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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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Texas Transportation Energy Data Book: Edition 2

by
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With Contributions by
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Texas Transportation Institute
The Texas A&M University System
College Station

June 1994

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

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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, and also contains a projection of world energy consumption in the year 2010. Chapter 2 provides a snapshot of the Texas transportation energy picture. Energy characteristics of the highway mode is detailed in chapter 3, while the energy characteristics of the non-highway modes of air, water, pipeline and rail are given in chapter 4. Chapter 5 concludes this volume and provides information concerning alternative energy fuels a new energy saving technology, including profiles of Electric Vehicles (EV).

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EXECUTIVE SUMMARY

Energy efficiency in transportation is a significant element in the State's ability to achieve and maintain reduced consumption of fossil fuels. The transportation sector consumes approximately 47% of the petroleum produced in the Texas. And of all the petroleum used by the transportation sector, nearly 45% 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 so 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 policies and alternative energy technologies among the transportation modes in Texas.

Chapter 1 primarily contains a comparison of Texas energy related transportation statistics with seven other similar states. Table 1.1 begins this volume with an estimate of world wide energy consumption for the year 2010. The table points out that although the USA began 1988 with the highest energy consumption in the world, it may be surpassed by the former Soviet Union should recent trends continue. It also points out that the USA would only contribute a very minor increase in world wide energy consumption and the pollution associated with the burning of fossil fuels.

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

highway programs in their regions.

Chapter 1 shows that Texas auto registrations, as a percentage of US auto registrations, has remained constant since 1972; however, the concentration of truck and bus registrations in Texas, as a percentage of US truck and bus registrations has risen from 8% to nearly 12% over this same period. Compared to the other seven states studied, motorists in Texas paid the fourth highest price per gallon in current dollars. Also in constant 1988 dollars, Texans have enjoyed an 4.2% annual reduction in motor gasoline prices since 1980. Freight haulers in Texas, however paid almost the least in distillate fuel prices, compared to the other states studied.

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

The key points of chapter 2 are: Texas has been a net importer of petroleum products since 1988, and the gap has widened significantly; the burgeoning air industry in Texas has increased the demand for jet fuel at an annual rate of 8.3% since 1973; the most efficient passenger mode in Texas is the school bus (859 Btu per passenger-mile), while the least efficient is air (11 035 Btu per passenger-mile); yet auto efficiency, in terms of percentage change in Btu per passenger-mile, has improved the most since 1973 and leads in average annual reduction at a rate of 2.7%; the most efficient freight mode is the pipeline at 272 Btu per ton-mile, while combination trucks are the most energy intensive at 2 483 Btu per ton-mile; in 1988 constant dollars, Texas motor fuel prices have fallen by 20% from 1973 prices, yet distillate prices in 1988 constant dollars have risen in Texas by over 40% since 1973.

Chapter 3 provides detailed information about the energy characteristics of the Texas highway mode. This chapter is divided into four sections. Section 3.1 is concerned with the

general energy and traffic characteristics of the State's highway mode. Section 3.2 concentrates on the household transportation energy characteristics of Texas and makes comparisons with other regions of the United States. Section 3.3 pertains to automobile and transit data. Finally, section 3.4 furnishes information pertaining to the trucking industry.

In the highway mode, motor gasoline accounts for over 80% of the energy use, while distillate usage is almost 19% and LPG usage is not even 0.1%. Since 1973, distillate usage has increased at an annual rate of 4.4%, while motor gasoline has increase by only 0.7% annually. Section 3.1 also shows that Texas automobile registrations have increased by 50% since 1973, yet this is far surpassed by truck registrations which have grown by about 125% from 1973-93. Public vehicle stock growth in Texas has increased by almost 250% over 1973 levels, while the US increase in public vehicle stock has increase less than 100% since 1973. And Texans still drive faster than the rest of the US-- 104% of the US average on rural roadways and 102% on urban for 1993.

In section 3.2, it is shown that: Texans drive farther than the average US citizen (11 489 miles/household vehicle vs. 11 169); are less efficient (92% of US average MPG for 1993 model year drivers); and correspondingly spend more money on vehicle related energy (109% of US average). In section 3.3, it is revealed that Texas statewide municipal transit ridership has increased by 100% over 1973 levels. Texas Truck characteristics, such as registrations, fuel efficiency, annual miles traveled by truck size, range and use, are shown in section 3.4.

Chapter 4 provides detailed information about the energy related characteristics of the non-highway modes of travel and freight movement in Texas. Section 4.1 presents characteristics of the air mode in Texas. It contains information on energy consumption by fuel type, travel data for domestic and international route certificated carriers operating in Texas, enplanements and energy use data for selected Texas cities, air freight data and statistics related to general aviation. As a percentage of US Air mode energy consumption , the Texas air industry usage has increased from 7.7% in 1973 to almost 25% in 1993.

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

Section 4.3 presents a time series of pipeline shipments of energy in Texas. The table contains: domestic natural gas consumption data, crude and refined petroleum products transported, and the energy consumed. This mode has increased its energy consumption at a very small rate-- 0.2% annually since 1973, despite an annual increase of 1.9% in ton-miles of product shipped.

Section 4.4 contains information on energy consumption by fuel type, and summary statistics for freight hauled, and energy intensity of Class I Railroads. The type of commodities shipped via rail in Texas are also included in this section. Energy usage has declined by 1.0% per year since 1973, due to improved energy efficiencies.

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

CHAPTER 1

COMPARATIVE ENERGY RELATED TRANSPORTATION STATISTICS

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

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

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

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

Table 1.1 Estimated World Energy Consumption for 2010

Nation	Million metric tons coal equivalent consumed 1988	Kilograms coal equivalent consumed per capita 1988	Metric tons coal equivalent consumed per capita annual change from 1980-88	Estimated average annual population change 1988-2010	Estimated million metric tons coal equivalent consumed 2010	Increase from 1988	Estimated Percent of world increase 1988-2010
Russia*	1,953.8	6,888	2.74%	0.69%	4,120.9	2,167.1	26.98%
Saudi Arabia	81.4	6,230	10.79%	3.51%	1,656.7	1,575.3	19.61%
China	820.1	756	3.57%	1.08%	2,248.7	1,428.6	17.78%
India	235.3	287	4.49%	1.59%	875.5	640.2	7.97%
South Korea	85.9	2,017	4.93%	0.59%	281.8	195.9	2.44%
Taiwan	59.4	2,957	4.21%	0.80%	175.4	116.0	1.44%
Italy	207.6	3,624	1.92%	0.03%	317.7	110.1	1.37%
Iran	69.5	1,308	1.33%	3.01%	178.4	108.9	1.36%
Turkey	50.3	940	3.42%	1.83%	157.1	106.8	1.33%
Pakistan	32.0	263	4.08%	2.70%	138.5	106.5	1.33%
Egypt	34.1	664	3.92%	2.23%	129.2	95.1	1.18%
Japan	480.0	3,921	0.64%	0.18%	574.4	94.4	1.18%
Malaysia	22.6	1,366	5.62%	1.93%	114.6	92.0	1.15%
Kuwait	15.6	8,069	6.11%	2.72%	104.0	88.4	1.10%
Indonesia	51.2	293	3.07%	1.51%	138.7	87.5	1.09%
Thailand	30.2	558	5.20%	1.09%	116.9	86.7	1.08%
South Africa	107.9	2,760	0.04%	2.62%	192.4	84.5	1.05%
Austrailia	113.5	6,942	1.43%	1.11%	197.8	84.3	1.05%
USA	**2,460.7**	**10,015**	**-0.45%**	**0.61%**	**2,543.0**	**82.3**	**1.02%**
Libya	15.1	3,567	4.78%	2.60%	74.2	59.1	0.74%
UAE	28.3	18,869	1.17%	3.98%	86.3	58.0	0.72%
Canada	275.0	10,540	-0.01%	0.85%	331.0	56.0	0.70%
Brazil	112.5	779	0.26%	1.55%	167.1	54.6	0.68%
Mexico	140.1	1,651	-0.43%	1.93%	194.2	54.1	0.67%
Argentina	62.2	1,973	1.54%	1.06%	109.8	47.6	0.59%
Syria	12.7	1,098	3.48%	3.73%	60.3	47.6	0.59%
New Zealand	16.1	4,859	5.56%	0.22%	55.5	39.4	0.49%
Yugoslavia	58.9	2,501	1.90%	0.43%	97.9	39.0	0.49%
Greece	28.2	2,823	3.84%	0.07%	65.6	37.4	0.47%
Nigeria	17.0	161	2.13%	2.96%	51.4	34.4	0.43%
Bangladesh	7.3	67	5.40%	2.44%	39.4	32.1	0.40%
Venezuela	57.5	3,070	-0.28%	2.04%	84.3	26.8	0.33%
UK	282.0	4,948	0.25%	0.16%	308.3	26.3	0.33%
Romania	108.4	4,705	0.54%	0.44%	134.6	26.2	0.33%
Subtotal	8,132.4				16,121.7	7,989.3	99.45%
Rest of World	1,740.8				1,784.7	43.9	0.55%
Total	9,873.2				17,906.4	8,033.2	100.00%

Source: U.S. Bureau of the Census, Statistical Abstract of the United States: 1991, Tables 1434,1473

Note: Applied population growth rate 1990-2010 to 1988-2010 period; applied 1980-88 per capita comsumption rate to 1990-2101 period

* Refers to the former Soviet Union

Table 1.2 Estimated Transportation Use of Petroleum Products for Selected States, 1993

	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	715.4	80%	0.4	0.5	21.4	146.6	5.5	889.8	48%	1,855.0
Pennsylvania	551.0	68%	0.6	0.6	72.5	149.1	35.1	808.7	59%	1,365.4
Midwest:										
Ohio	646.1	74%	1.0	1.4	65.6	161.0	0.1	875.3	72%	1,210.1
Illinois	635.1	75%	0.8	1.1	15.9	198.3	0.2	851.5	67%	1,261.6
West:										
California	1,707.2	55%	5.1	2.6	579.6	373.2	410.8	3,078.5	81%	3,813.1
Washington	290.1	44%	1.6	1.7	142.0	79.5	141.1	656.0	84%	780.7
South:										
Florida	779.8	64%	3.5	0.8	184.9	174.0	80.0	1,222.9	69%	1,783.9
Texas	**1,031.8**	47%	**3.0**	**0.9**	**608.0**	**363.3**	**183.5**	**2,190.6**	46%	4,746.5

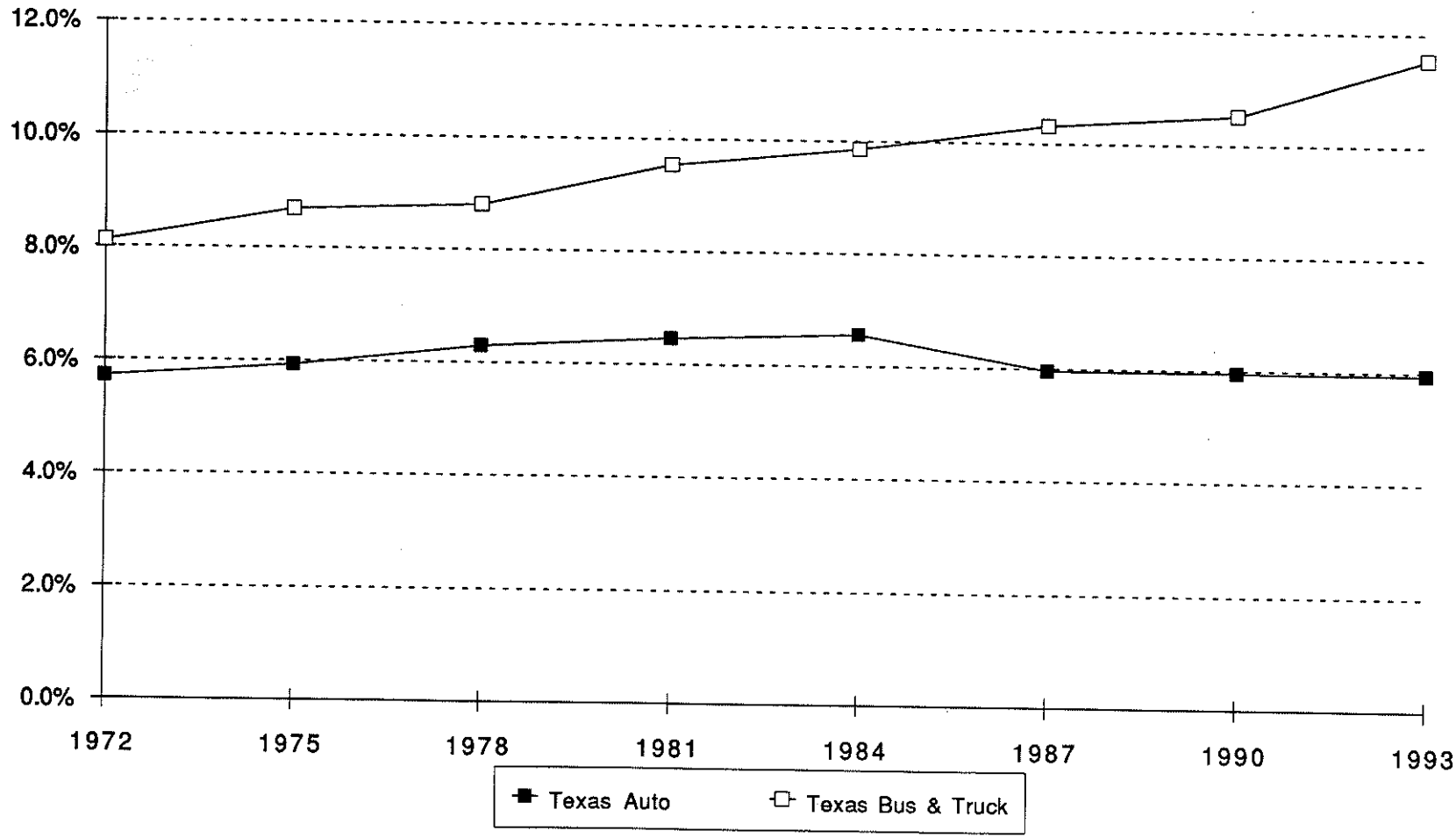
Source:

State Energy Data Report, Energy Information Administration, 1990

Note:

Data reflects allocation of lubricants, and estimates of 1993 consumption using EIA time series.

Figure 1.1 Texas Auto, Truck & Bus Registrations as a Percentage of U.S. Auto, Truck & Bus Registrations



Source : Tables 1.3 and 1.4

Table 1.3 Automobile Registrations for Selected States, 1973-93

Year	New York	Pennsylvania (a)	Ohio	Illinois	California	Washington	Florida	Texas
1973	6,531,932	5,090,991	5,817,020	5,120,721	10,910,604	1,784,389	4,536,840	5,880,897
1974	6,637,871	5,192,753	6,097,830	5,258,649	11,162,119	1,826,023	4,704,754	6,007,106
1975	6,735,148	5,267,491	6,288,050	5,350,375	11,226,325	1,883,271	4,499,154	6,217,464
1976	6,734,255	5,355,936	6,179,074	5,515,959	11,478,776	1,977,629	4,835,141	6,586,572
1977	6,799,072	5,520,994	6,358,807	5,712,606	11,694,053	2,118,314	4,978,925	6,970,581
1978	6,907,661	5,652,375	6,314,639	5,883,525	12,085,836	2,131,348	5,738,031	7,349,070
1979	6,992,216	5,689,399	6,341,428	6,059,653	12,466,173	2,231,064	6,011,033	7,210,280
1980	6,994,316	5,821,025	6,415,046	6,240,460	13,268,006	2,293,521	6,196,637	7,484,817
1981	7,097,565	5,920,737	6,393,685	6,334,050	13,208,593	2,374,996	6,484,571	7,860,366
1982	7,201,767	5,617,934	6,324,670	5,855,187	13,420,945	2,296,429	6,753,616	7,992,738
1983	7,357,044	5,738,155	6,429,344	5,929,783	13,935,390	2,360,117	7,113,942	8,159,008
1984	7,563,584	5,805,361	6,524,410	6,069,551	14,095,912	2,420,225	7,552,367	8,417,227
1985	7,901,004	5,889,416	6,746,339	6,104,331	14,723,189	2,484,484	7,849,144	8,562,581
1986	8,321,210	6,090,520	6,719,345	6,060,698	15,364,800	2,610,890	8,263,294	8,499,972
1987	8,294,971	6,144,474	6,975,380	6,174,594	15,566,810	2,685,341	8,444,040	8,260,166
1988	8,558,985	6,253,550	7,003,826	6,403,462	16,496,522	2,753,299	8,713,198	8,455,744
1989	8,636,000	6,309,087	7,738,303	6,369,099	16,531,300	2,859,667	8,891,893	8,415,243
1990	8,756,991	6,345,308	6,787,846	6,235,258	16,812,808	2,963,252	8,612,020	8,565,860
1991	8,421,505	6,391,515	7,025,421	6,562,098	17,067,803	3,077,624	7,825,966	8,513,317
1992*	8,541,225	6,472,809	7,099,477	6,653,140	17,497,406	3,172,247	8,066,640	8,682,731
1993*	8,662,647	6,555,137	7,174,313	6,745,446	17,937,822	3,269,779	8,314,715	8,863,018
				Average annual change				
Time Period:								
1973-93	1.4%	1.3%	1.1%	1.4%	2.5%	3.1%	3.1%	2.1%
1983-93	1.6%	1.3%	1.1%	1.3%	2.6%	3.3%	1.6%	0.8%

Source:

Highway Statistics, Summary to 1985; Annual 1986-91, Public and private automobiles

Notes:

* estimated

(a) estimates for 1970-76 via multivariate regression

Table 1.4 Private and Public Truck and Bus Registrations for Selected States, 1973-93

Year	New York	Pennsylvania (a)	Ohio	Illinois	California	Washington	Florida	Texas
1973	787,561	696,453	827,590	831,227	2,502,170	586,221	810,405	1,934,748
1974	819,931	720,219	867,651	915,453	2,522,280	618,423	911,316	2,046,163
1975	856,210	771,652	890,883	993,500	2,664,345	656,493	896,218	2,179,025
1976	916,414	830,041	966,760	1,160,624	2,837,067	707,274	1,109,887	2,383,182
1977	931,220	955,898	1,145,519	1,148,460	3,263,937	776,566	1,117,324	2,518,530
1978	959,009	1,059,449	1,332,423	1,209,128	3,491,065	828,622	1,177,909	2,802,474
1979	1,011,963	1,067,085	1,348,603	1,223,853	3,795,124	900,087	1,287,929	2,790,666
1980	1,007,230	1,104,830	1,356,190	1,239,372	3,605,111	931,741	1,416,902	2,989,999
1981	1,022,198	1,089,165	1,343,579	1,263,018	3,581,969	955,289	1,489,527	3,262,784
1982	1,033,090	1,106,805	1,311,190	1,386,795	3,709,458	940,425	1,580,978	3,371,446
1983	1,059,459	1,105,894	1,339,001	1,583,335	3,831,369	978,216	1,694,544	3,533,839
1984	1,080,866	1,275,910	1,369,367	1,528,687	3,869,091	1,010,127	1,841,808	3,754,466
1985	1,140,821	1,319,677	1,355,273	1,622,407	4,176,032	1,041,878	2,015,691	3,881,606
1986	1,194,165	1,386,497	1,439,826	1,358,837	4,395,460	1,141,352	2,098,218	3,906,636
1987	1,236,394	1,449,488	1,524,009	1,410,155	4,617,951	1,137,684	2,184,337	3,928,553
1988	1,278,623	1,512,479	1,608,192	1,461,473	4,840,442	1,134,015	2,270,456	3,950,469
1989	1,314,705	1,562,246	1,747,013	1,585,442	4,952,753	1,213,692	2,234,180	4,003,285
1990	1,364,837	1,587,349	1,592,493	1,573,513	4,954,025	1,277,497	2,254,954	4,085,661
1991	1,277,216	1,607,309	1,627,786	1,564,587	5,021,225	1,312,629	2,069,822	4,030,429
1992*	1,311,988	1,683,750	1,690,124	1,620,540	5,219,331	1,372,748	2,180,504	4,198,154
1993*	1,347,707	1,763,826	1,754,849	1,678,494	5,425,253	1,435,621	2,297,105	4,372,858
				Average annual change				
Time Period:								
1973-93	2.7%	4.8%	3.8%	3.6%	3.9%	4.6%	5.3%	4.2%
1983-93	2.4%	4.8%	2.7%	0.6%	3.5%	3.9%	3.1%	2.2%

Source:

Highway Statistics, Summary to 1985; Annual 1986-91

Notes:

*= estimated using 1973-91 avg. annual change

(a) years 1970-76 estimated by multivariate regression

Table 1.5 Private and Commercial Vehicles Per Capita for Selected States, 1973-93

Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
1973	0.41	0.49	0.62	0.53	0.64	0.66	0.71	0.65
1974	0.42	0.50	0.65	0.55	0.64	0.66	0.72	0.65
1975	0.42	0.51	0.67	0.56	0.64	0.68	0.66	0.67
1976	0.43	0.52	0.67	0.59	0.65	0.70	0.70	0.69
1977	0.44	0.55	0.70	0.61	0.67	0.74	0.70	0.72
1978	0.44	0.57	0.71	0.62	0.68	0.74	0.76	0.75
1979	0.45	0.57	0.71	0.64	0.70	0.77	0.78	0.72
1980	0.46	0.58	0.72	0.65	0.71	0.78	0.78	0.74
1981	0.46	0.59	0.72	0.66	0.69	0.79	0.78	0.75
1982	0.47	0.57	0.71	0.63	0.69	0.76	0.80	0.74
1983	0.48	0.58	0.72	0.65	0.70	0.78	0.82	0.74
1984	0.49	0.60	0.73	0.66	0.70	0.79	0.85	0.76
1985	0.51	0.61	0.75	0.67	0.72	0.80	0.87	0.76
1986	0.53	0.63	0.76	0.64	0.73	0.84	0.89	0.74
1987	0.54	0.64	0.78	0.66	0.74	0.84	0.89	0.74
1988	0.55	0.65	0.79	0.68	0.75	0.84	0.89	0.74
1989	0.55	0.65	0.87	0.68	0.23	0.86	0.88	0.73
1990	0.56	0.67	0.77	0.68	0.73	0.87	0.84	0.74
1991	0.54	0.67	0.80	0.70	0.73	0.89	0.76	0.73
1992*	0.55	0.68	0.80	0.71	0.75	0.92	0.77	0.74
1993*	0.56	0.69	0.82	0.72	0.76	0.94	0.79	0.75
				Average annual change				
Time Period:								
1973-93	1.6%	1.8%	1.4%	1.5%	0.9%	1.8%	0.6%	0.7%
1983-93	1.5%	1.9%	1.2%	0.9%	0.8%	2.0%	-0.3%	0.2%

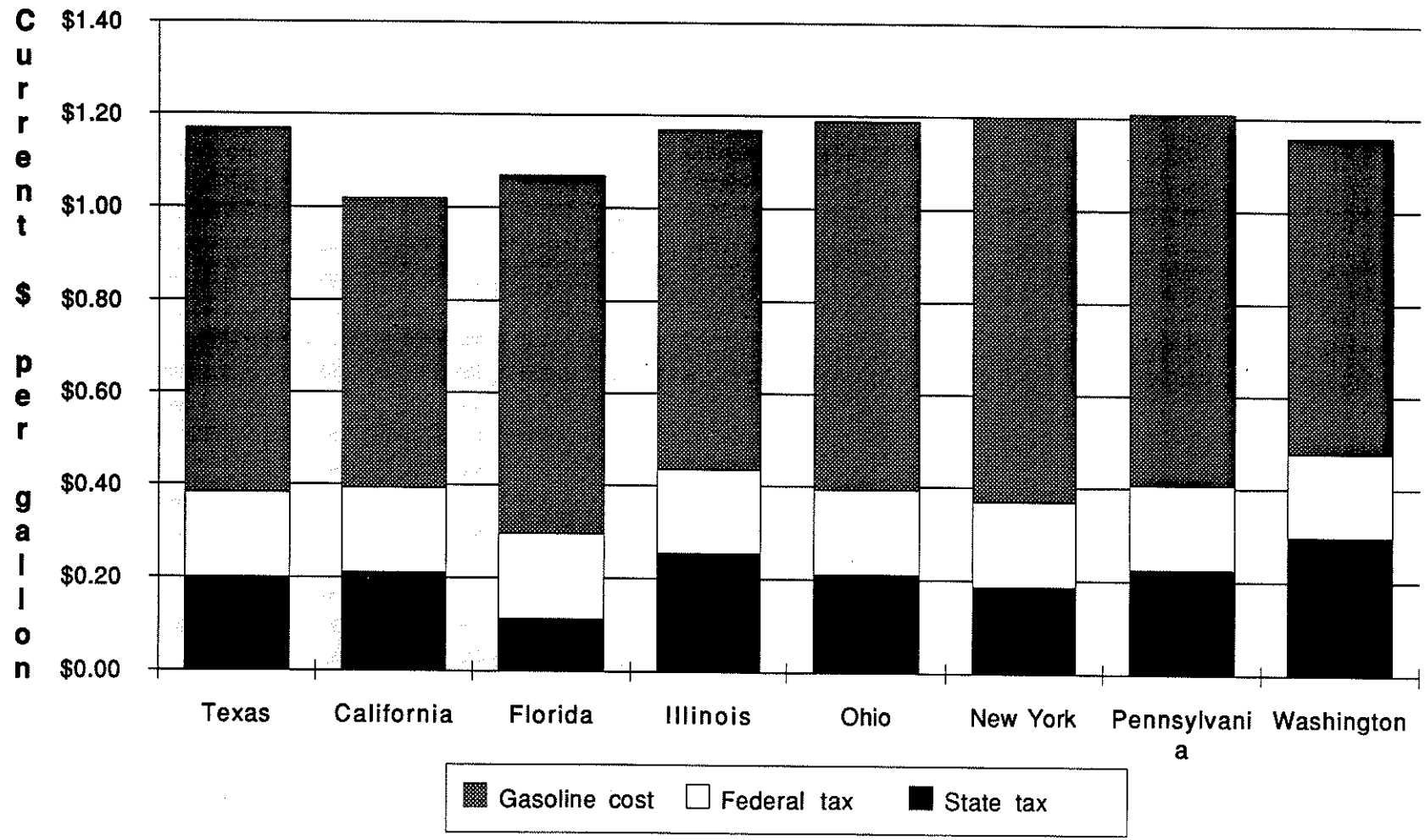
Sources:

Tables 1.2 and 1.3; Statistical Abstract of the United States 1991

Notes:

* estimate

Figure 1.2 Gasoline Prices of Selected States,1993



Source: Tables 1.6 and 1.8

Table 1.6 Motor Gasoline Prices for Selected States

	Current dollars per gallon (a)										Average annual change
	1980	1985	1986	1987	1988	1989	1990	1991	1992*	1993*	1980-93
Texas	1.16	1.10	0.81	0.90	0.92	0.99	1.15	1.14	1.13	1.17	0.1%
California	1.27	1.09	0.84	0.87	0.89	0.96	1.07	1.02	1.00	1.02	-1.7%
Florida	1.23	1.13	0.84	0.89	0.89	0.96	1.11	1.06	1.05	1.07	-1.0%
Illinois	1.23	1.13	0.85	0.90	0.91	1.00	1.17	1.14	1.13	1.17	-0.4%
Ohio	1.18	1.14	0.85	0.92	0.93	1.02	1.17	1.15	1.15	1.19	0.0%
New York	1.28	1.10	0.83	0.87	0.90	0.98	1.10	1.18	1.17	1.20	-0.5%
Pennsylvania	1.21	1.13	0.82	0.88	0.88	0.97	1.17	1.18	1.18	1.21	0.0%
Washington	1.24	1.16	0.91	0.92	0.93	1.00	1.18	1.14	1.13	1.16	-0.5%

	Constant 1988 dollars per gallon (b)										Average annual change
	1980	1985	1986	1987	1988	1989	1990	1991	1992*	1993*	1980-93
Texas	1.66	1.21	0.87	0.94	0.92	0.94	1.04	0.99	0.95	0.95	-4.2%
California	1.83	1.19	0.90	0.87	0.89	0.91	0.97	0.89	0.84	0.83	-5.9%
Florida	1.76	1.24	0.90	0.89	0.89	0.92	1.00	0.92	0.87	0.87	-5.3%
Illinois	1.76	1.24	0.91	0.90	0.91	0.95	1.06	0.99	0.95	0.94	-4.7%
Ohio	1.70	1.26	0.91	0.92	0.93	0.98	1.06	1.00	0.96	0.96	-4.3%
New York	1.84	1.21	0.89	0.87	0.90	0.93	1.00	1.02	0.98	0.97	-4.8%
Pennsylvania	1.74	1.24	0.88	0.88	0.88	0.93	1.06	1.02	0.98	0.98	-4.3%
Washington	1.78	1.28	0.98	0.92	0.93	0.96	1.07	0.99	0.95	0.94	-4.8%

Source:

Energy Information Agency/State Energy Price and Expenditure Report 1991

Notes:

* estimate

(a) Includes federal & state taxes

(b) Using Consumer Price Index

Table 1.7 Distillate Fuel Prices for Selected States

	Current dollars per gallon (a)										Average annual change
	1980	1985	1986	1987	1988	1989	1990	1991	1992*	1993*	1980-93
Texas	0.89	0.81	0.73	0.83	0.83	0.87	1.03	0.98	0.99	1.04	1.2%
California	0.88	0.86	0.74	0.84	0.81	0.89	1.03	1.00	1.01	1.07	1.4%
Florida	0.97	0.91	0.78	0.83	0.78	0.83	1.03	0.97	0.97	1.01	0.3%
Illinois	0.93	1.07	0.83	0.86	0.86	0.90	1.09	1.03	1.04	1.08	1.2%
Ohio	0.87	1.04	0.81	0.84	0.82	0.90	1.06	1.03	1.04	1.10	1.8%
New York	0.93	1.06	0.82	0.84	0.85	0.92	1.12	1.13	1.15	1.21	2.0%
Pennsylvania	0.88	1.04	0.82	0.84	0.83	0.88	1.10	1.07	1.09	1.15	2.0%
Washington	0.84	1.10	0.84	0.90	0.91	0.99	1.13	1.12	1.15	1.22	2.9%

	Constant 1988 dollars per gallon (b)										Average annual change
	1980	1985	1986	1987	1988	1989	1990	1991	1992*	1993*	1980-93
Texas	1.27	0.89	0.79	0.86	0.83	0.83	0.93	0.85	0.83	0.84	-3.1%
California	1.27	0.95	0.80	0.84	0.81	0.85	0.93	0.87	0.85	0.86	-2.9%
Florida	1.39	1.00	0.84	0.83	0.78	0.79	0.93	0.84	0.81	0.82	-4.0%
Illinois	1.34	1.17	0.89	0.86	0.86	0.86	0.99	0.89	0.86	0.88	-3.2%
Ohio	1.25	1.14	0.87	0.84	0.82	0.86	0.96	0.89	0.87	0.89	-2.6%
New York	1.34	1.17	0.89	0.84	0.85	0.88	1.02	0.98	0.96	0.98	-2.3%
Pennsylvania	1.27	1.15	0.88	0.84	0.83	0.84	0.99	0.93	0.91	0.93	-2.3%
Washington	1.21	1.21	0.91	0.90	0.91	0.94	1.02	0.97	0.96	0.99	-1.5%

Source:

Energy Information Agency/State Energy Price and Expenditure Report 1991

Notes:

* estimate

(a) Includes federal & state taxes

(b) Using Consumer Price Index

Table 1.8 Motor Gasoline Taxes for Selected States, 1973-93

	Cents per gallon							
Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	**Texas**
1973	8.0	8.0	7.0	7.5	7.0	9.0	8.0	5.0
1974	8.0	9.0	7.0	7.5	7.0	9.0	8.0	5.0
1975	8.0	9.0	7.0	7.5	7.0	9.0	8.0	5.0
1976	8.0	9.0	7.0	7.5	7.0	9.0	8.0	5.0
1977	8.0	9.0	7.0	7.5	7.0	11.0	8.0	5.0
1978	8.0	9.0	7.0	7.5	7.0	11.0	8.0	5.0
1979	8.0	11.0	7.0	7.5	7.0	12.0	8.0	5.0
1980	8.0	11.0	7.0	7.5	7.0	12.0	8.0	5.0
1981	8.0	11.0	10.3	7.5	7.0	13.5	8.0	5.0
1982	8.0	11.0	11.7	7.5	7.0	12.0	8.0	5.0
1983	8.0	12.0	12.0	11.0	9.0	16.0	9.7	5.0
1984	8.0	12.0	12.0	12.0	9.0	18.0	9.7	10.0
1985	8.0	12.0	12.0	13.0	9.0	18.0	9.7	10.0
1986	10.8	18.0	12.0	17.7	15.0	18.0	9.7	10.0
1987	10.8	18.0	14.8	17.7	15.0	18.0	9.7	10.0
1988	14.8	18.0	14.8	17.7	15.0	18.0	9.7	15.0
1989	14.8	18.0	14.8	21.0	15.0	18.0	9.7	15.0
1990	14.4	17.8	20.0	23.4	15.0	22.0	10.9	15.0
1991	18.6	22.4	21.0	25.3	21.0	29.5	11.2	20.0
1992*	18.6	22.4	21.0	25.3	21.0	29.5	11.2	20.0
1993*	18.6	22.4	21.0	25.3	21.0	29.5	11.2	20.0
Time Period:				**Average annual change**				
1973-93	4.3%	5.3%	5.6%	6.3%	5.6%	6.1%	1.7%	7.2%
1983-93	8.8%	6.4%	5.8%	8.7%	8.8%	6.3%	1.4%	14.9%

Source: Highway Statistics, Summary to 1985; annual 1986-91

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.

*= estimate

Table 1.9 Distillate Fuel Taxes for Selected States, 1973-93

Year	New York	Pennsylvania	Ohio	Illinois	California	Washington	Florida	Texas
				Cents per gallon				
1973	10.0	8.0	7.0	7.5	7.0	9.0	8.0	6.5
1974	10.0	9.0	7.0	7.5	7.0	9.0	8.0	6.5
1975	10.0	9.0	7.0	7.5	7.0	9.0	8.0	6.5
1976	10.0	9.0	7.0	7.5	7.0	9.0	8.0	6.5
1977	10.0	9.0	7.0	7.5	7.0	11.0	8.0	6.5
1978	10.0	9.0	7.0	7.5	7.0	11.0	8.0	6.5
1979	10.0	11.0	7.0	7.5	7.0	12.0	8.0	6.5
1980	10.0	11.0	7.0	7.5	7.0	12.0	8.0	6.5
1981	10.0	11.0	10.3	7.5	7.0	13.5	8.0	6.5
1982	10.0	11.0	11.7	7.5	7.0	12.0	8.0	6.5
1983	10.0	12.0	12.0	13.5	9.0	16.0	9.7	6.5
1984	10.0	12.0	12.0	14.5	9.0	18.0	9.7	10.0
1985	10.0	12.0	12.0	15.5	9.0	18.0	9.7	10.0
1986	16.8	18.0	12.0	19.7	15.0	18.0	9.7	10.0
1987	16.8	18.0	14.8	19.7	15.0	18.0	9.7	10.0
1988	16.8	24.0	14.8	20.5	15.0	18.0	9.7	15.0
1989	16.8	24.0	14.8	20.5	15.0	18.0	9.7	15.0
1990	18.4	23.8	20.0	26.0	15.0	28.5	10.9	15.0
1991	26.8	22.4	21.0	26.5	21.0	29.5	16.2	20.0
1992*	26.8	22.4	21.0	26.5	21.0	29.5	16.2	20.0
1993*	26.8	22.4	21.0	26.5	21.0	29.5	16.2	20.0
				Average annual change				
Time Period:								
1973-93	5.1%	5.3%	5.6%	6.5%	5.6%	6.1%	3.6%	5.8%
1983-93	10.4%	6.4%	5.8%	7.0%	8.8%	6.3%	5.3%	11.9%

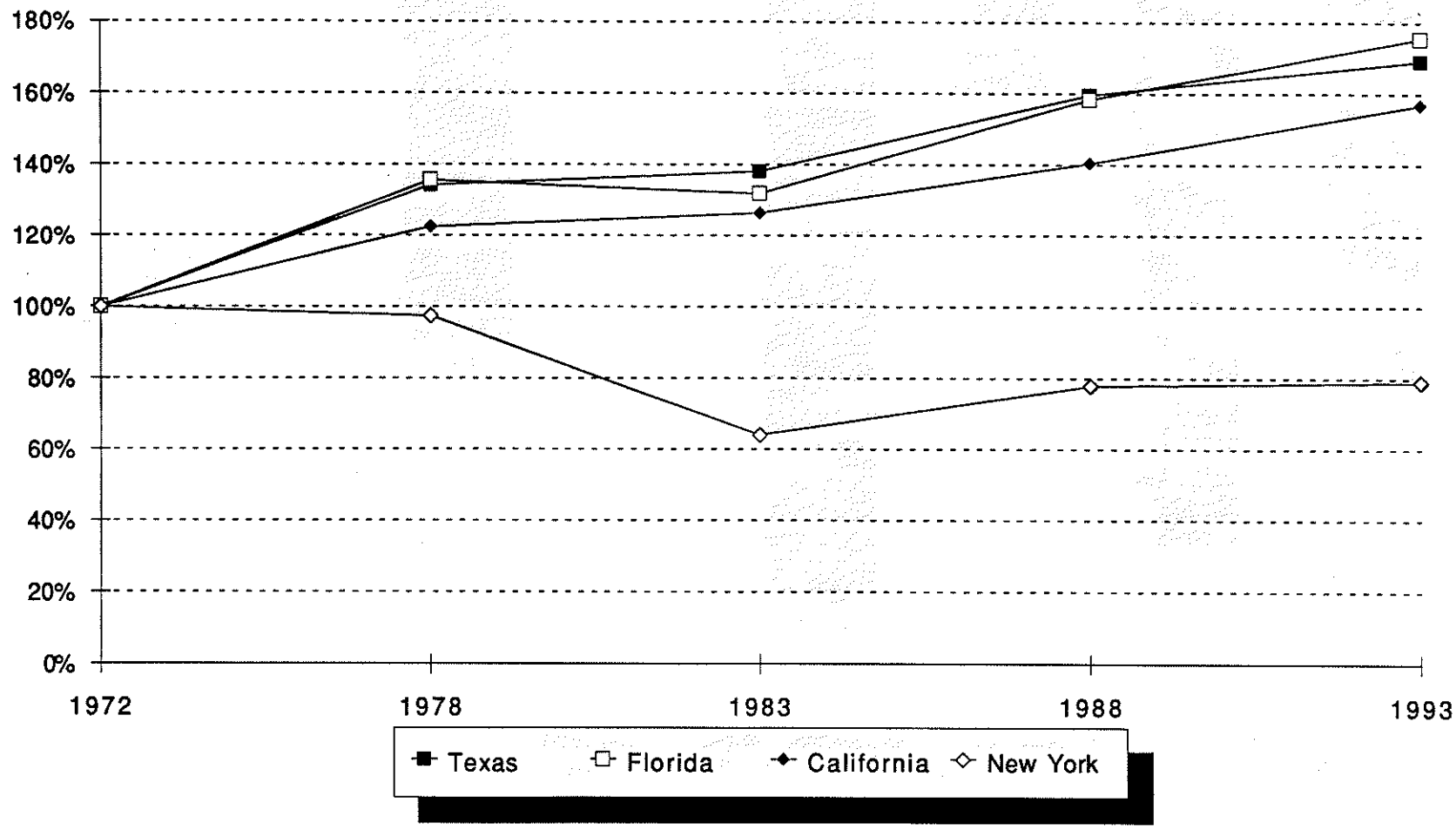
Source: Highway Statistics, Summary to 1985; annual 1986-91.

Notes:

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

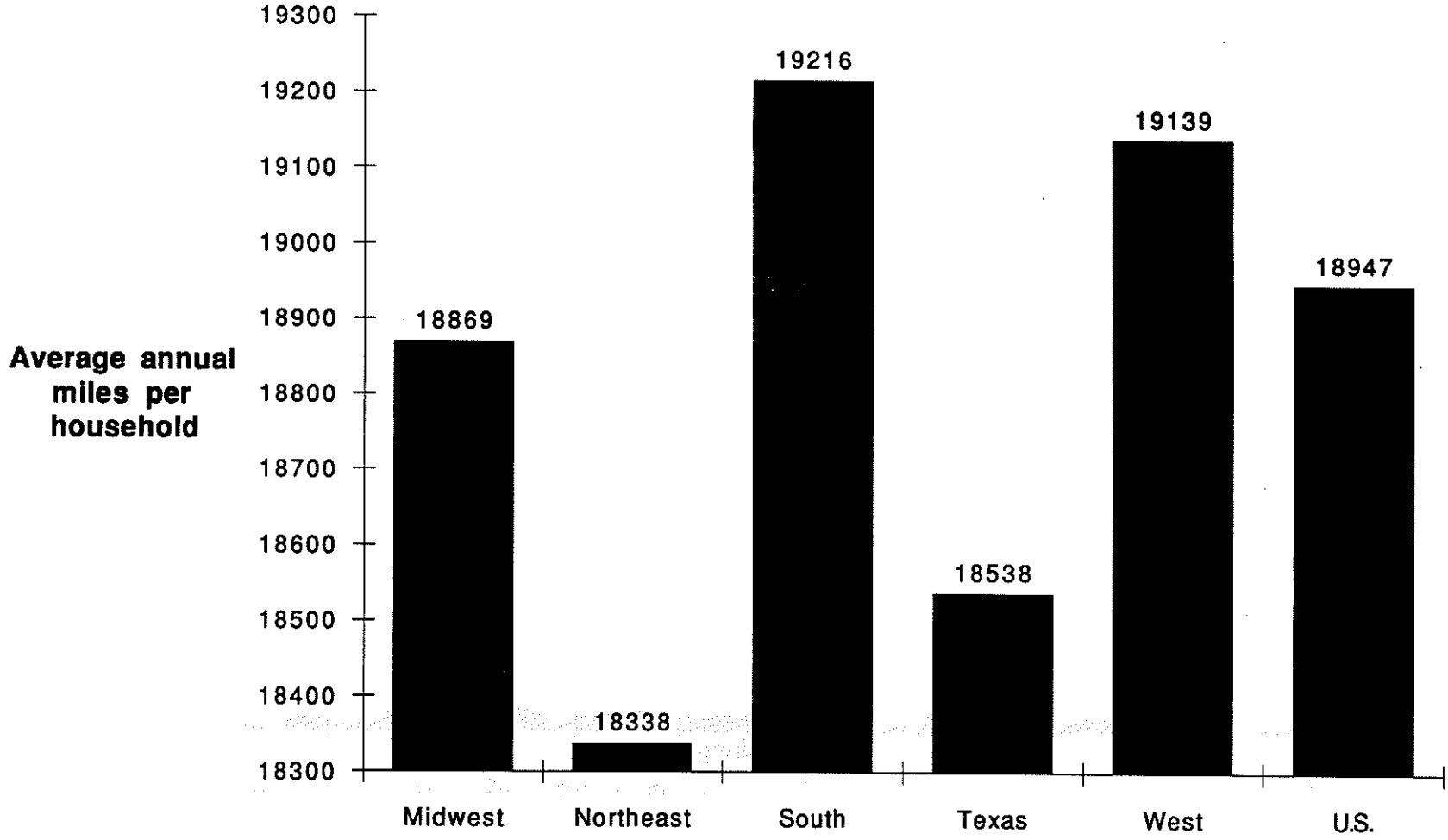
* estimate

Figure 1.3 Transportation Energy Consumption as a Percentage of 1972 Baseline



Source: Energy Information Agency, TTI Estimates

Figure 1.4 Household Vehicle Miles Traveled, 1993



Source: Table 1.10

Table 1.10 Estimated Household Vehicle Miles Traveled, Vehicle Fuel Consumption and Expenditures 1993

Census region	Average annual per household: Vehicle miles traveled	Consumption (gallons)	Expenditures
Midwest	18,869	932	$1,100
Northeast	18,338	933	$1,124
South	19,216	963	$1,030
Texas*	18,538	984	$1,151
West	19,139	926	$944
U. S.	18,947	936	$1,056

Sources:

Household Vehicle Energy Consumption 1988, Energy Information Agency
1993 Estimate by Texas Transportation Institute

Notes:

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

CHAPTER 2

TRANSPORTATION ENERGY CHARACTERISTICS OF TEXAS

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

Texas consumption of petroleum products continues to surpass Texas production of petroleum products (Figure 2.1), with transportation use of petroleum leading the increase in petroleum use (2.4% per annum since 1973), followed by industrial consumption increases of 2.2% per annum since 1973 (Table 2.2). Within the transportation sector in Texas, the highway mode remains the largest consumer of energy with about 55% of transportation energy (down from 68% in 1973) use; second is the air mode with about 25% of transportation energy (up from 8% in 1973) use. Over all, transportation energy consumption in Texas has increased at an annual rate of 2.2% since 1973; however, this growth trend has diminished slightly to a 2.1% increase for the 1983-93 period.

Figure 2.1 Texas Petroleum Production & Consumption

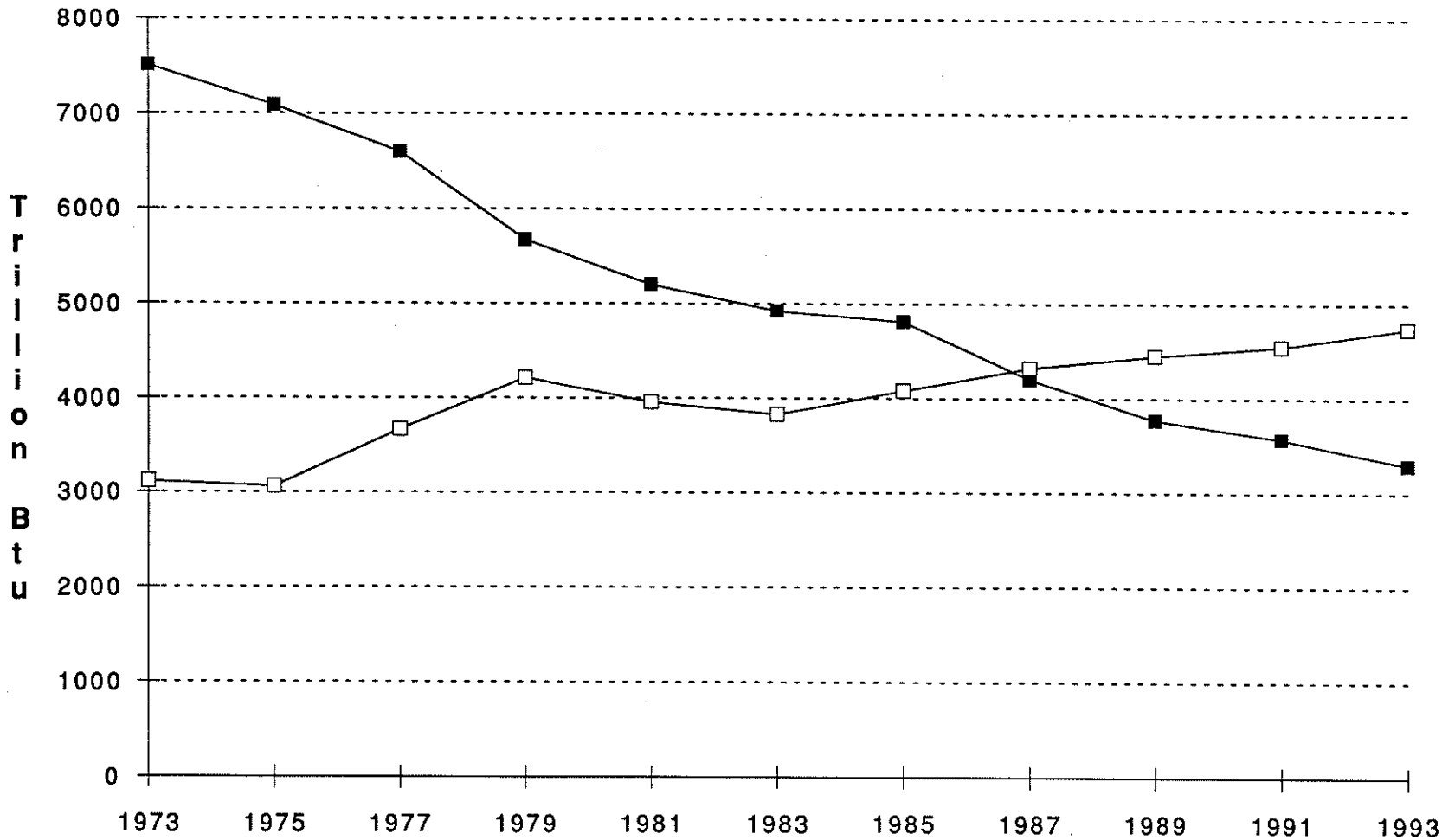


Table 2.1 Texas Petroleum Production and Consumption, 1973-1993

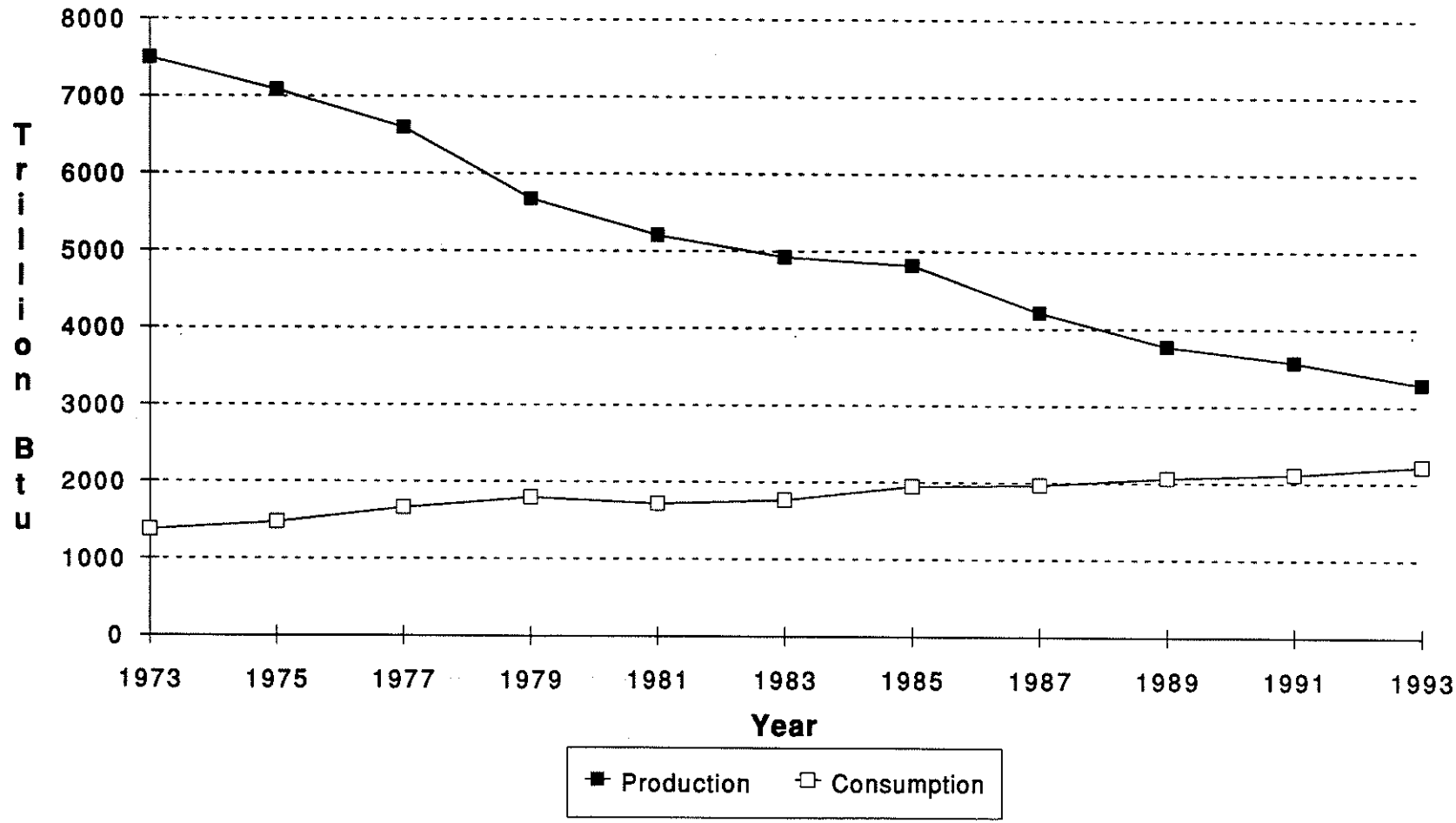
Trillion Btu

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
1973	7,509.1	4,390.7	3,118.4	34,846.7	58.5%	8.9%	18.4%
1974	7,320.3	4,185.5	3,134.8	33,422.5	57.2%	9.4%	19.3%
1975	7,087.2	4,020.2	3,067.0	32,712.0	56.7%	9.4%	20.8%
1976	6,899.2	3,580.9	3,318.3	35,191.2	51.9%	9.4%	22.3%
1977	6,599.7	2,933.8	3,665.9	37,158.1	44.5%	9.9%	25.1%
1978	6,037.6	2,151.5	3,886.1	37,956.6	35.6%	10.2%	29.0%
1979	5,675.6	1,446.9	4,228.7	37,161.9	25.5%	11.4%	31.7%
1980	5,400.3	1,308.8	4,091.5	34,200.0	24.2%	12.0%	31.4%
1981	5,205.9	1,242.3	3,963.6	31,968.0	23.9%	12.4%	33.1%
1982	5,056.3	1,248.9	3,807.4	30,231.6	24.7%	12.6%	35.1%
1983	4,924.6	1,093.8	3,830.8	30,033.0	22.2%	12.8%	35.9%
1984	4,903.9	740.5	4,163.4	31,047.9	15.1%	13.4%	38.3%
1985	4,817.5	728.3	4,089.2	30,932.0	15.1%	13.2%	40.4%
1986	4,547.8	448.7	4,099.1	32,202.8	9.9%	12.7%	44.2%
1987	4,205.2	21.3	4,183.9	32,870.4	0.5%	12.7%	46.9%
1988	4,049.7	-378.0	4,427.7	34,245.4	-9.3%	12.9%	50.9%
1989	3,773.0	-684.4	4,457.4	34,227.3	-18.1%	13.0%	54.9%
1990	3,726.2	-730.4	4,456.6	33,659.5	-19.6%	13.2%	55.5%
1991	3,575.7	-975.5	4,551.2	32,351.3	-27.3%	14.1%	57.4%
1992*	3,431.3	-1,216.5	4,647.8	32,218.1	-35.5%	14.4%	61.8%
1993*	3,292.7	-1,453.7	4,746.5	32,085.3	-44.1%	14.8%	66.5%
Time Period				Average annual changes			
1973-93	-4.0%	-	2.1%	-0.4%	-	-	-
1983-93	-3.9%	-	2.2%	0.7%	-	-	-

Sources:

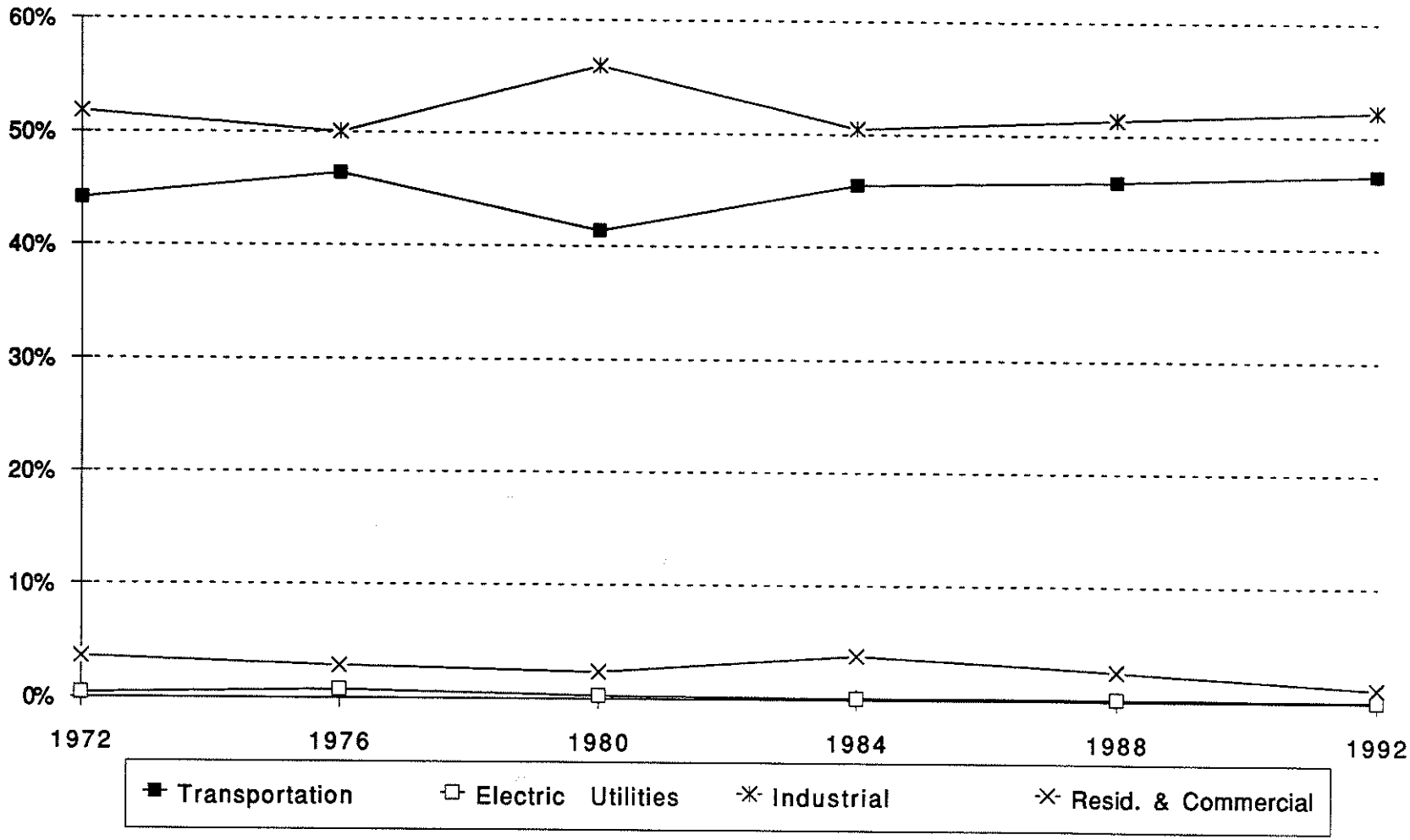
State Energy Data Report 1960-1990, Energy Information Administration;
Oil & Gas Annual Report, 1990, Railroad Commission of Texas

Figure 2.2 Texas Transportation Petroleum Consumption vs. Texas Petroleum Production



Source: Tables 2.1 and 2.2

Figure 2.3 Texas Petroleum Consumption by Sector



Source: Table 2.2

Table 2.2 Texas Petroleum Consumption by Sector

	Trillion Btu						
Year	Transportation	Percentage transportation of total	Residential	Commercial	Industrial	Electric Utilities	Texas petroleum consumption
1973	1,378.0	44.2%	54.2	53.3	1,593.3	39.6	3,118.4
1974	1,412.2	45.0%	48.1	49.5	1,590.5	34.5	3,134.8
1975	1,476.8	48.2%	44.2	48.8	1,485.8	11.4	3,067.0
1976	1,539.6	46.4%	45.4	47.9	1,661.1	24.2	3,318.2
1977	1,658.9	45.3%	43.1	58.0	1,874.0	31.8	3,665.8
1978	1,748.5	45.0%	47.8	63.2	1,983.4	43.4	3,886.3
1979	1,800.4	42.6%	27.3	100.4	2,270.9	29.7	4,228.7
1980	1,693.9	41.4%	23.7	72.4	2,290.7	10.7	4,091.4
1981	1,720.8	43.4%	23.4	84.4	2,125.9	9.0	3,963.5
1982	1,776.7	46.7%	19.3	54.8	1,943.4	13.3	3,807.5
1983	1,769.0	46.2%	23.0	141.7	1,873.7	23.4	3,830.8
1984	1,877.3	45.1%	23.0	124.8	2,132.6	5.7	4,163.4
1985	1,948.1	47.6%	27.0	73.7	2,030.2	10.1	4,089.1
1986	2,008.7	49.0%	24.4	49.3	2,011.6	5.1	4,099.1
1987	1,971.3	47.1%	26.6	68.1	2,111.4	6.5	4,183.9
1988	2,060.2	46.5%	23.2	53.0	2,282.9	8.4	4,427.7
1989	2,069.1	46.4%	24.4	43.3	2,294.9	25.7	4,457.4
1990	2,067.6	46.4%	22.4	35.6	2,325.4	5.7	4,456.7
1991	2,117.5	46.5%	21.3	34.8	2,377.7	5.1	4,556.4
1992*	2,168.7	46.6%	20.2	33.9	2,431.2	4.5	4,658.5
1993*	2,221.1	46.6%	19.2	33.2	2,485.8	4.0	4,763.3
Time Period				Average annual changes			
1973-93	2.4%	-	-5.1%	-2.3%	2.2%	-10.8%	2.1%
1983-93	2.3%	-	-1.8%	-13.5%	2.9%	-16.1%	2.2%

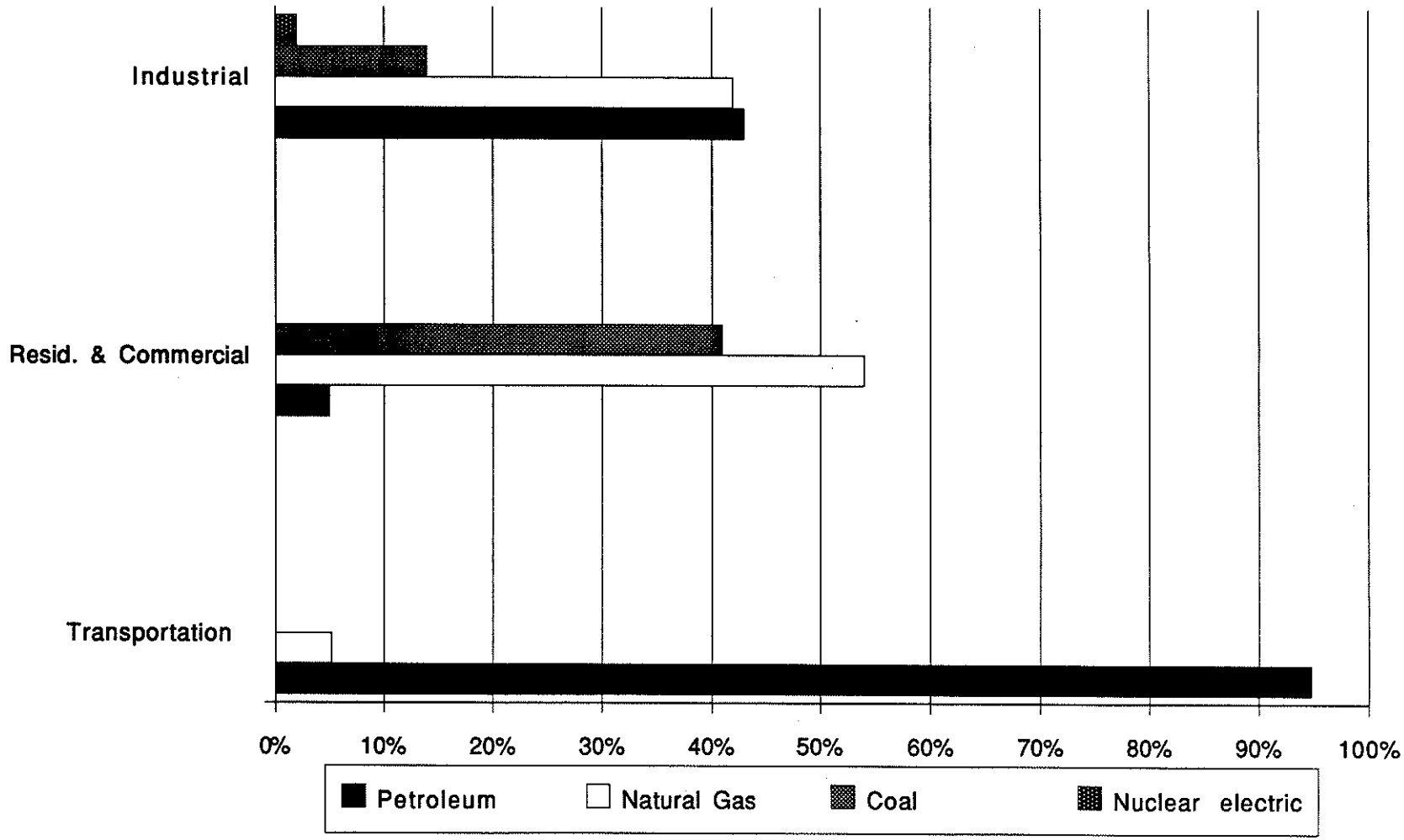
Source:

State Energy Data Report 1960-1991, Energy Information Administration

Notes:

* estimate

Figure 2.4 Distribution of Energy by End-Use Sector, 1993



Source: Table 2.3

Table 2.3 Distribution of Energy Consumption by Source

	Transportation		Residential & Commercial		Industrial	
Energy Source	1983	1993	1983	1993	1983	1993
Petroleum	94.2%	95.2%	9.7%	4.6%	42.7%	42.6%
Natural Gas	5.8%	4.8%	59.7%	53.6%	48.3%	41.6%
Coal	0.0%	0.0%	30.2%	41.4%	9.0%	13.7%
Hydroelectric	0.0%	0.0%	0.4%	0.1%	0.1%	0.1%
Nuclear electric	0.0%	0.0%	0.0%	0.4%	0.0%	2.0%
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 1960-1990, Energy Information Administration

Note:

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

Table 2.4 Energy Consumption by End-Use Sector, 1973-93

Trillion Btu

Year	Transportation	Percent of total	Residential & Commercial	Industrial	Total
1973	1,485.7	18.5%	1,358.2	5,169.5	8,013.4
1974	1,509.0	19.2%	1,337.8	5,019.1	7,865.9
1975	1,561.4	21.4%	1,323.0	4,424.4	7,308.8
1976	1,613.6	21.2%	1,362.3	4,640.5	7,616.4
1977	1,727.3	21.1%	1,528.5	4,943.9	8,199.7
1978	1,825.6	21.2%	1,643.0	5,151.8	8,620.4
1979	1,880.6	21.1%	1,757.1	5,276.3	8,914.0
1980	1,802.0	20.0%	1,687.0	5,499.3	8,988.3
1981	1,825.9	20.7%	1,696.9	5,289.0	8,811.8
1982	1,882.7	22.9%	1,775.5	4,554.6	8,212.8
1983	1,878.2	22.9%	1,841.0	4,485.5	8,204.7
1984	1,989.5	22.4%	1,982.3	4,892.6	8,864.4
1985	2,043.7	23.0%	1,984.9	4,842.1	8,870.7
1986	2,093.9	24.0%	1,932.8	4,703.2	8,729.9
1987	2,056.2	22.8%	2,009.0	4,941.5	9,006.7
1988	2,172.7	22.7%	2,065.2	5,316.2	9,554.1
1989	2,181.5	22.4%	2,124.3	5,433.5	9,739.3
1990	2,179.2	22.2%	2,124.6	5,494.2	9,798.0
1991	2,165.1	22.0%	2,181.9	5,513.9	9,861.0
1992*	2,231.4	22.3%	2,240.9	5,533.7	10,006.0
1993*	2,302.1	22.7%	2,301.6	5,553.6	10,157.3
		Average annual changes			
Time Period:					
1973-93	2.2%	-	2.7%	0.4%	1.2%
1983-93	2.1%	-	2.3%	2.2%	2.2%

Source:

State Energy Data Report 1960-1991, Energy Information Administration

Notes:

* estimate

Figure 2.5 Distribution of Texas Transportation Energy by Mode

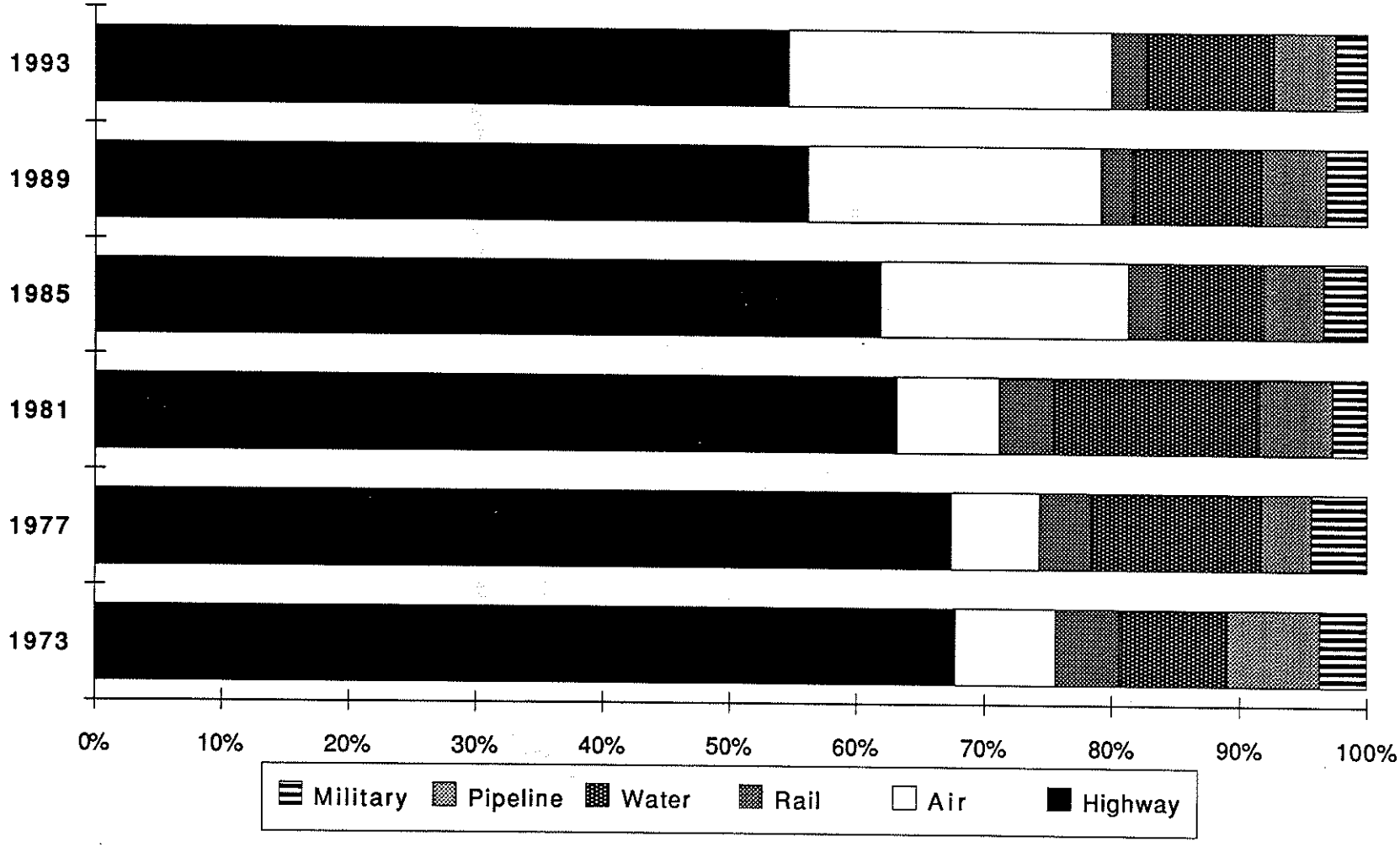


Table 2.5 Energy Consumption by Transportation Mode, 1973-93

Trillion Btu

	Transportation Mode						
Year	Highway	Air	Rail	Water	Pipeline	Military	Total
1973	1003.5	118.7	74.7	125.8	107.7	55.4	1,485.7
1974	990.7	114.6	80.7	156.5	96.8	69.7	1,509.0
1975	1034.4	123.2	72.2	177.2	84.6	69.8	1,561.4
1976	1100.0	115.5	67.1	192.1	74.0	65.0	1,613.6
1977	1164.3	120.3	69.4	231.2	68.4	73.7	1,727.3
1978	1223.0	130.2	66.6	258.8	77.1	69.8	1,825.6
1979	1197.9	138.1	66.1	357.7	80.2	40.6	1,880.6
1980	1098.1	144.6	46.2	325.2	108.1	79.9	1,802.0
1981	1152.8	148.1	75.9	295.7	105.1	48.3	1,825.9
1982	1186.7	211.3	75.0	247.9	106.0	55.8	1,882.7
1983	1214.7	237.5	53.0	186.7	109.2	77.1	1,878.2
1984	1222.6	335.6	57.6	185.7	112.2	75.7	1,989.5
1985	1258.9	397.6	52.5	171.2	95.6	68.0	2,043.7
1986	1265.8	432.2	42.5	211.8	85.2	56.4	2,093.9
1987	1225.1	453.6	49.1	180.4	84.4	63.6	2,056.2
1988	1242.3	509.8	52.0	186.6	111.8	70.2	2,172.7
1989	1224.6	501.8	54.3	218.6	111.4	70.8	2,181.5
1990	1230.7	521.6	50.9	206.1	110.5	59.3	2,179.2
1991	1222.7	496.5	62.3	215.9	111.1	56.6	2,165.1
1992*	1239.4	538.9	61.7	222.5	111.3	57.4	2,231.4
1993*	1256.6	585.1	61.2	229.4	111.5	58.3	2,302.1
	Average annual changes						
Time Period:							
1973-1993	1.1%	8.3%	-1.0%	3.1%	0.2%	0.3%	2.2%
1983-1993	0.3%	9.4%	1.4%	2.1%	0.2%	-2.8%	2.1%

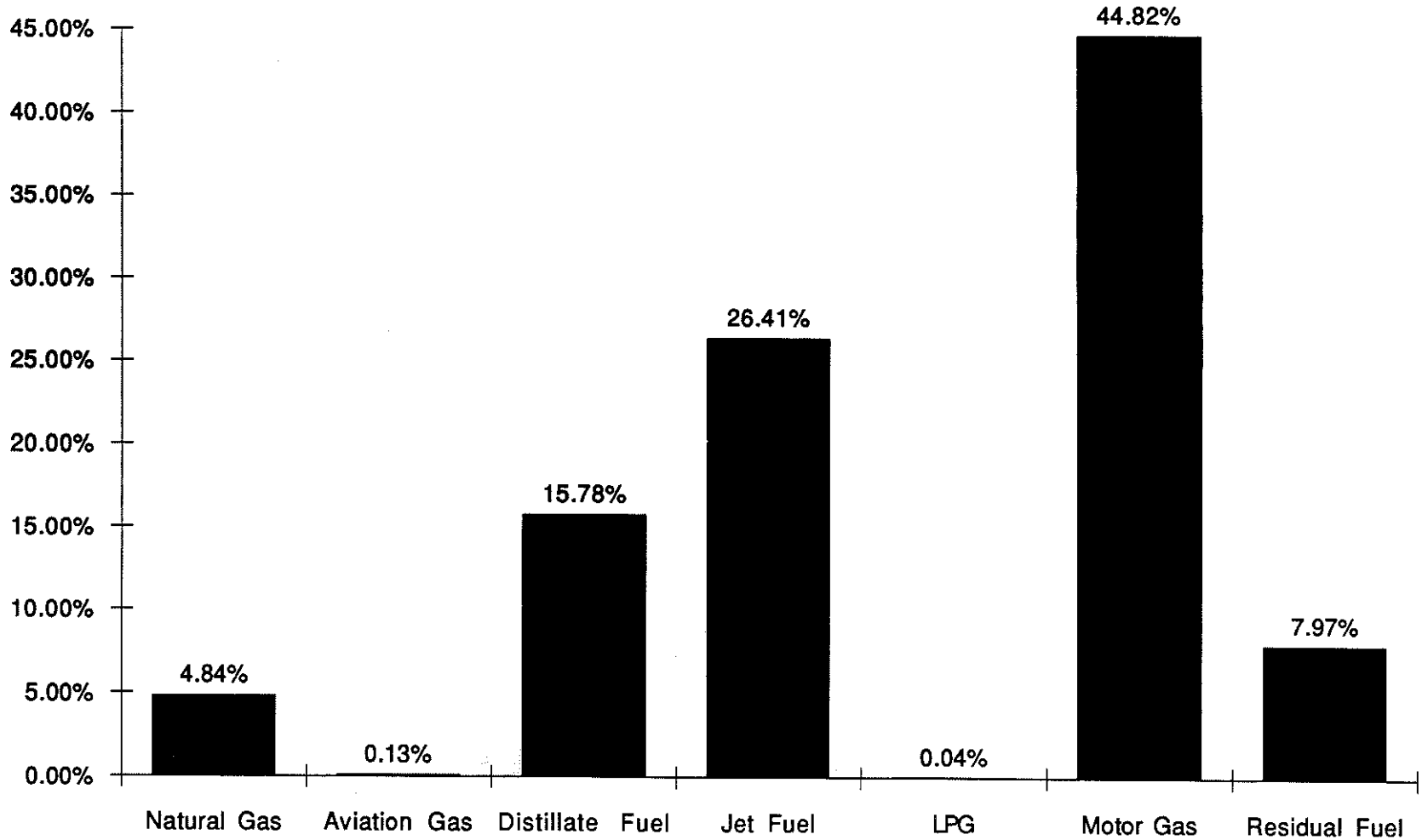
Sources:

State Energy Data Report 1960-1991, Energy Information Administration;
Background data sent by Ms. Julia Hutchins of the Energy Information Administration

Notes:

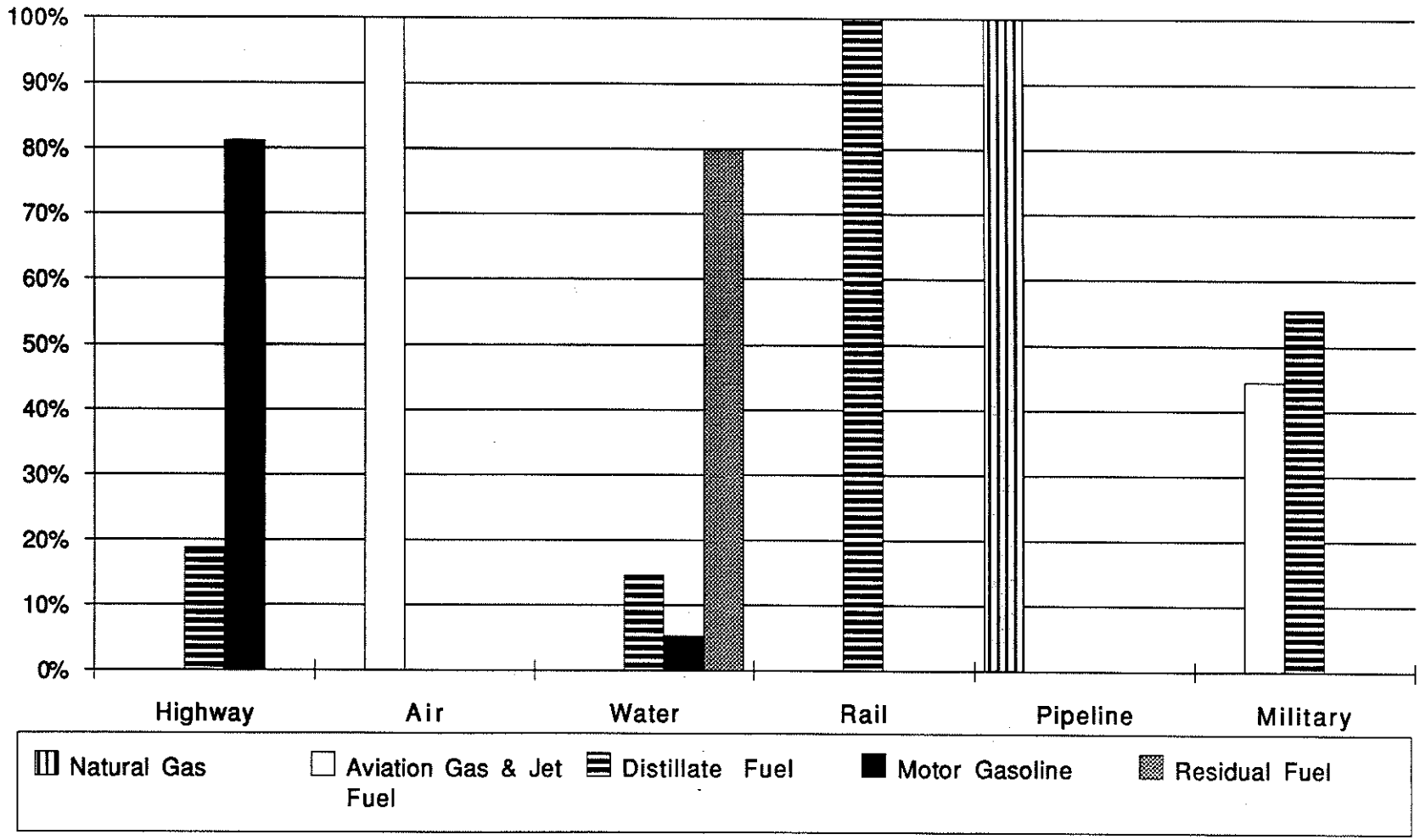
* estimate

Figure 2.6 Distribution of Texas Transportation Energy by Fuel Type, 1993



Source: Table 2.8

Figure 2.7 Energy Consumption by Mode & Fuel Type, 1993



Source: Table 2.8

Table 2.6 Energy Consumption by Mode and Fuel Type, 1973

Trillion Btu

Mode	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	Total
Highway	0.0	0.0	99.8	0.0	22.7	881.0	0.0	1003.5
Air	0.0	7.9	0.0	110.8	0.0	0.0	0.0	118.7
Water	0.0	0.0	24.4	0.0	0.0	6.7	94.7	125.8
Rail	0.0	0.0	73.8	0.0	0.0	0.0	0.9	74.7
Pipeline	107.7	0.0	0.0	0.0	0.0	0.0	0.0	107.7
Military	0.0	0.0	13.5	38.6	0.0	0.0	3.3	55.4
	107.7	7.9	211.5	149.4	22.7	887.7	98.9	1485.7

Table 2.7 Energy Consumption by Mode and Fuel Type, 1983

Trillion Btu

Mode	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	Total
Highway	0.0	0.0	202.3	0.0	5.2	1007.2	0.0	1214.7
Air	0.0	3.9	0.0	233.6	0.0	0.0	0.0	237.5
Water	0.0	0.0	21.7	0.0	0.0	7.7	157.4	186.7
Rail	0.0	0.0	53.0	0.0	0.0	0.0	0.0	53.0
Pipeline	109.2	0.0	0.0	0.0	0.0	0.0	0.0	109.2
Military	0.0	0.0	37.8	34.1	0.0	0.0	5.3	77.1
	109.2	3.9	314.8	267.6	5.2	1015.0	162.7	1878.2

Table 2.8 Estimated Energy Consumption by Mode and Fuel Type, 1993

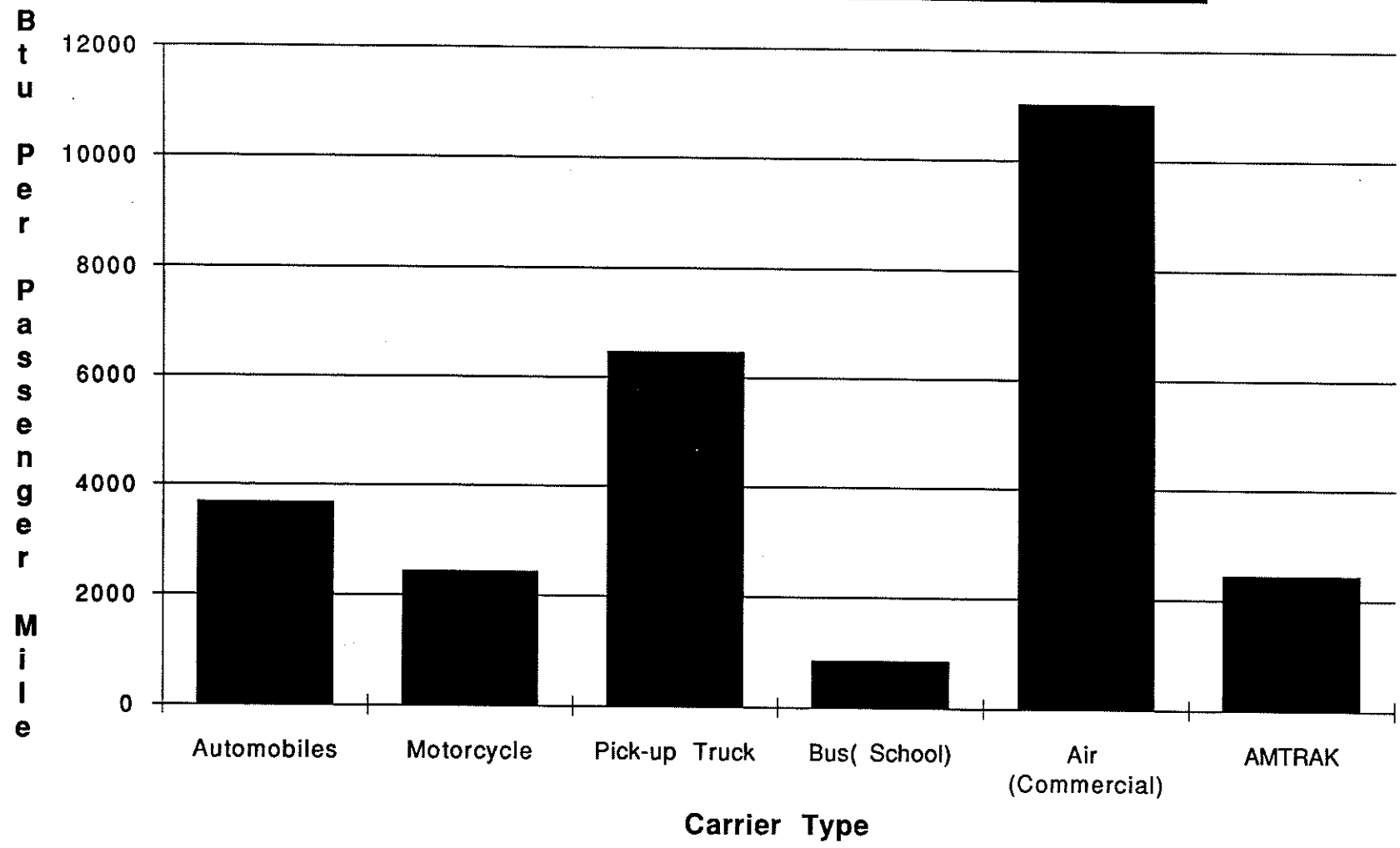
Trillion Btu

Mode	Natural Gas	Aviation Gas	Distillate Fuel	Jet Fuel	LPG	Motor Gas	Residual Fuel	Total
Highway	0.0	0.0	236.3	0.0	0.9	1019.4	0.0	1256.6
Air	0.0	3.0	0.0	582.1	0.0	0.0	0.0	585.1
Water	0.0	0.0	33.5	0.0	0.0	12.4	183.5	229.4
Rail	0.0	0.0	61.2	0.0	0.0	0.0	0.0	61.2
Pipeline	111.5	0.0	0.0	0.0	0.0	0.0	0.0	111.5
Military	0.0	0.0	32.3	25.9	0.0	0.0	0.0	58.2
	111.5	3.0	363.3	608.0	0.9	1031.8	183.5	2302.1

Sources:

State Energy Data Report 1960-1991, Energy Information Administration; Ms. Julia Hutchins, Energy Administration unpublished fuel time series.

Figure 2.8 Passenger Energy Intensity in Texas, 1993



Source: Table 2.9

Table 2.9 Estimated Passenger Travel and Energy Use in Texas, 1993

Mode	Number of vehicles (thousands)	Vehicle-miles (millions)	Passenger-miles (millions)	Load (a) factor (pers./veh.)	Est. Energy Intensity		Energy Use
					Btu per vehicle-mile	Btu per passenger-mile	trillion Btu
Automobiles	8,863.0	95,321.8	152,515	1.6	5,904	3,690	562.8
Motorcycle	160.8	365	402	1.1	2,680	2,437	1.0
Pick-up Truck	4,016.4	49,568.0	74,352	1.5	9,711	6,474	481.4
Buses							
Commercial	3.3	126.2	-	-	27,521	-	3.5
School & transit	61.9	466.1	9,088	19.5	16,752	859	7.8
Air							
Commercial	-	-	52,751	-	-	11,035	582.1
Rail							
AMTRAK	-	3	54	20.2	49,300	2,447	0.1

Sources:
Highway Statistics, 1991; TTI estimates; 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. in 1990.

Table 2.10 Energy Intensities of Passenger Modes in Texas

	Automobiles		Buses		Air	Rail (b)
		(a)	Commercial	School & other	Certified Carrier	AMTRAK
Year	Btu per Vehicle-mi	Btu per Passenger-mi	Btu per Vehicle-mi	Btu per Vehicle-mi	Btu per Passenger-mi	Btu per Passenger-mi
1973	10,831	6,371	31,780	17,645	12,652	3,756
1974	10,980	6,459	31,577	18,237	11,376	3,240
1975	10,795	6,350	30,472	18,245	12,241	3,677
1976	10,348	6,087	28,865	17,909	10,480	3,397
1977	10,219	6,011	29,237	18,080	9,821	3,568
1978	9,844	5,791	28,715	17,686	9,011	3,683
1979	10,127	5,957	29,998	18,623	8,134	3,472
1980	8,854	5,208	28,218	16,754	7,066	3,176
1981	8,437	4,963	28,044	16,463	6,562	2,976
1982	8,635	5,079	30,345	17,673	8,788	3,156
1983	8,244	4,850	30,012	17,265	9,506	2,957
1984	7,202	4,237	28,053	16,044	11,904	3,027
1985	7,373	4,337	29,267	16,605	12,643	2,800
1986	7,191	4,230	29,478	16,572	13,203	2,574
1987	6,745	3,968	29,128	16,259	13,050	2,537
1988	6,453	3,796	29,249	16,178	14,022	2,462
1989	6,247	3,675	29,179	17,542	11,883	2,731
1990	6,134	3,834	27,486	16,525	12,480	2,609
1991	6,108	3,817	27,174	16,337	11,173	2,554
1992*	6,042	3,776	27,295	16,615	11,104	2,500
1993*	5,904	3,690	27,521	16,752	11,035	2,447
			Average annual changes			
Period:						
1973-93	-3.0%	-2.7%	-0.7%	-0.3%	-0.7%	-2.1%
1983-93	-3.3%	-2.7%	-0.9%	-0.3%	1.5%	-1.9%

Sources: State Energy Data Report 1960-1991, Energy Information Administration; Highway Statistics, FHWA, USDOT, annual: Statistical Handbook of Aviation, annual; Railroad Facts, American Association of Railroads, annual

Air mode figures derived from Table 4.2

Notes: * estimate

(a) Based on U.S. load factor of 1.7 (b) U.S. figures

Table 2.11 Intercity Freight and Energy Use In Texas, 1993

	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	125.3	7,679.94	80,639	284.9	283	2,483	200.2
Waterborne	-	-	20,485	390.1	53	371	7.6
Pipeline (b)	-	-	78,700	140.5	560	272	21.4
Class I Rail.	-	43.0	80,603	344.0	234	399	32.2

Sources:

TTI estimates based on :Texas Railroad Facts, 1990, Railroad Commission of Texas; rate of growth projected by Eno Foundation

Highway Statistics 1991, USDOT,FHWA; Table 3.23

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

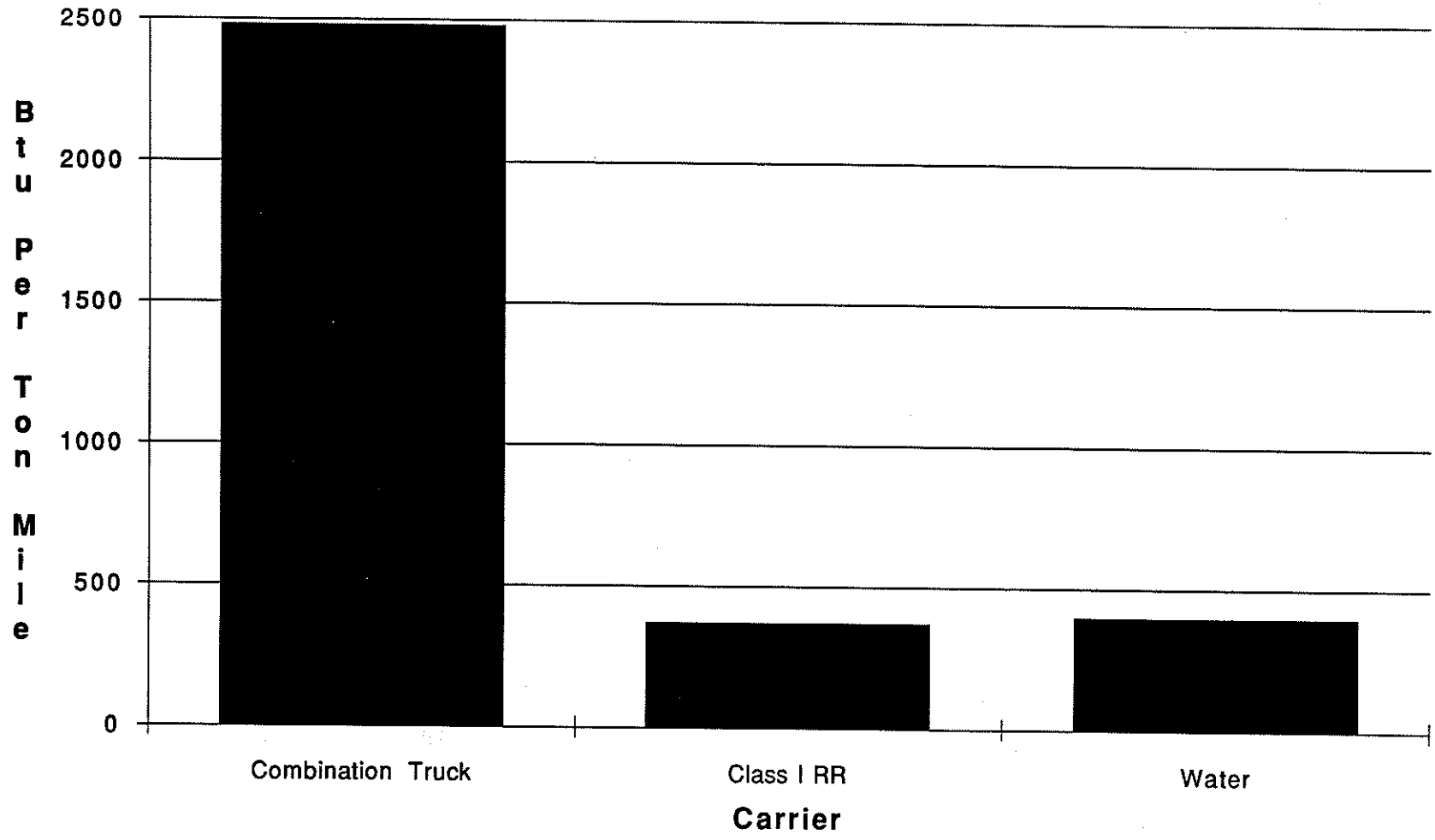
Table 4.18 for pipeline data

Notes:

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

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

Figure 2.9 Intercity Freight Energy Intensities in Texas, 1993



Source: Table 2.12

Table 2.12 Energy Intensities of Freight Modes in Texas

Year	Light Truck (Btu per Vehicle-mi)	Combinations (Btu per Vehicle-mi)	Class I Railroads (Btu per Ton-mi)	(a) Domestic Waterborne (Btu per Ton-mi)
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	361
1989	10,008	26,185	448	403
1990	9,815	25,474	432	396
1991	9,810	25,549	421	387
1992*	9,846	25,858	410	379
1993*	9,711	26,072	399	371
		Average annual changes		
Period:				
1973-93	-1.6%	-0.1%	-2.8%	-2.2%
1983-93	-0.9%	-0.8%	-3.0%	1.5%

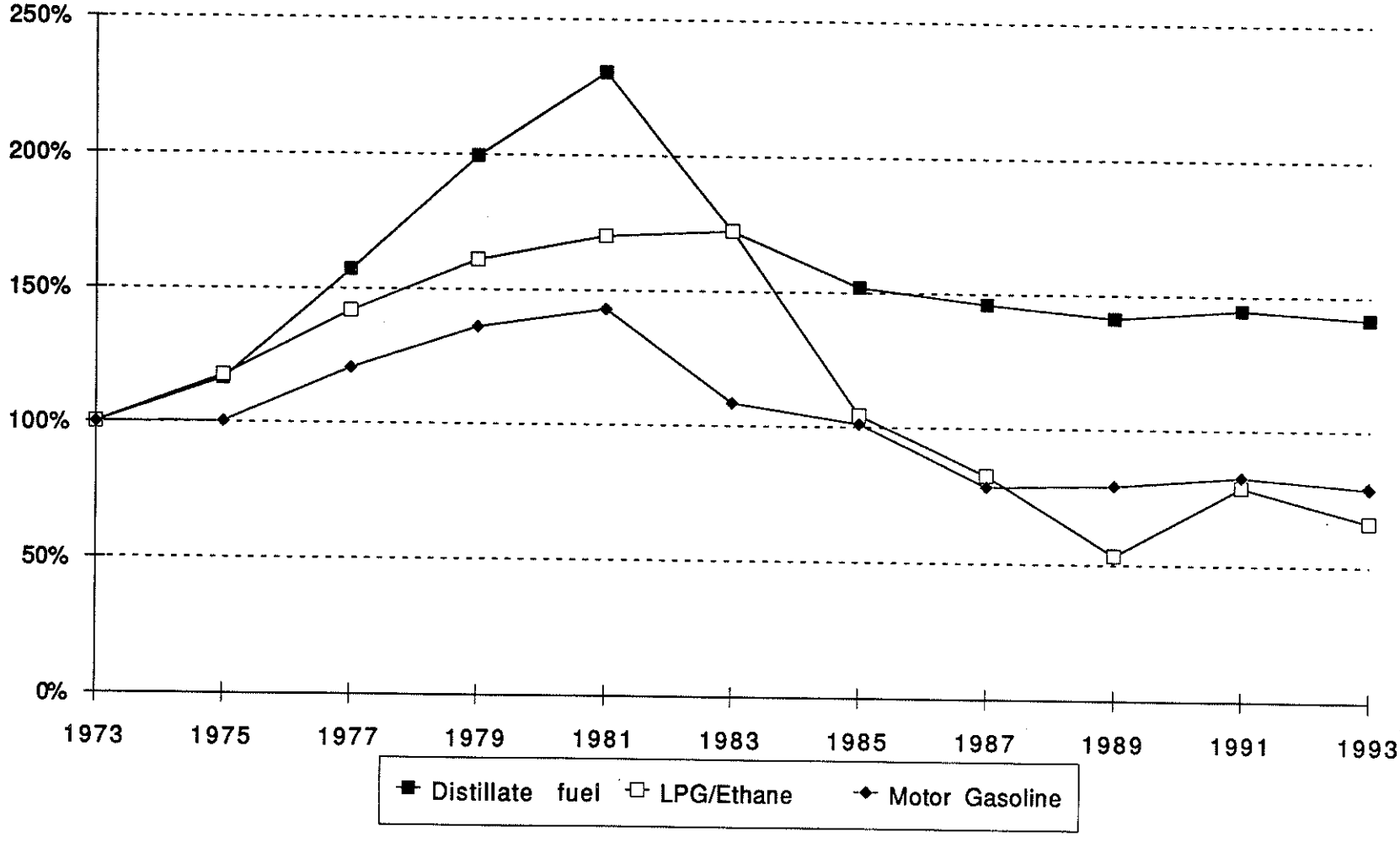
Sources:

State Energy Data Report 1960-1991, Energy Information Agency; Highway Statistics, FHWA, USDOT, annual; Texas Railroad Facts 1990, Railroad Commission of Texas; Z.A. Goff, Texas Transportation Institute; Transportation Energy Data Book: Edition 13, Oak Ridge National Laboratory

Notes:

(a) values from 1991-93 are estimates

Figure 2.10 Texas Motor Fuel Prices ($1988) as Percentage of Baseline



Source: Table 2.13

Table 2.13 Retail Prices of Selected Highway Motor Fuels

Cents per gallon, including tax

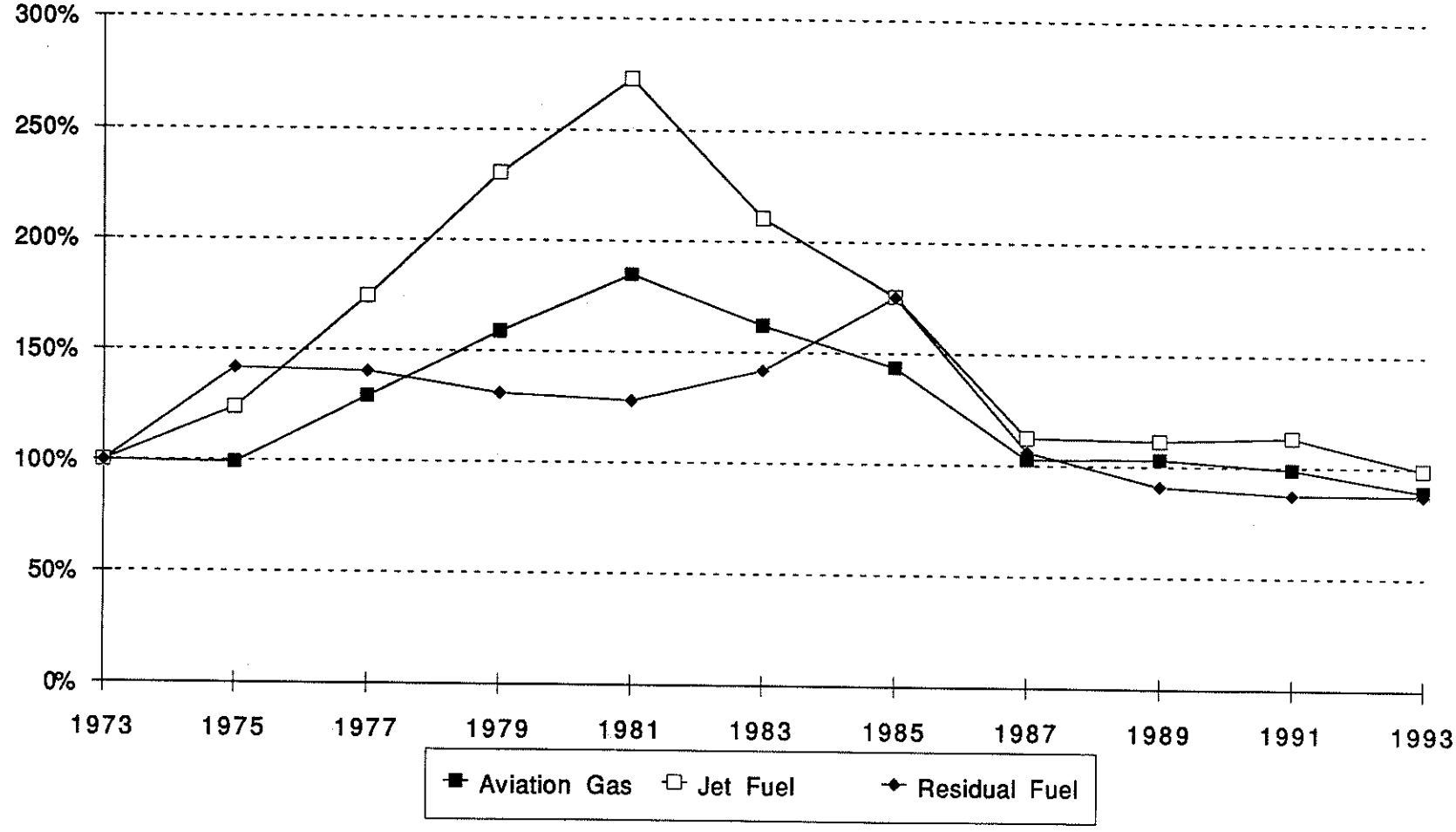
	Distillate fuel		LPG/Ethane		Motor Gasoline	
Year	Current	Constant 1988	Current	Constant 1988	Current	Constant 1988
1973	24.5	65.2	16.2	43.2	44.8	119.4
1974	29.1	69.8	19.3	46.4	49.5	118.7
1975	34.5	75.9	23.1	50.8	54.5	119.9
1976	42.6	88.5	26.9	56.0	63.4	131.9
1977	52.5	102.5	31.4	61.3	73.8	144.0
1978	64.7	117.5	36.6	66.5	85.8	155.6
1979	79.8	130.1	42.7	69.6	99.8	162.6
1980	98.3	141.2	49.9	71.6	115.8	166.3
1981	115.5	150.4	56.5	73.6	131.3	170.9
1982	109.0	133.6	57.8	70.8	122.9	150.7
1983	94.6	112.3	62.7	74.5	109.3	129.8
1984	94.3	107.4	61.1	69.6	108.3	123.3
1985	90.1	99.1	41.1	45.1	109.9	120.9
1986	81.0	87.4	39.6	42.8	80.9	87.3
1987	91.5	95.3	34.3	35.7	89.9	93.6
1988	89.3	89.3	33.1	33.1	91.6	91.6
1989	96.7	92.2	24.2	23.1	99.1	94.5
1990	113.7	102.9	38.2	34.6	114.6	103.7
1991	108.7	94.4	39.3	34.1	113.7	98.7
1992*	110.6	93.2	37.0	31.2	114.2	96.3
1993*	112.6	92.3	34.9	28.6	114.8	94.1
			Average annual changes			
Period:						
1973-93	7.9%	1.8%	3.9%	-2.0%	4.8%	-1.2%
1983-93	1.8%	-1.9%	-5.7%	-9.1%	-3.5%	-6.7%

Source:

State Energy Price and Expenditure Report 1991, Energy Information Administration

Note: * estimate

Figure 2.11 Texas Non-Highway Fuel Prices ($ 1988) as a Percentage of Baseline



Source: Table 2.14

Table 2.14 Retail Prices for Selected Transportation Fuels

Cents per gallon, including tax

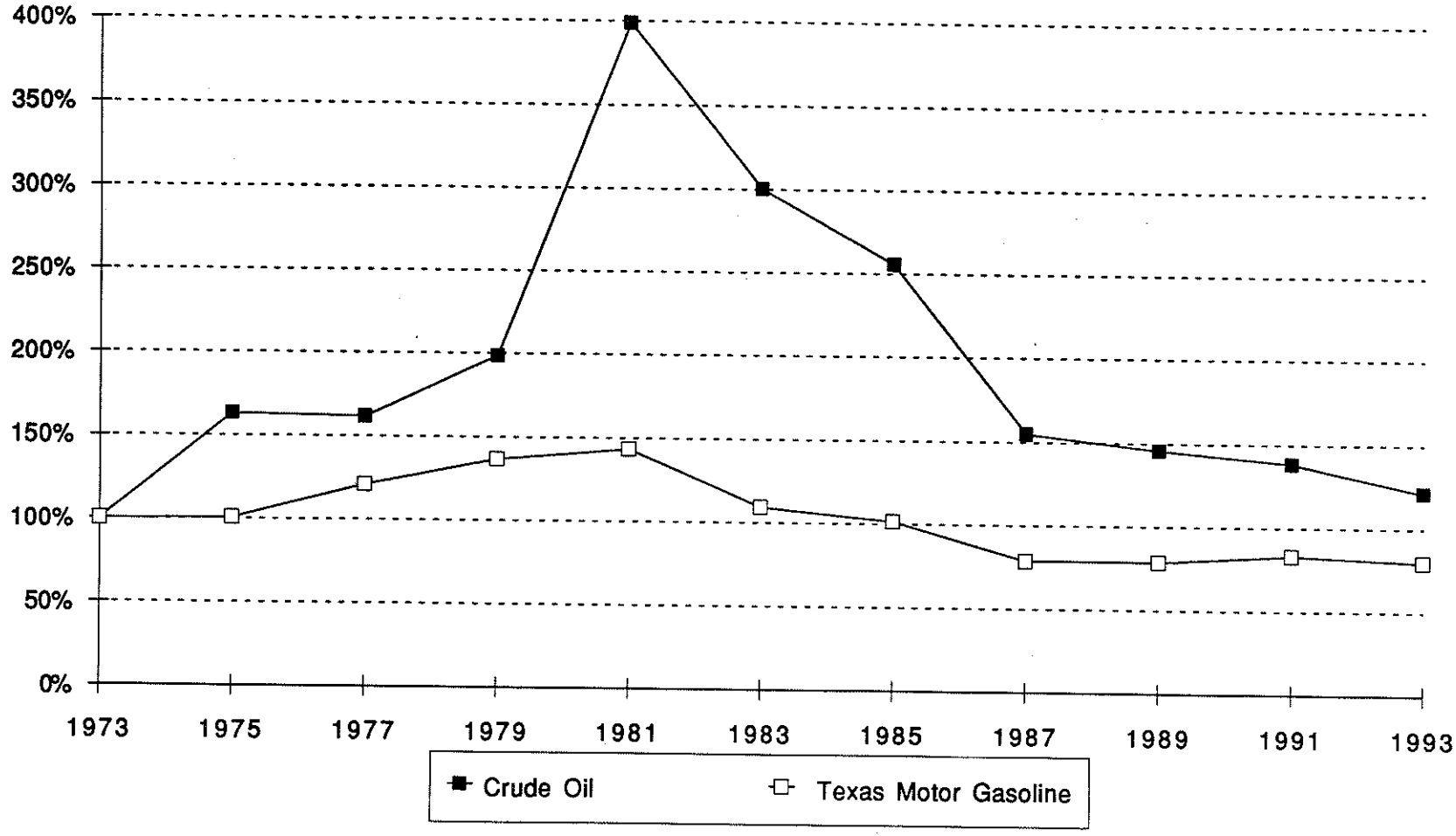
	Aviation Gas		Jet Fuel		Residual Fuel	
Year	Current	Constant 1988	Current	Constant 1988	Current	Constant 1988
1973	34.4	91.8	18.0	48.0	14.2	37.8
1974	37.8	90.7	22.1	53.0	18.6	44.7
1975	41.5	91.2	27.1	59.7	24.4	53.7
1976	50.3	104.5	34.1	71.0	25.8	53.6
1977	60.9	118.9	42.9	83.8	27.3	53.2
1978	73.8	133.9	54.0	98.0	28.8	52.3
1979	89.5	145.8	68.0	110.7	30.5	49.6
1980	108.4	155.6	85.6	122.9	32.2	46.2
1981	130.3	169.6	100.8	131.2	37.3	48.5
1982	131.2	160.9	95.7	117.3	42.1	51.6
1983	125.5	149.0	85.0	101.0	45.2	53.7
1984	123.4	140.5	81.8	93.1	48.6	55.4
1985	120.1	132.0	76.5	84.2	60.2	66.2
1986	101.1	109.1	48.1	51.9	21.3	22.9
1987	90.7	94.5	52.0	54.1	38.6	40.2
1988	89.1	89.1	48.2	48.2	27.4	27.4
1989	99.5	94.9	56.2	53.6	36.1	34.4
1990	112.0	101.4	73.0	66.1	37.1	33.6
1991	104.7	90.9	62.6	54.4	38.1	33.1
1992*	102.3	86.2	60.3	50.8	39.2	33.1
1993*	100.1	82.0	58.0	47.6	40.3	33.1
Period:			**Average annual changes**			
1973-93	5.5%	-0.6%	6.0%	0.0%	5.4%	-0.7%
1983-93	-2.2%	-5.8%	-3.8%	-7.3%	-2.7%	-3.7%

Source:

State Energy Price and expenditure Report 1987, Energy Information Administration

Note: * estimate

Figure 2.12 Crude Oil and Texas Gasoiline Prices ($ 1988) as a Percentage of Baseline



Source: Table 2.15

Table 2.15 Crude Oil and Gasoline Prices

Year	Average U.S. Crude Oil ($ per bbl) Current	Average U.S. Crude Oil ($ per bbl) Constant 1988	Average Texas Retail Gasoline ($ per gal) Current	Average Texas Retail Gasoline ($ per gal) Constant 1988
1973	3.89	10.36	0.45	1.19
1974	6.87	16.49	0.49	1.19
1975	7.67	16.87	0.55	1.20
1976	8.19	17.03	0.63	1.32
1977	8.57	16.73	0.74	1.44
1978	9.00	16.33	0.86	1.56
1979	12.64	20.60	1.00	1.63
1980	21.59	31.00	1.16	1.66
1981	31.77	41.35	1.31	1.71
1982	28.52	34.96	1.23	1.51
1983	26.19	31.11	1.09	1.30
1984	25.88	29.47	1.08	1.23
1985	24.09	26.49	1.10	1.21
1986	12.51	13.50	0.81	0.87
1987	15.41	16.05	0.90	0.94
1988	12.58	12.58	0.92	0.92
1989	15.86	15.13	0.99	0.94
1990	20.03	18.13	1.15	1.04
1991	16.54	14.36	1.14	0.99
1992*	15.99	13.35	1.13	0.95
1993*	15.51	12.57	1.17	0.95
Average annual changes				
Time Period				
1973-93	7.16%	0.97%	4.93%	-1.13%
1983-93	-5.11%	-8.66%	0.70%	-3.08%

Sources:

1993 Annual Energy Review, Energy Information Administration 1990, Table 67.

Table 2.13 this volume

CHAPTER 3

TEXAS HIGHWAY MODE CHARACTERISTICS

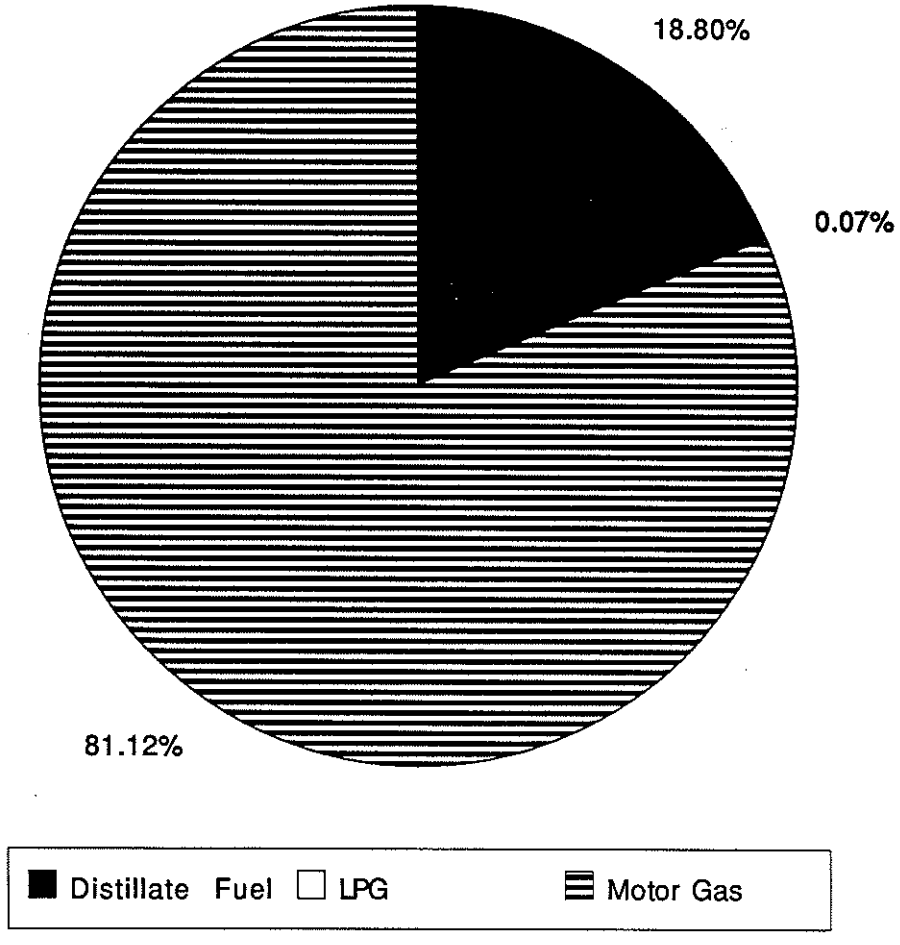
Chapter 3 provides detailed information about the energy characteristics of the Texas highway mode. This chapter is divided into four sections. Section 3.1 is concerned with the general energy and traffic characteristics of the State's highway mode. Section 3.2 concentrates on the household transportation 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 .

Figure 3.1 Texas Highway Energy Use by Fuel Type, 1993



Source: Table 3.1

Table 3.1 Texas Highway Mode Energy Consumption by Fuel Type

Year	Distillate Fuel	LPG	Motor Gasoline	Total
1973	99.8	22.7	881.0	1003.5
1974	98.9	19.9	871.9	990.7
1975	103.5	18.6	912.3	1034.4
1976	114.8	19.2	966.1	1100.0
1977	129.7	20.1	1014.5	1164.3
1978	151.7	18.5	1052.8	1223.0
1979	176.7	2.9	1018.3	1197.9
1980	166.0	2.4	929.7	1098.1
1981	184.6	5.0	963.1	1152.8
1982	191.0	4.4	991.4	1186.7
1983	202.3	5.2	1007.2	1214.7
1984	211.5	3.0	1008.0	1222.6
1985	215.7	2.2	1041.0	1258.9
1986	200.4	2.8	1062.6	1265.8
1987	184.0	1.7	1039.4	1225.1
1988	180.8	1.7	1059.8	1242.3
1989	193.5	1.6	1029.5	1224.6
1990	193.6	1.8	1035.3	1230.7
1991	216.8	1.3	1004.7	1222.7
1992*	226.3	1.1	1012.0	1239.4
1993*	236.3	0.9	1019.4	1256.6
Time Period:				
1973-1993	4.4%	-14.8%	0.7%	1.1%
1983-1993	1.6%	-15.9%	0.1%	0.3%

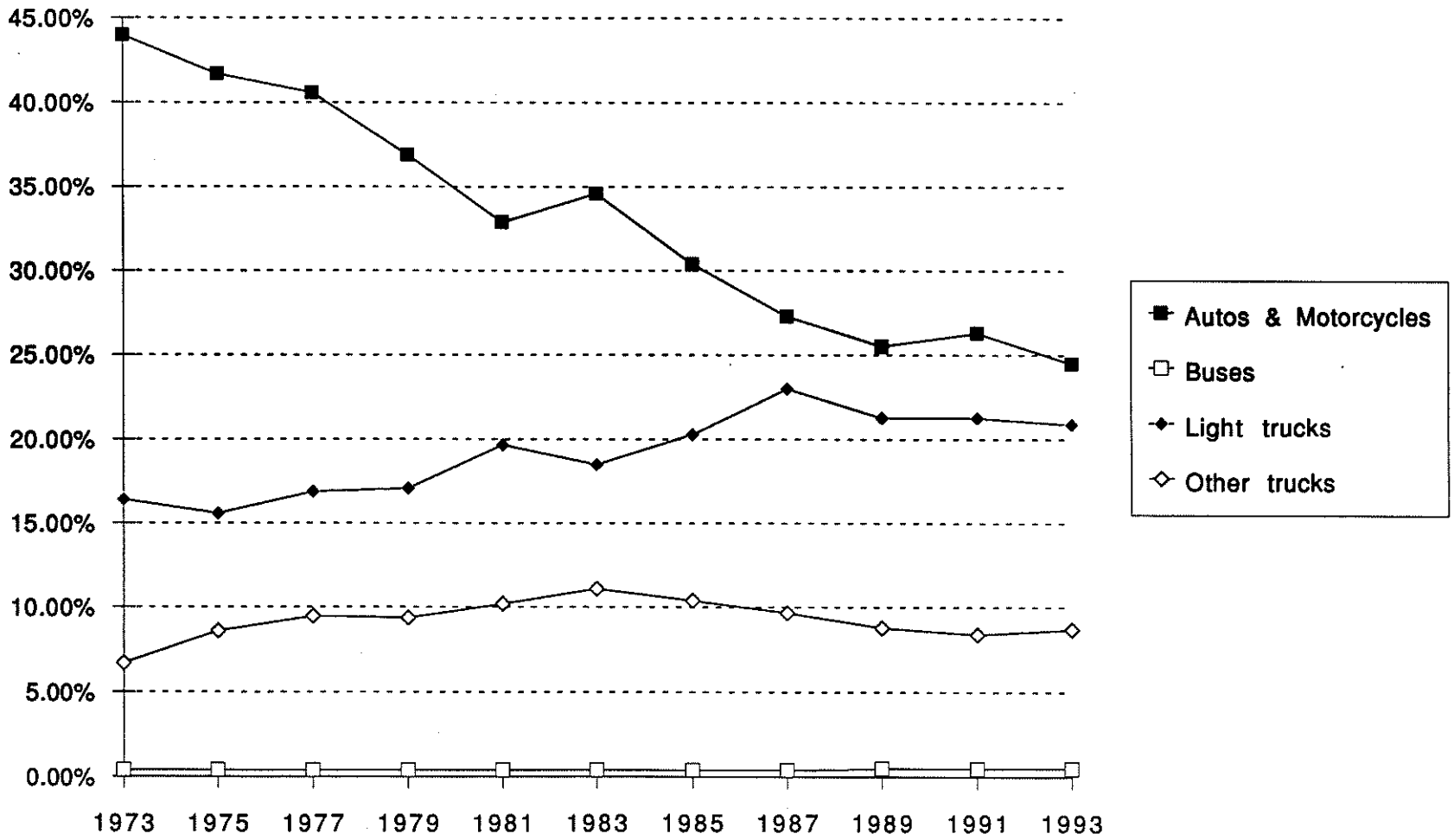
Sources:

State Energy Data Report, Energy Information Administration (EIA), 1991;
EIA unpublished fuel time series

Notes:

* estimate

Figure 3.2 Percentage of Texas Highway Energy Consumption by Mode



Source: Table 3.2

Table 3.2 Texas Highway Energy Use by Mode

	Trillion Btu										
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
1973	653.7	44.0%	5.6	0.4%	244.3	16.4%	99.9	6.7%	1003.5	67.5%	1485.7
1974	634.1	42.0%	5.9	0.4%	233.2	15.5%	117.6	7.8%	990.7	65.7%	1509.0
1975	650.6	41.7%	6.3	0.4%	243.1	15.6%	134.4	8.6%	1034.4	66.2%	1561.4
1976	666.0	41.3%	6.4	0.4%	275.4	17.1%	152.2	9.4%	1100.0	68.2%	1613.6
1977	701.9	40.6%	6.6	0.4%	291.7	16.9%	164.1	9.5%	1164.3	67.4%	1727.3
1978	727.2	39.8%	6.3	0.3%	313.8	17.2%	175.7	9.6%	1223.0	67.0%	1825.6
1979	693.6	36.9%	6.9	0.4%	321.1	17.1%	176.3	9.4%	1197.9	63.7%	1880.6
1980	606.7	33.7%	6.7	0.4%	326.9	18.1%	157.8	8.8%	1098.1	60.9%	1802.0
1981	600.1	32.9%	6.8	0.4%	360.3	19.7%	185.6	10.2%	1152.8	63.1%	1825.9
1982	659.6	35.0%	7.3	0.4%	366.4	19.5%	153.4	8.1%	1186.7	63.0%	1882.7
1983	650.1	34.6%	8.3	0.4%	347.1	18.5%	209.2	11.1%	1214.7	64.7%	1878.2
1984	594.0	29.9%	8.1	0.4%	391.4	19.7%	229.0	11.5%	1222.6	61.5%	1989.5
1985	622.1	30.4%	8.7	0.4%	415.5	20.3%	212.6	10.4%	1258.9	61.6%	2043.7
1986	589.7	28.2%	9.3	0.4%	465.0	22.2%	201.9	9.6%	1265.8	60.5%	2093.9
1987	561.0	27.3%	9.1	0.4%	473.5	23.0%	198.7	9.7%	1225.1	59.6%	2056.2
1988	553.4	25.5%	9.1	0.4%	471.4	21.7%	208.4	9.6%	1242.3	57.2%	2172.7
1989	556.4	25.5%	11.0	0.5%	464.5	21.3%	192.7	8.8%	1224.6	56.1%	2181.5
1990	565.2	25.9%	10.6	0.5%	464.6	21.3%	190.4	8.7%	1230.7	56.5%	2179.2
1991	568.9	26.3%	10.5	0.5%	460.7	21.3%	182.6	8.4%	1222.7	56.5%	2165.1
1992*	565.2	25.3%	10.8	0.5%	469.3	21.0%	194.2	8.7%	1239.4	55.5%	2231.4
1993*	563.7	24.5%	11.3	0.5%	481.4	20.9%	200.2	8.7%	1256.6	54.6%	2302.1
Period:					**Average annual changes**						
1973-93	-0.8%		4.0%		3.8%		3.9%		1.3%		2.5%
1983-93	-1.4%		3.1%		3.3%		-0.4%		0.3%		2.1%

Sources:

State Energy Data Report, Energy Information Administration, 1991;

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

Notes:

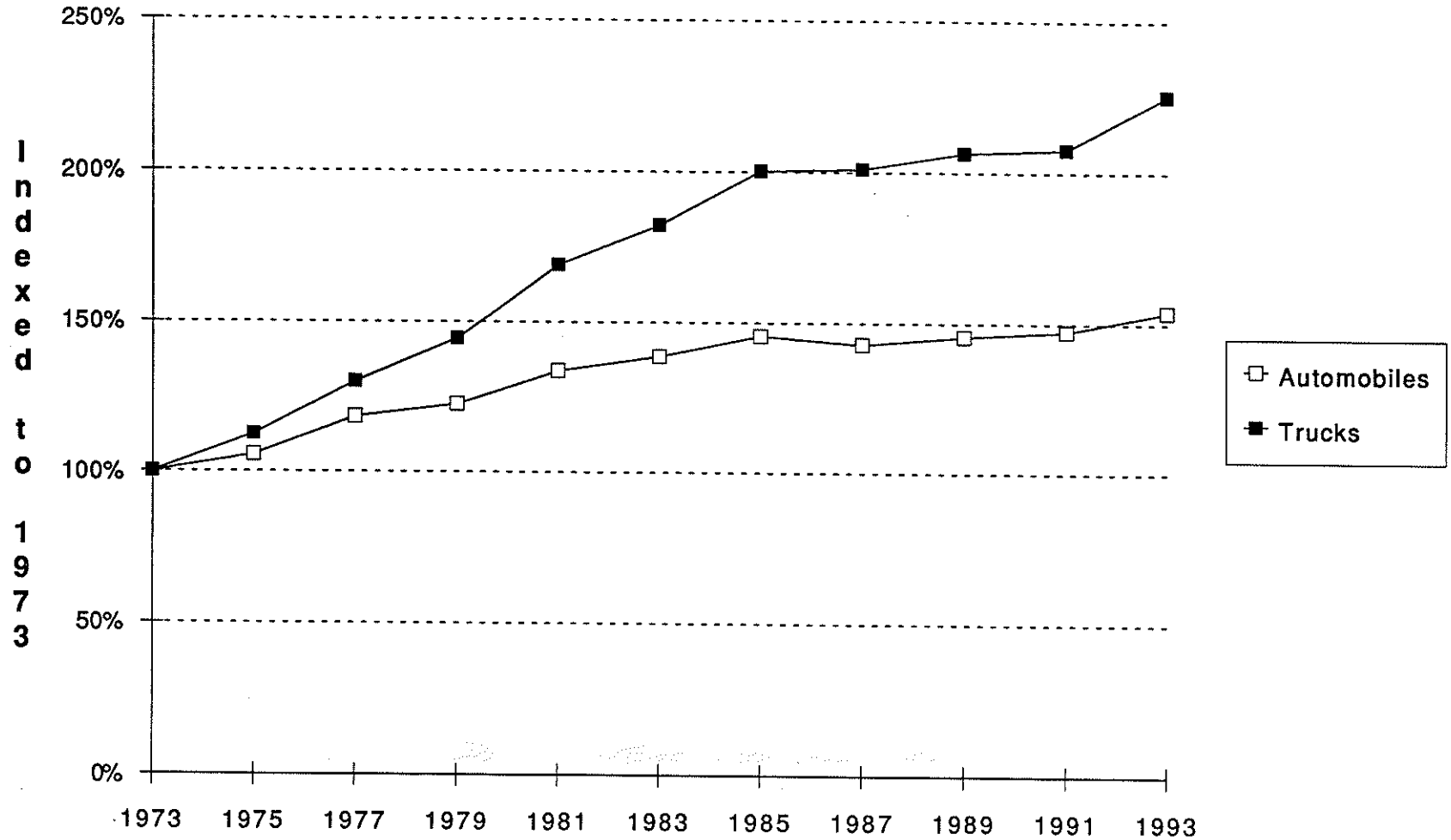
* estimated

Table 3.3 Estimated Vehicle Stock in Texas, 1993

	Registrations	As % of U.S.	Estimated Change from prior year
Automobiles	**9,054,875**	**6.3%**	**4.3%**
Two seaters	209,045		
Minicompact	276,106		
Subcompact	2,101,316		
Compact	2,419,511		
Midsize	2,576,624		
Large	1,472,346		
Private	8,877,107	6.2%	1.3%
Public	177,768	15.9%	4.6%
Motorcycles	**169,417**	**3.7%**	**-4.3%**
Private	165,462	3.6%	-4.5%
Public	3,955	11.2%	0.7%
Buses	**69,748**	**11.0%**	**6.3%**
Private	15,152	5.5%	0.4%
Public	54,596	15.1%	8.1%
Trucks	**4,305,171**	**9.4%**	4.2%
Light	4,059,776		
Medium	73,188		
Light-heavy	38,747		
Heavy-heavy	133,460		
Private	4,078,662	9.3%	4.1%
Public	226,509	12.4%	5.1%
All private vehicles	**13,136,383**	**6.9%**	**5.8%**
All public vehicles	**462,828**	**13.9%**	**12.3%**

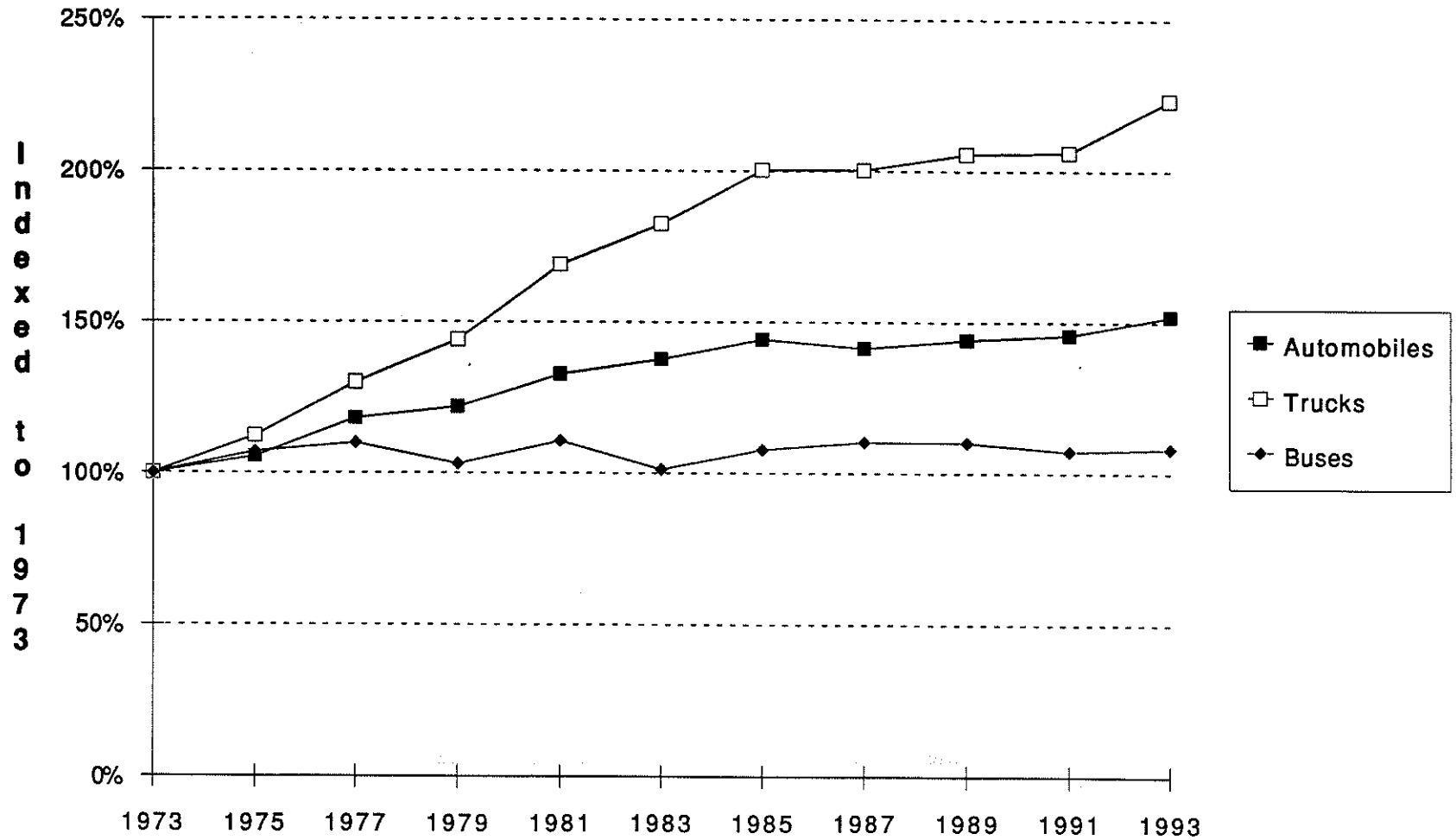
Source:
Data for estimates from Highway Statistics, annual

Figure 3.3 Automobiles and Trucks Registered in Texas



source: Table 3.4

Figure 3.4 Texas Private Vehicle Stock Growth



Source: Table 3.4

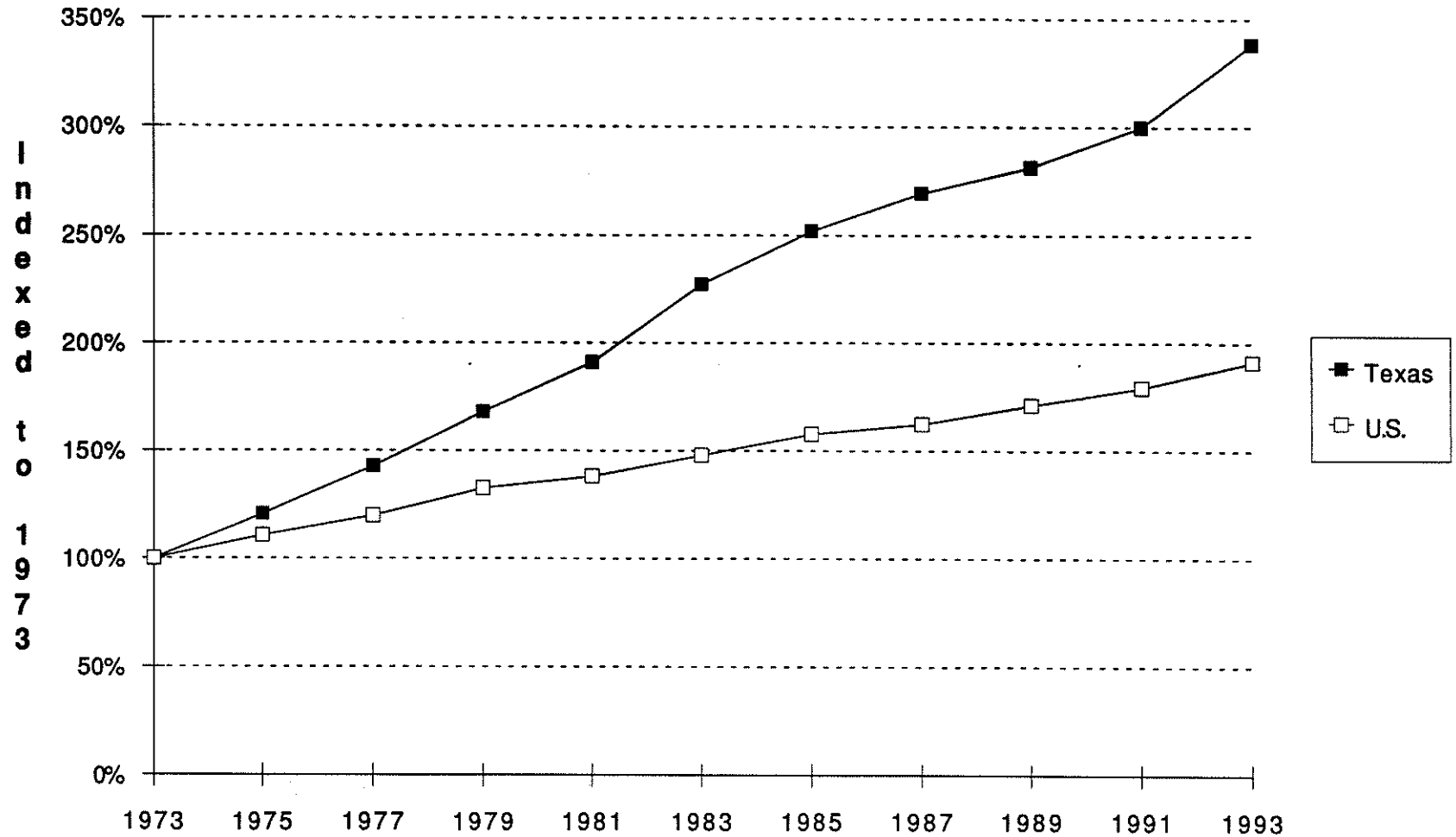
Table 3.4 Vehicle Stock in Texas, 1973-93

Year	Automobiles		Trucks		Buses		Texas public vehicles (000's)	U.S. public vehicles (000's)	Texas public vehicles as % of U.S.
	Private	Public	Private	Public	Private	Public			
1973	5,841,778	39,119	1,824,967	84,338	13,995	11,448	135	1,844.1	7.32%
1974	5,960,744	46,362	1,928,529	91,189	14,542	11,903	149	1,982.3	7.54%
1975	6,168,794	48,670	2,051,738	99,937	14,996	14,354	163	2,042.0	7.98%
1976	6,527,984	58,588	2,248,660	102,910	15,572	16,040	178	2,111.9	8.41%
1977	6,904,942	65,639	2,375,716	109,679	15,398	17,197	193	2,211.1	8.71%
1978	7,273,403	75,667	2,652,849	118,035	14,684	16,906	211	2,298.6	9.16%
1979	7,127,749	82,531	2,631,444	126,738	14,428	18,056	227	2,447.1	9.29%
1980	7,395,069	89,748	2,824,175	134,293	14,272	17,259	241	2,531.2	9.53%
1981	7,763,298	97,068	3,085,800	141,269	15,497	19,858	258	2,549.0	10.13%
1982	7,887,184	105,554	3,206,475	150,071	14,801	23,748	279	2,649.5	10.54%
1983	8,044,424	114,584	3,330,285	152,340	14,194	39,651	307	2,731.4	11.22%
1984	8,293,723	123,504	3,542,075	160,569	14,650	37,172	321	2,815.9	11.41%
1985	8,430,750	131,831	3,658,087	169,793	15,102	38,624	340	2,909.9	11.69%
1986	8,363,699	136,273	3,673,375	177,901	15,520	39,840	354	2,935.5	12.06%
1987	8,260,166	138,065	3,658,414	182,692	15,461	43,564	364	2,997.9	12.15%
1988	8,313,649	142,095	3,701,828	188,566	15,470	44,605	375	3,073.7	12.21%
1989	8,415,243	146,027	3,754,010	188,864	15,423	44,988	380	3,158.6	12.03%
1990	8,565,860	148,294	3,822,877	201,498	15,081	46,205	396	3,257.0	12.16%
1991	8,513,317	152,794	3,763,496	205,201	15,032	46,700	405	3,306.9	12.24%
1992	8,693,309	164,808	3,917,911	215,592	15,092	50,494	430	3,416.0	12.59%
1993	8,877,107	177,768	4,078,662	226,509	15,152	54,596	457	3,528.6	12.96%
			Average annual changes						
Period:									
1973-93	2.11%	7.86%	4.10%	5.06%	0.40%	8.12%	6.29%	3.30%	-
1983-93	0.99%	4.49%	2.05%	4.05%	0.66%	3.25%	4.08%	2.59%	-

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

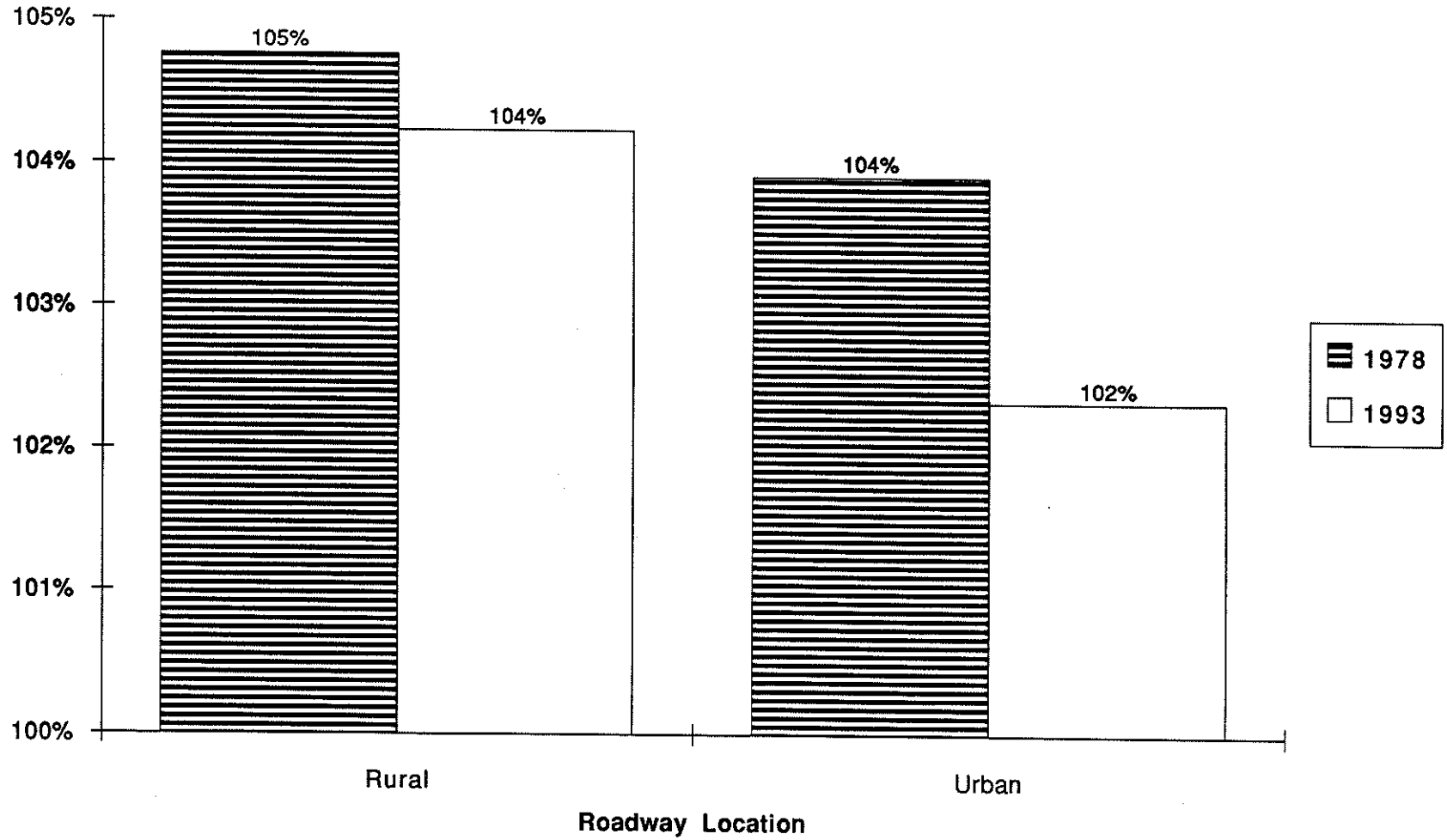
Notes: * estimate

Figure 3.5 Public Vehicle Stock Growth



Source: Table 3.4

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



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)
1989	60.4	68.0	69	47	24	61.1	67.9	(a)	(a)	(a)
1990	60.6	68.9	72	50	27	61.2	68.1	(a)	(a)	(a)
1991	61.3	69.2	72	51	28	61.3	68.2	(a)	(a)	(a)
1992*	61.4	69.5	72	52	30	61.4	68.3	(a)	(a)	(a)
1993*	61.6	69.7	71	53	31	61.5	68.5	(a)	(a)	(a)
				U.S. averages for 1978 and 1993						
1978	56.7	61.4	60	23	5	58.8	63.7	74	36	10
1993*	59.1	66.9	72	45	22	60.1	67.8	76	50	24

Source:

Highway Statistics, USDOT, FHWA, 1970 and annual

Notes:

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

* estimate

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
1989	59.3	65.6	71	41	16	58.5	65.5	66	37	16
1990	59.3	65.5	70	40	16	57.8	64.5	68	33	13
1991	59.1	66.0	76	40	17	57.8	64.5	66	33	13
1992*	59.5	66.6	79	44	20	57.9	64.5	67	33	13
1993*	59.9	67.3	82	49	24	58.0	64.5	67	33	13
					U.S. averages for 1993					
	58.3	65.4	68	36	15	56.7	49.3	58	28	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.

* estimate

Section 3.2

Household Transportation Energy Data

This section contains seven tables which depict transportation energy consumption of the household according to a number of interesting household characteristics such as income, engine characteristics, family size, vehicle fuel efficiency category, etc. This section begins with Table 3.7 which provides an overview of typical Texas household transportation energy statistics. This data is compared to that of other regions throughout the United States. The section 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 Estimated Average Per Household Vehicle: Vehicle Miles Traveled, Fuel Consumption, and Expenditures

Census region	Estimated Annual average per vehicle: Vehicle miles traveled 1993**	Vehicle miles traveled 1983	Average annual change	Consumption (gal) 1993**	Consumption (gal) 1983	Average annual change	Expenditures 1993**	Expenditures 1983	Average annual change
Midwest	10,948	9,153	1.81%	523	620	-1.70%	$398	$738	-5.98%
Northeast	11,209	9,511	1.66%	499	609	-1.98%	$392	$731	-6.03%
South	11,503	9,674	1.75%	556	644	-1.46%	$433	$758	-5.45%
Texas*	11,489	9,323	2.11%	588	659	-1.13%	$466	$751	-4.66%
West	10,886	9,144	1.76%	528	595	-1.18%	$410	$701	-5.23%
U. S.	11,169	9,399	1.74%	531	621	-1.55%	$411	$736	-5.66%

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)

** estimate

Table 3.8 Estimated U.S. Travel and Consumption Characteristics by Number of Cylinders, 1993 v. 1983

Estimated Annual average per household vehicle

Number of cylinders	Vehicle miles traveled		Avg. annual change	Consumption (gallons)		Avg. annual change	Expenditures		Avg. annual change	Miles per gallon		Avg. annual change
	1993*	1983		1993*	1983		1993*	1983		1993*	1983	
4	11,704	10,851	0.8%	429	478	-1.1%	$357	$564	-4.5%	27.3	22.7	1.9%
6	11,671	9,517	2.1%	526	618	-1.6%	$436	$729	-5.0%	22.2	15.4	3.7%
8	9,527	8,519	1.1%	632	687	-0.8%	$508	$811	-4.6%	15.1	12.4	2.0%

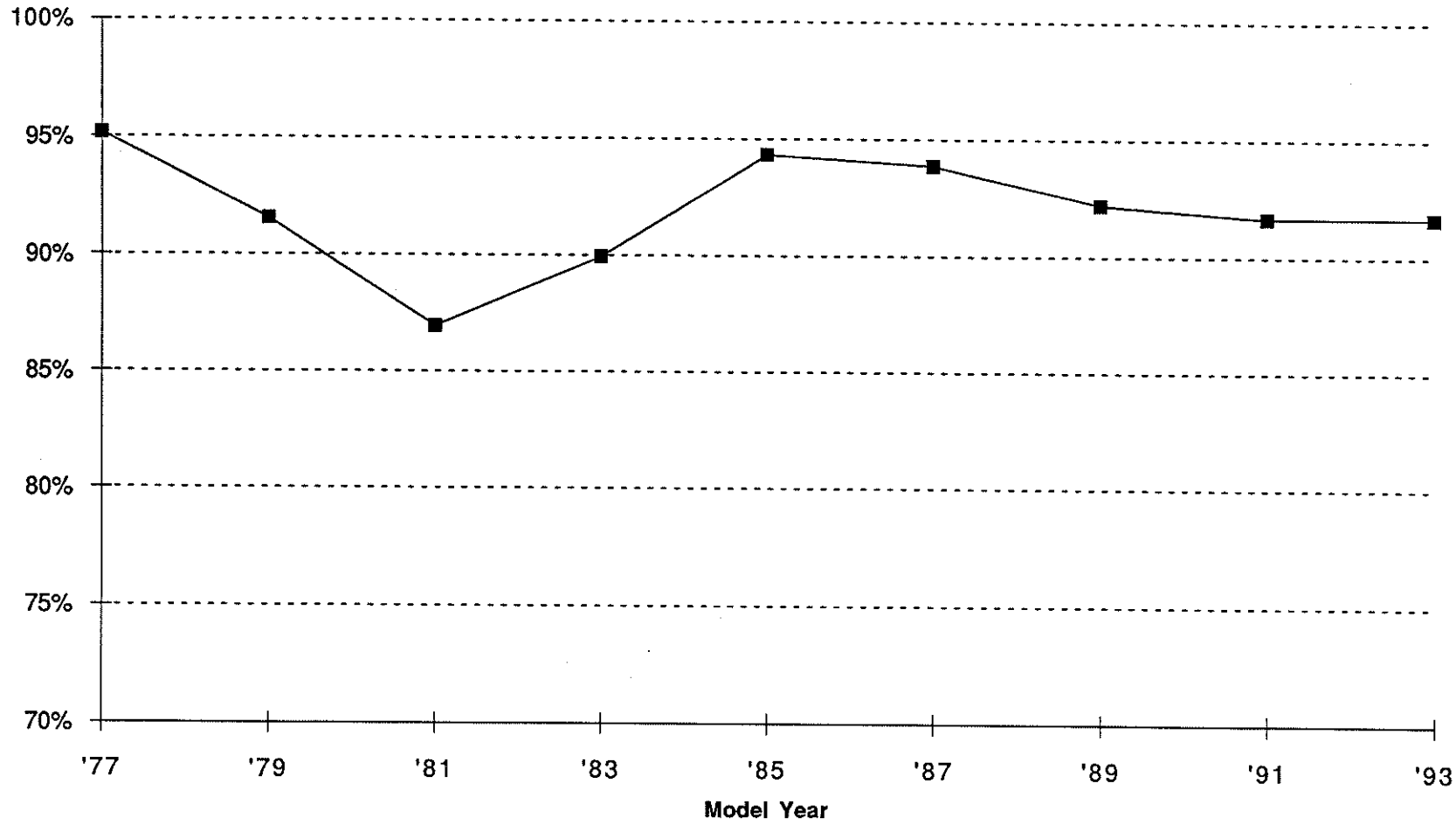
Sources:

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

Notes:

* estimate

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



Source: Table 3.9

Table 3.9 Estimated Average Miles Per Gallon by Model Year

Census region	All	Model year 1993**	1992**	1991	1990	1989	1988	1987	1986	1985	1984 1983	1982 1981	1980 1979	1978 1977	1976 Earlier
Midwest	20.2	21.6	21.6	21.6	21.6	22.0	23.0	22.0	21.5	21.5	20.4	20.7	16.7	14.6	12.2
Northeast	19.7	20.7	20.7	20.7	20.7	21.1	21.5	23.3	22.6	21.3	21.8	16.6	15.2	12.2	12.2
South	20.0	21.2	21.2	21.2	21.2	21.6	21.9	23.0	21.8	20.7	20.7	19.7	16.3	14.4	12.0
Texas*	18.8	19.8	19.8	19.8	19.8	20.2	20.8	21.5	21.1	20.0	18.8	18.0	15.2	13.8	12.1
West	20.7	22.1	22.1	22.1	22.1	22.5	22.3	23.6	22.3	20.4	21.8	21.5	17.0	14.4	12.7
U. S.	20.3	21.6	21.6	21.6	21.6	21.9	22.1	22.9	21.9	21.2	20.9	20.7	16.6	14.5	12.3

Sources:

Household Vehicle Energy Consumption 1988, Energy Information Agency, RTECS

TTI based regression equation to estimate years 1990-93

Table 3.11,Transportation Energy Data Book : Edition 13, Oak Ridge National Laboratory, 1993

Notes:

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

** estimate

Table 3.10 Vehicle Fuel Efficiency by Region

Census region	Average per household vehicle: Miles per gallon 1993**	1983	Average annual change
Midwest	20.2	14.8	3.2%
Northeast	19.7	15.6	2.3%
South	20.0	15.0	2.9%
Texas*	18.8	14.2	2.9%
West	20.7	15.4	3.0%
U. S.	20.3	15.1	3.0%

Sources:

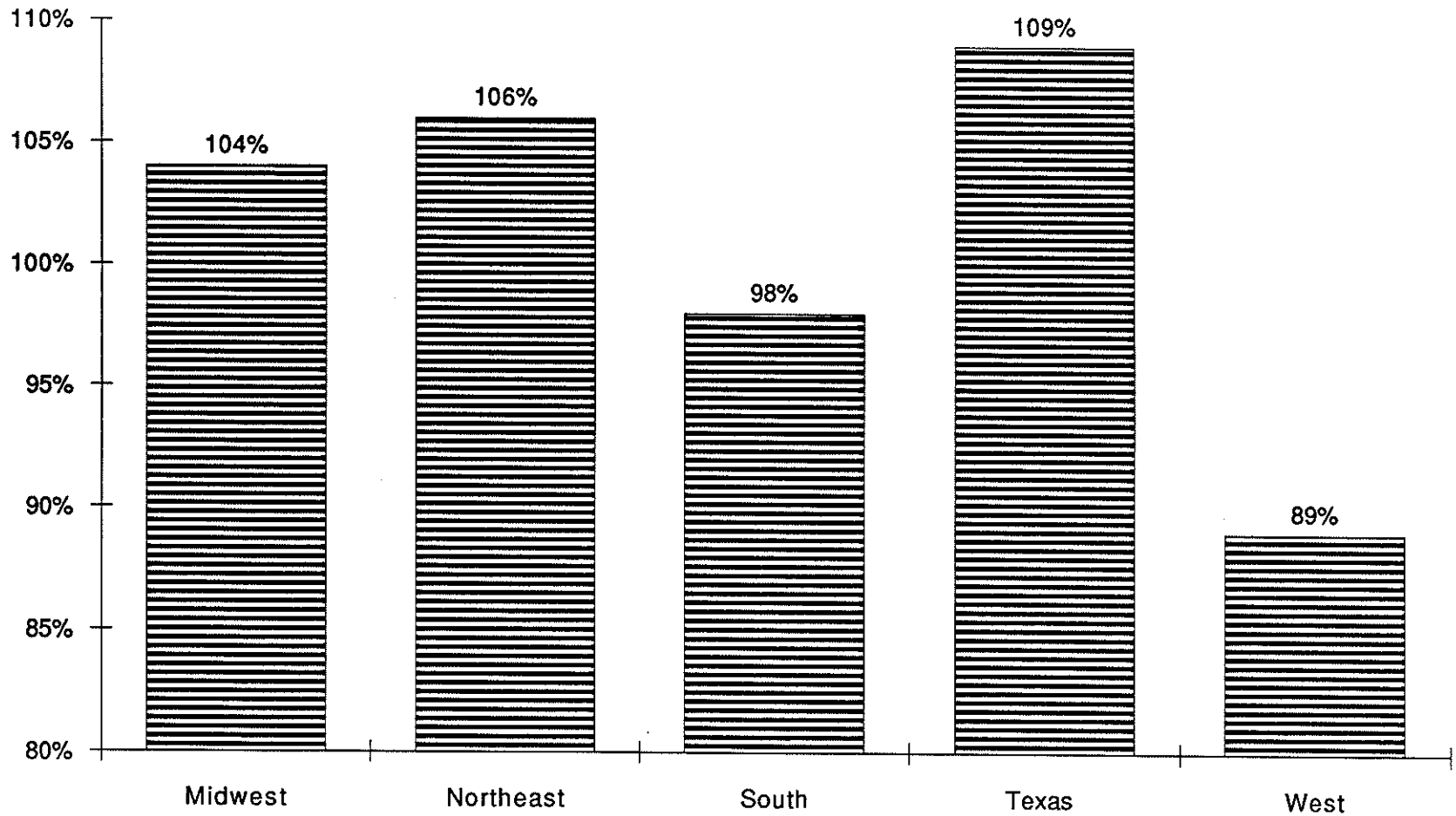
Consumption Patterns of Household Vehicles 1983, EIA, RTECS;
Table 3.9

Notes:

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

** estimate

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



Source: Table 3.11

Table 3.11 Estimated Average Household Energy and Vehicle Expenditures, 1993

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	$2,159	10.0	$1,079	90.0	$2,279	$1,179	$1,100
Northeast	$2,187	26.0	$1,117	74.0	$2,563	$1,439	$1,124
South	$2,073	10.0	$883	90.0	$2,205	$1,175	$1,030
Texas *	$2,202	6.5	$1,006	93.5	$2,285	$1,134	$1,151
West	$1,759	8.0	$613	92.0	$1,859	$914	$944
U. S.	$2,064	12.5	$968	87.5	$2,220	$1,164	$1,056

Source:

Household Vehicle Energy Consumption 1988, Energy Information Agency

State Energy Price and Expenditure Report 1991, Energy Information Agency

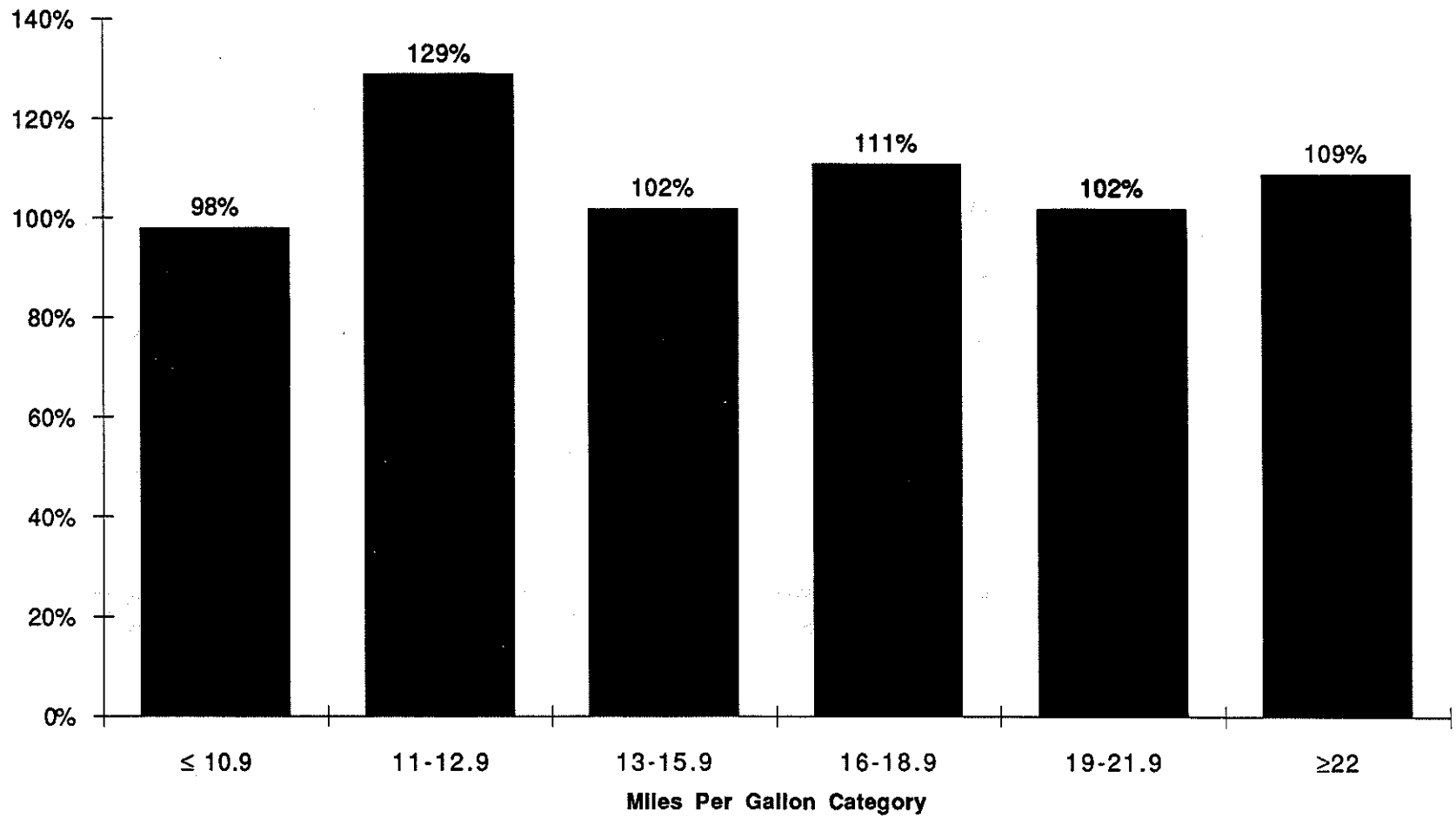
Table 1.10

Notes:

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

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

Figure 3.9 Texas Average Annual Household Vehicle Miles Traveled as a Percentage of U.S. Average, 1993



Source: Table 3.12

Table 3.12 Estimated Average Vehicle Miles Traveled by Vehicle Fuel Efficiency, 1993

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	10,200	4,900	8,100	9,000	10,500	12,400	12,300
Northeast	10,500	5,300	7,500	8,400	10,200	11,200	12,600
South	10,800	5,600	7,800	9,300	10,700	12,500	13,800
Texas*	10,600	5,600	10,100	9,300	11,400	12,400	14,000
West	10,200	6,500	7,700	9,100	9,100	11,600	12,900
U. S.	10,400	5,700	7,800	9,100	10,300	12,100	12,900

Source:

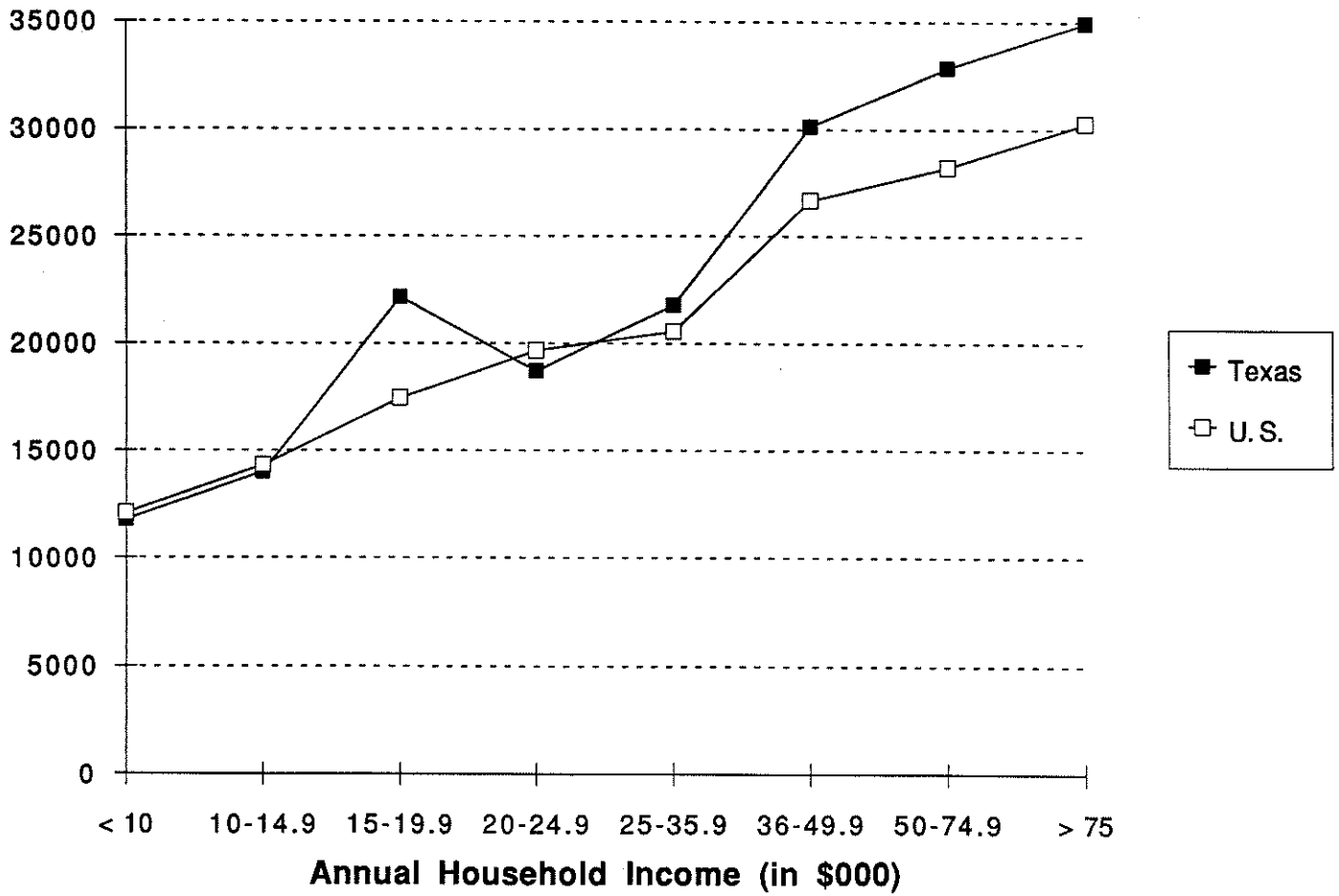
Household Vehicle Energy Consumption 1988, Energy Information Agency

1993 Estimate by Texas Transportation Institute

Notes:

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

Figure 3.10 Effect of Income on Average Annual Vehicle Miles Traveled, 1993



Source: Table 3.13

Table 3.13 Estimated Average Vehicle Miles Traveled Per Household by Family Income, 1993

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	20,445	11,667	13,727	17,953	21,145	20,490	27,491	29,576	28,144
Northeast	19,870	10,642	13,691	11,594	17,592	18,538	25,356	28,225	31,349
South	20,822	12,282	14,809	20,354	20,491	21,915	28,357	29,345	29,968
Texas *	20,087	11,762	14,019	22,146	18,750	21,776	30,136	32,876	34,940
West	20,738	13,113	14,736	17,074	18,305	20,257	24,766	26,077	30,756
U. S.	20,530	12,070	14,329	17,485	19,667	20,555	26,686	28,215	30,283

Source:

Household Vehicle Energy Consumption 1988, Energy Information Agency; TTI estimates of growth from 1988 to 1993.

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

Table 3.14 Estimated Average Vehicle Miles Traveled by Household Composition, 1993

Census region	Overall total	Households with children				Households without children						
			Age of oldest child				One adult, age of householder			Two or more adults, age of householder		
		Total	Under 7 years	7 to 15 years	16 or 17 years	Total	Under 35 years	35 to 59 years	60 Years or Over	Under 35 years	35 to 59 years	60 Years or Over
Midwest	20,445	25,074	21,947	23,744	35,104	17,867	14,136	12,837	7,673.4	23,531	26,329	15,887
Northeast	19,870	24,003	21,125	23,002	30,657	17,616	16,014	11,983	8,628.4	21,414	26,378	14,641
South	20,822	25,214	24,279	23,666	31,708	18,110	16,202	14,484	7,933.9	22,362	25,168	15,369
Texas *	20,087	24,281	25,000	20,804	30,693	17,694	15,126	14,431	10,044	18,051	24,975	15,548
West	20,738	24,753	22,389	23,403	30,322	18,354	14,056	14,610	7,651.3	21,833	26,099	16,100
U. S.	20,530	24,863	22,757	23,518	31,857	18,004	15,282	13,775	7,981.4	22,413	25,858	15,521

Source:

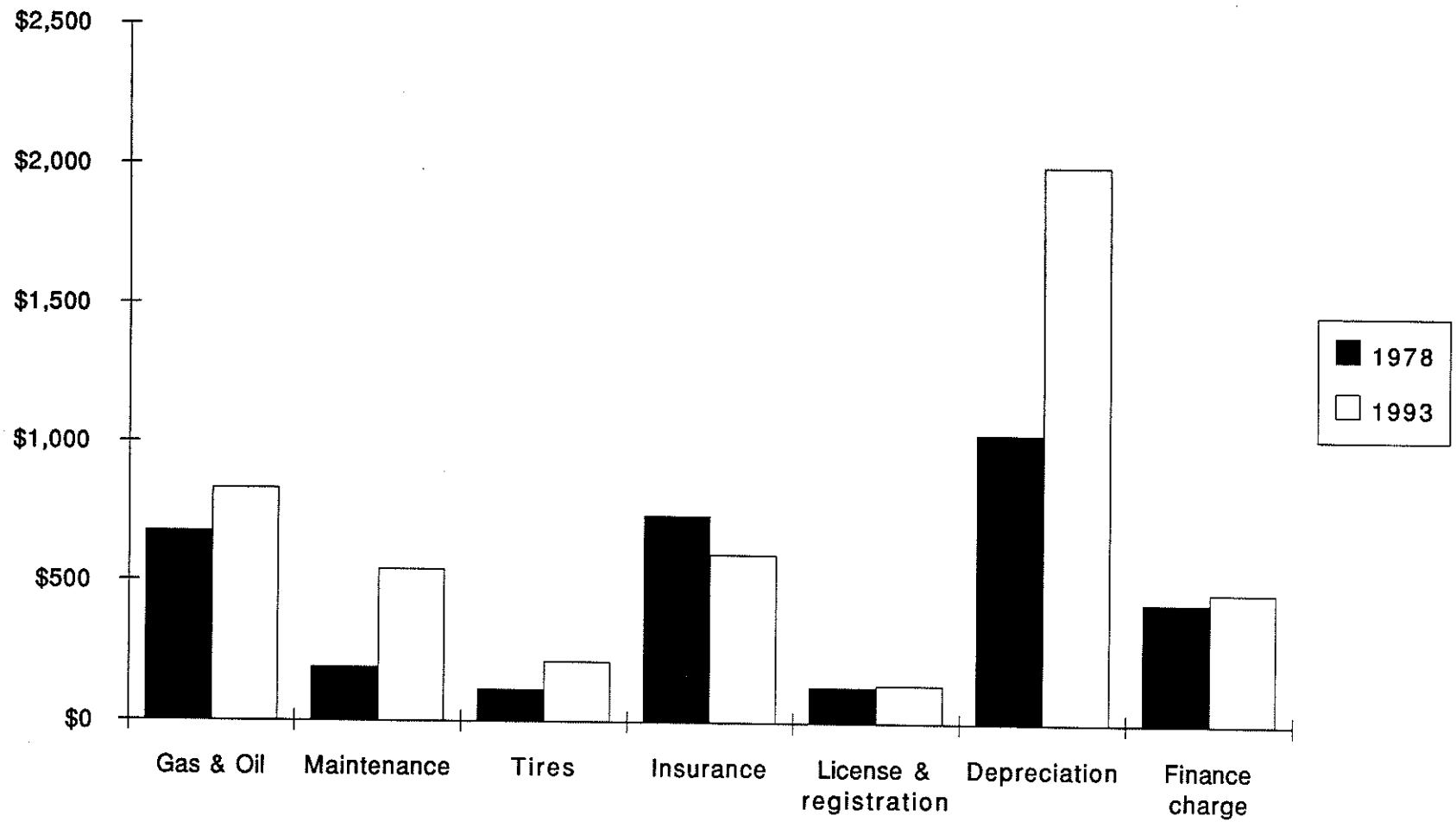
Household Vehicle Energy Consumption 1988, Energy information Agency; TTI estimates of growth rates.

Notes:

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

- 16-17 year old class estimated for Texas
- Under 35 year class (1 adult, no children) estimated for Texas

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



Source: Table 3.15

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 1994 model year automobiles , and statewide municipal ridership.

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

Current dollars

		1978	1993*	Average annual change
Cost per mile		**$0.1908**	**$0.5150**	**6.8%**
Total Cost	**per 10,000 miles**	**$1908**	**$5150**	**6.8%**
Variable Cost	**per mile**	**$0.0565**	**$0.1060**	**4.3%**
Gas & Oil	per mile	$0.0389	$0.0690	3.9%
Maintenance	per mile	$0.0110	$0.0270	6.2%
Tires	per mile	$0.0066	$0.0100	2.8%
Fixed Cost		**$1343**	**$4090**	**11.8%**
Insurance		$424	$765	4.0%
License & registration		$74	$175	5.9%
Depreciation		$596	$2550	10.2%
Finance charge		$249	$600	6.0%

Constant 1987 dollars

		1978	1993*	Average annual change
Cost per mile		**$0.3325**	**$0.4048**	**1.3%**
Total Cost	**per 10,000 miles**	**$3325**	**$4048**	**1.3%**
Variable Cost	**per mile**	**$0.0984**	**$0.0833**	**-1.1%**
Gas & Oil	per mile	$0.0678	$0.0542	-1.5%
Maintenance	per mile	$0.0192	$0.0212	0.7%
Tires	per mile	$0.0115	$0.0078	-2.5%
Fixed Cost		**$2340**	**$3215**	**2.1%**
Insurance		$739	$601	-1.4%
License & registration		$129	$138	0.4%
Depreciation		$1038	$2005	4.5%
Finance charge		$434	$472	0.6%

Sources:

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

Notes:

* estimate

• Consumer Price Index used to update costs to $ 1987

• Depreciation in 1978 adjusted to reflect 6 yr ownership

• Finance charges in 1978 estimated by regression techniques

Table 3.16 Estimated Automobile Fuel Economy by Vehicle Type, 1994 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						
4 cylinder	22	24	23	$481	$569	$656
6 cylinder	15	18	16	$678	$802	$925
8 cylinder	14	17	15	$723	$855	$986
Minicompact						
4 cylinder	22	23	22	$490	$579	$668
6 cylinder	16	19	17	$639	$755	$871
Subcompact						
4 cylinder	23	24	23	$469	$555	$640
6 cylinder	17	20	18	$603	$713	$823
8 cylinder	15	19	17	$664	$785	$905
Compact						
4 cylinder	21	24	22	$494	$584	$674
6 cylinder	17	20	18	$603	$713	$823
8 cylinder	14	17	15	$723	$855	$986
Midsize						
4 cylinder	20	22	21	$527	$623	$719
6 cylinder	17	20	18	$603	$713	$823
8 cylinder	15	18	16	$678	$802	$925
Large						
6 cylinder	17	21	19	$592	$699	$807
8 cylinder	15	19	17	$664	$785	$905

Source:

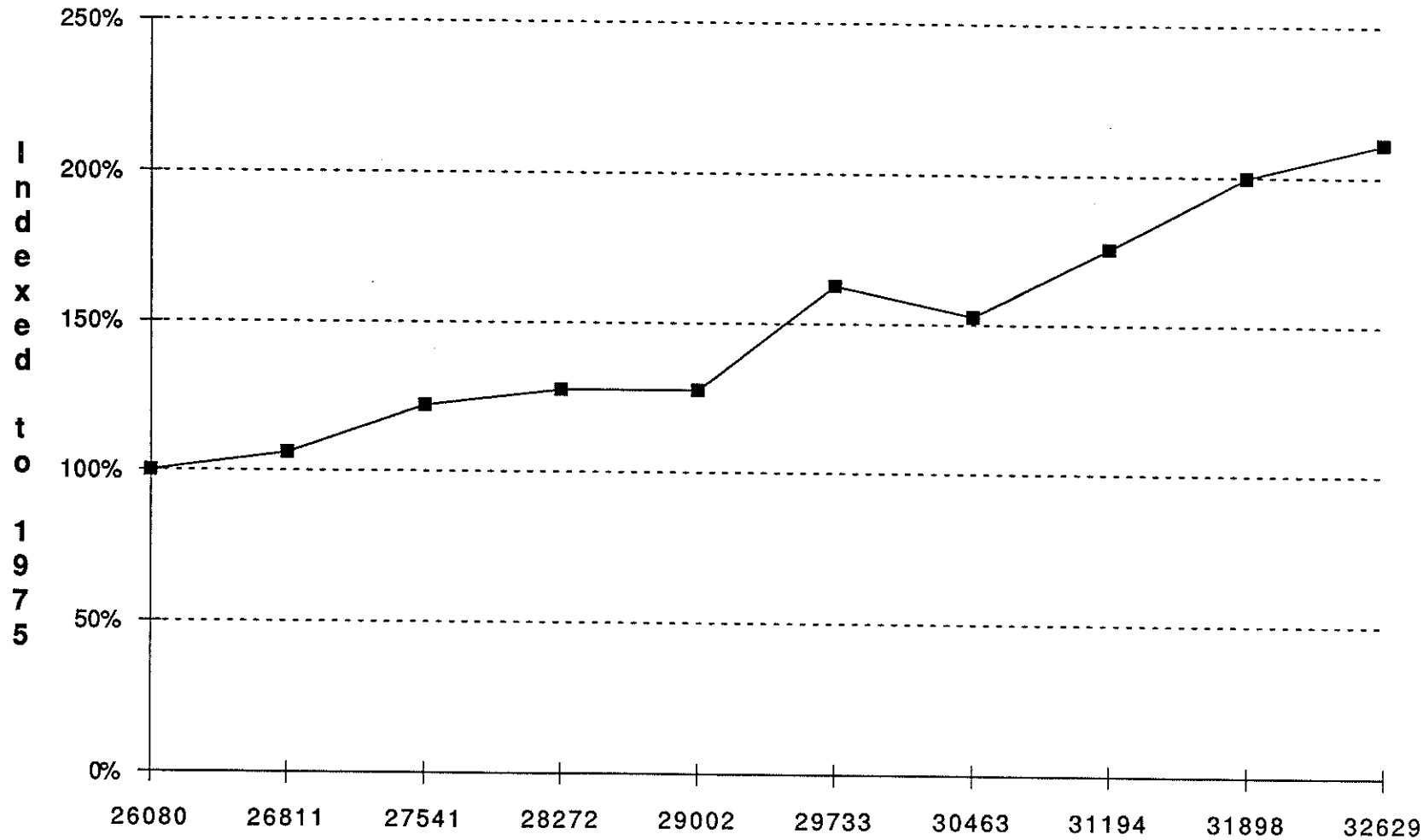
1994 Gas Mileage Guide, EPA Fuel Economy Estimates, Department of Energy

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

Figure 3.12 Texas Statewide Municipal Transit Ridership



Souarce: Table 3.17

Table 3.17 Texas Statewide Municipal Transit Ridership

Year	Total passengers	Change from previous year
1974	116,875,657	
1975	120,734,116	3.3%
1976	122,185,246	1.2%
1977	128,108,456	4.8%
1978	136,252,667	6.4%
1979	147,453,986	8.2%
1980	151,815,720	2.9%
1981	154,057,890	1.5%
1982	155,564,891	1.0%
1983	154,045,488	-1.0%
1984	174,434,290	13.2%
1985	196,351,105	12.6%
1986	190,543,830	-3.0%
1987	184,260,622	-3.3%
1988	198,497,042	7.8%
1989	211,818,182	6.7%
1990	234,181,818	10.6%
1991	241,245,889	3.0%
1992	244,694,210	1.4%
1993*	254,947,907	4.2%
Average annual change 1974-93		4.2%

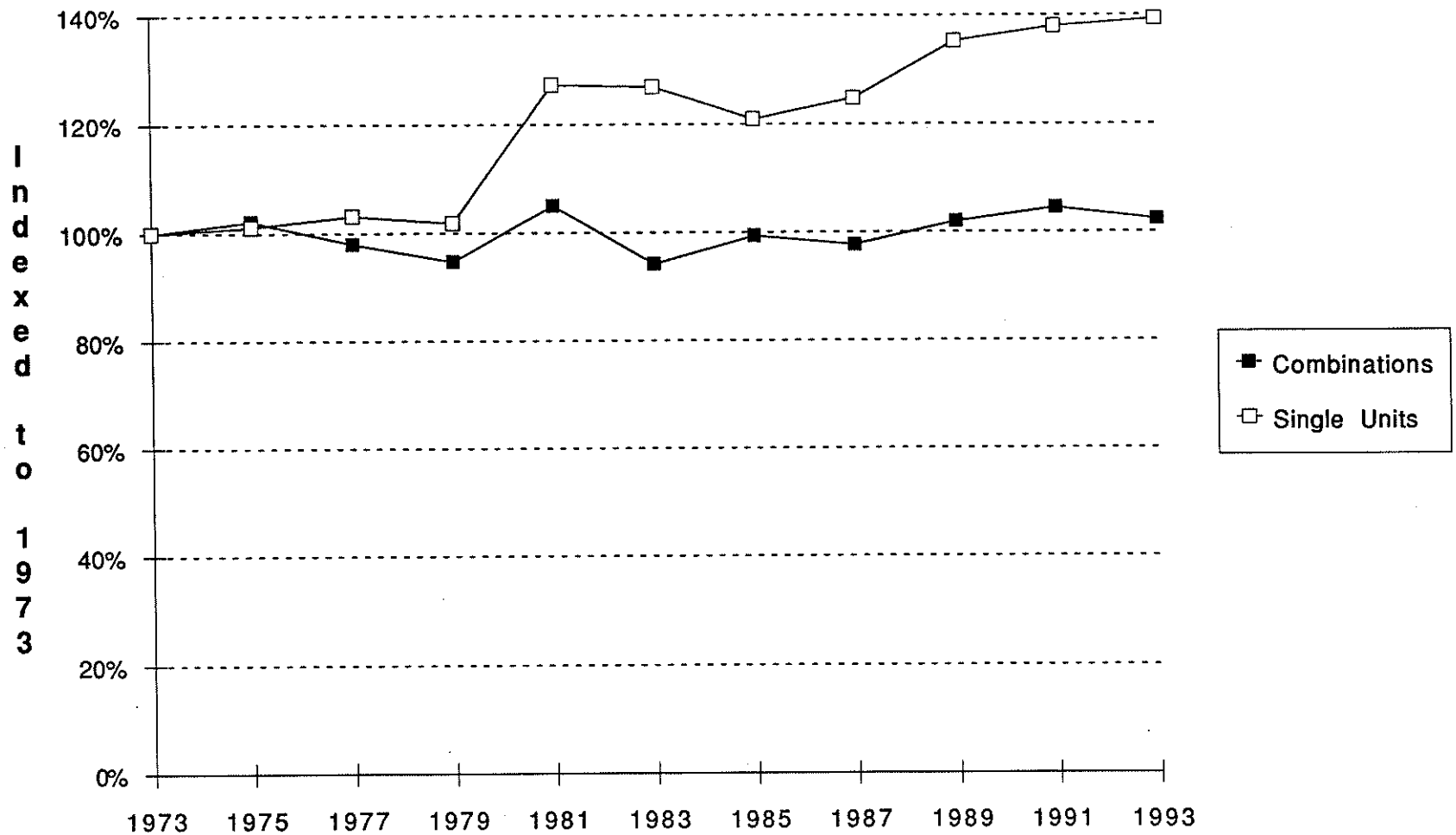
Source:
1988 Texas Transit Statistics,
State Department of Highways and Public Transportation

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.

Figure 3.13 Miles Per Gallon of Trucks Operating in Texas



Source: Tables 3.18 and 3.19

Table 3.18 Estimated Single Unit Truck Fuel Economy in Texas

Year	Registrations	Vehicle miles traveled (Billion)	Miles per gallon	Fuel use (Million gallons)
1973	1,829,086	18.0	9.24	1,954.1
1974	1,934,922	17.4	9.31	1,865.6
1975	2,044,865	18.2	9.34	1,945.4
1976	2,235,011	20.9	9.51	2,203.0
1977	2,365,166	22.2	9.53	2,331.8
1978	2,637,433	24.4	9.72	2,510.2
1979	2,631,809	24.2	9.41	2,568.3
1980	2,815,288	28.3	10.85	2,613.8
1981	3,071,614	33.9	11.76	2,880.9
1982	3,245,371	31.8	10.86	2,929.0
1983	3,354,713	32.6	11.73	2,774.2
1984	3,558,760	36.1	11.53	3,134.1
1985	3,696,672	37.1	11.17	3,321.5
1986	3,727,891	42.1	11.32	3,716.5
1987	3,721,451	43.6	11.53	3,785.8
1988	3,764,104	45.0	11.94	3,768.8
1989	3,820,503	46.4	12.50	3,714.2
1990	3,899,879	47.3	12.74	3,714.3
1991	3,850,408	47.0	12.75	3,683.5
1992*	3,861,860	47.7	12.70	3,751.9
1993*	4,016,391	49.6	12.88	3,848.8
Period:		**Average annual changes**		
1973-93	4.0%	5.2%	1.7%	3.4%
1983-93	1.8%	4.3%	0.9%	3.3%

Source:

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

Notes:

* estimated

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

Table 3.19 Estimated Combination Truck Fuel Economy in Texas

Year	Registrations	Vehicle miles traveled (Billion)	Miles per gallon	Fuel use (Million gallons)
1973	80,219	3.7	5.20	720.9
1974	84,796	4.4	5.16	848.3
1975	104,810	5.1	5.31	970.2
1976	116,559	5.6	5.13	1,097.7
1977	120,229	6.0	5.10	1,183.3
1978	133,451	6.6	5.19	1,267.8
1979	126,373	6.3	4.93	1,272.0
1980	143,180	6.1	5.37	1,137.7
1981	155,455	7.3	5.46	1,338.3
1982	111,175	5.6	5.07	1,106.1
1983	127,912	7.4	4.90	1,507.6
1984	143,884	8.8	5.34	1,654.1
1985	131,208	7.9	5.17	1,532.6
1986	123,385	7.3	5.01	1,455.2
1987	119,655	7.3	5.08	1,432.8
1988	126,290	7.7	5.13	1,503.0
1989	122,371	7.4	5.30	1,389.3
1990	124,496	7.5	5.44	1,372.7
1991	118,289	7.1	5.43	1,316.8
1992*	122,524	7.5	5.36	1,400.3
1993*	125,286	7.7	5.32	1,443.7
Period:		**Average annual changes**		
1973-93	2.3%	3.7%	0.1%	3.5%
1983-93	-0.2%	0.4%	0.8%	-0.4%

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

Notes:
* estimate

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
1988*	94.0%	12,300	1.7%	12,800	0.9%	11,300	3.4%	41,900
1989*	93.7%	12,300	1.7%	12,700	0.9%	11,200	3.7%	41,800
1990*	93.4%	12,300	1.7%	12,600	0.9%	11,100	4.0%	41,700
1991*	93.1%	12,300	1.7%	12,500	0.9%	11,000	4.3%	41,600
1992	93.1%	12,400	1.6%	12,600	0.9%	10,900	4.4%	41,600
1993*	93.2%	12,400	1.5%	12,500	0.9%	10,800	4.4%	41,500
Period:				**Average annual changes**				
1977-93		0.2%		-0.5%		-1.2%		-0.6%
1982-93		0.1%		-0.5%		-0.9%		-0.2%

Source:

Truck Inventory and Use Survey, 1977, 1982 and 1987, U.S. Department of Commerce, Bureau of Census
Texas Highway Cost Allocation Analysis and Estimates, 1992-94, Center for Transportation Research, Texas Transportation Institute

Notes:

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

Table 3.21 Texas Truck Mileage by Vehicle Range

	Local		Short Range		Long Range		Off-Road	
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	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
1988*	72.0%	12,000	18.8%	17,200	5.2%	24,600	4.0%	7,000
1989*	71.3%	12,000	19.6%	16,800	5.5%	24,100	3.6%	6,700
1990*	70.5%	12,000	20.4%	16,300	5.9%	23,500	3.2%	6,400
1991*	69.7%	12,000	21.2%	15,900	6.3%	22,800	2.8%	6,100
1992	68.8%	11,900	22.1%	15,500	6.7%	22,300	2.5%	5,800
1993*	67.8%	11,900	22.9%	15,100	7.1%	21,700	2.2%	5,500
Period:			**Average annual changes**					
1977-93		0.2%		-2.7%		-5.3%		-4.1%
1982-93		-0.4%		-2.2%		-4.1%		-4.5%

Source:

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

Notes:

* estimate

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.

Table 3.22 Texas Truck Mileage by Major Use

Major Use	1977 Percent of total trucks	1977 Avg. annual miles per truck	1993* Percent of total trucks	1993* Avg. annual miles per truck	Period: 1977-93 Average annual mileage changes
Personal transportation	56.0%	10,800	71.9%	10,200	-0.4%
Agriculture	18.2%	11,100	4.6%	7,900	-2.1%
Construction	6.0%	19,200	12.3%	14,100	-1.9%
Manufacturing	1.8%	28,100	1.2%	23,000	-1.2%
Retail trade	3.6%	16,900	3.7%	16,900	0.0%
Wholesale trade	3.7%	25,800	0.8%	30,600	1.1%
For Hire	1.9%	42,700	1.1%	56,600	1.8%
Utilities	2.1%	14,200	1.0%	17,200	1.2%
For Service	5.1%	15,300	2.4%	13,100	-1.0%
Mining and quarrying	0.8%	21,700	0.5%	11,900	-3.7%
Forestry and lumbering	0.4%	23,800	0.5%	25,400	0.4%
Daily rental	0.3%	37,100	0.0%	43,700	1.0%

Source:

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

Notes:

* estimate

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

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

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

CHAPTER 4

TEXAS NON-HIGHWAY MODE CHARACTERISTICS

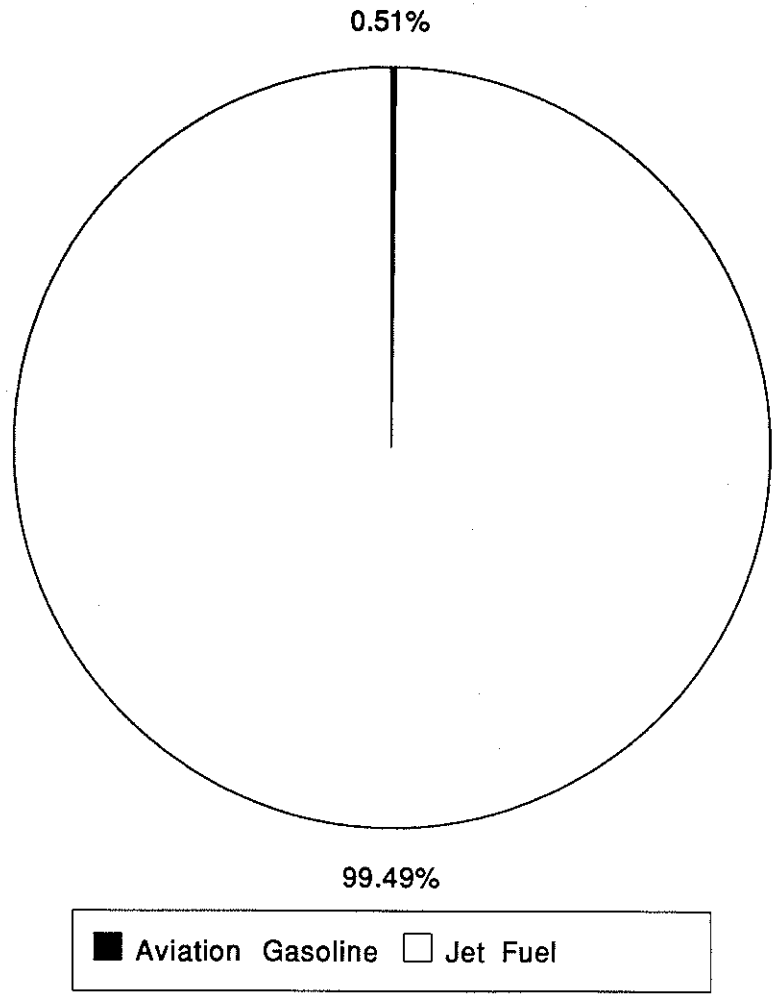
Chapter 4 provides detailed information about the energy related characteristics of the non-highway modes of travel and freight movement in Texas. Section 4.1 is concerned with the State's air mode. Section 4.2 concentrates on waterborne transportation energy characteristics in Texas. This section focuses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

Section 4.1

Air Mode

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

Figure 4.1 Texas Air Mode Energy Use by Fuel Type, 1993



Source: Table 4.1

Table 4.1 Air Mode Energy Consumption by Fuel Type

Trillion Btu

Year	Aviation Gas	Jet Fuel	Total
1973	7.9	110.8	118.7
1974	8.2	106.5	114.6
1975	6.7	116.5	123.2
1976	6.5	109.0	115.5
1977	6.9	113.4	120.3
1978	6.5	123.7	130.2
1979	6.0	132.1	138.1
1980	6.4	138.2	144.6
1981	6.6	141.5	148.1
1982	4.6	206.7	211.3
1983	3.9	233.6	237.5
1984	4.9	330.7	335.6
1985	6.7	390.9	397.6
1986	7.8	424.4	432.2
1987	5.8	447.7	453.6
1988	5.1	504.6	509.8
1989	4.2	497.7	501.8
1990	4.3	517.3	521.6
1991	3.3	493.1	496.5
1992*	3.2	535.8	538.9
1993*	3.0	582.1	585.1
Average annual changes			
Time Period:			
1973-93	0.0	0.1	8.3%
1983-93	0.0	0.1	9.4%

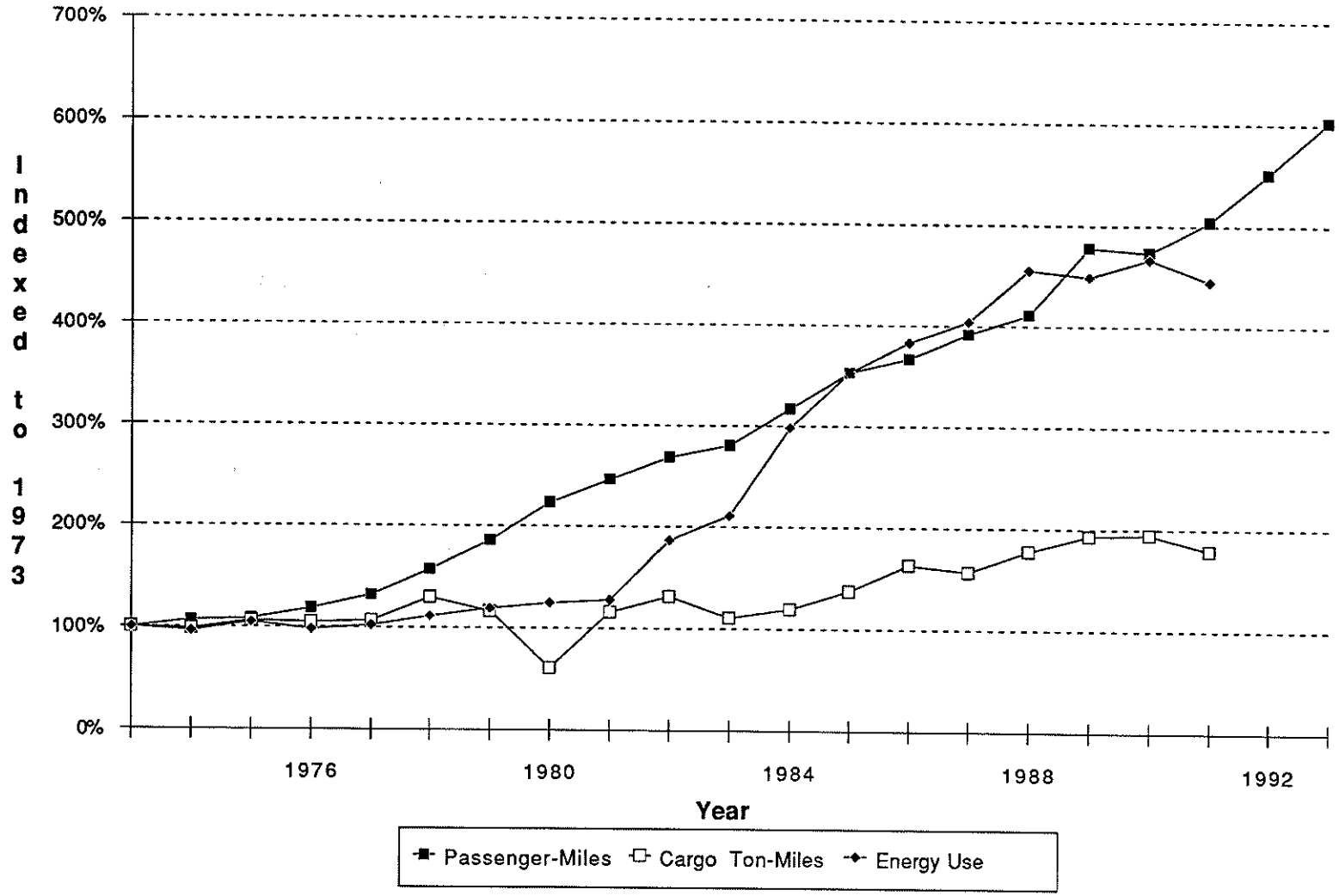
Sources:

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

Notes:

* estimate

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



Source: Table 4.2

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

Year	Number of departures	Total enplanements (millions)	Revenue aircraft miles (millions)	Average passenger trip length (mi)	Revenue passenger-miles (millions)	Revenue cargo ton-mi (millions)	Texas energy	
							Use (trillion Btu)	As percentage of U.S. Air mode(a)
1973	280,919	12.2	145.3	716	8,759.5	308.8	110.8	7.7%
1974	278,625	13.2	149.7	708	9,358.6	305.0	106.5	8.3%
1975	267,289	13.2	144.1	722	9,519.4	328.7	116.5	9.1%
1976	276,075	14.5	150.5	718	10,404.0	324.5	109.0	8.2%
1977	289,827	15.9	159.7	728	11,547.4	329.9	113.4	8.2%
1978	302,640	18.2	173.2	753	13,732.5	401.3	123.7	8.6%
1979	341,285	21.5	194.5	754	16,245.5	359.1	132.1	8.6%
1980	404,094	25.3	249.2	773	19,554.3	188.3	138.2	9.3%
1981	428,672	27.4	259.4	785	21,560.2	357.6	141.5	9.9%
1982	447,168	29.5	281.7	796	23,517.4	405.6	206.7	14.7%
1983	456,499	30.9	283.0	796	24,572.1	342.6	233.6	16.2%
1984	518,904	35.1	332.7	791	27,781.6	369.8	330.7	20.6%
1985	529,643	38.9	352.6	795	30,917.4	424.3	390.9	23.0%
1986	538,352	40.0	369.4	804	32,143.3	504.5	424.4	23.0%
1987	565,895	41.5	387.6	827	34,309.8	484.0	447.7	23.0%
1988	575,294	42.7	408.2	844	35,989.6	547.1	504.6	24.6%
1989	588,499	45.3	473.4	838	41,882.3	595.8	497.7	23.8%
1990	617,284	43.3	472.2	851	41,454.3	600.0	517.3	23.6%
1991	610,963	42.3	492.4	858	44,136.5	551.6	493.1	22.0%
1992*	637,913	45.3	527.2	867	48,251.8	572.1	535.8	23.3%
1993*	666,051	48.6	564.4	875	52,750.8	593.2	582.1	24.7%
Period:				**Average annual changes**				
1973-93	4.4%	7.1%	7.0%	1.0%	9.4%	3.3%	8.6%	-
1983-93	3.9%	4.6%	7.1%	0.9%	7.9%	5.6%	9.6%	-

Source:

FAA Statistical Handbook of Aviation, annual issues

Notes:

* estimate

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

Table 4.3 Enplanements and Estimated Energy Use for Selected Texas Cities

Year	Dallas/Ft. Worth Enplanements (in millions)	Est. Btu Use (tril.)	Houston Enplanements (in millions)	Est. Btu Use (tril.)	San Antonio Enplanements (in millions)	Est. Btu Use (tril.)	El Paso Enplanements (in millions)	Est. Btu Use (tril.)
1973	6.6	58.2	2.8	25.3	1.0	9.7	0.5	4.3
1974	7.0	54.9	2.9	23.3	0.9	7.9	0.6	4.6
1975	7.2	62.0	3.0	26.4	0.9	8.5	0.6	5.1
1976	7.8	57.3	3.2	23.6	0.9	6.9	0.6	4.3
1977	8.2	57.3	3.5	24.5	0.9	6.7	0.6	4.1
1978	9.7	65.0	4.7	31.2	1.1	7.9	0.8	5.2
1979	11.5	70.4	5.6	33.4	1.3	8.4	0.9	5.2
1980	12.8	69.1	6.8	36.6	1.6	9.0	0.9	4.7
1981	13.9	70.8	7.5	38.5	1.7	9.2	1.0	4.9
1982	14.7	102.7	8.5	59.7	1.6	10.7	1.0	6.7
1983	15.7	119.0	8.5	65.1	1.8	13.0	1.0	7.2
1984	18.5	172.9	9.2	88.7	2.0	18.1	1.1	10.0
1985	20.9	209.9	10.0	103.4	2.1	20.0	1.2	11.4
1986	21.8	229.8	10.3	114.3	2.2	22.1	1.2	12.0
1987	22.4	240.9	10.9	122.3	2.4	24.3	1.3	13.1
1988	23.5	276.7	10.7	132.9	2.4	26.5	1.4	15.5
1989	25.4	282.6	10.9	127.8	2.5	25.8	1.7	17.5
1990	25.8	308.3	11.5	137.4	2.6	31.1	1.7	20.3
1991	25.4	289.3	11.6	132.1	2.5	28.5	1.7	19.4
1992	27.4	338.7	12.6	155.3	2.6	32.5	1.8	22.5
1993*	29.5	396.6	13.6	182.6	2.8	37.2	1.9	26.2
				Average annual changes				
1972-93	7.8%	10.1%	8.2%	10.4%	5.2%	6.9%	7.0%	9.4%
1983-93	6.5%	12.8%	4.8%	10.9%	4.4%	11.1%	6.9%	13.7%

Source:

FAA Statistical Handbook of Aviation, annual issues

* estimated

Table 4.4 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
1973	33,400	82,608	10,835	35,313	4,301	6,541	1,444	4,867
1974	34,681	76,034	11,508	40,880	4,110	5,415	1,471	5,466
1975	34,457	70,284	11,616	39,786	4,068	4,492	1,479	5,606
1976	39,502	84,218	14,399	36,608	4,091	4,497	1,611	6,352
1977	41,405	94,665	14,847	41,986	4,202	5,322	1,688	7,776
1978	42,240	98,316	15,911	54,710	4,126	6,459	1,754	8,048
1979	43,018	98,315	16,679	52,632	4,301	6,166	1,911	9,318
1980	46,582	92,609	16,399	46,849	4,671	5,433	1,921	6,377
1981	48,765	84,448	16,246	42,660	4,473	4,838	1,666	6,225
1982	52,918	89,691	17,607	48,193	5,168	4,082	1,621	5,393
1983	58,205	78,821	16,549	38,218	4,923	3,326	1,348	3,621
1984	66,651	93,118	16,946	36,661	5,693	3,237	1,292	2,198
1985	54,767	92,307	23,088	56,676	6,143	2,386	1,323	2,642
1986	61,927	109,310	24,028	80,504	6,993	6,789	1,383	3,094
1987	71,908	106,951	22,949	50,853	7,146	7,942	1,349	3,796
1988	75,505	136,241	25,669	52,757	6,950	8,165	1,347	4,338
1989	76,930	140,077	23,038	60,023	7,057	8,793	1,234	4,284
1990	86,950	144,879	21,866	66,413	7,585	10,050	1,760	4,825
1991	86,645	141,303	19,383	75,432	7,120	11,265	1,601	5,757
1992*	91,357	145,580	20,020	78,681	7,322	11,610	1,610	5,811
1993*	96,326	149,987	20,677	82,069	7,530	11,966	1,619	5,865
			Average annual changes					
1973-93	5.4%	3.0%	3.3%	4.3%	2.8%	3.1%	0.6%	0.9%
1983-93	5.2%	6.6%	2.3%	7.9%	4.3%	13.7%	1.9%	4.9%

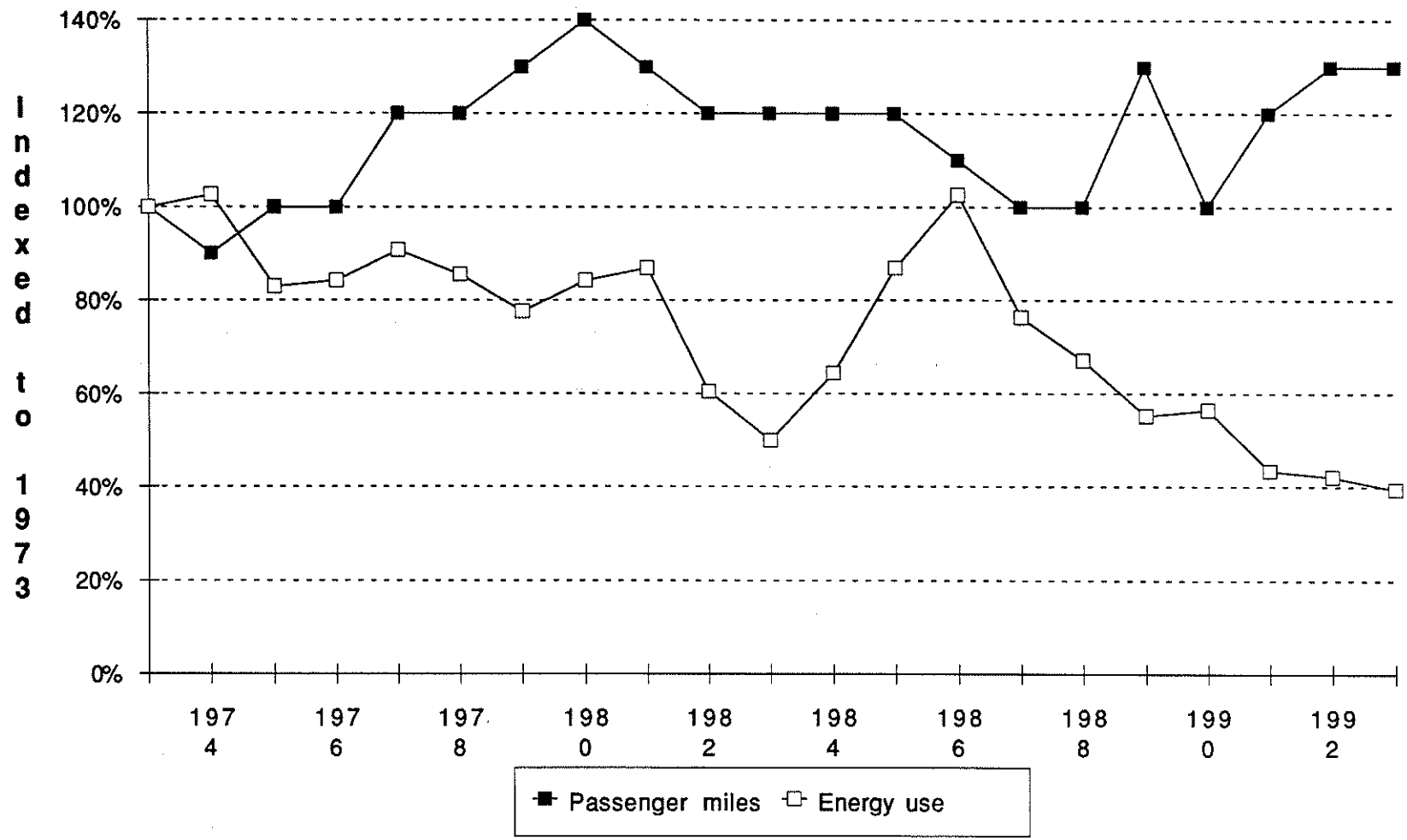
Source:

FAA Statistical Handbook of Aviation, annual issues

Notes:

* estimate

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



Source: Table 4.5

Table 4.5 Summary Statistics for General Aviation in Texas

Year	Estimated active Gen. Aviation aircraft	As % of U.S.	Estimated hours flown (000)	Btu per hr flown (millions)	Estimated intercity passenger-mi (billions)	Btu per passenger-mi	Btu used (trillions)
1973	13,028	8.8%	2,553	3.1	1.0	8,280	7.9
1974	11,858	7.3%	2,383	3.4	0.9	9,089	8.2
1975	12,603	7.5%	2,558	2.6	1.0	6,930	6.7
1976	13,479	7.6%	2,736	2.4	1.0	6,235	6.5
1977	16,050	8.7%	3,258	2.1	1.2	5,589	6.9
1978	14,355	7.2%	3,108	2.1	1.2	5,465	6.5
1979	15,231	7.2%	3,397	1.8	1.3	4,591	6.0
1980	18,674	8.9%	3,842	1.7	1.4	4,665	6.4
1981	19,481	9.1%	3,753	1.8	1.3	4,912	6.6
1982	19,153	9.1%	3,275	1.4	1.2	3,896	4.6
1983	20,414	9.6%	3,061	1.3	1.2	3,211	3.9
1984	19,941	9.0%	3,405	1.4	1.2	3,989	4.9
1985	19,887	9.4%	3,270	2.0	1.2	5,662	6.7
1986	19,961	9.1%	2,928	2.7	1.1	7,404	7.8
1987	18,358	8.5%	2,859	2.0	1.0	5,646	5.8
1988	17,424	8.3%	2,771	1.9	1.0	4,945	5.1
1989	18,321	8.3%	3,350	1.2	1.3	3,133	4.2
1990	16,655	7.8%	2,725	1.6	1.0	4,158	4.3
1991	16,206	7.5%	2,856	1.2	1.2	2,662	3.3
1992*	16,404	7.4%	2,874	1.1	1.3	2,520	3.2
1993*	16,604	7.3%	2,892	1.0	1.3	2,387	3.0
Average annual changes							
1973-93	1.2%	-0.9%	0.6%	-5.3%	1.4%	-6.0%	-4.7%
1983-93	-2.0%	-2.6%	-0.6%	-1.9%	0.5%	-2.9%	-2.4%

Source:

FAA Statistical Handbook of Aviation, annual issues

Notes:

* estimate

Table 4.6 Distribution of General Aviation Aircraft in Texas

Year	Estimated active Gen. Aviation aircraft	Fixed wing distribution			Non-fixed wing distribution	
		Piston	Turboprop	Turbojet	Rotary wing	Other
1974*	11,858	91.9%	2.2%	1.8%	3.2%	1.0%
1975*	12,603	91.4%	2.4%	1.9%	3.4%	1.0%
1976*	13,479	91.3%	2.3%	1.9%	3.5%	1.1%
1977*	16,050	90.7%	2.5%	2.0%	3.6%	1.3%
1978*	14,355	90.5%	2.5%	2.0%	3.7%	1.4%
1979	15,231	90.5%	2.4%	1.9%	3.3%	1.9%
1980	18,674	89.6%	2.8%	2.1%	3.5%	2.0%
1981	19,481	88.1%	3.3%	2.5%	4.0%	2.1%
1982	19,153	87.5%	3.4%	2.8%	4.3%	2.0%
1983	20,414	87.4%	3.3%	2.8%	4.2%	2.3%
1984	19,941	87.1%	3.5%	2.9%	4.2%	2.3%
1985	19,887	86.9%	3.4%	3.0%	4.2%	2.5%
1986	19,961	87.1%	3.2%	3.0%	4.2%	2.5%
1987	18,358	87.6%	2.9%	2.5%	4.3%	2.7%
1988	17,424	88.3%	2.5%	2.3%	3.9%	3.0%
1989	18,321	88.2%	2.9%	2.0%	3.4%	3.5%
1990	16,655	88.5%	2.7%	2.1%	3.5%	3.2%
1991	16,206	88.3%	2.7%	2.1%	3.5%	3.3%
1992*	16,404	88.1%	2.8%	2.1%	3.5%	3.5%
1993*	16,604	87.9%	2.8%	2.2%	3.6%	3.6%

Source:

FAA Statistical Handbook, annual issues

Notes:

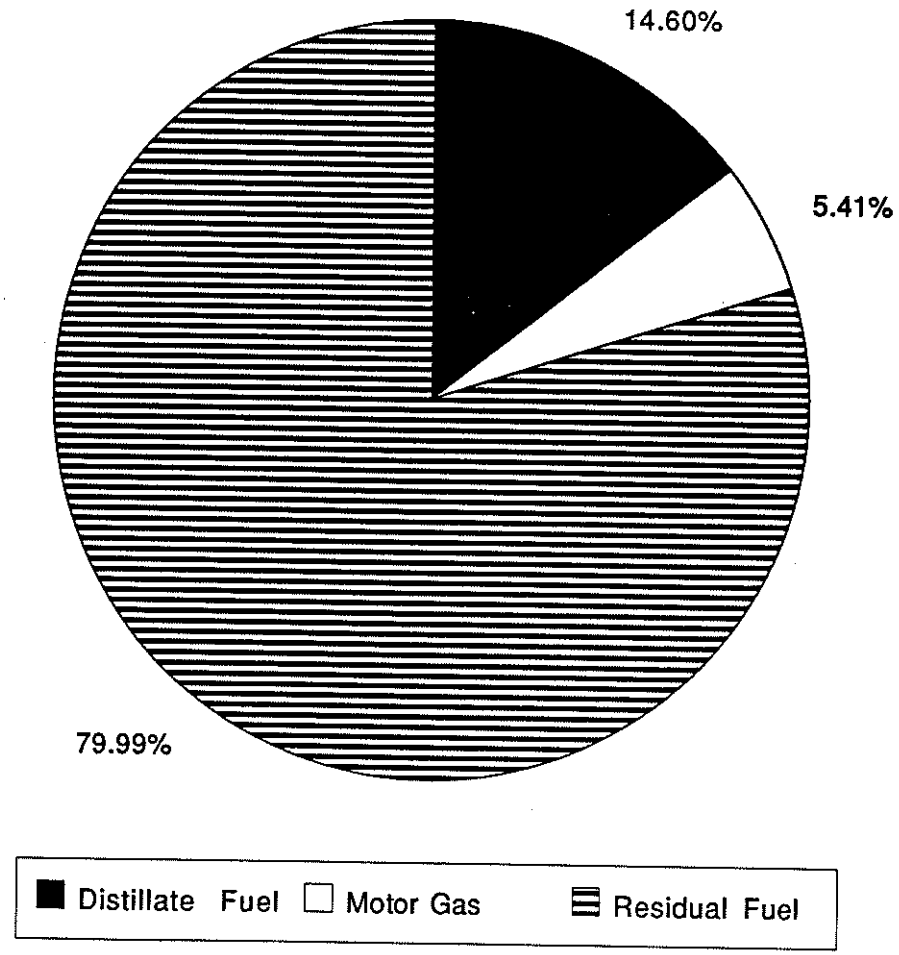
* estimate

Section 4.2

Water Mode

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

Figure 4.4 Water Mode Energy Use by Fuel Type, 1993



Source: Table 4.7

Table 4.7 Water Mode Energy Consumption by Fuel Type

Trillion Btu

Year	Distillate Fuel	Motor Gas	Residual Fuel	Total
1973	24.4	6.7	94.7	125.8
1974	22.0	6.9	127.6	156.5
1975	25.0	7.5	144.7	177.2
1976	28.5	7.3	156.3	192.1
1977	36.3	6.8	188.1	231.2
1978	36.2	7.8	214.8	258.8
1979	40.7	7.9	309.2	357.7
1980	33.9	7.7	283.5	325.2
1981	64.1	7.8	223.8	295.7
1982	48.7	7.9	191.3	247.9
1983	21.7	7.7	157.4	186.7
1984	21.3	10.6	153.8	185.7
1985	26.1	8.5	136.6	171.2
1986	41.8	8.6	161.4	211.8
1987	48.2	8.8	123.5	180.4
1988	38.3	9.1	139.2	186.6
1989	45.0	8.9	164.7	218.6
1990	31.5	8.8	165.8	206.1
1991	32.5	11.7	171.8	215.9
1992*	33.0	12.0	177.5	222.5
1993*	33.5	12.4	183.5	229.4
	Average annual changes			
Period:				
1973-93	1.6%	3.1%	3.4%	3.1%
1983-93	4.5%	4.8%	1.6%	2.1%

Sources:

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

Notes:

* estimate

Table 4.8 Summary Statistics for Domestic Waterborne Traffic in Texas

Year	Estimated tons shipped (millions)	Estimated ton-miles (millions)	Estimated avg. length of haul (miles)	Estimated energy intensity (Btu/ton-mi)	Estimated energy use (trillion Btu)
1973	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
1989	359.6	16,985.1	47.2	371	6.3
1990	342.9	16,758.0	48.9	359	6.0
1991	332.7	16,796.3	50.5	347	5.8
1992*	322.0	16,807.1	52.2	336	5.6
1993*	311.6	16,783.7	53.9	326	5.5
			Average annual changes		
1973-93	0.4%	1.7%	1.3%	-3.0%	-1.4%
1983-93	0.4%	3.1%	2.7%	-0.2%	2.9%

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

Notes:

* estimate

Table 4.9 Summary Statistics for Galveston District

Year	Estimated tons shipped (millions)	Estimated ton-miles (millions)	Estimated avg. length of haul (miles)	Estimated energy intensity (Btu/ton-mi)	Estimated energy use (trillion Btu)
1973	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
1989	288.5	10,357.9	34.8	371	3.8
1990	272.6	10,148.1	34.8	359	3.6
1991	263.6	10,281.6	34.8	347	3.6
1992*	254.0	10,375.3	34.8	336	3.5
1993*	244.7	10,434.7	34.8	326	3.4
			Average annual changes		
1973-93	0.4%	2.0%	0.6%	-3.0%	-1.0%
1983-93	0.3%	3.8%	1.4%	-0.2%	3.6%

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

Notes:

* estimate

Table 4.10 Summary Statistics for Texas Gulf Intracoastal Waterway

Year	Estimated tons shipped (millions)	Estimated ton-miles (millions)	Estimated avg. length of haul (miles)	Estimated energy intensity (Btu/ton-mi)	Estimated energy use (trillion Btu)
1973	63.0	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
1989	71.1	6,627.2	93.5	371	2.5
1990	70.3	6,609.9	93.5	359	2.4
1991	69.1	6,514.7	93.5	347	2.3
1992*	68.0	6,431.9	93.5	336	2.2
1993*	66.9	6,349.0	93.5	326	2.1
		Average annual changes			
1973-93	0.3%	1.2%	0.8%	-3.0%	-1.9%
1983-93	0.9%	2.1%	1.0%	-0.2%	1.9%

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

Notes:

* estimate

Table 4.11 Estimated Commodities Shipped by Water in Texas, 1993

Commodity	Galveston District (tons)	Texas GIWW (tons)	GIWW percent of total	Total (tons)	Commodity percent of total
Agriculture & Food products	13,697,524	473,785	3.3%	14,171,309	4.5%
Chemicals & related products	47,778,302	18,056,265	27.4%	65,834,567	21.1%
Forestry & paper products	656,253	37,366	5.4%	693,619	0.2%
Machinery	527,009	41,215	7.3%	568,223	0.2%
Metals, Metal products & ore	9,181,724	992,709	9.8%	10,174,433	3.3%
Miscellaneous	2,756,044	1,108,207	28.7%	3,864,251	1.2%
Petroleum & coal products	163,355,312	41,272,188	20.2%	204,627,500	65.7%
Radioactive materials	1,198	0	0.0%	1,198	0.0%
Sand, gravel, stones, rocks	2,793,013	2,201,462	44.1%	4,994,475	1.6%
Scrap & waste material	2,649,089	1,777,138	40.2%	4,426,228	1.4%
Textiles & textile products	95,292	33,022	25.7%	128,313	0.0%
Transportation equipment & parts	398,902	7,395	1.8%	406,297	0.1%
Shells	810,338	899,249	52.6%	1,709,588	0.5%
Total	244,700,000	66,900,000	21.5%	311,600,000	

Source:
Waterborne Commerce of the United States, 1990, Department of the Army, Corps of Engineers
TTI estimates for 1993

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 4.12 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)
1973	2,520	104.2	58.0	34.5	23.4	107.7
1974	2,340	96.9	55.8	33.4	22.4	96.8
1975	2,116	95.2	54.9	31.2	23.7	84.6
1976	1,971	92.3	50.9	29.9	20.9	74.0
1977	1,835	92.7	51.3	30.7	20.6	68.4
1978	2,225	111.3	66.4	40.8	25.6	77.1
1979	2,046	98.9	61.5	37.6	23.9	80.2
1980	2,563	123.9	75.8	46.8	29.1	108.1
1981	2,405	116.9	69.9	41.3	28.6	105.1
1982	2,389	127.9	75.1	44.5	30.7	106.0
1983	2,685	156.8	88.7	53.0	35.7	109.2
1984	2,773	155.6	87.8	51.4	36.3	112.2
1985	2,344	138.2	76.5	45.3	31.2	95.6
1986	2,020	128.9	72.0	41.7	30.3	85.2
1987	2,014	122.3	68.7	40.0	28.7	84.4
1988	2,446	144.8	81.5	47.6	33.9	111.8
1989	2,490	139.5	77.4	44.9	32.6	111.4
1990	2,367	132.3	73.8	42.4	31.5	110.5
1991	2,376	135.3	75.6	46.8	32.4	111.1
1992*	2,375	137.9	77.1	51.4	33.1	111.3
1993*	2,375	140.5	78.7	56.5	33.9	111.5
		Average Annual Percentage Rate				
Time Period:						
1973-93	-0.3%	1.5%	1.5%	2.5%	1.9%	0.2%
1983-93	-1.2%	-1.1%	-1.2%	0.7%	-0.5%	0.2%

Sources:

State Energy Data Report, Energy Information Administration;
ORNL Transportation Energy Book 1993

Notes:

* estimate

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 4.13 Rail Mode Energy Consumption by Fuel Type

Year	Distillate fuel	Residual fuel	Energy use (trillion Btu)
1973	73.8	0.9	74.7
1974	80.0	0.6	80.7
1975	71.9	0.4	72.2
1976	66.6	0.5	67.1
1977	69.0	0.3	69.4
1978	66.2	0.4	66.6
1979	65.6	0.5	66.1
1980	45.6	0.5	46.2
1981	75.5	0.4	75.9
1982	75.0	0.0	75.0
1983	53.0	0.0	53.0
1984	57.6	0.0	57.6
1985	52.5	0.0	52.5
1986	42.5	0.0	42.5
1987	49.1	0.0	49.1
1988	52.0	0.0	52.0
1989	54.3	0.0	54.3
1990	50.9	0.0	50.9
1991	62.3	0.0	62.3
1992*	61.7	0.0	61.7
1993*	61.2	0.0	61.2
Average annual changes			
Time Period:			
1973-93	-0.9%	-100.0%	-1.0%
1983-93	1.4%	-100.0%	1.4%

Sources:

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

Notes:

* estimate

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

Year	Estimated ton-miles (billions)	Estimated gallons consumed	Estimated energy use (trillion Btu)	Estimated energy intensity (Btu/ton-mi)
1973	106.53	538,692,199	74.7	701
1974	115.06	581,796,308	80.7	701
1975	103.14	520,895,842	72.2	700
1976	97.49	483,585,234	67.1	688
1977	102.74	500,104,076	69.4	675
1978	101.18	480,486,007	66.6	659
1979	102.90	476,728,516	66.1	643
1980	75.24	332,965,197	46.2	614
1981	128.49	547,318,129	75.9	591
1982	132.26	540,531,166	75.0	567
1983	97.72	382,456,196	53.0	543
1984	111.50	415,490,085	57.6	517
1985	102.06	378,487,152	52.5	514
1986	84.30	306,174,419	42.5	504
1987	104.24	354,243,982	49.1	471
1988	116.92	375,282,817	52.0	445
1989*	120.45	391,614,495	54.3	451
1990*	117.00	367,183,585	50.9	435
1991*	146.81	449,326,032	62.3	424
1992*	148.88	445,134,966	61.7	415
1993*	151.06	440,982,992	61.2	405
Average annual changes				
Time Period:				
1973-93	0.02	-1.0%	-1.0%	-2.7%
1983-93	0.04	1.4%	1.4%	-2.9%

Sources:

State Energy Data Report, Energy Information Administration, 1993

Transportation Energy Data Book : Edition 13,

Oak Ridge National Laboratories, 1993

Texas Railroad Facts, 1990

Note:

* estimate

Table 4.15 Comparative Statistics for 1993* Class I Railroads

	Units	Texas	United States	Texas as percentage of U.S.
Train miles	million	30	370	8%
Avg. length of haul	miles	240	760	31%
Revenue ton-miles	billions	151	1,100	14%
BTU/Revenue ton-mile	units	405	380	107%

Source:

Texas Railroad Facts 1990, Railroad Commission of Texas

Transportation Energy Data Book: Edition 13, Oak Ridge National Laboratories, 1993

Transportation in America, Supplement, Eno Transportation Foundation, 1993

Note:

* estimate

Table 4.16 Estimated Top Five Commodities of Total Freight by Tonnage, 1993

Commodity/Description	STCC Code (a)	Tons (millions)	Carloads (thousands)
Chemicals & allied products	28	65	780
Coal	11	62	610
Farm products	1	25	300
Food & kindred products	20	37	660
Nonmetalic minerals except fuels	14	55	650

Sources:
Texas Railroad Facts 1990, Railroad Commission of Texas
Transportation Energy Data Book : Edition 13, Oak Ridge National Laboratories, 1993
Notes:
(a) STCC refers to Standard Transportation Commodity Code

Table 4.17 Estimated Top Five Commodities of Total Freight by Carloads, 1993

Commodity/Description	STCC Code (a)	Carloads (thousands)	Tons (millions)
Misc. mixed shipments	46	900	20
Chemicals & allied products	28	780	65
Coal	11	610	62
Transportation equipment	37	400	10
Farm products	1	300	25

Sources:

Texas Railroad Facts 1990, Railroad Commission of Texas

Transportation Energy Data Book : Edition 13, Oak Ridge National Laboratories, 1993

Notes:

(a) STCC refers to Standard Transportation Commodity Code

CHAPTER 5

ALTERNATIVE FUELS AND NEW ENERGY SAVING TECHNOLOGY

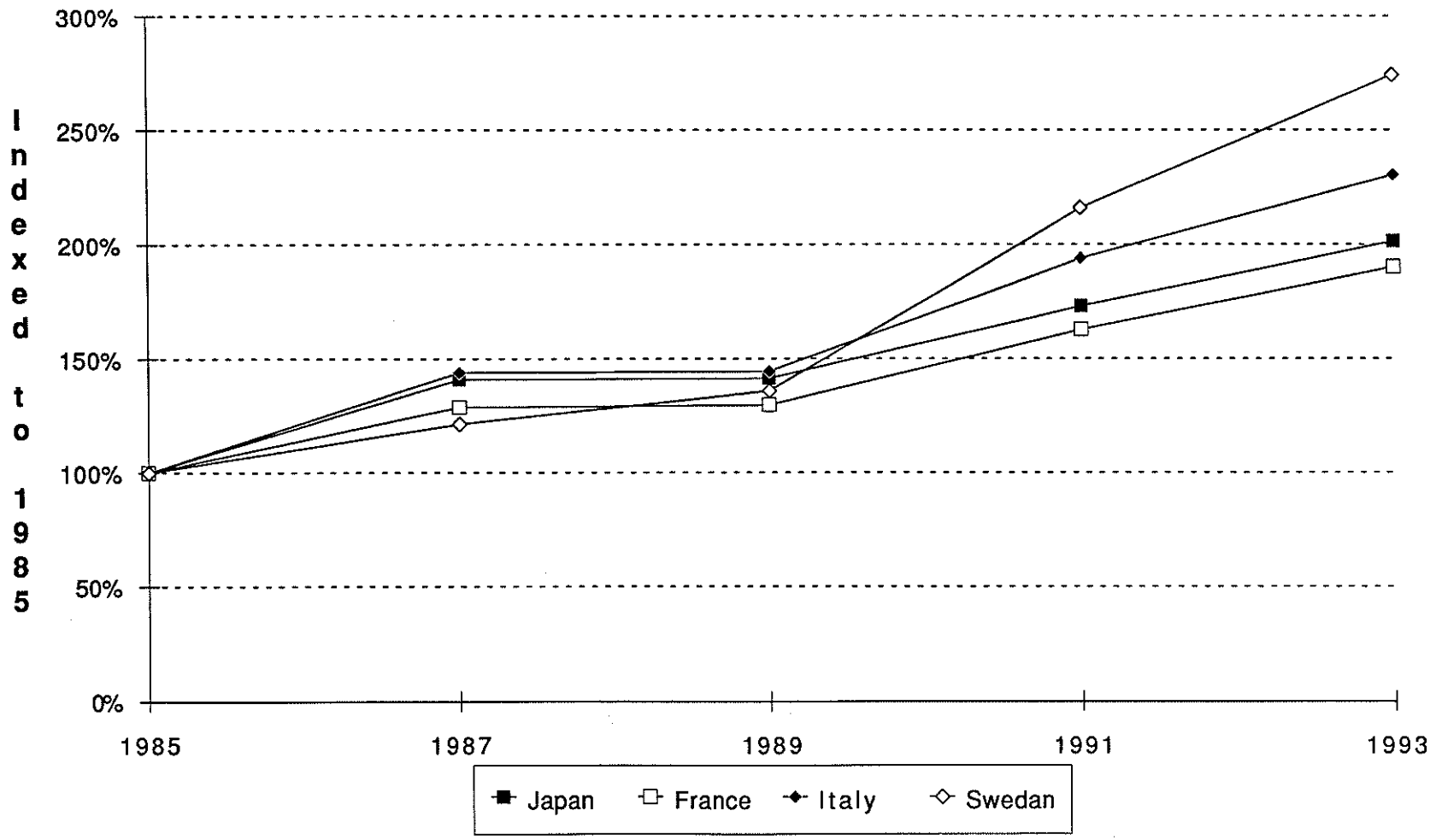
In this concluding chapter, information about alternative fuels and technology that reduces energy consumption are presented. Section 5.1 concentrates on the characteristics of alternative fuels and section 5.2 presents information on new technology, including profiles of Electric Vehicles (EV).

Section 5.1

Alternative Fuels

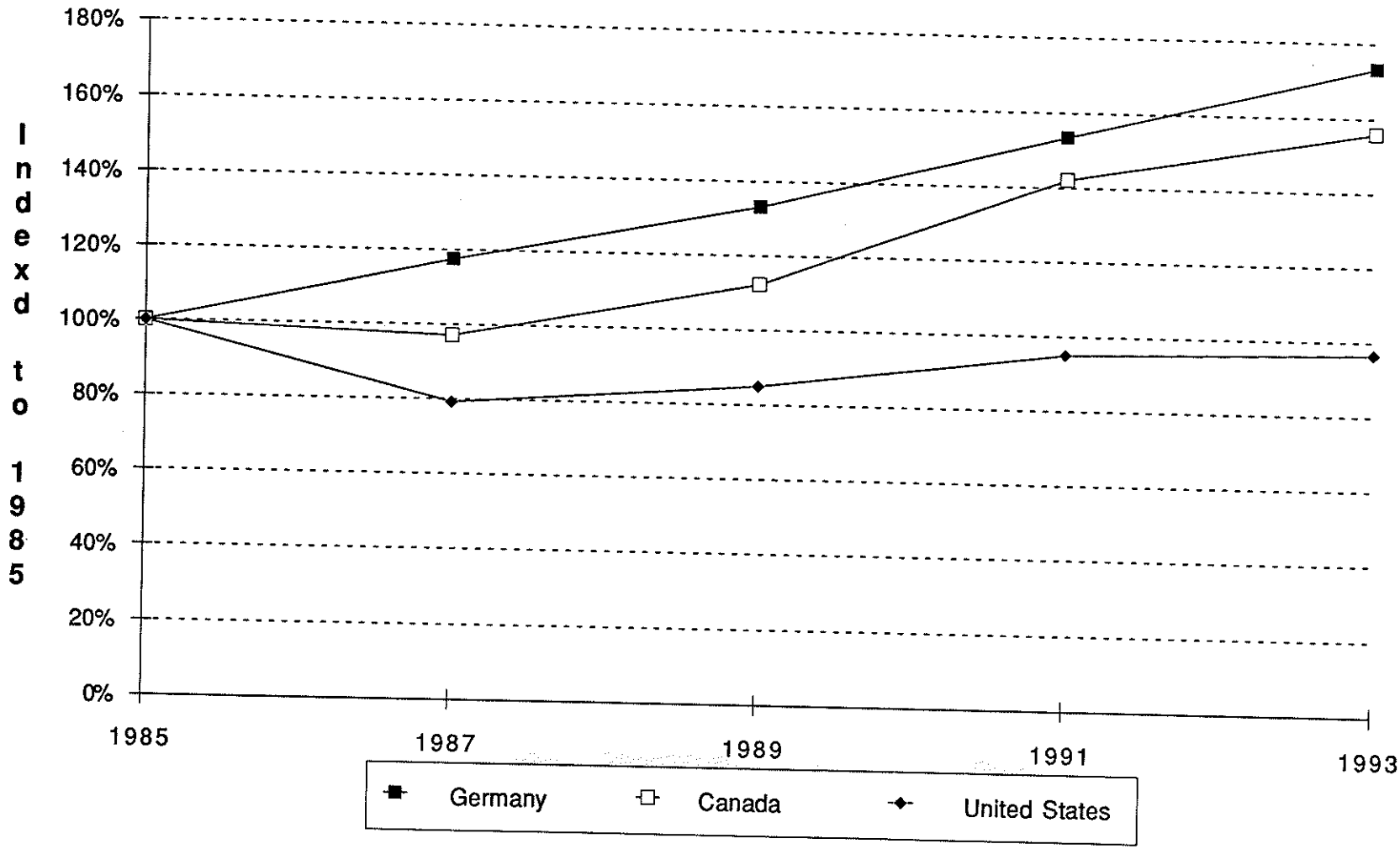
Table 5.1 presents fuel prices for countries having large fleets of alternatively fueled vehicles. In Table 5.2, a comparison of economically feasible alternative fuels are presented. Data on energy content, storage conditions, water solubility, and feedstocks are provided for six alternative fuels.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

Figure 5.1 Gasoline Prices (Per Gallon)



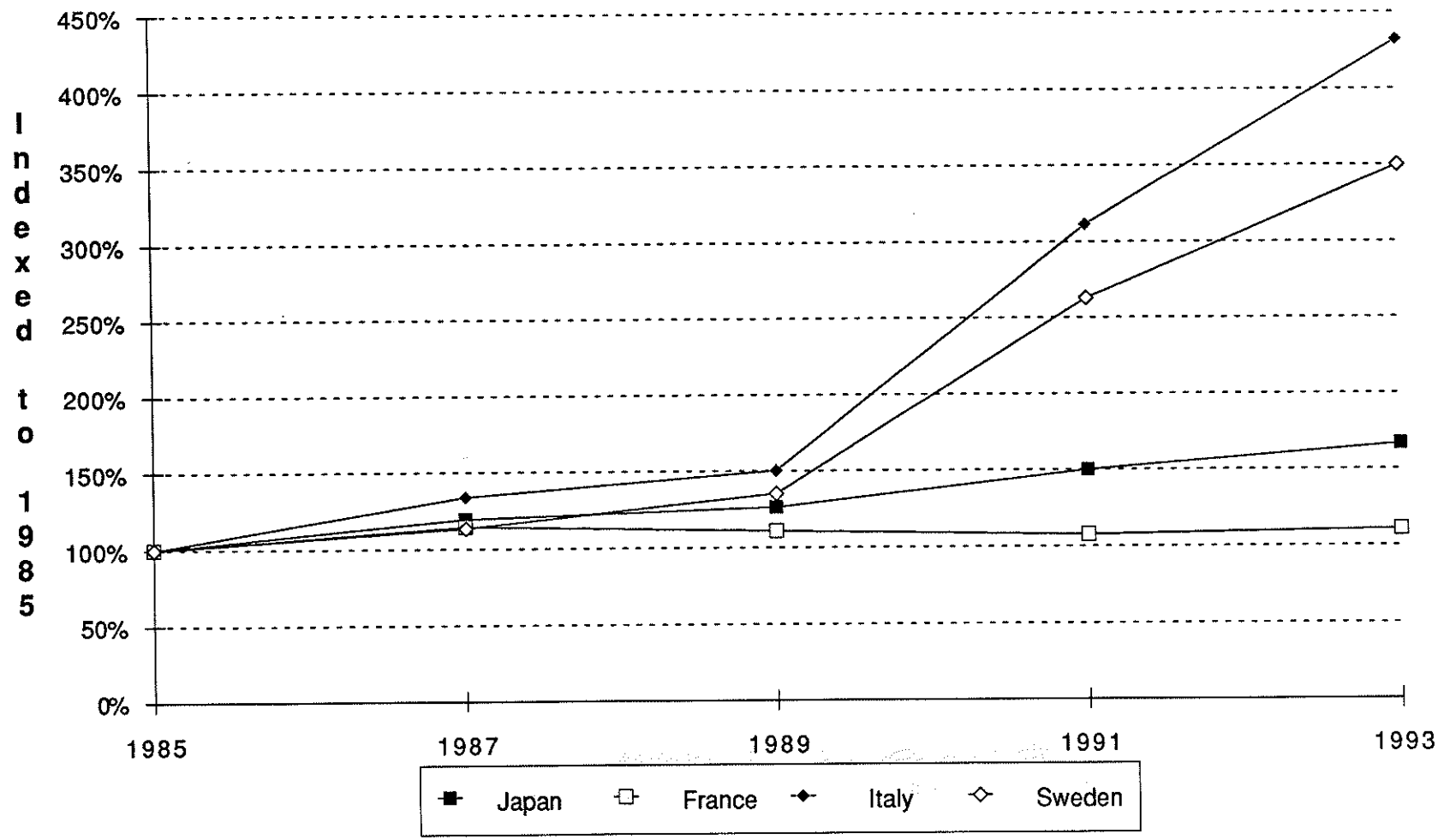
Source: Table 5.1

Figure 5.2 Gasoline Prices (Per Gallon)



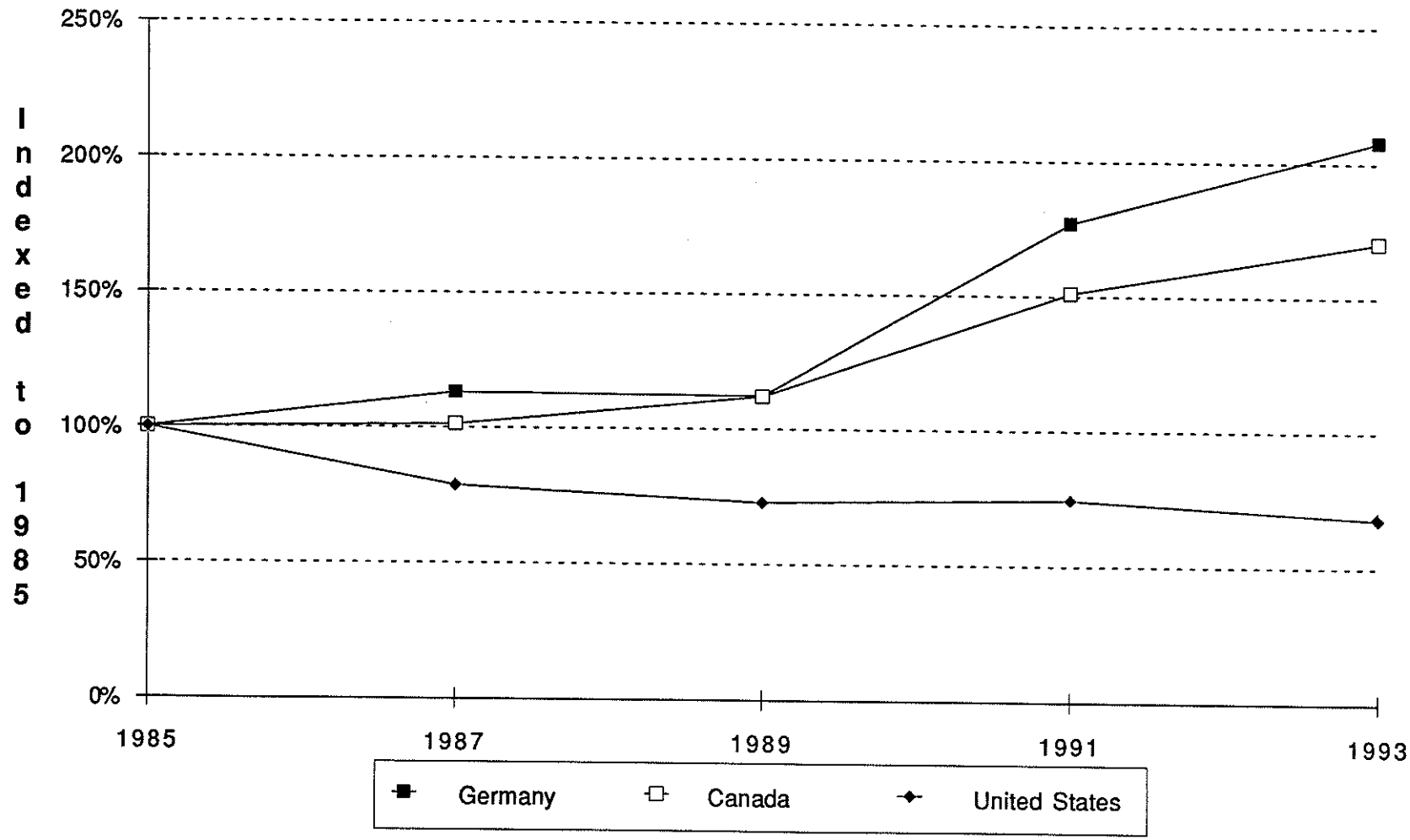
Source: Table 5.1

Figure 5.3 Diesel Prices (Per Gallon)



Source Table 5.1

Figure 5.4 Diesel Prices (Per Gallon)



Source: Table 5.1

Table 5.1 Fuel Prices for Countries Having Alternative Fueled Vehicles

	$ per gallon, including tax										
	1984	1985	1986	1987	1988	1989	1990	1991	Est. 1992	Est. 1993	Alternatively Fueled Vehicles as of 1987
Asia:											
Japan (a)											
Gasoline	2.31	2.25	2.79	3.17	3.43	3.18	3.05	3.9	4.20	4.53	1.4 - 1.7 million LPG vehicles
Diesel	1.66	1.60	1.90	1.91	2.02	2.02	1.75	2.4	2.53	2.67	
Europe:											
France											
Gasoline	2.24	2.37	2.58	3.05	3.06	3.07	3.40	3.86	4.17	4.51	2,000 CNG Vehicles
Diesel	1.63	1.68	1.69	1.92	1.84	1.86	1.78	1.81	1.83	1.86	43,000-53000 LPG Vehicles
Italy											
Gasoline	2.79	2.63	3.26	3.79	3.95	3.80	4.27	5.1	5.56	6.06	300,000 CNG Vehicles
Diesel	1.20	1.21	1.31	1.62	1.78	1.82	2.34	3.77	4.44	5.23	
Sweden											
Gasoline	1.93	2.06	2.20	2.50	2.76	2.80	3.23	4.45	5.01	5.65	2 Demonstration CNG Vehicles
Diesel	1.32	1.36	1.24	1.54	1.64	1.84	2.30	3.58	4.13	4.76	
Germany											
Gasoline	1.87	1.87	1.88	2.20	2.20	2.49	2.72	2.87	3.05	3.24	12,000-15,000 LPG Vehicles
Diesel	1.53	1.52	1.51	1.72	1.66	1.71	2.72	2.69	2.92	3.16	
North America:											
Canada (a)											
Gasoline	1.48	1.45	1.31	1.41	1.54	1.63	1.92	2.06	2.16	2.26	15,000 CNG Vehicles w/250,000
Diesel	1.30	1.31	1.27	1.33	1.45	1.47	1.55	1.98	2.10	2.23	proposed by 2005
											Approx. 50 Methanol Demo. Veh.
United States (a)											
Gasoline	1.21	1.20	0.93	0.95	0.95	1.02	1.16	1.14	1.13	1.16	30,000 CNG Vehicles
Diesel	1.22	1.22	0.94	0.96	0.95	0.89	0.99	0.91	0.87	0.83	300,000-370,000 LPG Vehicles

Sources:

Oak Ridge National Laboratory; "Transportation Energy Data Book: Edition 13," March 1993

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

Notes:

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

Table 5.2 Comparison of Economically Feasible Alternative Fuels

	Gasoline	Diesel	Methanol	Ethanol	Compressed Natural Gas (CNG)	Liquified Natural Gas (LNG)	Liquified Petroleum Gas (LPG-Propane)	Electricity or Hybrid Vehicles
Energy Content (Lower Heating Value)								
Btu/gallon	116,400	129,400	56,800	76,000	19,760 (a)	76,300 (b)	82,450	-
Btu/pound	18,900	18,310	8,570	11,500	21,300	21,300	19,770	-
Storage Conditions	Liquid	Liquid	Liquid	Liquid	Compressed Gas at 2,400-3,000 psi	Liquid at 25-60 psi	Liquid at 105-140 psi	Batteries/ Fuel Cells
Water 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	As Percent of Gasoline CO_2 Emissions	Btu per gram of CO_2	Btu/gallon
Gasoline	327.89	100%	11.1	125,000
M100	279.23	85%	11.1	64,600
M85	299.38	91%	11.1	73,600
E85	240.14	73%	12.5	84,600
LPG	205.38	63%	13.3	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 5.6 presents profiles of Electric Vehicles (EV).

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	Highway	Combined
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

Table 5.6 Selected Electric Vehicle Profiles by USA Automakers

Automaker	Models	Type	Scheduled Production Date	Number of Vehicles	Price	Driving Range (miles)	Maximum Speed (mph)	Battery Type
4E Corporation Pty. Ltd.	Exar-1	5 passenger car	Production ready Prototype-1994/5		$12,000	100 @ 55 mph	85	
Advanced Vehicle Systems, Inc.	Electric bus # 5122	22 passenger	Currently available	6		60-85	38	Lead Acid
	Electric bus # 5131	30 passenger	Currently available	7		50-60	45	Lead Acid
Bus Manufacturing USA	Electric transit bus	29 passsenger	Currently available	1		70-120	38	Lead Acid
	Electric Shuttle bus	29 passsenger	Currently available	2		60	40	Lead Acid
California Electric Cars, Inc.	Big Sur	Jeep	Prototype			60	60	Lead Acid
	Monterey	2 passenger car	Currently available		$30,000/ $35,000	100-150	70	Lead Acid
Calstart/BMI	School bus	72 passenger	December 1993	1		80	85	Lead Acid
Chrysler	TEVan	Minivan	Currently available to fleet buyers	48	$100,000/ $120,000	80	65	Niockel Iron
Dolphin Vehicles	Vortex	2 passenger car	Currently only plans available		$75 for plans	40-80	80	Lead Acid
Domino Cars	Minilight	4 passenger car	Currently available		$16,000/ $19,000	70-90	70	Lead Acid
Electric Car Company, Inc.	M-15 Thunderbolt	2 passenger car	Currently available		$29,000	100	82	Lead Acid
Ford	Ecostar	Van- 2 passenge + cargo	Currently in gloabl pilot program by utilities	105	$100,000 for 30 mo. lease	100	70	Sodium Sulpher
General Motors	Impact	2 passenger	Late 1990's	50		70-90	80	Lead Acid
Green Motorworks	Speedster	2 passenger	Currently available		$32,000	50	85	Lead Acid
Renaissance Cars (with GM support)	Tropica	2 passenger car	Florida GM dealerships 1994	50 first of '94 ≈130/mo. production	$10,000/ $12,000	80	65	Lead Acid
Sebring Auto-Cycle	ZEV-Colt	4 passenger car	Currently available	9	$25,000/ $28,000	75	65	Lead Acid
Solar Car Corp.	Chevy S-10	2 passenger	Currently available		$23,000	75-80	75	Lead Acid
	Festiva	2 passenger car	Currently available		$25,000	25-60	65	Lead Acid
U.S. Electricar	Electric bus	22 passenger	Currently available	4 n '93 50 in '94	$109,000/ $160,000	55	35	Lead Acid
	Electricar Sedan	5 passenger	Currently available	200-500	$39,000/ $45,000	50-80	80	Lead Acid
	Electricar GTP	2 passenger car	Currently available	2	$75,000	70	80	Lead Acid

Source:

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APPENDIX IMPORTANT CONVERSION FACTORS

Table A.1 Approximate Heating Values for Various Fuels

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

Source:
Energy Information Administration, State Energy Data Report 1960-1991

Notes:
(a) The Energy Information Agency uses a weighted average by multiplying the quantity consumed of each component product (e.g. ethane, propane, butane, etc.) by each products heating value.

Table A.2 Energy Unit Conversions

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

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

Table A.3 Power Conversions

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

Table A.4 Metric Conversion Factors: Length

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

E Notation:

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

Table A.5 Metric Conversion Factors: Mass

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

E Notation:

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

Table A.6 Metric Equivalents for Volume

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

Table A.7 Consumer Price Index (CPI)

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

Source:

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

Note:

CPI continued on next page

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

From	To									
	1982	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
1970	2.486	2.566	2.675	2.770	2.824	2.927	3.046	3.193	3.367	3.508
1971	2.382	2.458	2.563	2.654	2.705	2.804	2.918	3.059	3.226	3.361
1972	2.307	2.381	2.482	2.571	2.621	2.716	2.827	2.963	3.125	3.255
1973	2.173	2.243	2.338	2.421	2.468	2.558	2.662	2.791	2.943	3.066
1974	1.956	2.019	2.105	2.180	2.222	2.304	2.397	2.513	2.650	2.761
1975	1.792	1.850	1.929	1.997	2.036	2.110	2.196	2.302	2.428	2.529
1976	1.695	1.750	1.824	1.889	1.926	1.996	2.077	2.178	2.296	2.392
1977	1.594	1.645	1.715	1.776	1.810	1.876	1.952	2.047	2.158	2.249
1978	1.479	1.527	1.592	1.648	1.680	1.742	1.812	1.900	2.003	2.087
1979	1.330	1.373	1.431	1.482	1.511	1.566	1.630	1.708	1.801	1.877
1980	1.171	1.209	1.260	1.305	1.330	1.379	1.435	1.504	1.586	1.652
1981	1.062	1.096	1.142	1.183	1.206	1.250	1.301	1.363	1.438	1.498
1982	1.000	1.032	1.075	1.114	1.135	1.177	1.224	1.284	1.354	1.410
1983	0.970	1.000	1.043	1.080	1.101	1.142	1.188	1.245	1.313	1.368
1984	0.930	0.960	1.000	1.036	1.056	1.095	1.139	1.194	1.259	1.312
1985	0.897	0.926	0.966	1.000	1.019	1.057	1.100	1.153	1.215	1.266
1986	0.880	0.908	0.947	0.981	1.000	1.036	1.078	1.130	1.192	1.242
1987	0.850	0.878	0.915	0.947	0.966	1.000	1.042	1.092	1.152	1.200
1988	0.815	0.842	0.877	0.909	0.926	0.960	1.000	1.047	1.104	1.151
1989	0.778	0.803	0.837	0.867	0.884	0.916	0.953	1.000	1.054	1.098
1990	0.738	0.762	0.794	0.823	0.839	0.869	0.905	0.948	1.000	1.042
1991	0.709	0.731	0.762	0.789	0.805	0.834	0.868	0.910	0.960	1.000

Source:

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

GLOSSARY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Diesel Fuel: See **Distillate Fuel Oil.**

Distillate Fuel Oil : Light fuels fuel oils distilled during the refining process and used primarily for space heating, on- and off highway diesel engine fuel (including railroad engine fuel and fuel for agricultural machinery) and electric power generation. This definition is inclusive of such refined products termed as No. 1, No. 2 and No. 4 fuel oil and No.1, No. 2, and No. 4 diesel fuel, conforming to ASTM Specifications D396 or D975, respectively. No. 1 fuel oil is a light distillate fuel oil used in vaporizing pot-type burners, while No. 2 fuel oil is used in atomizing-type burners for domestic heating or moderate capacity commercial-industrial burner units. No. 4 fuel oil is a blend of distillate fuel oil and residual fuel oil typically used in commercial burner operations that are not equipped with preheating facilities. Diesel fuels are used in compression-ignition engines.

Ethane : A normally gaseous, paraffinic hydrocarbon (C_2H_6) extracted form natural gas or refinery gas streams. Used primarily as petrochemical feedstock for production of chemicals and plastic materials.

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

Ethylene : A normally gaseous, olefinic hydrocarbon (C_2H_4) recovered from refinery processes. Quantities are included with "ethane" data.

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

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

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

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

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

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

Jet Fuel : Includes both naptha-based and kerosene-based jet fuel meeting the standards for use in aircraft turbine engines or meeting ASTM Specification D1655. Naptha-based jet fuel is primarily used by the military in turbojet and turboprop aircraft engines; while kerosene-based jet fuel is mostly used in commercial turbojet and turboprop aircraft. Jet fuel is predominantly used in aircraft, although some is used to power turbines to produce electricity.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Revenue Cargo (Freight) Ton-Mile : One short ton of freight transported one mile. Ton-miles are computed by summation of the products of the aircraft miles flown on each interairport flight stage multiplied by the number of tons carried on that flight stage.

Standard Transportation Commodity Code (STCC) : Codification system for standard commodities developed by the Interstate Commerce Commission.

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

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