

1. Report No. SWUTC/95/60014-3	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Modal Energy Data Base for Transportation (Texas Transportation Energy Data Book: Edition 3)		5. Report Date September 1995	
		6. Performing Organization Code	
7. Author(s) Zane A. Goff and Kent J. Steffel		8. Performing Organization Report No. Research Report 60014-3	
9. Performing Organization Name and Address Texas Transportation Institute Texas A&M University System College Station, Texas 77843-3135		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No. 0079	
12. Sponsoring Agency Name and Address Southwest Region University Transportation Center Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135		13. Type of Report and Period Covered	
		14. Sponsoring Agency Code	
15. Supplementary Notes Supported by a grant from the Office of the Governor of the State of Texas, Energy Office			
16. Abstract The Texas Transportation Energy Data Book is a statistical data base which contains information regarding the transportation energy characteristics of Texas. This volume is divided into five chapters. Chapter 1 contains a comparison of Texas energy related transportation statistics with seven other similar states, and also contains a projection of world energy consumption in the year 2010. Chapter 2 provides a snapshot of the Texas transportation energy picture. Energy characteristics of the highway mode is detailed in chapter 3, while the energy characteristics of the non-highway modes of air, water, pipeline and rail are given in chapter 4. Chapter 5 concludes this volume and provides information concerning alternative energy fuels a new energy saving technology, including profiles of Electric Vehicles (EV).			
17. Key Words Transportation Energy, Energy Intensity, Energy Consumption, Oil Consumption, Gasoline Consumption		18. Distribution Statement No Restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161	
19. Security Classif.(of this report) Unclassified	20. Security Classif.(of this page) Unclassified	21. No. of Pages 200	22. Price

Texas Transportation Energy Data Book: Edition 3

by

Zane A. Goff

and

Kent J. Steffel

**Southwest Region University Transportation Center
Texas Transportation Institute
The Texas A&M University System
College Station**

August 1995

Users of the *Texas Transportation Energy Data Book* are encouraged to comment on errors, omissions, emphases, and organization of presentation to:

Zane A. Goff
Policy and Management Program
Texas Transportation Institute
The Texas A&M University System
College Station, TX 77843-3135
Telephone: (409) 845-9958
Telefax: (409) 845-9761

ABSTRACT

The *Texas Transportation Energy Data Book* is a statistical data base which contains information regarding the transportation energy characteristics of Texas. This volume is divided into five chapters. Chapter 1 contains a comparison of Texas energy related transportation statistics with seven other similar states, and also contains a projection of world energy consumption in the year 2010. Chapter 2 provides a snapshot of the Texas transportation energy picture. Energy characteristics of the highway mode is detailed in chapter 3, while the energy characteristics of the non-highway modes of air, water, pipeline and rail are given in chapter 4. Chapter 5 concludes this volume and provides information concerning alternative energy fuels a new energy saving technology, including profiles of Electric Vehicles (EV).

TABLE OF CONTENTS

List of Figures

Acknowledgment

Executive Summary

	<u>Page</u>	
Chapter 1	Comparative Energy Related Transportation Statistics	1
Table 1.1A	Estimated Energy Consumption (in Coal equivalent units) in 2010 for Selected World Regions	2
Table 1.1B	Petroleum Consumption and Oil Imports, 1990	3
Table 1.2	Estimated Transportation Use of Petroleum Products for Selected States, 1995	4
Table 1.3	Automobile Registrations for Selected States, 1973-95	8
Table 1.4	Private and Public Truck and Bus Registrations for Selected States, 1973-95	9
Table 1.5	Private and Commercial Vehicles per Capita for Selected States, 1973-95	10
Table 1.6	Motor Gasoline Prices for Selected States	11
Table 1.7	Distillate Fuel Prices for Selected States	13
Table 1.8	Motor Gasoline Taxes for Selected States, 1973-95	14
Table 1.9	Distillate Fuel Taxes for Selected States, 1973-95	15
Table 1.10	Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995	17
Chapter 2	Transportation Energy Characteristics of Texas	19
Table 2.1	Texas Petroleum Production and Consumption	21
Table 2.2	Texas Petroleum Consumption by Sector	24
Table 2.3	Distribution of Energy Consumption by Source	25
Table 2.4	Energy Consumption by End-Use Sector, 1973-95	27
Table 2.5	Energy Consumption by Transportation Mode, 1973-95	28

Table 2.6	Energy Consumption by Mode and Fuel Type, 1975	31
Table 2.7	Energy Consumption by Mode and Fuel Type, 1985	31
Table 2.8	Estimated Energy Consumption by Mode and Fuel Type, 1995	31
Table 2.9	Estimated Passenger Travel and Energy Use in Texas, 1995	34
Table 2.10	Energy Intensities of Passenger Modes in Texas	35
Table 2.11	Intercity Freight and Energy Use in Texas, 1995	37
Table 2.12	Energy Intensities of Freight Modes in Texas	39
Table 2.13	Retail Prices of Selected Highway Motor Fuels	40
Table 2.14	Retail Prices for Selected Transportation Fuels	41
Table 2.15	Crude Oil and Gasoline Prices	44
Chapter 3	Texas Highway Mode Characteristics	47
	<i>Section 3.1 General Highway Mode Characteristics</i>	49
Table 3.1	Texas Highway Mode Energy Consumption by Fuel Type	51
Table 3.2	Texas Highway Energy Use by Mode	53
Table 3.3	Estimated Vehicle Stock in Texas, 1995	54
Table 3.4	Vehicle Stock in Texas, 1973-95	55
Table 3.5	Texas Interstate Speed Data	59
Table 3.6	Texas Non-Interstate Speed Data	61
	<i>Section 3.2 Household Transportation Energy Data</i>	63
Table 3.7	Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures	64
Table 3.8	Estimated U.S. Travel and Consumption Characteristics Number of Cylinders, 1995 v. 1985	65
Table 3.9	Estimated Average Miles Per Gallon by Model Year	67
Table 3.10	Vehicle Fuel Efficiency by Region	68
Table 3.11	Estimated Average Household Energy and Vehicle Expenditures, 1995	69
Table 3.12	Estimated Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1995	72
Table 3.13	Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1995	73

Table 3.14	Estimated Average Vehicle Miles Traveled by Household Composition, 1995	75
<i>Section 3.3 Automobile and Transit Data</i>		77
Table 3.15	Cost of Operating an Automobile in the U.S.	79
Table 3.16	Estimated Automobile Fuel Economy by Vehicle Type, 1995 Model Year	80
Table 3.17	Texas Statewide Municipal Transit Ridership	81
<i>Section 3.4 Truck Data</i>		83
Table 3.18	Estimated Single Unit Truck Fuel Economy in Texas	84
Table 3.19	Estimated Combination Truck Fuel Economy in Texas	85
Table 3.20	Texas Truck Mileage by Vehicle Size	87
Table 3.21	Texas Truck Mileage by Vehicle Range	89
Table 3.22	Texas Truck Mileage by Major Use	89
Table 3.23	Estimated Commodities Shipped Via Texas Highways, 1995	90
Chapter 4	Texas Non-Highway Mode Characteristics	91
<i>Section 4.1 Air Mode</i>		93
Table 4.1	Air Mode Energy Consumption by Fuel Type	95
Table 4.2	Summary Statistics for Domestic and International Route Air Carriers Operating in Texas	97
Table 4.3	Enplanements and Estimated Energy Use for Selected Texas Cities	98
Table 4.4	Air Freight for Selected Texas Cities	99
Table 4.5	Summary Statistics for General Aviation in Texas	101
Table 4.6	Distribution of General Aviation Aircraft in Texas	102
<i>Section 4.2 Water Mode</i>		103
Table 4.7	Water Mode Energy Consumption by Fuel Type	105
Table 4.8	Summary Statistics for Domestic Waterborne Traffic in Texas	106
Table 4.9	Summary Statistics for Galveston District	107

Table 4.10	Summary Statistics for Texas Gulf Intracoastal Waterway	108
Table 4.11	Estimated Commodities Shipped by Water in Texas	109
<i>Section 4.3 Pipeline Mode</i>		111
Table 4.12	Texas Pipeline Shipments of Energy	112
<i>Section 4.4 Rail Mode</i>		113
Table 4.13	Rail Mode Energy Consumption by Fuel Type	114
Table 4.14	Freight and Energy Statistics of Class I Railroads Operating in Texas	115
Table 4.15	Summary Statistics for Class I Railroads in Texas	116
Table 4.16	Comparative Statistics for 1995 Class I Railroads	117
Table 4.17	Estimated Top Five Commodities of Total Freight by Tonnage, 1995	118
Table 4.18	Estimated Top Five Commodities of Total Freight by Carloads, 1995	119
Chapter 5	Alternative Fuels and New Energy Saving Technology	121
<i>Section 5.1 Alternative Fuels</i>		123
Table 5.1	Fuel Prices for Countries Having Alternative Fuel Vehicles	128
Table 5.2	Comparison of Economically Feasible Alternative Fuels	129
Table 5.3	Direct Carbon Dioxide (CO ₂) Emissions of Selected Alternative Fuels	130
<i>Section 5.2 Emissions and New Technology</i>		131
Table 5.4	Carbon Dioxide Emissions in Texas	132
Table 5.5	Methane Emissions in Texas	133
Table 5.6	NO _x Emissions in Texas	134
Table 5.7	HFC & PFC Emissions in Texas	135
Table 5.8	Estimated Texas Emissions of Carbon Monoxide, 1985-94	136

Table 5.9	Estimated Emissions of Carbon Monoxide from Texas Highway Vehicles, 1985-94	137
Table 5.10	Estimated Texas Emissions of Particulate Matter, 1985-94	138
Table 5.11	Estimated Emissions of Particulate Matter from Texas Highway Vehicles, 1985-94	139
Table 5.12	Estimated Texas Emissions of VOCs, 1985-94	140
Table 5.13	Estimated Emissions of VOCs from Texas Highway Vehicles, 1985-94	141
Table 5.14	Estimated Texas Emissions of Nitrogen Oxides	142
Table 5.15	Estimated Emissions of Nitrogen Oxides from Texas Highway Vehicles, 1985-94	143
Table 5.16	Estimated Texas Emissions of Sulfur Dioxide, 1985-94	144
Table 5.17	Estimated Emissions of Sulfur Dioxide from Texas Highway Vehicles, 1985-94	145
Table 5.18	Estimated Texas Emissions of Lead, 1985-94	146
Table 5.19	Estimated Emissions of Lead from Texas Highway Vehicles, 1985-94	147
Table 5.20	Technology Concepts for Improving Fuel Efficiency	148
Table 5.22	Selected Electric Vehicle Profiles by Non-USA Auto makers	149
Table 5.22	New Energy Saving Automobiles	150
Table 5.23	Goals of the United States Advanced Battery Consortium	151
Table 5.24	Current Status of Advanced Transit Battery Development	151
Title Index		153
Appendix: Important Conversion Factors		163
Table A.1	Approximate Heating Values for Various Fuels	164
Table A.2	Energy Unit Conversions	165
Table A.3	Power Conversions	166
Table A.4	Metric Conversion Factors: Length	167
Table A.5	Metric Conversion Factors: Mass	168
Table A.6	Metric Equivalents for Volume	169
Table A.7	Consumer Price Index	170
Glossary		173

LIST OF FIGURES

		<u>Page</u>
Chapter 1	Comparative Energy Related Transportation Statistics	1
Figure 1.1	Motor Gasoline per Licensed Driver in Relation to Driver Density, 1982	5
Figure 1.2	Motor Gasoline per Licensed Driver in Relation to Driver Density, 1992	6
Figure 1.3	Texas Auto, Bus, and Truck Registrations as a Percentage of U.S. Registrations, 1972-95	7
Figure 1.4	Gasoline Prices of Selected States, 1995	12
Figure 1.5	Transportation Energy Consumption as a Percentage of 1973 Baseline	16
Figure 1.6	Household Vehicle Miles Traveled, 1995	18
Chapter 2	Transportation Energy Characteristics of Texas	19
Figure 2.1	Texas Petroleum Production and Consumption	20
Figure 2.2	Texas Transportation Petroleum Consumption vs. Texas Petroleum Production	22
Figure 2.3	Petroleum Consumption by Sector	23
Figure 2.4	Distribution of Energy by End-Use Sector, 1995	26
Figure 2.5	Distribution of Texas Transportation Energy by Mode	29
Figure 2.6	Texas Highway Energy BTU per Licensed Driver in Relation to Licensed Drivers per Square Mile	30
Figure 2.7	Distribution of Transportation Energy Use by Mode, 1995	32
Figure 2.8	Texas Energy Consumption Energy by Mode & Fuel Type, 1995	33
Figure 2.9	Passenger Energy Intensity in Texas, 1995	36
Figure 2.10	Intercity Freight Energy Intensities in Texas, 1995	38
Figure 2.11	Texas Motor Fuel Prices (\$ 1988) as Percentage of Baseline	42
Figure 2.12	Texas Non-Highway Fuel (\$ 1988) as Percentage of Baseline	43
Figure 2.13	Crude Oil and Texas Gasoline Prices (\$ 1988) as Percentage of Baseline	45

Chapter 3	Texas Highway Mode Characteristics	47
	<i>Section 3.1 General Highway Mode Characteristics</i>	49
Figure 3.1	Texas Highway Energy Use by Fuel Type , 1995	50
Figure 3.2	Percentage of Highway Energy Consumption by Mode	52
Figure 3.3	Automobiles and Trucks Registered in Texas	56
Figure 3.4	Texas Private Vehicle Stock Growth	57
Figure 3.5	Public Vehicle Stock Growth	58
Figure 3.6	Texas Average Speed as a Percentage of U.S. Average Speed	60
	<i>Section 3.2 Household Transportation Energy Data</i>	63
Figure 3.7	Texas Average MPG as a Percentage of U.S. Average by Model Year	66
Figure 3.8	Average Household Vehicle Energy Expenditures as a Percentage of U.S. Average	70
Figure 3.9	Texas Average Annual Household Vehicle Miles Traveled as a Percentage of U.S. Average, 1995	71
Figure 3.10	Effect of Income on Average Annual Vehicle Miles Traveled, 1995	74
	<i>Section 3.3 Automobile and Transit Data</i>	77
Figure 3.11	Average Annual Cost of Operating an Automobile , Constant \$ 1987	78
Figure 3.12	Texas Statewide Municipal Transit Ridership	82
	<i>Section 3.4 Truck Data</i>	83
Figure 3.13	Miles Per Gallon of Trucks Operating in Texas	86
Chapter 4	Texas Non-Highway Mode Characteristics	91
	<i>Section 4.1 Air Mode</i>	93

Figure 4.1	Texas Air Mode Energy Use by Fuel Type, 1995	94
Figure 4.2	Passenger-Miles, Cargo Ton-Miles and Energy Use in Texas for Certificated Route Air Carriers	96
Figure 4.3	Passenger-Miles and Energy Use for General Aviation in Texas	100
<i>Section 4.2 Water Mode</i>		103
Figure 4.4	Water Mode Energy Use by Fuel Type, 1995	104
Chapter 5 Alternative Fuels and New Energy Saving Technology		121
<i>Section 5.1 Alternative Fuels</i>		123
Figure 5.1	Gasoline Prices (Per Gallon) for Japan, France, Italy and Sweden	124
Figure 5.2	Gasoline Prices (Per Gallon) for Germany, Canada and the United States	125
Figure 5.3	Diesel Prices (Per Gallon) for Japan, France, Italy and Sweden	126
Figure 5.4	Diesel Prices (Per Gallon) for Germany, Canada and the United States	127

ACKNOWLEDGEMENT

This publication was developed as part of the University Transportation Centers Program which is funded 50% in oil overcharge funds from the Stripper Well settlement as provided by the Texas State Energy Conservation Office and approved by the U.S. Department of Energy. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

This is the third and final edition of the *Texas Transportation Energy Data Book*. During these past few years, this research complemented SWUTC's theme of "Mobility for Regional Development" by enabling public policy experts and other decision makers in Texas to have a reliable, unbiased, and easily accessible source of information for evaluating the effectiveness of energy policies and alternative energy technologies among the transportation modes in Texas. Hopefully, this research will provide insights for those SWUTC researchers undertaking projects consistent with SWUTC's new theme of "Sustainable Transportation".

Chapter 1 begins with a comparison of the U.S. energy consumption with world economic powers. Table 1.1A estimates the energy consumption in the year 2010 of the three world economic powers: U.S., OECD-Europe, and Japan. It shows that among these economic giants, the U.S. alone has managed to improve its energy intensity, and will increase its total energy consumption by 25%, while the others increase their energy consumption from 40 to over 50%. In Table 1.1B, the issue of energy security is addressed. It shows that U.S. petroleum imports are nearly 50% of its petroleum consumption; however this compares favorably to Western Europe's and Japan's nearly 70% figure. Additionally the table shows that the U.S. dependence on Middle Eastern petroleum is far below that which is commonly thought.

However, the remainder of the chapter primarily concentrates on energy related transportation statistics from Texas compared with the same statistics from seven states which cover the four major census regions of the United States: Northeast, Midwest, South and West. These states are: New York and Pennsylvania in the Northeast; Ohio and Illinois in the Midwest; California and Washington represent the West census region; and, Florida represents the South census region. Each of these states is similar to Texas in two respects:

first, they are among the most populous states in their region; and second, they have some of the largest highway programs in their regions.

Chapter 1 shows that Texas auto registrations, as a percentage of US auto registrations, has remained constant since 1973; however, the concentration of truck and bus registrations in Texas, as a percentage of US truck and bus registrations has risen from 8% to nearly 9% over this same period. Compared to the other seven states studied, motorists in Texas paid the third highest price per gallon in current dollars. Also in constant 1988 dollars, Texans have enjoyed a 4.4% annual reduction in motor gasoline prices since 1980. Freight haulers in Texas, however paid the second lowest in distillate fuel prices, compared to the other states studied.

Chapter 2 provides a snapshot of the transportation energy characteristics of Texas. It includes time series data concerning Texas petroleum production and consumption, energy consumption by transportation mode, and consumption by fuel type. Energy intensities of passenger travel (i.e., BTU per passenger-mile of vehicle-mile) and energy intensities of intercity freight carriers (i.e., BTU per ton-mile) are also provided. Lastly, chapter two contains time series data for prices of both highway and non-highway fuels.

The key points of chapter 2 are: Texas has been a net importer of petroleum products since 1988, and the gap has widened significantly; the burgeoning air industry in Texas has increased the demand for jet fuel at an annual rate of 7.7% since 1973; the most efficient passenger mode in Texas is the school bus (824 BTU per passenger-mile), while the least efficient is air (9,729 BTU per passenger-mile); yet auto efficiency, in terms of percentage change in BTU per passenger-mile, has improved the most since 1973 and leads in average annual reduction at a rate of 2.6%; the most efficient freight mode is the pipeline at 262 BTU per ton-mile, while combination trucks are the most energy intensive at 2,411

BTU per ton-mile; in 1988 constant dollars, Texas motor fuel prices have fallen over 25% from 1973 prices, yet distillate prices in 1988 constant dollars have risen in Texas by over 25% since 1973.

Chapter 3 provides detailed information about the energy characteristics of the Texas highway mode. This chapter is divided into four sections. Section 3.1 is concerned with the general energy and traffic characteristics of the State's highway mode. Section 3.2 concentrates on the household transportation energy characteristics of Texas and makes comparisons with other regions of the United States. Section 3.3 pertains to automobile and transit data. Finally, section 3.4 furnishes information pertaining to the trucking industry.

In the highway mode, motor gasoline accounts for over 80% of the energy use, while distillate usage is almost 20% and LPG usage is not even 0.1%. Since 1973, distillate usage has increased at an annual rate of 4.4%, while motor gasoline has increase by only 0.8% annually. Section 3.1 also shows that Texas automobile registrations have increased by over 57% since 1973, yet this is far surpassed by truck registrations which have grown by over 125% from 1973-93. Public vehicle stock growth in Texas has increased by nearly 238% over 1973 levels, while the US increase in public vehicle stock has increase less than 100% since 1973. Also Texans still drive faster than the rest of the US on urban freeways-- 101% of the US average but slower on rural roadways-- 92% of the US average for 1995.

In section 3.2, it is shown that: Texans drive less than the average US citizen (10,879 miles/household vehicle vs. 11,098); are less efficient (93% of US average MPG for 1993 model year drivers); and correspondingly spend more money on vehicle related energy (109% of US average). In section 3.3, it is revealed that Texas statewide municipal

transit ridership has increased by nearly 137% over 1974 levels. Texas Truck characteristics, such as registrations, fuel efficiency, annual miles traveled by truck size, range and use, are shown in section 3.4.

Chapter 4 provides detailed information about the energy related characteristics of the non-highway modes of travel and freight movement in Texas. Section 4.1 presents characteristics of the air mode in Texas. It contains information on energy consumption by fuel type, travel data for domestic and international route certified carriers operating in Texas, enplanements and energy use data for selected Texas cities, air freight data and statistics related to general aviation. As a percentage of US Air mode energy consumption, the Texas air industry usage has increased from 7.7% in 1973 to almost 27% in 1995.

Section 4.2 presents characteristics of the water mode in Texas. It contains information on energy consumption by fuel type and summary statistics for the Galveston district and the Gulf Intracoastal Waterway (GIWW) on the Texas coast. The type of commodities shipped via Texas waterways and the annual amount are also included in this section.

Section 4.3 presents a time series of pipeline shipments of energy in Texas. The table contains: domestic natural gas consumption data, crude and refined petroleum products transported, and the energy consumed. This mode has decreased its energy consumption-- 1.2% annually since 1973, despite an annual increase of .9% in ton-miles of product shipped.

Section 4.4 contains information on energy consumption by fuel type, and summary statistics for freight hauled, and energy intensity of Class I Railroads. The type of

commodities shipped via rail in Texas are also included in this section. Energy usage has increased slightly by .6% per year since 1973.

In the concluding chapter, information about alternative fuels and technology that reduces energy consumption are presented. Section 5.1 concentrates on the characteristics of alternative fuels and section 5.2 presents information on new technology, including profiles of Electric Vehicles (EV).

CHAPTER 1

COMPARATIVE ENERGY RELATED TRANSPORTATION STATISTICS

Table 1.1 begins this volume with an estimate of world wide energy consumption for the year 2010. The table points out that although the USA began 1988 with the highest energy consumption in the world, it may be surpassed by the former Soviet Union should recent trends continue. It also points out that the USA would only contribute a very minor increase in world wide energy consumption, and the pollution associated with the burning of fossil fuels.

However, the remainder of the chapter primarily concentrates on energy related transportation statistics from Texas compared with the same statistics from seven states which cover the four major census regions of the United States-- Northeast, Midwest, South and West. These states are:

- New York and Pennsylvania (Northeast census region);
- Ohio and Illinois (Midwest census region);
- California and Washington (West census region); and,
- Florida (South census region).

Each of these states is similar to Texas in two respects. First, they are among the most populous states in their region; and second, they have some of the largest highway programs in their regions.

Table 1.1A Estimated Energy Consumption (in Coal equivalent units) in 2010 for Selected World Regions

	Energy Consumed (Coal equivalent) Million Megagrams 1991	GDP (in billions) 1985 Dollars 1991	Energy Intensity (MIn Mg/Bil \$GDP) 1991	Avg. annual compound growth (1980-91)		Estimated Energy Consumed (Coal equivalent) Million Megagrams 2010	Estimated Change in Energy Consumption 1991-2010
				GDP	Energy Intensity		
U.S.	2727	4641	0.5876	1.27%	-0.07%	3422	25.50%
OECD-Europe	1994	3574	0.5580	1.39%	0.44%	2821	41.50%
Japan	590	1358	0.4345	0.74%	1.63%	924	56.64%

Sources:

U.S. Bureau of the Census, Statistical Abstract of the United States: 1994
(114th edition). Washington, DC, 1994, Tables 1368, 1370, & 1393

Estimates made by Z.A. Goff, Texas Transportation Institute

Assumptions:

1. For the period 1991 to 2010, real GDP grows at 1980-91 average annual compound growth rates
2. For the period 1991 to 2010, the energy intensity changes at the 1980-91 average annual compound rate

**Table 1B. Petroleum Consumption and Oil Imports, 1990
(Million barrels per day)**

Country/Region	Domestic Consumption	Non-Mid East Imports	Mid East Imports	Refined Oil Imports	Total Imports	Total Imports as % of Consumption	Mid East Imports as % of Consumption
U.S.	16.99	4.09	1.80	2.10	7.99	47.05	10.59
Western Europe	13.78	6.30	3.40	0.00	9.70	70.41	24.67
Japan	5.45	1.10	2.70	0.00	3.80	69.72	49.54

Source:

U.S. Bureau of the Census, Statistical Abstract of the United States: 1994 (114th edition). Washington, DC, 1994, Tables 937,938,941

Commentary:

Much has been made about the "energy security" of the U.S. ; however, among the economic world powers, the U.S. fares the best by a wide margin. The salient point is that almost 90% of oil consumed by the U.S. is either from domestic production or "friendly", politically-stable nations. **Additionally, as of 1993, the U.S. has 355 days of imported Middle Eastern oil** in its Strategic Petroleum Reserve. Currently, the only Middle Eastern petroleum that the U.S. imports is from friends won in the Gulf War: Saudi Arabia and Kuwait.

Although Western Europe-about the same size and population as the U.S.- consumes less petroleum than the U.S., it is at the expense of extremely high taxes on motor fuel and personal vehicles.

It should also be noted that the phrase "proven petroleum reserves" pertains to reserves that are currently economically recoverable. That is, as the real price of petroleum increases, the quantity of "proven petroleum reserves increases because former, marginally profitable reserves are developed.

Table 1.2 Estimated Transportation Use of Petroleum Products for Selected States, 1995

	Trillion Btu								Percent transport. of total petroleum use	Total petroleum use
	Motor gasoline	Percent motor gasoline of transport. petroleum use	Aviation gasoline	LPG	Jet fuel	Distillate fuel	Residual fuel	Total transport. petroleum use		
Northeast:										
New York	662.6	80%	0.4	0.5	21.8	129.4	18.5	833.3	53%	1,561.9
Pennsylvania	555.6	68%	0.7	0.7	64.3	156.6	45.1	823.1	64%	1,282.6
Midwest:										
Ohio	549.3	71%	0.9	0.9	65.3	158.4	0.3	775.2	66%	1,175.3
Illinois	549.8	75%	0.9	1.1	34.2	147.9	0.1	734.2	64%	1,146.9
West:										
California	1,713.8	61%	4.9	2.6	518.8	336.4	219.5	2,796.0	82%	3,418.3
Washington	301.4	40%	1.5	1.1	153.1	79.9	225.3	762.3	82%	934.2
South:										
Florida	789.7	67%	2.5	0.6	135.3	177.3	81.3	1,186.7	69%	1,723.2
Texas	1,053.6	46%	3.6	0.7	621.5	408.9	209.4	2,297.8	47%	4,844.2

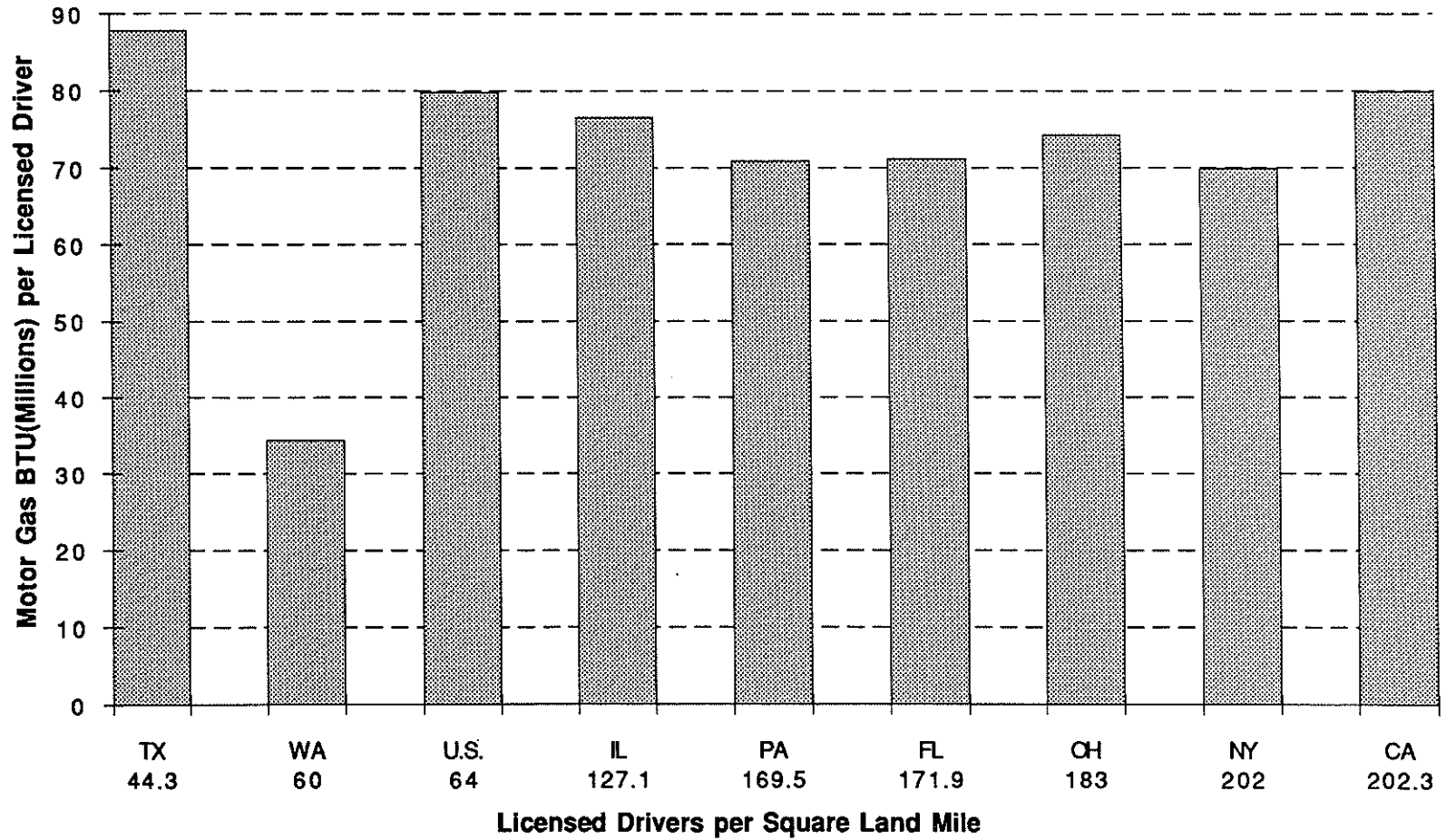
Source:

State Energy Data Report, Energy Information Administration, 1994

Note:

Data reflects allocation of lubricants, and estimates of 1995 consumption using EIA time series.

Figure 1.1 Motor Gasoline BTU per Licensed Driver in Relation to Driver Density, 1982



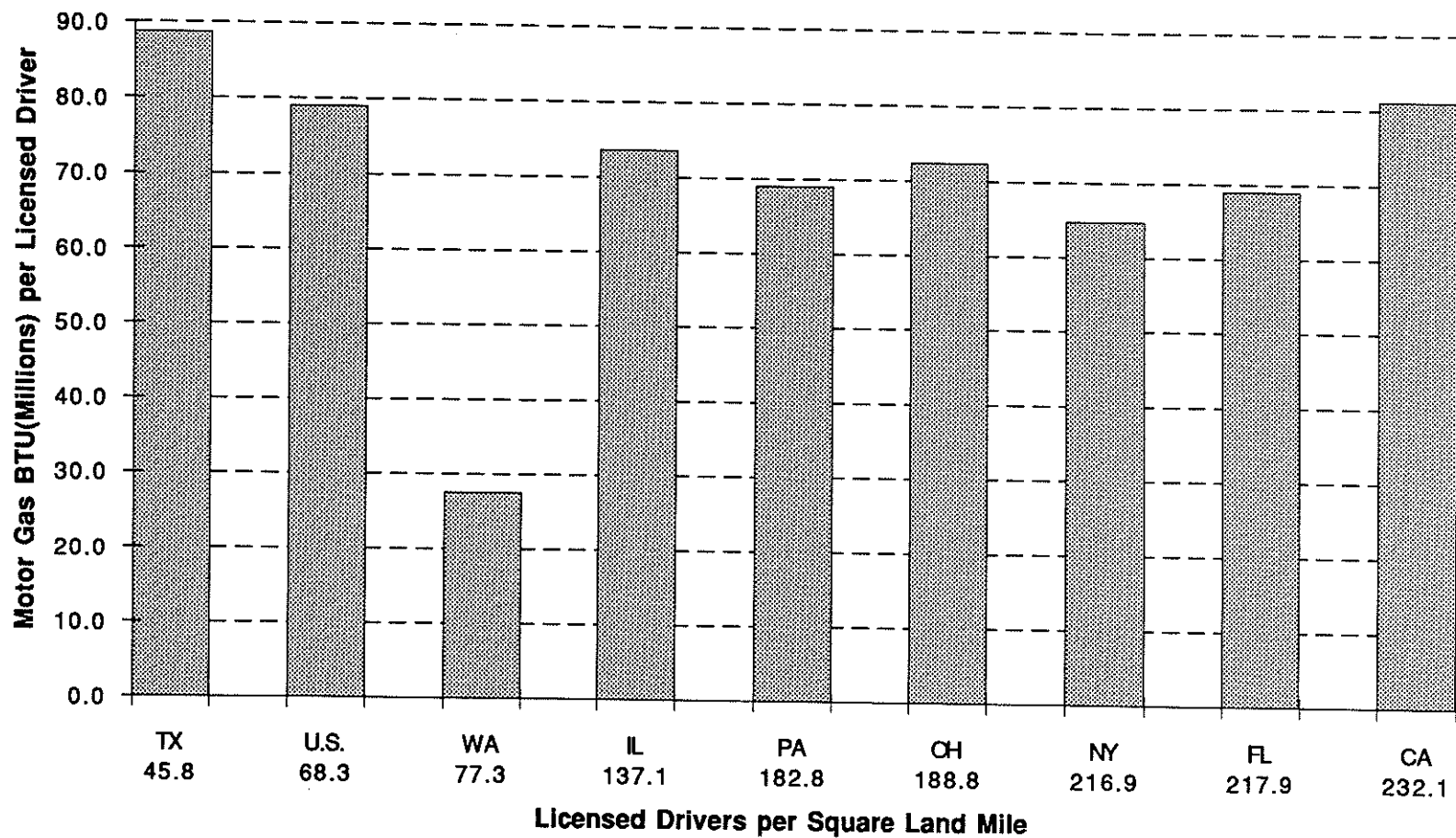
5

Sources: State Energy Data Report, Annual
 Statistical Abstract of the United States, Annual

Notes:

*Motor Gas equals Total Transportation Motor Gas(BTU's)
 *Driver density equals licensed drivers per non-federal land mile

Figure 1.2 Motor Gasoline BTU per Licensed Driver in Relation to Driver Density, 1992



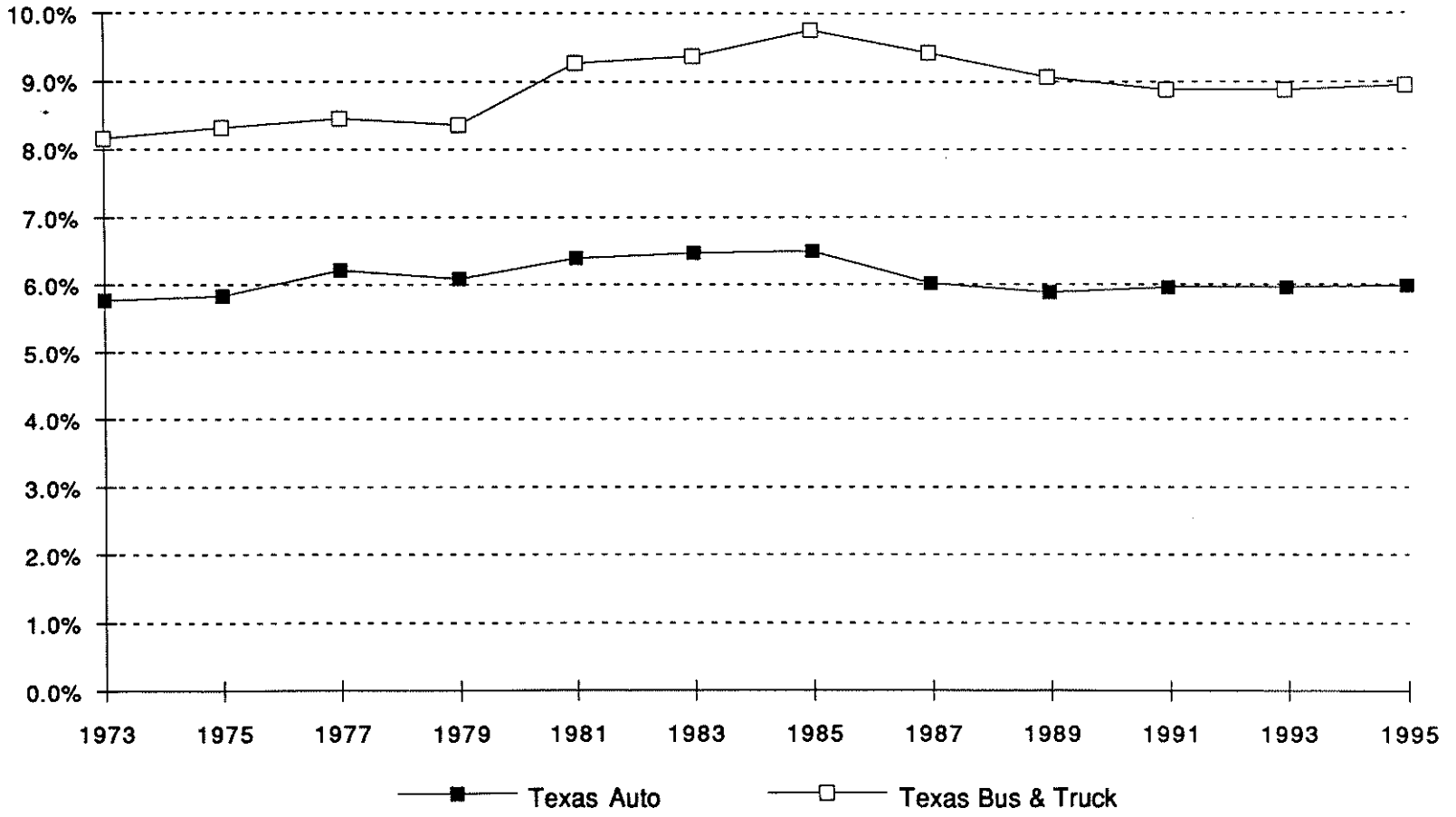
Source: State Energy Data Report, Annual
Statistical Abstract of the United States, Annual

Note:

- * Motor Gas refers to Total Transportation Motor Gas(BTU's)
- * Driver density equals licensed drivers per non-federal land mile

Figure 1.3 Texas Auto, Truck, & Bus Registrations as a Percentage of U.S. Auto, Truck, & Bus Registrations

7



Source: Table 1.3 and 1.4

Table 1.3 Automobile Registrations for Selected States, 1973-95

Year	(a)							
	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
1973	6,531,932	5,090,991	5,817,020	5,120,721	10,910,604	1,784,389	4,536,840	5,880,897
1974	6,637,871	5,192,753	6,097,830	5,258,649	11,162,119	1,826,023	4,704,754	6,007,106
1975	6,735,148	5,267,491	6,288,050	5,350,375	11,226,325	1,883,271	4,499,154	6,217,464
1976	6,734,255	5,355,936	6,179,074	5,515,959	11,478,776	1,977,629	4,835,141	6,586,572
1977	6,799,072	5,520,994	6,358,807	5,712,606	11,694,053	2,118,314	4,978,925	6,970,581
1978	6,907,661	5,652,375	6,314,639	5,883,525	12,085,836	2,131,348	5,738,031	7,349,070
1979	6,992,216	5,689,399	6,341,428	6,059,653	12,466,173	2,231,064	6,011,033	7,210,280
1980	6,994,316	5,821,025	6,415,046	6,240,460	13,268,006	2,293,521	6,196,637	7,484,817
1981	7,097,565	5,920,737	6,393,685	6,334,050	13,208,593	2,374,996	6,484,571	7,860,366
1982	7,201,767	5,617,934	6,324,670	5,855,187	13,420,945	2,296,429	6,753,616	7,992,738
1983	7,357,044	5,738,155	6,429,344	5,929,783	13,935,390	2,360,117	7,113,942	8,159,008
1984	7,563,584	5,805,361	6,524,410	6,069,551	14,095,912	2,420,225	7,552,367	8,417,227
1985	7,901,004	5,889,416	6,746,339	6,104,331	14,723,189	2,484,484	7,849,144	8,562,581
1986	8,321,210	6,090,520	6,719,345	6,060,698	15,364,800	2,610,890	8,263,294	8,499,972
1987	8,294,971	6,144,474	6,975,380	6,174,594	15,566,810	2,685,341	8,444,040	8,260,166
1988	8,558,985	6,253,550	7,003,826	6,403,462	16,496,522	2,753,299	8,713,198	8,455,744
1989	8,636,000	6,309,087	7,738,303	6,369,099	16,531,300	2,859,667	8,891,893	8,415,243
1990	8,756,991	6,345,308	6,787,846	6,235,258	16,812,808	2,963,252	8,612,020	8,565,860
1991	8,421,505	6,391,515	7,025,421	6,562,098	17,067,803	3,077,624	7,825,966	8,513,317
1992	8,395,384	6,495,058	7,271,311	6,555,392	17,053,362	3,124,859	8,045,345	8,513,888
1993	8,676,218	6,559,139	7,448,445	6,588,729	17,134,375	3,105,881	7,984,802	8,719,133
1994*	8,800,248	6,642,768	7,541,086	6,672,294	17,525,453	3,193,152	8,213,716	8,892,519
1995*	8,926,050	6,727,462	7,634,878	6,756,919	17,925,456	3,282,875	8,449,193	9,069,352

Average annual change

Time Period:

1973-95	1.6%	1.4%	1.4%	1.4%	2.5%	3.1%	3.2%	2.2%
1985-95	1.2%	1.3%	1.2%	1.0%	2.0%	2.8%	0.7%	0.6%

Source:

Highway Statistics, Summary to 1985; Annual 1986-93, Private and commercial automobiles

Notes:

* estimated

(a) estimates for 1970-76 via multivariate regression

Table 1.4 Private and Public Truck and Bus Registrations for Selected States, 1973-95

Year	(a)							
	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
1973	787,561	696,453	827,590	831,227	2,502,170	586,221	810,405	1,934,748
1974	819,931	720,219	867,651	915,453	2,522,280	618,423	911,316	2,046,163
1975	856,210	771,652	890,883	993,500	2,664,345	656,493	896,218	2,179,025
1976	916,414	830,041	966,760	1,160,624	2,837,067	707,274	1,109,887	2,383,182
1977	931,220	955,898	1,145,519	1,148,460	3,263,937	776,566	1,117,324	2,518,530
1978	959,009	1,059,449	1,332,423	1,209,128	3,491,065	828,622	1,177,909	2,802,474
1979	1,011,963	1,067,085	1,348,603	1,223,853	3,795,124	900,087	1,287,929	2,790,666
1980	1,007,230	1,104,830	1,356,190	1,239,372	3,605,111	931,741	1,416,902	2,989,999
1981	1,022,198	1,089,165	1,343,579	1,263,018	3,581,969	955,289	1,489,527	3,262,784
1982	1,033,090	1,106,805	1,311,190	1,386,795	3,709,458	940,425	1,580,978	3,371,446
1983	1,059,459	1,105,894	1,339,001	1,583,335	3,831,369	978,216	1,694,544	3,533,839
1984	1,080,866	1,275,910	1,369,367	1,528,687	3,869,091	1,010,127	1,841,808	3,754,466
1985	1,140,821	1,319,677	1,355,273	1,622,407	4,176,032	1,041,878	2,015,691	3,881,606
1986	1,194,165	1,386,497	1,439,826	1,358,837	4,395,460	1,141,352	2,098,218	3,906,636
1987	1,236,394	1,449,488	1,524,009	1,410,155	4,617,951	1,137,684	2,184,337	3,928,553
1988	1,278,623	1,512,479	1,608,192	1,461,473	4,840,442	1,134,015	2,270,456	3,950,469
1989	1,314,705	1,562,246	1,747,013	1,585,442	4,952,753	1,213,692	2,234,180	4,003,285
1990	1,364,837	1,587,349	1,592,493	1,573,513	4,954,025	1,277,497	2,254,954	4,085,661
1991	1,277,216	1,607,309	1,627,786	1,564,587	5,021,225	1,312,629	2,069,822	4,030,429
1992	1,312,334	1,644,366	1,725,632	1,359,448	4,983,123	1,325,807	2,100,944	4,078,758
1993	1,415,537	1,682,598	1,796,136	1,420,299	5,522,887	1,290,266	2,097,064	4,237,642
1994*	1,457,649	1,758,469	1,867,091	1,458,857	5,745,907	1,342,178	2,199,162	4,407,063
1995*	1,501,015	1,837,762	1,940,848	1,498,462	5,977,934	1,396,179	2,306,230	4,583,257
	Average annual change							
Time Period:								
1973-95	3.3%	5.0%	4.4%	3.0%	4.5%	4.4%	5.4%	4.4%
1985-95	2.8%	3.4%	3.7%	-0.8%	3.7%	3.0%	1.4%	1.7%

Source:

Highway Statistics, Summary to 1985; Annual 1986-93

Notes:

* estimated

(a) years 1970-76 estimated by multivariate regression

Table 1.5 Private and Commercial Vehicles Per Capita for Selected States, 1973-95

Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
1973	0.41	0.49	0.62	0.53	0.64	0.66	0.71	0.65
1974	0.42	0.50	0.65	0.55	0.64	0.66	0.72	0.65
1975	0.42	0.51	0.67	0.56	0.64	0.68	0.66	0.67
1976	0.43	0.52	0.67	0.59	0.65	0.70	0.70	0.69
1977	0.44	0.55	0.70	0.61	0.67	0.74	0.70	0.72
1978	0.44	0.57	0.71	0.62	0.68	0.74	0.76	0.75
1979	0.45	0.57	0.71	0.64	0.70	0.77	0.78	0.72
1980	0.46	0.58	0.72	0.65	0.71	0.78	0.78	0.74
1981	0.46	0.59	0.72	0.66	0.69	0.79	0.78	0.75
1982	0.47	0.57	0.71	0.63	0.69	0.76	0.80	0.74
1983	0.48	0.58	0.72	0.65	0.70	0.78	0.82	0.74
1984	0.49	0.60	0.73	0.66	0.70	0.79	0.85	0.76
1985	0.51	0.61	0.75	0.67	0.72	0.80	0.87	0.76
1986	0.53	0.63	0.76	0.64	0.73	0.84	0.89	0.74
1987	0.54	0.64	0.78	0.66	0.74	0.84	0.89	0.74
1988	0.55	0.65	0.79	0.68	0.75	0.84	0.89	0.74
1989	0.55	0.65	0.87	0.68	0.23	0.86	0.88	0.73
1990	0.56	0.67	0.77	0.68	0.73	0.87	0.84	0.74
1991	0.54	0.67	0.79	0.71	0.73	0.88	0.75	0.72
1992	0.54	0.68	0.82	0.68	0.71	0.67	0.75	0.71
1993	0.55	0.68	0.83	0.68	0.73	0.84	0.74	0.72
1994*	0.56	0.70	0.85	0.69	0.74	0.86	0.76	0.73
1995*	0.57	0.71	0.86	0.70	0.75	0.88	0.78	0.75
Average annual change								
Time Period:								
1973-95	1.6%	1.7%	1.5%	1.3%	0.7%	1.3%	0.4%	0.6%
1985-95	1.2%	1.5%	1.4%	0.5%	0.5%	0.9%	-1.1%	-0.1%

Sources:

Tables 1.2 and 1.3; Statistical Abstract of the United States 1994

Notes:

* estimate

Table 1.6 Motor Gasoline Prices for Selected States

	Current dollars per gallon (a)												Average annual change
	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994*	1995*	1980-95
Texas	1.16	1.10	0.81	0.90	0.92	0.99	1.15	1.14	1.13	1.13	1.13	1.13	-0.2%
California	1.27	1.09	0.84	0.87	0.89	0.96	1.07	1.02	1.15	1.14	1.13	1.12	-0.9%
Florida	1.23	1.13	0.84	0.89	0.89	0.96	1.11	1.06	1.04	1.02	1.01	0.99	-1.4%
Illinois	1.23	1.13	0.85	0.90	0.91	1.00	1.17	1.14	1.10	1.09	1.08	1.07	-0.9%
Ohio	1.18	1.14	0.85	0.92	0.93	1.02	1.17	1.15	1.12	1.12	1.11	1.11	-0.4%
New York	1.28	1.10	0.83	0.87	0.90	0.98	1.10	1.18	1.16	1.15	1.14	1.13	-0.8%
Pennsylvania	1.21	1.13	0.82	0.88	0.88	0.97	1.17	1.18	1.17	1.16	1.16	1.16	-0.3%
Washington	1.24	1.16	0.91	0.92	0.93	1.00	1.18	1.14	1.18	1.18	1.18	1.17	-0.4%

	Constant 1988 dollars per gallon (b)												Average annual change
	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994*	1995*	1980-95
Texas	1.66	1.21	0.87	0.94	0.92	0.94	1.04	0.99	0.95	0.92	0.89	0.85	-4.4%
California	1.83	1.19	0.90	0.87	0.89	0.91	0.97	0.89	0.97	0.93	0.89	0.84	-5.0%
Florida	1.76	1.24	0.90	0.89	0.89	0.92	1.00	0.92	0.87	0.84	0.80	0.75	-5.5%
Illinois	1.76	1.24	0.91	0.90	0.91	0.95	1.06	0.99	0.93	0.89	0.85	0.81	-5.1%
Ohio	1.70	1.26	0.91	0.92	0.93	0.98	1.06	1.00	0.95	0.92	0.88	0.83	-4.6%
New York	1.84	1.21	0.89	0.87	0.90	0.93	1.00	1.02	0.98	0.94	0.90	0.85	-5.0%
Pennsylvania	1.74	1.24	0.88	0.88	0.88	0.93	1.06	1.02	0.98	0.95	0.91	0.87	-4.5%
Washington	1.78	1.28	0.98	0.92	0.93	0.96	1.07	0.99	1.00	0.97	0.93	0.88	-4.6%

Source:

Energy Information Agency/State Energy Price and Expenditure Report 1994

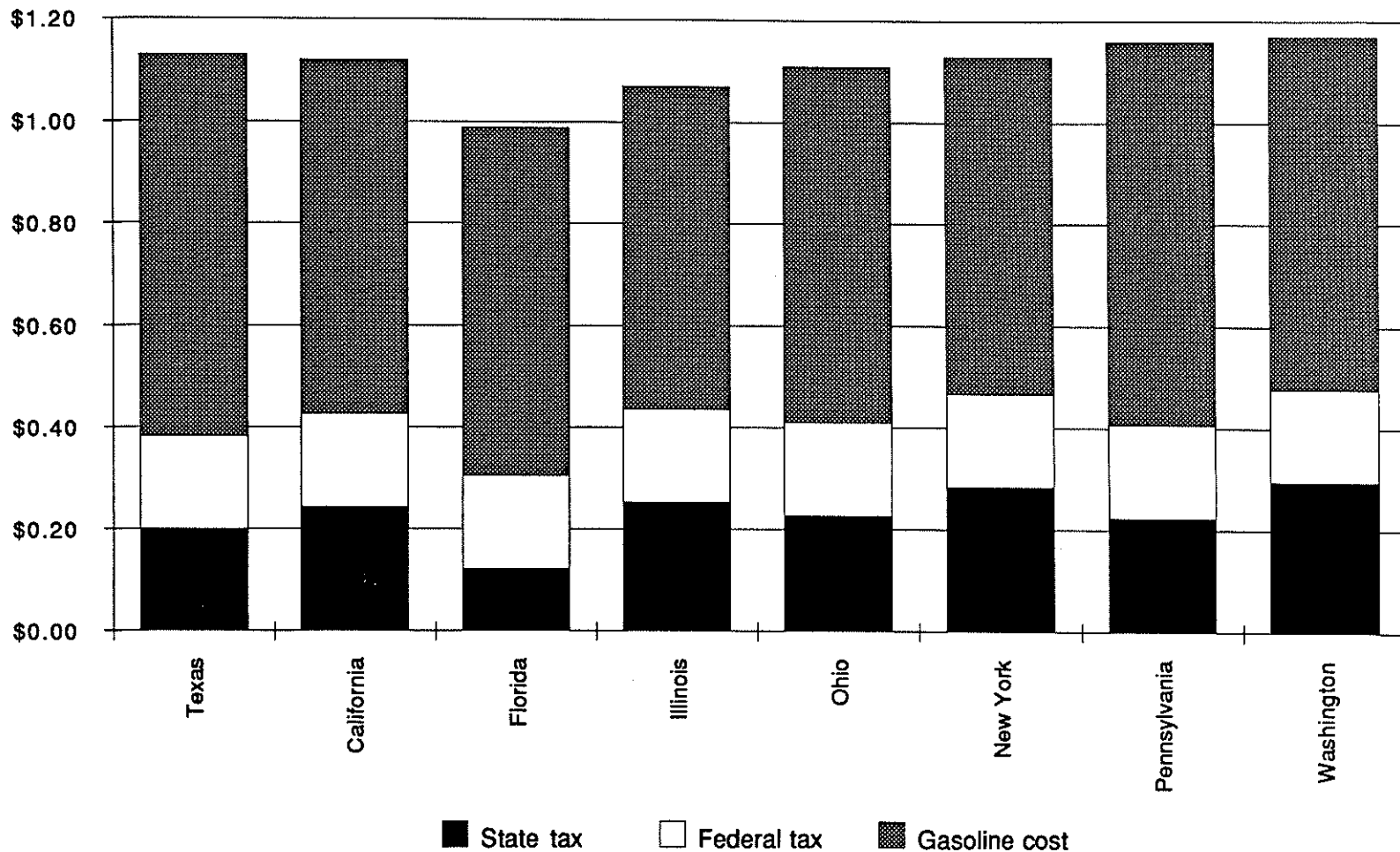
Notes:

* estimate

(a) Includes federal & state taxes

(b) Using Consumer Price Index

Figure 1.4 Gasoline Prices For Selected States, 1995



12

Sources: Tables 1.6 and 1.8

Table 1.7 Distillate Fuel Prices for Selected State

	Current dollars per gallon (a)												Average
	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994*	1995*	annual change 1980-95
Texas	0.89	0.81	0.73	0.83	0.83	0.87	1.03	0.98	1.00	1.01	1.02	1.03	1.0%
California	0.88	0.86	0.74	0.84	0.81	0.89	1.03	1.00	1.02	1.04	1.05	1.06	1.2%
Florida	0.97	0.91	0.78	0.83	0.78	0.83	1.03	0.97	0.99	0.99	0.99	1.00	0.2%
Illinois	0.93	1.07	0.83	0.86	0.86	0.90	1.09	1.03	1.01	1.02	1.02	1.03	0.7%
Ohio	0.87	1.04	0.81	0.84	0.82	0.90	1.06	1.03	1.00	1.02	1.03	1.04	1.2%
New York	0.93	1.06	0.82	0.84	0.85	0.92	1.12	1.13	1.11	1.13	1.15	1.16	1.5%
Pennsylvania	0.88	1.04	0.82	0.84	0.83	0.88	1.10	1.07	1.05	1.07	1.09	1.10	1.5%
Washington	0.84	1.10	0.84	0.90	0.91	0.99	1.13	1.12	1.09	1.11	1.13	1.16	2.2%

	Constant 1988 dollars per gallon (b)												Average
	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993*	1994*	1995*	annual change 1980-95
Texas	1.27	0.89	0.79	0.86	0.83	0.83	0.93	0.85	0.84	0.83	0.80	0.78	-3.2%
California	1.27	0.95	0.80	0.84	0.81	0.85	0.93	0.87	0.86	0.85	0.83	0.81	-3.0%
Florida	1.39	1.00	0.84	0.83	0.78	0.79	0.93	0.84	0.83	0.81	0.78	0.76	-4.0%
Illinois	1.34	1.17	0.89	0.86	0.86	0.86	0.99	0.89	0.85	0.83	0.81	0.78	-3.5%
Ohio	1.25	1.14	0.87	0.84	0.82	0.86	0.96	0.89	0.85	0.83	0.81	0.79	-3.0%
New York	1.34	1.17	0.89	0.84	0.85	0.88	1.02	0.98	0.94	0.92	0.90	0.88	-2.7%
Pennsylvania	1.27	1.15	0.88	0.84	0.83	0.84	0.99	0.93	0.89	0.88	0.86	0.84	-2.7%
Washington	1.21	1.21	0.91	0.90	0.91	0.94	1.02	0.97	0.91	0.91	0.89	0.88	-2.1%

Source:

Energy Information Agency/State Energy Price and Expenditure Report 1994

Notes:

* estimate

(a) Includes federal & state taxes

(b) Using Consumer Price Index

Table 1.8 Motor Gasoline Taxes for Selected States, 1973-95

Year	Cents per gallon							
	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
1973	8.0	8.0	7.0	7.5	7.0	9.0	8.0	5.0
1974	8.0	9.0	7.0	7.5	7.0	9.0	8.0	5.0
1975	8.0	9.0	7.0	7.5	7.0	9.0	8.0	5.0
1976	8.0	9.0	7.0	7.5	7.0	9.0	8.0	5.0
1977	8.0	9.0	7.0	7.5	7.0	11.0	8.0	5.0
1978	8.0	9.0	7.0	7.5	7.0	11.0	8.0	5.0
1979	8.0	11.0	7.0	7.5	7.0	12.0	8.0	5.0
1980	8.0	11.0	7.0	7.5	7.0	12.0	8.0	5.0
1981	8.0	11.0	10.3	7.5	7.0	13.5	8.0	5.0
1982	8.0	11.0	11.7	7.5	7.0	12.0	8.0	5.0
1983	8.0	12.0	12.0	11.0	9.0	16.0	9.7	5.0
1984	8.0	12.0	12.0	12.0	9.0	18.0	9.7	10.0
1985	8.0	12.0	12.0	13.0	9.0	18.0	9.7	10.0
1986	10.8	18.0	12.0	17.7	15.0	18.0	9.7	10.0
1987	10.8	18.0	14.8	17.7	15.0	18.0	9.7	10.0
1988	14.8	18.0	14.8	17.7	15.0	18.0	9.7	15.0
1989	14.8	18.0	14.8	21.0	15.0	18.0	9.7	15.0
1990	14.4	17.8	20.0	23.4	15.0	22.0	10.9	15.0
1991	24.8	22.4	21.0	25.3	21.0	29.5	11.2	20.0
1992	26.9	22.4	21.0	25.3	22.0	29.5	11.6	20.0
1993	26.9	22.4	22.0	25.3	23.0	29.5	11.8	20.0
1994*	27.6	22.4	22.3	25.3	23.7	29.5	12.0	20.0
1995*	28.4	22.4	22.7	25.3	24.4	29.5	12.2	20.0
Time Period:	Average annual change							
1973-95	6.5%	5.3%	6.1%	6.3%	6.5%	6.1%	2.1%	7.2%
1985-95	13.5%	6.4%	6.6%	6.9%	10.5%	5.1%	2.3%	7.2%

Source: Highway Statistics, Summary to 1985; annual 1986-93

Notes: Since 1986 NY, WA, IL, and FL have imposed a sales tax in addition to a gallonage tax. The taxes in this table reflect a gallonage rate plus the applicable sales tax rate @ \$1/ gal for these states.

* estimate

Table 1.9 Distillate Fuel Taxes for Selected States, 1973-95

Year	Cents per gallon							
	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
1973	10.0	8.0	7.0	7.5	7.0	9.0	8.0	6.5
1974	10.0	9.0	7.0	7.5	7.0	9.0	8.0	6.5
1975	10.0	9.0	7.0	7.5	7.0	9.0	8.0	6.5
1976	10.0	9.0	7.0	7.5	7.0	9.0	8.0	6.5
1977	10.0	9.0	7.0	7.5	7.0	11.0	8.0	6.5
1978	10.0	9.0	7.0	7.5	7.0	11.0	8.0	6.5
1979	10.0	11.0	7.0	7.5	7.0	12.0	8.0	6.5
1980	10.0	11.0	7.0	7.5	7.0	12.0	8.0	6.5
1981	10.0	11.0	10.3	7.5	7.0	13.5	8.0	6.5
1982	10.0	11.0	11.7	7.5	7.0	12.0	8.0	6.5
1983	10.0	12.0	12.0	13.5	9.0	16.0	9.7	6.5
1984	10.0	12.0	12.0	14.5	9.0	18.0	9.7	10.0
1985	10.0	12.0	12.0	15.5	9.0	18.0	9.7	10.0
1986	16.8	18.0	12.0	19.7	15.0	18.0	9.7	10.0
1987	16.8	18.0	14.8	19.7	15.0	18.0	9.7	10.0
1988	16.8	24.0	14.8	20.5	15.0	18.0	9.7	15.0
1989	16.8	24.0	14.8	20.5	15.0	18.0	9.7	15.0
1990	18.4	23.8	20.0	26.0	15.0	28.5	10.9	15.0
1991	26.8	22.4	21.0	26.5	21.0	29.5	12.2	20.0
1992	28.8	22.4	21.0	27.8	21.0	29.5	18.7	20.0
1993	28.8	22.4	22.0	27.8	23.0	29.5	21.0	20.0
1994*	29.6	22.4	22.3	28.2	23.7	29.5	25.2	20.0
1995*	30.3	22.4	22.7	28.6	24.4	29.5	30.2	20.0
	Average annual change							
Time Period:								
1973-95	5.7%	5.3%	6.1%	6.9%	6.5%	6.1%	6.9%	5.8%
1985-95	11.7%	6.4%	6.6%	6.3%	10.5%	5.1%	12.0%	7.2%

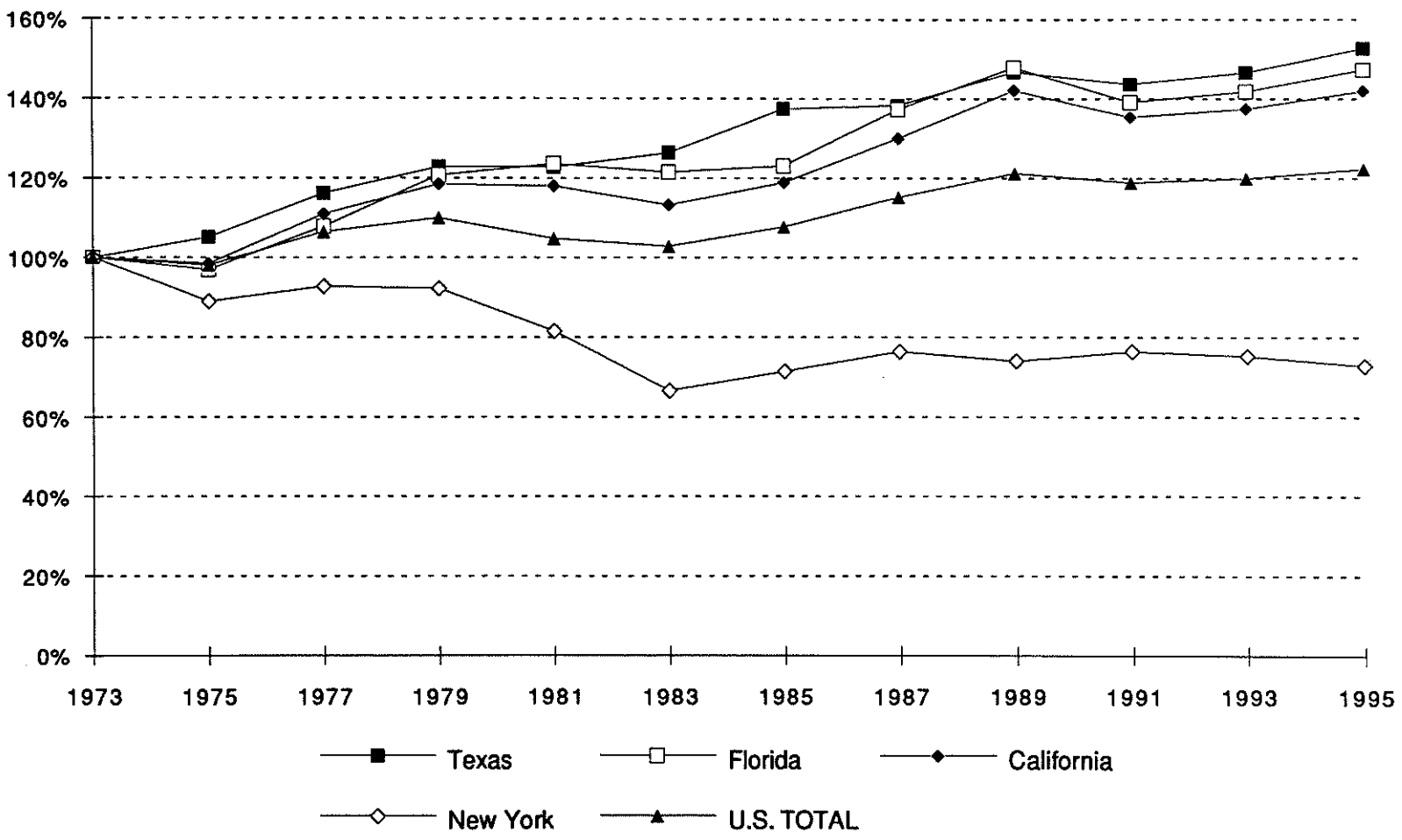
Source: Highway Statistics, Summary to 1985; annual 1986-93.

Notes: The taxes in this table reflect a gallonage rate plus the applicable sales tax rate @ \$1/ gal for those states imposing a sales tax.

* estimate

Figure 1.5 Transportation Energy Consumption as a Percentage of 1973 Baseline

16



Source: State Energy Data Report, annual

Table 1.10 Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995

Average annual per household			
Census region	Vehicle miles traveled	Consumption (gallons)	Expenditures
Midwest	20,860	969	1,124
Northeast	19,986	833	1,054
South	20,225	930	1,092
Texas*	19,050	943	1,138
West	18,781	907	1,078
U. S.	19,970	918	1,090

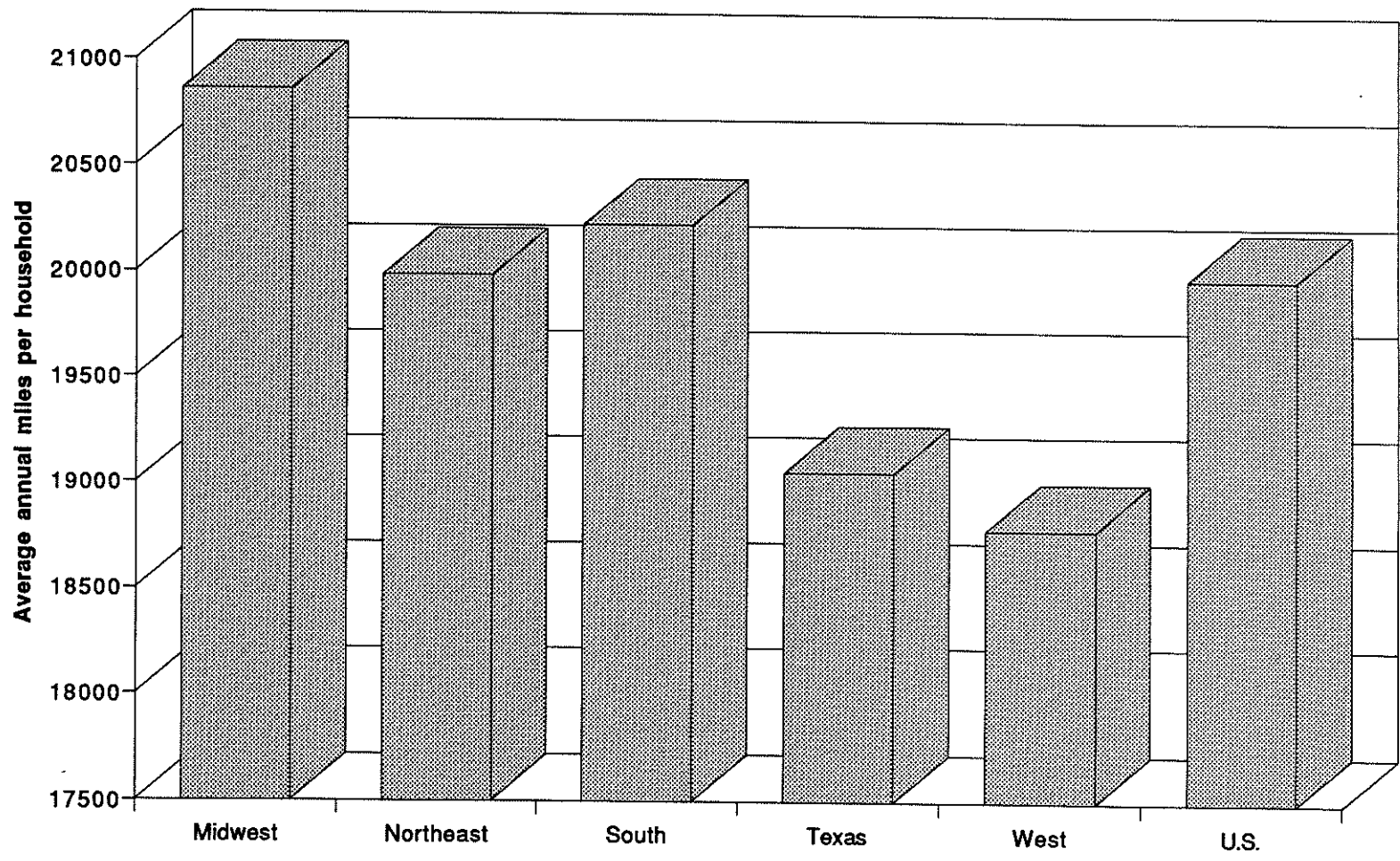
Sources:

Household Vehicle Energy Consumption 1991, Energy Information Agency
 1995 Estimate by Texas Transportation Institute

Notes:

* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant subset of the W. South Central data sample (per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, Energy Information Agency)

Figure 1.6 Household Vehicle Miles Traveled, 1995



Source: Table 1.10

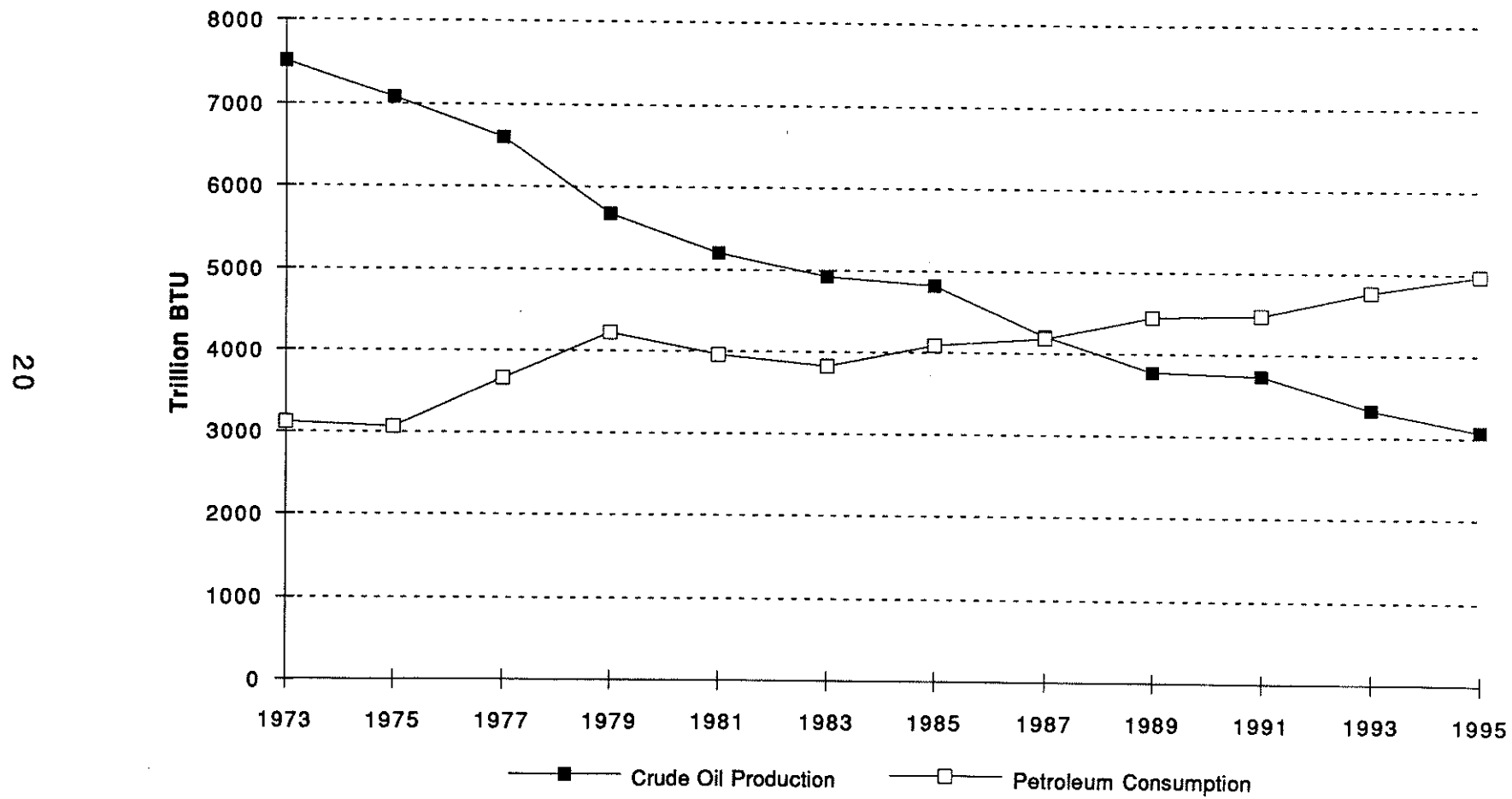
CHAPTER 2

TRANSPORTATION ENERGY CHARACTERISTICS OF TEXAS

This chapter provides a snapshot of the transportation energy characteristics of Texas. It includes time series data concerning Texas petroleum production and consumption, energy consumption by transportation mode, and consumption by fuel type. Energy intensities of passenger travel (i.e., Btu per passenger-mile of vehicle-mile) and energy intensities of intercity freight carriers (i.e., Btu per ton-mile) are also provided. Lastly, chapter two contains time series data for prices of both highway and non-highway fuels.

Texas consumption of petroleum products continues to surpass Texas production of petroleum products (Figure 2.1), with transportation use of petroleum leading the increase in petroleum use (2.6% per annum since 1973), followed by industrial consumption increases of 2.7% per annum since 1973 (Table 2.2). Within the transportation sector in Texas, the highway mode remains the largest consumer of energy with about 55% of transportation energy (down from 68% in 1973) use; second is the air mode with about 25% of transportation energy (up from 8% in 1973) use. Over all, transportation energy consumption in Texas has increased at an annual rate of 2.2% since 1973; however, this growth trend has diminished slightly to a 1.7% increase for the 1983-95 period.

Figure 2.1 Texas Petroleum Production and Consumption



Source: Table 2.1

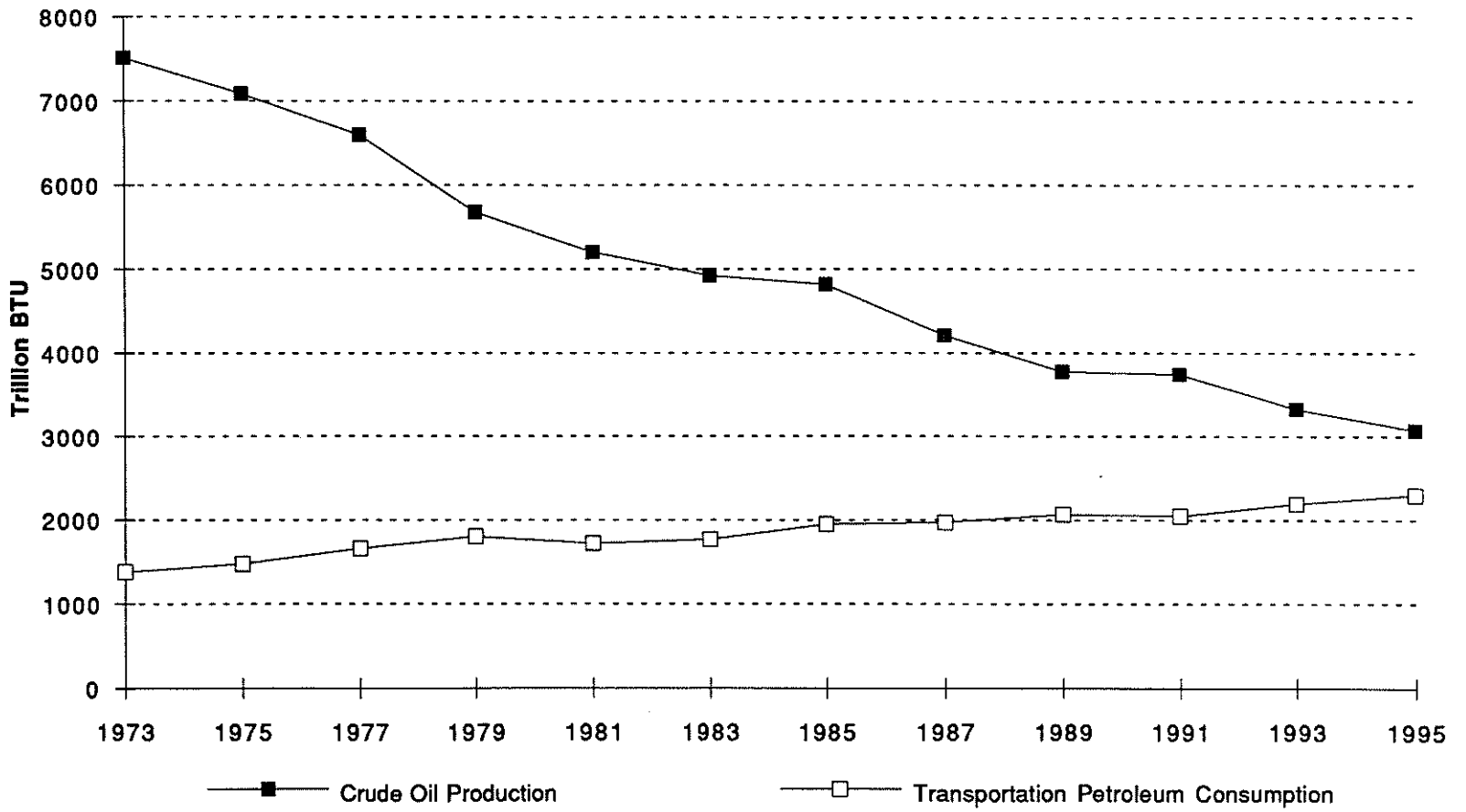
Table 2.1 Texas Petroleum Production and Consumption, 1973-1995

Year	Trillion Btu				Texas exports as a percentage of Texas production	Texas petroleum consumption as percentage of U.S. consumption	Texas transportation petroleum use as a percentage of Texas petroleum production
	Texas crude oil production	Total petroleum exports	Texas petroleum consumption	U.S. petroleum consumption			
1973	7,509.1	4,390.7	3,118.4	34,837.5	58.5%	9.0%	18.4%
1974	7,320.3	4,185.5	3,134.8	22,453.9	57.2%	14.0%	19.3%
1975	7,087.2	4,020.2	3,067.0	32,732.2	56.7%	9.4%	20.8%
1976	6,899.2	3,580.9	3,318.3	35,177.8	51.9%	9.4%	22.3%
1977	6,599.7	2,933.8	3,665.9	37,123.9	44.5%	9.9%	25.1%
1978	6,037.6	2,151.5	3,886.1	37,962.9	35.6%	10.2%	29.0%
1979	5,675.6	1,446.9	4,228.7	37,122.3	25.5%	11.4%	31.7%
1980	5,400.3	1,308.8	4,091.5	34,204.4	24.2%	12.0%	31.4%
1981	5,205.9	1,242.3	3,963.6	31,932.1	23.9%	12.4%	33.1%
1982	5,056.3	1,248.9	3,807.4	30,232.4	24.7%	12.6%	35.1%
1983	4,924.6	1,093.8	3,830.8	30,052.1	22.2%	12.7%	35.9%
1984	4,903.9	740.5	4,163.4	31,053.1	15.1%	13.4%	38.3%
1985	4,817.5	728.3	4,089.2	30,924.7	15.1%	13.2%	40.4%
1986	4,547.8	448.7	4,099.1	32,198.0	9.9%	12.7%	44.2%
1987	4,205.2	20.7	4,184.5	32,863.9	0.5%	12.7%	46.9%
1988	4,049.7	-378.8	4,428.5	34,245.4	-9.4%	12.9%	50.9%
1989	3,773.0	-675.7	4,448.7	34,209.0	-17.9%	13.0%	54.9%
1990	3,746.5	-723.4	4,469.9	33,551.6	-19.3%	13.3%	55.2%
1991	3,738.2	-735.5	4,473.7	32,845.8	-19.7%	13.6%	54.8%
1992	3,553.6	-1,111.1	4,664.7	33,524.9	-31.3%	13.9%	59.3%
1993	3,332.5	-1,432.1	4,764.6	33,457.2	-43.0%	14.2%	65.7%
1994*	3,199.8	-1,666.8	4,866.7	33,389.6	-52.1%	14.6%	69.4%
1995*	3,072.5	-1,898.5	4,970.9	33,322.2	-61.8%	14.9%	74.8%
Time Period	Average annual changes						
1973-95	-4.0%	-	2.1%	-0.2%	-	-	-
1985-95	-4.4%	-	2.0%	0.7%	-	-	-

Sources:

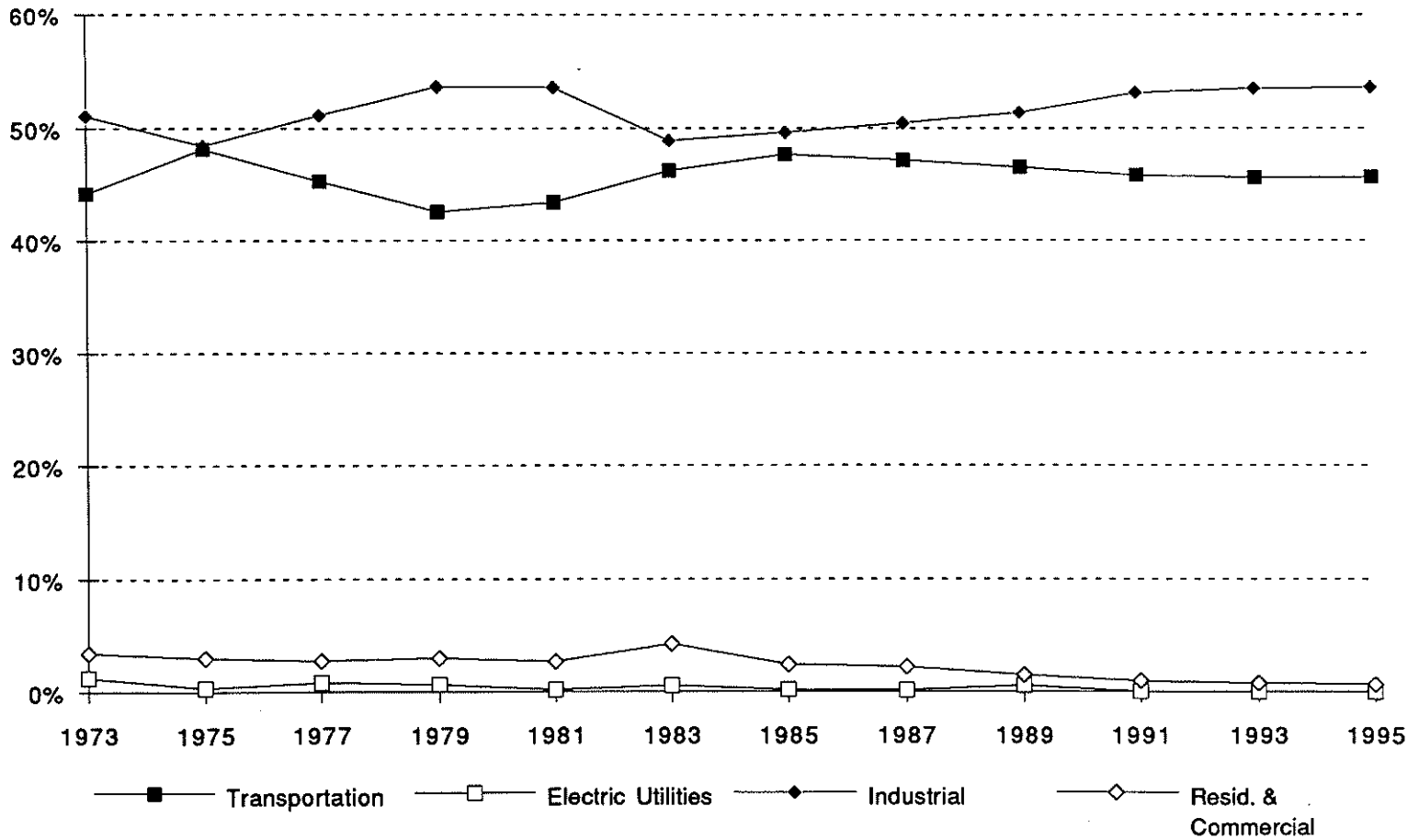
State Energy Data Report 1960-1994, Energy Information Administration;
Oil & Gas Annual Report, 1993, Railroad Commission of Texas

Figure 2.2 Texas Transportation Petroleum Consumption vs. Texas Petroleum Production



Source: Table 2.1

Figure 2.3 Texas Petroleum Consumption by Sector



Source: Table 2.2

Table 2.2 Texas Petroleum Consumption by Sector

Year	Transportation	Percentage transportation of total	Trillion Btu				Electric Utilities	Texas petroleum consumption
			Residential	Commercial	Industrial			
1973	1,378	44.2%	54.2	53.3	1,593.3	39.6	3,118.4	
1974	1,412.2	45.0%	48.1	49.5	1,590.5	34.5	3,134.8	
1975	1,476.8	48.2%	44.2	48.8	1,485.8	11.4	3,067.0	
1976	1,539.6	46.4%	45.4	47.9	1,661.1	24.2	3,318.2	
1977	1,658.9	45.3%	43.1	58.0	1,874.0	31.8	3,665.8	
1978	1,748.5	45.0%	47.8	63.2	1,983.4	43.4	3,886.3	
1979	1,800.4	42.6%	27.3	100.4	2,270.9	29.7	4,228.7	
1980	1,693.9	41.4%	23.7	72.4	2,290.7	10.7	4,091.4	
1981	1,720.8	43.4%	23.4	84.4	2,125.9	9.0	3,963.5	
1982	1,776.7	46.7%	19.3	54.8	1,943.4	13.3	3,807.5	
1983	1,769	46.2%	23.0	141.7	1,873.7	23.4	3,830.8	
1984	1,877.3	45.1%	23.0	124.8	2,132.6	5.7	4,163.4	
1985	1,948.1	47.6%	27.0	73.7	2,030.2	10.1	4,089.1	
1986	2,008.7	49.0%	24.4	49.3	2,011.6	5.1	4,099.1	
1987	1,971.8	47.1%	26.6	68.1	2,111.4	6.5	4,184.4	
1988	2,060.9	46.5%	23.2	53.0	2,283.0	8.4	4,428.5	
1989	2,070.2	46.5%	24.4	43.3	2,285.1	25.7	4,448.7	
1990	2,068.7	46.3%	22.4	35.6	2,337.7	5.7	4,470.1	
1991	2049.4	45.8%	14.8	29.7	2,377.1	2.7	4,473.7	
1992	2109.0	45.2%	12.6	28.4	2,511.9	2.8	4,664.7	
1993*	2190.6	45.6%	11.7	27.5	2,572.8	2.4	4,805.0	
1994*	2219.4	45.3%	10.8	26.6	2,635.2	2.1	4,894.1	
1995*	2297.8	45.6%	10.0	25.7	2,699.1	1.8	5,034.5	
Time Period			Average Annual Change					
1973-95	2.6%	-	-8.1%	-3.6%	2.7%	-14.2%	2.4%	
1985-95	1.7%	-	-9.4%	-10.0%	2.9%	-15.6%	2.1%	

Source:

State Energy Data Report 1960-1994, Energy Information Administration

Notes:

* estimate

Table 2.3 Distribution of Energy Consumption by Source

Energy Source	Transportation		Residential & Commercial		Industrial	
	1985	1995	1985	1995	1985	1995
Petroleum	95.3%	96.6%	5.8%	1.7%	42.4%	45.6%
Natural Gas	4.7%	3.4%	59.9%	48.1%	48.2%	40.9%
Coal	0.0%	0.0%	33.7%	39.7%	9.2%	10.8%
Hydroelectric	0.0%	0.0%	0.5%	0.5%	0.1%	0.1%
Nuclear electric	0.0%	0.0%	0.0%	9.9%	0.0%	2.5%
Other (a)	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

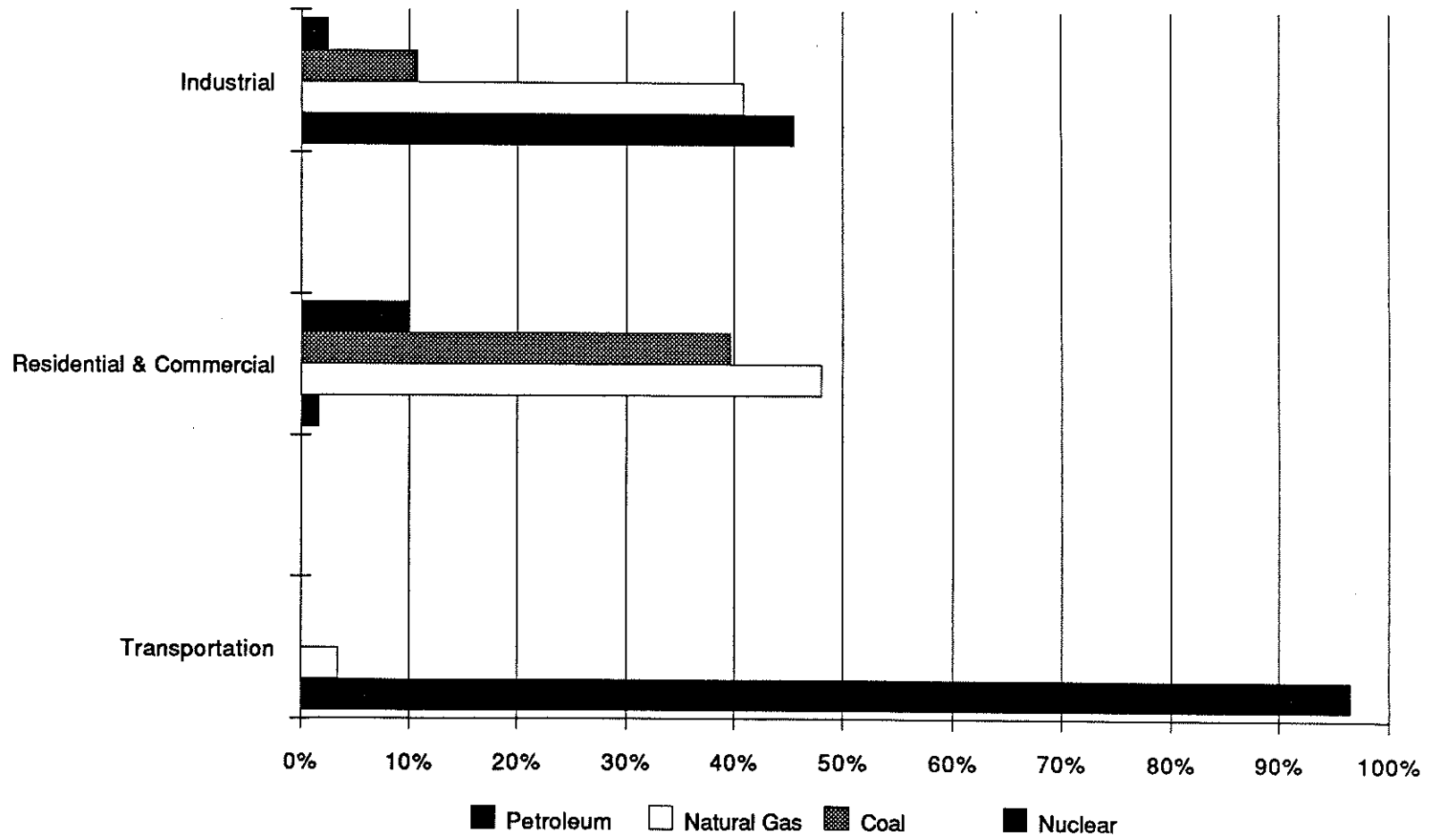
Source:

State Energy Data Report 1960-1994, Energy Information Administration

Note:

(a) Refers to energy generated from geothermal, wood, waste, wind, solar, etc.

Figure 2.4 Distribution of Energy by End-Use Sector, 1995



Source: Table 2.4

Table 2.4 Energy Consumption by End-Use Sector, 1973-95

Year	Trillion Btu				
	Transportation	Percent of total	Residential & Commercial	Industrial	Total
1973	1,486.7	18.6%	1,358.2	5,169.0	8,013.9
1974	1,509.0	19.2%	1,337.8	5,019.0	7,865.8
1975	1,561.4	21.4%	1,323.0	4,424.0	7,308.4
1976	1,613.6	21.2%	1,362.3	4,640.0	7,615.9
1977	1,727.3	21.1%	1,528.5	4,943.0	8,198.8
1978	1,825.6	21.2%	1,643.0	5,151.0	8,619.6
1979	1,880.6	21.1%	1,757.1	5,276.0	8,913.7
1980	1,802.0	20.0%	1,687.0	5,499.0	8,988.0
1981	1,825.9	20.7%	1,696.9	5,289.0	8,811.8
1982	1,882.7	22.9%	1,775.5	4,554.0	8,212.2
1983	1,878.2	22.9%	1,841.0	4,485.0	8,204.2
1984	1,989.5	22.4%	1,983.5	4,894.0	8,867.0
1985	2,043.7	23.0%	1,986.8	4,843.0	8,873.5
1986	2,093.9	24.0%	1,936.2	4,705.0	8,735.1
1987	2,056.2	22.8%	2,011.7	4,943.0	9,010.9
1988	2,172.7	22.7%	2,066.5	5,317.0	9,556.2
1989	2,181.5	22.4%	2,124.0	5,423.0	9,728.5
1990	2,179.2	22.2%	2,123.3	5,506.0	9,808.5
1991	2,134.6	21.8%	2,155.6	5,503.0	9,793.2
1992	2,193.9	22.1%	2,107.1	5,614.0	9,915.0
1993*	2,267.0	22.5%	2,157.2	5,638.5	10,062.6
1994*	2,344.5	22.9%	2,208.5	5,663.0	10,216.0
1995*	2,420.5	23.3%	2,261.2	5,687.7	10,369.4
Average annual changes					
Time Period:					
1973-95	2.2%	-	2.3%	0.4%	1.2%
1985-95	1.7%	-	1.3%	1.6%	1.6%

Source:

State Energy Data Report 1960-1992, Energy Information Administration

Notes:

* estimate

Table 2.5 Energy Consumption by Transportation Mode, 1973-95

Trillion Btu

Year	Transportation Mode						Total
	Highway	Air	Rail	Water	Pipeline	Military	
1973	1003.5	118.7	74.7	125.8	107.7	55.4	1,485.7
1974	990.7	114.6	80.7	156.5	96.8	69.7	1,509.0
1975	1034.4	123.2	72.2	177.2	84.6	69.8	1,561.4
1976	1100.0	115.5	67.1	192.1	74.0	65.0	1,613.6
1977	1164.3	120.3	69.4	231.2	68.4	73.7	1,727.3
1978	1223.0	130.2	66.6	258.8	77.1	69.8	1,825.6
1979	1197.9	138.1	66.1	357.7	80.2	40.6	1,880.6
1980	1098.1	144.6	46.2	325.2	108.1	79.9	1,802.0
1981	1152.8	148.1	75.9	295.7	105.1	48.3	1,825.9
1982	1186.7	211.3	75.0	247.9	106.0	55.8	1,882.7
1983	1214.7	237.5	53.0	186.7	109.2	77.1	1,878.2
1984	1222.6	335.6	57.6	185.7	112.2	75.7	1,989.5
1985	1258.9	397.6	52.5	171.2	95.6	68.0	2,043.7
1986	1265.8	432.2	42.5	211.8	85.2	56.4	2,093.9
1987	1225.1	453.6	49.1	180.4	84.4	63.6	2,056.2
1988	1242.3	509.8	52.0	186.6	111.8	70.2	2,172.7
1989	1224.6	501.8	54.3	218.6	111.4	70.8	2,181.5
1990	1230.7	521.6	50.9	206.1	110.5	59.3	2,179.2
1991	1222.7	496.5	62.3	215.9	85.2	52.0	2,134.5
1992	1241.3	492.4	80.4	243.1	84.9	51.8	2,193.9
1993*	1268.9	526.9	81.7	252.9	84.3	52.2	2,267.0
1994*	1295.0	563.7	83.8	265.8	83.6	52.6	2,344.5
1995*	1317.3	602.9	84.5	279.9	82.7	53.2	2,420.5
Average annual changes							
Time Period:							
1973-1995	1.2%	7.7%	0.6%	3.7%	-1.2%	-0.2%	2.2%
1985-1995	0.5%	4.3%	4.9%	5.0%	-1.4%	-2.4%	1.7%

Sources:

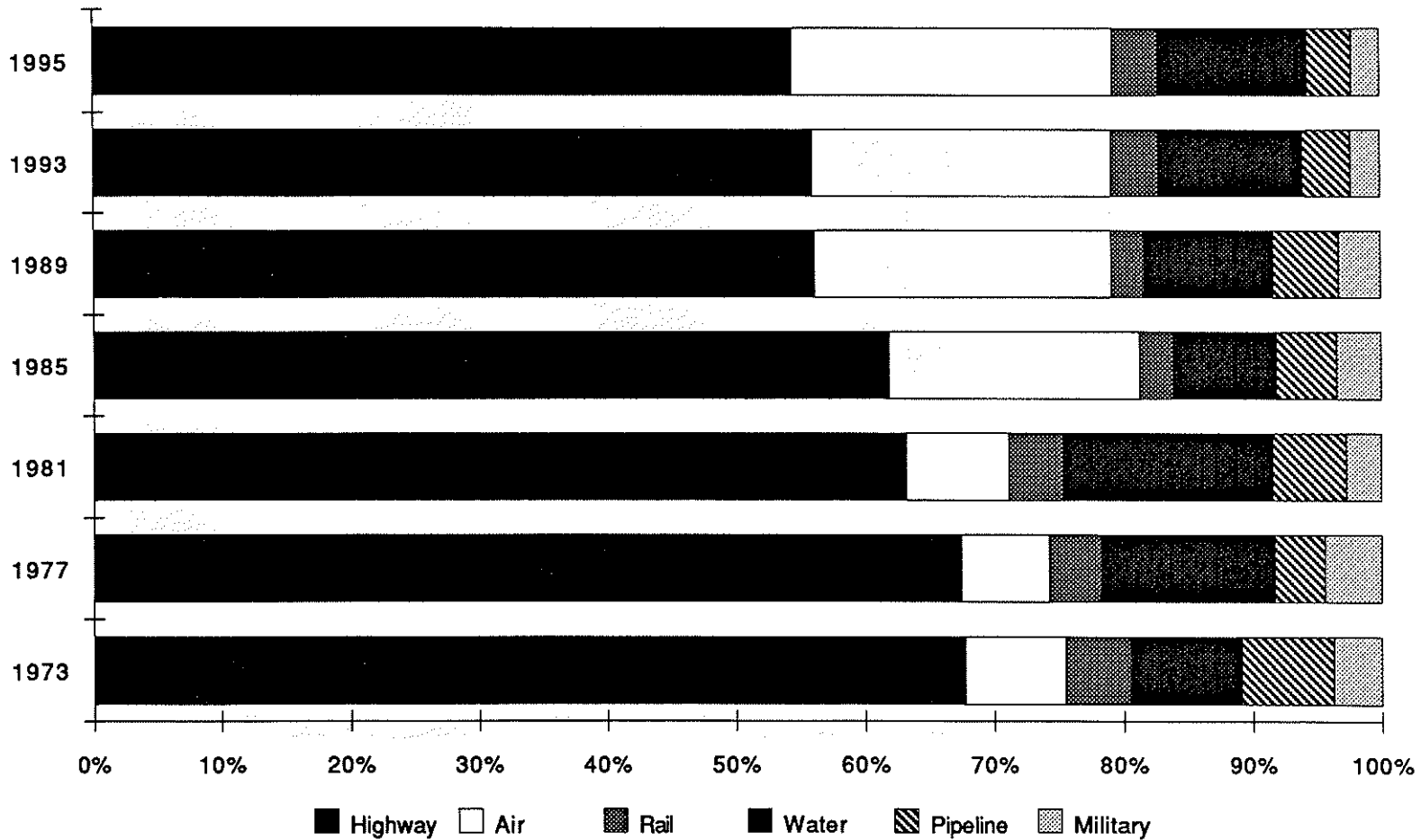
State Energy Data Report, Energy Information Administration, 1994;

Background data sent by Ms. Julia Hutchins of the Energy Information Administration

Notes:

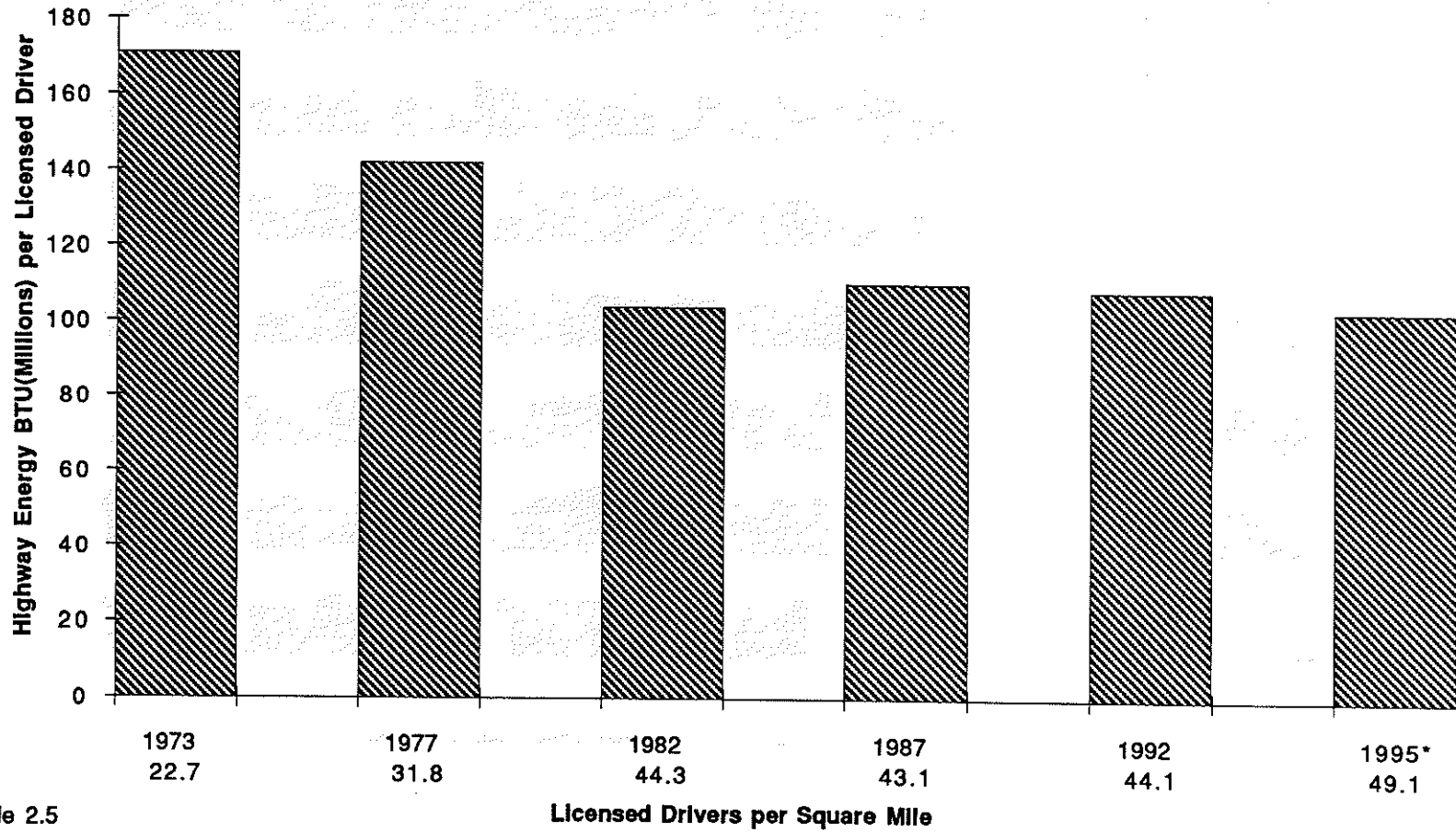
* estimate

Figure 2.5 Distribution of Texas Transportation Energy by Mode



Source: Table 2.5

Figure 2.6 Texas Highway Energy BTU per Licensed Driver in Relation to Licensed Drivers per Square Mile



30

Sources: Table 2.5
Statistical Abstract of the United States, Annual

Note:

- Square Miles refers to Non-Federal Land
- * Estimate

Table 2.6 Energy Consumption by Mode and Fuel Type, 1975

Mode	Trillion Btu							Total
	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	
Highway	0.0	0.0	103.5	0.0	18.6	912.3	0.0	1034.4
Air	0.0	6.7	0.0	116.5	0.0	0.0	0.0	123.2
Water	0.0	0.0	25.0	0.0	0.0	7.5	144.7	177.2
Rail	0.0	0.0	71.9	0.0	0.0	0.0	0.4	72.3
Pipeline	84.6	0.0	0.0	0.0	0.0	0.0	0.0	84.6
Military	0.0	0.0	19.0	37.2	0.0	0.0	13.6	69.8
	84.6	6.7	219.4	153.7	18.6	919.8	158.7	1561.5

Table 2.7 Energy Consumption by Mode and Fuel Type, 1985

Mode	Trillion Btu							Total
	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	
Highway	0.0	0.0	215.7	0.0	2.2	1041.0	0.0	1258.9
Air	0.0	6.7	0.0	390.9	0.0	0.0	0.0	397.6
Water	0.0	0.0	26.1	0.0	0.0	8.5	136.6	171.2
Rail	0.0	0.0	52.5	0.0	0.0	0.0	0.0	52.5
Pipeline	95.6	0.0	0.0	0.0	0.0	0.0	0.0	95.6
Military	0.0	0.0	36.0	32.0	0.0	0.0	0.0	68.0
	95.6	6.7	330.3	422.9	2.2	1049.5	136.6	2043.8

Table 2.8 Estimated Energy Consumption by Mode and Fuel Type, 1995*

Mode	Trillion Btu							Total
	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	
Highway	0.0	0.0	257.2	0.0	0.7	1059.4	0.0	1317.3
Air	0.0	3.5	0.0	599.4	0.0	0.0	0.0	602.9
Water	0.0	0.0	52.0	0.0	0.0	9.3	218.6	279.9
Rail	0.0	0.0	84.5	0.0	0.0	0.0	0.0	84.5
Pipeline	82.7	0.0	0.0	0.0	0.0	0.0	0.0	82.7
Military	0.0	0.0	31.7	21.5	0.0	0.0	0.0	53.2
	82.7	3.5	425.4	620.9	0.7	1068.7	218.6	2420.5

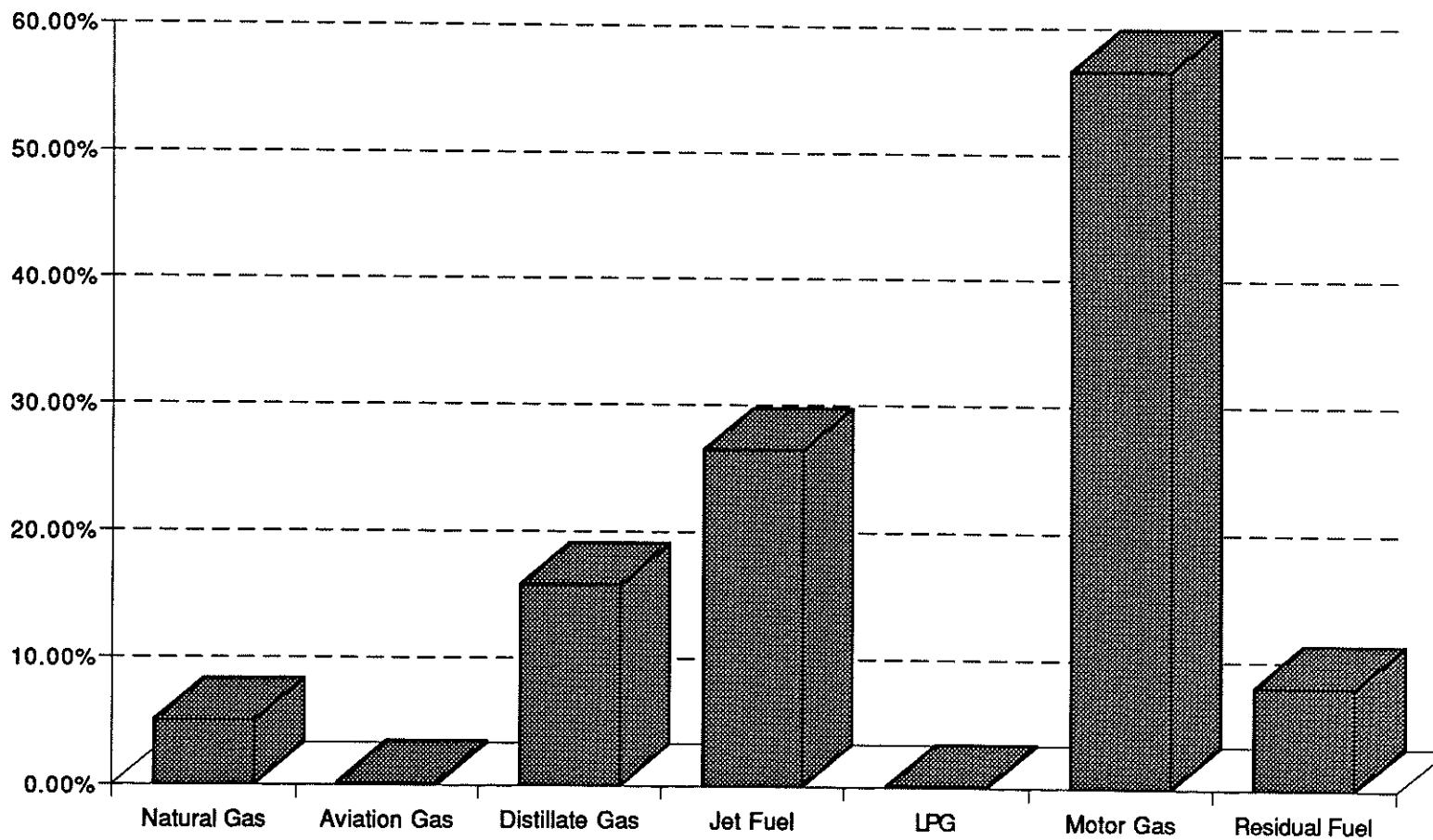
Sources:

State Energy Data Report, Energy Information Administration; Ms. Julia Hutchins, Energy Information Administration unpublished fuel time series, 1994

Note:

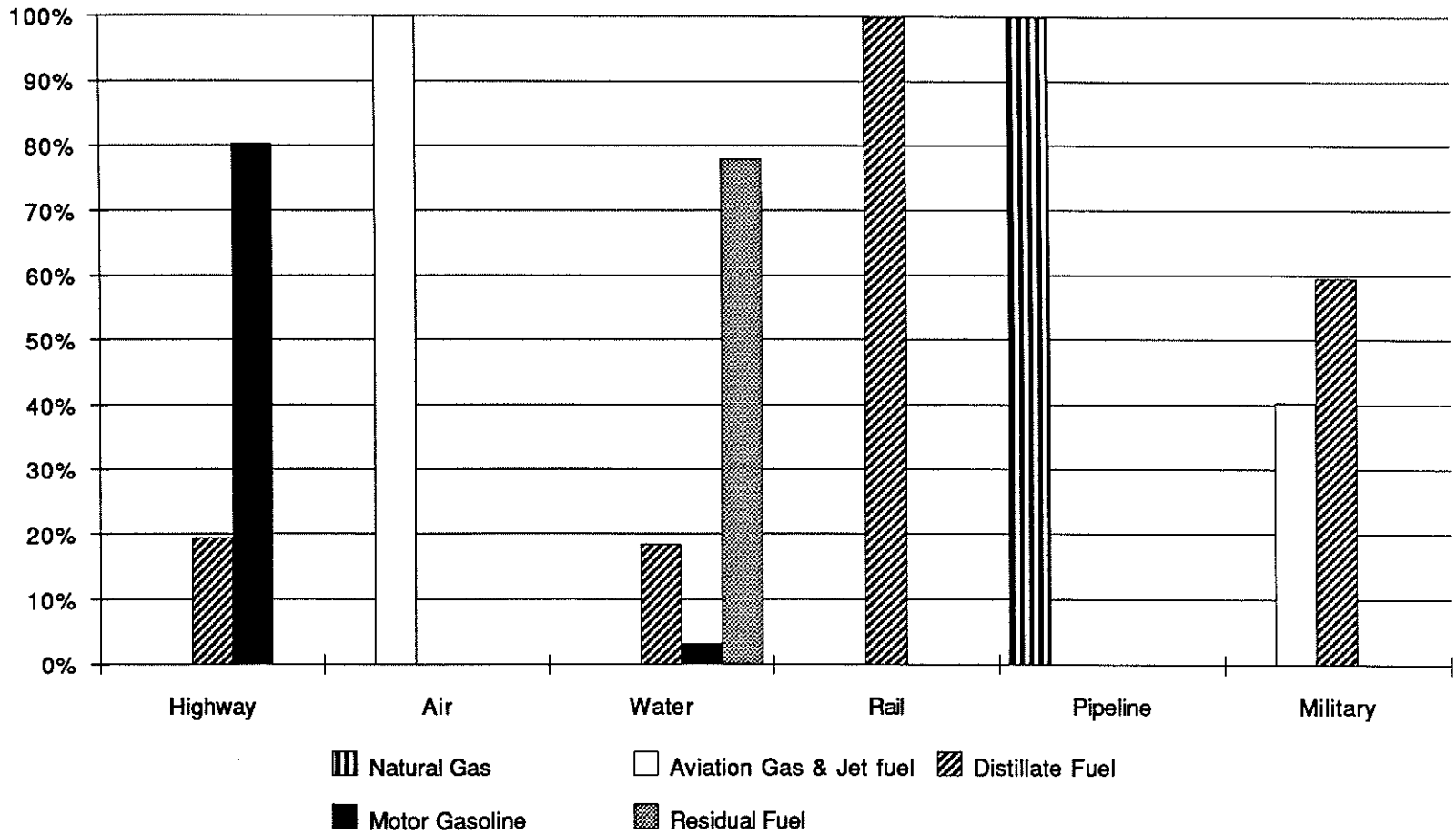
* Estimated

Figure 2.7 Distribution of Texas Transportation Energy by Fuel Type, 1995



Source: Table 2.8

Figure 2.8 Texas Energy Consumption by Mode & Fuel Type, 1995



Source: Table 2.8

Table 2.9 Estimated Passenger Travel and Energy Use in Texas, 1995

Mode	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger-miles (millions)	Load (a) factor (pers./veh.)	Est. Energy Intensity		Energy Use trillion Btu
					Btu per vehicle-mile	Btu per passenger-mile	
Automobiles	9,069.3	104,086.4	166,538	1.6	5,505	3,441	573.0
Motorcycle	120.6	384	538	1.4	2,551	1,822	1.0
Pick-up Truck	4,377.0	54,588.1	81,882	1.5	9,449	6,299	515.8
Buses							
Commercial	2.9	115.3	-	-	27,754	-	3.2
School & transit	65.6	557.0	10,806	19.4	15,978	824	8.9
Air							
Commercial	-	-	61,608	-	-	9,729	599.4
Rail							
AMTRAK	-	3	55	20.1	49,526	2,464	0.1

Sources:

Highway Statistics, 1993; TTI estimates; Table 2.5; Statistical Handbook of Aviation
 Railroad Facts, 1994; Texas Railroad Facts, 1990, Railroad Commission of Texas

Notes:

(a) Load factors are for the U.S. in 1991.

Table 2.10 Energy Intensities of Passenger Modes in Texas

Year	Automobiles		Buses		Air	Rail (b)	
	Btu per Vehicle-mi	(a)	Commercial	School & other	Certified Carrier	AMTRAK	
		Btu per Passenger-mi	Btu per Vehicle-mi	Btu per Vehicle-mi	Btu per Passenger-mi	Btu per Passenger-mi	
1973	10,831	6,371	31,780	17,645	12,652	3,756	
1974	10,980	6,459	31,577	18,237	11,376	3,240	
1975	10,795	6,350	30,472	18,245	12,241	3,677	
1976	10,348	6,087	28,865	17,909	10,480	3,397	
1977	10,219	6,011	29,237	18,080	9,821	3,568	
1978	9,844	5,791	28,715	17,686	9,011	3,683	
1979	10,127	5,957	29,998	18,623	8,134	3,472	
1980	8,854	5,208	28,218	16,754	7,066	3,176	
1981	8,437	4,963	28,044	16,463	6,562	2,976	
1982	8,635	5,079	30,345	17,673	8,788	3,156	
1983	8,244	4,850	30,012	17,265	9,506	2,957	
1984	7,202	4,237	28,053	16,044	11,904	3,027	
1985	7,373	4,337	29,267	16,605	12,643	2,800	
1986	7,191	4,230	29,478	16,572	13,203	2,574	
1987	6,745	3,968	29,128	16,259	13,050	2,537	
1988	6,453	3,796	29,249	16,178	14,022	2,462	
1989	6,247	3,675	29,179	17,542	11,883	2,731	
1990	6,134	3,834	27,486	16,525	12,480	2,609	
1991	6,108	3,817	27,174	16,337	10,453	2,503	
1992	6,033	3,771	27,630	16,611	10,337	2,610	
1993*	5,904	3,690	27,521	16,752	10,138	2,560	
1994*	5,661	3,538	27,409	16,283	9,932	2,512	
1995*	5,505	3,441	27,754	15,978	9,729	2,464	
			Average annual changes				
Period:							
1973-95	-3.0%	-2.8%	-0.6%	-0.5%	-1.2%	-1.9%	
1985-95	-2.9%	-2.3%	-0.5%	-0.4%	-2.6%	-1.3%	

Sources: State Energy Data Report, Energy Information Administration, 1994;

Highway Statistics, FHWA, USDOT, annual; Statistical Handbook of Aviation, annual;

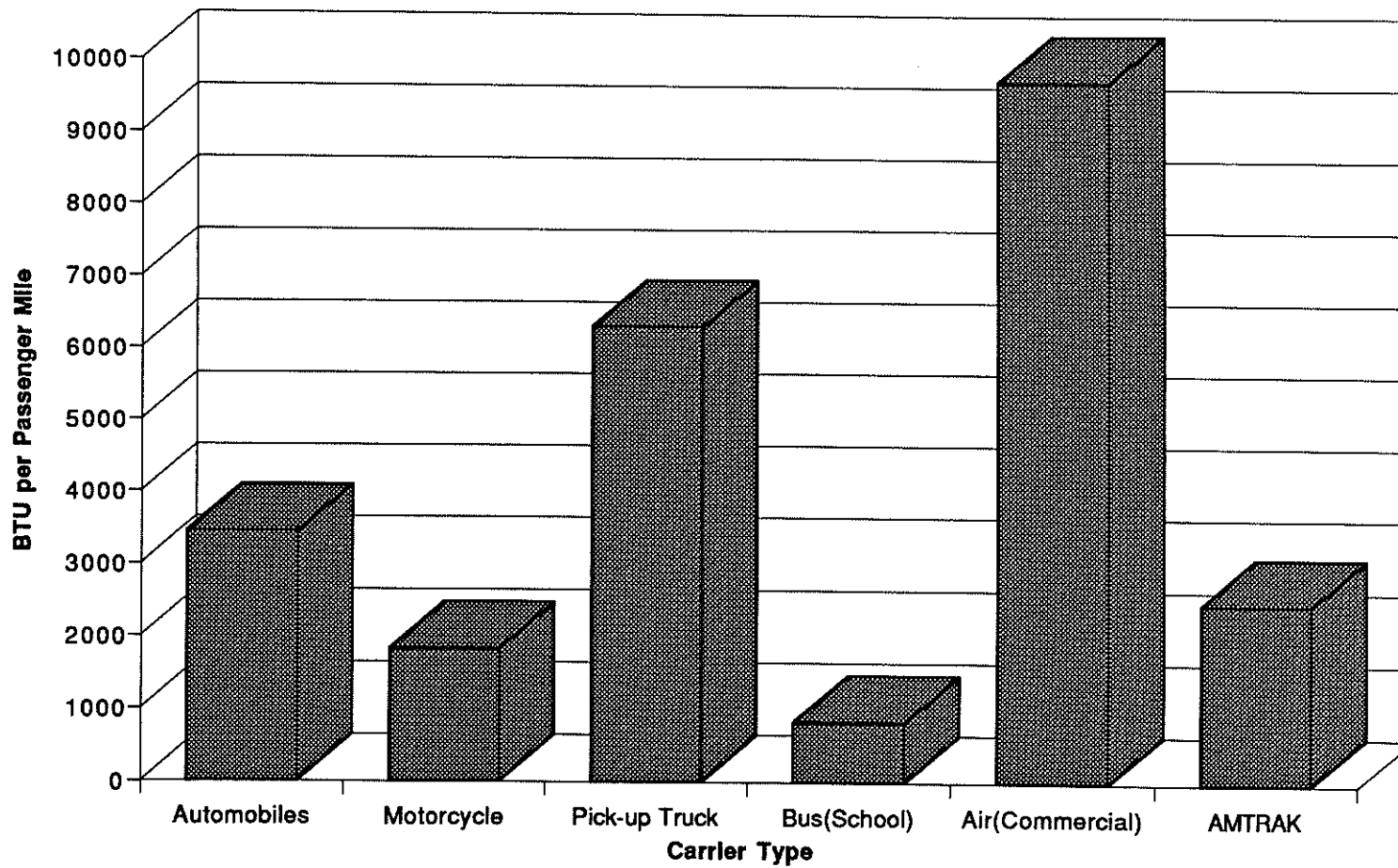
Railroad Facts, American Association of Railroads, annual

Air mode figures derived from Table 4.2

Notes: * estimate

(a) Based on U.S. load factor of 1.7 from 1973-1989, 1990-1995 1.6 (b) U.S. figures

Figure 2.9 Passenger Energy Intensity in Texas, 1995



Source: Table 2.10

Table 2.11 Intercity Freight and Energy Use In Texas, 1995*

	Number of vehicles (thousands)	(a) Vehicle- miles (millions)	(b) Ton- miles (millions)	Tons shipped (millions)	Average length of haul (miles)	Energy intensity (Btu per ton-mile)	Energy Use trillion Btu
Comb. Truck	135.0	8,230.8	86,423	338.4	255.4	2,411	208.4
Waterborne	-	-	18,542	496.6	37.3	388	7.2
Pipeline (c)	-	-	61,400	115.6	531.1	262	16.1
Class I Rail.	-	33.6	98,668	444.5	222.0	856	84.5

Sources:

Waterborne Commerce of the United States, Part 2, 1993

State Energy Data Report, EIA, 1994

State Statistics, R-1 Annual Reports to the ICC

Highway Statistics, FHWA, 1993

Trucking in Texas, TMTA, ATAF

Notes:

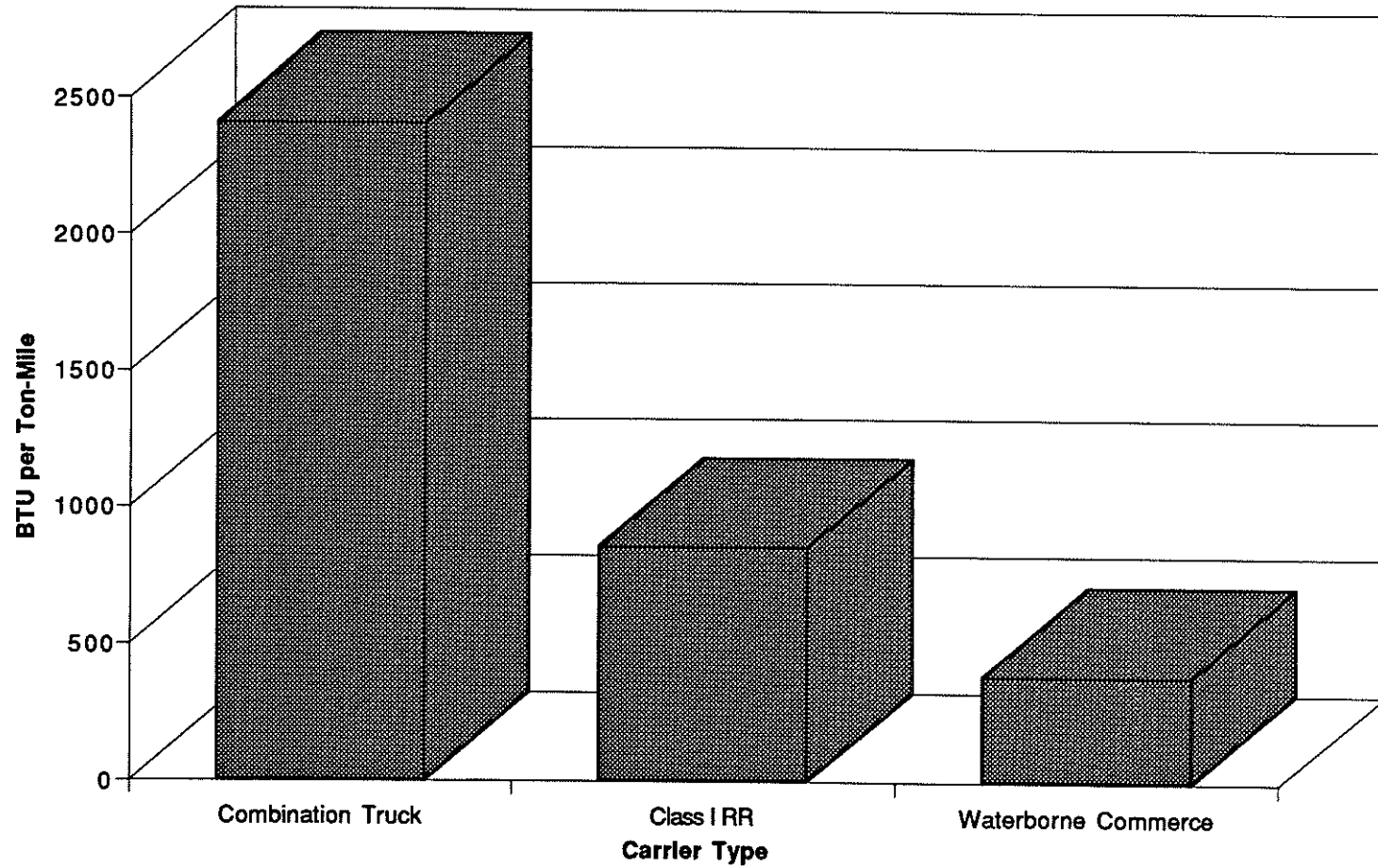
(a) In terms of train-miles for Class I Railroads

(b) In terms of revenue ton-miles for Class I Railroads

(c) Transport of crude petroleum and refined petroleum products only

* estimate

Figure 2.10 Intercity Freight Energy Intensities In Texas, 1995



Source: Table 2.12

Table 2.12 Energy Intensities of Freight Modes in Texas

Year	Light Truck (Btu per Vehicle-mi)	Combinations (Btu per Vehicle-mi)	Class I Railroads (Btu per Ton-mi)	Domestic Waterborne (Btu per Ton-mi)
1973	13,534	26,665	1,149	599
1974	13,420	26,840	1,243	503
1975	13,384	26,109	1,255	571
1976	13,152	27,032	1,107	487
1977	13,120	27,191	1,100	476
1978	12,864	26,729	1,018	398
1979	13,284	28,096	948	475
1980	11,530	25,803	659	372
1981	10,637	25,392	1,093	374
1982	11,514	27,369	1,232	323
1983	10,662	28,308	839	332
1984	10,827	25,926	820	360
1985	11,196	26,818	784	464
1986	11,051	27,679	641	481
1987	10,849	27,286	763	431
1988	10,477	27,028	668	375
1989	10,008	26,185	713	419
1990	9,815	25,474	677	403
1991	9,810	25,549	800	421
1992	9,894	25,769	974	420
1993	9,762	25,435	927	404
1994*	9,604	25,375	879	396
1995*	9,449	25,315	856	388
	Average annual changes			
Period:				
1973-95	-1.6%	-0.2%	-1.3%	-2.0%
1985-95	-1.7%	-0.6%	0.9%	-1.8%

Sources:

State Energy Data Report 1960-1994, Energy Information Agency;
Highway Statistics, FHWA, USDOT, annual;
State Statistics, R-1 Annual Reports to the ICC;
Transportation Energy Data Book: Edition 14, Oak Ridge National Laboratory

Notes:

* estimate

Table 2.13 Retail Prices of Selected Highway Motor Fuels

Year	Cents per gallon, including tax					
	Distillate fuel		LPG/Ethane		Motor Gasoline	
	Current	Constant 1988	Current	Constant 1988	Current	Constant 1988
1973	24.5	65.2	16.2	43.2	44.8	119.4
1974	29.1	69.8	19.3	46.4	49.5	118.7
1975	34.5	75.9	23.1	50.8	54.5	119.9
1976	42.6	88.5	26.9	56.0	63.4	131.9
1977	52.5	102.5	31.4	61.3	73.8	144.0
1978	64.7	117.5	36.6	66.5	85.8	155.6
1979	79.8	130.1	42.7	69.6	99.8	162.6
1980	98.3	141.2	49.9	71.6	115.8	166.3
1981	115.5	150.4	56.5	73.6	131.3	170.9
1982	109.0	133.6	57.8	70.8	122.9	150.7
1983	94.6	112.3	62.7	74.5	109.3	129.8
1984	94.3	107.4	61.1	69.6	108.3	123.3
1985	90.1	99.1	41.1	45.1	109.9	120.9
1986	81.0	87.4	39.6	42.8	80.9	87.3
1987	91.5	95.3	34.3	35.7	89.9	93.6
1988	89.3	89.3	33.1	33.1	91.6	91.6
1989	96.7	92.2	24.2	23.1	99.1	94.5
1990	113.7	102.9	38.2	34.6	114.6	103.7
1991	108.7	94.4	39.3	34.1	113.7	98.7
1992	110.8	93.4	37.3	31.5	113.2	95.4
1993*	112.8	92.5	35.2	28.9	113.6	93.1
1994*	103.5	82.5	43.6	34.7	114.1	91.0
1995*	105.3	81.7	41.1	31.9	114.5	88.8
Period:	Average annual changes					
1973-95	6.9%	1.0%	4.3%	-1.4%	4.4%	-1.3%
1985-95	1.6%	-1.9%	0.0%	-3.4%	0.4%	-3.0%

Source:

State Energy Price and Expenditure Report, Energy Information Administration, 1994

Note:

* estimate

Table 2.14 Retail Prices for Selected Transportation Fuels

Year	Cents per gallon, including tax					
	Aviation Gas		Jet Fuel		Residual Fuel	
	Current	Constant 1988	Current	Constant 1988	Current	Constant 1988
1973	34.4	91.8	18.0	48.0	14.2	37.8
1974	37.8	90.7	22.1	53.0	18.6	44.7
1975	41.5	91.2	27.1	59.7	24.4	53.7
1976	50.3	104.5	34.1	71.0	25.8	53.6
1977	60.9	118.9	42.9	83.8	27.3	53.2
1978	73.8	133.9	54.0	98.0	28.8	52.3
1979	89.5	145.8	68.0	110.7	30.5	49.6
1980	108.4	155.6	85.6	122.9	32.2	46.2
1981	130.3	169.6	100.8	131.2	37.3	48.5
1982	131.2	160.9	95.7	117.3	42.1	51.6
1983	125.5	149.0	85.0	101.0	45.2	53.7
1984	123.4	140.5	81.8	93.1	48.6	55.4
1985	120.1	132.0	76.5	84.2	60.2	66.2
1986	101.1	109.1	48.1	51.9	21.3	22.9
1987	90.7	94.5	52.0	54.1	38.6	40.2
1988	89.1	89.1	48.2	48.2	27.4	27.4
1989	99.5	94.9	56.2	53.6	36.1	34.4
1990	112.0	101.4	73.0	66.1	44.0	39.8
1991	104.7	90.9	62.6	54.4	44.9	39.0
1992	102.6	86.5	58.3	49.1	28.4	24.0
1993*	100.4	82.3	55.9	45.8	27.0	22.1
1994*	98.2	78.3	53.6	42.8	25.7	20.5
1995*	96.0	74.5	51.4	39.9	24.4	18.9
Period:	Average annual changes					
1973-95	4.8%	-0.9%	4.9%	-0.8%	2.5%	-3.1%
1985-95	-2.2%	-5.6%	-3.9%	-7.2%	-8.6%	-11.8%

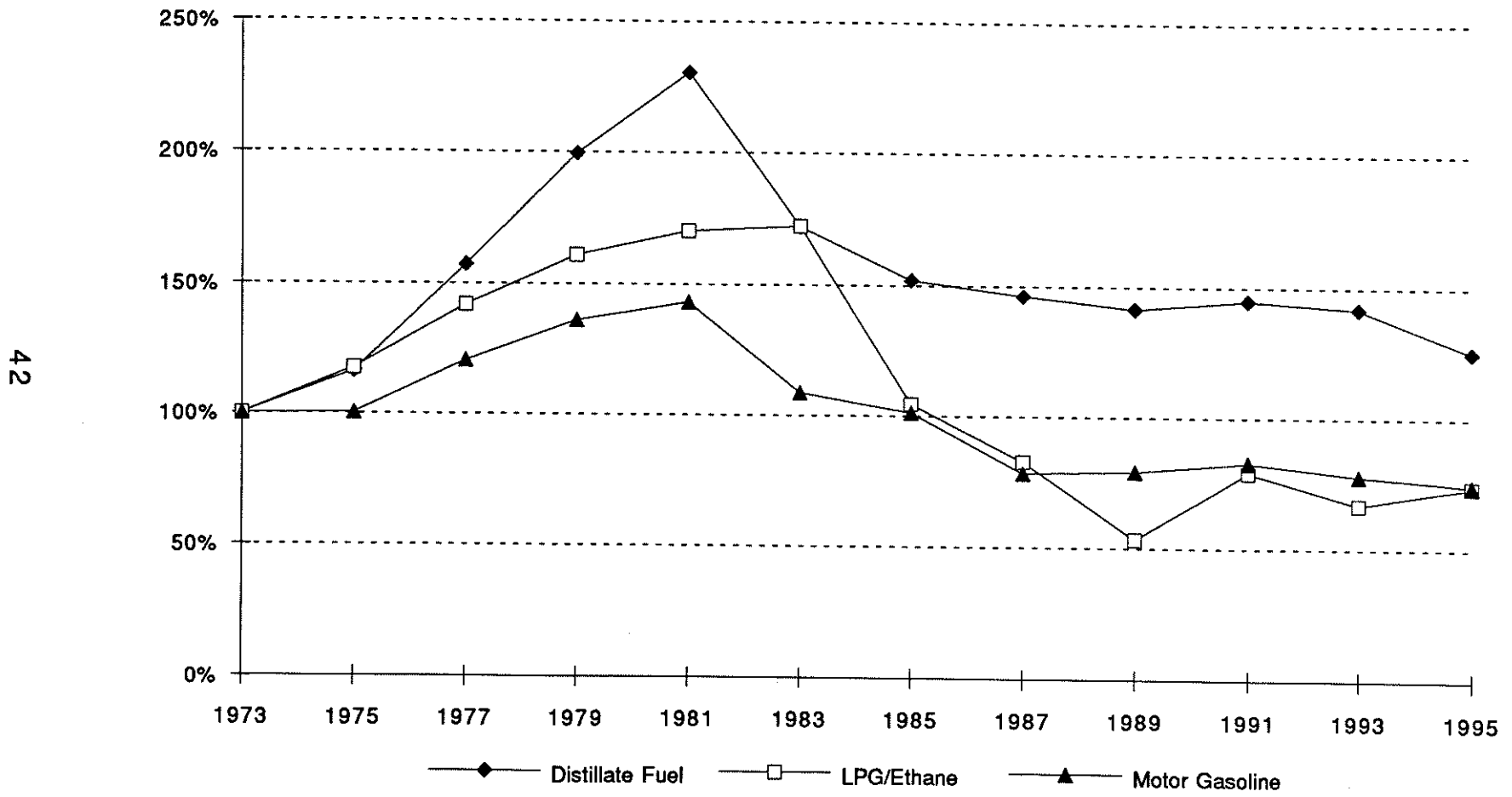
Source:

State Energy Price and expenditure Report 1992, Energy Information Administration

Note:

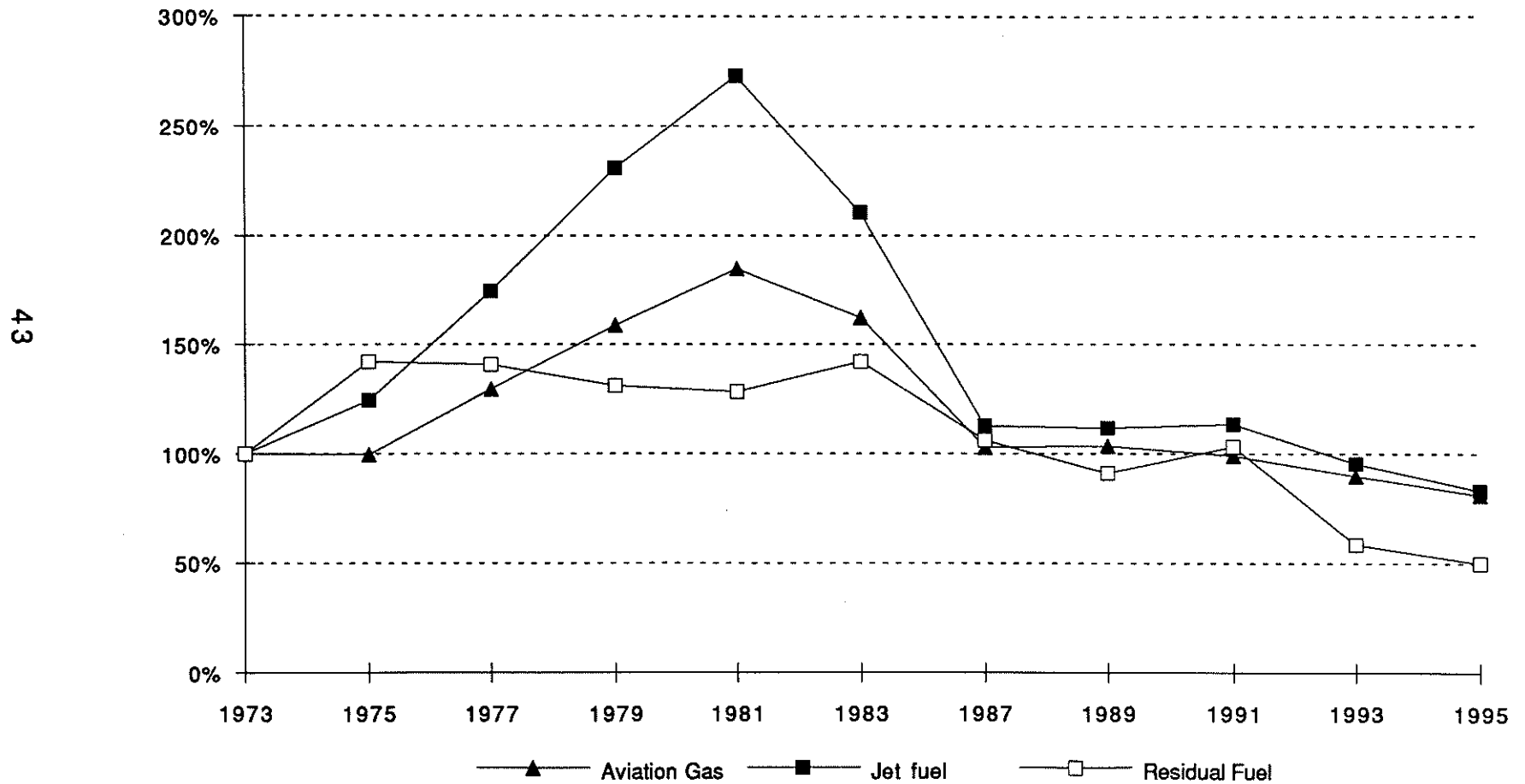
* estimate

Figure 2.11 Texas Motor Fuel Prices (\$1988) as Percentage of Baseline



Source: Table 2.13

Figure 2.12 Texas Non-Highway Fuel Prices (\$1988) as a Percentage of Baseline



Source: Table 2.14

Table 2.15 Crude Oil and Gasoline Prices

Year	Average U.S. Crude Oil (\$ per bbl)		Average Texas Retail Gasoline (\$ per gal)	
	Current	Constant 1988	Current	Constant 1988
	1973	3.89	10.36	0.45
1974	6.87	16.49	0.49	1.19
1975	7.67	16.87	0.55	1.20
1976	8.19	17.03	0.63	1.32
1977	8.57	16.73	0.74	1.44
1978	9.00	16.33	0.86	1.56
1979	12.64	20.60	1.00	1.63
1980	21.59	31.00	1.16	1.66
1981	31.77	41.35	1.31	1.71
1982	28.52	34.96	1.23	1.51
1983	26.19	31.11	1.09	1.30
1984	25.88	29.47	1.08	1.23
1985	24.09	26.49	1.10	1.21
1986	12.51	13.50	0.81	0.87
1987	15.41	16.05	0.90	0.94
1988	12.58	12.58	0.92	0.92
1989	15.86	15.13	0.99	0.94
1990	20.03	18.13	1.15	1.04
1991	16.54	14.36	1.14	0.99
1992	15.99	13.35	1.13	0.95
1993	14.24	11.54	1.13	0.93
1994*	14.02	11.19	1.14	0.91
1995*	13.80	10.56	1.15	0.88

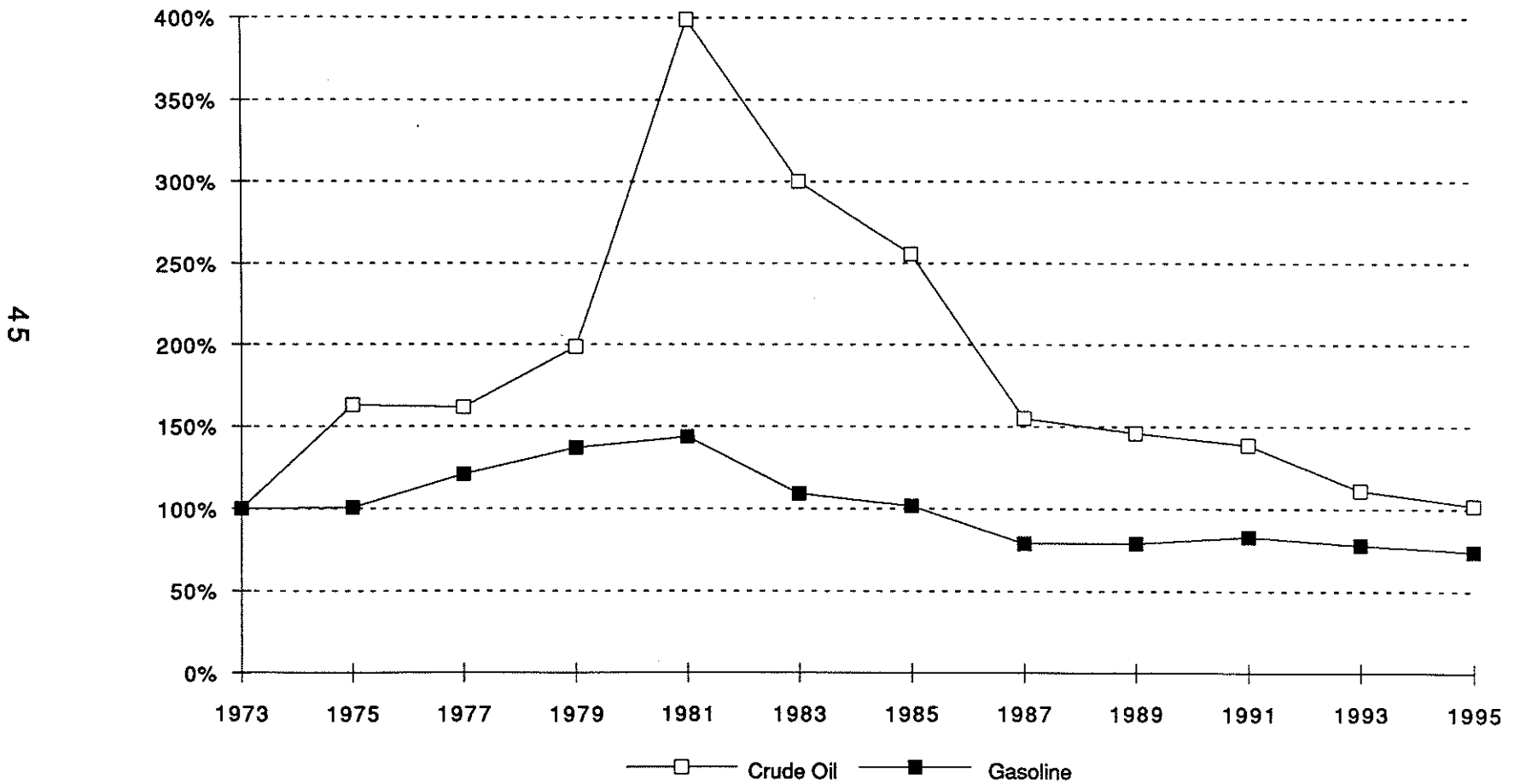
Average annual changes

Time Period	Current	Constant 1988	Current	Constant 1988
1973-95	5.92%	0.08%	4.38%	-1.37%
1985-95	-5.42%	-8.79%	0.45%	-3.12%

Sources:

1993 Annual Energy Review, Energy Information Administration,
Table 2.13 this volume

Figure 2.13 Crude Oil & Texas Gasoline Prices (\$1988) as a Percentage of Baseline



Source: Table 2.15

CHAPTER 3

TEXAS HIGHWAY MODE CHARACTERISTICS

Chapter 3 provides detailed information about the energy characteristics of the Texas highway mode. This chapter is divided into four sections. Section 3.1 is concerned with the general energy and traffic characteristics of the State's highway mode. Section 3.2 concentrates on household transportation energy characteristics of Texas and makes comparisons with other regions of the United States. Section 3.3 pertains to automobile and transit data. Finally, section 3.4 furnishes information pertaining to the trucking industry.

Section 3.1

General Highway Mode Characteristics

This section presents the general highway mode characteristics of Texas. It contains information on energy consumption by fuel type and sub-mode, the vehicle stock in Texas, and speed data on and off Texas interstates.

Figure 3.1 Texas Highway Energy Use by Fuel Type, 1995

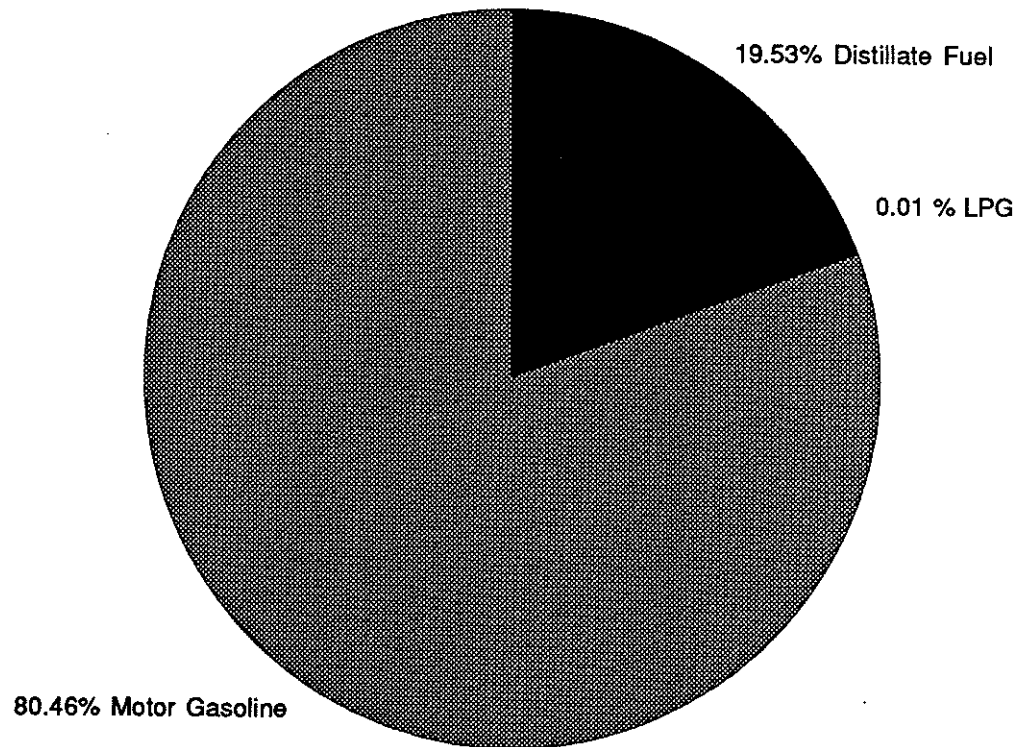


Table 3.1 Texas Highway Mode Energy Consumption by Fuel Type

Year	Trillion BTU			Total
	Distillate Fuel	LPG	Motor Gasoline	
1973	99.8	22.7	881.0	1003.5
1974	98.9	19.9	871.9	990.7
1975	103.5	18.6	912.3	1034.4
1976	114.8	19.2	966.1	1100.0
1977	129.7	20.1	1014.5	1164.3
1978	151.7	18.5	1052.8	1223.0
1979	176.7	2.9	1018.3	1197.9
1980	166.0	2.4	929.7	1098.1
1981	184.6	5.0	963.1	1152.8
1982	191.0	4.4	991.4	1186.7
1983	202.3	5.2	1007.2	1214.7
1984	211.5	3.0	1008.0	1222.6
1985	215.7	2.2	1041.0	1258.9
1986	200.4	2.8	1062.6	1265.8
1987	184.0	1.7	1039.4	1225.1
1988	180.8	1.7	1059.8	1242.3
1989	193.5	1.6	1029.5	1224.6
1990	193.6	1.8	1035.3	1230.7
1991	216.8	1.3	1004.7	1222.7
1992	219.6	1.1	1020.5	1241.3
1993*	232.6	1.0	1035.3	1268.9
1994*	245.5	0.9	1048.6	1295.0
1995*	257.2	0.7	1059.4	1317.3
Time Period:				
1973-1995	4.4%	-14.4%	0.8%	1.2%
1985-1995	1.8%	-10.4%	0.2%	0.5%

Sources:

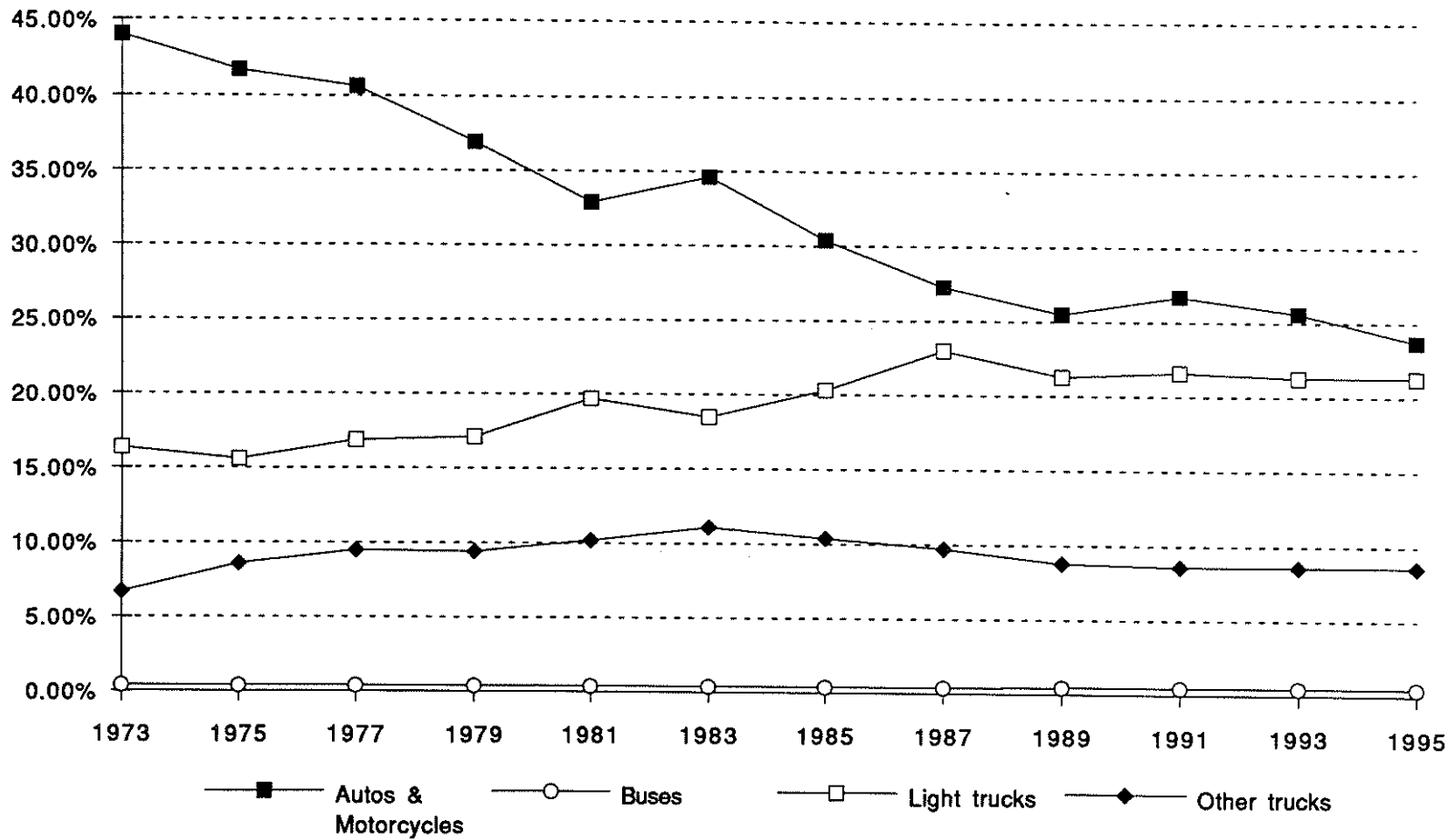
State Energy Data Report, Energy Information Administration (EIA), 1994;
EIA unpublished fuel time series

Notes:

* estimate

Figure 3.2 Percentage of Texas Highway Energy Consumption by Mode

52



Source: Table 3.2

Table 3.2 Texas Highway Energy Use by Mode

Year	Trillion Btu										
	Autos and motor-cycles	% of total transportation energy	Buses	% of total transportation energy	Light trucks	% of total transportation energy	Other trucks	% of total transportation energy	Total highway	% of total transportation energy	Total Transportation energy use
1973	653.7	44.0%	5.6	0.4%	244.3	16.4%	99.9	6.7%	1003.5	67.5%	1,485.7
1974	634.1	42.0%	5.9	0.4%	233.2	15.5%	117.6	7.8%	990.7	65.7%	1,509.0
1975	650.6	41.7%	6.3	0.4%	243.1	15.6%	134.4	8.6%	1034.4	66.2%	1,561.4
1976	666.0	41.3%	6.4	0.4%	275.4	17.1%	152.2	9.4%	1100.0	68.2%	1,613.6
1977	701.9	40.6%	6.6	0.4%	291.7	16.9%	164.1	9.5%	1164.3	67.4%	1,727.3
1978	727.2	39.8%	6.3	0.3%	313.8	17.2%	175.7	9.6%	1223.0	67.0%	1,825.6
1979	693.6	36.9%	6.9	0.4%	321.1	17.1%	176.3	9.4%	1197.9	63.7%	1,880.6
1980	606.7	33.7%	6.7	0.4%	326.9	18.1%	157.8	8.8%	1098.1	60.9%	1,802.0
1981	600.1	32.9%	6.8	0.4%	360.3	19.7%	185.6	10.2%	1152.8	63.1%	1,825.9
1982	659.6	35.0%	7.3	0.4%	366.4	19.5%	153.4	8.1%	1186.7	63.0%	1,882.7
1983	650.1	34.6%	8.3	0.4%	347.1	18.5%	209.2	11.1%	1214.7	64.7%	1,878.2
1984	594.0	29.9%	8.1	0.4%	391.4	19.7%	229.0	11.5%	1222.6	61.5%	1,989.5
1985	622.1	30.4%	8.7	0.4%	415.5	20.3%	212.6	10.4%	1258.9	61.6%	2,043.7
1986	589.7	28.2%	9.3	0.4%	465.0	22.2%	201.9	9.6%	1265.8	60.5%	2,093.9
1987	561.0	27.3%	9.1	0.4%	473.5	23.0%	198.7	9.7%	1225.1	59.6%	2,056.2
1988	553.4	25.5%	9.1	0.4%	471.4	21.7%	208.4	9.6%	1242.3	57.2%	2,172.7
1989	556.4	25.5%	11.0	0.5%	464.5	21.3%	192.7	8.8%	1224.6	56.1%	2,181.5
1990	565.2	25.9%	10.6	0.5%	464.6	21.3%	190.4	8.7%	1230.7	56.5%	2,179.2
1991	568.9	26.7%	10.5	0.5%	460.7	21.6%	182.6	8.6%	1222.7	57.3%	2,134.5
1992	579.8	26.4%	10.6	0.5%	465.9	21.2%	185.0	8.4%	1241.3	56.6%	2,193.9
1993	580.8	25.6%	11.3	0.5%	481.9	21.3%	194.9	8.6%	1268.9	56.0%	2,267.0
1994*	577.4	24.6%	11.7	0.5%	498.6	21.3%	201.5	8.6%	1295.0	55.2%	2,344.5
1995*	574.0	23.7%	12.1	0.5%	515.8	21.3%	208.4	8.6%	1317.3	54.4%	2,420.5
Period:					Average annual changes						
1973-95	-0.6%		3.6%		3.5%		3.4%		1.2%		2.2%
1985-95	-0.8%		3.3%		2.2%		-0.2%		0.5%		1.7%

Sources:

State Energy Data Report, Energy Information Administration, 1994;

Energy Information Administration unpublished fuel time series; Highway Statistics, USDOT, FHWA, annual.

Notes:

* estimated

Table 3.3 Estimated Vehicle Stock In Texas, 1995

	Registrations	As % of U.S.	Estimated Change from prior year
Automobiles	9,239,266	6.2%	3.9%
Two seaters	205,825		
Minicompact	225,633		
Subcompact	2,151,839		
Compact	2,610,551		
Midsize	2,598,344		
Large	1,447,073		
Private	9,069,352	6.2%	0.4%
Public	169,914	13.9%	0.5%
Motorcycles	124,700	3.3%	-6.9%
Private	120,643	3.2%	-7.1%
Public	4,057	10.4%	1.0%
Buses	68,543	10.2%	2.2%
Private	15,140	5.5%	-0.3%
Public	53,403	13.6%	2.9%
Trucks	4,311,558	8.8%	4.3%
Light	3,962,317		
Medium	99,169		
Light-heavy	72,944		
Heavy-heavy	176,770		
Private	4,078,662	8.7%	1.8%
Public	232,896	12.2%	3.6%
All private vehicles	13,283,797	6.7%	1.8%
All public vehicles	456,212	12.9%	2.9%

Source:

Data for estimates from Highway Statistics, annual

Table 3.4 Vehicle Stock In Texas, 1973-95

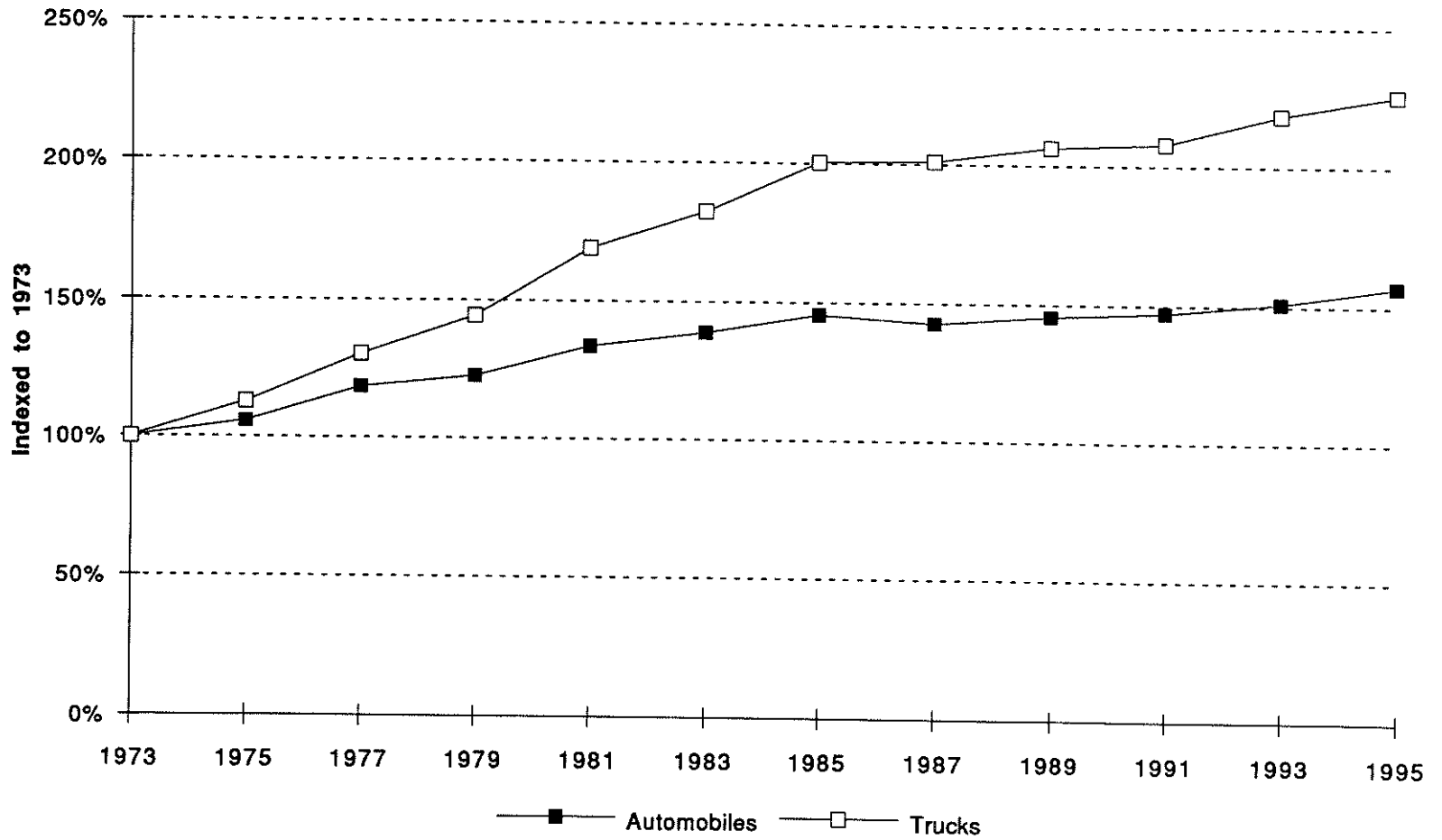
Year	Automobiles		Trucks		Buses		Texas	U.S.	Texas public vehicles as % of U.S.
	Private	Public	Private	Public	Private	Public	public vehicles (000's)	public vehicles (000's)	
1973	5,841,778	39,119	1,824,967	84,338	13,995	11,448	135	1,844.1	7.32%
1974	5,960,744	46,362	1,928,529	91,189	14,542	11,903	149	1,982.3	7.54%
1975	6,168,794	48,670	2,051,738	99,937	14,996	14,354	163	2,042.0	7.98%
1976	6,527,984	58,588	2,248,660	102,910	15,572	16,040	178	2,111.9	8.41%
1977	6,904,942	65,639	2,375,716	109,679	15,398	17,197	193	2,211.1	8.71%
1978	7,273,403	75,667	2,652,849	118,035	14,684	16,906	211	2,298.6	9.16%
1979	7,127,749	82,531	2,631,444	126,738	14,428	18,056	227	2,447.1	9.29%
1980	7,395,069	89,748	2,824,175	134,293	14,272	17,259	241	2,531.2	9.53%
1981	7,763,298	97,068	3,085,800	141,269	15,497	19,858	258	2,549.0	10.13%
1982	7,887,184	105,554	3,206,475	150,071	14,801	23,748	279	2,649.5	10.54%
1983	8,044,424	114,584	3,330,285	152,340	14,194	39,651	307	2,731.4	11.22%
1984	8,293,723	123,504	3,542,075	160,569	14,650	37,172	321	2,815.9	11.41%
1985	8,430,750	131,831	3,658,087	169,793	15,102	38,624	340	2,909.9	11.69%
1986	8,363,699	136,273	3,673,375	177,901	15,520	39,840	354	2,935.5	12.06%
1987	8,260,166	138,065	3,658,414	182,692	15,461	43,564	364	2,997.9	12.15%
1988	8,313,649	142,095	3,701,828	188,566	15,470	44,605	375	3,073.7	12.21%
1989	8,415,243	146,027	3,754,010	188,864	15,423	44,988	380	3,158.6	12.03%
1990	8,565,860	148,294	3,822,877	201,498	15,081	46,205	396	3,257.0	12.16%
1991	8,513,317	152,794	3,763,496	205,201	15,032	46,700	405	3,306.9	12.24%
1992	8,513,888	156,792	3,803,294	211,722	15,178	48,564	417	3,401.9	12.26%
1993	8,719,133	161,546	3,954,790	217,182	15,234	50,436	429	3,402.6	12.61%
1994*	8,892,519	165,677	4,006,641	224,902	15,187	51,898	446	3,511.7	12.70%
1995*	9,069,352	169,914	4,078,662	232,896	15,140	53,403	456	3,565.9	12.79%
Average annual changes									
Period:									
1973-95	2.02%	6.90%	3.72%	4.73%	0.36%	7.25%	5.69%	3.04%	-
1985-95	0.73%	2.57%	1.09%	3.21%	0.03%	3.29%	2.97%	2.05%	-

Source: Highway Statistics, USDOT, FHWA, 1970 and annual, Table 3.3

Notes: * estimate

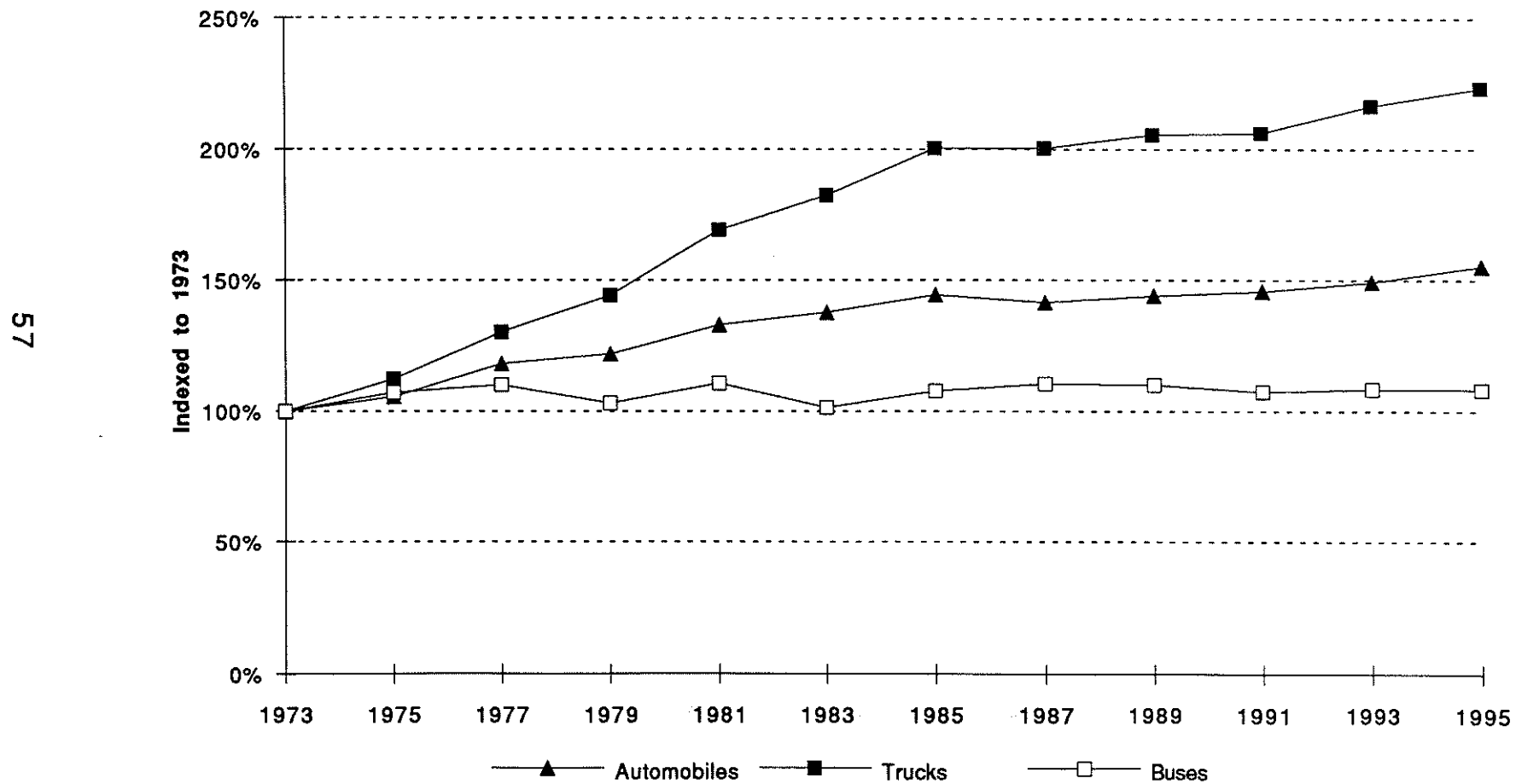
Figure 3.3 Automobiles & Trucks Registered in Texas

59



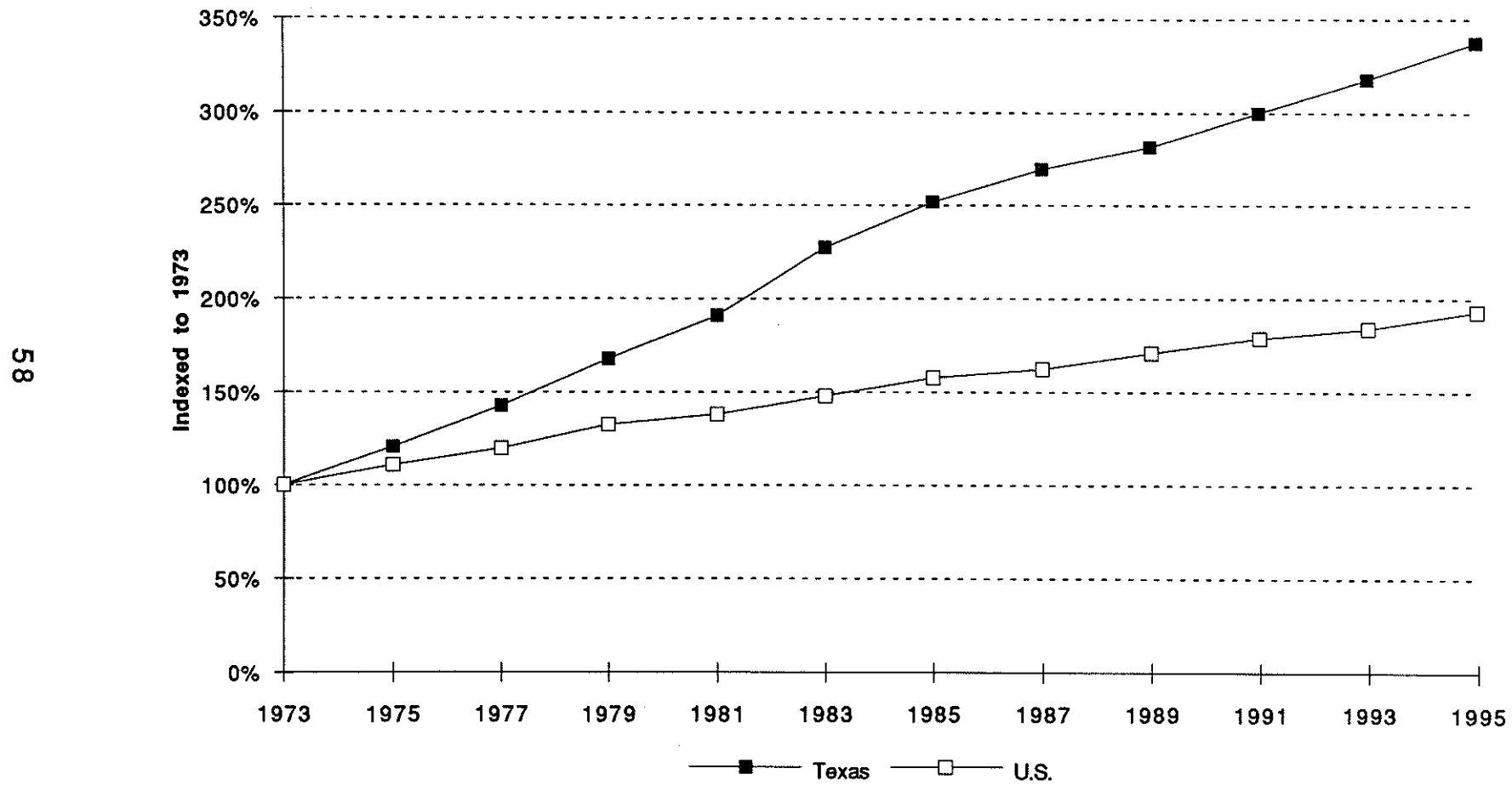
Source: Table 3.4

Figure 3.4 Texas Private Vehicle Stock Growth



Source: Table 3.4

Figure 3.5 Public Vehicle Stock Growth



Source: Table 3.4

Table 3.5 Texas Interstate Speed Data

Year	Urban					Rural				
	Average speed (mph)	85th percentile speed (mph)	% greater than 55 mph	% greater than 60 mph	% greater than 65 mph	Average speed (mph)	85th percentile speed (mph)	% greater than 55 mph	% greater than 60 mph	% greater than 65 mph
1978	59.4	65.9	78	39	14	61.1	68.6	85	48	23
1979	58.6	65.4	74	34	12	59.6	66.2	78	40	15
1980	56.8	63.3	64	22	6	59.0	66.0	73	38	13
1981	55.7	62.7	60	24	8	59.7	65.6	78	43	16
1982	55.4	61.5	55	19	5	60.7	66.8	80	50	20
1983	56.0	62.6	63	24	7	60.6	67.1	83	50	21
1984	57.3	64.2	68	31	12	59.9	66.3	86	45	18
1985	57.2	65.0	65	32	15	61.6	68.6	84	56	27
1986	56.5	64.3	67	29	13	60.6	67.6	82	51	23
1987	56.4	63.6	57	28	10	60.9	67.7	(a)	(a)	(a)
1988	60.3	67.7	72	47	23	61.0	67.8	(a)	(a)	(a)
1989	60.4	68.0	69	47	24	61.1	67.9	(a)	(a)	(a)
1990	60.6	68.9	72	50	27	61.2	68.1	(a)	(a)	(a)
1991	60.6	69.2	72	51	28	61.3	68.2	(a)	(a)	(a)
1992	60.6	68.2	71	49	25	61.4	68.3	(a)	(a)	(a)
1993	59.1	66.6	69	42	19	61.5	68.5	(a)	(a)	(a)
1994*	59.1	66.6	68	42	19	61.7	68.6	(a)	(a)	(a)
1995*	59.1	66.7	67	42	20	61.8	68.7	(a)	(a)	(a)
U.S. averages for 1978 and 1995										
1978	56.7	61.4	60	23	5	58.8	63.7	74	36	10
1995*	58.5	65.9	70	42	18	66.9	74.7	78	51	24

Source:

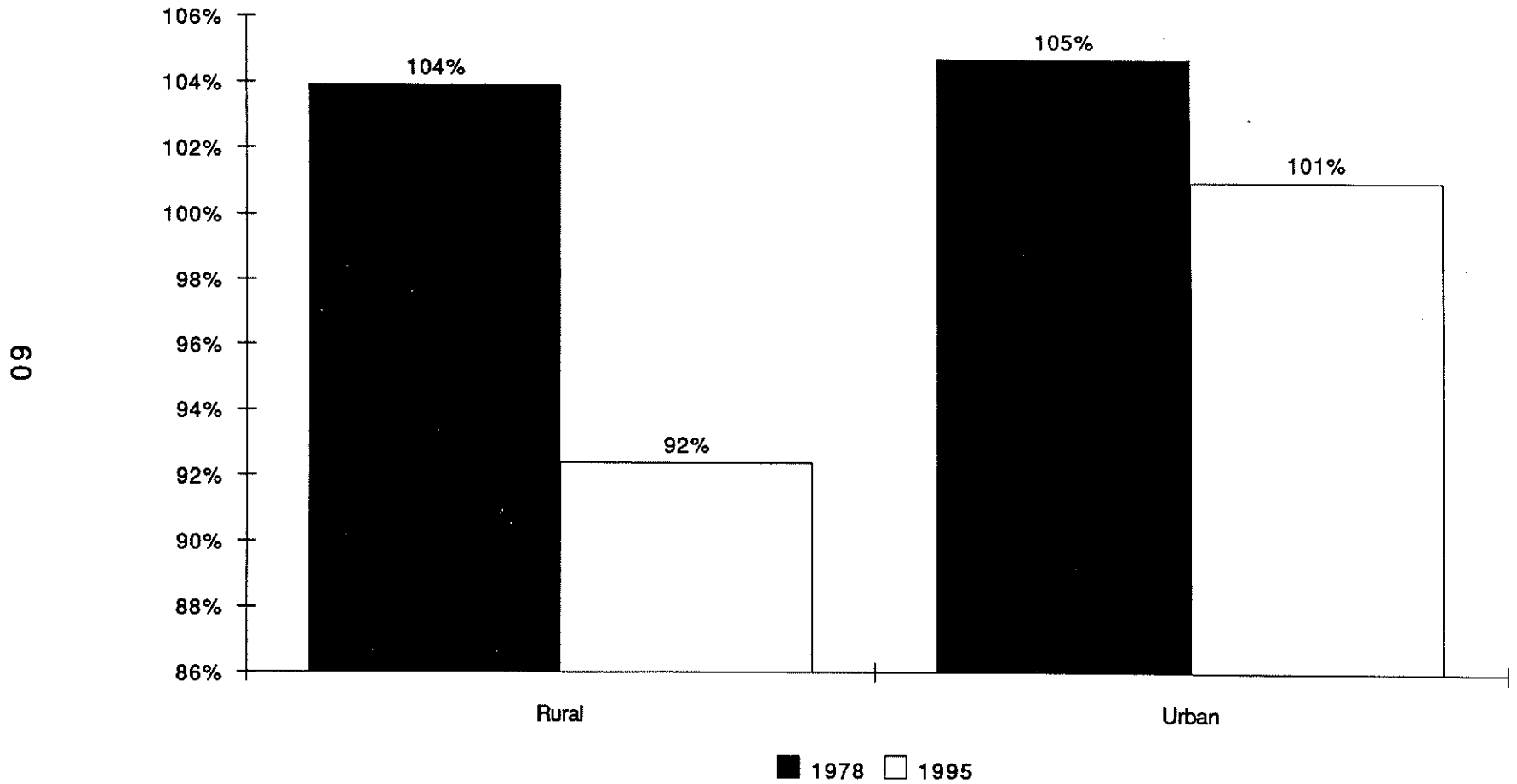
Highway Statistics, USDOT, FHWA, 1970 and annual

Notes:

(a) The FHWA did not require speed data for rural interstates during calendar years 1987-88.

* estimate

Figure 3.6 Texas Average Speed as a Percentage of U.S. Average Speed



Sources: Table 3.5 and 3.6

Table 3.6 Texas Non-Interstate Speed Data

Year	Urban Freeway and Expressway					Rural Other Principal and Minor Arterials				
	Average	85th	%	%	%	Average	85th	%	%	%
	speed	percentile	greater	greater	greater	speed	percentile	greater	greater	greater
(mph)	speed	than	than	than	(mph)	speed	than	than	than	
	(mph)	55 mph	60 mph	65 mph		(mph)	55 mph	60 mph	65 mph	
1981	55.2	60.0	53	15	3	56.9	64.3	61	31	13
1982	54.0	59.5	41	12	2	56.8	63.8	55	28	11
1983	56.5	63.0	57	25	8	57.5	64.2	61	31	12
1984	57.6	63.6	56	29	9	57.4	64.4	62	33	13
1985	55.9	64.0	53	27	12	57.1	64.0	62	31	11
1986	57.0	63.6	55	29	10	56.1	63.0	62	25	8
1987	56.5	63.8	56	27	11	57.8	64.3	67	34	12
1988	58.7	64.8	69	37	14	57.9	64.8	68	35	14
1989	59.3	65.6	71	41	16	58.5	65.5	66	37	16
1990	59.3	65.5	70	40	16	57.8	64.5	68	33	13
1991	59.1	66.0	76	40	17	57.8	64.5	66	33	13
1992	59.2	68.2	75	40	16	58.2	65.0	64	35	15
1993	58.8	65.2	70	38	15	57.7	64.1	65	32	12
1994*	59.1	65.7	72	41	17	57.8	64.1	66	32	12
1995*	59.4	66.1	73	45	20	57.8	64.1	66	32	12
						U.S. averages for 1995*				
	58.9	66.6	69	41	17	57.1	63.6	61	30	11

Source:

Highway Statistics, USDOT, FHWA, 1981 and annual

Notes:

The FHWA began designating non-Interstates as Freeway, Expressway, Other Principal and Minor Arterials in 1981.

* estimate

Section 3.2

Household Transportation Energy Data

This section contains seven tables which depict transportation energy consumption of the household according to a number of interesting household characteristics such as income, engine characteristics, family size, vehicle fuel efficiency category, etc. This section begins with Table 3.7 which provides an overview of typical Texas household transportation energy statistics. This data is compared to that of other regions throughout the United States. The section concludes with Table 3.14 which depicts the influence of household composition on vehicle miles traveled. These statistics for Texas are also compared to other regions in the United States.

Table 3.7 Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption, and Expenditures

Estimated Annual average per vehicle									
Census region	Vehicle miles traveled		Average annual change	Consumption (gal)		Average annual change	Expenditures		Average annual change
	1995**	1985		1995**	1985		1995**	1985	
Midwest	11,425	9,844	1.50%	528	629	-1.74%	\$618	\$745	-1.85%
Northeast	11,640	9,692	1.85%	497	572	-1.38%	\$642	\$688	-0.68%
South	11,288	9,995	1.22%	527	632	-1.79%	\$621	\$734	-1.65%
Texas*	10,879	9,969	0.88%	536	658	-2.04%	\$633	\$754	-1.74%
West	10,896	10,048	0.81%	513	608	-1.68%	\$591	\$723	-1.99%
U. S.	11,098	9,668	1.39%	518	599	-1.45%	\$616	\$708	-1.39%

Sources:

Consumption Patterns of Household Vehicles 1983,1985, EIA, RTECS;
Household Vehicle Energy Consumption 1988, 1991, EIA, RTECS

Notes:

* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant total of the W. South Central sample data (per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, Energy Information Agency)

** estimate

Table 3.8 Estimated U.S. Travel and Consumption Characteristics by Number of Cylinders, 1995 v. 1985

Estimated Annual average per household vehicle

Number of cylinders	Vehicle miles traveled			Consumption (gallons)			Expenditures			Miles per gallon		
	1995*	1985	Avg. annual change	1995*	1985	Avg. annual change	1995*	1985	Avg. annual change	1995*	1985	Avg. annual change
4	11,586	11,126	0.4%	427	492	-1.4%	505	589	-1.53%	27.2	22.7	1.8%
6	12,118	10,175	1.8%	551	638	-1.5%	655	757	-1.44%	21.9	16.0	3.2%
8	8,973	8,792	0.2%	605	674	-1.1%	719	788	-0.91%	14.9	13.0	1.4%

Sources:

Consumption Patterns of Household Vehicles 1985, EIA, RTECS;
Household Vehicle Energy Consumption 1991, EIA, RTECS

Notes:

* estimate

Figure 3.7 Texas Average MPG as a Percentage of U.S. Average MPG, by Model Year



Source: Table 3.9

Table 3.9 Estimated Average Miles Per Gallon by Model Year

Census region	Model year												
	All	1995**	1994**	1993**	1991 to 1992	1990	1989	1986 to 1988	1983 to 1985	1980 to 1982	1977 to 1979	1974 to 1976	1973 or earlier
Midwest	21.5	22.4	21.9	21.5	21.0	21.2	21.0	22.2	20.4	19.0	14.0	11.7	11.8
Northeast	24.2	25.6	24.7	23.8	23.0	22.2	22.4	22.7	21.0	19.3	14.4	12.9	12.5
South	21.7	23.5	22.8	22.1	21.5	21.0	22.4	21.9	20.4	18.7	14.0	13.0	11.5
Texas*	20.3	22.4	21.6	21.0	20.3	19.3	21.8	19.9	19.0	17.5	13.1	11.6	11.2
West	20.9	23.6	23.1	22.6	22.1	21.8	21.0	21.3	21.2	19.8	14.1	12.6	13.0
U. S.	21.8	23.6	23.0	22.4	21.8	21.5	21.8	22.0	20.6	19.1	14.1	12.6	12.2

Sources:

Household Vehicle Energy Consumption 1991, Energy Information Agency, RTECS
 TTI based regression equation to estimate years 1993-95

Notes:

* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant subset of the W. South Central sample data
 (per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, Energy Information Agency)

** estimate

Table 3.10 Vehicle Fuel Efficiency by Region

Census region	Average per household vehicle		Average annual change
	1995**	1985	
Midwest	21.5	15.6	3.3%
Northeast	24.2	17.0	3.6%
South	21.7	15.8	3.2%
Texas*	20.3	15.1	3.0%
West	20.9	16.5	2.4%
U. S.	21.8	16.1	3.1%

Sources:

Consumption Patterns of Household Vehicles 1983,1985, EIA, RTECS;
Household Vehicles Energy Consumption 1991, EIA, RTECS

Notes:

* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant total of the W. South Central sample data

(per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, Energy Information Agency)

** estimate

Table 3.11 Estimated Average Household Energy and Vehicle Expenditures, 1995

Census region	Annual household and vehicle energy expenditures (All categories)	Households without vehicles		Households with vehicles			
		Percent of households	Annual household energy expenditures	Percent of households	Annual household and vehicle energy expenditures	Annual household energy expenditures	Annual vehicle fuel expenditures
Midwest	\$2,233	9.8%	\$791	90.2%	\$2,362	\$1,238	\$1,124
Northeast	\$2,446	17.6%	\$974	82.4%	\$2,731	\$1,677	\$1,054
South	\$2,227	8.7%	\$911	91.3%	\$2,328	\$1,236	\$1,092
Texas *	\$2,435	7.5%	\$1,143	92.5%	\$2,512	\$1,374	\$1,138
West	\$2,054	8.2%	\$667	91.8%	\$2,208	\$1,130	\$1,078
U. S.	\$2,234	10.6%	\$854	89.4%	\$2,384	\$1,294	\$1,090

Source:

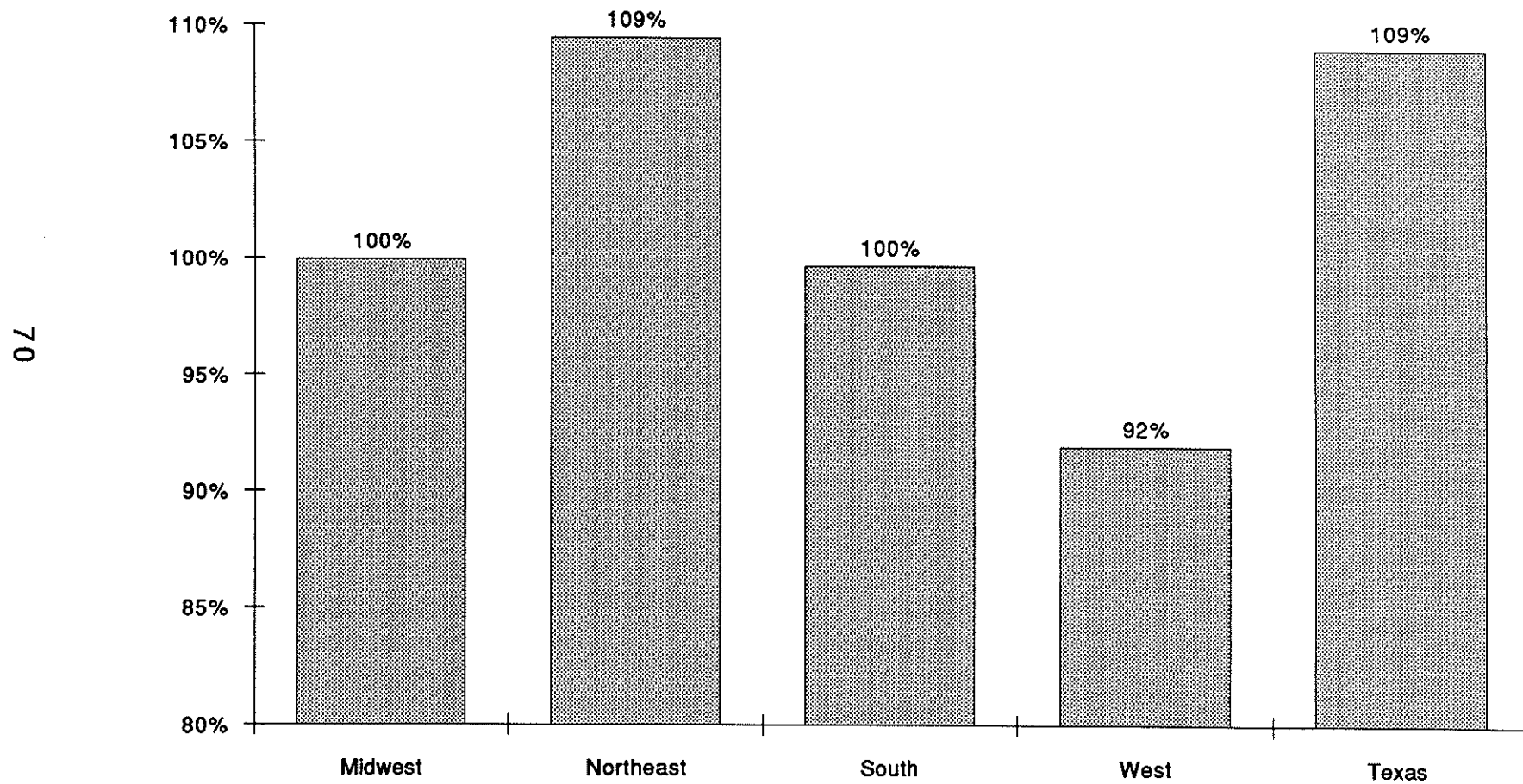
Household Vehicle Energy Consumption 1991, Energy Information Agency
 Consumption Patterns of Household Vehicles 1983 & 1985, Energy Information Agency
 Table 1.10

Notes:

* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant subset of the W. South Central sample data

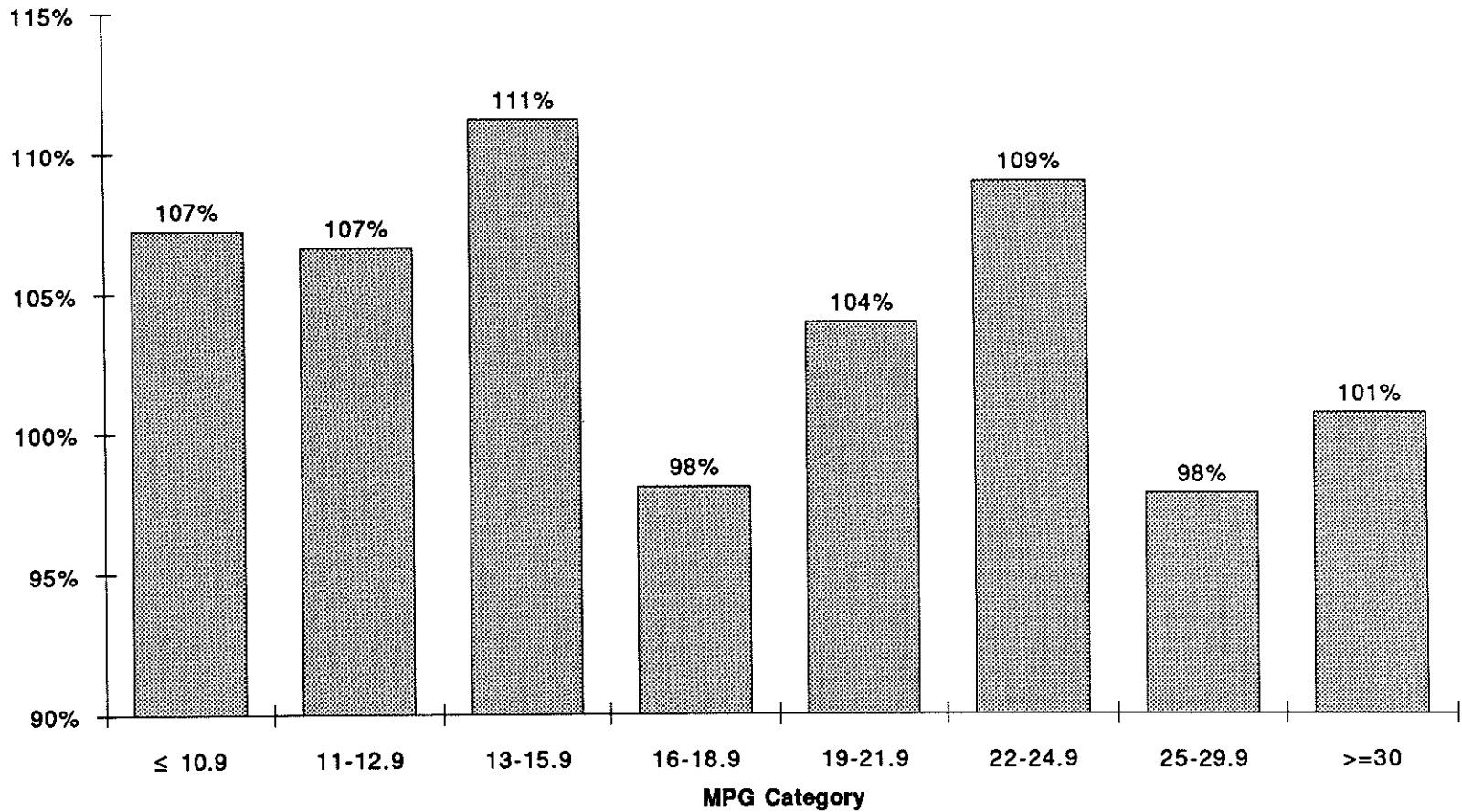
(per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, Energy Information Agency)

Figure 3.8 Average Annual Household Vehicle Energy Expenditures as a Percentage of U.S. Average, 1995



Source: Table 3.11

Figure 3.9 Texas Average Annual Household Vehicle Miles Traveled as a Percentage of U.S. Average, 1995



Source: Table 3.12

Table 3.12 Estimated Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1995

Census region	Fuel efficiency category (miles per gallon)								
	All	≤ 10.9	11	13	16	19	22	25	30
			to 12.9	to 15.9	to 18.9	to 21.9	to 24.9	to 29.9	or more
Midwest	11,000	6,100	7,100	8,300	10,800	12,800	11,900	14,400	16,500
Northeast	11,400	3,900	7,600	8,400	9,800	12,700	12,600	13,400	13,600
South	11,300	5,100	7,600	9,400	10,700	13,000	12,700	14,200	15,300
Texas*	11,000	5,900	8,000	9,900	10,200	13,100	13,200	13,500	15,000
West	10,500	5,800	7,600	8,700	9,700	11,900	12,000	13,000	14,400
U. S.	11,100	5,500	7,500	8,900	10,400	12,600	12,300	13,800	14,900

Source:

Household Vehicle Energy Consumption 1988 & 1991, Energy Information Agency
1995 Estimate by Texas Transportation Institute

Note:

* Surrogate measure based on W. South Central Region data in which Texas represents a predominant subset of the W. South Central sample data.

(per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, EIA)

• Estimate for Texas Vehicle miles for 11 to 12.9 mpg and 30 or more mpg categories computed using Regression Techniques

Table 3.13 Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1995

Census region	All income categories	Less than \$5,000	\$5,000 to \$9,999	\$10,000 to \$14,999	\$15,000 to \$24,999	\$25,000 to \$34,999	\$35,000 to \$49,999	\$50,000 or more
Midwest	20,200	12,200	11,800	14,900	16,700	21,500	24,100	29,000
Northeast	19,600	8,600	7,600	10,000	14,600	18,900	23,200	26,000
South	20,500	13,000	12,000	12,900	17,500	20,100	24,600	32,600
Texas *	19,700	12,200	13,000	12,400	17,100	19,400	23,500	31,200
West	19,600	14,400	10,900	11,600	16,100	20,300	22,300	27,400
U. S.	20,000	12,200	11,200	13,000	16,500	20,300	23,600	29,000

Source:

Household Vehicle Energy Consumption 1988 & 1991, Energy Information Agency; TTI estimates of growth from 1983 to 1991.

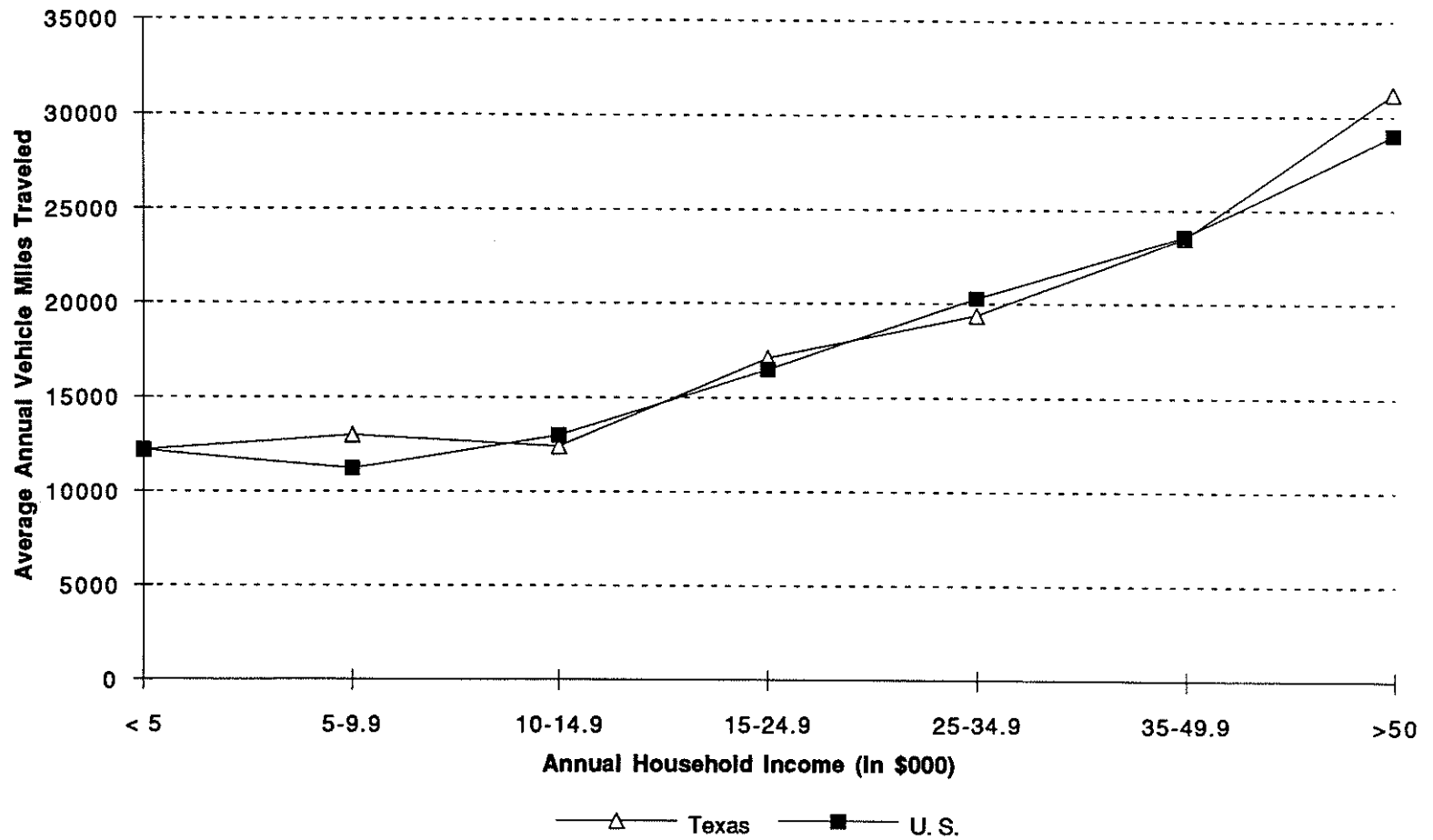
Notes:

* Estimate based on W. South Central Census Region data in which Texas data represents a predominant subset W. South Central sample data

(per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division)

• Estimate for Midwest and Texas Vehicles for income less the \$5,000 computed using Regression Techniques.

Figure 3.10 Effect of Income on Average Annual Vehicle Miles Traveled, 1995



74

Source: Table 3.13

Table 3.14 Estimated Average Vehicle Miles Traveled by Household Composition, 1995

Census region	Overall total	Households with children				Households without children						
		Total	Age of oldest child			Total	One adult, age of householder			Two or more adults, age of householder		
			Under 7 years	7 to 15 years	16 or 17 years		Under 35 years	35 to 59 years	60 Years or Over	Under 35 years	35 to 59 years	60 Years or Over
Midwest	20,200	23,200	21,400	22,800	27,700	17,000	16,000	12,300	5,600	24,700	24,500	15,300
Northeast	19,600	22,200	21,900	22,100	24,000	16,400	11,400	13,200	7,900	17,300	23,800	17,500
South	20,500	22,700	18,100	24,000	28,600	17,100	13,400	12,600	9,300	21,800	25,600	13,800
Texas *	19,700	20,200	16,900	20,900	24,000	17,100	15,400	14,000	11,200	28,200	23,900	12,700
West	19,600	23,600	21,500	22,700	29,000	15,000	15,100	12,100	8,800	19,500	20,800	16,000
U. S.	20,000	22,900	20,200	23,100	27,700	16,600	14,300	12,500	7,300	21,200	24,100	15,300

Source:

Household Vehicle Energy Consumption 1988 & 1991, Energy information Agency; TTI estimates of growth rates.

Notes:

* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant subset of the sample data

(per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, Energy Information Agency)

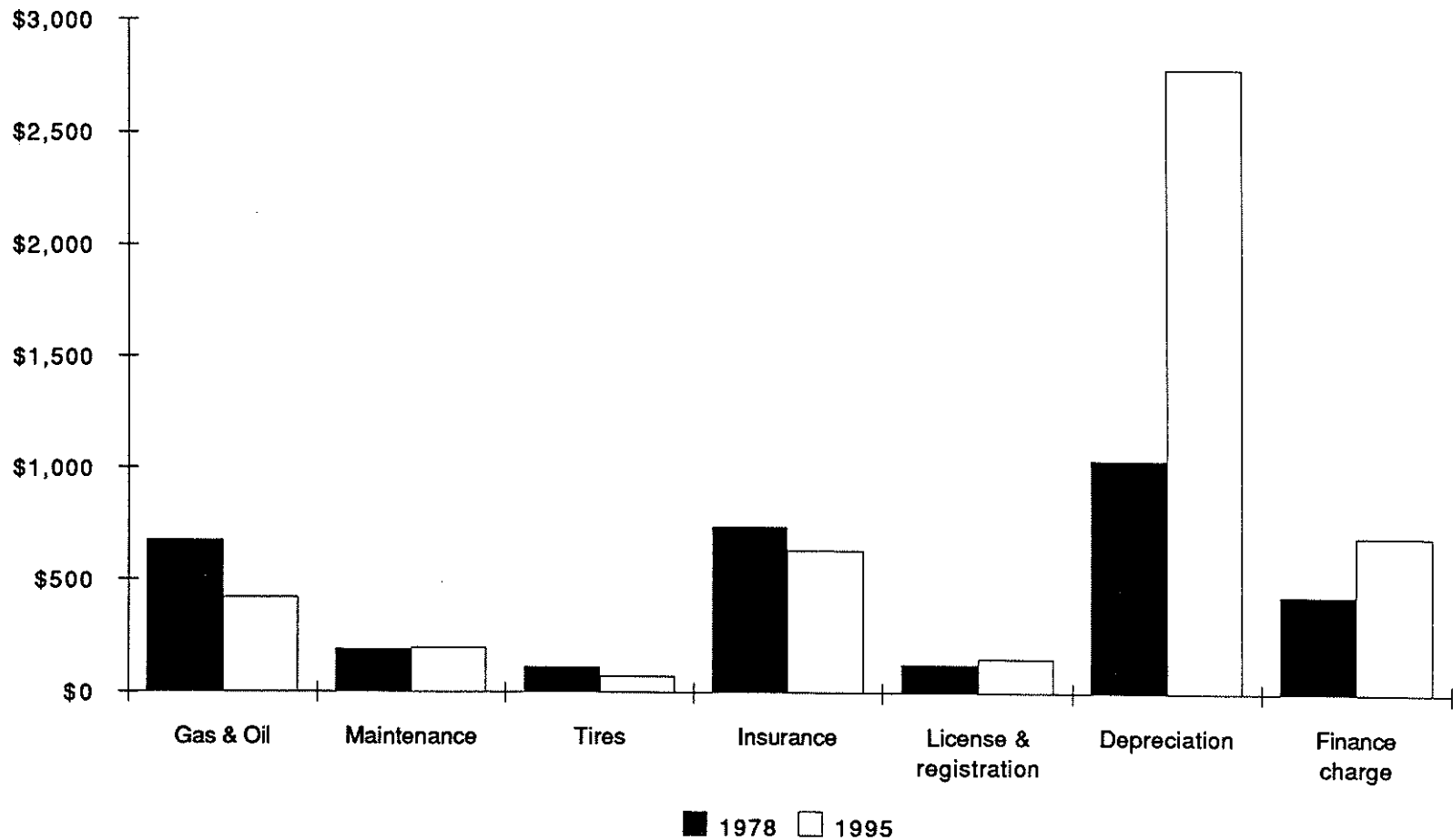
- Under 35 year class (1 adult, no children) estimated for Texas using Regression Techniques
- 35 to 59 year class (1 adult, no children) estimated for Texas using Regression Techniques

Section 3.3

Automobile and Transit Data

This section presents time series data concerning the operating costs of automobiles (in current and constant dollar terms), the estimated fuel economy of the 1995 model year automobiles, and statewide municipal ridership.

Figure 3.11 Average Annual Cost of Operating an Automobile, Constant 1987 \$



78

Source: Table 3.15

Table 3.15 Cost of Operating an Automobile in the U.S.

		Current dollars		Average annual change
		1978	1995*	
Cost per mile		\$0.1908	\$0.6970	9.0%
Total Cost	per 10,000 miles	\$1908	\$6970	9.0%
Variable Cost	per mile	\$0.0565	\$0.0979	3.7%
Gas & Oil	per mile	\$0.0389	\$0.0593	2.9%
Maintenance	per mile	\$0.0110	\$0.0282	6.5%
Tires	per mile	\$0.0066	\$0.0103	3.0%
Fixed Cost		\$1343	\$5991	16.1%
Insurance		\$424	\$885	5.0%
License & registration		\$74	\$216	7.4%
Depreciation		\$596	\$3912	13.4%
Finance charge		\$249	\$978	9.5%
		Constant 1987 dollars		Average annual change
		1978	1995*	
Cost per mile		\$0.3324	\$0.4976	2.7%
Total Cost	per 10,000 miles	\$3324	\$4976	2.7%
Variable Cost	per mile	\$0.0984	\$0.0699	-2.3%
Gas & Oil	per mile	\$0.0678	\$0.0423	-3.1%
Maintenance	per mile	\$0.0192	\$0.0201	0.3%
Tires	per mile	\$0.0115	\$0.0074	-2.9%
Fixed Cost		\$2340	\$4277	4.1%
Insurance		\$739	\$632	-1.0%
License & registration		\$129	\$154	1.2%
Depreciation		\$1038	\$2792	6.8%
Finance charge		\$434	\$698	3.2%

Sources:

Statistical Abstract of the United States 1994, U.S. Dept. of Commerce

Notes:

- * estimate
- Consumer Price Index used to update costs to \$ 1987
- Depreciation in 1978 adjusted to reflect 6 yr ownership
- Finance charges in 1978 estimated by regression techniques

Table 3.16 Estimated Automobile Fuel Economy by Vehicle Type, 1995 Model Year

Vehicle Type	Miles Per Gallon (a)			Estimated (b) annual fuel cost		
	City	Highway	Composite	@ \$1.10/gal	@ \$1.30/gal	@ \$1.50/gal
Two seaters						
4 cylinder	24	31	27	\$402	\$475	\$548
6 cylinder	18	24	21	\$529	\$625	\$721
8 cylinder	15	22	19	\$588	\$695	\$802
Minicompact						
4 cylinder	22	29	26	\$431	\$509	\$587
6 cylinder	18	25	21	\$516	\$610	\$704
Subcompact						
4 cylinder	26	34	30	\$364	\$430	\$496
6 cylinder	19	26	22	\$496	\$586	\$676
8 cylinder	15	16	15	\$729	\$862	\$994
Compact						
4 cylinder	25	32	29	\$386	\$456	\$526
6 cylinder	19	26	23	\$487	\$575	\$664
8 cylinder	15	23	19	\$581	\$687	\$792
Midsized						
4 cylinder	22	29	25	\$432	\$510	\$589
6 cylinder	18	27	23	\$484	\$571	\$659
8 cylinder	15	20	18	\$625	\$739	\$852
Large						
6 cylinder	19	27	23	\$481	\$568	\$656
8 cylinder	16	23	19	\$574	\$678	\$782

Source:

1995 Gas Mileage Guide, EPA Fuel Economy Estimates, Department of Energy

Notes:

(a) Miles Per Gallon (MPG) figures are adjusted using the 1988 Residential Transportation Energy Consumption Survey method for on-road MPG. This method provides a more realistic estimation of MPG.

(b) Estimated annual mileage is 10,000

**Table 3.17 Texas Statewide Municipal
Transit Ridership**

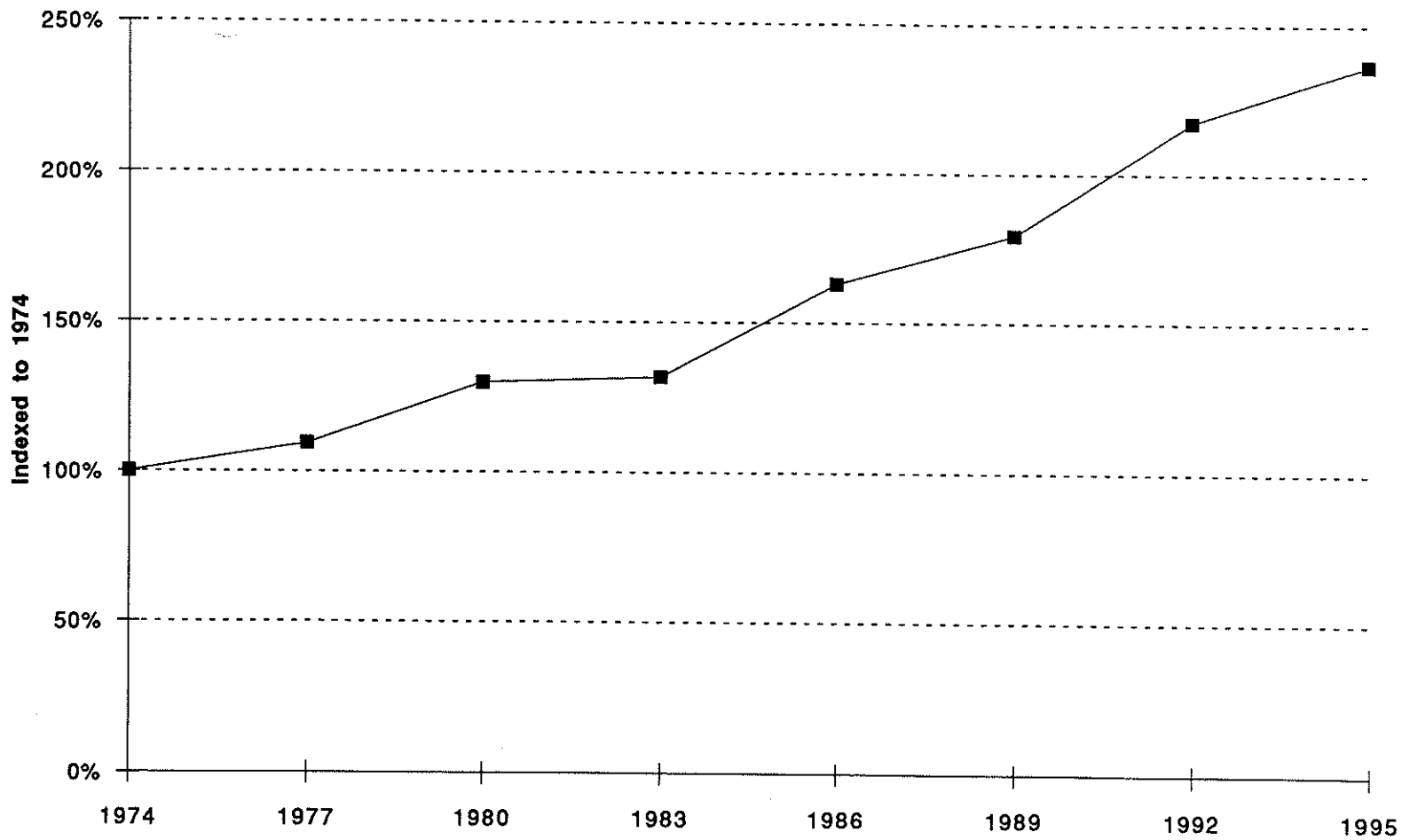
Year	Total passengers	Change from previous year
1974	116,875,657	
1975	120,734,116	3.3%
1976	122,185,246	1.2%
1977	128,108,456	4.8%
1978	136,252,667	6.4%
1979	147,453,986	8.2%
1980	151,815,720	2.9%
1981	154,057,890	1.5%
1982	155,564,891	1.0%
1983	154,045,488	-1.0%
1984	174,434,290	13.2%
1985	196,351,105	12.6%
1986	190,543,830	-3.0%
1987	184,260,622	-3.3%
1988	198,497,042	7.8%
1989	209,708,661	5.6%
1990	232,836,846	11.0%
1991*	243,085,853	4.4%
1992*	254,122,382	4.5%
1993*	264,957,148	4.3%
1994*	276,620,026	4.4%
Average annual change 1974-94		4.0%

Source:

1990 Texas Transit Statistics

State Department of Highways and Public Transportation

Figure 3.12 Texas Municipal Transit Ridership



Source: Table 3.17

Section 3.4

Truck Data

In this final section of chapter 3, truck data is presented. This data covers work trucks which can be described either as single unit trucks or combination trucks. Tables 3.18 and 3.19 present time series data on the fuel economy of single and combination trucks in Texas. Tables 3.20 through 3.22 are concerned with the mileage of work trucks. This mileage is depicted by vehicle size, by vehicle range, and by major usage, respectively. The section ends with Table 3.23 which provides information concerning the type of commodities hauled on Texas highways.

Table 3.18 Estimated Single Unit Truck Fuel Economy in Texas

Year	Registrations	Vehicle miles traveled (Billion)	Miles per gallon	Fuel use (Million gallons)
1973	1,829,086	18.0	9.24	1,954.1
1974	1,934,922	17.4	9.31	1,865.6
1975	2,044,865	18.2	9.34	1,945.4
1976	2,235,011	20.9	9.51	2,203.0
1977	2,365,166	22.2	9.53	2,331.8
1978	2,637,433	24.4	9.72	2,510.2
1979	2,631,809	24.2	9.41	2,568.3
1980	2,815,288	28.3	10.85	2,613.8
1981	3,071,614	33.9	11.76	2,880.9
1982	3,245,371	31.8	10.86	2,929.0
1983	3,354,713	32.6	11.73	2,774.2
1984	3,558,760	36.1	11.53	3,134.1
1985	3,696,672	37.1	11.17	3,321.5
1986	3,727,891	42.1	11.32	3,716.5
1987	3,721,451	43.6	11.53	3,785.8
1988	3,764,104	45.0	11.94	3,768.8
1989	3,820,503	46.4	12.50	3,714.2
1990	3,899,879	47.3	12.74	3,714.3
1991	3,850,408	47.0	12.75	3,683.5
1992	3,895,054	47.1	12.64	3,725.2
1993	4,043,188	49.4	12.81	3,853.3
1994*	4,206,767	51.9	13.02	3,986.5
1995*	4,376,963	54.6	13.24	4,124.0
Period:		Average annual changes		
1973-95	4.0%	5.2%	1.6%	3.5%
1985-95	1.7%	3.9%	1.7%	2.2%

Source:

Highway Statistics, Federal Highway Administration, 1970 and annual;
Texas Transportation Institute estimates

Notes:

* estimated

• Single unit trucks include both small and large pickups, and utility vans.

Table 3.19 Estimated Combination Truck Fuel Economy in Texas

Year	Registrations	Vehicle miles traveled (Billion)	Miles per gallon	Fuel use (Million gallons)
1973	80,219	3.7	5.20	720.9
1974	84,796	4.4	5.16	848.3
1975	104,810	5.1	5.31	970.2
1976	116,559	5.6	5.13	1,097.7
1977	120,229	6.0	5.10	1,183.3
1978	133,451	6.6	5.19	1,267.8
1979	126,373	6.3	4.93	1,272.0
1980	143,180	6.1	5.37	1,137.7
1981	155,455	7.3	5.46	1,338.3
1982	111,175	5.6	5.07	1,106.1
1983	127,912	7.4	4.90	1,507.6
1984	143,884	8.8	5.34	1,654.1
1985	131,208	7.9	5.17	1,532.6
1986	123,385	7.3	5.01	1,455.2
1987	119,655	7.3	5.08	1,432.8
1988	126,290	7.7	5.13	1,503.0
1989	122,371	7.4	5.30	1,389.3
1990	124,496	7.5	5.44	1,372.7
1991	118,289	7.1	5.43	1,316.8
1992	119,962	7.2	5.38	1,333.7
1993	128,784	7.7	5.45	1,405.4
1994*	131,869	7.9	5.47	1,452.9
1995*	135,027	8.2	5.48	1,502.6
Period:	Average annual changes			
1973-95	2.4%	3.6%	0.2%	3.4%
1985-95	0.3%	0.4%	0.6%	-0.2%

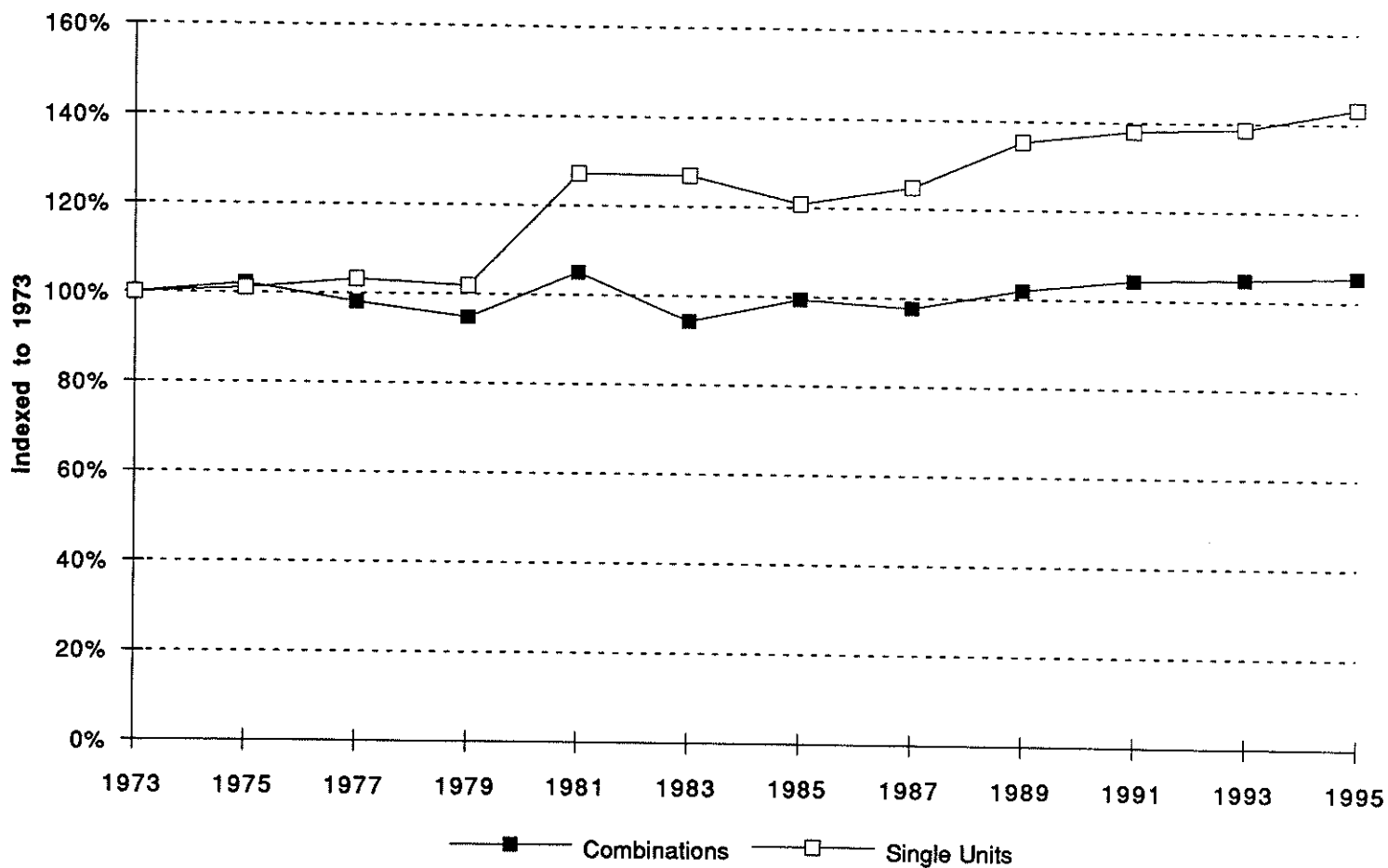
Source:

Highway Statistics, Federal Highway Administration, 1970 and annual;
Texas Transportation Institute estimates

Notes:

* estimate

Figure 3.13 MPG for Trucks Operating in Texas



Source: Table 3.18 and 3.19

Table 3.20 Texas Truck Mileage by Vehicle Size

Year	Light Trucks		Medium Trucks		Light-Heavy		Heavy-Heavy	
	Percent of total trucks	Avg. annual miles per truck	Percent of total trucks	Avg. annual miles per truck	Percent of total trucks	Avg. annual miles per truck	Percent of total trucks	Avg. annual miles per truck
1977	89.8%	12,000	4.4%	13,500	1.5%	13,000	4.2%	45,900
1982	90.9%	12,200	3.6%	13,200	1.4%	15,100	4.1%	45,300
1987	94.3%	12,300	1.7%	12,900	0.9%	11,400	3.1%	42,000
1992	95.6%	12,600	1.1%	11,000	0.7%	11,100	2.5%	41,100
1995*	96.8%	12,700	0.8%	10,600	0.6%	10,800	2.2%	40,200
Period:		Average annual changes						
1977-95		0.3%	-1.3%		-1.0%		-0.7%	
1987-95		0.4%	-2.4%		-0.7%		-0.5%	

Source:

Truck Inventory and Use Survey, 1977, 1982, 1987, and 1992 U.S. Department of Commerce, Bureau of Census

Notes:

- * estimate
- Light: GVW ≤ 10,000 lbs.
- Medium: 10,001 ≤ GVW ≤ 19,500
- Light-Heavy: 19,501 ≤ GVW ≤ 26,000
- Heavy-Heavy: GVW ≥ 26,001

Table 3.21 Texas Truck Mileage by Vehicle Range

Year	Local		Short Range		Long Range		Off-Road	
	Percent of total trucks	Avg. annual miles per truck	Percent of total trucks	Avg. annual miles per truck	Percent of total trucks	Avg. annual miles per truck	Percent of total trucks	Avg. annual miles per truck
1977	83.4%	11,500	9.8%	23,400	2.1%	51,600	4.6%	10,700
1982	67.1%	12,400	14.6%	19,200	3.4%	34,400	14.9%	9,100
1987	71.7%	12,000	17.8%	17,200	4.8%	24,600	5.6%	7,000
1992	70.5%	11,400	17.0%	20,300	4.4%	25,300	8.1%	10,400
1995*	68.2%	11,400	19.0%	19,700	5.1%	21,900	9.1%	10,300
Period:		Average annual changes						
1977-95		-0.05%		-0.95%		-4.65%		-0.21%
1987-95		-0.64%		1.71%		-1.44%		4.95%

Source:

Truck Inventory and Use Survey, 1977, 1982, 1987, and 1992 U.S. Department of Commerce, Bureau of Census

Notes:

The term truck includes pickups, utility vehicles

Local: Trucks used mostly in local area

Short range: Trucks used beyond local area but on trips (one-way) less than 200 miles.

Long range: Trucks used over-the-road on trips (one-way) more than 200 miles.

Off-road: Trucks engaged primarily in off-road use, usually associated with construction and farming.

* Estimate

Table 3.22 Texas Truck Mileage by Major Use

Major Use	1977		1995*		Period: 1977-95 Average annual mileage changes
	Percent of total trucks	Avg. annual miles per truck	Percent of total trucks	Avg. annual miles per truck	
	Personal transportation	56.0%	10,800	72.5%	12,000
Agriculture	18.2%	11,100	5.5%	9,100	-1.1%
Construction	6.0%	19,200	8.4%	21,100	0.5%
Manufacturing	1.8%	28,100	2.6%	23,500	-1.0%
Retail trade	3.6%	16,900	3.3%	17,700	0.3%
Wholesale trade	3.7%	25,800	1.2%	18,900	-1.7%
For Hire	1.9%	42,700	1.0%	52,100	1.1%
Utilities	2.1%	14,200	0.8%	11,800	-1.0%
For Service	5.1%	15,300	4.1%	15,000	-0.1%
Mining and quarrying	0.8%	21,700	0.8%	19,700	-0.5%
Forestry and lumbering	0.4%	23,800	0.5%	23,800	0.0%
Daily rental	0.3%	37,100	0.6%	25,400	-2.1%

Source:

Truck Inventory and Use Survey 1977, 1987, and 1992 U.S. Department of Commerce, Bureau of Census

Notes:

* estimate

Table 3.23 Estimated Commodities Shipped In Texas Via Texas Highways, 1993

Commodity group	Contents	Estimated annual tons shipped (millions)	Percent of total
Agricultural & Related Products	Farm products, forest products, marine products, leather products	42.7	15.0%
Hazardous Materials	Crude oil, natural gas, motor gasoline, ordnance & accessories, chemicals & allied products, petroleum & coal products, waste & scrap materials	57.0	20.0%
Construction supplies	Metallic ore, coal, non-metallic minerals (except fuels), sand & gravel, lumber & wood products (except furniture), stone, clay, glass, concrete products	114.0	40.0%
Food & Related Products	Food & kindred products, tobacco products	28.5	10.0%
Manufacturing Products	Textiles, apparel, furniture & fixtures, pulp, paper & allied products, rubber, metal products, transportation equipment, instruments, photographic & medical goods, watches, misc. products of mfg.	14.2	5.0%
Machinery & Equipment	All machinery (mechanical & electrical), equipment & supplies	14.2	5.0%
Mixed Freight Shipments	Miscellaneous freight shipments, empty shipping containers, mail & express traffic, freight forwarder traffic, small packaged freight	14.2	5.0%

Source:

Commodity Movements on Texas Highways, Texas Transportation Institute, Project 1104, 1992, preliminary findings; TTI estimates for 1993

CHAPTER 4

TEXAS NON-HIGHWAY MODE CHARACTERISTICS

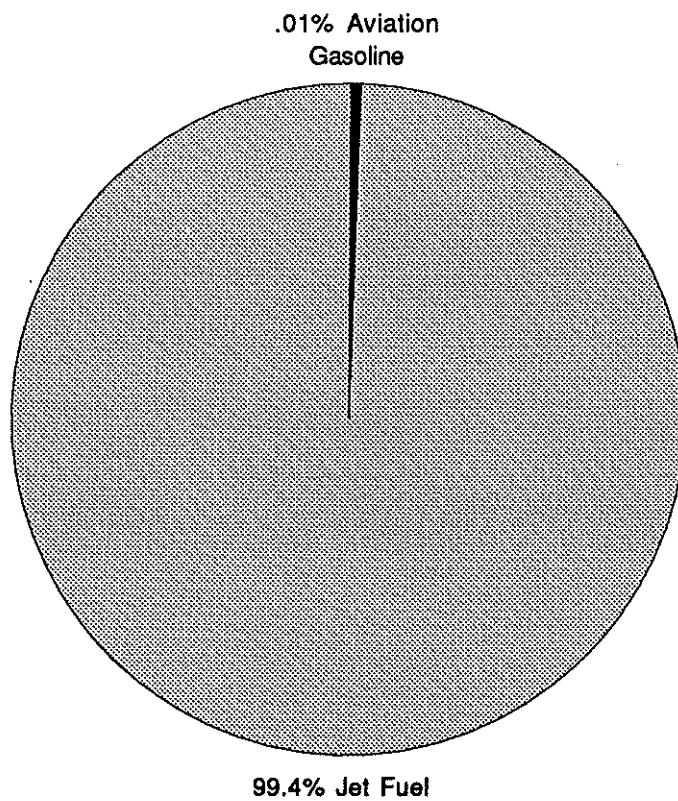
Chapter 4 provides detailed information about the energy related characteristics of the non-highway modes of travel and freight movement in Texas. Section 4.1 is concerned with the State's air mode. Section 4.2 concentrates on waterborne transportation energy characteristics in Texas. This section focuses on the Galveston District and the Gulf Intracoastal Waterway. Section 4.3 pertains to pipeline data. Finally, section 4.4 provides statistics on the rail industry.

Section 4.1

Air Mode

This section presents characteristics of the air mode in Texas. It contains information on energy consumption by fuel type, travel data for domestic and international route certificated carriers operating in Texas, enplanements and energy use for selected Texas cities, air freight data and statistics related to general aviation.

Figure 4.1 Texas Air Mode Energy use by Fuel Type, 1995



Source: Table 4.1

**Table 4.1 Air Mode Energy Consumption
by Fuel Type**

Trillion Btu			
Year	Aviation Gas	Jet Fuel	Total
1973	7.9	110.8	118.7
1974	8.2	106.5	114.6
1975	6.7	116.5	123.2
1976	6.5	109.0	115.5
1977	6.9	113.4	120.3
1978	6.5	123.7	130.2
1979	6.0	132.1	138.1
1980	6.4	138.2	144.6
1981	6.6	141.5	148.1
1982	4.6	206.7	211.3
1983	3.9	233.6	237.5
1984	4.9	330.7	335.6
1985	6.7	390.9	397.6
1986	7.8	424.4	432.2
1987	5.8	447.7	453.6
1988	5.1	504.6	509.8
1989	4.2	497.7	501.8
1990	4.3	517.3	521.6
1991	3.3	493.1	496.5
1992	4.0	488.4	492.4
1993	3.8	523.1	526.9
1994*	3.6	560.0	563.7
1995*	3.5	599.4	602.9

Average annual changes

Time Period:

1973-95	-3.6%	8.0%	7.7%
1985-95	-6.2%	4.4%	4.3%

Sources:

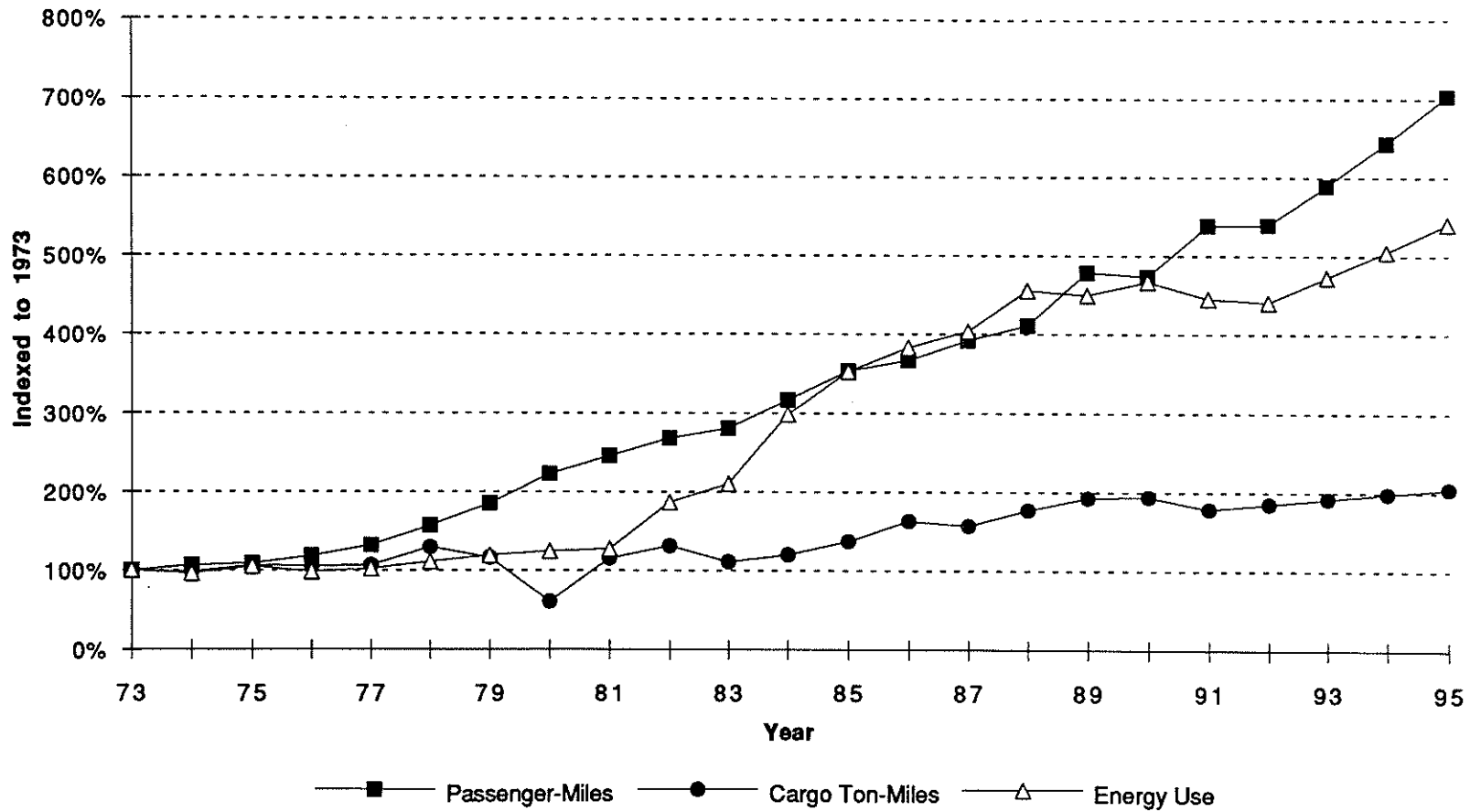
State Energy Data Report, Energy Information Administration; Energy Information Administration unpublished fuel time series.

Notes:

* estimate

Figure 4.2 Passenger-Miles, Cargo Ton-Miles, & Energy Use in Texas for Certified Route Air Carriers

96



Source: Table 4.2

Table 4.2 Summary Statistics for Domestic and International Route Air Carriers Operating in Texas

Year	Number of departures	Total enplanements (millions)	Revenue aircraft miles (millions)	Average passenger trip length (mi)	Revenue passenger-miles (millions)	Revenue cargo ton-mi (millions)	Texas energy	
							Use (trillion Btu)	As percentage of U.S. Air mode(a)
1973	280,919	12.2	145.3	716	8,759.5	308.8	110.8	7.7%
1974	278,625	13.2	149.7	708	9,358.6	305.0	106.5	8.3%
1975	267,289	13.2	144.1	722	9,519.4	328.7	116.5	9.1%
1976	276,075	14.5	150.5	718	10,404.0	324.5	109.0	8.2%
1977	289,827	15.9	159.7	728	11,547.4	329.9	113.4	8.2%
1978	302,640	18.2	173.2	753	13,732.5	401.3	123.7	8.6%
1979	341,285	21.5	194.5	754	16,245.5	359.1	132.1	8.6%
1980	404,094	25.3	249.2	773	19,554.3	188.3	138.2	9.3%
1981	428,672	27.4	259.4	785	21,560.2	357.6	141.5	9.9%
1982	447,168	29.5	281.7	796	23,517.4	405.6	206.7	14.7%
1983	456,499	30.9	283.0	796	24,572.1	342.6	233.6	16.2%
1984	518,904	35.1	332.7	791	27,781.6	369.8	330.7	20.6%
1985	529,643	38.9	352.6	795	30,917.4	424.3	390.9	23.0%
1986	538,352	40.0	369.4	804	32,143.3	504.5	424.4	23.0%
1987	565,895	41.5	387.6	827	34,309.8	484.0	447.7	23.0%
1988	575,294	42.7	408.2	844	35,989.6	547.1	504.6	24.6%
1989	588,499	45.3	473.4	838	41,882.3	595.8	497.7	23.8%
1990	617,284	43.3	472.1	851	41,445.6	600.0	517.3	23.6%
1991	610,963	45.8	526.3	855	47,175.1	551.6	493.1	23.8%
1992	630,739	48.9	516.2	857	47,248.5	572.1	488.4	23.1%
1993*	658,169	52.6	552.0	866	51,596.9	593.2	523.1	24.3%
1994*	686,792	56.6	590.4	874	56,380.7	612.9	560.0	25.5%
1995*	716,660	60.9	631.4	883	61,608.1	633.2	599.4	26.7%
Period:				Average annual changes				
1973-95	4.3%	7.6%	6.9%	1.0%	9.3%	3.3%	8.0%	-
1985-95	3.1%	4.6%	6.0%	1.1%	7.1%	4.1%	4.4%	-

Source:

FAA Statistical Handbook of Aviation, annual issues

Notes:

* estimate

(a) Refers to U.S. Domestic & International Certificated Air Carriers

Table 4.3 Enplanements and Estimated Energy Use for Selected Texas Cities

Year	Dallas/Ft. Worth		Houston		San Antonio		El Paso	
	Enplanements (in millions)	Est. Btu Use (tril.)	Enplanements (in millions)	Est. Btu Use (tril.)	Enplanements (in millions)	Est. Btu Use (tril.)	Enplanements (in millions)	Est. Btu Use (tril.)
1973	6.6	58.2	2.8	25.3	1.0	9.7	0.5	4.3
1974	7.0	54.9	2.9	23.3	0.9	7.9	0.6	4.6
1975	7.2	62.0	3.0	26.4	0.9	8.5	0.6	5.1
1976	7.8	57.3	3.2	23.6	0.9	6.9	0.6	4.3
1977	8.2	57.3	3.5	24.5	0.9	6.7	0.6	4.1
1978	9.7	65.0	4.7	31.2	1.1	7.9	0.8	5.2
1979	11.5	70.4	5.6	33.4	1.3	8.4	0.9	5.2
1980	12.8	69.1	6.8	36.6	1.6	9.0	0.9	4.7
1981	13.9	70.8	7.5	38.5	1.7	9.2	1.0	4.9
1982	14.7	102.7	8.5	59.7	1.6	10.7	1.0	6.7
1983	15.7	119.0	8.5	65.1	1.8	13.0	1.0	7.2
1984	18.5	172.9	9.2	88.7	2.0	18.1	1.1	10.0
1985	20.9	209.9	10.0	103.4	2.1	20.0	1.2	11.4
1986	21.8	229.8	10.3	114.3	2.2	22.1	1.2	12.0
1987	22.4	240.9	10.9	122.3	2.4	24.3	1.3	13.1
1988	23.5	276.7	10.7	132.9	2.4	26.5	1.4	15.5
1989	25.4	282.6	10.9	127.8	2.5	25.8	1.7	17.5
1990	25.8	308.3	11.5	137.4	2.6	31.1	1.7	20.3
1991	25.4	289.3	11.6	132.1	2.5	28.5	1.7	19.4
1992	27.3	307.9	12.3	138.7	2.6	29.3	1.7	19.2
1993*	29.4	355.4	13.3	160.6	2.7	33.0	1.8	21.9
1994*	31.7	410.0	14.4	185.9	2.9	37.2	1.9	25.0
1995*	34.2	472.9	15.5	215.1	3.0	41.9	2.1	28.5
Average annual changes								
1973-95	7.8%	10.0%	8.1%	10.2%	5.2%	6.9%	6.7%	9.0%
1985-95	5.0%	8.5%	4.5%	7.6%	3.7%	7.7%	5.6%	9.6%

Source:

FAA Statistical Handbook of Aviation, annual issues

Note:

* estimated

Table 4.4 Air Freight for Selected Texas Cities

Year	Dallas/Ft. Worth		Houston		San Antonio		El Paso	
	in tons		in tons		in tons		in tons	
	Mail	Freight	Mail	Freight	Mail	Freight	Mail	Freight
1973	33,400	82,608	10,835	35,313	4,301	6,541	1,444	4,867
1974	34,681	76,034	11,508	40,880	4,110	5,415	1,471	5,466
1975	34,457	70,284	11,616	39,786	4,068	4,492	1,479	5,606
1976	39,502	84,218	14,399	36,608	4,091	4,497	1,611	6,352
1977	41,405	94,665	14,847	41,986	4,202	5,322	1,688	7,776
1978	42,240	98,316	15,911	54,710	4,126	6,459	1,754	8,048
1979	43,018	98,315	16,679	52,632	4,301	6,166	1,911	9,318
1980	46,582	92,609	16,399	46,849	4,671	5,433	1,921	6,377
1981	48,765	84,448	16,246	42,660	4,473	4,838	1,666	6,225
1982	52,918	89,691	17,607	48,193	5,168	4,082	1,621	5,393
1983	58,205	78,821	16,549	38,218	4,923	3,326	1,348	3,621
1984	66,651	93,118	16,946	36,661	5,693	3,237	1,292	2,198
1985	54,767	92,307	23,088	56,676	6,143	2,386	1,323	2,642
1986	61,927	109,310	24,028	80,504	6,993	6,789	1,383	3,094
1987	71,908	106,951	22,949	50,853	7,146	7,942	1,349	3,796
1988	75,505	136,241	25,669	52,757	6,950	8,165	1,347	4,338
1989	76,930	140,077	23,038	60,023	7,057	8,793	1,234	4,284
1990	86,950	144,879	21,866	66,413	7,585	10,050	1,760	4,825
1991	86,645	141,303	19,383	75,432	7,120	11,265	1,601	5,757
1992	97,313	154,442	21,736	77,470	8,591	12,298	1,927	5,986
1993*	102,947	159,613	22,547	80,740	8,910	12,714	1,956	6,052
1994*	108,907	164,957	23,389	84,149	9,240	13,143	1,986	6,118
1995*	115,213	170,480	24,262	87,702	9,583	13,587	2,017	6,185
Average annual changes								
1973-95	5.8%	3.3%	3.7%	4.2%	3.7%	3.4%	1.5%	1.1%
1985-95	7.7%	6.3%	0.5%	4.5%	4.5%	19.0%	4.3%	8.9%

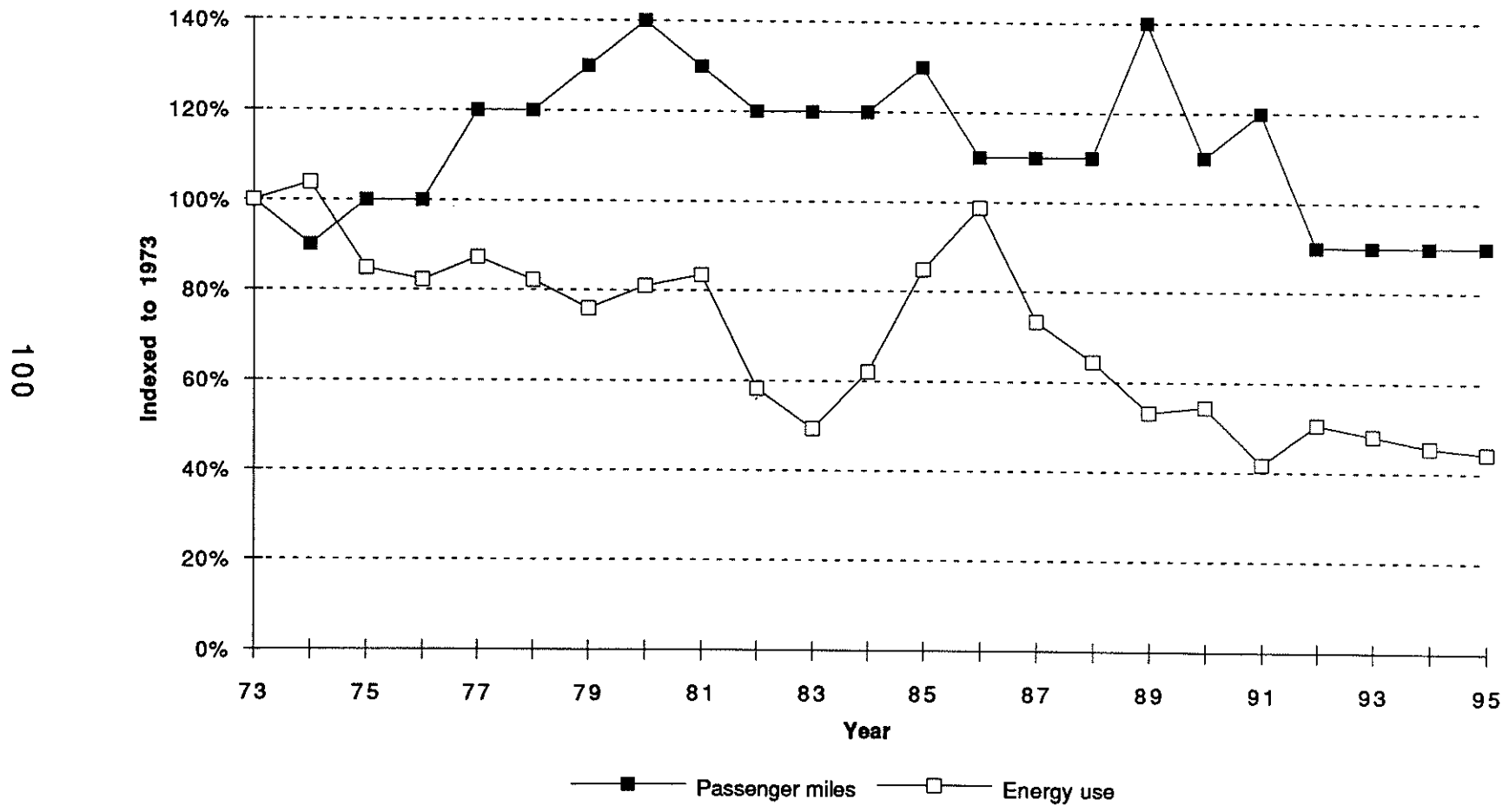
Source:

FAA Statistical Handbook of Aviation, annual issues

Notes:

* estimate

Figure 4.3 Passenger-Miles & Energy Use for General Aviation in Texas



Source: Table 4.5

Table 4.5 Summary Statistics for General Aviation in Texas

Year	Estimated active Gen. Aviation aircraft	As % of U.S.	Estimated hours flown (000)	Btu per hr flown (millions)	Estimated intercity passenger-m (billions)	Btu per passenger-mi	Btu used (trillions)
1973	13,028	8.8%	2,553	3.1	1.0	8,280	7.9
1974	11,858	7.3%	2,383	3.4	0.9	9,089	8.2
1975	12,603	7.5%	2,558	2.6	1.0	6,930	6.7
1976	13,479	7.6%	2,736	2.4	1.0	6,235	6.5
1977	16,050	8.7%	3,258	2.1	1.2	5,589	6.9
1978	14,355	7.2%	3,108	2.1	1.2	5,465	6.5
1979	15,231	7.2%	3,397	1.8	1.3	4,591	6.0
1980	18,674	8.9%	3,842	1.7	1.4	4,665	6.4
1981	19,481	9.1%	3,753	1.8	1.3	4,912	6.6
1982	19,153	9.1%	3,275	1.4	1.2	3,896	4.6
1983	20,414	9.6%	3,061	1.3	1.2	3,211	3.9
1984	19,941	9.0%	3,405	1.4	1.2	3,989	4.9
1985	19,887	9.4%	3,270	2.0	1.3	5,228	6.7
1986	19,961	9.1%	2,928	2.7	1.1	6,837	7.8
1987	18,358	8.5%	2,859	2.0	1.1	5,214	5.8
1988	17,424	8.3%	2,771	1.9	1.1	4,581	5.1
1989	18,321	8.3%	3,350	1.2	1.4	3,066	4.2
1990	16,655	7.8%	2,725	1.6	1.1	3,854	4.3
1991	16,206	8.2%	2,856	1.2	1.2	2,779	3.3
1992	14,787	8.0%	1,952	2.0	0.9	4,450	4.0
1993*	14,886	8.0%	1,925	2.0	0.9	4,241	3.8
1994*	14,985	7.9%	1,898	1.9	0.9	4,031	3.6
1995*	15,086	7.9%	1,871	1.9	0.9	3,931	3.5
Average annual changes							
1973-95	0.7%	-0.5%	-1.4%	-2.3%	-0.3%	-3.3%	-3.6%
1985-95	-2.7%	-1.8%	-5.4%	-0.9%	-3.6%	-2.8%	-6.3%

Source:

FAA Statistical Handbook of Aviation, annual issues

Notes:

* estimate

Table 4.6 Distribution of General Aviation Aircraft in Texas

Year	Estimated active Gen. Aviation aircraft	Fixed wing distribution			Non-fixed wing distribution	
		Piston	Turboprop	Turbojet	Rotary wing	Other
1974*	11,858	91.9%	2.2%	1.8%	3.2%	1.0%
1975*	12,603	91.4%	2.4%	1.9%	3.4%	1.0%
1976*	13,479	91.3%	2.3%	1.9%	3.5%	1.1%
1977*	16,050	90.7%	2.5%	2.0%	3.6%	1.3%
1978*	14,355	90.5%	2.5%	2.0%	3.7%	1.4%
1979	15,231	90.5%	2.4%	1.9%	3.3%	1.9%
1980	18,674	89.6%	2.8%	2.1%	3.5%	2.0%
1981	19,481	88.1%	3.3%	2.5%	4.0%	2.1%
1982	19,153	87.5%	3.4%	2.8%	4.3%	2.0%
1983	20,414	87.4%	3.3%	2.8%	4.2%	2.3%
1984	19,941	87.1%	3.5%	2.9%	4.2%	2.3%
1985	19,887	86.9%	3.4%	3.0%	4.2%	2.5%
1986	19,961	87.1%	3.2%	3.0%	4.2%	2.5%
1987	18,358	87.6%	2.9%	2.5%	4.3%	2.7%
1988	17,424	88.3%	2.5%	2.3%	3.9%	3.0%
1989	18,321	88.2%	2.9%	2.0%	3.4%	3.5%
1990	16,655	88.5%	2.7%	2.1%	3.5%	3.2%
1991	16,206	88.3%	2.5%	2.2%	3.2%	3.8%
1992	14,787	87.9%	2.6%	2.2%	3.1%	4.2%
1993*	14,886	87.7%	2.6%	2.2%	3.1%	4.3%
1994*	14,985	87.5%	2.6%	2.3%	3.1%	4.5%
1995*	15,086	87.3%	2.7%	2.3%	3.2%	4.6%

Source:

FAA Statistical Handbook, annual issues

Notes:

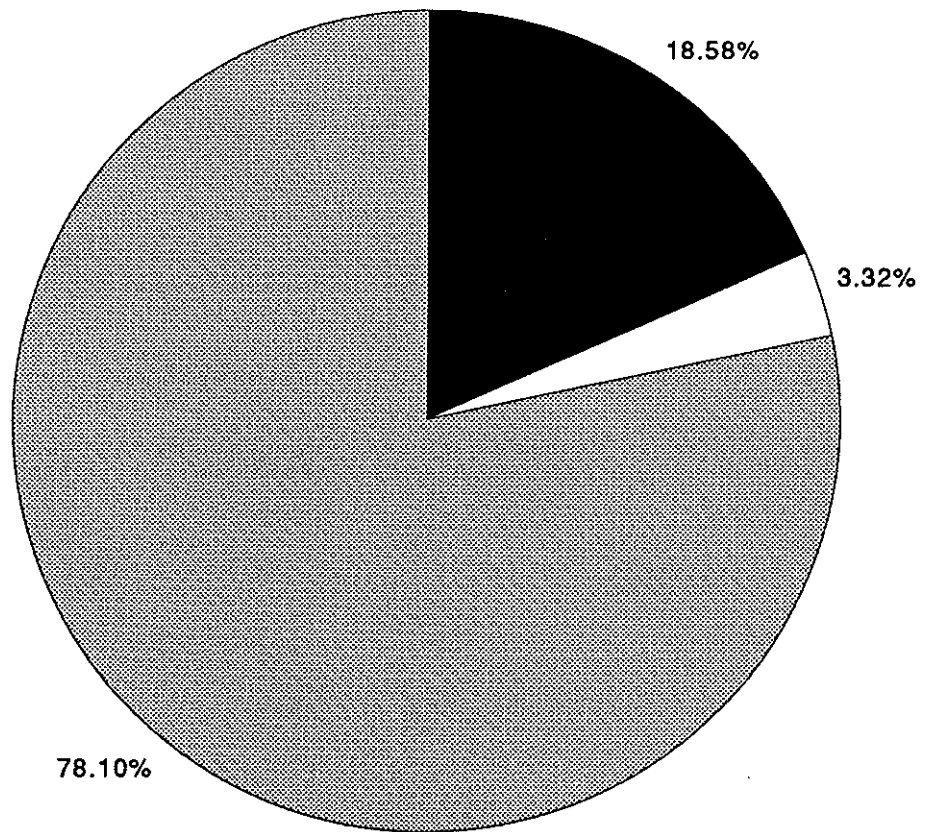
* estimate

Section 4.2

Water Mode

This section presents characteristics of the water mode in Texas. It contains information on energy consumption by fuel type and summary statistics for the Galveston district and the Gulf Intracoastal Waterway (GIWW) on the Texas coast. The type of commodities shipped via Texas waterways and the annual amount are also included in this section.

Figure 4.4 Water Mode Energy use by Fuel Type, 1995



■ Distillate Fuel □ Motor Gas ▨ Residual Fuel

Source: Table 4.7

**Table 4.7 Water Mode Energy Consumption
by Fuel Type**

Trillion Btu				
Year	Distillate Fuel	Motor Gas	Residual Fuel	Total
1973	24.4	6.7	94.7	125.8
1974	22.0	6.9	127.6	156.5
1975	25.0	7.5	144.7	177.2
1976	28.5	7.3	156.3	192.1
1977	36.3	6.8	188.1	231.2
1978	36.2	7.8	214.8	258.8
1979	40.7	7.9	309.2	357.7
1980	33.9	7.7	283.5	325.2
1981	64.1	7.8	223.8	295.7
1982	48.7	7.9	191.3	247.9
1983	21.7	7.7	157.4	186.7
1984	21.3	10.6	153.8	185.7
1985	26.1	8.5	136.6	171.2
1986	41.8	8.6	161.4	211.8
1987	48.2	8.8	123.5	180.4
1988	38.3	9.1	139.2	186.6
1989	45.0	8.9	164.7	218.6
1990	31.5	8.8	165.8	206.1
1991	32.5	11.7	171.8	215.9
1992	45.3	8.7	189.1	243.1
1993	47.1	9.0	196.7	252.9
1994*	49.6	9.2	207.1	265.8
1995*	52.0	9.3	218.6	279.9
Average annual changes				
Period:				
1973-95	3.5%	1.5%	3.9%	3.7%
1985-95	7.2%	0.9%	4.8%	5.0%

Sources:

State Energy Data Report, Energy Information Administration; Energy Information Administration unpublished fuel time series.

Notes:

* estimate

Table 4.8 Summary Statistics for Domestic Waterborne Traffic in Texas

Year	Estimated tons shipped (millions)	Estimated ton-miles (millions)	Estimated avg. length of haul (miles)	Estimated energy intensity (Btu/ton-mi)	Estimated energy use (trillion Btu)
1973	275.4	12318.5	44.7	599	7.4
1974	289.9	12846.7	44.3	503	6.5
1975	280.3	11742.3	41.9	571	6.7
1976	318.0	13069.9	41.1	487	6.4
1977	361.9	14696.3	40.6	476	7.0
1978	382.9	15319.8	40.0	398	6.1
1979	395.7	16223.6	41.0	475	7.7
1980	356.7	14111.5	39.6	372	5.2
1981	352.5	14166.1	40.2	374	5.3
1982	305.3	12355.1	40.5	323	4.0
1983	303.6	12738.6	42.0	332	4.2
1984	359.9	13389.9	37.2	360	4.8
1985	343.1	12845.4	37.4	464	6.0
1986	374.0	14044.2	37.6	481	6.8
1987	394.9	15605.0	39.5	431	6.7
1988	442.6	17618.5	39.8	375	6.6
1989	449.9	17788.9	39.5	419	7.5
1990	452.1	17921.1	39.6	403	7.2
1991	439.7	17016.9	38.7	421	7.2
1992	453.1	17441.2	38.5	420	7.3
1993	470.0	17844.2	38.0	404	7.2
1994*	483.1	18150.0	37.6	396	7.2
1995*	496.6	18541.5	37.3	388	7.2
Average annual changes					
1973-95	2.7%	1.9%	-0.8%	-2.0%	-0.1%
1985-95	3.8%	3.7%	0.0%	-1.8%	1.9%

Sources:

Waterborne Commerce of the United States, annual, Department of the Army, Corps of Engineers; Communications with Texas Transportation Institute's Marine Advisory Panel, and maritime industry carriers for Btu per ton-mile estimates
Transportation Energy Data Book, Edition 14, Oak Ridge National Laboratory, 1994

Notes:

* estimate

Table 4.9 Summary Statistics for Galveston District

Year	Estimated tons shipped (millions)	Estimated ton-miles (millions)	Estimated avg. length of haul (miles)	Estimated energy intensity (Btu/ton-mi)	Estimated energy use (trillion Btu)
1973	212.4	7295.6	34.3	599	4.4
1974	223.8	7483.7	33.4	503	3.8
1975	221.0	7166.2	32.4	571	4.1
1976	256.0	8386.5	32.8	487	4.1
1977	295.6	9551.1	32.3	476	4.5
1978	316.7	10237.6	32.3	398	4.1
1979	327.9	10741.9	32.8	475	5.1
1980	291.2	8835.3	30.3	372	3.3
1981	284.5	8734.9	30.7	374	3.3
1982	245.5	7714.4	31.4	323	2.5
1983	242.4	7559.8	31.2	332	2.5
1984	293.2	7851.5	26.8	360	2.8
1985	275.5	7140.9	25.9	464	3.3
1986	301.0	7878.6	26.2	481	3.8
1987	323.0	9615.2	29.8	431	4.1
1988	361.0	10547.2	29.2	375	4.0
1989	368.4	10728.7	29.1	419	4.5
1990	369.7	10760.6	29.1	403	4.3
1991	364.2	10625.7	29.2	421	4.5
1992	376.5	10927.4	29.0	420	4.6
1993	394.4	11366.4	28.8	404	4.6
1994*	406.8	11670.5	28.7	396	4.6
1995*	419.6	11984.1	28.6	388	4.7
Average annual changes					
1973-95	3.1%	2.3%	-0.8%	-2.0%	0.3%
1985-95	4.3%	5.3%	1.0%	-1.8%	3.5%

Sources:

Waterborne Commerce of the United States, annual, Department of the Army, Corps of Engineers Communications with Texas Transportation Institute's Marine Advisory Panel, and maritime industry carriers for Btu per ton-mile estimates
 Transportation Energy Data Book, Edition 14, Oak Ridge National Laboratory, 1994

Notes:

* Estimate

Table 4.10 Summary Statistics for Texas Gulf Intracoastal Waterway

Year	Estimated tons shipped (millions)	Estimated ton-miles (millions)	Estimated avg. length of haul (miles)	Estimated energy intensity (Btu/ton-mi)	Estimated energy use (trillion Btu)
1973	63.0	5022.9	79.7	599	3.0
1974	66.1	5363.0	81.1	503	2.7
1975	59.3	4576.1	77.2	571	2.6
1976	62.0	4683.4	75.5	487	2.3
1977	66.3	5145.2	77.6	476	2.5
1978	66.2	5082.2	76.8	398	2.0
1979	67.8	5481.7	80.9	475	2.6
1980	65.5	5276.2	80.6	372	2.0
1981	68.0	5431.2	79.9	374	2.0
1982	59.8	4640.7	77.6	323	1.5
1983	61.2	5178.8	84.6	332	1.7
1984	66.7	5538.4	83.0	360	2.0
1985	67.6	5704.5	84.4	464	2.6
1986	73.0	6165.6	84.5	481	3.0
1987	71.9	5989.8	83.3	431	2.6
1988	81.6	7071.3	86.7	375	2.7
1989	81.5	7060.1	86.6	419	3.0
1990	82.4	7160.5	86.9	403	2.9
1991	75.5	6391.2	84.7	421	2.7
1992	76.6	6513.8	85.0	420	2.7
1993	75.6	6477.8	85.7	404	2.6
1994*	76.3	6479.5	84.9	396	2.6
1995*	77.0	6557.4	85.2	388	2.5
Average annual changes					
1973-93	1.3%	1.8%	0.5%	-1.9%	-0.1%
1983-93	1.3%	1.4%	0.1%	-1.8%	-0.4%

Source:

Waterborne Commerce of the United States, annual, Dept. of the Army, Corps of Engineers;
 Communications with Texas Transportation Institute's Marine Advisory Panel,
 and industry marine carriers for Btu per ton-mile estimates
 Transportation Energy Data Book, Edition 14, Oak Ridge National Laboratory, 1994

Notes:

* estimate

Table 4.11 Estimated Commodities Shipped by Water in Texas, 1995

Commodity Group	Galveston	Texas GIWW (Thousand tons)	GIWW	Total (Thousand tons)	Commodity
	District (Thousand tons)		percent of total		percent of total
Coal	748	395	34.6%	1,143	0.2%
Petroleum & Petroleum Products	287,048	40,922	12.5%	327,970	66.0%
Chemical & Related Products	74,155	24,238	24.6%	98,393	19.8%
Crude Materials except fuels	22,608	6,242	21.6%	28,850	5.8%
Primary Manufactured Goods	7,363	1,782	19.5%	9,145	1.8%
Food and Farm Products	23,611	1,656	6.6%	25,267	5.1%
Machinery	2,293	220	8.8%	2,513	0.5%
Waste and Scrap	1,686	1,546	47.8%	3,232	0.7%
Unknown or not classified	88	0	0.0%	88	0.0%
Total	419,600	77,000	15.5%	496,600	

Source:

Waterborne Commerce of the United States, 1993, Department of the Army, Corps of Engineers
TTI estimates for 1995

Section 4.3

Pipeline Mode

This section presents Table 4.7 which is a time series of the shipments of energy in Texas. The table contains: domestic natural gas consumption data, crude and refined petroleum products transported, and the energy consumed

Table 4.12 Texas Pipeline Shipments of Energy

Year	Domestic natural gas consumption (billion cubic feet)	Total petroleum transported		Crude petroleum (billion ton-mi)	Refined petroleum products (billion ton-mi)	Energy use (trillion Btu)
		(million tons)	(billion ton-mi)			
1973	2,520	104.2	58.0	34.5	23.4	107.7
1974	2,340	96.9	55.8	33.4	22.4	96.8
1975	2,116	95.2	54.9	31.2	23.7	84.6
1976	1,971	92.3	50.9	29.9	20.9	74.0
1977	1,835	92.7	51.3	30.7	20.6	68.4
1978	2,225	111.3	66.4	40.8	25.6	77.1
1979	2,046	98.9	61.5	37.6	23.9	80.2
1980	2,563	123.9	75.8	46.8	29.1	108.1
1981	2,405	116.9	69.9	41.3	28.6	105.1
1982	2,389	127.9	75.1	44.5	30.7	106.0
1983	2,685	156.8	88.7	53.0	35.7	109.2
1984	2,773	155.6	87.8	51.4	36.3	112.2
1985	2,344	138.2	76.5	45.3	31.2	95.6
1986	2,020	128.9	72.0	41.7	30.3	85.2
1987	2,014	122.3	68.7	40.0	28.7	84.4
1988	2,446	144.8	81.5	47.6	33.9	111.8
1989	2,490	139.5	77.4	44.9	32.6	111.4
1990	2,367	133.7	73.8	42.4	31.5	110.5
1991	2,001	110.2	60.8	35.3	25.4	85.2
1992	2,086	114.1	60.9	34.6	26.4	84.9
1993*	2,077	114.1	61.2	32.8	28.0	84.3
1994*	2,064	115.0	61.6	32.9	28.4	83.6
1995*	2,046	115.6	61.8	32.8	28.6	82.7
Average Annual Percentage Rate						
Time Period:						
1973-95	-0.9%	0.5%	0.3%	-0.2%	0.9%	-1.2%
1985-95	-1.4%	-1.8%	-2.1%	-3.2%	-0.9%	-1.4%

Sources:

State Energy Data Report, Energy Information Administration; Annual
National Transportation Statistics, USDOT, Bureau of Transportation Statistics, 1995;
Transportation in America, Eno Foundation, 1994

Notes:

* estimate

Section 4.4

Railroad Mode

This section contains information on energy consumption by fuel type, summary statistics for freight hauled, and energy intensity of Class I Railroads. The type of commodities shipped via rail in Texas are also included in this section.

Table 4.13 Rail Mode Energy Consumption by Fuel Type

Year	Distillate fuel	Residual fuel	Energy use (trillion Btu)
1973	73.8	0.9	74.7
1974	80.0	0.6	80.7
1975	71.9	0.4	72.2
1976	66.6	0.5	67.1
1977	69.0	0.3	69.4
1978	66.2	0.4	66.6
1979	65.6	0.5	66.1
1980	45.6	0.5	46.2
1981	75.5	0.4	75.9
1982	75.0	0.0	75.0
1983	53.0	0.0	53.0
1984	57.6	0.0	57.6
1985	52.5	0.0	52.5
1986	42.5	0.0	42.5
1987	49.1	0.0	49.1
1988	52.0	0.0	52.0
1989	54.3	0.0	54.3
1990	50.9	0.0	50.9
1991	62.3	0.0	62.3
1992	80.4	0.0	80.4
1993*	81.7	0.0	81.7
1994*	83.8	0.0	83.8
1995*	84.5	0.0	84.5
Average annual changes			
Time Period:			
1973-95	0.6%	-100.0%	0.6%
1985-95	4.9%	N/A	4.9%

Sources:

State Energy Data Report, Energy Information Administration; Energy Information Administration unpublished fuel time series.

Notes:

* estimate

**Table 4.14 Freight and Energy Statistics of Class I
Railroads Operating in Texas**

Year	Total Revenue ton-miles (billions)	Estimated gallons consumed	Estimated energy use (trillion Btu)	Estimated energy intensity (Btu/ton-mi)
1973	65.00	538,692,199	74.7	1149
1974	64.93	581,796,308	80.7	1243
1975	57.55	520,895,842	72.2	1255
1976	60.59	483,585,234	67.1	1107
1977	63.05	500,104,076	69.4	1100
1978	65.48	480,486,007	66.6	1018
1979	69.72	476,728,516	66.1	948
1980	70.09	332,965,197	46.2	659
1981	69.45	547,318,129	75.9	1093
1982	60.87	540,531,166	75.0	1232
1983	63.20	382,456,196	53.0	839
1984	70.32	415,490,085	57.6	820
1985	66.92	378,487,152	52.5	784
1986	66.21	306,174,419	42.5	641
1987	64.38	354,243,982	49.1	763
1988	77.94	375,282,817	52.0	668
1989	76.16	391,614,495	54.3	713
1990	75.17	367,183,585	50.9	677
1991	77.91	449,326,032	62.3	800
1992	82.51	579,708,155	80.4	974
1993	88.10	589,081,545	81.7	927
1994*	95.35	604,223,176	83.8	879
1995*	98.67	609,270,386	84.5	856
Average annual changes				
Time Period:				
1973-95	1.9%	0.6%	0.6%	-1.3%
1985-95	4.0%	4.9%	4.9%	0.9%

Sources:

State Energy Data Report, Energy Information Administration, 1994
 Transportation Energy Data Book : Edition 14, ORNL, 1994
 State Statistics, R-1 Annual Reports to the ICC

Note:

* estimate

Table 4.15 Summary Statistics for Class I Railroads in Texas

Year	Loaded car miles	Total carloads of Revenue Freight	Average Length of Haul in Miles	Revenue ton miles	Train miles
1987	1,078,697,000	4,591,955	234.9	N/A	27,802,938
1988	1,060,354,000	4,842,217	219.0	77,633,505	29,766,184
1989	1,077,461,000	4,305,247	250.3	76,155,728	25,866,106
1990	1,029,677,000	4,324,316	238.1	75,167,211	29,094,737
1991	1,040,742,000	4,544,380	229.0	77,906,234	29,291,465
1992	1,108,166,000	4,776,269	232.0	82,505,304	31,052,282
1993	1,183,245,000	4,972,524	238.0	88,095,364	32,781,580
1994	1,204,901,000	5,389,964	223.5	95,346,011	32,824,940
1995*	1,224,097,000	5,514,765	222.0	98,668,400	33,612,888
Average Annual Change					
Time Period:					
1987-1995	1.6%	2.3%	-0.7%	3.5%	2.4%

Sources:

State Statistics, R-1 Annual Reports to the ICC

Note:

* estimate

Table 4.16 Comparative Statistics for 1995* Class I Railroads

	Units	Texas	United States	Texas as percentage of U.S.
Train miles	million	34	404	8%
Avg. length of haul	miles	222	825	27%
Revenue ton-miles	billions	99	1,146	9%
BTU/Revenue ton-mile	units	856	373	229%

Source:

State Statistics, R-1 Annual Reports to the ICC

Transportation Energy Data Book: Edition 14, Oak Ridge National Laboratories, 1994

1994 Railroad Facts

Note:

* estimate

Table 4.17 Estimated Top Five Commodities of Total Freight by Carloads, 1995

Commodity/Description	STCC Code (a)	Carloads	Tons
Misc. mixed shipments	46	886,095	38,533,676
Chemicals & allied products	28	670,440	55,326,602
Coal	11	510,703	44,643,273
Transportation equipment	37	416,448	8,504,164
Food Products	20	393,782	22,645,780

Sources:

State Statistics, R-1 Annual Reports to the ICC

Notes:

(a) STCC refers to Standard Transportation Commodity Code

Table 4.18 Estimated Top Five Commodities of Total Freight by Tonnage, 1995

Commodity/Description	STCC Code (a)	Tons	Carloads
Chemicals & allied products	28	55,326,602	670,440
Coal	11	44,643,273	510,703
Misc. mixed shipments	46	38,533,676	886,095
Nonmetallic minerals except fuels	14	28,867,299	262,802
Farm products	1	25,424,656	449,965

Sources:

State Statistics, R-1 Annual Reports to the ICC

Notes:

(a) STCC refers to Standard Transportation Commodity Code

CHAPTER 5

ALTERNATIVE FUELS AND NEW ENERGY SAVING TECHNOLOGY

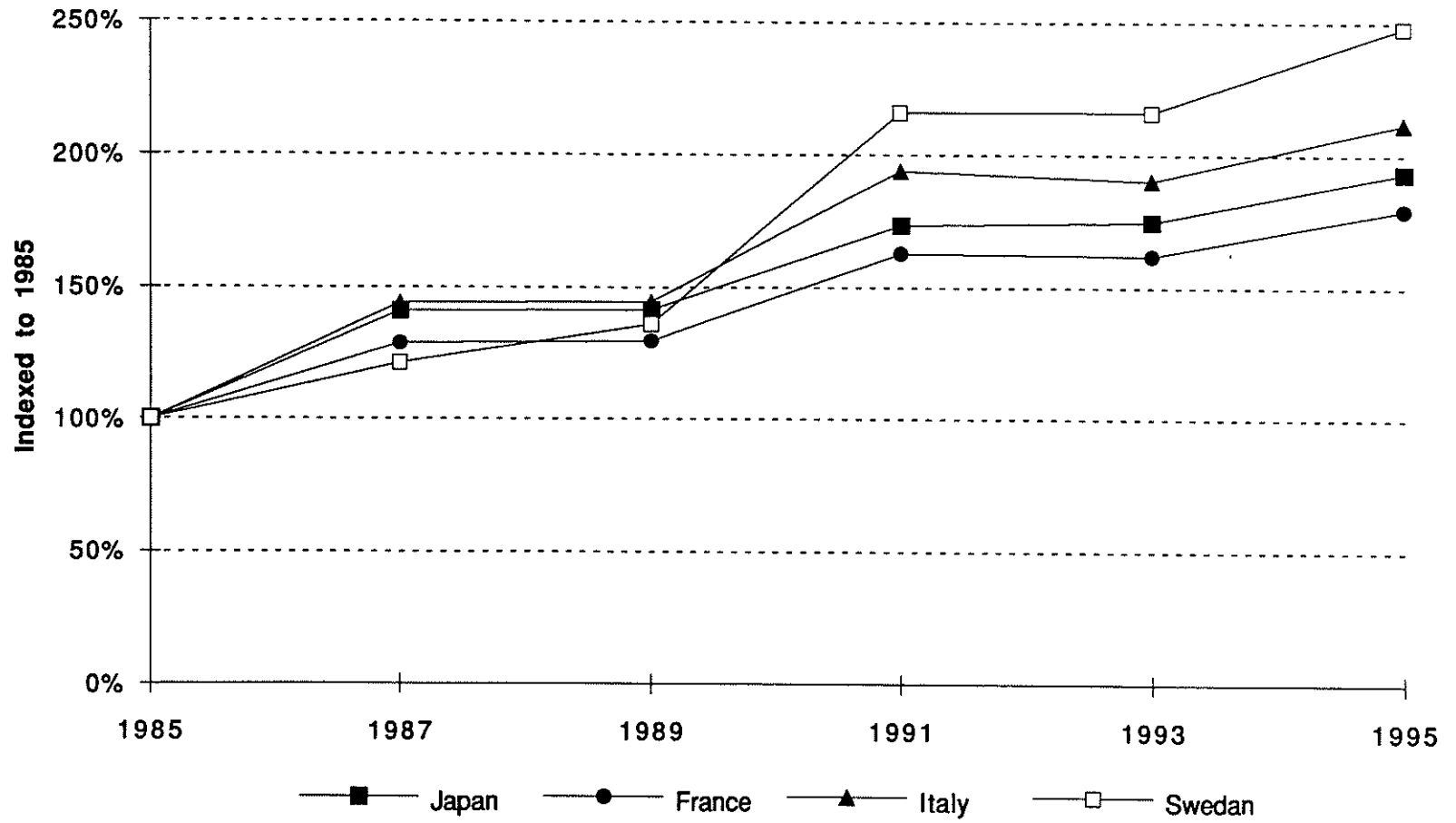
In this concluding chapter, information about alternative fuels and technology that reduces energy consumption are presented. Section 5.1 concentrates on the characteristics of alternative fuels and section 5.2 presents information on emissions data and new technology, including profiles of Electric Vehicles.

Section 5.1

Alternative Fuels

Table 5.1 presents fuel prices for countries having large fleets of alternatively fueled vehicles. In Table 5.2, a comparison of economically feasible alternative fuels are presented. Data on energy content, storage conditions, water solubility, and feedstocks are provided for six alternative fuels. The changes required for commercial acceptance for each alternative fuel is also given. Table 5.3 presents estimates of the direct emission of carbon dioxide (i.e., the "green house gas"), methanol, ethanol, and LPG.

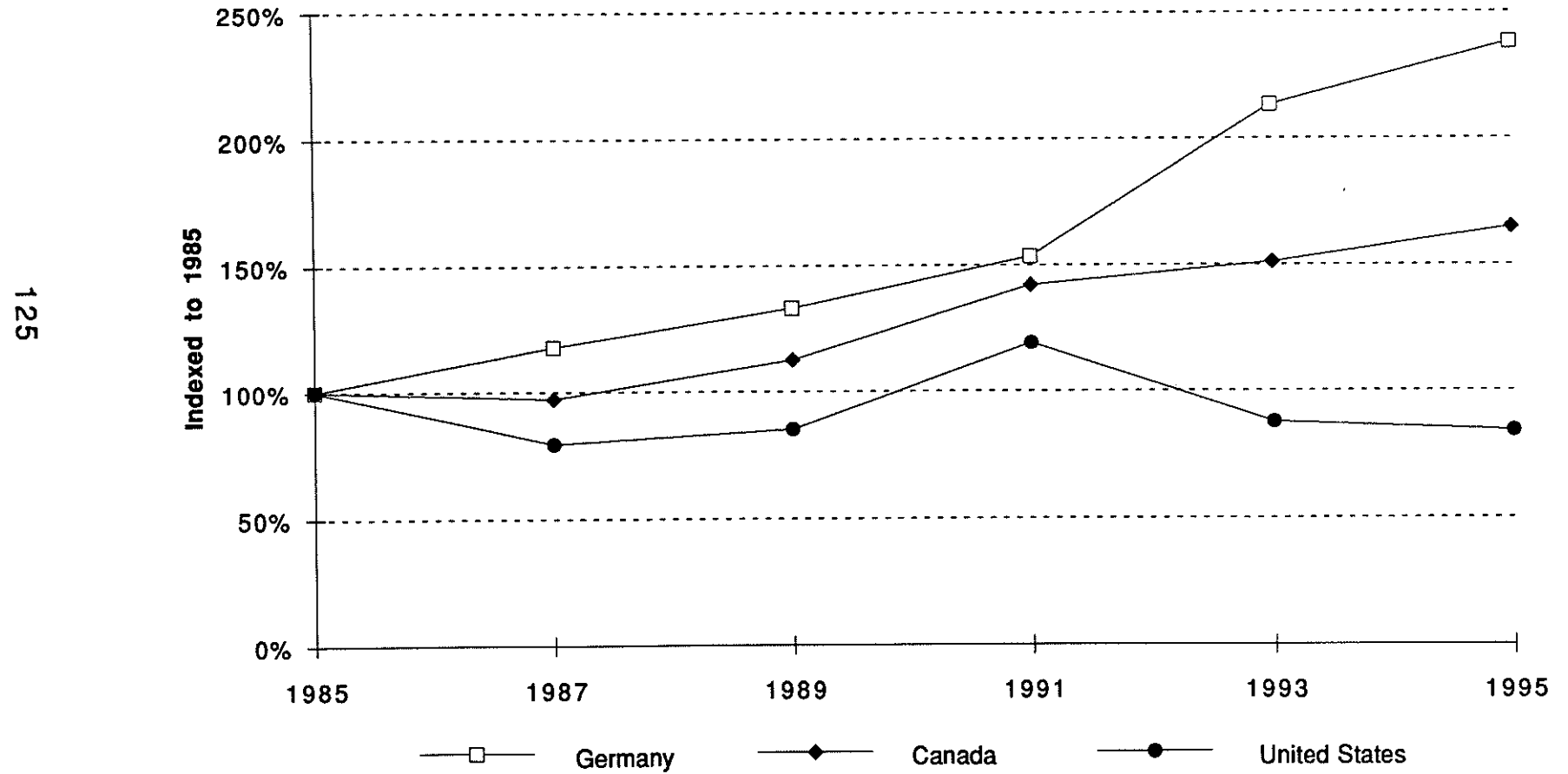
Figure 5.1 Gasoline Prices(per gallon)



124

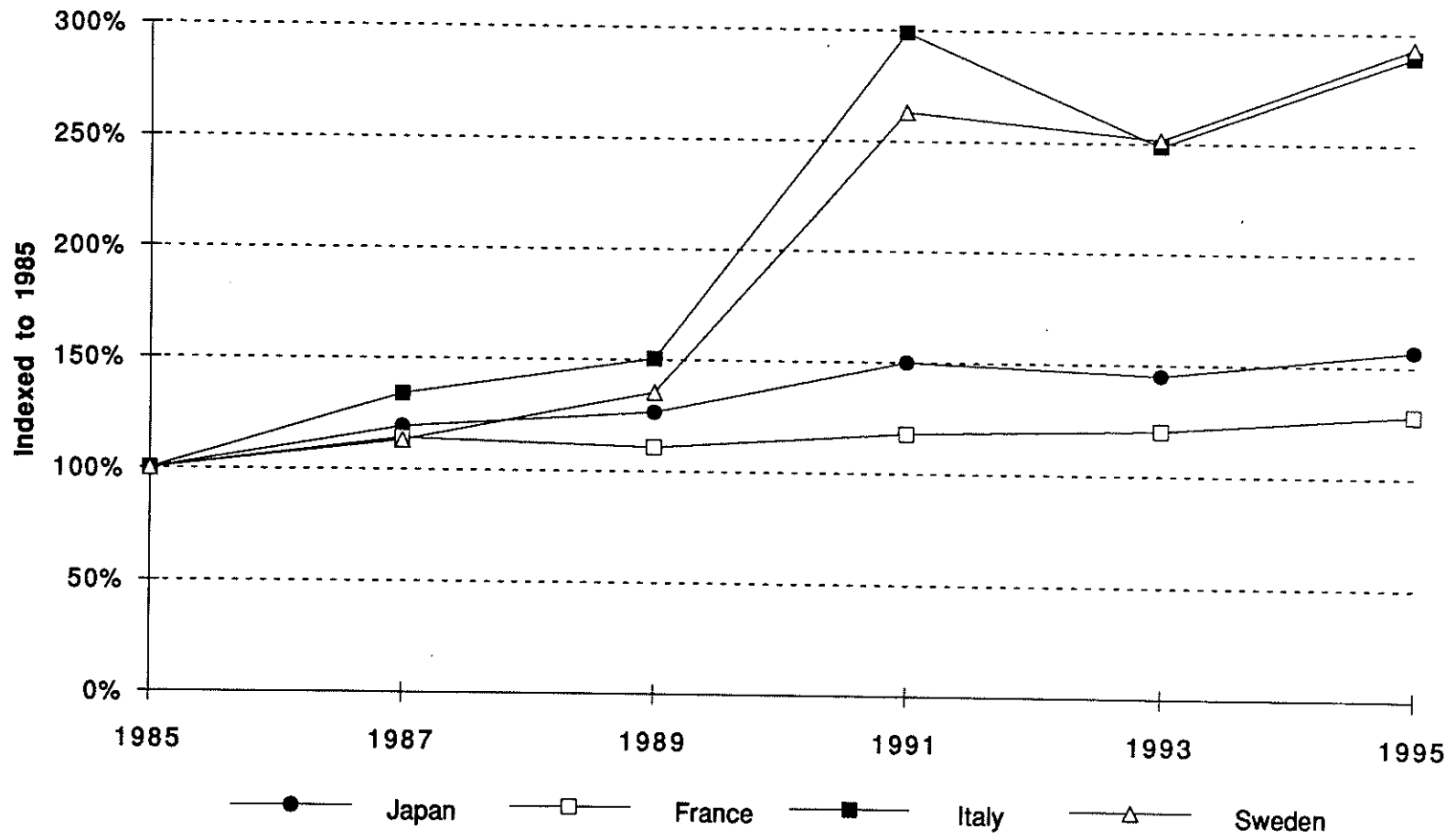
Source: Table 5.1

Figure 5.2 Gasoline Prices(per gallon)



Source: Table 5.1

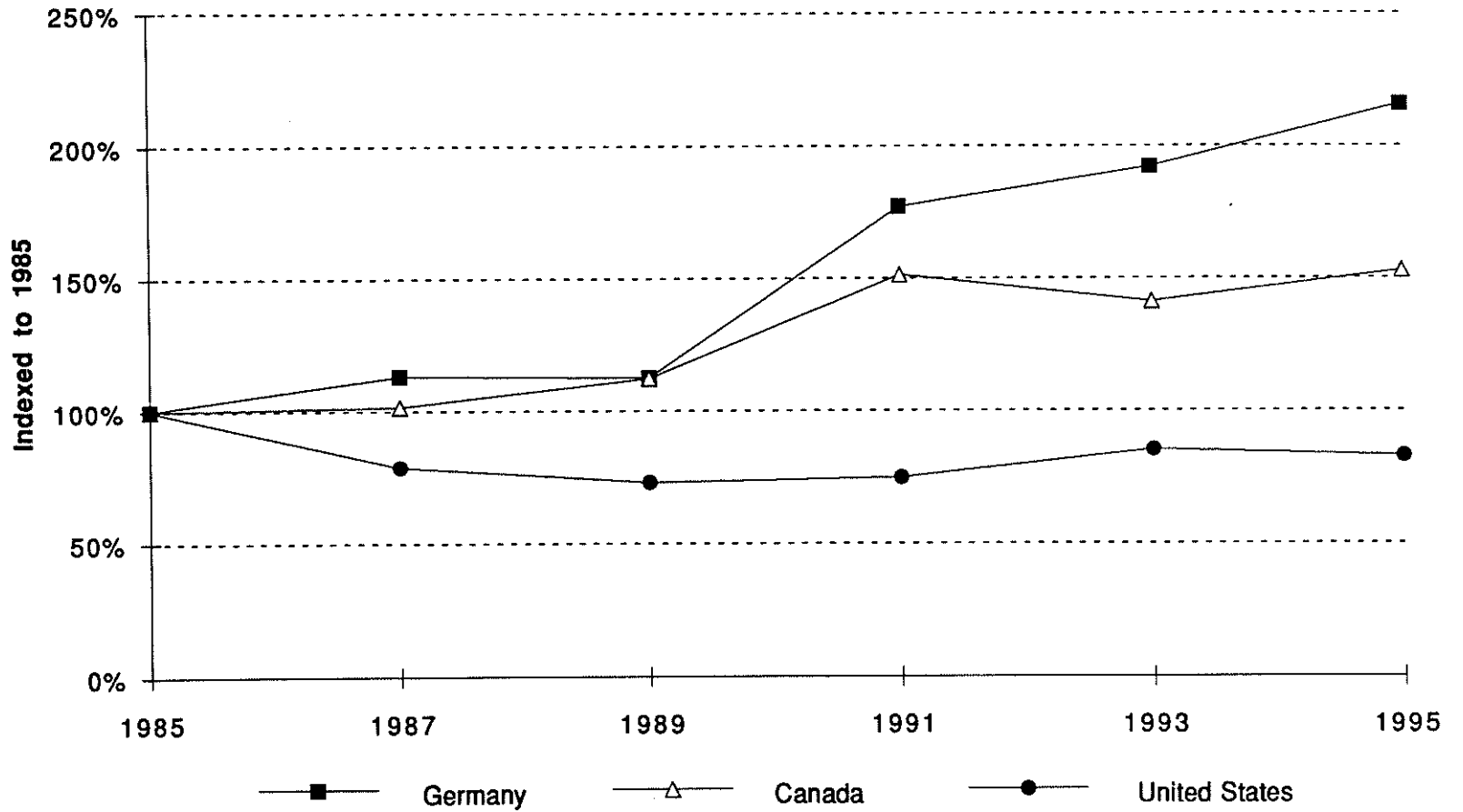
Figure 5.3 Diesel Prices(per gallon)



126

Source: Table 5.1

Figure 5.4 Diesel Prices(per gallon)



Source: Table 5.1

Table 5.1 Fuel Prices for Countries Having Alternative Fueled Vehicle

current \$ per gallon, including tax

	1984	1985	1986	1987	1988	1989	1990	1991	1992	Est. 1993	Est. 1994	Est. 1995	Alternatively Fueled Vehicles as of 1987
Asia:													
Japan (a)													
Gasoline	2.31	2.25	2.79	3.17	3.43	3.18	3.05	3.90	3.78	3.93	4.09	4.35	1.4 - 1.7 million LPG vehicles
Diesel	1.66	1.60	1.90	1.91	2.02	2.02	1.75	2.40	2.23	2.32	2.42	2.51	
Europe:													
France													
Gasoline	2.24	2.37	2.58	3.05	3.06	3.07	3.40	3.86	3.69	3.84	3.99	4.25	2,000 CNG Vehicles
Diesel	1.63	1.68	1.69	1.92	1.84	1.86	1.78	1.98	1.94	2.02	2.10	2.15	43,000-53000 LPG Vehicles
Italy													
Gasoline	2.79	2.63	3.26	3.79	3.95	3.80	4.27	5.10	4.81	5.00	5.20	5.57	300,000 CNG Vehicles
Diesel	1.20	1.21	1.31	1.62	1.78	1.82	2.34	3.62	2.90	3.01	3.13	3.50	
Sweden													
Gasoline	1.93	2.06	2.20	2.50	2.76	2.80	3.23	4.45	4.28	4.45	4.63	5.11	2 Demonstration CNG Vehicles
Diesel	1.32	1.36	1.24	1.54	1.64	1.84	2.30	3.58	3.29	3.42	3.56	3.99	
Germany													
Gasoline	1.87	1.87	1.88	2.20	2.20	2.49	2.72	2.87	3.84	3.99	4.15	4.54	12,000-15,000 LPG Vehicles
Diesel	1.53	1.52	1.51	1.72	1.66	1.71	2.72	2.69	2.81	2.92	3.04	3.28	
North America:													
Canada (a)													
Gasoline	1.48	1.45	1.31	1.41	1.54	1.63	1.92	2.06	2.11	2.19	2.28	2.39	15,000 CNG Vehicles w/250,000 proposed by 2005 Approx. 50 Methanol Demo. Veh.
Diesel	1.30	1.31	1.27	1.33	1.45	1.47	1.55	1.98	1.78	1.85	1.93	2.00	
United States (a)													
Gasoline	1.22	1.20	0.93	0.93	0.95	1.02	1.04	1.43	1.07	1.05	1.04	1.02	30,000 CNG Vehicles
Diesel	1.22	1.22	0.94	0.96	0.95	0.89	0.99	0.91	1.06	1.04	1.02	1.01	300,000-370,000 LPG Vehicles

Sources:

Oak Ridge National Laboratory; "Transportation Energy Data Book: Edition 14"

National Petroleum News Factbook(s) 1990-1984, International Prices for Gasoline and Fuel Oil, 1984-1990.

Notes:

(a) Price is for regular unleaded gasoline, all others are premium unleaded prices

Table 5.2 Comparison of Economically Feasible Alternative Fuels

	Gasoline	Diesel	Methanol	Ethanol	Compressed Natural Gas (CNG)	Liquified Natural Gas (LNG)	Liquified Petroleum Gas (LPG-Propane)	Electricity or Hybrid Vehicles
Energy Content (Lower Heating Value)								
Btu/gallon	116,400	129,400	56,800	76,000	19,760 (a)	76,300 (b)	82,450	-
Btu/pound	18,900	18,310	8,570	11,500	21,300	21,300	19,770	-
Storage Conditions	Liquid	Liquid	Liquid	Liquid	Compressed Gas at 2,400-3,000 psi	Liquid at 25-60 psi	Liquid at 105-140 psi	Batteries/ Fuel Cells
Water Solubility	Negligible	Negligible	100%	100%	N.A.	N.A.	N.A.	N.A.
Changes Required for Commercial Acceptance:								
Technology Advancement	None	None	None	None	Low	Low	Low	High
Increase Production Capacity	None	None	High	High	High	High	High	Moderate-Low
Change In Distribution Channels	None	None	Moderate	Moderate	High	High	High	High w/Low Cost
End User Change Over Costs	None	None	None-Moderate	None-Moderate	Moderate	Moderate	Moderate	High
Feedstocks	Crude Oil Coal	Crude Oil Coal	Crude Oil Natural Gas Biomass Coal Sea Water & Electricity	Biomass	Natural Gas	Natural Gas	Natural Gas Crude Oil	Electricity Hydro Coal Aero Petroleum Natural Gas

Sources:

Singh, M. K., "Environmental Concerns of Natural Gas Vehicles: Do we Know Enough?", Transportation Research Record 1049
Oak Ridge National Laboratory; "Transportation Energy Data Book: Edition 11," January 1991

Notes:

(a) 70 degrees F and 2,400 psi

(b) Normal boiling point at 1 atmosphere

Table 5.3 Direct Carbon Dioxide (CO₂) Emissions of Selected Fuels

Fuel	Typical MPG	Fuel Mass (g/gal)	Carbon content by weight	g C/mi	g CO ₂ / mi	As a % of Gasoline
M85	22	2981.46	44.85%	60.82	223.02	84.56
E85	28	2973.75	57.35%	60.90	223.28	84.66
Gasoline	34	2834.95	86.50%	71.93	263.75	100.00
M100	21	3007.32	37.50%	54.51	199.87	75.78

Sources:

MPG estimates from Society of Automotive Engineers (SAE)
Table 11.2, Automotive Fuels Handbook, Owen, Keith and Trevor Coley,
SAE, Warrendale, PA, 1990

Note:

M85 is 85 % methanol, 15% gasoline
E85 is 85% ethanol, 15% gasoline
M100 is 100% methanol

Section 5.2

Emissions and New Technology

This section concentrates on information regarding emissions and energy saving technology. Tables 5.4 to Table 5.19 concentrate on emissions data. Table 5.20 provides information on technology concepts for improving vehicle efficiency. Table 5.21 presents new energy saving vehicles, power trains used, and the reported fuel economy by the manufacturer. Finally, Tables 5.22 through 5.24 deal with Electric Vehicles and the batteries that power these vehicles.

Table 5.4 Carbon Dioxide Emissions in Texas

Economic Sector	Million Metric Tons of Carbon							
	1987	1988	1989	1990	1991	1992	1993*	1994*
Residential	3.62	3.55	3.87	3.54	3.58	3.46	3.43	3.40
Commercial	3.69	3.68	3.58	3.28	3.29	3.34	3.28	3.21
Industrial	52.54	56.90	58.23	59.56	57.38	58.99	60.37	61.78
Transportation	39.62	41.78	42.01	41.96	41.25	42.45	43.04	43.63
Electricity	44.79	46.47	47.86	47.46	47.23	46.48	46.82	47.17
Unmetered gas (a)	0.99	1.02	0.35	0.19	1.13	1.07	1.09	1.10
Cement production (b)	0.57	0.58	0.59	0.60	0.59	0.60	0.61	0.62
Other Industrial production (b)	0.51	0.55	0.56	0.57	0.57	0.59	0.61	0.62
Gas Flaring (c)	<u>0.42</u>	<u>0.51</u>	<u>0.50</u>	<u>0.51</u>	<u>0.56</u>	<u>0.53</u>	<u>0.55</u>	<u>0.57</u>
Total	146.76	155.05	157.54	157.68	155.59	157.50	157.50	157.50

Notes:

(a) allocated by ratio of Texas to US natural gas consumption times EIAs US unmetered figure

(b) allocated by population

(c) allocated by Industrial consumption of natural gas

* estimated value

Sources:

Energy Information Administration, Emissions of Greenhouse Gases In the United States, November, 1994.

Energy Information Administration, Tables 276-81, State Energy Data Report 1992, May, 1994.

Table 5.5 Methane Emissions in Texas

Sector	Million Metric Tons Carbon Equivalent							
	1987	1988	1989	1990	1991	1992	1993*	1994*
Coal Mining (a)	1.41	1.39	1.45	1.54	1.39	1.35	1.34	1.33
Oil & Gas Production (b)	5.77	5.90	5.55	5.65	5.69	5.51	5.46	5.41
Stationary Sources (c)	0.60	0.00	0.41	0.37	0.39	0.41	0.38	0.35
Transportation (d)	0.17	0.17	0.16	0.16	0.14	0.14	0.13	0.13
Landfills (e)	4.21	4.21	4.21	4.27	4.27	4.24	4.25	4.26
Animals (f)	6.02	6.32	6.46	6.37	6.54	6.76	6.92	7.08
Rice Paddies (g)	0.24	0.35	0.28	0.32	0.30	0.30	0.31	0.32
Chemical Production (h)	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
Iron & Steel Production (i)	<u>0.02</u>	<u>0.02</u>	<u>0.02</u>	<u>0.02</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>
Total	18.47	18.39	18.57	18.73	18.76	18.76	18.84	18.93

Notes:

- (a) allocated by ratio of Tx to USA coal production
 - (b) allocated by ratio of Tx to USA NG production
 - (c) allocated by ratio of Tx to USA Btu consumption of other fuels
 - (d) allocated by ratio of Tx to USA transportation Btu
 - (e) allocated by ratio of Tx to USA population
 - (f) allocated by ratio of Tx to USA cattle inventory
 - (g) allocated by ratio of Tx to USA rice production
 - (h) allocated by ratio of Tx to USA chemical employment
 - (i) allocated by ratio of Tx to USA primary metal industry employment
- * predicted

Sources:

- Texas Almanac 1994-1995, The Dallas Morning News, Dallas, TX, 1993
- State Energy Data Report 1992, EIA, Washington, DC, 1994
- U.S. Bureau of the Census, Statistical Abstract of the United States:1994 (114th ed.), Washington, DC, 1994

Table 5.6 NOx Emissions in Texas

Sector	1987	1988	1989	1990	1991	1992	1993*	1994*
Fertilizers (a)	0.60	0.63	0.63	0.70	0.69	0.73	0.76	0.79
Transportation (b)	0.75	0.87	0.90	0.94	0.97	0.98	1.03	1.09
Stationary sources (c)	0.24	0.20	0.18	0.17	0.16	0.16	0.15	0.14
Industrial Sources (d)	<u>0.47</u>	<u>0.49</u>	<u>0.48</u>	<u>0.48</u>	<u>0.49</u>	<u>0.46</u>	<u>0.46</u>	<u>0.46</u>
Total	2.06	2.19	2.19	2.29	2.31	2.33	2.40	2.47

Notes:

(a) allocated by farm acreage in Tx vs US

(b) allocated by Transportation Btu in Tx Vs US

(c) allocated by Commercial sector's consumption of coal, fuel oil and natural gas in Tx vs US

(d) allocated by population in Tx vs US

* estimated value

Sources:

Energy Information Administration, Tables 276-81, State Energy Data Report 1992, May, 1994.

US Bureau of the Census, Statistical Abstract of the United States 1994

Table 5.7 HFC & PFC Emissions in Texas

Million Metric Tons Carbon Equivalent

1987	1988	1989	1990	1991	1992	1993*
1.18	1.18	1.18	1.18	1.18	1.18	1.18

Notes:

HFC emissions allocated to Texas on basis of electricity consumption as percentage of US.

PFC emissions allocated to Texas on basis of Aluminum smelting employees

* estimate

Sources:

State Energy Data Report 1992, Energy Information Administration, DOE, 1994.

Texas Almanac 1994-1995, The Dallas Morning News, 1994.

Table 5.8 Estimated Texas Emissions of Carbon Monoxide, 1985-94P
(In thousands of short tons)

Source category	1985	1990	1991	1992	1993	1994P
Stationary source fuel consumption	1466	887	880	809	705	653
Industrial processes	355	342	342	337	339	338
Waste Disposal & Recycling	121	105	103	109	111	109
Transportation mode:						
Highway Vehicles	6073	4436	4461	4362	4326	4146
Aircraft	127	152	148	151	157	161
Railroad	17	18	19	20	21	21
Marine	7	8	8	9	9	9
Total transportation modes	6224	4614	4636	4543	4513	4338
Other Off-highway consumption	1247	1339	1232	1201	1209	1205
Miscellaneous	<u>382</u>	<u>788</u>	<u>618</u>	<u>550</u>	<u>608</u>	<u>644</u>
Total	9795	8076	7812	7548	7485	7287

Sources:

U.S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1993, October 1994

Z.A. Goff, Texas Transportation Institute, estimates derived via allocators

P=projected

Table 5.9 Estimated Emissions of Carbon Monoxide from Texas Highway Vehicles, 1985-94P
(in thousands of short tons)

Source category	1985	1990	1991	1992	1993	1994P
Gasoline powered:						
Light duty vehicles	5421	4097	4123	4030	3996	3830
Heavy duty vehicles	<u>528</u>	<u>219</u>	<u>212</u>	<u>203</u>	<u>201</u>	<u>193</u>
Total gasoline powered	5949	4316	4336	4232	4197	4023
Diesel powered:						
Light duty vehicles	2	4	5	6	5	5
Heavy duty vehicles	<u>122</u>	<u>116</u>	<u>120</u>	<u>125</u>	<u>124</u>	<u>118</u>
Total diesel powered	124	120	125	130	129	124
Total	6073	4436	4461	4362	4326	4146

Source:

Table (preceeding), Texas Transportation Energy Data Book, 1995

Z.A. Goff, Texas Transportation Institute, performed allocations for each vehicles type

P=projected

Table 5.10 Estimated Texas Emissions of Particulate Matter, 1985-94P
(in thousands of short tons)

Source category	1985	1990	1991	1992	1993	1994P
Stationary source fuel consumption	277	213	214	197	179	170
Industrial processes	65	62	61	61	62	62
Waste Disposal & Recycling	20	17	18	18	18	18
Transportation modes:						
Highway Vehicles	134	131	149	147	145	146
Aircraft	30	53	54	54	59	64
Railroad	20	26	31	34	35	38
Marine	20	26	31	34	35	38
Total for transportation modes	205	236	266	268	274	286
Other Off-highway consumption	22	18	16	17	17	16
Miscellaneous	<u>5266</u>	<u>5239</u>	<u>5653</u>	<u>5178</u>	<u>4850</u>	<u>4798</u>
Total	5855	5785	6228	5739	5401	5350

Sources:

U.S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1993, October 1994

Z.A. Goff, Texas Transportation Institute, estimates derived via allocators

P=projected

Table 5.11 Estimated Emissions of Particulate Matter from Texas Highway Vehicles, 1985-94P
(in thousands of short tons)

Source category	1985	1990	1991	1992	1993	1994P
Gasoline powered:						
Light duty vehicles	82	78	88	89	89	91
Heavy duty vehicles	<u>6</u>	<u>4</u>	<u>4</u>	<u>4</u>	<u>4</u>	<u>4</u>
Total gasoline powered	87	83	92	93	93	95
Diesel powered:						
Light duty vehicles	3	4	5	5	5	5
Heavy duty vehicles	<u>42</u>	<u>45</u>	<u>52</u>	<u>50</u>	<u>48</u>	<u>47</u>
Total diesel powered	45	49	57	55	52	51
Total	133	131	149	147	145	146

Source: Table (preceeding), Texas Transportation Energy Data Book, 1995

Z.A. Goff, Texas Transportation Institute, performed allocations for each vehicles type

P=projected

**Table 5.12 Estimated Texas Emissions of VOCs, 1985-94P
(in thousands of short tons)**

Source category	1985	1990	1991	1992	1993	1994P
Stationary source fuel consumption	199	150	151	150	142	136
Industrial processes	1592	1704	1734	1749	1788	1814
Waste Disposal & Recycling	189	185	182	188	190	190
Transportation:						
Highway Vehicles	962	632	611	579	575	539
Aircraft	33	39	39	39	41	42
Railroad	7	8	9	9	9	10
Marine	7	7	8	8	8	9
Total transportation modes	1009	687	665	635	633	599
Other Off-highway consumption	237	259	261	250	254	257
Miscellaneous	<u>35</u>	<u>108</u>	<u>77</u>	<u>65</u>	<u>75</u>	<u>82</u>
Total	3261	3093	3071	3037	3082	3078

Sources:

U.S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1993, October 1994

Z.A. Goff, Texas Transportation Institute, estimates derived via allocators

P=projected

Table 5.13 Estimated Emissions of VOCs from Texas Highway Vehicles, 1985-94P
(In thousands of short tons)

Source category	1985	1990	1991	1992	1993	1994P
Gasoline powered:						
Light duty vehicles	853	573	552	522	518	486
Heavy duty vehicles	<u>63</u>	<u>22</u>	<u>21</u>	<u>18</u>	<u>18</u>	<u>17</u>
Total gasoline powered	916	595	573	540	536	502
Diesel powered:						
Light duty vehicles	1	0	3	3	3	3
Heavy duty vehicles	<u>45</u>	<u>37</u>	<u>36</u>	<u>36</u>	<u>36</u>	<u>34</u>
Total diesel powered	46	37	39	39	39	36
Total	962	632	611	579	575	539

Source:

Table (preceeding), Texas Transportation Energy Data Book, 1995

Z.A. Goff Texas Transportation Institute, performed allocations for each vehicle type

P=projected

**Table 5.14 Estimated Texas Emissions of Nitrogen Oxides
(in thousands of short tons)**

Source category	1985	1990	1991	1992	1993	1994P
Stationary source fuel consumption	1609	1625	1649	1671	1698	1710
Industrial processes	75	68	69	68	70	69
Waste Disposal & Recycling	6	5	5	5	6	6
Transportation modes:						
Highway Vehicles	654	544	546	558	552	541
Aircraft	19	23	22	22	23	24
Railroad	132	143	148	158	159	163
Marine	21	23	24	26	26	26
Total for transportation modes	826	733	740	765	761	754
Other Off-highway consumption	169	164	147	146	152	149
Miscellaneous	<u>13</u>	<u>25</u>	<u>20</u>	<u>18</u>	<u>19</u>	<u>21</u>
Total	2697	2620	2629	2674	2705	2708

Sources:

U.S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1993, October 1994

Z.A. Goff, Texas Transportation Institute, estimates derived via allocators

P=projected

Table 5.15 Estimated Emissions of Nitrogen Oxides from Texas Highway Vehicles, 1985-94P
(in thousands of short tons)

Source category	1985	1990	1991	1992	1993	1994P
Gasoline powered:						
Light duty vehicles	419	327	333	346	342	336
Heavy duty vehicles	<u>22</u>	<u>14</u>	<u>14</u>	<u>15</u>	<u>15</u>	<u>14</u>
Total gasoline powered	441	341	347	361	357	350
Diesel powered:						
Light duty vehicles	3	5	6	6	6	6
Heavy duty vehicles	<u>210</u>	<u>198</u>	<u>193</u>	<u>191</u>	<u>189</u>	<u>185</u>
Total diesel powered	213	203	199	197	195	191
Total	654	544	546	558	552	541

Source:

Table (preceeding), Texas Transportation Energy Data Book, 1995

Z.A. Goff, Texas Transportation Institute, performed allocations for each vehicles type

P=projected

Table 5.16 Estimated Texas Emissions of Sulphur Dioxide, 1985-94P
(In thousands of short tons)

Source category	1985	1990	1991	1992	1993	1994P
Stationary source fuel consumption	1129	1283	1199	1140	1138	1139
Industrial processes	117	98	99	96	97	94
Waste Disposal & Recycling	1	1	1	1	1	1
Transportation modes:						
Highway Vehicles	17	16	16	17	15	15
Aircraft	0	1	1	1	1	1
Railroad	3	2	3	3	3	3
Marine	6	7	8	8	9	9
Total for transportation modes	26	26	27	29	27	27
Other Off-highway consumption	0	0	0	0	0	
Miscellaneous	0	0	0	0	0	0
Total	1273	1409	1327	1267	1263	1262

Sources:

U.S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1993, October 1994

Z.A. Goff, Texas Transportation Institute, estimates derived via allocators

P=projected

Table 5.17 Estimated Emissions of Sulphur Dioxide from Texas Highway Vehicles, 1985-94P
(in thousands of short tons)

Source category	1985	1990	1991	1992	1993	1994P
Gasoline powered:						
Light duty vehicles	7	7	7	7	6	6
Heavy duty vehicles	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total gasoline powered	8	7	7	7	6	6
Diesel powered:						
Light duty vehicles	0	0	0	0	0	0
Heavy duty vehicles	<u>9</u>	<u>9</u>	<u>9</u>	<u>10</u>	<u>9</u>	<u>9</u>
Total diesel powered	9	9	9	10	9	9
Total	17	16	16	17	15	15

Source:

Table (preceeding), Texas Transportation Energy Data Book, 1995

Z.A. Goff, Texas Transportation Institute, performed allocations for each vehicles type

P=projected

Table 5.18 Estimated Texas Emissions of Lead, 1985-94P
(In short tons)

Source category	1985	1990	1991	1992	1993	1994P
Stationary source fuel consumption	116	74	75	75	72	68
Industrial processes	171	137	123	116	118	112
Waste Disposal & Recycling	72	66	48	35	44	41
Transportation modes:						
Highway Vehicles	1573	156	137	131	123	90
Aircraft	0	0	0	0	0	0
Railroad	0	0	0	0	0	0
Marine	0	0	0	0	0	0
Total for transportation modes	1573	156	137	131	123	90
Other Off-highway consumption	31	28	26	26	28	27
Miscellaneous	0	0	0	0	0	0
Total	1963	461	409	382	383	337

Sources:

U.S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1993, October 1994

Z.A. Goff, Texas Transportation Institute, estimates derived via allocators

P=projected

Table 5.19 Estimated Emissions of Lead from Texas Highway Vehicles, 1985-94P
(In short tons)

Source category	1985	1990	1991	1992	1993	1994P
Gasoline powered:						
Light duty vehicles	1190	116	102	98	92	67
Heavy duty vehicles	<u>383</u>	<u>39</u>	<u>35</u>	<u>33</u>	<u>31</u>	<u>23</u>
Total gasoline powered	1573	156	137	131	123	90
Diesel powered:						
Light duty vehicles	0	0	0	0	0	0
Heavy duty vehicles	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total diesel powered	0	0	0	0	0	0
Total	1573	156	137	131	123	90

Source:

Table (preceeding), Texas Transportation Energy Data Book, 1995

Z.A. Goff, Texas Transportation Institute, performed allocations for each vehicles type

P=projected

Table 5.20 Technology Concepts for Improving Fuel Efficiency

Vehicle System	Technology	Benefits	Disadvantages
Engine	Direct injection diesel	Improves efficiency of conventional diesel by mixing fuel + air directly into combustion chamber	Emits substantial quantities of particulates
	Stratified-charge engine	Precise fuel injection creates rich mixture of fuel/air near spark plug so that spark can create ignition, yet creates lean burn mixture elsewhere in combustion chamber; thought to reduce fuel consumption by 20%	Oxygen-rich exhaust prevents catalytic converters from reducing NOx; can't meet toughest emission standards
	Stratified-charged 2 stroke engine application	Same benefits as above but reduces weight	Older designs had caused excessive pollution
Transmission	Addition of more gears	Keep high-load operation to increase efficiency	Cost
	Switching gears into optimal range more of the time--aided via on-board computer	Same as above	Same as above
	Continuously variable transmission	Same as above	Currently adaptable to small vehicles
Structural reduction of rolling resistance	Weight reduction via design change	Fuel economy increased by @ 5% per 200# reduction	Requires costly retooling
	Weight reduction via material substitution	Can save as much as 100# per car	Ability to recycle substitute materials; must address source and supply of materials
	Aerodynamics	As speed increases, drag reduced exponentially at relatively low cost	

Source:

D.L. Bleviss and P. Waizer, "Energy For Motor Vehicles", Scientific American, September, 1990

Table 5.21 Selected Electric Vehicle Profiles by Non- USA Automakers

Country	Automaker	Models	Type	Scheduled Production Date	Number of Vehicles	Price	Driving Range (miles)	Maximum Speed (mph)	Battery Type
Australia	Elroy Engineering Pty. Ltd.	B20	20 passenger van	Currently available		\$42,000	50	55	Lead Acid
		B90 Bus	Full length bus	Currently available		\$250,000	50	55	Lead Acid
	L & J Enterprises Pty. Ltd.	TE ECC	4 passenger sedan	Currently available		\$15,000	59	75	Lead Acid
Canada/USA	Ballard Power Systems/SAIC	Fuel Cell Bus	Bus-40 ft transit	1998 in California	100		350	65	Fuel Cells
France	PSA Peugeot/Citroen	Citroen C25	Van	Currently being used in city & corporate fleets	300	\$29,166	42	55	Lead Acid
			Citela	2 passenger	Concept car	1		65	68-75
		Citroen AX	Commuter car	1995 for general public	100		54	54	Nickel Cadmium & Lead Acid
Germany	Volkswagen	City Stromer	4 passenger Jetta	Currently available in Europe	70 originally built		90 @ 46 mph	63	Sodium Sulpher Lead & Gel
Italy	Fiat	Panda Elettra	2 passenger	Currently available in Italy		\$17,000	75-100	50	Lead Acid
Japan	Daihatsu/Kansai Electric Power Co.	Electric 'Rugger'	2 passenger Jeep	Currently in use by Kansai Electric Power	26		124	56	Lead Acid
	Toyota	Town Ace Van	4 passenger	Currently available in Japan	22	\$67,000	96 @ 25 mph	51	Lead Acid
Sweden	Volvo	ECC	4 passenger Hybrid car	Concept car			53		Nickel Cadmium

Source:

Electric Transportation Coalition, Washington, D.C., 1994

Table 5.22 New Energy Saving Automobiles

Test vehicle	Automobile company	Purpose	Engine	Transmission	Special additions	Reported Fuel MPG		
						City	High-way	Com-bined
Eco-Polo	VW	Urban commuting	2 cylinder diesel with advanced fuel injection	Glider automatic which shuts off engine during deceleration, turns on engine during acceleration	Exhaust filter & special iron based additives to reduce particulate emissions(b)			62
LCP2000	Volvo	Designed to withstand 35 mph head-on crash; assembled from modular components			Advanced material	63	81	
Hybrid (a)	VW	Transition car; accelerate $\leq 1/3$ full throttle car uses electric power; $\geq 1/3$ full throttle uses diesel engine	Diesel engine, electric motor & sodium-sulfur battery					100

Source:

D.L. Bleviss and P. Walzer, "Energy For Motor Vehicles", Scientific American, September, 1990

Notes:

(a) MPG is for 1 gallon diesel fuel & 25 KW

(b) Already lower than California emission standards

Table 5.23 Goals of the United States Advanced Battery Consortium

	Mid-term	Long-term
Power density (W/L)	250	600
Specific power(W/kg)	150	400
Energy density(Wh/L)	135	300
Power/energy ratio	1.5	2.5
Battery life (years)	5	10
Cycle life(cycles)	600	1000
Price (\$/kWh--10 000 units @ 40kWh)	<\$150	<\$100
Normal recharge time (hours)	<6	3 - 6
Fast recharge time@50% capacity (hours)	<0.5	<0.5

Source: U.S. Department of Energy, Office of Transportation Technologies, Washington, DC, 1991

Table 5.24 Current Status of Advanced Transit Battery Development

	Battery Type	
	Flooded Lead-Acid	Nickel-Cadmium
Power density (W/L)	387	370
Specific power(W/kg)	160	175
Energy density(Wh/L)	79	110
Power/energy ratio	2.0	1.6
Battery life (years)	4	8
Cycle life(cycles)	1000	2000
Price (\$/kWh)	233	638
Normal recharge time (hours)	5	5
Fast recharge time@50% capacity (hours)	0.5	0.5

Source: U.S. Department of Transportation, Federal Transit Administration, Office of Technology Assessment and Safety, "Four-Year Report on Battery-Electric Transit Vehicle Operation at The Santa Barbara Metropolitan Transit District", Washington, DC, 1995

TITLE INDEX

	<u>Page</u>
Air	
Air Freight for Selected Texas Cities	99
Air Mode Energy Consumption by Fuel Type	95
Summary Statistics for Domestic and International Route Air Carriers Operating in Texas	97
Aircraft	
Distribution of General Aviation Aircraft in Texas	102
Alternative	
Fuel Prices for Countries Having Alternative Fuel Vehicles	128
Comparison of Economically Feasible Alternative Fuels	129
Direct Carbon Dioxide (CO2) Emissions of Selected Alternative Fuels	130
Automobile	
Automobile Registrations for Selected States, 1973-95	8
Cost of Operating an Automobile in the U.S.	79
Estimated Automobile Fuel Economy by Vehicle Type, 1995 Model Year	80
New Energy Saving Automobiles	150
Aviation	
Summary Statistics for General Aviation in Texas	101
Distribution of General Aviation Aircraft in Texas	102
Battery	
Current Status of Advanced Transit Battery Development	151
Goals of the United States Advanced Battery Consortium	151
Bus	
Private and Public Truck and Bus Registrations for Selected States, 1973-95	9
Commodities	
Estimated Commodities Shipped by Water in Texas	109

Estimated Commodities Shipped Via Texas Highways, 1995	90
Estimated Top Five Commodities of Total Freight by Carloads, 1995	119
Estimated Top Five Commodities of Total Freight by Tonnage, 1995	118
Comparative	
Comparative Statistics for 1995 Class I Railroads	117
Comparison	
Comparison of Economically Feasible Alternative Fuels	129
Consumption	
Distribution of Energy Consumption by Source	25
Energy Consumption by End-Use Sector, 1973-95	27
Energy Consumption by Mode and Fuel Type, 1975	31
Energy Consumption by Mode and Fuel Type, 1985	31
Energy Consumption by Transportation Mode, 1973-95	28
Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures	64
Estimated Energy Consumption (in Coal equivalent units) in 2010 for Selected World Regions	2
Estimated Energy Consumption by Mode and Fuel Type, 1995	31
Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995	17
Estimated U.S. Travel and Consumption Characteristics Number of Cylinders, 1995 vs. 1985	65
Petroleum Consumption and Oil Imports, 1990	3
Rail Mode Energy Consumption by Fuel Type	114
Texas Highway Mode Energy Consumption by Fuel Type	51
Texas Petroleum Consumption by Sector	24
Texas Petroleum Production and Consumption	21
Water Mode Energy Consumption by Fuel Type	105
Cost	
Cost of Operating an Automobile in the U.S.	79

Cylinders

Estimated U.S. Travel and Consumption Characteristics Number of Cylinders, 1995 vs. 1985	65
---	----

Distillate

Distillate Fuel Prices for Selected States	13
Distillate Fuel Taxes for Selected States, 1973-95	15

Efficiency

Estimated Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1995	72
Technology Concepts for Improving Fuel Efficiency	148
Vehicle Fuel Efficiency by Region	68

Emissions

Carbon Dioxide Emissions in Texas	132
Direct Carbon Dioxide (CO ₂) Emissions of Selected Alternative Fuels	130
Estimated Emissions of Carbon Monoxide from Texas Highway Vehicles, 1985-94	137
Estimated Emissions of Lead from Texas Highway Vehicles, 1985-94	147
Estimated Emissions of Nitrogen Oxides from Texas Highway Vehicles, 1985-94	143
Estimated Emissions of Particulate Matter from Texas Highway Vehicles, 1985-94	139
Estimated Emissions of Sulfur Dioxide from Texas Highway Vehicles, 1985-94	145
Estimated Emissions of VOCs from Texas Highway Vehicles, 1985-94	141
Estimated Texas Emissions of Carbon Monoxide, 1985-94	136
Estimated Texas Emissions of Lead, 1985-94	146
Estimated Texas Emissions of Nitrogen Oxides	142
Estimated Texas Emissions of Particulate Matter, 1985-94	138
Estimated Texas Emissions of Sulfur Dioxide, 1985-94	144
Estimated Texas Emissions of VOCs, 1985-94	140
HFC & PFC Emissions in Texas	135
Methane Emissions in Texas	133
NO _x Emissions in Texas	134

Energy

Air Mode Energy Consumption by Fuel Type	95
Distribution of Energy Consumption by Source	25

Energy Consumption by End-Use Sector, 1973-95	27
Energy Consumption by Mode and Fuel Type, 1975	31
Energy Consumption by Mode and Fuel Type, 1985	31
Energy Consumption by Transportation Mode, 1973-95	28
Energy Intensities of Freight Modes in Texas	39
Energy Intensities of Passenger Modes in Texas	35
Enplanements and Estimated Energy Use for Selected Texas Cities	98
Estimated Average Household Energy and Vehicle Expenditures, 1995	69
Estimated Energy Consumption (in Coal equivalent units) in 2010 for Selected World Regions	2
Estimated Energy Consumption by Mode and Fuel Type, 1995	31
Estimated Passenger Travel and Energy Use in Texas, 1995	34
Freight and Energy Statistics of Class I Railroads Operating in Texas	115
Intercity Freight and Energy Use in Texas, 1995	37
New Energy Saving Automobiles	150
Rail Mode Energy Consumption by Fuel Type	114
Texas Highway Energy Use by Mode	53
Texas Highway Mode Energy Consumption by Fuel Type	51
Water Mode Energy Consumption by Fuel Type	105

Expenditures

Estimated Average Household Energy and Vehicle Expenditures, 1995	69
Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures	64
Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995	17

Family

Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1995	73
---	----

Freight

Air Freight for Selected Texas Cities	99
Energy Intensities of Freight Modes in Texas	39
Estimated Top Five Commodities of Total Freight by Carloads, 1995	119
Estimated Top Five Commodities of Total Freight by Tonnage, 1995	118
Freight and Energy Statistics of Class I Railroads Operating in Texas	115

Intercity Freight and Energy Use in Texas, 1995	37
Fuel	
Air Mode Energy Consumption by Fuel Type	95
Comparison of Economically Feasible Alternative Fuels	129
Direct Carbon Dioxide (CO2) Emissions of Selected Alternative Fuels	130
Distillate Fuel Prices for Selected States	13
Distillate Fuel Taxes for Selected States, 1973-95	15
Energy Consumption by Mode and Fuel Type, 1975	31
Energy Consumption by Mode and Fuel Type, 1985	31
Estimated Automobile Fuel Economy by Vehicle Type, 1995 Model Year	80
Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures	64
Estimated Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1995	72
Estimated Combination Truck Fuel Economy in Texas	85
Estimated Energy Consumption by Mode and Fuel Type, 1995	31
Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995	17
Estimated Single Unit Truck Fuel Economy in Texas	84
Fuel Prices for Countries Having Alternative Fuel Vehicles	128
Rail Mode Energy Consumption by Fuel Type	114
Retail Prices for Selected Transportation Fuels	41
Retail Prices of Selected Highway Motor Fuels	40
Technology Concepts for Improving Fuel Efficiency	148
Texas Highway Mode Energy Consumption by Fuel Type	51
Vehicle Fuel Efficiency by Region	68
Water Mode Energy Consumption by Fuel Type	105
Gasoline	
Crude Oil and Gasoline Prices	44
Motor Gasoline Prices for Selected States	11
Motor Gasoline Taxes for Selected States, 1973-95	14
Gulf Intracoastal Waterway	
Summary Statistics for Texas Gulf Intracoastal Waterway	108

Highway

Estimated Commodities Shipped Via Texas Highways, 1995	90
Estimated Emissions of Carbon Monoxide from Texas Highway Vehicles, 1985-94	137
Estimated Emissions of Lead from Texas Highway Vehicles, 1985-94	147
Estimated Emissions of Nitrogen Oxides from Texas Highway Vehicles, 1985-94	143
Estimated Emissions of Particulate Matter from Texas Highway Vehicles, 1985-94	139
Estimated Emissions of Sulfur Dioxide from Texas Highway Vehicles, 1985-94	145
Estimated Emissions of VOCs from Texas Highway Vehicles, 1985-94	141
Retail Prices of Selected Highway Motor Fuels	40
Texas Highway Energy Use by Mode	53
Texas Highway Mode Energy Consumption by Fuel Type	51

Household

Estimated Average Household Energy and Vehicle Expenditures, 1995	69
Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures	64
Estimated Average Vehicle Miles Traveled by Household Composition, 1995	75
Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1995	73
Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995	17
Estimated Average Household Energy and Vehicle Expenditures, 1995	69
Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures	64
Estimated Average Vehicle Miles Traveled by Household Composition, 1995	75
Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1995	73
Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995	17

Income

Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1995	73
---	----

Intensities

Energy Intensities of Freight Modes in Texas	39
Energy Intensities of Passenger Modes in Texas	35

Miles

Estimated Average Miles Per Gallon by Model Year	6 7
Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures	6 4
Estimated Average Vehicle Miles Traveled by Household Composition, 1995	7 5
Estimated Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1995	7 2
Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1995	7 3
Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995	1 7

Municipal

Texas Statewide Municipal Transit Ridership	8 1
---	-----

Oil (see also Petroleum)

Crude Oil and Gasoline Prices	4 4
Petroleum Consumption and Oil Imports, 1990	3

Passenger

Energy Intensities of Passenger Modes in Texas	3 5
Estimated Passenger Travel and Energy Use in Texas, 1995	3 4

Petroleum

Estimated Transportation Use of Petroleum Products for Selected States, 1995	4
Petroleum Consumption and Oil Imports, 1990	3
Texas Petroleum Consumption by Sector	2 4
Texas Petroleum Production and Consumption	2 1

Pipeline

Texas Pipeline Shipments of Energy	1 1 2
------------------------------------	-------

Prices

Crude Oil and Gasoline Prices	4 4
Distillate Fuel Prices for Selected States	1 3
Fuel Prices for Countries Having Alternative Fuel Vehicles	1 2 8
Motor Gasoline Prices for Selected States	1 1
Retail Prices for Selected Transportation Fuels	4 1

Retail Prices of Selected Highway Motor Fuels	40
Rail (Railroads)	
Comparative Statistics for 1995 Class I Railroads	117
Freight and Energy Statistics of Class I Railroads Operating in Texas	115
Rail Mode Energy Consumption by Fuel Type	114
Summary Statistics for Class I Railroads in Texas	116
Speed	
Texas Interstate Speed Data	59
Texas Non-Interstate Speed Data	61
Taxes	
Distillate Fuel Taxes for Selected States, 1973-95	15
Motor Gasoline Taxes for Selected States, 1973-95	14
Technology	
Technology Concepts for Improving Fuel Efficiency	148
Transportation	
Energy Consumption by Transportation Mode, 1973-95	28
Estimated Transportation Use of Petroleum Products for Selected States, 1995	4
Retail Prices for Selected Transportation Fuels	41
Energy Consumption by Transportation Mode, 1973-95	28
Truck	
Estimated Combination Truck Fuel Economy in Texas	85
Estimated Single Unit Truck Fuel Economy in Texas	84
Private and Public Truck and Bus Registrations for Selected States, 1973-95	9
Texas Truck Mileage by Major Use	89
Texas Truck Mileage by Vehicle Range	89
Texas Truck Mileage by Vehicle Size	87
Vehicle	
Estimated Average Household Energy and Vehicle Expenditures, 1995	69
Estimated Automobile Fuel Economy by Vehicle Type, 1995 Model Year	80

Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures	64
Estimated Average Vehicle Miles Traveled by Household Composition, 1995	75
Estimated Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1995	72
Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1995	73
Estimated Emissions of Carbon Monoxide from Texas Highway Vehicles, 1985-94	137
Estimated Emissions of Lead from Texas Highway Vehicles, 1985-94	147
Estimated Emissions of Nitrogen Oxides from Texas Highway Vehicles, 1985-94	143
Estimated Emissions of Particulate Matter from Texas Highway Vehicles, 1985-94	139
Estimated Emissions of Sulfur Dioxide from Texas Highway Vehicles, 1985-94	145
Estimated Emissions of VOCs from Texas Highway Vehicles, 1985-94	141
Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1995	17
Estimated Vehicle Stock in Texas, 1995	54
Fuel Prices for Countries Having Alternative Fuel Vehicles	128
Private and Commercial Vehicles per Capita for Selected States, 1973-95	10
Selected Electric Vehicle Profiles by Non-USA Auto makers	149
Texas Truck Mileage by Vehicle Range	89
Texas Truck Mileage by Vehicle Size	87
Vehicle Fuel Efficiency by Region	68
Vehicle Stock in Texas, 1973-95	55
Water	
Estimated Commodities Shipped by Water in Texas	109
Water Mode Energy Consumption by Fuel Type	105
Waterborne	
Summary Statistics for Domestic Waterborne Traffic in Texas	106
Waterway	
Summary Statistics for Texas Gulf Intracoastal Waterway	108

Appendix:
Important Conversion Factors

Table A.1 Approximate Heating Values for Various Fuels

Fuel	Unit	Btu (million)
Aviation gasoline	1 barrel or 42 gallons	5.048
Distillate fuel	1 barrel or 42 gallons	5.825
Jet fuel	1 barrel or 42 gallons	5.670
LPG (a)	1 barrel or 42 gallons	3.631
Lubricants	1 barrel or 42 gallons	6.065
Motor gasoline	1 barrel or 42 gallons	5.253
Residual fuel	1 barrel or 42 gallons	6.827
Crude oil (unrefined)	1 barrel or 42 gallons	5.800
Ethanol	1 barrel or 42 gallons	3.553
Gasohol	1 barrel or 42 gallons	5.048
Methanol	1 barrel or 42 gallons	2.713
Natural gas	1 million cubic feet	1.035
Coal		
Anthracite	2,000 pounds	23.268
Bituminous & lignite	2,000 pounds	21.772
Asphalt & road oil	1 barrel or 42 gallons	6.636

Source:

Energy Information Administration, State Energy Data Report 1960-1992

Notes:

(a) The Energy Information Agency uses a weighted average by multiplying the quantity consumed of each component product (e.g. ethane, propane, butane, etc.) by each products heating value. The figure used in this table is the average value from 1984 to 1988.

Table A.2 Energy Unit Conversions

1 Btu	= 778.2 ft-lb	1 kWhr ^{1/}	= 3,412 Btu
	= 107.6 kg-m		= 2.655 x 10 ⁻⁶ ft-lb
	= 1055 J		= 3.671 x 10 ⁵ kg-m
	= 39.30 x 10 ⁻⁵ hp-h		= 1.341 hp-h
	= 29.31 x 10 ⁻⁵ kWhr		= 1.360 metric hp-h
1 kg-m	= 92.95 x 10 ⁻⁴ Btu	1 Joule	= 94.78 x 10 ⁻⁵ Btu
	= 7.233 ft-lb		= 0.7376 ft-lb
	= 9.806 J		= 0.1020 kg-m
	= 36.53 x 10 ⁻⁷ hp-h		= 37.25 x 10 ⁻⁸ hp-h
	= 37.04 x 10 ⁻⁷ metric hp-h		= 37.77 x 10 ⁻⁸ metric hp-h
	= 27.24 x 10 ⁻⁷ kWhr		= 27.78 x 10 ⁻⁸ kWhr
1 hp-h	= 2,544 Btu	1 metric hp-h	= 2,510 Btu
	= 1.98 x 10 ⁶ ft-lb		= 1.953 x 10 ⁶ ft-lb
	= 2.738 x 10 ⁶ kg-m		= 27.0 x 10 ⁴ kg-m
	= 2.685 x 10 ⁶ J		= 2.648 x 10 ⁶ J
	= 1.014 metric hp-h		= 0.9863 hp-h
	= 0.7475 kWhr		= 0.7355 kWhr

1 /

Electricity generation and distribution efficiency is approximately 29%. If this fact were considered
1 kWhr = 11,765 Btu.

Table A.3 Power Conversions

From	To					
	Horsepower	Kilowatts	Metric horsepower	Ft-lb per sec	Kilocalories per sec	Btu per sec
Horsepower	1.0000	0.7457	1.0140	550	0.1781	0.7068
Kilowatts	1.3410	1.0000	1.3600	737.6	0.2390	0.9478
Metric horsepower	0.9862	0.7353	1.0000	542.5	0.1757	0.6971
Ft-lb per sec	0.0018	0.0014	0.0018	1.0000	0.0003	0.0013
Kilocalories per sec	5.6148	4.1841	5.6915	3088	1.0000	3.9680
Btu per sec	1.4148	1.0551	1.4345	778.2	0.2520	1.0000

Table A.4 Metric Conversion Factors: Length

From	To					
	Inches	Feet	Miles	Centimeters	Meters	Kilometers
Inches	1.0000E+00	8.3333E-02	1.5783E-05	2.5400E+00	2.5400E-02	2.5400E-05
Feet	1.2000E+01	1.0000E+00	1.8939E-04	3.0480E+01	3.0480E-01	3.0480E-04
Miles	6.3360E+04	5.2800E+03	1.0000E+00	1.6093E+05	1.6093E+03	1.6093E+00
Centimeters	3.9370E-01	3.2808E-02	6.2137E-06	1.0000E+00	1.0000E-02	1.0000E-05
Meters	3.9370E+01	3.2808E+00	6.2137E-04	1.0000E+02	1.0000E+00	1.0000E-03
Kilometers	3.9370E+04	3.2808E+03	6.2137E-01	1.0000E+05	1.0000E+03	1.0000E+00

E Notation:

E-06=1/1000000 E-05=1/100000 E-04=1/10000 E-03=1/1000 E-02=1/100 E-01=1/10

E+00=1 E+05=100000 E+04=10000 E+03=1000 E+02=100 E+01=10

Table A.5 Metric Conversion Factors: Mass

From	To					
	Ounces	Pounds	Short tons	Grams	Kilograms	Megagrams
Ounces	1.0000E+00	6.2500E-02	3.1250E-05	2.8350E+01	2.8350E-02	2.8350E-05
Pounds	1.6000E+01	1.0000E+00	5.0000E-04	4.5360E+02	4.5360E-01	4.5360E-04
Short tons	3.2000E+04	2.0000E+03	1.0000E+00	9.0720E+05	9.0720E+02	9.0720E-01
Grams	3.5273E-02	2.2046E-03	1.1023E-06	1.0000E+00	1.0000E-03	1.0000E-06
Kilograms	3.5273E+01	2.2046E+00	1.1023E-03	1.0000E+03	1.0000E+00	1.0000E-03
Megagrams	3.5273E+04	2.2046E+03	1.1023E+00	1.0000E+06	1.0000E+03	1.0000E+00

E Notation:

E-06=1/1000000	E-05=1/100000	E-04=1/10000	E-03=1/1000	E-02=1/100	E-01=1/10
E+00=1	E+05=100000	E+04=10000	E+03=1000	E+02=100	E+01=10

Table A.6 Metric Equivalents for Volume

1 cm ³	=	0.061 in ³
1 in ³	=	16.39 cm ³
1 m ³	=	35.314 ft ³
1 ft ³	=	0.02832 m ³
1 m ³	=	1.308 yd ³
1 yd ³	=	0.7646 m ³
1 L (dry)	=	0.908 qt
1 qt (dry)	=	1.101 L
1 L (liquid)	=	1.0567 qt
1 qt (liquid)	=	0.9463 L
1 US gal	=	3.785 L
<hr/>		
1 L	=	0.264 US gal

Table A.7 Consumer Price Index (CPI)

From	To											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1970	1.000	1.043	1.078	1.144	1.270	1.368	1.466	1.561	1.680	1.869	2.122	2.342
1971	0.958	1.000	1.033	1.096	1.217	1.311	1.404	1.495	1.609	1.791	2.033	2.244
1972	0.928	0.968	1.000	1.107	1.179	1.270	1.360	1.449	1.559	1.734	1.969	2.173
1973	0.874	0.912	0.942	1.000	1.110	1.196	1.281	1.364	1.468	1.634	1.855	2.047
1974	0.787	0.821	0.848	0.939	1.000	1.077	1.154	1.229	1.322	1.471	1.670	1.843
1975	0.721	0.752	0.777	0.860	0.916	1.000	1.057	1.125	1.211	1.348	1.530	1.689
1976	0.682	0.711	0.735	0.814	0.866	0.933	1.000	1.065	1.146	1.275	1.447	1.597
1977	0.641	0.669	0.691	0.765	0.814	0.877	0.940	1.000	1.077	1.198	1.360	1.501
1978	0.595	0.621	0.641	0.710	0.756	0.814	0.872	0.929	1.000	1.112	1.263	1.393
1979	0.535	0.558	0.577	0.638	0.679	0.732	0.784	0.835	0.899	1.000	1.135	1.253
1980	0.471	0.491	0.508	0.562	0.598	0.644	0.690	0.735	0.791	0.880	1.000	1.103
1981	0.427	0.445	0.460	0.509	0.542	0.584	0.626	0.667	0.717	0.798	0.906	1.000
1982	0.402	0.419	0.433	0.480	0.511	0.550	0.589	0.628	0.675	0.751	0.853	0.941
1983	0.390	0.407	0.420	0.465	0.495	0.534	0.572	0.609	0.655	0.729	0.828	0.913
1984	0.374	0.390	0.403	0.446	0.475	0.512	0.548	0.584	0.628	0.699	0.794	0.876
1985	0.361	0.377	0.389	0.431	0.458	0.494	0.529	0.564	0.606	0.675	0.766	0.845
1986	0.354	0.369	0.382	0.422	0.450	0.484	0.519	0.553	0.595	0.662	0.751	0.829
1987	0.342	0.357	0.369	0.408	0.434	0.468	0.501	0.534	0.575	0.639	0.726	0.801
1988	0.328	0.342	0.354	0.391	0.417	0.449	0.481	0.512	0.551	0.613	0.696	0.768
1989	0.313	0.326	0.337	0.373	0.398	0.428	0.459	0.489	0.526	0.585	0.664	0.733
1990	0.297	0.310	0.320	0.354	0.377	0.406	0.435	0.464	0.499	0.555	0.630	0.696
1991	0.285	0.297	0.307	0.340	0.362	0.390	0.418	0.445	0.479	0.533	0.605	0.667

Source:

U.S. Department of Labor Statistics, Monthly Labor Review, Washington, D.C., monthly

Note:

CPI continued on next page

Table A.7 Consumer Price Index (CPI) ...continued

From	To													
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995*
1970	2.486	2.566	2.675	2.770	2.824	2.927	3.046	3.193	3.367	3.508	3.614	3.724	3.820	3.888
1971	2.382	2.458	2.563	2.654	2.705	2.804	2.918	3.059	3.226	3.361	3.465	3.568	3.660	3.725
1972	2.307	2.381	2.482	2.571	2.621	2.716	2.827	2.963	3.125	3.255	3.354	3.457	3.546	3.609
1973	2.173	2.243	2.338	2.421	2.468	2.558	2.662	2.791	2.943	3.066	3.158	3.255	3.338	3.398
1974	1.956	2.019	2.105	2.180	2.222	2.304	2.397	2.513	2.650	2.761	2.846	2.931	3.007	3.060
1975	1.792	1.850	1.929	1.997	2.036	2.110	2.196	2.302	2.428	2.529	2.607	2.686	2.755	2.804
1976	1.695	1.750	1.824	1.889	1.926	1.996	2.077	2.178	2.296	2.392	2.465	2.540	2.605	2.651
1977	1.594	1.645	1.715	1.776	1.810	1.876	1.952	2.047	2.158	2.249	2.316	2.384	2.446	2.490
1978	1.479	1.527	1.592	1.648	1.680	1.742	1.812	1.900	2.003	2.087	2.151	2.216	2.273	2.314
1979	1.330	1.373	1.431	1.482	1.511	1.566	1.630	1.708	1.801	1.877	1.933	1.990	2.042	2.078
1980	1.171	1.209	1.260	1.305	1.330	1.379	1.435	1.504	1.586	1.652	1.703	1.754	1.799	1.831
1981	1.062	1.096	1.142	1.183	1.206	1.250	1.301	1.363	1.438	1.498	1.543	1.590	1.631	1.660
1982	1.000	1.032	1.075	1.114	1.135	1.177	1.224	1.284	1.354	1.410	1.454	1.497	1.536	1.563
1983	0.970	1.000	1.043	1.080	1.101	1.142	1.188	1.245	1.313	1.368	1.409	1.451	1.488	1.515
1984	0.930	0.960	1.000	1.036	1.056	1.095	1.139	1.194	1.259	1.312	1.351	1.391	1.427	1.452
1985	0.897	0.926	0.966	1.000	1.019	1.057	1.100	1.153	1.215	1.266	1.304	1.343	1.378	1.402
1986	0.880	0.908	0.947	0.981	1.000	1.036	1.078	1.130	1.192	1.242	1.280	1.318	1.352	1.377
1987	0.850	0.878	0.915	0.947	0.966	1.000	1.042	1.092	1.152	1.200	1.235	1.272	1.305	1.328
1988	0.815	0.842	0.877	0.909	0.926	0.960	1.000	1.047	1.104	1.151	1.186	1.221	1.253	1.275
1989	0.778	0.803	0.837	0.867	0.884	0.916	0.953	1.000	1.054	1.098	1.132	1.165	1.195	1.217
1990	0.738	0.762	0.794	0.823	0.839	0.869	0.905	0.948	1.000	1.042	1.074	1.106	1.134	1.154
1991	0.709	0.731	0.762	0.789	0.805	0.834	0.868	0.910	0.960	1.000	1.030	1.061	1.088	1.108
1992	0.688	0.710	0.740	0.767	0.781	0.810	0.843	0.883	0.931	0.971	1.000	1.030	1.056	1.075
1993	0.668	0.689	0.719	0.745	0.758	0.786	0.819	0.858	0.904	0.943	0.971	1.000	1.026	1.044
1994	0.651	0.672	0.701	0.726	0.739	0.766	0.798	0.837	0.882	0.919	0.947	0.975	1.000	1.018
1995	0.640	0.660	0.689	0.713	0.726	0.753	0.784	0.822	0.866	0.903	0.930	0.958	0.982	1.000

Source:

U.S. Department of Labor Statistics, Monthly Labor Review, Washington, D.C., monthly

Note:

* Based on the first quarter, 1995

GLOSSARY

Anthracite: A hard black, lustrous coal containing a high percentage of fixed carbon and a low percentage of volatile matter. It is also called hard coal.

ASTM: Acronym for the American Society for Testing and Materials.

Average Length of Haul: The total number of ton-miles divided by the total number of tons carried.

Aviation Gasoline: All special grades of gasoline used in aviation reciprocating engines, as given in the ASTM Specification D910. Does not include blending components used in blending or compounding into finished aviation gasoline.

Bituminous Coal: A coal greater in volatility than anthracite, and which has a rich carbon content. In the U.S., it is also known as soft coal.

British Thermal Unit (Btu): The amount of energy required to raise the temperature of 1 pound of water 1 degree F at or near 39.2 degrees F (approximately the energy generated by striking a single match). One Btu is approximately equal to 252 International Steam Table calories. An average Btu content of fuel is a heat value per unit quantity of fuel determined from tests of fuel samples.

Butane: A normally gaseous, paraffinic hydrocarbon extracted from natural gas or refinery streams. It is used primarily for blending into high-octane gasoline, for residential and commercial heating, and for industrial purposes, especially the manufacture of chemicals and synthetic rubber.

Certificated Air Carrier: An air carrier holding a Certificate of Public Convenience and Necessity issued by the USDOT, to conduct scheduled services interstate. Nonscheduled or chartered operations may also be conducted by these carriers. They operate large aircraft (at least 30 seats or a maximum payload of 7,500 pounds or more) in accordance with FAR part 121.

Combination(s) (Trucks): Consist of a power unit (called a truck tractor in the industry) and one or two trailing units (a semi-trailer). Vehicles termed "Semi" or "18-wheeler" are examples of combination trucks.

Commercial Sector: Nonmanufacturing business establishments, including hotels, motels, restaurants, wholesale businesses, retail stores, laundries, and other service enterprises; health, social, and educational institutions; and Federal, State, and local governments.

Compressed Natural Gas (CNG): An alternative automotive fuel derived from natural gas feedstock. Storage conditions are such that it must be compressed at approximately 3,000 pounds per square inch.

Constant Dollars: Dollars which have been adjusted by some index of inflation, such as the Consumer Price Index (CPI), to some baseline year. Also termed "real dollars".

Crude Oil: A mixture of hydrocarbon-carbons existing as a liquid in underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Lease condensate and liquid hydrocarbons from tar sands, gilsonite, oil shale, and drip gases are also included in this definition. However, residual oil and other unfinished oils are not.

Current Dollars: Dollars which have not been adjusted to account for the effect of inflation. Also termed "nominal dollars".

Diesel Fuel: See Distillate Fuel Oil.

Distillate Fuel Oil: Light fuels fuel oils distilled during the refining process and used primarily for space heating, on- and off highway diesel engine fuel (including railroad engine fuel and fuel for agricultural machinery) and electric power generation. This definition is inclusive of such refined products termed as No. 1, No. 2 and No. 4 fuel oil and No.1, No. 2, and No. 4 diesel fuel, conforming to ASTM Specifications D396 or D975, respectively. No. 1 fuel oil is a light distillate fuel oil used in vaporizing pot-type burners, while No. 2 fuel oil is used in atomizing-type burners for domestic heating or moderate capacity commercial-industrial burner units. No. 4 fuel oil is a blend of distillate fuel oil

and residual fuel oil typically used in commercial burner operations that are not equipped with preheating facilities. Diesel fuels are used in compression-ignition engines.

Ethane: A normally gaseous, paraffinic hydrocarbon (C₂H₆) extracted from natural gas or refinery gas streams. Used primarily as petrochemical feedstock for production of chemicals and plastic materials.

Ethanol: An alcohol fuel most commonly produced by hydration of ethylene or by fermentation of biomass. Most industrial-use ethanol is synthetically made by mixing ethylene with steam. To produce ethanol via fermentation, the action of certain enzymes derived from yeast cells upon carbohydrates, such as glucose, is required.

Ethylene: A normally gaseous, olefinic hydrocarbon (C₂H₄) recovered from refinery processes. Quantities are included with "ethane" data.

Exports: Shipments of goods from the 50 States and the District of Columbia to foreign countries, Puerto Rico, The Virgin Islands, and other U.S. possessions and territories.

Fossil Fuels: Refers to energy sources crude oil, natural gas, and coal.

Gasohol: A blend of finished motor gasoline and alcohol (most commonly ethanol) in which at least 10 percent of the product content is alcohol.

Heavy Oil: Heavy oils (i.e. No. 4, No. 5, and No. 6 fuel oils, crude oil, and residual fuel) used at electric utility plants for the generation of electricity. Except for start-up and flame stabilization, virtually all petroleum used at steam-electric plants can be classified as heavy oil.

Imports: Receipts of goods into the 50 States and the District of Columbia from foreign countries, Puerto Rico, The Virgin Islands, and other U.S. possessions and territories.

Industrial Sector: Refers to agriculture, construction, fishing, forestry, and manufacturing establishments.

Jet Fuel: Includes both naphtha-based and kerosene-based jet fuel meeting the standards for use in aircraft turbine engines or meeting ASTM Specification D1655. Naphtha-based jet fuel

is primarily used by the military in turbojet and turboprop aircraft engines; while kerosene-based jet fuel is mostly used in commercial turbojet and turboprop aircraft. Jet fuel is predominantly used in aircraft, although some is used to power turbines to produce electricity.

Kerosene: A middle distillate fuel oil, pale yellow in appearance, most suitable for use as an illuminant when burned in wick lamps. Included are No. 1-K and No. 2-K recognized in ASTM Specification D3699 and grades of kerosene called range oil, which has properties similar to No. 1 fuel oil. Kerosene is used primarily in space heaters, cooking stoves, and water heaters.

Lease Condensate: A natural gas liquid recovered from gas-well gas in lease separators or natural gas field facilities. It consists mostly of pentanes and heavier hydrocarbons and is generally blended with crude oil for refining.

Light Oil: Lighter fuel oils (No. 1 and No. 2 fuel oils, kerosene, and jet fuel) used at electric utilities for generation of electricity. Virtually all petroleum used in internal combustion and gas turbines electric power plants is light oil.

Light Trucks: Unless otherwise stated, light trucks are considered to be single unit, two axle, four tire vehicles weighing less than 10,000 pounds. This would include vans and utility vehicles, as well.

Lignite: A brownish-black coal of low rank with high inherent moisture and volatile matter, and is also referred to as brown coal.

Liquid Petroleum Gases (LPG): Ethane, propane, normal butane, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at natural gas processing plants, including plants that fractionate raw natural gas plant liquids. LPG also includes liquified refinery gases (ethylene, propylene, butylene, and isobutylene produced from crude oil at refineries).

Liquified Natural Gas (LNG): A liquified form of natural gas that has higher storage capacity than compressed natural gas (CNG), but is more energy intensive than CNG.

Load-Factor: The average number of persons per vehicle.

Lubricants: Petroleum base substances use to reduce friction between surfaces. They may be produced either from distillates or residues, and includes all grades of lubricating oils from spindle oil to cylinder oil and those used in greases.

Methanol: Methyl alcohol, the simplest of the alcohols. Used with other higher alcohols as an octane enhancer, and an automotive fuel by itself or blended with gasoline. It is produced from a wide variety of feedstocks such as natural gas, crude oil, coal, and biomass.

Motor Gasoline: A complex mixture of relatively volatile hydrocarbons, with or without small quantities of additives, that have been blended for suitable use in spark-ignition engines and conforming to ASTM Specification D439. Included are finished leaded gasoline, unleaded gasoline, and gasohol.

Natural Gas: A mixture of hydrocarbons (principally methane) and small quantities of various nonhydrocarbons existing in gaseous phase or in solution with crude oil in underground resevoirs.

Olefins: Also known as alkenes, are unsaturated hydrocarbons, one with a double bond between two carbons, and have the formula C_nH_{2n} . Examples are : ethelyne(C_2H_4) and propylene (C_3H_6).

Parafins: Also termed alkanes, are hydrocarbons having the formula C_nH_{2n+2} , i.e. CH_4 (methane), C_2H_6 (ethane), C_3H_8 (propane), etc.

Passenger-Mile (Traveled): One passenger transported one mile. The total number of miles traveled by all passengers in passenger vehicles.

Petroleum: A generic term applied to oil and oil products in all forms.

Propane: A normally gaseous, paraffinic hydrocarbon that is extracted from natural gas or refinery gas streams, and includes all products covered by Gas Producers Association Specifications for commercial propane and HD-5 propane and ASTM Specification D1835. It is primarily used for residential and commercial heating and cooling, and also as a transportation fuel. In the industrial sector, it is used as a petrochemical feedstock.

Propylene: A normally gaseous, olefinic hydrocarbon recovered from refinery processes. Quantities are included with "propane/ethane/LPG" data.

Public Vehicles: Includes Federal, State, County, and Municipal vehicles; but excludes those of the military.

Residential Sector: Private households which consume energy for space heating, water heating, airconditioning, lighting, refrigeration, cooking, and clothes drying.

Residual Fuel Oil: The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations and conform to ASTM Specifications D396 and 975. Included are No. 5, a residual fuel of medium viscosity; Navy Special, for use in steam-powered vessels in government service and in shore power plants; No. 6, which includes Bunker C fuel oil, and is used for commercial and industrial heating and electricity generation. In this data base, residual fuel oil is synonymous with marine use.

Revenue Aircraft Miles: Total number of miles traveled by aircraft for which remuneration was received.

Revenue Cargo (Freight) Ton-Mile: One short ton of freight transported one mile. Ton-miles are computed by summation of the products of the aircraft miles flown on each interairport flight stage multiplied by the number of tons carried on that flight stage. Standard Transportation Commodity Code (STCC) : Codification system for standard commodities developed by the Interstate Commerce Commission.

Transportation Sector: Private and public vehicles that move people and commodities. Included are automobiles, buses, motorcycles, trucks, railroads and railways, aircraft, ships, barges, and natural gas pipelines.

Vehicle-Miles (Traveled): Total number of annual miles traveled by all vehicles of interest. Suppose, for example, all households in North Zulch, Texas had three vehicles in 1991; vehicle A traveled 10,000 miles ; vehicle B traveled 14,000 miles; and, vehicle C traveled 12,000. Therefore, the number of vehicle-miles traveled in 1991 by households in North Zulch, Texas is 36,000 miles.