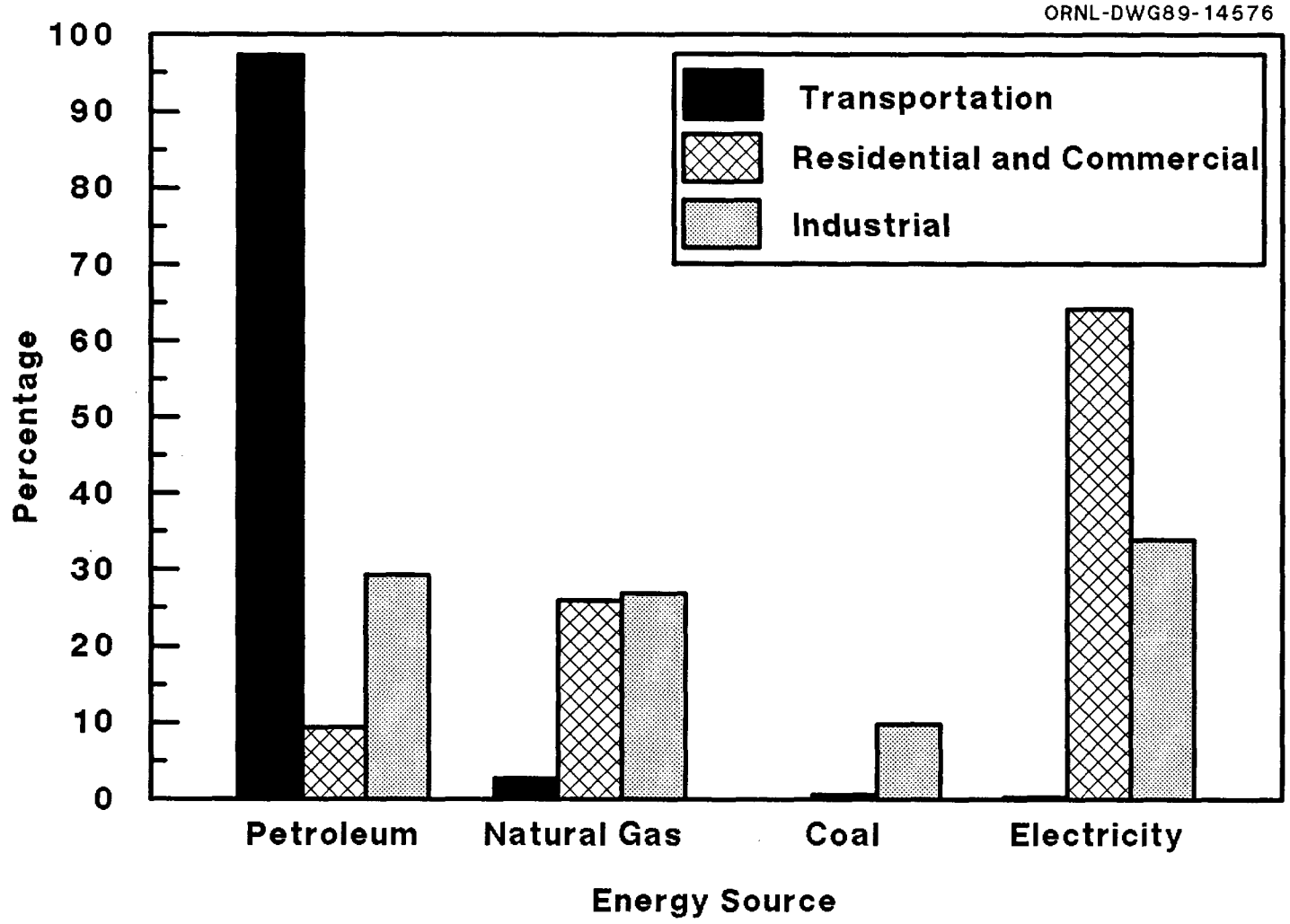
Table 2.4
Distribution of Energy Consumption by Source, 1978 and 1988
(percentage)

	Transportation		Residential and Commercial		Industrial	
Energy source	1978	1988	1978	1988	1978	1988
Petroleum	97.3	97.3	25.4	9.3	40.1	29.2
Natural gas[a]	2.6	2.6	47.6	25.9	34.6	26.9
Coal	0.0	0.0	1.3	0.6	13.4	9.8
Hydroelectric	0.0	0.0	0.0	0.0	0.1	0.1
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0
Electricity[b]	0.1	0.2	25.7	64.2	11.2	34.0
Other[c]	0.0	0.0	0.0	0.0	0.5	0.0
	100.0	100.0	100.0	100.0	100.0	100.0

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, December 1988, Washington, DC, March 1989, pp. 27, 31, 33, 35.

[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.

Figure 2.5. Distribution of Energy Consumption by Source, 1988



Source: See Table 2.4.

While total energy use has increased at an average rate of 2% per year since 1982, transportation energy use has increased at a slightly faster rate of 2.3% per year. Transportation energy use reached an all-time high of 21.86 quads in 1988.

Table 2.5
Consumption of Total Energy by End-Use Sector, 1970-88[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%	23.72	30.70	72.54
1975	18.24	25.9%	23.90	28.40	70.54
1976	19.10	25.7%	25.02	30.23	74.36
1977	19.82	26.0%	25.39	31.08	76.29
1978	20.61	26.4%	26.09	31.39	78.09
1979	20.47	25.9%	25.81	32.62	78.90
1980	19.70	25.9%	25.65	30.61	75.96
1981	19.51	26.4%	25.24	29.24	73.99
1982	19.07	26.9%	25.63	26.14	70.85
1983	19.13	27.1%	25.63	25.76	70.52
1984	19.87	26.8%	26.49	27.74	74.10
1985	20.11	27.2%	26.75	27.08	73.95
1986	20.77	28.0%	27.02	26.45	74.24
1987	21.38	27.8%	27.74	27.65	76.77
1988	21.86	27.3%	29.14	28.95	79.94
		Average annual percentage change			
1970-88	1.7%		1.6%	0.1%	1.0%
1982-88	2.3%		2.2%	1.7%	2.0%

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, December 1988, Washington, DC, March 1989, Table 2.2, p. 29.

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

Table 2.6
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1987
(trillion Btu)

	Gasoline	Distillate fuel oil	Liquefied petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity
HIGHWAY[a]	13,811.9	2,344.8	56.8				
Automobiles	8,715.6	147.3					
Motorcycles	24.6						
Buses	62.2	94.6					
Transit	1.3	73.0					
Intercity		21.6					
School	60.9						
Trucks	5,009.5	2,102.9	56.8				
Light trucks[b]	3,840.1	156.5	35.3				
Other trucks	1,169.4	1,946.4	21.5				
OFF-HIGHWAY[a] (heavy-duty)[c]	95.1	570.1					
Construction	31.4	178.5					
Farming	63.7	391.6					
NONHIGHWAY[a]	278.6	745.0		1,845.6	787.3	535.3	298.8
Air	48.3[d]			1,845.6			
General aviation[e]	48.3			90.8			
Domestic air carriers				1,564.2			
International air carriers				190.6[f]			
Water	230.3	308.4			787.3		
Freight		308.4			787.3		
Domestic trade		245.6			125.1		
Foreign trade		62.8			662.2		
Recreational boats	230.3						
Pipeline						535.3	239.7
Natural gas						535.3	27.6
Crude petroleum							91.0
Petroleum product							67.4
Coal slurry							3.7
Water							50.0
Rail		436.6					59.1
Freight[g]		417.9					
Passenger		18.7					59.1
Transit							41.0
Commuter rail		7.5					13.9
Intercity		11.2					4.2
MILITARY OPERATIONS	14.0[h]	173.6	0.1	449.2	10.4		
TOTAL[i]	14,199.6	3,833.5	56.9	2,294.8	797.7	535.3	298.8

Source: See Appendix A for Table 2.6.

[a]Civilian consumption only; military consumption shown separately.
[b]Two-axle, four-tire trucks.
[c]1985 data.
[d]Aviation gasoline.
[e]All aircraft in the U.S. civil air fleet except those operated under FAR parts 121 and 127 (i.e., air carriers larger than 30 seats and/or a payload capacity of more than 7,500 pounds). General aviation includes air taxies, commuter air carriers, and air travel clubs.
[f]This figure represents an estimate of the energy purchased in the U.S. for international air carrier consumption.
[g]Includes Class 1, 2, and 3 railroads.
[h]Includes approximately 99,000 barrels of aviation gasoline and 18,000 barrels of gasohol.
[i]Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).

Table 2.7
Distribution of Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1987 (percentage)

	Gasoline	Distillate fuel oil	Liquefied petroleum gas	Jet fuel	Residual fuel oil	Natural gas	Electricity
HIGHWAY[a]	97.3	61.2	99.8				
Automobiles	61.4	3.8					
Motorcycles	0.2						
Buses	0.4	2.5					
Transit	[b]	1.9					
Intercity		0.6					
School	0.4						
Trucks	35.3	54.9	99.8				
Light trucks[c]	27.0	4.1	62.0				
Other trucks	8.2	50.8	37.8				
OFF-HIGHWAY[a] (heavy-duty)[d]	0.7	14.9					
Construction	0.2	4.7					
Farming	0.4	10.2					
NONHIGHWAY[a]	2.0	19.4		80.4	98.7	100.0	100.0
Air	0.3[e]			80.4			
General aviation[f]	0.3			4.0			
Domestic air carriers				68.2			
International air carriers				8.3[g]			
Water	1.6	8.0			98.7		
Freight		8.0			98.7		
Domestic trade		6.4			15.7		
Foreign trade		1.6			83.0		
Recreational boats	1.6						
Pipeline						100.0	80.2
Natural gas						100.0	9.2
Crude petroleum							30.4
Petroleum product							22.6
Coal slurry							1.2
Water							16.7
Rail		11.4					19.8
Freight[h]		10.9					
Passenger		0.5					19.8
Transit							13.7
Commuter rail		0.2					4.7
Intercity		0.3					1.4
MILITARY OPERATIONS	[b]	4.5	0.2	19.6	1.3		
TOTAL[i] (by fuel type)	64.5	17.4	0.3	10.4	3.6	2.4	1.4

Source: See Appendix A for Table 2.6.

[a]Civilian consumption only; military consumption shown separately.
[b]Less than 0.05 percent.
[c]Two-axle, four-tire trucks.
[d]1985 data.
[e]Aviation gasoline.
[f]All aircraft in the U.S. civil air fleet except those operated under FAR parts 121 and 127 (i.e., air carriers larger than 30 seats and/or a payload capacity of more than 7,500 pounds). General aviation includes air taxies, commuter air carriers, and air travel clubs.
[g]This figure represents an estimate of the energy purchased in the U.S. for international air carrier consumption.
[h]Includes Class 1, 2, and 3 railroads.
[i]Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).

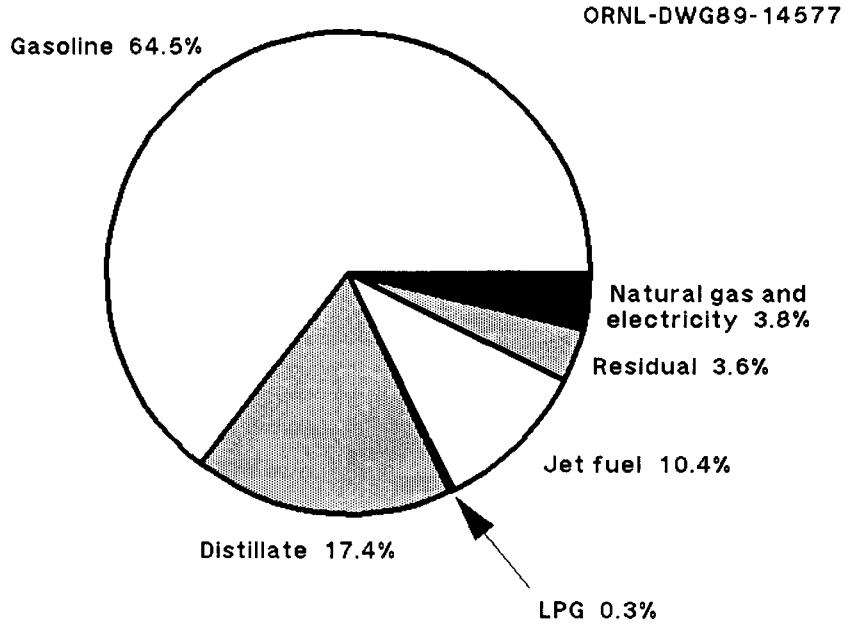
Table 2.8
Transportation Energy Use by Mode, 1987

	Trillion Btu	Thousand barrels per day crude oil equivalent[a]	Percentage of total
HIGHWAY[b]	**16,213.5**	**7658.1**	**73.6**
Automobiles	**8,862.9**	**4,186.2**	**40.3**
Motorcycles	**24.6**	**11.6**	**0.1**
Buses	**156.8**	**74.1**	**0.7**
Transit	74.3	35.1	0.3
Intercity	21.6	10.2	[c]
School	60.9	28.8	0.3
Trucks	**7,169.2**	**3,386.2**	**32.6**
Light trucks[d]	4,031.9	1,904.4	18.3
Other trucks	3,137.3	1,481.8	14.2
OFF-HIGHWAY[a] (heavy-duty)[e]	**665.2**	**314.2**	**3.0**
Construction	**209.9**	**99.1**	**1.0**
Farming	**455.3**	**215.1**	**2.1**
NONHIGHWAY[b]	**4490.6**	**2121.0**	**20.4**
Air	**1893.9**	**894.5**	**8.6**
General aviation[f]	139.1	65.7	0.6
Domestic air carriers	1,564.2	738.8	7.1
International air carriers	190.6[g]	90.0	0.9
Water	**1326.0**	**626.3**	**6.0**
Freight	1,095.7	517.5	5.0
Domestic trade	370.7	175.1	1.7
Foreign trade	725.0	342.4	3.3
Recreational boats	230.3	108.8	1.0
Pipeline	**775.0**	**366.1**	**3.5**
Natural gas	562.9	265.9	2.6
Crude petroleum	91.0	43.0	0.4
Petroleum product	67.4	31.8	0.3
Coal slurry	3.7	1.7	[c]
Water	50.0	23.6	0.2
Rail	**495.7**	**234.1**	**2.2**
Freight[h]	417.9	197.4	1.9
Passenger	77.8	36.7	0.3
Transit	41.0	19.4	0.2
Commuter rail	21.4	10.1	[c]
Intercity	15.4	7.3	[c]
MILITARY OPERATIONS	**647.3**	**305.7**	**2.9**
TOTAL[i]	**22,016.6**	**10,399.1**	**100.0**

Source:
See Appendix A for Table 2.6.

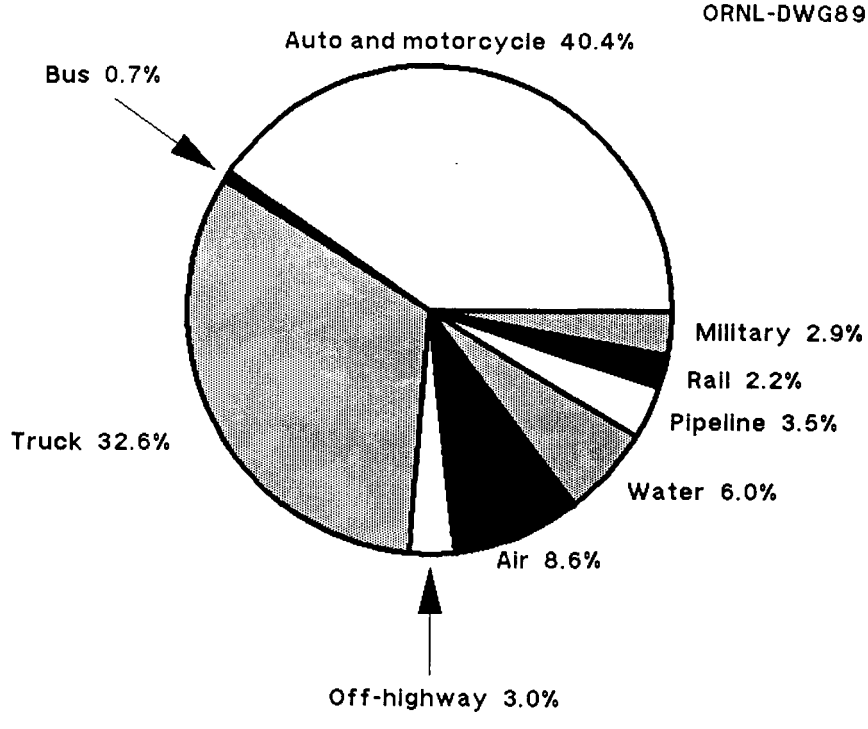
[a]Thousand barrels per day crude oil equivalents based on Btu content of a barrel of crude oil.
[b]Civilian consumption only; military consumption shown separately.
[c]Negligible.
[d]Two-axle, four-tire trucks.
[e]1985 data.
[f]All aircraft in the U.S. civil air fleet except those operated under FAR parts 121 and 127 (i.e., air carriers larger than 30 seats and/or a payload capacity of more than 7,500 pounds). General aviation includes air taxies, commuter air carriers, and air travel clubs.
[g]This figure represents an estimate of the energy purchased in the U.S. for international air carrier consumption.
[h]Includes Class 1, 2, and 3 railroads.
[i]Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).

Figure 2.6. Distribution of Transportation Fuel Use by Fuel Type, 1987



Source: See Table 2.7.

Figure 2.7. Distribution of Transportation Fuel Use by Mode, 1987



Source: See Table 2.8.

The combined energy use for highway and nonhighway modes has increased at an average annual rate of 2.2% since 1982. Although declining slightly, the highway share continued to account for more than three quarters of the combined transportation energy use for both highway and nonhighway modes. Of all the modes, light truck energy use has grown at the fastest rates, 6.2% annually from 1982 to 1987 and 5.8% annually from 1970 to 1987. Automobile energy use over these same periods grew at a rate of less than 1% annually.

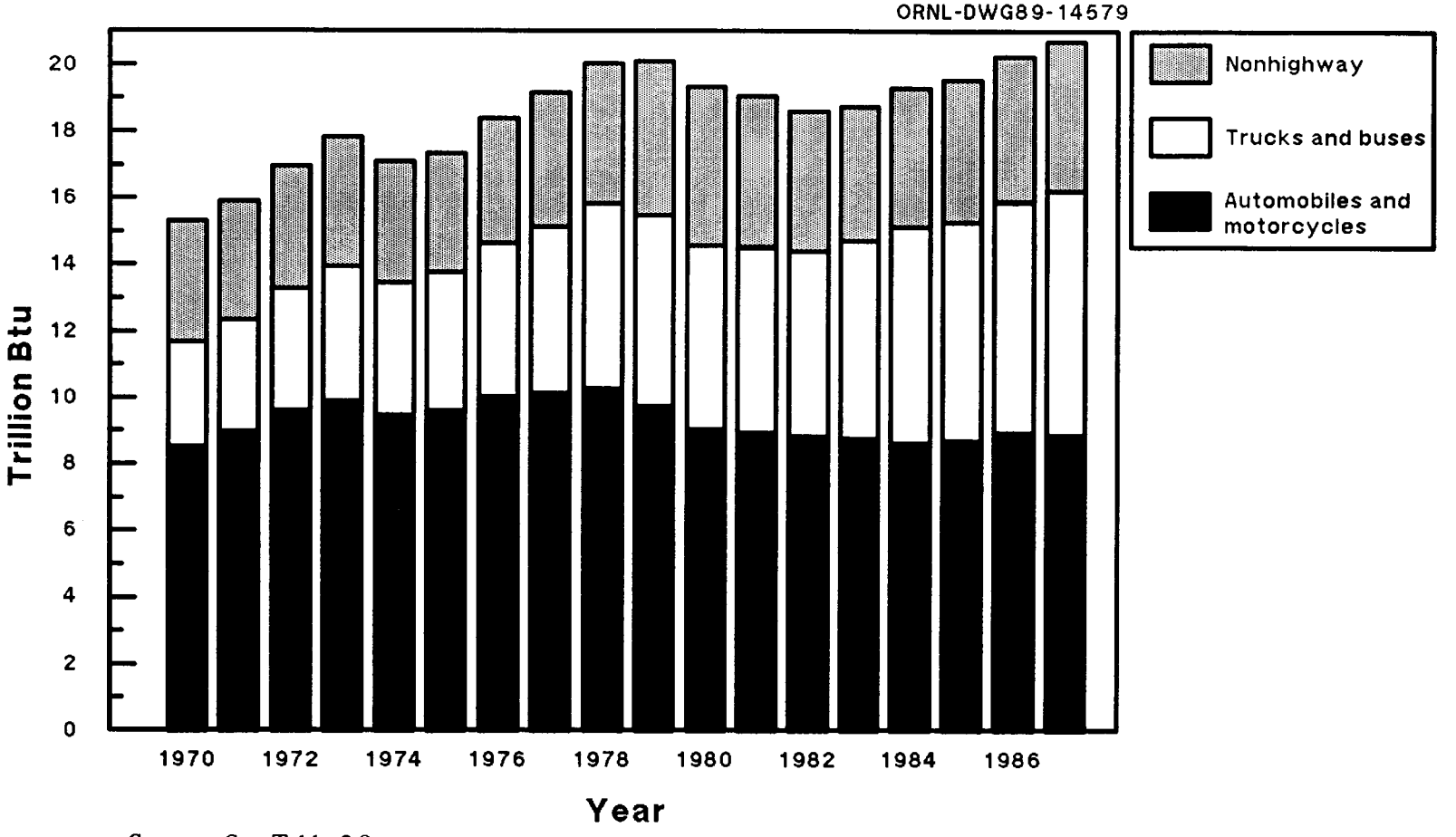
Table 2.9
Transportation Energy Consumption by Mode, 1970-87
(trillion Btu)

Year	Automobiles	Motorcycles	Buses	Light trucks[a]	Other trucks	Total highway	Air	Water	Pipeline	Rail	Total nonhighway	Total transportation[b]
1970	8,526	8	109	1,540	1,502	11,685	1,307	753	985	575	3,620	15,305
1971	8,971	9	108	1,686	1,568	12,342	1,304	698	1,007	556	3,565	15,907
1972	9,583	11	106	1,895	1,684	13,279	1,314	703	1,039	614	3,670	16,949
1973	9,890	13	109	2,105	1,844	13,961	1,377	827	996	652	3,852	17,813
1974	9,440	14	113	2,083	1,791	13,441	1,254	804	932	657	3,647	17,088
1975	9,611	14	119	2,240	1,789	13,773	1,274	851	835	596	3,556	17,329
1976	10,020	15	129	2,522	1,949	14,635	1,333	1,001	803	617	3,754	18,389
1977	10,108	16	132	2,738	2,155	15,149	1,411	1,103	781	627	3,922	19,071
1978	10,267	18	135	3,008	2,420	15,848	1,467	1,311	781	628	4,187	20,035
1979	9,719	22	137	3,094	2,510	15,482	1,568	1,539	856	656	4,619	20,101
1980	9,037	26	139	2,951	2,425	14,578	1,528	1,677	889	645	4,739	19,317
1981	8,927	27	143	2,964	2,461	14,522	1,455	1,562	899	627	4,543	19,065
1982	8,814	25	146	2,982	2,430	14,397	1,468	1,290	853	581	4,192	18,589
1983	8,762	22	145	3,196	2,599	14,724	1,505	1,187	738	574	4,004	18,728
1984	8,613	22	154	3,500	2,836	15,125	1,633	1,251	780	520	4,185	19,310
1985	8,673	23	161	3,630	2,924	15,411	1,678	1,311	758	501	4,248	19,659
1986	8,917	24	154	3,785	3,007	15,886	1,823	1,295	738	487	4,343	20,229
1987	8,863	25	157	4,032	3,137	16,214	1,894	1,326	775	496	4,491	20,704
						Average annual percentage change						
1970-87	0.2%	6.9%	2.2%	5.8%	4.4%	1.9%	2.2%	3.4%	-1.4%	-0.9%	1.3%	1.8%
1982-87	0.1%	0.0%	1.5%	6.2%	5.2%	2.4%	5.2%	0.6%	-1.9%	-3.1%	1.4%	2.2%

Source:
See Appendix A for Table 2.9

[a]Light trucks include only those trucks which have 2-axles **and** 4-tires.
[b]Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g. snowmobiles).

Figure 2.8. Transportation Energy Consumption by Mode, 1970-87[a]



Source: See Table 2.9.

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

Total highway fuel use has increased at an average rate of 2.4% per year since 1982, and in 1987 it was the highest to date. Gasoline consumption continued to account for more than 85% of total highway fuel use despite the fact that special fuels consumption has been increasing at a faster rate than gasoline consumption, 4.8% and 0.6%, respectively.

Table 2.10
Highway Usage of Gasoline and Diesel Fuel, 1973-88
(million gallons)

Year	Gasoline[a]	Special fuels[b]	Total highway fuel use
1973	98,936	9,837	108,773
1974	96,905	9,796	106,701
1975	98,951	9,631	108,582
1976	103,443	10,721	114,164
1977	106,393	11,646	118,039
1978	109,876	12,828	122,704
1979	104,273	13,989	118,262
1980	97,528	13,777	111,305
1981	97,661	14,856	112,517
1982	96,935	14,905	111,840
1983	98,165	15,975	114,140
1984	99,218	17,320	116,538
1985	101,263	17,751	119,014
1986	104,273	18,427	122,700
1987	106,823	19,046	125,869
1988	108,424	[c]	[c]
	Average annual percentage change		
1973-88	0.6%	4.8%[d]	1.0%[d]
1982-88	1.9%	5.0%[d]	2.4%[d]

Sources:
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, December 1988, Washington, DC, March 1989, Table 3.4, p. 55.
Special fuels - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1987, Washington, DC, 1988, Table MF-25, p. 8, and annual.
Total highway fuel use - Calculated as the sum of gasoline and special fuels.

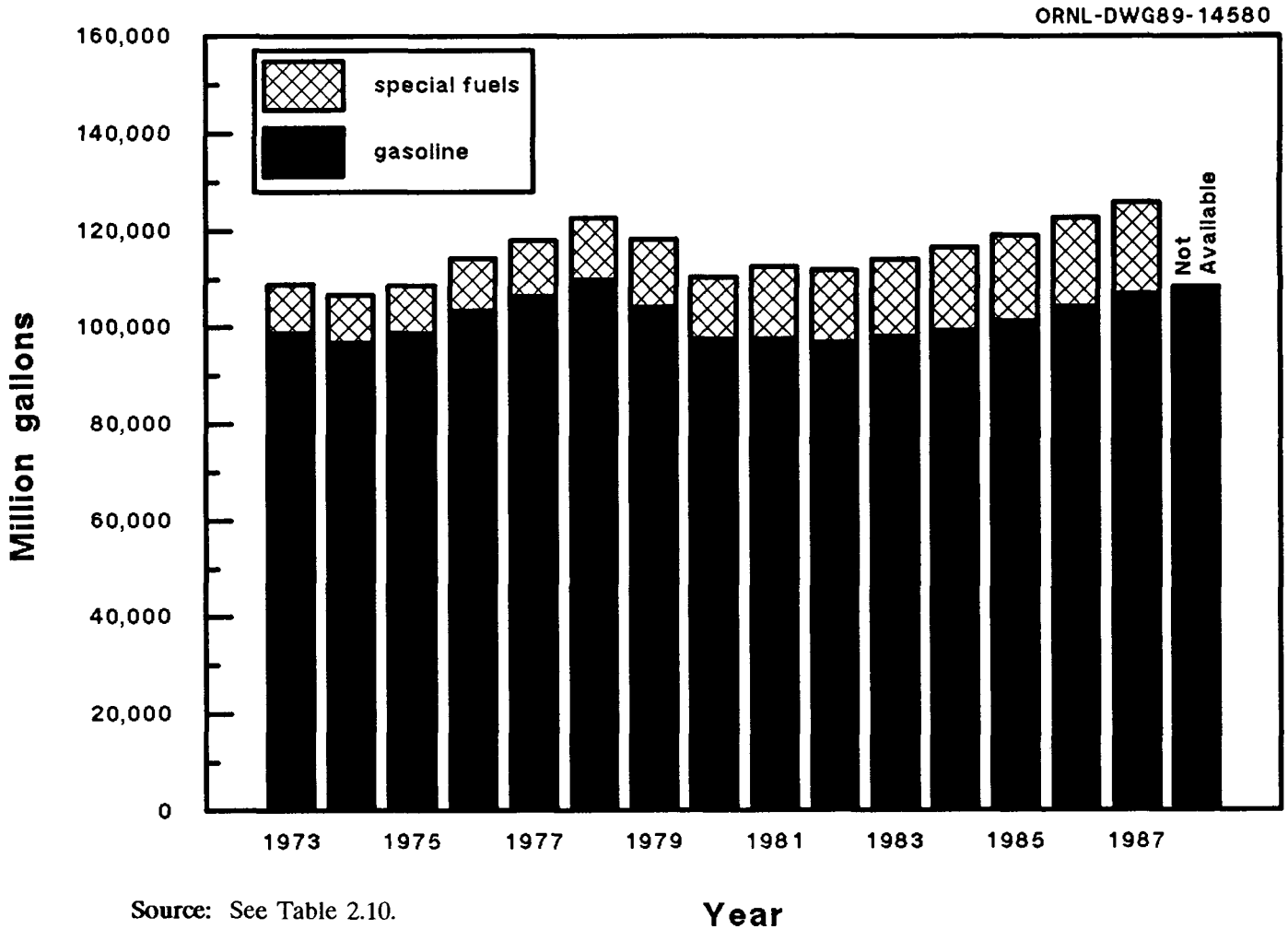
[a]Nonhighway use of gasoline has been subtracted from total gasoline use to calculate highway gasoline use. Nonhighway is assumed to be 3.3% of total gasoline use each year based on averages calculated from the Federal Highway Administration, Highway Statistics data series.

[b]Special fuels consist primarily of diesel fuel, with small quantities of liquified petroleum gas.

[c]Data are not available.

[d]Average annual percentage change is for years 1973-87 and 1982-87.

Figure 2.9. Highway Usage of Gasoline and Special Fuels, 1973-87



Source: See Table 2.10.

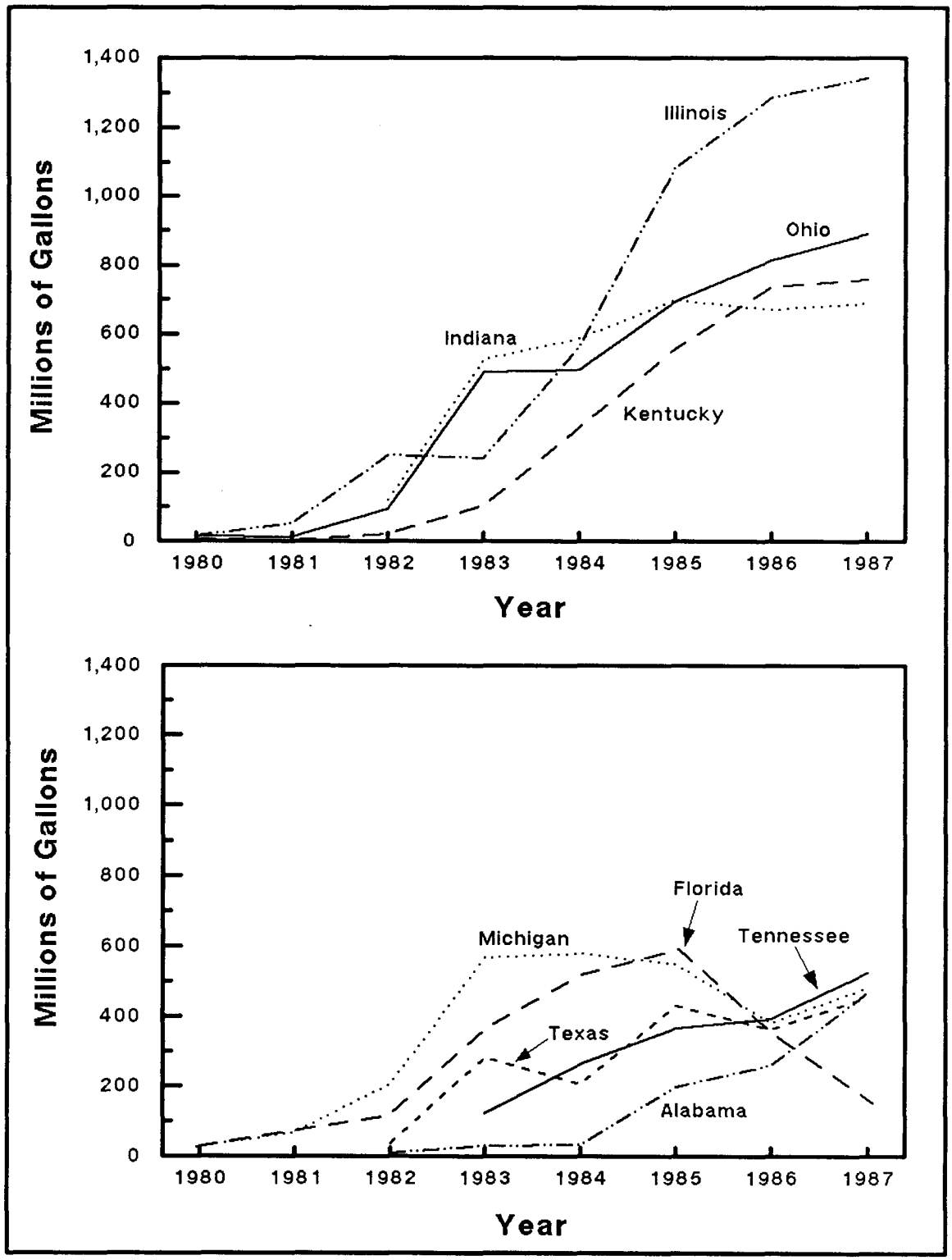
Table 2.11
Gasohol Consumption by Reporting States, 1980-87[a]
(thousands of gallons)

	1980	1981	1982	1983	1984	1985	1986	1987
Alabama			11,522	29,637	34,899	196,111	261,286	466,255
Alaska							171	381
Arizona	2,798	1,843	5,096	772				
Arkansas	8,250	6,104	8,462	12,631	28,871	9,913		
California		147,795	464,004	480,850	401,837	228,017	189,046	252,702
Colorado	3		23,990	56,562	82,233	237,553	70,462	21,400
Connecticut	15,849	9,495	4,461	1,476	5,421	16,409	5,323	
Delaware	1,512	20						
DC	124	20	34	52	84	22	205	328
Florida	14,359	60,357	103,053	357,232	508,751	581,364	334,041	139,616
Georgia	11,063	3,851	148	158	18			
Hawaii	1,095	1,411	368					
Idaho			2,464	8,747	8,067	21,167	22,016	24,207
Illinois	15,088	51,331	251,200	240,000	562,036	1,085,454	1,286,828	1,341,009
Indiana			120,569	525,076	587,396	696,137	668,638	685,814
Iowa	155,947	190,358	498,636	510,206	457,125	436,164	385,130	397,029
Kansas	37,786	14,096	7,448	67,396	273,077	281,617	232,604	139,831
Kentucky	4,763	2,507	18,872	100,646	328,238	556,478	736,349	757,390
Louisiana					24,424	123,597	336,187	252,975
Maine	2,634	1,287						
Maryland	18,549	7,754	107	74	82	720	501	
Massachusetts	16,209	4,517	290	56				
Michigan	29,924	66,530	206,794	565,991	577,723	548,885	382,010	482,896
Minnesota	11,776	3,086	4,653	3,578	2,707	350,169	374,032	214,005
Missouri			9,000	6,996	13,860	18,756	14,316	21,912
Montana	158	473	10,170	11,326	10,181	8,079	3,454	2,451
Nebraska	30,067	31,072	89,698	183,345	208,455	242,367	216,356	241,984
Nevada		641	964	283		1,142	18,650	58,877
New Hampshire	3,642	1,149						
New Jersey	6,567	1,680						
New Mexico			1,082	26,589	63,756	75,502	58,752	99,310
N. Carolina	10,688	13,174	7,456	2,912	34,037	121,220		
N. Dakota	13,491	11,003	6,499	4,440	5,469	36,680	65,327	62,726
Ohio	16,726	9,632	91,679	489,292	495,595	691,659	814,579	891,110
Oklahoma	28,910	37,499	155,053	75,704	23,620	25,374	26,994	
Oregon			2,073	1,370	296	168		
Rhode Island	1,763	399	22					
S. Carolina	11,608	14,518	59,688	1,018	154	700	15,550	37,647
S. Dakota	10,507	6,733	13,808	31,947	41,343	52,402	63,484	59,157
Tennessee				121,019	264,167	365,020	394,469	524,300
Texas			38,142	282,091	207,152	429,495	362,243	454,502
Utah			500		26,358	6,223	2,409	226
Virginia		1,991	30,834	46,213	131,618	349,930	423,709	310,274
Washington	14,063	9,982	7,230	7,943	9,143	7,574	26,797	53,840
W. Virginia	692	134						
Wisconsin			2,718	1,046	1,962	15,069	15,312	10,238
Wyoming	611	846	259	202	309	281	55	50
Total	**497,222**	**713,288**	**2,259,046**	**4,254,876**	**5,420,464**	**7,817,418**	**7,807,285**	**8,004,442**

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1987, Washington, DC, 1988, Table MF-33GLA, p. 11, 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.

Figure 2.10. Gasohol Consumption of Selected States, 1980-87



Source: See Table 2.11.

Heavy-duty off-highway diesel fuel use increased by almost 30% from 1975 to 1980. However, this trend of increasing diesel fuel use in off-highway modes did not continue in 1985. Off-highway gasoline fuel use experienced a great loss of 41%, from 161.5 trillion Btu in 1980 to only 95.1 trillion Btu in 1985. Most of the loss in 1985 occurred in agricultural use.

Table 2.12
Heavy-Duty Off-Highway Fuel Use - 1975, 1980, and 1985
(trillion Btu)

	Gasoline			Diesel		
	1975	1980	1985	1975	1980	1985
Construction	**34.3**	**60.5**	**31.4**	**152.7**	**167.4**	**178.5**
New construction	29.1	49.3	25.9	129.8	136.5	147.1
Maintenance and repair	5.1	11.2	5.5	22.9	30.9	31.4
Farming[a]	**144.8**	**101.0**	**63.7**	**297.3**	**412.2**	**391.6**
Agriculture products	106.4	73.3	47.6	263.0	352.8	343.9
Livestock products	36.0	24.0	11.9	30.2	52.9	40.1
Agriculture and fishery services	2.4	3.7	4.2	4.1	6.6	7.6
Total	**179.1**	**161.5**	**95.1**	**450.0**	**579.6**	**570.1**

Source:
Data were supplied by Marianne Mintz, Argonne National Laboratory, from the Public Use Data Base, National Energy Accounts, U.S. Department of Commerce, OBA-NEA-10, August 1988.

[a]Small amounts of diesel fuel were used for forestry and fishery products each year.

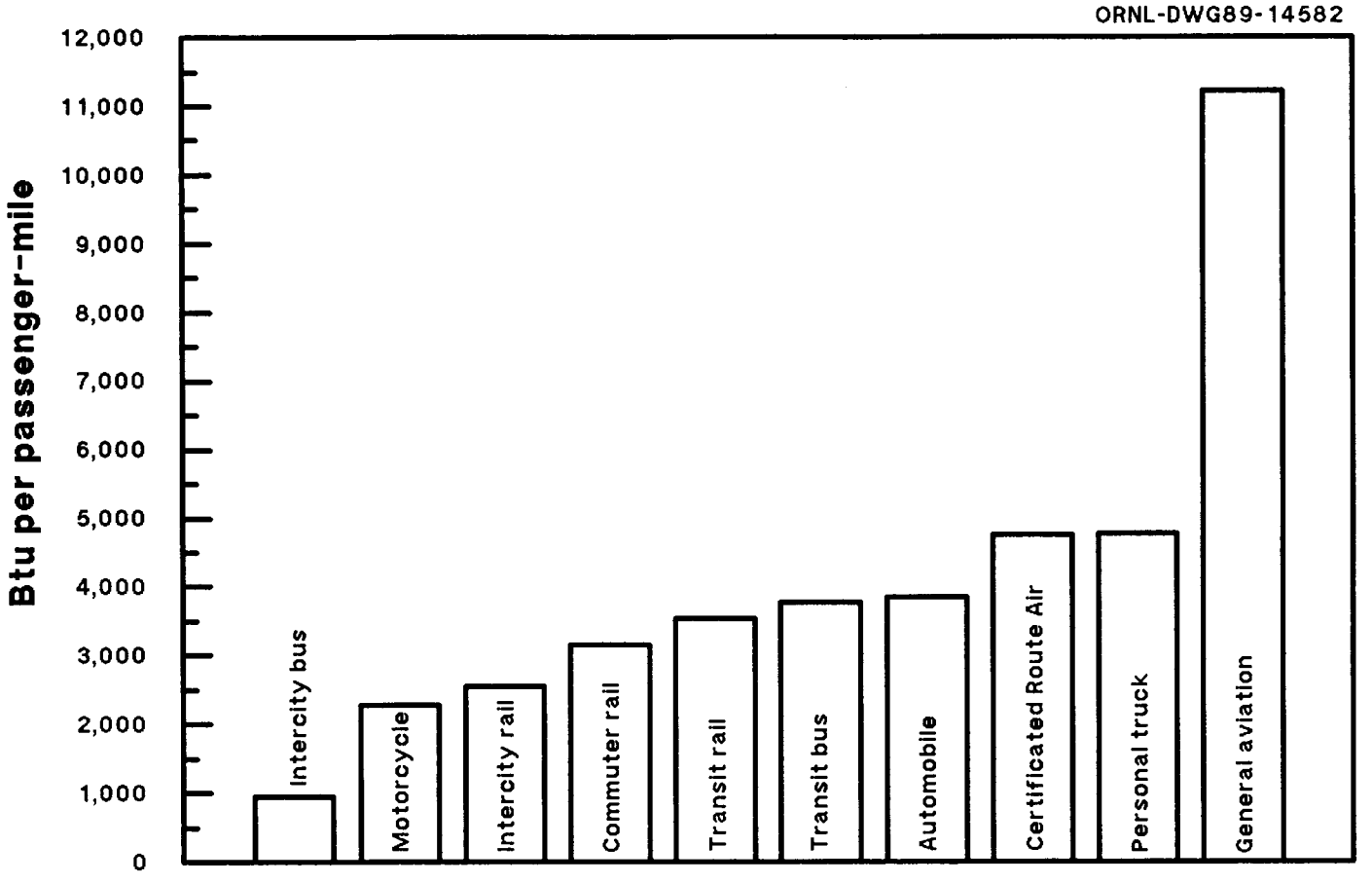
Table 2.13
Passenger Travel and Energy Use in the United States, 1987

	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger miles (millions)	Load factor[a] (percentage)	Energy intensities: Btu per vehicle-mile	Energy intensities: Btu per passenger-mile	Energy use trillion Btu
Automobiles	**119,849.0**	**1,357,191**	**2,307,225**	**1.7**	**6,530**	**3,841**	**8,862.9**
Personal Trucks	**26,939.0**	**245,620**	**466,678**	**1.9**	**9,048**	**4,762**	**2,222.4**
Motorcycles	**4,886.0**	**9,855**	**10,840**	**1.1**	**2,496**	**2,269**	**24.6**
Buses	**564.9**						**156.8**
Transit[b]	57.7	1,927	19,756	10.2	38,557	3,761	74.3
Intercity	20.4	[c]	23,000	[c]	[c]	939	21.6
School	486.8	[c]	[c]	[c]	[c]	[c]	60.9
Air	[c]	**7,717**	**341,470**	[c]	**220,721**	**4,988**	**1,703.3**
Certificated route (domestic)	[c]	3,646	329,070	61.6[d]	429,018	4,753	1,564.2
General aviation	217.0	4,071[e]	12,400	3.0	34,169	11,218	139.1
Recreational boats	**9,459.0**						**230.3**
Rail	**17.8**	**959**	**23,783**	**24.8[f]**	**57,039**	**2,300**	**76.0**
Intercity[g]	2.2[h]	261[i]	5,361[j]	20.5[d]	52,107	2,537	13.6
Transit[k]	10.9	509	11,603	22.8[d]	80,550[l]	3,534	41.0
Commuter	4.7	189	6,819	36.1[d]	113,228	3,138	21.4

Source:
See Appendix A for Table 2.13.

[a]Passenger miles divided by vehicle miles.
[b]Transit figures include motor bus only.
[c]Data is not available.
[d]Load factor is for scheduled services only.
[e]Nautical miles.
[f]Based on passenger train car-miles.
[g]Amtrak only.
[h]Sum of passenger train cars and locomotive units.
[i]Passenger train car-miles.
[j]Revenue passenger miles.
[k]Light and heavy rail.
[l]Large system-to-system variations exist within this category.

Figure 2.11. Passenger Energy Intensities by Type of Carrier, 1987



Source: See Table 2.13.

Table 2.14
Energy Intensities of Passenger Modes, 1970-87

Year	Automobiles[a] (Btu per vehicle-mile)	Automobiles[a] (Btu per passenger-mile)	Buses: Transit[b] (Btu per vehicle-mile)	Buses: Transit[b] (Btu per passenger-mile)	Buses: Intercity (Btu per passenger-mile)	Buses: School (Btu per vehicle-mile)	Air: Certificated air carriers (Btu per passenger-mile)	Air: General aviation (Btu per passenger-mile)	Rail: Intercity Amtrak (Btu per passenger-mile)	Rail: Rail transit (Btu per passenger-mile)
1970	9,301	5,471	31,796	2,472	1,051	17,857	10,351	10,374	[c]	2,453
1971	9,284	5,461	30,255	2,475	1,039	17,857	10,103	9,957	[c]	2,595
1972	9,383	5,519	30,352	2,454	1,016	16,956	9,017	10,340	[c]	2,540
1973	9,455	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	1,169	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	1,323	16,531	5,679	11,339	2,800	3,461
1986	6,853	4,031	39,869	3,527	869	15,622	5,447	11,935	2,574	3,531
1987	6,530	3,841	38,557	3,761	939	[c]	4,753	11,218	2,537	3,534
					Average annual percentage change					
1970-87	-2.1%	-2.1%	1.1%	2.5%	-0.7%	-0.8%[d]	-4.5%	0.5%	-2.8%[e]	2.2%
1982-87	-2.9%	-2.9%	-0.1%	3.0%	-4.0%	-0.8%[d]	-1.6%	-2.9%	-4.3%	2.9%

Source:
See Appendix A for Table 2.14.

[a]Based on Federal Highway Administration estimates.
[b]Transit bus statistics include motor bus only. 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.
[c]Data are not available.
[d]Average annual percentage change is for years 1970-86 and 1982-86.
[e]Average annual percentage change is for years 1973-87.

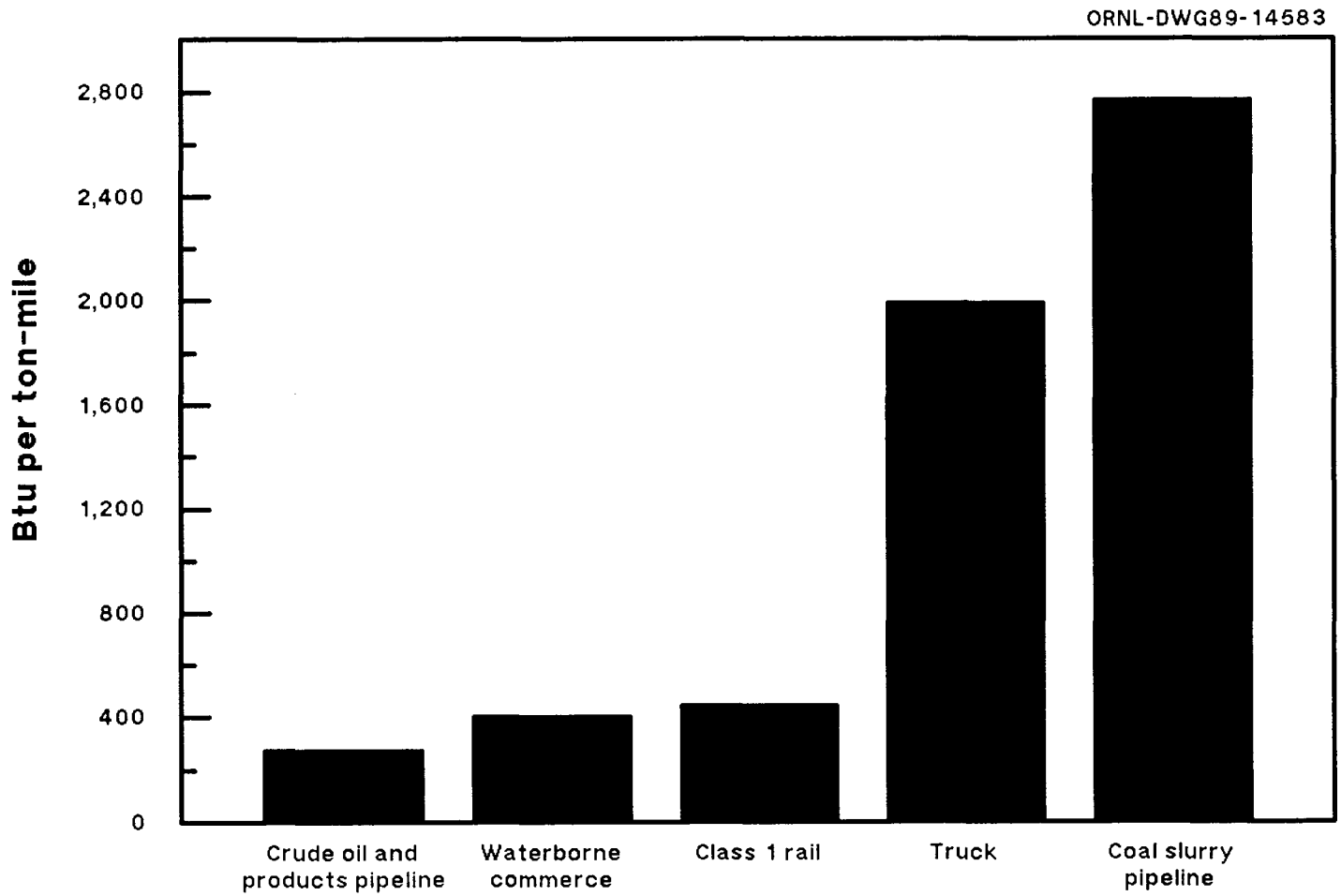
Table 2.15
Intercity Freight Movement and Energy Use in the United States, 1987

	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	**2,812**	**92,543**	**661,000**	**2,326**	**546[a]**	**1,898**	**1,254.6**
Waterborne commerce[b]	**40[c]**	**[d]**	**921,149**	**1,072**	**835**	**402**	**370.7**
Coastal	[d]	[d]	586,818	324	1,814	[d]	[d]
Lakewise	[d]	[d]	50,077	96	519	[d]	[d]
Internal and local	[d]	[d]	284,254	652	552[e]	[d]	[d]
Pipeline	**[d]**	**[d]**	**[d]**	**1,401**	**[d]**	**[d]**	**725.0**
Natural gas	[d]	[d]	[d]	442	[d]	[d]	562.9
Crude oil and products	[d]	[d]	587,100	954	[d]	270	158.4
Coal slurry	[d]	[d]	1,338	5	273	2,765	3.7
Class 1 Railroads[f]	**749**	**25,627**	**943,747**	**1,926**	**688**	**443**	**417.9**

Source:
See Appendix A for Table 2.15.

[a]For general freight (less than truckload). Based on data from the Transportation Policy Associates, the average length of haul for specialized freight (truckload) was 242 miles. The length has been steadily increasing for general freight and decreasing for specialized freight.
[b]Includes commerce by foreign and domestic carriers in the U.S.
[c]U.S. flag passenger and cargo vessels.
[d]Data are not available.
[e]Internal only. Average length of haul for local was 15 miles.
[f]Railroad measures are: Number vehicles = Number freight cars, Vehicle-miles = car-miles, Ton miles = revenue ton-miles.

Figure 2.12. Intercity Freight Energy Intensities by Type of Carrier, 1987



Source: See Table 2.15.

All freight modes experienced improved energy efficiencies during the period 1970 to 1987 - with the greatest improvement (2.3% per year) for Class I freight railroads. However, between 1982 and 1987, energy efficiency did not improve for some of the freight modes. For example, energy intensity (measured on a Btu per ton-mile basis) for domestic waterborne commerce has increased at an average rate of 5.3% per year since 1982.

Table 2.16
Energy Intensities of Freight Modes, 1970-87

Year	Trucks			Class I freight railroad		Domestic waterborne commerce (Btu per ton-mile)
	Light truck[a] (Btu per vehicle-mile)	Other trucks (Btu per vehicle-mile)	Total trucks (Btu per vehicle-mile)	(Btu per freight car-mile)	(Btu per ton-mile)	
1970	12,491	24,142	16,399	16,748	655	545
1971	12,229	23,685	15,945	17,655	696	506
1972	12,099	23,350	15,646	18,087	706	522
1973	11,909	23,251	15,417	18,046	662	576
1974	11,398	22,555	14,669	18,422	665	483
1975	11,161	21,997	14,286	18,604	682	549
1976	11,167	22,644	14,335	18,843	677	468
1977	10,926	22,679	14,157	19,180	667	458
1978	10,765	22,887	14,093	18,802	637	383
1979	10,599	23,027	13,978	19,113	616	457
1980	10,143	22,352	13,489	18,585	592	358
1981	10,002	22,640	13,394	18,582	571	360
1982	9,741	22,736	13,103	18,224	547	310
1983	9,755	22,967	13,146	17,719	521	319
1984	9,777	22,884	13,147	17,740	508	346
1985	9,730	23,100	12,851	17,131	487	446
1986	9,729	23,106	13,082	16,855	474	463
1987	9,692	23,075	12,988	16,307	443	402
			Average annual percentage change			
1970-87	-1.5%	-0.3%	-1.4%	-0.2%	-2.3%	-1.8%
1982-87	-0.1%	0.3%	-0.2%	-2.2%	-4.1%	5.3%

Source:
See Appendix A for Table 2.16.

[a]Two-axle, four-tire trucks.

Both gasoline and diesel fuel prices, either in current dollars or in constant 1987 dollars, have been declining since 1982. The greatest drop in price between 1982 and 1988 was observed in the unleaded regular grade of gasoline - an average decline of 8.3% per year.

Table 2.17
Retail Prices for Motor Fuel, 1978-88[a]
(cents per gallon, including tax)

Year	Diesel Fuel		Gasoline						Average for all gasoline types	
			Leaded regular		Unleaded regular		Unleaded premium			
	Current	Constant 1987[b]	Current	Constant 1987[b]	Current	Constant 1987[b]	Current	Constant 1987[b]	Current	Constant 1987[b]
1978	[c]	[c]	62.6	109.1	67.0	116.7	[c]	[c]	65.2	113.6
1979	[c]	[c]	85.7	134.2	90.3	141.4	[c]	[c]	88.2	138.1
1980	101.0	139.3	119.1	164.2	124.5	171.7	[c]	[c]	122.1	168.4
1981	118.0	147.5	131.1	163.9	137.8	172.3	147.0	183.8	135.3	169.1
1982	116.0	136.6	122.2	144.0	129.6	152.7	141.5	166.7	128.1	150.9
1983	120.0	136.9	115.7	132.0	124.1	141.6	138.3	157.8	122.5	139.8
1984	122.0	133.5	112.9	123.0	121.2	132.6	136.6	149.4	119.8	131.1
1985	122.0	129.0	111.5	117.9	120.2	127.1	134.0	141.6	119.6	126.4
1986	94.0	97.5	85.7	88.9	92.7	96.1	108.5	112.5	93.1	96.6
1987	96.0	96.0	89.7	89.7	94.8	94.8	109.3	109.3	95.7	95.7
1988	96.0	92.3	89.9	86.2	94.6	90.9	110.7	106.4	96.3	92.5
			Average annual percentage change							
1978-88	-0.6%[d]	-5.0%[d]	3.7%	-2.3%	3.5%	-2.5%	-4.0%[e]	-7.5%[d]	4.0%	-2.0%
1982-88	-3.1%	-6.3%	-5.0%	-8.2%	-5.1%	-8.3%	-4.0%	-7.2%	-4.6%	-7.8%

Sources:
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review December 1988, Washington, DC, March 1989, Table 9.4, p. 104.
Diesel - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1987, Washington, DC, October 1988, pp. 49-50.

[a]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.
[b]Adjusted by the Consumer Price Inflation Index.
[c]Data are not available.
[d]Average annual percentage change is for years 1980-88.
[e]Average annual percentage change is for years 1981-88.

Of the truck fuels, motor gasoline and No. 2 diesel fuel prices (in constant 1987 dollars) experienced a rate of decrease almost forty times faster than did propane fuel prices since 1982. In general, prices (in constant 1987 dollars) for all fuels used in aviation or in rail transportation have decreased at an average annual rate of at least 9% since 1982.

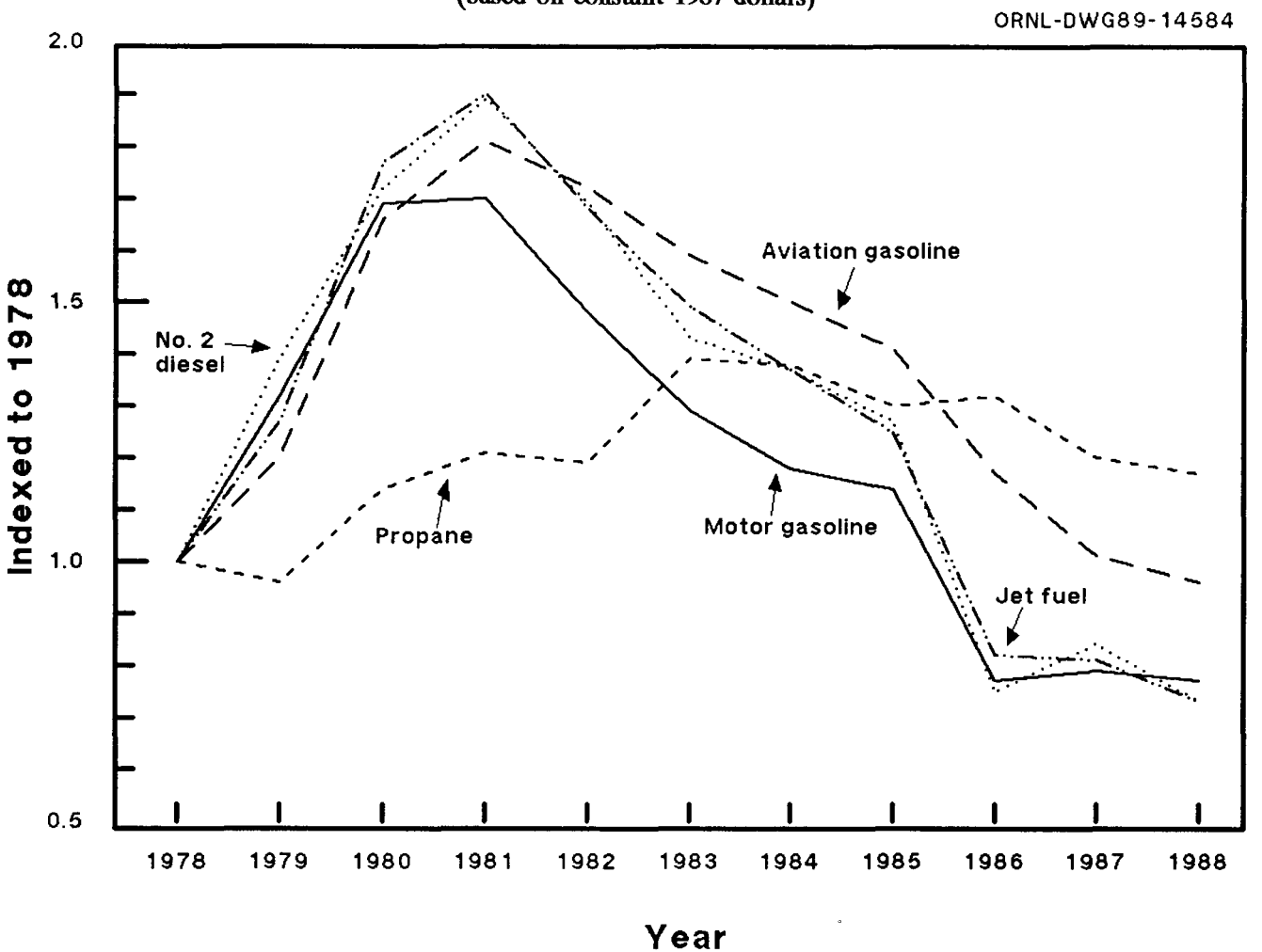
Table 2.18
Fuel Prices for Truck, Air and Railroad Transportation, 1978-88
(cents per gallon, excluding tax)

	Truck fuels						Aviation fuels				Railroad fuel	
	Motor gasoline[a]		Propane[b]		No. 2 diesel		Finished aviation gasoline		Kerosene-type jet fuel		Diesel fuel oil[c]	
Year	Current	Constant 1987[d]	Current	Constant 1987[d]	Current	Constant 1987[d]	Current	Constant 1987[d]	Current	Constant 1987[d]	Current	Constant 1987[d]
1978	48.4	84.3	33.5	58.4	37.7	65.7	51.6	89.9	38.7	67.4	37.9	66.0
1979	71.3	111.7	35.7	55.9	58.5	91.6	68.9	107.9	54.7	85.7	57.6	90.2
1980	103.5	142.7	48.2	66.5	81.8	112.8	108.4	149.5	86.6	119.4	83.0	114.5
1981	114.7	143.4	56.5	70.6	99.5	124.4	130.3	162.9	102.4	128.0	100.2	125.3
1982	106.0	124.9	59.2	69.7	94.2	111.0	131.2	154.6	96.3	113.4	95.4	112.4
1983	95.4	108.9	70.9	80.9	82.6	94.2	125.5	143.2	87.8	100.1	83.1	94.8
1984	90.7	99.2	73.7	80.6	82.3	90.0	123.4	135.0	84.2	92.1	82.6	90.4
1985	91.2	96.4	71.7	75.8	78.9	83.4	120.1	127.0	79.6	84.1	78.3	82.8
1986	62.4	64.7	74.5	77.3	47.8	49.6	101.1	104.8	52.9	54.9	49.2	51.0
1987	66.9	66.9	70.1	70.1	55.1	55.1	90.5	90.5	54.3	54.3	53.8	53.8
1988	67.2	64.6	71.3	68.5	50.0	48.1	89.4	85.9	51.2	49.2	[e]	[e]
						Average annual percentage change						
1978-88	3.3%	-2.6%	7.8%	1.6%	2.9%	-3.1%	5.6%	-0.5%	2.8%	-3.1%	4.0%[f]	-2.2%[f]
1982-88	-7.3%	-10.4%	3.1%	-0.3%	-10.0%	-13.0%	-6.2%	-9.3%	-10.0%	-13.0%	-10.8%[f]	-13.7%[f]

Sources:
Truck and air - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, December 1988, Washington, DC, March 1989, Table 9.7, p. 107.
Railroad - Association of American Railroads, Railroad Facts, 1988 edition, Washington, DC, November 1988, p. 60.

[a]Includes leaded, regular unleaded and premium unleaded gasoline.
[b]Consumer grade.
[c]Wholesale cost.
[d]Adjusted by the Consumer Price Inflation Index.
[e]Data are not available.
[f]Average annual percentage change is for years 1978-87 and 1982-87.

Figure 2.13. Fuel Prices for Truck and Air Transportation, 1978-88
(based on constant 1987 dollars)



Source: See Table 2.18.

In 1987, the price for a barrel of crude oil increased for the first time since 1981; however, it dropped again in 1988. Prices for either a barrel of crude oil or for a gallon of leaded or unleaded gasoline reached their peaks during 1980 and 1982, and have dropped significantly since 1982, with the greatest average decrease being 15% per year for crude oil.

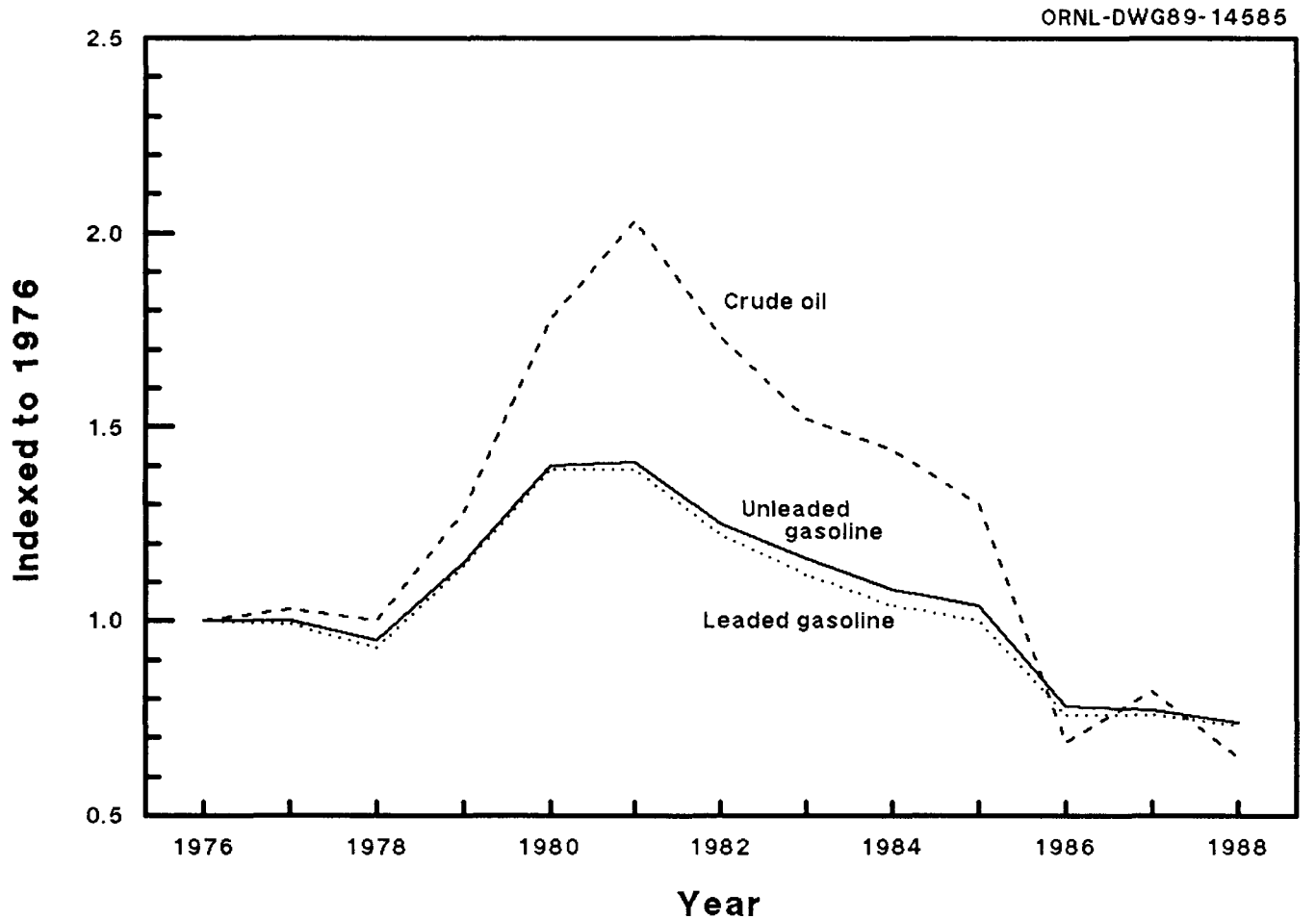
Table 2.19
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1976-88

Year	Crude Oil[a] (dollars per barrel)		Leaded Gasoline[b] (dollars per gallon)		Unleaded Gasoline[b] (dollars per gallon)	
	Current	Constant 1987[c]	Current	Constant 1987[c]	Current	Constant 1987[c]
1976	10.89	21.75	0.590	1.178	0.614	1.226
1977	11.96	22.44	0.622	1.167	0.656	1.231
1978	12.46	21.71	0.626	1.090	0.670	1.167
1979	17.72	27.75	0.857	1.342	0.903	1.414
1980	28.07	38.71	1.191	1.642	1.245	1.717
1981	35.24	44.05	1.311	1.639	1.378	1.723
1982	31.87	37.54	1.222	1.440	1.296	1.527
1983	28.99	33.08	1.157	1.320	1.241	1.416
1984	28.63	31.32	1.129	1.230	1.212	1.326
1985	26.75	28.27	1.115	1.179	1.202	1.271
1986	14.55	15.09	0.857	0.889	0.927	0.961
1987	17.90	17.90	0.897	0.897	0.948	0.948
1988	14.71	14.14	0.899	0.862	0.946	0.909
	Average annual percentage change					
1976-88	2.5%	-3.5%	3.5%	-2.6%	3.7%	-2.5%
1982-88	-12.1%	-15.0%	-5.0%	-8.2%	-5.1%	-8.3%

Sources:
Crude Oil - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, December 1988, Washington, DC, March 1989, Table 9.1, p. 101.
Gasoline - U.S. Department of Energy, Energy Information Administration Monthly Energy Review, December 1988, Washington, DC, March 1989, Table 9.4, p. 104.

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

Figure 2.14. Crude Oil and Gasoline Prices, 1976-88
(based on constant 1987 dollars)



Source: See Table 2.19.

In 1987, national product of the transportation industry accounted for 6.5% of the total Gross National Product (GNP). From 1982 to 1987, transportation GNP grew (in constant 1987 dollars) at an average annual rate of 5.1%, which was greater than the GNP annual increase of 4.0% for the same time period.

Table 2.20
Gross National Product (GNP) as Related to Transportation, 1970-87

Year	Gross National Product (billion dollars)		Transportation Gross National Product[a] (billion dollars)		Transportation GNP as a percent of total
	Current	Constant 1987[b]	Current	Constant 1987[b]	
1970	1,015.5	2,708.3	76.3	203.5	7.5%
1971	1,102.7	2,795.3	85.6	217.0	7.8%
1972	1,212.8	2,953.2	92.5	225.2	7.6%
1973	1,359.3	3,127.7	102.0	234.7	7.5%
1974	1,472.8	3,117.9	103.8	219.7	7.0%
1975	1,598.4	3,094.5	107.1	207.3	6.7%
1976	1,782.8	3,280.3	127.5	234.6	7.2%
1977	1,990.5	3,459.5	146.6	254.8	7.4%
1978	2,249.7	3,642.3	165.9	268.6	7.4%
1979	2,508.2	3,737.2	178.8	266.4	7.1%
1980	2,732.0	3,723.7	181.8	247.8	6.7%
1981	3,052.6	3,806.6	195.9	244.3	6.4%
1982	3,166.0	3,720.0	196.0	230.3	6.2%
1983	3,405.7	3,848.4	225.7	255.0	6.6%
1984	3,772.2	4,085.3	258.3	279.7	6.8%
1985	4,010.3	4,231.7	272.4	287.1	6.8%
1986	4,235.0	4,350.5	285.0	292.4	6.7%
1987	4,526.7	4,526.7	295.6	295.6	6.5%
	Average annual percentage change				
1970-87	9.2%	3.1%	8.3%	2.2%	
1982-87	7.4%	4.0%	8.6%	5.1%	

Sources:
1970-1986 data - U.S. Department of Commerce, Bureau of Census, Statistical Abstract of the United States 1988, p.410.
1987 data - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July, 1988.

[a]Transportation Gross National Product includes motor vehicle and other transportation equipment manufacturing; railroad transportation; local and interurban passenger transit; trucking and warehousing; water transportation; transportation by air; pipelines, except natural gas; transportation services; and auto repairs, services and garages.
[b]Adjusted by the implicit GNP price deflator.

Personal Consumption Expenditures (PCE) for transportation have increased at a slower rate of 3.8% per year since 1982 than did total PCE on all commodities (4.6%). The only expenditure categories more important in PCE are food and housing.

Table 2.21
Personal Consumption Expenditures (PCE) as Related to Transportation, 1970-87
(billion dollars)

Year	Personal Consumption Expenditures		Transportation Personal Consumption Expenditures[a]		Transportation PCE as a percent of total PCE
	Current	Constant 1987[b]	Current	Constant 1987[b]	
1970	640.0	1,706.9	81.5	217.4	12.7%
1971	691.6	1,753.2	95.2	241.3	13.8%
1972	757.6	1,844.8	105.8	257.6	14.0%
1973	837.2	1,926.4	116.0	266.9	13.9%
1974	916.5	1,940.2	119.8	253.6	13.1%
1975	1,012.8	1,960.8	131.2	254.0	13.0%
1976	1,129.3	2,077.9	157.1	289.1	13.9%
1977	1,257.2	2,185.0	181.5	315.4	14.4%
1978	1,403.5	2,272.3	199.9	323.6	14.2%
1979	1,566.8	2,334.5	222.0	330.8	14.2%
1980	1,732.6	2,361.5	238.5	325.1	13.8%
1981	1,915.1	2,388.1	261.5	326.1	13.7%
1982	2,050.7	2,409.6	267.6	314.4	13.0%
1983	2,234.5	2,525.0	295.4	333.8	13.2%
1984	2,430.5	2,632.2	329.5	356.8	13.6%
1985	2,629.4	2,697.3	359.5	378.9	13.7%
1986	2,799.8	2,880.5	365.5	375.0	13.0%
1987	3,012.1	3,012.1	378.9	378.9	12.6%
	Average annual percentage change				
1970-87	9.5%	3.4%	9.5%	3.3%	
1982-87	8.0%	4.6%	7.2%	3.8%	

Sources:
1970-1986 data - U.S. Department of Commerce, Bureau of Census, Statistical Abstract of the United States 1988, p.410.
1987 data - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July 1988.

[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 Gross National Product price deflator.

The Consumer Price Index (CPI) for transportation has almost tripled from 1970 to 1987. While consumers paid for a new automobile in 1987 more than double what they did in 1970, it cost 3.6 times more to purchase a used car in 1987 than it did in 1970.

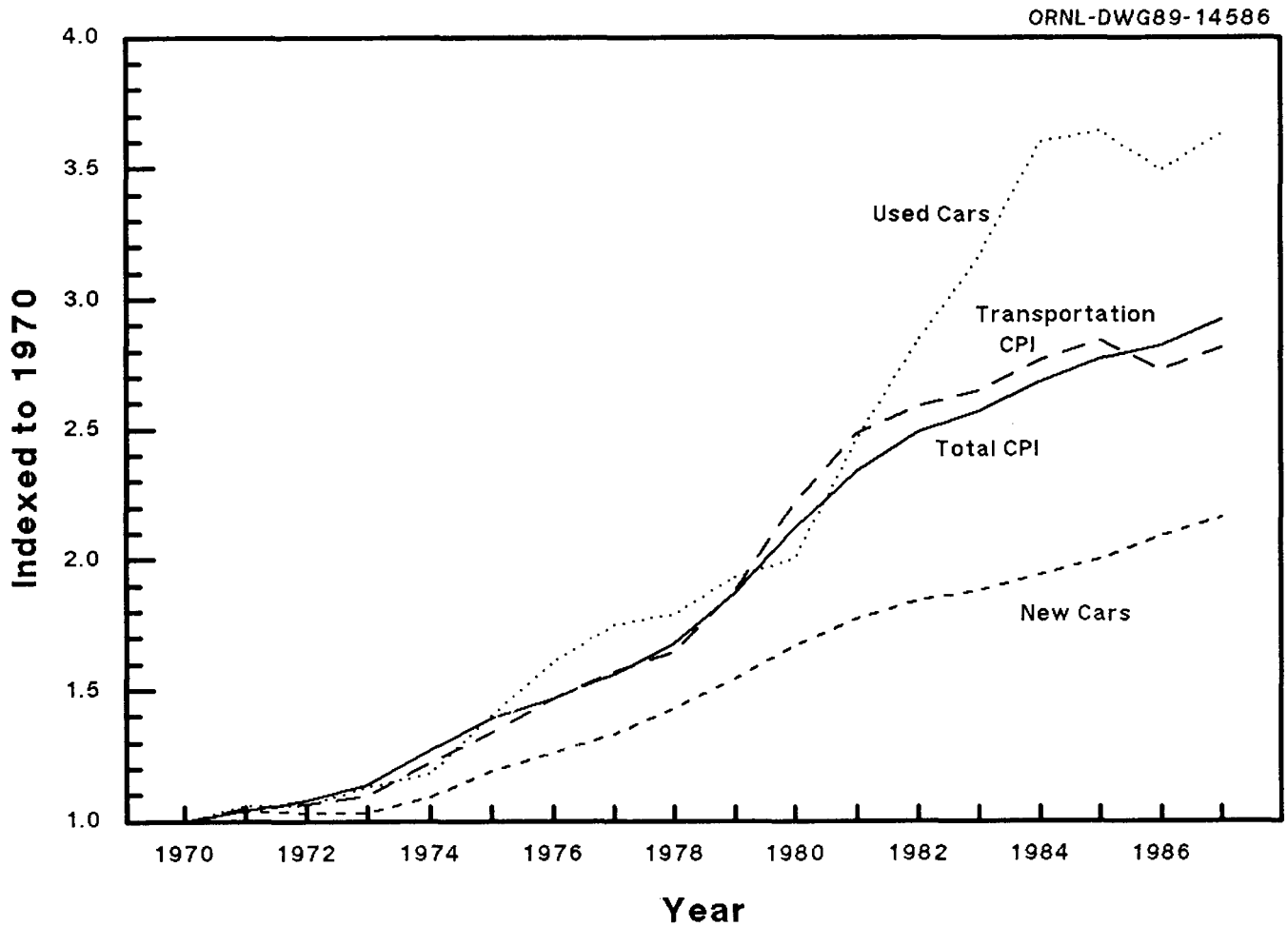
Table 2.22
Statistical Indices as Related to Transportation, 1970-87
(1970 = 1.000)

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	4.458

Sources:
U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Washington, DC, April 1988, p. S-6, and annual.
Gross National Product - Indexed to 1970 from Table 2.20.

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

Figure 2.15. Consumer Price Indices, 1970-87



Source: See Table 2.22.

The total cost of operating a passenger car 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 1988 (using constant 1987 cents) was approximately 32 cents per mile. Gas and oil had the largest cost decline from 1985 to 1988, with an average decrease of 8.4% annually. The fixed cost of operating a car 10,000 miles increased by 22% from 1985 to 1988.

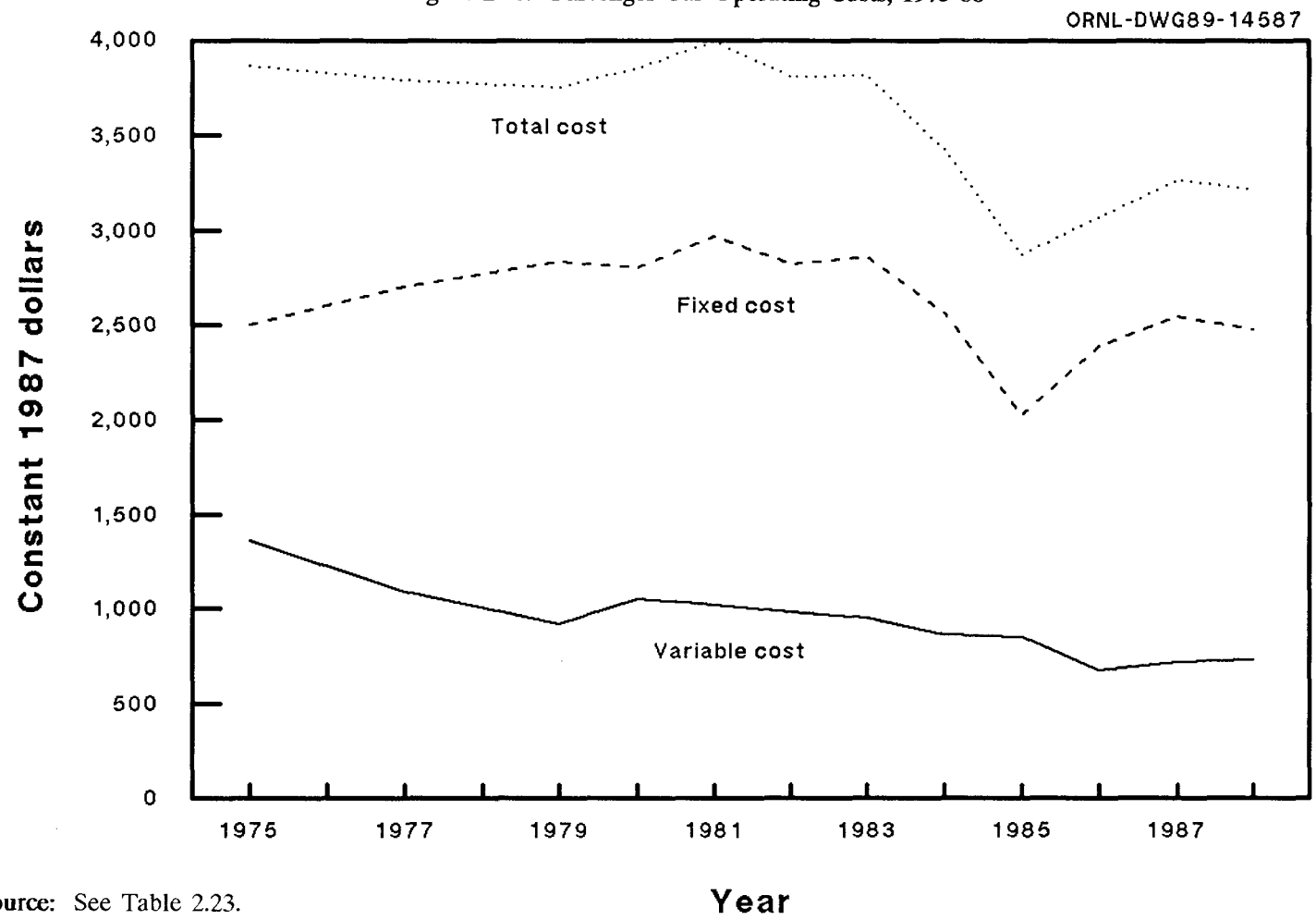
Table 2.23
Passenger Car Operating Costs, 1975-1988

Year[c]	Variable costs (Constant 1987 cents per mile[a])				Constant 1987 dollars per 10,000 miles[a]			Total cost per mile[b] (Constant 1987 cents[a])
	Gas and oil	Percentage gas and oil of total cost	Maintenance	Tires	Variable cost	Fixed cost	Total cost	
1975	10.18	26.3	2.05	1.39	1,362	2,505	3,867	38.67
1977	7.71	20.4	1.93	1.24	1,088	2,700	3,787	37.88
1979	6.44	17.1	1.72	1.02	918	2,836	3,754	37.54
1980	8.08	21.0	1.54	0.88	1,051	2,804	3,854	38.54
1981	7.84	19.6	1.48	0.90	1,021	2,969	3,990	39.90
1982	7.94	20.8	1.18	0.74	986	2,825	3,811	38.11
1983	7.58	19.9	1.19	0.78	954	2,859	3,813	38.13
1984	6.77	19.8	1.14	0.69	860	2,567	3,426	34.26
1985	6.51	22.6	1.30	0.69	850	2,025[d]	2,875[d]	28.75[d]
1986	4.65	15.1	1.42	0.69	676	2,392[d]	3,068[d]	30.68[d]
1987	4.80	14.7	1.60	0.80	720	2,544[d]	3,264[d]	32.60[d]
1988	5.00	15.6	1.54	0.77	730	2,480[d]	3,210[d]	32.10[d]
				Average annual percentage change				
1975-84	-4.4%		-6.3%	-7.5%	-5.0%	0.3%	-1.3%	-1.3%
1985-88	-8.4%		5.8%	3.7%	-4.9%	7.0%	3.7%	3.7%

Source:
Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '88, Detroit MI, 1988, p. 44.

[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 from 1985-88 are not comparable with figures before 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.

Figure 2.16. Passenger Car Operating Costs, 1975-88[a]



Source: See Table 2.23.

[a]Fixed and total operating costs from 1985-88 are not comparable with figures before 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.

CHAPTER 3
HIGHWAY MODE

The highway mode, accounting for 78.3% of total transportation energy use in 1987, dominates the U.S. transportation sector. Highway energy use has been increasing steadily since 1982 at an average rate of 2.3% per year (Table 3.1). The increase in highway energy use can be attributed in part to the combination of the increases in truck travel (at an average rate of 5% per year) and the increases in the number of automobiles and trucks in use (Table 3.3). Although automobiles still account for most of the total transportation energy use (42.9% in 1987), total truck energy use has almost doubled, from 19.9% in 1970 to 34.7% in 1987
(Table 3.1).

New retail sales of automobiles and trucks are reported on a calendar-year basis as well as on a model-year basis. The "model year" used in Tables 3.9 and 3.14 is the "sales" model year, instead of the "manufacturer's" model year. Therefore, a model year is defined as the period from October to the next September. One is, therefore, advised to be cautious when comparing the statistics from one table to the next. On a calendar-year basis, the 6.5% increase in domestic new car sales compensated for the loss in import car sales, and this resulted in a 3.5% increase in total new car sales from 1987 to 1988 (Table 3.5).

The majority of data on automobile travel are either from the Nationwide Personal Transportation Study (NPTS) conducted by the U.S. Bureau of the Census or from the Residential Transportation Energy Consumption Survey (RTECS) by the Energy Information Administration, U.S. Department of Energy. Since these data were estimated from statistical survey data, they included sample errors. Data discrepancies between two statistical surveys, therefore, should be acceptable (Table 3.8).

On the other hand, 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. Since the complete results from the 1987 survey are not available, findings from the 1982 survey are compared with findings from the 1977 survey. Since 1977, the number of trucks registered has increased by 25.7%, and trucks in 1982 traveled 7.6% less than trucks did in 1977 (Table 3.20).

The total number of buses in operation has been increasing about 1.5% per year since 1970, and the number of buses in operation was the highest to date in 1987 (Table 3.23). School and non-revenue buses, accounting for the largest segment of all buses in operation, 81% in 1987, traveled 3,700 million vehicle miles in 1986 which was more than double the travel of transit or intercity buses (Table 3.22). Of all the types of buses in operation, transit buses were the only type which did not have energy efficiency improvement between 1982 and 1987 (Table 3.24).

This chapter is organized into six sections. Section 3.1 presents statistics on automobiles. Truck data are presented in Section 3.2; bus data in Section 3.3; and fleet data in Section 3.4. Federal regulations and standards on fuel economy, airborne emissions, etc., are included in Section 3.5. The last section, Section 3.6, reports travel data on the household sector.

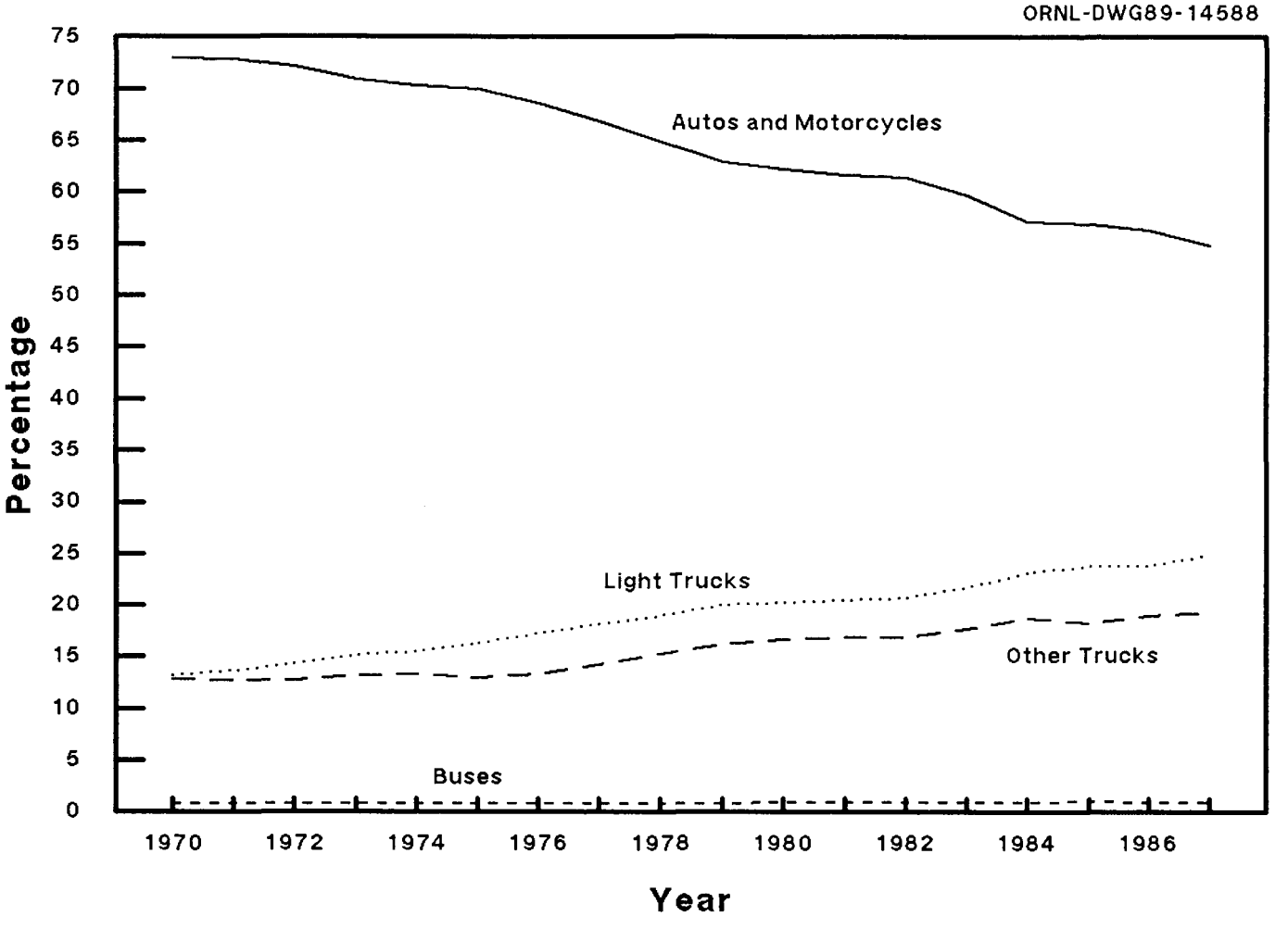
Table 3.1
Highway Energy Use by Mode, 1970-87[a]
(trillion Btu)

Year	Autos and motorcycles	Buses	Light trucks	Other trucks	Total highway	Transportation energy use[b]
1970	8,534	109	1,540	1,502	11,685	15,305
	(55.8%)	(0.7%)	(10.1%)	(9.8%)	(76.3%)	
1971	8,980	108	1,686	1,568	12,342	15,907
	(56.5%)	(0.7%)	(10.6%)	(9.9%)	(77.6%)	
1972	9,594	106	1,895	1,684	13,279	16,949
	(56.6%)	(0.6%)	(11.2%)	(9.9%)	(78.3%)	
1973	9.903	109	2,105	1,844	13,961	17,813
	(55.6%)	(0.6%)	(11.8%)	(10.4%)	(78.4%)	
1974	9,454	113	2,083	1,791	13,441	17,088
	(55.3%)	0.7%)	(12.2%)	(10.5%)	(78.7%)	
1975	9,625	119	2,240	1,789	13,773	17,329
	(55.5%)	(0.7%)	(12.9%)	(10.3%)	(79.5%)	
1976	10,035	129	2,522	1,949	14,635	18,389
	(54.6%)	(0.7%)	(13.7%)	(10.6%)	(79.6%)	
1977	10,124	132	2,738	2,155	15,149	19,071
	(53.1%)	(0.7%)	(14.4%)	(11.3%)	(79.4%)	
1978	10,285	135	3,008	2,420	15,848	20,035
	(51.3%)	(0.7%)	(15.0%)	(12.1%)	(79.1%)	
1979	9,741	137	3,094	2,510	15,482	20,101
	(48.5%)	(0.7%)	(15.4%)	(12.5%)	(77.0%)	
1980	9,063	139	2,951	2,425	14,578	19,317
	(46.9%)	(0.7%)	(15.3%)	(12.6%)	(75.5%)	
1981	8,954	143	2,964	2,461	14,522	19,065
	(47.0%)	(0.8%)	(15.5%0	(12.9%)	(76.2%)	
1982	8,839	146	2,982	2,430	14,397	18,589
	(47.5%)	(0.8%)	(16.0%)	(13.1%)	(77.4%)	
1983	8,784	145	3,196	2,599	14,724	18,728
	(46.9%)	(0.8%)	(17.1%)	(13.9%)	(78.6%)	
1984	8,635	154	3,500	2,836	15,125	19,310
	(44.7%)	(0.8%)	(18.1%)	(14.7%)	(78.3%)	
1985	8,695	161	3,630	2,924	15,411	19,659
	(44.2%)	(0.8%)	(18.5%)	(14.9%)	(78.4%)	
1986	8.940	154	3,785	3,007	15,886	20,229
	(44.2%)	(0.8%)	(18.7%)	(14.9%)	(78.5%)	
1987	8,888	157	4,032	3,137	16,214	20,704
	(42.9%)	(0.8%)	(19.5%)	(15.2%)	(78.3%)	

Source:
See Appendix A for Table 2.9.

[a]Numbers in parentheses are percentages of transportation energy use.
[b]Does not include off-highway and military transportation energy use.

Figure 3.1. Percentages of Highway Energy Consumption by Mode, 1970-87



Source: See Table 3.1.

Table 3.2
Vehicle Stock, New Sales and New Registrations in United States, 1987 Calendar Year[a]

		New Sales						New Registrations			
	Vehicle stock[b] (thousands)	Domestic[c] (thousands)	Domestic percentage of total	Import (thousands)	Import percentage of total	Total (thousands)	Total percentage by class	Domestic[c] (thousands)	Domestic percentage by class	Import (thousands)	Total (thousands)
Autos[d]	**119,849**	**7,081**	**69.6**	**3,114**	**30.4**	**10,195**	**100.0**	**7,074**	**100.0**	**3,048**	**10,122**
Two seaters	2,726	67	30.9	150	69.1	217	2.1	67	0.9	[e]	[d]
Minicompact	4,880	0	0.0	104	100.0	104	1.0	59	0.8	[e]	[e]
Subcompact	27,832	947	35.6	1,716	64.4	2,663	26.1	693	9.8	[e]	[e]
Compact	24,883	2,500	71.3	1,006	28.7	3,506	34.4	2,489	35.2	[e]	[e]
Midsize	34,076	2,350	94.9	127	5.1	2,477	24.3	2,555	36.1	[e]	[e]
Large	25,450	1,217	99.1	11	0.9	1,228	12.0	1,210	17.1	[e]	[e]
Fleets of ten or more	8,046[f]	[e]	[e]	[e]	[e]	[e]	[e]	1477	79.9	371	1,848
Personal autos	111,803	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	8,274
Motorcycles	**4,886[g]**	**125[h]**	**13.4**	**810[h]**	**86.6**	**935[h]**	**100.0**	[e]	[e]	[e]	**550[g]**
Recreational vehicles	[e]	**400**	**100.0**	**0**	**0.0**	**400**	**100.0**	[e]	[e]	[e]	[e]
Trucks[i]	**47,344**	**4,055**	**82.5**	**857**	**17.5**	**4,911**	**100.0**	**3,995**	**100.0**	**944**	**4,939**
Light	42,278	3,786	82.1	824	17.9	4,610	93.9	3,690	92.4	931	4,622
Medium	1,657	12	50.0	12	50.0	24	0.5	42	1.0	9	51
Light-heavy	1,136	38	86.4	6	13.6	44	0.9	47	1.2	1	48
Heavy-heavy	2,272	218	93.6	15	6.4	233	4.7	216	5.4	2	218

Source:
See Appendix A for Table 3.2.

[a]Totals may not equal sum of components due to rounding.
[b]Vehicle stock as of July 1, 1987.
[c]Includes domestic-sponsored imports.
[d]These figures represent only those automobiles that could be matched to the Environmental Protection Agency size classes.
[e]Data are not available.
[f]Federal Government fleet data for 1987 was not available; therefore, the 1987 data was assumed to be equal to the 1986 Federal Government fleet figures.
[g]Includes mostly on-highway motorcycles. Many states do not require registration for off-highway vehicles.
[h]Includes motorcycles, scooters, and all-terrain vehicles for on and off highway use.
[i]Trucks are classified by gross vehicle weight as follows:

Light	0-10,000 pounds
Medium	10,000-19,500 pounds
Light-heavy	19,501-26,000 pounds
Heavy-heavy	26,001 pounds and over.

Compared to the automobile population, the number of trucks in operation has increased at a faster rate - 6.0% per year since 1970. This has resulted in trucks having an increased share of the vehicle stock, from 18% in 1970 to 28.3% in 1987.

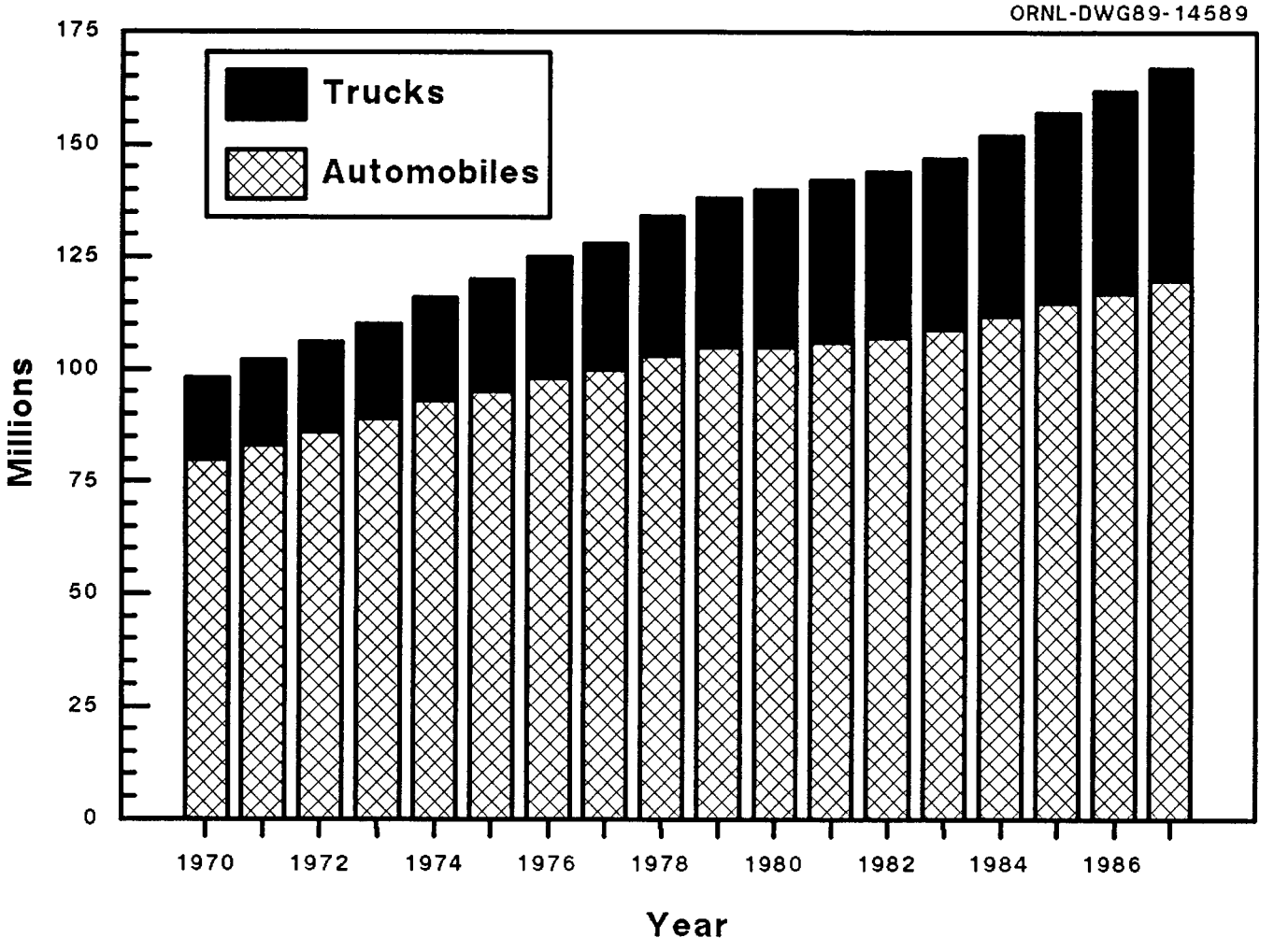
Table 3.3
Automobiles and Trucks in Use, 1970-87

Calendar year	Automobiles (thousands)	Trucks (thousands)	Percentage trucks of total vehicles
1970	80,448	17,688	18.0
1971	83,138	18,462	18.2
1972	86,439	19,773	18.6
1973	89,805	21,412	19.3
1974	92,608	23,312	20.1
1975	95,241	24,813	20.7
1976	97,818	26,560	21.4
1977	99,904	28,222	22.0
1978	102,957	30,565	22.9
1979	104,677	32,583	23.7
1980[a]	104,564	35,268	25.2
1981	105,839	36,069	25.4
1982	106,867	36,987	25.7
1983	108,961	38,143	25.9
1984	112,019	40,143	26.4
1985	114,662	42,387	27.0
1986	117,268	44,826	27.7
1987	119,849	47,344	28.3
	Average annual percentage change		
1970-87	2.4%	6.0%	
1982-87	2.3%	5.1%	

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

[a]Beginning in 1980, R. L. Polk reclassified 1,310,918 passenger vans from cars to trucks.

Figure 3.2. Automobiles and Trucks in Use, 1970-87



Source: See Table 3.3.

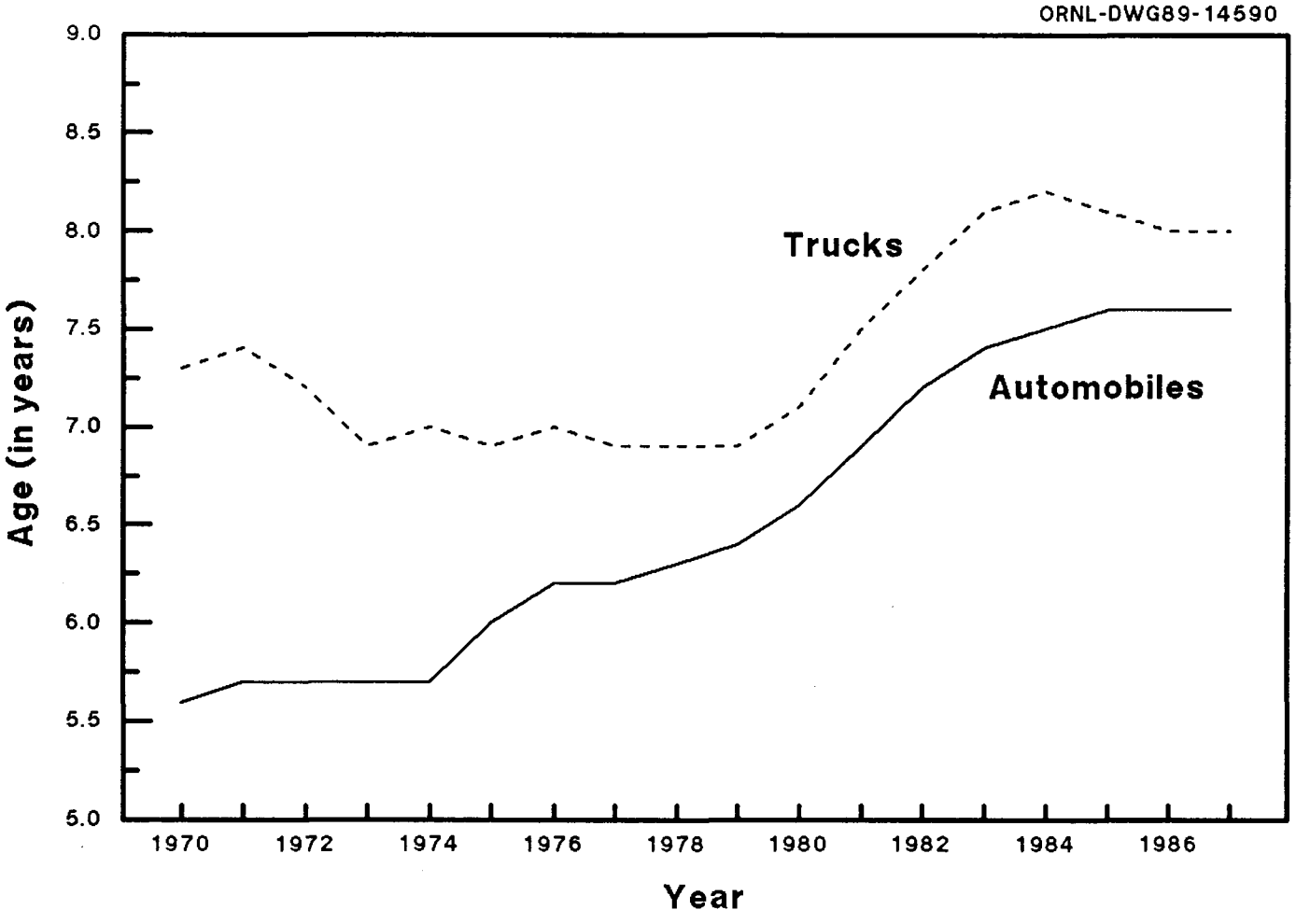
During the past 17 years, the automobile population has experienced larger shifts in vehicle age than the truck population. In 1970, the average truck was 7.3 years old, 1.7 years older than the average car. By 1987, the average age gap between trucks and cars was reduced to 0.4 years.

Table 3.4
Average Age of Automobiles and Trucks in Use, 1970-1987
(years)

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

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

Figure 3.3. Average Age of Automobiles and Trucks in Use, 1970-87



Source: See Table 3.4.

Section 3.1. Automobiles

Total automobile sales experienced a significant loss of 10.3% from 1986 to 1987. The 13.8% drop in domestic automobile sales in 1987 was mainly responsible for this loss and resulted in an all time high share of 31% for import cars as a percentage of total car sales. In 1988, however, total automobile sales increased by 3.5% despite the sales decline of import automobiles. Sales of diesel automobiles reached their peak in 1981 and have declined since then.

Table 3.5
New Retail Automobile Sales in the United States, 1970-88

Calendar Year	Domestic	Import[a]	Total	Percentage import	Diesel (thousands)	Percentage diesel
	(thousands)					
1970	7,119	1,285	8,404	15.3	[b]	[b]
1971	8,681	1,568	10,249	15.3	6	0.06
1972	9,327	1,623	10,950	14.8	6	0.05
1973	9,676	1,763	11,439	15.4	6	0.06
1974	7,454	1,399	8,853	15.8	18	0.20
1975	7,053	1,571	8,624	18.2	27	0.31
1976	8,611	1,499	10,110	14.8	23	0.22
1977	9,109	2,074	11,183	18.5	37	0.34
1978	9,312	2,002	11,314	17.7	115	1.02
1979	8,341	2,332	10,673	21.8	271	2.54
1980	6,581	2,398	8,979	26.7	387	4.31
1981	6,209	2,327	8,536	27.3	521	6.10
1982	5,759	2,223	7,982	27.9	355	4.44
1983	6,795	2,387	9,182	26.0	192	2.09
1984	7,952	2,439	10,391	23.5	151	1.45
1985	8,205	2,838	11,043	25.7	91	0.82
1986	8,215	3,238	11,453	28.3	42	0.37
1987	7,081	3,197	10,278	31.1	17	0.16
1988	7,539	3,099	10,638	29.1	1[c]	0.01[c]
			Average annual percentage change			
1970-88	0.3%	5.0%	1.3%		-10.0%[d]	
1982-88	4.6%	5.7%	4.9%		-62.4%	

Sources:

1970-1987 Domestic and import data - Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures, '88, Detroit, MI, 1988, p. 16, and annual.

1970-1987 Diesel data - H. A. Stark (ed), Ward's Communications, Inc., Ward's Automotive Yearbook, Detroit, MI, 1988, p. 48, and annual.

1988 data - H. A. Stark (ed), Ward's Communications, Inc., Ward's Automotive Reports, Detroit, MI, January 9, 1989, pp. 1, 10, and April 17, 1989, Factory Installation Report.

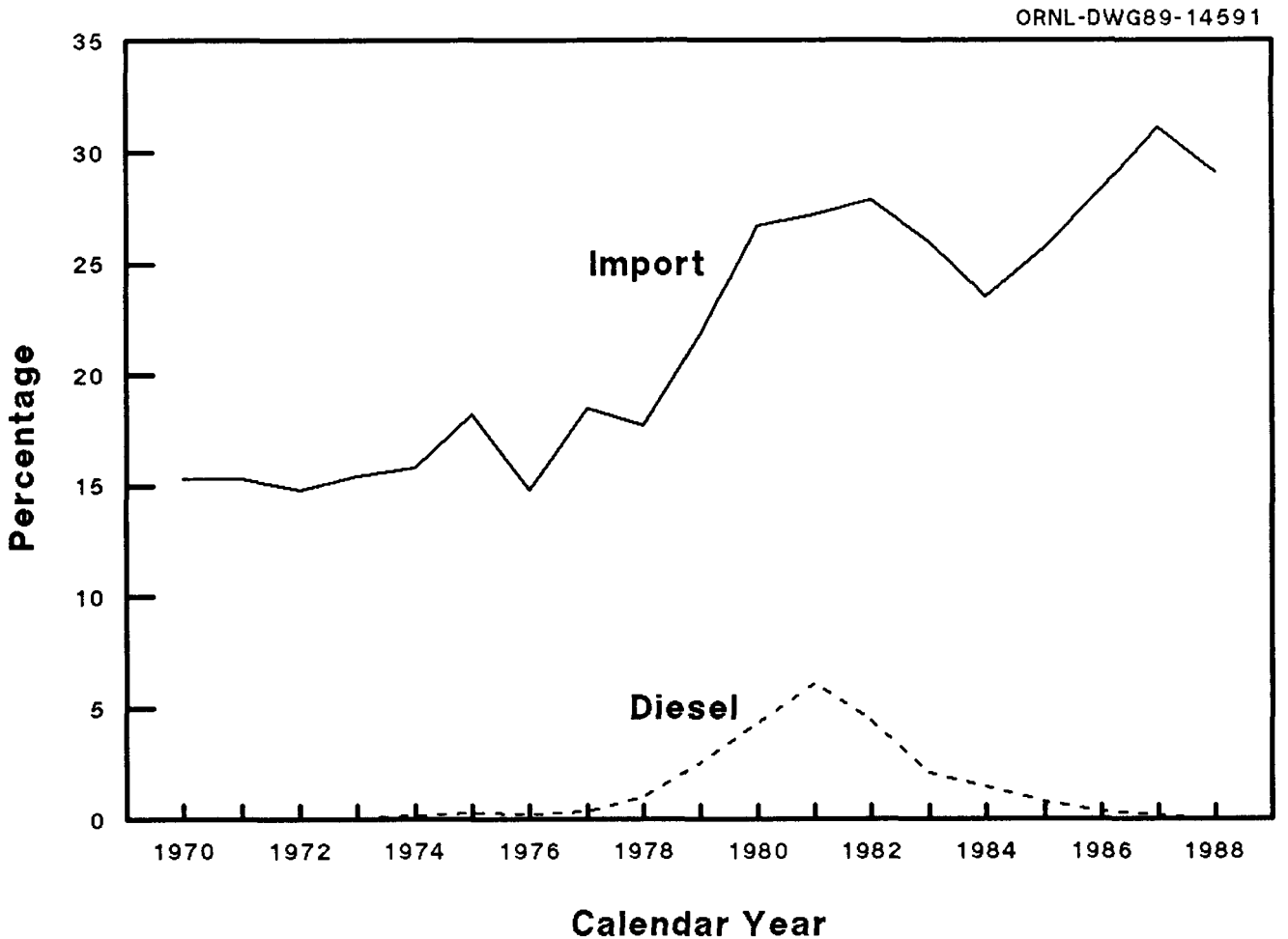
[a]Does not include import tourist deliveries.

[b]Data are not available.

[c]Based on factory installation of diesel engines in 1988 model year automobiles.

[d]Average annual percentage change is for years 1971-88.

Figure 3.4. Import and Diesel Shares of Automobile Sales, 1970-88



Source: See Table 3.5.

Compared to 1970, the automobile population shifted toward older automobiles in 1987. Fifty percent of the automobile population in 1970 was 4.9 years old or older while half of the automobile population in 1987 was 6.9 years old or older. The percent of cars 16 years old and older rose from 2.0% in 1970 to 7.3% in 1987.

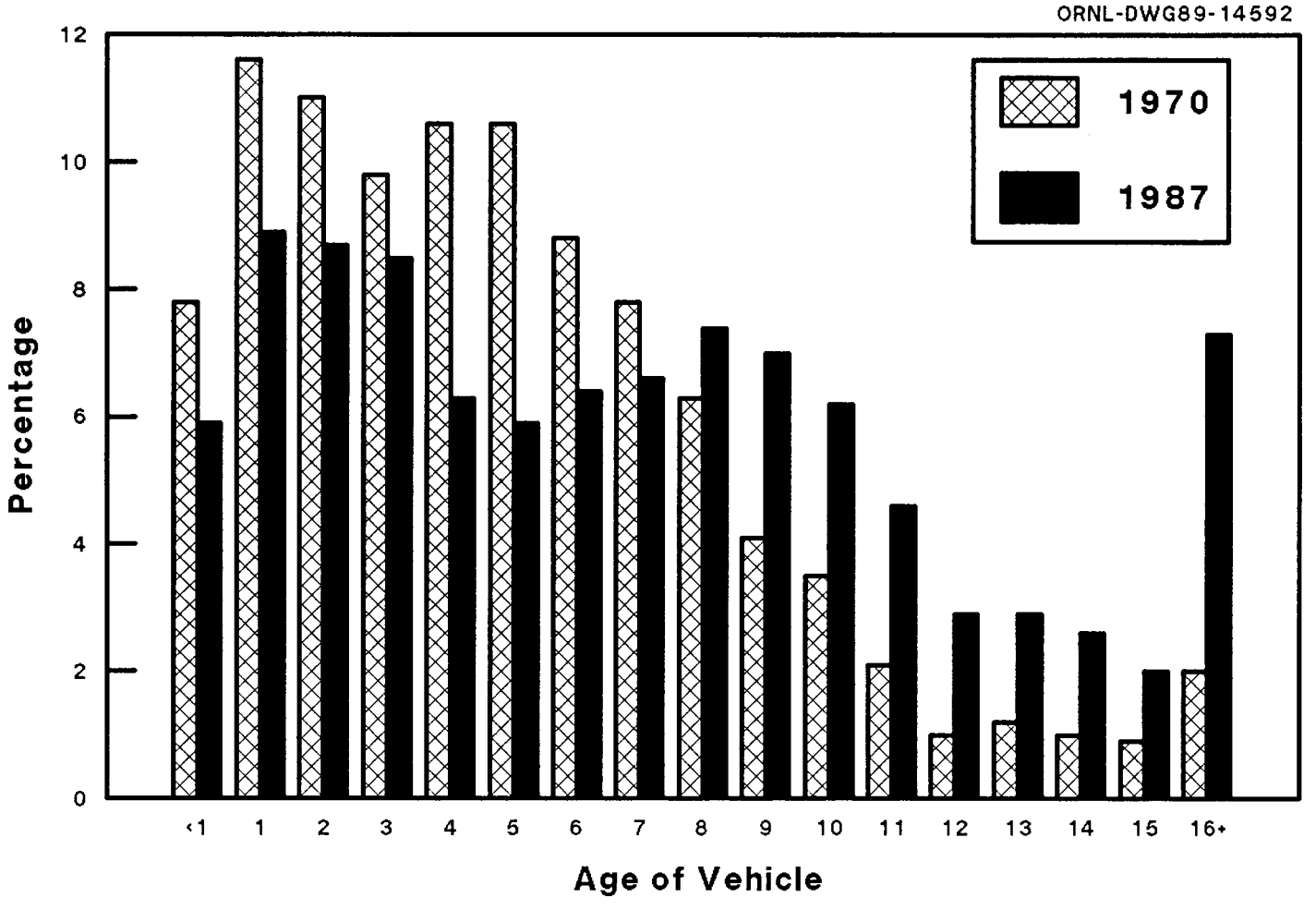
Table 3.6
Automobiles in Use by Age, 1970 and 1987

Age (years)	1970 Vehicles (thousands)	1970 Actual percentage	1970 Cumulative percentage	1987 Vehicles (thousands)	1987 Actual percentage	1987 Cumulative percentage
Under 1[a]	6,288	7.8	7.8	7,020	5.9	5.9
1	9,299	11.6	19.4	10,694	8.9	14.8
2	8,816	11.0	30.3	10,430	8.7	23.5
3	7,878	9.8	40.1	10,131	8.5	32.0
4	8,538	10.6	50.8	7,504	6.3	38.3
5	8,506	10.6	61.3	7,082	5.9	44.2
6	7,116	8.8	70.2	7,632	6.4	50.6
7	6,268	7.8	78.0	7,886	6.6	57.2
8	5,058	6.3	84.3	8,848	7.4	64.6
9	3,267	4.1	88.3	8,432	7.0	71.6
10	2,776	3.5	91.8	7,382	6.2	77.8
11	1,692	2.1	93.9	5,555	4.6	82.4
12	799	1.0	94.9	3,450	2.9	85.3
13	996	1.2	96.1	3,440	2.9	88.2
14	794	1.0	97.1	3,161	2.6	90.8
15	753	0.9	98.0	2,430	2.0	92.8
16 and older	1,583	2.0	100.0	8,764	7.3	100.0
Subtotal	80,427	100.0		119,842	100.0	
Age not given[b]	22			7		
Total	80,449			119,849		
Average age		5.55			7.57	
Median age		4.93			6.93	

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

[a]Automobiles sold as of July 1 of each year.
[b]Approximately 22,000 automobiles in 1970 and 7,000 in 1987 could not be classified by age.

Figure 3.5. Automobiles in Use by Age, 1970 and 1987



Source: See Table 3.6.

Automobiles which were 6 years old or under accounted for almost 60% of automobile travel and represented more than half of the automobiles in use in 1987. Older automobiles accounted for steadily declining shares of total automobile travel.

Table 3.7
Automobiles in Operation
and Vehicle Travel by Age of Vehicle, 1987

Vehicle age (years)	Number in operation			Estimated vehicle travel	
	Vehicles (thousands)	Actual percentage	Cumulative percentage	Actual percentage	Cumulative percentage
Under 1[a]	7,020	5.9	5.9	7.2	7.2
1	10,694	8.9	14.8	11.2	18.4
2	10,430	8.7	23.5	10.6	29.0
3	10,131	8.5	32.0	10.1	39.1
4	7,504	6.3	38.3	6.8	45.9
5	7,082	5.9	44.2	6.1	52.0
6	7,632	6.4	50.6	6.2	58.2
7	7,886	6.6	57.2	6.2	64.4
8	8,848	7.4	64.6	6.4	70.8
9	8,432	7.0	71.6	5.9	76.7
10 and older	34,182	28.4	100.0	23.3	100.0
Subtotal	119,842	100.0			
Age not given[b]	7				
Total	119,849				

Sources:

Number of vehicles in operation by age - R. L. Polk and Company, Detroit, MI. FURTHER REPRODUCTION PROHIBITED.

Vehicle travel - Average annual miles per auto by age were multiplied by the number of vehicles in operation by age to estimate the vehicle travel. Average annual miles per auto by age - provided by the U.S. Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division, were estimated from the 1985 Residential Transportation Energy Consumption Survey.

[a]Automobiles sold as of July 1, 1987.

[b]Approximately 7,000 automobiles could not be classified by age.

It is a common misconception that new vehicles are driven more miles than they are actually driven. 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 3.8
Average Annual Miles Per Automobile by Automobile Age

Vehicle age (years)	Nationwide Personal Transportation Study[a]			Residential Transportation Energy Consumption Survey[b]	
	1969	1977	1983	1983	1985
Under 1	17,500	11,800	14,200	13,400	12,700
1	16,100	13,400	17,000	13,000	13,000
2	13,200	13,400	14,000	12,700	12,600
3	11,400	12,100	12,500	12,100	12,400
4	11,700	11,300	11,400	11,300	11,100
5	10,000	10,700	11,000	9,700	10,600
6	10,300	10,500	9,900	9,700	10,000
7	8,600	9,500	9,400	9,500	9,700
8	10,900	8,600	8,700	8,700	8,900
9	8,000	8,800	8,100	8,400	8,600
10 and older	6,500	7,100	6,900	8,700	8,400
All vehicles	11,600	10,300	10,400	9,500	9,900

Sources:

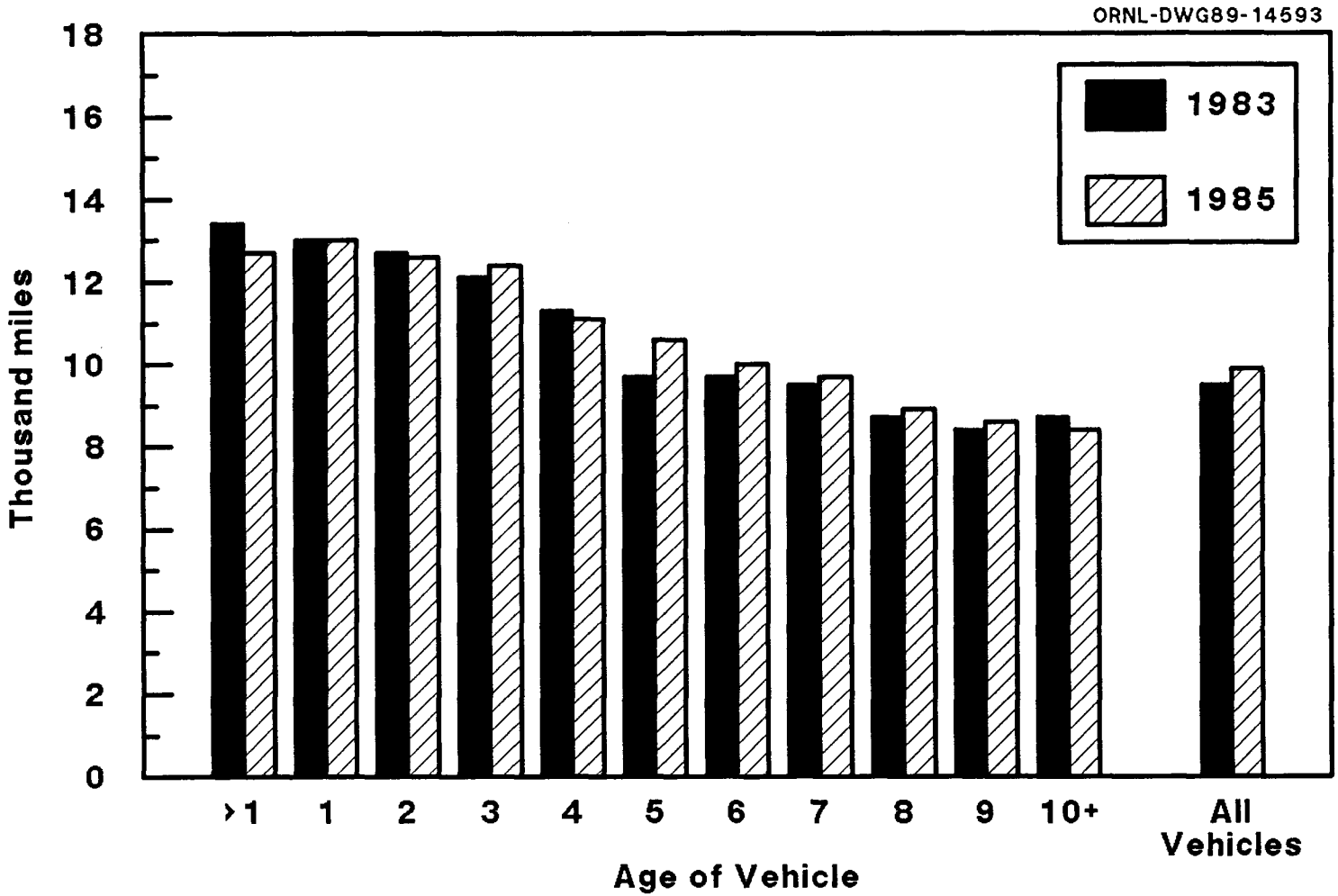
Nationwide Personal Transportation Study - D. Klinger and J. Richard Kuzmak, COMSIS Corporation, Personal Travel in the United States, Volume 1; 1983-84 Nationwide Personal Travel Study," prepared for the U.S. Department of Transportation, Washington, DC, August 1986, Table 4-22, p. 4-21.

Residential Transportation Energy Consumption Survey - Energy Information Agency, Office of Markets and End Use, Energy End Use Division, 1985 Residential Transportation Energy Consumption Survey, unpublished data.

[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.

Figure 3.6. Average Annual Miles per Automobile by Age from the 1983 and 1985 Residential Transportation Energy Consumption Surveys



Source: See Table 3.8.

FUEL ECONOMIES OF NEW AUTOMOBILES

- Automobile sales-weighted fuel economy increased slightly, from 28.2 mpg for model year 1987 to 28.3 mpg for model year 1988 (Table 3.9).

- The main reason for the mere 0.1 mpg gain can be attributed to two adverse factors. First, the fuel economy of the most popular size class, the compact, decreased 0.3 mpg from the previous model year. This mpg loss was compounded by the 0.2% market share gain of the compacts. However, this loss was then compensated by (1) the 0.4 mpg and 0.9% market share gains experienced by the subcompacts, and (2) the 0.5 mpg and 0.6% market share gains by the midsize class (Table 3.9 and Figure 3.7).

- Although minicompact, large and two seater size classes improved their respective fuel economies, their decreasing market shares neutralized the mpg improvements and hence did not contribute toward the overall fuel economy changes (Table 3.9).

- The greatest improvement in sales-weighted fuel economy was observed in minicompacts, from 33.1 mpg in model year 1987 to 37.4 mpg in model year 1988.

- Figure 3.7 shows that over the 13-year period, the fuel economy for all size classes increased substantially. Compact cars are now nearly as efficient as subcompact cars.

Table 3.9
Model Year Sales, Market Shares, and Sales-Weighted Fuel Economies of Domestic and Import Automobiles, Model Years 1976-88[a]

	1976	1977	1978	1979	1980	1981	1982
MINICOMPACT							
Total sales, units		852,556	947,327	590,043	428,346	296,702	221,699
Market share, %		8.1	8.5	5.5	4.7	3.3	2.9
Fuel economy, mpg		27.3	27.3	27.5	29.4	33.5	36.5
SUBCOMPACT							
Total sales, units	2,625,929	2,015,641	2,106,954	3,312,825	3,441,480	2,927,574	2,404,489
Market share, %	27.1	19.1	19.0	30.7	37.8	33.0	31.4
Fuel economy, mpg	23.5	24.6	24.7	25.2	27.3	29.3	30.2
COMPACT							
Total sales, units	2,839,603	2,840,635	1,684,964	905,786	599,423	1,191,194	1,300,372
Market share, %	29.3	26.9	15.2	8.4	6.6	13.4	17.0
Fuel economy, mpg	17.1	17.8	20.2	19.9	22.3	27.8	30.1
MIDSIZE							
Total sales, units	1,815,505	2,033,250	3,664,381	3,651,304	3,073,103	3,113,806	2,533,121
Market share, %	18.7	19.2	33.0	33.8	33.8	35.1	33.1
Fuel economy, mpg	15.3	16.6	18.7	19.0	21.3	22.9	24.1
LARGE							
Total sales, units	2,206,102	2,603,017	2,472,877	2,097,084	1,336,190	1,107,627	995,561
Market share, %	22.8	24.6	22.3	19.4	14.7	12.5	13.0
Fuel economy, mpg	13.9	16.1	16.3	17.1	19.3	20.6	20.6
TWO SEATER							
Total sales, units	199,716	220,698	214,146	231,215	215,964	242,961	202,929
Market share, %	2.1	2.1	1.9	2.1	2.4	2.7	2.6
Fuel economy, mpg	20.1	21.0	19.6	19.4	21.0	24.1	25.1
FLEET							
Total sales, units	9,686,855	10,565,797	11,090,649	10,788,257	9,094,506	8,879,864	7,658,171
Market share, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fuel economy, mpg	17.2	18.6	19.7	20.5	23.2	25.3	26.3

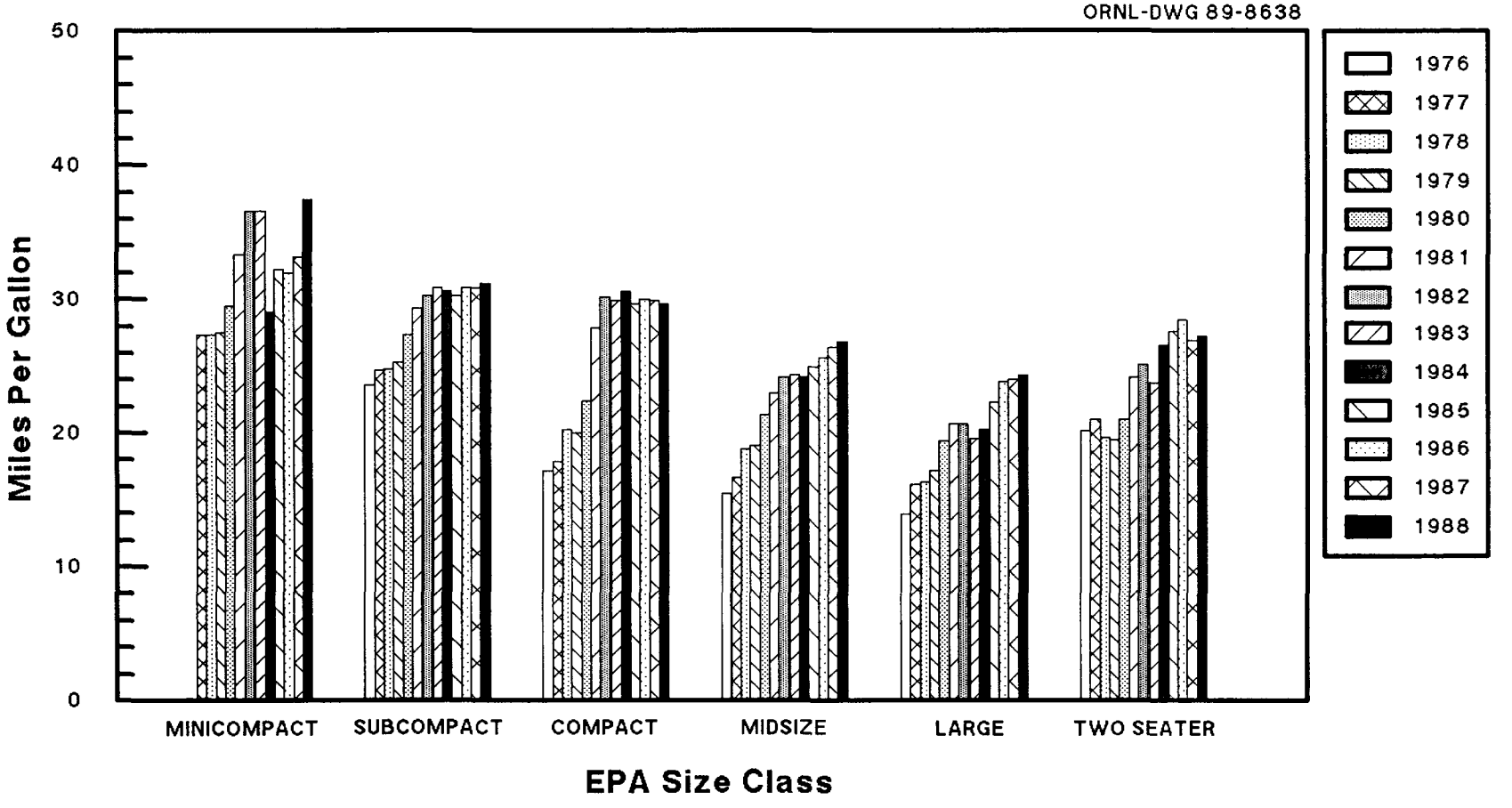
Table 3.9 (Continued)
Model Year Sales, Market Shares, and Sales-Weighted Fuel Economies of Domestic and Import Automobiles, Model Years 1976-88[a]

	1983	1984	1985	1986	1987	1988
MINICOMPACT						
Total sales, units	230,547	41,368	52,295	191,490	146,872	84,186
Market share, %	2.6	0.4	0.5	1.7	1.4	0.8
Fuel economy, mpg	36.5	29.0	32.7	31.9	33.1	37.4
SUBCOMPACT						
Total sales, units	2,353,847	2,510,929	2,382,339	2,490,527	2,036,612	2,116,001
Market share, %	26.8	24.6	21.7	22.4	19.5	20.4
Fuel economy, mpg	30.7	30.5	30.1	30.7	30.7	31.1
COMPACT						
Total sales, units	1,927,460	2,768,056	3,526,118	3,688,647	4,072,402	4,066,990
Market share, %	22.0	27.1	32.1	33.2	39.0	39.2
Fuel economy, mpg	29.9	30.6	29.6	30.0	29.9	29.6
MIDSIZE						
Total sales, units	2,779,178	3,059,647	3,117,817	2,985,835	2,535,712	2,584,471
Market share, %	31.7	30.0	28.4	26.9	24.3	24.9
Fuel economy, mpg	24.3	24.1	24.9	25.6	26.3	26.8
LARGE						
Total sales, units	1,275,939	1,502,097	1,516,249	1,467,077	1,396,687	1,335,210
Market share, %	14.5	14.7	13.8	13.2	13.4	12.9
Fuel economy, mpg	19.5	20.2	22.3	23.8	24.0	24.2
TWO SEATER						
Total sales, units	203,442	328,968	373,697	275,470	245,852	186,127
Market share, %	2.3	3.2	3.4	2.5	2.4	1.8
Fuel economy, mpg	23.7	26.5	27.6	28.4	26.9	27.2
FLEET						
Total sales, units	8,770,413	10,211,065	10,968,515	11,099,046	10,434,137	10,372,985
Market share, %	100.0	100.0	100.0	100.0	100.0	100.0
Fuel economy, mpg	26.1	26.3	27.0	27.9	28.2	28.3

Source:
Patricia S. Hu, Linda S. Williams, and Dennis J. Beal, Light Duty Vehicle MPG and Market Shares Report: Model Year 1988, ORNL-6549, Oak Ridge, TN, 1989, p. 2-4, 2-5.

[a]These figures represent only those sales that could be matched to the Environmental Protection Agency fuel economy values.

Figure 3.7. Fuel Economies of New Domestic and Import Automobiles by Size Class 1976-88



Source: See Table 3.9.

Section 3.2. Trucks

Since 1982, light truck sales have increased at an average annual rate of 12.0% - a higher growth rate than their automobile counterparts (see Table 3.5). Light trucks have gained a larger share (31.4%) of the light-duty vehicle market and a larger share (94.5%) of the total truck market in 1988.

Table 3.10
New Retail Sales of Light Trucks in the United States, 1970-88

Calendar Year	Light truck sales[a] (thousands)	Percentages: Import of total light truck	Diesel of total light truck	Four-wheel drive on domestic light trucks	Light trucks of light duty vehicle sales[b]	Light trucks of total truck sales
1970	1,463	4.5	[c]	[d]	14.8	80.4
1971	1,757	4.8	[c]	[d]	14.6	83.4
1972	2,239	6.4	[c]	[d]	16.7	83.3
1973	2,745	8.5	[c]	[d]	18.8	84.2
1974	2,338	7.5	[c]	18.0	20.3	84.2
1975	2,281	10.0	[c]	23.4	20.1	87.9
1976	2,956	8.0	[c]	23.8	22.0	89.8
1977	3,430	9.4	[c]	24.6	22.8	89.7
1978	3,808	8.8	1.0	28.5	24.5	89.2
1979	3,311	14.1	1.0	29.4	22.4	88.7
1980	2,440	19.7	3.2	20.7	19.8	88.9
1981	2,189	20.3	3.3	18.6	19.2	89.8
1982	2,470	16.5	5.0	16.8	23.0	92.8
1983	2,984	15.6	4.0	28.5	24.2	93.6
1984	3,863	15.7	3.8	27.0	26.9	93.0
1985	4,458	17.2	3.3	29.1	28.7	93.6
1986	4,594	20.1	2.6	27.0	28.6	94.3
1987	4,610	17.9	2.3	32.0	31.0	93.9
1988	4,864	14.2	2.0[e]	24.8[e]	31.4	94.5
		Average annual percentage change				
1970-88	6.9%					
1982-88	12.0%					

Sources:

Four-wheel drive - H. A. Stark (ed.), Ward's Communications, Inc., Ward's Automotive Yearbook, Detroit, MI, 1988, p. 162, and annual.

All other - Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '88, Detroit, MI, 1988, pp. 11, 15, 19, and annual.

1988 data - H. A. Stark (ed), Wards Communications, Inc., Ward's Automotive Reports, Detroit, MI, January 9, 1989, p. 13, and January 16, 1989, p. 21, and Factory Installation Report.

[a]Includes domestic, domestic-sponsored import, and import trucks of 10,000 pounds gross vehicle weight and less.

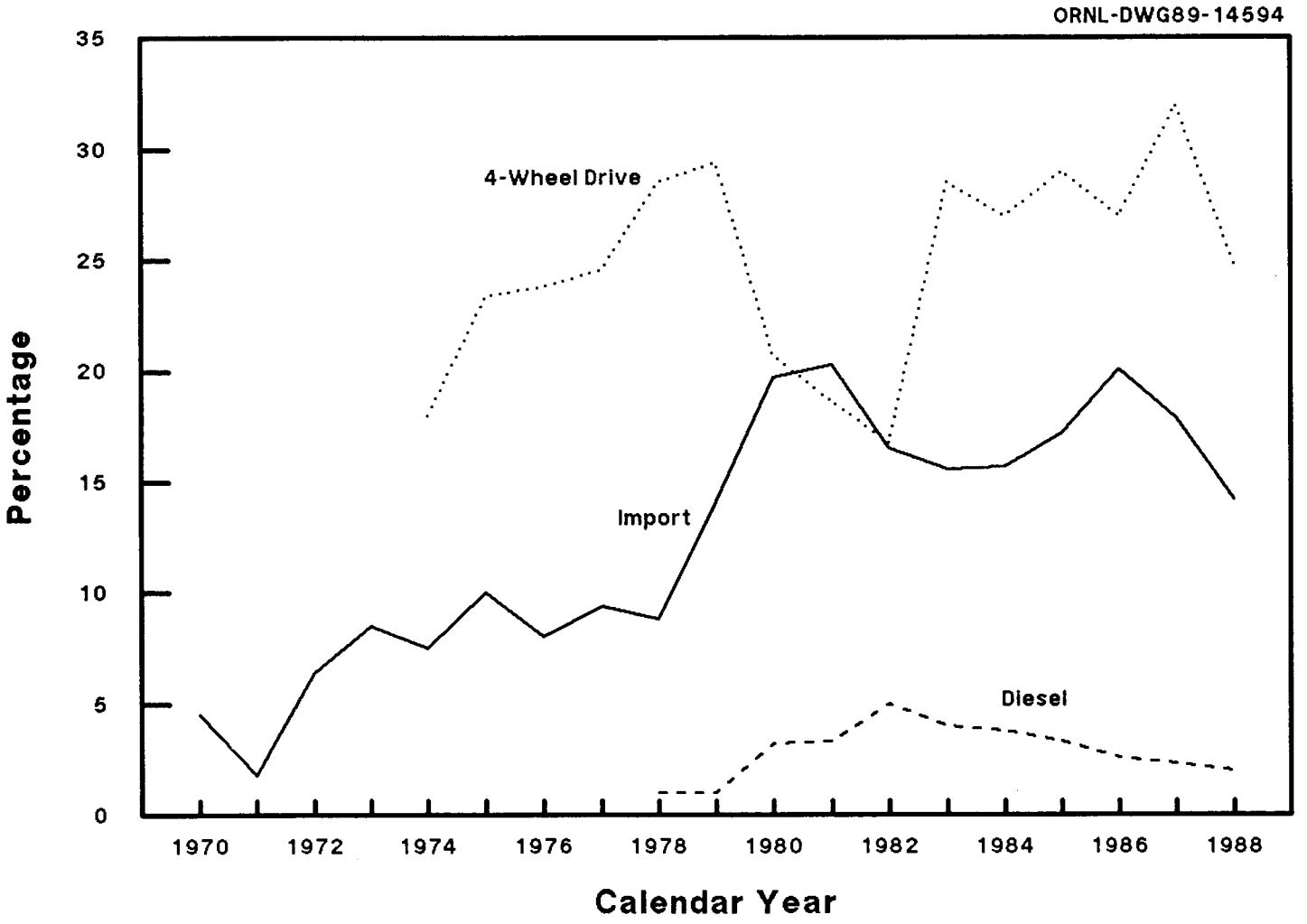
[b]Light-duty vehicles include cars and light trucks.

[c]Indicates less than 1 percent.

[d]Data are not available.

[e]Based on factory installations in 1988 model year light trucks.

Figure 3.8. Import, Diesel, and Four-Wheel Drive Shares of Light Truck Sales, 1970-88



Source: See Table 3.10.

Table 3.11
New Retail Domestic Truck Sales by Gross Vehicle Weight, 1970-88[a]
(thousands)

Calendar Year	Class 1 6,000 lbs. or less	Class 2 6,001-10,000 lbs.	Class 3 10,001-14,000 lbs.	Class 4 14,001-16,000 lbs.	Class 5 16,001-19,500 lbs.	Class 6 19,501-26,000 lbs.	Class 7 26,001-33,000 lbs.	Class 8 33,001 lbs. and over	Total[b]
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	100	135	3,983
1986	2,458	1,214	5	[d]	6	40	88	112	3,921
1987	2,611	1,175	4	[d]	6	38	88	130	4,055
1988	2,863	1,333	4	20	5	48	87	148	4,607
				Average annual percentage change					
1970-88	5.7%	6.8%	-2.2%	2.9%	-12.7%	-5.5%	5.0%	2.9%	5.4%
1982-88	17.2%	5.6%	26.0%	[e]	30.8%	1.5%	5.8%	11.7%	12.7%

Source:
Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '88, Detroit, MI, 1988, p. 18-19, and annual.
1988 data - H. A. Stark (ed.), Ward's Communications, Inc., Ward's Automotive Reports, Detroit, MI, January 16, 1989, p. 21.

[a]Sales for the years 1981-1988 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.
[e]Data are not available.

Compared to the automobile population (shown on Table 3.6), the truck population experienced less of a shift toward older trucks. In 1970, more than half of the trucks in use were 5 years old or younger. However, in 1987, this same age group accounted for only 43% of the trucks in use. The average age of trucks in use increased by only 0.6 years from 1970 to 1987.

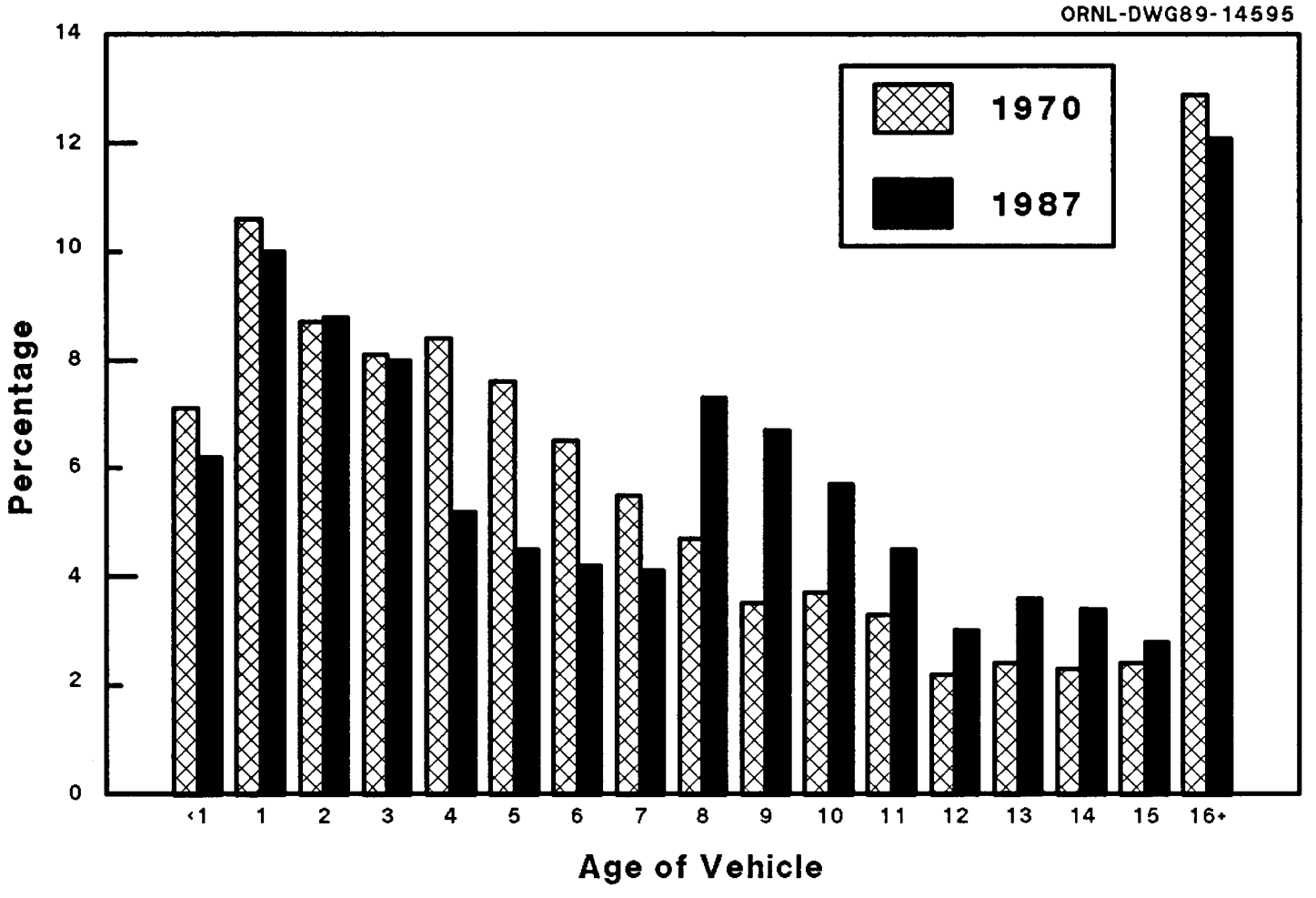
Table 3.12
Trucks in Use by Age, 1970 and 1987

Age (years)	1970 Vehicles (thousands)	1970 Actual percentage	1970 Cumulative percentage	1987 Vehicles (thousands)	1987 Actual percentage	1987 Cumulative percentage
Under 1[a]	1,262	7.1	7.1	2,954	6.2	6.2
1	1,881	10.6	17.8	4,739	10.0	16.3
2	1,536	8.7	26.5	4,180	8.8	25.1
3	1,428	8.1	34.6	3,764	8.0	33.0
4	1,483	8.4	43.0	2,439	5.2	38.2
5	1,339	7.6	50.5	2,118	4.5	42.7
6	1,154	6.5	57.1	1,979	4.2	46.8
7	975	5.5	62.6	1,962	4.1	51.0
8	826	4.7	67.3	3,451	7.3	58.3
9	621	3.5	70.8	3,150	6.7	64.9
10	658	3.7	74.5	2,708	5.7	70.6
11	583	3.3	77.8	2,108	4.5	75.1
12	383	2.2	80.0	1,436	3.0	78.1
13	417	2.4	82.3	1,700	3.6	81.7
14	414	2.3	84.7	1,610	3.4	85.1
15	432	2.4	87.1	1,320	2.8	87.9
16 and older	2,278	12.9	100.0	5,721	12.1	100.0
Subtotal	17,670	100.0		47,339	100.0	
Age not given[b]	15			5		
Total	17,685			47,344		
Average age		7.33			7.95	
Median age		5.93			7.76	

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

[a]Trucks sold as of July 1 of each year.
[b]Approximately 15,000 trucks in 1970 and 5,000 in 1987 could not be classified by age.

Figure 3.9. Trucks in Use by Age, 1970-87



Source: See Table 3.12.

Data from the 1982 TIUS (the most recent data available on national truck population) were used to estimate 1987 truck travel patterns by age group. Trucks which were 5 years old or under accounted for 61% of the total truck travel and represented 43% of the total number of trucks in use in 1987.

Table 3.13
Trucks in Operation
and Vehicle Travel by Age of Vehicle, 1987

Vehicle age (years)	Number in operation			Estimated vehicle travel	
	Vehicles (thousands)	Actual percentage	Cumulative percentage	Actual percentage	Cumulative percentage
Under 1[a]	2,954	6.2	6.2	11.3	11.3
1	4,739	10.0	16.3	15.7	27.0
2	4,180	8.8	25.1	13.4	40.4
3	3,764	8.0	33.0	10.1	50.5
4	2,439	5.2	38.2	5.9	56.4
5	2,118	4.5	42.7	5.0	61.3
6	1,979	4.2	46.8	4.0	65.4
7	1,962	4.1	51.0	3.8	69.1
8	3,451	7.3	58.3	6.2	75.4
9	3,150	6.7	64.9	5.3	80.7
10	16,603	35.1	100.0	19.3	100.0
Subtotal	47,339	100.0			
Age not given[b]	5				
Total	47,344				

Sources:

Number of trucks in operation by age - R. L. Polk and Company, Detroit, MI. **FURTHER REPRODUCTION PROHIBITED.**

Vehicle travel - The average annual vehicle miles per truck by age were multiplied by the number of trucks in operation by age to estimate the vehicle travel for 1987. Average annual miles per truck by age were generated by ORNL from the 1982 Truck Inventory and Use Survey public use tape provided by U.S. Department of Commerce, Bureau of Census, Washington, DC, 1985.

[a]Trucks sold as of July 1, 1987.

[b]Approximately 5,000 vehicles could not be classified by age.

FUEL ECONOMIES OF NEW LIGHT TRUCKS

- The sales-weighted fuel economy of light trucks showed a decline of 0.2 mpg, from 20.9 mpg in 1987 to 20.7 mpg for model year 1988 (Table 3.14).

- The only size class to show an increase in sales-weighted fuel economy in model year 1988 was the large van with an improvement of 0.4 mpg (Table 3.14). This 0.4 mpg improvement can be attributed to the fact that every vehicle in the large van size class except one experienced either an increase or no change in mpg.

- Figure 3.10 shows that over the 13 years, only the small utility vehicle showed much improvement in fuel economy.

Table 3.14
Model Year Sales, Market Shares, and Sales-Weighted Fuel Economies of Domestic and Import Light Trucks, Model Years 1976-88[a]

	1976	1977	1978	1979	1980	1981	1982
SMALL PICKUP							
Total sales, units	170,351	275,217	308,790	451,548	516,412	472,611	579,263
Market share, %	7.1	11.1	10.5	16.1	23.3	24.4	27.2
Fuel economy, mpg	23.9	26.7	26.9	23.6	25.5	28.1	28.1
LARGE PICKUP							
Total sales, units	1,586,020	1,718,306	1,886,782	1,635,745	1,115,248	967,242	1,000,772
Market share, %	66.4	69.3	64.0	58.4	50.3	50.0	46.9
Fuel economy, mpg	15.1	16.6	16.6	15.8	17.0	18.5	18.6
SMALL VAN							
Total sales, units	18,651	24,547	24,755	18,153	13,649	11,007	11,964
Market share, %	0.8	1.0	0.8	0.6	0.6	0.6	0.6
Fuel economy, mpg	19.5	22.7	19.5	17.9	19.6	18.8	22.5
LARGE VAN							
Total sales, units	574,745	415,733	670,453	580,883	328,065	327,730	379,110
Market share, %	24.1	16.8	22.8	20.7	14.8	16.9	17.8
Fuel economy, mpg	15.4	17.0	16.4	14.9	16.3	17.4	17.0
SMALL UTILITY							
Total sales, units	11,607	15,002	11,588	61,796	79,776	42,813	31,226
Market share, %	0.5	0.6	0.4	2.2	3.6	2.2	1.5
Fuel economy, mpg	12.5	15.2	15.7	17.0	16.7	19.5	20.0
LARGE UTILITY							
Total sales, units	25,536	30,708	44,091	53,038	163,387	114,013	130,505
Market share, %	1.1	1.2	1.5	1.9	7.4	5.9	6.1
Fuel economy, mpg	16.2	17.2	15.5	15.2	14.6	16.2	17.0
FLEET							
Total sales, units	2,386,910	2,479,513	2,946,459	2,801,163	2,216,537	1,935,416	2,132,840
Market share, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fuel economy, mpg	15.6	17.5	17.2	16.5	18.1	19.8	20.0

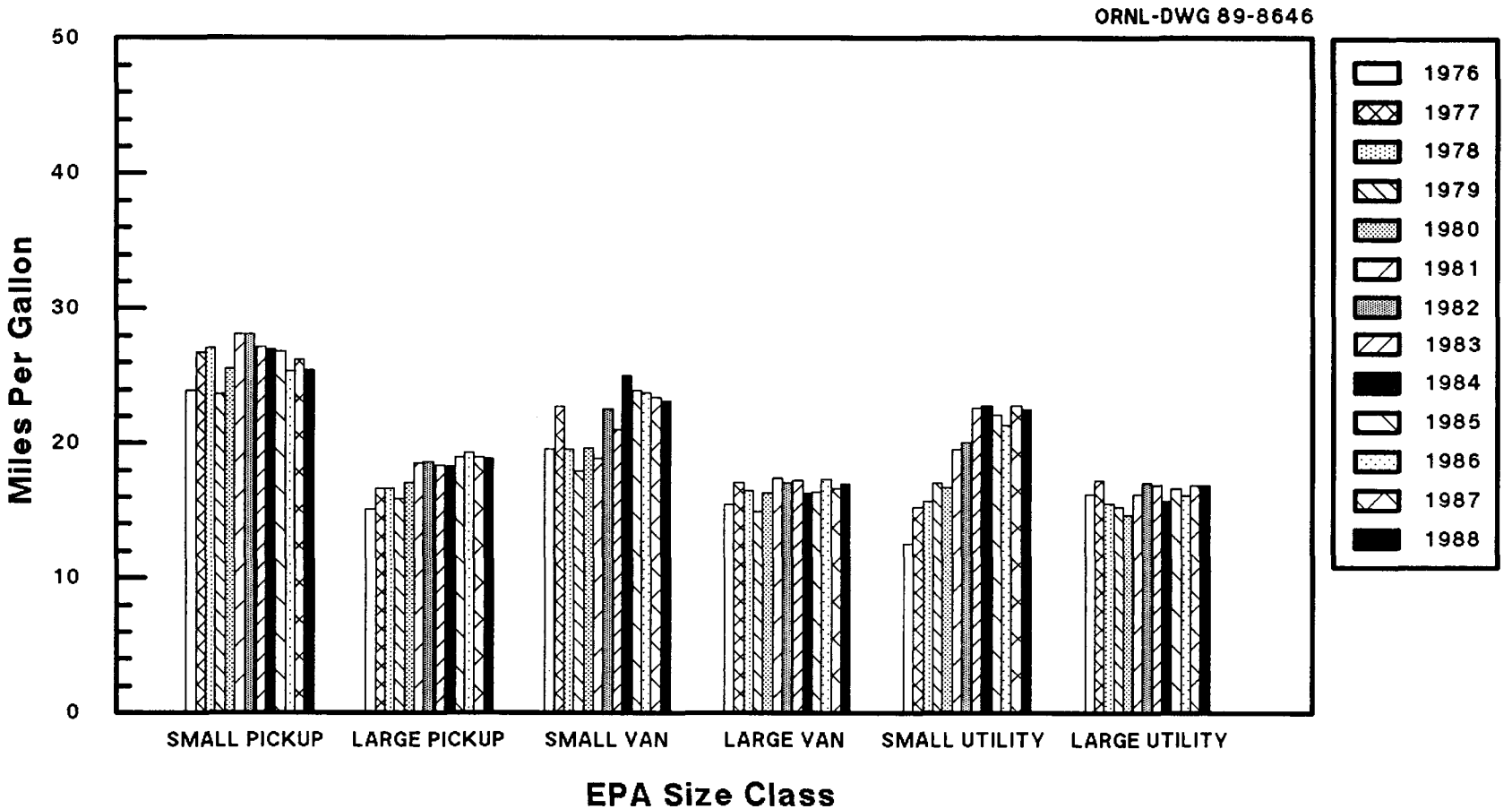
Table 3.14 (Continued)
Model Year Sales, Market Shares, and Sales-Weighted Fuel Economies of Domestic and Import Light Trucks, Model Years 1976-88[a]

	1983	1984	1985	1986	1987	1988
SMALL PICKUP						
Total sales, units	894,432	857,804	863,584	981,857	971,882	943,501
Market share, %	33.3	23.7	20.4	21.7	21.2	19.9
Fuel economy, mpg	27.2	27.0	26.8	25.4	26.2	25.5
LARGE PICKUP						
Total sales, units	958,408	1,375,948	1,690,931	1,593,512	1,542,591	1,545,846
Market share, %	35.7	38.1	39.9	35.1	33.7	32.6
Fuel economy, mpg	18.3	18.3	19.0	19.3	19.0	18.9
SMALL VAN						
Total sales, units	13,716	222,798	437,660	640,936	733,504	851,384
Market share, %	0.5	6.2	10.3	14.1	16.0	18.0
Fuel economy, mpg	21.0	25.0	23.9	23.8	23.4	23.2
LARGE VAN						
Total sales, units	484,349	545,595	536,242	510,558	473,268	486,981
Market share, %	18.0	15.1	12.7	11.3	10.3	10.3
Fuel economy, mpg	17.2	16.3	16.4	17.3	16.6	17.0
SMALL UTILITY						
Total sales, units	174,982	399,611	477,706	568,517	610,280	649,011
Market share, %	6.5	11.1	11.3	12.5	13.3	13.7
Fuel economy, mpg	22.6	22.8	22.1	21.3	22.8	22.5
LARGE UTILITY						
Total sales, units	161,412	211,178	229,242	239,508	248,511	266,277
Market share, %	6.0	5.8	5.4	5.3	5.4	5.6
Fuel economy, mpg	16.9	15.7	16.6	16.1	16.9	16.9
FLEET						
Total sales, units	2,687,299	3,612,934	4,235,365	4,534,888	4,580,036	4,743,000
Market share, %	100.0	100.0	100.0	100.0	100.0	100.0
Fuel economy, mpg	20.5	20.1	20.4	20.7	20.9	20.7

Source:
Patricia S. Hu, Linda S. Williams, and Dennis J. Beal, Light Duty Vehicle MPG and Market Shares Report: Model Year 1988, ORNL-6549, Oak Ridge, TN, pp. 3-3, 3-4.

[a]These figures represent only those sales that could be matched to the Environmental Protection Agency fuel economy values.

Figure 3.10. Fuel Economies of New Domestic and Import Light Trucks by Size Class, 1976-88



Source: See Table 3.11.

TRUCK POPULATION

Tables 3.15-3.17 present the Federal Highway Administration's (FHWA) data on the U.S. truck population. The FHWA classifies trucks into three categories: two-axle, four-tire trucks; other single-unit trucks; and combination trucks. Other single unit trucks are defined as all single-unit trucks with more than two axles or more than four tires. Figure 3.11 compares 1987 registrations, fuel economy, vehicle travel, and fuel use for each truck type. Observations from these graphs follow.

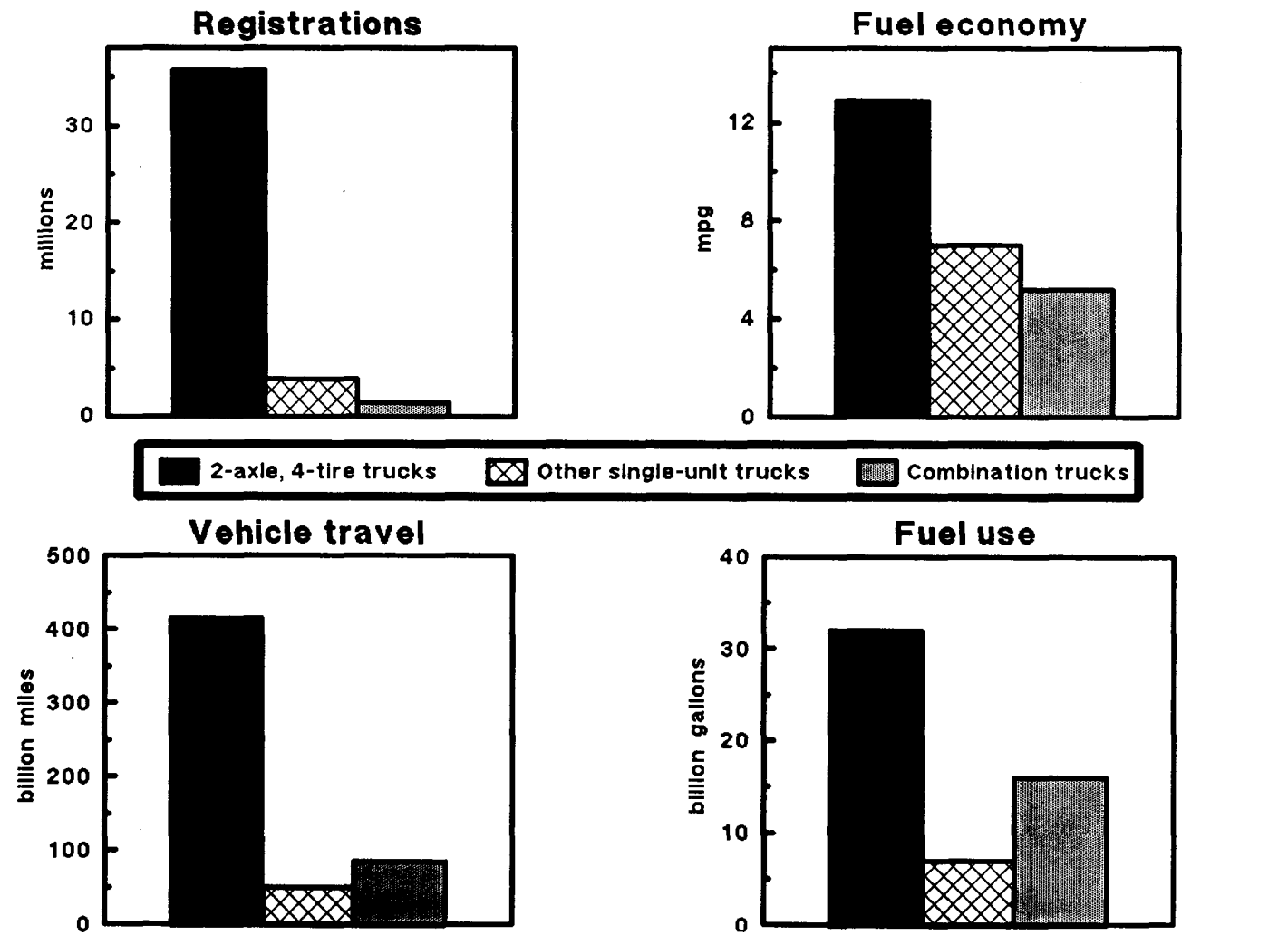
- Light trucks had the best fuel economy of all truck types (12.9 mpg), but also used the most fuel (32 billion gallons) in 1987. This was due to the large population of light trucks (35 million trucks) and the great amount of vehicle travel (416 billion miles).

- Although registrations of combination trucks were less than half that of other single-unit trucks (1.4 million and 3.8 million trucks, respectively), combination trucks used twice as much fuel as other single-unit trucks (16 billion and 7 billion gallons, respectively) because of the combination truck's higher vehicle travel and lower fuel economy.

- Combination trucks accounted for only 3% of the truck population in 1987, but almost 16% of all truck miles.

- Other single unit trucks, which accounted for approximately 9% of the truck population, had the lowest vehicle travel (49 billion miles) and least fuel use (7 billion gallons) in 1987.

Figure 3.11. Summary Statistics by Type of Truck, 1987



Source: See Tables 3.15 - 3.17.

Fuel economy of two-axle four-tire trucks increased steadily from 1970 to 1984, but has remained stable since then. Growth in the light truck stock, travel, and fuel use was strong over the period.

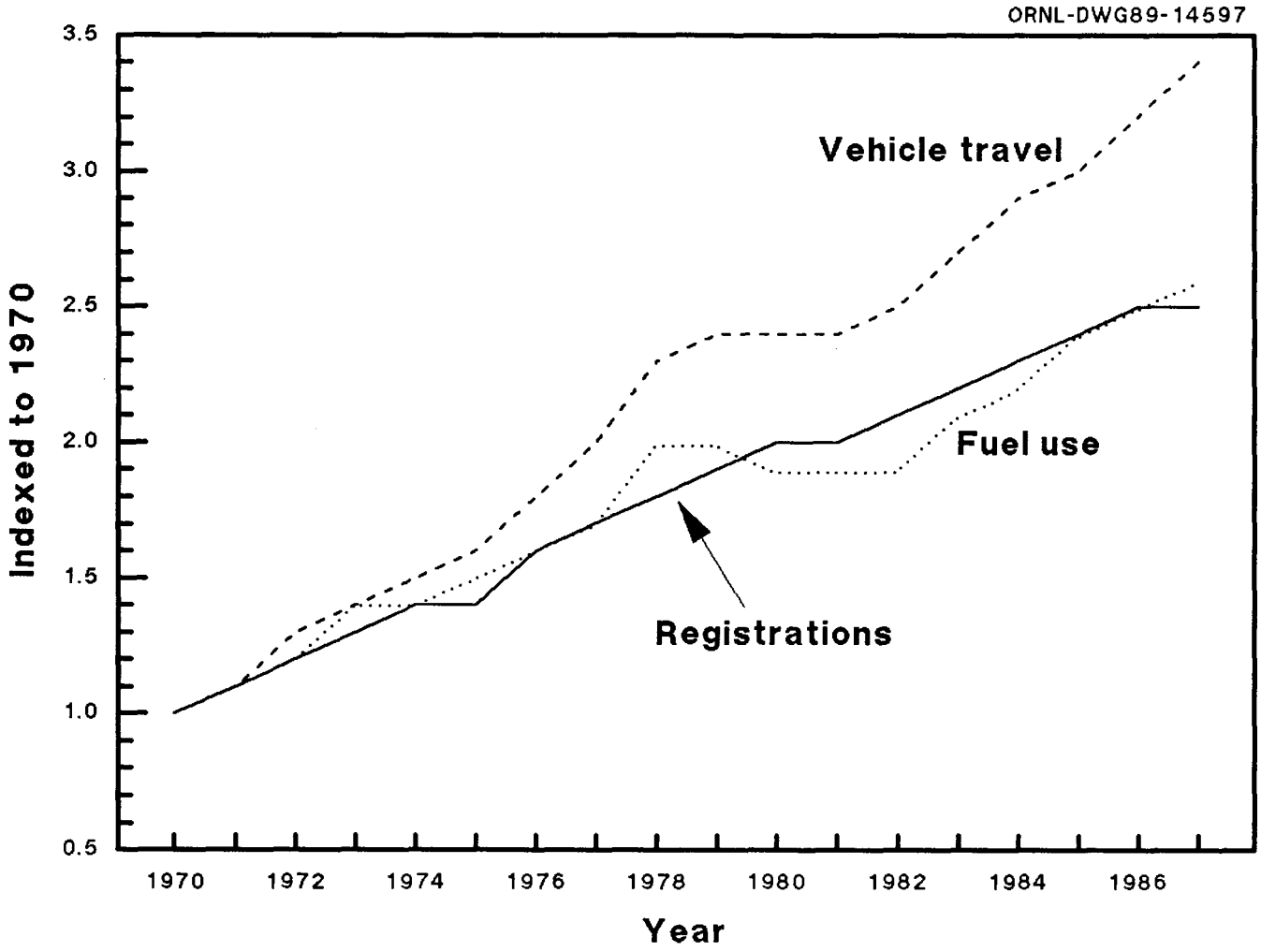
Table 3.15
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970-1987

Year	Registrations[a] (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	21,055	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	35,819	416,008	32,236	12.9
		Average annual percentage change		
1970-87	5.6%	7.4%	5.8%	1.5%
1982-87	3.8%	6.3%	6.2%	0.2%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1987, Washington, DC, 1988, Table VM-1, p. 177, and annual.

[a]This number differs from R. L. Polk's estimates of "number of trucks in use."

Figure 3.12. Registrations, Vehicle Travel, and Fuel Use for Two-Axle, Four-Tire Trucks, 1970-87



Source: See Table 3.15.

Unlike two-axle four-tire trucks, the number of other single-unit trucks has declined 2.1% each year since 1982. Despite the decreased number of other single-unit trucks, total vehicle travel increased from 1970 to 1987, at an average annual rate of 4.3% and resulted in an overall increase of 74% in individual truck travel (vehicle travel divided by the number of truck registrations), from 7,357 miles to 12,784 miles. Fuel economy of other single-unit trucks has remained relatively constant during the reporting period.

Table 3.16
Summary Statistics for Other Single-Unit Trucks[a], 1970-87

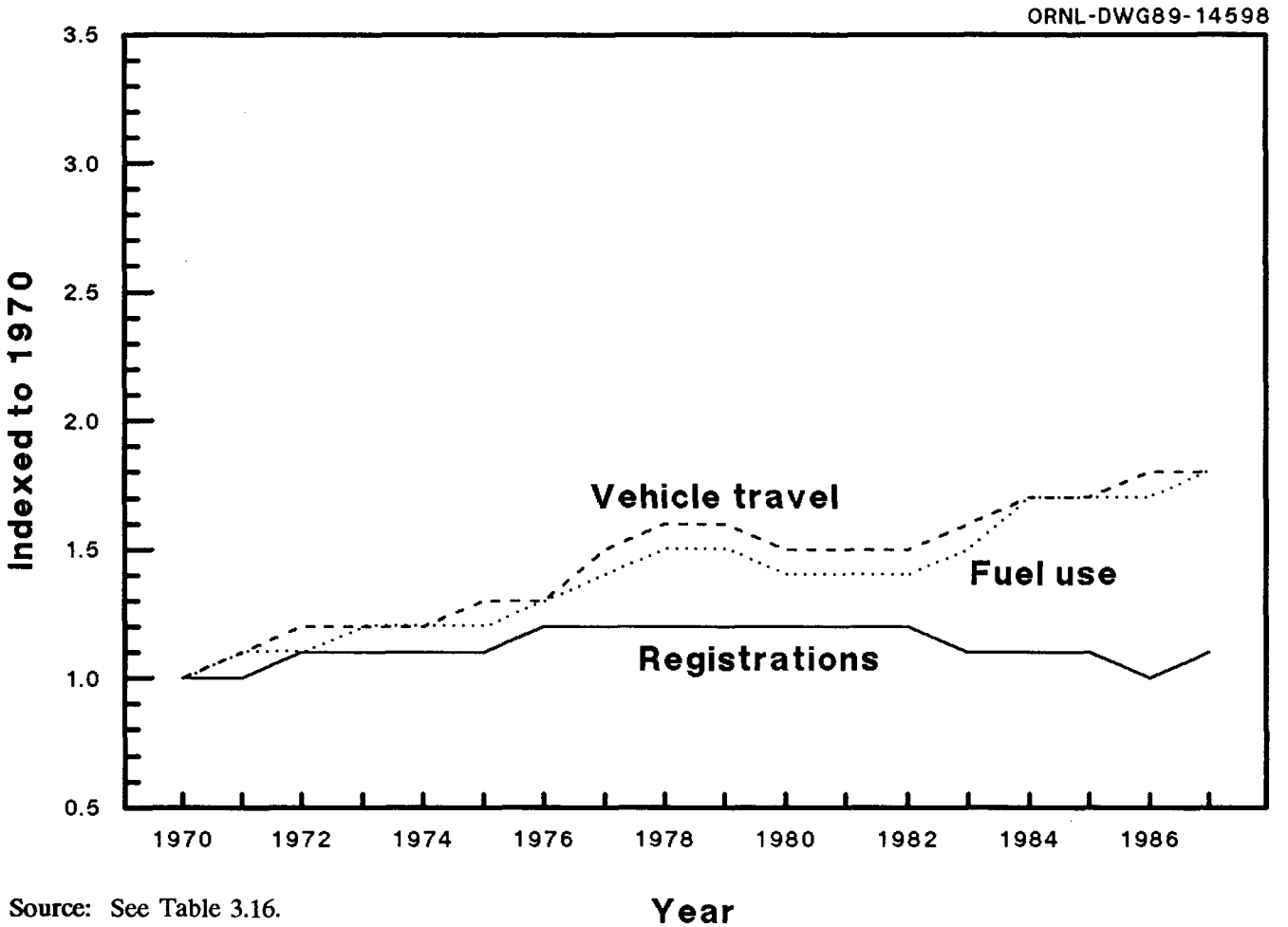
Year	Registrations[b] (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	3,681	27,081	3,968	6.8
1971	3,770	28,985	4,212	6.9
1972	3,918	31,414	4,560	6.9
1973	4,131	33,661	4,859	6.9
1974	4,211	33,441	4,687	7.1
1975	4,232	34,606	4,825	7.2
1976	4,350	36,390	5,140	7.1
1977	4,450	39,339	5,559	7.1
1978	4,518	42,727	6,106	7.0
1979	4,505	42,012	6,036	7.0
1980	4,374	39,813	5,557	7.2
1981	4,455	39,568	5,574	7.1
1982	4,325	40,212	5,661	7.1
1983	4,204	43,409	6,118	7.1
1984	4,061	46,560	6,582	7.1
1985	3,927	46,980	6,735	7.0
1986	3,850	48,308	6,929	7.0
1987	3,881	49,613	7,097	7.0
		Average annual percentage change		
1970-87	0.3%	3.6%	3.5%	0.2%
1982-87	-2.1%	4.3%	4.6%	-0.3%

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1987, Washington, DC, 1988, Table VM-1, p. 177, and annual.

[a]Other single-unit trucks are defined as all single-unit trucks with more than two axles **or** more than four tires.

[b]This number differs from R. L. Polk's estimates of "number of trucks in use."

Figure 3.13. Registrations, Vehicle Travel, and Fuel Use for Other Single-Unit Trucks[a], 1970-87



Source: See Table 3.16.

[a]Other single-unit trucks are defined as all single-unit trucks with more than two axles or more than four tires.

The average vehicle miles traveled by a combination truck (vehicle travel divided by the number of truck registrations) in 1987 was more than one and one-half times that in 1970, 60,884 miles and 38,822 miles, respectively. Fuel economy of combination trucks increased only slightly between 1970 and 1987.

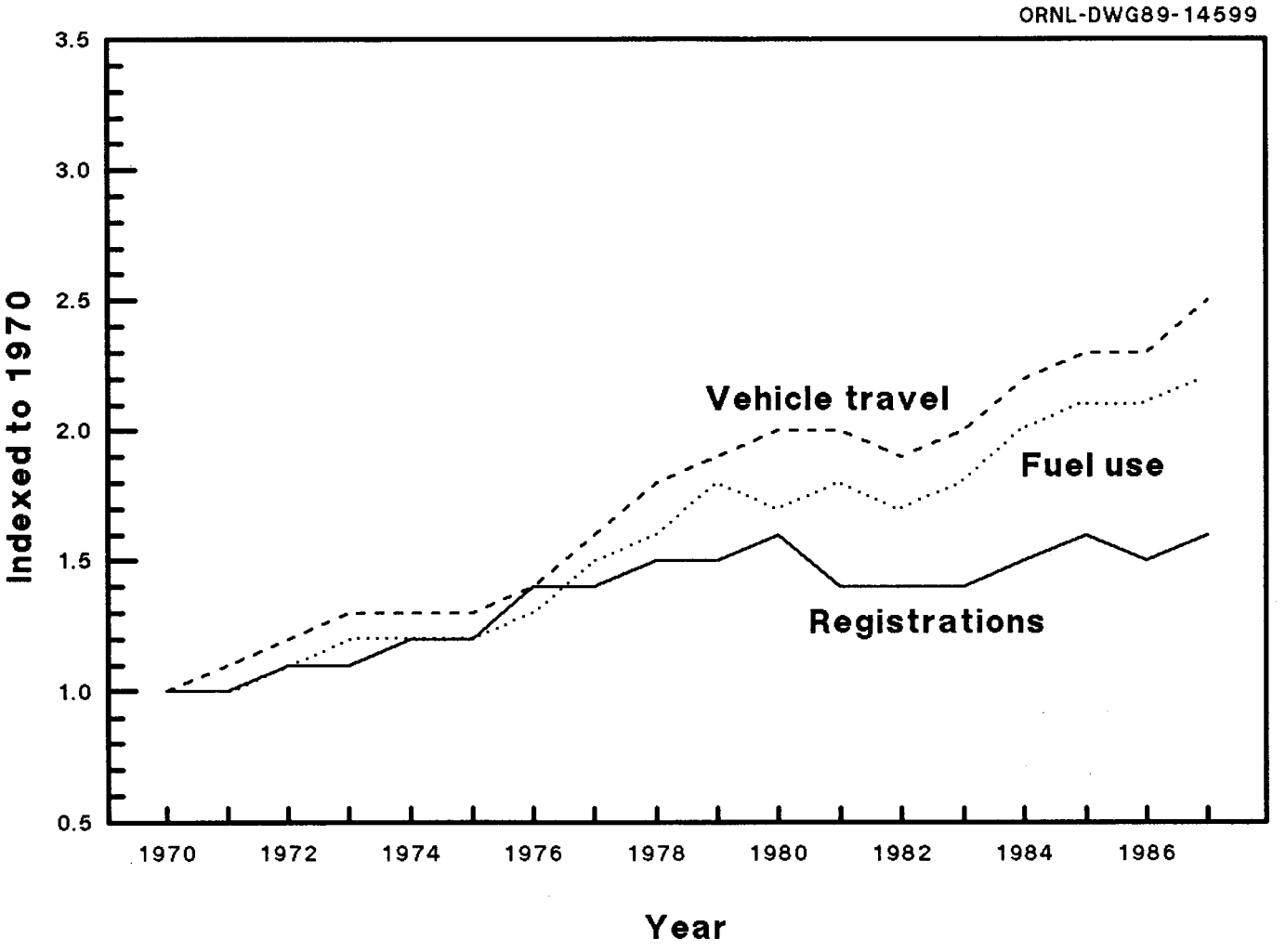
Table 3.17
Summary Statistics for Combination Trucks, 1970-1987

Year	Registrations[a] (thousands)	Vehicle travel (million miles)	Fuel use (million gallons)	Fuel economy (miles per gallon)
1970	905	35,134	7,347	4.8
1971	919	37,217	7,595	4.9
1972	961	40,706	8,120	5.0
1973	1,029	45,649	9,026	5.1
1974	1,085	45,966	8,800	5.2
1975	1,131	46,724	8,653	5.4
1976	1,225	49,680	9,536	5.2
1977	1,240	55,683	10,673	5.2
1978	1,342	62,992	12,113	5.2
1979	1,386	66,992	12,864	5.2
1980	1,417	68,678	12,703	5.4
1981	1,261	69,134	12,960	5.3
1982	1,265	66,668	12,636	5.3
1983	1,304	69,754	13,447	5.2
1984	1,340	77,367	14,781	5.2
1985	1,403	79,600	15,280	5.2
1986	1,399	81,833	15,716	5.2
1987	1,418	86,334	16,527	5.2
		Average annual percentage change		
1970-87	2.7%	5.4%	4.9%	0.5%
1982-87	2.3%	5.3%	5.5%	-0.4%

Source:
Department of Transportation, Federal Highway Administration, Highway Statistics 1987, Washington, DC, 1988, Table VM-1, p. 177, and annual.

[a]This number differs from R. L. Polk's estimates of "number of trucks in use."

Figure 3.14. Registrations, Vehicle Travel, and Fuel Use for Combination Trucks, 1970-87



Source: See Table 3.17.

Between 1977 and 1982, all of the truck classes experienced improvements in their fuel economies, except for Classes 2, 3, and 5. Trucks in Class 7 showed the greatest improvement, 0.9 mpg.

Table 3.19
Truck Fuel Economy by Size Class, 1977 and 1982
(miles per gallon)

Size Class	Weight	1977 TIUS[a]	1982 TIUS[a]	Percentage change
Class 1	6,000 pounds and less	13.2	14.2	7.6%
Class 2	6,001-10,000 pounds	11.5	11.1	-3.5%
Class 3	10,000-14,000 pounds	9.4	8.1	-13.8%
Class 4	14,001-16,000 pounds	6.9	7.5	8.7%
Class 5	16,001-19,500 pounds	7.6	7.2	-5.3%
Class 6	19,501-26,000 pounds	6.1	6.9	13.1%
Class 7	26,001-33,000 pounds	5.3	6.2	17.0%
Class 8	33,001 and over	4.8	5.2	8.3%

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

[a]Truck Inventory and Use Survey.

Based on data from the 1977 and 1982 Truck Inventory and Use Surveys (TIUS), almost 50% of the total truck gasoline consumption is for personal use. For-hire trucks had the largest share of truck diesel consumption in 1977 as well as in 1982. While truck gasoline consumption was lower in 1982 than in 1977, truck diesel consumption was higher by 3.8% in 1982.

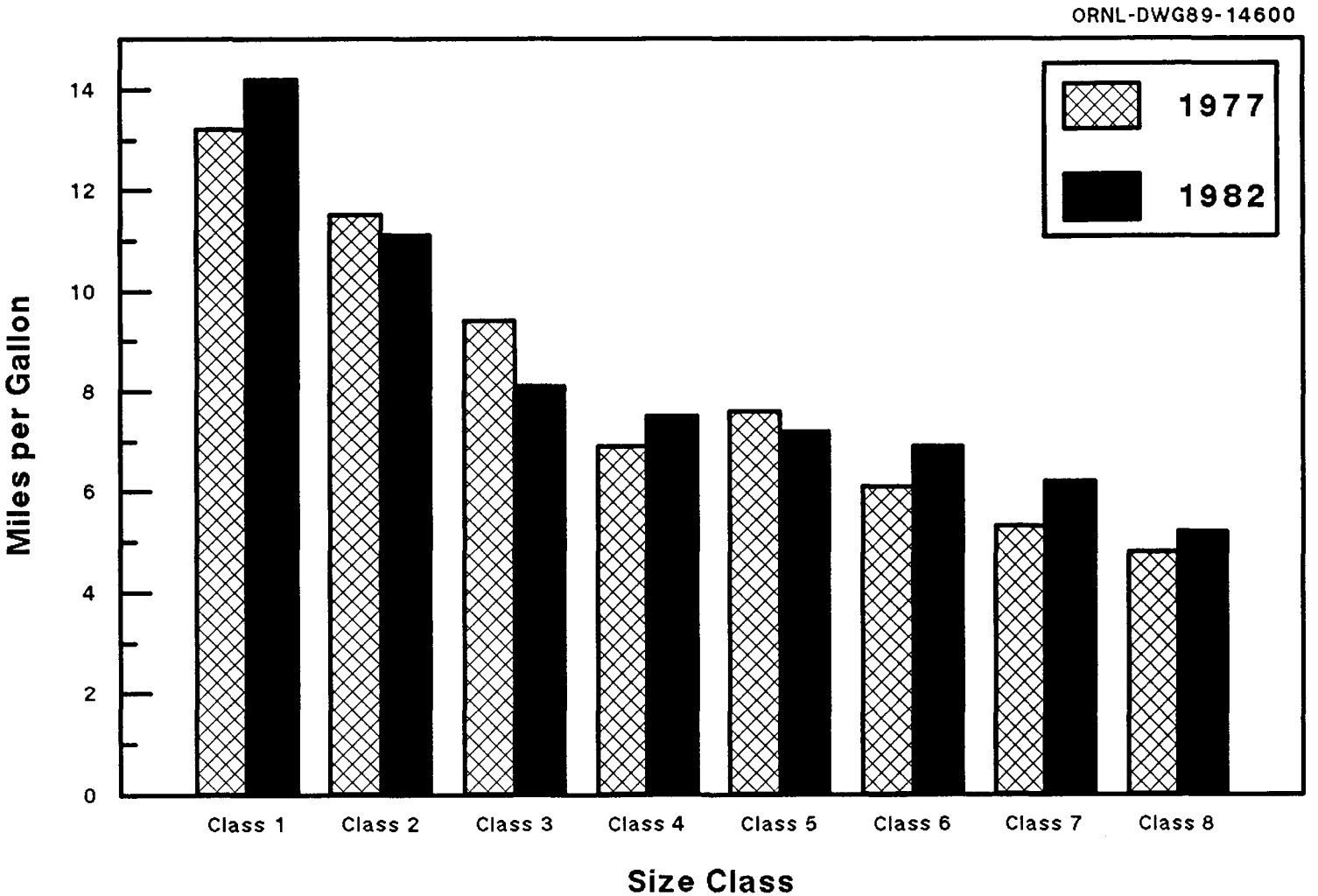
Table 3.18
Truck Gasoline and Diesel Consumption by Major Use, 1977 and 1982 TIUS[a]

Major use	Total gallons of gasoline (millions) 1977	1982	Percentage change	Total gallons of diesel (millions) 1977	1982	Percentage change
Agricultural activity	3,097	2,665	-13.9%	653	645	-1.2%
Construction	2,214	1,431	-35.4%	976	707	-27.6%
Daily rental	115	142	23.5%	202	277	37.1%
For hire	738	551	-25.3%	4,619	5,711	23.6%
Forestry	248	549	121.4%	461	293	-36.4%
Manufacturing	537	494	-8.0%	1,131	1,102	-2.6%
Mining	196	312	59.2%	234	239	2.1%
Other	248	292	17.7%	84	13	-84.5%
Personal	10,436	10,919	4.6%	3	73	2333.3%
Retail trade	1,540	1,335	-13.3%	546	512	-6.2%
Services	1,885	1,549	-17.8%	213	185	-13.1%
Utilities	587	597	1.7%	40	42	5.0%
Wholesale trade	1,865	1,326	-28.9%	1,380	1,145	-17.0%
Not in use	8	17	112.5%	6	5	-19.4%
Total	**23,714**	**22,179**	**-6.5%**	**10,548**	**10,949**	**3.8%**

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

[a]Truck Inventory and Use Survey.

Figure 3.15. Truck Fuel Economy by Size Class, 1977 and 1982



Source: See Table 3.19.

Based on TIUS data, the number of trucks increased 26% from 1977 to 1982 while the average annual truck travel was lower by 7.6%. Gasoline trucks in 1982 accounted for almost 90% of the total number of trucks in operation. In 1982, a diesel truck on the average traveled more than any gasoline or LPG truck regardless of the truck weight. The sample size for the light diesel truck category in the 1977 TIUS prohibited an accurate estimate of its fuel economy. On the average, 1982 trucks were more fuel efficient than trucks in 1977.

Table 3.20
Summary Statistics for Trucks by Size Class and Fuel Type, 1977 and 1982[a]

	Number of trucks (thousands)		Average annual truck travel (miles)		Fuel economy (mpg)	
	1977	1982	1977	1982	1977	1982
Gasoline						
Light	22,522.9	29,696.7	10,610	9,805	12.8	13.6
Medium	1,720.6	1,098.9	10,066	8,853	8.3	7.7
Light-heavy	858.1	671.1	9,756	7,538	6.2	6.8
Heavy-heavy	633.1	440.0	12,296	9,378	4.8	5.4
Diesel						
Light	12.9	301.5	12,828	18,223	9.1	24.9
Medium	25.9	68.0	17,413	17,745	7.4	8.0
Light-heavy	48.1	96.6	22,057	21,859	5.4	7.7
Heavy-heavy	1,002.2	1,164.7	49,156	46,778	4.8	5.2
Liquid Petroleum Gas						
Light	57.2	169.1	15,880	14,748	11.2	9.6
Medium	11.6	18.5	12,753	15,002	5.6	5.5
Light-heavy	15.7	22.3	13,572	15,530	5.1	5.1
Heavy-heavy	6.8	11.1	18,720	17,968	4.6	4.0
Total[b]	**26,921.8**	**33,834.4**	**12,065**	**11,151**	**9.4**	**10.6**

Sources:
Estimated based on data provided on the following two public use tapes: U.S. Department of Commerce, Bureau of the Census, 1977 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1980; and U.S. Department of Commerce, Bureau of the Census, 1982 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1985.

[a]In the 1977 Truck Inventory and Use Survey (TIUS) approximately 7,000 trucks did not report fuel type or size class; for the 1982 TIUS, this number rose to 76,000 trucks. Government trucks are not included in this survey. Trucks are classified by gross vehicle weight as follows:

Light	0-10,000 pounds
Medium	10,001-19,500 pounds
Light-Heavy	19,501-26,000 pounds
Heavy-Heavy	26,001 pounds and over.

[b]Totals may not equal the sum of the individual components because some respondents did not report this information.

Section 3.3. Buses

Transit buses consumed more than twice as much energy in their operations as did intercity buses. This can be attributed to the fact that there were twice as many transit buses in use as there were intercity buses (see Table 3.23). Energy use by intercity buses has decreased at an average annual rate of 6.9% since 1982.

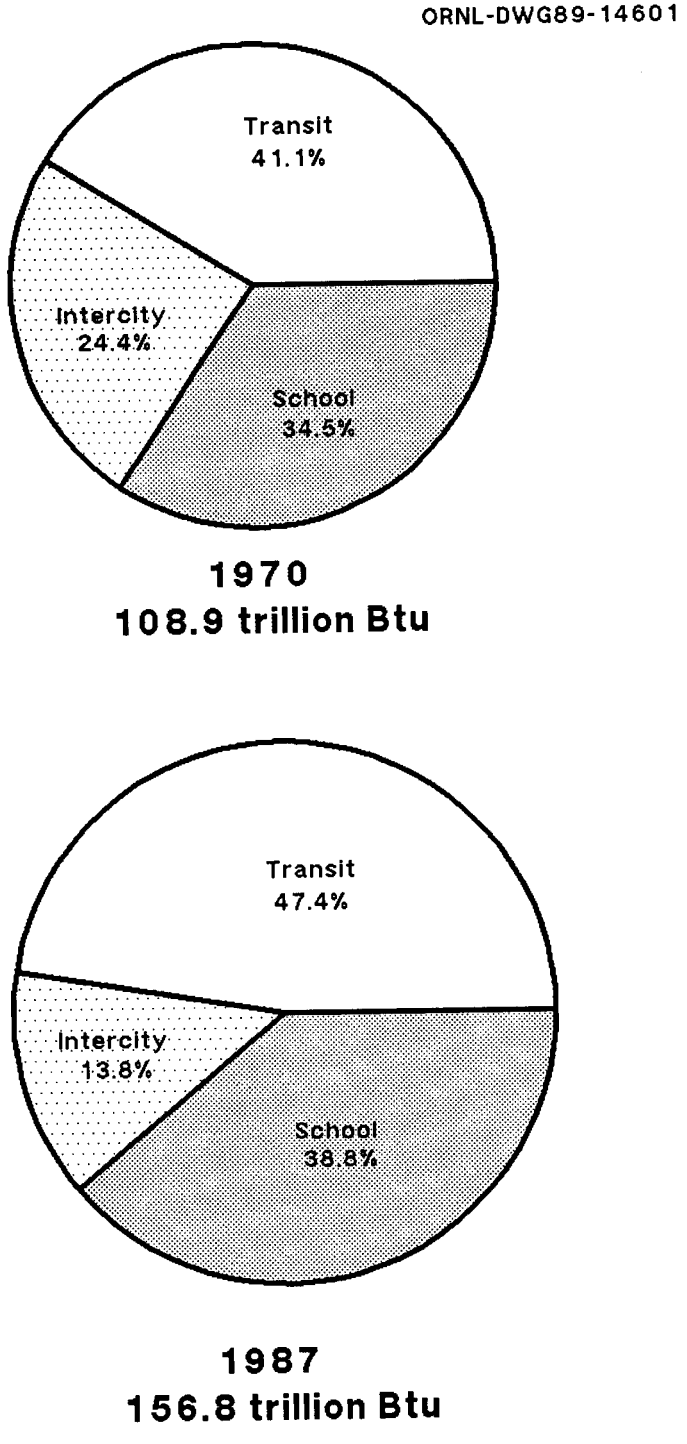
Table 3.21
Energy Consumption by Type of Bus, 1970-1987
(trillion Btu)

Year	Transit bus[a]	Intercity bus	School bus
1970	44.8	26.6	37.5
1971	41.6	26.5	39.5
1972	39.7	26.0	40.0
1973	42.0	25.9	40.9
1974	45.1	26.3	41.6
1975	51.5	24.8	42.6
1976	54.7	25.0	48.8
1977	57.0	24.7	50.1
1978	59.7	24.2	50.9
1979	59.8	26.2	50.6
1980	61.3	29.3	47.5
1981	63.6	31.3	48.5
1982	64.7	30.9	49.9
1983	63.7	31.1	50.3
1984	69.2	33.8	50.7
1985	72.4	31.5	57.0
1986	75.6	20.6	57.8
1987	74.3	21.6	60.9
	Average annual percentage change		
1970-87	3.0%	-1.2%	2.9%
1982-87	2.8%	-6.9%	4.1%

Sources:
See Appendix A for Table 2.9.

[a]Transit bus statistics include motor bus only. 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.

Figure 3.16. Energy Consumption by Type of Bus, 1970 and 1987



Source: See Table 3.21.

Despite increasing vehicle travel by transit buses, passenger miles of travel have decreased by 8% from 1986 to 1987. This might be attributed to the fact that in 1987 fewer passengers traveled by transit buses and the average trip length was shorter compared to 1986 (from 11.3 passenger-miles per vehicle-mile in 1986 to 10.3 in 1987). Passenger and vehicle travel by intercity buses have both experienced declines since 1970.

Table 3.22
Passenger and Vehicle Travel by Bus Type, 1970-1987

Year	Passenger travel (million miles)		Vehicle travel (million miles)		
	Transit bus[a]	Intercity bus	Transit bus[a]	Intercity bus	School bus
1970	18,120	25,300	1,409	1,209	2,100
1971	16,810	25,500	1,375	1,202	2,212
1972	16,180	25,600	1,308	1,182	2,359
1973	16,170	26,400	1,370	1,178	2,412
1974	17,910	27,700	1,431	1,195	2,450
1975	18,300	25,400	1,526	1,126	2,500
1976	18,890	25,100	1,581	1,118	2,862
1977	19,730	25,700	1,623	1,102	2,950
1978	20,708	25,400	1,631	1,081	2,991
1979	21,393	27,200	1,634	1,132	2,980
1980	21,790	27,400	1,677	1,162	2,900
1981	21,012	27,100	1,685	1,134	2,960
1982	19,987	26,900	1,669	1,115	3,062
1983	20,047	26,500	1,678	1,120	3,098
1984	21,595	27,100	1,845	1,098	3,400
1985	21,161	23,800	1,863	933	3,448
1986	21,435	23,700	1,896	1,021	3,700
1987	19,756	23,000	1,927	[b]	[b]
			Average annual percentage change		
1970-87	0.5%	-0.6%	1.9%	-1.1%[c]	3.6%[c]
1982-87	-0.2%	-3.1%	2.9%	-2.2%[c]	4.8%[c]

Sources:

Transit buses - 1970-87: American Public Transit Association, 1988 Transit Fact Book, Washington, DC, 1988, pp. 33, 34, and annual.

Intercity buses - 1970-84: American Bus Association, Annual Report, Washington, DC, Annual. 1985-1987: Transportation Policy Associates, Transportation in America, November 1988 Supplement, Washington, DC, p. 8.

School buses - 1970-84: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1984, Washington, DC, Table VM-1, p. 175, and annual.
1985-1987: U.S. Department of Transportation, Research and Special Programs Administration, National Transportation Statistics, Figure 2, p. 5, and annual.

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[a]Transit bus statistics include motor bus only. Series not continuous between 1983 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]Data are not available.

[c]Average annual percentage change is for years 1970-86 and 1982-86.

Although the total number of buses in use has increased at an average rate of 2.8% per year since 1970, intercity buses and trolley coach transit vehicles have decreased in number. The numbers of transit buses and intercity buses in operation reached their peaks in 1984.

Table 3.23
Buses in Operation by Type

Year	Transit[a]		Intercity bus	School and other nonrevenue[c]	Other[d]	Total
	Motor bus	Trolley coach[b]				
1970	49,700	1,050	22,000	288,700	16,112	377,562
1971	49,150	1,037	21,900	307,300	17,688	397,075
1972	49,075	1,030	21,400	318,200	17,161	406,866
1973	48,286	794	20,800	336,000	19,040	424,920
1974	48,700	718	21,000	356,900	19,730	447,048
1975	50,811	703	20,500	368,300	21,842	462,156
1976	52,382	685	20,100	381,498	23,674	478,339
1977	51,968	645	20,300	393,810	24,038	490,761
1978	52,866	593	20,250	398,804	32,841	505,354
1979	54,490	725	20,680	415,117	35,753	526.765
1980	59,411	823	21,400	418,255	28,930	528,789
1981	60,393	751	21,500	432,813	28,437	543,894
1982	62,114	763	22,000	442,133	32,190	559,200
1983	62,093	686	23,500	470,727	25,878	582,884
1984	63,497	664	25,000	471,461	23,049	583,671
1985	57,285	676	20,200	480,400	34,924	593,485
1986	58,000	680	20,300	479,076	35,672	593,728
1987	57,687	671	20,400	486,753	36,544	602,055
			Average annual percentage change			
1970-87	0.9%	-2.6%	-0.4%	3.1%	4.9%	2.8%
1982-87	-1.5%	-2.5%	-1.5%	1.9%	2.6%	1.5%

Sources:

Transit buses - American Public Transit Association, 1988 Transit Fact Book, Washington, DC, 1988, p. 44, and annual.

Intercity buses - 1970-84: American Bus Association, 1984 Annual Report, Washington, DC, and annual. 1985-87: U.S. Department of Transportation, Transportation Systems Center, National Transportation Statistics, Cambridge, MA, August 1988, Figure 7, p. 10, and annual.

Other buses - Derived by subtracting Transit, Intercity, and School buses from Total buses.

School buses and Total buses - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1987, Washington, DC, 1988, Table MV-10, p. 20, and annual.

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[a]Series not continuous between 1983 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]Trolley coach - a rubber tired transit vehicle that usually draws its power from overhead wires.

[c]Includes some industrial and other private buses.

[d]Includes government buses, private buses, and other miscellaneous buses.

Since 1982, intercity buses have experienced improvements in their energy efficiencies on both a per vehicle-mile and per passenger-mile basis. From 1986 to 1987, energy intensities of transit buses showed a 3.3% decrease if based on vehicle mileage but a 6.7% increase if based on passenger mileage.

Table 3.24
Historical Energy Intensities by Type of Bus, 1970-87

Year	Btu per passenger-mile		Btu per vehicle-mile		
	Transit bus[a]	Intercity bus	Transit bus[a]	Intercity bus	School bus
1970	2,472	1,051	31,796	22,002	17,857
1971	2,475	1,039	30,255	22,047	17,857
1972	2,454	1,016	30,352	21,997	16,956
1973	2,597	981	30,657	21,986	16,957
1974	2,518	949	31,516	22,008	16,980
1975	2,814	976	33,748	22,025	17,040
1976	2,896	996	34,598	22,361	17,051
1977	2,889	961	35,120	22,414	16,983
1978	2,883	953	36,603	22,387	17,018
1979	2,795	963	36,597	23,145	16,980
1980	2,813	1,069	36,553	25,215	16,379
1981	3,027	1,155	37,745	27,601	16,385
1982	3,237	1,149	38,766	27,713	16,296
1983	3,177	1,174	37,962	27,768	16,236
1984	3,204	1,247	37,507	30,783	14,912
1985	3,421	1,323	38,862	31,722	16,531
1986	3,527	869	39,873	20,176	15,622
1987	3,761	939	38,557	[b]	[b]
			Average annual percentage change		
1970-87	2.5%	-0.7%	1.1%	-0.5%[c]	-0.8%[c]
1982-87	3.0%	-4.1%	-0.1%	-7.6%[c]	-1.1%[c]

Source:
Energy intensities by passenger-mile were calculated by dividing energy use (from Table 3.21) by passenger-miles (from Table 3.22). Energy intensities by vehicle-mile were calculated by dividing energy use (from Table 3.21) by vehicle-miles (from Table 3.22).

[a]Transit bus statistics include motor bus only. Series not continuous between 1983 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]Data are not available.

[c]Average annual percentage change is for years 1970-86 and 1982-86.

The number of automobiles in fleets has increased at an average annual rate of 3.7% since 1975. Although declining slightly since 1983, midsize automobiles as a percentage of the total number of vehicles in the fleets continued to account for almost half of the automobile fleet. The shift away from large cars toward compact cars started in 1981.

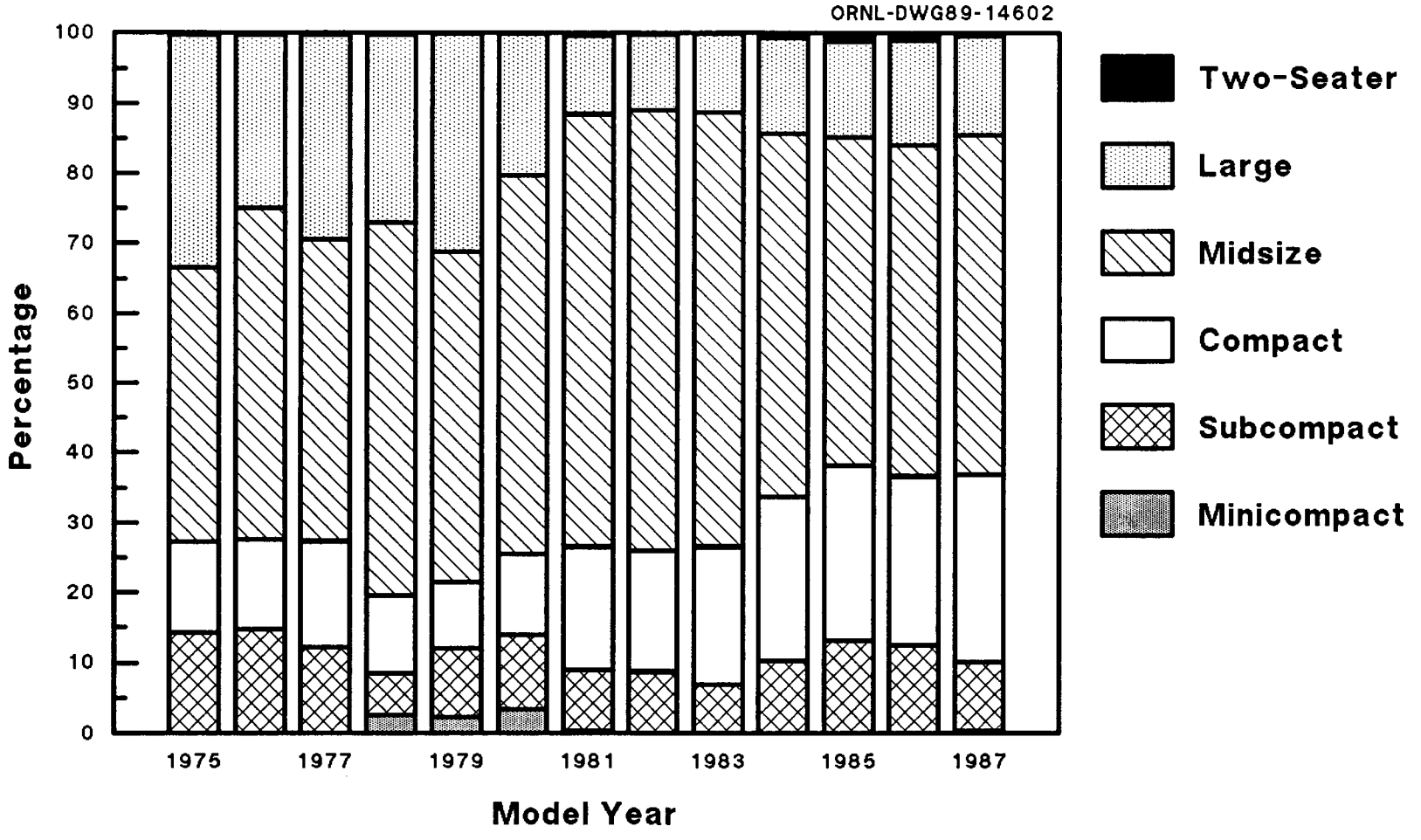
Table 3.25
Distribution of New Domestic Fleet Automobile Registrations by Size Class, 1975-1987

Model Year	Percentage						Total New Registrations
	Minicompact	Subcompact	Compact	Midsize	Large	Two-Seater	
1975	0	14.3	12.9	39.3	33.2	0.2	966,099
1976	0	14.7	12.9	47.4	24.7	0.3	1,044,485
1977	0	12.2	15.1	43.2	29.2	0.3	1,182,292
1978	2.6[a]	5.8	11.1	53.4	26.8	0.2	1,379,630
1979	2.2	9.8	9.5	47.3	31.0	0.3	1,371,782
1980	3.3	10.6	11.6	54.1	20.2	0.2	1,130,119
1981	0.2	8.8	17.5	61.9	11.2	0.4	1,133,013
1982	0	8.7	17.3	63.0	10.7	0.3	1,022,588
1983	0	6.9	19.6	62.2	11.1	0.2	1,137,976
1984	0	10.3	23.3	52.0	13.6	0.7	1,483,790
1985	0	13.1	25.0	47.0	13.7	1.1	1,536,299
1986	0	12.4	24.2	47.4	14.9	1.0	1,507,559
1987	0.2	9.8	26.8	48.6	14.2	0.5	1,500,683
			Average annual percentage change				
1975-87							3.7%
1982-87							8.0%

Source:
Bobit Publishing Company, Automotive Fleet Research Department, Automotive Fleet Factbook, Redondo Beach, CA, 1988, p. 20, and annual. Percentages were derived by classifying data into Environmental Protection Agency size classes.

[a]In 1978, Ford Pinto and Mercury Bobcat changed size classes from subcompact to minicompact. Both models were discontinued in 1982.

Figure 3.17. New Registrations of Domestic Fleet Automobiles by Size Class, 1975-87



Source: See Table 3.25.

Most of the vehicles in automobile fleets (with 10 or more cars per fleet) were either for business use or for individual leasing - 70% in 1987. Taxi fleets from 1982 to 1987 increased at a low rate of 0.4% per year, while individually leased fleets grew at a rapid rate of 5.0% annually.

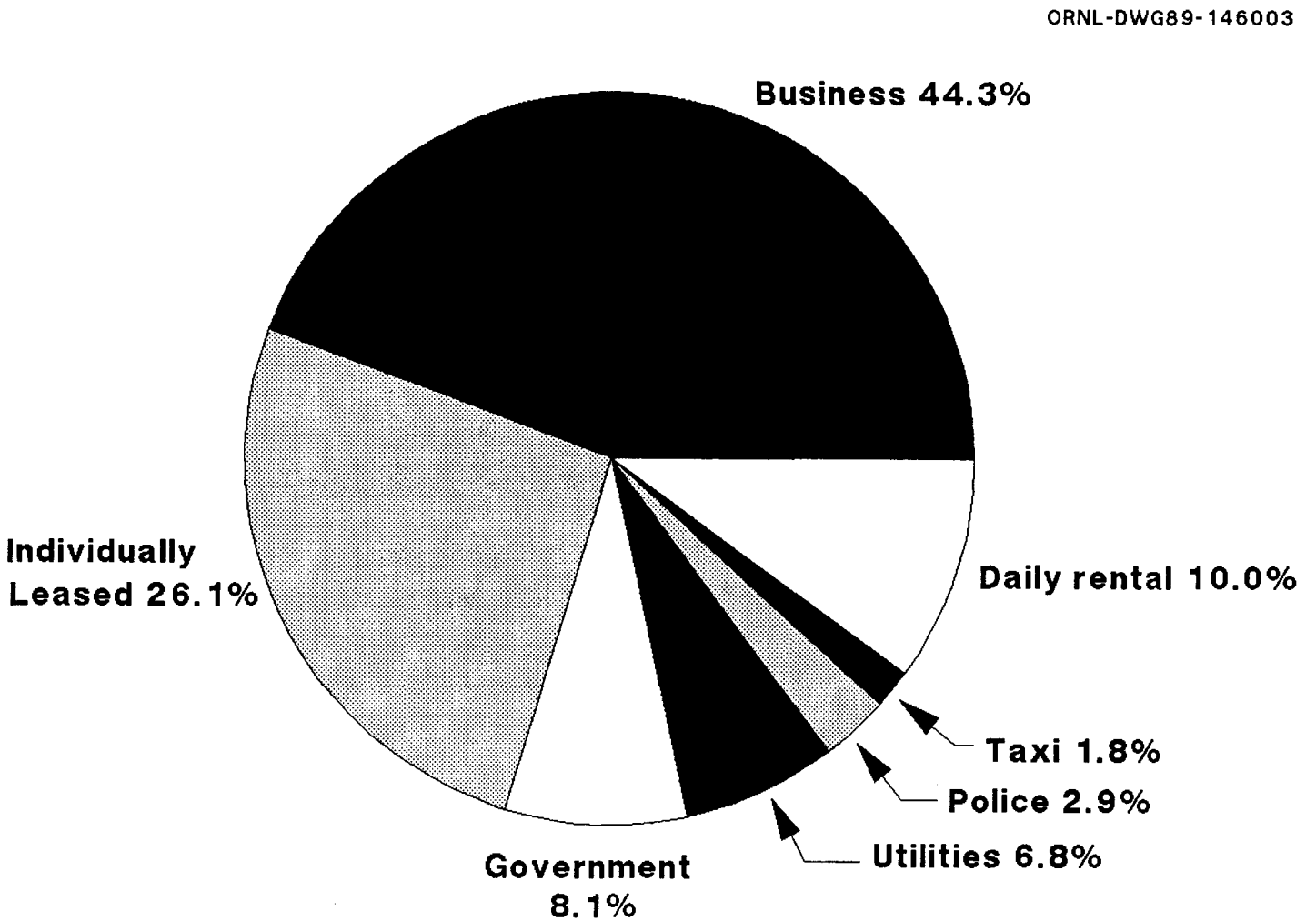
Table 3.26
Automobile Fleets by Use, 1970-87
(thousands)

Year	Cars in fleets of 10 or more								Cars in fleets of 4 or more
	Business fleets[a]	Individual leased	Government[b]	Utilities	Police	Taxi	Daily rental	Total cars	
1970	2,529	803	674	416	207	171	314	5,114	9,992
1971	2,573	834	695	421	218	174	319	5,234	10,070
1972	2,664	925	670	438	236	177	341	5,451	10,094
1973	2,890	974	686	467	249	182	364	5,812	10,214
1974	2,928	1,008	701	482	261	185	361	5,926	10,324
1975	2,934	1,072	715	497	278	193	354	6,043	10,398
1976	3,066	1,217	727	508	286	202	373	6,379	10,403
1977	3,093	1,385	735	518	292	202	385	6,610	10,414
1978	3,148	1,610	747	523	294	205	448	6,975	10,423
1979	3,195	1,690	752	529	291	207	462	7,126	10,428
1980	3,279	1,708	752	532	288	205	500	7,264	10,433
1981	3,306	1,713	757	537	284	198	462	7,257	10,436
1982	3,324	1,645	603	530	223	141	457	6,923	10,076
1983	3,383	1,653	606	533	221	139	466	7,001	10,400
1984	3,422	1,657	638	540	228	140	755[c]	7,380	10,475
1985	3,484	1,800	643	540	233	140	760	7,600	10,508
1986	3,530	1,975	647	545	238	143	790	7,868	10,560
1987	3,564	2,098	650[d]	550	240	144	800	8,046	10,578
	Average annual percentage change								
1970-87	2.0%	5.8%	-0.2%	1.7%	0.9%	-1.0%	5.7%[e]	2.7%	0.3%
1982-87	1.4%	5.0%	1.5%	0.7%	1.5%	0.4%	11.8%[e]	3.1%	1.0%

Source:
Bobit Publishing Company, Automotive Fleet Research Department, Automotive Fleet Fact Book, Redondo Beach, CA, 1988, p. 9, and annual.

[a]Includes driver schools.
[b]Data from Automotive Fleet Fact Book include state and local government vehicles only. Federal fleet data are taken from Federal Motor Vehicle Fleet Report, GSA, Table 1 (all agencies - domestic sedans and station wagons).
[c]Major adjustment by Automotive Fleet Fact Book with new data for 1984. Daily rentals were underestimated from 1970 to 1983.
[d]Federal government data for 1987 is not available; therefore, the 1987 data is assumed to be equal to the 1986 federal government figures.
[e]Average annual percentage change is misleading due to the data change in daily rentals in 1984.

Figure 3.18. Distribution of Automobile Fleets by Use, 1987



Source: See Table 3.26.

Section 3.5. Federal Standards and Motor Vehicle Fuel Economy

Table 3.27
Corporate Average Fuel Economy (CAFE) Standards for Automobiles and Light Trucks, 1978-1991[a] (miles per gallon)

Model Year	Autos	Light trucks[b]		
		Two-wheel drive	Four-wheel drive	Combined[c]
1978	18.0	[d]	[d]	[d]
1979	19.0	17.2	15.8	17.2
1980	20.0	16.0	14.0	[d]
1981	22.0	16.7	15.0	[d]
1982	24.0	18.0	16.0	17.5
1983	26.0	19.5	17.5	19.0
1984	27.0	20.3	18.5	20.0
1985	27.5	19.7	18.9	19.5
1986	26.0	20.5	19.5	20.0
1987	26.0	21.0	19.5	20.5
1988	26.0	21.0	19.5	20.5
1989	26.5	21.5	19.0	20.5
1990	27.5	20.5	19.0	20.0
1991	27.5[e]	20.5	19.1	20.2

Sources:

U.S. Department of Transportation, National Highway Traffic Safety Administration, Automotive Fuel Economy Program, 11th Annual Report to the Congress, Washington, DC, January 1987, Table I-1, p.3.

1988-91 Personal Communication with Mr. Orron Kee, National Highway Traffic Safety Administration.

[a]Only vehicles with at least 75 percent domestic content can be counted in the average fuel economy for a manufacturer. CAFE standards were originally established by Congress in Title V of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 1901 et seq.), with subsequent amendments.

[b]Gross vehicle weight of 0-6,000 pounds for model year 1979 and 0-8,500 pounds for subsequent years.

[c]Optional combined light truck fleet CAFE standards.

[d]No standard was set for this year.

[e]Subject to modification due to ongoing rulemaking.

Except for the automobile fuel economy in model year 1984, 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 is meeting the standards each year. Some manufacturers still fall short, while others exceed the standards.

Table 3.28
Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates
for Automobiles and Light Trucks, 1978-89[a]
(miles per gallon)

Model Year	Automobiles		Light Trucks[b]	
	Standard	CAFE[c]	Standard	CAFE[c]
1978	18.0	19.9	[d]	[e]
1979	19.0	20.3	17.2	18.2
1980	20.0	24.3	[d]	18.5
1981	22.0	25.9	[d]	20.1
1982	24.0	26.6	17.5	20.5
1983	26.0	26.4	19.0	20.7
1984	27.0	26.9	20.0	20.6
1985	27.5	27.6	19.5	20.7
1986	26.0	28.1	20.0	21.5
1987	26.0	28.4	20.5	21.6
1988	26.0	28.7	20.5	21.3
1989	26.5	28.3	20.5	21.0

Sources:
Standards - U.S. Department of Transportation, National Highway Traffic Safety Administration, Automotive Fuel Economy Program, 11th Annual Report to Congress, Washington, DC, January 1987, Table I-1, p.3.
CAFE - U.S. Department of Transportation, National Highway Traffic Safety Administration, "Summary of Fuel Economy Performance Estimated on a Year-To-Year Basis Comparing Grouped Vehicle Fleets and Manufacturers' Individual Fleets," February 1, 1989.

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

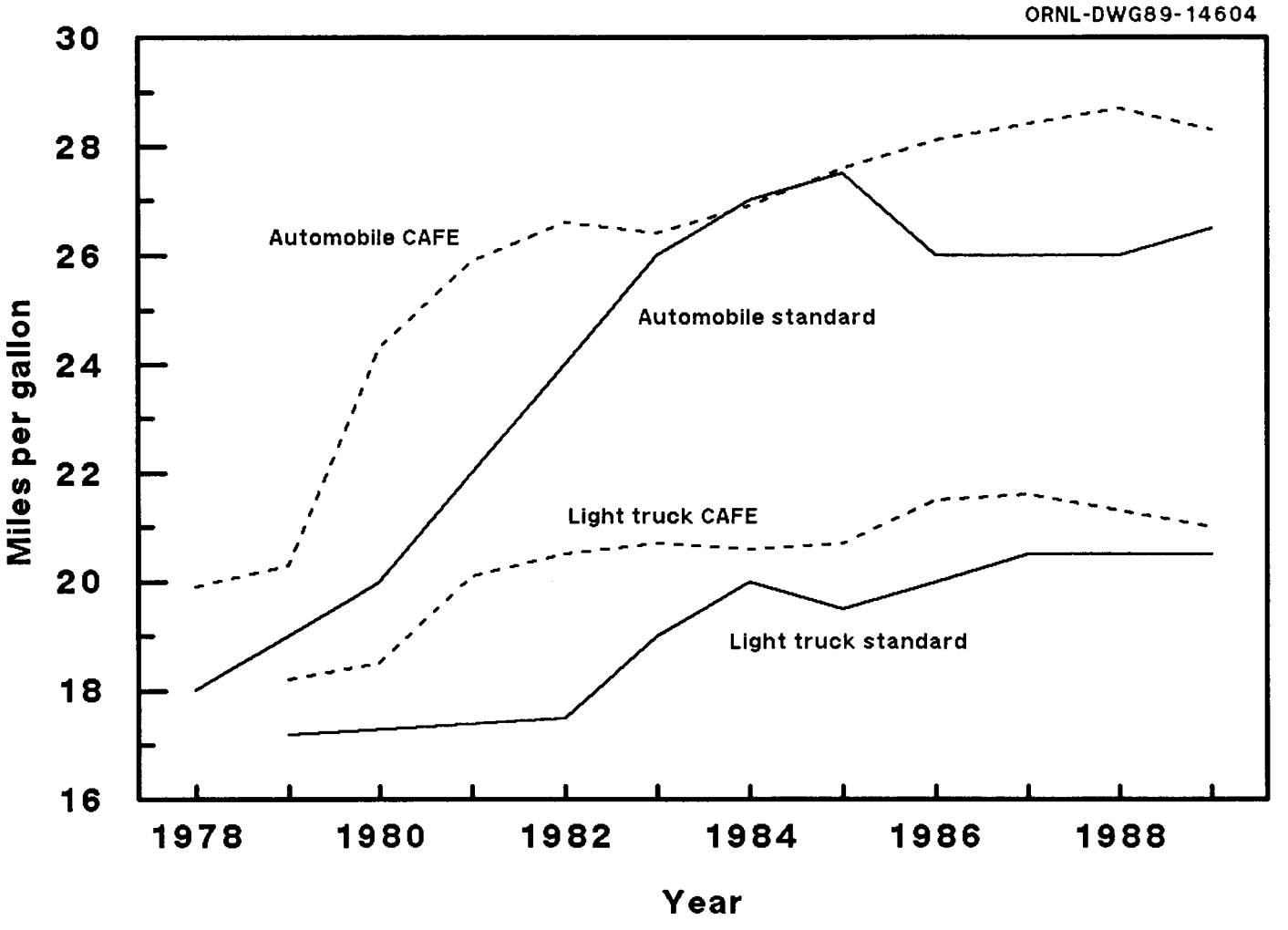
[b]Represents two- and four-wheel drive trucks combined. Gross vehicle weight of 0-6,000 pounds for model year 1979 and 0-8,500 pounds for subsequent years.

[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.

Figure 3.19. Corporate Average Fuel Economy Standards and Sales-Weighted Fuel Economies for Automobiles and Light Trucks, 1978-89



Source: See Table 3.28.

Table 3.29
Federal Emission Control Requirements for Automobiles and Light Trucks, 1976-94[a]
(grams per mile)

Model Year	Automobiles				Light trucks[b]			
	Hydro-carbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO_x)	Particulates[c]	Hydro-carbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO_x)	Particulates[c]
1976	1.50	15.0	3.1	[d]	2.0	20.0	3.1	[d]
1977	1.50	15.0	2.0	[d]	2.0	20.0	3.1	[d]
1978	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	0.41	3.4	1.0	0.6	1.7	18.0	2.3	0.60
1983	0.41	3.4	1.0	0.6	1.7	18.0	2.3	0.60
1984	0.41	3.4	1.0	0.6	0.8	10.0	2.3	0.60
1985	0.41	3.4	1.0	0.6	0.8	10.0	2.3	0.60
1986	0.41	3.4	1.0	0.6	0.8	10.0	2.3	0.60
1987	0.41	3.4	1.0	0.2	0.8	10.0	2.3	0.26
1988	0.41	3.4	1.0	0.2	0.8	10.0	1.2[e]	0.26
1989	0.41	3.4	1.0	0.2	0.8	10.0	1.2[e]	0.26
1990	0.41	3.4	1.0	0.2	0.8	10.0	1.2[e]	0.26
1991	0.41	3.4	1.0	0.2	0.8	10.0	1.2[e]	0.26
1992	0.41	3.4	1.0	0.2	0.8	10.0	1.2[e]	0.26
1993	0.41	3.4	1.0	0.2	0.8	10.0	1.2[e]	0.26
1994	0.41	3.4	1.0	0.2	0.8	10.0	1.2[e]	0.26

Source:
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.

[a]California standards not included.
[b]Applies to trucks under 6,000 pounds gross vehicle weight (GVW) until model year 1978 and under 8,500 pounds GVW 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). The standard for light trucks over 3,750 pounds LVW is 2.3 until 1990 when it reverts to 1.7.

Table 3.30
Federal Emission Control Requirements for Heavy-Duty Gasoline Trucks, 1976-94[a]
(grams per brake horsepower hour)

Model Year	Hydrocarbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO_x)	Hydrocarbons + nitrogen oxides (HC + NO_x)
1976	[b]	40.0	[b]	16.0
1977	[b]	40.0	[b]	16.0
1978	[b]	40.0	[b]	16.0
1979	1.5	25.0	[b]	10.0
1980	1.5	25.0	[b]	10.0
1981	1.5	25.0	[b]	10.0
1982	1.5	25.0	[b]	10.0
1983	1.5	25.0	[b]	10.0
1984	1.3	15.5	10.7	[b]
1985	2.5	40.0	10.7	[b]
1986	2.5	40.0	10.7	[b]
1987	1.9	37.1	10.6	[b]
1988	1.9	37.1	10.6	[b]
1989	1.9	37.1	10.6	[b]
1990	1.9	37.1	6.0	[b]
1991	1.9	37.1	5.0	[b]
1992	1.9	37.1	5.0	[b]
1993	1.9	37.1	5.0	[b]
1994	1.9	37.1	5.0	[b]

Source:
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.

[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 from 1987 to 1994.

[b]No standard was set for this year.

Table 3.31
Federal Emission Control Requirements for Heavy-Duty Diesel Trucks, 1976-94[a]
(grams per brake horsepower hour)

Model Year	Hydrocarbons (HC)	Carbon monoxide (CO)	Nitrogen oxides (NO_x)	Hydrocarbons + nitrogen oxides (HC + NO_x)	Particulates
1976	[b]	40.0	[b]	16.0	[b]
1977	[b]	40.0	[b]	16.0	[b]
1978	[b]	40.0	[b]	16.0	[b]
1979	1.5	25.0	[b]	10.0	[b]
1980	1.5	25.0	[b]	10.0	[b]
1981	1.5	25.0	[b]	10.0	[b]
1982	1.5	25.0	[b]	10.0	[b]
1983	1.5	25.0	[b]	10.0	[b]
1984	1.3	15.5	10.7	5.0	[b]
1985	1.3	15.5	10.7	[b]	[b]
1986	1.3	15.5	10.7	[b]	[b]
1987	1.3	15.5	10.7	[b]	[b]
1988	1.3	15.5	10.7	[b]	0.60
1989	1.3	15.5	10.7	[b]	0.60
1990	1.3	15.5	6.0	[b]	0.60
1991	1.3	15.5	5.0	[b]	0.25
1992	1.3	15.5	5.0	[b]	0.25
1993	1.3	15.5	5.0	[b]	0.25
1994	1.3	15.5	5.0	[b]	0.10

Source:
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.

[a]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.

[b]No standard was set for this year.

From 1986 onward, consumers must pay the Gas Guzzler Tax when purchasing an automobile that has an Environmental Protection Agency (EPA) fuel economy rating less than 22.5 miles per gallon.

Table 3.32
The Gas Guzzler Tax on New Cars, 1980-89
(in dollars)

Vehicle fuel economy (mpg)	1980	1981	1982	1983	1984	1985	1986-89
Over 22.5	0	0	0	0	0	0	0
22.0-22.5	0	0	0	0	0	0	500
21.5-22.0	0	0	0	0	0	0	500
21.0-21.5	0	0	0	0	0	0	650
20.5-21.0	0	0	0	0	0	500	650
20.0-20.5	0	0	0	0	0	500	850
19.5-20.0	0	0	0	0	0	600	850
19.0-19.5	0	0	0	0	450	600	1050
18.5-19.0	0	0	0	350	450	800	1050
18.0-18.5	0	0	200	350	600	800	1300
17.5-18.0	0	0	200	500	600	1000	1300
17.0-17.5	0	0	350	500	750	1000	1500
16.5-17.0	0	200	350	650	750	1200	1500
16.0-16.5	0	200	450	650	950	1200	1850
15.5-16.0	0	350	450	800	950	1500	1850
15.0-15.5	0	350	600	800	1150	1500	2250
14.5-15.0	200	450	600	1000	1150	1800	2250
14.0-14.5	200	450	750	1000	1450	1800	2700
13.5-14.0	300	550	750	1250	1450	2200	2700
13.0-13.5	300	550	950	1250	1750	2200	3200
12.5-13.0	550	650	950	1550	1750	2650	3200
Under 12.5	550	650	1200	1550	2150	2650	3850

Source:
Internal Revenue Service, Form 6197, "Gas Guzzler Tax for 1986 and Later Model Year Automobiles," and annual.

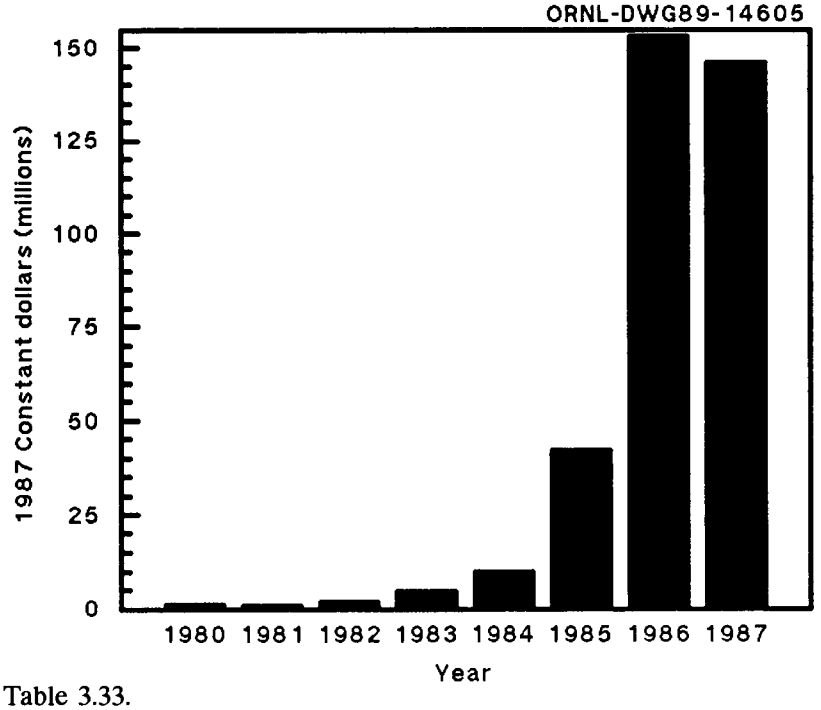
Gas guzzler tax revenue (in constant 1987 dollars) has increased at an impressive average annual rate of 51% since 1980.

Table 3.33
Tax Receipts from the Sale of Gas Guzzlers, 1980-87

	Thousands	
Fiscal year	Current dollars	1987 constant dollars[a]
1980	740	1,020
1981	780	975
1982	1,720	2,026
1983	4,020	4,587
1984	8,820	9,649
1985	39,790	42,058
1986	147,660	153,123
1987	145,900	145,900

Source:
Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '88, Detroit, MI, 1988, p. 77.

Figure 3.20. Tax Receipts from the Sale of Gas Guzzlers, 1980-87



Source: See Table 3.33.

[a]Adjusted by the Consumer Price Inflation Index.

Table 3.34
Model Year 1988 and 1989 Cars Subject to Gas Guzzler Tax

Manufacturer Division	Model	Transmission	Miles per gallon[a] 1988	Tax (dollars) 1988	Miles per gallon[a] 1989	Tax (dollars) 1989
Aston-Martin	Lagonda	L3	11	3,850	11	3,850
	Saloon/Vantage/Volante	L3	11	3,850	11	3,850
	Saloon/Vantage/Volante	M5	11	3,850	11	3,850
BMW	5 Series	L4	21	650	19	1,050
	(3.4 liter engine)	M5	20	850	21	650
	(3.5 liter engine)	M5	15	2,250	[b]	2,250
	6 Series	L4	18	1,300	19	650
	(3.4 liter engine)	M5	20	850	21	1,050
	(3.5 liter engine)	M5	15	2,250	15	1,850
	7 Series	M5	20	850	21	650
	(3.4 liter engine)	L4	19	1,050	19	1,050
	(5.0 liter engine)	L4	16	1,850	16	1,850
Cadillac	Allante	L4	23[c]	[d]	20	850
Chrysler	Newport/Fifth Avenue	L3	23	[d]	21	650
	TC by Maserati	A3	[b]	[b]	22	500
Dodge	Diplomat	L3	23	[d]	21	650
Ferrari	Testarossa	M5	13	3,200	13	3,200
	GTS/GTB	M5	17	1,500	17	1,500
	Mondial/Cabriolet	M5	17	1,500	17	1,500
Jaquar	XJ-SC	A3	17	1,500	16	1,850
Lamborghini	Countach	M5	9	3,850	[b]	[b]
Mercedes-Benz	300TE	A4	21	650	22	500
	300SE	A4	21	650	21	650
	300SEL	A4	21	650	21	650
	420SEL	A4	19	1,050	19	1,050
	560SEC	A4	17	1,500	17	1,500
	560SL	A4	17	1,500	17	1,500
	560SEL	A4	17	1,500	17	1,500
Plymouth	Gran Fury	L3	23	[d]	21	650
Porsche	Carrera (Turbo)	M5	[b]	[b]	18	1,300
	911 Turbo	M5	21	650	20	850
	928 S4	A4	21	650	20	850
	928 S4	M5	21	650	20	850
Rolls-Royce	Bentley Continental	A3	12	3,850	12	3,850
	Bentley Eight/Bentley Mulsan	A3	12	3,850	12	3,850
	Bentley Turbo R	A3	[b]	[b]	13	3,200
	Corniche II	A3	12	3,850	12	3,850
	Silver Spur Limousine	A3	12	3,850	12	3,850
	Silver Spirit/Silver Spur	A3	12	3,850	12	3,850
Volvo	760	A4	21	650	21	650
	780	A4	21	650	21	650

Source:
Data compiled from information sent to ORNL on diskette by the U.S. Environmental Protection Agency, Ann Arbor, MI, October 19, 1988.

[a]The figures shown here are the **unadjusted** fuel economies produced by the Environmental Protection Agency (EPA). These numbers will not match the numbers published in the 1988 and 1989 Gas Mileage Guides. Mpg is calculated based on EPA rating of 55-percent city and 45-percent highway mileage.

[b]This model was not tested by the EPA in this year.

[c]Buyers of the Cadillac Allante did not pay gas guzzler tax in 1988 because the fuel economy was between 22.5 and 23 mpg. The number was rounded to 23 mpg.

[d]This model was not subject to the gas guzzler tax in 1988.

Fifteen vehicles were tested to study the relationship between vehicle speed and vehicle fuel efficiency. Other than the fact that the fuel efficiency of a vehicle changed with its speed, data from the study also indicated that the speed that achieved the maximum fuel efficiency varied from vehicle to vehicle and that a greater fuel economy loss occurred with a shift from 65 to 75 miles per hour (mph) than with a shift from 55 to 65 mph. However, the majority of the non-diesel vehicles achieved their highest fuel efficiencies at 45 mph.

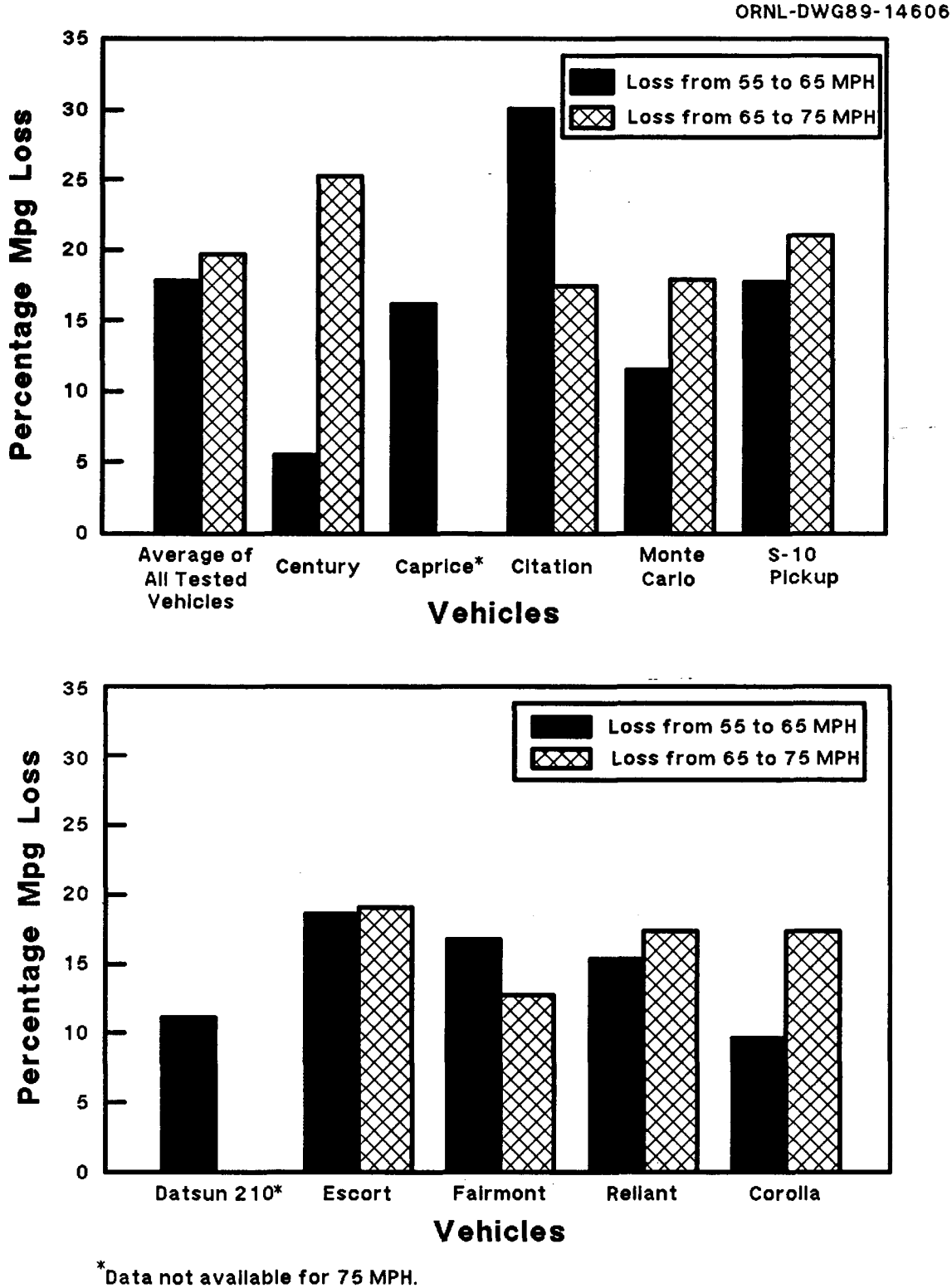
Table 3.35
Fuel Economy at Various Speeds for Selected Vehicles[a]
(miles per gallon)

Vehicles	Speed (miles per hour)							Fuel economy loss from:	
	15	25	35	45	55	65	75	55-65 mph	65-75 mph
1981 Buick Century (6-cylinder)	23.5	29.4	30.2	31.3	29.2	27.6	20.7	5.5%	25.2%
1981 Chevrolet Caprice - Diesel (8-cylinder)	21.2	31.3	33.7	36.5	33.0	27.7	[b]	16.1%	[b]
1982 Chevrolet Caprice Wagon (8-cylinder)	17.5	20.1	24.6	30.6	23.3	21.4	16.1	8.2%	24.7%
1982 Chevrolet Chevette - Diesel (4-cylinder)	57.3	70.7	49.0	47.2	39.7	27.6	[b]	30.5%	[b]
1982 Chevrolet Citation (4-cylinder)	15.1	25.2	32.6	36.4	33.7	23.6	19.5	30.0%	17.4%
1983 Chevrolet Monte Carlo (6-cylinder)	20.9	28.6	31.4	31.9	29.5	26.1	21.4	11.5%	17.9%
1983 Chevrolet Pickup - Diesel (8-cylinder)	18.2	24.7	24.7	23.8	22.9	18.9	16.2	17.5%	14.3%
1984 Chevrolet S-10 Pickup (4-cylinder)	22.0	28.4	33.6	34.1	26.5	21.8	17.2	17.7%	21.0%
1982 Datsun 210 (4-cylinder)	44.0	55.5	54.7	43.0	37.7	33.5	[b]	11.1%	[b]
1983 Ford Escort (4-cylinder)	28.9	45.1	45.7	39.0	36.3	29.6	24.0	18.5%	19.0%
1982 Ford Fairmont (4-cylinder)	21.4	30.9	32.2	32.2	27.6	23.0	20.1	16.7%	12.7%
1982 Ford Futura (6-cylinder)	24.6	33.5	33.6	31.8	28.0	23.6	18.6	15.7%	21.2%
1983 Pontiac Firebird (6-cylinder)	21.3	29.2	38.0	34.2	33.6	30.6	26.5	8.9%	13.3%
1983 Plymouth Reliant (4-cylinder)	21.6	32.4	32.5	29.9	28.1	23.8	19.7	15.3%	17.3%
1982 Toyota Corolla (4-cylinder)	37.0	35.0	36.3	32.8	30.3	27.4	22.7	9.6%	17.3%
Sales-Weighted Average	21.1	**30.0**	**33.6**	**33.5**	**30.3**	**24.9**	20.0	**17.8%**	**19.7%**

Source:
For methodology see: Dr. R. McGill, Fuel Consumption and Emission Values for Traffic Models (FHWA/RD-85/053), May 1985. Data provided by Mr. Bruce Peterson, ORNL.

[a]Cruise speeds (zero acceleration).
[b]Data are not available.

Figure 3.21. Fuel Economy Losses of Individual Test Vehicles

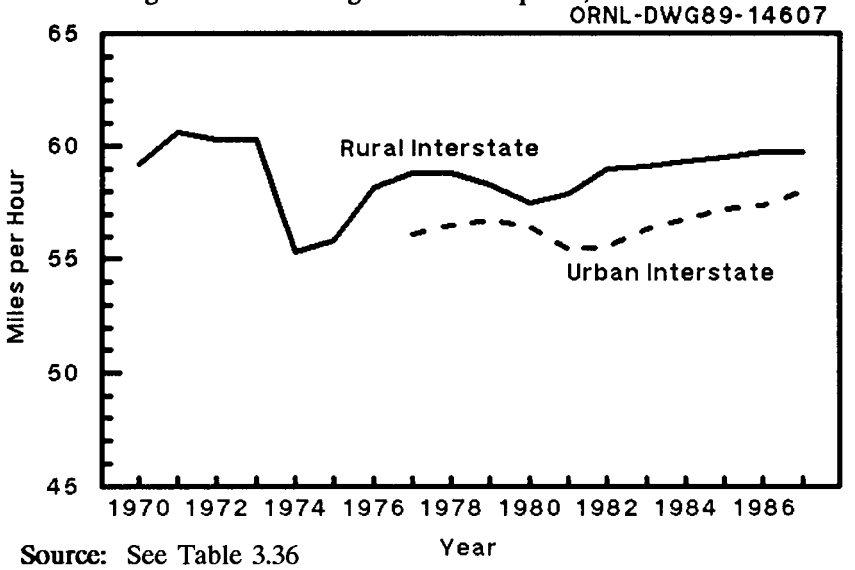


*Data not available for 75 MPH.

Source: See Table 3.35

Both urban and rural average interstate speeds declined from 1978 to 1980, but since 1980 the speeds have been increasing each year. The difference in speed between urban and rural interstate has been approximately 2 mph since the urban data was first collected in 1976.

Figure 3.22. Average Interstate Speeds, 1970-87



Source: See Table 3.36

Table 3.36
Average Urban and Rural Interstate Speeds, 1970-87[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

Source:
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1987, Washington, DC, 1988, Table VS-1, p. 176, 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 the 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.

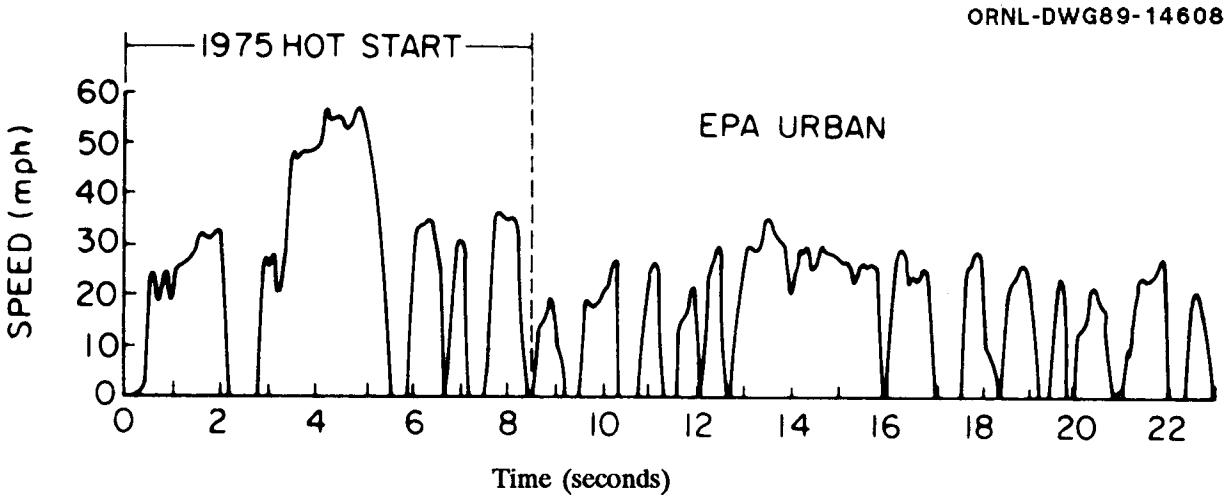


Figure 3.23. Urban Driving Cycle
Length of cycle: 1870 seconds, including idle time.
Average speed: 21.3 mph with idle; 26.5 mph without idle.

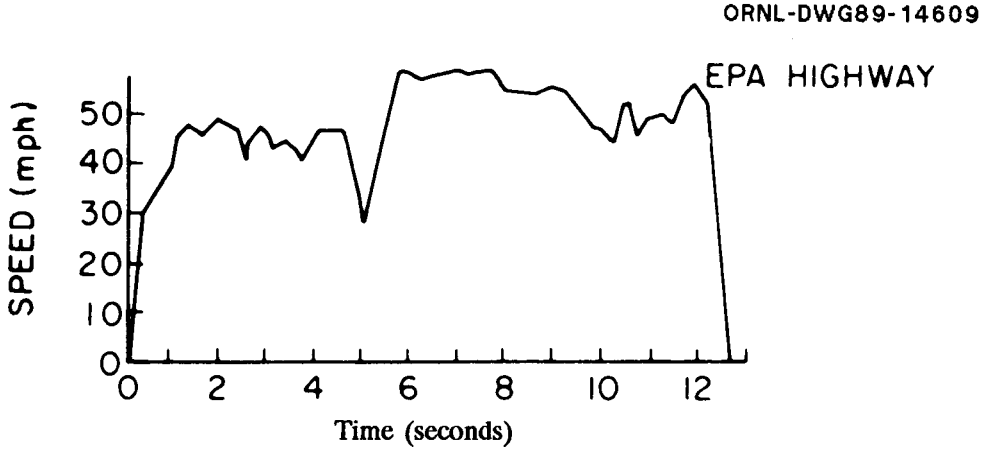


Figure 3.24. Highway Driving Cycle
Length of cycle: 765 seconds.
Average speed: 48.5 mph.

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.

Table 3.37
Population and Vehicle Profile, 1970-87

Year	Resident population[a] (thousands)	Total households (thousands)	Number of vehicles in operation (thousands)	Number of licenced drivers (thousands)	Number of civilian employed persons (thousands)	Vehicles per capita	Vehicles per household	Licenced drivers per household	Vehicles per licenced driver	Vehicles per civilian employed persons
1970	203,984	63,401	98,136	111,543	78,678	0.48	1.55	1.76	0.88	1.25
1971	206,827	64,374	101,600	114,426	79,367	0.49	1.58	1.78	0.89	1.28
1972	209,284	66,676	106,212	118,414	82,153	0.51	1.56	1.78	0.90	1.29
1973	211,357	68,631	111,217	121,546	85,064	0.53	1.59	1.77	0.92	1.31
1974	213,342	69,859	115,920	125,427	86,794	0.54	1.63	1.79	0.92	1.34
1975	215,465	71,120	120,054	129,791	85,846	0.56	1.69	1.82	0.92	1.40
1976	217,563	72,867	124,378	134,036	88,752	0.57	1.69	1.83	0.93	1.40
1977	219,760	74,142	128,126	138,121	92,017	0.58	1.73	1.85	0.93	1.40
1978	222,095	76,030	133,522	140,844	96,048	0.60	1.76	1.84	0.95	1.39
1979	224,567	77,330	137,260	143,284	98,824	0.61	1.70	1.83	0.97	1.39
1980	227,255	80,776	139,832	145,295	99,303	0.62	1.73	1.80	0.96	1.41
1981	229,637	82,368	141,908	147,075	100,397	0.62	1.72	1.79	0.96	1.41
1982	231,996	83,527	143,854	150,234	99,526	0.62	1.72	1.80	0.96	1.45
1983	234,284	83,918	147,104	154,389	100,834	0.63	1.75	1.83	0.95	1.46
1984	236,477	85,407	152,162	155,424	105,005	0.64	1.78	1.82	0.98	1.45
1985	238,741	86,789	157,048	156,868	107,150	0.66	1.81	1.81	1.00	1.47
1986	241,078	88,458	162,094	159,487	109,597	0.67	1.83	1.80	1.02	1.48
1987	243,249	89,479	167,193	161,818	112,440	0.69	1.87	1.81	1.03	1.49
				Average annual percentage change						
1970-87	1.0%	2.0%	3.2%	2.2%	2.1%	2.2%	1.1%	0.2%	0.9%	1.0%
1982-87	1.0%	1.4%	3.1%	1.5%	2.5%	2.2%	1.7%	0.1%	1.4%	0.5%

Sources:

1970-86 Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States 1988, 107th edition, Washington, DC, pp. 7, 43, 368, and annual.

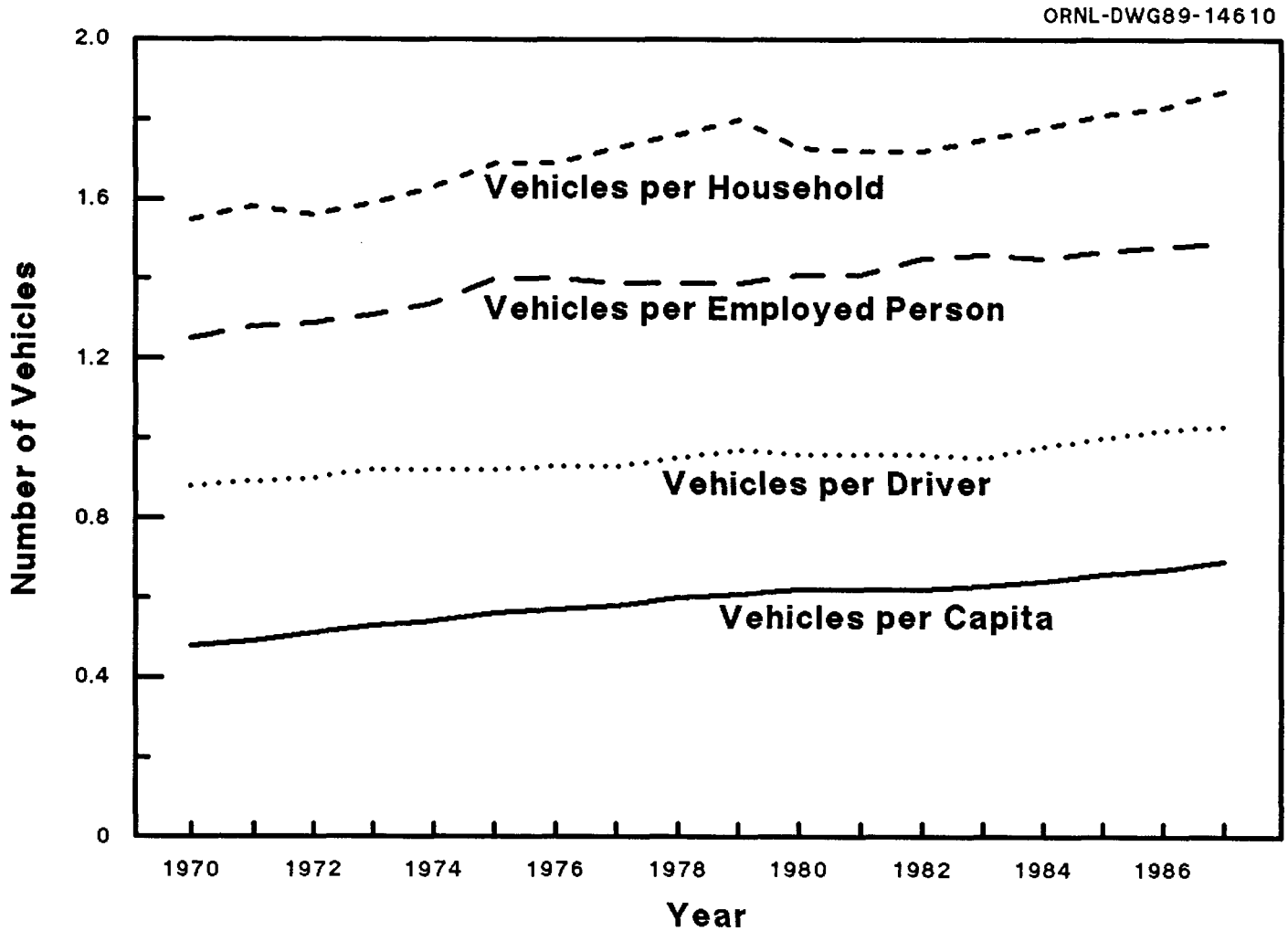
1970-86 Vehicles in use - R. L. Polk and company. **FURTHER REPRODUCTION PROHIBITED.**

1970-86 Licensed drivers - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1987, Table DL-1, p. 29, and annual.

1987 data - Personal communication with the Bureau of the Census, Bureau of Labor Statistics, and Federal Highway Administration.

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

Figure 3.25. Population and Vehicle Profile, 1970-87



Source: See Table 3.37.

Table 3.38
Financial Profile of the Population, 1970-87

Year	Median household income: Current dollars	Median household income: Constant 1987 dollars[c]	Vehicles per household	Household income per household vehicle[a]: Constant 1987 dollars[c]	Disposable income per capita: Current dollars	Disposable income per capita: Constant 1987 dollars[c]	Vehicles per capita	Disposable income per vehicle[b]: Constant 1987 dollars[c]
1970	8,734	25,564	1.55	16,493	3,489	10,212	0.48	21,275
1971	9,028	25,333	1.58	16,034	3,740	10,494	0.49	21,416
1972	9,697	26,347	1.56	16,889	4,000	10,868	0.51	21,310
1973	10,512	26,890	1.59	16,912	4,481	11,462	0.53	21,626
1974	11,197	25,809	1.63	15,834	4,855	11,191	0.54	20,724
1975	11,800	24,922	1.69	14,747	5,291	11,175	0.56	19,955
1976	12,686	25,334	1.69	14,991	5,744	11,471	0.57	20,125
1977	13,572	25,461	1.73	14,717	6,262	11,747	0.58	20,253
1978	15,064	26,241	1.76	14,910	6,968	12,138	0.60	20,230
1979	16,461	25,778	1.70	15,164	7,682	12,030	0.61	19,721
1980	17,710	24,422	1.73	14,117	8,421	11,612	0.62	18,729
1981	19,074	23,842	1.72	13,862	9,243	11,554	0.62	18,635
1982	20,171	23,761	1.72	13,815	9,724	11,455	0.62	18,476
1983	21,018	23,982	1.75	13,704	10,340	11,798	0.63	18,727
1984	22,415	24,522	1.78	13,776	11,257	12,315	0.64	19,242
1985	23,618	24,964	1.81	13,792	11,861	12,537	0.66	18,995
1986	24,897	25,818	1.83	14,108	12,496	12,958	0.67	19,340
1987	25,986	25,986	1.87	13,896	13,157	13,157	0.69	19,068
				Average annual percentage change				
1970-87	6.6%	0.1%	1.1%	-1.0%	8.1%	1.5%	2.2%	-0.6%
1982-87	5.2%	1.8%	1.7%	0.1%	6.2%	2.8%	2.2%	0.6%

Sources:

Median household income and disposable income per capita - U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 107th ed., Washington, DC, 1988, pp. 415, 422, and annual.

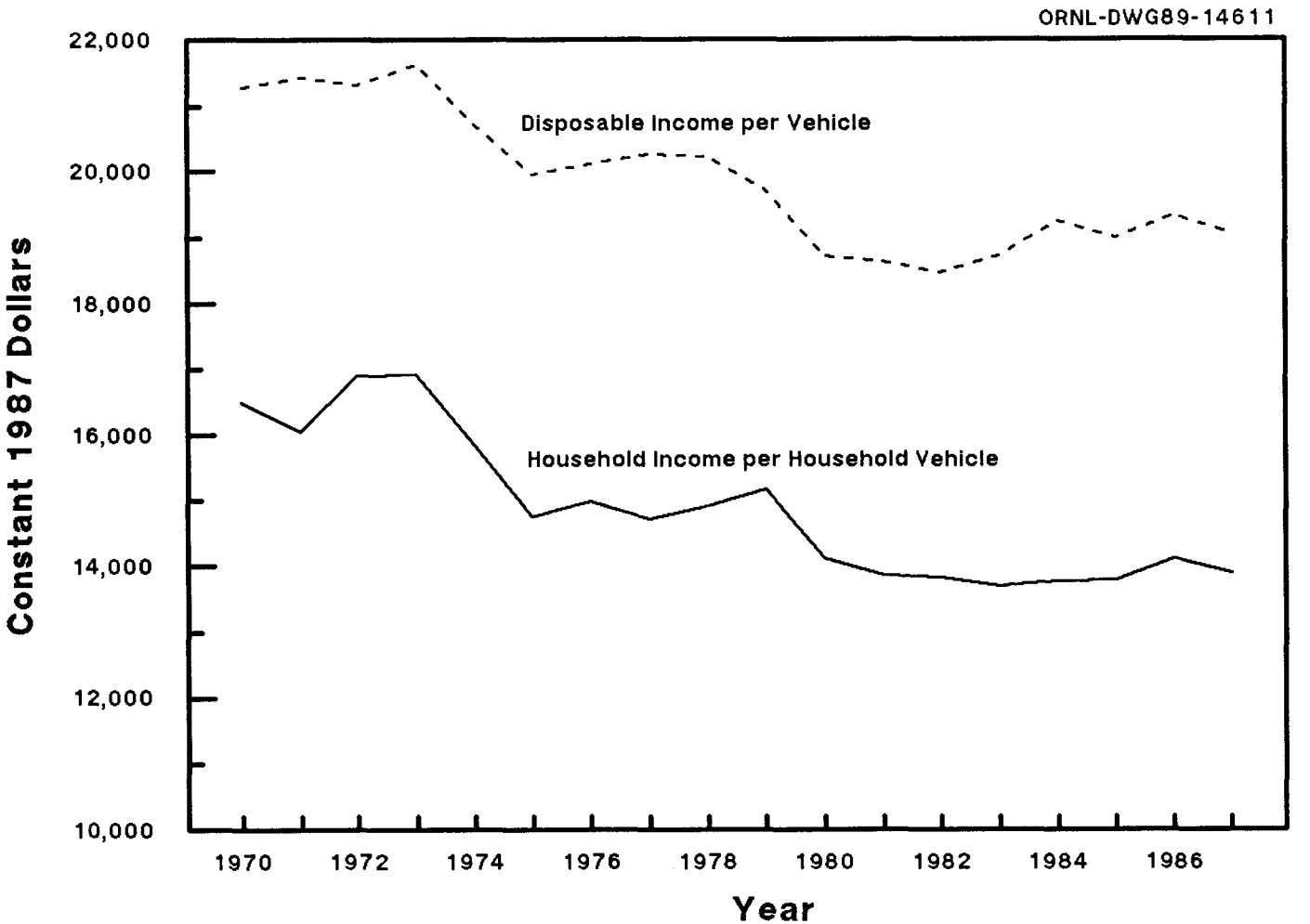
Vehicles per household and vehicles per capita - See Table 3.37.

[a]Median household income divided by the number of vehicles per household equals the household income per household vehicle.

[b]Disposable income per capita divided by the number of vehicles per capita equals disposable income per vehicle.

[c]Adjusted by the Consumer Price Inflation Index.

Figure 3.26. Financial Profile, 1970-87



Source: See Table 3.38.

The number of air trips is much less than the number of auto and truck trips, but since the air trips are much longer, the total miles traveled by air for long trips is more than that for highway travel.

Table 3.39
Demographic Characteristics of Auto/Truck/Recreational Vehicle (RV) and Air Travelers, 1987[a]
(percentage)

	Total travelers	Auto/truck/RV travelers	Air travelers
Sex			
Male	51	50	54
Female	49	50	46
Age			
18-24 years	15	15	13
25-34 years	27	26	29
35-44 years	21	20	23
45-54 years	15	15	15
55-64 years	12	13	10
65 years and over	11	12	9
Household size			
One person	20	18	24
Two people	32	33	32
Three people	18	19	18
Four people	17	18	15
Five or more people	12	12	11
Family income			
Less than 10,000	9	9	6
$10,000 - $19,999	18	21	12
$20,000 - $29,999	21	23	16
$30,000 - $39,999	19	19	20
$40,000 - $49,999	13	13	14
$50,000 - $74,999	13	11	18
$75,000 - $99,999	3	2	6
$100,000 or more	3	2	7
Region of origin of trip			
New England	5	4	5
Mid-Atlantic	14	13	17
South Atlantic	17	18	16
East South Central	7	7	6
East North Central	16	16	15
West South Central	11	12	9
West North Central	9	10	6
Mountain	7	6	9
Pacific	15	14	17
Average trip distance[b] (miles)	990	650	2030
Total miles (billions)	630	282	326
Total trips (millions)	636.3[c]	433.7	160.7

Source:
U.S. Travel Data Center, 1987 Travel Market Close-Up, Washington, DC, 1988, pp. 81, 89, and 93.

[a]The sum of the components may not equal 100 percent due to rounding.
[b]Based on total trips taken in category, not total travelers.
[c]The total exceeds the sum of automobile and air travel because some trips are made by bus and rail.

Americans on the average traveled much more in 1987 than they did in 1974. The number of business trips increased by 132%, while total number of trips increased by 127%. The length of the trips also increased during this time period; average distance of weekend trips increased by 36%, and total trip distance increased by 25% from 1974 to 1987. Of the trip types, the number of vacation and pleasure trips increased the most from 1974 to 1986.

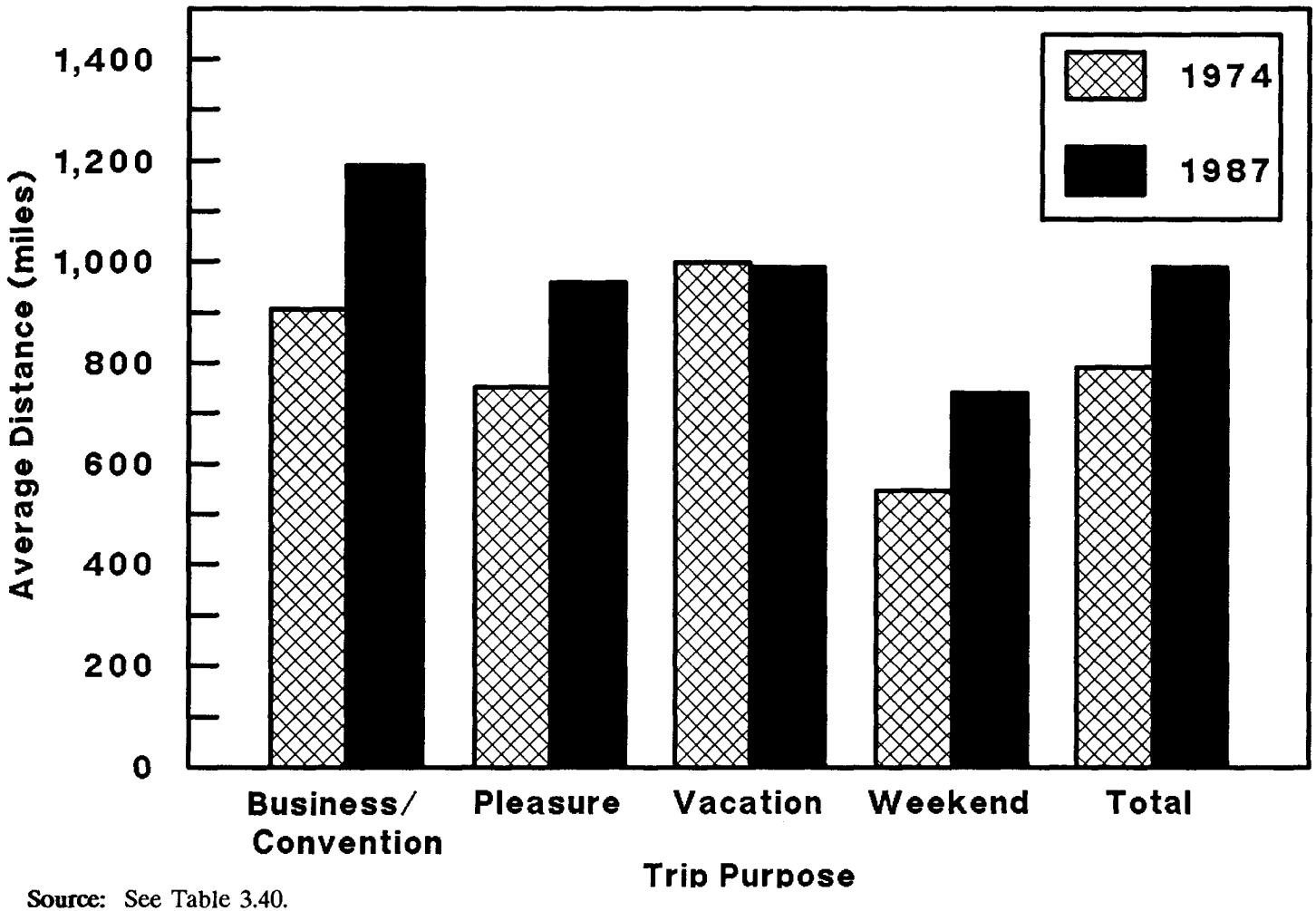
Table 3.40
Distribution of Trips for All Modes by Trip Purpose and Round-Trip Distance, 1974 and 1987[a]
(percentage)

Round-trip distance (miles)	Business/convention		Pleasure		Vacation		Weekend		Total	
	1974	1987	1974	1987	1974	1987	1974	1987	1974	1987
200-299	16	15	21	21	14	20	22	25	20	20
300-399	16	12	18	16	13	15	21	20	18	15
400-599	20	16	20	16	18	16	25	18	20	16
600-999	18	18	16	16	18	16	18	17	16	16
1,000-1,999	17	17	11	14	16	15	8	9	13	14
2,000 or more	11	18	9	12	15	12	3	8	9	13
Outside U.S.	2	4	5	6	8	7	2	3	4	5
Total[b]	100	100	100	100	100	100	100	100	100	100
Average distance[c]	905	1190	751	960	998	990	546	740	791	990
Total trips (millions)	**67.8**	**157.5**	**163.9**	**444.9**	**113.9**	**366.2**	**109.4**	**274.4**	**280.7**	**636.3**

Source:
1974 data - U.S. Travel Data Center, 1974 National Travel Survey, Full Year Report, Washington, DC, 1975, pp. 34, 50, 58, 62, 66.
1987 data - U.S. Travel Data Center, 1987 Travel Market Close-Up, Washington, DC, 1988, p. 1.

[a]A trip is defined as "each time a person goes to a place at least 100 miles from home and returns." Trip types are not mutually exclusive.
[b]Totals may not equal the sum of the components due to rounding.
[c]Round trip straight-line distance for domestic travel only.

Figure 3.27. Average Distance of Trips by Trip Purpose, 1974 and 1987



Source: See Table 3.40.

Spending on transportation was the second largest expenditure in an average household - 21% of the total income. In 1986, approximately 30% of total expenditures on transportation was for purchasing new vehicles, and 19% was for gasoline and motor oil. The higher income groups spent more than the average rate on purchasing new vehicles and less than the average rate on gasoline and motor oil.

Table 3.41
Average Annual Expenditures of Households by Income, 1986[a]

	All households	Income: Less than $5,000	$5,000 to $9,999	$10,000 to $14,999	$15,000 to $19,999	$20,000 to $29,999	$30,000 to $39,999	$40,000 and over
Total expenditures	$22,710	$11,340	$11,513	$15,084	$18,266	$23,008	$28,043	$43,996
	Percentage of total expenditures[b]							
Food[c]	16.0	19.8	19.5	18.2	17.0	15.7	15.3	13.6
Housing	30.3	33.9	34.5	31.6	31.1	29.3	28.6	28.8
Apparel and services	5.1	5.0	4.9	4.5	4.8	4.9	5.0	5.3
Transportation	21.1	19.2	17.4	20.6	20.6	22.4	22.2	21.2
Cars and trucks, new	**6.2**	**4.1**	**3.6**	**4.6**	**4.2**	**5.4**	**6.3**	**7.9**
Cars and trucks, used	**3.9**	**4.6**	**3.4**	**4.2**	**4.6**	**5.0**	**4.0**	**3.1**
Other vehicles	**0.1**	**0.1**	**0.0**	**0.1**	**0.2**	**0.2**	**0.2**	**0.1**
Vehicle finance charges	**1.2**	**0.8**	**0.6**	**0.9**	**1.1**	**1.3**	**1.4**	**1.3**
Gasoline & motor oil	**4.0**	**4.3**	**4.5**	**5.0**	**4.7**	**4.4**	**4.4**	**3.2**
Maintenance and repairs	**2.0**	**2.0**	**2.1**	**2.3**	**2.3**	**2.2**	**2.1**	**1.8**
Vehicle insurance	**1.8**	**1.4**	**1.6**	**1.9**	**1.9**	**2.0**	**2.1**	**1.8**
Public transportation	**1.1**	**1.3**	**1.0**	**1.0**	**0.9**	**1.0**	**0.9**	**1.2**
Vehicle rental, licenses and other charges	**0.7**	**0.5**	**0.5**	**0.5**	**0.7**	**0.7**	**0.8**	**0.8**
Health care	4.7	5.7	7.1	6.6	6.5	4.8	3.9	3.3
Entertainment	4.8	4.7	3.4	4.0	4.6	4.6	5.4	5.2
Personal insurance and pensions	9.4	2.8	3.6	5.4	8.3	9.8	12.0	13.6
Others[d]	8.6	9.0	9.5	9.0	7.1	8.5	7.6	8.9

Source:
U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey: Interview Survey, 1986, press release, Washington, DC, April 1988; and computer printouts from the Bureau of Labor Statistics.

[a]In some cases average annual expenditures may exceed the reported amount of income. This is due to several factors such as incorrect reporting of income, indebtedness, student status, etc. 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.

In 1983, almost 16% of all workers in the United States commuted to work using carpools. On the average, commuting to work using public transportation had the longest average trip length and a low average travel speed, resulting in the longest average commute time.

Table 3.42
Characteristics of Transportation to Work, 1983

	Percent of workers	Average trip length (miles)	Average commute time (minutes)	Average travel speed (miles per hour)
Passenger car	70.6	9.9	19.1	31.1
Truck, van, and other private transportation	15.6	11.3	20.1	33.7
Public transportation	5.3	15.1	46.1	19.7
Walk	4.1	0.4	8.9	2.7
Work at home	3.5	[a]	[a]	[a]
Other	0.9	5.6	29.9	11.2
Total	100.0	9.9	20.4	29.1

Total number of workers	103,244,000
Total number of carpoolers	16,059,000
Percent carpoolers of total workers	15.6%

Source:
D. Klinger and J. Richard Kuzmyak, COMSIS Corporation, Personal Travel in the United States, Volume 1; 1983-84 Nationwide Personal Transportation Study, prepared for the U.S. Department of Transportation, Washington, DC, August 1986, pp. 7-2, 7-9,7-24.

[a]Not applicable.

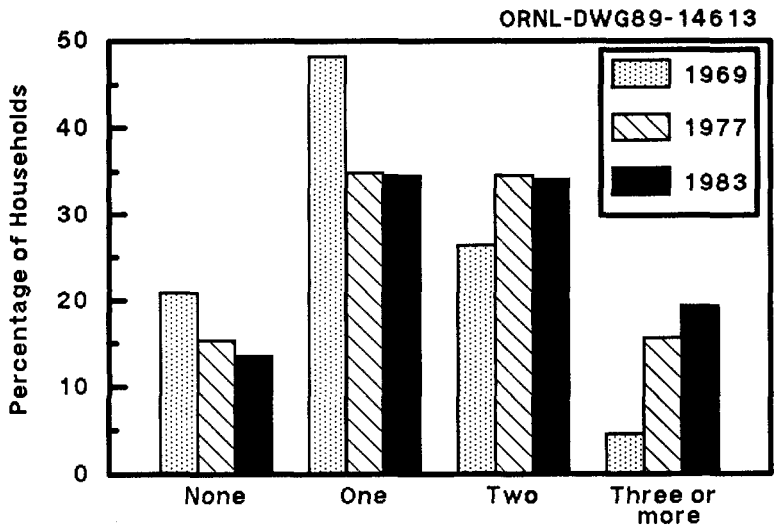
In 1969, only 31% of all households owned two or more vehicles. By 1983, over half of all households owned two or more vehicles. The percentage of households which did not own a vehicle declined from 20.9% in 1969 to 13.5% in 1983.

Table 3.43
Distribution of Households by Vehicle Ownership, 1969, 1977, and 1983[a]
(percentage)

	Number of Vehicles			
Year	None	One	Two	Three or more
1969	20.9	48.2	26.4	4.6
1977	15.3	34.7	34.4	15.6
1983	13.5	33.7	33.5	19.3

Source:
D. Klinger and J. Richard Kuzmyak, COMSIS Corporation, Personal Travel in the United States, Volume 1; 1983-84 Nationwide Personal Transportation Study, prepared for the U.S. Department of Transportation, Washington, DC, August 1986.

Figure 3.28. Distribution of Households by Vehicle Ownership, 1969, 1977, and 1983



Source: See Table 3.43.

[a]Data for 1969 includes autos and passenger vans only; data for 1977 and 1983 also includes pickup trucks and other trucks.

On the average, HOV lanes saved 45% to 50% in commuting time on highly congested highways in 1985. HOV projects were usually implemented in highways with traffic volumes of at least one thousand passengers per lane per hour during the peak period.

Table 3.44
High-Occupancy Vehicle (HOV) Projects in Operation on Freeways as of 1985

HOV lanes	Length (miles)	Year implemented	Average peak hour time saving (percent)	Peak period volume per lane per hour (number of passengers) Morning	Afternoon	Peak hour violation rate[a] (percent)
Exclusive Facilities						
I-10, Houston, TX	6.2	1984	40	1110[b]	1090[b]	[c]
I-45, Houston, TX	9.6[d]	1979	60	2390	2420	[c]
I-10, Los Angeles, CA	11.0	1973	55	3835	3560	9
I-395, Washington, DC	11.0	1969	55	4500	4370	5
I-66, Washington, DC	9.6	1982	[e]	5460	3720	20-30
Concurrent Flow						
Moanalua Fwy, Honolulu, HA	2.3	1978	65	[c]	[c]	20
Rte 91, Los Angeles, CA	8.0	1985	50	[e]	2820	7
I-95, Miami, FL	7.5	1976	20	[c]	[c]	40
Rte, 55, Orange County, FL	11.0	1985	50	2130	2630	6
I-4, Orlando, FL, Northbound	6.2	1979	[c]	940	920	75[f]
I-4, Orlando, FL Southbound	14.5	1979	[c]	130	290	75[f]
Bay Bridge, San Francisco, CA	0.9	1970	75	3480	2520	4
US 101 San Francisco, CA	3.7	1974	35	2480	2690	5
I-5, Seattle WA	40NB, 5.6SB	1983	25[g]	[c]	[c]	19[h]
SR 520 Seattle, WA	3.0	1973	60	2555	[e]	[c]
Contraflow						
Kalanianole Hwy,Honolulu, HA	2.2	1978	[c]	[c]	[e]	5-10
NJ Rte 495, New York City, NY	2.5	1970	80	16400	[e]	[c]
US 101 San Francisco, CA	4.2	1972	0	[e]	6000	0

Source:
Institute of Transportation Engineers, The Effectiveness of High-Occupancy Vehicle Facilities, 1988, pp. 11, 19, 21, 25; based on data from the 1985 Survey of Transitway Projects.

[a]As a percent of legal HOV traffic.
[b]I-10 data for 3+ carpools. Utilization by 2+ carpools now permitted.
[c]Data not available.
[d]In the mornings, a 3.2 mile concurrent flow lane is also in operation (total HOV length = 12.8 mi).
[e]Not applicable (no parallel route or comparable travel pattern).
[f]Not enforced.
[g]Time savings do not include priority ramp entry.
[h]Violation rates vary widely by location and time of day.

Table 3.45
Characteristics of Freeway High-Occupancy Vehicle Priority Lanes Proposed as of 1985[a]

City, Freeway, Type of HOV Project	Project length (miles)	Date of operation	Design and construction cost (millions)[b]	Eligible groups
1. Denver, I-25, N of CBD	10.0	1989	$66	buses, 3+ carpools
• S. 2 mi, 2-lane reversible				
• N. 8 mi, concurrent flow				
2. Houston, US 59, Southwest Fwy.	8.5	1990	$102	buses, vans
• Physically separated in fwy median				
• Initial, 1-lane reversible				
• Ultimate, 7.5 mi of 2-lane, 2-way + 1 mi of l-lane reversible (1995)				
3. Houston, US 290, Northwest Fwy.	14.0	1988	$105	buses, vans
• Physically separated in fwy median				
2 lanes, 2 direction	2.0			
1 lane reversible	12.0			
4. Houston, I-10 Katy Freeway	5.3	1987	$13	buses, 3+ carpool
• Extension of Operating Transitway				
• Physically separated in fwy median				
• 1-lane reversible				
5. Houston, I-45, Gulf Fwy	15.5	1988-90	$90	buses, vans
• Physically separated in fwy median				
• l-lane reversible				
6. Houston, I-45, North Freeway	4.9	1988	$22	buses, vans
• Extension of operating transitway				
• Physically separated in fwy median				
7. Miami/Fort Lauderdale				
• Extension of I-95 concurrent flow	42.0	1991	$456	buses, 3+ carpools
• 1 lane each direction				
8. Seattle, I-5, S of CBD				
• 1 Concurrent flow NB lane	7.3	1992	$33	buses, 3+ carpools
• 1 Concurrent flow SB lane	4.8			
9. Seattle, I-90, E of CBD	9.5	1993	$470	buses, carpools, future light rail
• 2 lanes-reversible				
10. Seattle, I-405, Tukwila-N. Renton	5.0	1991	$75	buses, carpools
• 1 Concurrent flow lane each direction				
11. Washington, DC, I-395, Shirley Hwy	7.0	1986	$4	buses 4+ carpools
• Interim, concurrent flow				
12. Washington, DC, I-395, Shirley Hwy	19.0	1990	$95	buses 4+
• Permanent, 2-lanes reversible				
13. Norfolk, VA, I-64	12.0	1990	[c]	buses, 3+ carpools
• Permanent, 2-lanes reversible				

Source:
Institute of Transportation Engineers, The Effectiveness of High-Occupancy Vehicle Facilities, 1988, p. 17; based on data from the 1985 Survey of Transitway Projects.

[a]CBD - Central Business District; NB - Northbound; SB - Southbound.
[b]Costs must be viewed with caution since the different projects do not include the same cost elements.
[c]Data are not available.

CHAPTER 4
NONHIGHWAY MODES

This chapter presents statistics for four major nonhighway transportation modes: air, water, pipeline, and rail. The combined energy use for these four modes accounted for approximately 22% of the total energy use in the transportation sector in 1987 (Table 4.1), and the largest share (42%) of nonhighway transportation energy use was in air transportation (Figure 4.1).

Section 4.1 discusses data on air transportation. Statistics on water transportation are included in Section 4.2; pipeline data in Section 4.3; and rail data in Section 4.4.

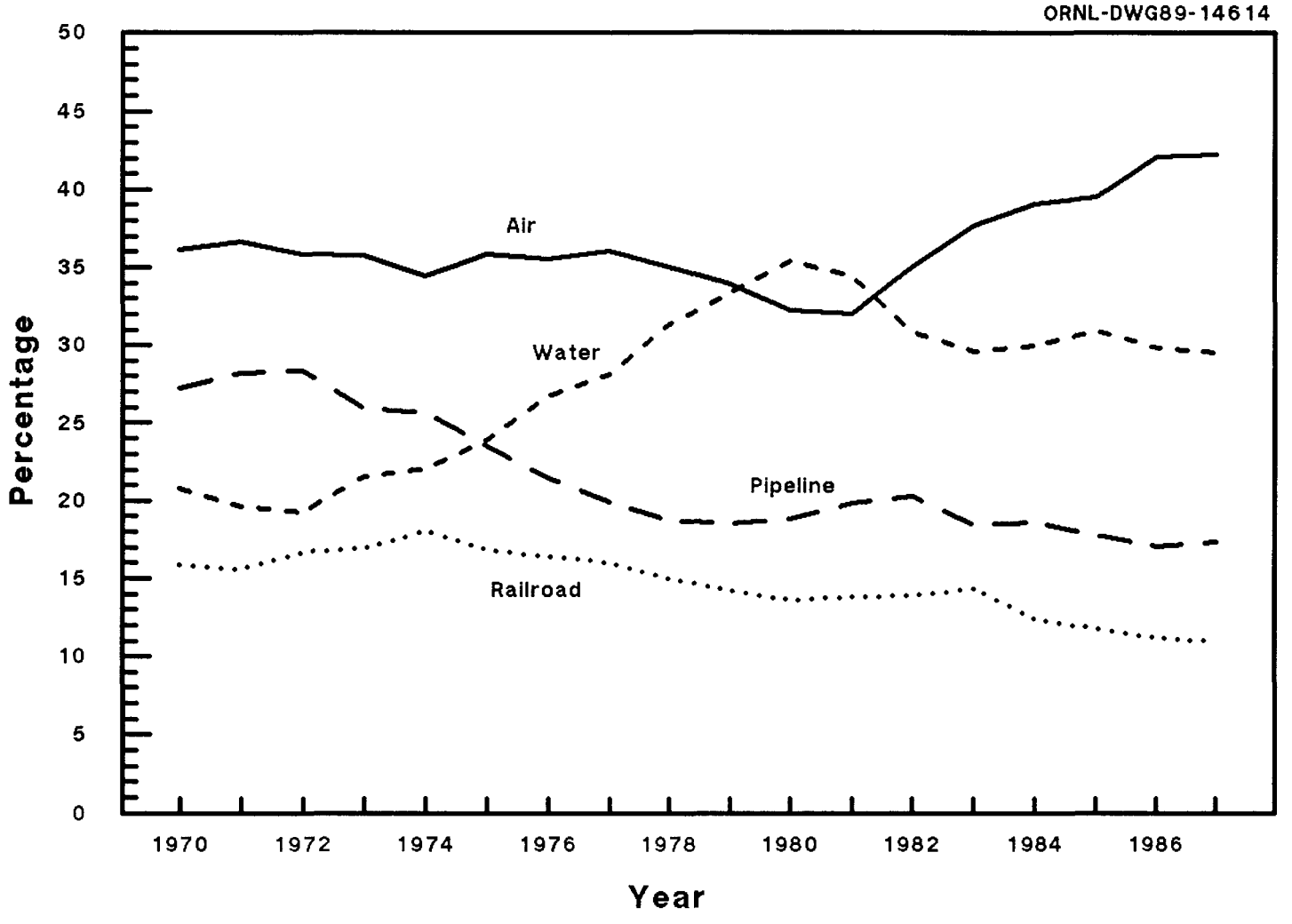
Table 4.1
Nonhighway Energy Use by Mode, 1970-87[a]
(trillion Btu)

Year	Air	Water	Pipeline	Rail	Nonhighway energy use	Transportation energy use[b]
1970	1,307	753	985	575	3,620	15,305
	(8.5%)	(4.9%)	(6.4%)	(3.8%)	(23.7%)	
1971	1,304	698	1,007	556	3,565	15,907
	(8.2%)	(4.4%)	(6.3%)	(3.5%)	(22.4%)	
1972	1,314	703	1,039	614	3,670	16,949
	(7.8%)	(4.1%)	(6.1%)	(3.6%)	(21.7%)	
1973	1,377	827	996	652	3,852	17,813
	(7.7%)	(4.6%)	(5.6%)	(3.7%)	(21.6%)	
1974	1,254	804	932	657	3,647	17,088
	(7.3%)	(4.7%)	(5.5%)	(3.8%)	(21.3%)	
1975	1,274	851	835	596	3,556	17,329
	(7.4%)	(4.9%)	(4.8%)	(3.4%)	(20.5%)	
1976	1,333	1,001	803	617	3,754	18,389
	(7.2%)	(5.4%)	(4.4%)	(3.4%)	(20.4%)	
1977	1,411	1,103	781	627	3,922	19,071
	(7.4%)	(5.8%)	(4.1%)	(3.3%)	(20.6%)	
1978	1,467	1,311	781	628	4,187	20,035
	(7.3%)	(6.5%)	(3.9%)	(3.1%)	(20.9%)	
1979	1,568	1,539	856	656	4,619	20,101
	(7.8%)	(7.7%)	(4.3%)	(3.3%)	(23.0%)	
1980	1,528	1,677	889	645	4,739	19,317
	(7.9%)	(8.7%)	(4.6%)	(3.3%)	(24.5%)	
1981	1,455	1,562	899	627	4,543	19,065
	(7.6%)	(8.2%)	(4.7%)	(3.3%)	(23.8%)	
1982	1,468	1,290	853	581	4,192	18,589
	(7.9%)	(6.9%)	(4.6%)	(3.1%)	(22.6%)	
1983	1,505	1,187	738	574	4,004	18,728
	(8.0%)	(6.3%)	(3.9%)	(3.1%)	(21.4%)	
1984	1,633	1,252	780	520	4,185	19,310
	(8.5%)	(6.5%)	(4.0%)	(2.7%)	(21.7%)	
1985	1,678	1,311	758	501	4,248	19,659
	(8.5%)	(6.7%)	(3.9%)	(2.5%)	(21.6%)	
1986	1,823	1,295	738	487	4,343	20,229
	(9.0%)	(6.4%)	(3.6%)	(2.4%)	(21.5%)	
1987	1,894	1,326	775	496	4,491	20,704
	(9.2%)	(6.4%)	(3.7%)	(2.4%)	(21.7%)	

Source:
See Appendix A for Table 2.9.

[a]Numbers in parentheses are percentages of transportation energy use.
[b]Does not include off-highway and military transportation energy use.

Figure 4.1. Percentages of Nonhighway Energy Consumption by Mode, 1970-87



Source: See Table 4.1.

Section 4.1. Air

In general, air transportation activities can be categorized into two groups: air carrier and general aviation. General aviation aircraft serve a variety of purposes such as business 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 resulted in their having a significantly smaller share of total aircraft energy use than the air carrier fleet (Table 4.2 and Table 4.4).

During the period between 1982 and 1987, both revenue passenger miles and cargo ton-miles of certificated route air carriers showed significant increases at an average annual rate of 8.9% and 10.8%, respectively (Table 4.2). These increases reversed the decreasing trend between 1978 and 1982 which was attributable in part to the combination of the 1980 recession and the increased costs of air travel during that period. Revenue aircraft miles of domestic and international certificated route air carriers increased by 7.8% in 1987 and resulted in a 5.3% increase in energy use from 1986. This 1987 energy use was the highest reported to date (Table 4.3).

Domestic air carriers are classified based on operating revenues for the purposes of statistical and financial reporting and analysis. The classifications, which were updated in January 1984, are:

Carrier Group	Operating Revenue (millions of dollars)
Major	Over $1,000
National	$100 - 1,000
Large regional	$10 - 99.9
Medium regional	$0 - 9.99

An 11% increase in the passenger load factor and an 18% increase in the revenue aircraft miles resulted in an impressive 25% gain in the revenue passenger miles of international air carriers from 1986 to 1987 (Table 4.3). This also resulted in a larger share of the total revenue passenger miles for the international air carriers, from 18.7% in 1986 to 21.2% in 1987. However, the shares of revenue cargo ton-miles between domestic and international air carriers remained stable during the same period.

The number of general aviation aircraft increased steadily between 1970 and 1987 at an average annual rate of 3.0% (Table 4.4). The hours flown and the number of aircraft for general aviation aircraft both decreased slightly from 1986 to 1987, while intercity passenger travel remained constant during the period, and the average trip length increased. The decline in the number of hours flown from 1986 to 1987 contributed to a 6% decline in energy use for general aviation aircraft.

Revenue passenger miles grew at an average annual rate of 7.0% whereas energy use rose only 2.1% annually from 1970 to 1987. Part of the increase in efficiency was due to higher load factors (series high of 62.3% in 1987) and more seats per aircraft (2.2% annual growth rate).

Table 4.2
Summary Statistics for Domestic and International Certificated Route Air Carriers (Combined Totals), 1970-87

Year	Number of aircraft	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]
1970	2,437	2,383	678	131,719[e]	264,904[e]	111	49.7[e]	4,994	1363.4
1971	2,389	2,344	681	135,658[e]	279,823[e]	119	48.5[e]	5,120	1370.5
1972	2,361	2,337	685	152,406[e]	287,411[e]	122	53.0[e]	5,506	1374.3
1973	2,361	2,402	689	174,352	322,992	129	54.0	6,046	1444.5
1974	2,237	2,351	684	174,052	310,130	126	56.1	6,133	1289.8
1975	2,261	2,241	698	173,324	315,823	135	54.9	5,944	1283.4
1976	2,261	2,320	704	191,823	338,349	139	56.7	6,222	1324.1
1977	2,254	2,418	704	206,082	361,172	143	57.1	6,587	1386.2
1978	2,346	2,608	719	236,998	381,113	147	62.2	7,395	1436.3
1979	2,466	2,859	714	269,719	425,411	146	63.4	7,580	1534.8
1980	2,425	2,924	736	267,722	448,479	148	59.7	7,515	1489.6
1981	2,523	2,703	749	260,063	438,778	157	59.3	7,917	1429.3
1982	2,468	2,804	766	272,435	455,938	157	59.8	7,807	1406.6
1983	2,618	2,923	765	295,144	480,977	159	61.4	8,497	1439.2
1984	2,692	3,264	759	319,504	534,104	164	59.8	9,328	1607.4
1985	2,860	3,462	758	351,073	565,677	163	62.1	9,048	1701.5
1986	[f]	3,873	767	378,923	623,073	161	60.8	10,987	1847.1
1987	[f]	4,177	779	417,823	670,691	161	62.3	13,040[g]	1945.4
				Average annual percentage change					
1970-87	1.1%[h]	3.4%	0.8%	7.0%	5.6%	2.2%		5.8%	2.1%
1982-87	5.0%[h]	8.3%	0.3%	8.9%	8.0%	0.5%		10.8%	6.7%

Sources:

U.S. Department of Transportation, Federal Aviation Administration, FAA Statistical Handbook of Aviation, 1987 Edition, Washington, DC, 1988, pp. 110-113, 121, 122, and annual.

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

1982-87: 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.

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[a] Scheduled services of domestic operations only. The average passenger trip length for international operations is approximately three 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.

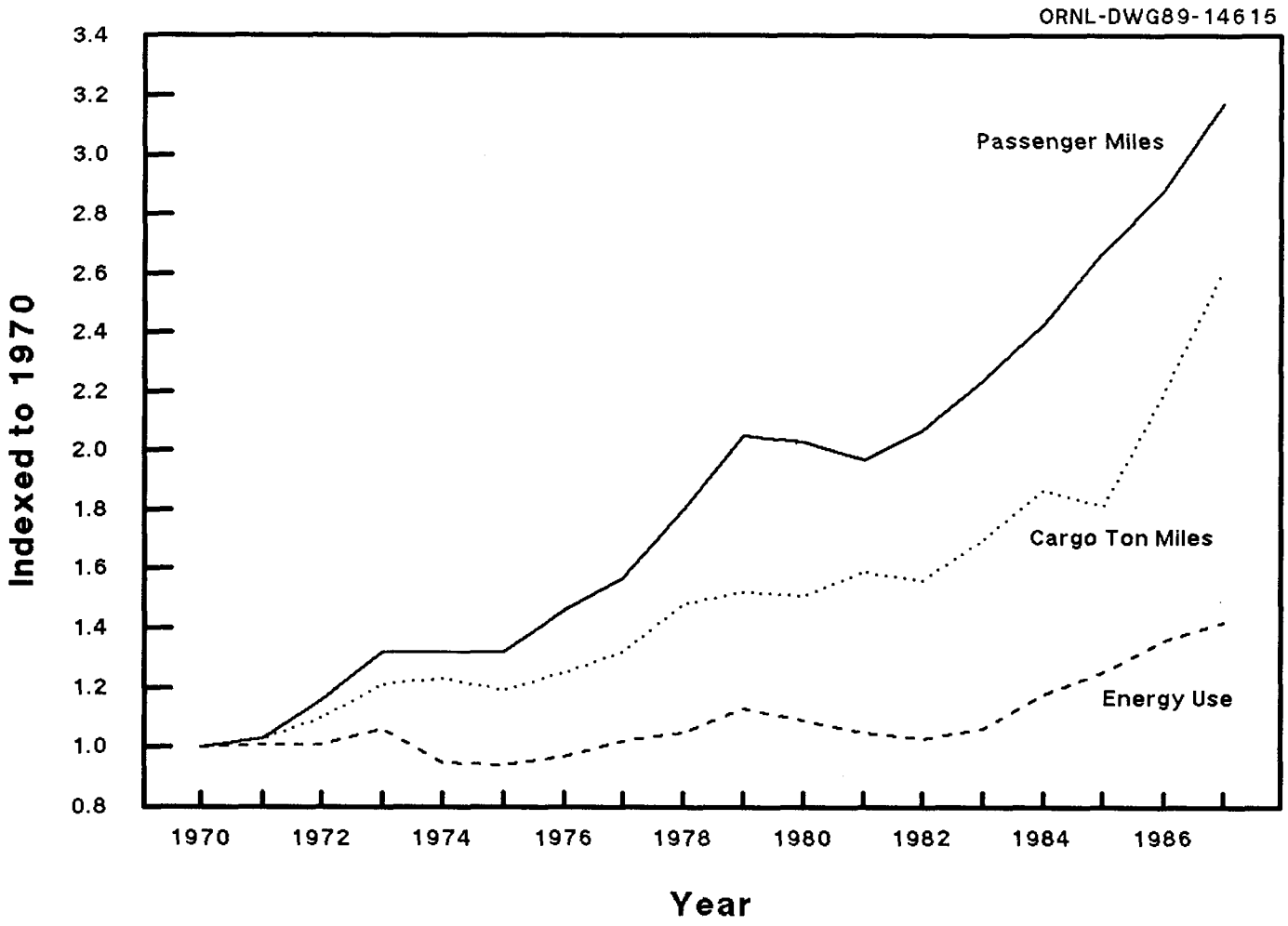
[e] Scheduled services only.

[f] The Federal Aviation Administration has discontinued the publication of these estimates. No comparable data are available.

[g] This number differs from the corresponding number on Table 4.3 as a result of different sources for data.

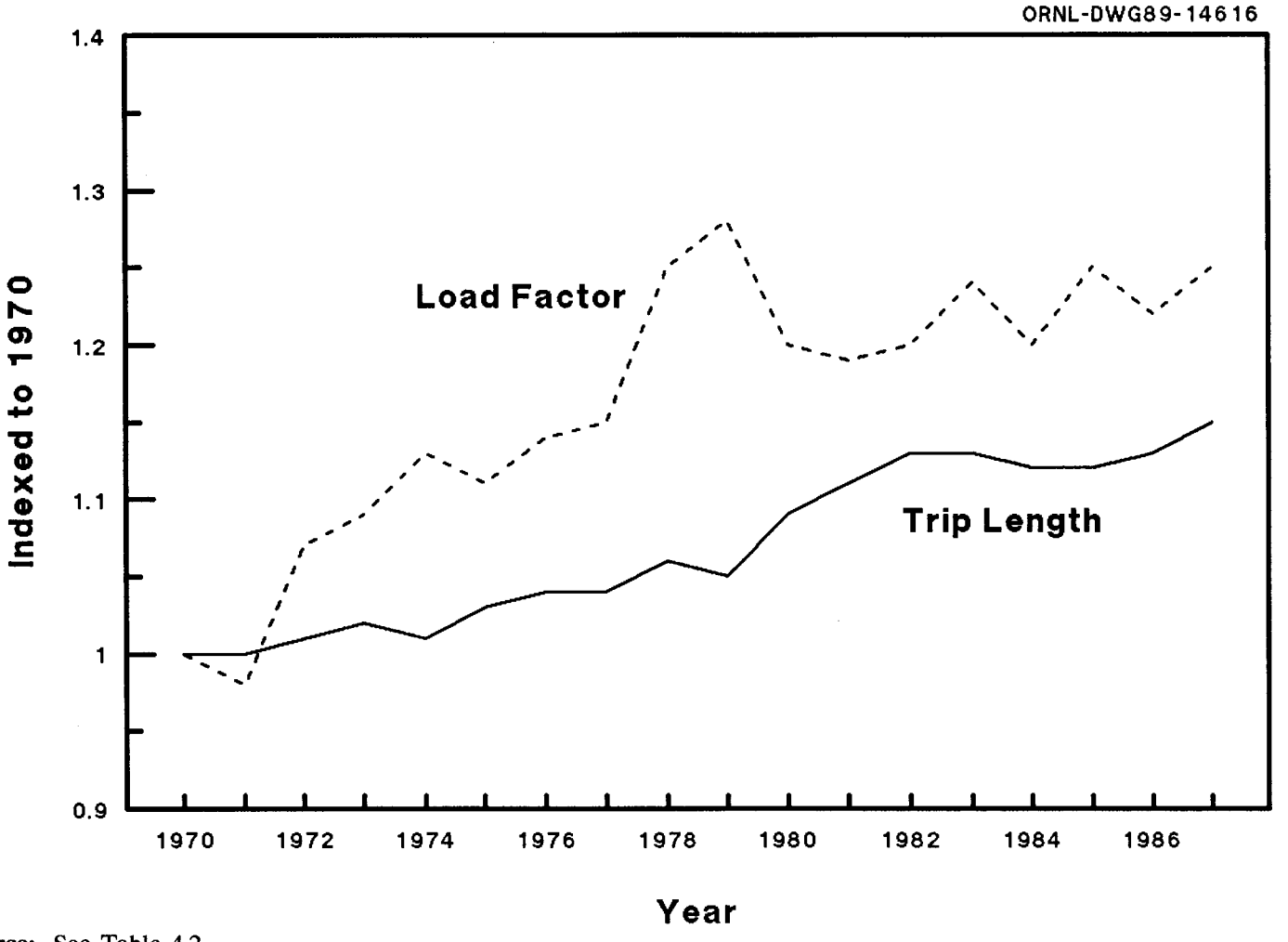
[h] Average annual percentage change is for year 1970-85 and 1982-85.

Figure 4.2. Passenger Miles, Cargo Ton-Miles, and Energy Use for Certificated Route Air Carriers, 1970-1987



Source: See Table 4.2.

Figure 4.3. Average Trip Length and Load Factor for Certificated Route Air Carriers, 1970-1987



Source: See Table 4.2.

The only carrier group that showed significant losses in all areas (e.g., revenue aircraft miles, revenue passenger and cargo miles, passenger load factor) was the national air carriers. International air carriers experienced a significant increase in passenger load factor in 1987 and resulted in an impressive increase of 25 percent in revenue passenger miles.

Table 4.3
Traffic Data for Large Certificated Route Air Carriers By Carrier Group, Scheduled and Nonscheduled Services, 1986 and 1987[a]

	Revenue aircraft miles[b] (millions)		Revenue passenger miles (millions)		Available seat miles[b] (millions)		Revenue passenger load factor[c] (percentage)		Revenue cargo ton-miles[d] (millions)		Energy use (trillion Btu)	
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987
Carrier Group[e]												
Majors	3,036	3,490	316,099	370,617	519,224	589,748	60.8	62.8	8,935	10,152	*f*	*f*
Nationals	643	476	54,793	38,736	91,365	63,586	58.4	58.2	561	259	*f*	*f*
Regionals[g]	194	212	8,031	8,470	12,484	17,357	53.7[h]	61.7[h]	1,792	2,634	*f*	*f*
Total Air Carriers	**3,873**	**4,177**	**378,923**	**417,823**	**623,073**	**670,691**	**60.3**	**62.4**	**10,987**	**13,046**	**1847.1**	**1945.4**
Domestic	3,422	3,646	307,885	329,070	505,734	532,993	60.7	61.6	6,356	7,545	1503.5	1564.2
International	451	531	71,038	88,753	117,339	137,698	58.9	65.6	4,632	5,501	343.6	381.2

Sources:

U.S. Department of Transportation, Transportation Systems Center, Air Carrier Traffic Statistics Monthly, December 1986/87 and Twelve Months Ending December 31, Cambridge, MA, 1988, pp. 1, 2, 3, 58, 93, 157.

Energy use - 1970-81: Department of Transportation, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, DC, 1981, and annual.
1982-87: 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]The data presented in this table represent all international carrier operations, and domestic air carriers that hold a Section 401 certificate and operate aircraft designed to have a maximum passenger capacity of more than 60 or a maximum payload capacity of more than 18,000 pounds.

[b]Calculated as the sum of scheduled and nonscheduled services.

[c]Load factor applies to scheduled services only.

[d]Cargo includes freight, express, and mail shipments.

[e]Large certificated air carriers are classified according to their total annual operating revenue as listed:
Majors - $1,000,000,000 and up; Nationals - $1,000,000,000 to $999,999,999; Large Regionals - $10,000,000 to $99,999,999; Medium Regionals - $0 to $9,999,999.

[f]Data are not available.

[g]Calculated as the sum of Large Regionals and Medium Regionals.

[h]Load factor was calculated as the sum of Large and Medium Regionals' scheduled revenue passenger miles divided by the sum of Large and Medium Regionals' scheduled available seat miles.

The number of aircraft in general aviation in 1987 decreased by 1.3% from the previous year. The decrease resulted in a 3% decrease in hours flown and a 6% decrease in energy use. The intercity passenger travel in 1987, however, is holding steady at 12.4 billion passenger miles.

Table 4.4
Summary Statistics for General Aviation, 1970-87

Year	Number of aircraft (thousands)	Hours flown (thousands)	Intercity passenger travel (billion passenger-miles)	Energy use (trillion Btu)
1970	131.7[a]	26,030[b]	9.1	94.4
1971	131.1[a]	25,512[b]	9.2	91.6
1972	145.0[a]	26,974[b]	10.0	103.4
1973	148.0[a]	28,599	10.7	90.4
1974	161.5	29,758	11.2	101.4
1975	168.5	30,298	11.4	121.5
1976	178.0	31,950	12.1	130.3
1977	184.3	33,679	12.8	149.7
1978	199.2	36,844	14.1	159.4
1979	210.3	40,432	15.5	167.2
1980	211.0	41,016	14.7	169.0
1981	213.2	40,704	14.6	162.4
1982	209.8	36,457	13.1	170.5
1983	213.2	35,249	12.7	143.9
1984	220.9	36,119	13.0	148.9
1985	210.7	34,063	12.3	144.0
1986	220.0	34,416	12.4	148.0
1987	217.2	33,443	12.4	139.1
		Average annual percentage change		
1970-87	3.0%	1.5%	1.8%	2.3%
1982-87	0.7%	-1.7%	-1.1%	-4.0%

Sources:

Aircraft and hours flown - U.S. Department of Transportation, Federal Aviation Administration, FAA Statistical Handbook of Aviation, Calendar Year 1987, Washington, DC, 1988, pp. 170, 172, and annual.

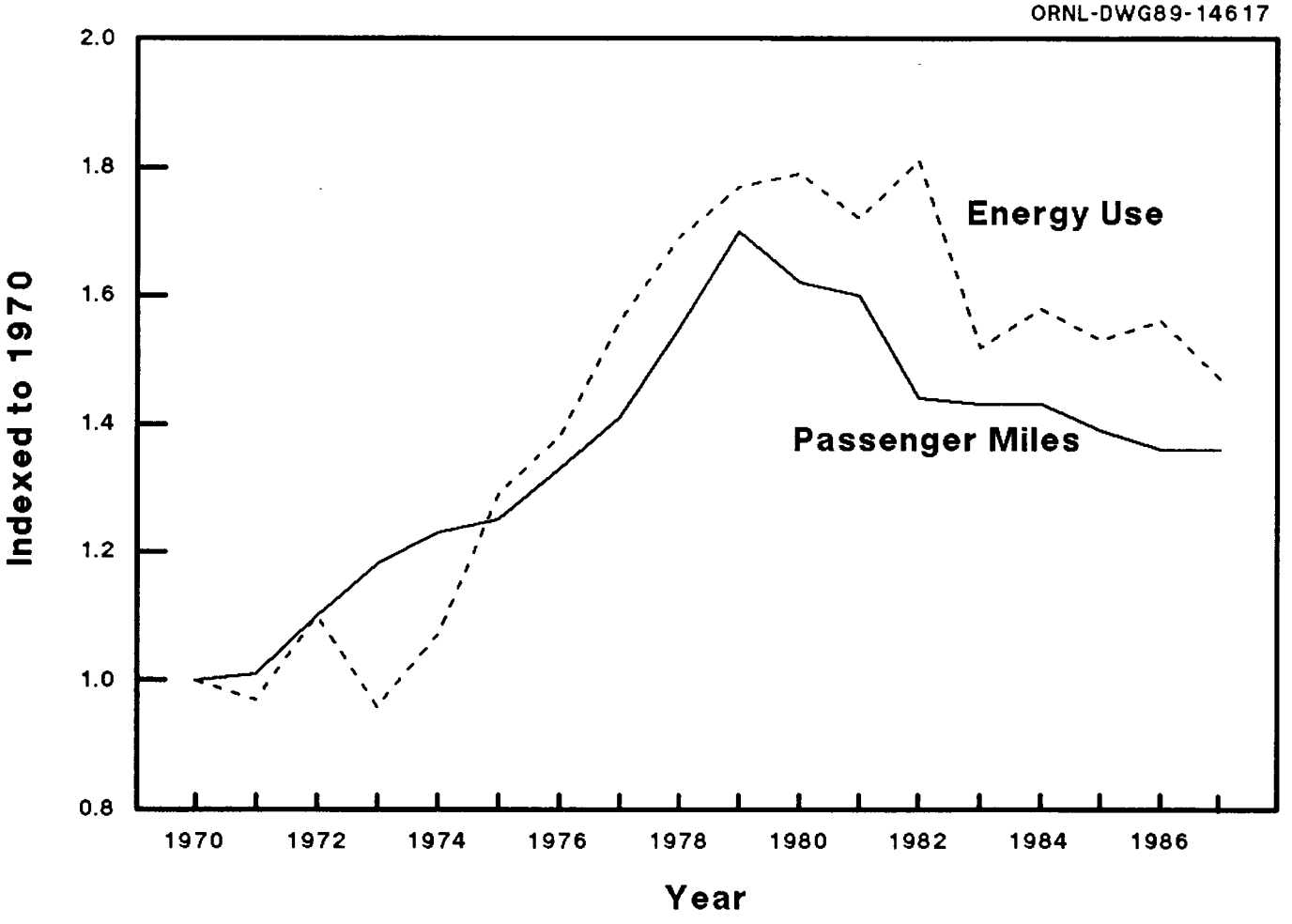
Intercity passenger miles - Transportation Policy Associates, Transportation in America, 6th Edition, November 1988 Supplement, Washington, DC, 1988, p. 8.

Energy Use - See Appendix A for Table 2.9.

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

[b]Include rotocraft.

Figure 4.4. Passenger Miles and Energy Use in General Aviation, 1970-1987



Source: See Table 4.4.

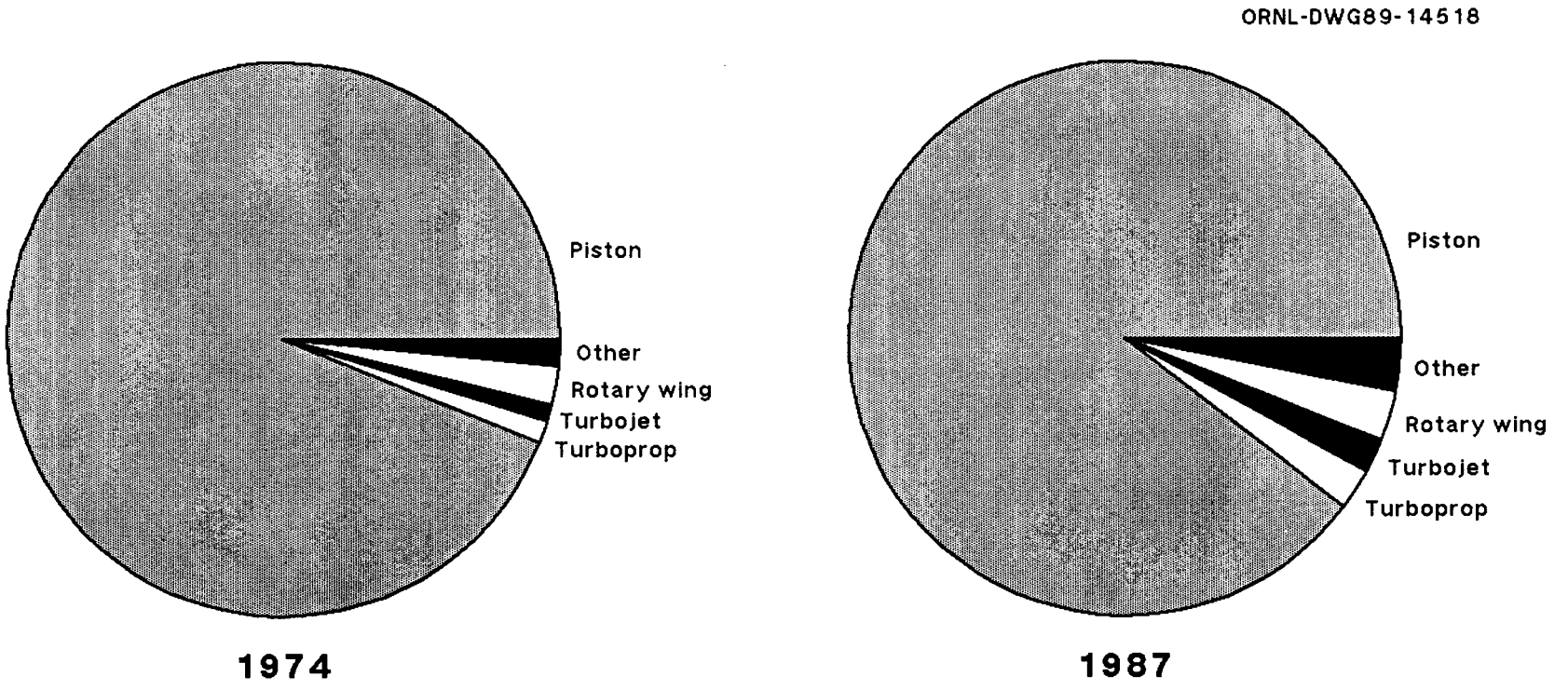
Although the share of the piston aircraft has declined since 1974, they continued to account for the majority of general aviation aircraft.

Table 4.5
Percentage Distribution of General
Aviation Aircraft by Type of Aircraft, 1974-1987

Calendar year	Fixed wing			Rotary wing	Other	Total number of aircraft
	Piston	Turboprop	Turbojet			
1974	93.9	1.3	1.0	2.2	1.6	161,502
1975	93.4	1.5	1.1	2.4	1.7	168,475
1976	93.3	1.4	1.1	2.5	1.8	177,964
1977	92.7	1.6	1.2	2.6	2.0	184,294
1978	92.5	1.6	1.2	2.7	2.0	199,178
1979	92.0	1.7	1.3	2.8	2.3	210,339
1980	91.5	1.9	1.4	2.8	2.3	211,045
1981	90.7	2.2	1.5	3.3	2.4	213,226
1982	90.2	2.5	1.9	2.9	2.5	209,779
1983	89.8	2.6	1.8	3.1	2.8	213,293
1984	89.4	2.6	2.0	3.2	2.8	220,943
1985	89.3	2.6	2.1	3.0	3.0	210,654
1986	88.9	2.7	2.0	3.2	3.2	220,044
1987	89.5	2.4	2.0	2.9	3.1	217,183
	Average Annual Percentage Change					
1974-87						2.3%
1982-87						0.7%

Source:
U.S. Department of Transportation, Federal Aviation Administration, FAA Statistical Handbook of Aviation, Washington, DC, 1988 Edition, p. 170, and annual.

Figure 4.5. Distribution of General Aviation Aircraft by Type of Aircraft, 1974 and 1987



Source: See Table 4.5.

Section 4.2. **Water**

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. Although declining slightly from 1985, domestic traffic still accounted for more than half of the total tons shipped in waterborne commerce. An 8% increase in the foreign tonnage from 1985 to 1986 in conjunction with a 2% increase in the domestic tonnage resulted in an overall 5% increase in the total tons shipped in waterborne commerce during this period (Table 4.6).

Although the tons shipped in domestic waterborne commerce increased by 2% from 1986 to 1987, the combination of fewer vessels and the shorter average lengths of hauling contributed to a 13% improvement in energy efficiency for the period. Energy use increased 1.4% during this period as a result of the decline in the average length of haul (Table 4.7).

Internal and local traffic accounted for 62% of total domestic marine cargo transportation (Table 4.8). Of the total domestic marine cargo, petroleum products comprised the largest proportion (44.5%) of all commodities shipped. Barges were the most commonly used vehicles in the internal and local movement of commodities, accounting for 94.3% of total internal and local marine traffic.

The tonnage shipped in international waterborne commerce increased almost 8% from 1985 to 1986, while the domestic tonnage increased by only 2% in the same time period. Nevertheless, the domestic share of waterborne commerce still accounted for over half of the total tonnage shipped in waterborne commerce.

Table 4.6
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970-86
(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	1,761	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	1,078	53.9%
1981	1,942	887	1,055	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%
	Average annual percentage change			
1970-86	1.3%	2.3%	0.5%	
1982-86	1.3%	0.5%	2.0%	

Source:
U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1986, Part 5: National Summaries, New Orleans, LA, May 1988, p. 5, and annual.

[a]All movements between the U.S. and foreign countries and between Puerto Rico and 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.

In 1986, shorter lengths of haul contributed to a 3.8% increase in energy intensity in domestic waterborne commerce. The energy consumption for 1987 decreased by 8.2% from the previous year.

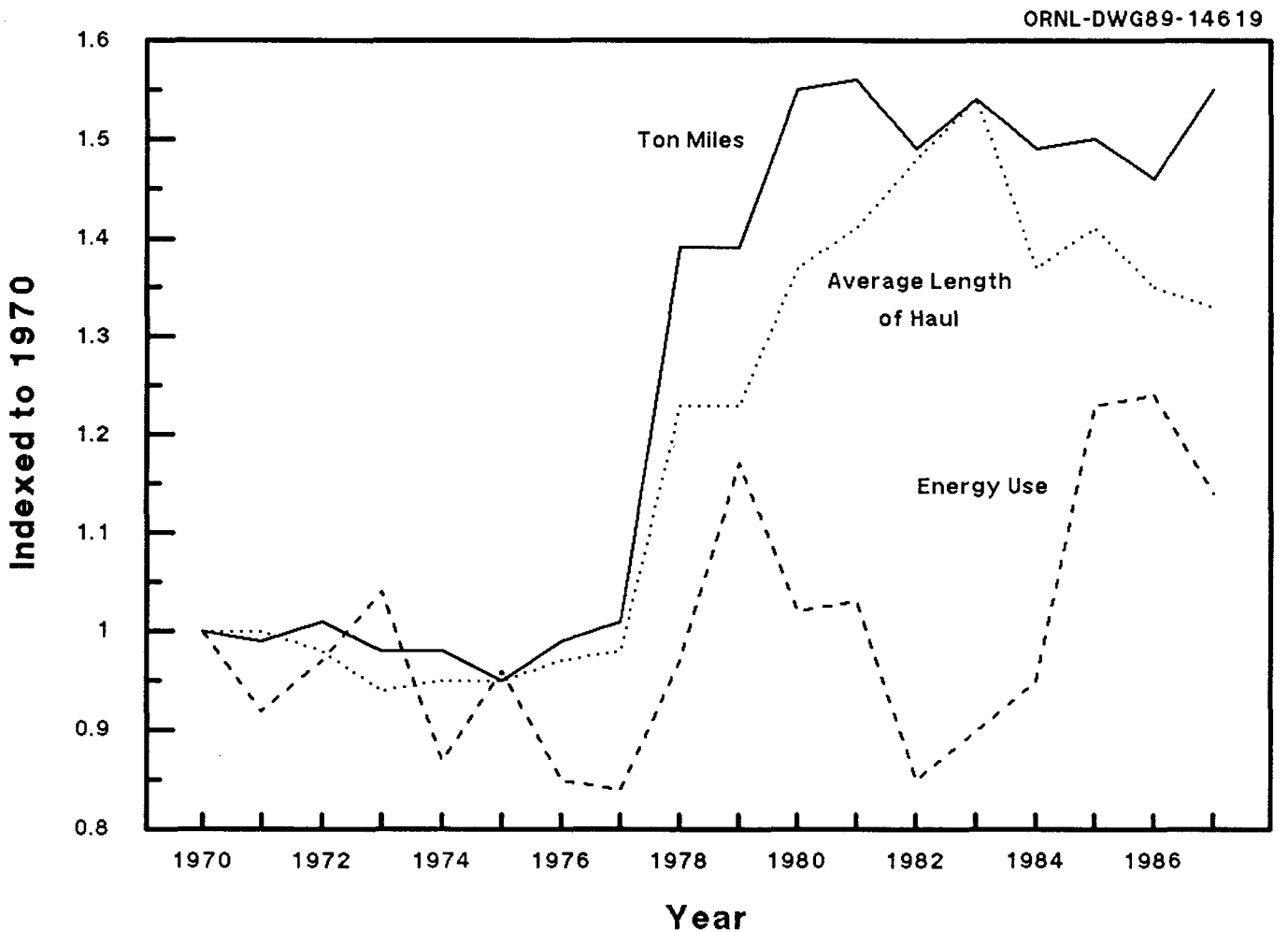
Table 4.7
Summary Statistics for Domestic Waterborne Commerce, 1970-87

Year	Number of vessels[a]	Ton-miles (billions)	Tons shipped (millions)[b]	Average length of haul (ton-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	921	1,072	835.0	402	370.7
			Average annual percentage change			
1970-87	2.6%	2.6%	0.7%	1.7%	-1.8%	0.8%
1982-87	-1.0%	0.8%	2.4%	-2.1%	5.3%	6.2%

Sources:
1970-87 Number of vessels - Personal communication with the U.S. Department of the Army, Corps of Engineers, New Orleans, LA, 1988.
1970-86 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 1986, Part 5: National Summaries, New Orleans, LA, May 1988, p. 89 and previous editions.
1987 Ton miles, tons shipped, average length of haul - Personal communication with the U.S. Department of the Army, Corps of Engineers, New Orleans, LA, 1989.
Energy Use - See Appendix A for Table 2.6.

[a]Grand total for self-propelled and nonself-propelled.
[b]These figures are not consistent with the figures on Table 4.6 because intraterritory tons are not included in this table.

Figure 4.6. Ton Miles, Average Length of Haul, and Energy Use for Domestic Waterborne Commerce, 1970-1987



Source: See Table 4.7.

Eighty-seven percent (601.6 million tons) of all domestic barge traffic is internal and local cargo movement. Petroleum and related products accounted for 45% of all domestic marine cargo shipped; and 57% of the petroleum products moved in domestic waterborne commerce were transported over the ocean (coastwise).

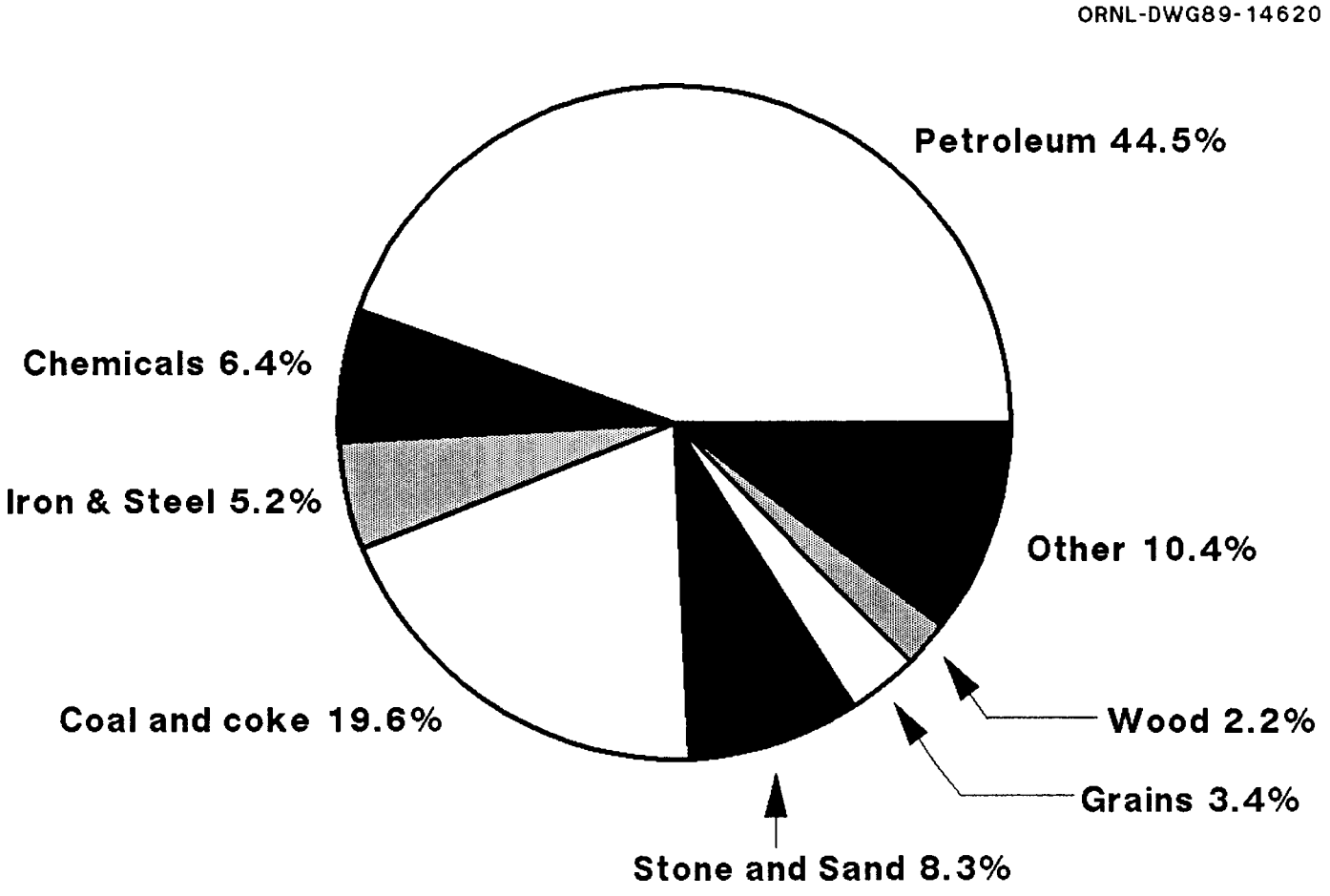
Table 4.8
Breakdown of Domestic Marine Cargo by Commodity Class, 1986

	Coastwise[a]		Lakewise[b]		Internal and local[c]		Total domestic		
Commodity class	Tons shipped (millions)	Average haul per ton (miles)	Tons shipped (millions)	Average haul per ton (miles)	Tons shipped (millions)	Average haul per ton (miles)	Tons shipped (millions)	Percentage	Average haul per ton (miles)
Petroleum and products	259	2,047	2	262	197	188	458	44.5	1240
Chemicals and related products	16	1,191	[d]	254	50	638	66	6.4	766
Iron, iron ore, and steel	[d]	1,197	41	610	12	940	53	5.2	688
Coal and coke	10	548	19	489	172	447	202	19.6	456
Sand, gravel, stone, and shell	2	78	18	305	69	117	85	8.3	158
Grains	[d]	1,774	1	987	34	979	35	3.4	993
Logs and lumber	1	1,303	[d]	61	22	79	23	2.2	149
All others	19	1,219	6	254	82	590	107	10.4	687
Total	308	1,886	87	494	638	391	1,029	100.0	845
Barge traffic (million tons)	87.4		4.2		601.6		693.2		
Percentage by barge	28.4%		4.8%		94.3%		67.4%		

Source:
U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1986, Part 5: National Summaries, New Orleans, LA, May 1988, pp. 32, 93.

[a]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.
[b]Applied to traffic between United States ports on the Great Lakes.
[c]Internal applies to traffic between ports or landing wherein the entire movement takes place on inland waterways. Local applies to movements of freight within the confines of a port.
[d]Negligible.

Figure 4.7. Breakdown of Domestic Marine Cargo by Commodity Class, 1986



Source: See Table 4.8.

Section 4.3. Pipeline

Pipeline shipments of natural gas have shown an average annual decrease of 1.7% over the past 15 years. Increases in natural gas, crude oil, and refined petroleum product shipments contributed to an increase of 5.4% in total energy use from 1986 to 1987.

Table 4.9
Pipeline Shipments of Energy, 1972-87

Year	Domestic natural gas consumption[a] (billion cubic feet)	Total petroleum transported (million tons)	Total petroleum transported (billion ton-miles)	Crude petroleum (billion ton-miles)	Refined petroleum products (billion ton-miles)	Energy use[b] (trillion Btu)
1972	22,100	876	476	285	191	985.3
1973	22,049	912	507	302	205	942.2
1974	21,223	879	506	303	203	877.9
1975	19,538	879	507	288	219	781.2
1976	19,946	934	515	303	212	749.0
1977	19,521	986	546	327	219	727.5
1978	19,627	982	586	360	226	680.0
1979	20,241	978	608	372	236	793.4
1980	19,877	921	588	363	226	838.5
1981	19,404	886	564	333	231	848.1
1982	18,001	897	566	335	231	798.8
1983	16,835	899	556	332	224	684.6
1984	17,951	917	568	333	235	726.2
1985	17,281	918	564	334	230	704.7
1986	16,221	945	578	335	243	684.1
1987	17,137	954	587	342	245	721.3
			Average annual percentage change			
1972-87	-1.7%	0.6%	1.4%	1.2%	1.7%	-2.1%
1982-87	-1.0%	1.2%	0.7%	0.4%	1.2%	-2.0%

Sources:

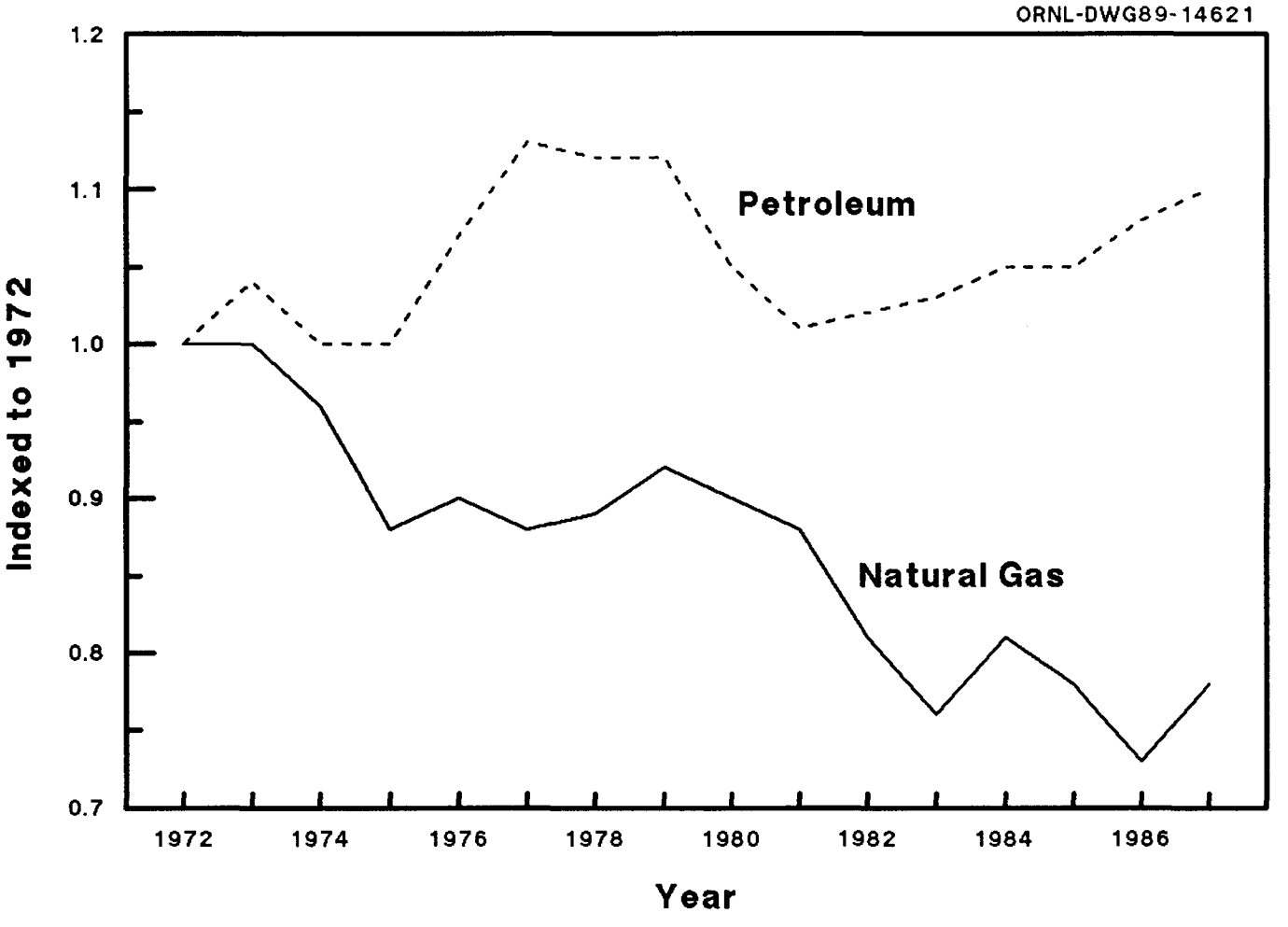
Natural gas consumption - U.S. Department of Energy, Energy Information Administration, Natural Gas Annual 1987,Washington, DC, 1988, p. 2, and annual.

Petroleum transport, crude petroleum, and refined petroleum products - Transportation Policy Associates, Transportation in America, Sixth edition, November 1988 Supplement, Washington, DC, 1988, pp. 6, 7, 16, and annual.

Energy use - See Appendix A for Table 2.6.

[a]Natural gas consumption is the best available indicator for the amount of natural gas transported by pipeline.
[b]Represents energy use for natural gas, crude petroleum, and refined petroleum pipelines.

Figure 4.8. Natural Gas and Petroleum Shipped by Pipeline, 1972-1987



Source: See Table 4.9.

Section 4.4. Railroad

Although the railroad freight industry experienced losses in the total numbers of locomotives and freight cars (in service), and in revenue tonnage, the combination of a greater amount of travel by both trains and freight cars and a longer average length of haul contributed to an 8.8% increase in revenue ton-miles from 1986 to 1987 (Table 4.10).

The average length of haul for freight railroads has been increasing at an average annual rate of 1.7% since 1970. The energy intensity has reduced 2.3% per year in this period due to more efficient locomotives and operations, as evidenced by the increase in the average length of haul (Table 4.10).

The railroad freight industry experienced a 23% drop in its revenue carloadings from 1974 to 1987. Except for coal, all commodity groups experienced declines in their shares of revenue carloadings during the period. Over the past 17 years, coal has not only remained the major commodity being hauled by the railroads, but its share of revenue carloads has also increased by 19.5% from 1974 to 1987. The largest decline, on the other hand, has been for metallic ores, which have dropped 74.1% during the period (Table 4.11).

The passenger railroad industry (Amtrak) experienced an increase of 7% in revenue passenger miles in 1987. This increased revenue passenger miles can be attributed to the increases in the total numbers of locomotives and passenger cars (in service), in passenger travel, and in a longer average trip length (Table 4.12).

Despite the decreased number of passenger vehicles for rail transit operations from 1986 to 1987, the highest vehicle miles and the highest number of passenger trips reported to date contributed to a 5.3% increase in passenger miles in rail transit operations from 1986 to 1987 (Table 4.13).

In 1987, the longer average haul per ton compensated for the loss in revenue tonnage and resulted in an increase of 1.6% in total energy consumption.

Table 4.10
Summary Statistics for Class I Freight Railroads, 1970-87[a]

Year	Number of locomotives in service[b]	Number of freight cars (thousands)[c]	Train-miles (millions)	Car-miles (millions)	Revenue tons (millions)	Average length of haul (miles)	Revenue ton-miles (millions)	Energy intensity (Btu/ton-mile)	Energy use (trillion Btu)
1970	27,077[d]	1,424	427	29,890	2,616	515	764,809	655	500.6
1971	27,160[d]	1,422	430	29,181	2,458	507	739,723	697	515.6
1972	27,044	1,411	451	30,309	2,543	511	776,746	706	548.2
1973	27,438	1,395	469	31,248	2,701	531	851,809	662	563.9
1974	27,627	1,375	469	30,719	2,732	527	850,961	665	565.9
1975	27,855	1,359	403	27,656	2,437	541	754,252	682	514.5
1976	27,233	1,332	425	28,530	2,452	540	794,059	677	537.6
1977	27,298	1,287	428	28,749	2,439	549	826,292	667	551.4
1978	26,959	1,226	433	29,076	2,312	617	858,105	637	546.7
1979	27,660	1,217	438	29,436	2,463	611	913,669	616	562.6
1980	27,948	1,168	428	29,277	2,434	616	918,621	592	544.1
1981	27,410	1,111	408	27,968	2,386	626	910,169	571	519.7
1982	26,677	1,039	345	23,952	1,990	629	797,759	547	436.5
1983	25,450	1,007	346	24,358	1,936	641	828,275	521	431.6
1984	24,119	948	369	26,409	2,119	645	921,542	508	468.5
1985	22,550	867	347	24,920	1,985	664	876,984	487	426.9
1986	20,792	799	347	24,414	1,938	664	867,722	474	411.5
1987	19,647	749	361	25,627	1,926	688	943,747	443	417.9
				Average annual percentage change					
1970-87	-1.9%	-3.7%	-1.0%	-0.9%	-1.8%	1.7%	1.2%	-2.3%	-1.1%
1982-87	-5.9%	-6.3%	0.9%	1.4%	-0.7%	1.8%	3.4%	-4.1%	-0.9%

Sources:
Association of American Railroads, Railroad Facts, Washington, DC, November 1988, pp. 29, 31, 34, 44, and 46.
Revenue tons - Association of American Railroads, Analysis of Class I Railroads 1987, p. 109, and annual.
Energy use - See Appendix A for Table 2.6.

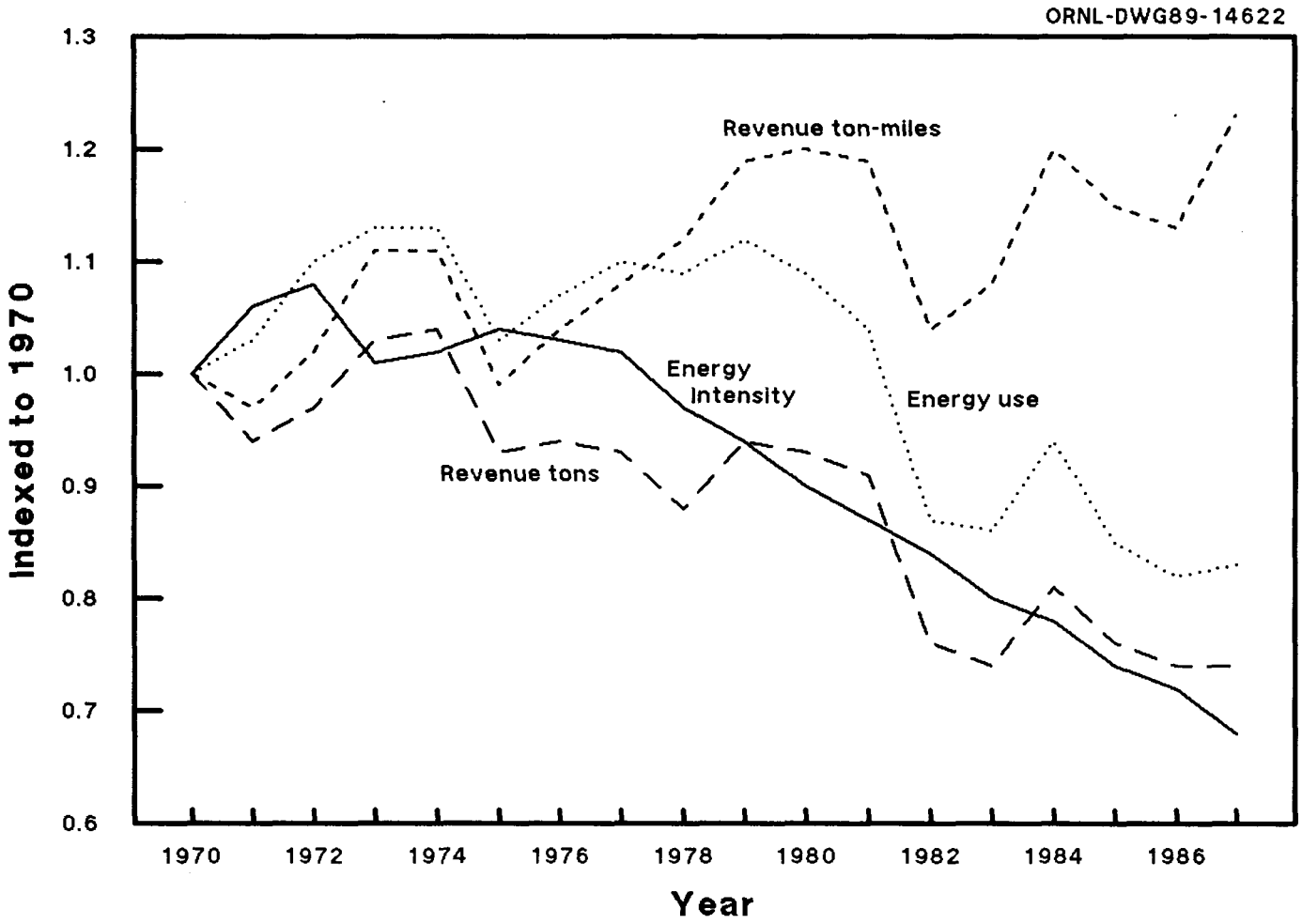
[a]Class I railroads are defined by the Interstate Commerce Commission as having annual operating revenues equal to or over $83.5 million in constant 1978 dollars. Operating Class I railroads account for more than 95 percent of the industry's freight.

[b]Does not include self-powered units. After 1971, the number of locomotives used in AMTRAK passenger operations (See Table 4.11) are subtracted from the total locomotives used in passenger and freight service to calculate the number of Class I locomotives in service.

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

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

Figure 4.9. Revenue Tons, Revenue Ton-Miles, Energy Intensity, and Energy Use for Class I Freight Railroads, 1970-87



Source: See Table 4.10.

Total revenue carloadings from 1974 to 1986 declined by 23.1%. The only commodity groups that showed increases in revenue carloadings were coal and "others." The greatest decline in revenue carloadings for this period was for metalic ores - a decrease of 74.1% from 1974 to 1987.

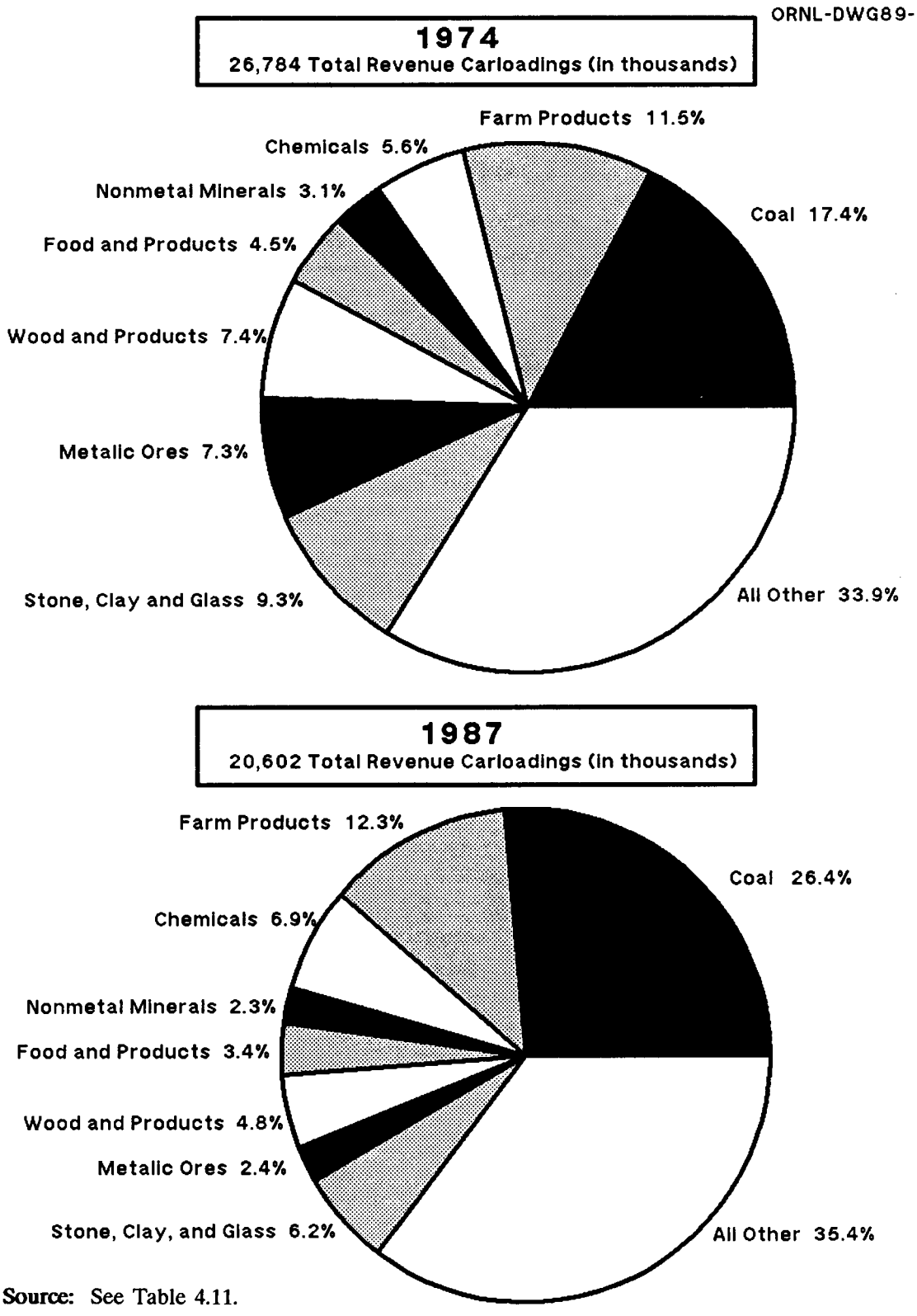
Table 4.11
Railroad Revenue Carloadings by Commodity Group, 1974 and 1987

Commodity group	Carloadings (thousands) 1974	Carloadings (thousands) 1987	1987 Percent distribution	Percentage change 1974-87
Coal	4,544	5,430	26.4	19.5
Farm products	3,021	2,534	12.3	-16.1
Chemicals and allied products	1,464	1,420	6.9	-3.0
Nonmetalic products[a]	821	476	2.3	-42.0
Food and kindred products[b]	1,777	700	3.4	-40.5
Lumber and wood products[c]	1,930	986	4.8	-48.9
Metalic ores	1,910	494	2.4	-74.1
Stone, clay and glass	2,428	1,271	6.2	-47.7
Pulp, paper, and allied	1,180	661	3.2	-44.0
Petroleum and coke products	877	510	2.5	-41.8
Primary metal products	1,366	451	2.2	-67.0
Waste and scrap material	889	440	2.1	-50.5
Transportation equipment	1,126	1,031	5.0	-8.4
Others	3,451	4,198	20.4	21.6
Total	26,784	20,602	100.0	-23.1

Sources:
1974 - Association of American Railroads, Railroad Facts, 1976 Edition, Washington, DC, 1975, p. 26.
1987 - Association of American Railroads, Railroad Facts, 1988 Edition, Washington, DC, 1988, p. 25.

[a]Nonmetalic products include crushed stone, gravel, sand, and other nonmetalic minerals.
[b]Food and kindred products include grain mill products.
[c]Lumber and wood products include primary forest products.

Figure 4.10. Distribution of Railroad Revenue Carloadings, 1974 and 1987



Source: See Table 4.11.

Although the number of railroad passenger cars declined at an average annual rate of 0.8% since 1982, the revenue passenger miles increased 6.1% annually during the same time period. The 7% increase in revenue passenger miles from 1986 to 1987 was partly due to the longer average trip length. The 1987 revenue passenger miles was the highest since 1973 and resulted in the best energy efficiency rating for Amtrak during this period.

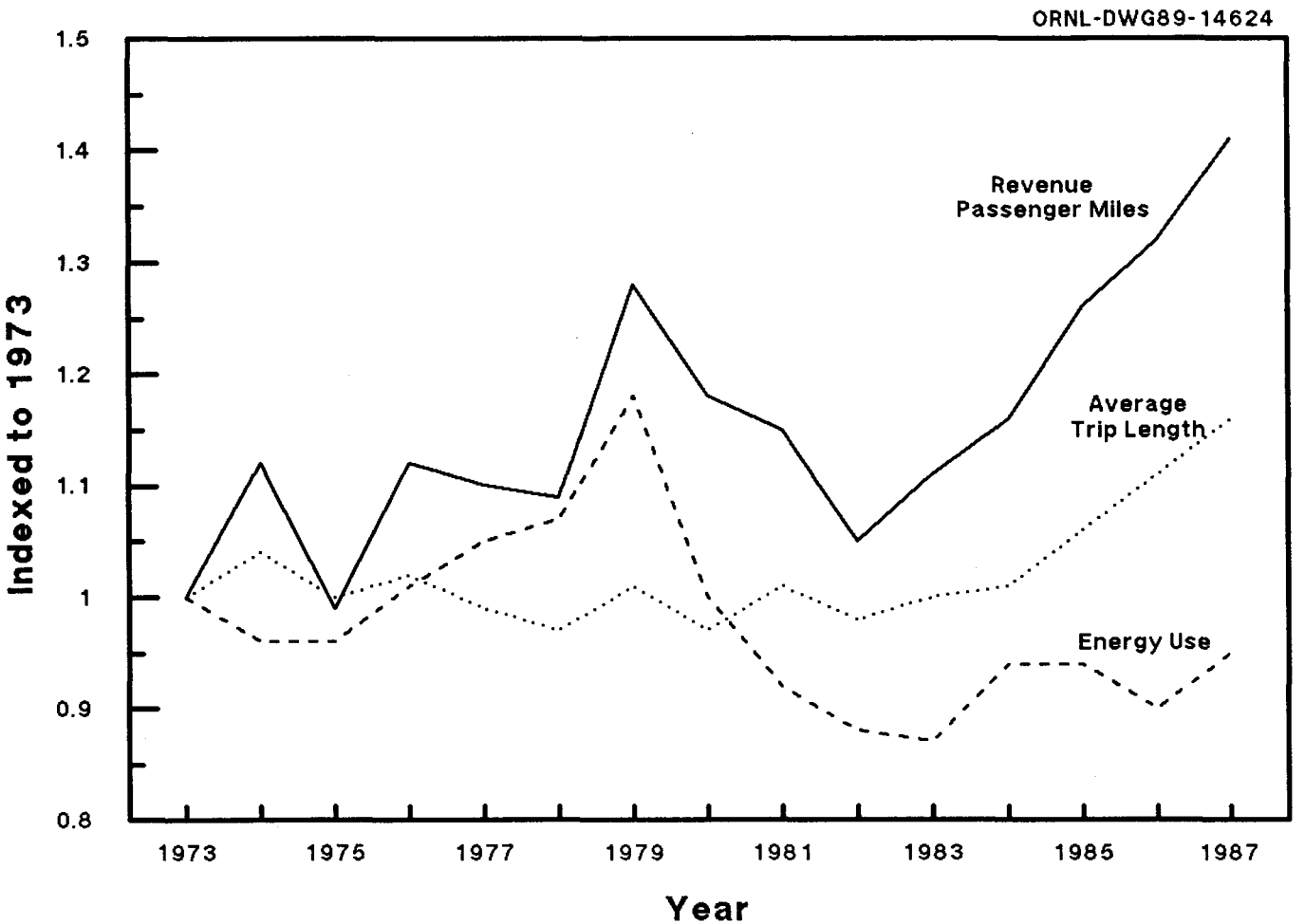
Table 4.12
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971-87

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
				Average annual percentage change				
1971-87	2.0%[b]	2.9%	3.7%	4.0%	6.4%	2.0%	-2.8%[c]	-0.4%[c]
1982-87	-0.8%	-0.8%	0.5%	3.7%	6.1%	3.3%	-4.3%	1.5%

Sources:
1971-83 - Association of American Railroads, Economics and Finance Department, Statistics of Class I Railroads, Washington, DC, and annual.
1984-87 - Association of American Railroads, Railroad Facts, 1988 Edition, Washington, DC, November 1988, p. 61, and annual.
Energy use - 1971-84: Association of American Railroads, Railroad Facts, 1984 Edition, Washington, DC, 1984, and annual.
1985-87: Personal communication with the Accounting Division of Amtrak, Washington, DC.

[a]Data are not available.
[b]Average annual percentage change is for years 1972-87.
[c]Average annual percentage change is for years 1973-87.

Figure 4.11. Revenue Passenger Miles, Average Trip Length, and Energy Use for Amtrak, 1973-87



Source: See Table 4.12.

The increased number of passenger trips and the longer average trip length in 1987 compared to those in 1986 contributed to the highest energy consumption level for rail transit operations during the past 17 years.

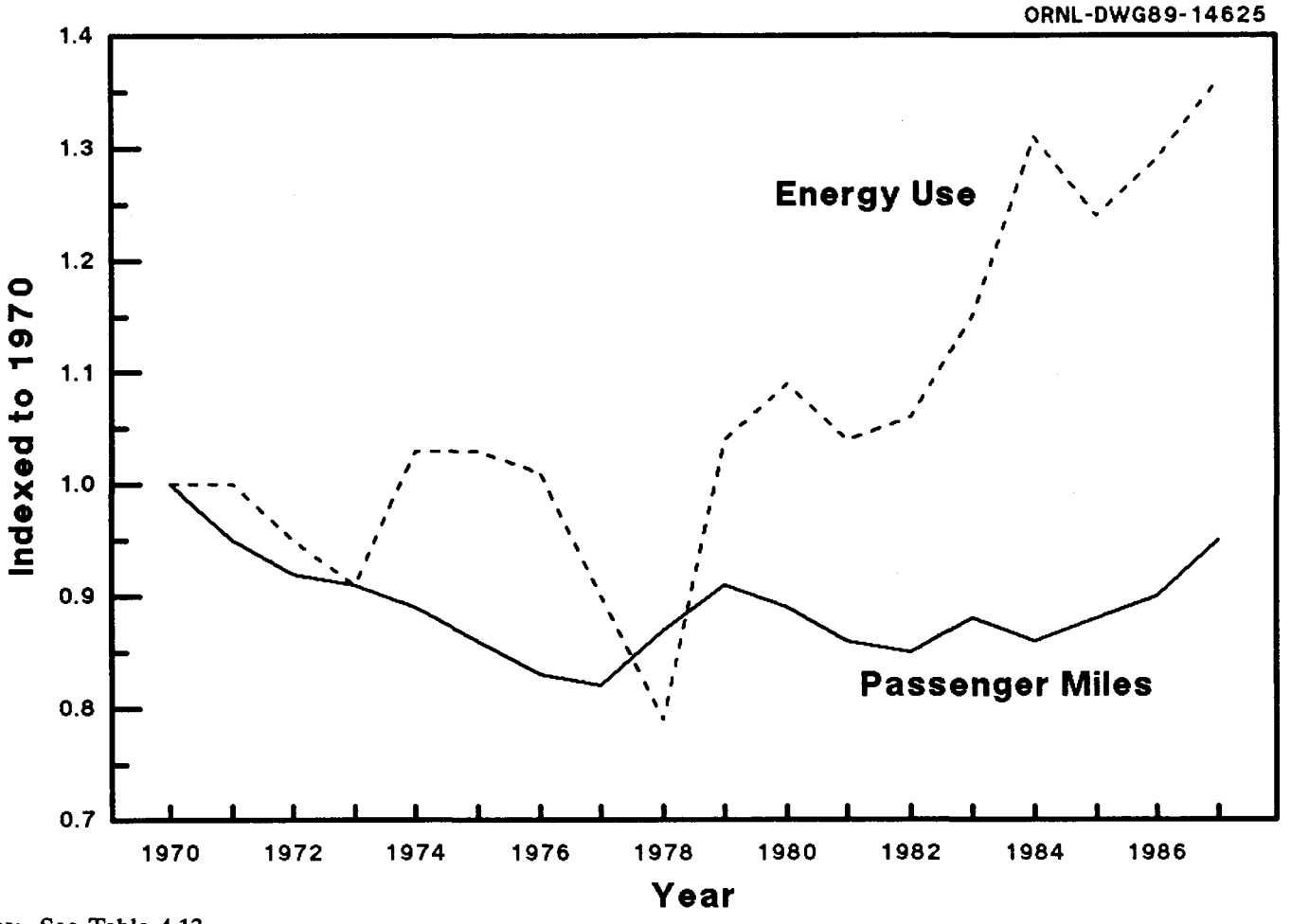
Table 4.13
Summary Statistics for Rail Transit Operations, 1970-87[a]

Year	Number of passenger vehicles	Vehicle miles (millions)	Passenger trips (millions)[b]	Estimated passenger miles (millions)[c]	Average trip length (miles)	Energy intensity (Btu/passenger-mile)[d]	Energy use (trillion Btu)
1970	10,548	440.8	2,116	12,273[c]	[e]	2,453	30.1
1971	10,550	440.4	2,000	11,600[c]	[e]	2,595	30.1
1972	10,599	417.8	1,942	11,264[c]	[e]	2,540	28.6
1973	10,510	438.5	1,921	11,142[c]	[e]	2,460	27.4
1974	10,471	458.8	1,876	10,881[c]	[e]	2,840	30.9
1975	10,617	446.9	1,797	10,423[c]	[e]	2,962	31.1
1976	10,625	428.1	1,744	10,115[c]	[e]	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
			Average annual percentage change				
1970-87	0.2%	0.8%	1.1%	-0.3%	-2.3%[f]	2.2%	1.8%
1982-87	0.2%	2.7%	2.9%	2.2%	0.0%	2.9%	5.1%

Sources:
American Public Transit Association, 1988 Transit Fact Book, Washington, DC, August 1988, pp. 11, 32, 33, 44.
Energy use - See Appendix A for Table 2.6.

[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 passenger trips.
[c]Estimated by ORNL for years 1970-76 based on an average trip length of 5.8 miles.
[d]Large system-to-system variations exist within this category.
[e]Data are not available.
[f]Average annual percentage change is calculated for years 1977-87.

Figure 4.12. Passenger Miles and Energy Use for Rail Transit Operations, 1970-87



Source: See Table 4.13.

APPENDIX A

SOURCES

In previous editions of the Transportation Energy Data Book, all data source information was located at the bottom of tables or, for lengthy sources, on the page opposite the table. Because of space limitations, some sources were not thorough as to the exact calculation of the estimates. An appendix is included in this edition of the data book to document the estimation procedures used by ORNL. The reader can now 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 as before. Abbreviations are used throughout the appendix; so a list of abbreviations is also included.

List of Abbreviations Used in Appendix A

AAR	Association of American Railroads
APTA	American Public Transit Association
Amtrak	National Railroad Passenger Corporation
Btu	British thermal unit
DOC	Department of Commerce
DOE	U.S. Department of Energy
DOT	U.S. 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
MVMA	Motor Vehicle Manufacturers Association
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
TPA	Transportation Policy Associates
TSC	Transportation Systems Center
vmt	vehicle-miles traveled

Table 2.6
Domestic Consumption of Transportation Energy by Mode
and Fuel Type, 1987

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 1987, Table VM-1, p. 171. These were distributed as follows: 98.5% gasoline and 1.5% diesel. Percentages were obtained from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, 1985 Residential Transportation Energy Consumption Patterns of Household Vehicles (RTECS), August 1987, pp. 25, 27.

Motorcycles

DOT, FHWA, Highway Statistics 1987, Table VM-1, p.171. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:

APTA Transit Fact Book, 1988 Edition, Washington, D.C., p. 39. Gallons of gasoline used by motorbuses (10.836×10^6) was obtained through personal communication with APTA's Research and Statistics Department.

Intercity:

Estimate provided by Frank Smith, Transportation Policy Associates, Washington, D.C.

School:

Estimate provided by Frank Smith, Transportation Policy Associates, Washington, D.C.

Trucks

Total:

DOT, FHWA, Highway Statistics 1987, Table VM-1, p. 171.

Light Trucks:

DOT, FHWA, Highway Statistics 1987, Table VM-1, p. 171, for single-unit, 2-axle, 4-tire trucks. 95.3% of fuel assumed to be gasoline, 3.5% diesel, and 1.2% lpg; percentages were generated from the 1982 TIUS Public Use Tape.

Other Trucks:

Total gallons for other trucks was the difference between total and light trucks. These gallons were distributed as follows based on data from the 1982 TIUS Public Use Tape: 39.6% of fuel assumed to be gasoline, 59.4% diesel, and 1.0% lpg.

Off Highway

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

Non-Highway

Air

General Aviation:

DOT, FAA, General Aviation Activity and Avionics Survey: Annual Summary Report 1987 Data, Table 2-21, p. 2-161.

Domestic and International Air Carrier:

DOT, Research and Special Programs Administration, Data Administration Division, "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 purchases for international flights.

Water

Freight:

Total - DOE, EIA, Petroleum Marketing Monthly, June, 1988, "Annual Report on Sales of Fuel Oil and Kerosene, 1987," pp. 200 and 201. Totals for deliveries of distillate and residual fuel oil for vessel bunkering. (These totals include residual fuel oil purchased by domestic and foreign vessels as reported in Bunker Fuels. *See below*).

Domestic and Foreign - DOC, U.S. Foreign Trade, Bunker Fuels, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade", annual, 1987. In this were fuel oil (i.e. residual) and diesel oil laden in the U.S. on vessels engaged in foreign trade (Note that the units were barrels;

gallons were obtained by multipling by 42 gallons/barrel). The totals for residual and diesel used by foreign vessels and American vessels for foreign trade were subtracted from the EIA totals for residual and diesel deliveries to obtain the value for domestic trade.

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 1987" (Whitney Communications, N.Y. City). The total was the sum of inboard, outboard and inboard/outboard boats.

Pipeline

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 1987, Table 1, p. 2. 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 29.305×10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,756 Btu.

Crude petroleum and petroleum product:

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

Coal slurry and water:

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

Rail

Total:

DOE, EIA, Petroleum Marketing Monthly, June 1988, "Annual Report on Sales of Fuel Oil and Kerosene, 1987," pp. 200 and 201. Totals for deliveries of distillate and residual fuel oil for railroad. (Source material indicated that distillate fuel oil used by Class I railroads and Amtrak was obtained from the AAR.)

Freight:

Distillate fuel oil was obtained by subtracting total passenger fuel use from total distillate as reported by EIA.

Passenger:

Transit and Commuter - APTA, Transit Fact Book, 1988 Edition, Washington, D.C., p. 39. Transit was defined as the sum of "heavy rail" and "all other".

Intercity - Sum of fuel used by Amtrak and Class I passenger trains. Source for Amtrak was personal communication with the Accounting Division of Amtrak, Washington, D.C. Source for fuel use by Class I passenger trains was the AAR, Statistics of Class I Railroads, 1987, p. 157. Fuel use for Class I passenger was derived as follows: fuel use for passenger locomotive, including weighted percent of fuel for yard switching. Diesel fuel consumed by work train was not included as it was considered to be indirect energy.

Military Operations

Defense Logistics Agency, Defense Fuel Supply Center, Fact Book Fiscal Year 1987, "Retail Consumption," (in barrels), p. 18. [For conversion to Btu, 95% of "fuel oils" and "reclaimed fuel oils" were assumed to be distillate and 5% residual (based on percentage distribution of distillate and residual categories).] This number represents total fuel consumed by the military, both domestic and abroad. An estimate of 68.9% was purchased in the United States, based on the percentage of total fuel supplied by the Continental U.S., Alaska, and Hawaii (see "Source of Bulk Product Table," p. 30.).

Table 2.9
Transportation Energy Consumption by Mode, 1970-1987

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 and 1987 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

1970-1980 - 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.
1985-1987 - 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.

Motorcycles

Department of Transportation, Federal Highway Administration, Highway Statistics Summary to 1985, Table VM-201A; and Table VM-1 in the 1986 and 1987 annual editions. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Sum of transit, intercity and school.

Transit:

1970-1986 - APTA, 1988 Transit Fact Book, Washington, D.C., 1988, pp. 33, 34, and annual.
1987 - See **Buses** under Table 2.6, Appendix A.

Intercity:

1970-1984 - American Bus Association, Annual Report, Washington, D.C., annual.
1985-1986 - TPA, Transportation in America, November 1988 Supplement, Washington, D.C., p. 8.
1987 - See **Buses** under Table 2.6, Appendix A.

School:

1970-1984 - DOT, FHWA, Highway Statistics 1984, Washington, D.C., Table VM-1, and annual.
1985-1986 - DOT, Research and Special Programs Administration, National Transportation Statistics, Figure 2, p. 5, and annual.
1987 - See **Buses** under Table 2.6, Appendix A.

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 and 1987 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.

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 and 1987 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.

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:

1985-1987 - See **General Aviation** under Table 2.6, Appendix A.
1975-1985 - DOT, FAA, FAA Aviation Forecasts, Washington, D.C., annual.
1970-1974 - DOT, TSC, National Transportation Statistics, Cambridge, MA, 1981.

Certificated Route Air Carrier:

1982-1987 - See **Certificated Route Air Carrier** under Table 2.6, Appendix A.

1970-1981 - DOT, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, D.C., annual.

Water

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

Freight:

See **Water** under Table 2.6, Appendix A.

Recreational Boating:

1985-1987 - See **Recreational boating** under Table 2.6, Appendix A.

1970-1984 - DOT, FHWA, Highway Statistics, Washington, D.C., Table MF-24 annual.

Pipeline

See **Pipeline** under Table 2.6, Appendix A.

Rail

See **Rail** under Table 2.6, Appendix A.

Table 2.13
Passenger Travel and Energy Use in the United States, 1987

Highway

Automobiles

Number of Vehicles - R. L. Polk and Company. FURTHER REPRODUCTION PROHIBITED.
Vmt - DOT, FHWA, Highway Statistics 1987, Table VM-1, p. 171.
Pmt - Calculated by ORNL (load factor times vmt).
Load Factor - DOT, FHWA, Personal Travel in the U.S.: Vol. 1: A Report on Findings from the 1983-84 NPTS, August 1986, p. 8-18.
Energy Use - See **Automobiles** under Table 2.6, Appendix A.

Personal Trucks

Number of Vehicles - 56% of total trucks in operation (as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED) were assumed to be for personal use. This percentage was derived by ORNL from the 1982 TIUS Public Use tape.
Vmt - 44.5% of Total truck vmt (as reported by DOT, FHWA in Highway Statistics 1987, Table VM-1, p. 171) were for personal use. This percentage was derived by ORNL from the 1982 TIUS Public Use tape.
Pmt - Calculated by ORNL (load factor times vmt)
Load Factor - Calculated as average for pick-up truck and pick-up truck with camper from the 1983-84 NPTS Public Use Tape.
Energy Use - 31% of total truck energy use was for personal use. This percentage was derived by ORNL from the 1982 TIUS Public Use tape. See **Truck** under Table 2.6, Appendix A.

Motorcycles

Number of Vehicles, Vmt and Energy Use - DOT, FHWA, Highway Statistics 1987, Table VM-1, p. 171.
Pmt - Calculated by ORNL (load factor times vmt).
Load Factor - DOT, TSC, National Transportation Statistics 1988, p. 23.

Buses

Transit:
Number of Vehicles, Vmt, Pmt, and Energy Use - Motor bus only. APTA, Transit Fact Book, 1988 Edition, Washington, D.C., pp. 10, 11, 12.
Load Factor - Calculated by ORNL (pmt/vmt).

Intercity:

Number of Vehicles - Estimated by ORNL based on historical trends.
Pmt - TPA, Transportation in America, 6th Edition, March 1988, and November 1988 Supplement, p. 8.
Energy Use - Preliminary estimate provided by Frank Smith, TPA, Washington, D.C.

School:

Number of Vehicles - School and other nonrevenue as reported in DOT, FHWA, Highway Statistics 1987, Table MV-10.
Energy Use - Preliminary estimate provided by Frank Smith, TPA.

Non-Highway

Air

Large Certified Route Air Carriers:

Vmt - Revenue aircraft miles flown, DOT, FAA, FAA Statistical Handbook of Aviation Calendar Year 1987, p. 122.
Pmt - Revenue pmt domestic operations, scheduled and unscheduled, DOT, FAA, FAA Statistical Handbook of Aviation Calendar Year 1987, p. 122.
Load Factor - For scheduled services only. DOT, TSC, Air Carrier Traffic Statistics Monthly, December 1986/1987, Cambridge, Mass., 1988, p. 1.
Energy Use - See **Certificated Route Air Carrier** under Table 2.6, Appendix A.

General Aviation:

Number of Vehicles, Vmt, Energy Use - DOT, FAA, General Aviation Activity and Avionic, Survey: Annual Summary Report 1987 Data, pp. 1-12, 2-161, 2-184.
Pmt - TPA Transportation in America, 6th Edition, March 1988, and November Supplement, p. 8 (pmt by private air carriers).
Load Factor - Calculated by ORNL (pmt/vmt).

Recreational Boating

Number of Vehicles - Whitney Communications, Boating Industry Magazine, Annual Report, "The Boating Business 1987." The total was the sum of inboard, outboard, and inboard/outboard boats.
Energy Use - See **Recreational boating** under Table 2.6, Appendix A.

Rail

Intercity:

Number of Vehicles, Vmt and Pmt - AAR, Railroad Facts 1988, p. 61.
Load Factor - Calculated by ORNL (pmt/vmt).
Energy Use - See **Rail** under Table 2.6, Appendix A.

Transit and Commuter:

Number of Vehicles, Vmt and Pmt - APTA, Transit Fact Book, 1988 Edition, Washington, D.C., pp. 10, 11 and 12.
Load Factor - Calculated by ORNL (pmt/vmt).
Energy Use - See **Rail** under Table 2.6, Appendix A.

Table 2.14
Energy Intensities of Passenger Modes, 1970-87

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 in Table 2.14 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 annual edition.
Pmt - vmt times 1.7 load factor.
Energy Use - See Automobiles under Table 2.6, Appendix A.

Buses

Transit:
Vmt and Pmt - See Table 3.22.
Energy Use - See **Buses** under Table 2.6, Appendix A.

Intercity:
Pmt - See Table 3.22.
Energy Use - See **Buses** under Table 2.6, Appendix A.

School:
Vmt - See Table 3.22.
Energy Use - See **Buses** under Table 2.6, Appendix A.

Non-Highway

Air

Certificated Air Carriers:
Pmt - See Table 4.2.
Energy Use - See **Air** under Table 2.6, Appendix A.

General Aviation:
Pmt - See Table 4.4.
Energy Use - See **Air** under Table 2.6, Appendix A.

Rail

Passenger (Amtrak):
Pmt - See Table 4.12.
Energy Use - See **Rail** under Table 2.6, Appendix A.

Transit:
Pmt - See Table 4.13.
Energy Use - See **Rail** under Table 2.6, Appendix A.

Table 2.15
Intercity Freight Movement and Energy Use in the United States, 1987

Highway

Trucks

Vehicles - Trucks engaged in intercity freight movement were defined as all short and long haul trucks with the following major uses; agriculture, forestry and lumbering, mining and quarrying, construction, manufacturing, wholesale trade, retail trade, for-hire transportation, and daily rental. According to data from the 1982 TIUS, such trucks accounted for 5.94% of all trucks in operation in 1982. This percentage was applied to the number of total trucks in operation in 1987 (47.344×10^6) as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED).

Vmt - According to data from the above source, trucks engaged in intercity freight traveled approximately 32,910 miles per truck. This average annual vmt was multiplied by the estimated number of vehicles in operation in 1987 to obtain an estimate of total vmt.

Ton Miles, Tons Shipped and Average Length of Haul - TPA, Transportation in America, 6th Edition, Washington, D.C., November 1988 Supplement, pp. 6, 7, 25.

Energy Intensity - Energy use divided by ton-miles.

Energy Use - According to data from the 1982 TIUS, trucks engaged in intercity freight in 1982 used about 17.5% of total truck energy use. This percentage was applied to total truck energy use (7169.2×10^2 Btu). See **Trucks** under Table 2.6, Appendix A.

Non-Highway

Waterborne Commerce

Vehicles - Personal communication with the U.S. Department of the Army, Corps of Engineers, in New Orleans, LA. Data represent the number of U.S. flag passenger and cargo vessels operating or available for operation.

Ton Miles, Tons Shipped, and Average Length of Haul - U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the U.S. Part 5 National Summary, 1987, Part 3, Table 1 (preliminary data).

Energy Intensity - Energy use divided by ton miles.

Energy Use - See Water under Table 2.6, Appendix A.

Pipeline

Natural Gas:

Tons shipped - DOE, EIA, Natural Gas Annual, Washington, D.C., 1987, p. 2. Total natural gas disposition divided by 44,870 ft^3/ton.

Energy use - See **Pipeline** under Table 2.6, Appendix A.

Crude Oil and Petroleum Product:

Ton Miles and Tons Shipped - TPA, Transportation in America, 6th Edition, March 1988, November Supplement, pp. 6, 7.

Coal Slurry - Ton Miles, Tons Shipped, and Average Length of Haul: DOT, Transport of Solid Commodities via Freight Pipelines, Freight Pipeline Technology, Vol. 11, Washington, D.C., 1976, p. 6.

Energy Use - W. F. Banks, Systems, Science, and Software, Inc., Energy Consumption in the Pipeline Industry, LaJolla, CA, 1977.

Rail

Vehicles, Vmt, Ton Miles, Tons Shipped, Average Length of Haul - AAR, Railroad Facts 1988, pp. 9, 27, 29, 34, 46.

Energy Use - See **Rail** under Table 2.6, Appendix A.

Table 2.16
Energy Intensities of Freight Modes, 1970-87

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 in Table 2.16 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 annual edition. 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. See Table 3.15 for light truck vmt.
Energy Use - See Trucks under Table 2.6, Appendix A.

Non-Highway

Water

Ton Miles - See Table 4.7.

Rail

Freight Car Mile - See Table 4.10.
Ton Miles - See Table 4.10.
Energy Use - See Rail under Table 2.6, Appendix A.

Table 3.2
Vehicle Stock, New Sales and New Registrations
in the United States, 1987 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, D.C. Market shares for the years 1976-1988 were found in Patricia S. Hu and Linda S. Williams, Light Duty Vehicle MPG and Market Shares Report: First Six Months of Model Year 1988, ORNL-6496, August 1988, Table 1. 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 for 1987. This method assumed that all vehicles, large and small, were scrapped at the same rate.

Sales:

Domestic - MVMA, Facts and Figures '88, pp. 14 and 15. Retail sales by make were classified by ORNL into EPA size classes (*see below*).

Import - Import car retail sales and tourist deliveries (as reported in H. A. Stark (ed.), Ward's Communication, Inc., 1988 Ward's Automotive Yearbook, Detroit, MI, pp. 228 and 229) were classified by ORNL into EPA size classes (see below). Tourist and Hawaii categories were distributed among the EPA size classes based on the manufacturer's percentage distribution for overall sales. Sales of vans were not included.

Total - Calculated by ORNL as the sum of domestic and import.

New Registrations:

Domestic - The number of registrations for new automobiles was derived as follows: new car registrations by make (as reported in H. A. Stark (ed.), Ward's Communication, Inc., 1988 Ward's Automotive Yearbook, Detroit, MI, p. 176), were classified by ORNL into EPA size classes (see below). Totals included Federal Government registrations and domestic sponsored imports. Van registrations were not included.

Import - Calculated by ORNL as the difference between total and domestic.
Total - Taken from MVMA, Facts and Figures '88, p. 20.
See Glossary for definition of Automobile Size Classifications.

Fleet

Business:

Stock and Registrations - E. J. Bobit (ed.), Bobit Publishing Company, Automotive Fleet Fact Book, Redondo Beach, CA, 1988, p. 14. Total was equal to the sum of business fleets 25 or more, business fleets 10-24, individually leased, and "other" fleets. This number excluded cars in Federal Government fleets.

Personal:

Stock and Registrations - Calculated by ORNL as the difference between total auto and fleets.

Motorcycles

Stock - DOT, FHWA, Highway Statistic 1987, Table VM-1 p. 171.
Sales and Registrations - MIC, 1988 Motorcycle Statistical Annual, pp. 12 and 13. Domestic sales were assumed to equal U.S. production (p. 13), and included sales of motorcycles, scooters, and ATV's for on and off highway use. Import was the difference between total sales (p. 12) and domestic (p. 13).

Recreational Vehicles

Sales - Recreation Vehicle Industry Association, A Year End Report/1987, p. 4, "Total Shipments".

Trucks

Stock - Vehicles in use by weight class were determined by applying the percentage in use by weight class in 1982 as reported in DOC, Bureau of the Census, 1982 TIUS, (<6000 lbs, 77.8%; 6-10,000 lbs, 11.6%; 10-14,000 lbs, 1.6%; 14-16,000, 0.9%; 16-19,500 lbs, 1.0% 19.5-26,000 lbs, 2.3%; 26-33,000, 1.0%; >33,000 lbs, 3.8%) to the total number of trucks in use as reported by R. L. Polk and Company, FURTHER REPRODUCTION PROHIBITED.
Sales - MVMA, Facts and Figures '88, p. 19.
Registrations - H. A. Stark (ed.), Ward's Communications, Inc., 1988 Ward's Automotive Yearbook, Detroit, MI, p. 185.

APPENDIX B

CONVERSIONS

A Note About Heating Values

The heat content of a fuel is the quantity of energy released by burning a unit amount of that fuel. However, this value is not absolute and can vary according to several factors. For example, empirical formulae for determining the heating value of liquid fuels depend on the fuels' American Petroleum Institute (API) gravity. The API gravity varies depending on the percent by weight of the chemical constituents and impurities in the fuel, both of which are affected by the combination of raw materials used to produce the fuel and by the type of manufacturing process. Temperature and climatic conditions are also factors.

Because of these variations, the heating values in Table B.1 may differ from values in other publications. The figures in this report are representative or average values, not absolute ones. The gross heating values used here agree with those used by the Energy Information Administration (EIA).

Heating values fall into two categories, gross and net. If the products of fuel combustion are cooled back to the initial fuel-air or fuel-oxidizer mixture temperature and the water formed during combustion is condensed, the energy released by the process is the higher (gross) heating value. If the products of combustion are cooled to the initial fuel-air temperature, but the water is considered to remain as a vapor, the energy released by the process is lower (net) heating value. Usually the difference between the gross and net heating values for fuels used in transportation is around 5 to 8 percent; however, it is important to be consistent in their use.

Table B.1
Approximate Heat Content for Various Fuels

Automotive gasoline	125,000 Btu/gal (gross)	= 115,400 Btu/gal (net)
Diesel motor fuel	138,700 Btu/gal (gross)	= 128,700 Btu/gal (net)
Methanol	64,600 Btu/gal (gross)	= 56,560 Btu/gal (net)
Ethanol	84,600 Btu/gal (gross)	= 75,670 Btu/gal (net)
Gasohol	120,900 Btu/gal (gross)	= 112,417 Btu/gal (net)
Aviation gasoline	120,200 Btu/gal (gross)	= 112,000 Btu/gal (net)
Propane	91,300 Btu/gal (gross)	= 83,500 Btu/gal (net)
Butane	103,000 Btu/gal (gross)	= 93,000 Btu/gal (net)
Jet fuel (naphtha)	127,500 Btu/gal (gross)	= 118,700 Btu/gal (net)
Jet fuel (kerosene)	135,000 Btu/gal (gross)	= 128,100 Btu/gal (net)
Lubricants	144,400 Btu/gal (gross)	= 130,900 Btu/gal (net)
Waxes	131,800 Btu/gal (gross)	= 120,200 Btu/gal (net)
Asphalt and road oil	158,000 Btu/gal (gross)	= 157,700 Btu/gal (net)
Petroleum coke	143,400 Btu/gal (gross)	= 168,300 Btu/gal (net)
Natural gas		
Wet	1,112 Btu/ft^3	
Dry	1,031 Btu/ft^3	
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		23.108 x 10^6 Btu/short ton
Bituminous and lignite		21.828 x 10^6 Btu/short ton
Production average		21.832 x 10^6 Btu/short ton
Consumption average		21.340 x 10^6 Btu/short ton

Table B.2
Alternative 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} kWh		= 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} kWh		= 27.78×10^{-8} kWh
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 kWh		= 0.7355 kWh

[a]This figure does not take into account the fact that electricity generation and distribution efficiency is approximately 29%. If generation and distribution efficiency are taken into account, 1 kWhr = 11,765 Btu

Table B.4
Distance and Velocity Conversions

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

1 ft/sec = 0.3048 m/s = 0.6818 mph = 1.0972 km/h

1 m/sec = 3.281 ft/s = 2.237 mph = 3.600 km/h

1 km/h = 0.9114 ft/s = 0.2778 m/s = 0.6214 mph

1 mph = 1.467 ft/s = 0.4469 m/s = 1.609 km/h

Table B.5
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		= 1.00 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.6

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.7
Fuel Efficiency Conversions[a]

MPG	Miles/liter	Kilometers/L	L/100 kilometers
10	2.64	4.25	23.52
15	3.96	6.38	15.68
20	5.28	8.50	11.76
25	6.60	10.63	9.41
30	7.93	12.75	7.84
35	9.25	14.88	6.72
40	10.57	17.00	5.88
45	11.89	19.13	5.23
50	13.21	21.25	4.70
55	14.53	23.38	4.28

[a]To convert fuel efficiency from miles per gallon (mpg) to liters per hundred kilometers, divide mpg into 235.24.

Table B.8
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.9
Metric Units and Abbreviations

Quantity	Unit name	Symbol
Energy	joule	J
Specific energy	joule/kilogram	J/kg
Specific energy consumption	joule/kilogram•kilometer	J/(kg•km)
Energy consumption	joule/kilometer	J/km
Energy economy	kilometer/kilojoule	km/J
Power	kilowatt	Kw
Specific power	watt/kilogram	W/kg
Power density	watt/meter^3	W/m^3
Speed	kilometer/hour	km/h
Acceleration	meter/second^2	m/s^2
Range (distance)	kilometer	km
Weight	kilogram	kg
Torque	newton•meter	N•m
Volume	meter^3	m^3
Mass; payload	kilogram	kg
Length; width	meter	m
Brake specific fuel consumption	kilogram/joule	kg/J
Fuel economy (heat engine)	liters/100 km	L/100 km

Conversion of Constant Dollar Values

Many types of information in this data book are expressed in dollars. Generally, constant dollars are used--that is, dollars of a fixed value for a specific year, such as 1987 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.10 and B.11). Table B.10 shows conversion factors using the Gross National Product inflation factors. Table B.11 shows conversion factors for the Consumer Price Index inflation factors.

Table B.10
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Source:
U. S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Washington, DC, monthly.

Table B.11
Consumer Price Inflation (CPI) Index

From	To																		
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Source:
U.S. Department of Labor, Bureau of Labor Statistics, Monthly Labor Review, Washington, DC, monthly.

GLOSSARY

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 Amercian 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.

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.*

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.

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 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.

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.

Medium truck - See *Truck size classifications.*

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, and 1983 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.*

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. For 1987, the threshold for Class I railroads was $87.9 million. In 1987, Class I railroads comprised only 3% of the number of railroads; however, they operated about 82% of the mileage and employed 90% of the railroad labor force.

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 was conducted in 1983, 1985, and 1987. Data for the 1987 RTECS are not yet available.

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.

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.

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, and 1987, although complete data from the 1987 TIUS are not yet available.

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.*

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.

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Notations:

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

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