Texas Transportation Energy Data Book

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The Texas A&M University System
College Station, Texas 77843-3135

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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 compares energy related transportation statistics of Texas with seven other comparable states. Chapter 2 provides a snapshot of the Texas transportation energy picture. Energy characteristics of the highway and non-highway modes are found in chapters 3 and 4, respectively. Chapter 5 concludes this volume and furnishes information about alternative fuels and new energy saving technology.

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TABLE OF CONTENTS

Page

List of Figures vi

Acknowledgment ix

Abstract x

Introduction xi

Chapter 1 Comparative Energy Related Transportation Statistics 1

Table 1.1 Transportation Use of Petroleum for Selected States, 1988... 2
Table 1.2 Automobile Registrations for Selected States, 1970-88 3
Table 1.3 Truck and Bus Registrations for Selected States, 1970-88 ...4
Table 1.4 Private and Commercial Vehicles Per Capita for Selected States, 1970-88 6
Table 1.5 Motor Gasoline Prices for Selected States 7
Table 1.6 Distillate Fuel Prices for Selected States 8
Table 1.7 Motor Gasoline Taxes for Selected States, 1970-88 10
Table 1.8 Distillate Fuel Taxes for Selected States, 1970-88 11
Table 1.9 Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1988 14

Chapter 2 Transportation Energy Characteristics of Texas 18

Table 2.1 Texas Petroleum Production and Consumption 19
Table 2.2 Texas Petroleum Consumption by Sector 21
Table 2.3 Distribution of Energy Consumption by Source 24
Table 2.4 Energy Consumption by End-Use Sector, 1970-88 27
Table 2.5 Energy Consumption by Transportation Mode 28
Table 2.6 Energy Consumption by Mode and Fuel Type, 1970 30
Table 2.7 Energy Consumption by Mode and Fuel Type, 1978 30
Table 2.8 Energy Consumption by Mode and Fuel Type, 1988 30
Table 2.9 Passenger Travel and Energy Use in Texas, 1988 35
Table 2.10 Energy Intensities of Passenger Modes in Texas 37
Table 2.11 Intercity Freight and Energy Use in Texas, 1988 38
Table 2.12 Energy Intensities of Freight Modes in Texas 39
Table 2.13 Retail Prices of Selected Highway Motor Fuels 41
Table 2.14 Retail Prices for Selected Transportation Fuels 43
Table 2.15 Crude Oil and Gasoline Prices 45

Chapter 3 Texas Highway Mode Characteristics **47**

Section 3.1 General Highway Mode Characteristics *48*

Table 3.1 Highway Mode Energy Consumption by Fuel Type 49
Table 3.2 Texas Highway Energy Use by Mode 53
Table 3.3 Detailed Vehicle Stock in Texas, 1988..... 55
Table 3.4 Vehicle Stock in Texas, 1970-88 58
Table 3.5 Texas Interstate Speed Data 61
Table 3.6 Texas Non-Interstate Speed Data 63

Section 3.2 Household Transportation Energy Data *65*

Table 3.7 Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures 66
Table 3.8 U.S. Travel and Consumption Characteristics by Number of Cylinders, 1988 v. 1983 70
Table 3.9 Average Miles Per Gallon by Model Year 75
Table 3.10 Vehicle Fuel Efficiency by Region..... 77
Table 3.11 Average Household Energy and Vehicle Expenditures, 1988..79
Table 3.12 Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1988 83
Table 3.13 Average Vehicle Miles Traveled Per Household by Family Income, 1988 85
Table 3.14 Average Vehicle Miles Traveled by Household Composition, 1988 88

Section 3.3 Automobile and Transit Data *92*

Table 3.15 Cost of Operating an Automobile in the U.S. 93
Table 3.16 Estimated Automobile Fuel Economy by Vehicle Type, 1991 Model Year 96
Table 3.17 Texas Statewide Municipal Transit Ridership 97

Section 3.4 Truck Data *99*

Table 3.18 Estimated Single Unit Truck Fuel Economy in Texas 100
Table 3.19 Estimated Combination Truck Fuel Economy in Texas 101
Table 3.20 Texas Truck Mileage by Vehicle Size 103
Table 3.21 Texas Truck Mileage by Vehicle Range 105
Table 3.22 Texas Truck Mileage by Major Use 107
Table 3.23 Commodities Shipped Via Texas Highways, 1991 108

Chapter 4 Texas Non-Highway Mode Characteristics **110**

Section 4.1 Air Mode *111*

Table 4.1 Air Mode Energy Consumption by Fuel Type 112

Table 4.2 Summary Statistics for Domestic and International Route Air Carriers Operating in Texas 115
Table 4.3 Texas Traffic Data for Large Certificated Air Carriers 118
Table 4.4 Enplanements and Estimated Energy Use for Selected Texas Cities 119
Table 4.5 Air Freight for Selected Texas Cities 120
Table 4.6 Summary Statistics for General Aviation in Texas 123
Table 4.7 Distribution of General Aviation Aircraft in Texas 125

Section 4.2 Water Mode 127

Table 4.8 Water Mode Energy Consumption by Fuel Type 128
Table 4.9 Summary Statistics for Domestic Waterborne Traffic in Texas 131
Table 4.10 Summary Statistics for Galveston District 133
Table 4.11 Statistics for Galveston District by Selected Waterway 135
Table 4.12 Summary Statistics for Texas Gulf Intracoastal Waterway 137
Table 4.13 Sabine-Galveston Leg of Gulf Intracoastal Waterway 139
Table 4.14 Galveston-Corpus Christi Leg of Gulf Intracoastal Waterway 141
Table 4.15 Corpus Christi-Border Leg of Gulf Intracoastal Waterway 143
Table 4.16 Commodities Shipped by Water in Texas 145

Section 4.3 Pipeline Mode 147

Table 4.18 Texas Pipeline Shipments of Energy 148

Section 4.4 Rail Mode 149

Table 4.19 Rail Mode Energy Consumption by Fuel Type 150
Table 4.20 Freight and Energy Statistics of Class I Railroads Operating in Texas 151
Table 4.21 Comparative Statistics for 1988 Class I Railroads 152
Table 4.22 Route Miles of Track Owned in Texas by Class I Railroads . 153
Table 4.23 Top Five Commodities of Total Freight by Tonnage, 1988 .. 154
Table 4.24 Top Five Commodities of Total Freight by Carloads,1988 .. 156

Chapter 5 Alternative Fuels and New Energy Saving Technology 158

Section 5.1 Alternative Fuels 159

Table 5.1 Fuel Prices for Countries Having Alternative Fuel Vehicles 160
Table 5.2 Comparison of Economically Feasible Alternative Fuels 165
Table 5.3 Direct Carbon Dioxide (CO_2) Emissions of Selected Alternative Fuels 166

Section 5.2 New Technology *167*

Table 5.4 Technology Concepts for Improving Fuel Efficiency 168
Table 5.5 New Energy Saving Automobiles 169

Title Index **170**

LIST OF FIGURES

Page

Chapter 1 Comparative Energy Related Transportation Statistics ... 1

Figure 1.1 Texas Auto, Bus, and Truck Registrations as a Percentage of U.S. Registrations, 1970-88 ... 5
Figure 1.2 Gasoline Prices of Selected States, 1988 ... 9
Figure 1.3 Distillate Fuel Prices of Selected States, 1988 ... 12
Figure 1.4 Transportation Energy Consumption as a Percentage of 1972 Baseline ... 13
Figure 1.5 Household Vehicle Miles Traveled, 1988 ... 15
Figure 1.6 Annual Gallons Consumed Per Household, 1988 ... 16
Figure 1.7 Annual Vehicle Fuel Expenditures Per Household, 1988 ... 17

Chapter 2 Transportation Energy Characteristics of Texas ... 18

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, 1988 ... 25
Figure 2.5 Texas Transportation Petroleum Consumption as a Percentage of Texas Petroleum Production ... 26
Figure 2.6 Distribution of Texas Transportation Energy by Mode ... 29
Figure 2.7 Distribution of Texas Transportation Energy by Fuel Type, 1970 . 31
Figure 2.8 Distribution of Texas Transportation Energy by Fuel Type, 1978 . 32
Figure 2.9 Distribution of Texas Transportation Energy by Fuel Type, 1988 . 33
Figure 2.10 Distribution of Transportation Energy Use by Mode, 1988 ... 34
Figure 2.11 Passenger Energy Intensity in Texas ... 36
Figure 2.12 Intercity Freight Energy Intensities in Texas, 1988 ... 40
Figure 2.13 Prices (in Constant $ 1988) of Motor Fuels in Texas ... 42
Figure 2.14 Prices (in Constant $ 1988) of Non-Highway Fuels in Texas ... 44
Figure 2.15 Prices (in Constant $ 1988) of Crude Oil and Gasoline ... 46

Chapter 3 Texas Highway Mode Characteristics ... 47

Section 3.1 General Highway Mode Characteristics ... 48

Figure 3.1 Texas Highway Energy Use by Fuel Type , 1970 ... 50
Figure 3.2 Texas Highway Energy Use by Fuel Type , 1988 ... 51
Figure 3.3 Percentage of Highway Energy Consumption by Mode ... 52
Figure 3.4 Automobiles and Trucks Registered in Texas ... 54
Figure 3.5 Texas Private Vehicle Stock Growth ... 56
Figure 3.6 Public Vehicle Stock Growth ... 57
Figure 3.7 Speed of Vehicles on Texas Interstates ... 59
Figure 3.8 Urban and Rural Interstate Speed Data, 1978 and 1988 ... 60

Figure 3.9 Speed of Vehicles on Texas Freeways, Expressways, Other Primary and Major Arterials 62
Figure 3.10 Urban and Rural Speed Data for Freeways, Expressways, Other Primary and Major Arterials, 1988..... 64

Section 3.2 Household Transportation Energy Data 65

Figure 3.11 Average Annual Miles Traveled Per Household Vehicle 67
Figure 3.12 Average Annual Consumption Per Household Vehicle..... 68
Figure 3.13 Average Annual Energy Expenditures Per Household Vehicle 69
Figure 3.14 U.S. Average Annual Miles Traveled by Number of Cylinders 71
Figure 3.15 U.S. Average Annual Gallons Consumed by Number of Cylinders 72
Figure 3.16 U.S. Average Annual Expenditures by Number of Cylinders 73
Figure 3.17 U.S. Average Miles Per Gallon by Number of Cylinders 74
Figure 3.18 U.S. Average Fuel Efficiency by Model Year 76
Figure 3.19 U.S. Average Household Fuel Efficiency by Region 78
Figure 3.20 Average Household and Vehicle Energy Expenditures, 1988 80
Figure 3.21 Average Annual Energy Expenditures, 1988 81
Figure 3.22 Distribution of Average Annual Household Energy Costs, 1988 82
Figure 3.23 Average Annual Household Vehicle Miles Traveled by Fuel Efficiency Category 84
Figure 3.24 Average Annual Household Vehicle Miles Traveled, 1988 86
Figure 3.25 Effect of Household Income on Average Annual Vehicle Miles Traveled 87
Figure 3.26 Effect of Children on Average Annual Household Vehicle Miles Traveled 89
Figure 3.27 Effect of Childrens' Age on Average Annual Household Vehicle Miles Traveled, 1988..... 90
Figure 3.28 Average Annual Texas Household Vehicle Miles Traveled for Childless Households by Age of Adults, 1988 91

Section 3.3 Automobile and Transit Data 92

Figure 3.29 Average Annual Cost of Operating an Automobile, Current Dollars . 94
Figure 3.30 Average Annual Cost of Operating an Automobile , Constant $ 1987 95
Figure 3.31 Texas Statewide Municipal Transit Ridership, 1974-1988 98

Section 3.4 Truck Data 99

Figure 3.32 Miles Per Gallon of Trucks Operating in Texas 102
Figure 3.33 Distribution of Texas Trucks by Size 104
Figure 3.34 Distribution of Texas Trucks by Range of Operation 106
Figure 3.35 Distribution of Tons Shipped Via Texas Highways, 1991 109

Chapter 4 Texas Non-Highway Mode Characteristics 110

Section 4.1 Air Mode 111

Figure 4.1 Texas Air Mode Energy Use by Fuel Type, 1970 113
Figure 4.2 Texas Air Mode Energy Use by Fuel Type, 1988 114
Figure 4.3 Passenger-Miles, Cargo Ton-Miles and Energy Use in Texas for Certificated Route Air Carriers 116
Figure 4.4 Average Passenger Trip Length for Certificated Route Air Carriers 117
Figure 4.5 Tons of Air Mail for Selected Texas Cities 121
Figure 4.6 Tons of Air Freight for Selected Texas Cities 122
Figure 4.7 Passenger-Miles and Energy Use for General Aviation in Texas ... 124
Figure 4.8 General Aviation Aircraft Growth in Texas 126

Section 4.2 Water Mode 127

Figure 4.9 Water Mode Energy Use by Fuel Type, 1970 129
Figure 4.10 Water Mode Energy Use by Fuel Type, 1988 130
Figure 4.11 Traffic Growth and Energy Use on Texas Waterways 132
Figure 4.12 Traffic Growth and Energy Use for Galveston District 134
Figure 4.13 Contribution of Selected Waterways to Galveston District Tonnage.136
Figure 4.14 Texas Gulf Intracoastal Waterway Traffic Growth and Energy Use .138
Figure 4.15 Traffic Growth and Energy Use on Sabine-Galveston Leg of GIWW 140
Figure 4.16 Traffic Growth and Energy Use on Galveston-Corpus Christi Leg of GIWW 142
Figure 4.17 Traffic Growth and Energy Use on Corpus Christi-Border Leg of GIWW 144
Figure4.18 Commodities Shipped by Water in Texas, 1988 146

Section 4.4 Rail Mode 149

Figure 4.19 Texas Commodity Distribution of Railroad Revenue Tonnage, 1988 155
Figure 4.20 Texas Commodity Distribution of Railroad Revenue Carloadings, 1988 157

Chapter 5 Alternative Fuels and New Energy Saving Technology 158

Section 5.1 Alternative Fuels 159

Figure 5.1 Gasoline Prices (Per Gallon) for Japan, France, Italy and Sweden.161
Figure 5.2 Gasoline Prices (Per Gallon) for Germany, Canada and the United States 162
Figure 5.3 Diesel Prices (Per Gallon) for Japan, France, Italy and Sweden ...163
Figure 5.4 Diesel Prices (Per Gallon) for Germany, Canada and the United States 164

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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. 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.

INTRODUCTION

Energy efficiency in transportation is a significant element in the State's ability to achieve and maintain reduced consumption of fossil fuels. The Texas transportation sector consumes approximately 50% of the petroleum produced in the State. And of all the petroleum used by the transportation sector, over 50% of the fuel used in transporting people and freight in Texas is motor gasoline. Obviously, improvements in energy efficiencies of all transportation modes are a vital element in the future energy health of the State and Nation. The ***Texas Transportation Energy Data Book*** was developed in order that public policy experts and other decision makers in Texas would have a reliable and easily accessible source of information for evaluating the effectiveness of energy efficiencies and alternative energy technologies among the transportation modes in Texas.

CHAPTER 1

COMPARATIVE ENERGY RELATED TRANSPORTATION STATISTICS

In this chapter, energy related transportation statistics from Texas are 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 1.1 compares the transportation use of petroleum products for these selected states. Tables 1.2 through 1.4 shows the vehicle stock of these states. Tables 1.5 and 1.6 depicts motor fuel prices for these states in current and constant dollars. Table 1.7 and 1.8 detail state motor fuel taxes, and Table 1.9 provides household transportation information.

Table 1.1 Transportation Use of Petroleum Products for Selected States, 1988

	Trillion Btu									
	Motor gasoline	Percent motor gasoline of transport. petroleum use	Aviation gasoline	LPG	Jet fuel	Distillate fuel	Residual fuel	Total transport. petroleum use	Percent transport. of total petroleum use	Total petroleum use
Northeast:										
New York	692.5	82.2%	0.5	0.4	27.0	108.3	14.2	842.9	45.9%	1,834.8
Pennsylvania	578.1	70.7%	1.0	0.5	67.4	146.3	24.2	817.6	61.4%	1,332.5
Midwest:										
Ohio	599.8	75.0%	1.7	1.5	52.3	143.9	0.1	799.4	69.6%	1,149.1
Illinois	606.8	80.0%	0.9	1.5	22.1	124.9	2.3	758.5	61.2%	1,239.7
West:										
California	1,581.7	58.8%	6.6	3.0	461.0	355.4	281.8	2,689.6	77.2%	3,481.9
Washington	263.2	51.7%	1.1	0.9	112.2	73.3	58.5	509.2	72.1%	706.2
South:										
Florida	736.9	66.6%	4.5	0.6	179.5	148.3	36.5	1,106.3	71.0%	1,559.2
Texas	**1,069.0**	**52.3%**	**5.1**	**1.7**	**540.6**	**307.6**	**120.7**	**2,044.6**	**45.9%**	**4,457.1**

Source:

State Energy Data Report, Energy Information Administration, 1990

Note:

Data reflects allocation of lubricants

Table 1.2 Automobile Registrations for Selected States, 1970-88

Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
1970	6,000,468	5,058,682	5,305,381	4,559,069	9,883,790	1,618,603	3,556,410	5,127,921
1971	6,162,960	5,214,078	5,344,159	4,707,141	10,234,172	1,656,103	3,917,887	5,335,492
1972	6,269,906	5,460,277	5,644,930	4,903,960	10,560,142	1,702,412	4,132,336	5,553,182
1973	6,531,932	5,746,394	5,817,020	5,120,721	10,910,604	1,784,389	4,536,840	5,880,897
1974	6,637,871	6,166,528	6,097,830	5,258,649	11,162,119	1,826,023	4,704,754	6,007,106
1975	6,735,148	6,589,466	6,288,050	5,350,375	11,226,325	1,883,271	4,499,154	6,217,464
1976	6,734,255	6,947,303	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	8,440,098	6,172,035	6,861,586	6,232,080	15,930,661	2,682,095	8,488,246	8,477,858
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
				Average annual change				
Time Period:								
1970-88	2.0%	1.2%	1.6%	1.9%	2.9%	3.0%	5.1%	2.8%
1983-88	3.1%	1.7%	1.7%	1.5%	3.4%	3.1%	4.1%	0.7%

Source:

Highway Statistics, Summary to 1985; Annual 1986-88

Public and private automobiles

Table 1.3 Truck and Bus Registrations for Selected States, 1970-88

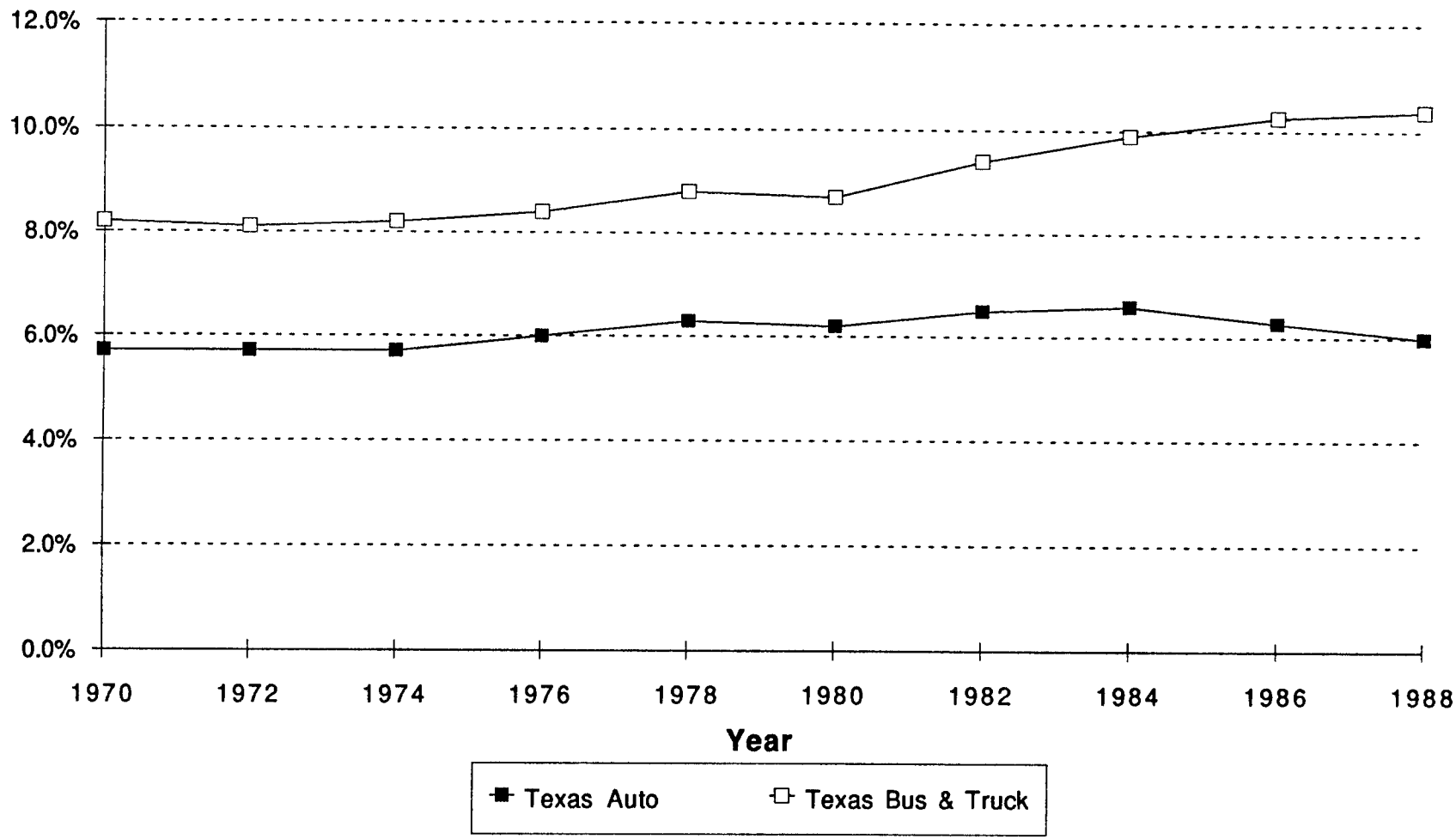
Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	**Texas**
1970	717,558	759,871	668,520	678,807	2,017,106	483,358	563,953	1,565,359
1971	727,884	809,497	698,950	709,880	2,133,009	507,014	616,413	1,648,777
1972	736,546	851,053	769,415	739,893	2,292,086	539,468	703,650	1,762,529
1973	787,561	928,346	827,590	831,227	2,502,170	586,221	810,405	1,934,748
1974	819,931	1,008,517	867,651	915,453	2,522,280	618,423	911,316	2,046,163
1975	856,210	1,069,839	890,883	993,500	2,664,345	656,493	896,218	2,179,025
1976	916,414	1,180,152	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
				Average annual change				
Time Period:								
1970-88	3.3%	3.9%	5.0%	4.4%	5.0%	4.9%	8.0%	5.3%
1983-88	3.8%	6.5%	3.7%	-1.6%	4.8%	3.0%	6.0%	2.3%

Source:

Highway Statistics, Summary to 1985; Annual 1986-88

Public and private vehicles

Figure 1.1 Texas Auto, Bus, and Truck Registrations as a Percentage of U.S. Registrations, 1970-88



Source: Tables 1.2 and 1.3

Table 1.4 Private and Commercial Vehicles Per Capita for Selected States, 1970-88

Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
1970	0.37	0.49	0.56	0.47	0.60	0.62	0.61	0.60
1971	0.38	0.51	0.57	0.49	0.61	0.62	0.64	0.61
1972	0.39	0.53	0.60	0.51	0.62	0.63	0.66	0.62
1973	0.41	0.56	0.62	0.53	0.64	0.66	0.71	0.65
1974	0.42	0.61	0.65	0.55	0.64	0.66	0.72	0.65
1975	0.42	0.65	0.67	0.56	0.64	0.68	0.66	0.67
1976	0.43	0.69	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	0.80	0.68	0.75	0.85	0.89	0.72
				Average annual change				
Time Period:								
1970-88	2.3%	1.5%	2.0%	2.0%	1.3%	1.8%	2.1%	1.1%
1983-88	2.9%	2.5%	2.0%	0.7%	1.4%	1.7%	1.6%	-0.5%

Sources:

Highway Statistics, Summary to 1985; Annual 1986-88; Statistical Abstract of the United States 1989

Table 1.5 Motor Gasoline Prices for Selected States

	Current dollars per gallon (a)									Average annual change
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1980-88
Texas	1.16	1.31	1.23	1.09	1.08	1.10	0.81	0.90	0.92	-3.3%
California	1.27	1.42	1.35	1.12	1.09	1.09	0.84	0.87	0.89	-5.1%
Florida	1.23	1.37	1.31	1.14	1.12	1.13	0.84	0.89	0.89	-4.5%
Illinois	1.23	1.33	1.29	1.14	1.10	1.13	0.85	0.90	0.91	-4.2%
Ohio	1.18	1.33	1.29	1.18	1.14	1.14	0.85	0.92	0.93	-3.4%
New York	1.28	1.40	1.31	1.15	1.09	1.10	0.83	0.87	0.90	-5.0%
Pennsylvania	1.21	1.35	1.26	1.15	1.11	1.13	0.82	0.88	0.88	-4.5%
Washington	1.24	1.38	1.32	1.14	1.16	1.16	0.91	0.92	0.93	-4.1%

	Constant 1988 dollars per gallon (b)									Average annual change
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1980-88
Texas	1.66	1.71	1.51	1.30	1.23	1.21	0.87	0.94	0.92	-8.2%
California	1.83	1.84	1.66	1.33	1.25	1.19	0.90	0.87	0.89	-9.9%
Florida	1.76	1.78	1.61	1.36	1.27	1.24	0.90	0.89	0.89	-9.3%
Illinois	1.76	1.73	1.58	1.35	1.26	1.24	0.91	0.90	0.91	-9.0%
Ohio	1.70	1.73	1.58	1.40	1.30	1.26	0.91	0.92	0.93	-8.2%
New York	1.84	1.83	1.60	1.36	1.24	1.21	0.89	0.87	0.90	-9.8%
Pennsylvania	1.74	1.76	1.54	1.36	1.27	1.24	0.88	0.88	0.88	-9.4%
Washington	1.78	1.79	1.61	1.35	1.32	1.28	0.98	0.92	0.93	-8.9%

Source:
Energy Information Agency/State Energy Price and Expenditure Report 1988; conversion from $/Mbtu to $/gallon by Texas Transportation Institute

Notes:
(a) Includes federal & state taxes
(b) Using Consumer Price Index

Table 1.6 Distillate Fuel Prices for Selected States

	Current dollars per gallon (a)									Average annual change
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1980-88
Texas	0.89	1.04	0.98	0.85	0.85	0.81	0.73	0.83	0.83	-0.9%
California	0.88	1.02	1.00	0.89	0.87	0.86	0.74	0.84	0.81	-1.2%
Florida	0.97	1.15	1.03	0.94	0.93	0.91	0.78	0.83	0.78	-3.0%
Illinois	0.93	1.10	1.07	1.00	1.05	1.07	0.83	0.86	0.86	-1.1%
Ohio	0.87	1.07	1.04	1.02	1.03	1.04	0.81	0.84	0.82	-0.8%
New York	0.93	1.18	1.12	1.12	1.10	1.06	0.82	0.84	0.85	-1.3%
Pennsylvania	0.88	1.08	1.05	1.04	1.06	1.04	0.82	0.84	0.83	-0.8%
Washington	0.84	1.02	1.01	1.07	1.08	1.10	0.84	0.90	0.91	1.1%

	Constant 1988 dollars per gallon (b)									Average annual change
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1980-88
Texas	1.27	1.36	1.21	1.01	0.97	0.89	0.79	0.86	0.83	-5.9%
California	1.27	1.32	1.22	1.06	0.99	0.95	0.80	0.84	0.81	-6.2%
Florida	1.39	1.49	1.27	1.11	1.05	1.00	0.84	0.83	0.78	-7.9%
Illinois	1.34	1.43	1.31	1.19	1.20	1.17	0.89	0.86	0.86	-6.1%
Ohio	1.25	1.39	1.27	1.21	1.18	1.14	0.87	0.84	0.82	-5.8%
New York	1.34	1.54	1.37	1.33	1.26	1.17	0.89	0.84	0.85	-6.3%
Pennsylvania	1.27	1.41	1.29	1.24	1.20	1.15	0.88	0.84	0.83	-5.8%
Washington	1.21	1.33	1.24	1.27	1.24	1.21	0.91	0.90	0.91	-4.0%

Source:

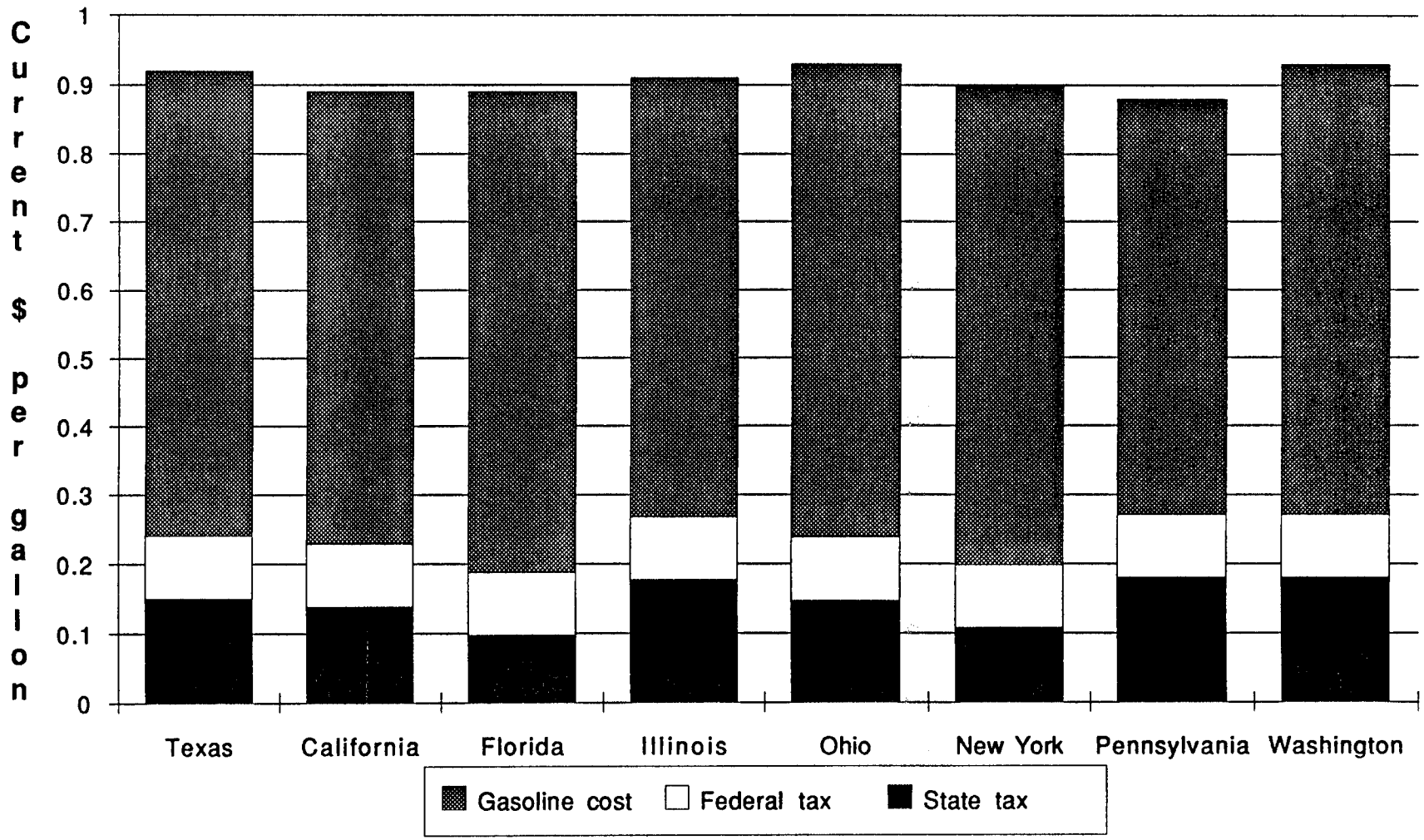
Energy Information Agency/State Energy Price and Expenditure Report 1988; conversion from $/Mbtu to $/ gallon by Texas Transportation Institute

Notes:

(a) Includes federal & state taxes

(b) Using Consumer Price Index

Figure 1.2 Gasoline Prices of Selected States,1988



Source: Tables 1.5 and 1.7

Table 1.7 Motor Gasoline Taxes for Selected States, 1970-88

				Cents per gallon				
Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	**Texas**
1970	7.0	7.0	7.0	7.5	7.0	9.0	7.0	5.0
1971	7.0	8.0	7.0	7.5	7.0	9.0	8.0	5.0
1972	8.0	8.0	7.0	7.5	7.0	9.0	8.0	5.0
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	10.8	18.0	14.8	17.7	15.0	18.0	9.7	15.0
				Average annual change				
Time Period:								
1970-88	2.4%	5.4%	4.2%	4.9%	4.3%	3.9%	1.9%	6.3%
1983-88	6.1%	8.4%	4.3%	10.0%	10.8%	2.4%	0.0%	24.6%

Source:

Highway Statistics, Summary to 1985; annual 1986-88

Notes:

Since 1986 NY, PA, 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

Table 1.8 Distillate Fuel Taxes for Selected States, 1970-88

				Cents per gallon				
Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	**Texas**
1970	9.0	8.0	7.0	7.5	7.0	9.0	7.0	6.5
1971	9.0	8.0	7.0	7.5	7.0	9.0	8.0	6.5
1972	10.0	8.0	7.0	7.5	7.0	9.0	8.0	6.5
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	12.8	18.0	12.0	19.7	15.0	18.0	9.7	10.0
1987	12.8	18.0	14.8	19.7	15.0	18.0	9.7	10.0
1988	12.8	18.0	14.8	19.7	15.0	18.0	9.7	15.0
				Average annual change				
Time Period:								
1970-88	2.0%	4.6%	4.2%	5.5%	4.3%	3.9%	1.9%	4.8%
1983-88	5.0%	8.4%	4.3%	7.9%	10.8%	2.4%	0.1%	18.2%

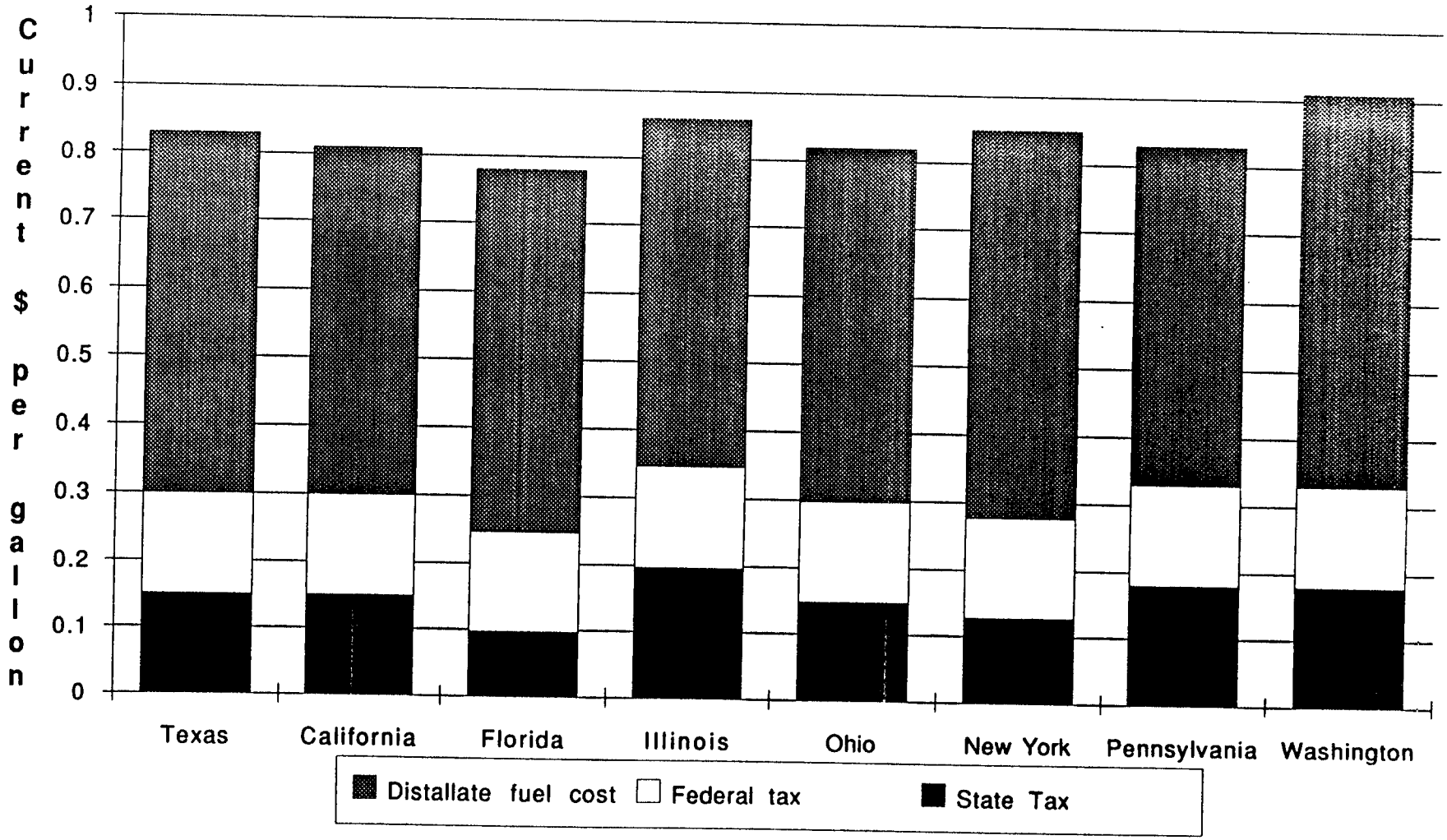
Source:

Highway Statistics, Summary to 1985; annual 1986-88

Notes:

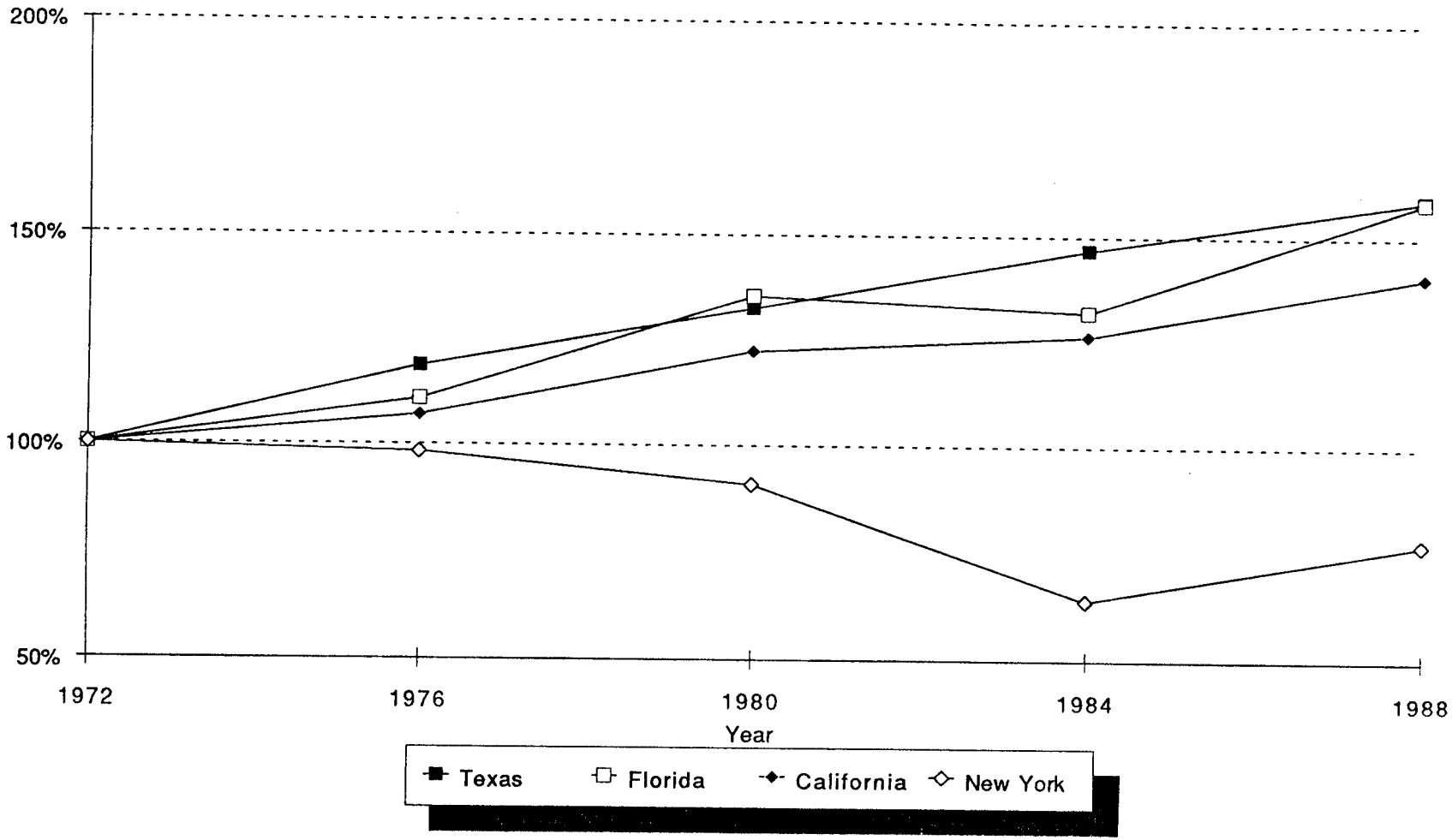
Since 1986 NY, PA, IL, and FL have imposed a sales tax in addition to a gallonage tax. The taxes in this table reflect a gallonage rate plus the applicable sales tax rate @ $1/ gal for these states.

Figure 1.3 Distillate Fuel Prices of Selected States, 1988



Source: Tables 1.6 and 1.8

Figure 1.4 Transportation Energy Consumption as a Percentage of 1972 Baseline



Source: State Energy Data Report, Energy Information Agency

Table 1.9 Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1988

Census region	Average annual per household		
	Vehicle miles traveled	Consumption (gallons)	Expenditures
Midwest	18,518	1,016	$995
Northeast	17,997	917	$928
South	18,859	1,046	$1,027
Texas*	18,193	1,081	$1,051
West	18,783	1,046	$1,015
U. S.	18,595	1,014	$998

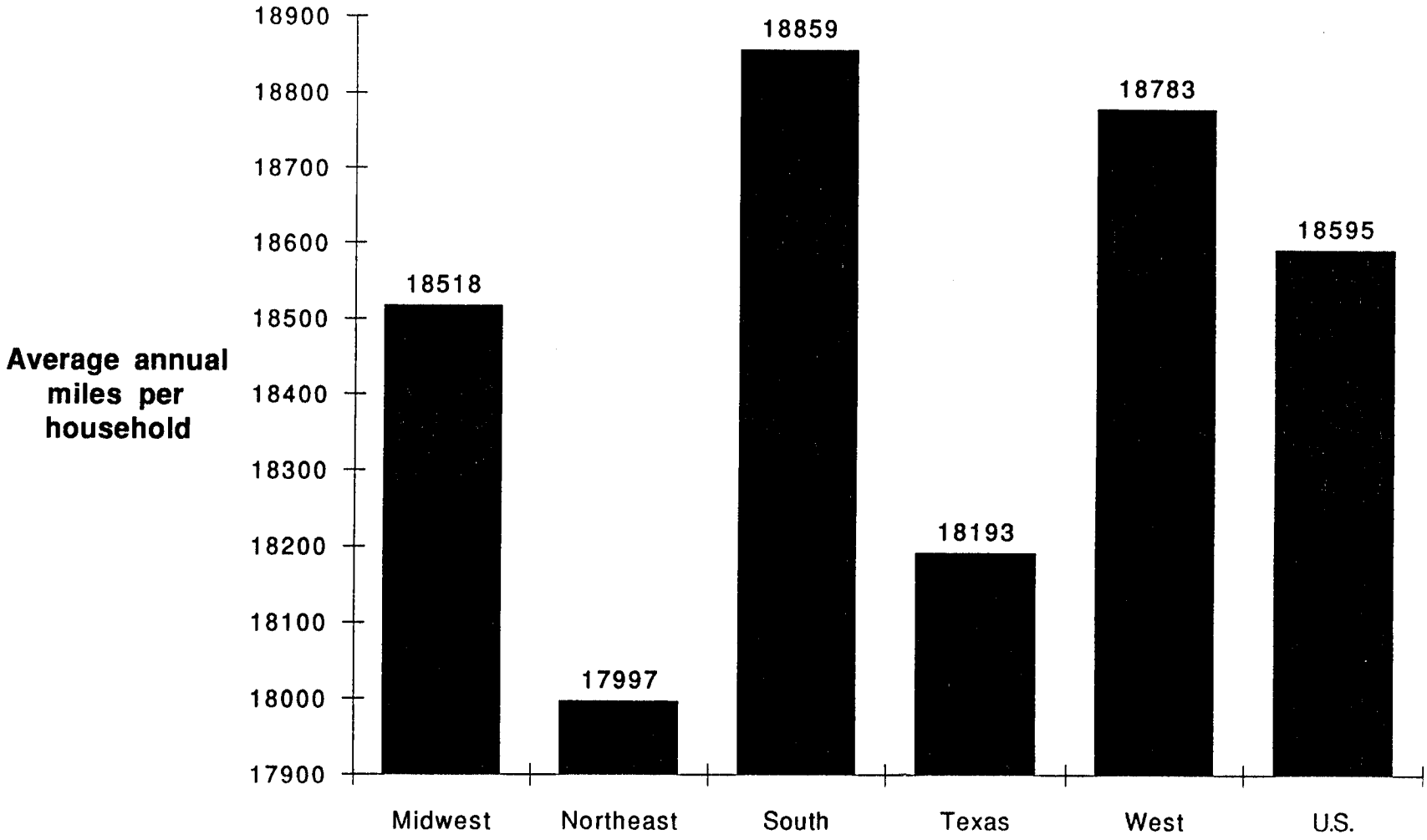
Source:

Household Vehicle Energy Consumption 1988, Energy Information Agency

Notes:

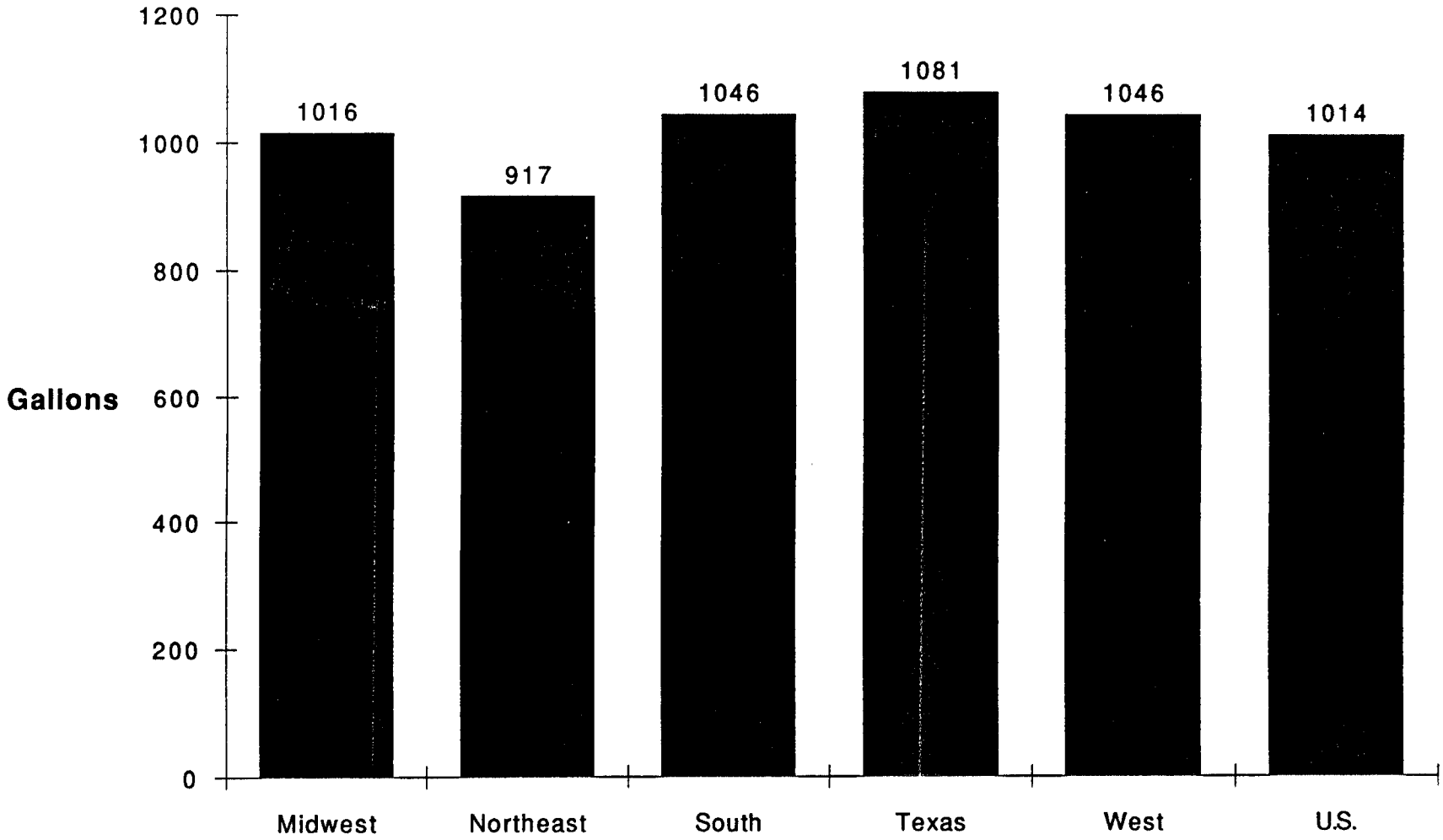
* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant subset of the W. South Central data sample (per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division,Energy Information Agency)

Figure 1.5 Household Vehicle Miles Traveled, 1988



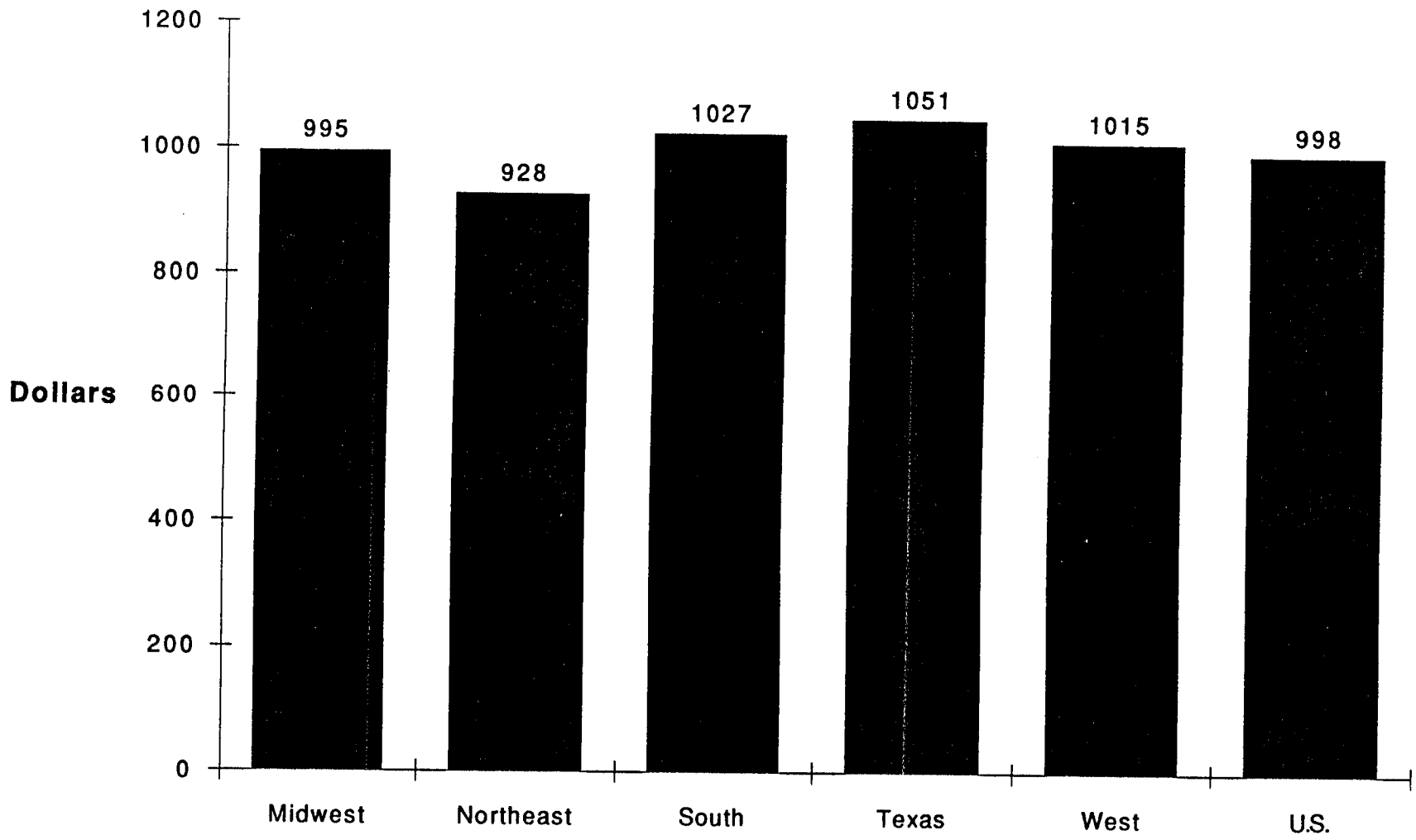
Source: Table 1.9

Figure 1.6 Annual Gallons Consumed Per Household, 1988



Source: Table 1.9

Figure 1.7 Annual Vehicle Fuel Expeditures Per Household, 1988



Source: Table 1.9

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.

Tables 2.1 through 2.4 show petroleum production and consumption in Texas, petroleum consumption by sector, and the distribution of energy consumption by end-use sector and energy source. Tables 2.5 through 2.8 concentrate on energy consumption by transportation mode and by fuel type. Tables 2.9 through 2.12 provide energy intensity information on passenger travel and intercity freight movement. Retail prices of highway fuels and non-highway fuels are found in Tables 2.13 and 2.14, while Table 2.15 demonstrates the relationship between crude oil prices and retail motor gasoline prices in Texas.

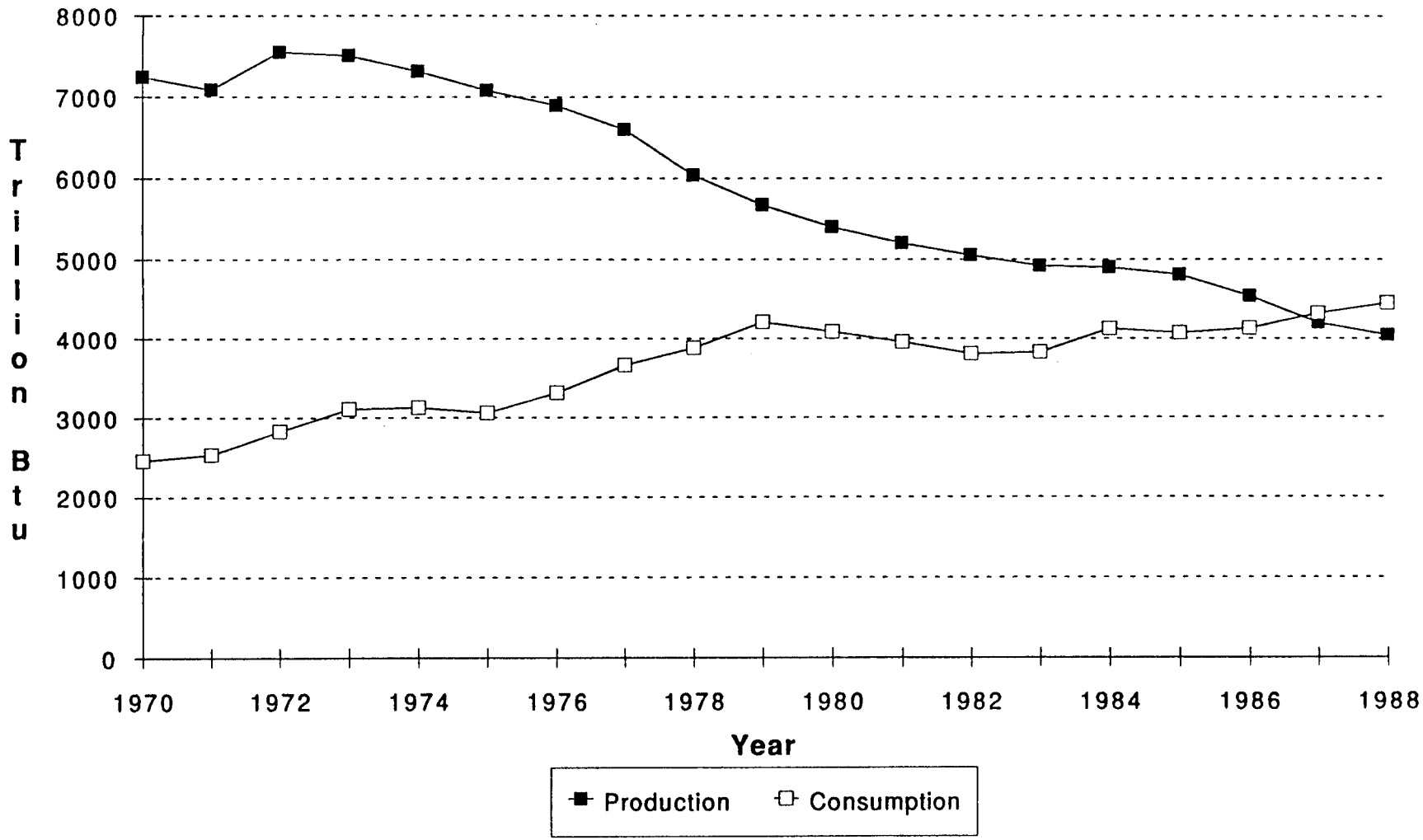
Table 2.1 Texas Petroleum Production and Consumption

Year	Texas crude oil production	Total petroleum exports	Texas petroleum consumption	U.S. petroleum consumption	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
				Trillion Btu			
1970	7,248.2	4,783.3	2,464.9	29,521.6	66.0%	8.3%	15.3%
1971	7,093.0	4,556.3	2,536.7	30,564.0	64.2%	8.3%	16.3%
1972	7,549.8	4,718.8	2,831.0	32,947.0	62.5%	8.6%	16.6%
1973	7,509.1	4,393.9	3,115.2	34,837.5	58.5%	8.9%	18.3%
1974	7,320.3	4,188.8	3,131.5	33,453.9	57.2%	9.4%	19.3%
1975	7,087.2	4,023.1	3,064.1	32,732.2	56.8%	9.4%	20.8%
1976	6,899.2	3,581.5	3,317.7	35,177.8	51.9%	9.4%	22.3%
1977	6,599.7	2,934.4	3,665.3	37,123.9	44.5%	9.9%	25.1%
1978	6,037.6	2,152.0	3,885.6	37,962.9	35.6%	10.2%	29.0%
1979	5,675.6	1,461.9	4,213.7	37,122.3	25.8%	11.4%	31.7%
1980	5,400.3	1,309.3	4,091.0	34,204.4	24.2%	12.0%	31.4%
1981	5,205.9	1,244.4	3,961.5	31,932.1	23.9%	12.4%	33.1%
1982	5,056.3	1,250.4	3,805.9	30,232.4	24.7%	12.6%	35.1%
1983	4,924.6	1,095.5	3,829.1	30,052.1	22.2%	12.7%	35.9%
1984	4,903.9	772.9	4,131.0	31,053.1	15.8%	13.3%	38.3%
1985	4,817.5	738.5	4,079.0	30,924.7	15.3%	13.2%	40.3%
1986	4,547.8	412.7	4,135.1	32,198.0	9.1%	12.8%	43.4%
1987	4,205.2	-120.4	4,325.6	32,863.9	-2.9%	13.2%	46.5%
1988	4,049.7	-407.4	4,457.1	34,223.1	-10.1%	13.0%	50.5%
Time Period				Average annual changes			
1970-88	-3.2%	-	3.3%	0.8%	-	-	-
1983-88	-3.8%	-	3.1%	2.6%	-	-	-

Sources:

State Energy Data Report 1960-1988, Energy Information Administration;
Oil & Gas Annual Report, 1988, Railroad Commission of Texas

Figure 2.1 Texas Petroleum Production and Consumption



Source: Table 2.1

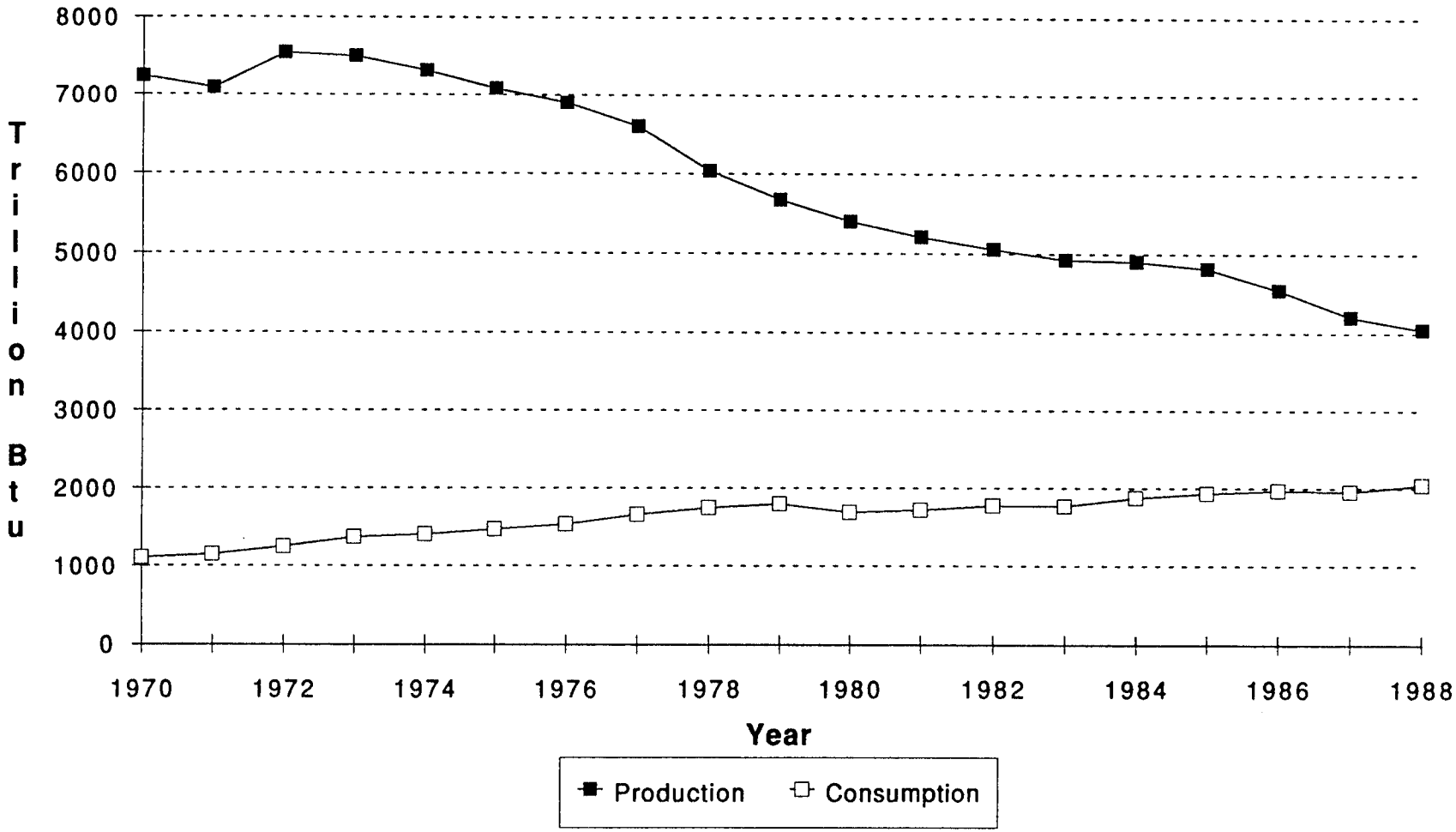
Table 2.2 Texas Petroleum Consumption by Sector

			Trillion Btu				
Year	Transportation	Percentage transportation of total	Residential	Commercial	Industrial	Electric Utilities	Texas petroleum consumption
1970	1,110.0	45.0%	59.2	39.7	1,255.2	0.9	2,464.9
1971	1,152.9	45.4%	56.9	36.0	1,288.8	2.1	2,536.7
1972	1,250.2	44.2%	59.2	42.7	1,467.4	11.5	2,831.0
1973	1,375.6	44.2%	54.2	53.3	1,592.5	39.6	3,115.2
1974	1,409.6	45.0%	48.1	49.5	1,589.8	34.5	3,131.5
1975	1,474.6	48.1%	44.2	48.8	1,485.1	11.4	3,064.1
1976	1,539.6	46.4%	45.4	47.9	1,660.4	24.2	3,317.7
1977	1,658.9	45.3%	43.1	58.0	1,873.5	31.8	3,665.3
1978	1,748.5	45.0%	47.8	63.2	1,982.8	43.4	3,885.6
1979	1,800.4	42.7%	27.3	100.4	2,255.8	29.7	4,213.7
1980	1,693.9	41.4%	23.7	72.4	2,290.2	10.7	4,091.0
1981	1,720.8	43.4%	23.4	84.4	2,123.9	9.0	3,961.5
1982	1,776.7	46.7%	19.3	54.8	1,941.9	13.3	3,805.9
1983	1,769.0	46.2%	23.0	141.7	1,872.0	23.4	3,829.1
1984	1,880.4	45.5%	27.6	130.6	2,086.7	5.7	4,131.0
1985	1,939.4	47.5%	36.0	90.0	2,003.5	10.1	4,079.0
1986	1,973.2	47.7%	29.3	71.8	2,055.7	5.1	4,135.1
1987	1,956.6	45.2%	33.0	105.7	2,223.8	6.5	4,325.6
1988	2,044.6	45.9%	31.8	81.4	2,290.9	8.4	4,457.1
Time Period				**Average annual changes**			
1970-88	3.5%	-	3.3%	4.1%	3.4%	13.2%	3.3%
1983-88	2.9%	-	3.1%	-10.5%	4.1%	-18.5%	3.1%

Source:

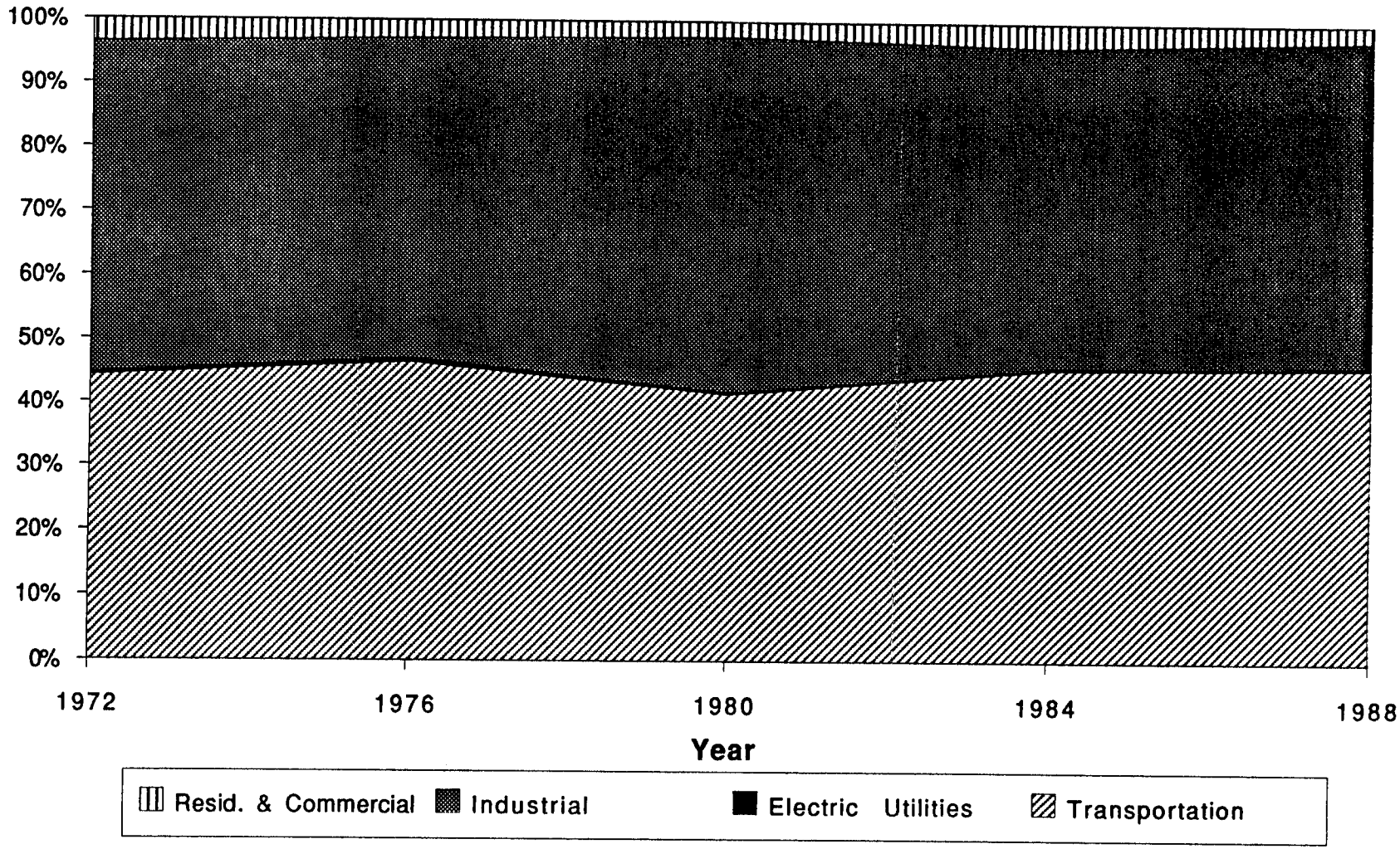
State Energy Data Report 1960-1988, Energy Information Administration

Figure 2.2 Texas Transportation Petroleum Consumption vs. Texas Petroleum Production



Source: Tables 2.1 and 2.2

Figure 2.3 Petroleum Consumption by Sector



Source: Table 2.2

Table 2.3 Distribution of Energy Consumption by Source

Energy Source	Transportation 1978	Transportation 1988	Residential & Commercial 1978	Residential & Commercial 1988	Industrial 1978	Industrial 1988
Petroleum	95.8%	94.8%	12.6%	11.3%	43.6%	48.8%
Natural Gas	4.2%	5.2%	51.8%	40.0%	49.6%	44.2%
Coal	0.0%	0.0%	0.0%	0.0%	1.3%	1.1%
Hydroelectric	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Nuclear	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Electricity	0.0%	0.0%	35.6%	48.7%	5.4%	5.9%
Other (a)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

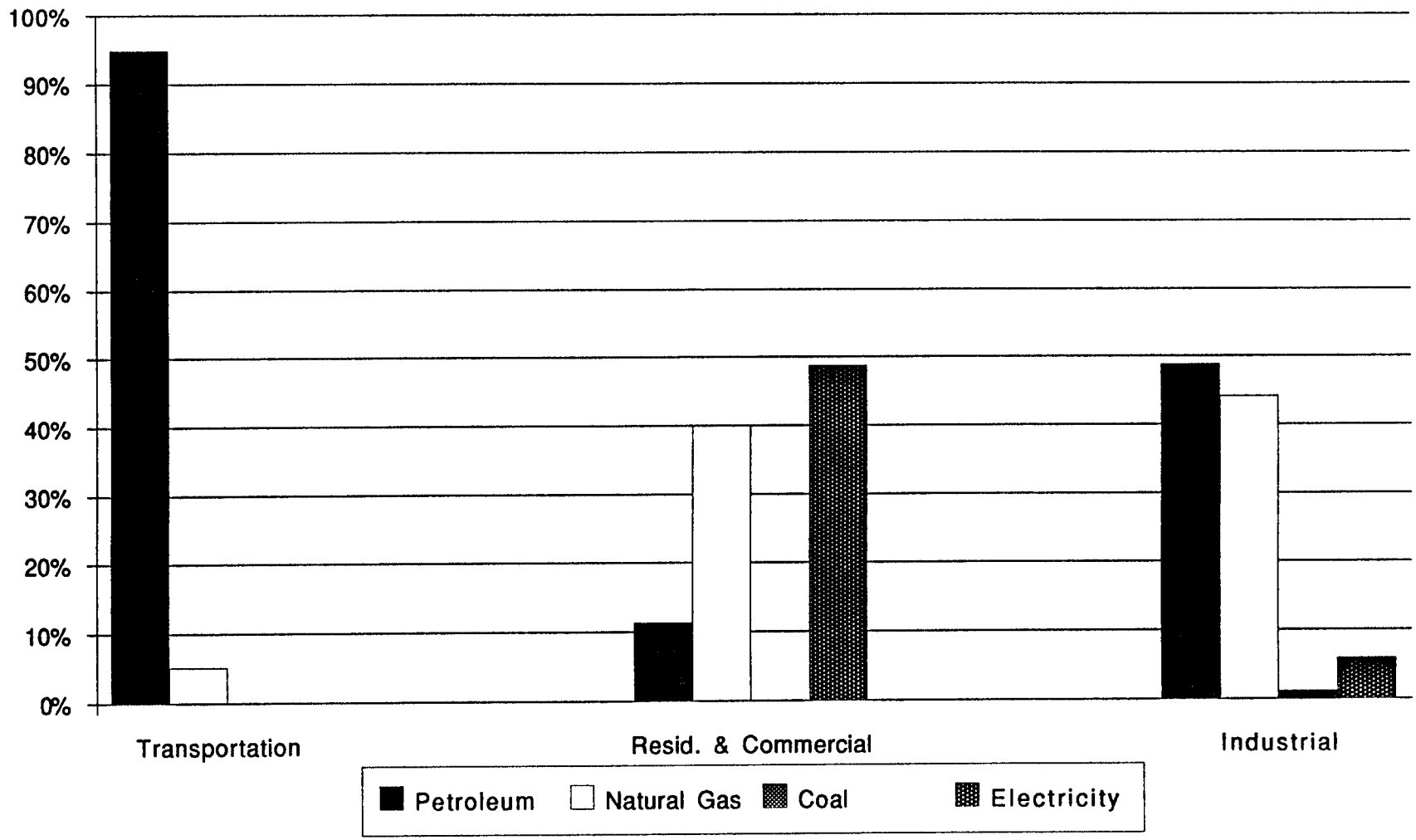
Source:

State Energy Data Report 1960-1988, Energy Information Administration

Note:

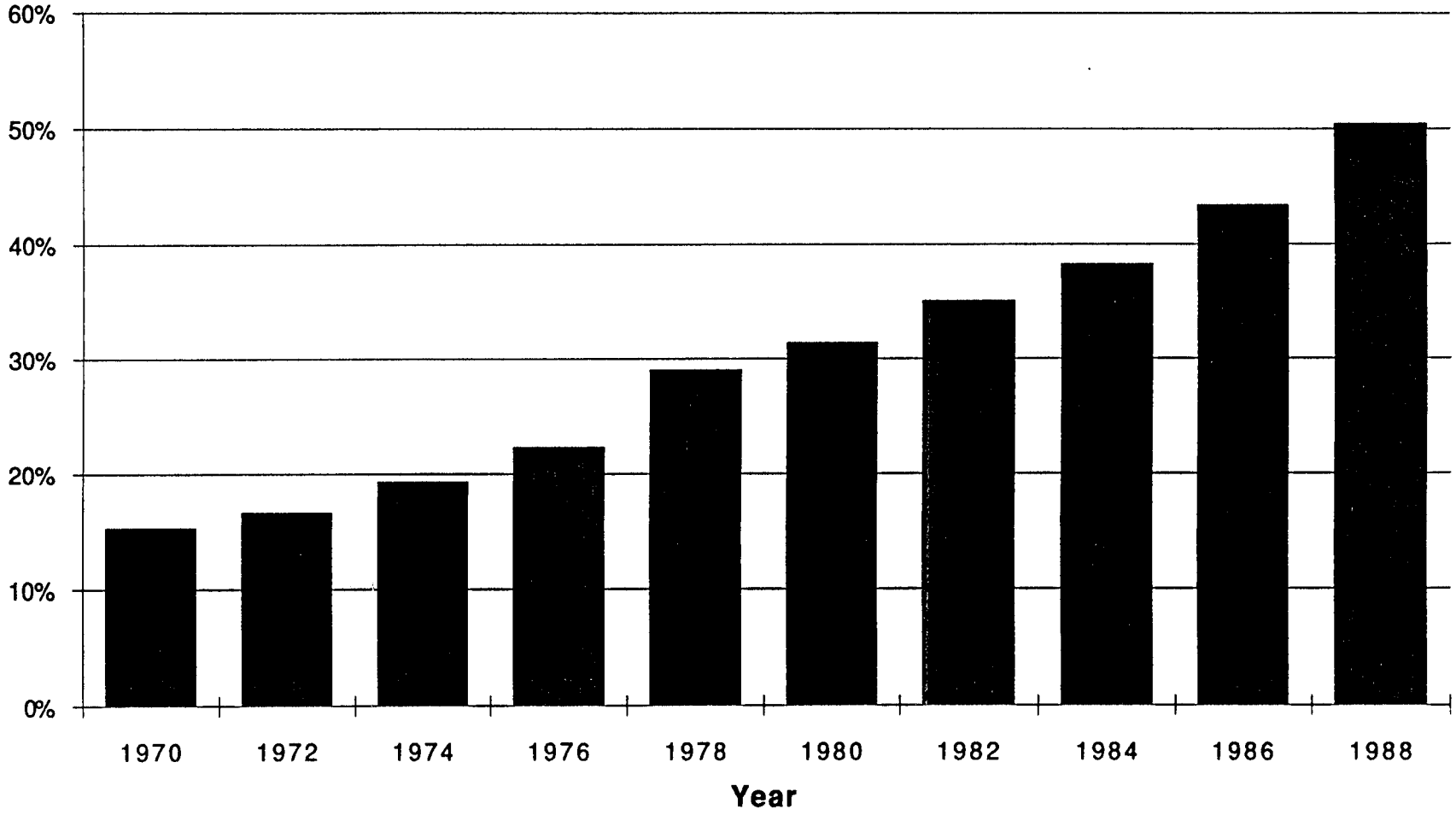
(a) Refers to energy generated from geothermal, wood, waste, wind, solar, etc.

Figure 2.4 Distribution of Energy by End-Use Sector, 1988



Source: Table 2.3

Figure 2.5 Texas Transportation Petroleum Consumption as a Percentage of Texas Petroleum Production



Source: Table 2.1

Table 2.4 Energy Consumption by End-Use Sector, 1970-88

Trillion Btu

Year	Transportation	Percent of total	Residential & Commercial	Industrial	Total
1970	1,208.8	18.0%	1,135.1	4,382.6	6,726.5
1971	1,254.7	17.8%	1,197.9	4,597.3	7,049.9
1972	1,357.6	18.3%	1,300.5	4,747.8	7,405.9
1973	1,483.4	18.5%	1,358.2	5,168.7	8,010.3
1974	1,506.4	19.2%	1,337.8	5,018.3	7,862.5
1975	1,559.1	21.3%	1,323.0	4,423.7	7,305.8
1976	1,613.7	21.2%	1,362.3	4,639.9	7,615.9
1977	1,727.3	21.1%	1,528.5	4,943.3	8,199.1
1978	1,825.6	21.2%	1,643.0	5,151.2	8,619.8
1979	1,880.6	21.1%	1,757.1	5,261.2	8,898.9
1980	1,801.9	20.0%	1,687.0	5,498.8	8,987.7
1981	1,826.0	20.7%	1,696.9	5,287.0	8,809.9
1982	1,882.6	22.9%	1,775.5	4,553.0	8,211.1
1983	1,878.2	22.9%	1,841.0	4,483.8	8,203.0
1984	1,992.5	22.6%	1,992.6	4,846.7	8,831.8
1985	2,035.1	23.0%	2,010.2	4,815.4	8,860.7
1986	2,058.4	23.5%	1,960.2	4,747.4	8,766.0
1987	2,041.0	22.3%	2,053.0	5,053.9	9,147.9
1988	2,156.4	22.5%	2,102.2	5,324.2	9,582.8
		Average annual changes			
Time Period:					
1970-88	3.3%	-	3.5%	1.1%	2.0%
1983-88	2.8%	-	2.7%	3.5%	3.2%

Source:

State Energy Data Report 1960-1988, Energy Information Administration

Table 2.5 Energy Consumption by Transportation Mode

Trillion Btu

	Transportation Mode						
Year	Highway	Air	Rail	Water	Pipeline	Military	Total
1970	815.2	100.9	43.7	91.0	98.8	59.2	1,208.7
1971	861.8	102.3	46.7	82.0	101.8	60.1	1,254.7
1972	936.2	108.4	67.2	82.5	107.4	56.0	1,357.6
1973	1,004.0	116.8	74.7	125.3	107.7	54.9	1,483.4
1974	991.3	112.6	80.7	156.0	96.8	69.2	1,506.6
1975	1,035.4	121.3	72.2	176.2	84.6	69.4	1,559.2
1976	1,100.5	113.9	67.1	191.6	74.0	66.5	1,613.6
1977	1,164.1	118.8	69.4	231.4	68.4	75.4	1,727.4
1978	1,223.7	128.7	66.6	258.2	77.1	71.3	1,825.7
1979	1,198.4	136.6	66.1	357.3	80.2	42.1	1,880.7
1980	1,098.3	143.0	46.2	325.1	108.1	81.5	1,802.1
1981	1,152.8	146.6	75.9	295.7	105.1	49.8	1,825.9
1982	1,186.6	209.6	75.0	248.0	106.0	57.5	1,882.7
1983	1,214.3	235.6	53.0	187.2	109.2	78.9	1,878.2
1984	1,224.6	333.7	57.6	184.1	112.2	80.4	1,992.6
1985	1,258.7	395.7	52.5	162.6	95.6	69.8	2,034.9
1986	1,265.5	430.6	42.5	176.6	85.2	58.1	2,058.4
1987	1,224.9	451.8	49.1	165.3	84.4	65.4	2,041.0
1988	1,242.3	507.8	52.1	168.1	111.8	74.2	2,156.4

Average annual changes

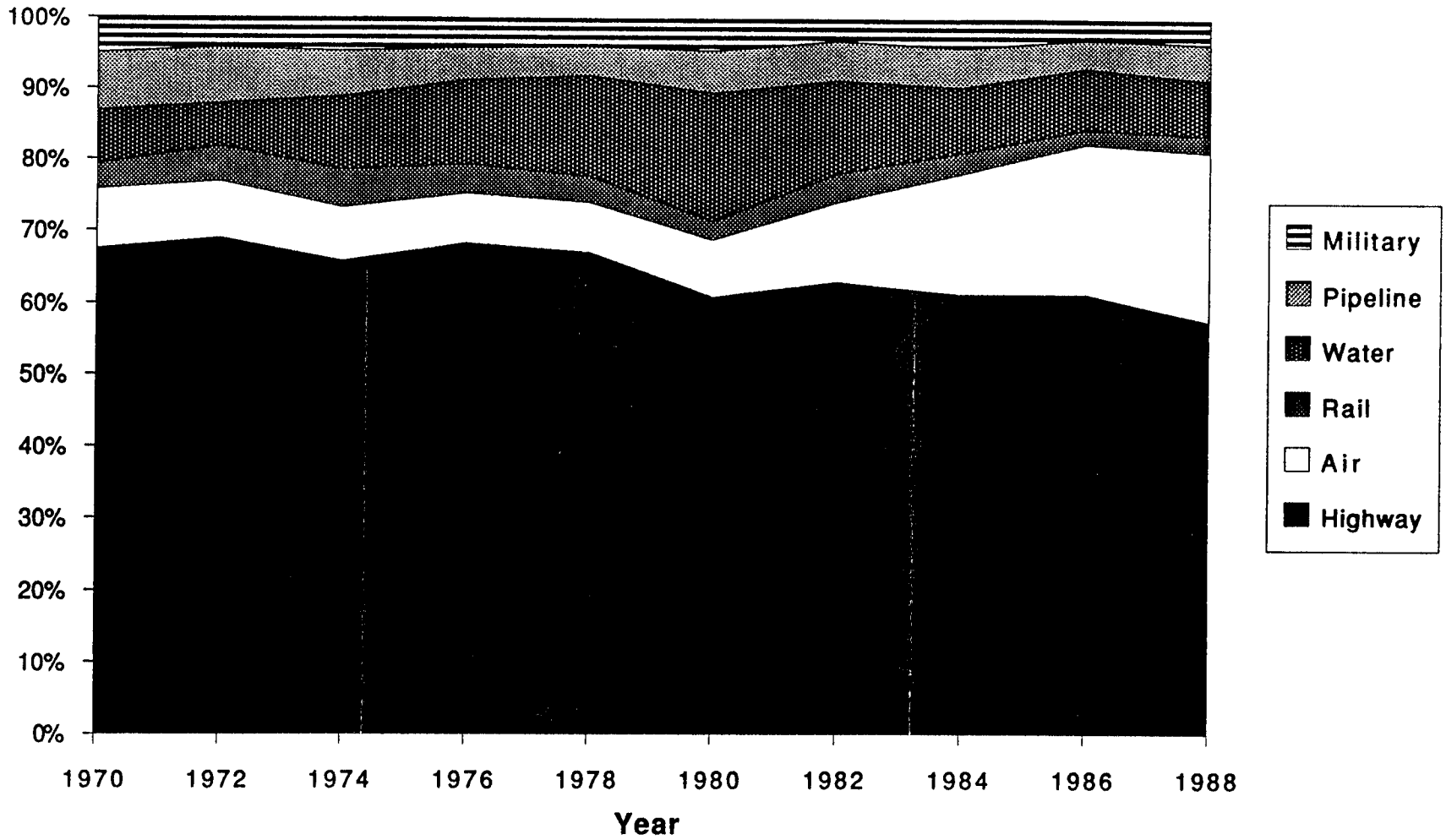
Time Period:							
1970-198	2.37%	9.40%	0.98%	3.47%	0.69%	1.27%	3.27%
1983-198	0.46%	16.60%	-0.38%	-2.12%	0.47%	-1.20%	2.80%

Sources:

State Energy Data Report 1960-1988, Energy Information Administration;

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

Figure 2.6 Distribution of Texas Transportation Energy by Mode



Source : Table 2.5

Table 2.6 Energy Consumption by Mode and Fuel Type, 1970

	Trillion Btu							
Mode	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	Total
Highway	0.0	0.0	61.3	0.0	21.3	732.6	0.0	815.2
Air	0.0	9.7	0.0	91.2	0.0	0.0	0.0	100.9
Water	0.0	0.0	13.8	0.0	0.0	5.6	71.6	91.0
Rail	0.0	0.0	43.6	0.0	0.0	0.0	0.1	43.7
Pipeline	98.8	0.0	0.0	0.0	0.0	0.0	0.0	98.8
Military	0.0	0.0	13.3	43.6	0.0	0.0	2.2	59.2
	98.8	9.7	132.0	134.8	21.3	738.2	74.0	1208.7

Table 2.7 Energy Consumption by Mode and Fuel Type, 1978

	Trillion Btu							
Mode	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	Total
Highway	0.0	0.0	151.8	0.0	18.5	1053.4	0.0	1223.7
Air	0.0	6.5	0.0	122.2	0.0	0.0	0.0	128.7
Water	0.0	0.0	36.2	0.0	0.0	7.2	214.8	258.2
Rail	0.0	0.0	66.2	0.0	0.0	0.0	0.4	66.6
Pipeline	77.1	0.0	0.0	0.0	0.0	0.0	0.0	77.1
Military	0.0	0.0	19.6	35.4	0.0	0.0	16.2	71.3
	77.1	6.5	273.8	157.6	18.5	1060.6	231.4	1825.7

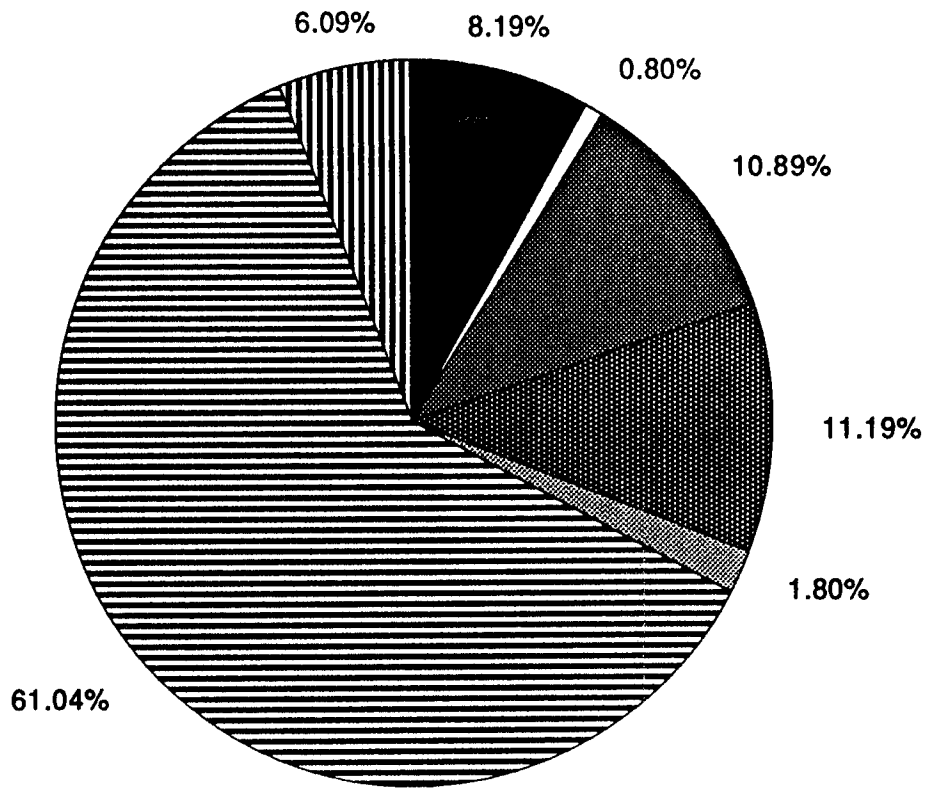
Table 2.8 Energy Consumption by Mode and Fuel Type, 1988

	Trillion Btu							
Mode	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	Total
Highway	0.0	0.0	180.8	0.0	1.7	1059.8	0.0	1242.3
Air	0.0	5.1	0.0	502.7	0.0	0.0	0.0	507.8
Water	0.0	0.0	38.3	0.0	0.0	9.2	120.7	168.1
Rail	0.0	0.0	52.1	0.0	0.0	0.0	0.0	52.1
Pipeline	111.8	0.0	0.0	0.0	0.0	0.0	0.0	111.8
Military	0.0	0.0	36.4	37.8	0.0	0.0	0.0	74.2
	111.8	5.1	307.6	540.6	1.7	1069.0	120.7	2156.4

Sources:

State Energy Data Report 1960-1988, Energy Information Administration; Ms. Julia Hutchins, Energy Administration unpublished fuel time series.

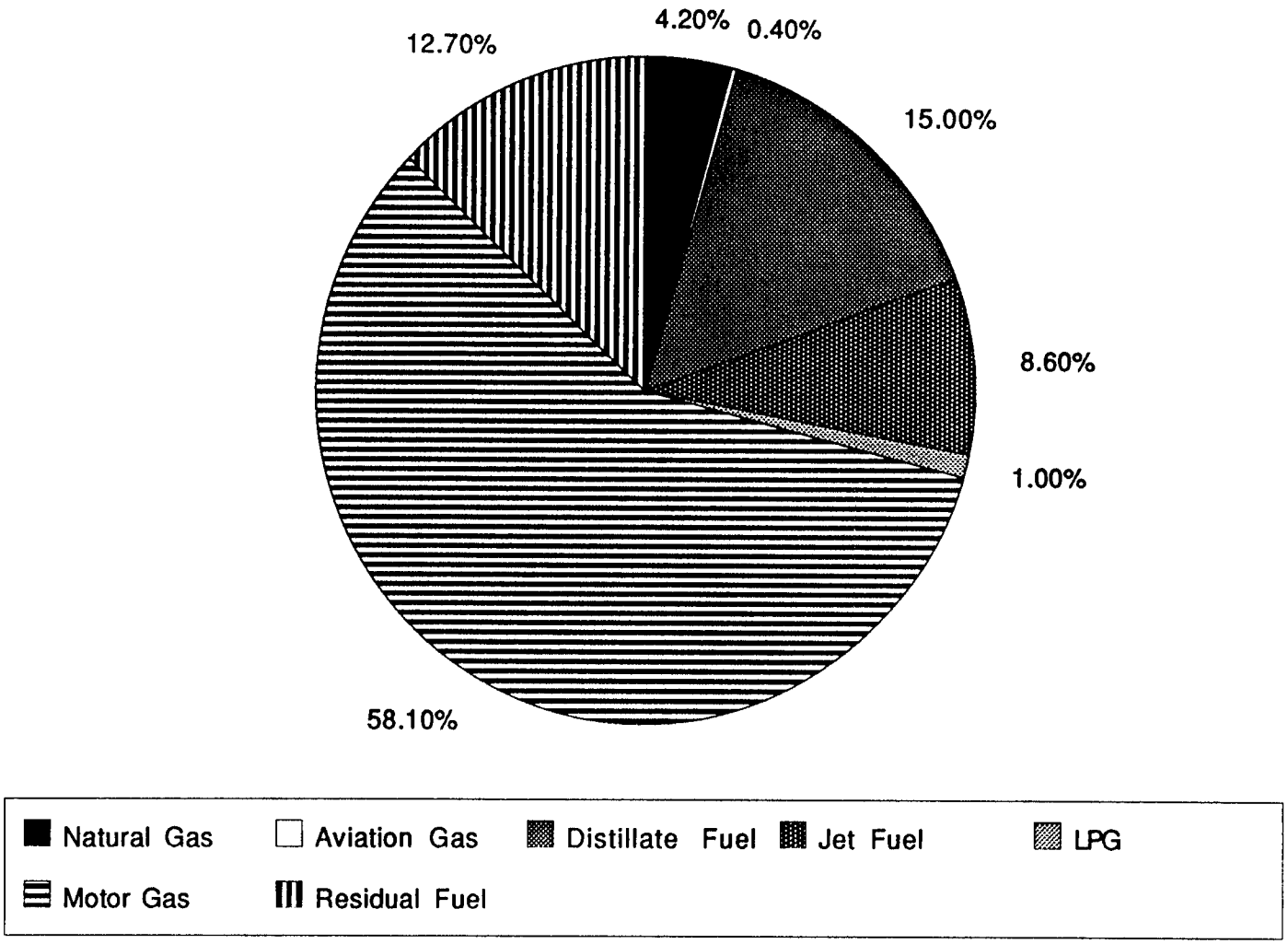
Figure 2.7 Distribution of Transportation Energy Use by Fuel Type, 1970



Natural Gas | Aviation Gas | Distillate Fuel | Jet Fuel | LPG
Motor Gas | Residual Fuel

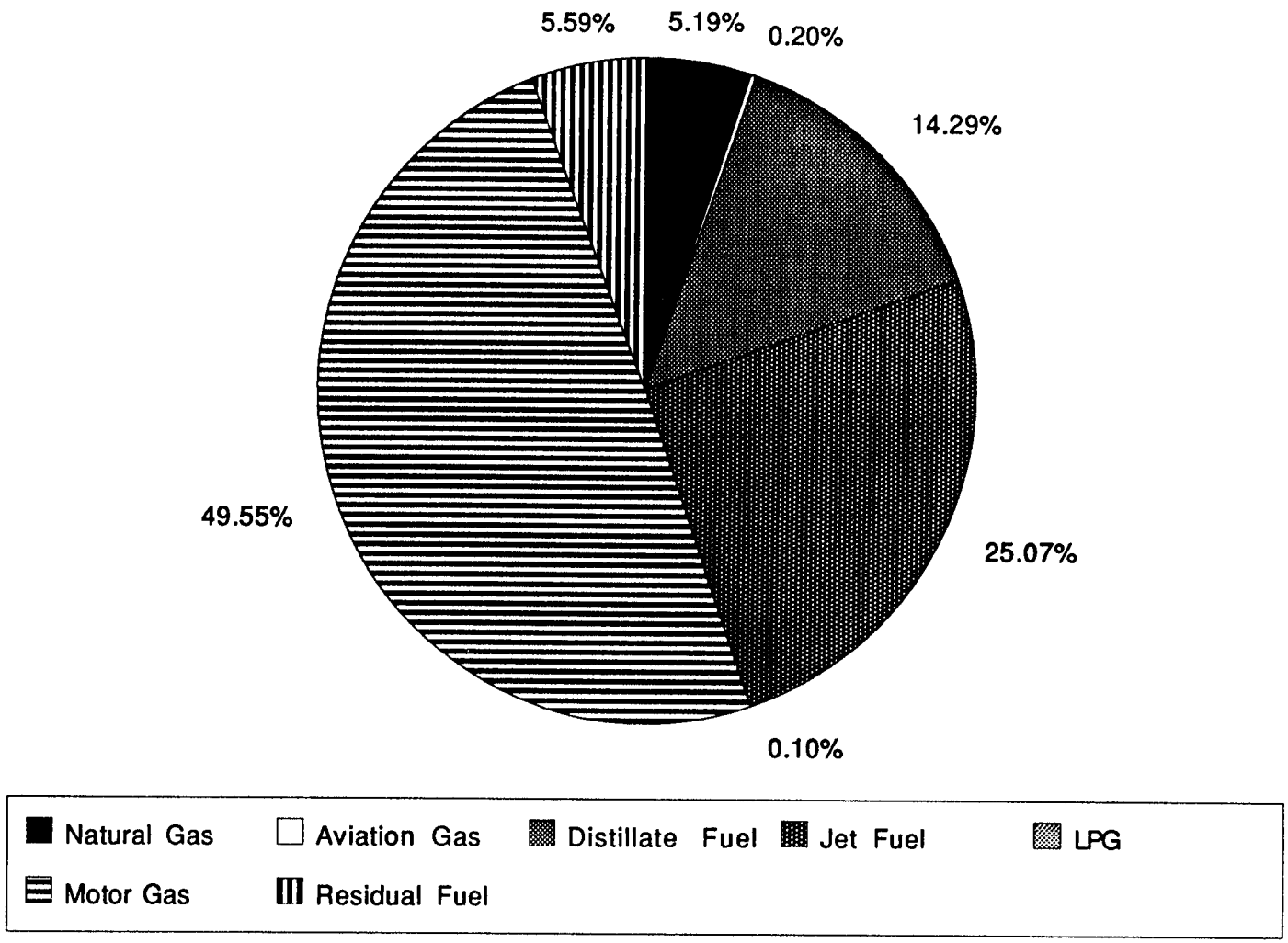
Source: Table 2.6

Figure 2.8 Distribution of Transportation Energy Use by Fuel Type, 1978



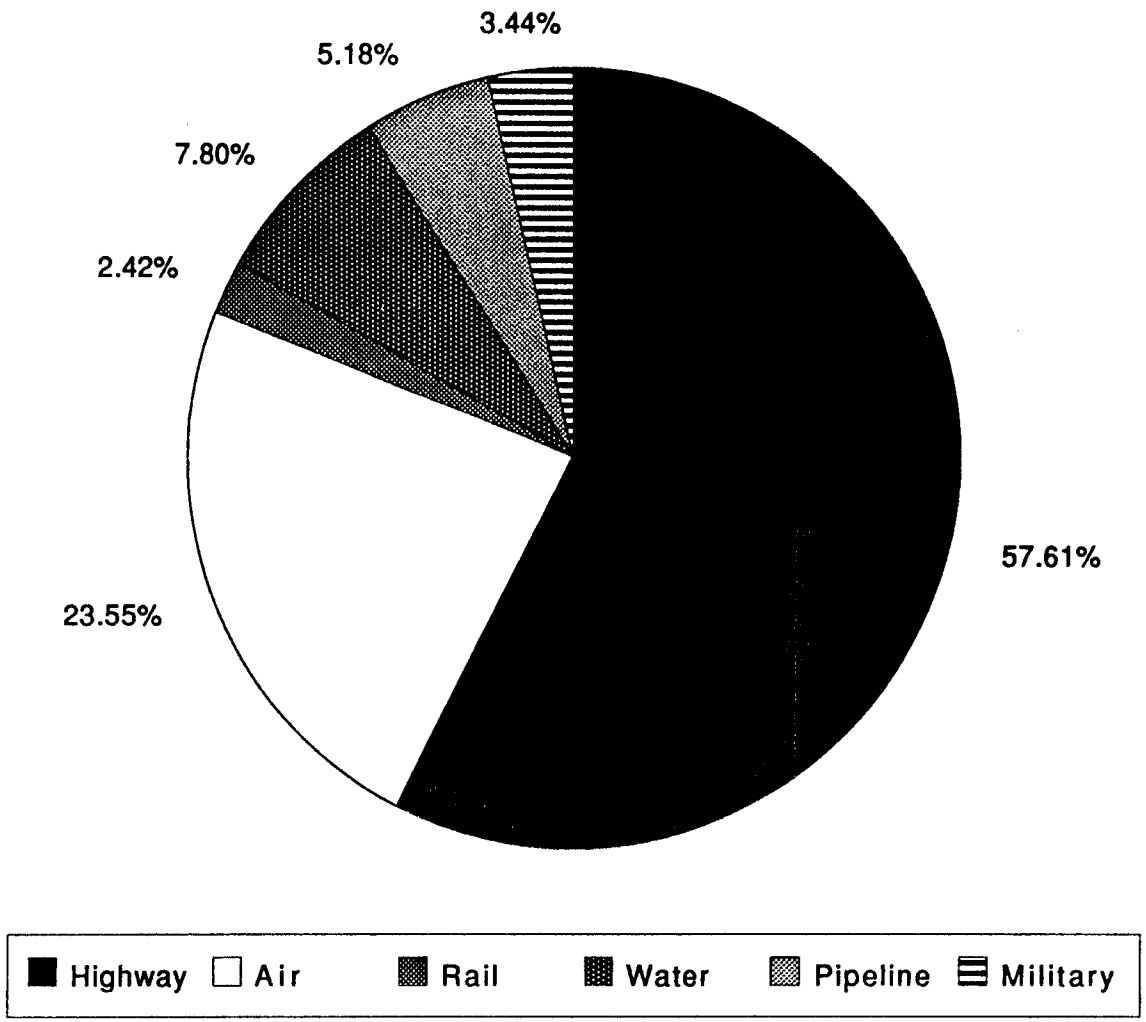
Source: Table 2.7

Figure 2.9 Distribution of Transportation Energy Use by Fuel Type, 1988



Source: Table 2.8

Figure 2.10 Distribution of Transportation Energy Use by Mode, 1988



Source: Table 2.8

Table 2.9 Passenger Travel and Energy Use in Texas, 1988

Mode	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger-miles (millions)	Load (a) factor (pers./veh.)	Energy Intensity: Btu per vehicle-mile	Energy Intensity: Btu per passenger-mile	Energy Use trillion Btu
Automobiles	8,456	85,564	145,458	1.7	6,449	3,793	551.8
Motorcycle	212	463	509	1.1	2,567	2,334	1.2
Pick-up Truck	3,764	44,989	85,478	1.9	10,470	5,510	471.0
Buses							
Commercial	3	30	-	-	29,592	-	0.9
School & other	57	504	10,222	20.3	18,156	894	9.1
Air (b)							
Commercial	-	-	35,990	74.1	-	13,968	502.7
Rail							
AMTRAK	-	2	49	20.5	51,000	2,488	0.1

Sources:

Highway Statistics, 1988; Table 2.5; Statistical Handbook of Aviation

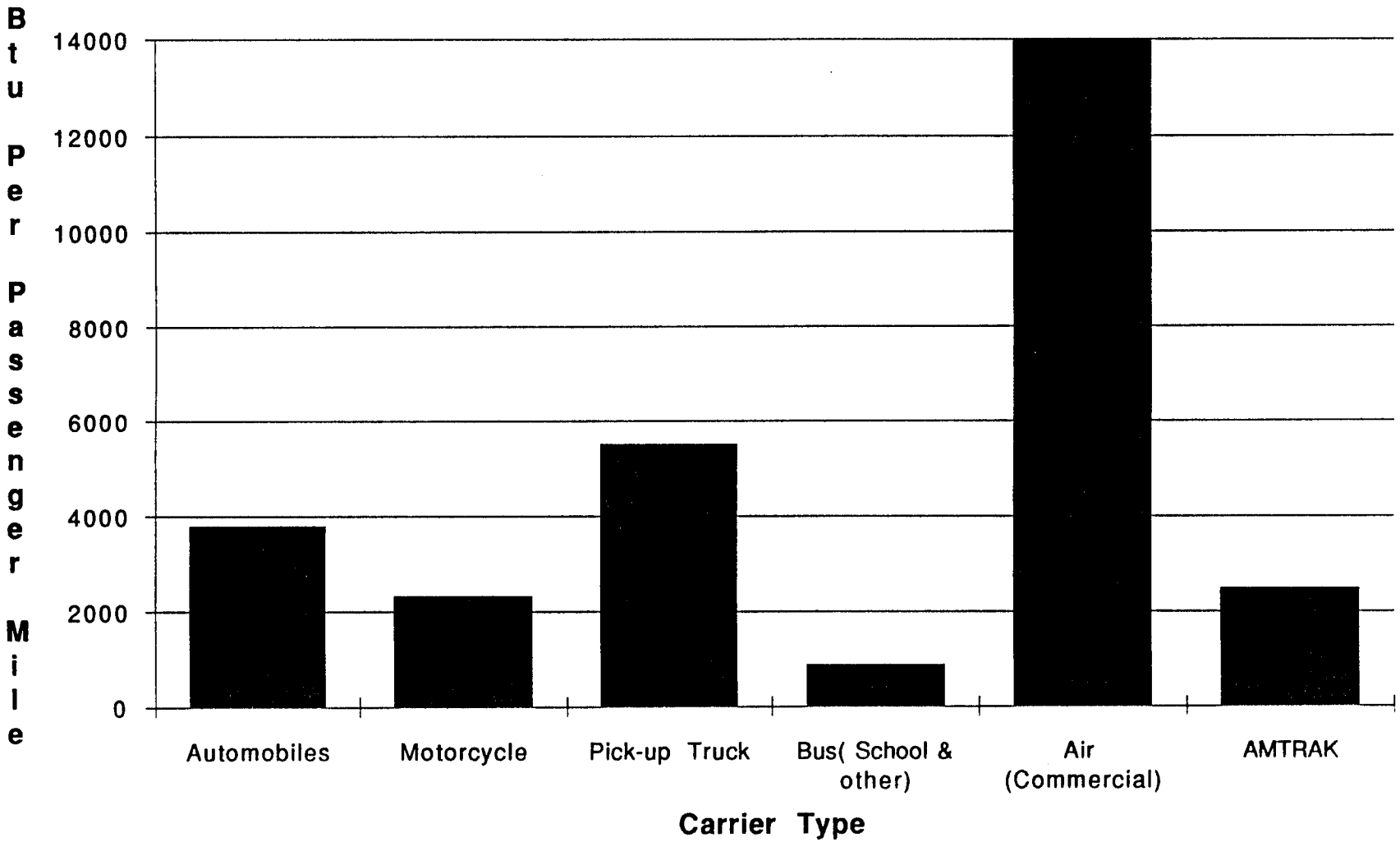
Railroad Facts, 1988; Texas Railroad Facts, 1990, Railroad Commission of Texas

Notes:

(a) Load factors are for the U.S., with the exception of the Air mode. The load factor, in this case, represents Texas enplanements per Texas departures.

(b) Data represents flights having Texas departures and not limited to flights originating and terminating within Texas; includes international flights and flights beyond Texas borders

Figure 2.11 Passenger Energy Intensity in Texas, 1988



Source: Table 2.9

Table 2.10 Energy Intensities of Passenger Modes in Texas

Year	Automobiles		Buses		Air	Rail (b)
		(a)	Commercial	School & other	Certified Carrier	AMTRAK
	Btu per Vehicle-mi	Btu per Passenger-mi	Btu per Vehicle-mi	Btu per Vehicle-mi	Btu per Passenger-mi	Btu per Passenger-mi
1970	10,511	6,183	34,498	16,909	12,696	3,977
1971	10,478	6,164	33,366	17,067	12,937	3,900
1972	10,672	6,278	32,749	17,497	12,630	3,822
1973	10,831	6,371	31,780	17,645	12,464	3,756
1974	10,980	6,459	31,577	18,237	11,169	3,240
1975	10,795	6,350	30,472	18,245	12,033	3,677
1976	10,348	6,087	28,865	17,909	10,171	3,397
1977	10,219	6,011	29,237	18,080	9,665	3,568
1978	9,844	5,791	28,715	17,686	8,880	3,683
1979	10,127	5,957	29,998	18,623	8,025	3,472
1980	8,854	5,208	28,218	16,754	6,981	3,176
1981	8,437	4,963	28,044	16,463	6,503	2,976
1982	8,635	5,079	30,345	17,673	8,734	3,156
1983	8,244	4,850	30,012	17,265	9,433	2,957
1984	7,202	4,237	28,053	16,044	11,846	3,027
1985	7,373	4,337	29,267	16,605	12,584	2,800
1986	7,191	4,230	29,478	16,572	13,148	2,574
1987	6,745	3,968	29,128	16,259	13,002	2,537
1988	6,453	3,796	29,249	16,178	13,945	2,578
			Average annual changes			
Period:						
1970-88	-2.7%	-2.7%	-0.9%	-0.2%	0.5%	-2.4%
1983-88	-4.8%	-4.8%	-0.5%	-1.3%	8.1%	-2.7%

Sources:

State Energy Data Report 1960-1988, Energy Information Administration;
Highway Statistics, FHWA, USDOT, annual: Statistical Handbook of Aviation, annual;
Railroad Facts, American Association of Railroads, annual
(a) Based on U.S. load factor of 1.7 (b) U.S. figures

Table 2.11 Intercity Freight and Energy Use in Texas, 1988

	Number of vehicles (thousands)	(a) Vehicle-miles (millions)	Ton-miles (millions)	Tons shipped (millions)	Average length of haul (miles)	Energy intensity (Btu per ton-mile)	Energy Use trillion Btu
Comb. Truck	126.3	5,321.3	55,645	333.3	167	2,585	143.8
Waterborne	-	-	16,606	355.6	47	375	6.2
Pipeline (b)	-	-	83,000	134.6	617	259	21.5
Class I Railroads	-	29.8	76,491	315.1	243	445	34.1

Sources:

Texas Railroad Facts, 1990, Railroad Commission of Texas;

1987 Truck Inventory and Use Survey, Heavy-heavy trucks for Texas, US Dept. of Commerce;

Highway Statistics 1988, USDOT,FHWA;

Table 3.23

Waterborne Commerce of the United States, 1988, Part 2, Dept. of the Army, Corps of Engineers

Table 4.18 for pipeline data

Notes:

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

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

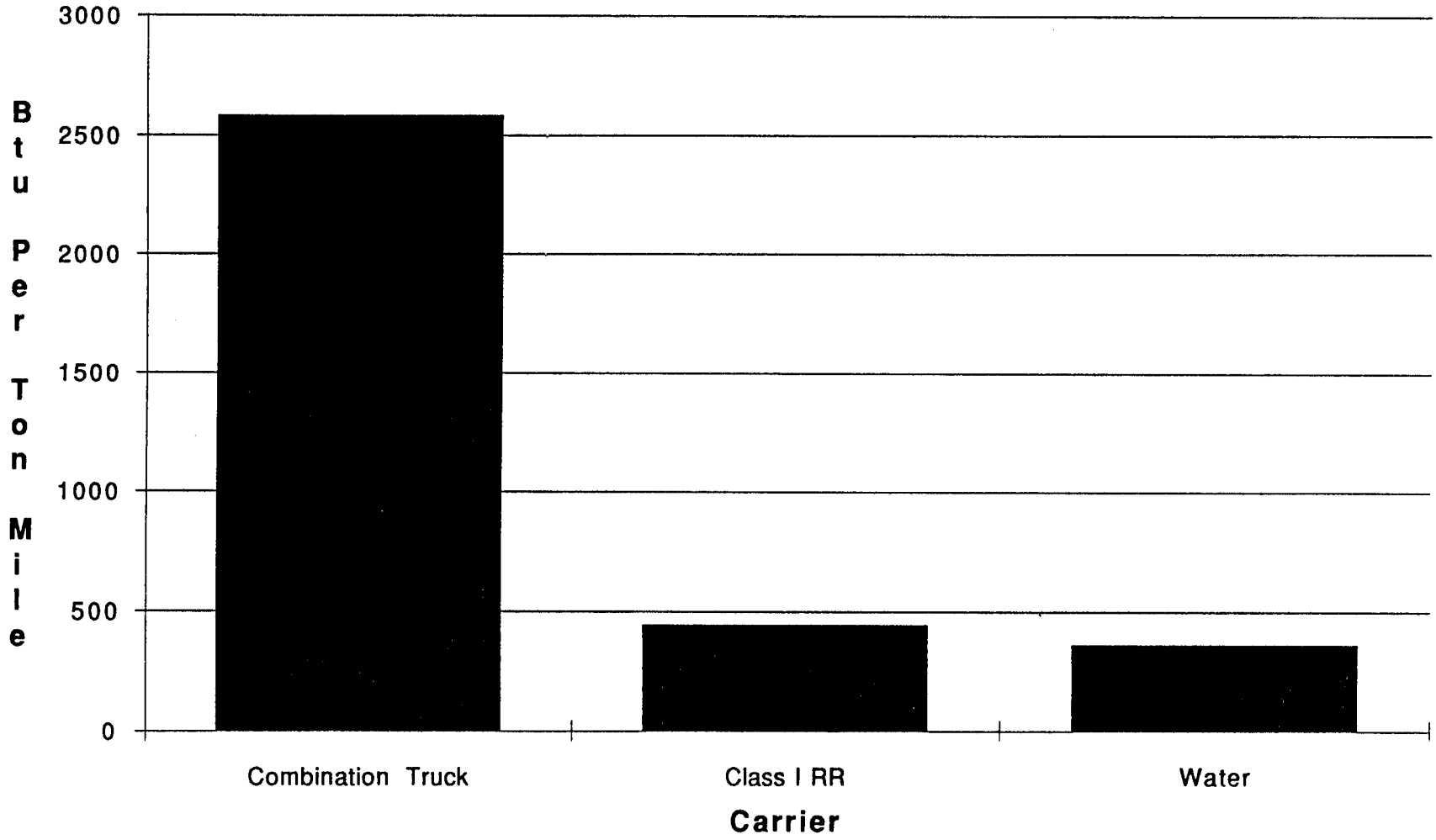
Table 2.12 Energy Intensities of Freight Modes in Texas

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)
1970	12,481	29,119	700	545
1971	12,547	29,273	701	506
1972	13,463	26,526	701	522
1973	13,541	26,679	701	576
1974	13,427	26,855	701	483
1975	13,397	26,134	700	549
1976	13,158	27,044	688	468
1977	13,118	27,187	675	458
1978	12,871	26,744	659	383
1979	13,290	28,109	643	457
1980	11,531	25,806	614	358
1981	10,637	25,392	591	360
1982	11,512	27,366	567	310
1983	10,658	28,297	543	319
1984	10,844	25,968	517	346
1985	11,194	26,814	514	446
1986	11,048	27,671	504	463
1987	10,849	27,287	471	402
1988	10,478	27,029	445	364
		Average annual changes		
Period:				
1970-88	-1.0%	-0.4%	-2.5%	-2.2%
1983-88	-0.3%	-0.9%	-3.9%	2.7%

Sources:

State Energy Data Report 1960-1988, Energy Information Agency; Highway Statistics, FHWA, USDOT, annual; Texas Railroad Facts 1990, Railroad Commission of Texas; Z.A. Goff, Texas Transportation Institute

Figure 2.12 Intercity Freight Energy Intensities in Texas, 1988



Source: Table 2.12

Table 2.13 Retail Prices of Selected Highway Motor Fuels

Cents per gallon, including tax

Year	Distillate fuel Current	Distillate fuel Constant 1988	LPG/Ethane Current	LPG/Ethane Constant 1988	Motor Gasoline Current	Motor Gasoline Constant 1988
1970	14.6	44.4	9.5	29.1	33.3	101.4
1971	17.3	50.6	11.4	33.3	36.7	107.3
1972	20.6	58.3	13.6	38.5	40.5	114.8
1973	24.5	65.2	16.2	43.2	44.8	119.3
1974	29.1	69.8	19.3	46.4	49.4	118.6
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
Average annual changes						
Period:						
1970-88	10.6%	4.0%	7.2%	0.7%	5.8%	-0.6%
1983-88	-0.3%	-4.5%	-12.0%	-15.0%	-3.5%	-6.7%

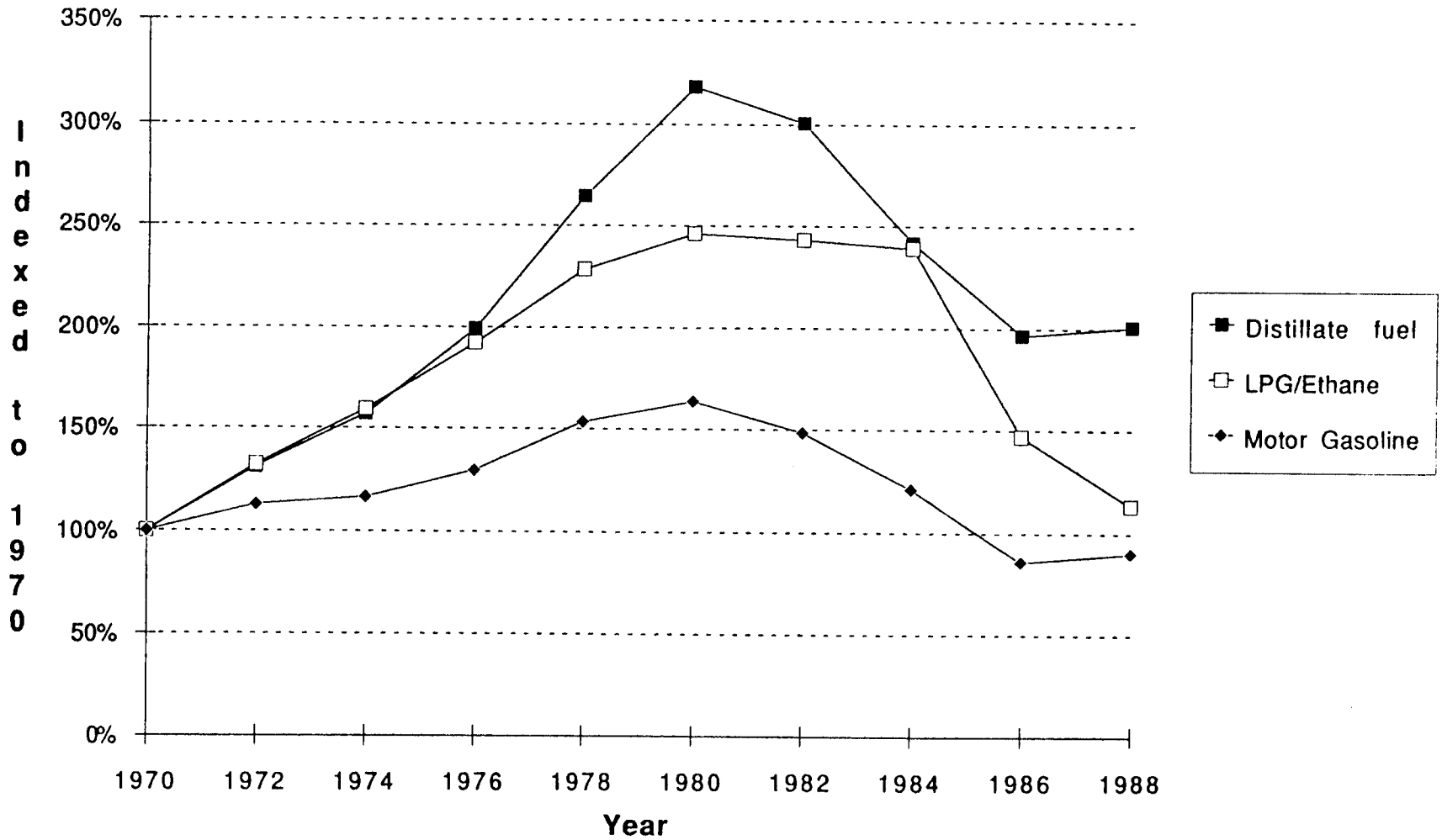
Source:

State Energy Price and Expenditure Report 1987, Energy Information Administration

Note:

Prices estimated using compound growth rate 1971-74, 1976-79

Figure 2.13 Prices (in Constant $ 1988) of Motor Fuels in Texas



Source: Table 2.13

Table 2.14 Retail Prices for Selected Transportation Fuels

Cents per gallon, including tax

Year	Aviation Gas Current	Aviation Gas Constant 1988	Jet Fuel Current	Jet Fuel Constant 1988	Residual Fuel Current	Residual Fuel Constant 1988
1970	26.1	79.5	9.7	29.6	6.3	19.2
1971	28.6	83.6	11.9	34.9	8.2	24.1
1972	31.4	88.9	14.7	41.5	10.8	30.6
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	24.2	53.1	24.4	53.7
1976	50.3	104.5	30.4	63.2	25.8	53.6
1977	60.9	118.9	38.2	74.6	27.3	53.2
1978	73.8	133.9	48.1	87.3	28.8	52.3
1979	89.5	145.8	60.5	98.6	30.5	49.6
1980	108.4	155.6	76.2	109.4	32.2	46.2
1981	130.3	169.6	89.8	116.8	37.3	48.5
1982	131.2	160.9	85.2	104.5	42.1	51.6
1983	125.5	149.0	75.7	89.9	45.2	53.7
1984	123.4	140.5	72.8	82.9	48.6	55.4
1985	120.1	132.0	68.1	74.9	60.2	66.2
1986	101.1	109.1	42.8	46.2	21.3	22.9
1987	90.7	94.5	46.3	48.2	38.6	40.2
1988	89.1	89.1	42.9	42.9	27.4	27.4
Period:			**Average annual changes**			
1970-88	7.1%	0.6%	8.6%	2.1%	8.5%	2.0%
1983-88	-1.9%	-2.8%	-3.1%	-4.0%	-2.7%	-3.7%

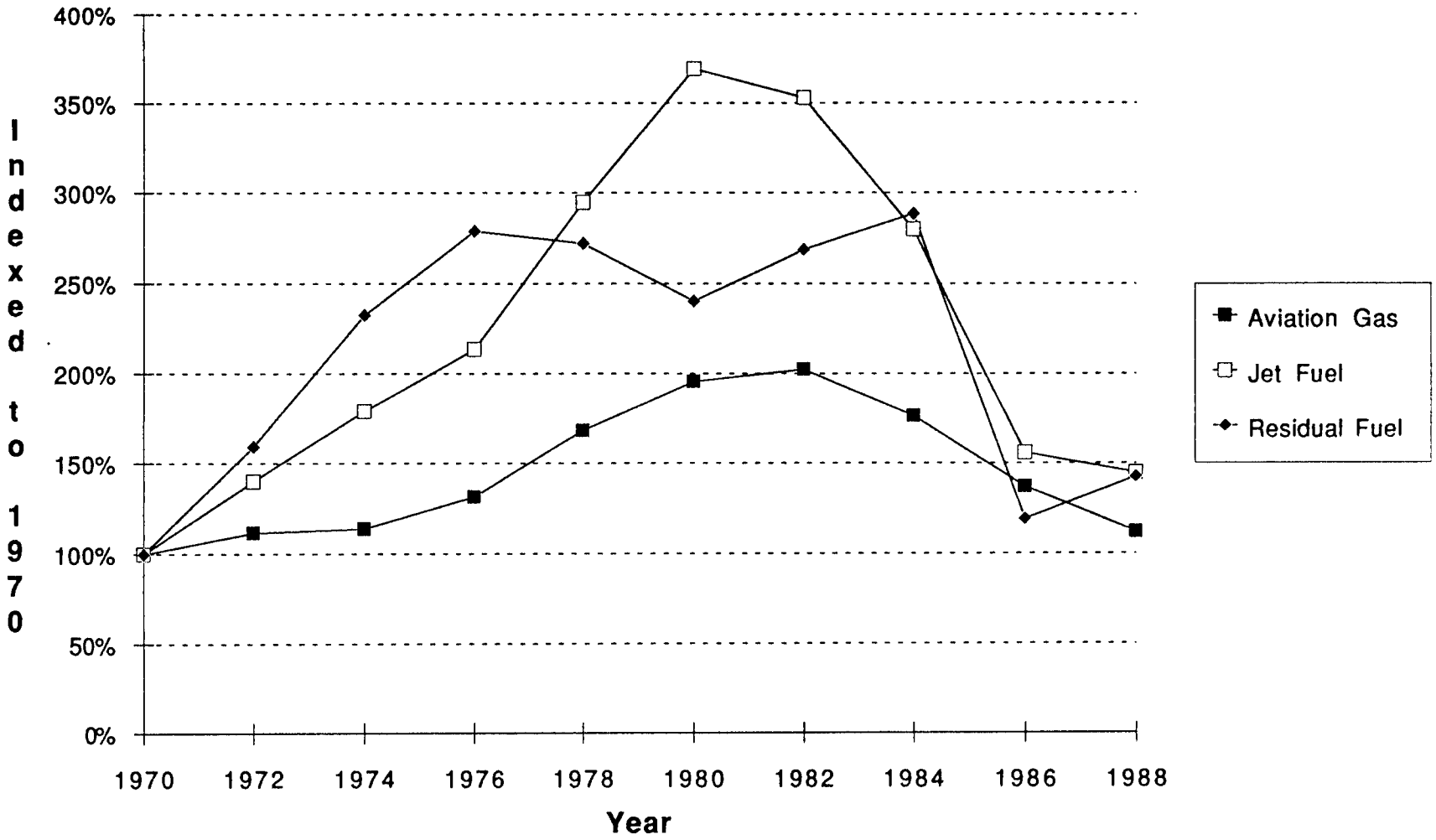
Source:

State Energy Price and expenditure Report 1987, Energy Information Administration

Note:

Prices estimated using compound growth rate 1971-74, 1976-79

Figure 2.14 Prices (In Constant $ 1988) of Non-Highway Fuels in Texas



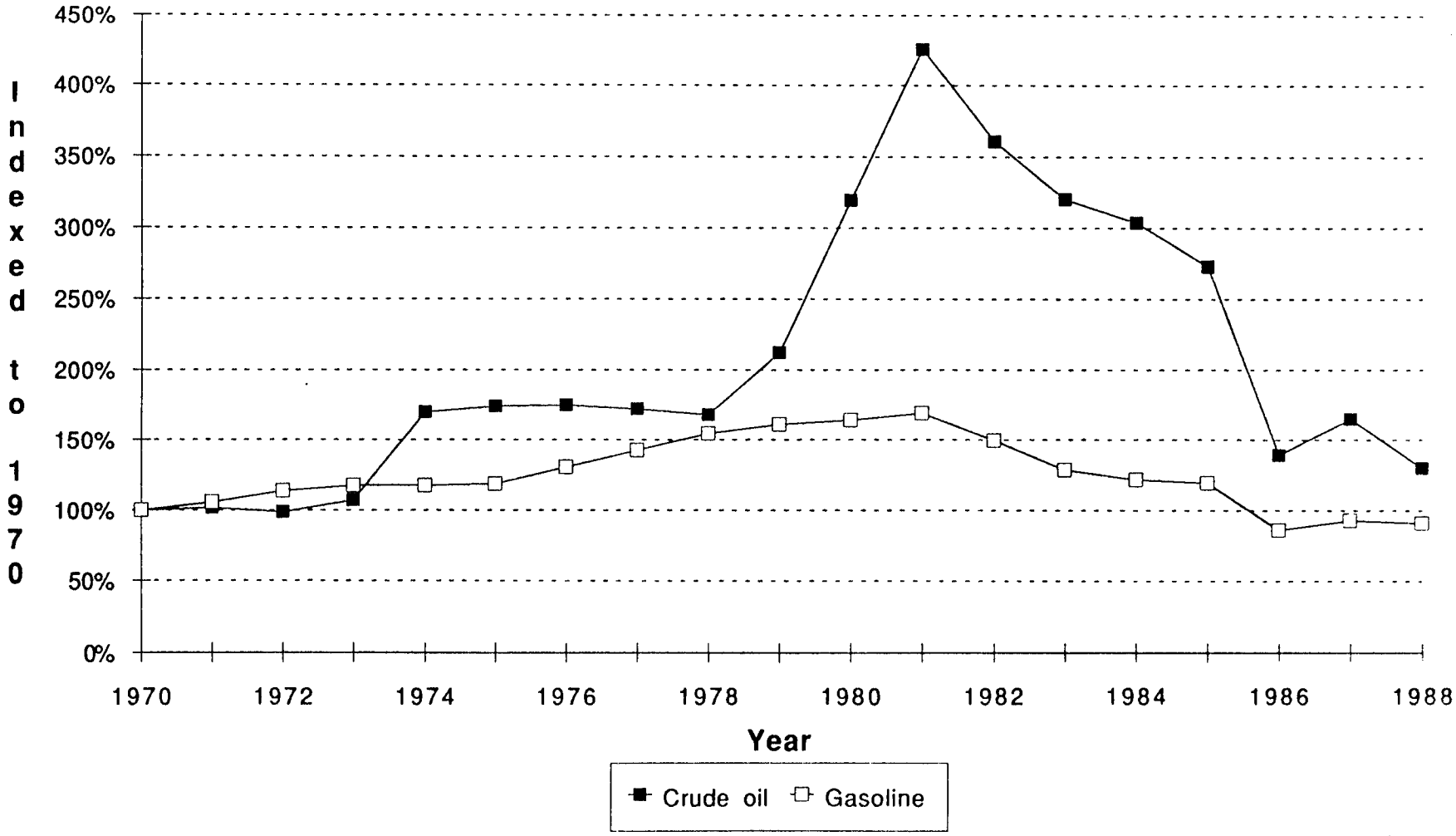
Source: Table 2.14

Table 2.15 Crude Oil and Gasoline Prices

Year	Average U.S. Crude Oil ($ per bbl) Current	Constant 1988	Average Texas Retail Gasoline ($ per gal) Current	Constant 1988
1970	3.18	9.7	0.33	1.01
1971	3.39	9.9	0.37	1.07
1972	3.39	9.6	0.41	1.15
1973	3.89	10.4	0.45	1.19
1974	6.87	16.5	0.49	1.19
1975	7.67	16.9	0.55	1.20
1976	8.19	17.0	0.63	1.32
1977	8.57	16.7	0.74	1.44
1978	9.00	16.3	0.86	1.56
1979	12.64	20.6	1.00	1.63
1980	21.59	31.0	1.16	1.66
1981	31.77	41.3	1.31	1.71
1982	28.52	35.0	1.23	1.51
1983	26.19	31.1	1.09	1.30
1984	25.88	29.5	1.08	1.23
1985	24.09	26.5	1.10	1.21
1986	12.51	13.5	0.81	0.87
1987	15.41	16.0	0.90	0.94
1988	12.58	12.6	0.92	0.92
Average annual changes				
Time Period				
1970-88	0.08	0.01	5.8%	-0.6%
1983-88	-0.14	-0.17	-3.5%	-6.7%

Sources:
Annual Energy Review, Energy Information Administration 1990, Table 67.

Figure 2.15 Prices (in Constant $ 1988) of Crude Oil and Gasoline



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 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.

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 .

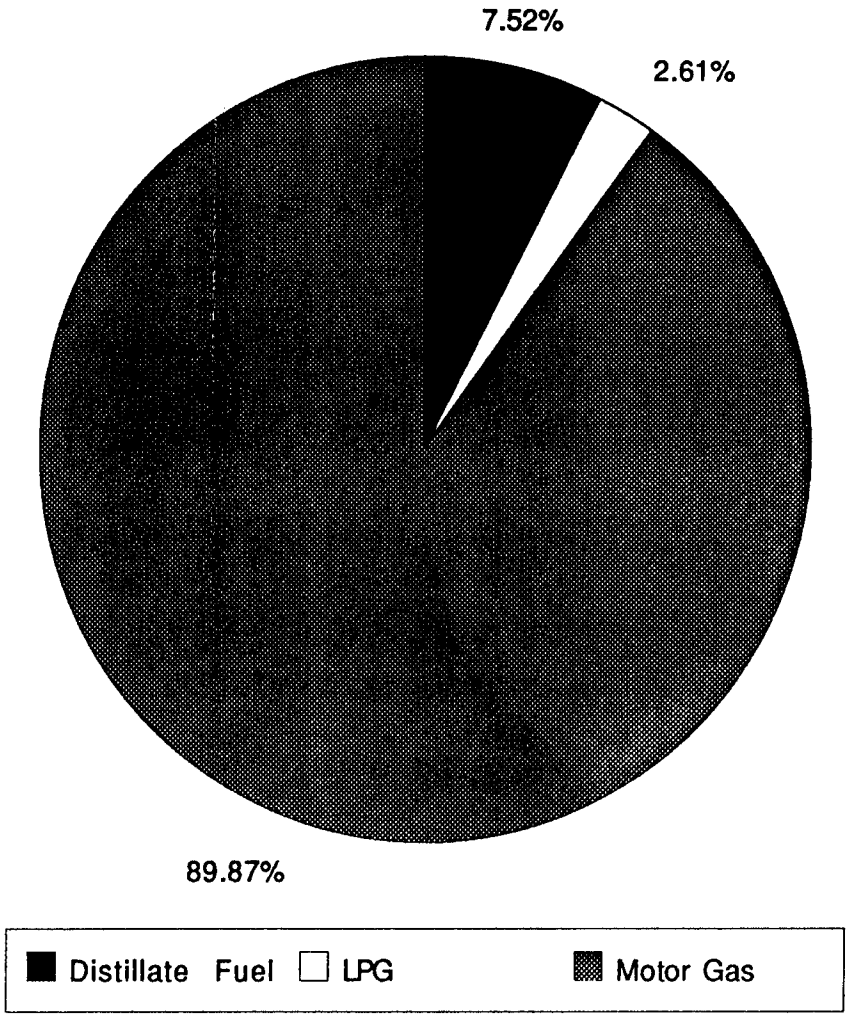
Table 3.1 Highway Mode Energy Consumption by Fuel Type

Year	Distillate Fuel	LPG	Motor Gasoline	Total
1970	61.3	21.3	732.6	815.2
1971	67.2	24.2	770.4	861.8
1972	83.4	24.8	827.9	936.2
1973	99.8	22.7	881.5	1,004.0
1974	98.9	19.9	872.4	991.3
1975	103.5	18.6	913.2	1,035.4
1976	114.8	19.1	966.6	1,100.5
1977	129.7	20.0	1,014.3	1,164.1
1978	151.8	18.5	1,053.4	1,223.7
1979	176.7	2.9	1,018.8	1,198.4
1980	166.0	2.4	929.8	1,098.3
1981	184.6	5.0	963.2	1,152.8
1982	191.0	4.3	991.3	1,186.6
1983	202.3	5.1	1,006.8	1,214.3
1984	211.5	2.7	1,010.3	1,224.6
1985	215.7	2.1	1,040.9	1,258.7
1986	200.4	2.4	1,062.6	1,265.5
1987	184.1	1.6	1,039.3	1,224.9
1988	180.8	1.7	1,059.8	1,242.3
Time Period:				
1970-88	6.2%	-13.1%	2.1%	2.4%
1983-88	-2.2%	-19.7%	1.0%	0.5%

Sources:

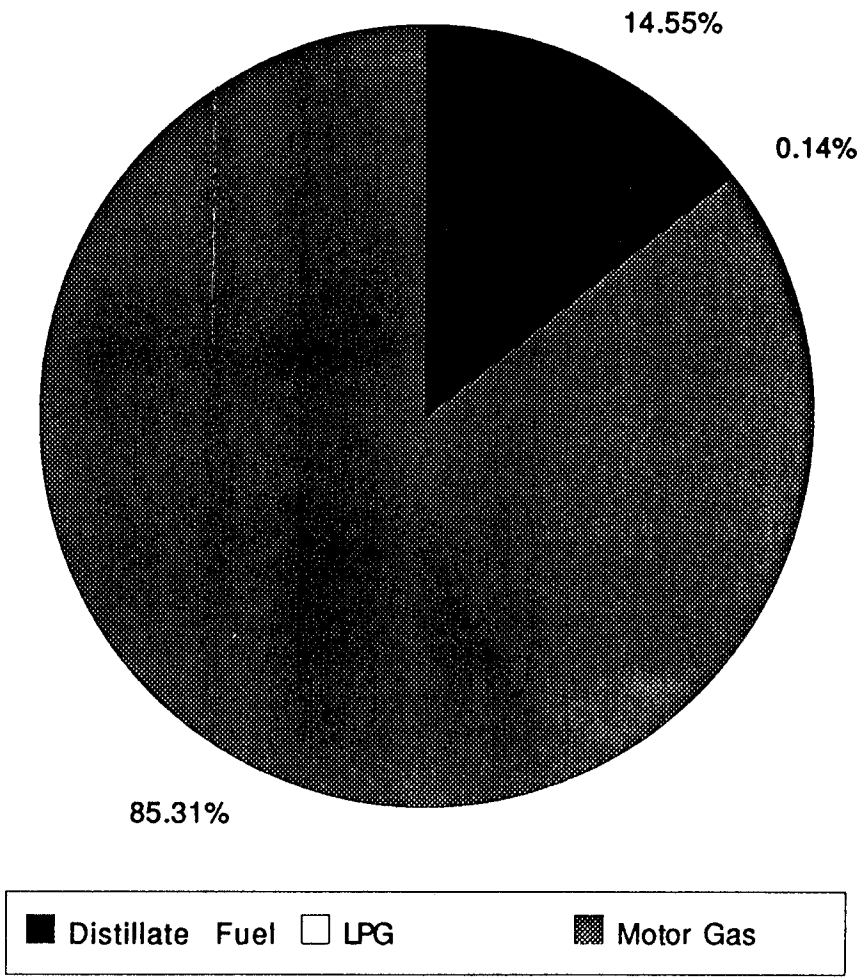
State Energy Data Report, Energy Information Administration, 1990;
Energy Information Administration unpublished fuel time series

Figure 3.1 Texas Highway Energy Use by Fuel Type, 1970



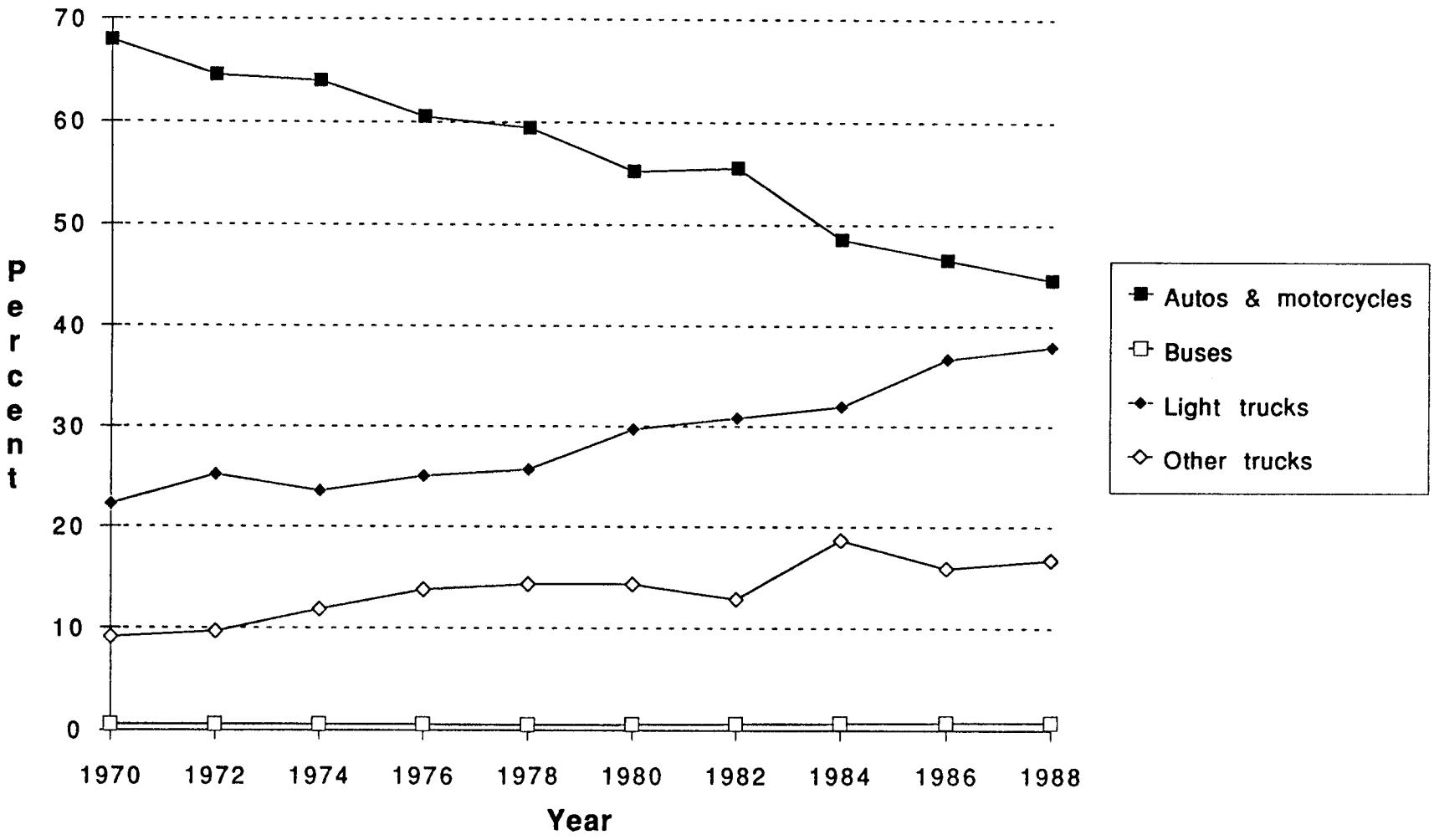
Sourace: Table 3.1

Figure 3.2 Texas Highway Energy Use by Fuel Type, 1988



Source: Table 3.1

Figure 3.3 Percentage of Highway Energy Consumption by Mode



Source: Table 3.1

Table 3.2 Texas Highway Energy Use by Mode

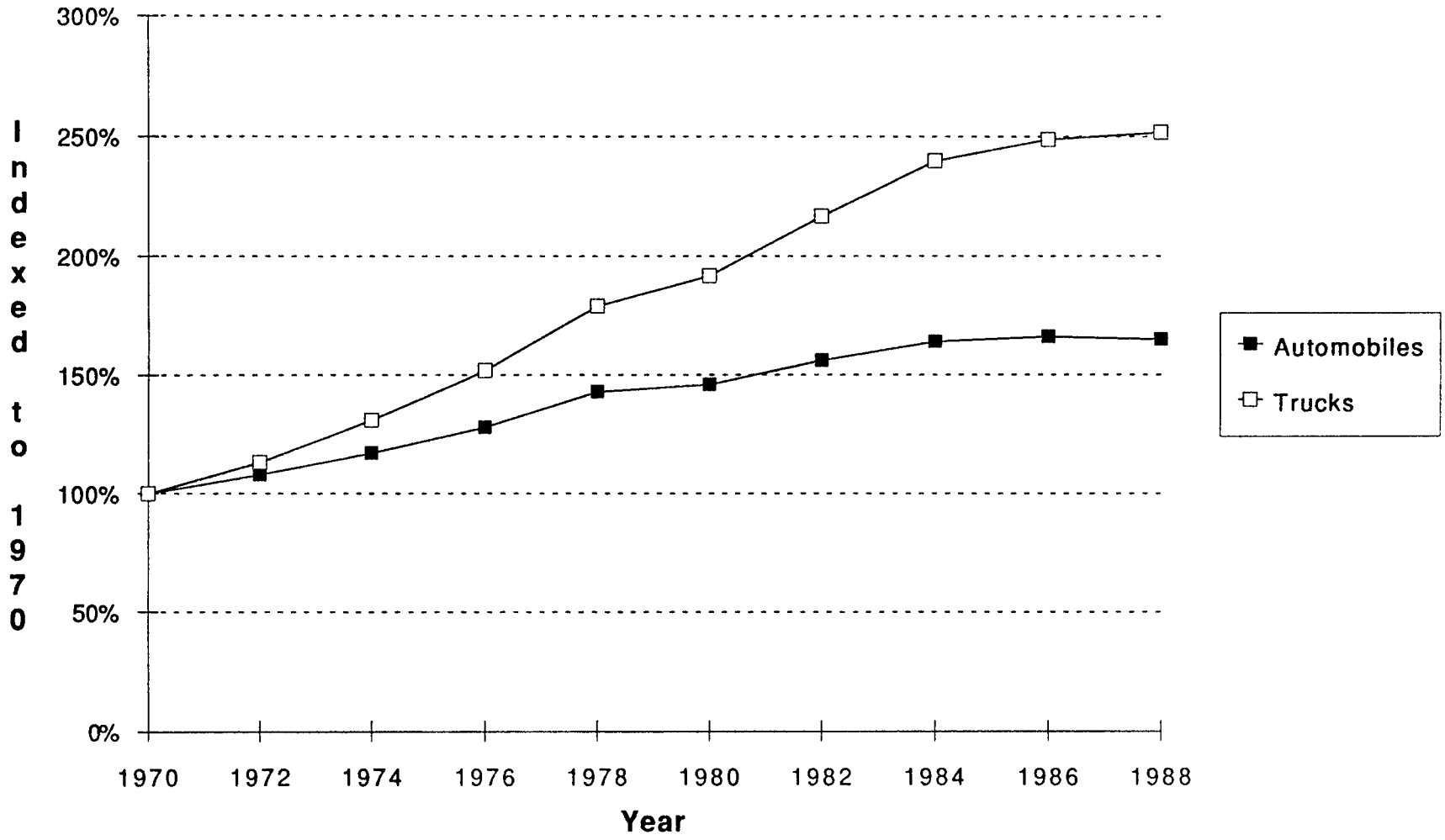
Year	Autos and motor-cycles	% of total transpor-tation energy	Buses	% of total transpor-tation energy	Light trucks	% of total transpor-tation energy	Other trucks	% of total transpor-tation energy	Total highway	% of total transpor-tation energy	Transpor-tation energy use
					Trillion Btu						
1970	554.0	45.8%	4.9	0.4%	181.5	15.0%	74.8	6.2%	815.2	67.4%	1,208.7
1971	583.2	46.5%	5.4	0.4%	191.9	15.3%	81.4	6.5%	861.8	68.7%	1,254.7
1972	604.2	44.5%	5.2	0.4%	235.9	17.4%	90.9	6.7%	936.2	69.0%	1,357.6
1973	654.0	44.1%	5.6	0.4%	244.4	16.5%	100.0	6.7%	1,004.0	67.7%	1,483.4
1974	634.4	42.1%	5.9	0.4%	233.3	15.5%	117.7	7.8%	991.3	65.8%	1,506.6
1975	651.2	41.8%	6.3	0.4%	243.3	15.6%	134.6	8.6%	1,035.4	66.4%	1,559.2
1976	666.3	41.3%	6.5	0.4%	275.5	17.1%	152.2	9.4%	1,100.5	68.2%	1,613.6
1977	701.8	40.6%	6.6	0.4%	291.6	16.9%	164.1	9.5%	1,164.1	67.4%	1,727.4
1978	727.6	39.9%	6.3	0.3%	314.0	17.2%	175.8	9.6%	1,223.7	67.0%	1,825.7
1979	693.9	36.9%	6.9	0.4%	321.2	17.1%	176.4	9.4%	1,198.4	63.7%	1,880.7
1980	606.8	33.7%	6.7	0.4%	326.9	18.1%	157.8	8.8%	1,098.3	60.9%	1,802.1
1981	600.1	32.9%	6.8	0.4%	360.3	19.7%	185.6	10.2%	1,152.8	63.1%	1,825.9
1982	659.5	35.0%	7.3	0.4%	366.3	19.5%	153.4	8.1%	1,186.6	63.0%	1,882.7
1983	649.9	34.6%	8.3	0.4%	347.0	18.5%	209.1	11.1%	1,214.3	64.7%	1,878.2
1984	595.0	29.9%	8.2	0.4%	392.0	19.7%	229.4	11.5%	1,224.6	61.5%	1,992.6
1985	622.0	30.6%	8.7	0.4%	415.4	20.4%	212.6	10.4%	1,258.7	61.9%	2,034.9
1986	589.5	28.6%	9.3	0.5%	464.8	22.6%	201.8	9.8%	1,265.5	61.5%	2,058.4
1987	561.0	27.5%	9.1	0.4%	473.5	23.2%	198.7	9.7%	1,224.9	60.0%	2,041.0
1988	553.4	25.7%	9.1	0.4%	471.4	21.9%	208.4	9.7%	1,242.3	57.6%	2,156.4
					Average annual changes						
1970-88	0.0%		3.5%		0.8%		5.9%		2.4%		3.3%
1983-88	-3.2%		1.9%		6.3%		-0.1%		0.5%		2.8%

Sources:

State Energy Data Report, Energy Information Administration, 1990;

Energy Information Administration unpublished fuel time series; Highway Statistics, USDOT, FHWA, 1970-1988.

Figure 3.4 Automobiles and Trucks Registered in Texas



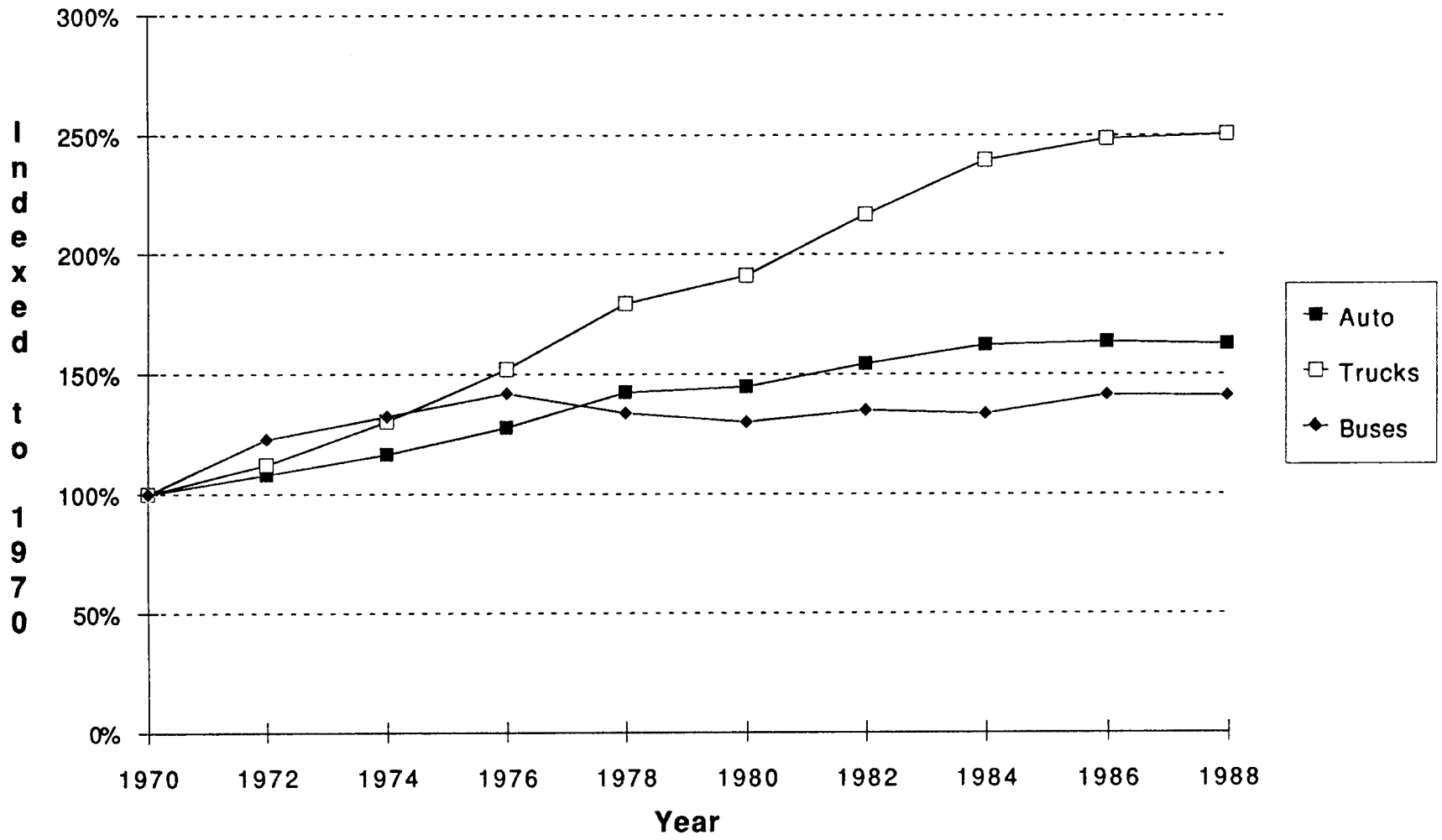
Source: Table 3.2

Table 3.3 Detailed Vehicle Stock in Texas, 1988

	Registrations	As % of U.S.	Change from prior year
Automobiles	**8,455,744**	**6.0%**	**0.7%**
Two seaters	192,328		
Minicompact	344,300		
Subcompact	1,963,640		
Compact	1,755,578		
Midsize	2,404,175		
Large	1,795,582		
Private	8,313,649	5.9%	0.6%
Public	142,095	13.0%	2.9%
Motorcycles	**211,668**	**4.6%**	**-7.9%**
Private	207,852	4.6%	-8.0%
Public	3,816	10.8%	-0.3%
Buses	**60,075**	**9.8%**	**1.8%**
Private	15,470	5.7%	0.1%
Public	44,605	13.0%	2.4%
Trucks	**3,890,394**	**9.1%**	1.3%
Light	3,668,642		
Medium	66,137		
Light-heavy	35,014		
Heavy-heavy	120,602		
Private	3,701,828	9.1%	1.2%
Public	188,566	11.5%	3.2%
All private vehicles	**12,238,799**	**6.6%**	**2.6%**
All public vehicles	**379,082**	**12.2%**	**4.1%**

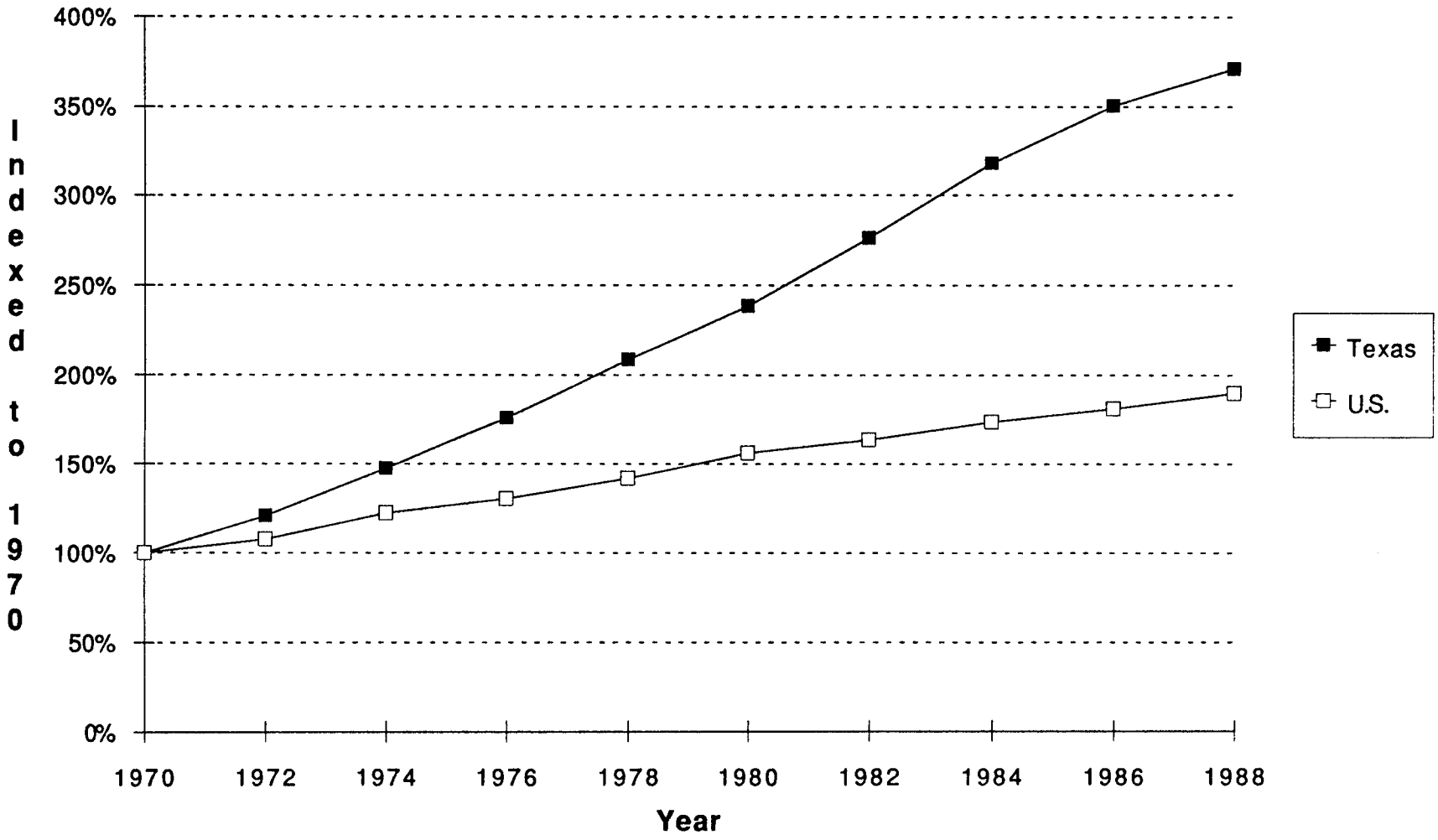
Source:
Data compiled by Texas Transportation Institute from Highway Statistics

Figure 3.5 Texas Private Vehicle Stock Growth



Source: Table 3.3

Figure 3.6 Public Vehicle Stock Growth



Source: Table 3.3

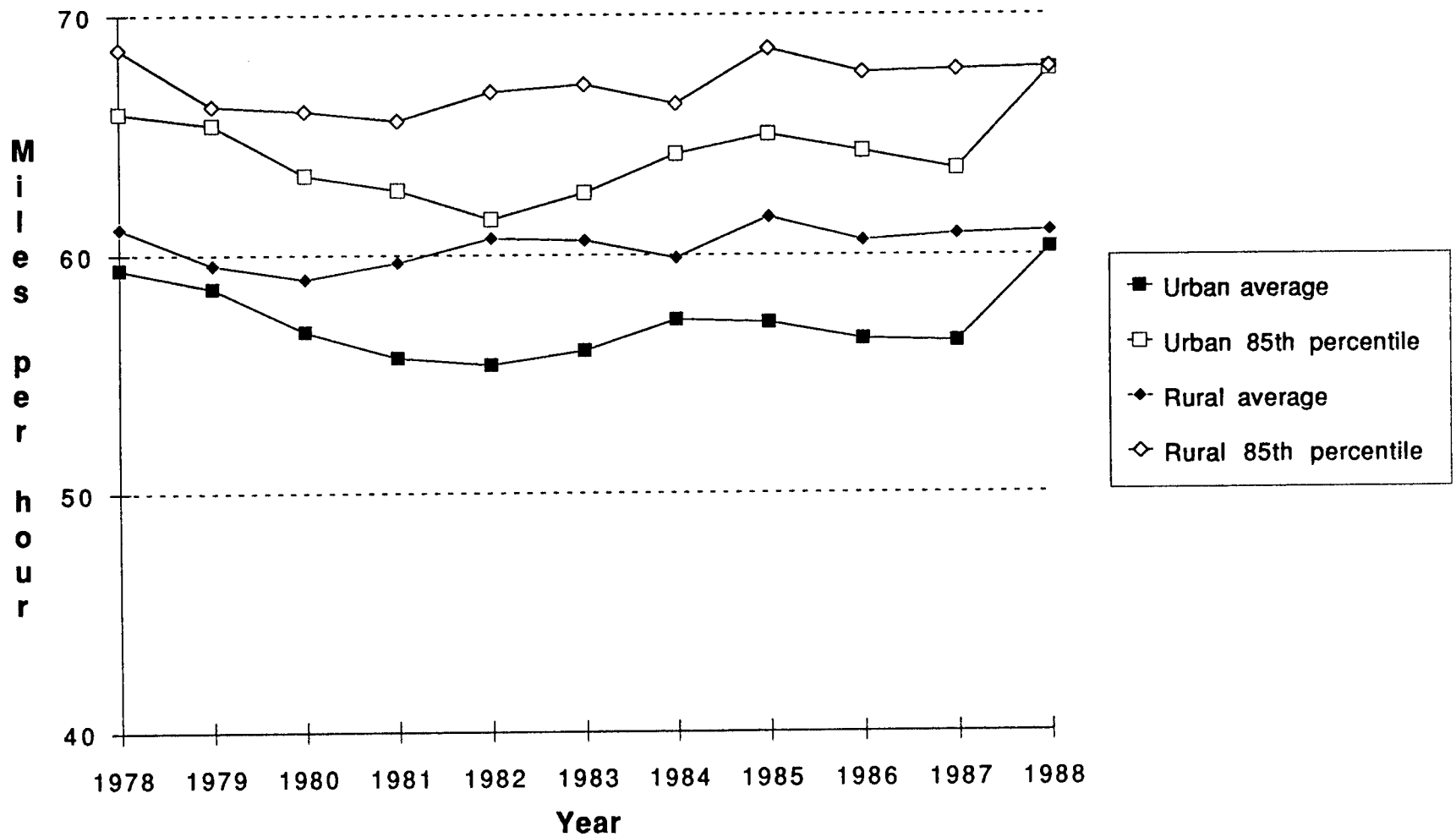
Table 3.4 Vehicle Stock in Texas, 1970-88

Year	Automobiles Private	Automobiles Public	Trucks Private	Trucks Public	Buses Private	Buses Public	Texas public vehicles (000's)	U.S. public vehicles (000's)	% Texas public vehicles of U.S.
1970	5,104,238	23,683	1,477,151	66,953	10,960	10,295	100.9	1,617.7	6.2%
1971	5,307,630	27,862	1,553,187	71,671	13,663	10,256	109.8	1,690.6	6.5%
1972	5,520,343	32,839	1,659,550	78,101	13,490	11,388	122.3	1,745.0	7.0%
1973	5,841,778	39,119	1,824,967	84,338	13,995	11,448	134.9	1,844.1	7.3%
1974	5,960,744	46,362	1,928,529	91,189	14,542	11,903	149.5	1,982.3	7.5%
1975	6,168,794	48,670	2,051,738	99,937	14,996	14,354	163.0	2,042.0	8.0%
1976	6,527,984	58,588	2,248,660	102,910	15,572	16,040	177.5	2,111.9	8.4%
1977	6,904,942	65,639	2,375,716	109,679	15,398	17,197	192.5	2,211.1	8.7%
1978	7,273,403	75,667	2,652,849	118,035	14,684	16,906	210.6	2,298.6	9.2%
1979	7,127,749	82,531	2,631,444	126,738	14,428	18,056	227.3	2,447.1	9.3%
1980	7,395,069	89,748	2,824,175	134,293	14,272	17,259	241.3	2,531.2	9.5%
1981	7,763,298	97,068	3,085,800	141,269	15,497	19,858	258.2	2,549.0	10.1%
1982	7,887,184	105,554	3,206,475	150,071	14,801	23,748	279.4	2,649.5	10.5%
1983	8,044,424	114,584	3,330,285	152,340	14,194	39,651	306.6	2,731.4	11.2%
1984	8,293,723	123,504	3,542,075	160,569	14,650	37,172	321.2	2,815.9	11.4%
1985	8,430,750	131,831	3,658,087	169,793	15,102	38,624	340.2	2,909.9	11.7%
1986	8,363,699	136,273	3,673,375	177,901	15,520	39,840	354.0	2,935.5	12.1%
1987	8,260,166	138,065	3,658,414	182,692	15,461	43,564	364.3	2,997.9	12.2%
1988	8,313,649	142,095	3,701,828	188,566	15,470	44,605	375.3	3,073.7	12.2%
Average annual changes									
Period:									
1970-88	2.7%	10.5%	5.2%	5.9%	1.9%	8.5%	7.6%	3.6%	-
1983-88	0.7%	4.4%	2.1%	4.4%	1.7%	2.4%	4.1%	2.4%	-

Source:

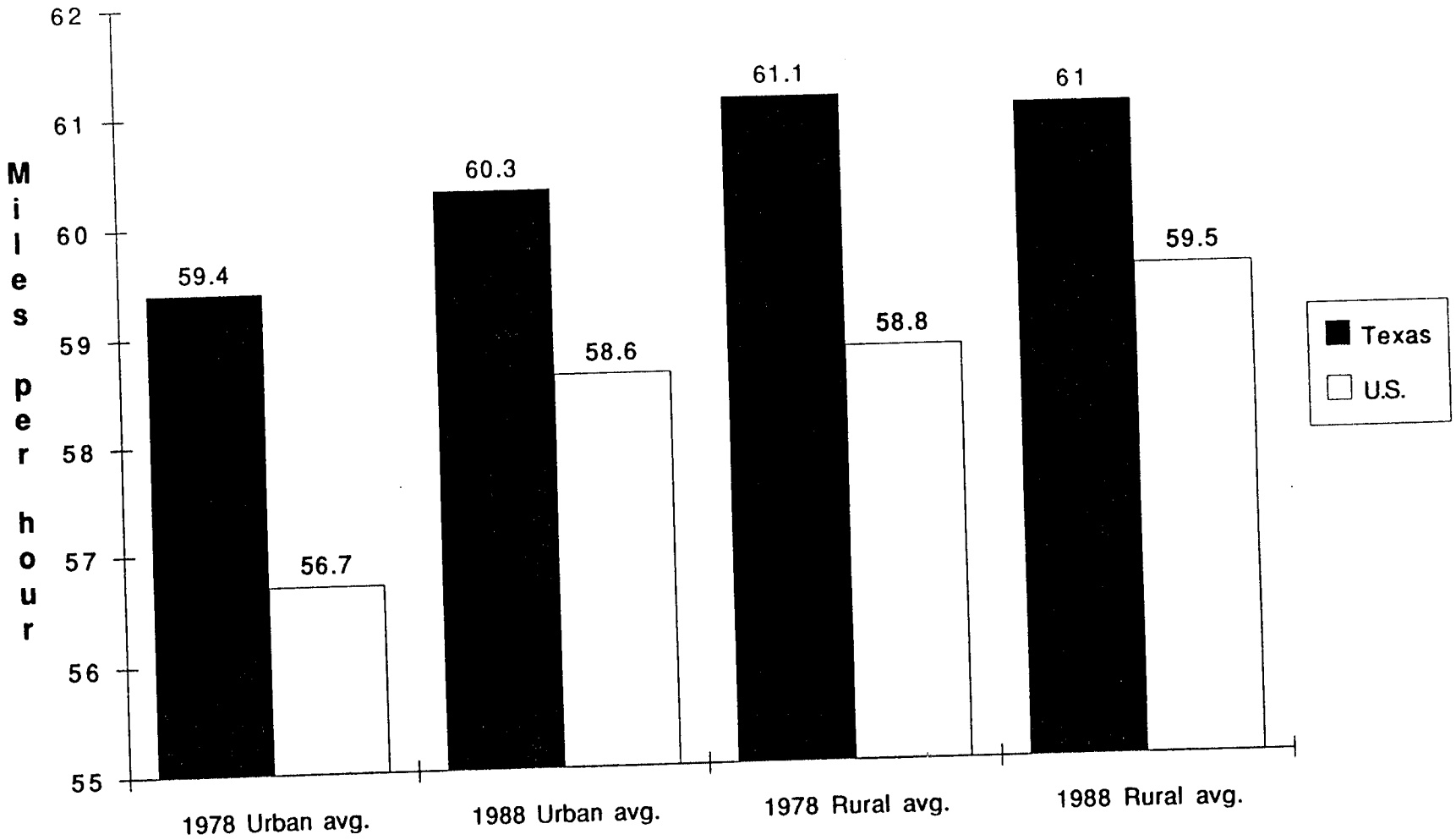
Highway Statistics, USDOT, FHWA, 1970 and annual

Figure 3.7 Speed of Vehicles on Texas Interstates



Source: Table 3.4

Figure 3.8 Urban and Rural Interstate Speed Data, 1978 and 1988



Source: Table 3.5

Table 3.5 Texas Interstate Speed Data

	Urban					Rural				
Year	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)
U.S. averages for 1978 and 1988										
1978	56.7	61.4	60	23	5	58.8	63.7	74	36	10
1988	58.6	65.6	70	40	16	59.5	66.4	74	46	19

Source:

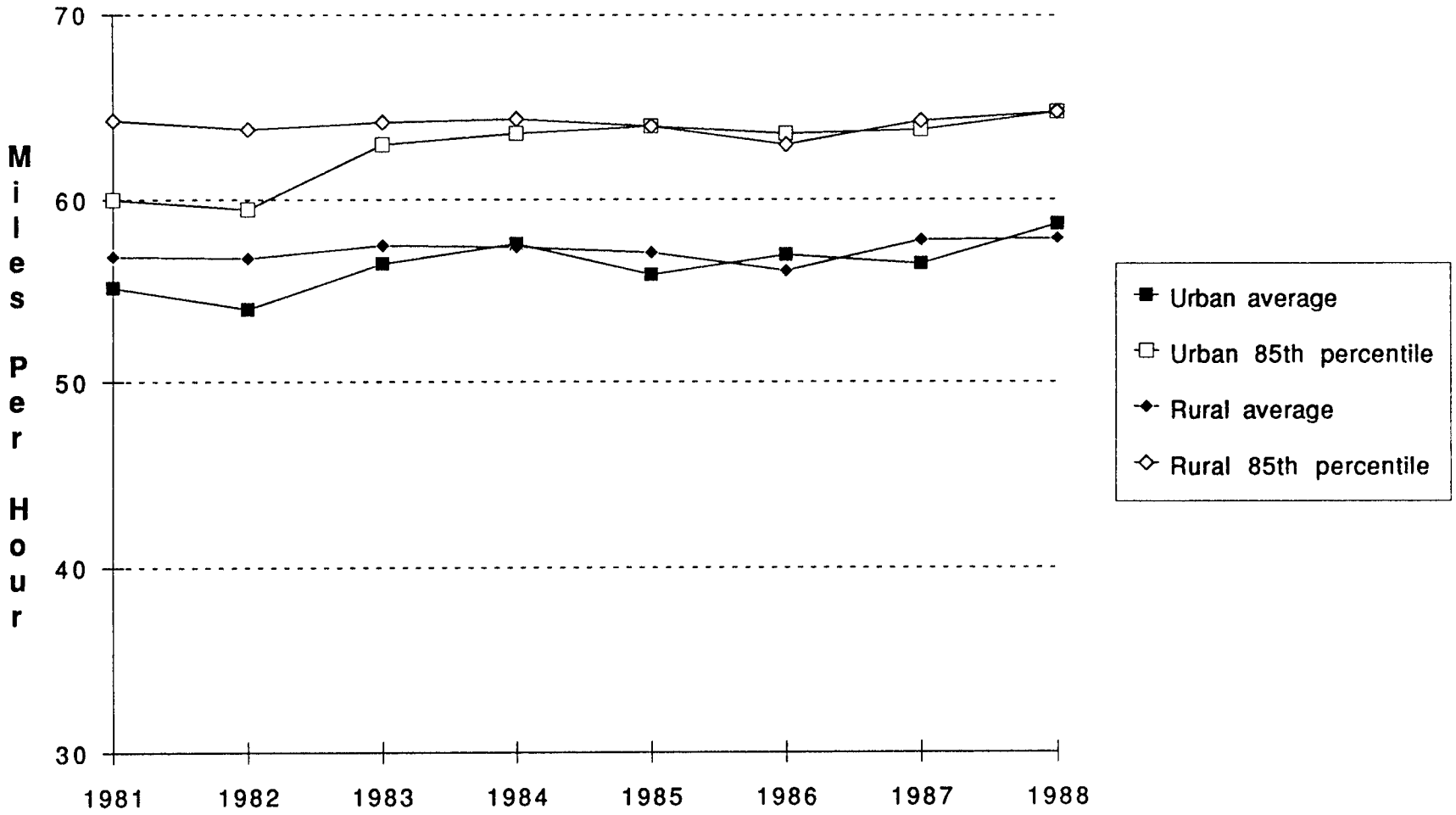
Highway Statistics, USDOT, FHWA, 1970 and annual

Notes:

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

The speed data shown in this table is estimated by a trend line for 1987-88 for rural interstates.

Figure 3.9 Speed of Vehicles on Texas Freeways, Expressways, Other Primary and Major Arterials



Source: Table 3.6

Table 3.6 Texas Non-Interstate Speed Data

	Urban Freeway and Expressway					Rural Other Principal and Minor Arterials				
Year	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
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
U.S. averages for 1988										
1988	57.5	64.2	65	33	11	56	62.8	55	25	9

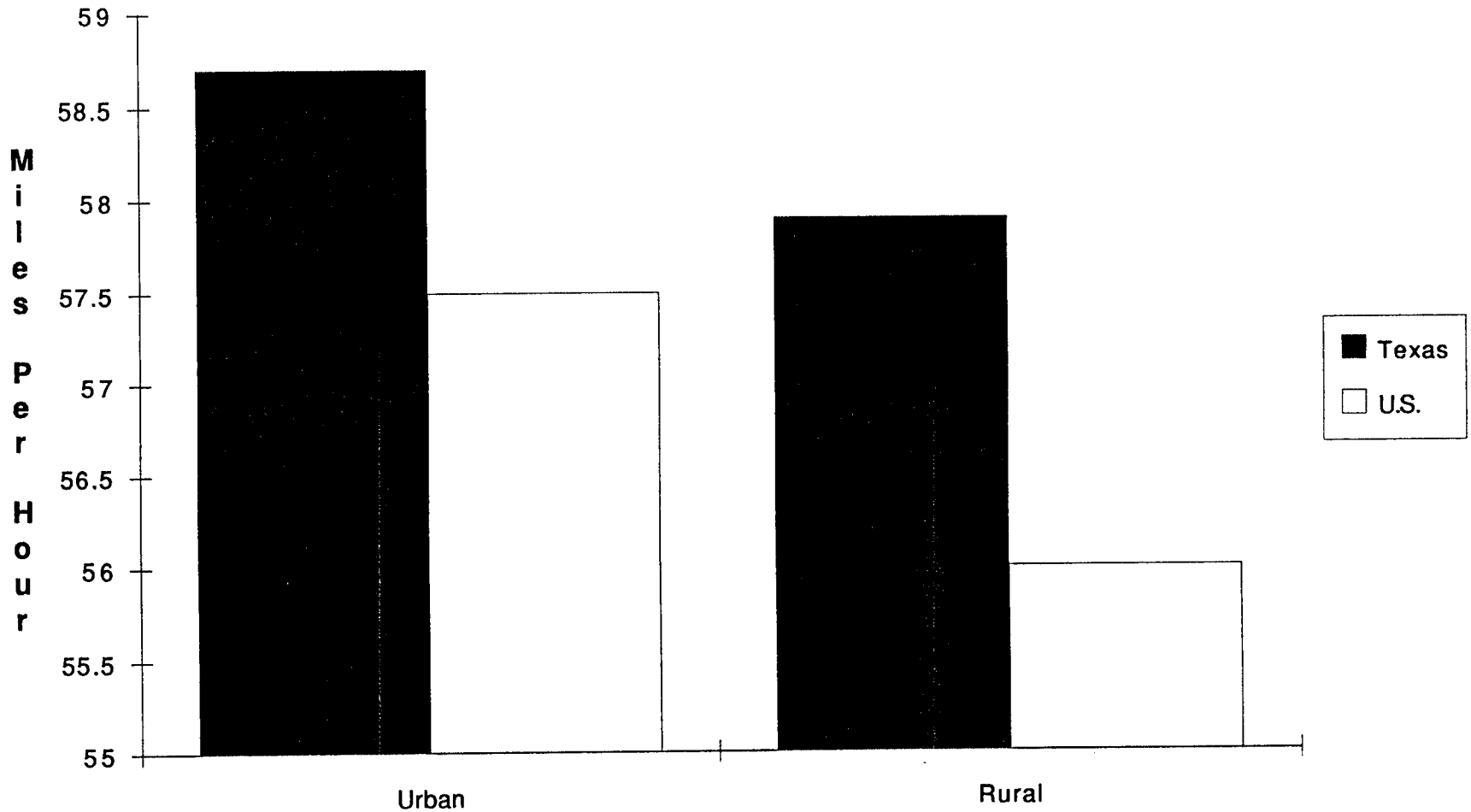
Source:

Highway Statistics, USDOT, FHWA, 1981 and annual

Notes:

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

Figure 3.10 Urban and Rural Speed Data for Freeways, Expressways, Other Principal and Major Arterials, 1988



Source: Table 3.6

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 conclude 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.

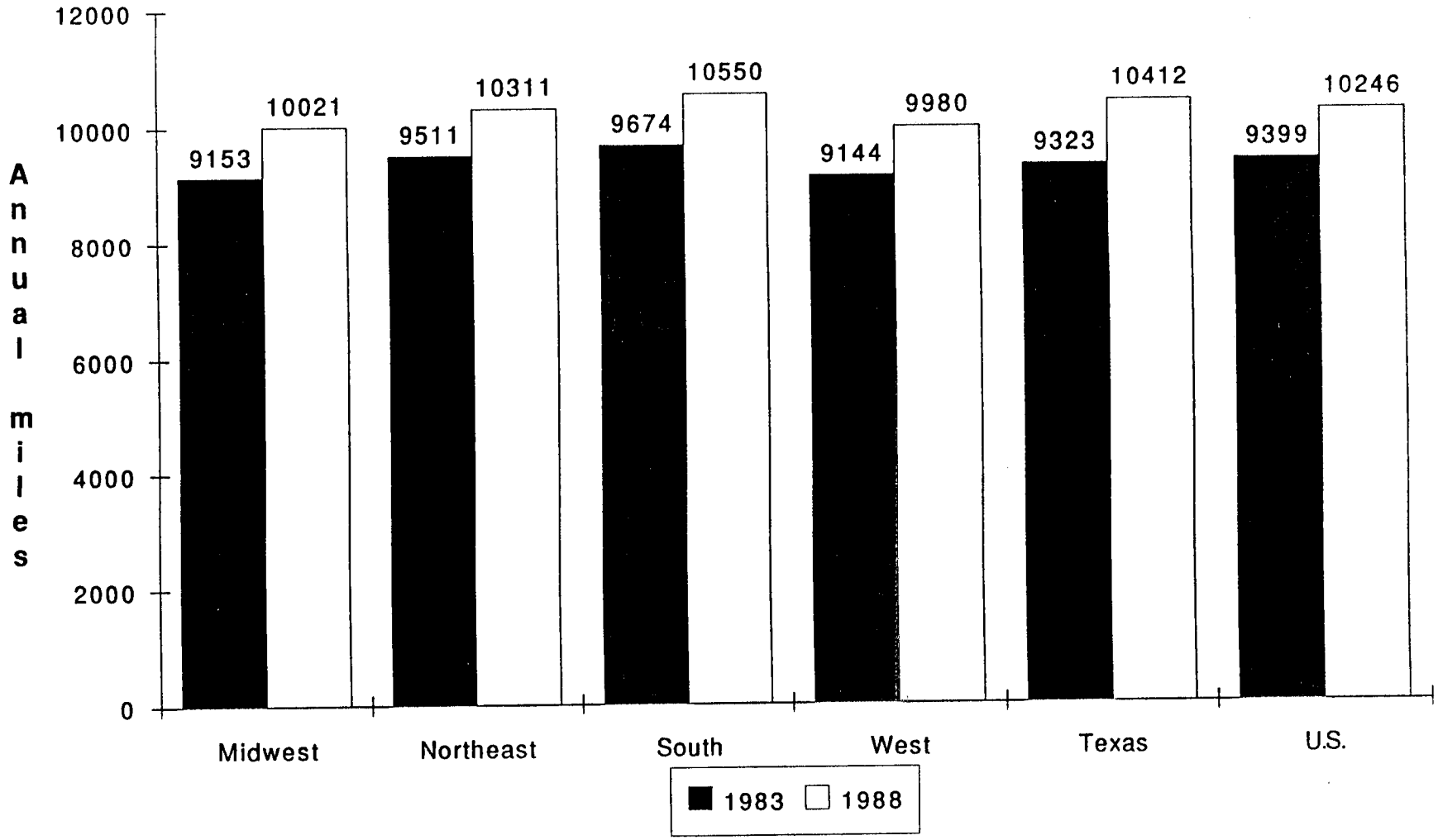
Table 3.7 Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption, and Expenditures

Census region	Vehicle miles traveled 1988	Vehicle miles traveled 1983	Average annual change	Consumption (gal) 1988	Consumption (gal) 1983	Average annual change	Expenditures 1988	Expenditures 1983	Average annual change
	Annual average per vehicle								
Midwest	10,021	9,153	1.8%	550	620	-2.4%	$539	$738	-6.1%
Northeast	10,311	9,511	1.6%	525	609	-2.9%	$532	$731	-6.2%
South	10,550	9,674	1.7%	585	644	-1.9%	$575	$758	-5.4%
Texas*	10,412	9,323	2.2%	619	659	-1.2%	$602	$751	-4.3%
West	9,980	9,144	1.8%	556	595	-1.3%	$540	$701	-5.1%
U. S.	10,246	9,399	1.7%	559	621	-2.1%	$550	$736	-5.7%

Sources:
Consumption Patterns of Household Vehicles 1983, EIA, RTECS;
Household Vehicle Energy Consumption 1988, EIA, RTECS

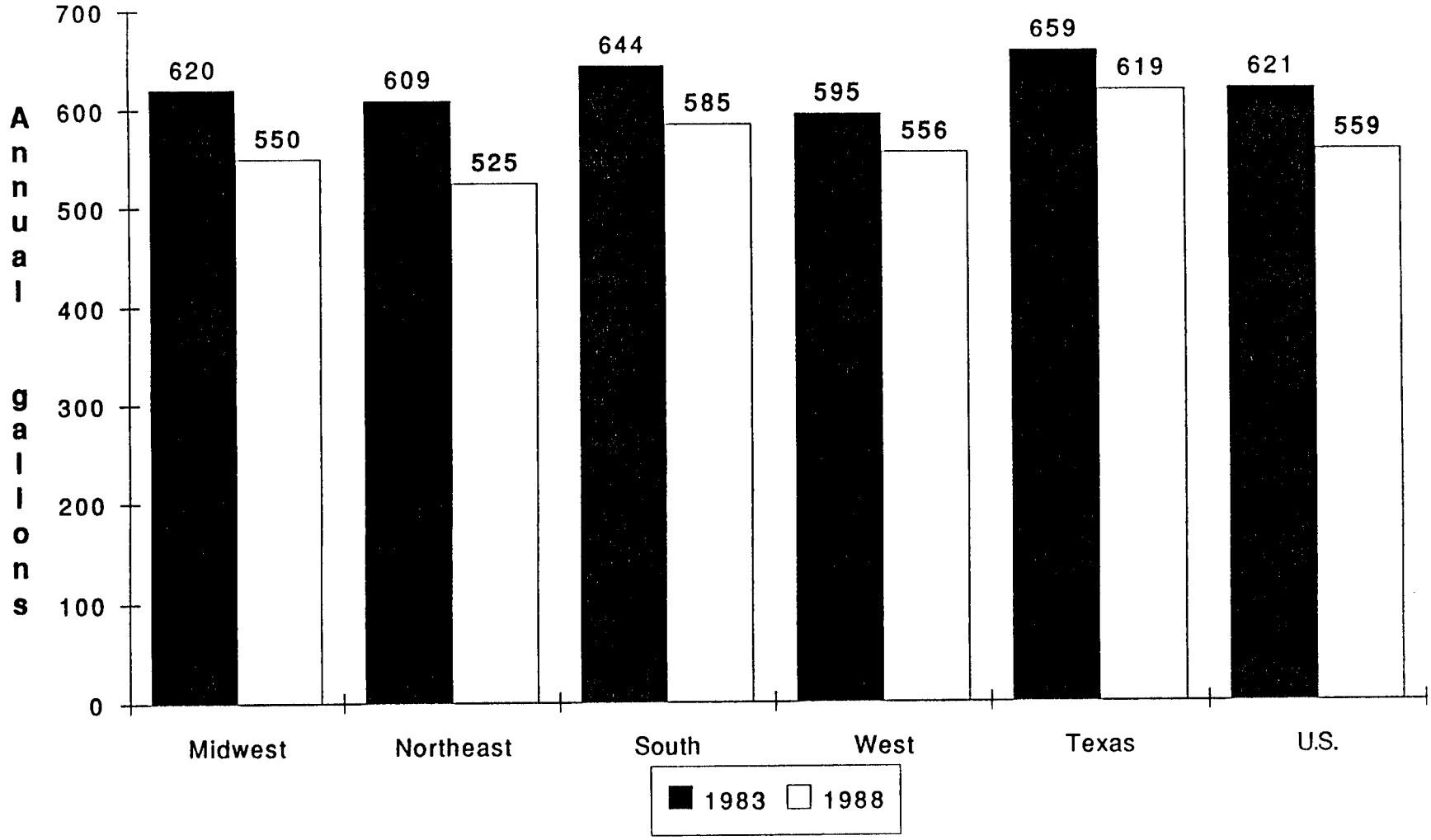
Notes:
* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant total of the W. South Central sample data (per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, Energy Information Agency)

Figure 3.11 Average Annual Miles Traveled Per Household Vehicle



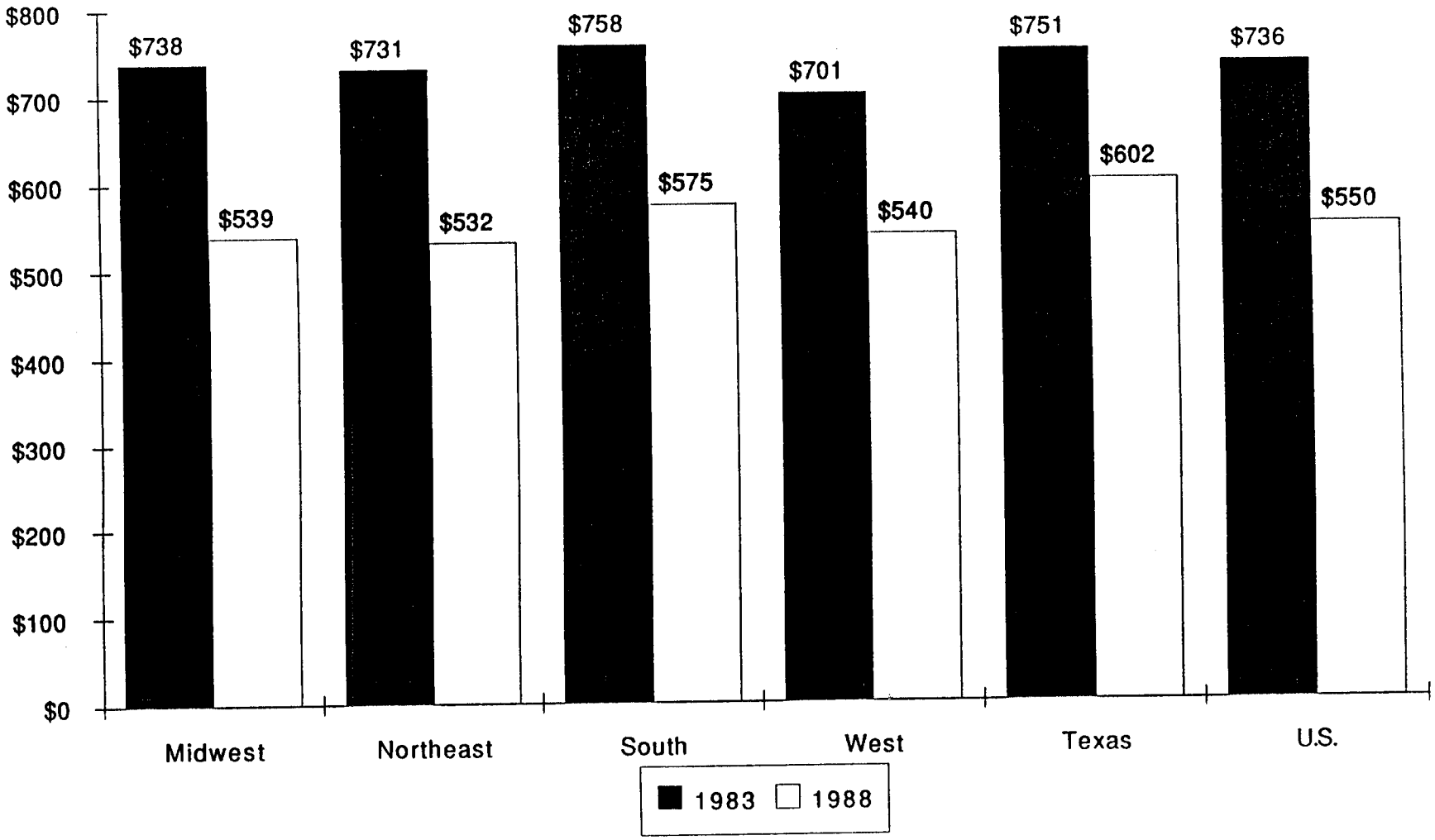
Source: Table 3.7

Figure 3.12 Average Annual Consumption Per Household Vehicle



Source: Table 3.7

Figure 3.13 Average Annual Energy Expenditures Per Household Vehicle



Source: Table 3.7

Table 3.8 U.S. Travel and Consumption Characteristics by Number of Cylinders, 1988 v. 1983

Annual average per household vehicle

Number of cylinders	Vehicle miles traveled 1988	1983	Avg. annual change	Consumption (gallons) 1988	1983	Avg. annual change	Expenditures 1988	1983	Avg. annual change	Miles per gallon 1988	1983	Avg. annual change
4	11,269	10,851	0.8%	453	478	-1.1%	$449	$564	-4.5%	24.9	22.7	1.9%
6	10,539	9,517	2.1%	570	618	-1.6%	$564	$729	-5.0%	18.5	15.4	3.7%
8	9,009	8,519	1.1%	659	687	-0.8%	$642	$811	-4.6%	13.7	12.4	2.0%

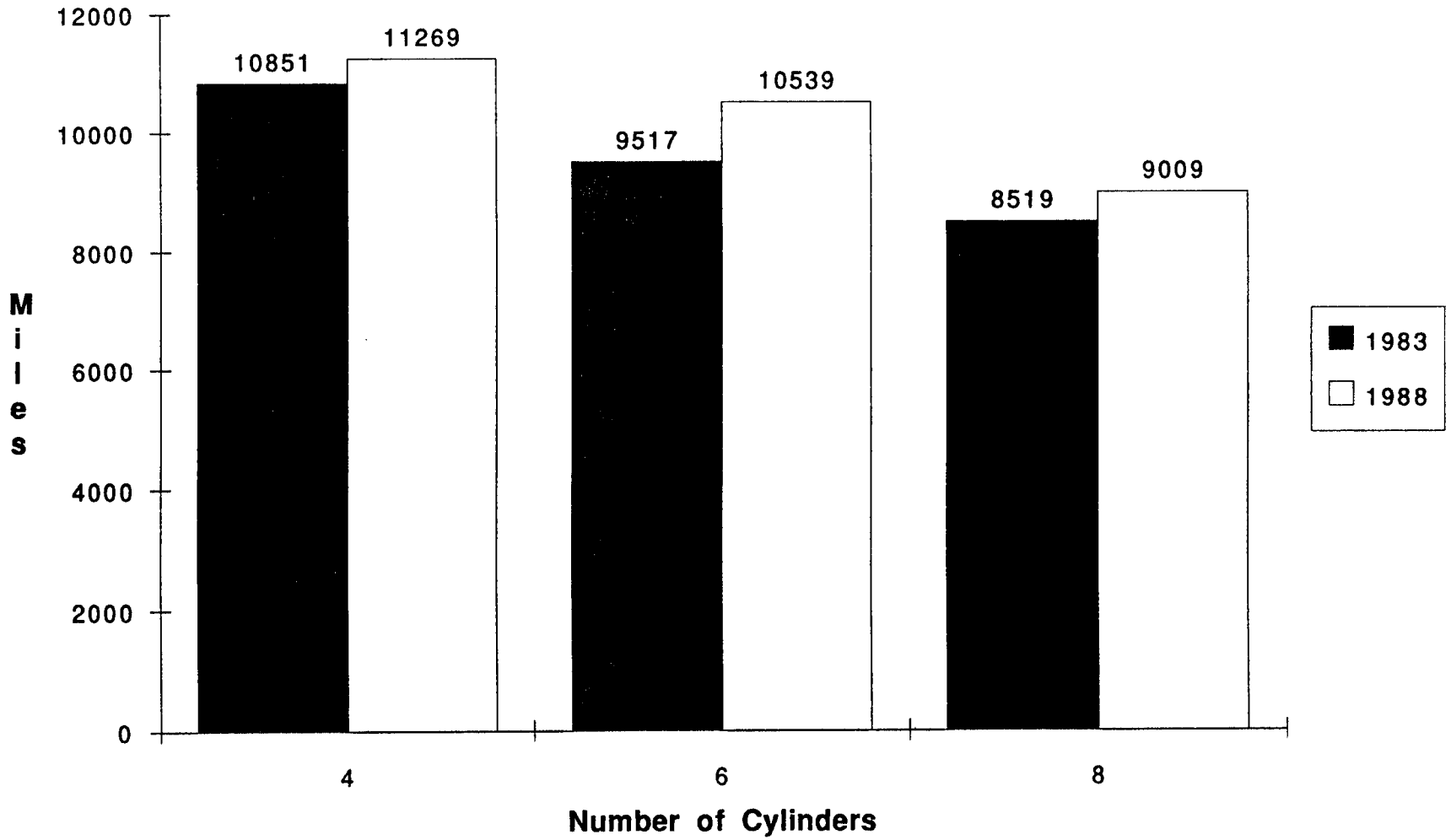
Sources:

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

Notes:

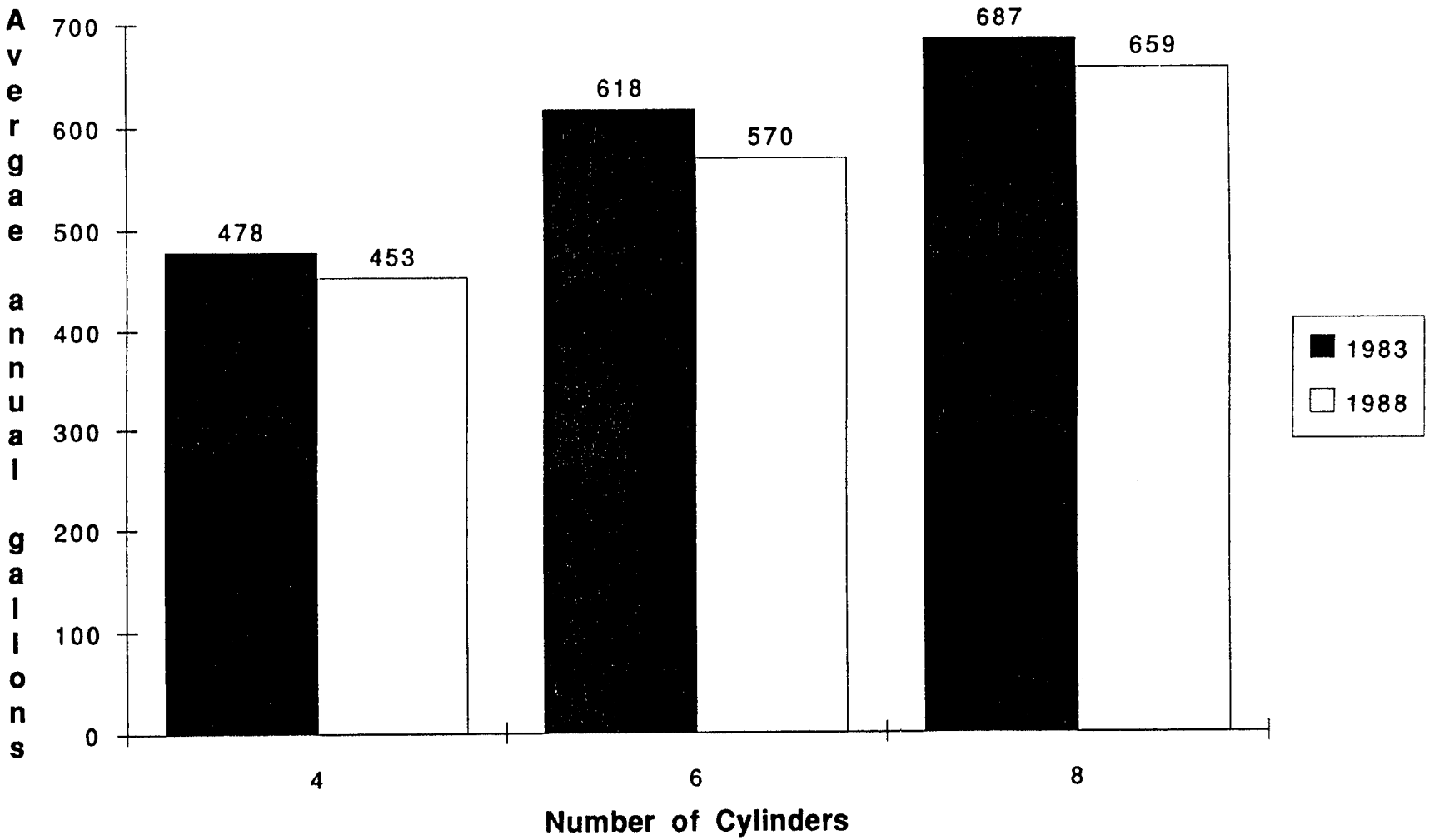
- 1983 Vehicle Miles Traveled obtained by multiplying gal consumed by miles per gal
- Expenditures for 1983 derived from 1983 source document value of $1.18/gal multiplied by consumption figure for 1983

Figure 3.14 U. S. Average Annual Miles Traveled by Number of Cylinders



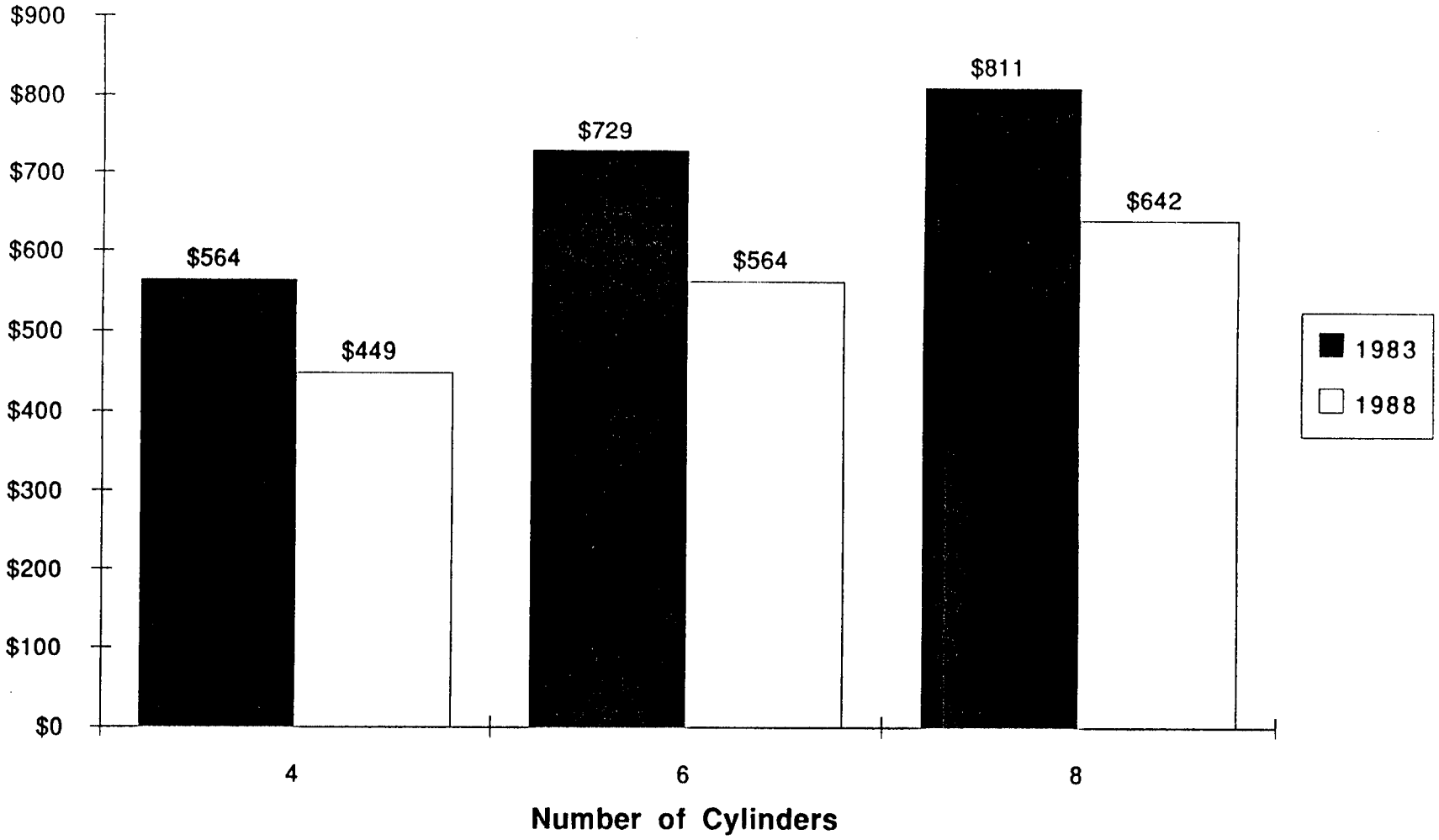
Source: Table 3.8

Figure 3.15 U.S. Average Annual Gallons Consumed by Number of Cylinders



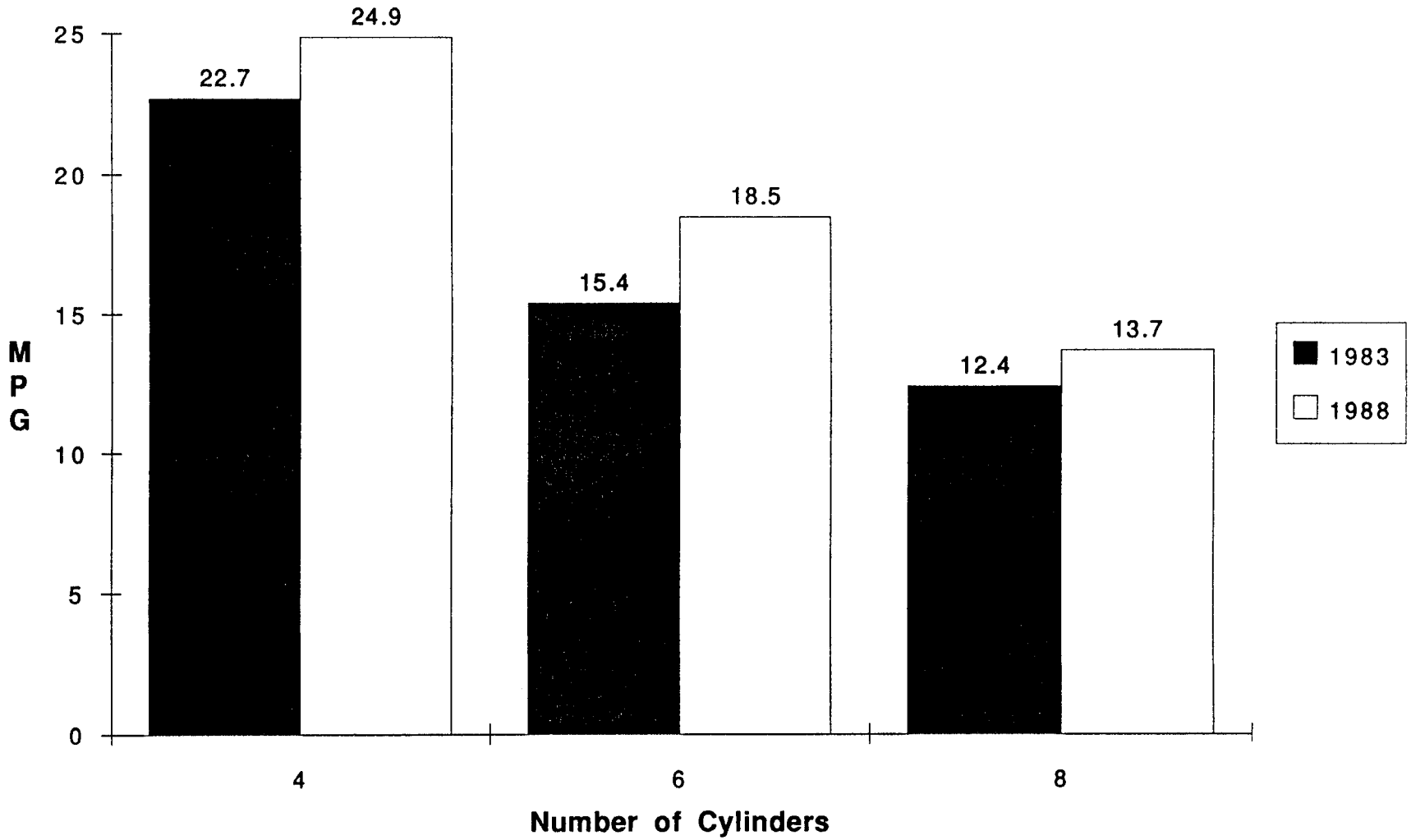
Source: Table 3.8

Figure 3.16 U.S. Average Annual Expenditures by Number of Cylinders



Source: Table 3.8

Figure 3.17 U.S. Average Miles Per Gallon by Number of Cylinders



Source: Table 3.8

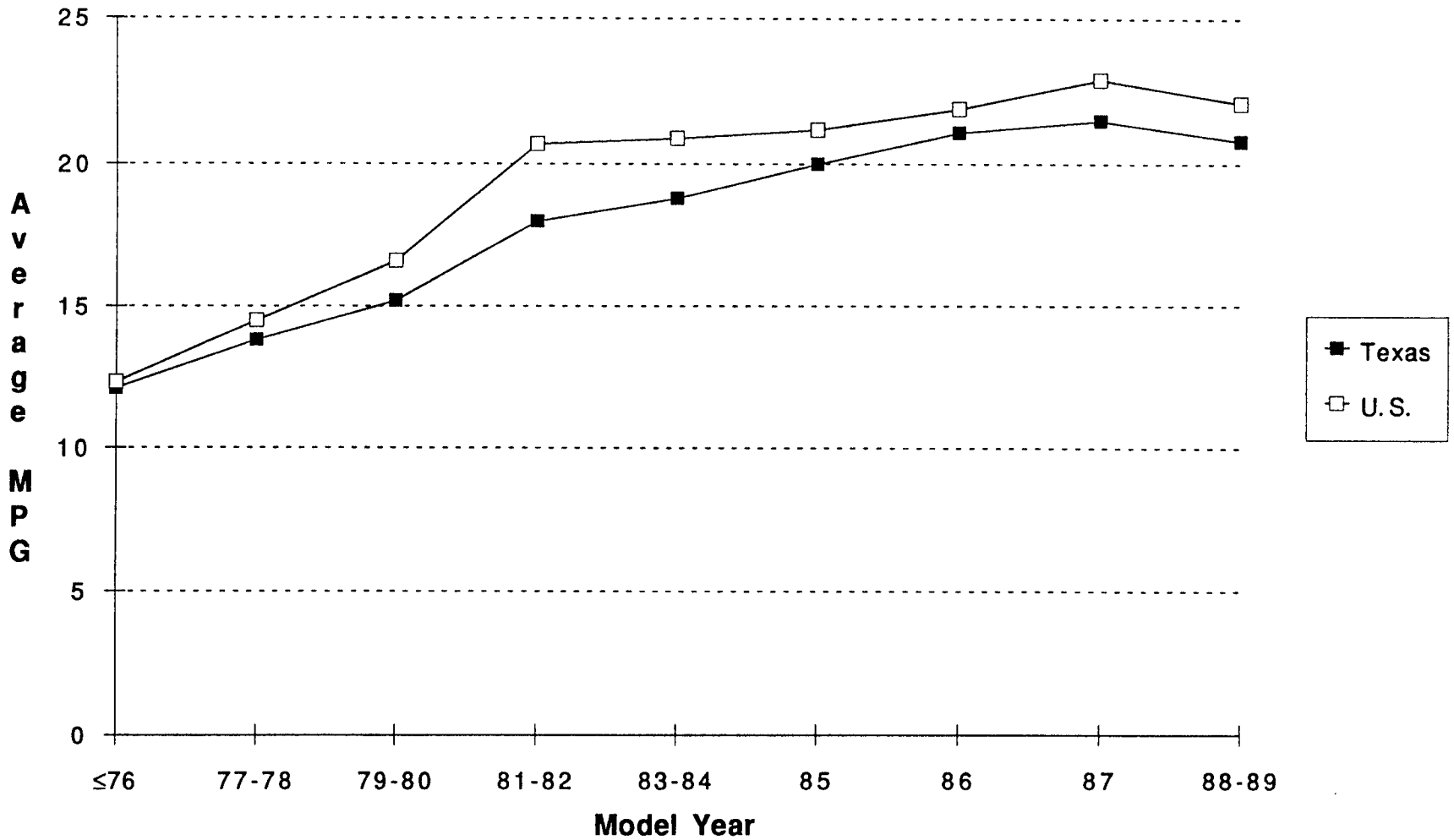
Table 3.9 Average Miles Per Gallon by Model Year

Census region	All	Model year: 1989 or 1988	1987	1986	1985	1984 or 1983	1982 or 1981	1980 or 1979	1978 or 1977	1976 or Earlier
Midwest	18.2	23.0	22.0	21.5	21.5	20.4	20.7	16.7	14.6	12.2
Northeast	19.6	21.5	23.3	22.6	21.3	21.8	16.6	15.2	12.2	12.2
South	18.0	21.9	23.0	21.8	20.7	20.7	19.7	16.3	14.4	12.0
Texas*	16.8	20.8	21.5	21.1	20.0	18.8	18.0	15.2	13.8	12.1
West	18.0	22.3	23.6	22.3	20.4	21.8	21.5	17.0	14.4	12.7
U. S.	18.3	22.1	22.9	21.9	21.2	20.9	20.7	16.6	14.5	12.3

Source:
Household Vehicle Energy Consumption 1988, Energy Information Agency, RTECS

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 3.18 U.S. Average Fuel Efficiency by Model Year



Source: Table 3.9

Table 3.10 Vehicle Fuel Efficiency by Region

Census region	Average per household vehicle: Miles per gallon 1988	Miles per gallon 1983	Average annual change
Midwest	18.2	14.8	4.2%
Northeast	19.6	15.6	4.7%
South	18.0	15.0	3.7%
Texas*	16.8	14.2	3.4%
West	18.0	15.4	3.2%
U. S.	18.3	15.1	3.9%

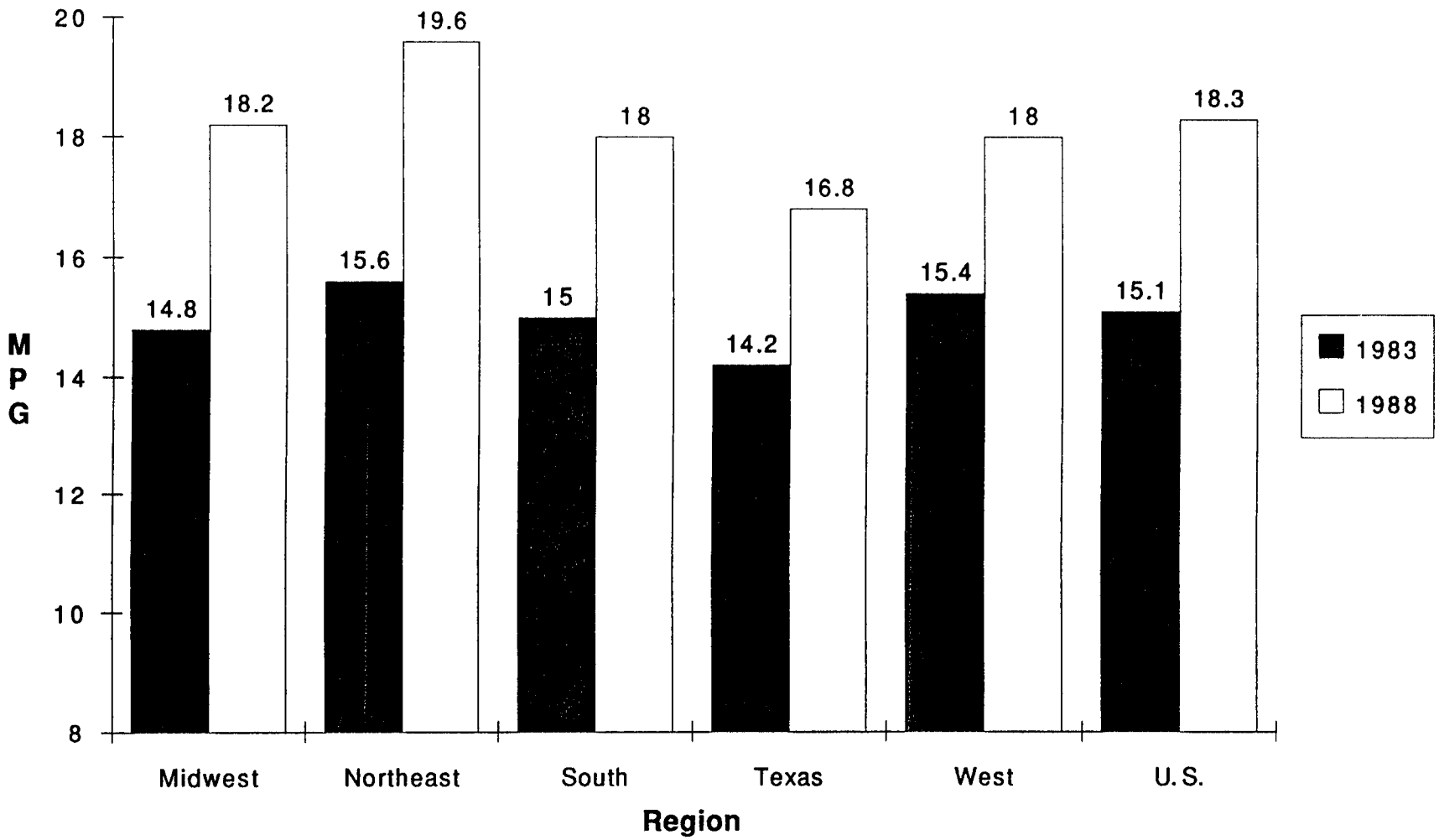
Sources:

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

Figure 3.19 U.S. Average Household Fuel Efficiency by Region



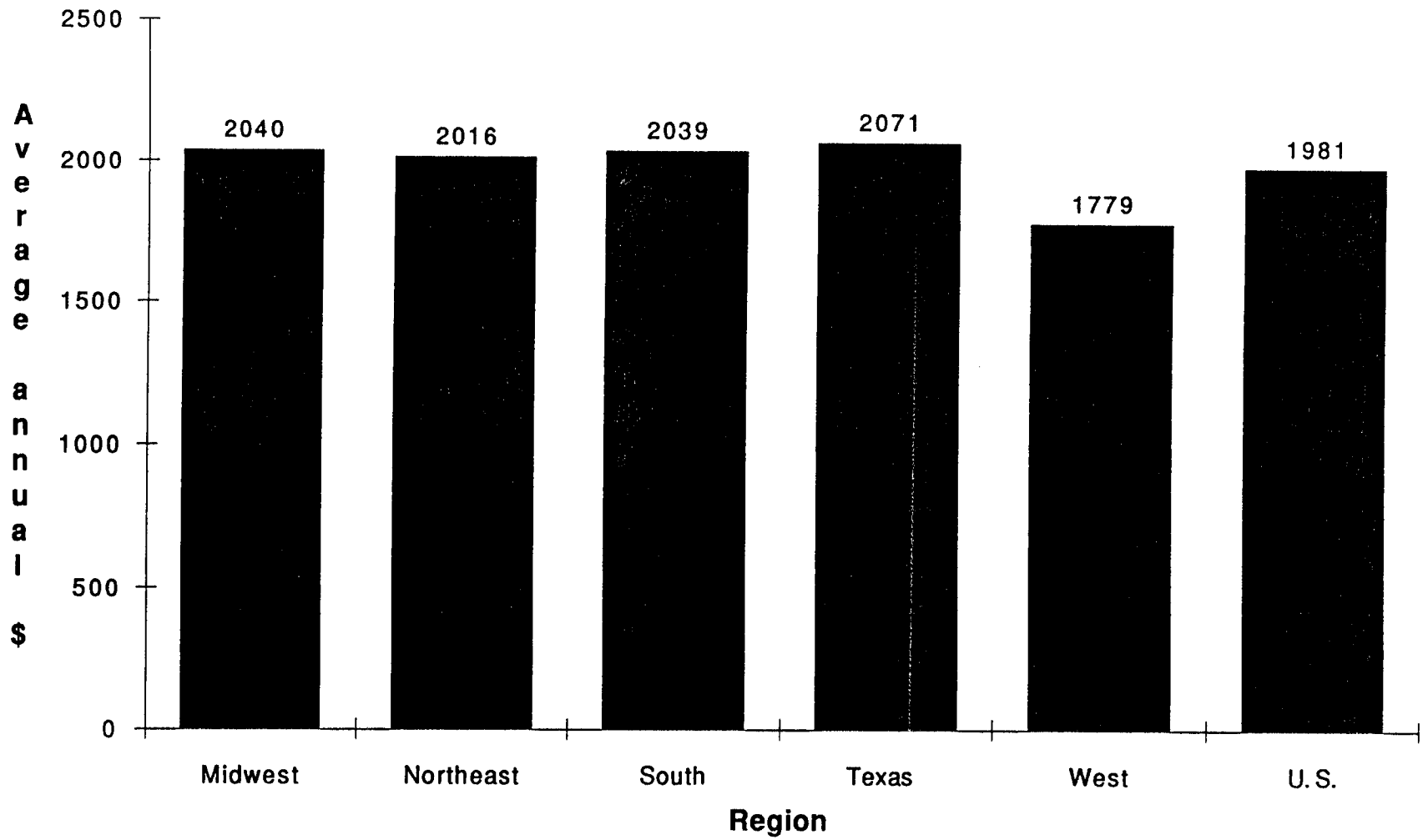
Source: Table 3.10

Table 3.11 Average Household Energy and Vehicle Expenditures, 1988

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	$2,040	10.3	$1,049	89.7	$2,141	$1,146	$995
Northeast	$2,016	26.3	$1,042	73.7	$2,270	$1,342	$928
South	$2,039	10.2	$852	89.8	$2,160	$1,133	$1,027
Texas *	$2,071	6.9	$969	93.1	$2,144	$1,093	$1,051
West	$1,779	8.1	$575	91.9	$1,873	$858	$1,015
U. S.	$1,981	12.7	$929	87.3	$2,115	$1,117	$998

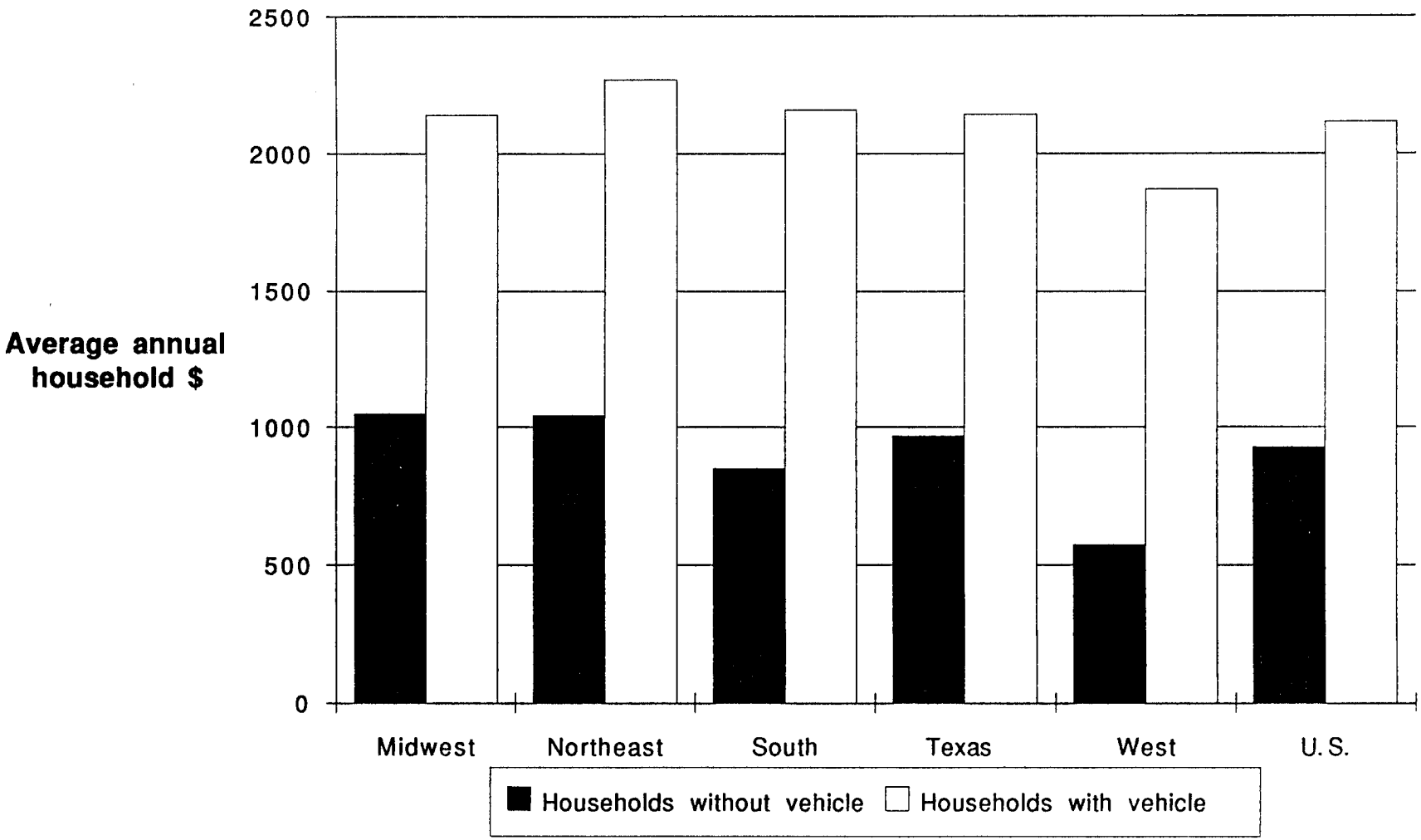
Source:
Household Vehicle Energy Consumption 1988, Energy Information Agency
Notes:
* Surrogate measure based on W. South Central Census Region data in which Texas represents a predominant subset of the W. South Central sample data
(per telephone conversation with Lynda T. Carlson, Director of Energy End Use Division, Energy Information Agency)

Figure 3.20 Average Household and Vehicle Energy Expenditures , 1988



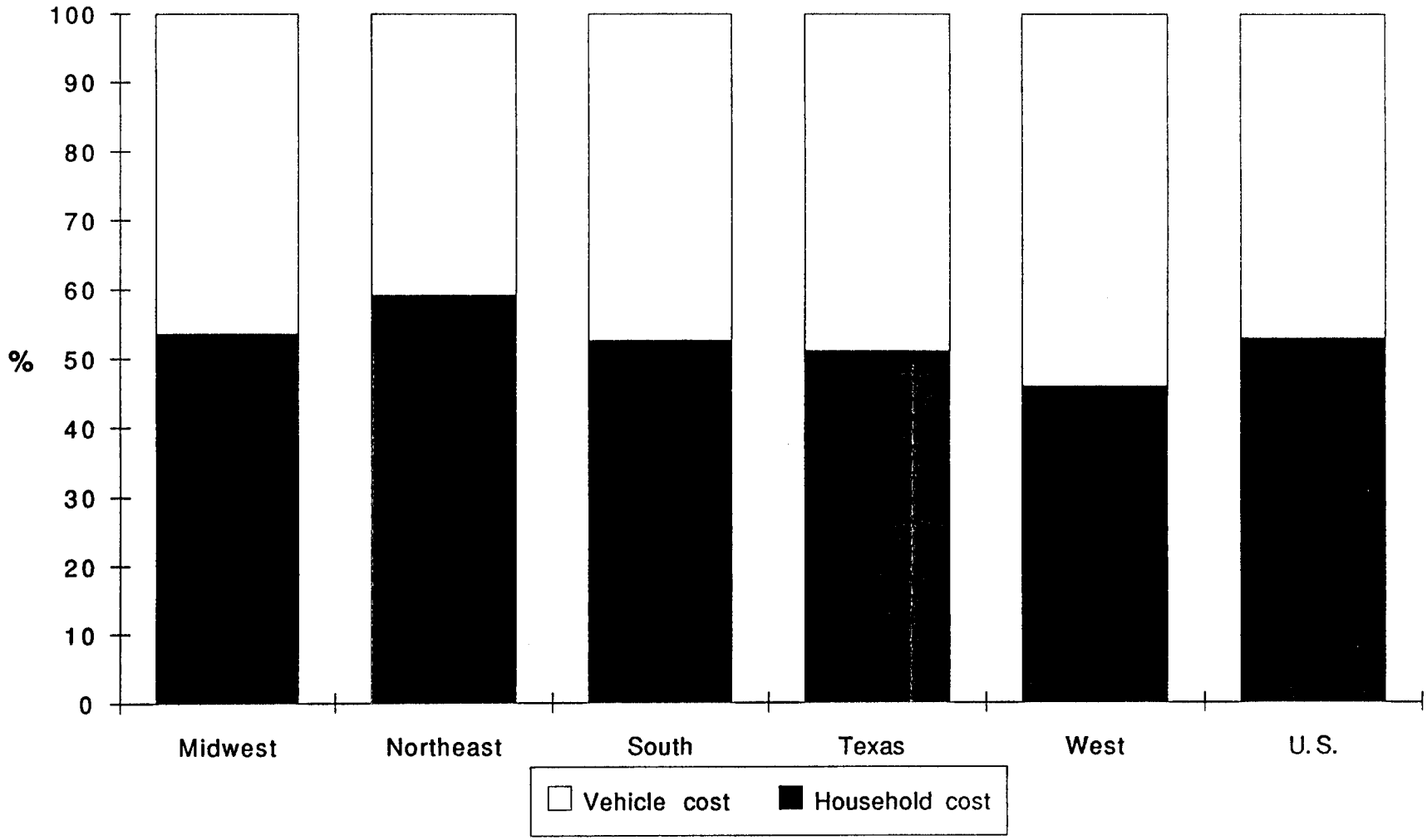
Source: Table 3.11

Figure 3.21 Average Annual Energy Expenditures, 1988



Source: Table 3.11

Figure 3.22 Distribution of Average Annual Household Energy Costs, 1988



Source: Table 3.11

Table 3.12 Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1988

Census region	All	Fuel efficiency category (miles per gallon) ≤ 10.9	11 to 12.9	13 to 15.9	16 to 18.9	19 to 21.9	22 or more
Midwest	10,021	4,851	7,943	8,868	10,293	12,135	12,064
Northeast	10,311	5,186	7,312	8,204	10,051	11,024	12,404
South	10,550	5,537	7,701	9,161	10,513	12,303	13,545
Texas*	10,412	5,472	9,914	9,121	11,232	12,145	13,723
West	9,980	6,427	7,531	8,943	8,977	11,396	12,631
U. S.	10,246	5,584	7,682	8,882	10,063	11,836	12,708

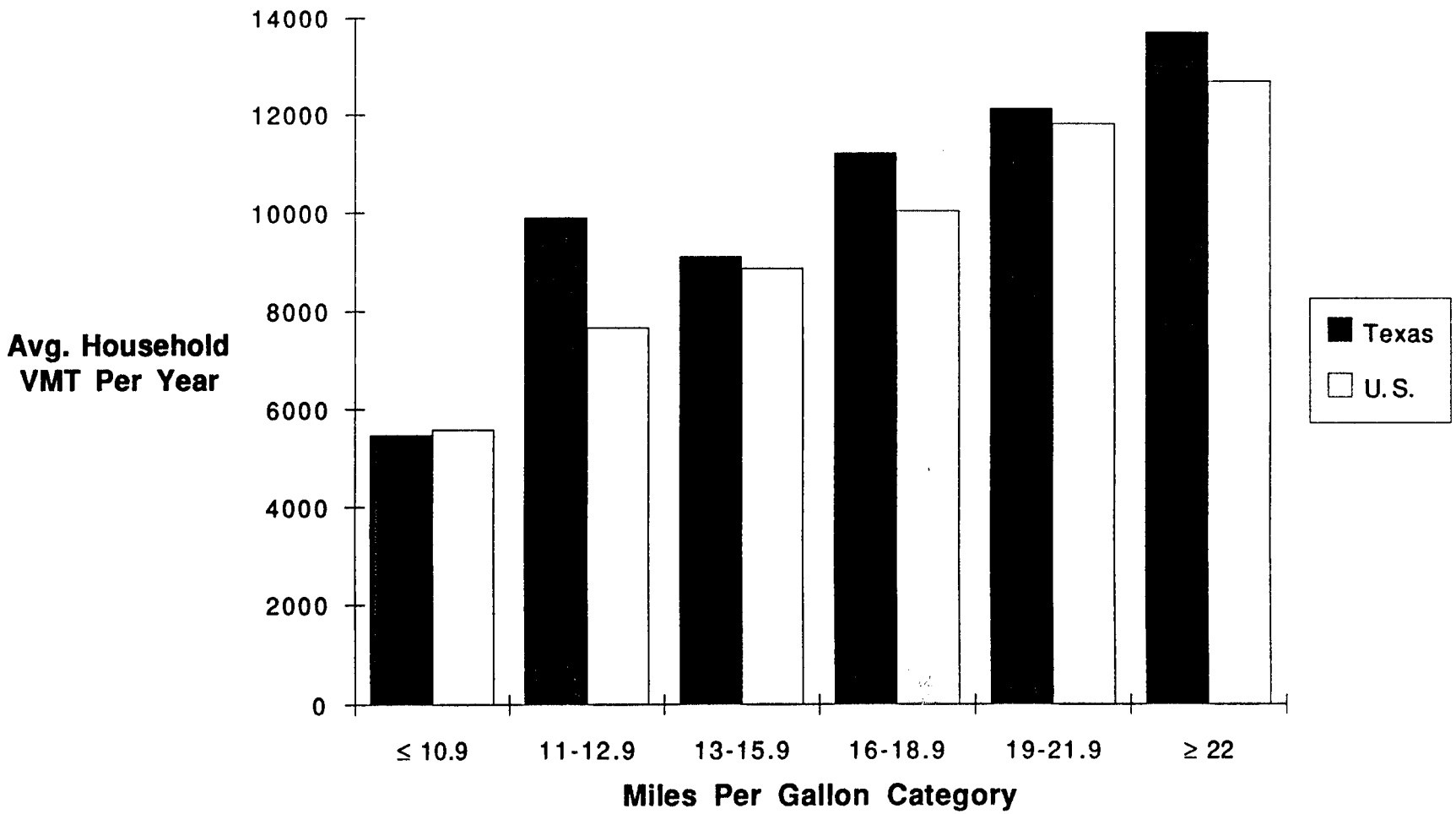
Source:

Household Vehicle Energy Consumption 1988, Energy Information Agency

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 3.23 Average Annual Household Vehicle Miles Traveled by Fuel Efficiency Category



Source: Table 3.12

Table 3.13 Average Vehicle Miles Traveled Per Household by Family Income, 1988

Census region	All income categories	Less than $10,000	$10,000 to $14,999	$15,000 to $19,999	$20,000 to $24,999	$25,000 to $34,999	$35,000 to $49,999	$50,000 to $74,999	$75,000 or More
Midwest	18,518	10,567	12,433	16,261	19,152	18,558	24,899	26,788	25,491
Northeast	17,997	9,639	12,400	10,501	15,934	16,790	22,966	25,564	28,394
South	18,859	11,124	13,413	18,435	18,559	19,849	25,684	26,579	27,143
Texas *	18,193	10,653	12,697	20,058	16,982	19,723	27,295	29,777	31,646
West	18,783	11,877	13,347	15,464	16,579	18,347	22,431	23,619	27,857
U. S.	18,595	10,932	12,978	15,837	17,813	18,617	24,170	25,555	27,428

Source:

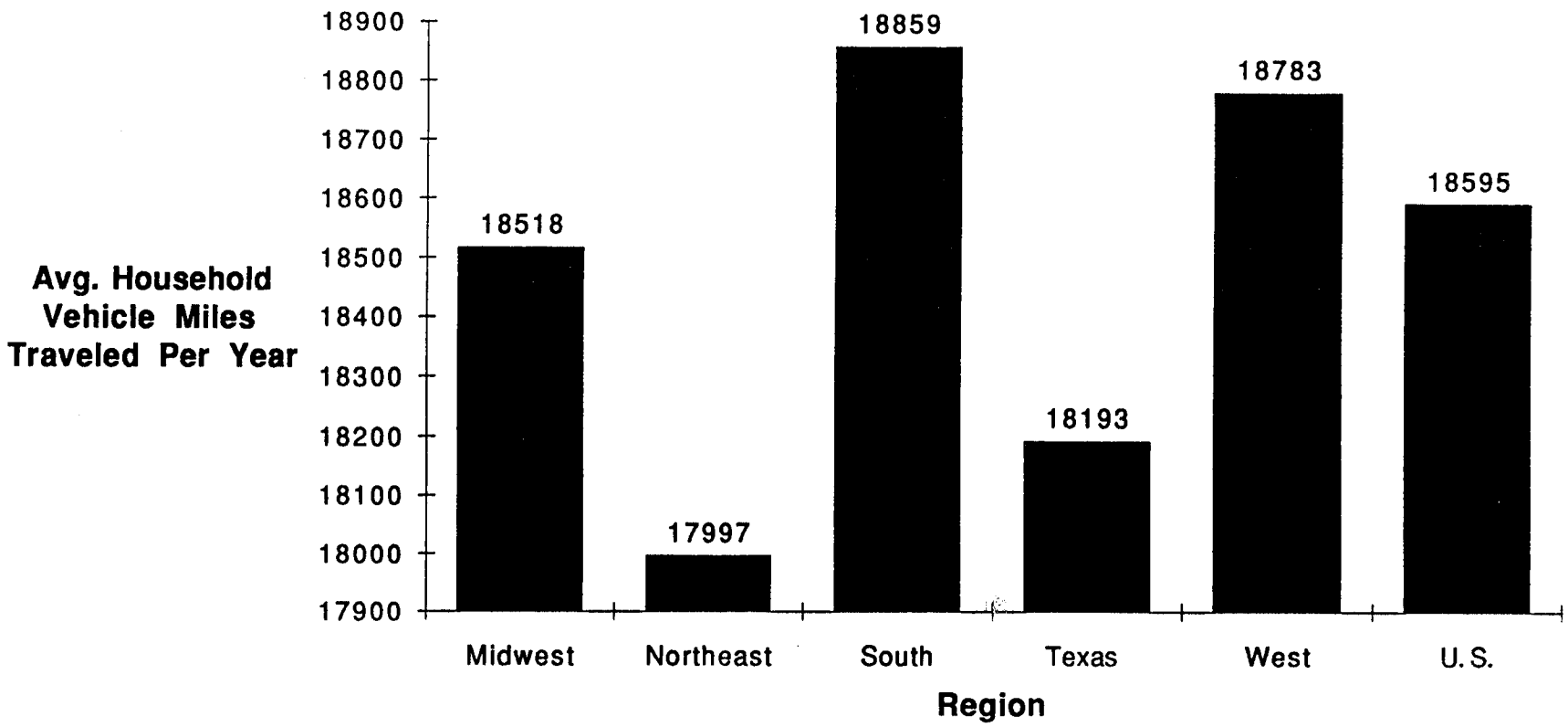
Household Vehicle Energy Consumption 1988, Energy Information Agency

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)

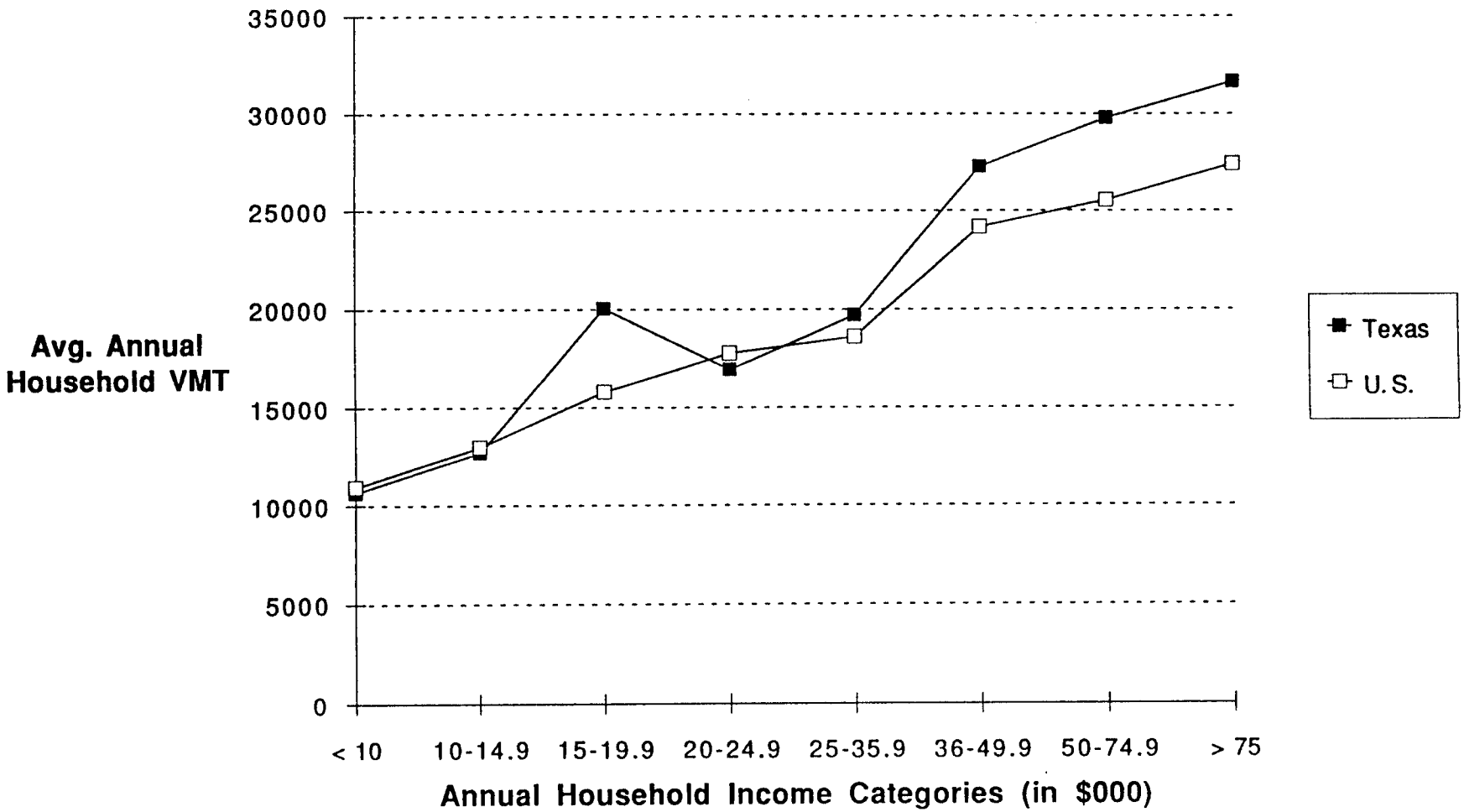
• Estimate for Texas $75,000 or more category using regression techniques

Figure 3.24 Average Annual Household Vehicle Miles Traveled, 1988



Source: Table 3.13

Figure 3.25 Effect of Household Income on Average Annual Vehicle Miles Traveled



Source: Table 3.13

Table 3.14 Average Vehicle Miles Traveled by Household Composition, 1988

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	18,518	22,710	19,878	21,506	31,795	16,183	12,803	11,627	6,950	21,313	23,847	14,389
Northeast	17,997	21,740	19,134	20,834	27,767	15,955	14,504	10,853	7,815	19,395	23,891	13,261
South	18,859	22,837	21,990	21,435	28,719	16,403	14,675	13,119	7,186	20,254	22,795	13,920
Texas *	18,193	21,992	22,643	18,843	27,800	16,026	13,700	13,071	9,097	16,349	22,621	14,082
West	18,783	22,420	20,278	21,197	27,464	16,624	12,731	13,233	6,930	19,775	23,639	14,582
U. S.	18,595	22,519	20,612	21,301	28,854	16,307	13,841	12,476	7,229	20,300	23,420	14,058

Source:

Household Vehicle Energy Consumption 1988, Energy information Agency

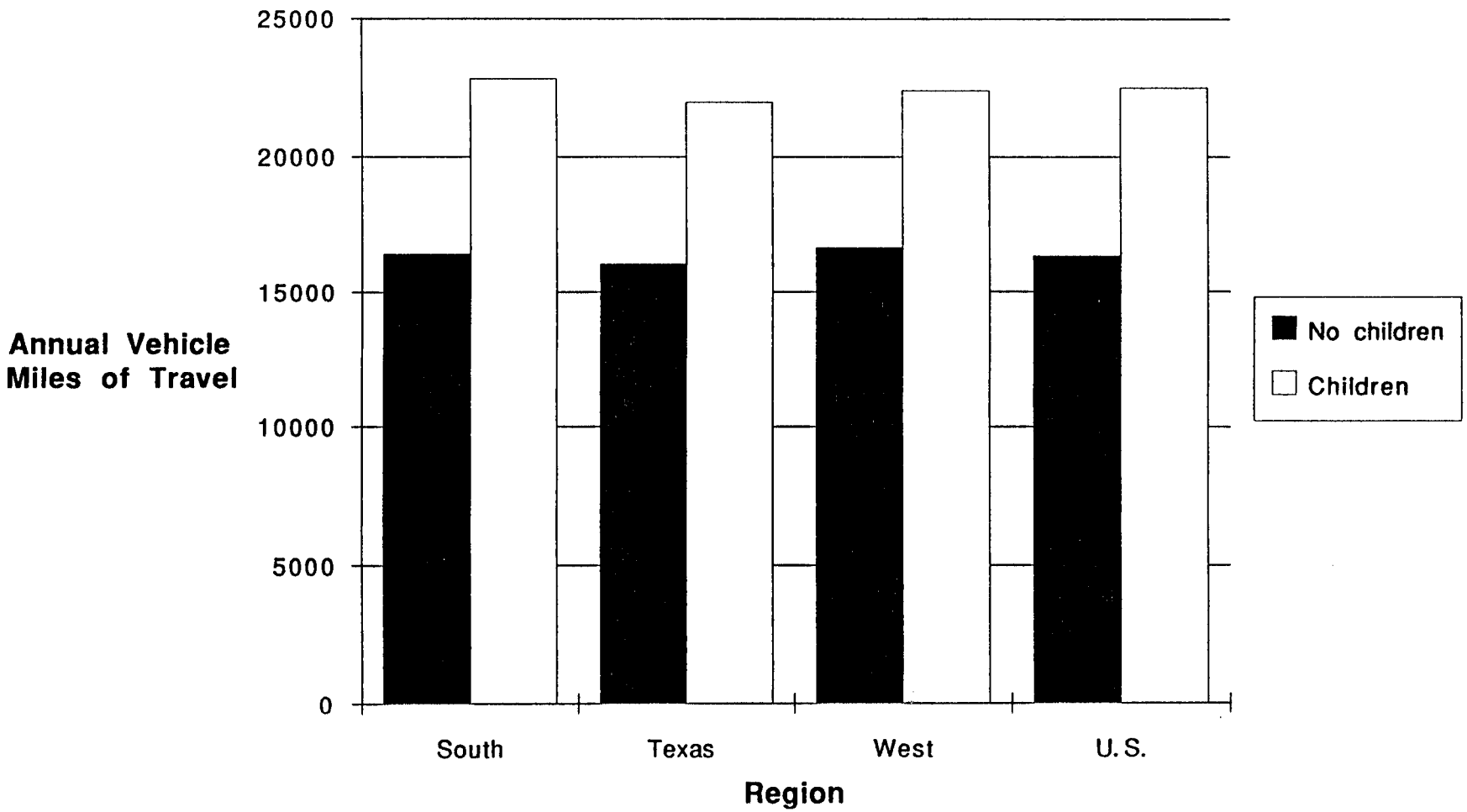
Notes:

* 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)

• 16-17 year old class estimated for Texas

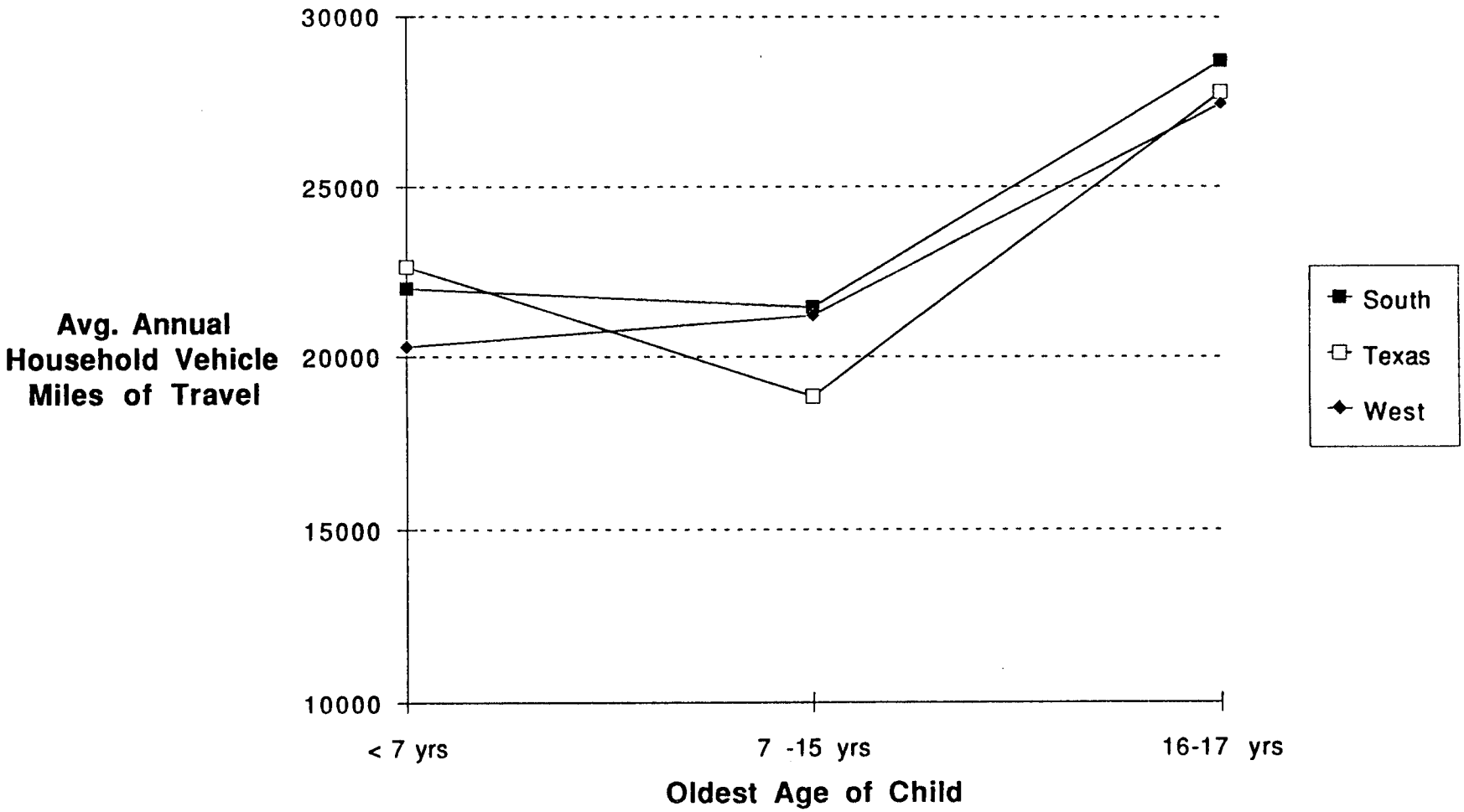
• Under 35 year class (1 adult, no children) estimated for Texas

Figure 3.26 Effect of Children on Annual Household Vehicle Miles Traveled, 1988



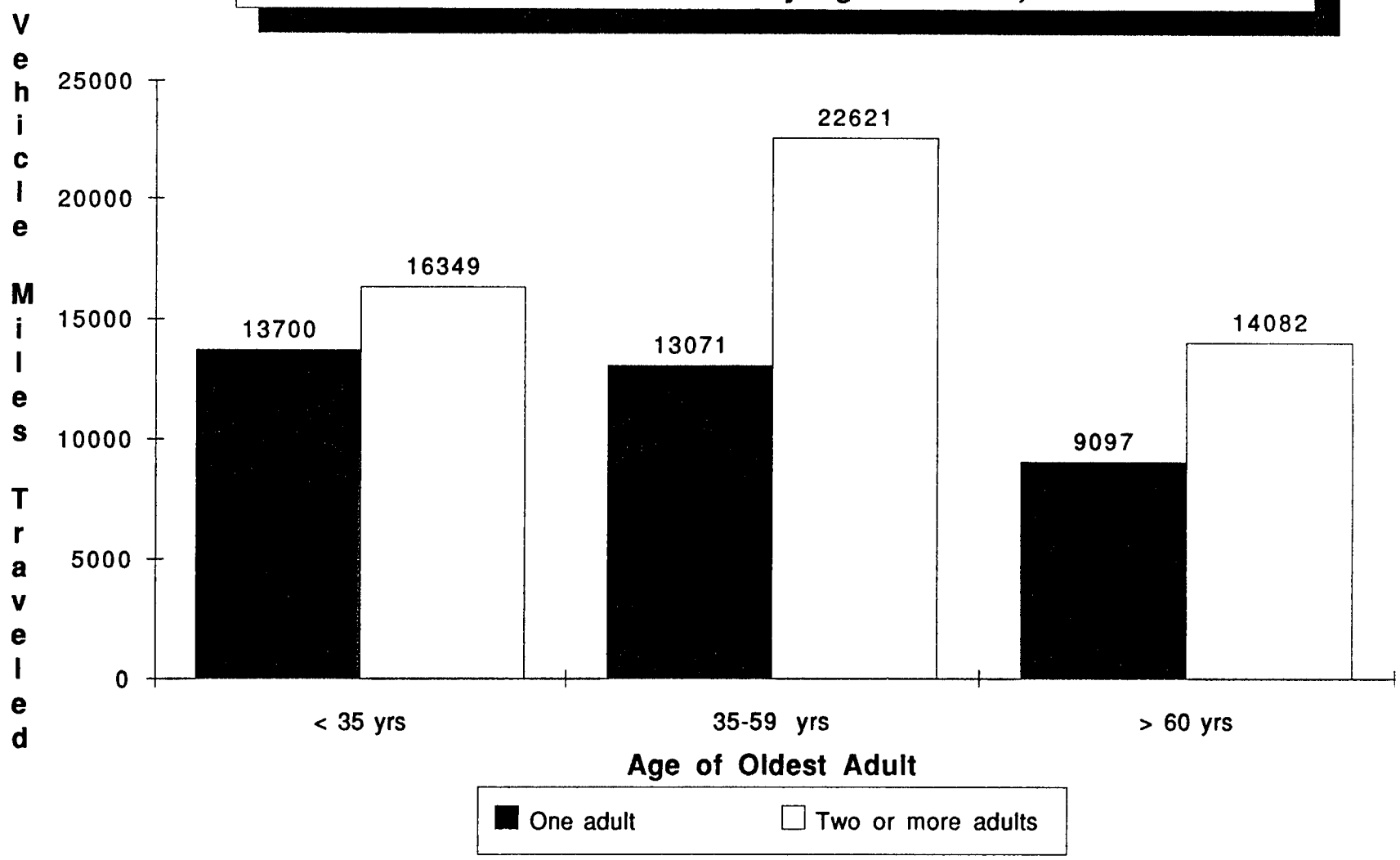
Source: Table 3.14

Figure 3.27 Effect of Children's Age on Household Vehicle Miles Traveled, 1988



Source: Table 3.14

Figure 3.28 Average Annual Texas Household Vehicle Miles Traveled for Childless Households by Age of Adults, 1988



Source: Table 3.14

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 1991 model year automobiles , and statewide municipal ridership.

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

Current dollars

		1978	1987	Average annual change
Cost per mile		**$0.1908**	**$0.3502**	**6.3%**
Total Cost	**per 10,000 miles**	**$1908**	**$3502**	**6.3%**
Variable Cost	**per mile**	**$0.0565**	**$0.0720**	**2.5%**
Gas & Oil	per mile	$0.0389	$0.0480	2.1%
Maintenance	per mile	$0.0110	$0.0160	3.8%
Tires	per mile	$0.0066	$0.0080	1.9%
Fixed Cost		**$1343**	**$2782**	**7.6%**
Insurance		$424	$535	2.4%
License & registration		$74	$140	6.6%
Depreciation		$596	$1506	9.7%
Finance charge		$249	$601	9.2%

Constant 1987 dollars

		1978	1987	Average annual change
Cost per mile		**$0.3325**	**$0.3502**	**0.5%**
Total Cost	**per 10,000 miles**	**$3325**	**$3502**	**0.5%**
Variable Cost	**per mile**	**$0.0984**	**$0.0720**	**-3.1%**
Gas & Oil	per mile	$0.0678	$0.0480	-3.4%
Maintenance	per mile	$0.0192	$0.0160	-1.8%
Tires	per mile	$0.0115	$0.0080	-3.6%
Fixed Cost		**$2340**	**$2782**	**1.7%**
Insurance		$739	$535	-3.2%
License & registration		$129	$140	0.8%
Depreciation		$1038	$1506	3.8%
Finance charge		$434	$601	3.3%

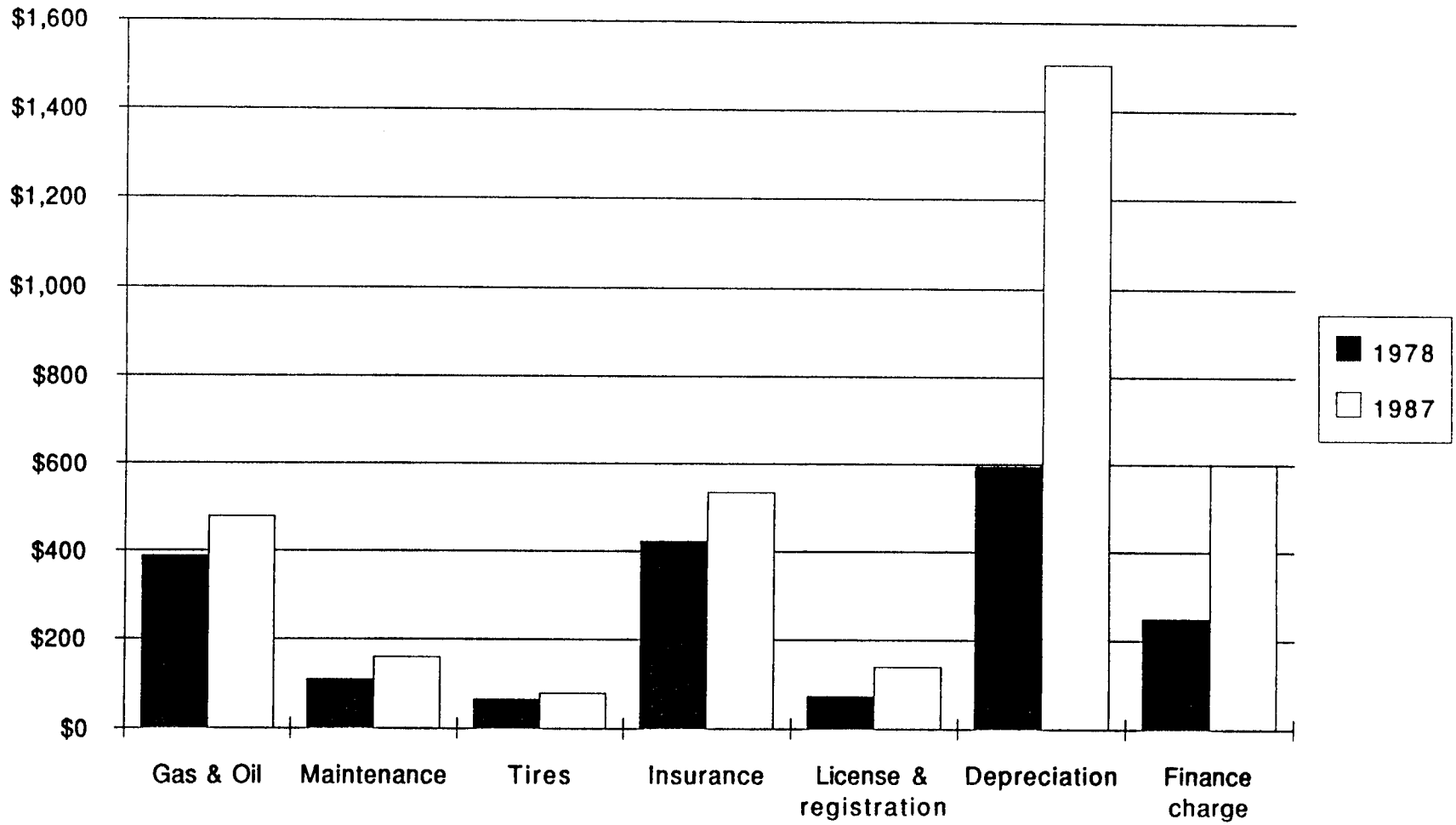
Sources:

Statistical Abstract of the United States 1989, U.S. Dept. of Commerce

Notes:

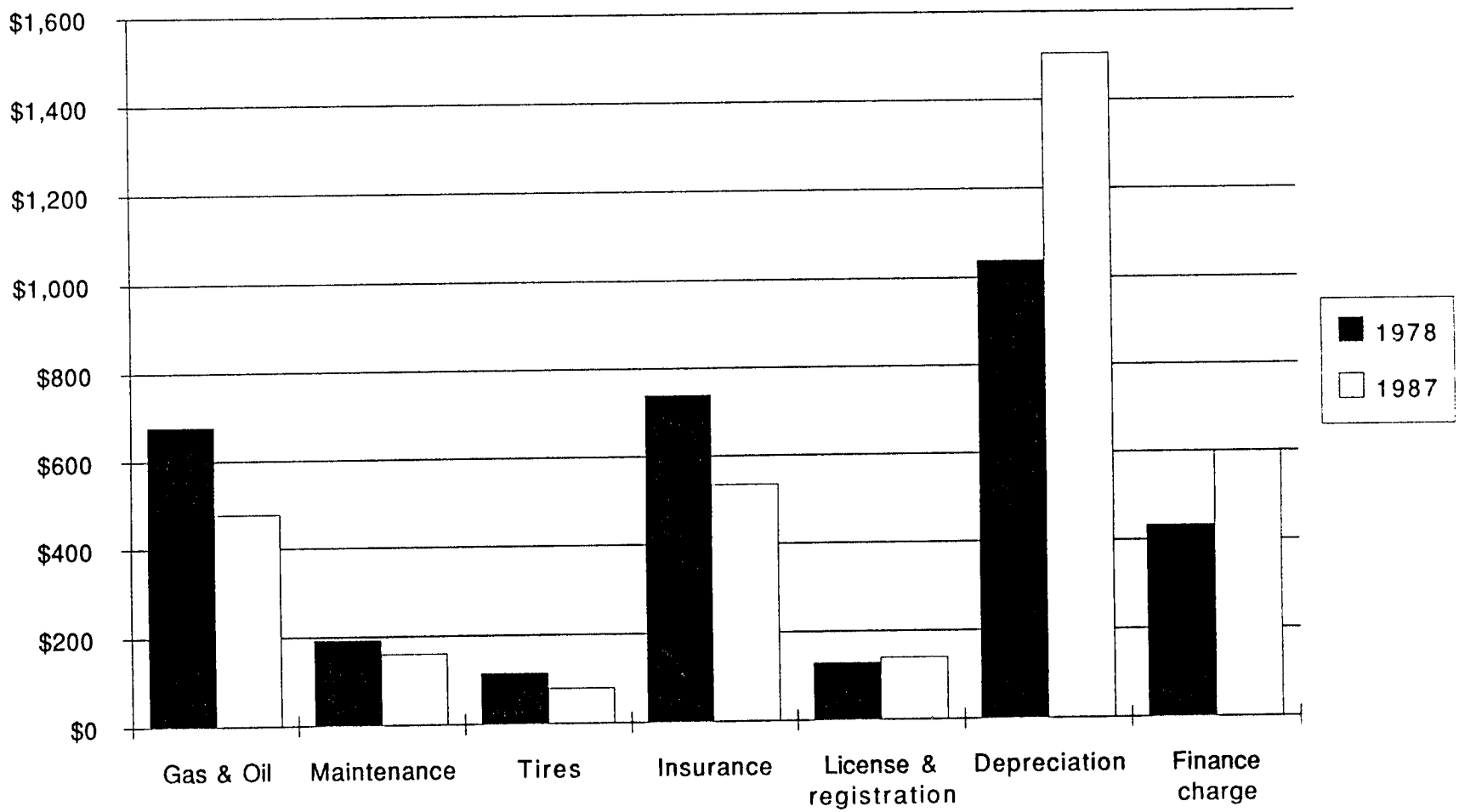
- Consumer Price Index used to update costs to $ 1987
- Depreciation in 1978 adjusted to reflect 6 yr ownership
- Finance charges in 1978 estimated by regression techniques

Figure 3.29 Average Annual Cost of Operating an Automobile, Current Dollars



Source: Table 3.15

Figure 3.30 Average Annual Cost of Operating an Automobile, Constant $ 1987



Source: Table 3.15

Table 3.16 Estimated Automobile Fuel Economy by Vehicle Type, 1991 Model Year

	Miles Per Gallon (a)			Estimated (b) annual fuel cost		
Vehicle Type	City	Highway	Composite	@ $1.10/gal	@ $1.30/gal	@ $1.50/gal
Two seaters	17	19	18	$621	$734	$846
Minicompact	24	30	26	$422	$498	$575
Subcompact	20	23	21	$524	$619	$714
Compact	20	23	21	$524	$619	$714
Midsize	17	21	19	$579	$684	$789
Large	16	20	18	$599	$708	$817

Source:

1991 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.

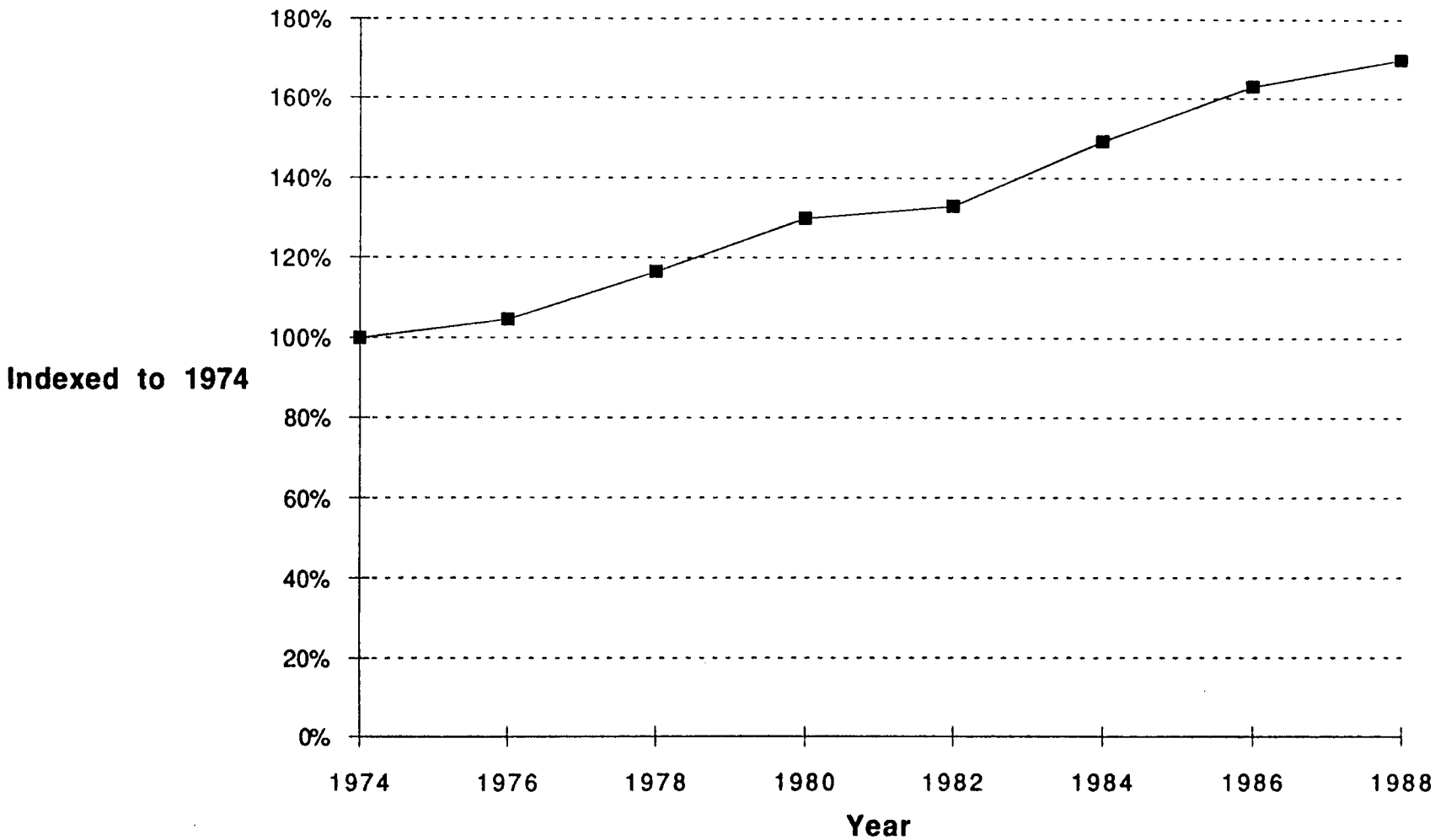
(b) Estimated annual mileage is 10,000

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%
Average annual change 1974-88		3.9%

Source:
1988 Texas Transit Statistics,
State Department of Highways and Public Transportation

Figure 3.31 Texas Statewide Municipal Transit Ridership, 1974-1988



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 unit 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)
1970	1,482,812	14.5	10.02	1,451.1
1971	1,561,303	15.3	9.97	1,534.0
1972	1,664,866	17.5	9.29	1,886.2
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
Period:		**Average annual changes**		
1970-88	5.3%	6.5%	1.0%	5.4%
1983-88	2.3%	6.7%	0.3%	6.3%

Source:

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

Notes:

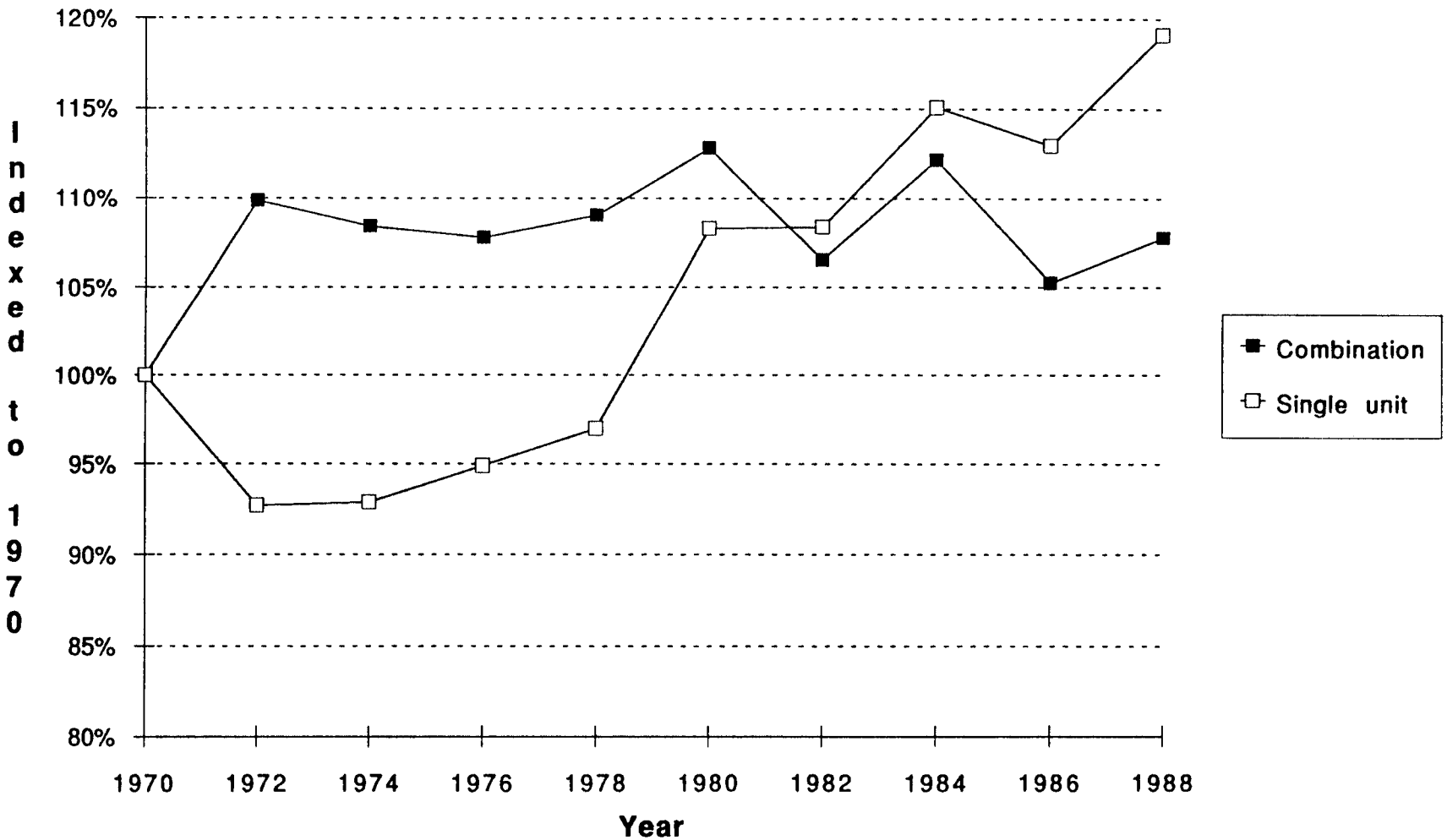
• Single unit trucks include both small and large pickups, and utility vans.

Table 3.19 Estimated Combination Truck Fuel Economy in Texas

Year	Registrations	Vehicle miles traveled (Billion)	Miles per gallon	Fuel use (Million gallons)
1970	61,292	2.6	4.76	539.2
1971	63,555	2.8	4.74	587.3
1972	72,785	3.4	5.23	655.4
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
Period:		**Average annual changes**		
1970-88	4.1%	6.3%	0.4%	5.9%
1983-88	-0.3%	0.9%	0.9%	-0.1%

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

Figure 3.32 Miles Per Gallon of Trucks Operating in Texas



Source: Tables 3.18 and 3.19

Table 3.20 Texas Truck Mileage by Vehicle Size

	Light Trucks		Medium Trucks		Light-Heavy		Heavy-Heavy	
Year	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
1978	89.9%	12,000	4.2%	13,400	1.4%	13,400	4.5%	46,000
1979	90.3%	12,100	4.0%	13,400	1.3%	13,800	4.4%	45,600
1980	90.8%	12,100	3.7%	13,300	1.3%	14,200	4.2%	45,200
1981	91.2%	12,100	3.4%	13,300	1.2%	14,600	4.1%	44,800
1982	90.9%	12,200	3.6%	13,200	1.4%	15,100	4.1%	45,300
1983	92.1%	12,200	2.9%	13,100	1.1%	14,400	3.9%	44,000
1984	92.6%	12,200	2.6%	13,100	1.1%	13,700	3.8%	43,600
1985	93.0%	12,300	2.3%	13,000	1.0%	13,000	3.7%	43,200
1986	93.4%	12,300	2.0%	13,000	1.0%	12,300	3.6%	42,800
1987	94.3%	12,300	1.7%	12,900	0.9%	11,400	3.1%	42,000
Period:				**Average annual changes**				
1977-87		0.2%		-0.5%		-1.3%		-0.9%
1982-87		0.2%		-0.5%		-5.5%		-1.5%

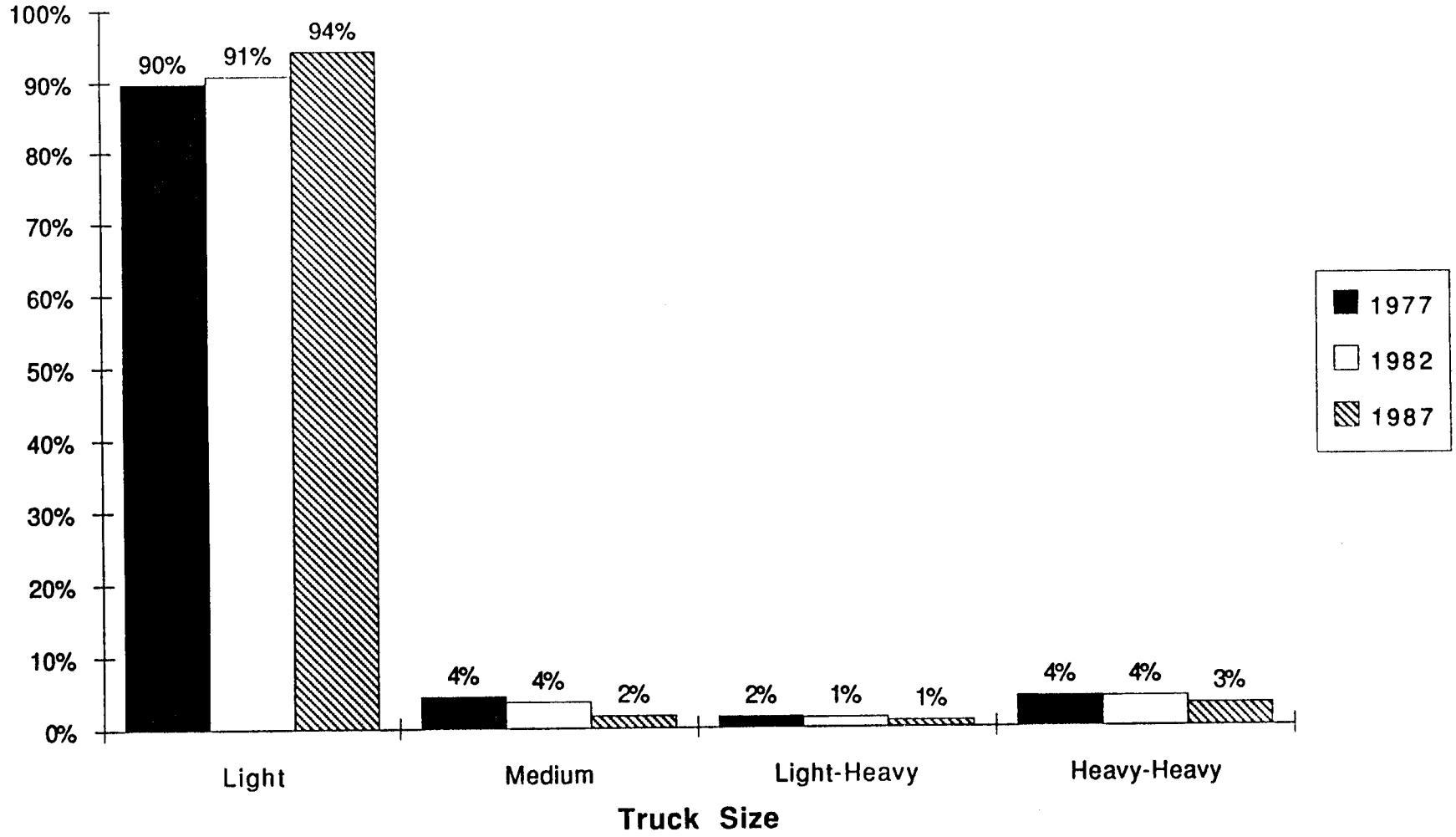
Source:

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

Notes:

- Light: GVW ≤ 10,000 lbs.
- Medium: 10,001 ≤ GVW ≤ 19,500
- Light-Heavy: 19,501 ≤ GVW ≤ 26,000
- Heavy-Heavy: GVW ≥ 26,001
- For years 1978-81 & 1983-86, data estimated by trend line

Figure 3.33 Distribution of Texas Trucks by Size



Source: Table 3.20

Table 3.21 Texas Truck Mileage by Vehicle Range

Year	Local: Percent of total trucks	Local: Avg. annual miles per truck	Short Range: Percent of total trucks	Short Range: Avg. annual miles per truck	Long Range: Percent of total trucks	Long Range: Avg. annual miles per truck	Off-Road: Percent of total trucks	Off-Road: Avg. annual miles per truck
1977	83.7%	11,500	9.8%	23,400	2.2%	51,600	4.4%	10,700
1978	78.9%	11,700	10.9%	22,400	2.4%	47,700	7.8%	10,400
1979	77.8%	11,900	11.7%	21,800	2.7%	45,000	7.8%	10,000
1980	76.7%	12,100	12.5%	21,200	2.9%	42,300	7.8%	9,700
1981	75.6%	12,300	13.3%	20,600	3.2%	39,600	7.9%	9,300
1982	67.3%	12,400	14.6%	19,200	3.4%	34,400	14.7%	9,100
1983	73.4%	12,300	15.0%	19,300	3.7%	34,200	7.9%	8,600
1984	72.4%	12,200	15.8%	18,700	4.0%	31,500	7.9%	8,200
1985	71.3%	12,100	16.6%	18,100	4.2%	28,800	7.9%	7,800
1986	70.2%	12,000	17.4%	17,500	4.5%	26,100	7.9%	7,500
1987	72.6%	12,000	18.0%	17,200	4.8%	24,600	4.5%	7,000
Average annual changes								
Period:								
1977-87		0.4%		-3.0%		-7.1%		-4.2%
1982-87		-0.7%		-2.2%		-6.5%		-5.1%

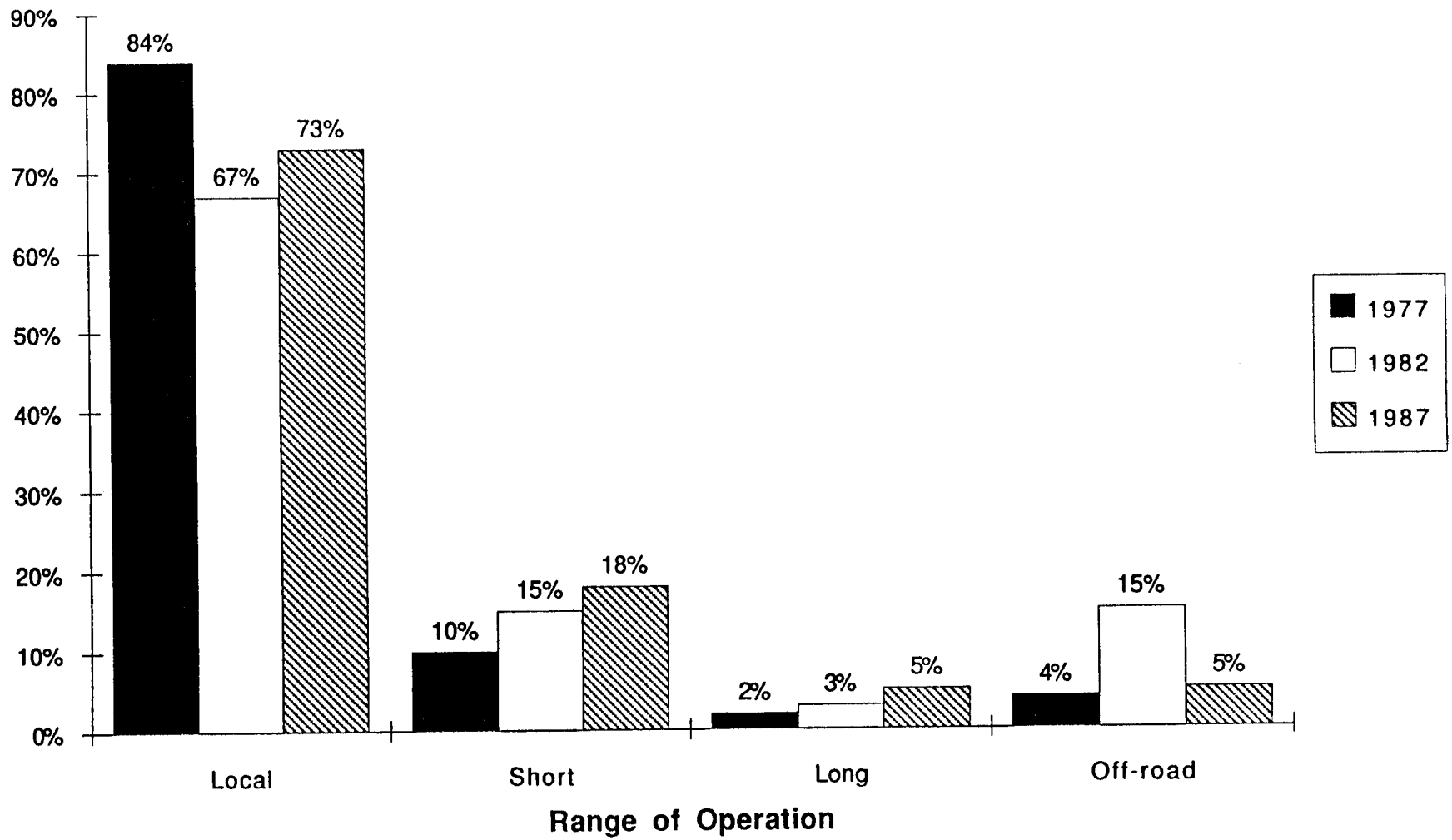
Source:

Truck Inventory and Use Survey, 1977, 1982 and 1987, 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.
- For years 1978-81 & 1983-86, data estimated by trend line

Figure 3.34 Distribution of Texas Trucks by Range of Operation



Source: Table 3.21

Table 3.22 Texas Truck Mileage by Major Use

Major Use	1977 Percent of total trucks	1977 Avg. annual miles per truck	1987 Percent of total trucks	1987 Avg. annual miles per truck	Period: 1977-87 Average annual mileage changes
Personal transportation	56.0%	10,800	68.2%	10,400	-0.4%
Agriculture	18.2%	11,100	8.0%	9,000	-2.1%
Construction	6.0%	19,200	9.8%	15,800	-1.9%
Manufacturing	1.8%	28,100	1.5%	24,800	-1.2%
Retail trade	3.6%	16,900	3.8%	16,900	0.0%
Wholesale trade	3.7%	25,800	1.5%	28,700	1.1%
For Hire	1.9%	42,700	1.4%	50,900	1.8%
Utilities	2.1%	14,200	1.4%	16,000	1.2%
For Service	5.1%	15,300	3.3%	13,900	-1.0%
Mining and quarrying	0.8%	21,700	0.6%	14,900	-3.7%
Forestry and lumbering	0.4%	23,800	0.5%	24,800	0.4%
Daily rental	0.3%	37,100	0.1%	41,100	1.0%

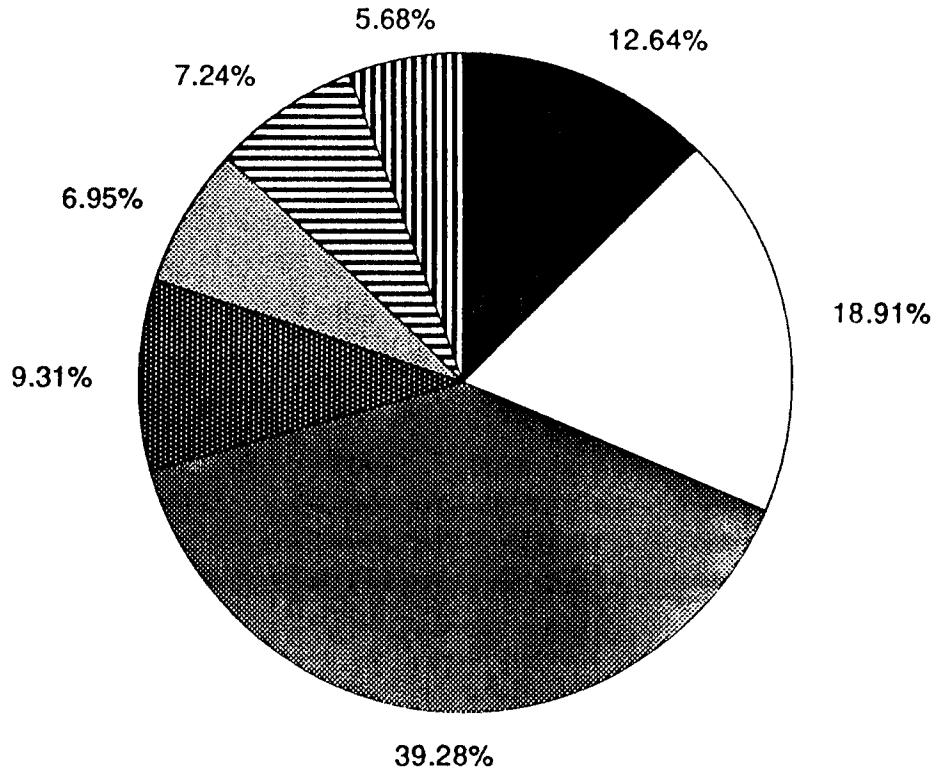
Source:
Truck Inventory and Use Survey, 1977 and 1987, U.S. Department of Commerce, Bureau of Census

Table 3.23 Commodities Shipped In Texas In Texas Via Texas Highways, 1991

Commodity group	Contents	Estimated annual tons shipped (millions)	Percent of total
Agricultural & Related Products	Farm products, forest products, marine products, leather products	42.1	12.6%
Hazardous Materials	Crude oil, natural gas, motor gasoline, ordnance & accessories, chemicals & allied products, petroleum & coal products, waste & scrap materials	63.0	18.9%
Construction supplies	Metallic ore, coal, non-metallic minerals (except fuels), sand & gravel, lumber & wood products (except furniture), stone, clay, glass, concrete products	130.9	39.3%
Food & Related Products	Food & kindred products, tobacco products	31.0	9.3%
Manufacturing Products	Textiles, apparel, furniture & fixtures, pulp, paper & allied products, rubber, metal products, transportation equipment, instruments, photographic & medical goods, watches, misc. products of mfg.	23.2	6.9%
Machinery & Equipment	All machinery (mechanical & electrical), equipment & supplies	24.1	7.2%
Mixed Freight Shipments	Miscellaneous freight shipments, empty shipping containers, mail & express traffic, freight forwarder traffic, small packaged freight	18.9	5.7%

Source:
Commodity Movements on Texas Highways, Texas Transportation Institute, Project 1104, 1992, preliminary findings

Figure 3.35 Distribution of Tons Shipped Via Texas Highways, 1991



- Agricultural & Related Products
- Hazardous Materials
- Construction supplies
- Food & Related Products
- Manufacturing Products
- Machinery & Equipment
- Mixed Freight Shipments

Source: Table 3.23

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 data for selected Texas cities, air freight data and statistics related to general aviation.

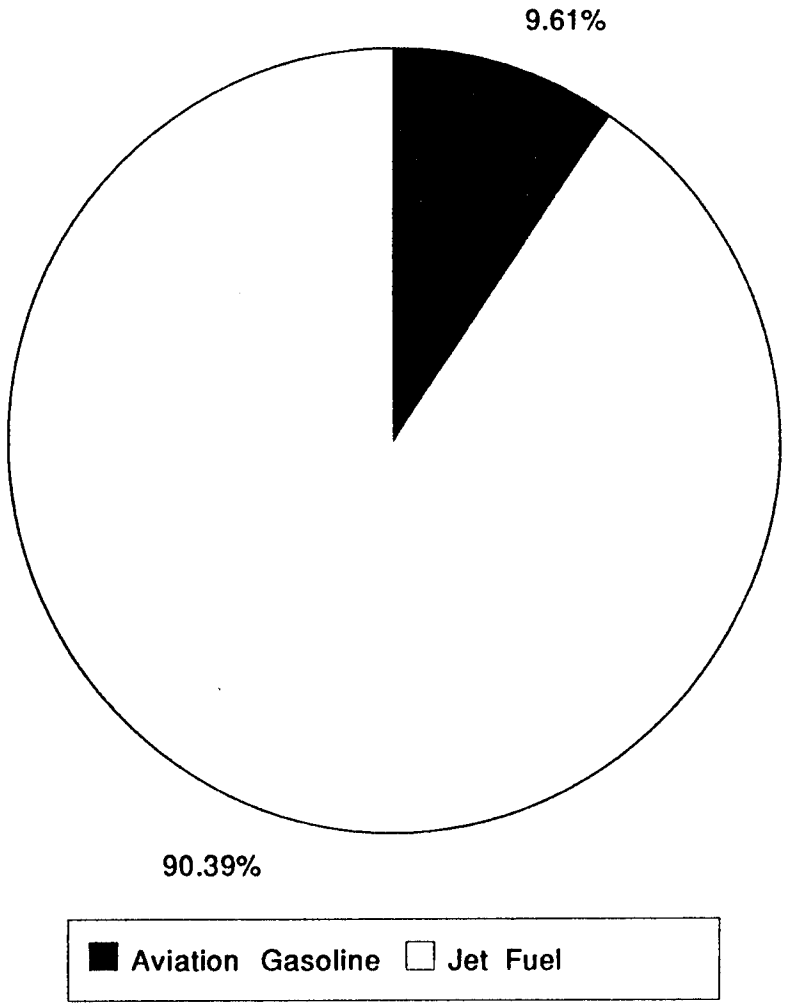
Table 4.1 Air Mode Energy Consumption by Fuel Type

Trillion Btu

Year	Aviation Gas	Jet Fuel	Total
1970	9.7	91.2	100.9
1971	9.5	92.8	102.3
1972	7.6	100.8	108.4
1973	7.6	109.3	116.8
1974	7.8	104.9	112.6
1975	6.3	115.0	121.3
1976	6.4	107.5	113.9
1977	6.9	111.8	118.8
1978	6.5	122.2	128.7
1979	5.9	130.6	136.6
1980	6.4	136.5	143.0
1981	6.6	139.9	146.6
1982	4.6	205.0	209.6
1983	3.8	231.8	235.6
1984	4.9	328.8	333.7
1985	6.6	389.1	395.7
1986	7.8	422.7	430.6
1987	5.8	446.0	451.8
1988	5.1	502.7	507.8
Average annual changes			
Time Period:			
1970-88	-3.5%	9.9%	9.4%
1983-88	6.1%	16.7%	16.6%

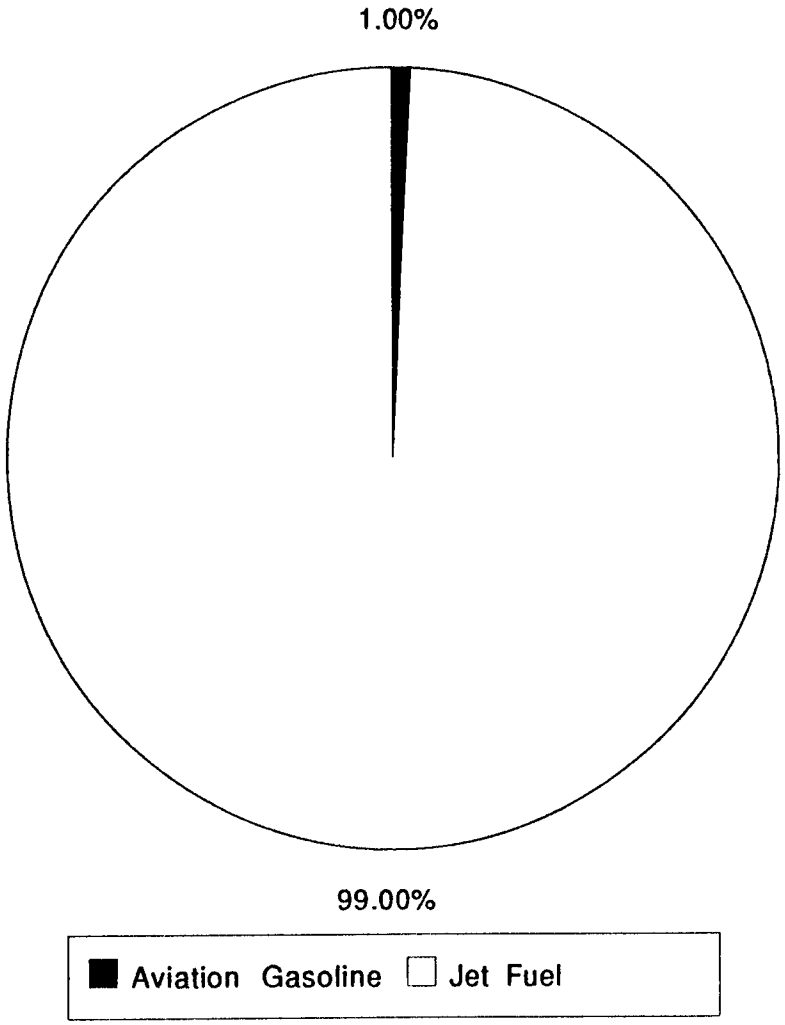
Sources:
State Energy Data Report, Energy Information Administration; Energy Information Administration unpublished fuel time series.

Figure 4.1 Texas Air Mode Energy Use by Fuel Type, 1970



Source: Table 4.1

Figure 4.2 Texas Air Mode Energy Use by Fuel Type, 1988



Source: Table 4.1

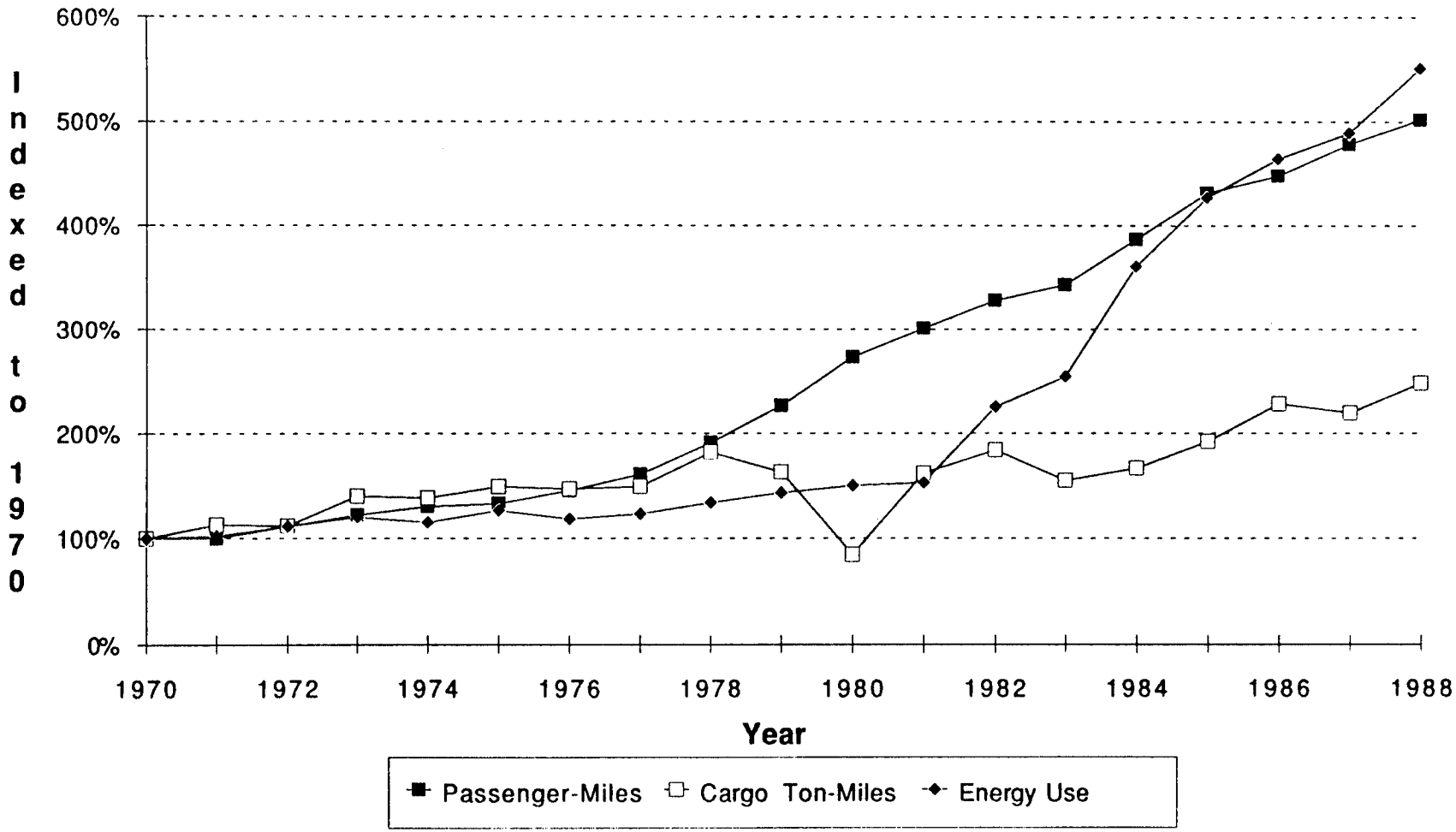
Table 4.2 Summary Statistics for Domestic and International Route Air Carriers Operating In Texas

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)
1970	276,267	10.3	143.8	699	7,172.8	220.9	91.2	6.7%
1971	281,745	10.2	137.2	703	7,147.7	249.1	92.8	6.8%
1972	283,729	11.3	137.5	708	7,973.3	246.8	100.8	7.3%
1973	280,919	12.2	145.3	716	8,759.5	308.8	109.3	7.6%
1974	278,625	13.2	149.7	708	9,358.6	305.0	104.9	8.1%
1975	267,289	13.2	144.1	722	9,519.4	328.7	115.0	9.0%
1976	276,075	14.5	150.5	718	10,404.0	324.5	107.5	8.1%
1977	289,827	15.9	159.7	728	11,547.4	329.9	111.8	8.1%
1978	302,640	18.2	173.2	753	13,732.5	401.3	122.2	8.5%
1979	341,285	21.5	194.5	754	16,245.5	359.1	130.6	8.5%
1980	404,094	25.3	249.2	773	19,554.3	188.3	136.5	9.2%
1981	428,672	27.4	259.4	785	21,560.2	357.6	139.9	9.8%
1982	447,168	29.5	281.7	796	23,517.4	405.6	205.0	14.6%
1983	456,499	30.9	283.0	796	24,572.1	342.6	231.8	16.1%
1984	518,904	35.1	332.7	791	27,781.6	369.8	328.8	20.5%
1985	529,643	38.9	352.6	795	30,917.4	424.3	389.1	22.9%
1986	538,352	40.0	369.4	804	32,143.3	504.5	422.7	22.9%
1987	565,895	41.5	387.6	827	34,309.8	484.0	446.0	22.9%
1988	575,294	42.7	408.2	844	35,989.6	547.1	502.7	24.5%
Period:			**Average annual changes**					
1970-88	4.2%	8.2%	6.0%	1.0%	9.4%	5.2%	9.9%	-
1983-88	4.7%	6.7%	7.6%	1.2%	7.9%	9.8%	16.7%	-

Source:
FAA Statistical Handbook of Aviation, annual issues

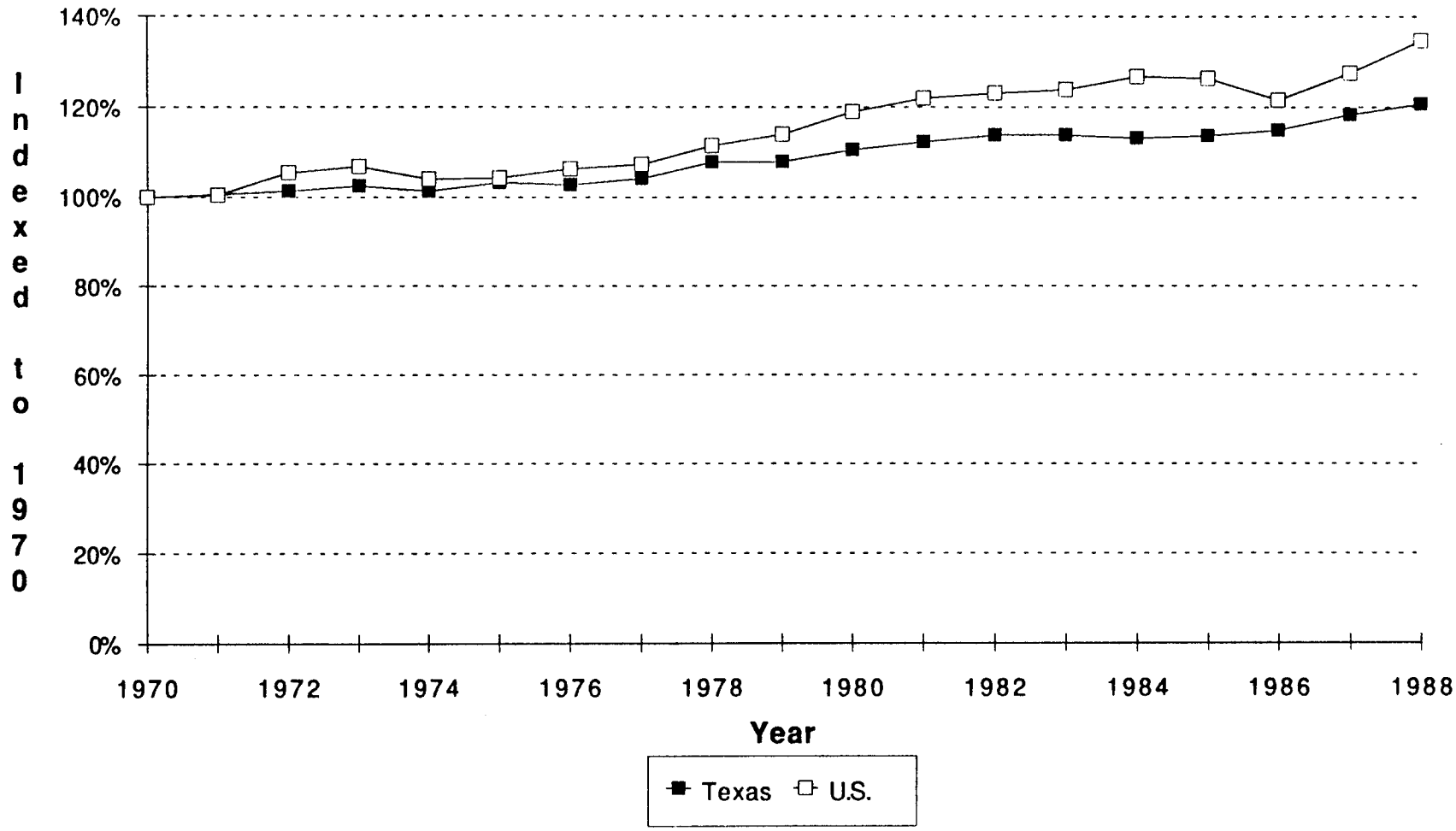
(a) Refers to U.S. Domestic & International Certificated Air Carriers

Figure 4.3 Passenger-Miles, Cargo Ton-Miles and Energy Use in Texas for Certificated Route Air Carriers



Source: Table 4.2

Figure 4.4 Average Passenger Trip Length for Certificated Route Air Carriers



Sources: Table 4.2; FAA Statistical Handbook of Aviation

Table 4.3 Texas Traffic Data for Large Certificated Air Carriers

Year	Enplanements: Domestic (in millions)	Enplanements: International (in millions)	Domestic passenger-miles (in millions)	International passenger-miles (in millions)	Average length of trip	Btu used for trips originating in Texas: Domestic (in trillions)	Btu used for trips originating in Texas: International (in trillions)	Total Btu (in trillions)
1970	10.0	0.2	6,805	368	699	86.1	5.0	91.2
1971	9.9	0.2	6,771	376	703	87.9	4.9	92.8
1972	11.0	0.2	7,551	422	708	95.8	5.0	100.8
1973	12.0	0.3	8,239	520	716	103.4	5.9	109.3
1974	12.9	0.3	8,844	514	708	99.8	5.1	104.9
1975	12.9	0.3	9,016	503	722	109.7	5.2	115.0
1976	14.2	0.3	9,875	529	718	102.9	4.6	107.5
1977	15.6	0.3	10,988	560	728	107.2	4.6	111.8
1978	17.8	0.4	12,807	925	753	115.1	7.1	122.2
1979	21.0	0.6	14,969	1,276	754	121.8	8.9	130.6
1980	24.7	0.6	18,177	1,378	773	128.4	8.2	136.5
1981	26.9	0.6	20,113	1,447	785	131.6	8.3	139.9
1982	29.0	0.5	22,238	1,279	796	195.0	10.0	205.0
1983	30.3	0.6	23,165	1,408	796	219.2	12.6	231.8
1984	34.5	0.6	26,206	1,576	791	312.5	16.3	328.8
1985	38.2	0.8	28,908	2,009	795	363.5	25.6	389.1
1986	39.1	0.8	30,010	2,133	804	392.8	29.9	422.7
1987	40.4	1.1	31,457	2,852	827	408.2	37.8	446.0
1988	41.3	1.3	32,466	3,524	844	456.3	46.4	502.7
1989	43.8	1.5	34,754	4,123	857	452.4	50.3	502.7
			Average annual changes					
1970-89	8.1%	10.7%	9.0%	13.6%	1.1%	9.1%	12.9%	9.4%
1984-89	4.9%	19.9%	5.8%	21.2%	1.6%	7.7%	25.3%	8.9%

Source:

FAA Statistical Handbook of Aviation, annual issues

Table 4.4 Enplanements and Estimated Energy Use for Selected Texas Cities

	Dallas/Ft. Worth			Houston			San Antonio			El Paso		
	Enplanements (in millions)		Est. Btu Use	Enplanements (in millions)		Est. Btu Use	Enplanements (in millions)		Est. Btu Use	Enplanements (in millions)		Est. Btu Use
Year	Dom.	Intl.	(tril.)	Dom.	Intl.	(tril.)	Dom.	Intl.	(tril.)	Dom.	Intl.	(tril.)
1971	5.1	0.1	47.5	2.3	0.0	20.3	0.7	0.1	8.6	0.5	0.0	4.4
1972	5.7	0.1	51.2	2.5	0.1	23.4	0.9	0.1	9.5	0.5	0.0	4.3
1973	6.5	0.1	58.2	2.7	0.1	25.3	0.9	0.1	9.7	0.5	0.0	4.3
1974	6.9	0.1	54.9	2.8	0.1	23.3	0.8	0.1	7.9	0.6	0.0	4.6
1975	7.1	0.1	62.0	2.9	0.1	26.4	0.8	0.1	8.5	0.6	0.0	5.1
1976	7.6	0.2	57.3	3.1	0.1	23.6	0.8	0.1	6.9	0.6	0.0	4.3
1977	8.0	0.2	57.3	3.4	0.1	24.5	0.8	0.1	6.7	0.6	0.0	4.1
1978	9.4	0.3	65.0	4.6	0.1	31.2	1.0	0.1	7.9	0.8	0.0	5.2
1979	11.1	0.4	70.4	5.5	0.1	33.4	1.2	0.1	8.4	0.9	0.0	5.2
1980	12.4	0.4	69.1	6.6	0.2	36.6	1.5	0.1	9.0	0.9	0.0	4.7
1981	13.6	0.3	70.8	7.3	0.2	38.5	1.6	0.1	9.2	1.0	0.0	4.9
1982	14.4	0.3	102.7	8.3	0.2	59.7	1.6	0.0	10.7	1.0	0.0	6.7
1983	15.4	0.3	119.0	8.3	0.2	65.1	1.8	0.0	13.0	1.0	0.0	7.2
1984	18.2	0.3	172.9	8.9	0.3	88.7	2.0	0.0	18.1	1.1	0.0	10.0
1985	20.5	0.4	209.9	9.7	0.3	103.4	2.1	0.0	20.0	1.2	0.0	11.4
1986	21.4	0.4	229.8	9.9	0.4	114.3	2.2	0.0	22.1	1.2	0.0	12.0
1987	21.8	0.6	240.9	10.4	0.5	122.3	2.4	0.0	24.3	1.3	0.0	13.1
1988	22.8	0.7	276.7	10.1	0.6	132.9	2.4	0.0	26.5	1.4	0.0	15.5
1989	24.6	0.8	282.6	10.3	0.6	127.8	2.5	0.0	25.8	1.7	0.0	17.5
Average annual changes												
1971-89	9.1%	12.2%	10.4%	8.7%	11.1% *	10.5% *	7.3%	-100.0%	6.3%	7.0%	0.0%	8.0%
1984-89	6.2%	21.7%	10.3%	3.0%	14.9%	7.6%	4.6%	0.0%	7.3%	9.1%	0.0%	12.0%

Source:

FAA Statistical Handbook of Aviation, annual issues

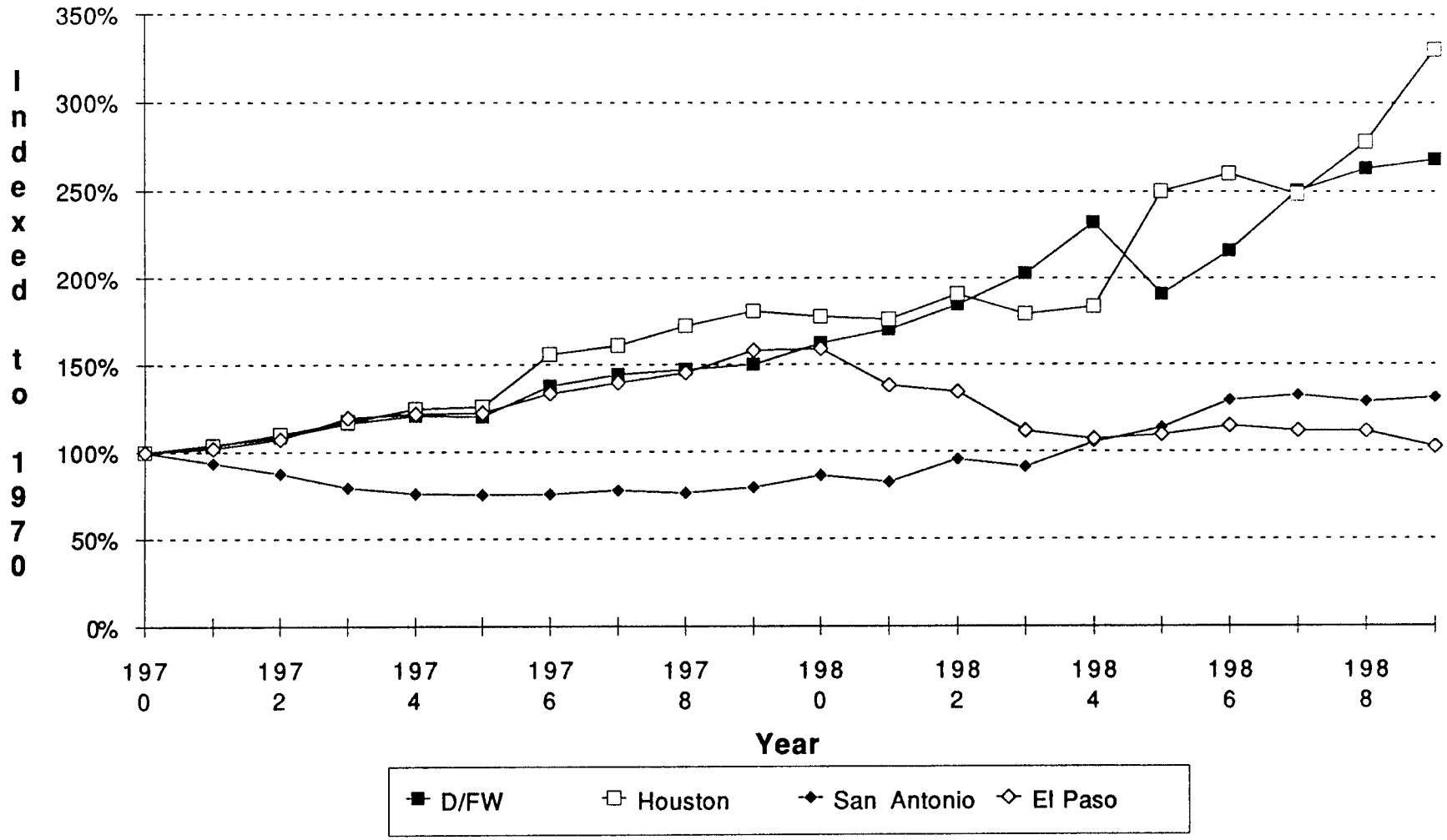
* For years 1972-89

Table 4.5 Air Freight for Selected Texas Cities

	Dallas/Ft. Worth		Houston		San Antonio		El Paso	
	in tons		in tons		in tons		in tons	
Year	Mail	Freight	Mail	Freight	Mail	Freight	Mail	Freight
1970	28,684	56,911	9,227	27,096	5,406	7,399	1,207	2,180
1971	29,851	62,736	9,555	27,090	5,053	7,113	1,231	2,776
1972	31,173	68,724	10,161	29,030	4,739	6,827	1,295	3,634
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	30,447	60,023	7,057	8,793	1,234	4,284
			Average annual changes					
1970-89	5.3%	4.9%	6.5%	4.3%	1.4%	0.9%	0.1%	3.6%
1984-89	2.9%	8.5%	12.4%	10.4%	4.4%	22.1%	-0.9%	14.3%

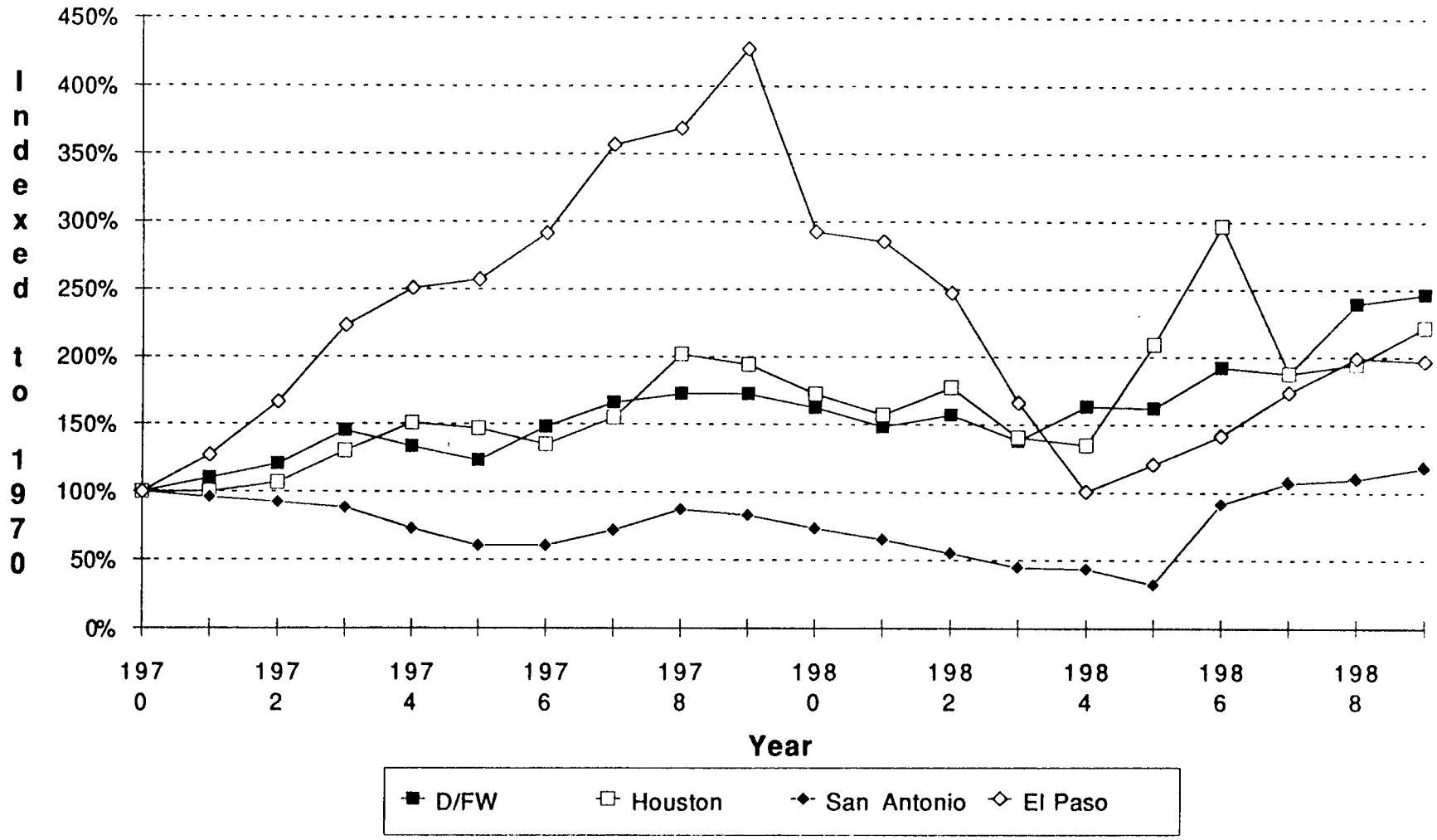
Source:
FAA Statistical Handbook of Aviation, annual issues

Figure 4.5 Tons of Air Mail for Selected Texas Cities



Source: Table 4.5

Figure 4.6 Tons of Air Freight for Selected Texas Cities



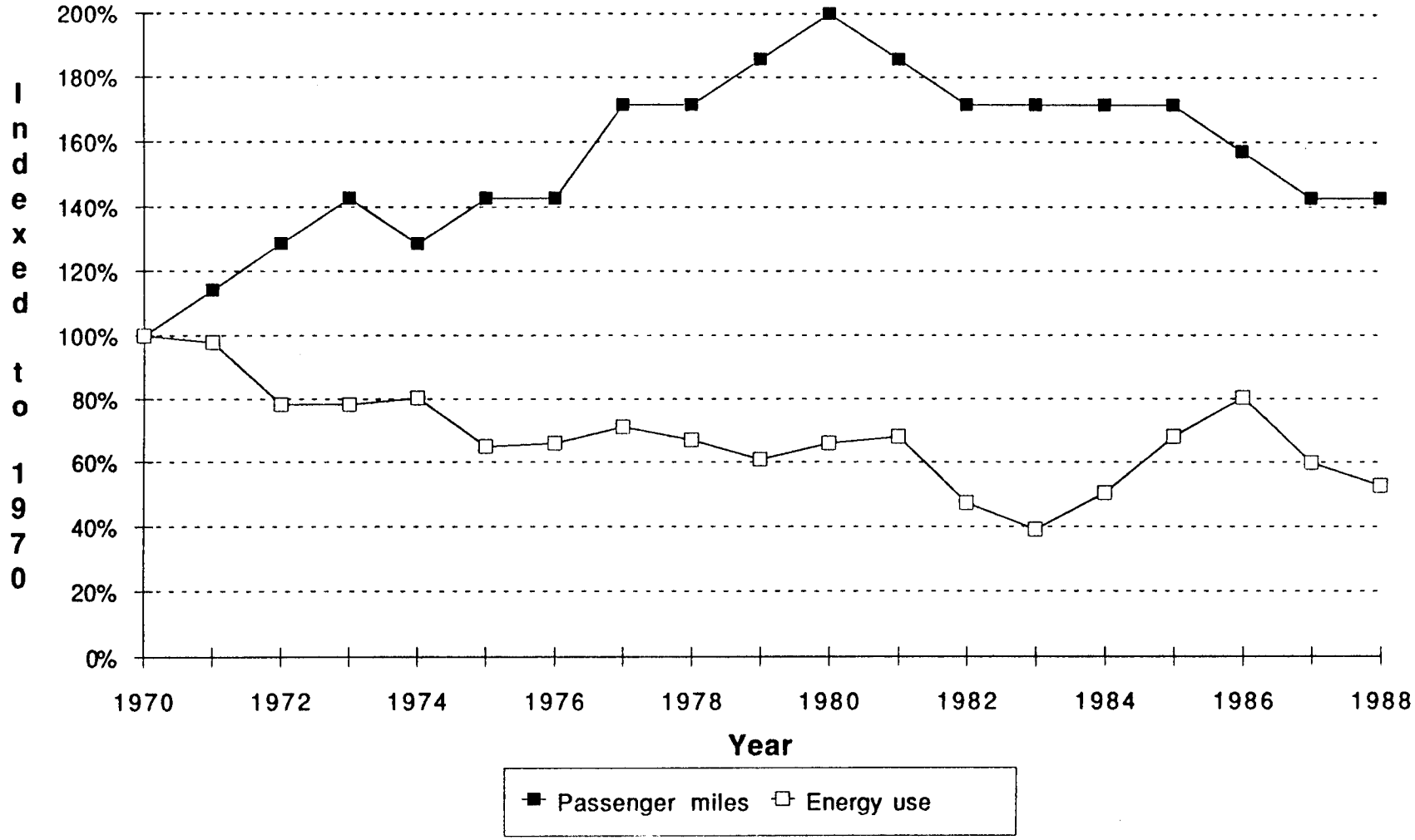
Source: Table 4.5

Table 4.6 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-mi (billions)	Btu per passenger-mi	Btu used (trillions)
1970	10,572	8.0%	2,062	4.7	0.7	13,439	9.7
1971	10,941	8.3%	2,133	4.4	0.8	12,324	9.5
1972	12,581	8.7%	2,466	3.1	0.9	8,274	7.6
1973	13,028	8.8%	2,553	3.0	1.0	7,914	7.6
1974	11,858	7.3%	2,383	3.3	0.9	8,649	7.8
1975	12,603	7.5%	2,558	2.5	1.0	6,591	6.3
1976	13,479	7.6%	2,736	2.4	1.0	6,223	6.4
1977	16,050	8.7%	3,258	2.1	1.2	5,611	6.9
1978	14,355	7.2%	3,108	2.1	1.2	5,504	6.5
1979	15,231	7.2%	3,397	1.7	1.3	4,563	5.9
1980	18,674	8.9%	3,842	1.7	1.4	4,680	6.4
1981	19,481	9.1%	3,753	1.8	1.3	4,935	6.6
1982	19,153	9.1%	3,275	1.4	1.2	3,931	4.6
1983	20,414	9.6%	3,061	1.2	1.2	3,171	3.8
1984	19,941	9.0%	3,405	1.4	1.2	4,022	4.9
1985	19,887	9.4%	3,270	2.0	1.2	5,620	6.6
1986	19,961	9.1%	2,928	2.7	1.1	7,433	7.8
1987	18,358	8.5%	2,859	2.0	1.0	5,640	5.8
1988	17,424	8.3%	2,771	1.9	1.0	5,138	5.1
Average annual changes							
1970-88	2.8%	0.2%	1.7%	-5.0%	1.8%	-5.2%	-3.5%
1983-88	-3.1%	-2.9%	-2.0%	8.2%	-3.7%	10.1%	6.1%

Source:
FAA Statistical Handbook of Aviation, annual issues

Figure 4.7 Passenger-Miles and Energy Use for General Aviation in Texas



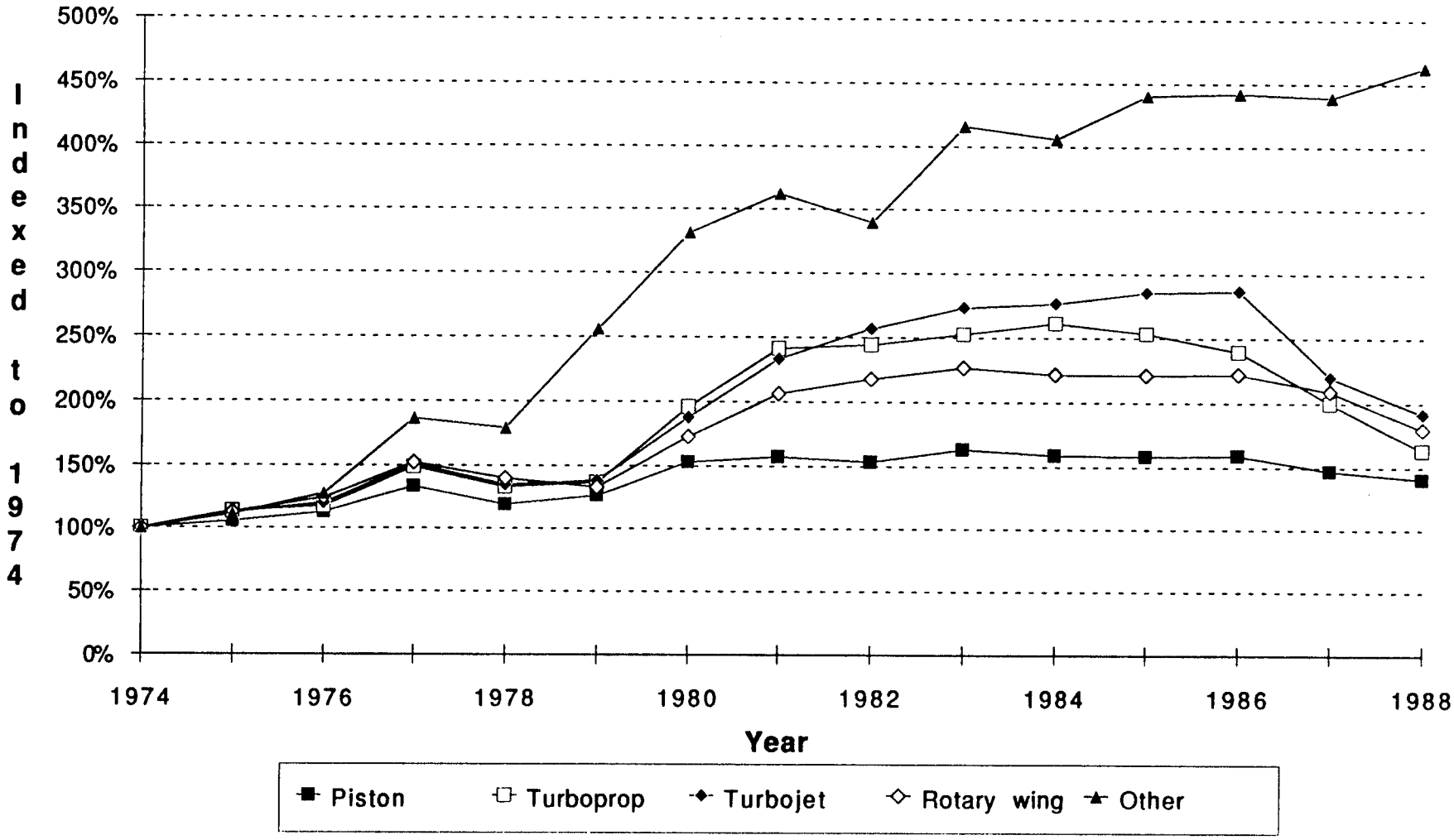
Source: Table 4.6

Table 4.7 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
1974E	11,858	91.9%	2.2%	1.8%	3.2%	1.0%
1975E	12,603	91.4%	2.4%	1.9%	3.4%	1.0%
1976E	13,479	91.3%	2.3%	1.9%	3.5%	1.1%
1977E	16,050	90.7%	2.5%	2.0%	3.6%	1.3%
1978E	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%

Source:
FAA Statistical Handbook, annual issues
Note:
Years 1974-78 estimated by regression techniques

Figure 4.8 General Aviation Aircraft Growth in Texas



Source: Table 4.7

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.

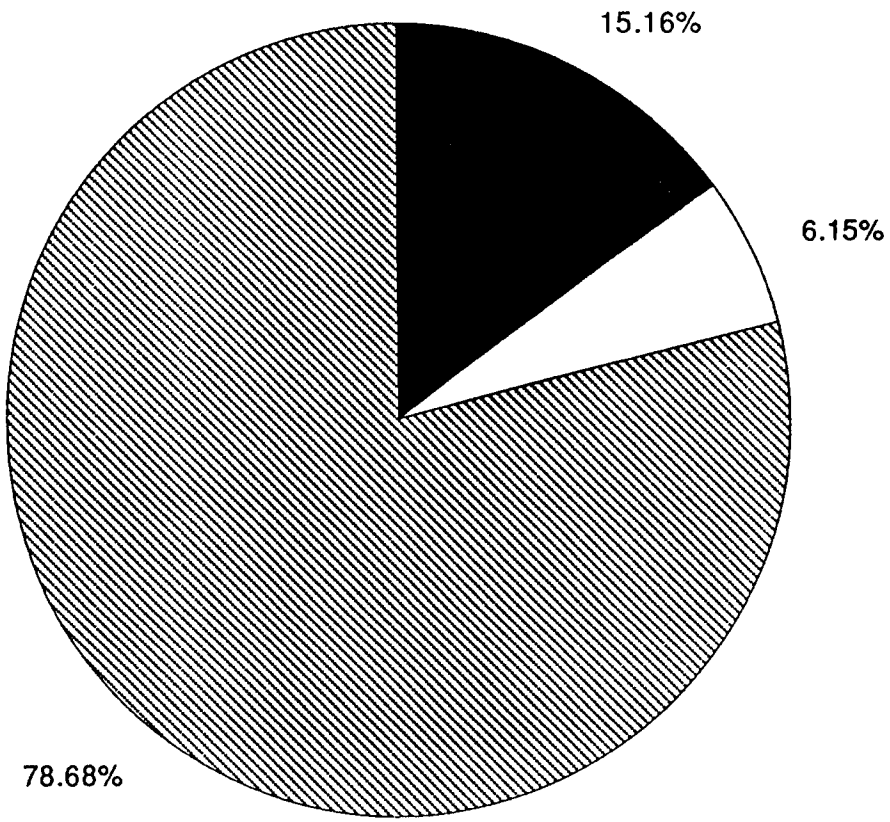
Table 4.8 Water Mode Energy Consumption by Fuel Type

Trillion Btu

Year	Distillate Fuel	Motor Gas	Residual Fuel	Total
1970	13.8	5.6	71.6	91.0
1971	14.9	5.8	61.3	82.0
1972	16.5	6.0	60.0	82.5
1973	24.4	6.2	94.6	125.3
1974	22.0	6.4	127.7	156.0
1975	25.0	6.6	144.7	176.2
1976	28.5	6.8	156.3	191.6
1977	36.3	7.0	188.1	231.4
1978	36.2	7.2	214.8	258.2
1979	40.7	7.4	309.2	357.3
1980	33.9	7.6	283.5	325.1
1981	64.1	7.8	223.7	295.7
1982	48.7	8.0	191.3	248.0
1983	21.6	8.2	157.4	187.2
1984	21.3	8.4	154.5	184.1
1985	26.1	8.6	128.0	162.6
1986	41.8	8.8	126.1	176.6
1987	48.2	9.0	108.1	165.3
1988	38.3	9.2	120.7	168.1
Average annual changes				
Period:				
1970-88	5.8%	2.7%	2.9%	3.5%
1983-88	12.1%	2.3%	-5.2%	-2.1%

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

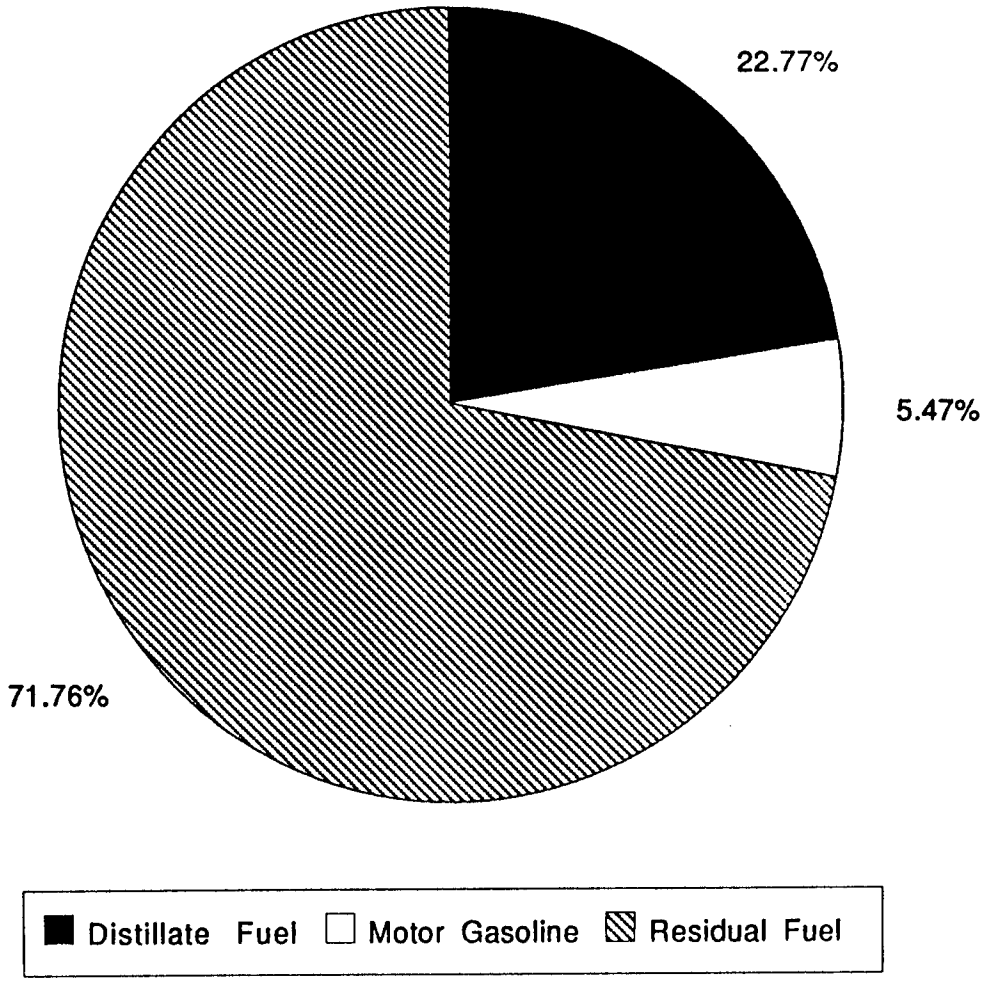
Figure 4.9 Water Mode Energy Use by Fuel Type, 1970



Distillate Fuel | Motor Gasoline | Residual Fuel

Source: Table 4.8

Figure 4.10 Water Mode Energy Use by Fuel Type, 1988



Source: Table 4.8

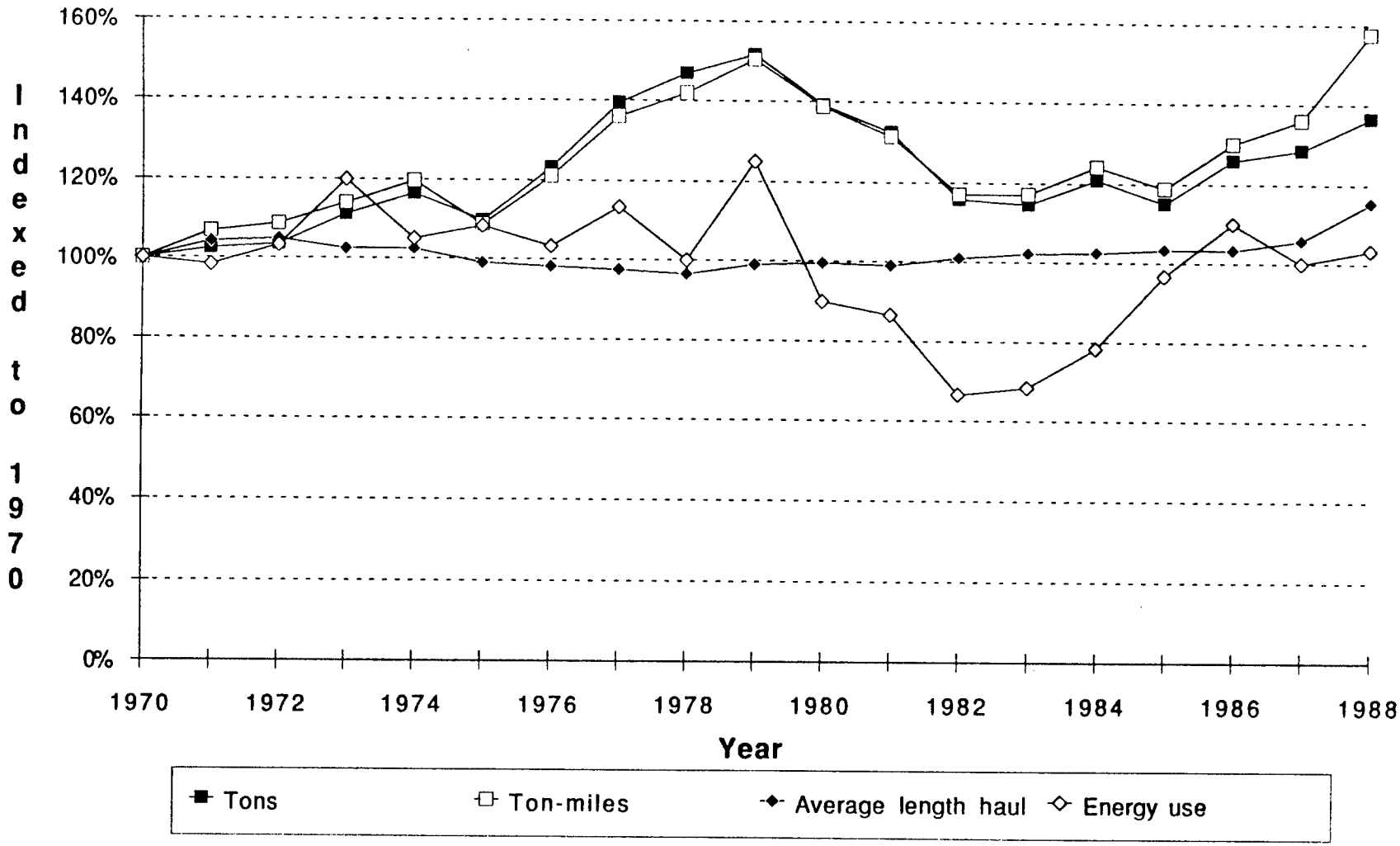
Table 4.9 Summary Statistics for Domestic Waterborne Traffic in Texas

Year	Tons shipped (millions)	Ton-miles (millions)	Avg. length of haul (miles)	Energy intensity (Btu/ton-mi)	Energy use (trillion Btu)
1970	260.3	10,533.9	40.5	567	6.0
1971	266.6	11,247.9	42.2	526	5.9
1972	269.5	11,448.4	42.5	543	6.2
1973	289.6	12,012.6	41.5	599	7.2
1974	303.5	12,602.2	41.5	502	6.3
1975	285.9	11,457.2	40.1	571	6.5
1976	320.7	12,756.9	39.8	487	6.2
1977	363.2	14,333.4	39.5	476	6.8
1978	382.5	14,958.6	39.1	398	6.0
1979	395.0	15,847.6	40.1	475	7.5
1980	362.5	14,621.1	40.3	372	5.4
1981	345.0	13,843.0	40.1	374	5.2
1982	301.6	12,329.0	40.9	322	4.0
1983	298.3	12,350.6	41.4	332	4.1
1984	314.9	13,077.3	41.5	360	4.7
1985	299.4	12,516.6	41.8	464	5.8
1986	327.9	13,705.6	41.8	482	6.6
1987	334.8	14,342.2	42.8	418	6.0
1988	355.6	16,606.0	46.7	375	6.2
			Average annual changes		
1970-88	1.7%	2.6%	0.8%	-2.3%	0.2%
1983-88	1.0%	1.7%	0.7%	0.7%	2.4%

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

Figure 4.11 Traffic Growth and Energy Use on Texas Waterways



Source: Table 4.9

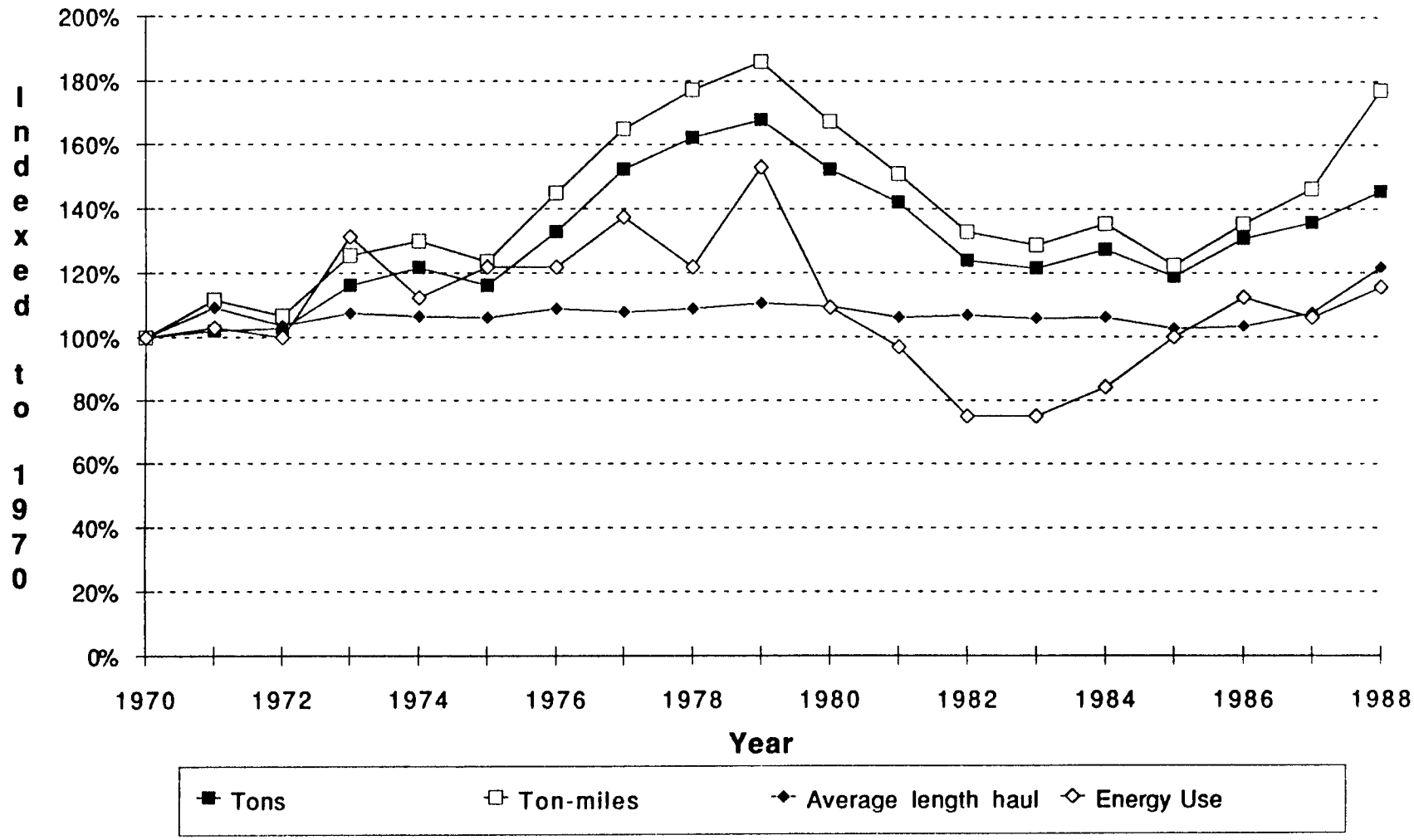
Table 4.10 Summary Statistics for Galveston District

Year	Tons shipped (millions)	Ton-miles (millions)	Avg. length of haul (miles)	Energy intensity (Btu/ton-mi)	Energy use (trillion Btu)
1970	194.9	5,569.5	28.6	567	3.2
1971	199.0	6,230.2	31.3	526	3.3
1972	200.6	5,956.7	29.7	543	3.2
1973	226.6	6,990.5	30.8	599	4.2
1974	237.4	7,241.8	30.5	502	3.6
1975	226.5	6,881.5	30.4	571	3.9
1976	258.8	8,074.1	31.2	487	3.9
1977	296.9	9,188.2	30.9	476	4.4
1978	316.3	9,876.4	31.2	398	3.9
1979	327.1	10,365.9	31.7	475	4.9
1980	297.0	9,320.7	31.4	372	3.5
1981	277.0	8,411.9	30.4	374	3.1
1982	241.7	7,398.2	30.6	322	2.4
1983	237.0	7,171.9	30.3	332	2.4
1984	248.2	7,538.9	30.4	360	2.7
1985	231.8	6,820.0	29.4	464	3.2
1986	254.9	7,540.0	29.6	482	3.6
1987	264.6	8,152.1	30.8	418	3.4
1988	283.6	9,876.4	34.8	375	3.7
			Average annual changes		
1970-88	2.1%	3.2%	1.1%	-2.3%	0.9%
1983-88	3.7%	6.6%	2.8%	2.5%	9.3%

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

Figure 4.12 Traffic Growth and Energy Use for Galveston District



Source: Table 4.10

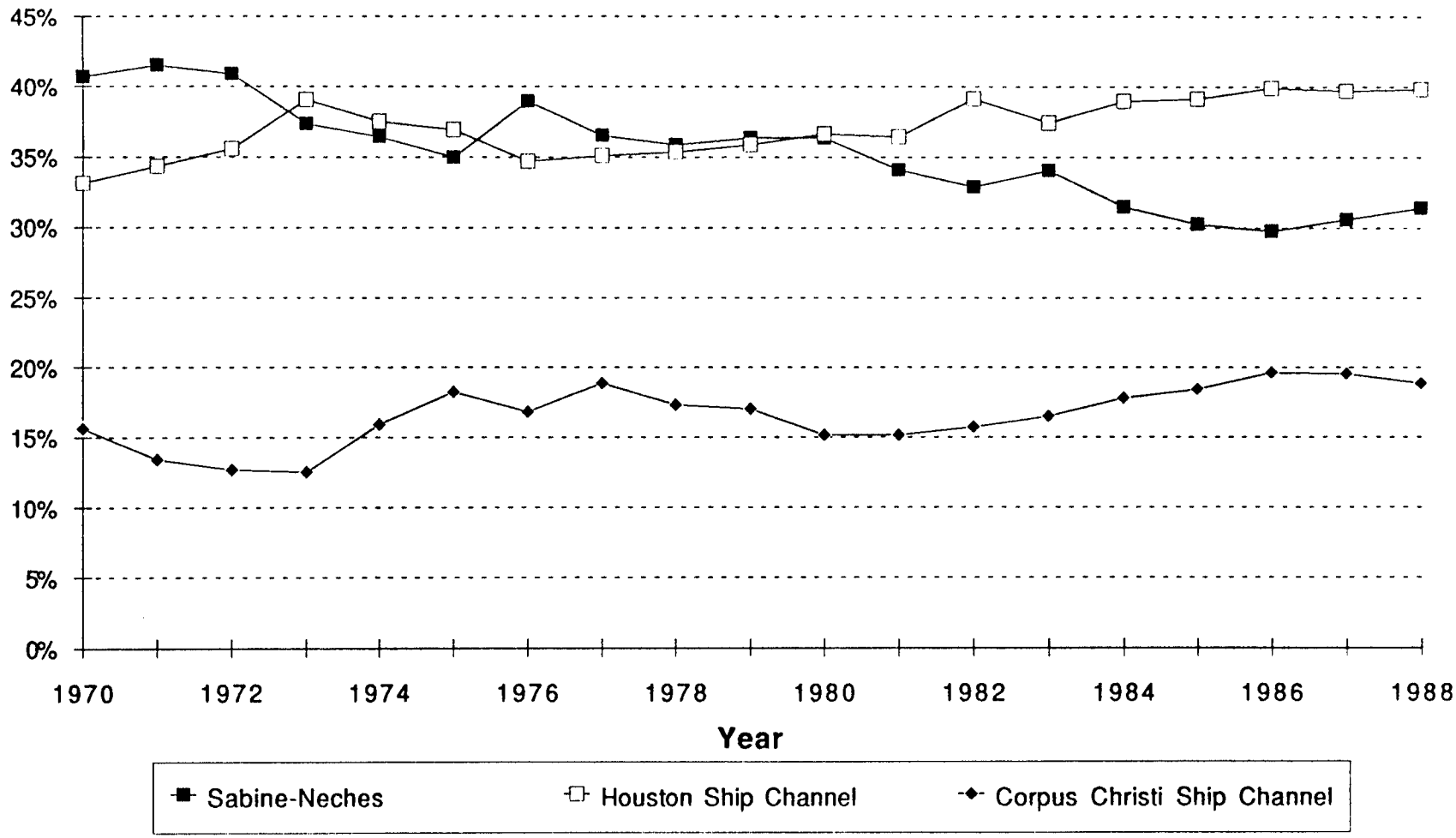
Table 4.11 Statistics for Galveston District by Selected Waterway

	Sabine-Neches		Houston Ship Channel		Corpus Christi Ship Channel	
Year	Tons shipped (millions)	Ton-miles (millions)	Tons shipped (millions)	Ton-miles (millions)	Tons shipped (millions)	Ton-miles (millions)
1970	79.3	2,116.9	64.6	2,657.6	30.5	563.9
1971	82.6	2,195.0	68.4	2,865.5	26.8	495.7
1972	82.0	2,228.1	71.4	2,948.3	25.5	500.1
1973	84.7	2,390.7	88.5	3,741.9	28.4	574.0
1974	86.6	2,403.4	89.1	3,767.1	37.8	765.0
1975	79.3	2,175.9	83.7	3,550.9	41.3	866.2
1976	100.8	3,000.1	89.9	3,834.6	43.5	930.9
1977	108.5	3,290.0	104.3	4,452.1	56.0	1,146.9
1978	113.5	3,504.2	111.9	4,862.2	54.7	1,148.0
1979	119.0	3,799.5	117.5	5,103.8	55.6	1,106.6
1980	108.1	3,371.3	108.9	4,687.3	45.0	908.9
1981	94.5	2,875.3	101.0	4,304.7	42.0	860.3
1982	79.5	2,238.7	94.6	4,046.1	38.0	789.1
1983	80.8	2,374.4	88.7	3,704.1	39.1	782.6
1984	78.1	2,214.6	96.8	4,082.3	44.1	917.5
1985	70.2	1,864.1	90.7	3,756.5	42.7	876.4
1986	75.9	1,930.9	101.7	4,247.5	50.1	1,041.6
1987	80.9	2,337.5	105.1	4,444.1	51.8	1,049.0
1988	89.1	2,960.0	113.0	5,260.0	53.5	1,300.0
			Average Annual Change			
1970-88	0.7%	1.9%	3.2%	3.9%	3.2%	4.7%
1983-88	2.0%	4.5%	5.0%	7.3%	6.5%	10.7%

Source:

Waterborne Commerce of the United States, annual, Department of the Army, Corps of Engineers

Figure 4.13 Contribution of Selected Waterways to Galveston District Tonnage



Source: Tables 4.10 and 4.11

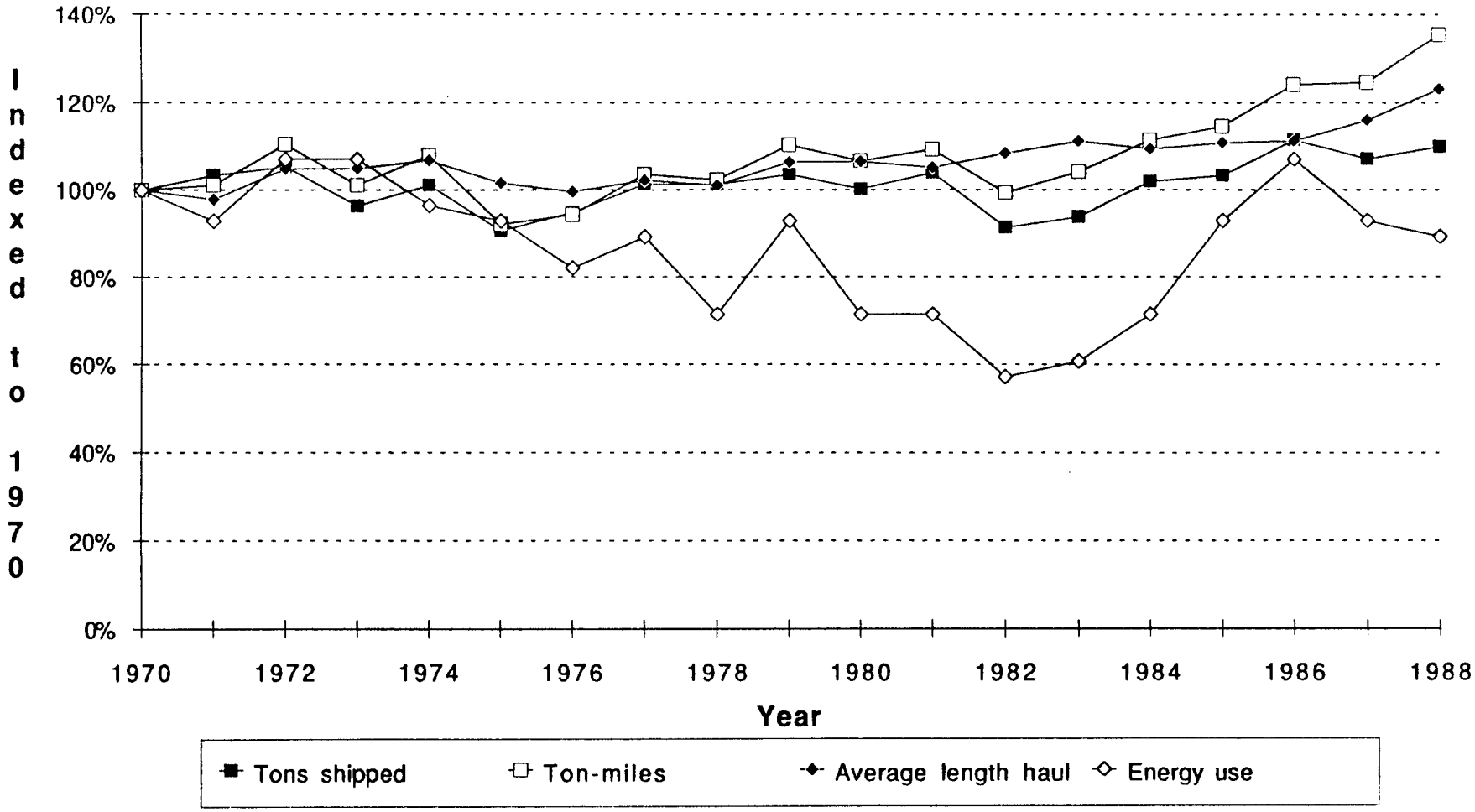
Table 4.12 Summary Statistics for Texas Gulf Intracoastal Waterway

Year	Tons shipped (millions)	Ton-miles (millions)	Avg. length of haul (miles)	Energy intensity (Btu/ton-mi)	Energy use (trillion Btu)
1970	65.4	4,964.4	75.9	567	2.8
1971	67.6	5,017.7	74.2	526	2.6
1972	68.9	5,491.7	79.6	543	3.0
1973	63.0	5,022.1	79.7	599	3.0
1974	66.1	5,360.4	81.1	502	2.7
1975	59.3	4,575.7	77.1	571	2.6
1976	62.0	4,682.8	75.6	487	2.3
1977	66.3	5,145.2	77.6	476	2.5
1978	66.2	5,082.2	76.7	398	2.0
1979	67.8	5,481.7	80.8	475	2.6
1980	65.5	5,300.4	80.9	372	2.0
1981	68.0	5,431.2	79.9	374	2.0
1982	59.8	4,930.8	82.4	322	1.6
1983	61.3	5,178.8	84.5	332	1.7
1984	66.7	5,538.4	83.1	360	2.0
1985	67.6	5,696.6	84.2	464	2.6
1986	73.0	6,165.6	84.5	482	3.0
1987	70.2	6,190.1	88.1	418	2.6
1988	72.0	6,729.6	93.5	375	2.5
		Average annual changes			
1970-88	0.5%	1.7%	1.2%	-2.3%	-0.6%
1983-88	3.3%	5.4%	2.0%	2.5%	8.0%

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

Figure 4.14 Texas Gulf Intracoastal Waterway Traffic Growth and Energy Use



Source: Table 4.12

Table 4.13 Sabine-Galveston Leg of Gulf Intracoastal Waterway

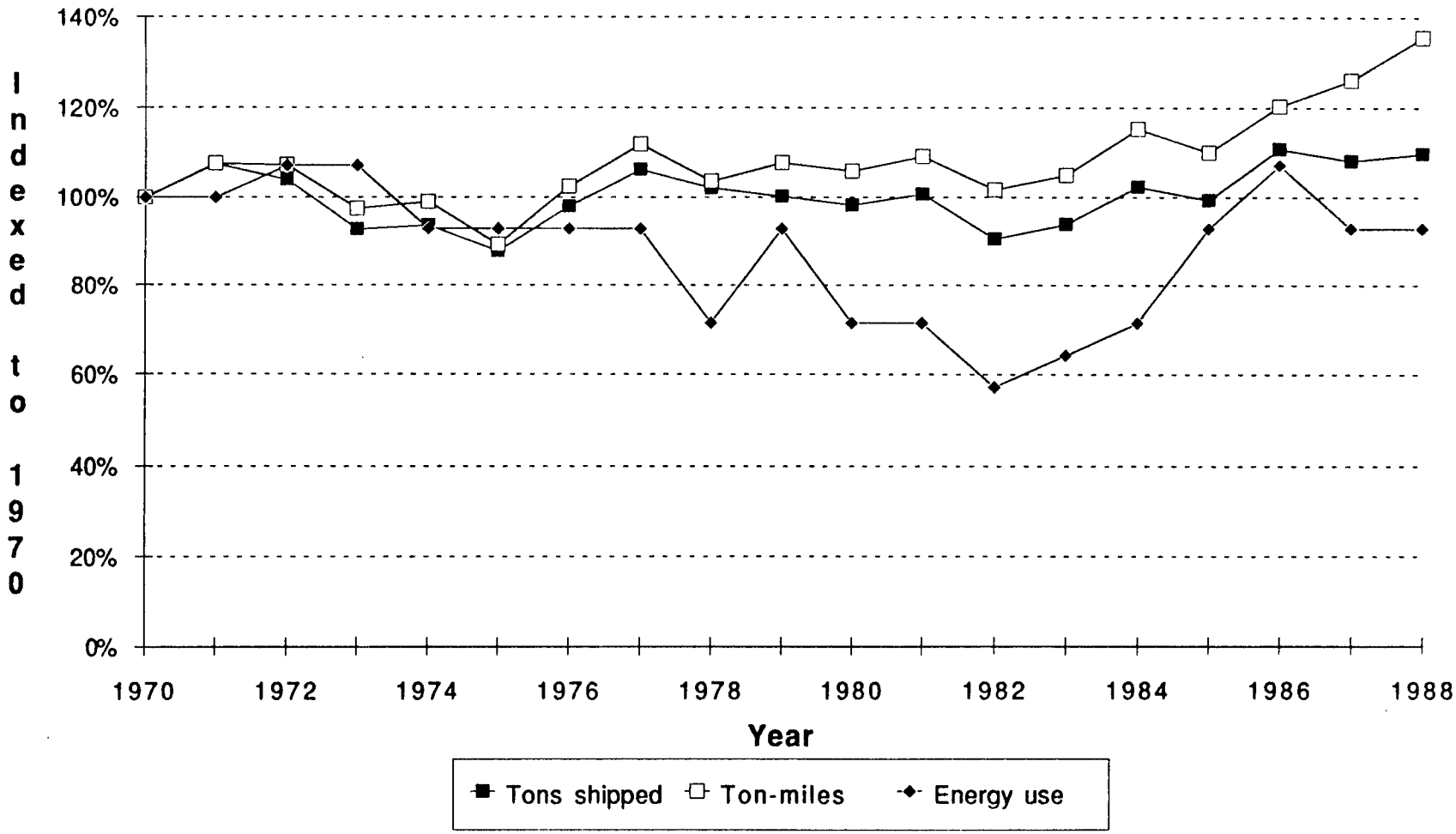
Year	Tons shipped (millions)	Ton-miles (millions)	Est. energy use (trillion Btu)
1970	42.8	2,527.6	1.4
1971	46.0	2,721.6	1.4
1972	44.5	2,711.3	1.5
1973	39.7	2,463.9	1.5
1974	40.1	2,499.7	1.3
1975	37.6	2,258.4	1.3
1976	41.9	2,591.3	1.3
1977	45.5	2,830.0	1.3
1978	43.7	2,618.0	1.0
1979	42.9	2,724.6	1.3
1980	42.0	2,676.2	1.0
1981	43.1	2,758.2	1.0
1982	38.8	2,572.1	0.8
1983	40.2	2,654.6	0.9
1984	43.8	2,915.9	1.0
1985	42.5	2,781.8	1.3
1986	47.4	3,043.2	1.5
1987	46.3	3,190.5	1.3
1988	47.0	3,429.6	1.3
	Average annual changes		
1970-88	0.5%	1.7%	-0.6%
1983-88	3.2%	5.3%	7.9%

Sources:

Waterborne Commerce of the United States, annual, Department of the Army, Corps of Engineers;

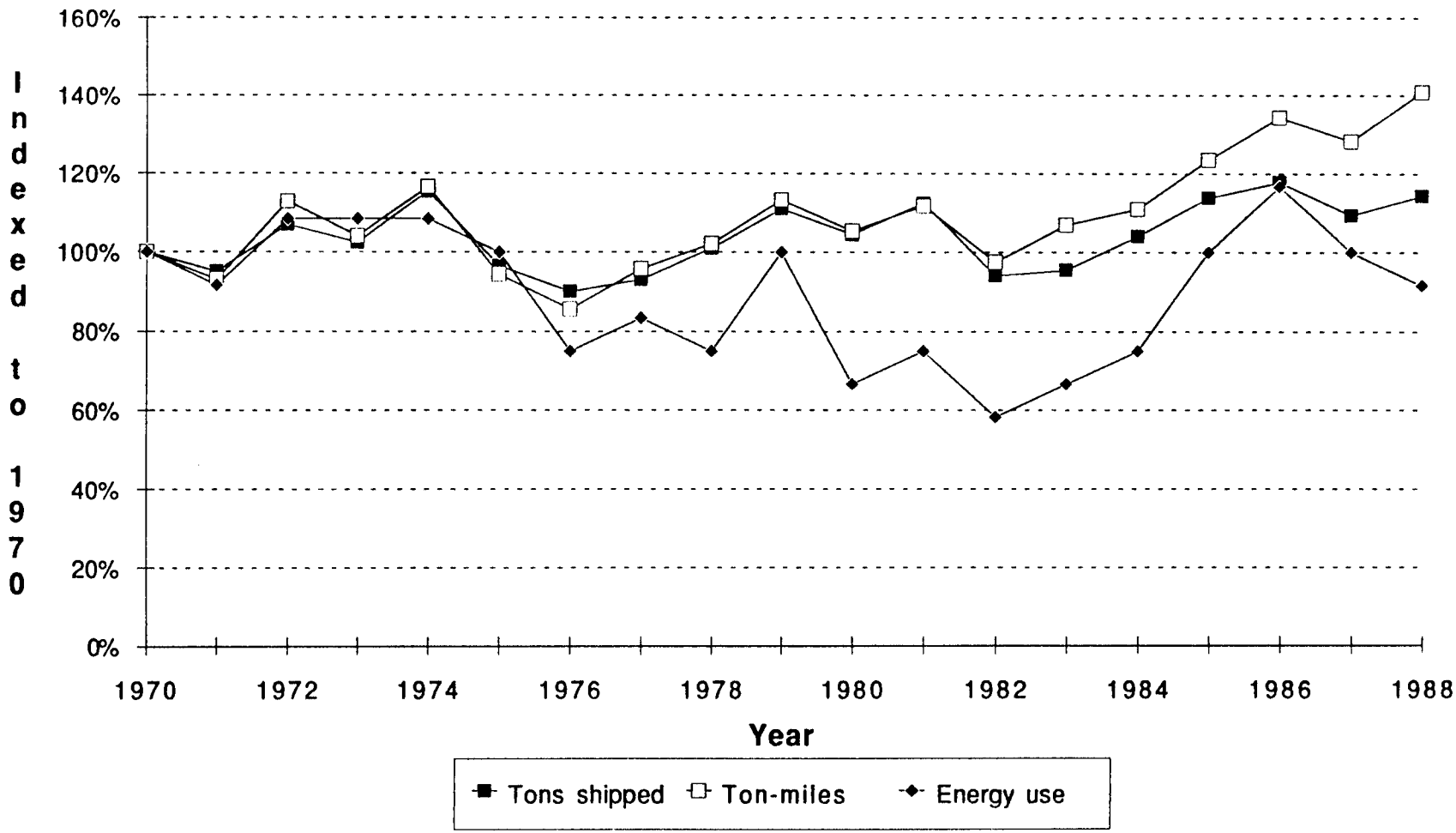
Communications with Texas Transportation Institute's Marine Advisory Panel, and maritime industry carriers for Btu per ton-mile estimates

Figure 4.15 Traffic Growth and Energy Use on Sabine-Galveston Leg of GIWW



Source: Table 4.13

Figure 4.16 Traffic Growth and Energy Use on Galveston-Corpus Christi Leg of GIWW



Source: Table 4.14

Table 4.15 Corpus Christi-Border Leg of Gulf Intracoastal Waterway

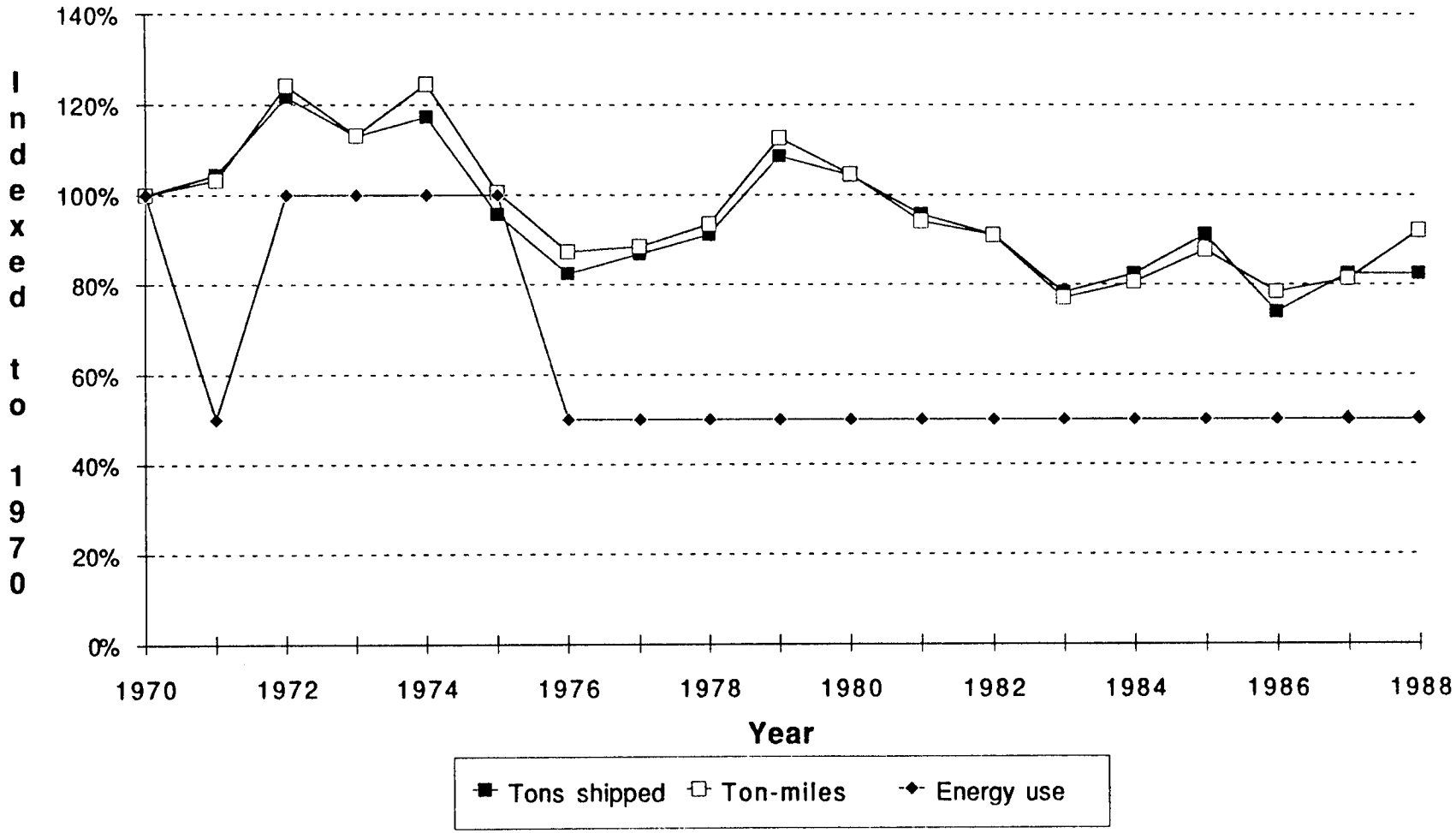
Year	Tons shipped (millions)	Ton-miles (millions)	Est. energy use (trillion Btu)
1970	2.3	271.4	0.2
1971	2.4	280.3	0.1
1972	2.8	337.3	0.2
1973	2.6	307.1	0.2
1974	2.7	338.5	0.2
1975	2.2	273.0	0.2
1976	1.9	237.5	0.1
1977	2.0	240.5	0.1
1978	2.1	254.0	0.1
1979	2.5	306.0	0.1
1980	2.4	283.8	0.1
1981	2.2	255.6	0.1
1982	2.1	247.3	0.1
1983	1.8	208.9	0.1
1984	1.9	219.0	0.1
1985	2.1	238.6	0.1
1986	1.7	212.8	0.1
1987	1.9	221.0	0.1
1988	1.9	250.0	0.1
	Average annual changes		
1970-88	-1.3%	-0.5%	-2.7%
1983-88	0.9%	3.7%	6.3%

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

Figure 4.17 Traffic Growth and Energy Use on Corpus Christi-Border Leg of GIWW



Source: Table 4.1

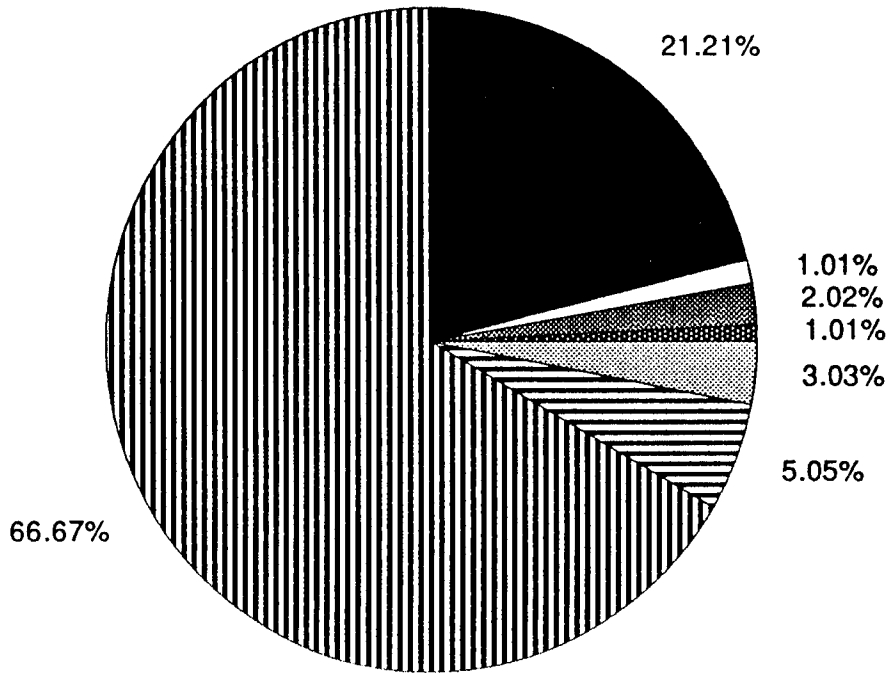
Table 4.16 Commodities Shipped by Water in Texas, 1988

Commodity	Galveston district (tons)	Texas GIWW (tons)	GIWW percent of total	Total (tons)	Commodity percent of total
Agriculture & food products	15,874,462	708,975	4.3%	16,583,437	4.7%
Chemicals & related products	55,371,674	20,166,710	26.7%	75,538,383	21.2%
Forestry & paper products	760,551	44,863	5.6%	805,414	0.2%
Machinery	610,766	27,346	4.3%	638,112	0.2%
Metals, metal products & ores	10,640,969	1,209,683	10.2%	11,850,652	3.3%
Miscellaneous	3,194,060	674,537	17.4%	3,868,597	1.1%
Petroleum & coal products	189,317,258	44,472,322	19.0%	233,789,580	65.8%
Radioactive materials	1,389	0	0.0%	1,389	0.0%
Sand, Gravel, stones, rocks	3,236,905	1,897,197	37.0%	5,134,102	1.4%
Scrap & waste material	3,070,107	1,783,208	36.7%	4,853,315	1.4%
Textiles & textile products	110,436	12,593	10.2%	123,029	0.0%
Transportation equipment & parts	462,299	284	0.1%	462,583	0.1%
Shells	939,125	962,284	50.6%	1,901,408	0.5%
Total	283,590,000	71,960,000	20.2%	355,550,000	-

Source:

Waterborne Commerce of the United States, 1988, Department of the Army, Corps of Engineers

Figure 4.18 Commodities Shipped by Water in Texas, 1988



- Chemicals & related products
- Scrap & waste material
- Other
- Sand, gravel, stones, rocks
- Metals, metal products & ores
- Agriculture & food products
- Petroleum & coal products

Source: Table 4.16

Section 4.3

Pipeline Mode

This section presents Table 4.17 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 4.17 Texas Pipeline Shipments of Energy

Year	Domestic natural gas consumption (billion cubic feet)	Total petroleum transported (million tons)	Total petroleum transported (billion ton-mi)	Crude petroleum (billion ton-mi)	Refined petroleum products (billion ton-mi)	Energy use (trillion Btu)
1972	2,409	95.5	51.9	31.1	20.8	107.4
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	118.7	75.8	46.8	29.1	108.1
1981	2,405	109.8	69.9	41.3	28.6	105.1
1982	2,389	119.0	75.1	44.5	30.7	106.0
1983	2,685	143.4	88.7	53.0	35.7	109.2
1984	2,773	141.7	87.8	51.4	36.3	112.2
1985	2,344	124.5	76.5	45.3	31.2	95.6
1986	2,020	117.7	72.0	41.7	30.3	85.2
1987	2,014	111.6	68.7	40.0	28.7	84.4
1988	2,446	134.6	83.0	49.0	34.1	111.8
		Average Annual Percentage Rate				
Time Period:						
1970-8	0.1%	2.2%	3.0%	2.9%	3.1%	0.3%
1983-8	-1.8%	-1.3%	-1.3%	-1.5%	-1.0%	0.5%

Sources:

State Energy Data Report, Energy Information Administration;
ORNL Transportation Energy Book 1990

Section 4.4

Rail Mode

This section 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.

Table 4.18 Rail Mode Energy Consumption by Fuel Type

Year	Distillate Fuel	Residual Fuel	Total Btu (trillion)
1970	43.6	0.1	43.7
1971	46.6	0.1	46.7
1972	67.1	0.1	67.2
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	52.1	0.0	52.1
	Average annual changes		
Time Period:			
1970-88	1.0%	-100.0%	1.0%
1983-88	-0.4%	-	-0.4%

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

Table 4.19 Freight and Energy Statistics of Class I Railroads Operating In Texas

Year	Estimated ton-miles (billions)	Estimated gallons consumed	Btu's used (trillions)	Energy intensity (Btu/ton-mi)
1970	48.9	247,113,936	34.3	700
1971	50.0	252,995,271	35.1	701
1972	52.7	266,344,128	36.9	701
1973	63.2	319,366,015	44.3	701
1974	59.9	303,103,618	42.0	701
1975	54.7	276,498,414	38.3	700
1976	51.7	256,431,583	35.6	688
1977	61.7	300,500,563	41.7	675
1978	66.9	317,698,114	44.1	659
1979	70.7	327,728,762	45.5	643
1980	77.0	340,832,136	47.3	614
1981	75.0	319,514,049	44.3	591
1982	66.0	269,786,404	37.4	567
1983	68.7	268,778,814	37.3	543
1984	74.0	275,672,418	38.2	517
1985	67.5	250,436,010	34.7	514
1986	61.3	222,722,728	30.9	504
1987	71.8	244,003,024	33.8	471
1988	76.5	245,521,464	34.1	445
		Average annual changes		
Time Period:				
1970-88	2.5%	0.0%	0.0%	-2.5%
1983-88	2.2%	-1.8%	-1.8%	-3.9%

Sources:

Texas Railroad Facts, 1990 and annual issues, Railroad Commission of Texas; Railroad Statistics, 1970 and annual, Railroad Commission of Texas

Table 4.20 Comparative Statistics for 1988 Class I Railroads

	Texas	United States	As percentage of U.S. figure
Train miles	29,766,184	379,000,000	7.85%
Avg. length of haul	219	697	31.42%
Revenue ton-miles	76,490,822,000	966,182,000,000	7.92%
Revenue carloadings	4,842,217	21,600,000	22.42%
BTU/Revenue ton-mile	445	434	2.57%

Source:
Texas Railroad Facts 1990, Railroad Commission of Texas

Table 4.21 Route Miles of Track Owned in Texas by Class I Railroads

Railroads	1986	1987	1988
Atchison, Topeka, & Santa Fe (ATSF)	3,268	3,261	3,261
Burlington Northern (BN)	1,157	1,100	1,095
Kansas City Southern (KCS)	252	252	252
Missouri-Kansas-Texas (MKT)	796	796	(a)
Union Pacific (UP)	2,816	2,787	3,562
Southern Pacific (SP)	2,477	2,453	2,421
St. Louis Southwestern (SSW)	614	614	614
Total	11,380	11,263	11,205

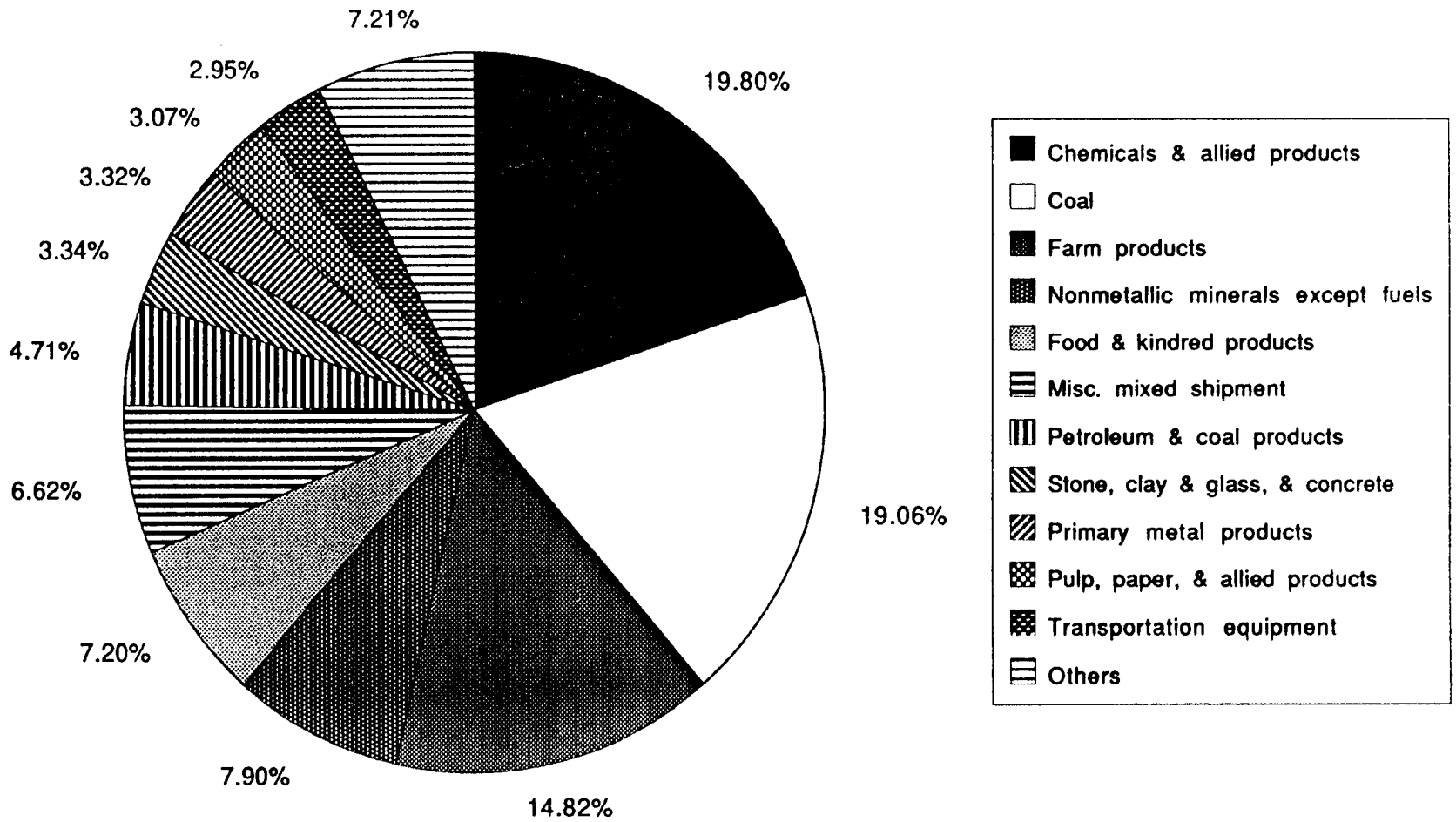
Source:
Texas Railroad Facts 1990, Railroad Commission of Texas
Notes:
(a) Merged with Union Pacific

Table 4.22 Top Five Commodities of Total Freight by Tonnage, 1988

Commodity/Description	STCC Code	Tons	Carloads
Chemicals & allied products	28	60,144,464	717,405
Coal	11	54,314,525	531,837
Farm products	1	42,376,801	504,632
Food & kindred Products	20	21,131,008	372,404
Nonmetalic minerals except fuels	14	20,595,898	241,369

Source:
Texas Railroad Facts 1990, Railroad Commission of Texas

Figure 4.19 Texas Commodity Distribution of Railroad Revenue Tonnage, 1988



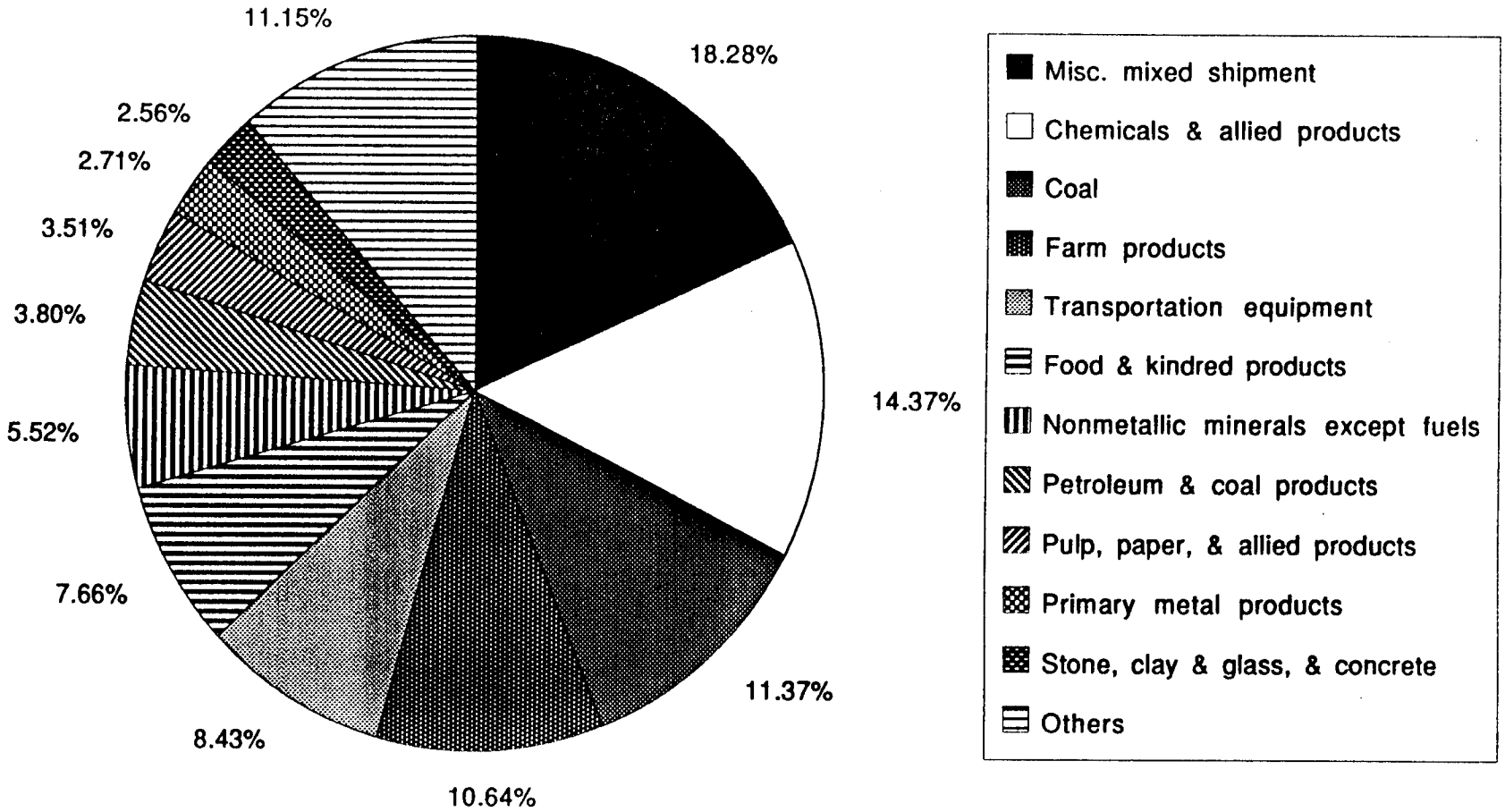
Source: Table 4.22

Table 4.23 Top Five Commodities of Total Freight by Carloads, 1988

Commodity/Description	STCC Code	Carloads	Tons
Misc. mixed shipments	46	898,462	19,926,386
Chemicals & allied products	28	717,405	60,144,464
Coal	11	531,837	54,314,525
Farm products	1	504,632	42,376,801
Transportation equipment	37	422,638	9,002,820

Source:
Texas Railroad Facts 1990, Railroad Commission of Texas

Figure 4.20 Texas Commodity Distribution of Railroad Revenue Carloadings, 1988



Source: Table 4.23

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 new energy saving technology.

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.

Table 5.1 Fuel Prices for Countries Having Alternative Fueled Vehicles

	$ per gallon, including tax							Alternatively Fueled Vehicles
	1984	1985	1986	1987	1988	1989	1990	as of 1987
Asia:								
Japan								
Gasoline	2.38	2.22	2.84	2.89	3.49	3.41	3.05	1.4 - 1.7 million LPG vehicles
Diesel	N.A.	1.32	1.83	1.80	2.08	2.02	1.75	
Europe:								
France								
Gasoline	N.A.	2.35	2.58	2.95	3.08	3.11	3.40	2,000 CNG Vehicles
Diesel	N.A.	1.30	1.87	1.91	1.20	1.86	1.78	43,000-53000 LPG Vehicles
Italy								
Gasoline	2.43	2.85	3.09	3.71	4.09	3.91	4.27	300,000 CNG Vehicles
Diesel	N.A.	0.96	1.40	1.55	1.77	1.82	2.34	
Sweden								
Gasoline	1.83	2.02	2.26	2.39	2.68	2.92	3.23	2 Demonstration CNG Vehicles
Diesel	N.A.	1.07	1.40	1.47	1.64	1.84	2.30	
Germany								
Gasoline	1.59	1.80	2.04	2.09	2.18	2.53	2.72	12,000-15,000 LPG Vehicles
Diesel	N.A.	1.18	1.70	1.67	1.75	1.71	1.91	
North America:								
Canada								
Gasoline	N.A.	1.33 a	1.38 a	1.30 a	1.52 a	1.65 a	1.92	15,000 CNG Vehicles w/250,000
Diesel	N.A.	1.35	1.30	1.26	1.43	1.47	1.55	proposed by 2005
								Approx. 50 Methanol Demo. Veh.
United States								
Gasoline	1.31 a	1.37 a	1.19 a	.82 a	.91 a	.92 a	1.04 a	30,000 CNG Vehicles
Diesel	N.A.	1.16	1.16	0.87	0.96	0.89	0.99	300,000-370,000 LPG Vehicles

Sources:

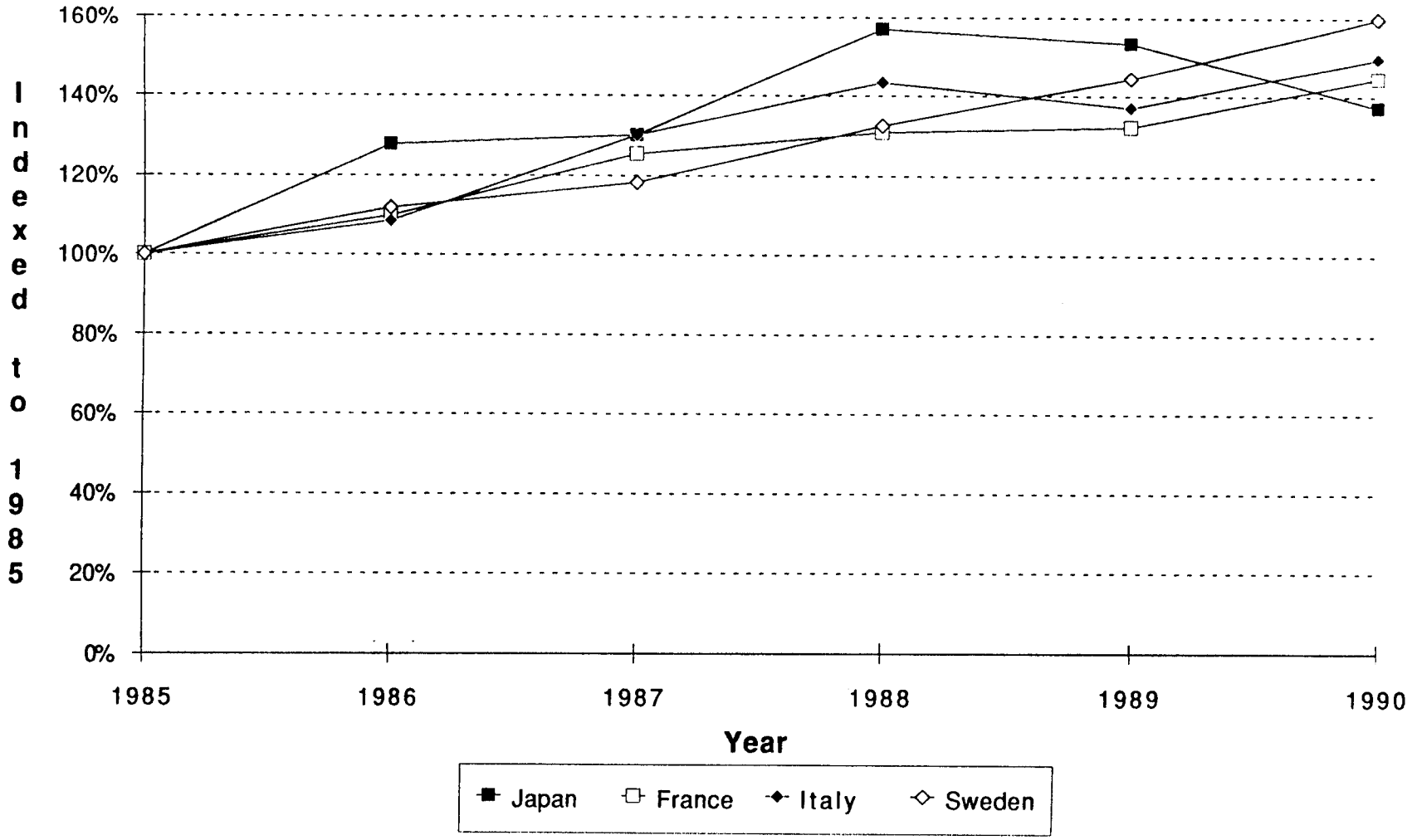
Oak Ridge National Laboratory; "Transportation Energy Data Book: Edition 11," January 1991

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

Notes:

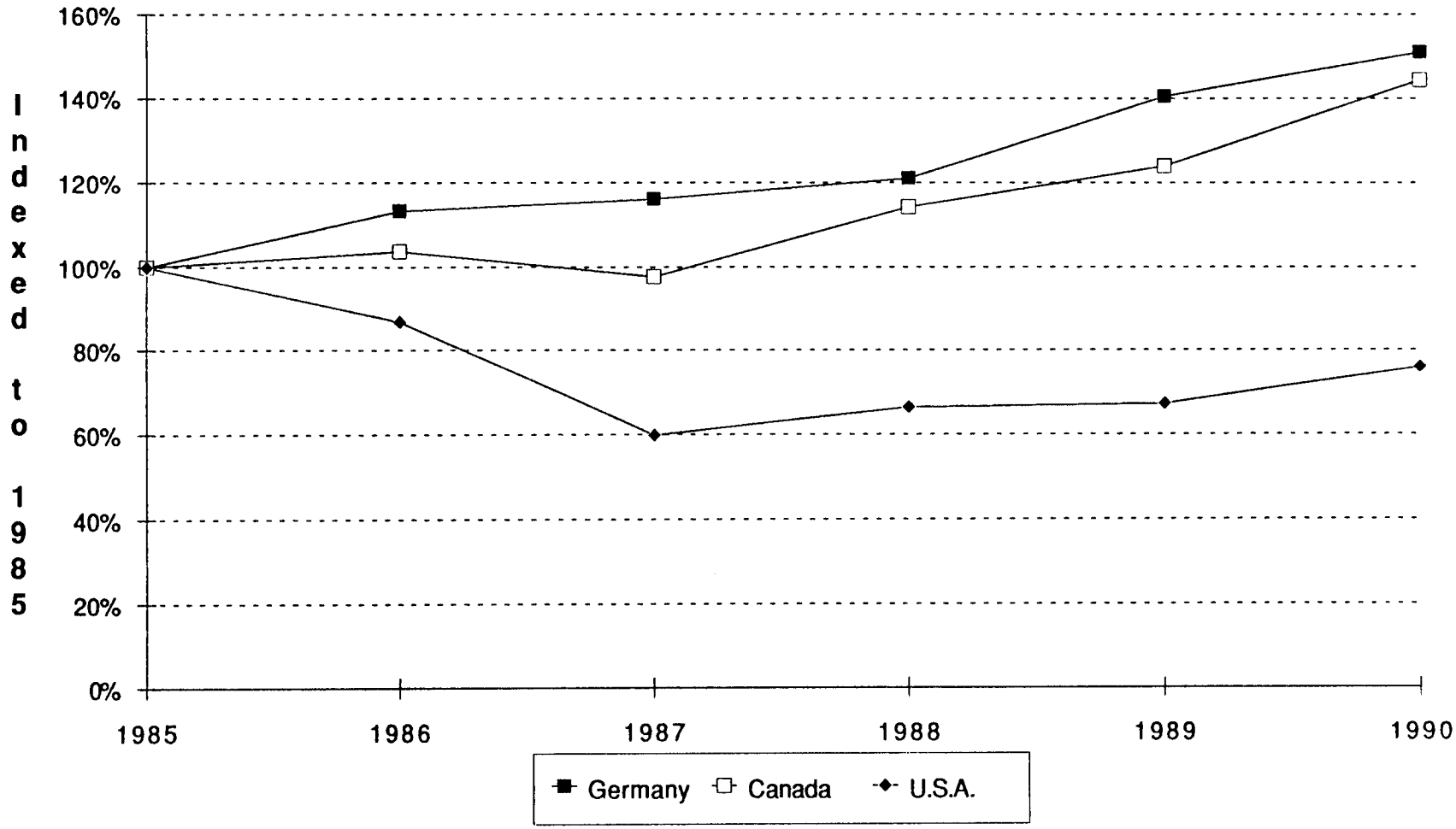
(a) Price is for regular unleaded gasoline, all others are premium unleaded prices

Figure 5.1 Gasoline Prices (Per Gallon) for Japan, France, Italy and Sweden



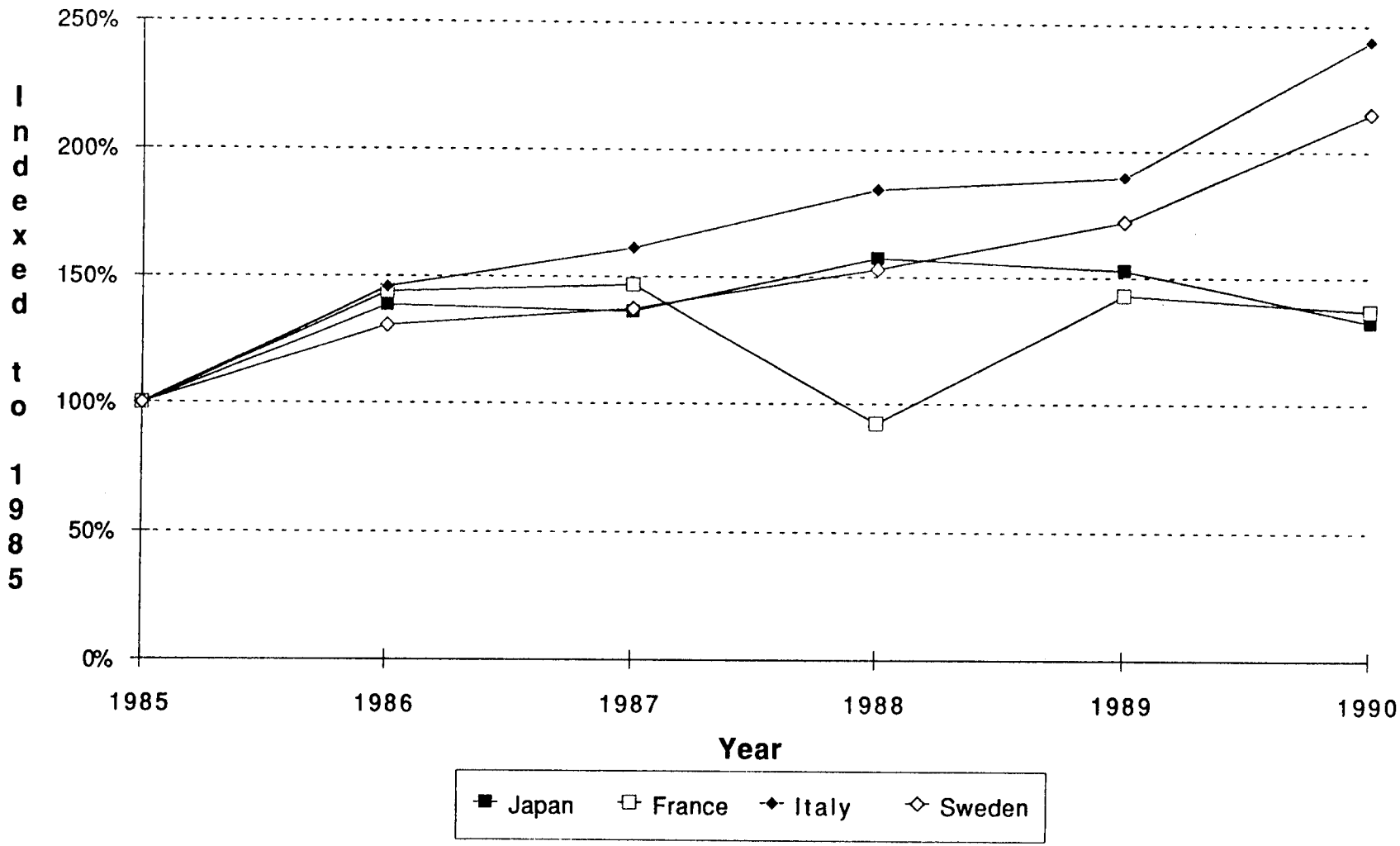
Source: Table 5.1

Figure 5.2 Gasoline Prices (Per Gallon) for Germany, Canada and the United States



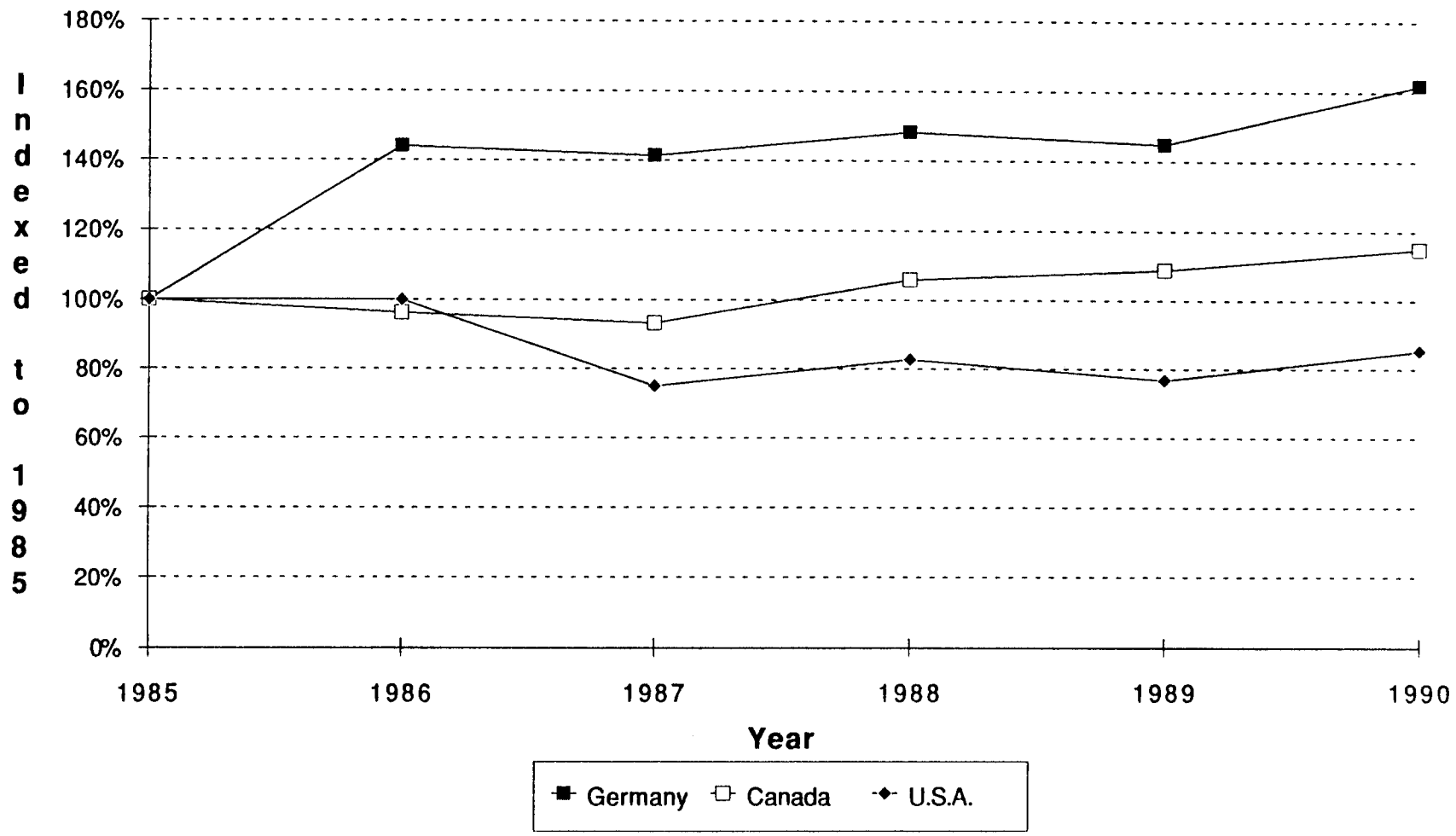
Source: Table 5.1

Figure 5.3 Diesel Prices (Per Gallon) for Japan, France, Italy and Sweden



Source: Table 5.1

Figure 5.4 Diesel Prices (Per Gallon) for Germany, Canada and the United States



Source: Table 5.1

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 Solubilty	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 (CO_2) Emmissions of Selected Alternative Fuels

Fuel	Grams CO_2 per mile	Percent of Gasoline CO_2 Emissions	Btu per gram of CO_2	Btu/gallon
Gasoline	128.08	100%	975.95	125,000
M100	109.07	85%	592.28	64,600
M85	116.95	91%	629.33	73,600
E85	93.80	73%	901.92	84,600
LPG	80.22	63%	1063.33	85,300

Source:
Society of Automotive Engineers
Notes:
- M100 is 100% methanol
- M85 is 85% methanol, 15% gasoline
- E85 is 85% ethanol, 15% gasoline

Section 5.2

New Technology

This section concentrates on information regarding energy saving technology. Table 5.4 provides information on technology concepts for improving vehicle fuel efficiency. For selected vehicle systems, technology for improving efficiency and the benefits and disadvantages of each technology are presented. Table 5.5 presents new energy saving vehicles, power trains used, and the reported fuel economy by the manufacturer.

Table 5.4 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 toughes 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. Walzer, "Energy For Motor Vehicles", Scientific American, September, 1990

Table 5.5 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 ≤ 1/3 full throttle car uses electric power; ≥ 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

TITLE INDEX

page

Air

Air Freight for Selected Texas Cities 120

Air Mode Energy Consumption by Fuel Type 112

Summary Statistics for Domestic & International Route Air Carriers Operating in Texas 115

Texas Traffic Data for Large Certificated Air Carriers..... 118

Aircraft

Distribution of General Aviation Aircraft in Texas 125

Alternative

Comparison of Economically Feasible Alternative Fuels 165

Direct Carbon Dioxide (CO2) Emissions of Selected Alternative Fuels.... 166

Fuel Prices for Countries Having Alternative Fuel Vehicles 160

Automobile(s)

Automobile Registrations for Selected States 3

Cost of Operating an Automobile in the U.S. 93

Estimated Automobile Fuel Economy by Vehicle Type, 1991 Model Year.. 96

New Energy Saving Automobiles 169

Aviation

Distribution of General Aviation Aircraft in Texas 125

Summary Statistics for General Aviation in Texas 123

Bus

Truck and Bus Registrations for Selected States, 1970-88 4

page

Commodities

Commodities Shipped Via Texas Highways, 1991 108

Commodities Shipped by Water in Texas 145

Top Five Commodities of Total Freight by Carloads, 1988 156

Top Five Commodities of Total Freight by Tonnage, 1988 154

Comparative

Comparative Statistics for 1988 Class I Railroads 152

Comparison

Comparison of Economically Feasible Alternative Fuels 165

Composition

Average Vehicle Miles Traveled by Household Composition, 1988 88

Consumption

Air Mode Energy Consumption by Fuel Type 112

Air Mode Energy Consumption by Fuel Type 112

Average Per Household Vehicle: Vehicle Miles Traveled,

Fuel Consumption and Expenditures 66

Distribution of Energy Consumption by Source 24

Energy Consumption by End-Use Sector, 1970-88 27

Energy Consumption by Mode and Fuel Type, 1970 30

Energy Consumption by Mode and Fuel Type, 1978 30

Energy Consumption by Mode and Fuel Type, 1988 30

Energy Consumption by Transportation Mode 28

Highway Mode Energy Consumption by Fuel Type 49

page

Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1988 14

Rail Mode Energy Consumption by Fuel Type 150

Texas Petroleum Consumption by Sector 21

Texas Petroleum Production and Consumption 19

U.S. Travel and Consumption Characteristics by Number of Cylinders, 1988 v. 1983 70

Water Mode Energy Consumption by Fuel Type 128

Cost

Cost of Operating an Automobile in the U.S. 93

Cylinders

U.S. Travel and Consumption Characteristics by Number of Cylinders, 1988 v. 1983 70

Distillate

Distillate Fuel Prices for Selected States 8

Distillate Fuel Taxes for Selected States, 1970-88 11

Distribution

Distribution of Energy Consumption by Source 24

Distribution of General Aviation Aircraft in Texas 125

Efficiency

Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1988 83

Technology Concepts for Improving Fuel Efficiency 168

Vehicle Fuel Efficiency 77

page

Emissions

Direct Carbon Dioxide (CO_2) Emissions of Selected Alternative Fuels 166

Energy

Energy Consumption by End-Use Sector, 1970-88 27

Energy Consumption by Mode and Fuel Type, 1970 30

Energy Consumption by Mode and Fuel Type, 1978 30

Energy Consumption by Mode and Fuel Type, 1988 30

Energy Consumption by Transportation Mode 28

Energy Intensities of Freight Modes in Texas 39

Energy Intensities of Passenger Modes in Texas 37

Freight and Energy Statistics of Class I Railroads Operating in Texas 151

New Energy Saving Automobiles 169

Enplanements, Estimated Energy Use for Selected Texas Cities 119

Expenditures

Average Household Energy & Vehicle Expenditures 79

Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures 66

Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1988 14

Family

Average Vehicle Miles Traveled (Per Household) by Family Income, 1988 85

Freight

Air Freight for Selected Texas Cities 120

page

Energy Intensities of Freight Modes in Texas 39

Freight and Energy Statistics of Class I Railroads Operating in Texas ... 151

Intercity Freight and Energy Use in Texas, 1988 38

Top Five Commodities of Total Freight by Carloads, 1988 156

Top Five Commodities of Total Freight by Tonnage, 1988 154

Fuel

Air Mode Energy Consumption by Fuel Type 112

Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures 66

Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1988 83

Comparison of Economically Feasible Alternative Fuels 165

Direct Carbon Dioxide (CO2) Emissions of Selected Alternative Fuels .. 166

Distillate Fuel Prices for Selected States 8

Distillate Fuel Taxes for Selected States, 1970-88 11

Energy Consumption by Mode and Fuel Type, 1970 30

Energy Consumption by Mode and Fuel Type, 1978 30

Energy Consumption by Mode and Fuel Type, 1988 30

Estimated Automobile Fuel Economy by Vehicle Type, 1991 Model Year.. 96

Estimated Combination Truck Fuel Economy in Texas 101

Estimated Single Unit Truck Fuel Economy in Texas 100

Fuel Prices for Countries Having Alternative Fuel Vehicles 160

Highway Mode Energy Consumption by Fuel Type 49

Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1988 14

page

Rail Mode Energy Consumption by Fuel Type 150

Retail Prices for Selected Transportation Fuels 43

Retail Prices of Selected Highway Motor Fuels..... 41

Technology Concepts for Improving Fuel Efficiency 168

Vehicle Fuel Efficiency 77

Water Mode Energy Consumption by Fuel Type 128

Galveston

Statistics for Galveston District by Selected Waterway 135

Summary Statistics for Galveston District 133

Gasoline

Crude Oil and Gasoline Prices in Texas 45

Motor Gasoline Prices for Selected States 7

Motor Gasoline Taxes for Selected States, 1970-88 10

Gulf Intracoastal Waterway

Corpus Christi-Border Leg of Gulf Intracoastal Waterway 143

Galveston-Corpus Christi Leg of Gulf Intracoastal Waterway 141

Sabine-Galveston Leg of Gulf Intracoastal Waterway 139

Summary Statistics for Texas Gulf Intracoastal Waterway 137

Highway(s)

Commodities Shipped Via Texas Highways, 1991 108

Highway Mode Energy Consumption by Fuel Type 49

Retail Prices of Selected Highway Motor Fuels 41

Texas Highway Energy Use by Mode 53

page

Household

Average Household Energy & Vehicle Expenditures 79

Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures 66

Average Vehicle Miles Traveled (Per Household) by Family Income, 1988 85

Average Vehicle Miles Traveled by Household Composition, 1988 88

Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1988 14

Income

Average Vehicle Miles Traveled (Per Household) by Family Income,1988..... 85

Intensities

Energy Intensities of Freight Modes in Texas 39

Energy Intensities of Passenger Modes in Texas 37

Miles

Average Miles Per Gallon by Model Year 75

Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures 66

Average Vehicle Miles Traveled (Per Household) by Family Income, 1988 85

Average Vehicle Miles Traveled by Household Composition, 1988 88

Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1988 83

Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1988 14

Route Miles of Track Owned in Texas by Class I Railroads 153

page

Municipal

Statewide Municipal Ridership 97

Oil (see also Petroleum)

Crude Oil and Gasoline Prices in Texas 45

Passenger

Energy Intensities of Passenger Modes in Texas 37

Passenger Travel and Energy Use in Texas, 1988 35

Petroleum

Texas Petroleum Consumption by Sector 21

Texas Petroleum Production and Consumption 19

Transportation Use of Petroleum for Selected States, 1988..... 2

Pipeline

Texas Pipeline Shipments of Energy 148

Prices

Crude Oil and Gasoline Prices in Texas 45

Distillate Fuel Prices for Selected States 8

Fuel Prices for Countries Having Alternative Fuel Vehicles 160

Motor Gasoline Prices for Selected States 7

Retail Prices for Selected Transportation Fuels 43

Retail Prices of Selected Highway Motor Fuels 41

Rail (Railroads)

Comparative Statistics for 1988 Class I Railroads 152

Freight and Energy Statistics of Class I Railroads Operating in Texas 151

page

Rail Mode Energy Consumption by Fuel Type 150

Route Miles of Track Owned in Texas by Class I Railroads 153

Speed

Texas Interstate Speed Data 61

Texas Non-Interstate Speed Data 63

Taxes

Distillate Fuel Taxes for Selected States, 1970-88 11

Motor Gasoline Taxes for Selected States, 1970-88 10

Technology

Technology Concepts for Improving Fuel Efficiency 168

Transportation

Energy Consumption by Transportation Mode 28

Retail Prices for Selected Transportation Fuels 43

Transportation Use of Petroleum for Selected States, 1988..... 2

Truck

Estimated Combination Truck Fuel Economy in Texas 101

Estimated Single Unit Truck Fuel Economy in Texas 100

Texas Truck Mileage by Major Use 107

Texas Truck Mileage by Vehicle Range 105

Texas Truck Mileage by Vehicle Size 103

Truck and Bus Registrations for Selected States, 1970-88 4

Vehicle

Average Household Energy and Vehicle Expenditures 79

page

Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption and Expenditures 66

Average Vehicle Miles Traveled (Per Household) by Family Income, 1988 85

Average Vehicle Miles Traveled by Household Composition, 1988 88

Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1988 83

Estimated Automobile Fuel Economy by Vehicle Type, 1991 Model Year.. 96

Fuel Prices for Countries Having Alternative Fuel Vehicles 160

Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1988 14

Private and Commercial Vehicles for Selected States 1970-88 6

Vehicle Fuel Efficiency 77

Vehicle Stock in Texas, 1970-88 58

Vehicle Stock in Texas, 1988 55

Water

Commodities Shipped by Water in Texas 145

Water Mode Energy Consumption by Fuel Type 128

Waterborne

Summary Statistics for Domestic Waterborne Traffic in Texas 131

Waterway

Corpus Christi-Border Leg of Gulf Intracoastal Waterway 143

Galveston-Corpus Christi Leg of Gulf Intracoastal Waterway 141

Sabine-Galveston Leg of Gulf Intracoastal Waterway 139

Statistics for Galveston District by Selected Waterway 135

Summary Statistics for Texas Gulf Intracoastal Waterway 137