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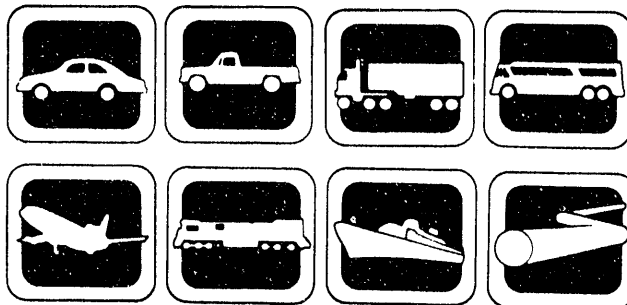
**OAK RIDGE  
NATIONAL  
LABORATORY**

**MARTIN MARIETTA**

**Transportation Energy  
Data Book:  
Edition**

**13**

**Stacy C. Davis  
Sonja G. Strang**



**MANAGED BY  
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DEPARTMENT OF ENERGY**

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## COMMON CONVERSIONS

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

<sup>a</sup>Electricity generation and distribution have been taken into account. Without electricity generation and distribution, 1 gigawatthour =  $0.3412 \times 10^{-5}$  Quads, 1 Quad = 293,083.2 gigawatthours.

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Energy Division

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## FOREWORD

Even the birth of a baby boy did not slow Stacy Davis down in her pursuit of producing this year's Transportation Energy Data Book. She and her team at ORNL have made additions in this edition which make it more useful than ever.

To give the reader an appreciation of the scope of this document, consider the following diverse data facts:

- The United States share of world automobile registrations and world truck registrations is about 32 percent (Figure 1.1), down from much higher values 40 years ago.
- Between 1980 and 1990, the real price of gasoline dropped in all the selected, developed countries, except for Canada (Figure 1.4).
- The average price of a new imported car did not equal the price of a new domestic car until 1982. In 1991, the new import average price was nearly \$2000 more than that for the average domestic car (Table 2.22).
- Gasoline and oil costs as a percent of total operating costs for automobiles are only about 15 percent (Table 2.23).
- The R. L. Polk estimate of the number of vehicles in use for a calendar year is preferable to the Federal Highway Administration estimate of registered vehicles for purposes of comparing to fuel use or miles driven per vehicle (Table 3.4).

- In 1970, 8.2 percent of the autos in use were over 10 years old. By 1991, this figure rose to 25.9 percent (Table 3.10).
- The percentage of conventional steel in the average weight of a new auto dropped from 53.8 in 1978 to 44.0 in 1992 (Table 3.14).
- The percentage of trucks in operation that are in class 1 (under 6000 pounds gross vehicle weight) rose from 66.0 in 1977 to 85.4 in 1987 (Table 3.28).
- The miles of High-Occupancy Vehicle (HOV) lanes grew to 339 in 1990 (Table 3.52).
- Average vehicle occupancy dropped from 1.9 in 1977 to 1.6 in 1990 (Table 4.11).
- The average distance for commuting trips rose from 9.2 miles in 1977 to 10.6 miles in 1990 (Table 4.13).
- The gross and net heating values for transportation fuels are shown in Table B.1.

I hope you find this data book to be useful. Let me know if you have suggestions for data that should be added.

*Philip D. Patterson*

## **ACKNOWLEDGEMENTS**

We wish to express our gratitude to the many individuals who assisted in the preparation of this document. First, we would like to thank Philip D. Patterson and the staff of the Office of Transportation Technologies for their continued support of the Transportation Energy Data Book. This document also benefits from the criticism and careful review of Phil Patterson of the U.S. Department of Energy, John Maples, consultant, and Patricia Hu, David Greene, Bruce Peterson, Frank Southworth, Jerry Hadder, Scott Stevens, Shih-Miao Chin, and Shaw-Pin Miaou of Oak Ridge National Laboratory (ORNL). We would also like to thank the Federal Highway Administration (FHWA), for allowing the publication of the 1990 Nationwide Personal Transportation Study (NPTS) data. The tables, text, and figures from the NPTS were done for the FHWA by Patricia Hu, ORNL, and Jennifer Young, University of Tennessee.

In addition, we would like to acknowledge the contributions of Sherry Campbell of the Health, Safety, Environment, and Accountability Division for the preparation of the title index. Finally, we are indebted to Maggie Bruer for her skills in assisting with the preparation of the manuscript.

## **ABSTRACT**

The Transportation Energy Data Book: Edition 13 is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Transportation Technologies in the Department of Energy (DOE). Designed for use as a desk-top reference, the data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use. The purpose of this document is to present relevant statistical data in the form of tables and graphs. Each of the major transportation modes - highway, air, water, rail, pipeline - is treated in separate chapters or sections. Chapter 1 compares U.S. transportation data with data from seven other countries. Aggregate energy use and energy supply data for all modes are presented in Chapter 2. The highway mode, which accounts for over three-fourths of total transportation energy consumption, is dealt with in Chapter 3. Topics in this chapter include automobiles, trucks, buses, fleet automobiles, federal standards, fuel economies, and vehicle emission data. Household travel behavior characteristics are displayed in Chapter 4. Chapter 5 contains information on alternative fuels and alternatively-fueled vehicles. The last chapter, Chapter 6, covers each of the nonhighway modes: air, water, pipeline, and rail, respectively.

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\*Certificated route air carriers and general aviation.  
 †General aviation aircraft only.  
 ‡1989 data.  
 §Coal slurry and crude oil and products pipeline only.  
 ¶Class I rail only.

**\*Class I rail only.**

## INTRODUCTION

In January 1976, the Transportation Energy Conservation (TEC) Division of the Energy Research and Development Administration contracted with Oak Ridge National Laboratory (ORNL) to prepare a Transportation Energy Data Conservation Data Book to be used by TEC staff in their evaluation of current and proposed conservation strategies. The major purposes of the data book were to draw together, under one cover, transportation data from diverse sources, to resolve data conflicts and inconsistencies, and to produce a comprehensive document. The first edition of the TEC Data Book was published in October 1976. With the passage of the Department of Energy (DOE) Organization Act, the work being conducted by the former Transportation Energy Conservation Division fell under the purview of the DOE's Office of Transportation Programs (now the Office of Transportation Technologies). DOE, through the Office of Transportation Technologies, has supported the compilation of Editions 3 through 13.

Policymakers and analysts need to be well-informed about activity in the transportation sector. The organization and scope of the data book reflect the need for different kinds of information. For this reason, Edition 13 updates much of the same type of data that is found in previous editions.

Chapter 1 contains information which compares U.S. transportation data with data from seven selected countries in Asia, Europe, and North America. The U.S. data in this chapter are presented for comparison with other international data only and, therefore, should not match domestic data found in other chapters of the book. Chapter 2, Transportation Energy Characteristics, presents aggregate energy use data for each of the major transportation modes (i.e., highway, air, water, pipeline, and rail), as well as related statistics on the price and supply of transportation fuels. Chapter 3 covers detailed statistics on three major highway modes: automobiles, trucks, and buses. Also contained in this chapter is information on federal standards and fuel economies of highway vehicles, and vehicle emission data. Household travel behavior characteristics are displayed in Chapter 4. Chapter 5 presents data on alternative fuels and alternatively-fueled vehicles. Chapter 6 consists of data for the nonhighway modes: air, water, pipeline, and rail. Sources used represent the latest available data.

In any attempt to compile a comprehensive set of statistics on transportation activity, numerous instances of inadequacies and inaccuracies in the basic data are encountered. Where such problems occur, estimates are developed by ORNL. To minimize the misuse of these statistics, an appendix (Appendix A) is included in this edition to document the estimation procedures. The attempt is to provide sufficient information for the conscientious user to evaluate the estimates and to form his or her own opinions as to their utility. Clearly, the

accuracy of the estimates cannot exceed the accuracy of the primary data, an accuracy which in most instances is unknown. In cases where data accuracy is known or substantial errors are strongly suspected in the data, the reader is alerted. In all cases it should be recognized that the estimates are not precise.

The majority of the statistics contained in the data book are taken directly from published sources, although these data may be reformatted for presentation by ORNL. Consequently, neither ORNL nor DOE can endorse the validity of these data.

Edition 13 of the Transportation Energy Data Book includes over 200 pages of tables and figures. To facilitate use of this information, several aids in format and presentation techniques are included. Statistical highlights from the data book precede this introduction, and a synopsis of chapter contents is provided at the beginning of each chapter. Some of the average rates of change in the data book are calculated using 1982 as a base year. This is because an oil embargo was affecting the economy in 1982, and the year was chosen as a year of economic recession.

## **CHAPTER 1**

### **INTERNATIONAL TRANSPORTATION STATISTICS**

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

In 1950, 76% of the world's automobiles were registered in the United States; by 1990, that percentage had dropped to 32.3% (Table 1.1). The U.S. had a lower annual growth rate in automobile registrations from 1950 to 1990 than any of the other listed countries except Sweden, for which data are not available for the years 1950 to 1970. The U.S. also accounts for 32.7% of the world's truck and bus registrations. Japan has experienced the largest growth in truck and bus registrations since 1950, 12.9% annually (Table 1.2).

The U.S. had the highest number of automobiles per capita in 1990 (0.574), with Italy following second (0.478). Japan has had the lowest number of automobiles per capita of any of the listed countries. However, Japan, whose truck and bus registration growth was noted earlier, closely follows the U.S. in the number of trucks and buses per capita, 0.175 and 0.180, respectively (Table 1.3).

The data on gasoline prices indicate that Italy has had the highest gasoline prices since 1982, while the U.S. has had the lowest of the listed countries (Table 1.4). Italy's high gasoline prices in 1990 were mainly due to the gasoline tax (Figure 1.4). In 1990 over 50% of the diesel price could be attributed to tax in four countries - Italy, France, the United Kingdom, and West Germany (Figure 1.5).

Data from the Lawrence Berkeley Laboratory (LBL) are contained in Tables 1.6, 1.7 and 1.10-1.16. These data are generated by LBL using various country sources:

- Japan - Japan Institute for Energy Economics and Ministry of Transport;
- France - Agence Francaise pour la Matrixe d'Energie, now Agence d'Environnement et Matrixe de L'Energie;
- Italy - Data provided by Agip Petroli, 1990 (private communication) and Italstat, National Accounts of Transportation;
- Sweden - Transport Raadet (Transportation Council), National Board of Industry, Energy Board, and Ministry of Communications and Transport;
- UK - Digest of Transport Statistics, Energy Technology Support Unit, D. Martin (private communication);
- Germany - "Vehker in Zahlen" ("Transportation in Figures," published by the Ministry of Transport) compiled by Deutsches Institut fuer Wirtschaft, Berlin;
- US - Data from various tables and editions of the Transportation Energy Data Book, Oak Ridge National Laboratory.

Details on the methodology for compiling these data can be found in "Energy Efficiency and Human Activity," by Lee Schipper, Steve Myers, et. al., Cambridge University Press, Cambridge, MA, 1992, and the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect."

Table 1.1  
Automobile Registrations for Selected Countries, 1950-90  
(thousands)

| Year                                    | Asia   |  | Europe            |        |                   |                   | North America     |        | Percentage<br>U.S. of<br>world | All other<br>countries <sup>a</sup> | World<br>total |
|---|--------|--|-------------------|--------|-------------------|-------------------|-------------------|--------|--------------------------------|-------------------------------------|----------------|
|   | Japan  |  | France            | Italy  | Sweden            | United<br>Kingdom | West<br>Germany   | Canada | United<br>States               |                                     |                |
| 1950                                    | 43     |  | <sup>b</sup>      | 342    | <sup>b</sup>      | 2,307             | <sup>b</sup>      | 1,913  | 40,339                         | 76.0%                               | 53,051         |
| 1955                                    | 153    |  | <sup>b</sup>      | 861    | <sup>b</sup>      | 3,609             | 1,821             | 2,961  | 52,145                         | 71.4%                               | 73,036         |
| 1960                                    | 457    |  | 4,873             | 1,976  | <sup>b</sup>      | 5,650             | 4,559             | 4,104  | 61,671                         | 62.7%                               | 98,305         |
| 1965                                    | 2,181  |  | 8,718             | 5,473  | <sup>b</sup>      | 9,131             | 9,043             | 5,279  | 75,258                         | 53.8%                               | 139,776        |
| 1970                                    | 8,779  |  | 12,280            | 10,181 | <sup>b</sup>      | 11,802            | 13,299            | 6,602  | 89,244                         | 46.1%                               | 193,479        |
| 1975                                    | 17,236 |  | 15,555            | 15,060 |                   | 14,061            | 16,764            | 8,870  | 106,706                        | 41.0%                               | 260,201        |
| 1980                                    | 23,660 |  | 19,150            | 17,686 |                   | 15,438            | 21,455            | 10,256 | 121,601                        | 38.0%                               | 320,390        |
| 1981                                    | 24,612 |  | 19,725            | 18,603 |                   | 15,633            | 21,812            | 10,199 | 123,098                        | 37.2%                               | 330,799        |
| 1982                                    | 25,539 |  | 20,420            | 19,616 |                   | 17,644            | 22,086            | 10,530 | 123,702                        | 36.4%                               | 340,266        |
| 1983                                    | 26,385 |  | 20,950            | 20,389 |                   | 18,108            | 22,624            | 10,732 | 126,444                        | 35.9%                               | 352,032        |
| 1984                                    | 27,144 |  | 21,175            | 20,888 |                   | 18,532            | 23,193            | 10,781 | 128,158                        | 35.1%                               | 365,105        |
| 1985                                    | 27,845 |  | 21,325            | 22,495 |                   | 18,953            | 23,777            | 11,118 | 131,864                        | 35.2%                               | 374,483        |
| 1986                                    | 28,654 |  | 21,575            | 23,495 |                   | 19,415            | 24,700            | 11,586 | 135,431                        | 35.1%                               | 386,350        |
| 1987                                    | 29,478 |  | 21,950            | 24,320 |                   | 20,108            | 25,558            | 11,686 | 137,324                        | 34.9%                               | 394,030        |
| 1988                                    | 30,776 |  | 22,370            | 25,290 |                   | 20,977            | 26,228            | 12,086 | 141,252                        | 34.2%                               | 412,907        |
| 1989                                    | 32,621 |  | 23,010            | 26,267 |                   | 21,919            | 26,914            | 12,380 | 143,081                        | 33.7%                               | 424,366        |
| 1990                                    | 34,924 |  | 23,550            | 27,300 |                   | 22,528            | 27,218            | 12,622 | 143,550                        | 32.3%                               | 444,900        |
| <i>Average annual percentage change</i> |        |  |                   |        |                   |                   |                   |        |                                |                                     |                |
| 1950-90                                 | 18.2%  |  | 5.4% <sup>c</sup> | 11.6%  | <sup>b</sup>      | 5.9%              | 9.4% <sup>d</sup> | 4.8%   | 3.2%                           | 7.6%                                | 5.5%           |
| 1970-90                                 | 4.7%   |  | 2.2%              | 3.3%   | 1.8% <sup>a</sup> | 3.3%              | 3.6%              | 3.3%   | 2.4%                           | 6.6%                                | 4.3%           |
| 1982-90                                 | 4.0%   |  | 1.8%              | 4.2%   | 2.6%              | 3.1%              | 2.6%              | 2.3%   | 1.9%                           | 5.5%                                | 3.4%           |

Source: Motor Vehicle Manufacturers Association, *World Motor Vehicle Data, 1992 Edition*, Detroit, Michigan, 1992, pp. 31, 82, 145, 169, 190, 234, 261, 321, 353, and annual.

<sup>a</sup>Automobile registrations for all other countries were calculated by subtracting listed countries' registrations from the world total.

<sup>b</sup>Data are not available.

<sup>c</sup>Average annual percentage change is for 1960-90.

<sup>d</sup>Average annual percentage change is for 1955-90.

<sup>e</sup>Average annual percentage change is for 1975-90.

**Table 1.2**  
**Truck and Bus Registrations for Selected Countries, 1950-90**  
**(thousands)**

| Year                             | Europe |                    |       |                   |                | North America     |               | Percentage U.S. of world | All other countries <sup>a</sup> | World total |
|----------------------------------|--------|--------------------|-------|-------------------|----------------|-------------------|---------------|--------------------------|----------------------------------|-------------|
|                                  | Asia   |                    | West  |                   |                | Canada            | United States |                          |                                  |             |
|                                  | Japan  | France             | Italy | Sweden            | United Kingdom |                   |               |                          |                                  |             |
| 1950                             | 170    | <sup>b</sup>       | 235   | <sup>b</sup>      | 1,060          | <sup>b</sup>      | 643           | 8,823                    | 50.9%                            | 17,349      |
| 1955                             | 285    | <sup>b</sup>       | 335   | <sup>b</sup>      | 1,244          | 760               | 952           | 10,544                   | 46.1%                            | 22,860      |
| 1960                             | 832    | 1,467              | 455   | <sup>b</sup>      | 1,534          | 1,079             | 1,056         | 12,186                   | 42.6%                            | 28,583      |
| 1965                             | 3,968  | 1,910              | 664   | <sup>b</sup>      | 1,748          | 1,690             | 1,232         | 15,100                   | 39.6%                            | 38,118      |
| 1970                             | 8,470  | 2,115              | 929   | <sup>b</sup>      | 1,769          | 2,298             | 1,481         | 19,175                   | 36.3%                            | 52,899      |
| 1975                             | 10,270 | 2,377              | 1,193 | 171               | 1,934          | 2,725             | 2,158         | 26,243                   | 38.8%                            | 67,698      |
| 1980                             | 13,407 | 2,571              | 1,429 | 194               | 1,920          | 3,385             | 2,955         | 34,195                   | 37.8%                            | 90,592      |
| 1981                             | 14,187 | 2,625              | 1,547 | 199               | 1,890          | 3,501             | 3,192         | 35,188                   | 38.9%                            | 96,405      |
| 1982                             | 14,947 | 2,690              | 1,642 | 207               | 3,022          | 3,584             | 3,293         | 35,941                   | 36.4%                            | 98,787      |
| 1983                             | 15,667 | 2,734              | 1,764 | 215               | 3,106          | 3,725             | 3,363         | 37,306                   | 36.0%                            | 103,888     |
| 1984                             | 16,471 | 2,746              | 1,792 | 224               | 3,230          | 3,878             | 3,099         | 38,091                   | 35.1%                            | 107,925     |
| 1985                             | 17,371 | 2,765              | 1,910 | 231               | 3,278          | 4,032             | 3,149         | 39,790                   | 35.3%                            | 113,024     |
| 1986                             | 18,341 | 2,828              | 2,008 | 244               | 3,336          | 4,270             | 3,213         | 40,760                   | 35.9%                            | 113,436     |
| 1987                             | 19,397 | 2,904              | 2,069 | 260               | 3,452          | 4,534             | 3,576         | 41,714                   | 34.4%                            | 121,176     |
| 1988                             | 20,588 | 2,972              | 2,191 | 281               | 3,621          | 4,795             | 3,766         | 43,145                   | 34.0%                            | 126,882     |
| 1989                             | 21,326 | 4,748 <sup>c</sup> | 2,311 | 309               | 3,754          | 5,140             | 3,889         | 44,179                   | 33.3%                            | 132,566     |
| 1990                             | 21,567 | 4,910 <sup>c</sup> | 2,427 | 324               | 3,774          | 5,453             | 3,931         | 45,106                   | 32.7%                            | 138,082     |
| Average annual percentage change |        |                    |       |                   |                |                   |               |                          |                                  |             |
| 1950-90                          | 12.9%  | 4.1% <sup>d</sup>  | 6.0%  | <sup>b</sup>      | 3.2%           | 5.8% <sup>e</sup> | 4.6%          | 4.2%                     | 5.3%                             | 5.3%        |
| 1970-90                          | 4.8%   | 4.3%               | 4.9%  | 4.4% <sup>f</sup> | 3.9%           | 4.4%              | 5.0%          | 4.4%                     | 5.7%                             | 4.9%        |
| 1982-90                          | 4.7%   | 7.8%               | 5.0%  | 5.8%              | 2.8%           | 5.4%              | 2.2%          | 2.9%                     | 5.3%                             | 4.3%        |

**Source:** Individual countries - Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1992 Edition, Detroit, Michigan, 1992, pp 31, 82, 145, 169, 190, 234, 261, 321, 353, and annual.

et-Traut and have registrations for all other countries were calculated by subtracting listed countries' registrations from the world total.

<sup>b</sup>Data are not available.

**Different data source.**

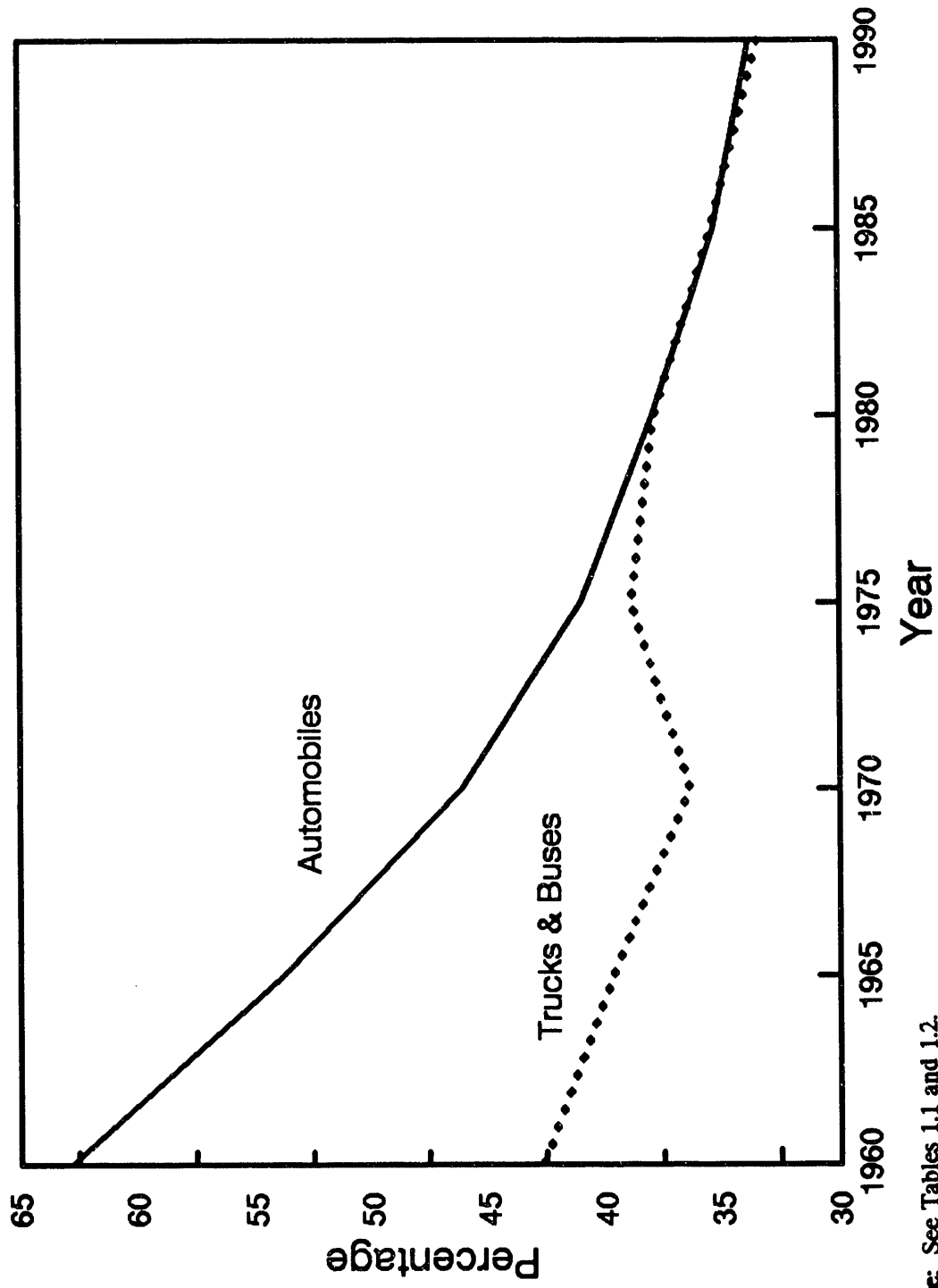
\*Average annual percentage change is for 1960-90.

•Average annual percentage change is for 1955-90

<sup>a</sup> Average annual percentage change is for 1975-90.

Figure 1.1. United States Automobile and Truck & Bus Registrations as a Percent of World Registrations, 1960-90

ONRPL-DWG 83-6647



Source: See Tables 1.1 and 1.2.

Table 1.3  
Vehicles per Capita for Selected Countries, 1950-90

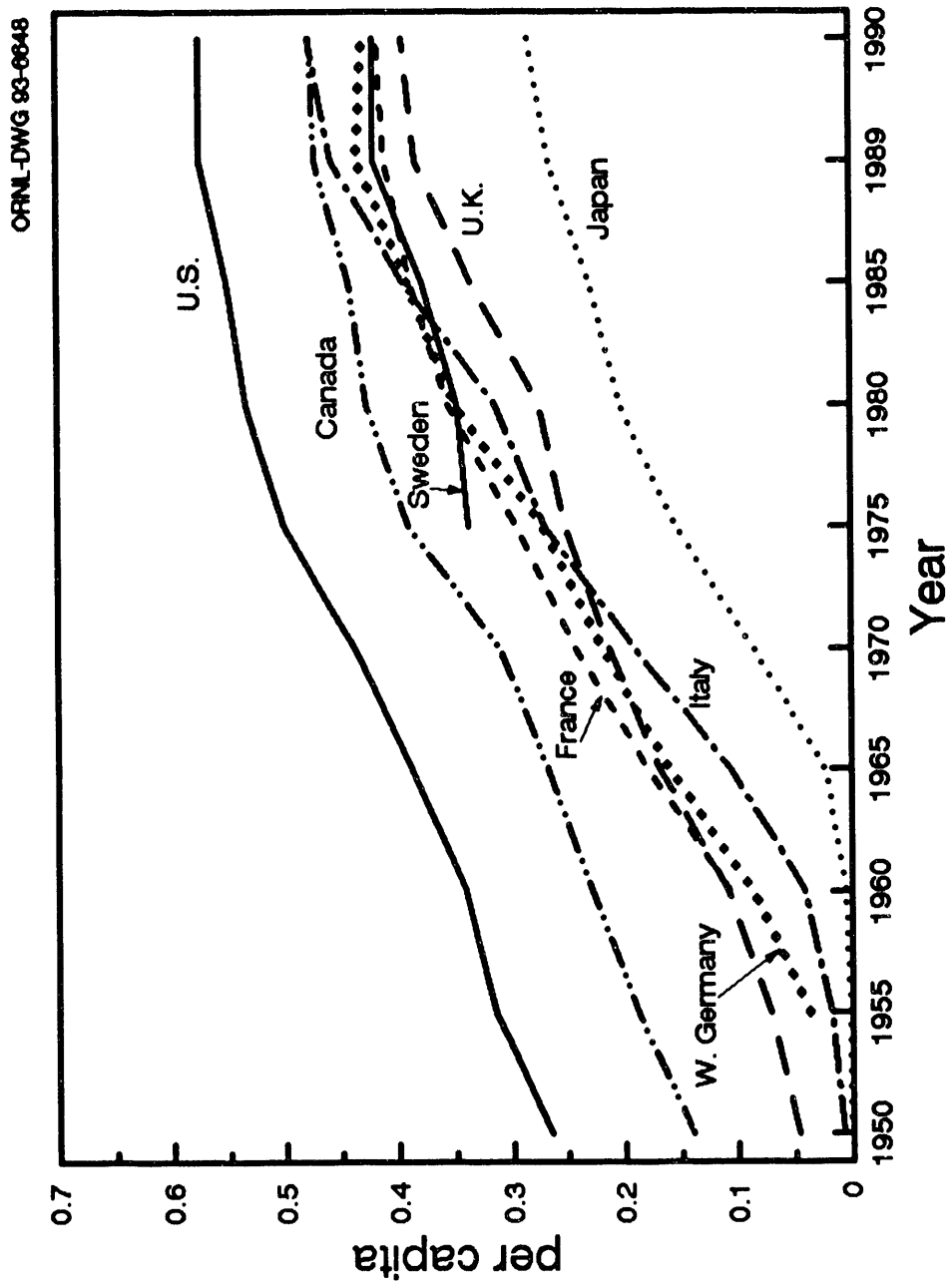
| Year                        | Asia  | Europe |       |        |                | North America |        |               |
|-----------------------------|-------|--------|-------|--------|----------------|---------------|--------|---------------|
|                             | Japan | France | Italy | Sweden | United Kingdom | West Germany  | Canada | United States |
| Automobiles per capita      |       |        |       |        |                |               |        |               |
| 1950                        | 0.001 | *      | 0.007 | *      | 0.046          | *             | 0.140  | 0.265         |
| 1955                        | 0.002 | *      | 0.018 | *      | 0.071          | 0.036         | 0.188  | 0.314         |
| 1960                        | 0.005 | 0.107  | 0.040 | *      | 0.108          | 0.086         | 0.229  | 0.341         |
| 1965                        | 0.022 | 0.179  | 0.106 | *      | 0.168          | 0.159         | 0.268  | 0.387         |
| 1970                        | 0.085 | 0.242  | 0.190 | *      | 0.213          | 0.219         | 0.310  | 0.438         |
| 1975                        | 0.154 | 0.295  | 0.270 | 0.337  | 0.252          | 0.271         | 0.390  | 0.550         |
| 1980                        | 0.203 | 0.355  | 0.313 | 0.347  | 0.274          | 0.349         | 0.427  | 0.534         |
| 1985                        | 0.230 | 0.387  | 0.394 | 0.377  | 0.335          | 0.390         | 0.442  | 0.551         |
| 1989                        | 0.265 | 0.410  | 0.457 | 0.421  | 0.383          | 0.434         | 0.472  | 0.575         |
| 1990                        | 0.283 | 0.417  | 0.478 | 0.421  | 0.394          | 0.430         | 0.476  | 0.574         |
| Trucks and buses per capita |       |        |       |        |                |               |        |               |
| 1950                        | 0.002 | *      | 0.005 | *      | 0.021          | *             | 0.047  | 0.058         |
| 1955                        | 0.003 | *      | 0.007 | *      | 0.024          | 0.015         | 0.060  | 0.064         |
| 1960                        | 0.009 | 0.032  | 0.009 | *      | 0.029          | 0.020         | 0.059  | 0.067         |
| 1965                        | 0.041 | 0.039  | 0.013 | *      | 0.032          | 0.030         | 0.063  | 0.078         |
| 1970                        | 0.082 | 0.042  | 0.017 | *      | 0.032          | 0.039         | 0.069  | 0.094         |
| 1975                        | 0.092 | 0.045  | 0.021 | 0.021  | 0.035          | 0.044         | 0.095  | 0.123         |
| 1980                        | 0.115 | 0.048  | 0.025 | 0.023  | 0.034          | 0.055         | 0.123  | 0.150         |
| 1985                        | 0.144 | 0.050  | 0.033 | 0.028  | 0.058          | 0.066         | 0.125  | 0.166         |
| 1989                        | 0.173 | 0.085  | 0.040 | 0.036  | 0.066          | 0.083         | 0.148  | 0.178         |
| 1990                        | 0.175 | 0.087  | 0.043 | 0.035  | 0.066          | 0.086         | 0.148  | 0.180         |

**Sources:**

Vehicle registrations - Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1992 Edition, Detroit, Michigan, 1991, pp. 31, 82, 145, 169, 190, 234, 261, 321, 353, and annual.  
Population - United Nations, Department of International Economic and Social Affairs, Statistical Office, 1990 Demographic Yearbook, New York, 1992, pp. 145-148, and annual.

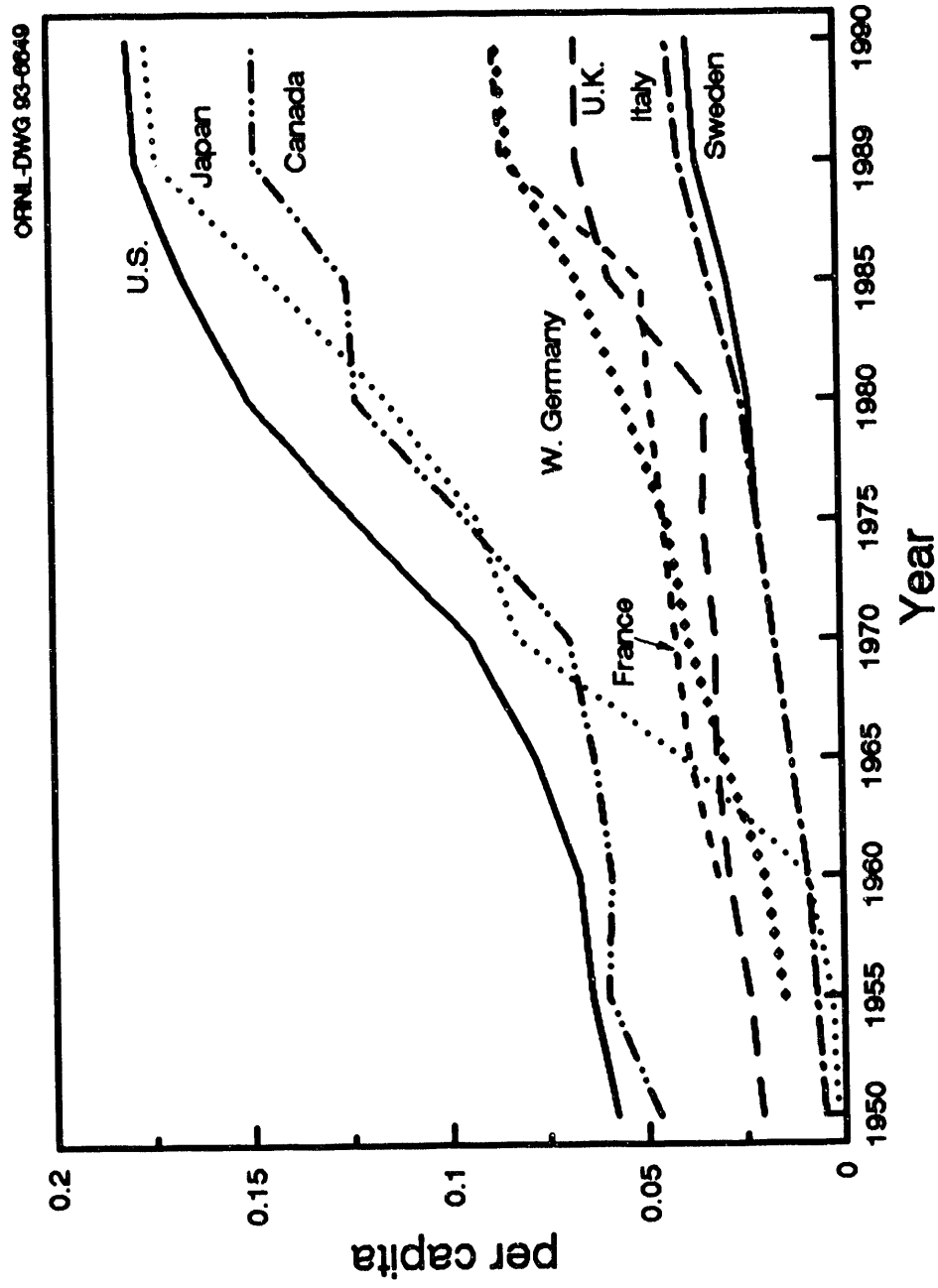
\*Data are not available.

Figure 1.2. Automobiles per Capita for Selected Countries, 1950-90



Source: See Table 1.3.

Figure 1.3. Trucks and Buses per Capita for Selected Countries, 1950-90



Source: See Table 1.3.

Table 1.4  
Gasoline Prices for Selected Countries\*, 1978-91

|                            | Current dollars per gallon |      |      |      |      |      |      |      |      |      |      | Average annual percentage change |                   |                   |         |         |
|----------------------------|----------------------------|------|------|------|------|------|------|------|------|------|------|----------------------------------|-------------------|-------------------|---------|---------|
|                            | 1978                       | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989                             | 1990 <sup>b</sup> | 1991 <sup>b</sup> | 1978-91 | 1982-91 |
| Japan <sup>c</sup>         | 2.00                       | 2.10 | 2.58 | 2.64 | 2.60 | 2.42 | 2.31 | 2.25 | 2.79 | 3.17 | 3.43 | 3.18                             | 3.05              | 3.90              | 5.3%    | 4.6%    |
| France                     | 2.15                       | 2.56 | 3.03 | 2.70 | 2.56 | 2.37 | 2.24 | 2.37 | 2.58 | 3.05 | 3.06 | 3.07                             | 3.40              | 3.86              | 4.6%    | 4.7%    |
| Italy                      | 2.23                       | 2.47 | 3.10 | 2.97 | 2.88 | 2.93 | 2.79 | 2.63 | 3.26 | 3.79 | 3.95 | 3.80                             | 4.27              | 5.10              | 6.6%    | 6.6%    |
| Sweden                     | 1.56                       | 1.94 | 2.64 | 2.64 | 2.40 | 2.07 | 1.93 | 2.06 | 2.20 | 2.50 | 2.76 | 2.80                             | 3.23              | 4.45              | 8.4%    | 7.1%    |
| United Kingdom             | 1.22                       | 1.79 | 2.50 | 2.57 | 2.42 | 2.25 | 2.05 | 2.12 | 2.07 | 2.39 | 2.51 | 2.51                             | 2.55              | 2.55              | 5.8%    | 0.6%    |
| West Germany               | 1.75                       | 2.06 | 2.43 | 2.38 | 2.17 | 2.04 | 1.87 | 1.87 | 1.88 | 2.20 | 2.20 | 2.49                             | 2.72              | 2.87              | 3.9%    | 3.2%    |
| Canada <sup>d</sup>        | 0.69                       | 0.73 | 0.85 | 1.13 | 1.37 | 1.47 | 1.48 | 1.45 | 1.31 | 1.41 | 1.54 | 1.63                             | 1.92              | 2.06              | 8.8%    | 4.6%    |
| United States <sup>d</sup> | 0.66                       | 0.87 | 1.23 | 1.37 | 1.32 | 1.25 | 1.22 | 1.20 | 0.93 | 0.93 | 0.95 | 1.02                             | 1.04              | 1.43              | 6.1%    | 0.9%    |

|                            | Constant 1990 dollars* per gallon |      |      |      |      |      |      |      |      |      |      | Average annual percentage change |                   |                   |         |         |
|----------------------------|-----------------------------------|------|------|------|------|------|------|------|------|------|------|----------------------------------|-------------------|-------------------|---------|---------|
|                            | 1978                              | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989                             | 1990 <sup>b</sup> | 1991 <sup>b</sup> | 1978-91 | 1982-91 |
| Japan <sup>c</sup>         | 4.01                              | 3.78 | 4.09 | 3.79 | 3.52 | 3.17 | 2.91 | 2.73 | 3.33 | 3.64 | 3.79 | 3.35                             | 3.05              | 3.74              | -0.5%   | 0.7%    |
| France                     | 4.31                              | 4.61 | 4.81 | 3.45 | 3.47 | 3.11 | 2.82 | 2.88 | 3.07 | 3.51 | 3.38 | 3.24                             | 3.40              | 3.70              | -1.2%   | 0.7%    |
| Italy                      | 4.47                              | 4.45 | 4.92 | 4.27 | 3.90 | 3.84 | 3.51 | 3.19 | 3.89 | 4.36 | 4.36 | 4.01                             | 4.27              | 4.89              | 0.7%    | 2.5%    |
| Sweden                     | 3.12                              | 3.49 | 4.19 | 3.79 | 3.25 | 2.72 | 2.43 | 0.50 | 2.62 | 2.87 | 3.05 | 2.95                             | 3.23              | 4.27              | 2.4%    | 3.1%    |
| United Kingdom             | 2.44                              | 3.22 | 3.96 | 3.69 | 3.28 | 2.95 | 2.58 | 2.58 | 2.47 | 2.75 | 2.77 | 2.65                             | 2.55              | 2.45              | 0.0%    | -3.2%   |
| West Germany               | 3.51                              | 3.71 | 3.85 | 3.42 | 2.94 | 2.68 | 2.35 | 2.27 | 2.24 | 2.53 | 2.43 | 2.62                             | 2.72              | 2.75              | -1.9%   | -0.7%   |
| Canada <sup>d</sup>        | 1.38                              | 1.31 | 1.35 | 1.62 | 1.85 | 1.93 | 1.86 | 1.76 | 1.56 | 1.62 | 1.70 | 1.72                             | 1.92              | 1.98              | 2.8%    | 0.8%    |
| United States <sup>d</sup> | 1.32                              | 1.57 | 1.95 | 1.97 | 1.79 | 1.64 | 1.53 | 1.46 | 1.11 | 1.07 | 1.05 | 1.08                             | 1.04              | 1.37              | 0.3%    | -2.9%   |

Source:

U.S. Department of Energy, Energy Information Administration, *International Energy Annual 1990*, Washington, DC, January 1992, pp. 135, 136, and annual.

\*Prices represent the retail prices (including taxes) for premium leaded gasoline unless otherwise noted. Prices are representative for each country based on quarterly data averaged for the year.

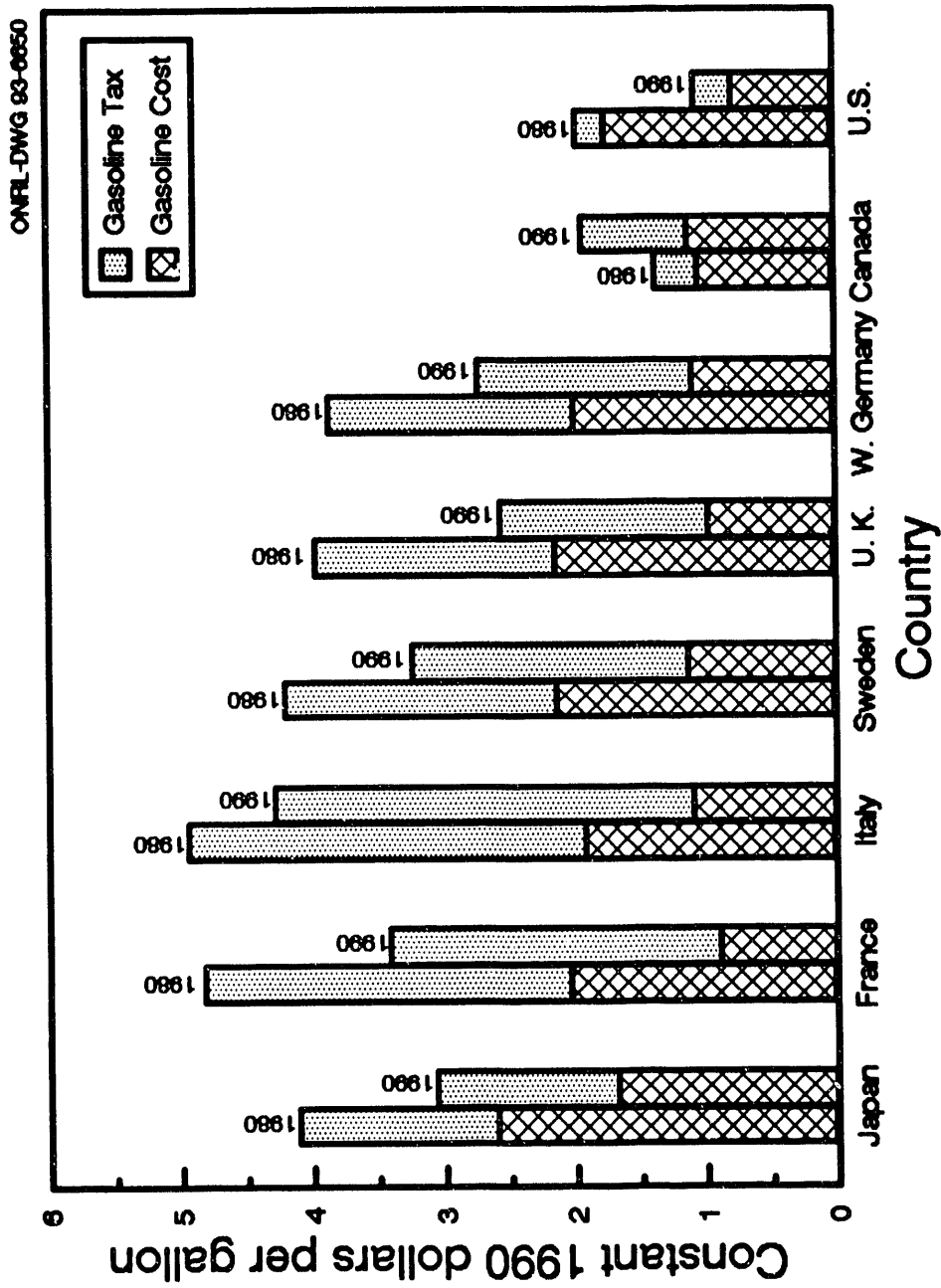
<sup>b</sup>Prices represent the retail prices (including taxes) for premium leaded gasoline on January 1 of the year.

<sup>c</sup>All prices for Japan and Canada are unleaded regular gasoline.

<sup>d</sup>All prices for the United States are unleaded regular gasoline. These estimates are for international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.

\*Adjusted by the U.S. Consumer Price Inflation Index.

Figure 1.4. Gasoline Prices for Selected Countries, 1980 and 1990



Source:  
 International Energy Agency, Energy Prices and Taxes, 1991 Edition, Paris, France, 1992, pp. 82, 115, 126, 156,  
 168, 229, 257, and 268.  
 Table 1.4.

Table 1.5  
Diesel Fuel Prices for Selected Countries<sup>a</sup>, 1978-91

|   | Current dollars per gallon |      |      |      |      |      |      |      |      |      |      | Average annual percentage change |                   |                   |                   |                   |
|---|----------------------------|------|------|------|------|------|------|------|------|------|------|----------------------------------|-------------------|-------------------|-------------------|-------------------|
|   | 1978                       | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989                             | 1990 <sup>a</sup> | 1991 <sup>b</sup> | 1978-91           | 1982-91           |
| Japan   | •                          | 1.23 | 1.70 | 1.81 | 1.78 | 1.72 | 1.66 | 1.60 | 1.90 | 1.91 | 2.02 | 2.02                             | 1.75              | 2.40              | 5.7 <sup>a</sup>  | 3.4               |
| France  | 1.30                       | 1.65 | 2.11 | 1.98 | 1.88 | 1.76 | 1.63 | 1.68 | 1.69 | 1.92 | 1.84 | 1.86                             | 1.78              | •                 | 2.7 <sup>a</sup>  | -0.7              |
| Italy   | 0.64                       | 0.80 | 1.21 | 1.11 | 1.19 | 1.26 | 1.20 | 1.21 | 1.31 | 1.62 | 1.78 | 1.82                             | 2.34              | 3.77              | 14.6              | 13.7              |
| Sweden  | 0.62                       | 0.83 | 1.31 | 1.35 | 1.41 | 1.26 | 1.32 | 1.36 | 1.24 | 1.54 | 1.64 | 1.84                             | 2.30              | 3.58              | 14.4              | 10.9              |
| United Kingdom                                | 1.24                       | 1.70 | 2.19 | 2.23 | 2.05 | 1.87 | 1.68 | 1.78 | 1.71 | 1.89 | 1.99 | 2.06                             | 2.04              | •                 | 4.2 <sup>a</sup>  | -0.1 <sup>a</sup> |
| West Germany                                  | 1.48                       | 1.77 | 2.10 | 1.90 | 1.81 | 1.66 | 1.53 | 1.52 | 1.51 | 1.72 | 1.66 | 1.71                             | 2.72              | 2.69              | 4.7               | 4.5               |
| Canada  | •                          | •    | •    | 1.27 | 1.27 | 1.33 | 1.30 | 1.31 | 1.27 | 1.33 | 1.45 | 1.47                             | 1.55              | 1.98              | •                 | 5.1               |
| United States <sup>c</sup>                    | 0.54                       | 0.73 | 1.01 | 1.18 | 1.16 | 1.20 | 1.22 | 1.22 | 0.94 | 0.96 | 0.95 | 0.89                             | 0.99              | 0.91              | 4.1               | -2.7              |
| Constant 1990 dollars <sup>e</sup> per gallon |                            |      |      |      |      |      |      |      |      |      |      |                                  |                   |                   |                   |                   |
|   | 1978                       | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989                             | 1990 <sup>a</sup> | 1991 <sup>b</sup> | 1978-91           | 1982-91           |
| Japan   | •                          | 2.21 | 2.70 | 2.60 | 2.41 | 2.26 | 2.09 | 1.94 | 2.26 | 2.20 | 2.23 | 2.13                             | 1.75              | 2.30              | 0.3 <sup>a</sup>  | -0.5              |
| France  | 2.60                       | 2.97 | 3.35 | 2.84 | 2.55 | 2.31 | 2.05 | 2.04 | 2.01 | 2.21 | 2.03 | 1.96                             | 1.78              | •                 | -3.1 <sup>a</sup> | -4.4 <sup>a</sup> |
| Italy   | 1.28                       | 1.44 | 1.92 | 1.59 | 1.61 | 1.65 | 1.51 | 1.47 | 1.56 | 1.86 | 1.97 | 1.92                             | 2.34              | 3.62              | 8.3               | 9.4               |
| Sweden  | 1.24                       | 1.49 | 2.08 | 1.94 | 1.91 | 1.65 | 1.66 | 1.65 | 1.48 | 1.77 | 1.81 | 1.94                             | 2.30              | 3.43              | 8.1               | 6.7               |
| United Kingdom                                | 2.48                       | 3.06 | 3.47 | 3.20 | 2.78 | 2.45 | 2.11 | 2.16 | 2.04 | 2.17 | 2.20 | 2.17                             | 2.04              | •                 | -1.6 <sup>a</sup> | -3.8 <sup>a</sup> |
| West Germany                                  | 2.96                       | 3.19 | 3.33 | 2.73 | 2.45 | 2.18 | 1.92 | 1.85 | 1.80 | 1.98 | 1.83 | 1.80                             | 2.72              | 2.58              | -1.1              | 0.6               |
| Canada  | •                          | •    | •    | 1.82 | 1.72 | 1.74 | 1.64 | 1.59 | 1.51 | 1.53 | 1.60 | 1.55                             | 1.55              | 1.90              | •                 | 1.1               |
| United States                                 | 1.08                       | 1.31 | 1.60 | 1.70 | 1.57 | 1.57 | 1.53 | 1.48 | 1.12 | 1.10 | 1.05 | 0.94                             | 0.99              | 0.87              | -1.6              | -6.3              |

Source:

U.S. Department of Energy, Energy Information Administration, International Energy Annual 1990, Washington, DC, January 1992, pp. 134, 135, and annual.

<sup>a</sup>Prices represent the retail prices (including taxes) for diesel fuel unless otherwise noted. Prices are representative for each country based on quarterly data averaged for the year.

<sup>b</sup>Prices represent the retail prices (including taxes) for diesel fuel on January 1 of the year.

<sup>c</sup>Data are not available.

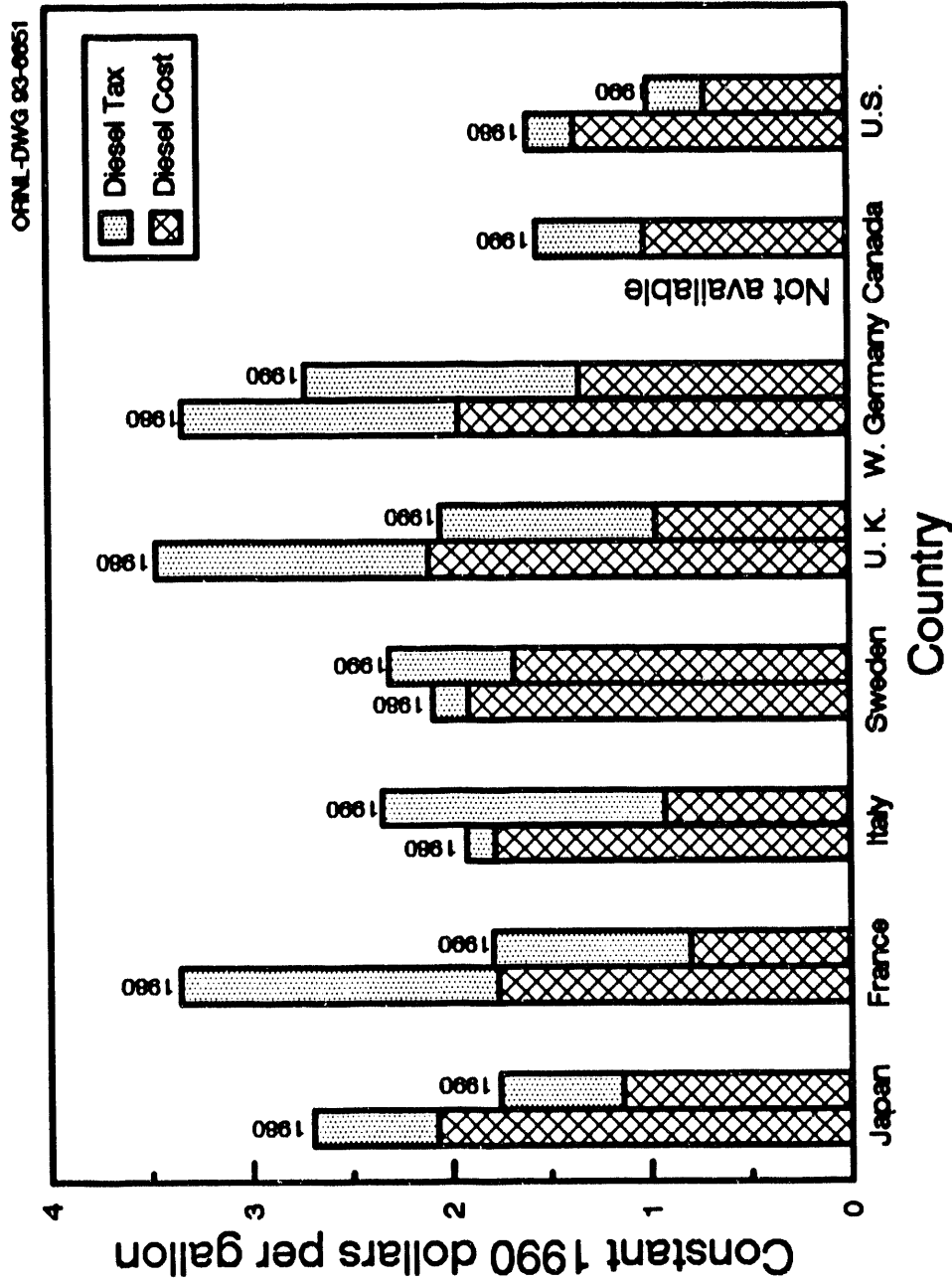
<sup>d</sup>Average annual percentage change is for years 1979-91.

<sup>e</sup>Average annual percentage changes are for 1978-90 and 1982-90.

<sup>f</sup>These estimates are for international comparisons only and do not necessarily correspond to diesel price estimates in other sections of the book.

<sup>g</sup>Adjusted by the U.S. Consumer Price Inflation Index.

Figure 1.5. Diesel Fuel Prices for Selected Countries, 1980 and 1990



Source: International Energy Agency, *Energy Prices and Taxes, 1991 Edition*, Paris, France, 1992, pp. 82, 115, 126, 156, 168, 229, 257, and 268. Table 1.5.

*According to the best available data, new cars in France have the highest fuel economy of the listed countries. Caution should be used, however, when comparing fuel economy data between countries because each country may use different methods of calculating new car fuel economy. The data, therefore, may not be directly comparable.*

**Table 1.6**  
**New Gasoline Car Fuel Economy for Selected Countries, 1973-89**  
**(miles per gallon)**

| Year                                    | Japan              | France            | Italy             | Sweden            | Germany           | United States |
|---|--------------------|-------------------|-------------------|-------------------|-------------------|---------------|
| 1973                                    | 22.7               | •                 | •                 | •                 | 23.0              | 13.1          |
| 1974                                    | 22.1               | •                 | •                 | •                 | •                 | 13.8          |
| 1975                                    | 21.3               | 27.7              | •                 | •                 | •                 | 15.4          |
| 1976                                    | 22.7               | 28.2              | •                 | •                 | •                 | 16.8          |
| 1977                                    | 25.1               | 28.5              | •                 | •                 | •                 | 17.8          |
| 1978                                    | 27.0               | 28.7              | •                 | 25.4              | 24.1              | 18.7          |
| 1979                                    | 27.4               | 29.1              | •                 | 25.7              | 24.6              | 18.8          |
| 1980                                    | 27.4               | 30.4              | 28.4              | 26.3              | 26.2              | 22.6          |
| 1981                                    | 29.1               | 31.9              | 28.8              | 27.2              | •                 | 24.2          |
| 1982                                    | 30.8               | 33.1              | 29.6              | 27.5              | •                 | 24.8          |
| 1983                                    | 30.3               | 33.7              | 31.9              | 27.5              | 29.2              | 24.7          |
| 1984                                    | 30.3               | 34.5              | 32.9              | 27.8              | 30.3              | 24.7          |
| 1985                                    | 29.3               | 35.1              | 32.9              | 27.8              | 31.1              | 25.1          |
| 1986                                    | 28.4               | 35.3              | 33.8              | 28.2              | 31.5              | 25.8          |
| 1987                                    | 27.9               | 35.7              | 34.3              | 28.8              | 30.7              | 26.0          |
| 1988                                    | 27.4               | 36.1              | 34.3              | 28.5              | 29.9              | 25.9          |
| 1989                                    | •                  | 36.3              | •                 | 28.5              | •                 | 25.6          |
| <i>Average annual percentage change</i> |                    |                   |                   |                   |                   |               |
| 1973-89                                 | 1.3% <sup>b</sup>  | 2.0% <sup>c</sup> | 2.4% <sup>d</sup> | 1.1% <sup>e</sup> | 1.8% <sup>f</sup> | 4.3%          |
| 1982-89                                 | -1.9% <sup>b</sup> | 1.3%              | 2.5% <sup>d</sup> | 0.5%              | 0.5% <sup>f</sup> | 0.5%          |

**Sources:**

International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1991. Data were compiled from country sources; such as oil companies, energy economics institutes, and government ministries.

<sup>a</sup>Data are not available.

<sup>b</sup>Average annual percentage changes are for years 1973-88 and 1982-88.

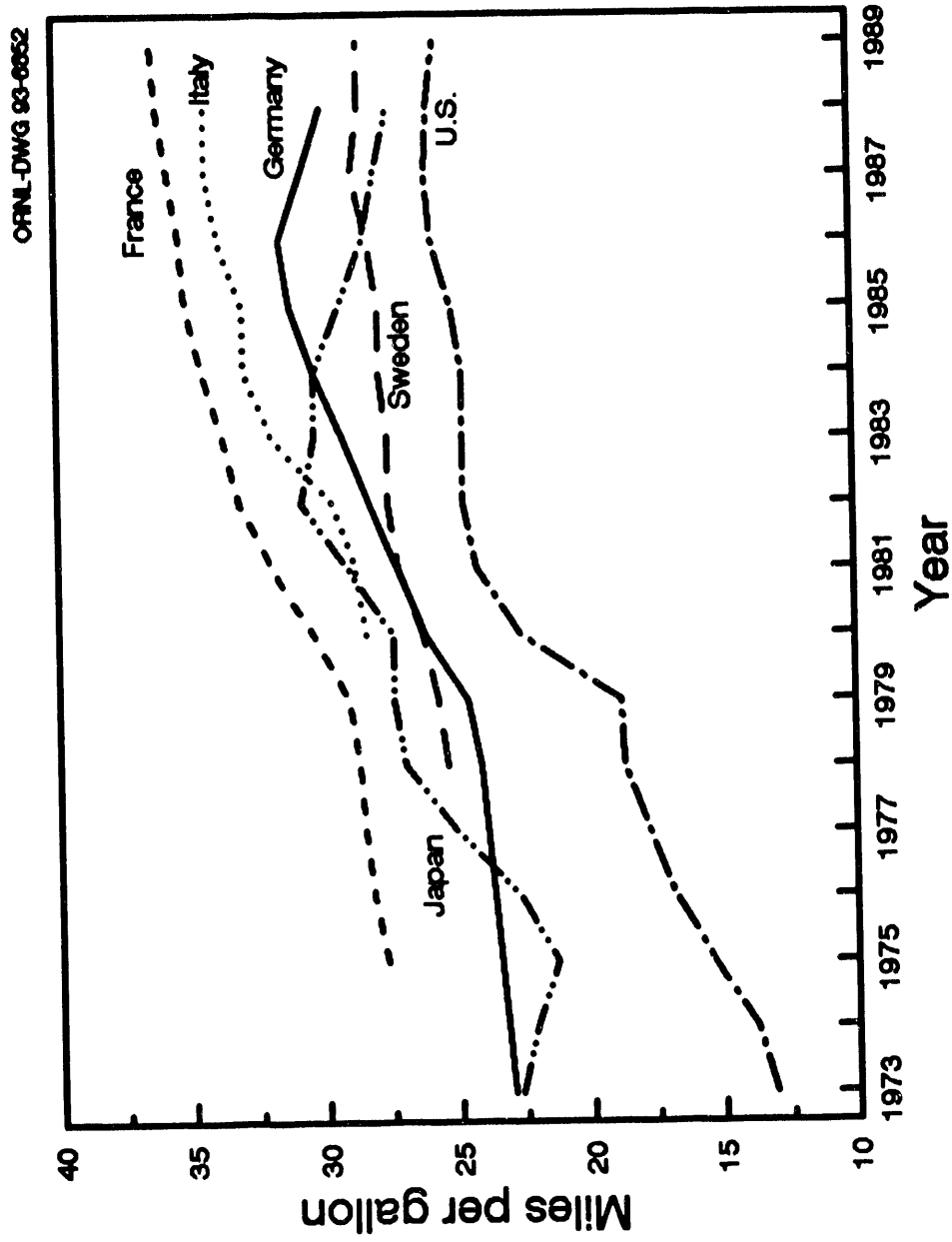
<sup>c</sup>Average annual percentage change is for years 1975-89.

<sup>d</sup>Average annual percentage changes are for years 1980-88 and 1982-88.

<sup>e</sup>Average annual percentage change is for years 1978-89.

<sup>f</sup>Average annual percentage changes are for years 1973-88 and 1983-88.

Figure 1.6. New Gasoline Car Fuel Economy for Selected Countries, 1973-89



Source: See Table 1.6.

*Because each country may use different methods of calculating fuel economies, caution should be used when comparing fuel economy data between countries. The data for the United States were generated specifically for international comparisons and should be used only for that purpose; they are not consistent with other domestic fuel economy figures.*

**Table 1.7**  
**Fuel Economy of the Gasoline Automobile Population for Selected Countries, 1970-89**  
**(miles per gallon)**

| Year                                    | Japan             | France | Italy             | Sweden | United Kingdom | Germany | United States |
|---|-------------------|--------|-------------------|--------|----------------|---------|---------------|
| 1970                                    | 21.4              | 27.8   | •                 | 22.9   | 23.5           | 23.1    | 13.3          |
| 1971                                    | 19.6              | 27.8   | •                 | •      | 23.4           | 22.0    | 13.2          |
| 1972                                    | 21.4              | 27.8   | •                 | 22.4   | 22.0           | 21.5    | 13.2          |
| 1973                                    | 21.4              | 28.0   | 27.8              | 22.2   | 21.8           | 22.0    | 13.1          |
| 1974                                    | 21.4              | 27.6   | •                 | •      | 21.8           | 22.1    | 13.1          |
| 1975                                    | 21.4              | 27.3   | •                 | 22.3   | 22.6           | 22.0    | 13.3          |
| 1976                                    | 21.4              | 26.4   | •                 | 22.1   | 22.7           | 21.9    | 13.3          |
| 1977                                    | 21.4              | 26.5   | •                 | •      | 22.5           | 21.7    | 13.5          |
| 1978                                    | 19.6              | 26.1   | •                 | 21.7   | 22.1           | 21.5    | 13.7          |
| 1979                                    | 19.6              | 26.4   | 27.9              | •      | 21.6           | 21.8    | 14.0          |
| 1980                                    | 19.6              | 27.7   | 27.9              | 21.7   | 22.7           | 21.6    | 15.0          |
| 1981                                    | 19.6              | 28.1   | 28.1              | 21.8   | 23.6           | 21.7    | 15.4          |
| 1982                                    | 21.4              | 26.9   | 28.1              | 21.8   | 23.8           | 21.7    | 16.0          |
| 1983                                    | 21.4              | 26.8   | 28.4              | 21.9   | 23.8           | 21.7    | 16.4          |
| 1984                                    | 21.4              | 27.0   | 28.9              | 21.9   | 23.8           | 21.7    | 16.9          |
| 1985                                    | 21.4              | 27.0   | 29.1              | 22.1   | 24.2           | 21.7    | 17.2          |
| 1986                                    | 21.4              | 26.9   | 29.6              | 22.5   | 24.2           | 21.7    | 17.2          |
| 1987                                    | 21.4              | 27.0   | 30.0              | 23.0   | 24.5           | 21.9    | 17.6          |
| 1988                                    | 21.4              | 26.7   | 30.3              | 23.2   | 24.2           | 22.1    | 18.5          |
| 1989                                    | •                 | 27.0   | 30.7              | 23.2   | 25.5           | 22.5    | 19.0          |
| <i>Average annual percentage change</i> |                   |        |                   |        |                |         |               |
| 1970-89                                 | 0.0% <sup>b</sup> | -0.2%  | 0.6% <sup>c</sup> | 0.1%   | 0.4%           | -0.1%   | 1.9%          |
| 1982-89                                 | 0.0% <sup>b</sup> | 0.1%   | 1.3%              | 0.9%   | 1.0%           | 0.5%    | 2.5%          |

**Sources:**

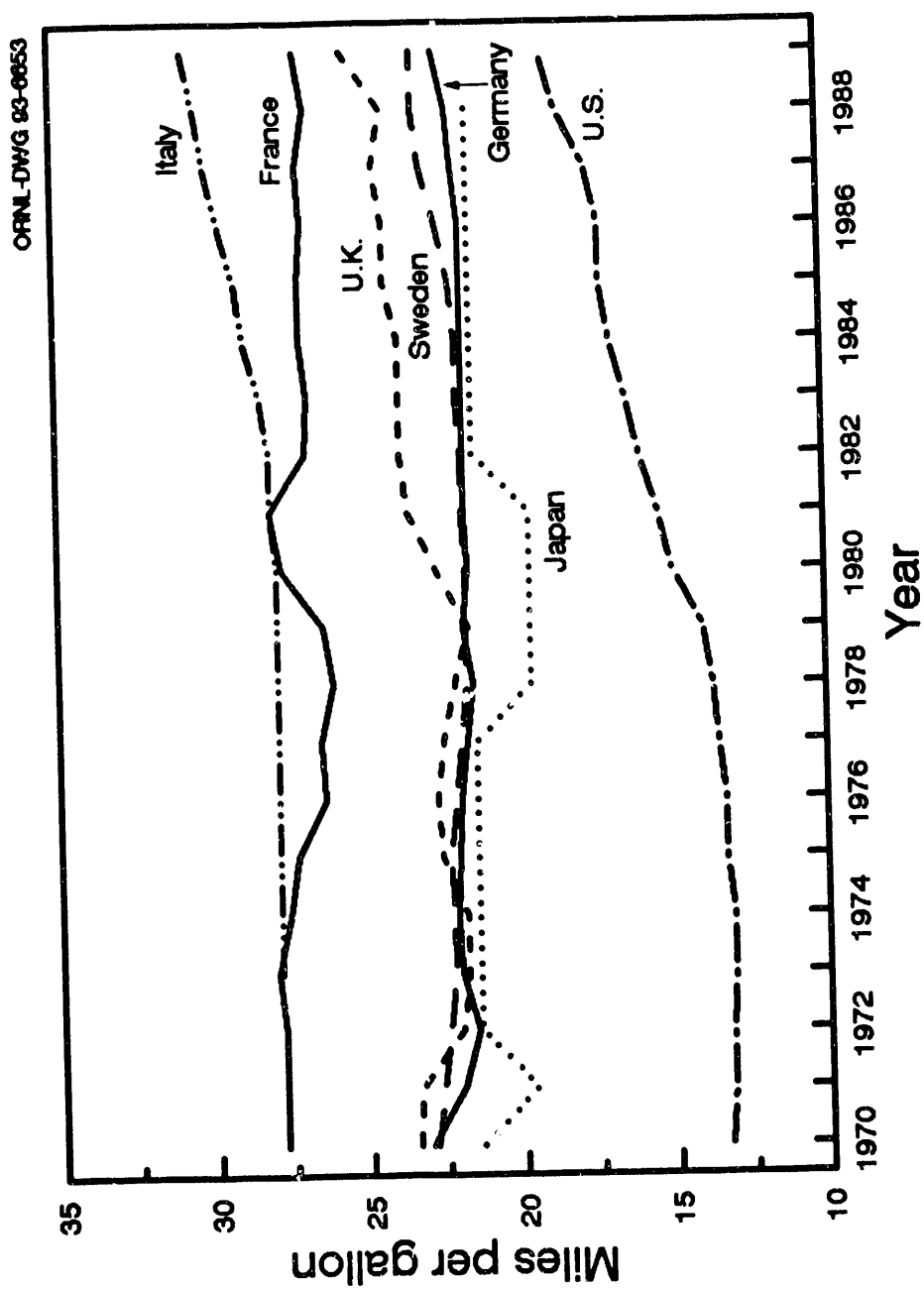
International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1991. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries.

<sup>a</sup>Data are not available.

<sup>b</sup>Average annual percentage changes are for years 1970-88 and 1982-88.

<sup>c</sup>Average annual percentage change is for years 1973-89.

Figure 1.7. Fuel Economy of the Gasoline Automobile Population for Selected Countries, 1970-89



Source: See Table 1.7.

**Table 1.8**  
**Annual Miles Driven per Vehicle for Selected Countries, 1984-90**  
**(miles)**

|                              | 1984   | 1985   | 1986   | 1987   | 1988   | 1989   | 1990   |
|------------------------------|--------|--------|--------|--------|--------|--------|--------|
| <b><u>Asia:</u></b>          |        |        |        |        |        |        |        |
| <i>Japan</i>                 |        |        |        |        |        |        |        |
| Cars                         | 6,486  | 6,503  | 6,519  | 6,274  | 6,124  | 6,074  | *      |
| Trucks                       | 7,485  | 7,438  | 7,483  | 6,786  | 6,913  | 6,920  | *      |
| Buses                        | 17,052 | 17,070 | 17,250 | 17,299 | 17,310 | 16,120 | *      |
| <b><u>Europe:</u></b>        |        |        |        |        |        |        |        |
| <i>France</i>                |        |        |        |        |        |        |        |
| Cars                         | 7,643  | 7,768  | 8,078  | 8,451  | 8,389  | 8,451  | 8,451  |
| Trucks                       | 12,428 | 12,428 | 12,428 | 12,428 | 13,049 | 13,671 | 13,671 |
| Buses                        | 29,827 | 29,827 | 29,827 | 29,827 | 29,827 | 31,070 | 31,070 |
| <i>Italy</i>                 |        |        |        |        |        |        |        |
| Cars                         | 6,152  | 6,152  | 6,152  | 6,214  | 6,338  | *      | *      |
| Trucks                       | 19,596 | 13,453 | 13,566 | 13,648 | 13,647 | *      | *      |
| Buses                        | 31,960 | 32,822 | 34,616 | 35,636 | 36,787 | *      | *      |
| <i>Sweden</i>                |        |        |        |        |        |        |        |
| Cars                         | 7,457  | 7,457  | 7,457  | 7,768  | 7,768  | 7,457  | *      |
| Trucks                       | *      | *      | 27,342 | 27,963 | 27,963 | *      | *      |
| Buses                        | *      | *      | *      | *      | *      | *      | *      |
| <i>United Kingdom</i>        |        |        |        |        |        |        |        |
| Cars                         | 8,078  | 8,700  | 8,700  | 9,197  | 9,102  | 9,496  | 10,377 |
| Trucks                       | 30,449 | 30,449 | 31,691 | 35,544 | 29,963 | 13,752 | 35,349 |
| Buses                        | 28,584 | 26,720 | 27,963 | 22,592 | 16,947 | 19,529 | 23,439 |
| <i>West Germany</i>          |        |        |        |        |        |        |        |
| Cars                         | 8,700  | 8,451  | 8,700  | 8,886  | 9,072  | 9,010  | 9,010  |
| Trucks                       | 17,337 | 17,710 | 18,083 | 18,145 | 18,207 | 18,642 | 19,139 |
| Buses                        | 32,375 | 33,121 | 33,369 | 34,488 | 35,047 | 35,420 | 36,041 |
| <b><u>North America:</u></b> |        |        |        |        |        |        |        |
| <i>Canada</i>                |        |        |        |        |        |        |        |
| Cars                         | 10,119 | 10,092 | 10,267 | 10,715 | *      | *      | *      |
| Trucks                       | *      | *      | *      | *      | *      | *      | *      |
| Buses                        | *      | *      | *      | *      | *      | *      | *      |
| <i>United States</i>         |        |        |        |        |        |        |        |
| Cars                         | 9,785  | 9,558  | 9,606  | 9,882  | 10,117 | 10,380 | 10,556 |
| Trucks                       | 11,873 | 12,745 | 12,955 | 13,421 | 13,654 | 13,899 | 13,868 |
| Buses                        | 11,532 | 8,215  | 8,536  | 8,844  | 8,875  | 9,094  | 9,136  |

**Sources:**

International Road Foundation, World Road Statistics 1986-90, Washington, DC, 1991, pp. 76, 78, 80, 82, 86, and 88.

1990 U.S. data - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table VM-1, p. 192.

\*Data are not available.

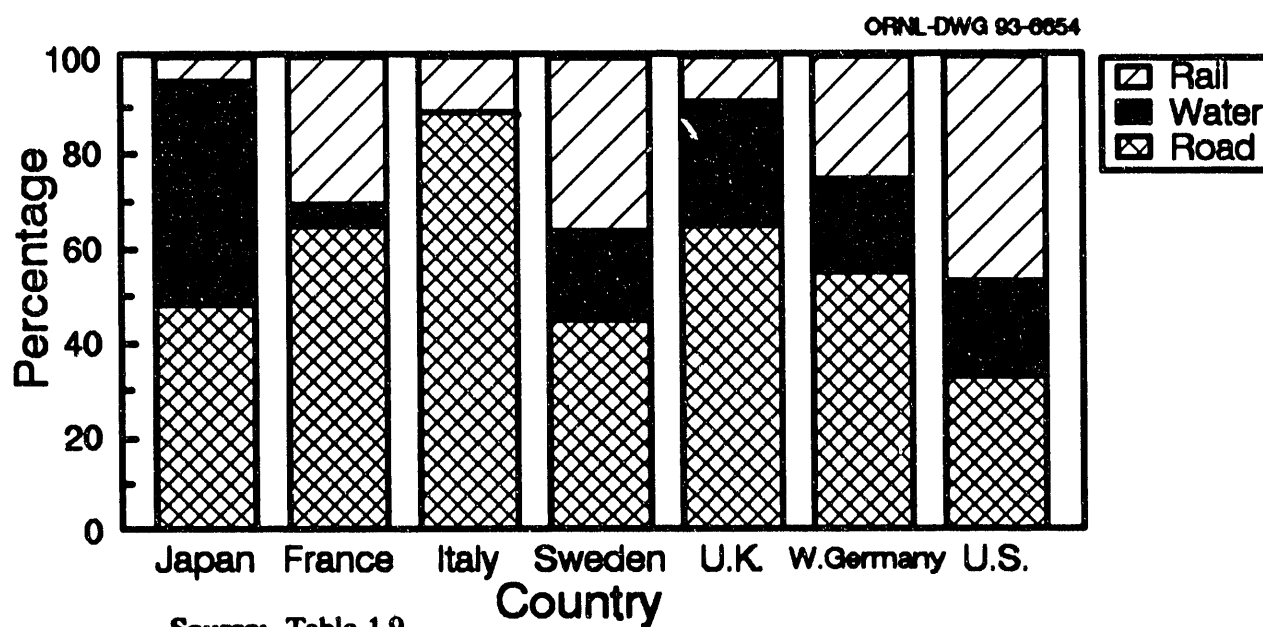
**Table 1.9**  
**Inland Surface Transport of Goods for Selected Countries, 1985**  
**(million ton-miles)**

|                              | Road    | Water   | Rail    |
|------------------------------|---------|---------|---------|
| <b><u>Asia:</u></b>          |         |         |         |
| Japan                        | 127,992 | 127,915 | 13,623  |
| <b><u>Europe:</u></b>        |         |         |         |
| France                       | 69,608  | 5,221   | 33,561  |
| Italy                        | 89,576  | 125     | 11,718  |
| Sweden                       | 13,162  | 5,594   | 10,930  |
| United Kingdom               | 63,455  | 25,917  | 9,509   |
| West Germany                 | 83,343  | 29,956  | 39,776  |
| <b><u>North America:</u></b> |         |         |         |
| United States                | 609,691 | 382,223 | 894,960 |

**Source:**

International Road Foundation, World Road Statistics 1985-89,  
Washington, DC, 1990, pp. 79, 81, 83, 87, and 89.

**Figure 1.8. Inland Surface Transport of Goods for Selected Countries, 1985**



**Table 1.10**  
**Annual Vehicle Miles Traveled by Personal Vehicles\***  
**for Selected Countries, 1970-89<sup>b</sup>**

| Year                                    | Japan              | France | Italy | Sweden | United Kingdom | Germany | United States |
|---|--------------------|--------|-------|--------|----------------|---------|---------------|
| 1970                                    | 9,387              | 8,357  | 7,344 | 9,016  | 13,658         | 8,903   | 11,097        |
| 1972                                    | 7,941              | 8,358  | 6,187 | 9,084  | 13,988         | 8,519   | 11,527        |
| 1973                                    | 7,789              | 8,913  | 6,403 | 9,072  | 13,884         | 8,336   | 11,383        |
| 1975                                    | 6,687              | 8,148  | 6,115 | 8,867  | 13,411         | 8,454   | 10,669        |
| 1976                                    | 6,610              | 8,080  | 5,925 | 8,939  | 13,779         | 8,321   | 10,841        |
| 1977                                    | 6,848              | 8,012  | 5,780 | 8,960  | 14,040         | 8,187   | 10,965        |
| 1978                                    | 6,755              | 7,981  | 6,089 | 9,221  | 14,635         | 8,127   | 11,037        |
| 1979                                    | 6,762              | 7,852  | 6,429 | 8,908  | 14,052         | 7,972   | 10,590        |
| 1980                                    | 6,720              | 8,037  | 6,377 | 8,887  | 14,537         | 7,917   | 10,529        |
| 1981                                    | 6,688              | 8,191  | 6,366 | 8,806  | 14,668         | 7,354   | 10,543        |
| 1982                                    | 6,773              | 7,796  | 6,430 | 8,855  | 14,837         | 7,538   | 10,737        |
| 1983                                    | 6,728              | 7,790  | 6,326 | 8,830  | 17,051         | 7,645   | 10,838        |
| 1984                                    | 6,758              | 7,926  | 6,401 | 8,902  | 15,186         | 7,685   | 10,897        |
| 1985                                    | 6,948              | 7,883  | 7,029 | 8,776  | 15,192         | 7,486   | 10,923        |
| 1986                                    | 7,003              | 8,105  | 7,186 | 9,079  | 15,540         | 7,710   | 11,034        |
| 1987                                    | 7,254              | 8,191  | 7,392 | 9,249  | 16,301         | 7,895   | 11,282        |
| 1988                                    | 7,392              | 8,321  | 7,584 | 9,224  | 15,991         | 8,049   | 11,698        |
| 1989                                    | <sup>c</sup>       | 8,444  | 7,745 | 9,230  | 17,099         | 7,998   | 11,970        |
| <i>Average annual percentage change</i> |                    |        |       |        |                |         |               |
| 1970-89                                 | -1.3% <sup>d</sup> | 0.1%   | 0.3%  | 0.1%   | 1.2%           | -0.6%   | 0.4%          |
| 1982-89                                 | 1.5% <sup>d</sup>  | 1.1%   | 2.7%  | 0.6%   | 2.0%           | 0.8%    | 1.6%          |

**Sources:**

Lee Schipper, Steve Myers, et. al., "Energy Efficiency and Human Activity," Cambridge University Press, Cambridge, MA, 1992, and the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect."

<sup>a</sup>Includes privately owned automobiles and light trucks.

<sup>b</sup>Data for 1971 and 1974 are not available.

<sup>c</sup>Data are not available.

<sup>d</sup>Average annual percentage changes are for 1970-88 and 1982-88.

**Table 1.11**  
**Passenger Travel by Personal Vehicles<sup>a</sup> for Selected Countries, 1970-89<sup>b</sup>**  
**(billion passenger-miles)**

| Year                                    | Japan | France | Italy             | Sweden | United Kingdom | Germany | United States |
|---|-------|--------|-------------------|--------|----------------|---------|---------------|
| 1970                                    | 183   | 188    | <sup>c</sup>      | 34     | 179            | 216     | 2,109         |
| 1972                                    | 210   | 209    | 158               | 37     | 198            | 232     | 2,289         |
| 1973                                    | 204   | 235    | 170               | 38     | 208            | 240     | 2,323         |
| 1975                                    | 213   | 231    | 186               | 40     | 199            | 249     | 2,249         |
| 1976                                    | 225   | 237    | 194               | 41     | 209            | 256     | 2,327         |
| 1977                                    | 224   | 246    | 205               | 42     | 217            | 265     | 2,377         |
| 1978                                    | 247   | 256    | 220               | 42     | 230            | 275     | 2,454         |
| 1979                                    | 265   | 263    | 227               | 42     | 230            | 285     | 2,383         |
| 1980                                    | 265   | 279    | 233               | 41     | 243            | 288     | 2,352         |
| 1981                                    | 272   | 289    | 241               | 41     | 247            | 272     | 2,359         |
| 1982                                    | 288   | 289    | 243               | 42     | 252            | 281     | 2,399         |
| 1983                                    | 302   | 295    | 248               | 42     | 254            | 289     | 2,447         |
| 1984                                    | 306   | 304    | 254               | 44     | 267            | 295     | 2,508         |
| 1985                                    | 325   | 305    | 260               | 45     | 271            | 294     | 2,563         |
| 1986                                    | 334   | 319    | 267               | 47     | 286            | 311     | 2,624         |
| 1987                                    | 380   | 329    | 275               | 49     | 307            | 325     | 2,718         |
| 1988                                    | 417   | 342    | 283               | 51     | 319            | 340     | 2,839         |
| 1989                                    | 454   | 356    | <sup>c</sup>      | 54     | 343            | 348     | 2,920         |
| <i>Average annual percentage change</i> |       |        |                   |        |                |         |               |
| 1970-89                                 | 4.9%  | 3.4%   | 3.7% <sup>d</sup> | 2.5%   | 3.5%           | 2.5%    | 1.7%          |
| 1982-89                                 | 6.7%  | 3.0%   | 2.6% <sup>d</sup> | 3.7%   | 4.5%           | 3.1%    | 2.8%          |

**Sources:**

Lee Schipper, Steve Myers, et. al., "Energy Efficiency and Human Activity," Cambridge University Press, Cambridge, MA, 1992, and the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect."

<sup>a</sup>Includes privately owned automobiles and light trucks.

<sup>b</sup>Data for 1971 and 1974 are not available.

<sup>c</sup>Data are not available.

<sup>d</sup>Average annual percentage changes are for 1972-88 and 1982-88.

**Table 1.12**  
**Energy Use by Personal Vehicles<sup>a</sup> for Selected Countries, 1970-89<sup>b</sup>**  
**(trillion Btu)**

| Year                                    | Japan | France | Italy             | Sweden       | United Kingdom | Germany | United States |
|---|-------|--------|-------------------|--------------|----------------|---------|---------------|
| 1970                                    | 488   | 431    | <sup>c</sup>      | 104          | 510            | 631     | 9,263         |
| 1972                                    | 602   | 480    | <sup>c</sup>      | 112          | 612            | 744     | 10,551        |
| 1973                                    | 687   | 534    | 379               | 117          | 652            | 755     | 10,999        |
| 1975                                    | 759   | 540    | <sup>c</sup>      | 125          | 621            | 805     | 10,867        |
| 1976                                    | 797   | 573    | <sup>c</sup>      | 130          | 648            | 842     | 11,479        |
| 1977                                    | 834   | 593    | <sup>c</sup>      | <sup>c</sup> | 666            | 885     | 11,742        |
| 1978                                    | 918   | 627    | <sup>c</sup>      | 135          | 707            | 939     | 12,119        |
| 1979                                    | 958   | 636    | 473               | <sup>c</sup> | 720            | 965     | 11,685        |
| 1980                                    | 968   | 648    | 493               | 133          | 733            | 997     | 10,972        |
| 1981                                    | 985   | 673    | 512               | 133          | 719            | 940     | 10,891        |
| 1982                                    | 1,023 | 690    | 536               | 134          | 740            | 975     | 10,811        |
| 1983                                    | 1,087 | 705    | 538               | 135          | 752            | 1,009   | 10,926        |
| 1984                                    | 1,098 | 718    | 550               | 140          | 793            | 1,037   | 11,008        |
| 1985                                    | 1,134 | 715    | 574               | 140          | 801            | 1,031   | 11,183        |
| 1986                                    | 1,179 | 754    | 594               | 146          | 845            | 1,099   | 11,562        |
| 1987                                    | 1,218 | 773    | 620               | 151          | 896            | 1,152   | 11,711        |
| 1988                                    | 1,284 | 799    | 654               | 154          | 944            | 1,205   | 11,902        |
| 1989                                    | 1,414 | 811    | <sup>c</sup>      | 159          | 997            | 1,214   | 12,046        |
| <i>Average annual percentage change</i> |       |        |                   |              |                |         |               |
| 1970-89                                 | 5.8%  | 3.4%   | 3.7% <sup>d</sup> | 2.3%         | 3.6%           | 3.5%    | 1.4%          |
| 1982-89                                 | 4.7%  | 2.3%   | 3.4% <sup>d</sup> | 2.5%         | 4.4%           | 3.2%    | 1.6%          |

**Sources:**

Lee Schipper, Steve Myers, et. al., "Energy Efficiency and Human Activity," Cambridge University Press, Cambridge, MA, 1992, and the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect."

<sup>a</sup>Includes privately owned automobiles and light trucks.

<sup>b</sup>Data for 1971 and 1974 are not available.

<sup>c</sup>Data are not available.

<sup>d</sup>Average annual percentage changes are for 1973-88 and 1982-88.

**Table 1.13**  
**Passenger Travel by Bus for Selected Countries, 1970-89<sup>a</sup>**  
**(billion passenger-miles)**

| Year                                    | Japan | France | Italy             | Sweden | United Kingdom | Germany | United States |
|---|-------|--------|-------------------|--------|----------------|---------|---------------|
| 1970                                    | 64    | 16     | <sup>b</sup>      | 3      | 33             | 30      | 85            |
| 1972                                    | 67    | 18     | 30                | 4      | 31             | 33      | 88            |
| 1973                                    | 69    | 19     | 31                | 4      | 33             | 34      | 90            |
| 1975                                    | 68    | 21     | 33                | 4      | 34             | 36      | 93            |
| 1976                                    | 61    | 22     | 36                | 4      | 33             | 36      | 101           |
| 1977                                    | 65    | 23     | 37                | 4      | 31             | 38      | 104           |
| 1978                                    | 66    | 24     | 37                | 4      | 31             | 38      | 105           |
| 1979                                    | 67    | 24     | 39                | 4      | 30             | 40      | 107           |
| 1980                                    | 68    | 24     | 40                | 5      | 28             | 40      | 106           |
| 1981                                    | 67    | 24     | 40                | 5      | 26             | 41      | 107           |
| 1982                                    | 65    | 24     | 42                | 5      | 25             | 41      | 107           |
| 1983                                    | 64    | 24     | 41                | 5      | 26             | 40      | 108           |
| 1984                                    | 64    | 25     | 40                | 6      | 26             | 38      | 116           |
| 1985                                    | 65    | 23     | 45                | 6      | 26             | 33      | 113           |
| 1986                                    | 63    | 24     | 46                | 6      | 25             | 33      | 118           |
| 1987                                    | 64    | 26     | 48                | 6      | 25             | 33      | 121           |
| 1988                                    | 66    | 26     | 50                | 6      | 25             | 33      | 127           |
| 1989                                    | 68    | 24     | <sup>b</sup>      | 6      | 25             | 33      | 125           |
| <i>Average annual percentage change</i> |       |        |                   |        |                |         |               |
| 1970-89                                 | 0.3%  | 2.2%   | 3.2% <sup>c</sup> | 3.7%   | -1.5%          | 0.5%    | 2.1%          |
| 1982-89                                 | 0.6%  | 0.0%   | 2.9% <sup>c</sup> | 2.6%   | 0.0%           | -3.1%   | 2.2%          |

**Sources:**

Lee Schipper, Steve Myers, et. al., "Energy Efficiency and Human Activity," Cambridge University Press, Cambridge, MA, 1992, and the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect."

<sup>a</sup>Data for 1971 and 1974 are not available.

<sup>b</sup>Data are not available.

<sup>c</sup>Average annual percentage changes are for 1972-88 and 1982-88.

**Table 1.14**  
**Energy Use by Bus for Selected Countries, 1970-89<sup>a</sup>**  
**(trillion Btu)**

| Year                                    | Japan | France | Italy              | Sweden       | United Kingdom | Germany | United States |
|---|-------|--------|--------------------|--------------|----------------|---------|---------------|
| 1970                                    | 47    | 14     | <sup>b</sup>       | 5            | 37             | 24      | 109           |
| 1972                                    | 54    | 16     | <sup>b</sup>       | 6            | 35             | 27      | 106           |
| 1973                                    | 59    | 17     | 22                 | 6            | 35             | 28      | 109           |
| 1975                                    | 56    | 20     | <sup>b</sup>       | 7            | 32             | 30      | 119           |
| 1976                                    | 56    | 21     | <sup>b</sup>       | 7            | 32             | 31      | 129           |
| 1977                                    | 56    | 22     | <sup>b</sup>       | <sup>b</sup> | 32             | 33      | 132           |
| 1978                                    | 55    | 23     | <sup>b</sup>       | 7            | 32             | 34      | 135           |
| 1979                                    | 55    | 24     | 32                 | <sup>b</sup> | 32             | 35      | 137           |
| 1980                                    | 53    | 25     | 32                 | 6            | 32             | 36      | 138           |
| 1981                                    | 53    | 26     | 32                 | 7            | 31             | 37      | 143           |
| 1982                                    | 53    | 27     | 36                 | 7            | 32             | 37      | 146           |
| 1983                                    | 54    | 27     | 38                 | 8            | 34             | 38      | 145           |
| 1984                                    | 52    | 27     | 43                 | 8            | 41             | 38      | 154           |
| 1985                                    | 52    | 27     | 47                 | 8            | 43             | 38      | 161           |
| 1986                                    | 53    | 28     | 51                 | 9            | 44             | 38      | 154           |
| 1987                                    | 54    | 28     | 57                 | 9            | 44             | 39      | 157           |
| 1988                                    | 55    | 27     | 60                 | 9            | 44             | 39      | 159           |
| 1989                                    | 59    | 29     | <sup>b</sup>       | 9            | 44             | 39      | 163           |
| <i>Average annual percentage change</i> |       |        |                    |              |                |         |               |
| 1970-89                                 | 1.2%  | 3.9%   | 8.9% <sup>c</sup>  | 3.1%         | 0.9%           | 2.6%    | 2.1%          |
| 1982-89                                 | 1.5%  | 1.0%   | 15.0% <sup>c</sup> | 3.7%         | 4.7%           | 0.8%    | 1.6%          |

**Sources:**

Lee Schipper, Steve Myers, et. al., "Energy Efficiency and Human Activity," Cambridge University Press, Cambridge, MA, 1992, and the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect."

<sup>a</sup>Data for 1971 and 1974 are not available.

<sup>b</sup>Data are not available.

<sup>c</sup>Average annual percentage changes are for 1973-88 and 1982-88.

**Table 1.15**  
**Passenger Travel by Rail for Selected Countries, 1970-89<sup>a</sup>**  
**(billion passenger-miles)**

| Year                                    | Japan | France | Italy             | Sweden | United Kingdom | Germany | United States |
|---|-------|--------|-------------------|--------|----------------|---------|---------------|
| 1970                                    | 178   | 29     | 21                | 3      | 22             | 30      | 23            |
| 1972                                    | 185   | 31     | 23                | 3      | 21             | 31      | 21            |
| 1973                                    | 193   | 32     | 24                | 3      | 22             | 31      | 21            |
| 1975                                    | 200   | 35     | 24                | 4      | 22             | 30      | 20            |
| 1976                                    | 197   | 36     | 26                | 4      | 20             | 29      | 20            |
| 1977                                    | 193   | 36     | 26                | 4      | 21             | 29      | 20            |
| 1978                                    | 192   | 38     | 26                | 4      | 21             | 29      | 21            |
| 1979                                    | 193   | 38     | 26                | 4      | 22             | 30      | 22            |
| 1980                                    | 194   | 38     | 27                | 4      | 21             | 31      | 22            |
| 1981                                    | 195   | 39     | 27                | 4      | 21             | 31      | 21            |
| 1982                                    | 195   | 40     | 26                | 4      | 19             | 30      | 21            |
| 1983                                    | 198   | 41     | 26                | 4      | 21             | 29      | 21            |
| 1984                                    | 200   | 43     | 26                | 4      | 22             | 30      | 21            |
| 1985                                    | 204   | 44     | 25                | 4      | 22             | 32      | 22            |
| 1986                                    | 207   | 43     | 27                | 4      | 23             | 31      | 23            |
| 1987                                    | 213   | 43     | 27                | 4      | 24             | 30      | 24            |
| 1988                                    | 223   | 45     | 29                | 4      | 25             | 31      | 24            |
| 1989                                    | 228   | 46     | <sup>b</sup>      | 4      | 24             | 31      | 25            |
| <i>Average annual percentage change</i> |       |        |                   |        |                |         |               |
| 1970-89                                 | 1.3%  | 2.5%   | 1.8% <sup>c</sup> | 1.5%   | 0.5%           | 0.2%    | 0.4%          |
| 1982-89                                 | 2.3%  | 2.0%   | 1.8% <sup>c</sup> | 0.0%   | 3.4%           | 0.5%    | 2.5%          |

**Sources:**

Lee Schipper, Steve Myers, et. al., "Energy Efficiency and Human Activity," Cambridge University Press, Cambridge, MA, 1992, and the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect."

<sup>a</sup>Data for 1971 and 1974 are not available.

<sup>b</sup>Data are not available.

<sup>c</sup>Average annual percentage changes are for 1970-88 and 1982-88.

**Table 1.16**  
**Energy Use by Rail for Selected Countries, 1970-89<sup>a</sup>**  
**(trillion Btu)**

| Year                                    | Japan | France | Italy             | Sweden       | United Kingdom     | Germany | United States |
|---|-------|--------|-------------------|--------------|--------------------|---------|---------------|
| 1970                                    | 54    | 21     | <sup>b</sup>      | 4            | 33                 | 30      | 61            |
| 1972                                    | 56    | 19     | 18                | 4            | 33                 | 29      | 59            |
| 1973                                    | 58    | 18     | 17                | 4            | 33                 | 29      | 58            |
| 1975                                    | 58    | 20     | 16                | 5            | 33                 | 26      | 62            |
| 1976                                    | 60    | 20     | 17                | 5            | 32                 | 25      | 62            |
| 1977                                    | 60    | 21     | 16                | <sup>b</sup> | 35                 | 22      | 59            |
| 1978                                    | 60    | 21     | 17                | 5            | 34                 | 25      | 55            |
| 1979                                    | 61    | 21     | 18                | <sup>b</sup> | 34                 | 27      | 65            |
| 1980                                    | 60    | 21     | 16                | 5            | 35                 | 28      | 63            |
| 1981                                    | 60    | 21     | 17                | 5            | 34                 | 28      | 54            |
| 1982                                    | 61    | 22     | 17                | 5            | 31                 | 27      | 56            |
| 1983                                    | 62    | 23     | 17                | 5            | 33                 | 26      | 60            |
| 1984                                    | 60    | 23     | 18                | 5            | 32                 | 26      | 69            |
| 1985                                    | 61    | 23     | 18                | 6            | 34                 | 27      | 70            |
| 1986                                    | 61    | 22     | 19                | 5            | 32                 | 27      | 72            |
| 1987                                    | 64    | 23     | 19                | 5            | 31                 | 27      | 76            |
| 1988                                    | 67    | 23     | 19                | 6            | 31                 | 27      | 78            |
| 1989                                    | 70    | 23     | <sup>b</sup>      | 5            | <sup>b</sup>       | 28      | 81            |
| <i>Average annual percentage change</i> |       |        |                   |              |                    |         |               |
| 1970-89                                 | 1.4%  | 0.5%   | 0.3% <sup>c</sup> | 1.2%         | -0.3% <sup>d</sup> | -0.4%   | 1.5%          |
| 1982-89                                 | 2.0%  | 0.6%   | 1.9% <sup>c</sup> | 0.0%         | 0.0% <sup>d</sup>  | 0.5%    | 5.4%          |

**Sources:**

Lee Schipper, Steve Myers, et. al., "Energy Efficiency and Human Activity," Cambridge University Press, Cambridge, MA, 1992, and the "Proceedings of the ACEEE Conference on Automobiles and the Greenhouse Effect."

<sup>a</sup>Data for 1971 and 1974 are not available.

<sup>b</sup>Data are not available.

<sup>c</sup>Average annual percentage changes are for 1972-88 and 1982-88.

<sup>d</sup>Average annual percentage changes are for years 1970-88 and 1982-88.

## **CHAPTER 2**

### **TRANSPORTATION ENERGY CHARACTERISTICS**

The U.S. was responsible for more than one-quarter of the world's petroleum consumption in 1990. Domestic crude oil production, which had been declining every year from 1985 to 1990 rose by 0.02 million barrels per day in 1991. While domestic crude oil production has declined 17.8% from 1985 to 1991, the amount of crude oil imported has increased 49.5% in that time period to meet the domestic demand. Imports in 1991 accounted for 45.5% of U.S. petroleum consumption, down from a high of 47.2% in 1990 (Table 2.2).

Most of the petroleum consumed in the U.S. was in the transportation sector, 65.4% (Table 2.3), accounting for 27.3% of total energy use in 1991 (Table 2.6). While the transportation section depended primarily on petroleum, the residential and commercial sector depended heavily on electricity (Table 2.4).

The fuels used in the transportation sector include gasoline, distillate fuel oil (diesel fuel), jet fuel, residual fuel oil, natural gas, and electricity. Gasoline, however, accounted for the majority of transportation energy consumption in 1990 (60.4%) (Figure 2.7). Of total transportation energy use in 1990, 72.4% was consumed by the highway mode while the nonhighway mode (which includes water, air, pipeline, and rail transportation) accounted for 21.5%. The remaining 6.1% of transportation energy use was consumed by the off-highway mode and military activities (Table 2.9).

The average price for all types of gasoline jumped 10 cents from 1989 to 1990 (in constant 1990 cents). Unleaded regular gasoline prices (in constant 1990 cents) experienced an average decline of 5% annually from 1982 to 1991 (Table 2.16). The refiner sales prices for other transportation fuels such as propane, aviation gasoline and jet fuel also increased from 1989 to 1990 and declined in 1991 (Table 2.17). Many of these fuel price fluctuations are due to the \$22.24 price for a barrel of crude oil in 1990 (a \$3.30 increase from 1989 in constant 1990 dollars) and the 1991 price of \$18.30 per barrel in constant 1990 dollars (Table 2.18).

Transportation's share of the gross national product (GNP) fell below 17% in 1991. GNP has been growing at an average rate of 3.0% from 1982 to 1991, while transportation outlays have grown an average of 1.9% annually (Table 2.19). Transportation personal consumption expenditures (PCE) for 1991 were at approximately the same level as 1989, while total PCE have grown. Transportation PCE was approximately 11.3% of total PCE in 1991, the lowest in the twenty-year series (Table 2.20).

Although consumers in 1990 spent almost four times more for a used car than they would have in 1970, the used car Consumer Price Index (CPI) has declined slightly from a high of 3.859 in 1989 (Table 2.21). The average price of a new domestic car in constant 1990 dollars declined again in 1991 to \$256 less than the high in 1989. Import car prices also decreased slightly from 1990 to 1991. The average price of a domestic car was approximately \$2,000 less than an import car in 1991 (Table 2.22). The cost of operating a car rose to 41.85 cents per mile in 1991. Gas and oil, once as much as one-quarter of the total cost to operate a car, accounted for only 15.4% of the total cost in 1991, which was up from 13.2% in 1990 (Table 2.23).

## **Section 2.1.**

# **Energy Consumption and Supply**

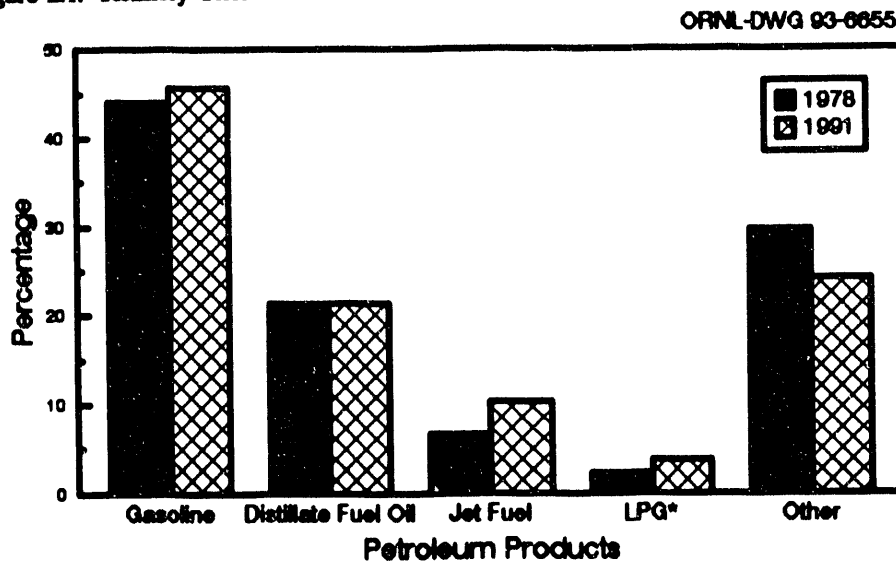
**Table 2.1**  
**Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978-91<sup>a</sup>**  
**(percentage)**

| Year | Motor Gasoline | Distillate fuel oil | Jet fuel | Liquefied petroleum gas | Other <sup>b</sup> |
|------|----------------|---------------------|----------|-------------------------|--------------------|
| 1978 | 44.1           | 21.4                | 6.6      | 2.3                     | 29.6               |
| 1979 | 43.0           | 21.5                | 6.9      | 2.3                     | 30.3               |
| 1980 | 44.5           | 19.7                | 7.4      | 2.4                     | 30.0               |
| 1981 | 44.8           | 20.5                | 7.6      | 2.4                     | 28.7               |
| 1982 | 46.4           | 21.5                | 8.1      | 2.2                     | 26.2               |
| 1983 | 47.6           | 20.5                | 8.5      | 2.7                     | 24.8               |
| 1984 | 46.7           | 21.5                | 9.1      | 2.9                     | 24.2               |
| 1985 | 45.6           | 21.6                | 9.6      | 3.1                     | 24.6               |
| 1986 | 45.7           | 21.2                | 9.8      | 3.2                     | 24.8               |
| 1987 | 46.4           | 20.5                | 10.0     | 3.4                     | 24.5               |
| 1988 | 46.0           | 20.8                | 10.0     | 3.6                     | 24.4               |
| 1989 | 45.7           | 20.8                | 10.1     | 4.0                     | 24.2               |
| 1990 | 45.6           | 20.9                | 10.7     | 3.6                     | 24.1               |
| 1991 | 45.7           | 21.3                | 10.3     | 3.8                     | 24.1               |

Source:

Department of Energy, Energy Information Administration, Petroleum Supply Annual 1991,  
 Vol. 1, June 1992, Table 19, p. 52, and annual.

**Figure 2.1. Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978 and 1991**



\* Liquefied Petroleum Gas

Source: See Table 2.1.

<sup>a</sup>Products sum greater than 100% due to processing gain. The processing gain for years 1978 to 1980 is assumed to be 4%.

<sup>b</sup>Includes aviation gasoline, kerosene, naphtha and other oils for petrochemical feedstock use, special naphthas, lubricants, waxes, petroleum coke, asphalt and road oil, still gas, and miscellaneous products.

Table 2.2  
United States Petroleum Production and Consumption, 1970-91  
(million barrels per day)

| Year                             | Domestic<br>crude oil<br>production | Gross imports |                       | U.S.<br>petroleum<br>consumption <sup>a</sup> | World<br>petroleum<br>consumption | Imports<br>as a<br>percentage<br>of U.S.<br>petroleum<br>consumption | Petroleum<br>products as<br>a percentage<br>of gross<br>imports | U.S.<br>petroleum<br>consumption as<br>a percentage<br>of world<br>consumption | Transportation<br>petroleum<br>use as a<br>percentage<br>of domestic<br>production <sup>b</sup> |
|----------------------------------|-------------------------------------|---------------|-----------------------|---|-----------------------------------|--|---|--|---|
|                                  |                                     | Crude<br>oil  | Petroleum<br>products |   |                                   |  |   |  |   |
| 1970                             | 9.64                                | 1.32          | 2.10                  | 14.70   | 46.38                             | 23.3   | 61.4  | 31.7   | *   |
| 1971                             | 9.46                                | 1.68          | 2.25                  | 15.21   | 50.00                             | 25.8   | 57.3  | 30.4   | *   |
| 1972                             | 9.44                                | 2.22          | 2.53                  | 16.37   | 52.42                             | 29.0   | 53.3  | 31.2   | *   |
| 1973                             | 9.21                                | 3.24          | 3.01                  | 17.31   | 56.39                             | 36.1   | 48.2  | 30.7   | 91.5  |
| 1974                             | 8.77                                | 3.48          | 2.64                  | 16.65   | 55.91                             | 36.8   | 43.1  | 29.8   | 93.7  |
| 1975                             | 8.37                                | 4.10          | 1.95                  | 16.32   | 55.48                             | 37.1   | 32.2  | 29.4   | 99.4  |
| 1976                             | 8.13                                | 5.29          | 2.03                  | 17.46   | 58.74                             | 41.9   | 27.7  | 29.7   | 107.6   |
| 1977                             | 8.25                                | 6.61          | 2.19                  | 18.43   | 61.63                             | 47.7   | 24.9  | 29.9   | 110.2   |
| 1978                             | 8.71                                | 6.36          | 2.01                  | 18.85   | 63.30                             | 44.4   | 24.0  | 29.8   | 108.7   |
| 1979                             | 8.55                                | 6.52          | 1.94                  | 18.51   | 65.17                             | 45.7   | 22.9  | 28.4   | 109.6   |
| 1980                             | 8.60                                | 5.26          | 1.65                  | 17.06   | 63.07                             | 40.5   | 23.9  | 27.0   | 104.4   |
| 1981                             | 8.57                                | 4.40          | 1.60                  | 16.06   | 60.87                             | 37.4   | 26.7  | 26.4   | 103.7   |
| 1982                             | 8.65                                | 3.49          | 1.63                  | 15.30   | 59.47                             | 33.5   | 31.8  | 25.7   | 100.6   |
| 1983                             | 8.69                                | 3.33          | 1.72                  | 15.23   | 58.70                             | 33.2   | 34.1  | 25.9   | 101.1   |
| 1984                             | 8.88                                | 3.43          | 2.01                  | 15.73   | 59.79                             | 34.6   | 36.9  | 26.3   | 102.3   |
| 1985                             | 8.97                                | 3.20          | 1.87                  | 15.73   | 59.87                             | 32.2   | 36.9  | 26.3   | 102.6   |
| 1986                             | 8.68                                | 4.18          | 2.05                  | 16.28   | 61.52                             | 38.3   | 32.9  | 26.5   | 110.3   |
| 1987                             | 8.35                                | 4.67          | 2.00                  | 16.67   | 62.78                             | 40.0   | 30.0  | 26.6   | 118.1   |
| 1988                             | 8.14                                | 5.11          | 2.30                  | 17.28   | 64.50                             | 42.8   | 31.1  | 26.8   | 125.4   |
| 1989                             | 7.61                                | 5.84          | 2.22                  | 17.33   | 65.71                             | 46.5   | 27.5  | 26.4   | 135.7   |
| 1990                             | 7.35                                | 5.89          | 2.12                  | 16.99   | 65.90                             | 47.2   | 26.4  | 25.8   | 140.1   |
| 1991                             | 7.37                                | 5.78          | 1.79                  | 16.64   | 66.00                             | 45.5   | 23.6  | *  | 137.1   |
| Average annual percentage change |                                     |               |                       |   |                                   |  |   |  |   |
| 1970-90                          | -1.3%                               | 7.3%          | -0.8%                 | 0.6%  | 1.8% <sup>c</sup>                 |  |   |  |   |
| 1982-90                          | -1.8%                               | 5.8%          | 1.0%                  | 0.9%  | 1.3% <sup>d</sup>                 |  |   |  |   |

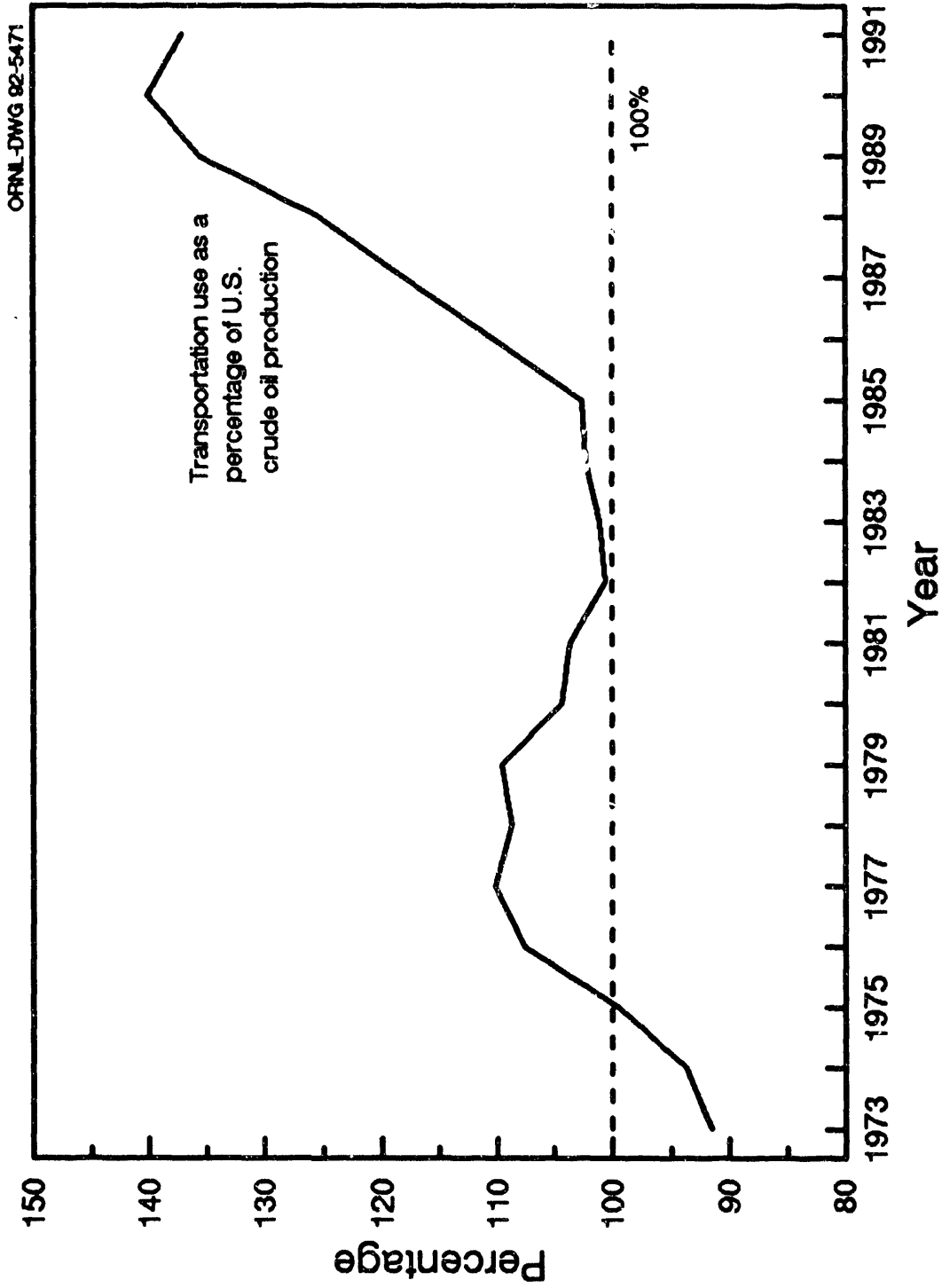
## Sources:

U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1992, pp. 42-43.

World petroleum consumption - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1990, January 1992, p. 24.

<sup>a</sup>Best estimate for U.S. petroleum consumption is the amount of petroleum products supplied to the U.S. in a given year.<sup>b</sup>Transportation petroleum use can be found on Table 2.3.<sup>c</sup>Data are not available.<sup>d</sup>Average annual percentage change for years 1970-90 and 1982-90.

Figure 2.2. Transportation Petroleum Consumption as a Percentage of Total United States Crude Oil Production, 1973-91



Source: See Table 2.2.

*Over 65% of the petroleum consumed in the U.S. in 1991 was used by the transportation sector. Although, transportation's share of petroleum use has increased since 1989, the total petroleum declined slightly between 1989 and 1991.*

**Table 2.3**  
**Consumption of Petroleum by End-Use Sector, 1973-91**  
**(quadrillion Btu)**

| Year                                    | Transportation | Percentage<br>transportation<br>of total | Residential<br>and<br>commercial | Industrial | Electric<br>utilities | Total | Total in<br>million barrels<br>per day* |
|---|----------------|--|----------------------------------|------------|-----------------------|-------|---|
| 1973                                    | 17.83          | 51.2%                                    | 4.39                             | 9.10       | 3.52                  | 34.84 | 16.46                                   |
| 1974                                    | 17.40          | 52.0%                                    | 4.00                             | 8.69       | 3.37                  | 33.46 | 15.81                                   |
| 1975                                    | 17.61          | 53.8%                                    | 3.81                             | 8.15       | 3.17                  | 32.74 | 15.47                                   |
| 1976                                    | 18.51          | 52.6%                                    | 4.18                             | 9.01       | 3.48                  | 35.18 | 16.62                                   |
| 1977                                    | 19.24          | 51.8%                                    | 4.21                             | 9.77       | 3.90                  | 37.12 | 17.53                                   |
| 1978                                    | 20.04          | 52.8%                                    | 4.07                             | 9.87       | 3.99                  | 37.97 | 17.94                                   |
| 1979                                    | 19.83          | 53.4%                                    | 3.45                             | 10.57      | 3.28                  | 37.13 | 17.54                                   |
| 1980                                    | 19.01          | 55.6%                                    | 3.04                             | 9.53       | 2.63                  | 34.21 | 16.16                                   |
| 1981                                    | 18.81          | 58.9%                                    | 2.63                             | 8.29       | 2.20                  | 31.93 | 15.08                                   |
| 1982                                    | 18.42          | 60.9%                                    | 2.45                             | 7.79       | 1.57                  | 30.23 | 14.28                                   |
| 1983                                    | 18.59          | 61.9%                                    | 2.50                             | 7.42       | 1.54                  | 30.05 | 14.19                                   |
| 1984                                    | 19.22          | 61.9%                                    | 2.54                             | 8.01       | 1.29                  | 31.06 | 14.67                                   |
| 1985                                    | 19.50          | 63.1%                                    | 2.52                             | 7.81       | 1.09                  | 30.92 | 14.61                                   |
| 1986                                    | 20.27          | 63.0%                                    | 2.56                             | 7.92       | 1.45                  | 32.20 | 15.21                                   |
| 1987                                    | 20.87          | 63.5%                                    | 2.59                             | 8.15       | 1.26                  | 32.87 | 15.53                                   |
| 1988                                    | 21.62          | 62.2%                                    | 2.61                             | 8.43       | 1.56                  | 34.22 | 16.16                                   |
| 1989                                    | 21.86          | 63.9%                                    | 2.54                             | 8.13       | 1.69                  | 34.22 | 16.16                                   |
| 1990                                    | 21.80          | 65.0%                                    | 2.18                             | 8.31       | 1.25                  | 33.54 | 15.84                                   |
| 1991                                    | 21.41          | 65.4%                                    | 2.17                             | 7.96       | 1.18                  | 32.72 | 15.46                                   |
| <i>Average annual percentage change</i> |                |  |                                  |            |                       |       |   |
| 1973-91                                 | 1.0%           |  | -3.8%                            | -0.7%      | -5.9%                 | -0.3% |   |
| 1982-91                                 | 1.7%           |  | -1.3%                            | 0.2%       | -3.1%                 | 0.9%  |   |

**Source:**

U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1992, pp. 27, 29, 31, 33.

\*Calculated from Total column. One million barrels per day of petroleum equals 2.117 quadrillion Btu per year.

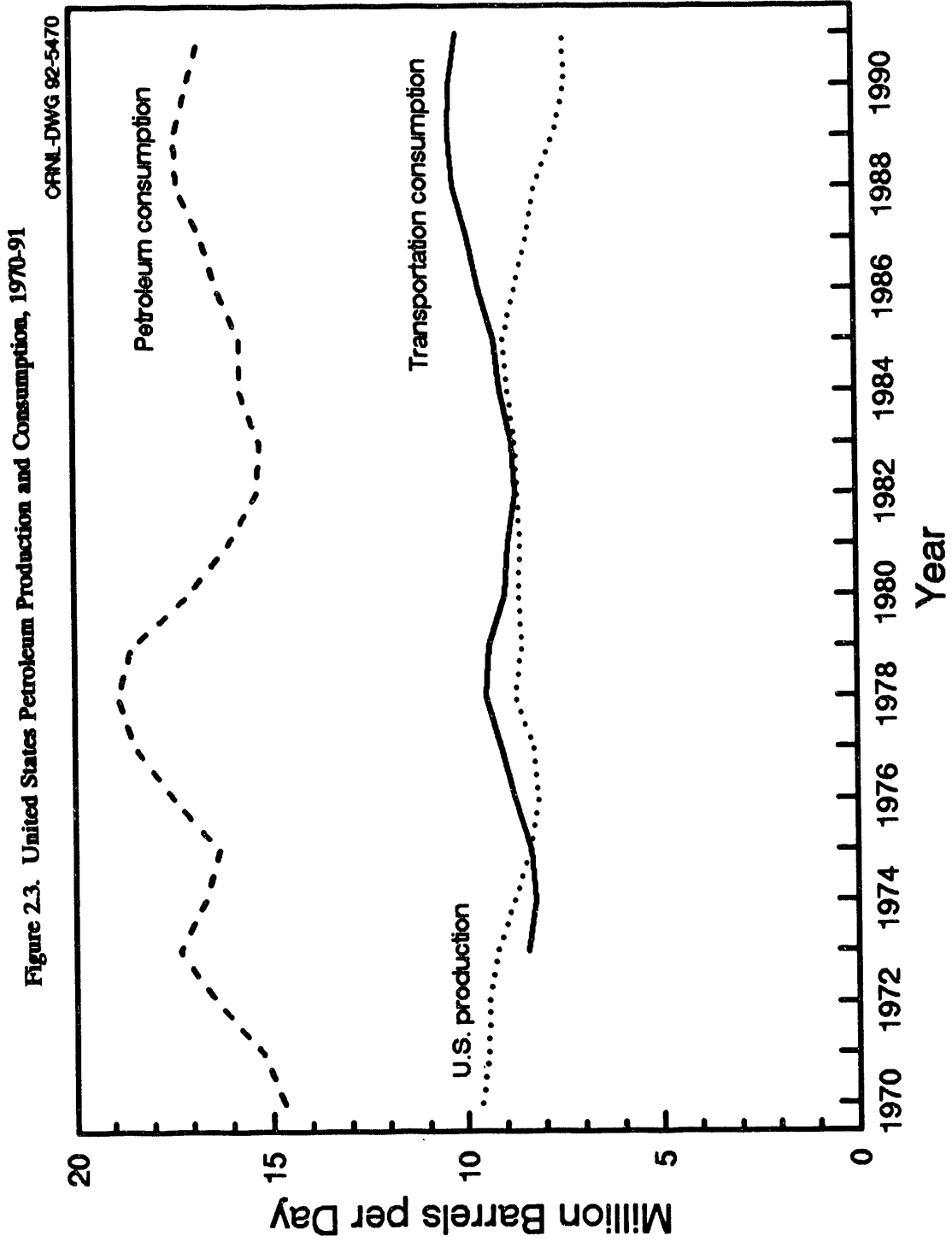
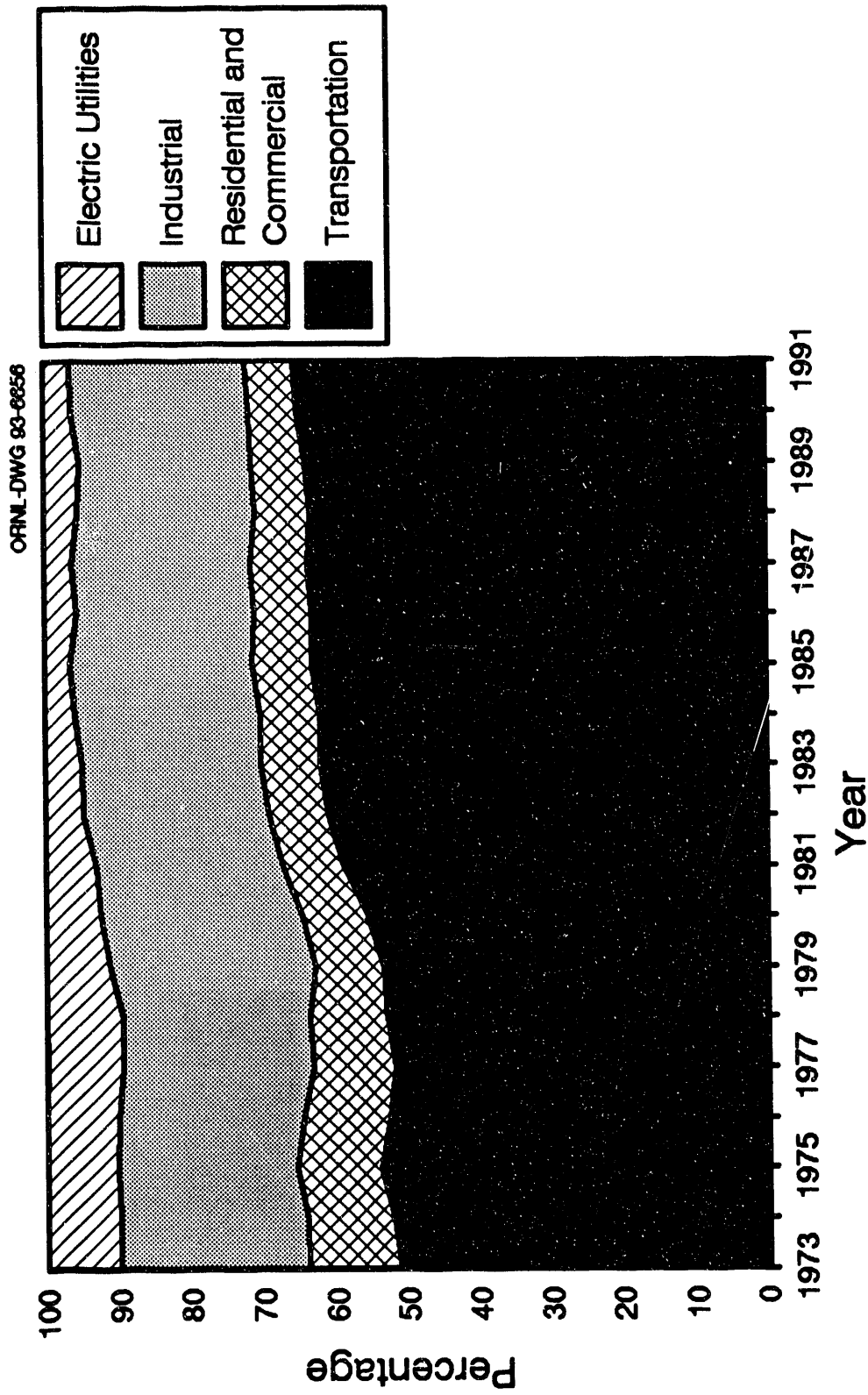


Figure 2.4. Petroleum Use by End-Use Sector, 1973-91



Source: See Table 2.3.

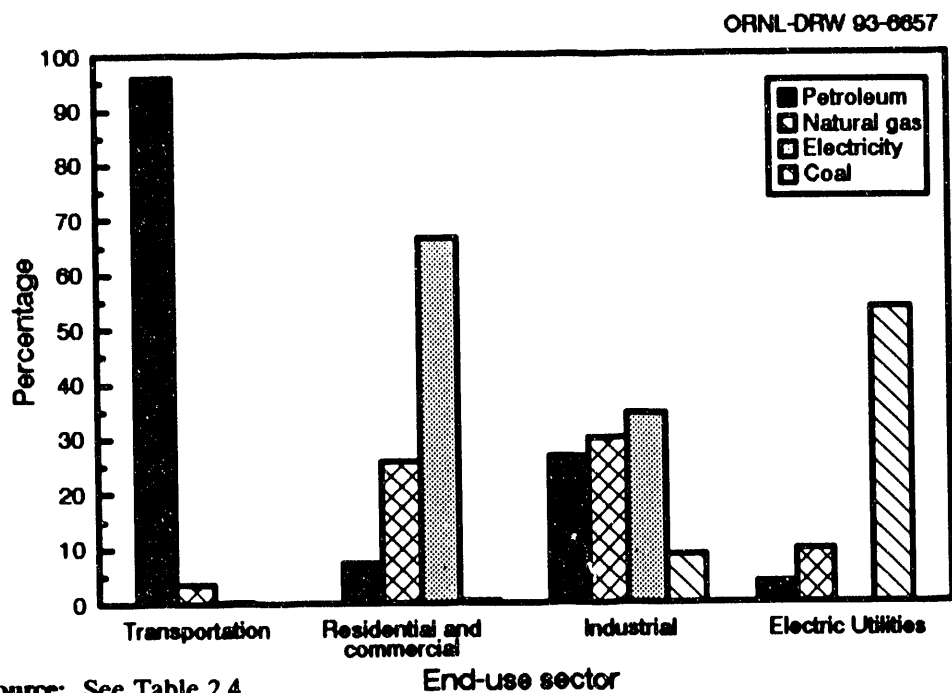
**Table 2.4**  
**Distribution of Energy Consumption by Source, 1981 and 1991**  
**(percentage)**

| Energy source            | Transportation |       | Residential and Commercial |       | Industrial |       | Electric Utilities |       |
|--------------------------|----------------|-------|----------------------------|-------|------------|-------|--------------------|-------|
|                          | 1981           | 1991  | 1981                       | 1991  | 1981       | 1991  | 1981               | 1991  |
| Petroleum                | 96.4           | 96.1  | 10.4                       | 7.3   | 28.3       | 26.8  | 8.9                | 3.9   |
| Natural gas <sup>a</sup> | 3.4            | 3.7   | 28.7                       | 25.7  | 28.2       | 29.9  | 15.2               | 9.6   |
| Coal                     | 0.0            | 0.0   | 0.7                        | 0.5   | 10.8       | 8.8   | 50.8               | 53.7  |
| Hydroelectric            | 0.0            | 0.0   | 0.0                        | 0.0   | 0.1        | 0.1   | 12.6               | 10.2  |
| Nuclear                  | 0.0            | 0.0   | 0.0                        | 0.0   | 0.0        | 0.0   | 11.2               | 21.9  |
| Electricity <sup>b</sup> | 0.2            | 0.2   | 60.2                       | 66.5  | 32.6       | 34.4  | 0.0                | 0.0   |
| Other <sup>c</sup>       | 0.0            | 0.0   | 0.0                        | 0.0   | 0.0        | 0.0   | 0.5                | 0.6   |
|                          | 100.0          | 100.0 | 100.0                      | 100.0 | 100.0      | 100.0 | 100.0              | 100.0 |

Source:

U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1992, Washington, DC, pp. 27, 29, 31, 33.

**Figure 2.5. Distribution of Energy Consumption by Sector, 1991**



Source: See Table 2.4.

<sup>a</sup>Includes supplemental gaseous fuels. Transportation sector includes pipeline fuel only.

<sup>b</sup>Includes electrical system energy losses.

<sup>c</sup>Energy generated from geothermal, wood, waste, wind, photovoltaic, and solar thermal energy sources.

*From 1973 to 1991 electricity generation has depended less on natural gas, petroleum, and hydro-electric power and has depended more on coal, nuclear generated electric power, and other sources. Although nuclear generated electric power grew tremendously from 1973 to 1991, coal continued to be the predominant source for electricity generation - 54% in 1991.*

**Table 2.5**  
**Electric Utility Energy Input by Source, 1973-91**  
(quadrillion Btu)

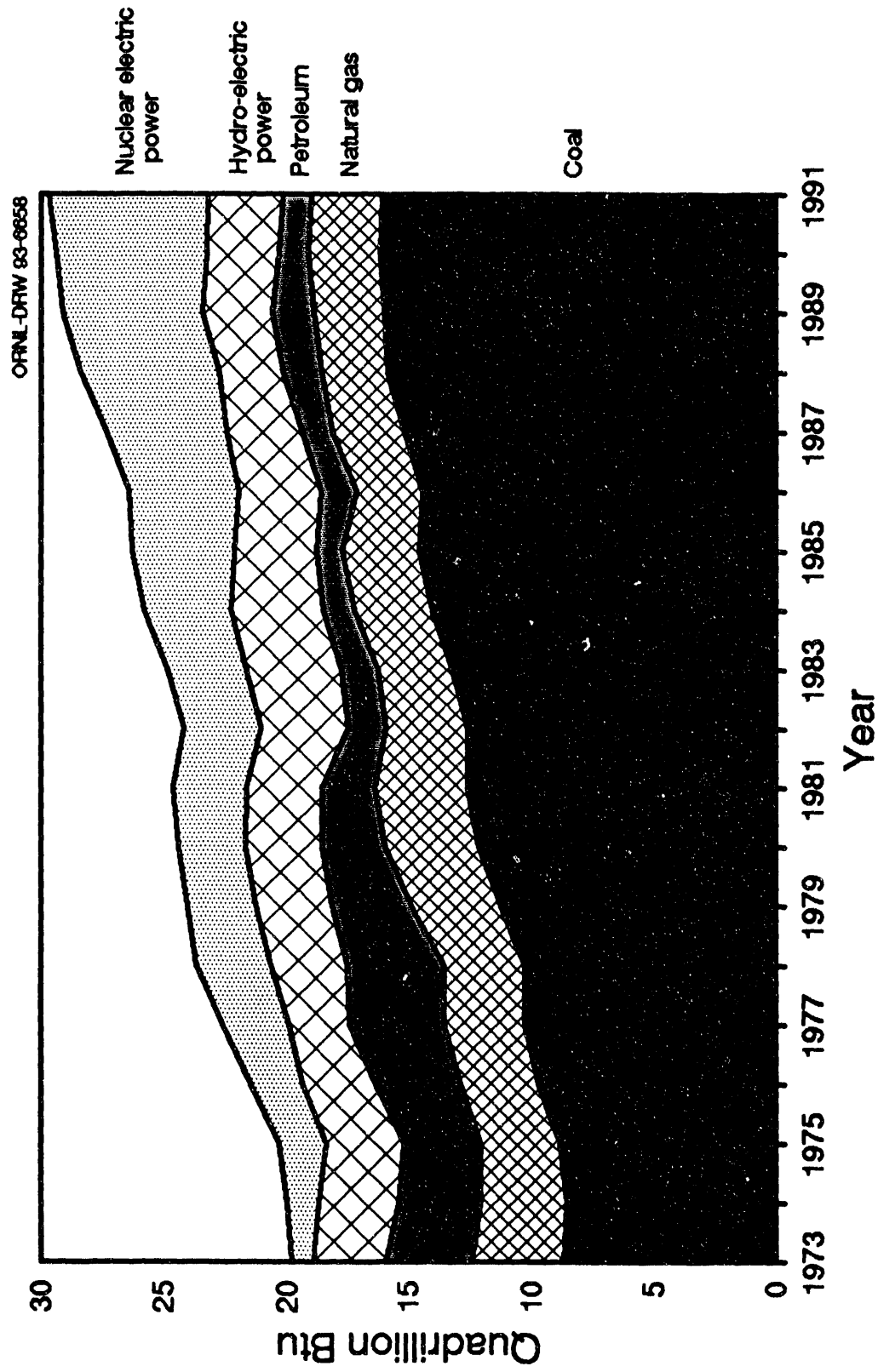
| Year                                    | Coal  | Natural gas | Petroleum | Hydro-electric power | Nuclear electric power | Other <sup>a</sup> | Total |
|---|-------|-------------|-----------|----------------------|------------------------|--------------------|-------|
| 1973                                    | 8.66  | 3.75        | 3.52      | 2.98                 | 0.91                   | 0.05               | 19.85 |
| 1974                                    | 8.53  | 3.52        | 3.37      | 3.28                 | 1.27                   | 0.06               | 20.02 |
| 1975                                    | 8.79  | 3.24        | 3.17      | 3.19                 | 1.90                   | 0.07               | 20.35 |
| 1976                                    | 9.72  | 3.15        | 3.48      | 3.03                 | 2.11                   | 0.08               | 21.57 |
| 1977                                    | 10.26 | 3.28        | 3.90      | 2.48                 | 2.70                   | 0.08               | 22.71 |
| 1978                                    | 10.24 | 3.30        | 3.99      | 3.11                 | 3.02                   | 0.07               | 23.72 |
| 1979                                    | 11.26 | 3.61        | 3.28      | 3.11                 | 2.78                   | 0.10               | 24.13 |
| 1980                                    | 12.12 | 3.81        | 2.63      | 3.09                 | 2.74                   | 0.11               | 24.51 |
| 1981                                    | 12.58 | 3.77        | 2.20      | 3.07                 | 3.01                   | 0.13               | 24.76 |
| 1982                                    | 12.58 | 3.34        | 1.57      | 3.54                 | 3.13                   | 0.11               | 24.27 |
| 1983                                    | 13.21 | 3.00        | 1.54      | 3.87                 | 3.20                   | 0.13               | 24.96 |
| 1984                                    | 14.00 | 3.22        | 1.27      | 3.73                 | 3.55                   | 0.17               | 25.98 |
| 1985                                    | 14.54 | 3.16        | 1.09      | 3.33                 | 4.15                   | 0.21               | 26.48 |
| 1986                                    | 14.44 | 2.69        | 1.45      | 3.35                 | 4.47                   | 0.23               | 26.64 |
| 1987                                    | 15.17 | 2.94        | 1.26      | 3.04                 | 4.91                   | 0.24               | 27.56 |
| 1988                                    | 15.85 | 2.71        | 1.56      | 2.61                 | 5.66                   | 0.24               | 28.63 |
| 1989                                    | 15.99 | 2.88        | 1.69      | 2.85                 | 5.68                   | 0.22               | 29.30 |
| 1990                                    | 16.19 | 2.88        | 1.25      | 2.91                 | 6.16                   | 0.20               | 29.60 |
| 1991                                    | 16.07 | 2.88        | 1.18      | 3.05                 | 6.54                   | 0.19               | 29.90 |
| <i>Average annual percentage change</i> |       |             |           |                      |                        |                    |       |
| 1973-91                                 | 3.5%  | -1.5%       | -5.9%     | 0.1%                 | 11.6%                  | 7.7%               | 2.3%  |
| 1982-91                                 | 2.8%  | -1.6%       | -3.1%     | -1.6%                | 8.5%                   | 6.3%               | 2.3%  |

**Source:**

U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1992, p. 33.

<sup>a</sup>Other consists of electricity generated for distribution from wood, waste, geothermal, wind, photovoltaic, and solar thermal energy.

Figure 2.6. Electric Utility Energy Input by Source, 1973-91



Source: See Table 2.5.

*The transportation sector has accounted for over 27% of total energy use since 1985. Total energy use is up to 81.51 quads in 1991, after a slight decline in 1990.*

**Table 2.6**  
**Consumption of Total Energy by End-Use Sector, 1970-91\***  
(quadrillion Btu)

| Year                                    | Transportation | Percentage<br>transportation<br>of total | Residential<br>and<br>Commercial | Industrial | Total |
|---|----------------|--|----------------------------------|------------|-------|
| 1970                                    | 16.07          | 24.2%                                    | 21.71                            | 28.65      | 66.43 |
| 1971                                    | 16.70          | 24.6%                                    | 22.59                            | 28.59      | 67.88 |
| 1972                                    | 17.70          | 24.8%                                    | 23.69                            | 29.88      | 71.27 |
| 1973                                    | 18.61          | 25.1%                                    | 24.14                            | 31.53      | 74.28 |
| 1974                                    | 18.12          | 25.0%                                    | 23.72                            | 30.70      | 72.54 |
| 1975                                    | 18.24          | 25.9%                                    | 23.90                            | 28.40      | 70.54 |
| 1976                                    | 19.10          | 25.7%                                    | 25.02                            | 30.23      | 74.36 |
| 1977                                    | 19.82          | 26.0%                                    | 25.39                            | 31.08      | 76.29 |
| 1978                                    | 20.61          | 26.4%                                    | 26.09                            | 31.39      | 78.09 |
| 1979                                    | 20.47          | 25.9%                                    | 25.81                            | 32.62      | 78.90 |
| 1980                                    | 19.70          | 25.9%                                    | 25.65                            | 30.61      | 75.96 |
| 1981                                    | 19.51          | 26.4%                                    | 25.24                            | 29.24      | 73.99 |
| 1982                                    | 19.07          | 26.9%                                    | 25.63                            | 26.14      | 70.85 |
| 1983                                    | 19.13          | 27.1%                                    | 25.63                            | 25.76      | 70.52 |
| 1984                                    | 19.80          | 26.7%                                    | 26.45                            | 27.85      | 74.10 |
| 1985                                    | 20.07          | 27.1%                                    | 26.68                            | 27.20      | 73.95 |
| 1986                                    | 20.81          | 28.0%                                    | 26.81                            | 26.61      | 74.24 |
| 1987                                    | 21.44          | 27.9%                                    | 27.60                            | 27.81      | 76.85 |
| 1988                                    | 22.30          | 27.8%                                    | 28.92                            | 28.98      | 80.20 |
| 1989                                    | 22.55          | 27.7%                                    | 29.41                            | 29.38      | 81.35 |
| 1990                                    | 22.53          | 27.7%                                    | 28.86                            | 29.90      | 81.29 |
| 1991                                    | 22.29          | 27.3%                                    | 29.56                            | 29.66      | 81.51 |
| <i>Average annual percentage change</i> |                |  |                                  |            |       |
| 1970-91                                 | 1.6%           |  | 1.5%                             | 0.2%       | 1.0%  |
| 1982-91                                 | 1.7%           |  | 1.6%                             | 1.4%       | 1.6%  |

**Source:**

U.S. Department of Energy, Energy Information Administration, Monthly Energy Review,  
March 1992, Washington, DC, Table 2.2, p. 25.

\*Electrical energy losses have been distributed among the sectors.

**Table 2.7**  
**Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1990**  
**(trillion Btu)**

|  | Gasoline                | Diesel fuel    | Liquefied petroleum gas | Jet fuel           | Residual fuel oil | Natural gas  | Electricity  |
|--|-------------------------|----------------|-------------------------|--------------------|-------------------|--------------|--------------|
| <b>HIGHWAY*</b>                              | <b>13,605.2</b>         | <b>3,183.9</b> | <b>7.5</b>              |                    |                   |              |              |
| Automobiles                                  | 8,945.7                 | 120.6          |                         |                    |                   |              |              |
| Motorcycles                                  | 23.9                    |                |                         |                    |                   |              |              |
| Buses  | 29.7                    | 133.1          |                         |                    |                   |              |              |
| Transit                                      | 0.2                     | 78.7           |                         |                    |                   |              |              |
| Intercity                                    |                         | 21.7           |                         |                    |                   |              |              |
| School                                       | 29.5                    | 32.7           |                         |                    |                   |              |              |
| Trucks                                       | 4,605.9                 | 2,930.2        | 7.5                     |                    |                   |              |              |
| Light trucks <sup>b</sup>                    | 4,001.7                 | 151.7          | 3.0                     |                    |                   |              |              |
| Other trucks                                 | 604.2                   | 2,778.5        | 4.5                     |                    |                   |              |              |
| <b>OFF-HIGHWAY* (heavy-duty)<sup>c</sup></b> | <b>95.1</b>             | <b>570.1</b>   |                         |                    |                   |              |              |
| Construction                                 | 31.4                    | 178.5          |                         |                    |                   |              |              |
| Farming                                      | 63.7                    | 391.6          |                         |                    |                   |              |              |
| <b>NONHIGHWAY*</b>                           | <b>289.1</b>            | <b>750.0</b>   |                         | <b>2,016.9</b>     | <b>935.4</b>      | <b>680.3</b> | <b>309.1</b> |
| Air  | 42.4 <sup>d</sup>       |                |                         | 2,016.9            |                   |              |              |
| General aviation <sup>e</sup>                | 42.4                    |                |                         | 89.5               |                   |              |              |
| Domestic air carriers                        |                         |                |                         | 1,663.6            |                   |              |              |
| International air carriers                   |                         |                |                         | 263.8 <sup>f</sup> |                   |              |              |
| Water  | 246.7                   | 304.8          |                         |                    | 935.4             |              |              |
| Freight                                      |                         | 304.8          |                         |                    | 935.4             |              |              |
| Domestic trade                               |                         | 236.2          |                         |                    | 87.0              |              |              |
| Foreign trade                                |                         | 68.6           |                         |                    | 848.4             |              |              |
| Recreational boats                           | 246.7                   |                |                         |                    |                   |              |              |
| Pipeline                                     |                         |                |                         |                    |                   | 680.3        | 247.3        |
| Natural gas                                  |                         |                |                         |                    |                   | 680.3        | 35.2         |
| Crude petroleum <sup>g</sup>                 |                         |                |                         |                    |                   |              | 91.0         |
| Petroleum product <sup>h</sup>               |                         |                |                         |                    |                   |              | 67.4         |
| Coal slurry <sup>i</sup>                     |                         |                |                         |                    |                   |              | 3.7          |
| Water <sup>j</sup>                           |                         |                |                         |                    |                   |              | 50.0         |
| Rail   |                         | 445.2          |                         |                    |                   |              | 61.8         |
| Freight <sup>k</sup>                         |                         | 425.2          |                         |                    |                   |              |              |
| Passenger                                    |                         | 20.0           |                         |                    |                   |              | 61.8         |
| Transit                                      |                         |                |                         |                    |                   |              | 42.7         |
| Commuter rail                                |                         | 7.3            |                         |                    |                   |              | 14.4         |
| Intercity                                    |                         | 12.7           |                         |                    |                   |              | 4.7          |
| <b>MILITARY OPERATIONS<sup>l</sup></b>       | <b>17.2<sup>m</sup></b> | <b>173.8</b>   |                         | <b>542.1</b>       | <b>24.6</b>       |              |              |
| <b>TOTAL<sup>n</sup></b>                     | <b>14,006.6</b>         | <b>4,677.8</b> | <b>7.5</b>              | <b>2,559.0</b>     | <b>960.0</b>      | <b>680.3</b> | <b>309.1</b> |

Source: See Appendix A for Table 2.7.

\*Civilian consumption only; military consumption shown separately.

<sup>b</sup>Two-axle, four-tire trucks.

<sup>c</sup>1985 data.

<sup>d</sup>Aviation gasoline.

<sup>e</sup>All aircraft in the U.S. civil air fleet except those operated under FAR parts 121 and 127 (i.e., air carriers larger than 30 seats and/or a payload capacity of more than 7,500 pounds). General aviation includes air taxis, commuter air carriers, and air travel clubs.

<sup>f</sup>This figure represents an estimate of the energy purchased in the U.S. for international air carrier consumption.

<sup>g</sup>1981 data.

<sup>h</sup>1977 data.

<sup>i</sup>Includes Class 1, 2, and 3 railroads.

<sup>j</sup>Based on fuel purchases.

<sup>k</sup>Includes aviation gasoline and motor gasoline.

<sup>l</sup>Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).

**Table 2.8**  
**Distribution of Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1990**  
**(percentage)**

|   | Gasoline         | Diesel fuel | Liquefied petroleum gas | Jet fuel          | Residual fuel oil | Natural gas  | Electricity  |
|---|------------------|-------------|-------------------------|-------------------|-------------------|--------------|--------------|
| <b>HIGHWAY</b>  | <b>97.1</b>      | <b>68.1</b> | <b>100.0</b>            |                   |                   |              |              |
| Automobiles   | 63.9             | 2.6         |                         |                   |                   |              |              |
| Motorcycles   | 0.2              |             |                         |                   |                   |              |              |
| Buses   | 0.2              | 2.8         |                         |                   |                   |              |              |
| Transit   |                  | 1.7         |                         |                   |                   |              |              |
| Intercity   |                  | 0.5         |                         |                   |                   |              |              |
| School  | 0.2              | 0.7         |                         |                   |                   |              |              |
| Trucks  | 32.9             | 62.6        | 100.0                   |                   |                   |              |              |
| Light trucks <sup>c</sup>                                 | 28.6             | 3.2         | 40.0                    |                   |                   |              |              |
| Other trucks  | 4.3              | 59.4        | 60.0                    |                   |                   |              |              |
| <b>OFF-HIGHWAY</b> <sup>a</sup> (heavy-duty) <sup>d</sup> | <b>0.7</b>       | <b>12.2</b> |                         |                   |                   |              |              |
| Construction  | 0.2              | 3.8         |                         |                   |                   |              |              |
| Farming   | 0.5              | 8.4         |                         |                   |                   |              |              |
| <b>NONHIGHWAY</b>   | <b>2.1</b>       | <b>16.0</b> |                         | <b>78.8</b>       | <b>97.4</b>       | <b>100.0</b> | <b>100.0</b> |
| Air   | 0.3 <sup>e</sup> |             |                         | 78.8              |                   |              |              |
| General aviation <sup>f</sup>                             | 0.3              |             |                         | 3.5               |                   |              |              |
| Domestic air carriers                                     |                  |             |                         | 65.0              |                   |              |              |
| International air carriers                                |                  |             |                         | 10.3 <sup>g</sup> |                   |              |              |
| Water   | 1.8              | 6.5         |                         |                   | 97.4              |              |              |
| Freight   |                  | 6.5         |                         |                   | 97.4              |              |              |
| Domestic trade  |                  | 5.0         |                         |                   | 9.1               |              |              |
| Foreign trade   |                  | 1.5         |                         |                   | 88.4              |              |              |
| Recreational boats  | 1.8              |             |                         |                   |                   |              |              |
| Pipeline  |                  |             |                         |                   |                   | 100.0        | 80.0         |
| Natural gas   |                  |             |                         |                   |                   | 100.0        | 11.3         |
| Crude petroleum <sup>h</sup>                              |                  |             |                         |                   |                   |              | 29.4         |
| Petroleum product <sup>h</sup>                            |                  |             |                         |                   |                   |              | 21.8         |
| Coal slurry <sup>i</sup>                                  |                  |             |                         |                   |                   |              | 1.2          |
| Water <sup>j</sup>  |                  |             |                         |                   |                   |              | 16.2         |
| Rail  |                  | 9.5         |                         |                   |                   |              | 20.0         |
| Freight <sup>k</sup>                                      |                  | 9.1         |                         |                   |                   |              |              |
| Passenger   |                  | 0.4         |                         |                   |                   |              | 20.0         |
| Transit   |                  |             |                         |                   |                   |              | 13.8         |
| Commuter rail   |                  | 0.2         |                         |                   |                   |              | 4.7          |
| Intercity   |                  | 0.3         |                         |                   |                   |              | 1.5          |
| <b>MILITARY OPERATIONS</b> <sup>l</sup>                   | <b>0.1</b>       | <b>3.7</b>  |                         | <b>21.2</b>       | <b>2.6</b>        |              |              |
| <b>TOTAL</b> <sup>1</sup> (by fuel type)                  | <b>60.4</b>      | <b>20.2</b> |                         | <b>11.0</b>       | <b>4.1</b>        | <b>2.9</b>   | <b>1.3</b>   |

Source: See Appendix A for Table 2.7.

<sup>a</sup>Civilian consumption only; military consumption shown separately.

<sup>b</sup>Less than 0.05 percent.

<sup>c</sup>Two-axle, four-tire trucks.

<sup>d</sup>1985 data.

<sup>e</sup>Aviation gasoline.

<sup>f</sup>All aircraft in the U.S. civil air fleet except those operated under FAR parts 121 and 127 (i.e., air carriers larger than 30 seats and/or a payload capacity of more than 7,500 pounds). General aviation includes air taxis, commuter air carriers, and air travel clubs.

<sup>g</sup>This figure represents an estimate of the energy purchased in the U.S. for international air carrier consumption.

<sup>h</sup>1981 data.

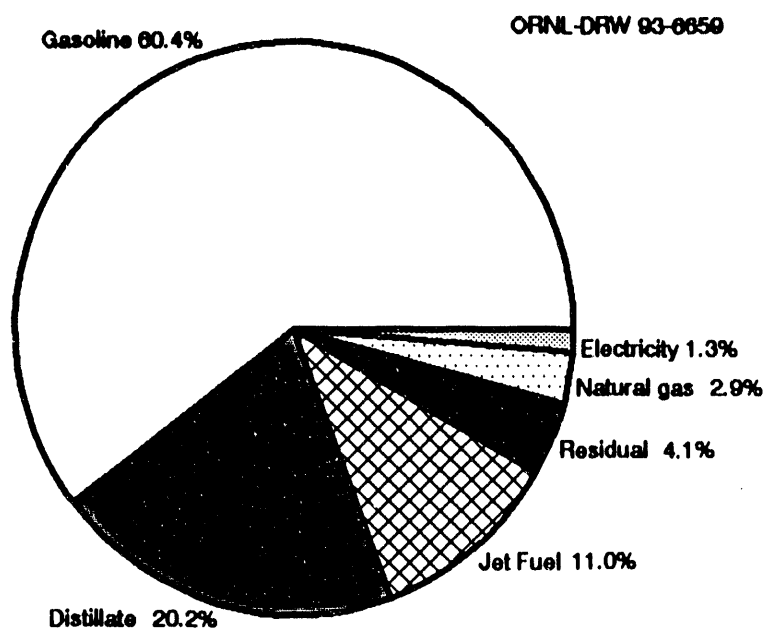
<sup>i</sup>1977 data.

<sup>j</sup>Includes Class 1, 2, and 3 railroads.

<sup>k</sup>Based on fuel purchased.

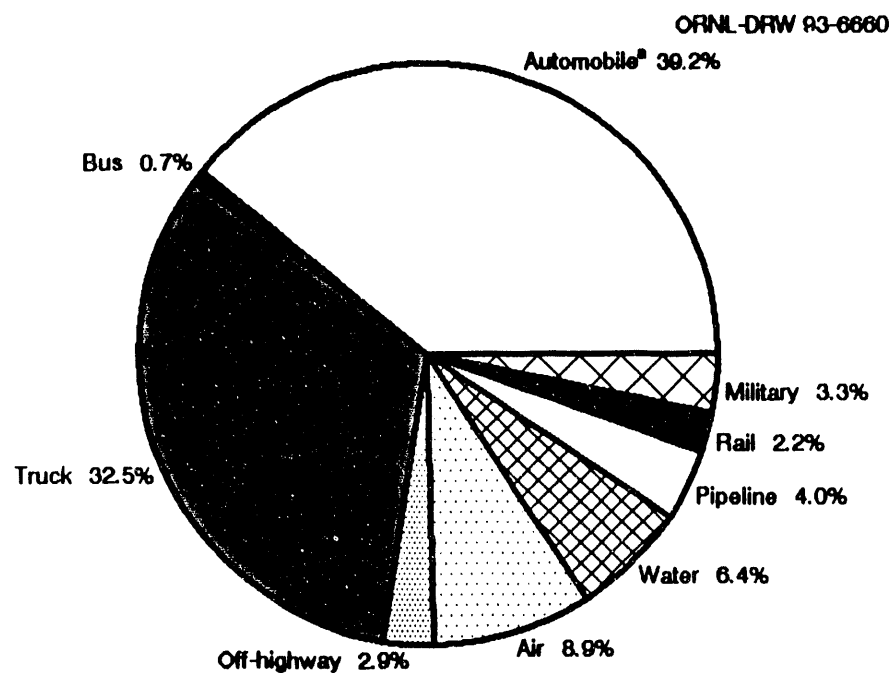
<sup>l</sup>Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).

**Figure 2.7. Distribution of Transportation Energy Use by Fuel Type, 1990**



Source: See Table 2.8.

**Figure 2.8. Distribution of Transportation Energy Use by Mode, 1990**



Source: See Table 2.9.

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\*Includes motorcycles.

**Table 2.9**  
**Transportation Energy Use by Mode, 1990**

|   | Trillion Btu       | Thousand barrels per day<br>crude oil equivalent <sup>a</sup> | Percentage<br>of total |
|---|--------------------|---|------------------------|
| <b>HIGHWAY<sup>a</sup></b>                              | <b>16,796.6</b>    | <b>7,934.2</b>  | <b>72.4</b>            |
| Automobiles   | 9,066.3            | 4,282.6   | 39.1                   |
| Motorcycles   | 23.9               | 11.3  | 0.1                    |
| Buses   | 162.8              | 76.9  | 0.7                    |
| Transit   | 78.9               | 37.3  | 0.3                    |
| Intercity   | 21.7               | 10.3  | 0.1                    |
| School  | 62.2               | 29.4  | 0.3                    |
| Trucks  | 7,543.6            | 3,563.3   | 32.5                   |
| Light trucks <sup>c</sup>                               | 4,156.4            | 1,963.3   | 17.9                   |
| Other trucks  | 3,387.2            | 1,600.0   | 14.6                   |
| <b>OFF-HIGHWAY<sup>a</sup> (heavy-duty)<sup>d</sup></b> | <b>665.2</b>       | <b>314.2</b>  | <b>2.9</b>             |
| Construction  | 209.9              | 99.1  | 0.9                    |
| Farming   | 455.3              | 215.1   | 2.0                    |
| <b>NONHIGHWAY<sup>a</sup></b>                           | <b>4,980.8</b>     | <b>2,352.8</b>  | <b>21.5</b>            |
| Air   | 2,059.3            | 972.7   | 8.9                    |
| General aviation <sup>e</sup>                           | 131.9              | 62.3  | 0.6                    |
| Domestic air carriers                                   | 1,663.6            | 785.8   | 7.2                    |
| International air carriers                              | 263.8 <sup>f</sup> | 124.6   | 1.1                    |
| Water   | 1,486.9            | 702.4   | 6.4                    |
| Freight   | 1,240.2            | 585.8   | 5.3                    |
| Domestic trade  | 323.2              | 152.7   | 1.4                    |
| Foreign trade   | 917.0              | 433.2   | 4.0                    |
| Recreational boats                                      | 246.7              | 116.5   | 1.1                    |
| Pipeline  | 927.6              | 438.2   | 4.0                    |
| Natural gas   | 715.5              | 338.0   | 3.1                    |
| Crude petroleum <sup>g</sup>                            | 91.0               | 43.0  | 0.4                    |
| Petroleum products <sup>h</sup>                         | 67.4               | 31.8  | 0.3                    |
| Coal slurry <sup>i</sup>                                | 3.7                | 1.7   | 0.0                    |
| Water <sup>j</sup>                                      | 50.0               | 23.6  | 0.2                    |
| Rail  | 507.0              | 239.5   | 2.2                    |
| Freight <sup>k</sup>                                    | 425.2              | 200.9   | 1.8                    |
| Passenger   | 81.8               | 38.6  | 0.4                    |
| Transit   | 42.7               | 20.2  | 0.2                    |
| Commuter rail   | 21.7               | 10.3  | 0.1                    |
| Intercity   | 17.4               | 8.2   | 0.1                    |
| <b>MILITARY OPERATIONS<sup>l</sup></b>                  | <b>757.7</b>       | <b>357.9<sup>m</sup></b>                                      | <b>3.3</b>             |
| <b>TOTAL<sup>1</sup></b>                                | <b>23,200.3</b>    | <b>10,959.0</b>   | <b>100.0</b>           |

Source:

See Appendix A for Table 2.7.

<sup>a</sup>Thousand barrels per day crude oil equivalents based on Btu content of a barrel of crude oil.<sup>b</sup>Civilian consumption only; military consumption shown separately.<sup>c</sup>Two-axle, four-tire trucks.<sup>d</sup>1985 data.<sup>e</sup>All aircraft in the U.S. civil air fleet except those operated under FAR parts 121 and 127 (i.e., air carriers larger than 30 seats and/or a payload capacity of more than 7,500 pounds). General aviation includes air taxis, commuter air carriers, and air travel clubs.<sup>f</sup>This figure represents an estimate of the energy purchased in the U.S. for international air carrier consumption.<sup>g</sup>1981 data.<sup>h</sup>1977 data.<sup>i</sup>Includes Class 1, 2, and 3 railroads.<sup>j</sup>Based on fuel purchased.<sup>k</sup>Purchases were the best estimates available for fuel consumption, both domestic and abroad.<sup>l</sup>Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).

*Total transportation energy use continued to increase in 1990 despite the decline in highway energy use. The decline in other truck energy use was the primary reason for the decline in highway energy use. Light truck energy use continues to grow at a faster rate than any other mode.*

**Table 2.10**  
**Transportation Energy Consumption by Mode, 1970-90**  
(trillion Btu)

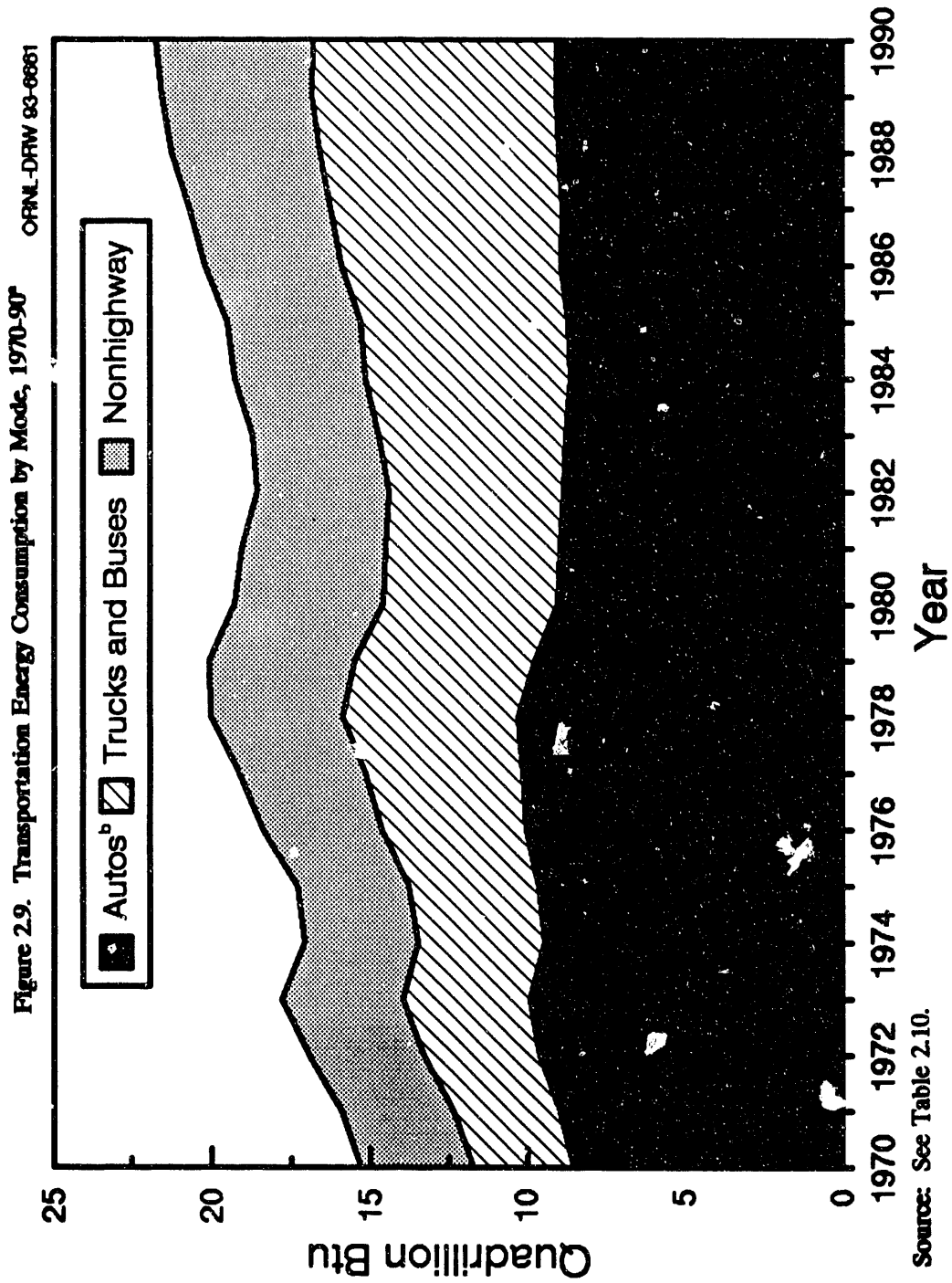
| Year                                    | Automobiles | Motorcycles | Buses | Light trucks <sup>a</sup> | Other trucks | Total highway | Air   | Water | Pipeline | Rail  | Total nonhighway transportation <sup>b</sup> | Total  |
|---|-------------|-------------|-------|---------------------------|--------------|---------------|-------|-------|----------|-------|--|--------|
| 1970                                    | 8,526       | 8           | 109   | 1,540                     | 1,502        | 11,685        | 1,307 | 753   | 985      | 575   | 3,620  | 15,305 |
| 1971                                    | 8,971       | 9           | 108   | 1,686                     | 1,568        | 12,342        | 1,304 | 698   | 1,007    | 556   | 3,565  | 15,907 |
| 1972                                    | 9,583       | 11          | 106   | 1,895                     | 1,684        | 13,279        | 1,314 | 703   | 1,039    | 614   | 3,670  | 16,949 |
| 1973                                    | 9,890       | 13          | 109   | 2,105                     | 1,844        | 13,961        | 1,377 | 827   | 996      | 652   | 3,852  | 17,813 |
| 1974                                    | 9,440       | 14          | 113   | 2,083                     | 1,791        | 13,441        | 1,254 | 804   | 932      | 657   | 3,647  | 17,088 |
| 1975                                    | 9,611       | 14          | 119   | 2,240                     | 1,789        | 13,773        | 1,274 | 851   | 835      | 596   | 3,556  | 17,329 |
| 1976                                    | 10,020      | 15          | 129   | 2,522                     | 1,949        | 14,635        | 1,333 | 1,001 | 803      | 617   | 3,754  | 18,389 |
| 1977                                    | 10,108      | 16          | 132   | 2,738                     | 2,155        | 15,149        | 1,411 | 1,103 | 781      | 627   | 3,922  | 19,071 |
| 1978                                    | 10,267      | 18          | 135   | 3,008                     | 2,420        | 15,848        | 1,467 | 1,311 | 781      | 628   | 4,187  | 20,035 |
| 1979                                    | 9,719       | 22          | 137   | 3,094                     | 2,510        | 15,482        | 1,568 | 1,539 | 856      | 656   | 4,619  | 20,101 |
| 1980                                    | 9,037       | 26          | 139   | 2,951                     | 2,425        | 14,578        | 1,528 | 1,677 | 889      | 645   | 4,739  | 19,317 |
| 1981                                    | 8,927       | 27          | 143   | 2,964                     | 2,461        | 14,572        | 1,455 | 1,562 | 899      | 627   | 4,543  | 19,065 |
| 1982                                    | 8,814       | 25          | 146   | 2,982                     | 2,430        | 14,397        | 1,468 | 1,290 | 853      | 581   | 4,192  | 18,589 |
| 1983                                    | 8,762       | 22          | 145   | 3,196                     | 2,599        | 14,724        | 1,505 | 1,187 | 738      | 574   | 4,004  | 18,728 |
| 1984                                    | 8,613       | 22          | 154   | 3,500                     | 2,836        | 15,125        | 1,633 | 1,251 | 780      | 520   | 4,185  | 19,310 |
| 1985                                    | 8,673       | 23          | 161   | 3,630                     | 2,924        | 15,411        | 1,678 | 1,311 | 758      | 501   | 4,248  | 19,659 |
| 1986                                    | 8,917       | 24          | 154   | 3,785                     | 3,007        | 15,886        | 1,823 | 1,295 | 738      | 487   | 4,343  | 20,229 |
| 1987                                    | 8,863       | 25          | 157   | 4,032                     | 3,137        | 16,214        | 1,894 | 1,326 | 775      | 496   | 4,491  | 20,704 |
| 1988                                    | 8,969       | 25          | 159   | 4,109                     | 3,310        | 16,572        | 1,978 | 1,338 | 878      | 512   | 4,706  | 21,278 |
| 1989                                    | 9,054       | 26          | 163   | 4,147                     | 3,440        | 16,830        | 1,981 | 1,376 | 895      | 516   | 4,768  | 21,598 |
| 1990                                    | 9,066       | 24          | 163   | 4,156                     | 3,387        | 16,797        | 2,059 | 1,487 | 928      | 507   | 4,981  | 21,778 |
| <i>Average annual percentage change</i> |             |             |       |                           |              |               |       |       |          |       |  |        |
| 1970-90                                 | 0.3%        | 5.6%        | 2.0%  | 5.1%                      | 4.1%         | 1.8%          | 2.3%  | 3.5%  | -0.3%    | -0.6% | 1.6%   | 1.8%   |
| 1982-90                                 | 0.4%        | -0.5%       | 1.4%  | 4.2%                      | 4.2%         | 1.9%          | 4.3%  | 1.8%  | 1.1%     | -1.7% | 2.2%   | 2.0%   |

Source:

See Appendix A for Table 2.10.

<sup>a</sup>Light trucks include only those trucks which have 2-axes and 4-tires.

<sup>b</sup>Total transportation figures do not include military and off-highway energy use and may not include all possible uses of fuel for transportation (e.g. snowmobiles).



*The special fuels share of highway fuel use continued to be above 15% in 1990. Highway use of special fuels has been growing at a much faster rate than gasoline consumption.*

**Table 2.11**  
**Highway Usage of Gasoline and Special Fuels, 1973-90**  
 (million gallons)

| Year                                    | Gasoline | Special fuels <sup>a</sup> | Percent special fuels | Total highway fuel use |
|---|----------|----------------------------|-----------------------|------------------------|
| 1973                                    | 100,636  | 9,837                      | 8.9                   | 110,473                |
| 1974                                    | 96,505   | 9,796                      | 9.2                   | 106,301                |
| 1975                                    | 99,354   | 9,631                      | 8.8                   | 108,985                |
| 1976                                    | 104,978  | 10,721                     | 9.3                   | 115,699                |
| 1977                                    | 107,978  | 11,646                     | 9.7                   | 119,624                |
| 1978                                    | 112,239  | 12,828                     | 10.3                  | 125,067                |
| 1979                                    | 108,126  | 13,989                     | 11.5                  | 122,115                |
| 1980                                    | 101,183  | 13,777                     | 12.0                  | 114,960                |
| 1981                                    | 99,597   | 14,856                     | 13.0                  | 114,453                |
| 1982                                    | 98,479   | 14,905                     | 13.1                  | 113,384                |
| 1983                                    | 100,106  | 15,975                     | 13.8                  | 116,081                |
| 1984                                    | 101,416  | 17,320                     | 14.6                  | 118,736                |
| 1985                                    | 103,571  | 17,751                     | 14.6                  | 121,322                |
| 1986                                    | 106,756  | 18,427                     | 14.7                  | 125,183                |
| 1987                                    | 108,702  | 19,046                     | 14.9                  | 127,748                |
| 1988                                    | 109,816  | 20,070                     | 15.5                  | 129,886                |
| 1989                                    | 110,632  | 21,232                     | 16.1                  | 131,864                |
| 1990                                    | 110,184  | 21,399                     | 16.3                  | 131,583                |
| <i>Average annual percentage change</i> |          |                            |                       |                        |
| 1973-90                                 | 0.5%     | 4.7%                       |                       | 1.0%                   |
| 1982-90                                 | 1.4%     | 4.6%                       |                       | 1.9%                   |

**Source:**

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, pp. 6, 8, and annual.

Total highway fuel use - Calculated as the sum of gasoline and special fuels.

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<sup>a</sup>Special fuels consist primarily of diesel fuel, with small quantities of liquified petroleum gas.

## **Section 2.2.**

# **Energy Efficiency and Intensity**

Table 2.12  
Passenger Travel and Energy Use in the United States, 1990

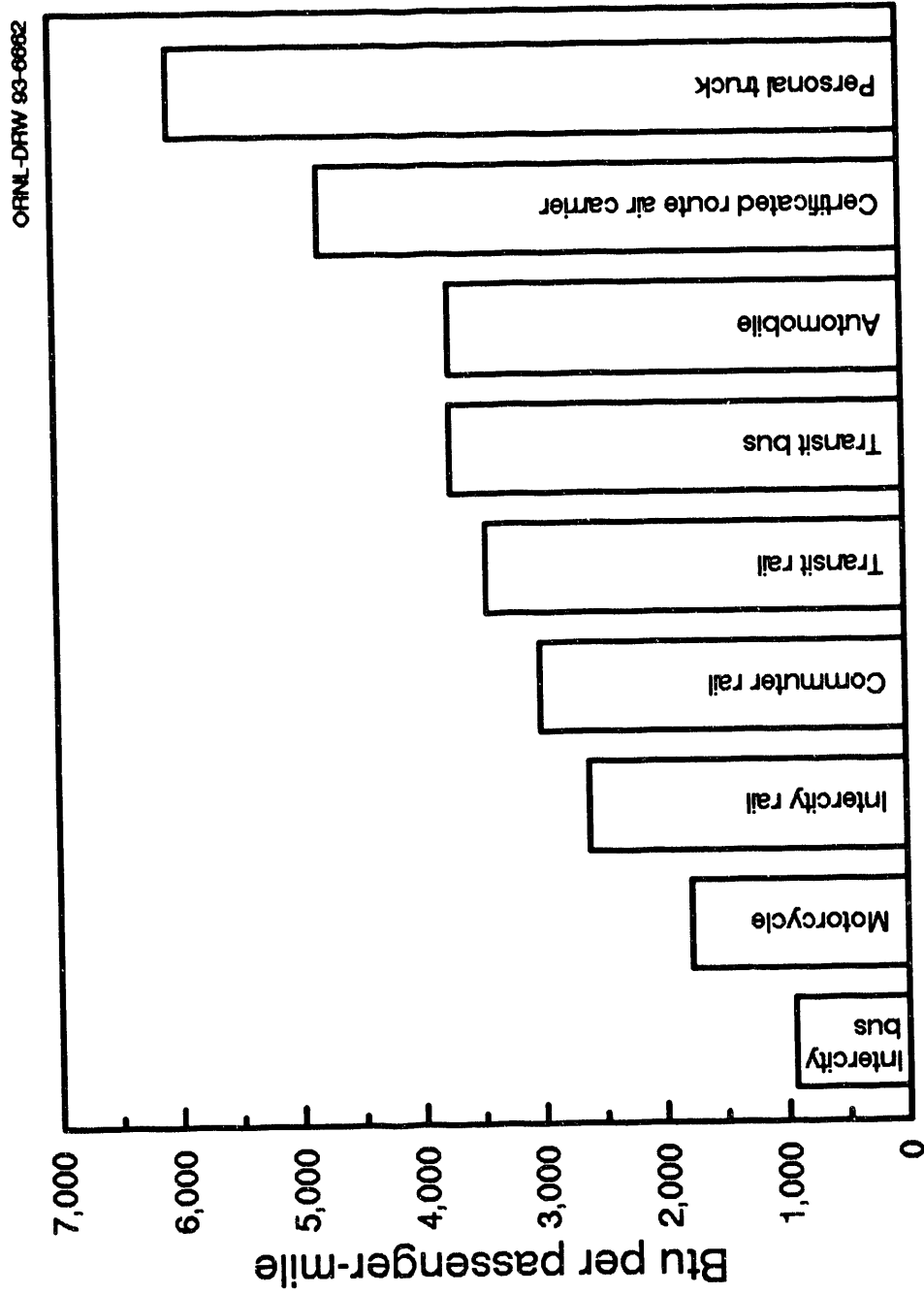
|                               | Number of vehicles (thousands) | Vehicle-miles (millions) | Passenger miles (millions) | Load factor (persons/vehicle) | Energy intensities     |                          | Energy use (trillion Btu) |
|-------------------------------|--------------------------------|--------------------------|----------------------------|-------------------------------|------------------------|--------------------------|---------------------------|
|                               |                                |                          |                            |                               | (Btu per vehicle-mile) | (Btu per passenger-mile) |                           |
| Automobiles                   | 143,549.6                      | 1,515,370                | 2,424,592                  | 1.6                           | 5,983                  | 3,739                    | 9,066.3                   |
| Personal Trucks               | 27,161.9                       | 296,151                  | 444,227                    | 1.5                           | 9,063                  | 6,042                    | 2,694.9                   |
| Motorcycles                   | 4,259.5                        | 9,572                    | 13,401                     | 1.4                           | 2,497                  | 1,783                    | 23.9                      |
| Buses                         | 588.7                          | 6,944                    | 118,327                    | 17.0                          | 23,445                 | 1,376                    | 162.8                     |
| Transit <sup>a</sup>          | 59.8                           | 2,153                    | 21,127                     | 9.8                           | 36,647                 | 3,735                    | 78.9                      |
| Intercity                     | 20.6                           | 991                      | 23,000                     | 23.2                          | 21,897                 | 944                      | 21.7                      |
| School                        | 508.3                          | 3,800                    | 74,200                     | 19.5                          | 16,368                 | 838                      | 62.2                      |
| Air                           | 1                              | 8,161                    | 358,763                    | 44.0                          | 220,010                | 5,005                    | 1,795.5                   |
| Certificated route (domestic) | 1                              | 3,964                    | 345,763                    | 87.2                          | 419,677                | 4,811                    | 1,663.6                   |
| General aviation              | 212.2                          | 4,197 <sup>c</sup>       | 13,000                     | 3.1                           | 31,427                 | 10,146                   | 131.9                     |
| Recreational boats            | 10,134.0                       |                          |                            |                               |                        |                          | 246.7                     |
| Rail                          | 17.9                           | 1,075                    | 25,310                     | 23.5 <sup>d</sup>             | 73,581                 | 3,125                    | 79.1                      |
| Intercity <sup>e</sup>        | 2.1 <sup>f</sup>               | 301 <sup>g</sup>         | 6,057 <sup>h</sup>         | 20.1 <sup>i</sup>             | 52,492                 | 2,609                    | 15.8                      |
| Transit <sup>j</sup>          | 11.3                           | 561                      | 12,046                     | 21.5 <sup>k</sup>             | 74,153 <sup>l</sup>    | 3,453                    | 41.6                      |
| Commuter                      | 4.5                            | 213                      | 7,207                      | 33.8 <sup>m</sup>             | 101,878                | 3,011                    | 21.7                      |

## Source:

See Appendix A for Table 2.12.

<sup>a</sup>Transit figures include motor bus only.<sup>b</sup>Data are not available.<sup>c</sup>Nautical miles.<sup>d</sup>Based on passenger train car-miles.<sup>e</sup>Amtrak only.<sup>f</sup>Sum of passenger train cars and locomotive units.<sup>g</sup>Passenger train car-miles.<sup>h</sup>Revenue passenger miles.<sup>i</sup>Light and heavy rail.<sup>j</sup>Large system-to-system variations exist within this category.

Figure 2.10. Passenger Energy Intensities by Type of Carrier, 1990



Source: See Table 2.12.

Table 2.13  
Energy Intensities of Passenger Modes, 1970-90

| Year                             | Automobiles <sup>a</sup> |              |  |              | Buses                                 |                                  |  |   | Air                                |   |  | Rail |  |
|----------------------------------|--------------------------|--------------|--|--------------|---------------------------------------|----------------------------------|--|---|------------------------------------|---|--|------|--|
|                                  | (Btu per vehicle-mile)   |              | Transit <sup>b</sup><br>(Btu per vehicle-mile) |              | Intercity<br>(Btu per passenger-mile) | School<br>(Btu per vehicle-mile) | Certificated<br>air carriers<br>(Btu per passenger-mile) | General<br>aviation<br>(Btu per passenger-mile) | Amtrak<br>(Btu per passenger-mile) | Rail<br>transit<br>(Btu per passenger-mile) |  |      |  |
|                                  | passenger-mile           | vehicle-mile | passenger-mile                                 | vehicle-mile |                                       |                                  |  |   |                                    |   |  |      |  |
| 1970                             | 9,301                    | 5,471        | 31,796   | 2,472        | 1,051                                 | 17,857                           | 10,351   | 10,374  | •                                  | 2,453                                       |  |      |  |
| 1971                             | 9,284                    | 5,461        | 30,255   | 2,475        | 1,039                                 | 17,857                           | 10,103   | 9,957   | •                                  | 2,595                                       |  |      |  |
| 1972                             | 9,383                    | 5,519        | 30,352   | 2,454        | 1,016                                 | 16,956                           | 9,017  | 10,340  | •                                  | 2,540                                       |  |      |  |
| 1973                             | 9,455                    | 5,562        | 30,657   | 2,597        | 981                                   | 16,957                           | 8,919  | 8,449   | 3,756                              | 2,460                                       |  |      |  |
| 1974                             | 9,372                    | 5,513        | 31,516   | 2,518        | 949                                   | 16,980                           | 7,917  | 9,054   | 3,240                              | 2,840                                       |  |      |  |
| 1975                             | 9,295                    | 5,468        | 33,748   | 2,814        | 976                                   | 17,040                           | 7,883  | 10,658  | 3,677                              | 2,962                                       |  |      |  |
| 1976                             | 9,293                    | 5,467        | 34,598   | 2,896        | 996                                   | 17,051                           | 7,481  | 10,769  | 3,397                              | 2,971                                       |  |      |  |
| 1977                             | 9,113                    | 5,360        | 35,120   | 2,889        | 961                                   | 16,983                           | 7,174  | 11,695  | 3,568                              | 2,691                                       |  |      |  |
| 1978                             | 8,955                    | 5,268        | 36,603   | 2,883        | 953                                   | 17,018                           | 6,333  | 11,305  | 3,683                              | 2,210                                       |  |      |  |
| 1979                             | 8,727                    | 5,134        | 36,597   | 2,795        | 963                                   | 16,980                           | 5,858  | 10,787  | 3,472                              | 2,794                                       |  |      |  |
| 1980                             | 8,130                    | 4,782        | 36,553   | 2,813        | 1,169                                 | 16,379                           | 5,837  | 11,497  | 3,176                              | 3,008                                       |  |      |  |
| 1981                             | 7,894                    | 4,644        | 37,745   | 3,027        | 1,155                                 | 16,385                           | 5,743  | 11,123  | 2,957                              | 2,946                                       |  |      |  |
| 1982                             | 7,558                    | 4,446        | 38,766   | 3,237        | 1,149                                 | 16,296                           | 5,147  | 13,015  | 3,156                              | 3,069                                       |  |      |  |
| 1983                             | 7,314                    | 4,302        | 37,962   | 3,177        | 1,174                                 | 16,236                           | 5,107  | 11,331  | 2,957                              | 3,212                                       |  |      |  |
| 1984                             | 7,031                    | 4,136        | 37,507   | 3,204        | 1,247                                 | 14,912                           | 5,031  | 11,912  | 3,027                              | 3,732                                       |  |      |  |
| 1985                             | 6,880                    | 4,047        | 38,862   | 2,421        | 1,323                                 | 16,531                           | 5,679  | 11,339  | 2,800                              | 3,461                                       |  |      |  |
| 1986                             | 6,853                    | 4,031        | 39,869   | 3,512        | 869                                   | 15,622                           | 5,447  | 11,935  | 2,574                              | 3,531                                       |  |      |  |
| 1987                             | 6,530                    | 3,841        | 38,557   | 3,542        | 939                                   | 15,615                           | 4,753  | 11,218  | 2,537                              | 3,534                                       |  |      |  |
| 1988                             | 6,275                    | 3,598        | 39,121   | 3,415        | 965                                   | 15,585                           | 4,814  | 11,966  | 2,462                              | 3,585                                       |  |      |  |
| 1989                             | 6,095                    | 3,809        | 36,583   | 3,711        | 963                                   | 15,575                           | 4,796  | 10,984  | 2,731                              | 3,397                                       |  |      |  |
| 1990                             | 5,983                    | 3,739        | 36,647   | 3,735        | 944                                   | 16,368                           | 4,811  | 10,146  | 2,609                              | 3,453                                       |  |      |  |
| Average annual percentage change |                          |              |  |              |                                       |                                  |  |   |                                    |   |  |      |  |
| 1970-90                          | -2.2%                    | -1.9%        | 0.7%   | 2.1%         | -0.5%                                 | -0.4%                            | -3.8%  | -0.1%   | -2.1% <sup>d</sup>                 | 1.7%  |  |      |  |
| 1982-90                          | -2.9%                    | -2.1%        | -0.7%  | 1.8%         | -2.4%                                 | 0.1%                             | -0.8%  | -3.1%   | -2.4%                              | 1.5%  |  |      |  |

Source:

See Appendix A for Table 2.13.

<sup>a</sup>Based on Federal Highway Administration estimates.<sup>b</sup>Transit bus statistics include motor bus only. Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.<sup>c</sup>Data are not available.<sup>d</sup>Average annual percentage change is for years 1973-90.

**Table 2.14**  
**Intercity Freight Movement and Energy Use in the United States, 1990**

|  | Number<br>of vehicles<br>(thousands) | Vehicle-miles<br>(millions) | Ton-miles<br>(millions)    | Tons shipped<br>(millions) | Average length<br>of haul<br>(miles) | Energy<br>intensity<br>(Btu/ton-mile) | Energy use<br>(trillion Btu) |
|--|--------------------------------------|-----------------------------|----------------------------|----------------------------|--------------------------------------|---------------------------------------|------------------------------|
| <b>Truck</b>                           | <b>4,187</b>                         | <b>139,257</b>              | <b>735,000</b>             | <b>2,598</b>               | <b>571<sup>a</sup></b>               | <b>3,357</b>                          | <b>2,467.0</b>               |
| <b>Waterborne commerce<sup>b</sup></b> | <b>39<sup>c</sup></b>                | <b>d</b>                    | <b>815,550<sup>f</sup></b> | <b>1,097<sup>e</sup></b>   | <b>743<sup>e</sup></b>               | <b>396</b>                            | <b>323.2</b>                 |
| Coastal                                | d                                    | d                           | 483,889 <sup>e</sup>       | 302 <sup>e</sup>           | 1,602 <sup>e</sup>                   | d                                     | d                            |
| Lakewise                               | d                                    | d                           | 58,308 <sup>e</sup>        | 109 <sup>e</sup>           | 535 <sup>e</sup>                     | d                                     | d                            |
| Internal and local                     | d                                    | d                           | 273,353 <sup>e</sup>       | 686 <sup>e</sup>           | 449 <sup>e,e</sup>                   | d                                     | d                            |
| <b>Pipeline</b>                        | <b>d</b>                             | <b>d</b>                    | <b>d</b>                   | <b>1,542</b>               | <b>d</b>                             | <b>d</b>                              | <b>877.6</b>                 |
| Natural gas                            | d                                    | d                           | d                          | 483                        | d                                    | d                                     | 715.5                        |
| Crude oil and products                 | d                                    | d                           | 583,000                    | 1,046                      | d                                    | 272                                   | 158.4                        |
| Coal slurry                            | d                                    | d                           | 1,338                      | 5                          | 273                                  | 2,765                                 | 3.7                          |
| <b>Class I Railroads<sup>f</sup></b>   | <b>659</b>                           | <b>26,159</b>               | <b>1,033,969</b>           | <b>1,987</b>               | <b>726</b>                           | <b>411</b>                            | <b>425.2</b>                 |

**Source:**

See Appendix A for Table 2.14.

<sup>a</sup>For general freight (less than truckload). Based on data from the Eno Transportation Foundation, the average length of haul for specialized freight (truckload) was 232 miles.

<sup>b</sup>Includes commerce by foreign and domestic carriers in the U.S.

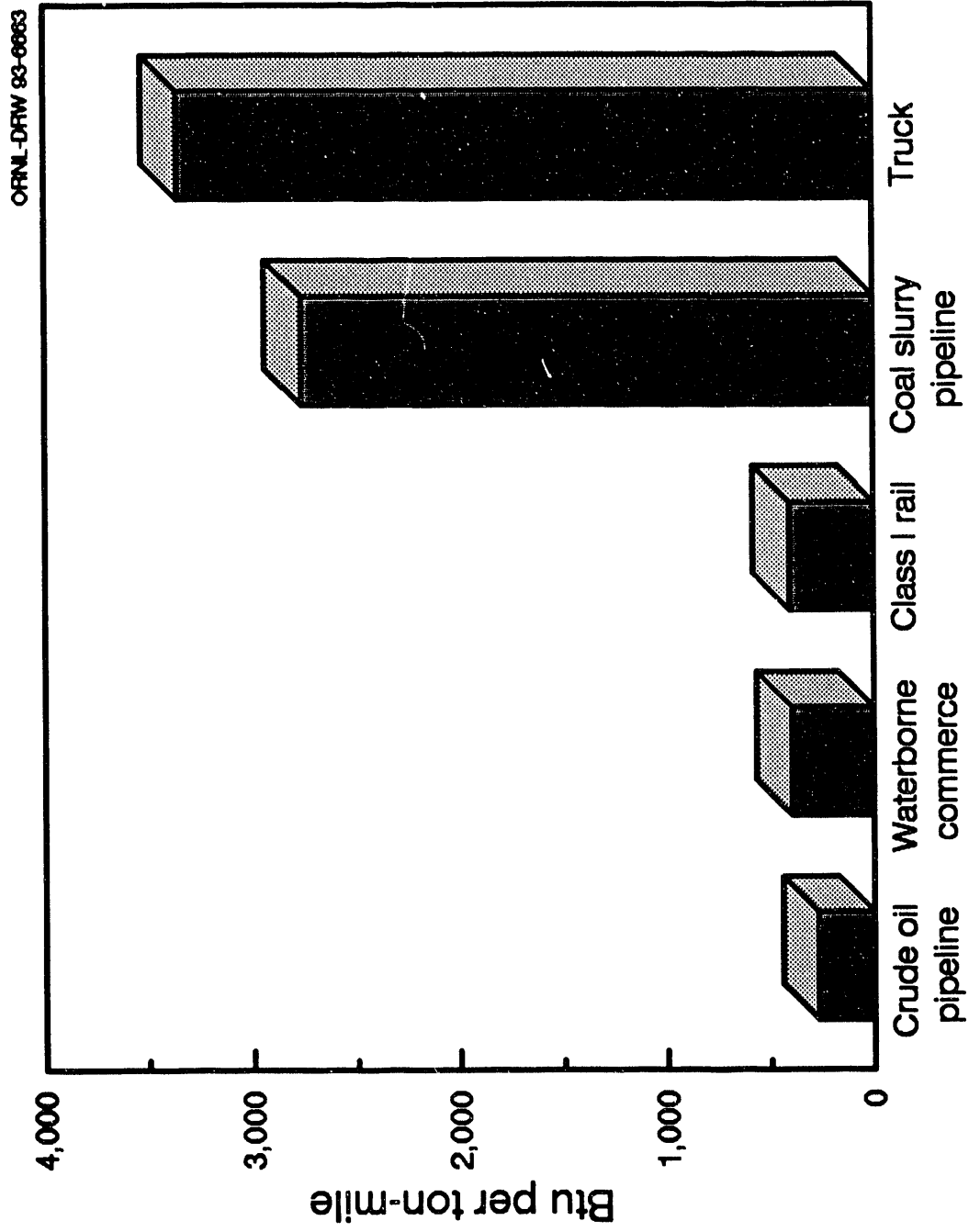
<sup>c</sup>1989 data. 1990 data are not yet available.

<sup>d</sup>Data are not available.

<sup>e</sup>Internal only. Average length of haul for local was 15 miles.

<sup>f</sup>Railroad measures are: Number vehicles = Number freight cars, Vehicle-miles = car-miles, Ton miles = revenue ton-miles.

Figure 2.11. Intercity Freight Energy Intensities by Type of Carrier, 1990



Source: See Table 2.14.

*All freight modes experienced energy efficiency improvements from 1970 to 1990. Domestic waterborne commerce, however, reversed this trend from 1982 to 1989 with a 3.1% decline in energy efficiency.*

**Table 2.15**  
**Energy Intensities of Freight Modes, 1970-90**

| Year                                    | Trucks                                 |  |  | Class I freight railroad   |                    | Domestic waterborne commerce<br>(Btu per ton-mile) |
|---|--|--|--|----------------------------|--------------------|--|
|   | Light truck*<br>(Btu per vehicle-mile) | Other trucks<br>(Btu per vehicle-mile) | Total trucks<br>(Btu per vehicle-mile) | (Btu per freight car-mile) | (Btu per ton-mile) |  |
| 1970                                    | 12,491                                 | 24,142                                 | 16,399                                 | 16,748                     | 655                | 545  |
| 1971                                    | 12,229                                 | 23,685                                 | 15,945                                 | 17,655                     | 696                | 506  |
| 1972                                    | 12,099                                 | 23,350                                 | 15,646                                 | 18,087                     | 706                | 522  |
| 1973                                    | 11,909                                 | 23,251                                 | 15,417                                 | 18,046                     | 662                | 576  |
| 1974                                    | 11,398                                 | 22,555                                 | 14,669                                 | 18,422                     | 665                | 483  |
| 1975                                    | 11,161                                 | 21,997                                 | 14,286                                 | 18,604                     | 682                | 549  |
| 1976                                    | 11,167                                 | 22,644                                 | 14,335                                 | 18,843                     | 677                | 468  |
| 1977                                    | 10,926                                 | 22,679                                 | 14,157                                 | 19,180                     | 667                | 458  |
| 1978                                    | 10,765                                 | 22,887                                 | 14,093                                 | 18,802                     | 637                | 383  |
| 1979                                    | 10,599                                 | 23,027                                 | 13,978                                 | 19,113                     | 616                | 457  |
| 1980                                    | 10,143                                 | 22,352                                 | 13,489                                 | 18,585                     | 592                | 358  |
| 1981                                    | 10,002                                 | 22,640                                 | 13,394                                 | 18,582                     | 571                | 360  |
| 1982                                    | 9,741                                  | 22,736                                 | 13,103                                 | 18,224                     | 547                | 310  |
| 1983                                    | 9,755                                  | 22,967                                 | 13,146                                 | 17,719                     | 521                | 319  |
| 1984                                    | 9,777                                  | 22,884                                 | 13,147                                 | 17,740                     | 508                | 346  |
| 1985                                    | 9,730                                  | 23,100                                 | 12,851                                 | 17,131                     | 487                | 446  |
| 1986                                    | 9,729                                  | 23,106                                 | 13,082                                 | 16,855                     | 474                | 463  |
| 1987                                    | 9,705                                  | 23,136                                 | 13,010                                 | 16,307                     | 443                | 402  |
| 1988                                    | 9,350                                  | 23,387                                 | 12,767                                 | 16,436                     | 434                | 361  |
| 1989                                    | 9,081                                  | 23,128                                 | 12,532                                 | 16,525                     | 427                | 403  |
| 1990                                    | 8,904                                  | 22,581                                 | 12,230                                 | 16,254                     | 411                | 396 <sup>b</sup>                                   |
| <i>Average annual percentage change</i> |  |  |  |                            |                    |  |
| 1970-90                                 | -1.7%                                  | -0.3%                                  | -1.5%                                  | -0.1%                      | -2.3%              | -1.6%  |
| 1982-90                                 | -1.1%                                  | 0.1%                                   | -0.9%                                  | -1.4%                      | -3.5%              | 3.1%   |

Source:

See Appendix A for Table 2.15.

\*Two-axle, four-tire trucks.

<sup>b</sup>Assuming 1990 ton-miles remain constant from 1989. 1990 data are not yet available.

## **Section 2.3. Economics**

Table 2.16  
Retail Prices for Motor Fuel, 1978-91\*  
(cents per gallon, including tax)

| Year                             | Gasoline <sup>c</sup>    |                            |                |                            |                  |                            |                    |                            |   |                            |
|----------------------------------|--------------------------|----------------------------|----------------|----------------------------|------------------|----------------------------|--------------------|----------------------------|---|----------------------------|
|                                  | Diesel Fuel <sup>b</sup> |                            | Leaded regular |                            | Unleaded regular |                            | Unleaded premium   |                            | Average for all gasoline types <sup>d</sup> |                            |
|                                  | Current                  | Constant 1990 <sup>e</sup> | Current        | Constant 1990 <sup>e</sup> | Current          | Constant 1990 <sup>e</sup> | Current            | Constant 1990 <sup>e</sup> | Current                                     | Constant 1990 <sup>e</sup> |
| 1978                             | <sup>d</sup>             | <sup>d</sup>               | 62.6           | 125.4                      | 67.0             | 134.2                      | <sup>d</sup>       | <sup>d</sup>               | 65.2  | 130.6                      |
| 1979                             | <sup>d</sup>             | <sup>d</sup>               | 85.7           | 154.3                      | 90.3             | 162.6                      | <sup>d</sup>       | <sup>d</sup>               | 88.2  | 158.8                      |
| 1980                             | 101.0                    | 160.2                      | 119.1          | 188.9                      | 124.5            | 197.4                      | <sup>d</sup>       | <sup>d</sup>               | 122.1                                       | 193.6                      |
| 1981                             | 118.0                    | 169.5                      | 131.1          | 188.4                      | 137.8            | 198.0                      | 147.0              | 211.2                      | 135.3                                       | 194.4                      |
| 1982                             | 116.0                    | 157.0                      | 122.2          | 165.4                      | 129.6            | 175.5                      | 141.5              | 191.6                      | 128.1                                       | 173.4                      |
| 1983                             | 120.0                    | 157.4                      | 115.7          | 151.8                      | 124.1            | 162.8                      | 138.3              | 181.4                      | 122.5                                       | 160.7                      |
| 1984                             | 122.0                    | 153.5                      | 112.9          | 142.0                      | 121.2            | 152.5                      | 136.6              | 171.9                      | 119.8                                       | 150.7                      |
| 1985                             | 122.0                    | 148.2                      | 111.5          | 135.4                      | 120.2            | 146.0                      | 134.0              | 162.8                      | 119.6                                       | 145.3                      |
| 1986                             | 94.0                     | 112.0                      | 85.7           | 102.1                      | 92.7             | 110.5                      | 108.5              | 129.3                      | 93.1  | 111.0                      |
| 1987                             | 96.0                     | 110.4                      | 89.7           | 103.1                      | 94.8             | 109.0                      | 109.3              | 125.7                      | 95.7  | 110.0                      |
| 1988                             | 95.0                     | 104.9                      | 89.9           | 99.3                       | 94.6             | 104.5                      | 110.7              | 122.3                      | 96.3  | 106.4                      |
| 1989                             | 102.0                    | 107.5                      | 99.8           | 105.2                      | 102.1            | 107.6                      | 119.7              | 126.2                      | 106.0                                       | 111.7                      |
| 1990                             | 99.0                     | 99.0                       | 114.9          | 114.9                      | 116.4            | 116.4                      | 134.9              | 134.9                      | 121.7                                       | 121.7                      |
| 1991                             | 91.0                     | 87.3                       | <sup>d</sup>   | <sup>d</sup>               | 114.0            | 109.3                      | 132.1              | 126.7                      | 119.6                                       | 114.7                      |
| Average annual percentage change |                          |                            |                |                            |                  |                            |                    |                            |   |                            |
| 1978-91                          | -0.9% <sup>*</sup>       | -5.4% <sup>*</sup>         | 5.2%           | -0.7%                      | 4.2%             | -1.6%                      | -1.1% <sup>f</sup> | -5.0% <sup>f</sup>         | 4.8%  | -1.0%                      |
| 1982-91                          | -2.7%                    | -6.3%                      | -0.8%          | -4.5%                      | -1.4%            | -5.1%                      | -0.8%              | -4.5%                      | -0.8%                                       | -4.5%                      |

## Sources

Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review March 1992, Washington, DC, Table 9.4, p. 110.

Diesel - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1990, Washington, DC, January 1992, pp. 91-92.

\*These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.

<sup>b</sup>Collected from a survey of prices, January 1, 1991.

<sup>c</sup>Adjusted by the Consumer Price Inflation Index.

<sup>d</sup>Data are not available.

<sup>e</sup>Average annual percentage change is for years 1980-90.

<sup>f</sup>Average annual percentage change is for years 1981-90.

The fuel prices shown here are refiner sales prices of transportation fuels to end users, excluding tax. Sales to end users are those made directly to the ultimate consumer, including bulk consumers. Bulk sales to utility, industrial, and commercial accounts previously included in the wholesale category are now counted as sales to end users.

Table 2.17  
Prices for Selected Transportation Fuels, 1978-91  
(cents per gallon, excluding tax)

| Year                             | Propane <sup>a</sup> |                            | Finished aviation gasoline |                            | Kerosene-type jet fuel |                            | Diesel fuel oil <sup>b</sup> |                            |
|----------------------------------|----------------------|----------------------------|----------------------------|----------------------------|------------------------|----------------------------|------------------------------|----------------------------|
|                                  | Current              | Constant 1990 <sup>d</sup> | Current                    | Constant 1990 <sup>d</sup> | Current                | Constant 1990 <sup>d</sup> | Current                      | Constant 1990 <sup>d</sup> |
| 1978                             | 33.5                 | 67.1                       | 51.6                       | 103.4                      | 38.7                   | 77.5                       | 37.9                         | 75.9                       |
| 1979                             | 35.7                 | 64.3                       | 68.9                       | 124.0                      | 54.7                   | 98.5                       | 57.6                         | 103.7                      |
| 1980                             | 48.2                 | 76.4                       | 108.4                      | 171.9                      | 86.6                   | 137.3                      | 83.0                         | 131.6                      |
| 1981                             | 56.5                 | 81.2                       | 130.3                      | 187.2                      | 102.4                  | 147.1                      | 100.2                        | 144.0                      |
| 1982                             | 59.2                 | 80.1                       | 131.2                      | 177.6                      | 96.3                   | 130.4                      | 95.4                         | 129.2                      |
| 1983                             | 70.9                 | 93.0                       | 125.5                      | 164.6                      | 87.8                   | 115.2                      | 83.1                         | 109.0                      |
| 1984                             | 73.7                 | 92.7                       | 123.4                      | 155.3                      | 84.2                   | 105.9                      | 82.6                         | 103.9                      |
| 1985                             | 71.7                 | 87.1                       | 120.1                      | 145.9                      | 79.6                   | 96.7                       | 78.3                         | 95.1                       |
| 1986                             | 74.5                 | 88.8                       | 101.1                      | 120.5                      | 52.9                   | 63.0                       | 49.2                         | 58.6                       |
| 1987                             | 70.1                 | 80.6                       | 90.7                       | 104.3                      | 54.3                   | 62.4                       | 53.8                         | 61.9                       |
| 1988                             | 71.4                 | 78.9                       | 89.1                       | 98.4                       | 51.3                   | 56.7                       | 49.2                         | 54.4                       |
| 1989                             | 61.5                 | 64.8                       | 99.5                       | 104.9                      | 59.2                   | 62.4                       | 56.3                         | 59.3                       |
| 1990                             | 74.5                 | 74.5                       | 112.0                      | 112.0                      | 76.6                   | 76.6                       | 69.2                         | 69.2                       |
| 1991                             | 72.9                 | 69.9                       | 104.7                      | 100.4                      | 65.3                   | 62.6                       | .                            | .                          |
| Average annual percentage change |                      |                            |                            |                            |                        |                            |                              |                            |
| 1978-91                          | 6.2%                 | 0.3%                       | 5.6%                       | -0.2%                      | 4.1%                   | -1.6%                      | 5.1%                         | -0.8%                      |
| 1982-91                          | 2.3%                 | -1.5%                      | -2.5%                      | -6.1%                      | -4.2%                  | -7.8%                      | -3.9%                        | -7.5%                      |

#### Sources:

U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, March 1992, Washington, DC, Table 9.7, p. 113.  
Diesel fuel oil - Association of American Railroads, *Railroad Facts*, 1991 edition, Washington, DC, September 1991, p. 60.

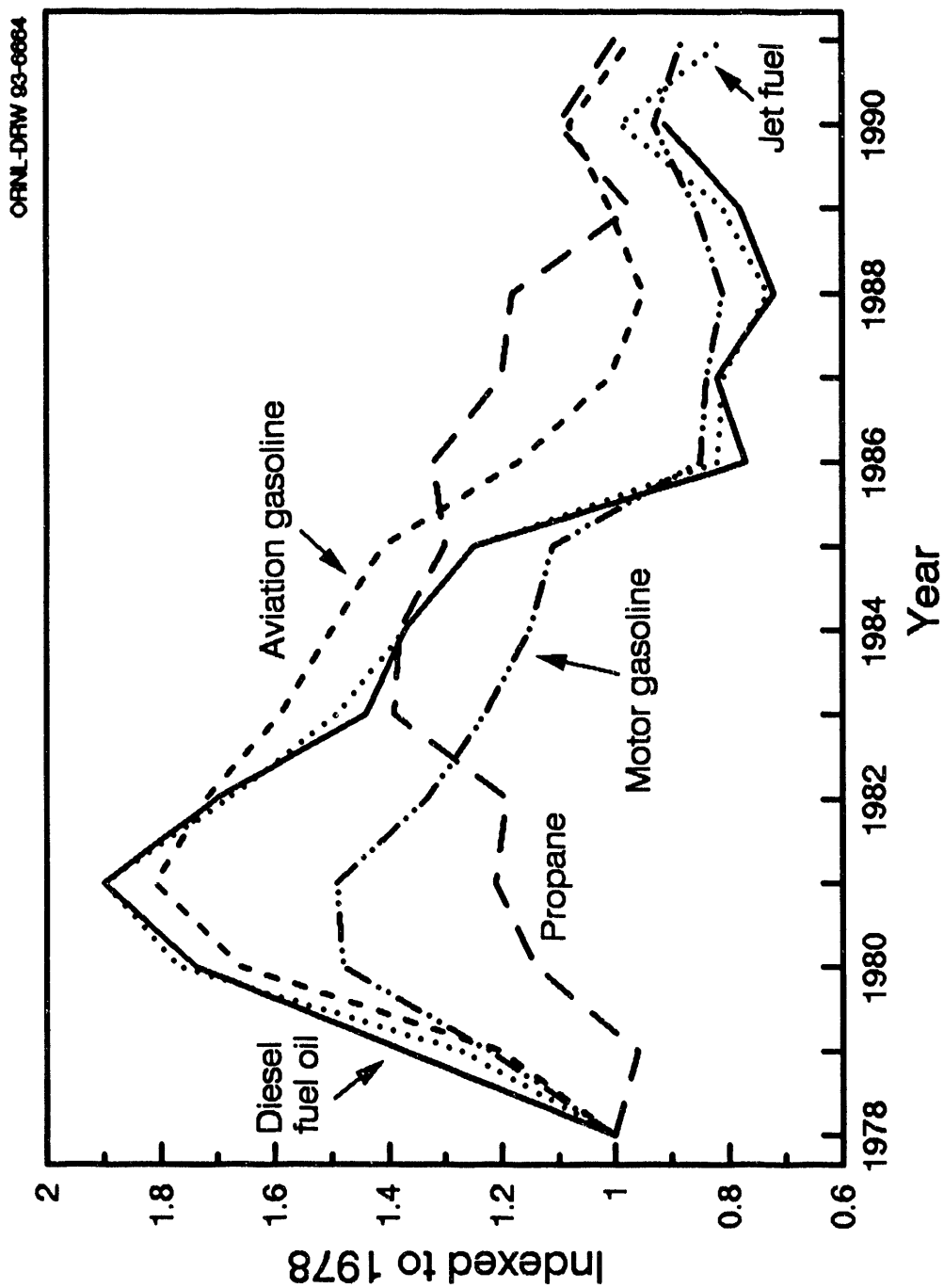
<sup>a</sup>Consumer grade.

<sup>b</sup>Wholesale cost.

<sup>c</sup>Data are not available.

<sup>d</sup>Average annual percentage change is for years 1978-90 and 1982-90.

Figure 2.12. Price Indices for Selected Transportation Fuels, 1978-91  
(based on constant 1990 dollars)



Source: See Tables 2.16 and 2.17.

*The average price of a barrel of crude oil dropped by more than three dollars from 1990 to 1991. The price of unleaded regular gasoline reflected the decline, but only dropped by 2.4¢ (\$1.01 per barrel) in current dollars.*

**Table 2.18**  
**Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1976-91**

| Year                                    | Crude Oil <sup>a</sup><br>(dollars per barrel) |                            | Leaded Gasoline <sup>b</sup><br>(dollars per gallon) |                            | Unleaded Regular Gasoline <sup>b</sup><br>(dollars per gallon) |                            |
|---|--|----------------------------|--|----------------------------|--|----------------------------|
|   | Current  | Constant 1990 <sup>c</sup> | Current  | Constant 1990 <sup>c</sup> | Current  | Constant 1990 <sup>c</sup> |
| 1976                                    | 10.89  | 25.00                      | 0.590  | 1.354                      | 0.614  | 1.407                      |
| 1977                                    | 11.96  | 25.79                      | 0.622  | 1.341                      | 0.656  | 1.415                      |
| 1978                                    | 12.46  | 24.96                      | 0.626  | 1.254                      | 0.670  | 1.342                      |
| 1979                                    | 17.72  | 31.90                      | 0.857  | 1.543                      | 0.903  | 1.626                      |
| 1980                                    | 28.07  | 44.52                      | 1.191  | 1.889                      | 1.245  | 1.974                      |
| 1981                                    | 35.24  | 50.63                      | 1.311  | 1.884                      | 1.378  | 1.980                      |
| 1982                                    | 31.87  | 43.15                      | 1.222  | 1.654                      | 1.296  | 1.755                      |
| 1983                                    | 28.99  | 38.03                      | 1.157  | 1.518                      | 1.241  | 1.628                      |
| 1984                                    | 28.63  | 36.02                      | 1.129  | 1.420                      | 1.212  | 1.525                      |
| 1985                                    | 26.75  | 32.50                      | 1.115  | 1.354                      | 1.202  | 1.460                      |
| 1986                                    | 14.55  | 17.34                      | 0.857  | 1.021                      | 0.927  | 1.105                      |
| 1987                                    | 17.90  | 20.58                      | 0.897  | 1.031                      | 0.948  | 1.090                      |
| 1988                                    | 14.67  | 16.21                      | 0.899  | 0.993                      | 0.946  | 1.045                      |
| 1989                                    | 17.97  | 18.94                      | 0.998  | 1.052                      | 1.021  | 1.076                      |
| 1990                                    | 22.22  | 22.22                      | 1.149  | 1.149                      | 1.164  | 1.164                      |
| 1991                                    | 19.05  | 18.30                      | <sup>d</sup>   | <sup>d</sup>               | 1.140  | 1.100                      |
| <i>Average annual percentage change</i> |  |                            |  |                            |  |                            |
| 1976-91                                 | 3.8%   | -2.1%                      | 4.9% <sup>e</sup>                                    | -1.2% <sup>e</sup>         | 4.2%   | -1.6%                      |
| 1982-91                                 | -5.6%  | -9.1%                      | -0.8% <sup>e</sup>                                   | -4.5% <sup>e</sup>         | -1.4%  | -5.1%                      |

**Sources:**

Crude Oil - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1992, Washington, DC, Table 9.1, p. 107.

Gasoline - U.S. Department of Energy, Energy Information Administration Monthly Energy Review, March 1992, Washington, DC, Table 9.4, p. 110.

<sup>a</sup>Refiner acquisition cost of composite (domestic and import) crude oil.

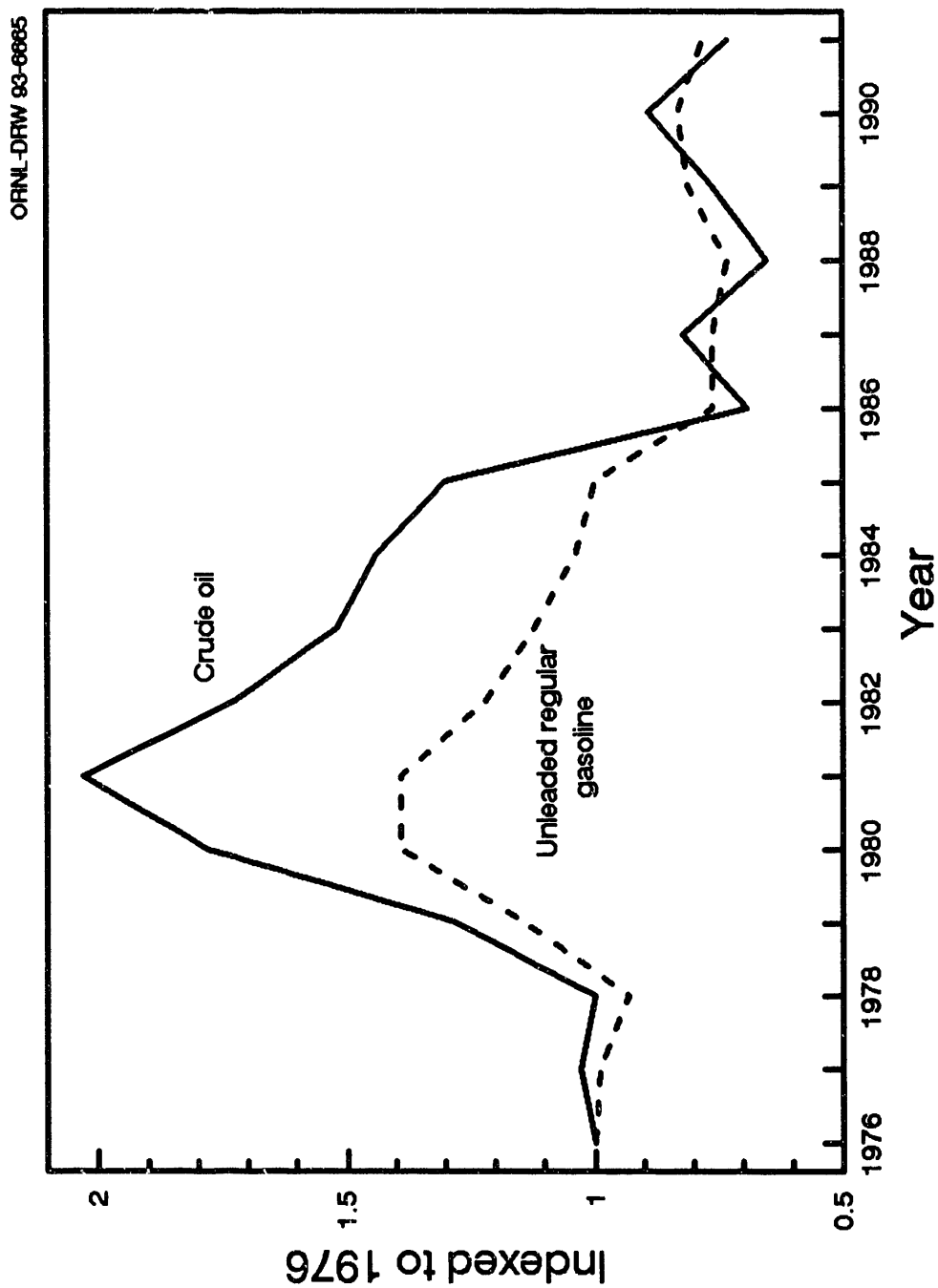
<sup>b</sup>These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.

<sup>c</sup>Adjusted by the Consumer Price Inflation Index.

<sup>d</sup>Data are not available.

<sup>e</sup>Average annual percentage changes are for years 1976-90 and 1982-90.

Figure 2.13. Crude Oil and Gasoline Price Indices, 1976-91  
(based on constant 1990 dollars)



Source: See Table 2.18.

*Transportation's share of the Gross National Product (GNP) fell below 17% in 1991. GNP has been growing at an average rate of 3.0% from 1982 to 1991, while transportation outlays have grown an average of 1.9% annually, in constant 1990 dollars.*

**Table 2.19**  
**Gross National Product (GNP) as Related to Transportation, 1970-91**

| Year                                    | Gross National Product<br>(billion dollars) |                   | Total transportation<br>outlays<br>(billion dollars) |                   | Transportation<br>outlays<br>as a percent<br>of GNP |
|---|---|-------------------|--|-------------------|---|
|   | Current                                     | Constant<br>1990* | Current  | Constant<br>1990* |   |
| 1970                                    | 1,015.5                                     | 3,031.3           | 195.2  | 582.7             | 19.2%   |
| 1971                                    | 1,102.7                                     | 3,127.8           | 222.0  | 629.7             | 20.1%   |
| 1972                                    | 1,212.8                                     | 3,304.5           | 242.3  | 660.2             | 20.0%   |
| 1973                                    | 1,359.3                                     | 3,499.9           | 266.5  | 686.2             | 19.6%   |
| 1974                                    | 1,472.8                                     | 3,490.0           | 282.6  | 669.7             | 19.2%   |
| 1975                                    | 1,598.4                                     | 3,463.9           | 298.9  | 647.8             | 18.7%   |
| 1976                                    | 1,782.8                                     | 3,671.3           | 351.1  | 723.0             | 19.7%   |
| 1977                                    | 1,990.5                                     | 3,871.3           | 400.9  | 779.7             | 20.1%   |
| 1978                                    | 2,249.7                                     | 4,076.6           | 453.4  | 821.6             | 20.2%   |
| 1979                                    | 2,508.2                                     | 4,182.2           | 503.0  | 838.7             | 20.1%   |
| 1980                                    | 2,732.0                                     | 4,167.4           | 524.9  | 800.7             | 19.2%   |
| 1981                                    | 3,052.6                                     | 4,259.0           | 592.5  | 826.7             | 19.4%   |
| 1982                                    | 3,166.0                                     | 4,163.3           | 591.4  | 777.7             | 18.7%   |
| 1983                                    | 3,405.7                                     | 4,308.3           | 643.2  | 813.7             | 18.9%   |
| 1984                                    | 3,772.2                                     | 4,573.5           | 715.5  | 867.5             | 19.0%   |
| 1985                                    | 4,010.3                                     | 4,730.4           | 753.0  | 888.2             | 18.8%   |
| 1986                                    | 4,235.0                                     | 4,861.8           | 771.7  | 885.9             | 18.2%   |
| 1987                                    | 4,515.6                                     | 5,053.2           | 808.7  | 905.0             | 17.9%   |
| 1988                                    | 4,873.7                                     | 5,268.1           | 857.6  | 927.0             | 17.6%   |
| 1989                                    | 5,200.8                                     | 5,416.5           | 906.3  | 943.9             | 17.4%   |
| 1990                                    | 5,524.5                                     | 5,524.5           | 969.4  | 969.4             | 17.5%   |
| 1991                                    | 5,685.8                                     | 5,452.7           | 959.5  | 917.3             | 16.9%   |
| <i>Average annual percentage change</i> |   |                   |  |                   |   |
| 1970-91                                 | 8.5%  | 2.8%              | 7.9%   | 2.2%              |   |
| 1982-91                                 | 6.7%  | 3.0%              | 5.5%   | 1.9%              |   |

**Sources:**

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

1987-91 GNP - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July, 1991, and annual.

Transportation Outlays - Eno Transportation Foundation, Transportation in America, Tenth Edition, Washington, DC, 1992, p.38.

\*Adjusted by the implicit GNP price deflator.

*Transportation's share of personal consumption expenditures (PCE) dropped to 11.3% in 1991, the lowest share in the twenty-year series.*

**Table 2.20**  
**Personal Consumption Expenditures (PCE) as Related to Transportation, 1970-91**

| Year                                    | Personal Consumption Expenditures<br>(billion dollars) |                            | Transportation Personal Consumption Expenditures <sup>a</sup><br>(billion dollars) |                            | Transportation PCE<br>as a percent of<br>total PCE |
|---|--|----------------------------|--|----------------------------|--|
|   | Current  | Constant 1990 <sup>b</sup> | Current  | Constant 1990 <sup>b</sup> |  |
| 1970                                    | 640.0  | 1,910.4                    | 81.5   | 243.3                      | 12.7%  |
| 1971                                    | 691.6  | 1,961.7                    | 95.2   | 270.0                      | 13.8%  |
| 1972                                    | 757.6  | 2,064.2                    | 105.8  | 288.3                      | 14.0%  |
| 1973                                    | 837.2  | 2,155.6                    | 116.0  | 298.7                      | 13.9%  |
| 1974                                    | 916.5  | 2,171.8                    | 119.8  | 283.9                      | 13.1%  |
| 1975                                    | 1,012.8  | 2,194.9                    | 131.2  | 284.3                      | 13.0%  |
| 1976                                    | 1,129.3  | 2,325.6                    | 157.1  | 323.5                      | 13.9%  |
| 1977                                    | 1,257.2  | 2,445.1                    | 181.5  | 353.0                      | 14.4%  |
| 1978                                    | 1,403.5  | 2,543.2                    | 199.9  | 362.2                      | 14.2%  |
| 1979                                    | 1,566.8  | 2,612.5                    | 222.0  | 370.2                      | 14.2%  |
| 1980                                    | 1,732.6  | 2,642.9                    | 238.5  | 363.8                      | 13.8%  |
| 1981                                    | 1,915.1  | 2,672.0                    | 261.5  | 364.8                      | 13.7%  |
| 1982                                    | 2,050.7  | 2,696.7                    | 267.6  | 351.9                      | 13.0%  |
| 1983                                    | 2,234.5  | 2,826.7                    | 295.4  | 373.7                      | 13.2%  |
| 1984                                    | 2,430.5  | 2,946.8                    | 329.5  | 399.5                      | 13.6%  |
| 1985                                    | 2,629.0  | 3,101.1                    | 359.5  | 424.1                      | 13.7%  |
| 1986                                    | 2,797.4  | 3,211.4                    | 366.3  | 420.5                      | 13.0%  |
| 1987                                    | 3,009.4  | 3,357.7                    | 379.7  | 424.9                      | 12.6%  |
| 1988                                    | 3,296.1  | 3,562.9                    | 413.2  | 446.6                      | 12.5%  |
| 1989                                    | 3,523.1  | 3,669.2                    | 437.3  | 455.4                      | 12.4%  |
| 1990                                    | 3,448.4  | 3,448.4                    | 453.7  | 453.7                      | 13.1%  |
| 1991                                    | 3,887.7  | 3,716.6                    | 438.2  | 418.9                      | 11.3%  |
| <i>Average annual percentage change</i> |  |                            |  |                            |  |
| 1970-91                                 | 9.0%   | 3.2%                       | 8.3%   | 2.6%                       |  |
| 1982-91                                 | 7.4%   | 3.6%                       | 5.6%   | 2.0%                       |  |

**Sources:**

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

1987-91 data - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July 1992, p. 59, and annual.

<sup>a</sup>Transportation Personal Consumption Expenditures include user operating expenses (new and used auto purchases, gas and oil, repair, greasing, washing, parking, storage, rental, other motor vehicles, tires, tubes and other parts, insurance premiums); purchased intercity transportation; and purchased local transportation.

<sup>b</sup>Adjusted by the implicit GNP price deflator.

*The Consumer Price Index (CPI) for transportation has more than tripled from 1970 to 1990; and the Used Car CPI continued to grow at a much faster rate than did the New Car CPI. This means that while consumers paid for a new automobile in 1990 more than double what they did in 1970, they paid almost four times more to buy a used car in 1990 than in 1970. Although the Used Car CPI declined from 1989 to 1990, it rose again in 1991.*

**Table 2.21**  
**Statistical Indices as Related to Transportation, 1970-91**  
**(1970 = 1.000)**

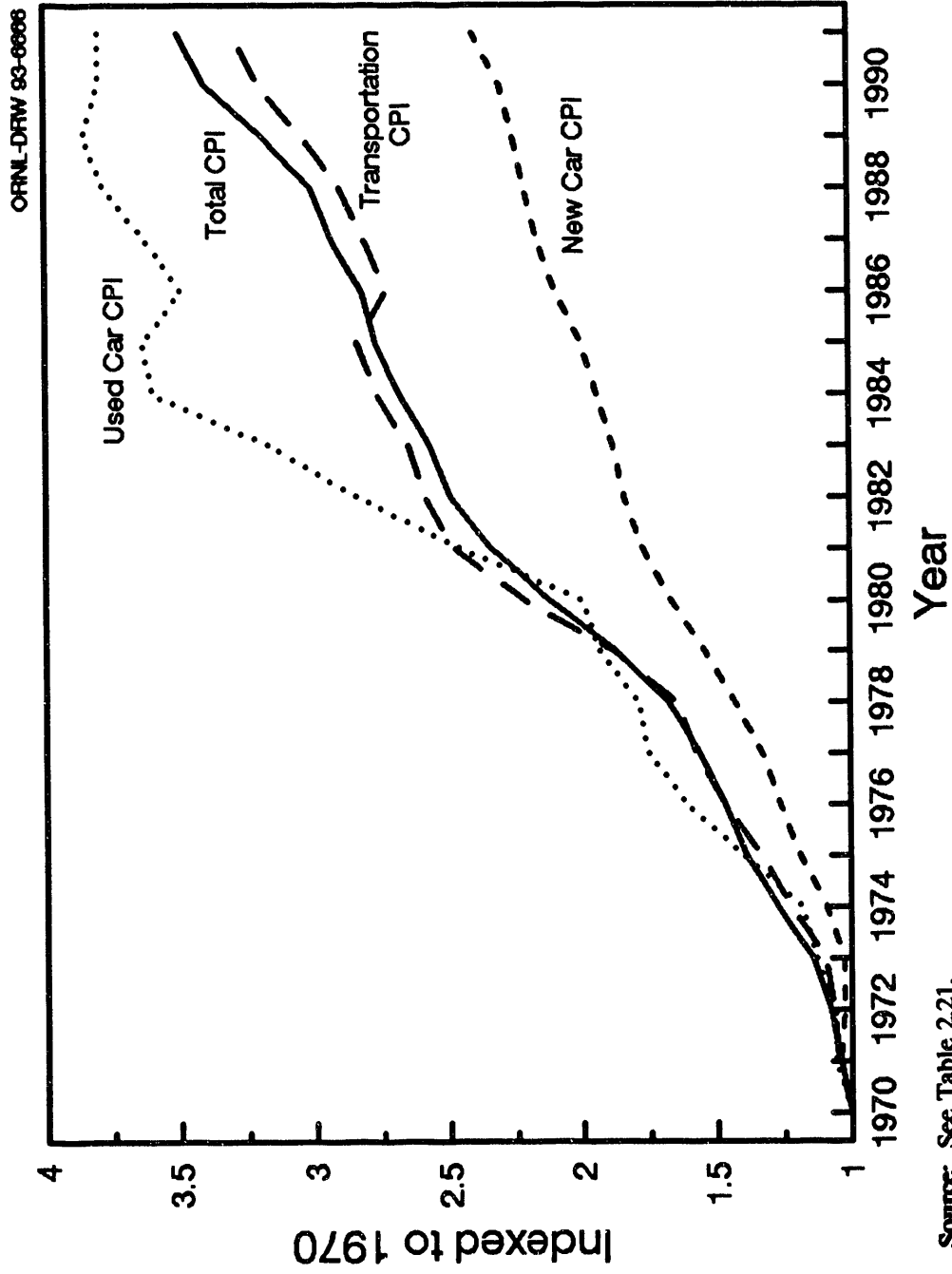
| Year | Consumer Price Index | Transportation Consumer Price Index <sup>a</sup> | New car Consumer Price Index | Used car Consumer Price Index | Gross National Product |
|------|----------------------|--|------------------------------|-------------------------------|------------------------|
| 1970 | 1.000                | 1.000  | 1.000                        | 1.000                         | 1.000                  |
| 1971 | 1.043                | 1.052  | 1.041                        | 1.057                         | 1.086                  |
| 1972 | 1.077                | 1.064  | 1.032                        | 1.059                         | 1.194                  |
| 1973 | 1.144                | 1.098  | 1.033                        | 1.128                         | 1.339                  |
| 1974 | 1.270                | 1.222  | 1.092                        | 1.175                         | 1.450                  |
| 1975 | 1.386                | 1.336  | 1.186                        | 1.404                         | 1.574                  |
| 1976 | 1.466                | 1.469  | 1.261                        | 1.610                         | 1.756                  |
| 1977 | 1.561                | 1.572  | 1.328                        | 1.753                         | 1.960                  |
| 1978 | 1.680                | 1.646  | 1.429                        | 1.788                         | 2.215                  |
| 1979 | 1.869                | 1.881  | 1.543                        | 1.927                         | 2.470                  |
| 1980 | 2.122                | 2.216  | 1.667                        | 1.995                         | 2.690                  |
| 1981 | 2.342                | 2.484  | 1.768                        | 2.463                         | 3.006                  |
| 1982 | 2.486                | 2.587  | 1.836                        | 2.842                         | 3.118                  |
| 1983 | 2.566                | 2.648  | 1.883                        | 3.161                         | 3.354                  |
| 1984 | 2.675                | 2.766  | 1.938                        | 3.602                         | 3.715                  |
| 1985 | 2.770                | 2.838  | 2.000                        | 3.640                         | 3.954                  |
| 1986 | 2.824                | 2.728  | 2.087                        | 3.487                         | 4.176                  |
| 1987 | 2.927                | 2.811  | 2.162                        | 3.625                         | 4.447                  |
| 1988 | 3.046                | 2.899  | 2.206                        | 3.782                         | 4.799                  |
| 1989 | 3.193                | 3.043  | 2.249                        | 3.859                         | 5.121                  |
| 1990 | 3.365                | 3.213  | 2.283                        | 3.769                         | 5.382                  |
| 1991 | 3.508                | 3.301  | 2.364                        | 3.785                         | 5.599                  |

**Sources:**

U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Washington, DC, May 1992, p. S-6, and annual.  
Gross National Product - Indexed to 1970 from Table 2.19.

<sup>a</sup>Transportation Consumer Price Index includes new and used cars, gasoline, auto insurance rates, intracity mass transit, intracity bus fare, and airline fares.

Figure 2.14. Consumer Price Indices, 1970-91



\*For each data series, the 1970 value is set equal to one, and other annual values are expressed as relative proportions.

*The average price of all new cars in 1990 constant dollars declined from 1990 to 1991 - the first decline since 1980. Domestic car prices, in 1990 constant dollars, have been declining since 1989. In current dollars, the price gap between domestic and import cars rose to \$2,046 in 1991.*

**Table 2.22**  
**Average Price of a New Car, 1970-91**

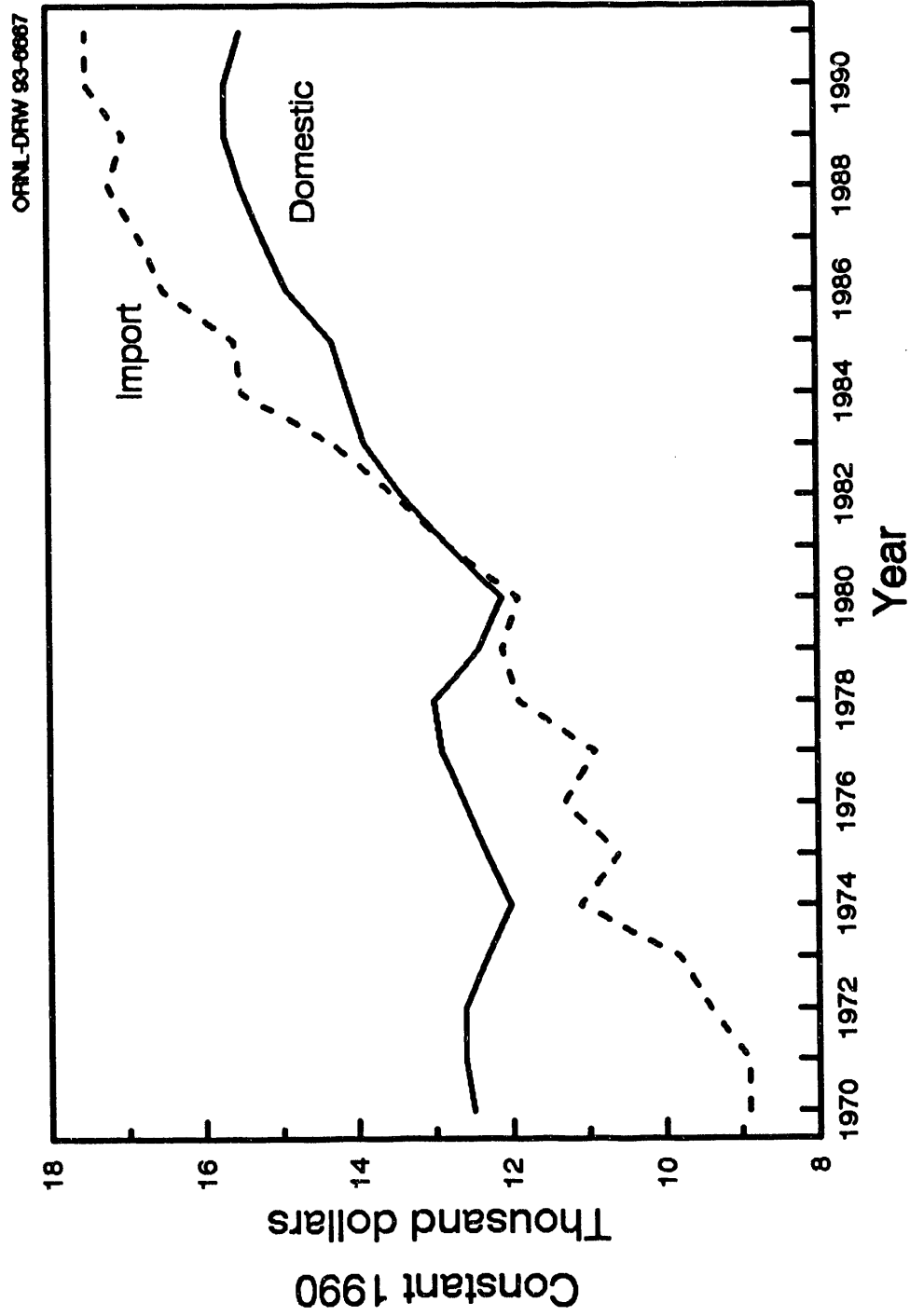
| Year                                    | Domestic        |                                    | Import          |                                    | Total           |                                    |
|---|-----------------|------------------------------------|-----------------|------------------------------------|-----------------|------------------------------------|
|   | Current dollars | Constant 1990 dollars <sup>a</sup> | Current dollars | Constant 1990 dollars <sup>a</sup> | Current dollars | Constant 1990 dollars <sup>a</sup> |
| 1970                                    | 3,708           | 12,479                             | 2,648           | 8,912                              | 3,542           | 11,920                             |
| 1971                                    | 3,919           | 12,645                             | 2,769           | 8,935                              | 3,742           | 12,074                             |
| 1972                                    | 4,034           | 12,601                             | 2,994           | 9,352                              | 3,879           | 12,117                             |
| 1973                                    | 4,181           | 12,295                             | 3,344           | 9,834                              | 4,052           | 11,915                             |
| 1974                                    | 4,524           | 11,988                             | 4,206           | 11,146                             | 4,440           | 11,766                             |
| 1975                                    | 5,084           | 12,344                             | 4,384           | 10,645                             | 4,950           | 12,019                             |
| 1976                                    | 5,506           | 12,640                             | 4,923           | 11,301                             | 5,418           | 12,438                             |
| 1977                                    | 5,985           | 12,906                             | 5,072           | 10,938                             | 5,814           | 12,538                             |
| 1978                                    | 6,478           | 12,976                             | 5,934           | 11,886                             | 6,379           | 12,778                             |
| 1979                                    | 6,889           | 12,403                             | 6,704           | 12,070                             | 6,847           | 12,327                             |
| 1980                                    | 7,609           | 12,067                             | 7,482           | 11,886                             | 7,574           | 12,012                             |
| 1981                                    | 8,912           | 12,805                             | 8,896           | 12,782                             | 8,910           | 12,802                             |
| 1982                                    | 9,865           | 13,356                             | 9,957           | 13,480                             | 9,890           | 13,390                             |
| 1983                                    | 10,559          | 13,850                             | 10,873          | 14,262                             | 10,640          | 13,956                             |
| 1984                                    | 11,172          | 14,056                             | 12,354          | 15,543                             | 11,450          | 14,405                             |
| 1985                                    | 11,733          | 14,253                             | 12,875          | 15,640                             | 12,022          | 14,604                             |
| 1986                                    | 12,526          | 14,929                             | 13,815          | 16,465                             | 12,894          | 15,368                             |
| 1987                                    | 13,239          | 15,223                             | 14,602          | 16,790                             | 13,657          | 15,703                             |
| 1988                                    | 14,029          | 15,498                             | 15,537          | 17,164                             | 14,468          | 15,983                             |
| 1989                                    | 14,937          | 15,746                             | 16,126          | 16,999                             | 15,278          | 16,105                             |
| 1990                                    | 15,682          | 15,682                             | 17,543          | 17,543                             | 16,148          | 16,148                             |
| 1991                                    | 16,152          | 15,490                             | 18,198          | 17,452                             | 16,700          | 16,015                             |
| <i>Average annual percentage change</i> |                 |                                    |                 |                                    |                 |                                    |
| 1970-91                                 | 7.3%            | 1.0%                               | 9.6%            | 3.3%                               | 7.7%            | 1.4%                               |
| 1982-91                                 | 5.6%            | 1.7%                               | 6.9%            | 2.9%                               | 6.0%            | 2.0%                               |

**Source:**

Motor Vehicle Manufacturer's Association, Motor Vehicle Facts and Figures '92, Detroit, MI, 1992, p.53.

<sup>a</sup>Adjusted by the Consumer Price Inflation Index.

Figure 2.15. Average Price of New Cars, 1970-91



Source: See Table 2.22.

*The total cost of operating an automobile is the sum of the fixed cost (depreciation, insurance, finance charge, and license fee) and the variable cost, which is related to the amount of travel. The cost of operating a car in 1991 was approximately 42 cents per mile. From 1985 to 1991 the fixed costs have risen an average of 5.7% per year while the variable costs have declined at an average annual rate of 0.6%.*

**Table 2.23**  
**Automobile Operating Costs, 1975-91**

| Year <sup>a</sup> | Variable costs (Constant 1990 cents per mile <sup>b</sup> ) |                                      |             | Constant 1990 dollars per 10,000 miles <sup>c</sup> |               |                    | Total cost per mile <sup>d</sup><br>(Constant 1990 cents <sup>e</sup> ) |
|-------------------|---|--------------------------------------|-------------|---|---------------|--------------------|---|
|                   | Gas and oil   | Percentage gas and oil of total cost | Maintenance | Tires   | Variable cost | Fixed cost         | Total cost  |
| 1975              | 11.70   | 26.3%                                | 2.36        | 1.60  | 1,566         | 2,880              | 4,446   |
| 1977              | 8.86  | 20.3%                                | 2.22        | 1.42  | 1,251         | 3,103              | 4,354   |
| 1979              | 7.40  | 17.1%                                | 1.98        | 1.17  | 1,055         | 3,260              | 4,315   |
| 1980              | 9.29  | 21.0%                                | 1.78        | 1.01  | 1,208         | 3,224              | 4,433   |
| 1981              | 9.01  | 19.6%                                | 1.70        | 1.03  | 1,174         | 3,413              | 4,586   |
| 1982              | 9.12  | 21.5%                                | 1.35        | 0.97  | 1,133         | 3,145              | 4,243   |
| 1983              | 8.71  | 19.9%                                | 1.36        | 0.89  | 1,097         | 3,287              | 4,384   |
| 1984              | 7.79  | 19.8%                                | 1.31        | 0.79  | 989           | 2,952              | 3,940   |
| 1985              | 7.48  | 22.6%                                | 1.49        | 0.79  | 977           | 2,328 <sup>d</sup> | 3,304 <sup>d</sup>  |
| 1986              | 5.34  | 15.1%                                | 1.63        | 0.80  | 777           | 2,750 <sup>d</sup> | 3,527 <sup>d</sup>  |
| 1987              | 5.52  | 14.7%                                | 1.84        | 0.92  | 828           | 2,925 <sup>d</sup> | 3,753 <sup>d</sup>  |
| 1988              | 5.74  | 15.6%                                | 1.77        | 0.88  | 840           | 2,851 <sup>d</sup> | 3,691 <sup>d</sup>  |
| 1989              | 5.48  | 13.6%                                | 2.00        | 0.84  | 833           | 3,194 <sup>d</sup> | 4,027 <sup>d</sup>  |
| 1990              | 5.40  | 13.2%                                | 2.10        | 0.90  | 840           | 3,256 <sup>d</sup> | 4,096 <sup>d</sup>  |
| 1991              | 6.43  | 15.4%                                | 2.11        | 0.86  | 940           | 3,245 <sup>d</sup> | 4,185 <sup>d</sup>  |
|                   | <i>Average annual percentage change</i>                     |                                      |             |   |               |                    |   |
| 1975-84           | -4.4%   |                                      | -6.3%       | -7.5%   | -5.0%         | 0.3%               | -1.3%   |
| 1985-91           | -2.5%   |                                      | 6.0%        | 1.4%  | -0.6%         | 5.7%               | 4.0%  |

Source:

American Automobile Association, "Your Driving Costs," 1992 Edition, Falls Church, VA, and annual.

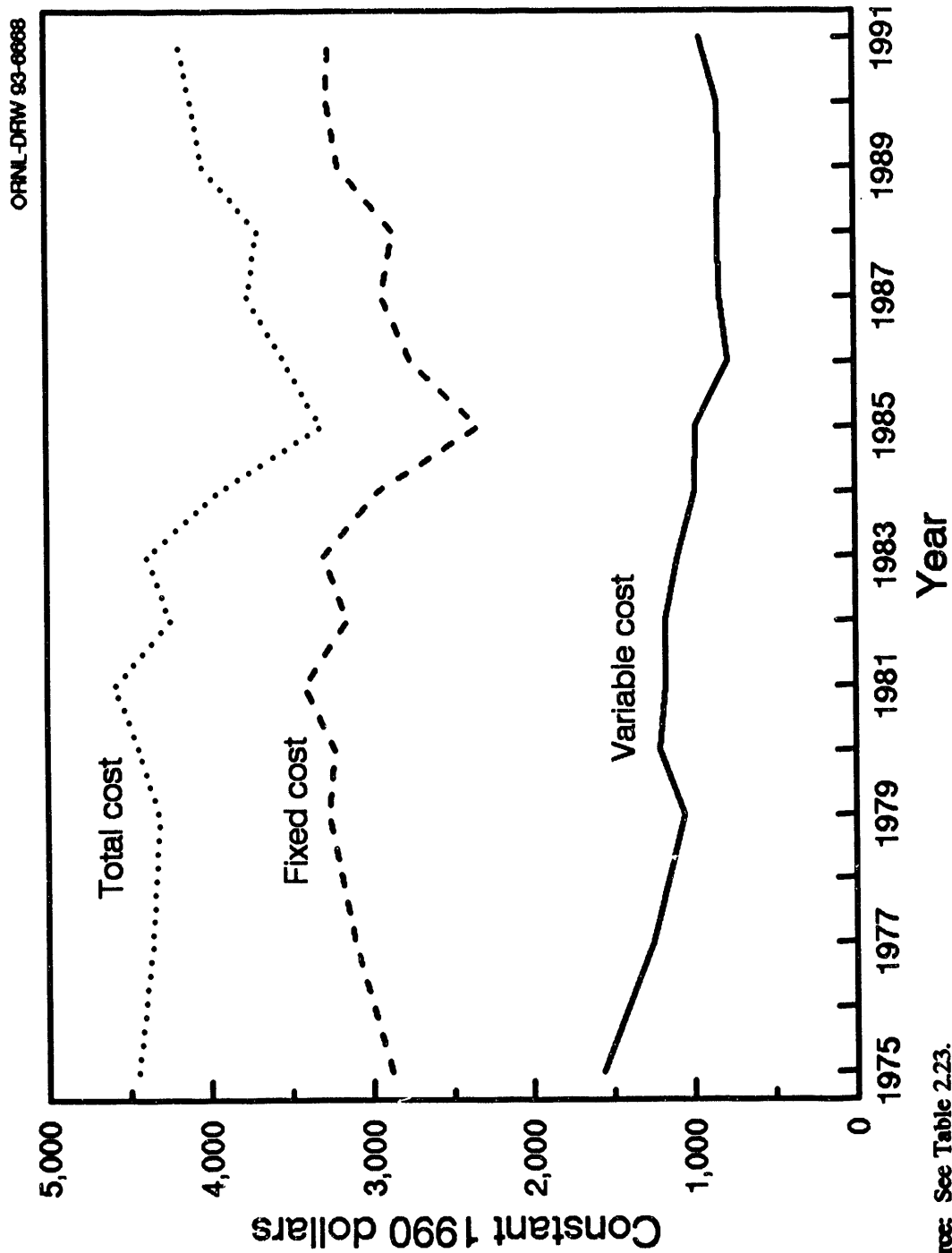
<sup>a</sup>Adjusted by the Consumer Price Inflation Index.

<sup>b</sup>Based on 10,000 miles per year.

<sup>c</sup>Data for 1976 and 1978 are not available.

<sup>d</sup>Fixed and total operating costs from 1985-90 are not comparable with figures before 1985. Fixed cost depreciation from 1975-84 was based on four years or 60,000 miles. After 1984, the depreciation was based on six years or 60,000 miles.

Figure 2.16. Automobile Operating Costs, 1975-91\*



\*Fixed and total operating costs from 1985-91 are not comparable with figures before 1985. Fixed cost depreciation from 1975-84 was based on four years or 60,000 miles. After 1984, the depreciation was based on six years or 60,000 miles.

## CHAPTER 3

### HIGHWAY MODE

This chapter presents data on highway transportation and is organized into eight sections. The first Section compares data for all types of highway transportation modes. Section 3.2 presents statistics on automobiles. Truck data are presented in Section 3.3, bus data in Section 3.4, and fleet data in Section 3.5. Federal regulations and standards on fuel economy are included in Section 3.6. Section 3.7 reports data on vehicle emissions. High-occupancy vehicle (HOV) lanes are the subject of Section 3.8.

Highway energy use represented 77.1% of transportation energy use in 1990. Of the highway modes, automobiles<sup>a</sup> had the greatest share of energy use, 41.6% (Table 3.1). The automobiles<sup>a</sup> were also responsible for the majority of vehicle miles traveled in 1990. Light trucks with two axles and four tires have experienced a rapid increase in vehicle miles traveled, an average of 6.9% annually from 1970 to 1990 (Table 3.2).

Automobile sales declined in 1991 to 8.2 million autos, dropping below 9 million for the first time since 1982. Imports accounted for 24.9% of sales in 1991, declining from a high of 31.1% in 1987 (Table 3.9). Fuel economy for the automobile population has increased from 13.5 miles per gallon in 1970 to 20.9 miles per gallon in 1990 (Table 3.12). As the older autos are scrapped, they are replaced with newer, more fuel efficient autos which help to raise the population fuel economy. The sales-weighted fuel economy for new automobiles remained at 27.6 mpg for 1990 and 1991 sales periods, as well as the first six months of the 1992 sales period (Table 3.18).

Truck travel data are based mainly on the Truck Inventory and Use Survey (TIUS) conducted by the U.S. Bureau of the Census. As part of the nation's economic surveys, TIUS is required by law to be conducted every 5 years for the years ending in 2 and 7 to provide data on the physical and operational characteristics of the nation's truck population. The survey is based on a probability sample of private and commercial trucks registered (or licensed) in each state. The most recent survey was conducted in 1987. In addition to trucks, the following types of vehicles were also included in the 1987 survey: minivans, vans, station wagons, and jeep-like vehicles. The 1977 and 1982 surveys did not

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<sup>a</sup>Motorcycles are also included in this category.

include those vehicle types. The estimated number of trucks that were within the scope of the TIUS and registered in the U.S. as of July 1, 1987 was 44.6 million. These trucks were estimated to have been driven a total of 529,315 million miles during 1987, an increase of 40.3% from 1982. The average annual miles traveled per truck was estimated at 11,900 miles.

School and other non-revenue buses accounted for more than 81% of all 1990 buses in operation, but accounted for only 38% of bus energy use (Tables 3.29 and 3.32). School buses have been the most efficient bus type on a vehicle-mile basis since 1970 (Table 3.32). Intercity buses travel more miles per bus than transit or school buses (Table 3.31).

Although the average Corporate Average Fuel Economy (CAFE) of automobiles and light trucks has met the CAFE standard each year except 1984, there are still manufacturers who fall short of meeting the standard. The domestic automobile CAFE estimate did not meet the 1992 standard, but the import estimate exceeded the standard, pulling the combined automobile CAFE estimate above the standard (Table 3.36). The fines collected for model year 1991 violations totalled more than 47 million dollars (Table 3.37). Since 1986 the Gas Guzzler tax has been assessed on automobiles with a fuel economy rating of less than 22.5 miles per gallon. These tax rates, which remained constant from 1986 to 1990, doubled in 1991 (Table 3.39).

The Federal emission control requirements for automobiles, light trucks, and heavy trucks can be found in Section 3.7. These requirements were set by the Clean Air Act of 1990 (Tables 3.42 - 3.44). Because of the wide use of unleaded gasoline, the transportation sector's share of lead emissions declined from a high of 87.9% in 1978 to 31% in 1990 (Table 3.45). The California Air Resources Board has declared emission standards for California vehicles. In order to meet these standards it is suggested that ten percent of the manufacturer's fleet in 1992 should be transitional low-emission vehicles, which have more stringent standards than conventional vehicles. Low-emission vehicles and ultra-low emission vehicles should then be phased into the fleet in 1997 (Table 3.46). As many as 10% of the manufacturer's fleet in the year 2003 should be zero-emission vehicles in order to meet the emission standards.

## **Section 3.1. Highway Vehicle Characteristics**

**Table 3.1**  
**Highway Energy Use by Mode, 1970-90**

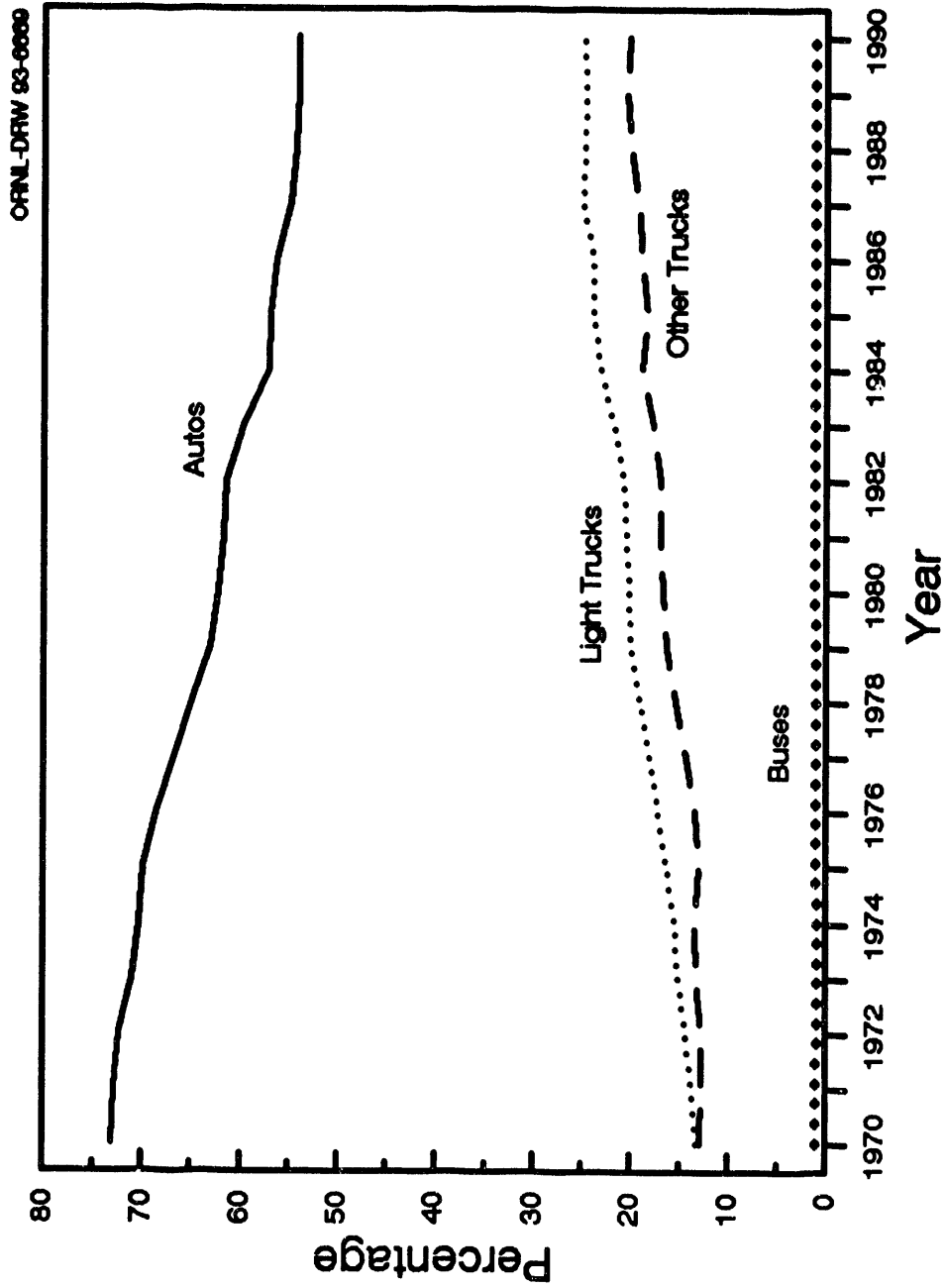
| Year | Autos <sup>a</sup>    | Buses | Light trucks | Other trucks | Total highway | Transportation energy use <sup>b</sup><br>(trillion Btu) |
|------|-----------------------|-------|--------------|--------------|---------------|--|
|      | (percentage of total) |       |              |              |               |  |
| 1970 | 55.8%                 | 0.7%  | 10.1%        | 9.8%         | 76.3%         | 15,305   |
| 1971 | 56.5%                 | 0.7%  | 10.6%        | 9.9%         | 77.6%         | 15,907   |
| 1972 | 56.6%                 | 0.6%  | 11.2%        | 9.9%         | 78.3%         | 16,949   |
| 1973 | 55.6%                 | 0.6%  | 11.8%        | 10.4%        | 78.4%         | 17,813   |
| 1974 | 55.3%                 | 0.7%  | 12.2%        | 10.5%        | 78.7%         | 17,088   |
| 1975 | 55.5%                 | 0.7%  | 12.9%        | 10.3%        | 79.5%         | 17,329   |
| 1976 | 54.6%                 | 0.7%  | 13.7%        | 10.6%        | 79.6%         | 18,389   |
| 1977 | 53.1%                 | 0.7%  | 14.4%        | 11.3%        | 79.4%         | 19,071   |
| 1978 | 51.3%                 | 0.7%  | 15.0%        | 12.1%        | 79.1%         | 20,035   |
| 1979 | 48.5%                 | 0.7%  | 15.4%        | 12.5%        | 77.0%         | 20,101   |
| 1980 | 46.9%                 | 0.7%  | 15.3%        | 12.6%        | 75.5%         | 19,317   |
| 1981 | 47.0%                 | 0.8%  | 15.5%        | 12.9%        | 76.2%         | 19,065   |
| 1982 | 47.5%                 | 0.8%  | 16.0%        | 13.1%        | 77.4%         | 18,589   |
| 1983 | 46.9%                 | 0.8%  | 17.1%        | 13.9%        | 78.6%         | 18,728   |
| 1984 | 44.7%                 | 0.8%  | 18.1%        | 14.7%        | 78.3%         | 19,310   |
| 1985 | 44.2%                 | 0.8%  | 18.5%        | 14.9%        | 78.4%         | 19,659   |
| 1986 | 44.2%                 | 0.8%  | 18.7%        | 14.9%        | 78.5%         | 20,229   |
| 1987 | 42.9%                 | 0.8%  | 19.5%        | 15.2%        | 78.3%         | 20,704   |
| 1988 | 42.3%                 | 0.8%  | 19.3%        | 15.5%        | 77.9%         | 21,278   |
| 1989 | 42.0%                 | 0.8%  | 19.2%        | 15.9%        | 77.9%         | 21,598   |
| 1990 | 41.6%                 | 0.8%  | 19.1%        | 15.6%        | 77.1%         | 21,778   |

**Source:**

See Appendix A for Table 2.10.

<sup>a</sup>Includes motorcycles.<sup>b</sup>Does not include off-highway and military transportation energy use.

Figure 3.1. Percentages of Highway Energy Use by Mode, 1970-90



Source: See Table 3.1.

*Although automobiles continued to be responsible for the majority of highway travel, two-axle, four-tire trucks had the fastest average growth in vehicle miles for 1970-90 and 1982-90.*

**Table 3.2**  
**Highway Vehicle Miles Traveled by Mode, 1970-90**  
(million miles)

| Year                                    | Automobiles <sup>a</sup> | Buses <sup>b</sup> | Two-axle,<br>four-tire<br>trucks | Other<br>single-unit<br>trucks | Combination<br>trucks | Total     |
|---|--------------------------|--------------------|----------------------------------|--------------------------------|-----------------------|-----------|
| 1970                                    | 919,679                  | 4,544              | 123,286                          | 27,081                         | 35,134                | 1,109,724 |
| 1971                                    | 969,947                  | 4,792              | 137,870                          | 28,985                         | 37,217                | 1,178,811 |
| 1972                                    | 1,025,696                | 5,348              | 156,622                          | 31,414                         | 40,706                | 1,259,786 |
| 1973                                    | 1,051,175                | 5,792              | 176,833                          | 33,661                         | 45,649                | 1,313,110 |
| 1974                                    | 1,012,696                | 5,684              | 182,757                          | 33,441                         | 45,966                | 1,280,544 |
| 1975                                    | 1,039,579                | 6,055              | 200,700                          | 34,606                         | 46,724                | 1,327,664 |
| 1976                                    | 1,084,218                | 6,258              | 225,834                          | 36,390                         | 49,680                | 1,402,380 |
| 1977                                    | 1,115,592                | 5,823              | 250,591                          | 39,339                         | 55,682                | 1,467,027 |
| 1978                                    | 1,153,666                | 5,885              | 279,414                          | 42,747                         | 62,992                | 1,544,704 |
| 1979                                    | 1,122,277                | 5,947              | 291,905                          | 42,012                         | 66,992                | 1,529,133 |
| 1980                                    | 1,121,810                | 6,059              | 290,935                          | 39,813                         | 68,678                | 1,527,295 |
| 1981                                    | 1,141,517                | 6,241              | 296,343                          | 39,568                         | 69,134                | 1,552,803 |
| 1982                                    | 1,176,166                | 5,823              | 306,141                          | 40,212                         | 66,668                | 1,595,010 |
| 1983                                    | 1,206,783                | 5,199              | 327,643                          | 43,409                         | 69,754                | 1,652,788 |
| 1984                                    | 1,233,703                | 4,640              | 357,999                          | 46,560                         | 77,367                | 1,720,269 |
| 1985                                    | 1,269,651                | 4,876              | 373,072                          | 46,980                         | 79,600                | 1,774,179 |
| 1986                                    | 1,312,921                | 5,087              | 389,123                          | 48,413                         | 82,696                | 1,838,240 |
| 1987                                    | 1,364,836                | 5,318              | 415,449                          | 49,537                         | 86,064                | 1,921,204 |
| 1988                                    | 1,439,603                | 5,466              | 439,496                          | 51,239                         | 90,158                | 2,025,962 |
| 1989                                    | 1,488,140                | 5,659              | 454,339                          | 52,969                         | 95,349                | 2,096,456 |
| 1990                                    | 1,524,942                | 5,728              | 466,827                          | 53,522                         | 96,482                | 2,147,501 |
| <i>Average annual percentage change</i> |                          |                    |                                  |                                |                       |           |
| 1970-90                                 | 2.6%                     | 1.2%               | 6.9%                             | 3.5%                           | 5.2%                  | 3.4%      |
| 1982-90                                 | 3.3%                     | -0.2%              | 5.4%                             | 3.6%                           | 4.7%                  | 3.8%      |

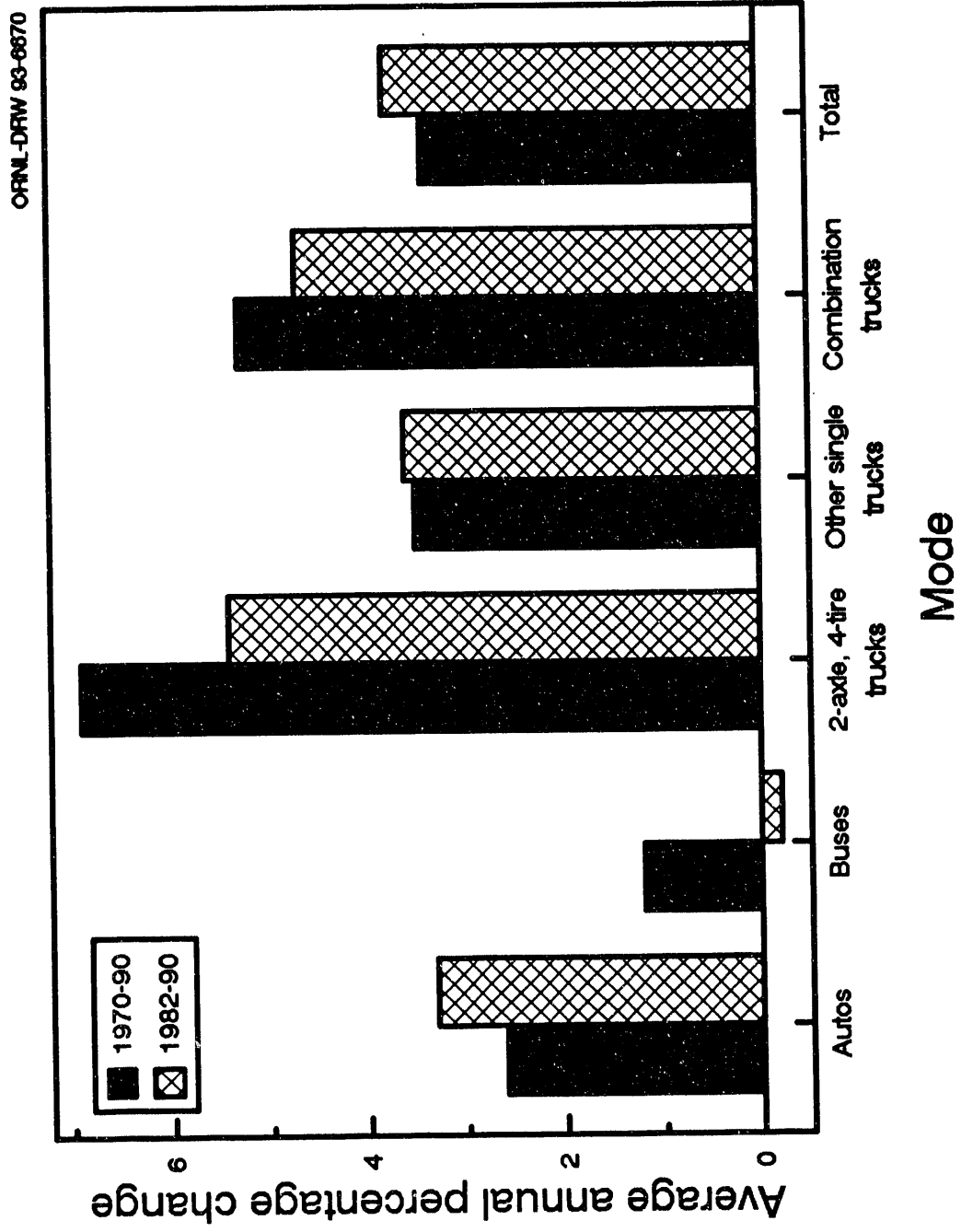
**Source:**

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table VM-1, p.192, and annual.

<sup>a</sup>Includes motorcycles.

<sup>b</sup>The data do not correspond with vehicle miles of travel presented in the Bus section of this chapter due to differing data sources.

Figure 3.2. Annual Growth Rates of Highway Vehicle Miles Traveled by Mode, 1970-90 and 1982-90



Source: See Table 3.2.

**Table 3.3**  
**Vehicle Stock and New Sales in United States, 1990 Calendar Year\***

|                              | Vehicle Stock <sup>b</sup><br>(thousands) | New Sales               |                                    |                       |
|------------------------------|---|-------------------------|------------------------------------|-----------------------|
|                              |   | Domestic<br>(thousands) | Import <sup>c</sup><br>(thousands) | Total<br>(thousands)  |
| <b>Autos<sup>d</sup></b>     | <b>123,276</b>                            | <b>6,897 (74.2%)</b>    | <b>2,404 (25.8%)</b>               | <b>9,301 (100.0%)</b> |
| Two seaters                  | 2,846                                     | 35 (20.1%)              | 139 (79.9%)                        | 174 (100.0%)          |
| Minicompact                  | 3,759                                     | 0 (0.0%)                | 82 (100.0%)                        | 82 (100.0%)           |
| Subcompact                   | 28,608                                    | 1,014 (50.2%)           | 1,007 (49.8%)                      | 2,021 (100.0%)        |
| Compact                      | 32,940                                    | 2,338 (73.4%)           | 846 (26.6%)                        | 3,184 (100.0%)        |
| Midsize                      | 35,079                                    | 2,214 (87.3%)           | 322 (12.7%)                        | 2,536 (100.0%)        |
| Large                        | 20,045                                    | 1,296 (99.3%)           | 9 (0.7%)                           | 1,305 (100.0%)        |
| Fleets of ten or more        | 8,188 <sup>e</sup>                        | f                       | f                                  | f                     |
| Personal autos               | 115,088                                   | f                       | f                                  | f                     |
| <b>Motorcycles</b>           | <b>4,259<sup>g</sup></b>                  | <b>140 (33.3%)</b>      | <b>322 (77.7%)</b>                 | <b>462 (100.0%)</b>   |
| <b>Recreational vehicles</b> | <b>56,023</b>                             | <b>354 (100.0%)</b>     | <b>0 (0.0%)</b>                    | <b>354 (100.0%)</b>   |
| <b>Trucks<sup>h</sup></b>    | <b>51,485</b>                             | <b>3,813 (87.4%)</b>    | <b>551 (12.6%)</b>                 | <b>4,364 (100.0%)</b> |
| Light                        | 1,289                                     | 3,595 (87.2%)           | 527 (12.8%)                        | 4,122 (100.0%)        |
| Medium                       | 1,289                                     | 33 (68.8%)              | 15 (31.3%)                         | 48 (100.0%)           |
| Light-heavy                  | 952                                       | 19 (82.6%)              | 4 (17.4%)                          | 23 (100.0%)           |
| Heavy-heavy                  | 2,297                                     | 166 (97.1%)             | 5 (2.9%)                           | 171 (100.0%)          |

Source:

See Appendix A for Table 3.3

\*Totals may not equal sum of components due to rounding.

<sup>b</sup>Vehicle stock as of July 1.

<sup>c</sup>Includes domestic-sponsored imports.

<sup>d</sup>These figures represent only those automobiles that could be matched to the Environmental Protection Agency size classes.

<sup>e</sup>Federal Government fleet data for 1990 were not available; therefore, the 1990 data were assumed<sup>g</sup> to be equal to the 1988 Federal Government fleet figures.

<sup>f</sup>Data are not available.

<sup>g</sup>Includes mostly on-highway motorcycles. Many states do not require registration for off-highway vehicles.

<sup>h</sup>Trucks are classified by gross vehicle weight as follows:

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

Both the Federal Highway Administration (FHWA) and R. L. Polk and Company report figures on the automobile and truck population. The two estimates, however, differ by as much as 18.1% for trucks. The differences can be attributed to several factors.

(1) The FHWA data include all vehicles which have been registered at any time throughout the calendar year. Therefore, the data include vehicles which were retired during the year and may double count vehicles which have been registered twice in different or the same states. The R. L. Polk data include only those vehicles which are registered on July 1 of the given year.

(2) In many states mini-vans, station wagons on truck chassis, and utility vehicles (e.g., jeep-like vehicles) are classified as passenger cars and are included in the FHWA automobile data. The R. L. Polk data include passenger vans in the automobile count until 1970; since 1980 all vans have been counted as trucks.

Table 3.4.  
Automobiles and Trucks in Use, 1970-1991  
(thousands)

| Years | Automobiles |            |                       | Trucks |            |                       | Total   |            |                       |
|-------|-------------|------------|-----------------------|--------|------------|-----------------------|---------|------------|-----------------------|
|       | FHWA        | R. L. Polk | Percentage Difference | FHWA   | R. L. Polk | Percentage Difference | FHWA    | R. L. Polk | Percentage Difference |
| 1970  | 89,244      | 80,448     | 11.0                  | 18,797 | 17,688     | 6.3                   | 108,041 | 98,136     | 10.1%                 |
| 1971  | 92,718      | 83,138     | 11.5                  | 19,871 | 18,462     | 7.6                   | 112,589 | 101,600    | 10.8%                 |
| 1972  | 97,082      | 86,439     | 12.3                  | 21,308 | 19,773     | 7.8                   | 118,390 | 106,212    | 11.5%                 |
| 1973  | 101,985     | 89,805     | 13.6                  | 23,244 | 21,412     | 8.6                   | 125,229 | 111,217    | 12.6%                 |
| 1974  | 104,856     | 92,608     | 13.2                  | 24,630 | 23,312     | 5.7                   | 129,486 | 115,920    | 11.7%                 |
| 1975  | 106,704     | 95,241     | 12.0                  | 25,781 | 24,813     | 3.9                   | 132,485 | 120,054    | 10.4%                 |
| 1976  | 110,189     | 97,818     | 12.6                  | 27,876 | 26,560     | 5.0                   | 138,065 | 124,378    | 11.0%                 |
| 1977  | 112,288     | 99,904     | 12.4                  | 29,314 | 28,222     | 3.7                   | 141,602 | 128,126    | 10.5%                 |
| 1978  | 116,573     | 102,957    | 13.2                  | 31,336 | 30,565     | 2.5                   | 147,909 | 133,522    | 10.8%                 |
| 1979  | 118,429     | 104,677    | 13.1                  | 32,914 | 32,583     | 1.0                   | 151,343 | 137,260    | 10.3%                 |
| 1980  | 121,601     | 104,564    | 16.3                  | 33,667 | 35,268     | -4.5                  | 155,268 | 139,832    | 11.0%                 |
| 1981  | 123,098     | 105,839    | 16.3                  | 34,644 | 36,069     | -4.0                  | 157,742 | 141,908    | 11.2%                 |
| 1982  | 123,902     | 106,867    | 15.9                  | 35,382 | 36,987     | -4.3                  | 159,284 | 143,854    | 10.7%                 |
| 1983  | 126,444     | 108,961    | 16.0                  | 36,723 | 38,143     | -3.7                  | 163,167 | 147,104    | 10.9%                 |
| 1984  | 128,158     | 112,019    | 14.4                  | 37,507 | 40,143     | -6.6                  | 165,665 | 152,162    | 8.9%                  |
| 1985  | 131,864     | 114,662    | 15.0                  | 39,196 | 42,387     | -7.5                  | 171,060 | 157,049    | 8.9%                  |
| 1986  | 135,431     | 117,268    | 15.5                  | 40,069 | 44,826     | -10.6                 | 175,500 | 162,094    | 8.3%                  |
| 1987  | 137,208     | 119,849    | 14.5                  | 41,144 | 47,344     | -13.1                 | 178,352 | 167,193    | 6.7%                  |
| 1988  | 141,252     | 121,519    | 16.2                  | 42,529 | 50,221     | -15.3                 | 183,781 | 171,740    | 7.0%                  |
| 1989  | 143,026     | 122,758    | 16.5                  | 43,609 | 53,202     | -18.0                 | 186,635 | 175,960    | 6.1%                  |
| 1990  | 143,550     | 123,276    | 16.4                  | 44,479 | 56,023     | -20.6                 | 188,029 | 179,299    | 4.9%                  |
| 1991  | *           | 123,268    | *                     | *      | 58,170     | *                     | *       | 181,438    | *                     |

**Sources:**

FHWA - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table VM-1, p. 192, and annual. R. L. Polk - R. L. Polk and Company, Detroit, Michigan. **FURTHER REPRODUCTION PROHIBITED.**

\*Data are not available.

*The average age of automobiles continued to increase in 1991 after remaining steady from 1985 to 1989. The average age gap between autos and trucks in 1991 was 0.2 years, as it was in 1990. The median age for both autos and trucks rose in 1991.*

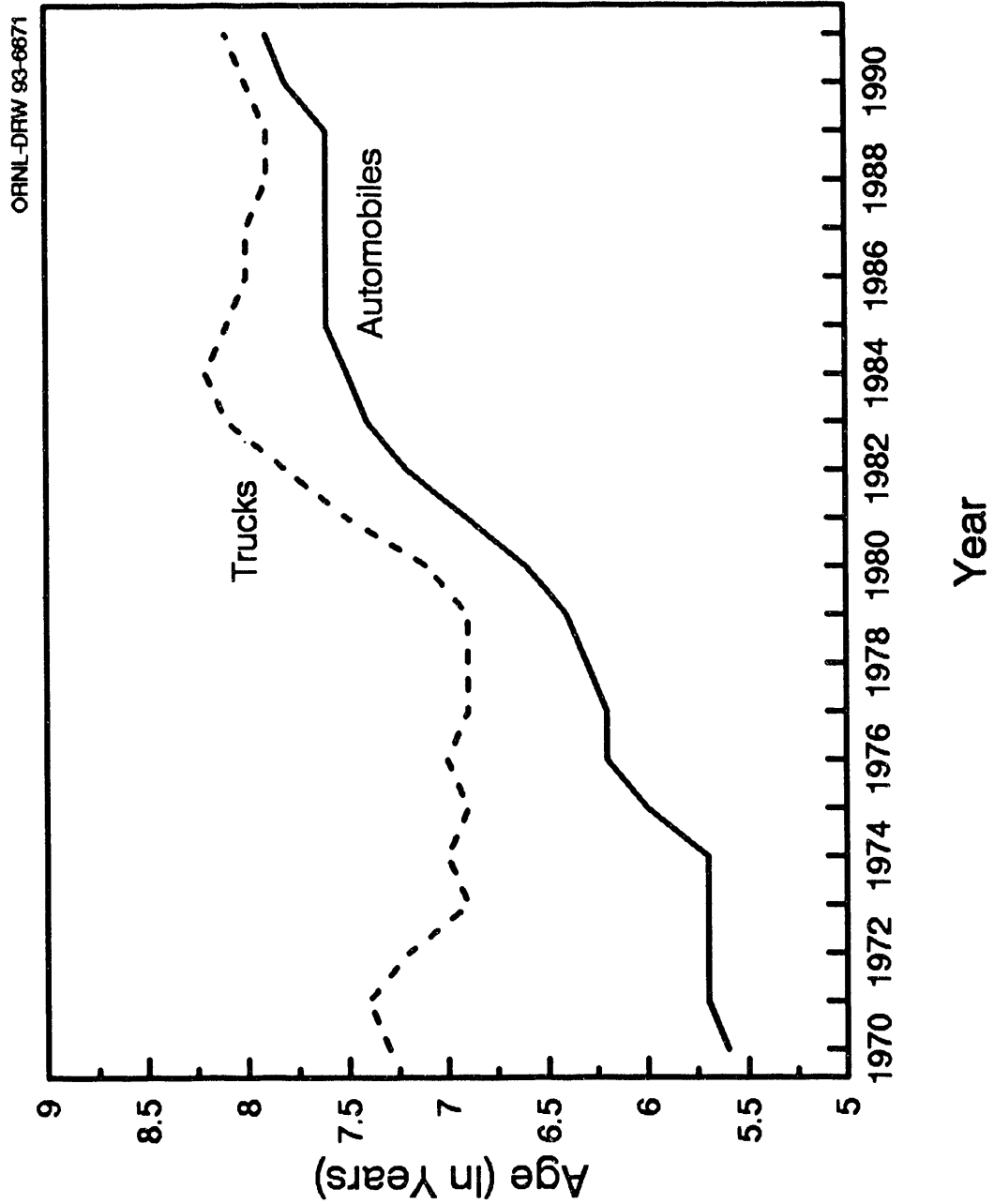
**Table 3.5**  
**Average Age of Automobiles and Trucks in Use, 1970-1991**  
**(years)**

| Calendar<br>year | Automobiles |        | Trucks |        |
|------------------|-------------|--------|--------|--------|
|                  | Mean        | Median | Mean   | Median |
| 1970             | 5.6         | 4.9    | 7.3    | 5.9    |
| 1971             | 5.7         | 5.1    | 7.4    | 6.1    |
| 1972             | 5.7         | 5.1    | 7.2    | 6.0    |
| 1973             | 5.7         | 5.1    | 6.9    | 5.8    |
| 1974             | 5.7         | 5.2    | 7.0    | 5.6    |
| 1975             | 6.0         | 5.4    | 6.9    | 5.8    |
| 1976             | 6.2         | 5.5    | 7.0    | 5.8    |
| 1977             | 6.2         | 5.6    | 6.9    | 5.7    |
| 1978             | 6.3         | 5.7    | 6.9    | 5.8    |
| 1979             | 6.4         | 5.9    | 6.9    | 5.9    |
| 1980             | 6.6         | 6.0    | 7.1    | 6.3    |
| 1981             | 6.9         | 6.0    | 7.5    | 6.5    |
| 1982             | 7.2         | 6.2    | 7.8    | 6.8    |
| 1983             | 7.4         | 6.5    | 8.1    | 7.2    |
| 1984             | 7.5         | 6.7    | 8.2    | 7.4    |
| 1985             | 7.6         | 6.9    | 8.1    | 7.6    |
| 1986             | 7.6         | 7.0    | 8.0    | 7.7    |
| 1987             | 7.6         | 6.9    | 8.0    | 7.8    |
| 1988             | 7.6         | 6.8    | 7.9    | 7.1    |
| 1989             | 7.6         | 6.5    | 7.9    | 6.7    |
| 1990             | 7.8         | 6.5    | 8.0    | 6.5    |
| 1991             | 7.9         | 6.7    | 8.1    | 6.8    |

**Source:**

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

Figure 3.3. Average Age of Automobiles and Trucks in Use, 1970-91



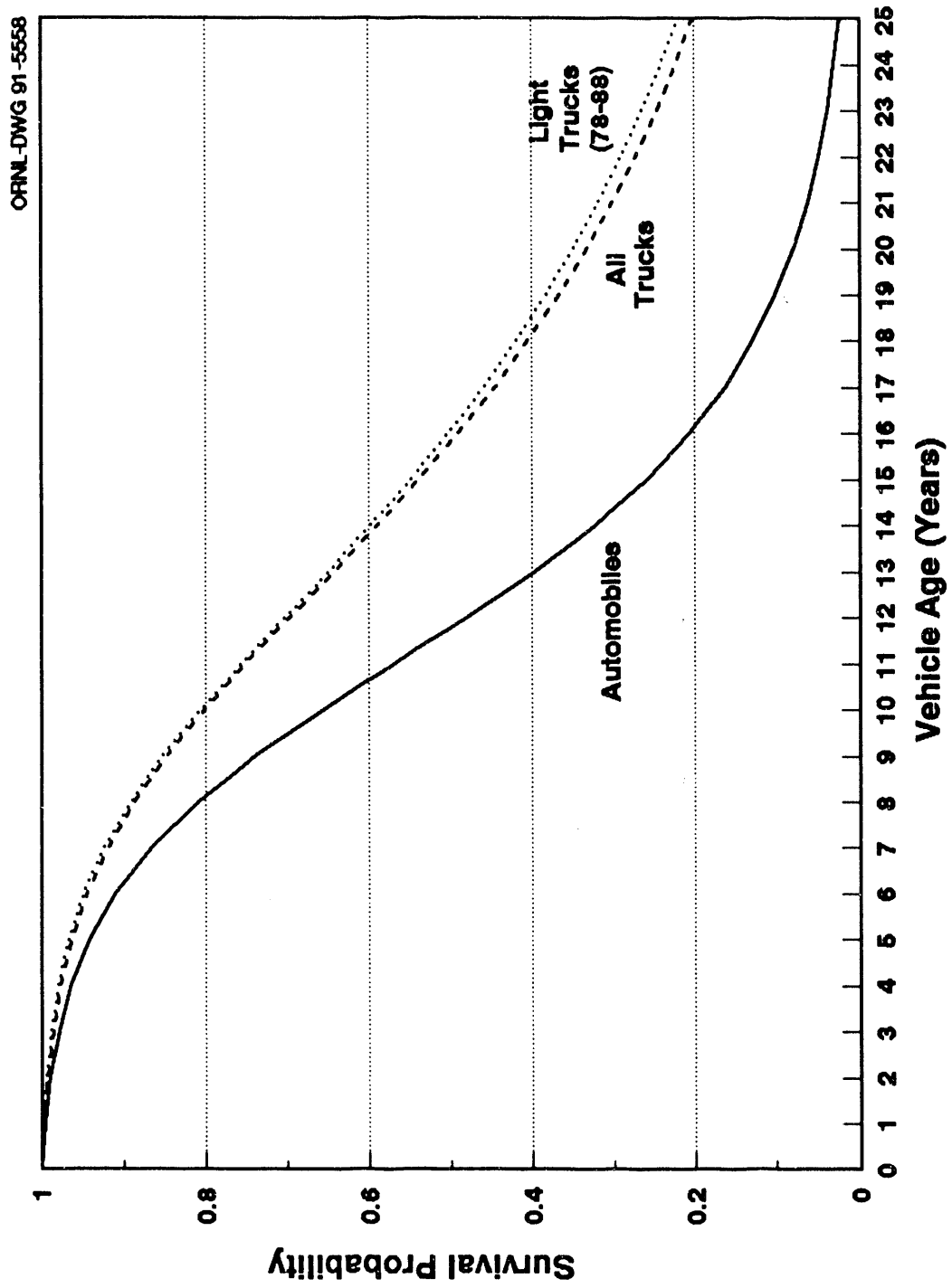
**Table 3.6**  
**Scrapage and Survival Rates for Automobiles,**  
**All Trucks, and Light Trucks**

| Vehicle<br>Age<br>(Years) | Automobiles<br>(1978-89) |                  | All Trucks<br>(1978-89) |                  | Light Trucks<br>(1978-88) |                  |
|---------------------------|--------------------------|------------------|-------------------------|------------------|---------------------------|------------------|
|                           | Scrapage<br>Rate         | Survival<br>Rate | Scrapage<br>Rate        | Survival<br>Rate | Scrapage<br>Rate          | Survival<br>Rate |
| 0                         | 0.00000                  | 1.00000          | 0.00000                 | 1.00000          | 0.00000                   | 1.00000          |
| 1                         | 0.00441                  | 0.99559          | 0.00312                 | 0.99688          | 0.00249                   | 0.99751          |
| 2                         | 0.00674                  | 0.98888          | 0.00461                 | 0.99228          | 0.00383                   | 0.99369          |
| 3                         | 0.01025                  | 0.97874          | 0.00676                 | 0.98557          | 0.00583                   | 0.98790          |
| 4                         | 0.01546                  | 0.96361          | 0.00980                 | 0.97591          | 0.00877                   | 0.97923          |
| 5                         | 0.02303                  | 0.94142          | 0.01399                 | 0.96226          | 0.01296                   | 0.96654          |
| 6                         | 0.03368                  | 0.90971          | 0.01957                 | 0.94343          | 0.01869                   | 0.94848          |
| 7                         | 0.04803                  | 0.86602          | 0.02663                 | 0.91830          | 0.02606                   | 0.92376          |
| 8                         | 0.06629                  | 0.80861          | 0.03507                 | 0.88609          | 0.03488                   | 0.89154          |
| 9                         | 0.08790                  | 0.73753          | 0.04445                 | 0.84671          | 0.04454                   | 0.85182          |
| 10                        | 0.11137                  | 0.65539          | 0.05408                 | 0.80092          | 0.05416                   | 0.80569          |
| 11                        | 0.13460                  | 0.56717          | 0.06320                 | 0.75030          | 0.06285                   | 0.75505          |
| 12                        | 0.15557                  | 0.47894          | 0.07121                 | 0.69687          | 0.07006                   | 0.70215          |
| 13                        | 0.17300                  | 0.39608          | 0.07776                 | 0.64268          | 0.07562                   | 0.64905          |
| 14                        | 0.18650                  | 0.32221          | 0.08285                 | 0.58944          | 0.07967                   | 0.59734          |
| 15                        | 0.19641                  | 0.25893          | 0.08662                 | 0.53838          | 0.08251                   | 0.54805          |
| 16                        | 0.20339                  | 0.20626          | 0.08932                 | 0.49029          | 0.08443                   | 0.50178          |
| 17                        | 0.20818                  | 0.16332          | 0.09122                 | 0.44557          | 0.08571                   | 0.45877          |
| 18                        | 0.21140                  | 0.12880          | 0.09253                 | 0.40434          | 0.08655                   | 0.41907          |
| 19                        | 0.21353                  | 0.10130          | 0.09343                 | 0.36656          | 0.08710                   | 0.38257          |
| 20                        | 0.21493                  | 0.07952          | 0.09403                 | 0.33209          | 0.08745                   | 0.34911          |
| 21                        | 0.21585                  | 0.06236          | 0.09444                 | 0.30073          | 0.08768                   | 0.31850          |
| 22                        | 0.21644                  | 0.04886          | 0.09471                 | 0.27225          | 0.08783                   | 0.29052          |
| 23                        | 0.21683                  | 0.03827          | 0.09490                 | 0.24641          | 0.08793                   | 0.26498          |
| 24                        | 0.21708                  | 0.02996          | 0.09502                 | 0.22300          | 0.08799                   | 0.24166          |
| 25                        | 0.21724                  | 0.02345          | 0.09510                 | 0.20179          | 0.08803                   | 0.22039          |

**Source:**

Miaou, Shaw-Pin, "Study of Vehicle Scrapage Rates," Oak Ridge National Laboratory,  
 Oak Ridge, TN, August 1990.

Figure 3.4. Survival Probabilities of Automobiles, All Trucks, and Light Trucks



Source: See Table 3.6.

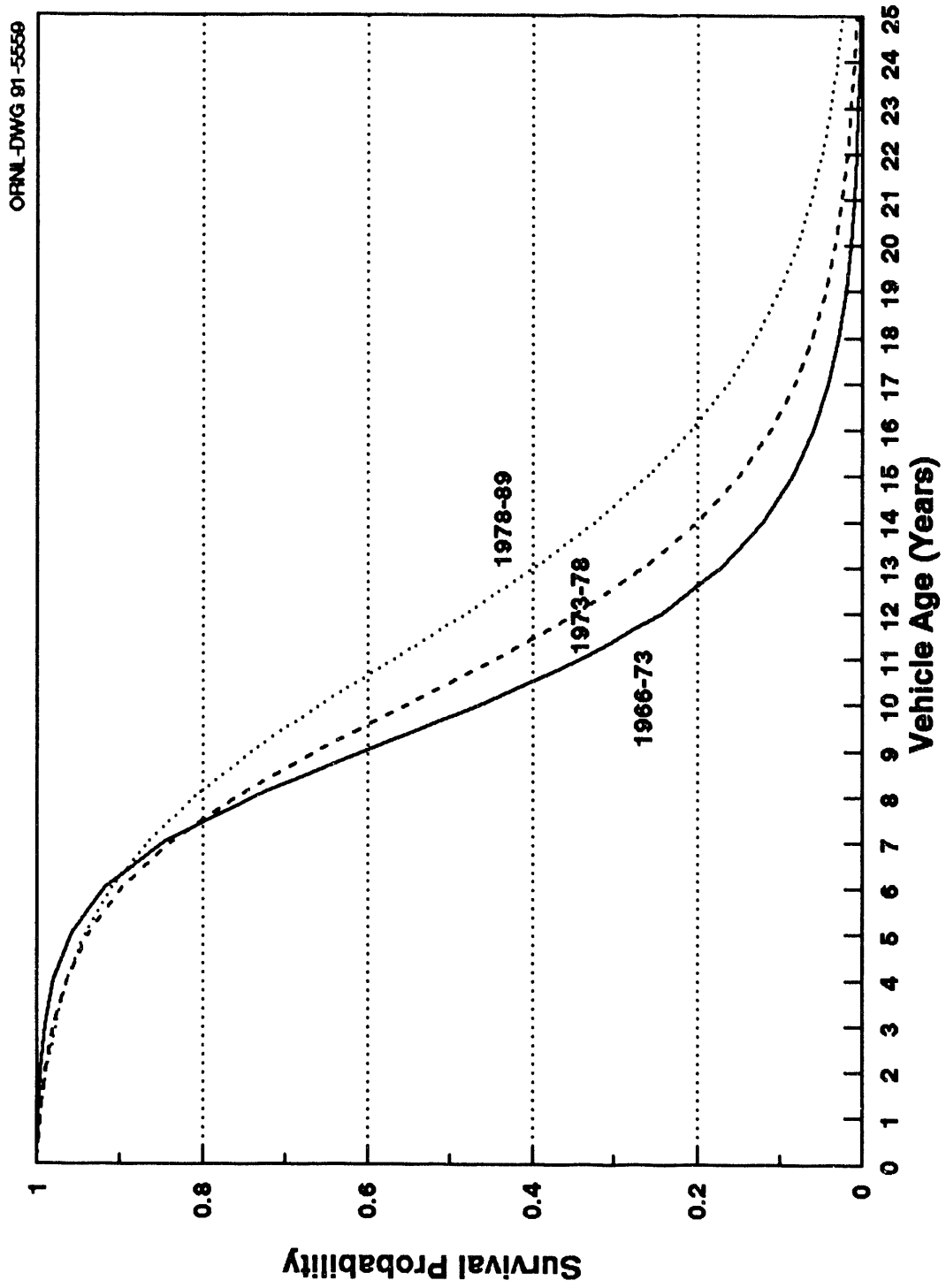
**Table 3.7**  
**Scrapage and Survival Rates for Automobiles**

| Vehicle<br>Age<br>(Years) | (1966-73)        |                  | (1973-78)        |                  | (1978-89)        |                  |
|---------------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                           | Scrapage<br>Rate | Survival<br>Rate | Scrapage<br>Rate | Survival<br>Rate | Scrapage<br>Rate | Survival<br>Rate |
| 0                         | 0.00000          | 1.00000          | 0.00000          | 1.00000          | 0.00000          | 1.00000          |
| 1                         | 0.00115          | 0.99885          | 0.00347          | 0.99653          | 0.00441          | 0.99559          |
| 2                         | 0.00244          | 0.99641          | 0.00589          | 0.99065          | 0.00674          | 0.98888          |
| 3                         | 0.00513          | 0.99130          | 0.00993          | 0.98082          | 0.01025          | 0.97874          |
| 4                         | 0.01069          | 0.98070          | 0.01656          | 0.96457          | 0.01546          | 0.96361          |
| 5                         | 0.02182          | 0.95931          | 0.02714          | 0.93839          | 0.02303          | 0.94142          |
| 6                         | 0.04283          | 0.91822          | 0.04329          | 0.89778          | 0.03368          | 0.90971          |
| 7                         | 0.07844          | 0.84619          | 0.06633          | 0.83822          | 0.04803          | 0.86602          |
| 8                         | 0.12895          | 0.73707          | 0.09627          | 0.75753          | 0.06629          | 0.80861          |
| 9                         | 0.18510          | 0.60064          | 0.13071          | 0.65851          | 0.08790          | 0.73753          |
| 10                        | 0.23288          | 0.46076          | 0.16524          | 0.54970          | 0.11137          | 0.65539          |
| 11                        | 0.26512          | 0.33860          | 0.19538          | 0.44230          | 0.13460          | 0.56717          |
| 12                        | 0.28362          | 0.24257          | 0.21867          | 0.34558          | 0.15557          | 0.47894          |
| 13                        | 0.29327          | 0.17143          | 0.23503          | 0.26436          | 0.17300          | 0.39608          |
| 14                        | 0.29804          | 0.12034          | 0.24577          | 0.19939          | 0.18650          | 0.32221          |
| 15                        | 0.30034          | 0.08420          | 0.25251          | 0.14904          | 0.19641          | 0.25893          |
| 16                        | 0.30144          | 0.05882          | 0.25662          | 0.11079          | 0.20339          | 0.20626          |
| 17                        | 0.30196          | 0.04106          | 0.25908          | 0.08209          | 0.20818          | 0.16332          |
| 18                        | 0.30221          | 0.02865          | 0.26054          | 0.06070          | 0.21140          | 0.12880          |
| 19                        | 0.30232          | 0.01999          | 0.26140          | 0.04483          | 0.21353          | 0.10130          |
| 20                        | 0.30238          | 0.01394          | 0.26190          | 0.03309          | 0.21493          | 0.07952          |
| 21                        | 0.30240          | 0.00973          | 0.26220          | 0.02442          | 0.21585          | 0.06236          |
| 22                        | 0.30241          | 0.00679          | 0.26237          | 0.01801          | 0.21644          | 0.04886          |
| 23                        | 0.30242          | 0.00473          | 0.26247          | 0.01328          | 0.21683          | 0.03827          |
| 24                        | 0.30242          | 0.00330          | 0.26253          | 0.00980          | 0.21708          | 0.02996          |
| 25                        | 0.30242          | 0.00230          | 0.26257          | 0.00722          | 0.21724          | 0.02345          |

**Source:**

Miaou, Shaw-Pin, "Study of Vehicle Scrapage Rates," Oak Ridge National Laboratory, Oak Ridge, TN, August 1990.

Figure 3.5. Survival Probabilities of Automobiles



Source: See Table 3.7.

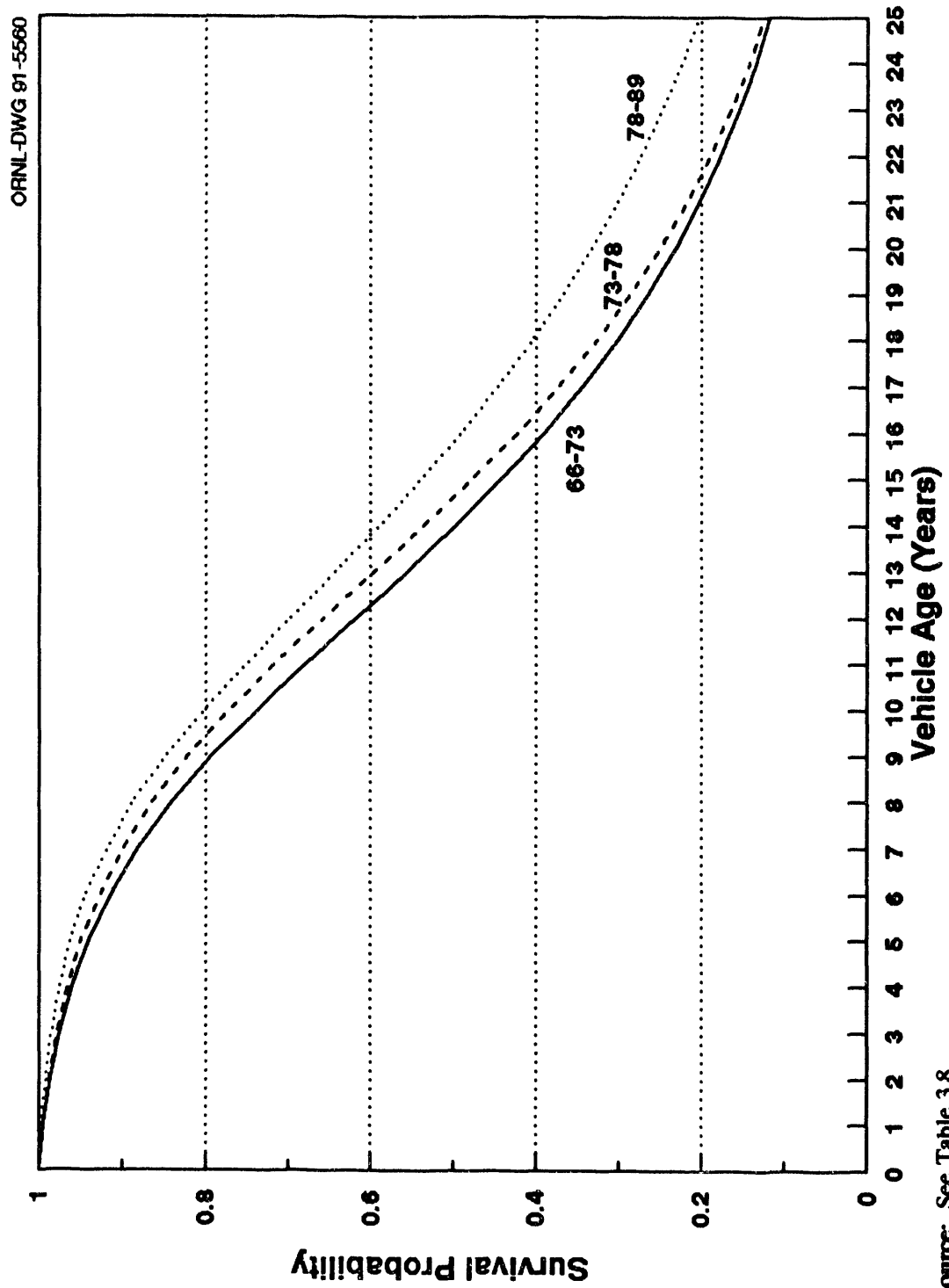
**Table 3.8.**  
**Scrappage and Survival Rates for All Trucks**

| Vehicle<br>Age<br>(Years) | (1966-73)         |                  | (1973-78)         |                  | (1978-89)         |                  |
|---------------------------|-------------------|------------------|-------------------|------------------|-------------------|------------------|
|                           | Scrappage<br>Rate | Survival<br>Rate | Scrappage<br>Rate | Survival<br>Rate | Scrappage<br>Rate | Survival<br>Rate |
| 0                         | 0.00000           | 1.00000          | 0.00000           | 1.00000          | 0.00000           | 1.00000          |
| 1                         | 0.00582           | 0.99418          | 0.00505           | 0.99495          | 0.00312           | 0.99688          |
| 2                         | 0.00814           | 0.98608          | 0.00698           | 0.98801          | 0.00461           | 0.99228          |
| 3                         | 0.01129           | 0.97495          | 0.00958           | 0.97854          | 0.00676           | 0.98557          |
| 4                         | 0.01550           | 0.95983          | 0.01306           | 0.96576          | 0.00980           | 0.97591          |
| 5                         | 0.02101           | 0.93967          | 0.01762           | 0.94873          | 0.01399           | 0.96226          |
| 6                         | 0.02798           | 0.91337          | 0.02347           | 0.92647          | 0.01957           | 0.94343          |
| 7                         | 0.03649           | 0.88005          | 0.03073           | 0.89800          | 0.02663           | 0.91830          |
| 8                         | 0.04638           | 0.83923          | 0.03943           | 0.86260          | 0.03507           | 0.88609          |
| 9                         | 0.05730           | 0.79114          | 0.04940           | 0.81999          | 0.04445           | 0.84671          |
| 10                        | 0.06863           | 0.73685          | 0.06026           | 0.77058          | 0.05408           | 0.80092          |
| 11                        | 0.07970           | 0.67812          | 0.07147           | 0.71551          | 0.06320           | 0.75030          |
| 12                        | 0.08987           | 0.61718          | 0.08239           | 0.65656          | 0.07121           | 0.69687          |
| 13                        | 0.09872           | 0.55625          | 0.09247           | 0.59585          | 0.07776           | 0.64268          |
| 14                        | 0.10605           | 0.49726          | 0.10130           | 0.53548          | 0.08285           | 0.58944          |
| 15                        | 0.11189           | 0.44162          | 0.10871           | 0.47727          | 0.08662           | 0.53838          |
| 16                        | 0.11638           | 0.39023          | 0.11468           | 0.42254          | 0.08932           | 0.49029          |
| 17                        | 0.11976           | 0.34349          | 0.11936           | 0.37210          | 0.09122           | 0.44557          |
| 18                        | 0.12225           | 0.30150          | 0.12294           | 0.32636          | 0.09253           | 0.40434          |
| 19                        | 0.12406           | 0.26410          | 0.12562           | 0.28536          | 0.09343           | 0.36656          |
| 20                        | 0.12536           | 0.23099          | 0.12761           | 0.24894          | 0.09403           | 0.33209          |
| 21                        | 0.12629           | 0.20182          | 0.12906           | 0.21681          | 0.09444           | 0.30073          |
| 22                        | 0.12696           | 0.17620          | 0.13012           | 0.18860          | 0.09471           | 0.27225          |
| 23                        | 0.12743           | 0.15374          | 0.13089           | 0.16392          | 0.09490           | 0.24641          |
| 24                        | 0.12776           | 0.13410          | 0.13144           | 0.14237          | 0.09502           | 0.22300          |
| 25                        | 0.12799           | 0.11694          | 0.13183           | 0.12360          | 0.09510           | 0.20179          |

**Source:**

Miaou, Shaw-Pin, "Study of Vehicle Scrappage Rates," Oak Ridge National Laboratory,  
Oak Ridge, TN, August 1990.

Figure 3.6. Survival Probabilities of All Trucks



## **Section 3.2. Automobiles**

*Although the import share of total retail automobile sales dropped to 24.9% in 1991, the percentage of transplant sales increased by nearly 3% in the same time period. Total sales in 1991 dropped below 9 million for the first time since 1982.*

**Table 3.9**  
**New Retail Automobile Sales in the United States, 1970-91**

| Calendar year                           | Domestic | Import <sup>a</sup><br>(thousands) | Total  | Percentage import | Percentage transplants <sup>b</sup> on model year basis | Percentage imports and transplants | Percentage diesel |
|---|----------|------------------------------------|--------|-------------------|---|------------------------------------|-------------------|
| 1970                                    | 7,119    | 1,285                              | 8,404  | 15.3              | c   | c                                  | c                 |
| 1971                                    | 8,681    | 1,568                              | 10,249 | 15.3              | c   | c                                  | 0.06              |
| 1972                                    | 9,327    | 1,623                              | 10,950 | 14.8              | c   | c                                  | 0.05              |
| 1973                                    | 9,676    | 1,763                              | 11,439 | 15.4              | c   | c                                  | 0.06              |
| 1974                                    | 7,454    | 1,399                              | 8,853  | 15.8              | c   | c                                  | 0.20              |
| 1975                                    | 7,053    | 1,571                              | 8,624  | 18.2              | c   | c                                  | 0.31              |
| 1976                                    | 8,611    | 1,499                              | 10,110 | 14.8              | 0.0   | 14.8                               | 0.22              |
| 1977                                    | 9,109    | 2,074                              | 11,183 | 18.5              | 0.0   | 18.5                               | 0.34              |
| 1978                                    | 9,312    | 2,002                              | 11,314 | 17.7              | 0.0   | 17.7                               | 1.02              |
| 1979                                    | 8,341    | 2,332                              | 10,673 | 21.8              | 1.3   | 23.1                               | 2.54              |
| 1980                                    | 6,581    | 2,398                              | 8,979  | 26.7              | 2.1   | 28.8                               | 4.31              |
| 1981                                    | 6,209    | 2,327                              | 8,536  | 27.3              | 1.8   | 29.1                               | 6.10              |
| 1982                                    | 5,759    | 2,223                              | 7,982  | 27.9              | 1.4   | 29.3                               | 4.44              |
| 1983                                    | 6,795    | 2,387                              | 9,182  | 26.0              | 1.3   | 27.3                               | 2.09              |
| 1984                                    | 7,952    | 2,439                              | 10,391 | 23.5              | 2.0   | 25.5                               | 1.45              |
| 1985                                    | 8,205    | 2,838                              | 11,043 | 25.7              | 2.2   | 27.9                               | 0.82              |
| 1986                                    | 8,215    | 3,238                              | 11,453 | 28.3              | 2.8   | 31.1                               | 0.37              |
| 1987                                    | 7,081    | 3,197                              | 10,278 | 31.1              | 5.2   | 36.3                               | 0.16              |
| 1988                                    | 7,526    | 3,099                              | 10,626 | 29.2              | 5.8   | 35.0                               | 0.01              |
| 1989                                    | 7,073    | 2,825                              | 9,898  | 28.5              | 7.3   | 35.8                               | 0.13              |
| 1990                                    | 6,897    | 2,404                              | 9,301  | 25.8              | 11.2  | 37.0                               | 0.08              |
| 1991                                    | 6,137    | 2,038                              | 8,175  | 24.9              | 13.7  | 38.6                               | 0.13              |
| <i>Average annual percentage change</i> |          |                                    |        |                   |   |                                    |                   |
| 1970-91                                 | -0.7%    | 2.2%                               | -0.1%  |                   |   |                                    |                   |
| 1982-91                                 | 0.7%     | -1.0%                              | 0.3%   |                   |   |                                    |                   |

**Sources:**

Domestic and import data - Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '92, Detroit, MI, 1992, p. 16, and annual.

Diesel data - H. A. Stark (ed), Ward's Communications, Inc., Ward's Automotive Yearbook, Detroit, MI, 1992, p. 57, and annual.

Transplant data - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares Data System, Oak Ridge, TN, 1992

<sup>a</sup>Does not include import tourist deliveries.

<sup>b</sup>A transplant is an automobile which was built in the U.S. by a foreign firm. Also included are joint ventures which are built in the U.S.

<sup>c</sup>Data are not available.

*Compared to 1970, the automobile population has shifted toward older automobiles in 1991. Fifty percent of the automobile population in 1970 was 4.9 years old or older while half of the automobile population in 1990 was 6.7 years old or older. The percent of cars 10 years old and older has nearly tripled from 11.7% in 1970 to 30.7% in 1991.*

**Table 3.10**  
**Automobiles in Use by Age, 1970 and 1991**

| Age<br>(years)             | 1970                    |                      |                          | 1991                    |                      |                          |
|----------------------------|-------------------------|----------------------|--------------------------|-------------------------|----------------------|--------------------------|
|                            | Vehicles<br>(thousands) | Actual<br>percentage | Cumulative<br>percentage | Vehicles<br>(thousands) | Actual<br>percentage | Cumulative<br>percentage |
| Under 1 <sup>a</sup>       | 6,288                   | 7.8                  | 7.8                      | 5,763                   | 4.7                  | 4.7                      |
| 1                          | 9,299                   | 11.6                 | 19.4                     | 8,696                   | 7.1                  | 11.7                     |
| 2                          | 8,816                   | 11.0                 | 30.3                     | 9,713                   | 7.9                  | 19.6                     |
| 3                          | 7,878                   | 9.8                  | 40.1                     | 10,124                  | 8.2                  | 27.8                     |
| 4                          | 8,538                   | 10.6                 | 50.8                     | 10,049                  | 8.1                  | 36.0                     |
| 5                          | 8,506                   | 10.6                 | 61.3                     | 10,214                  | 8.3                  | 44.2                     |
| 6                          | 7,116                   | 8.8                  | 70.2                     | 9,732                   | 7.9                  | 52.1                     |
| 7                          | 6,268                   | 7.8                  | 78.0                     | 9,208                   | 7.5                  | 59.6                     |
| 8                          | 5,058                   | 6.3                  | 84.3                     | 6,543                   | 5.3                  | 64.9                     |
| 9                          | 3,267                   | 4.1                  | 88.3                     | 5,721                   | 4.6                  | 69.5                     |
| 10                         | 2,776                   | 3.5                  | 91.8                     | 5,673                   | 4.6                  | 74.1                     |
| 11                         | 1,692                   | 2.1                  | 93.9                     | 5,326                   | 4.3                  | 78.5                     |
| 12                         | 799                     | 1.0                  | 94.9                     | 5,743                   | 4.7                  | 83.1                     |
| 13                         | 996                     | 1.2                  | 96.1                     | 4,891                   | 4.0                  | 87.1                     |
| 14                         | 794                     | 1.0                  | 97.1                     | 3,759                   | 3.0                  | 90.1                     |
| 15 and older               | 2,336                   | 2.9                  | 100.0                    | 12,167                  | 9.9                  | 100.0                    |
| Subtotal                   | 80,427                  | 100.0                |                          | 123,322                 | 100.0                |                          |
| Age not given <sup>b</sup> | 22                      |                      |                          | 6                       |                      |                          |
| Total                      | 80,449                  |                      |                          | 123,328                 |                      |                          |
| Average age                |                         | 5.55                 |                          |                         | 7.91                 |                          |
| Median age                 |                         | 4.93                 |                          |                         | 6.73                 |                          |

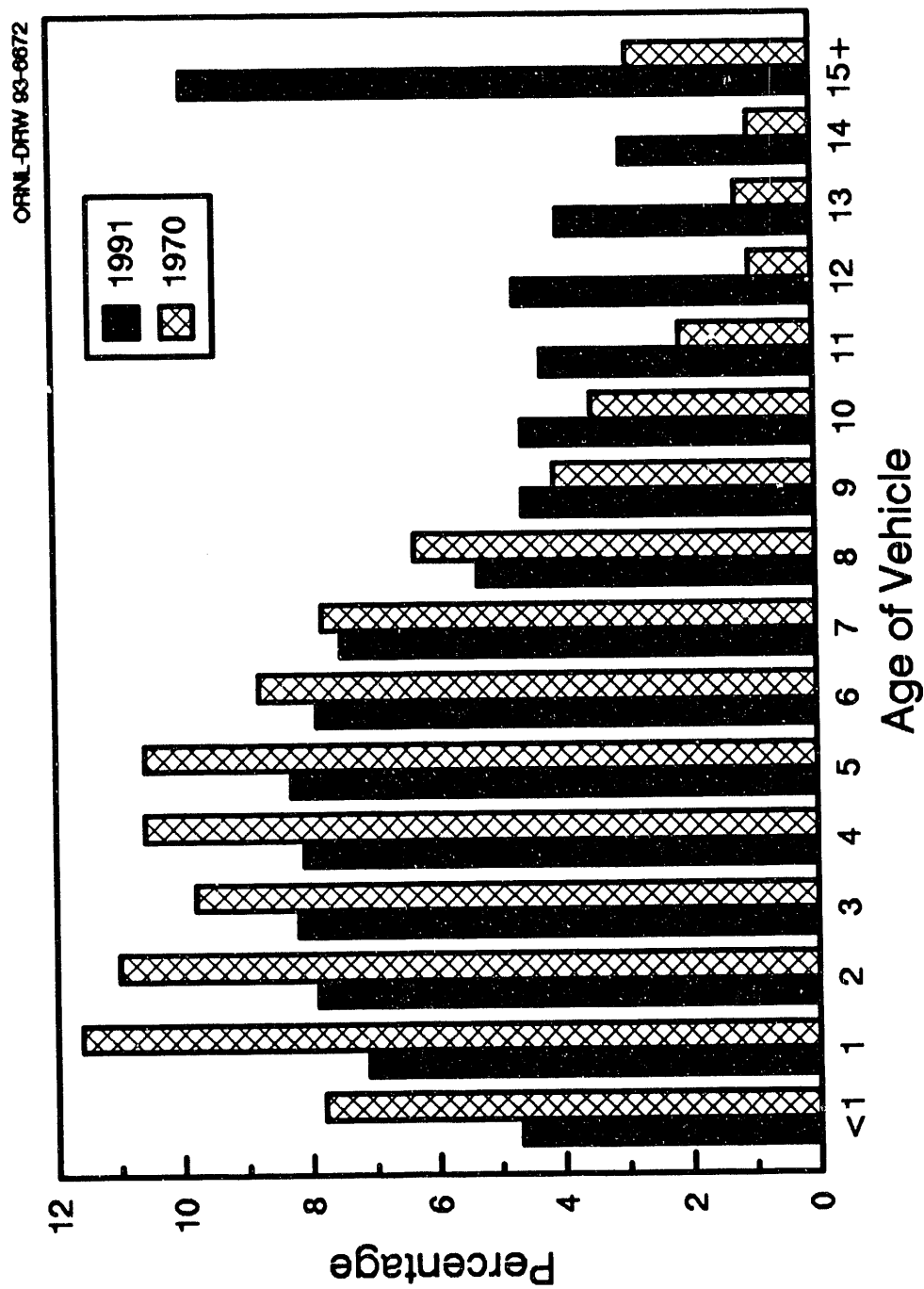
**Source:**

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

<sup>a</sup>Automobiles sold as of July 1 of each year.

<sup>b</sup>Approximately 22,000 automobiles in 1970 and 6,000 in 1991 could not be classified by age.

Figure 3.7. Automobiles in Use by Age, 1970 and 1991



Source: See Table 3.10.

*In 1991, automobiles 5 years old and younger accounted for 53% of all automobile travel. Although 70% of all automobiles in operation in 1991 were less than 10 years old, those autos were responsible for 78% of automobile travel.*

**Table 3.11**  
**Automobiles in Operation**  
**and Vehicle Travel by Age of Vehicle, 1991**

| Vehicle age (years)        | Number in operation  |                   |                       | Estimated vehicle travel |                       |
|----------------------------|----------------------|-------------------|-----------------------|--------------------------|-----------------------|
|                            | Vehicles (thousands) | Actual percentage | Cumulative percentage | Actual percentage        | Cumulative percentage |
| Under 1 <sup>a</sup>       | 5,763                | 4.7               | 4.7                   | 5.9                      | 5.9                   |
| 1                          | 8,696                | 7.1               | 11.7                  | 9.3                      | 15.2                  |
| 2                          | 9,713                | 7.9               | 19.6                  | 9.8                      | 25.0                  |
| 3                          | 10,124               | 8.2               | 27.8                  | 9.8                      | 34.7                  |
| 4                          | 10,049               | 8.1               | 36.0                  | 9.2                      | 44.0                  |
| 5                          | 10,214               | 8.3               | 44.2                  | 8.6                      | 52.6                  |
| 6                          | 9,732                | 7.9               | 52.1                  | 8.4                      | 61.0                  |
| 7                          | 9,208                | 7.5               | 59.6                  | 7.3                      | 68.3                  |
| 8                          | 6,543                | 5.3               | 64.9                  | 5.4                      | 73.7                  |
| 9                          | 5,721                | 4.6               | 69.5                  | 4.1                      | 77.8                  |
| 10                         | 5,673                | 4.6               | 74.1                  | 4.1                      | 81.8                  |
| 11                         | 5,326                | 4.3               | 78.5                  | 3.6                      | 85.4                  |
| 12                         | 5,743                | 4.7               | 83.1                  | 3.6                      | 89.0                  |
| 13                         | 4,891                | 4.0               | 87.1                  | 2.9                      | 91.9                  |
| 14                         | 3,759                | 3.0               | 90.1                  | 2.2                      | 94.1                  |
| 15 and older               | 12,167               | 9.9               | 100.0                 | 5.9                      | 100.0                 |
| Subtotal                   | 123,322              | 100.0             |                       | 100.0                    |                       |
| Age not given <sup>b</sup> | 6                    |                   |                       |                          |                       |
| Total                      | 123,328              |                   |                       |                          |                       |

**Sources:**

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

Vehicle travel - Average annual miles per auto by age were multiplied by the number of vehicles in operation by age to estimate the vehicle travel. Average annual miles per auto by age - generated by ORNL from the 1988 Residential Transportation Energy Consumption Survey public use tape, provided by the U.S. Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division, 1990.

<sup>a</sup>Automobiles sold as of July 1, 1991.

<sup>b</sup>Approximately 6,000 automobiles could not be classified by age.

*While automobile registrations remained relatively the same from 1989 to 1990 (0.4% increase), automobile travel increased by 2.5% in this period. The fuel economy for the automobile population reached nearly 21 miles per gallon in 1990; as the older autos are scrapped, they are replaced by newer fuel efficient autos which raises the population fuel economy.*

**Table 3.12**  
**Summary Statistics for Passenger Cars, 1970-90**

| Year                                    | Registrations <sup>a</sup><br>(thousands) | Vehicle travel<br>(million miles) | Fuel use<br>(million gallons) | Fuel economy <sup>b</sup><br>(miles per gallon) |
|---|---|-----------------------------------|-------------------------------|---|
| 1970                                    | 89,244                                    | 916,700                           | 67,820                        | 13.5  |
| 1971                                    | 92,718                                    | 966,340                           | 71,351                        | 13.5  |
| 1972                                    | 97,082                                    | 1,021,365                         | 76,222                        | 13.4  |
| 1973                                    | 101,985                                   | 1,045,981                         | 78,668                        | 13.3  |
| 1974                                    | 104,856                                   | 1,007,251                         | 75,083                        | 13.4  |
| 1975                                    | 106,704                                   | 1,033,950                         | 76,447                        | 13.5  |
| 1976                                    | 110,189                                   | 1,078,215                         | 79,693                        | 13.5  |
| 1977                                    | 112,288                                   | 1,109,243                         | 80,397                        | 13.8  |
| 1978                                    | 116,573                                   | 1,146,508                         | 81,661                        | 14.0  |
| 1979                                    | 118,429                                   | 1,113,640                         | 77,304                        | 14.4  |
| 1980                                    | 121,601                                   | 1,111,596                         | 71,883                        | 15.5  |
| 1981                                    | 123,098                                   | 1,130,827                         | 70,954                        | 15.9  |
| 1982                                    | 123,902                                   | 1,166,256                         | 70,062                        | 16.7  |
| 1983                                    | 126,444                                   | 1,198,023                         | 69,906                        | 17.1  |
| 1984                                    | 128,158                                   | 1,224,919                         | 68,717                        | 17.8  |
| 1985                                    | 131,864                                   | 1,260,565                         | 69,268                        | 18.2  |
| 1986                                    | 135,431                                   | 1,301,214                         | 71,216                        | 18.3  |
| 1987                                    | 137,208                                   | 1,335,330                         | 70,573                        | 19.2  |
| 1988                                    | 141,252                                   | 1,429,579                         | 71,949                        | 19.9  |
| 1989                                    | 143,026                                   | 1,477,769                         | 72,749                        | 20.3  |
| 1990                                    | 143,550                                   | 1,515,370                         | 72,435                        | 20.9  |
| <i>Average annual percentage change</i> |   |                                   |                               |   |
| 1970-90                                 | 2.4%                                      | 2.5%                              | 0.3%                          | 2.2%  |
| 1982-90                                 | 1.9%                                      | 3.3%                              | 0.4%                          | 2.8%  |

**Source:**

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table VM-1, p. 192, and annual.

<sup>a</sup>This number differs from R. L. Polk's estimates of "number of automobiles in use." See Table 3.4.

<sup>b</sup>Fuel economy for automobile population.

*The data from the Nationwide Personal Transportation Study (NPTS) is based on estimates by survey respondents. The Residential Transportation Energy Consumption Survey (RTECS) data, which represents actual odometer readings of automobiles, has little bias from respondent estimations and, therefore, is the preferred data.*

**Table 3.13**  
**Average Annual Miles Per Automobile by Automobile Age**

| Vehicle age<br>(years) | Nationwide Personal<br>Transportation Study <sup>a</sup> |        |        |        | Residential Transportation<br>Energy Consumption Survey <sup>b</sup> |        |        |
|------------------------|--|--------|--------|--------|--|--------|--------|
|                        | 1969   | 1977   | 1983   | 1990   | 1983   | 1985   | 1988   |
| Under 1                | 17,500   | 11,800 | 14,200 | 19,800 | 13,400   | 12,700 | 12,900 |
| 1                      | 16,100   | 13,400 | 17,000 | 16,900 | 13,000   | 13,000 | 13,400 |
| 2                      | 13,200   | 13,400 | 14,000 | 16,300 | 12,700   | 12,600 | 12,600 |
| 3                      | 11,400   | 12,100 | 12,500 | 14,400 | 12,100   | 12,400 | 12,100 |
| 4                      | 11,700   | 11,300 | 11,400 | 13,800 | 11,300   | 11,100 | 11,500 |
| 5                      | 10,000   | 10,700 | 11,000 | 12,600 | 9,700  | 10,600 | 10,600 |
| 6                      | 10,300   | 10,500 | 9,900  | 12,900 | 9,700  | 10,000 | 10,800 |
| 7                      | 8,600  | 9,500  | 9,400  | 12,400 | 9,500  | 9,700  | 10,000 |
| 8                      | 10,900   | 8,600  | 8,700  | 12,300 | 8,700  | 8,900  | 10,300 |
| 9                      | 8,000  | 8,800  | 8,100  | 11,200 | 8,400  | 8,600  | 8,900  |
| 10 and older           | 6,500  | 7,100  | 6,900  | 9,300  | 8,700  | 8,400  | 7,500  |
| All vehicles           | 11,600   | 10,300 | 10,400 | 12,600 | 9,400  | 9,900  | 10,200 |

**Sources:**

Nationwide Personal Transportation Study - 1969-83: D. Klinger and J. Richard Kuzmyak, COMSIS Corporation, Personal Travel in the United States, Volume 1: 1983-84 Nationwide Personal Travel Study,<sup>a</sup> prepared for the U.S. Department of Transportation, Washington, DC, August 1986, Table 4-22, p. 4-21.

1990: U.S. Department of Transportation, Federal Highway Administration, Office of Highway Information Management, Nationwide Personal Transportation Study, Public Use Tape, 1991.

Residential Transportation Energy Consumption Survey - Energy Information Agency, Office of Markets and End Use, Energy End Use Division, 1983, 1985, and 1988 Residential Transportation Energy Consumption Survey, Public Use Tapes.

<sup>a</sup>Includes only auto vehicles (standard auto, station wagon, taxi, and van-bus/minibus) owned by or available to the household on a regular basis.

<sup>b</sup>Includes all household vehicles - automobiles, station wagons, pick-up trucks, vans, and utility vehicles.

*The average weight of the domestic automobile has been reduced 359 pounds from 1978 to 1992. Much of this weight reduction was due to the declining use of conventional steel and iron and the increasing use of aluminum and plastics. Conventional steel, however, remained the predominant component of automobiles in 1992 with a 44% share of total materials.*

**Table 3.14**  
**Average Material Consumption for a Domestic Automobile,**  
**1978, 1984, and 1992**

| Material            | 1978    |            | 1984    |            | 1992    |            |
|---------------------|---------|------------|---------|------------|---------|------------|
|                     | Pounds  | Percentage | Pounds  | Percentage | Pounds  | Percentage |
| Conventional steel  | 1,880.0 | 53.8       | 1,487.5 | 47.3       | 1,379.0 | 44.0       |
| High-strength steel | 127.5   | 3.6        | 214.0   | 6.8        | 247.0   | 7.9        |
| Stainless steel     | 25.0    | 0.7        | 29.0    | 0.9        | 41.5    | 1.3        |
| Other steels        | 56.0    | 1.6        | 45.0    | 1.4        | 42.0    | 1.3        |
| Iron                | 503.0   | 14.4       | 454.5   | 14.5       | 429.5   | 13.7       |
| Aluminum            | 112.0   | 3.2        | 137.0   | 4.4        | 173.5   | 5.5        |
| Rubber              | 141.5   | 4.1        | 133.5   | 4.2        | 133.0   | 4.2        |
| Plastics/Composites | 176.0   | 5.0        | 206.5   | 6.6        | 243.0   | 7.7        |
| Glass               | 88.0    | 2.5        | 87.0    | 2.8        | 88.0    | 2.8        |
| Copper              | 39.5    | 1.1        | 44.0    | 1.4        | 45.0    | 1.4        |
| Zinc die castings   | 28.0    | 0.8        | 17.0    | 0.5        | 16.0    | 0.5        |
| Power metal parts   | 16.0    | 0.5        | 18.5    | 0.6        | 25.0    | 0.8        |
| Fluids & lubricants | 189.0   | 5.4        | 180.0   | 5.7        | 177.0   | 5.6        |
| Other materials     | 112.5   | 3.2        | 88.0    | 2.8        | 96.0    | 3.1        |
| Total               | 3,494.0 | 100.0      | 3,141.5 | 100.0      | 3,135.5 | 100.0      |

**Source:**

H. A. Stark (ed), Ward's Communications, Inc., Wards Automotive Yearbook, Detroit, MI, 1992, p. 36, and annual.

**Table 3.15**  
**Sales-Weighted Engine Size of Domestic and Import Automobiles by Size Class,**  
**Sales Periods 1976-1992**  
**(cubic inches – 1 liter = 61.026 cubic inches)**

| <b>Model<br/>year</b> | <b>Minicompact</b> | <b>Subcompact</b> | <b>Compact</b> | <b>Midsize</b> | <b>Large</b> | <b>Two seater</b> | <b>Fleet</b> |
|-----------------------|--------------------|-------------------|----------------|----------------|--------------|-------------------|--------------|
| <b>76</b>             |                    | 163.1             | 304.9          | 357.0          | 414.2        | 176.2             | 298.5        |
| <b>77</b>             | 120.8              | 166.4             | 292.4          | 333.5          | 367.2        | 171.6             | 278.3        |
| <b>78</b>             | 125.5              | 162.8             | 241.0          | 298.6          | 376.3        | 183.8             | 264.4        |
| <b>79</b>             | 113.2              | 146.0             | 228.5          | 268.9          | 339.4        | 168.8             | 230.8        |
| <b>80</b>             | 115.8              | 128.2             | 184.8          | 237.9          | 312.3        | 170.0             | 196.5        |
| <b>81</b>             | 96.1               | 124.6             | 134.2          | 221.2          | 304.8        | 151.7             | 182.0        |
| <b>82</b>             | 93.5               | 127.2             | 129.3          | 212.0          | 288.4        | 147.2             | 176.1        |
| <b>83</b>             | 97.8               | 133.6             | 134.3          | 210.3          | 302.0        | 153.8             | 182.1        |
| <b>84</b>             | 132.7              | 135.3             | 135.1          | 207.3          | 297.1        | 152.4             | 181.2        |
| <b>85</b>             | 118.8              | 139.8             | 138.8          | 205.5          | 283.6        | 150.9             | 178.3        |
| <b>86</b>             | 88.4               | 133.6             | 134.6          | 194.9          | 267.3        | 172.5             | 168.3        |
| <b>87</b>             | 90.2               | 133.4             | 134.4          | 182.4          | 266.3        | 157.1             | 163.5        |
| <b>88</b>             | 92.5               | 125.0             | 135.1          | 183.1          | 263.4        | 167.9             | 162.2        |
| <b>89</b>             | 155.2              | 127.0             | 128.8          | 183.5          | 263.1        | 171.3             | 163.5        |
| <b>90</b>             | 147.7              | 119.6             | 137.5          | 190.7          | 264.3        | 157.0             | 166.1        |
| <b>91</b>             | 132.6              | 120.2             | 135.8          | 192.9          | 268.3        | 163.1             | 166.2        |
| <b>92*</b>            | 108.4              | 122.4             | 138.6          | 196.9          | 264.5        | 173.9             | 167.5        |

**Source:**

Hu, Patricia S. and An Lu, "Light-Duty Vehicle Summary: First Six Months of Sales Period 1992," Working Paper, Oak Ridge National Laboratory, Oak Ridge, TN, July 1992, p. 31.

- \* These figures represent sales for the first six months of the 1992 sales period (October 91 through March 92).

**Table 3.16**  
**Sales-Weighted Curb Weight of Domestic and Import Automobiles by Size Class,**  
**Sales Periods 1976-1992**  
**(pounds)**

| <b>Model<br/>yca.</b> | <b>Minicompact</b> | <b>Subcompact</b> | <b>Compact</b> | <b>Midsize</b> | <b>Large</b> | <b>Two seater</b> | <b>Fleet</b> |
|-----------------------|--------------------|-------------------|----------------|----------------|--------------|-------------------|--------------|
| <b>76</b>             |                    | 2,577.2           | 3,608.7        | 4,046.1        | 4,562.7      | 2,624.1           | 3,608.0      |
| <b>77</b>             | 2,228.0            | 2,586.3           | 3,549.8        | 3,900.3        | 4,025.8      | 2,608.1           | 3,424.4      |
| <b>78</b>             | 2,199.6            | 2,444.3           | 3,137.5        | 3,426.8        | 3,955.7      | 2,762.5           | 3,196.5      |
| <b>79</b>             | 2,120.1            | 2,366.7           | 3,048.0        | 3,286.7        | 3,763.4      | 2,699.1           | 3,000.4      |
| <b>80</b>             | 2,154.3            | 2,270.4           | 2,812.5        | 3,080.9        | 3,667.4      | 2,713.6           | 2,790.3      |
| <b>81</b>             | 1,919.8            | 2,370.5           | 2,381.7        | 2,995.7        | 3,671.8      | 2,583.0           | 2,744.3      |
| <b>82</b>             | 2,002.1            | 2,301.7           | 2,421.8        | 2,991.9        | 3,702.8      | 2,524.8           | 2,729.8      |
| <b>83</b>             | 2,072.0            | 2,333.9           | 2,441.3        | 3,026.5        | 3,779.0      | 2,662.5           | 2,787.9      |
| <b>84</b>             | 2,375.9            | 2,380.4           | 2,453.7        | 2,990.0        | 3,733.6      | 2,559.3           | 2,787.7      |
| <b>85</b>             | 2,210.8            | 2,391.8           | 2,464.3        | 2,953.6        | 3,575.4      | 2,538.6           | 2,743.4      |
| <b>86</b>             | 2,120.3            | 2,414.8           | 2,431.5        | 2,856.7        | 3,451.2      | 2,574.5           | 2,675.3      |
| <b>87</b>             | 1,959.7            | 2,422.5           | 2,474.0        | 2,856.8        | 3,483.0      | 2,601.8           | 2,688.5      |
| <b>88</b>             | 1,932.7            | 2,346.3           | 2,558.1        | 2,880.3        | 3,487.3      | 2,693.0           | 2,716.8      |
| <b>89</b>             | 2,575.8            | 2,357.3           | 2,517.1        | 2,984.5        | 3,495.7      | 2,734.9           | 2,759.6      |
| <b>90</b>             | 2,650.7            | 2,368.4           | 2,637.2        | 3,065.3        | 3,593.9      | 2,656.3           | 2,827.7      |
| <b>91</b>             | 2,583.6            | 2,405.8           | 2,652.1        | 3,084.7        | 3,649.6      | 2,707.3           | 2,848.2      |
| <b>92*</b>            | 2,335.9            | 2,364.7           | 2,722.2        | 3,161.1        | 3,652.5      | 2,888.0           | 2,878.0      |

**Source:**

Hu, Patricia S. and An Lu, "Light-Duty Vehicle Summary: First Six Months of Sales Period 1992," Working Paper, Oak Ridge National Laboratory, Oak Ridge, TN, July 1992, p. 33.

\* These figures represent sales for the first six months of the 1992 sales period (October 91 through March 92).

**Table 3.17**  
**Sales-Weighted Interior Space of Domestic and Import Automobiles by Size Class,**  
**Sales Periods 1976-1992**  
**(cubic feet)**

| <b>Model<br/>year</b> | <b>Minicompact<br/>( &lt; 85)</b> | <b>Subcompact<br/>(85-99)</b> | <b>Compact<br/>(100-109)</b> | <b>Midsize<br/>(110-119)</b> | <b>Large<br/>( &gt; 120)</b> | <b>Two seater<sup>a</sup></b> | <b>Fleet</b> |
|-----------------------|-----------------------------------|-------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| <b>76<sup>b</sup></b> |                                   |                               |                              |                              |                              |                               |              |
| <b>77</b>             | 78.8                              | 89.8                          | 107.1                        | 113.0                        | 128.0                        |                               | 107.9        |
| <b>78</b>             | 79.4                              | 89.8                          | 105.3                        | 112.9                        | 128.5                        |                               | 107.9        |
| <b>79</b>             | 80.0                              | 90.2                          | 105.8                        | 113.4                        | 130.1                        |                               | 106.9        |
| <b>80</b>             | 82.4                              | 89.9                          | 105.4                        | 113.5                        | 130.8                        |                               | 104.9        |
| <b>81</b>             | 83.3                              | 90.2                          | 103.6                        | 113.7                        | 130.6                        |                               | 105.5        |
| <b>82</b>             | 83.1                              | 91.3                          | 102.9                        | 113.9                        | 130.4                        |                               | 106.0        |
| <b>83</b>             | 82.7                              | 93.3                          | 103.0                        | 113.1                        | 131.3                        |                               | 107.3        |
| <b>84</b>             | 77.0                              | 93.8                          | 103.0                        | 113.3                        | 130.7                        |                               | 108.0        |
| <b>85</b>             | 77.8                              | 94.1                          | 103.1                        | 113.5                        | 129.7                        |                               | 107.9        |
| <b>86</b>             | 80.1                              | 94.5                          | 102.8                        | 113.8                        | 127.6                        |                               | 107.0        |
| <b>87</b>             | 81.6                              | 93.1                          | 103.0                        | 113.9                        | 127.5                        |                               | 106.9        |
| <b>88</b>             | 81.0                              | 93.5                          | 103.3                        | 113.6                        | 127.2                        |                               | 107.0        |
| <b>89</b>             | 75.0                              | 93.3                          | 102.7                        | 113.8                        | 127.4                        |                               | 107.5        |
| <b>90</b>             | 79.9                              | 93.9                          | 103.2                        | 113.8                        | 127.8                        |                               | 107.3        |
| <b>91</b>             | 79.6                              | 94.4                          | 103.2                        | 113.8                        | 128.3                        |                               | 107.1        |
| <b>92<sup>c</sup></b> | 79.1                              | 93.8                          | 104.0                        | 114.2                        | 129.2                        |                               | 107.3        |

**Source:**

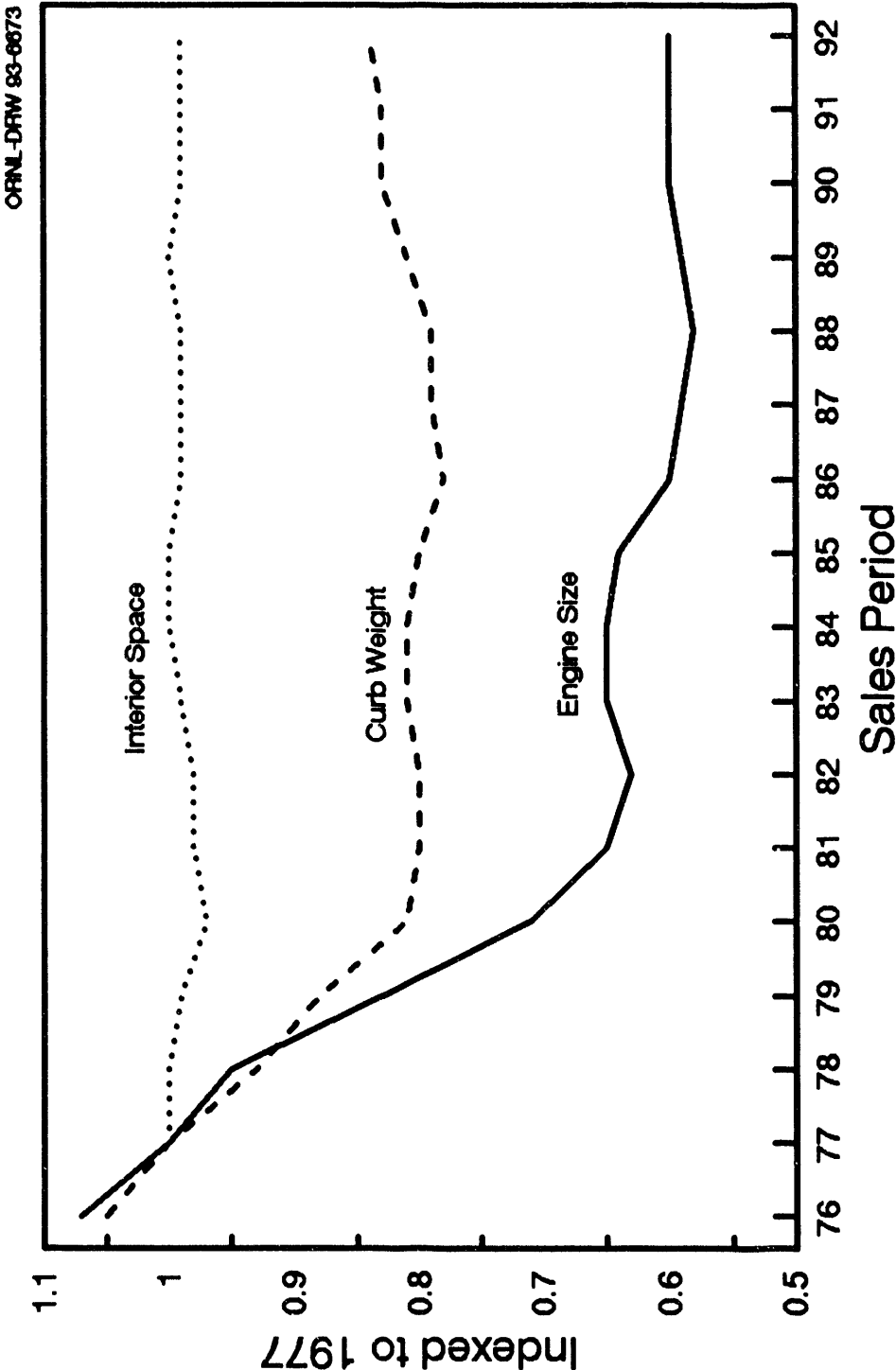
Hu, Patricia S. and An Lu, "Light-Duty Vehicle Summary: First Six Months of Sales Period 1992," Working Paper, Oak Ridge National Laboratory, Oak Ridge, TN, July 1992, p. 35.

<sup>a</sup> Interior volumes of two seaters are not reported to EPA.

<sup>b</sup> Data not available.

<sup>c</sup> These figures represent sales for the first six months of the 1992 sales period (October 91 through March 92).

Figure 3.8 . Engine Size, Curb Weight, and Interior Space of Domestic and Import Automobiles by Size Class, 1976-92



Source: See Tables 3.15, 3.16, and 3.17.

**Table 3.18**  
**Period Sales, Market Shares, and Sales-Weighted Fuel Economics**  
**of New Domestic and Import Automobiles, Selected Sales Periods 1976-1992\***

|                    | 1976      | 1980      | 1982      | 1984       | 1986       | 1988       | 1989       | 1990      | 1991      | 1992 <sup>b</sup> |
|--------------------|-----------|-----------|-----------|------------|------------|------------|------------|-----------|-----------|-------------------|
| <b>MINICOMPACT</b> |           |           |           |            |            |            |            |           |           |                   |
| Total sales, units |           | 428,346   | 221,699   | 41,368     | 191,490    | 84,186     | 20,677     | 76,698    | 73,562    | 46,013            |
| Market share, %    |           | 4.7       | 2.9       | 0.4        | 1.7        | 0.8        | 0.2        | 0.8       | 0.9       | 1.2               |
| Fuel economy, mpg  |           | 29.4      | 36.5      | 29.0       | 31.9       | 37.8       | 24.9       | 26.4      | 28.0      | 31.3              |
| <b>SUBCOMPACT</b>  |           |           |           |            |            |            |            |           |           |                   |
| Total sales, units | 2,625,929 | 3,441,480 | 2,404,489 | 2,510,929  | 2,350,081  | 1,983,353  | 1,963,385  | 2,030,226 | 2,172,496 | 973,731           |
| Market share, %    | 27.1      | 37.8      | 31.4      | 24.6       | 21.2       | 19.1       | 19.3       | 22.0      | 26.1      | 26.2              |
| Fuel economy, mpg  | 23.5      | 27.3      | 30.2      | 30.5       | 30.7       | 31.7       | 31.3       | 31.3      | 31.5      | 31.4              |
| <b>COMPACT</b>     |           |           |           |            |            |            |            |           |           |                   |
| Total sales, units | 2,839,603 | 599,423   | 1,300,372 | 2,768,056  | 3,829,093  | 4,199,638  | 3,690,419  | 3,156,481 | 2,458,967 | 1,152,445         |
| Market share, %    | 29.3      | 6.6       | 17.0      | 27.1       | 34.5       | 40.5       | 36.3       | 34.2      | 29.5      | 31.0              |
| Fuel economy, mpg  | 17.1      | 22.3      | 30.1      | 30.6       | 30.0       | 29.8       | 29.8       | 28.9      | 28.7      | 28.6              |
| <b>MIDSIZE</b>     |           |           |           |            |            |            |            |           |           |                   |
| Total sales, units | 1,815,505 | 3,073,103 | 2,533,121 | 3,059,647  | 2,985,835  | 2,550,964  | 2,939,948  | 2,511,503 | 2,333,104 | 975,169           |
| Market share, %    | 18.7      | 33.8      | 33.1      | 30.0       | 26.9       | 24.6       | 28.9       | 27.2      | 28.0      | 26.2              |
| Fuel economy, mpg  | 15.3      | 21.3      | 24.1      | 24.1       | 25.6       | 26.9       | 26.4       | 25.9      | 25.8      | 25.4              |
| <b>LARGE</b>       |           |           |           |            |            |            |            |           |           | 3.30              |
| Total sales, units | 2,206,102 | 1,336,190 | 995,561   | 1,502,097  | 1,467,077  | 1,368,717  | 1,400,514  | 1,279,092 | 1,161,679 | 527,175           |
| Market share, %    | 22.8      | 14.7      | 13.0      | 14.7       | 13.2       | 13.2       | 13.8       | 13.9      | 13.9      | 14.2              |
| Fuel economy, mpg  | 13.9      | 19.3      | 20.6      | 20.2       | 23.8       | 24.2       | 23.9       | 23.5      | 23.4      | 23.9              |
| <b>TWO SEATER</b>  |           |           |           |            |            |            |            |           |           |                   |
| Total sales, units | 199,716   | 215,964   | 202,929   | 328,968    | 275,470    | 186,127    | 158,884    | 170,465   | 139,296   | 48,205            |
| Market share, %    | 2.1       | 2.4       | 2.6       | 3.2        | 2.5        | 1.8        | 1.6        | 1.8       | 1.7       | 1.3               |
| Fuel economy, mpg  | 20.1      | 21.0      | 25.1      | 26.5       | 28.4       | 27.3       | 27.0       | 28.0      | 27.4      | 26.5              |
| <b>FLEET</b>       |           |           |           |            |            |            |            |           |           |                   |
| Total sales, units | 9,686,855 | 9,094,506 | 7,658,171 | 10,211,065 | 11,099,046 | 10,372,985 | 10,173,827 | 9,224,465 | 8,339,104 | 3,722,738         |
| Market share, %    | 100.0     | 100.0     | 100.0     | 100.0      | 100.0      | 100.0      | 100.0      | 100.0     | 100.0     | 100.0             |
| Fuel economy, mpg  | 17.2      | 23.2      | 26.3      | 26.3       | 27.9       | 28.5       | 28.0       | 27.6      | 27.6      | 27.6              |

**Source:** Hu, Patricia S. and An Lu, "Light-Duty Vehicle Summary: First Six Months of Sales Period 1992," Working Paper, Oak Ridge National Laboratory, Oak Ridge, TN, July 1992, p. 10.

\*These figures represent only those sales that could be matched to corresponding EPA fuel economy values.  
<sup>b</sup>These figures represent sales for the first six months of the 1992 sales period (October 91 through March 92).

## **Section 3.3**

### **Trucks**

*Although light truck sales have been declining since 1988, their share of total truck sales has been growing. In 1991 light trucks accounted for 31.5% of all truck sales, and 33.5% of all light-duty vehicle sales.*

**Table 3.19**  
**New Retail Sales of Light Trucks in the United States, 1970-91**

| Calendar Year                           | Light truck sales <sup>a</sup><br>(thousands) | Percentages                                 |                                |   |   |   |
|---|---|---|--------------------------------|---|---|---|
|   |   | Import of total <sup>b</sup><br>light truck | Diesel of total<br>light truck | Four-wheel drive<br>on domestic<br>light trucks | Light trucks<br>of light-duty<br>vehicle sales <sup>c</sup> | Light trucks<br>of total<br>truck sales |
| 1970                                    | 1,463   | 4.5   | d                              | e   | 14.8  | 80.4                                    |
| 1971                                    | 1,757   | 4.8   | e                              | d   | 14.6  | 83.4                                    |
| 1972                                    | 2,239   | 6.4   | e                              | d   | 16.7  | 83.3                                    |
| 1973                                    | 2,745   | 8.5   | e                              | d   | 18.8  | 84.2                                    |
| 1974                                    | 2,338   | 7.5   | e                              | 18.0  | 20.3  | 84.2                                    |
| 1975                                    | 2,281   | 10.0  | e                              | 23.4  | 20.1  | 87.9                                    |
| 1976                                    | 2,956   | 8.0   | e                              | 23.8  | 22.0  | 89.8                                    |
| 1977                                    | 3,430   | 9.4   | e                              | 24.6  | 22.8  | 89.7                                    |
| 1978                                    | 3,808   | 8.8   | 1.0                            | 28.5  | 24.5  | 89.2                                    |
| 1979                                    | 3,311   | 14.1  | 1.0                            | 29.4  | 22.4  | 88.7                                    |
| 1980                                    | 2,440   | 19.7  | 3.2                            | 20.7  | 19.8  | 88.9                                    |
| 1981                                    | 2,189   | 20.3  | 3.3                            | 18.6  | 19.2  | 89.8                                    |
| 1982                                    | 2,470   | 16.5  | 5.0                            | 16.8  | 23.0  | 92.8                                    |
| 1983                                    | 2,984   | 15.6  | 4.0                            | 28.5  | 24.2  | 93.6                                    |
| 1984                                    | 3,863   | 15.7  | 3.8                            | 27.0  | 26.9  | 93.0                                    |
| 1985                                    | 4,458   | 17.2  | 3.3                            | 29.1  | 28.7  | 93.6                                    |
| 1986                                    | 4,594   | 20.1  | 2.6                            | 27.0  | 28.6  | 94.3                                    |
| 1987                                    | 4,610   | 17.9  | 2.3                            | 32.0  | 31.0  | 93.9                                    |
| 1988                                    | 4,800   | 12.6  | 2.0                            | 32.1  | 31.1  | 93.2                                    |
| 1989                                    | 4,610   | 10.9  | 2.1                            | 26.9 <sup>e</sup>                               | 31.8  | 93.3                                    |
| 1990                                    | 4,548   | 13.2  | 2.2 <sup>f</sup>               | 19.8 <sup>e</sup>                               | 32.8  | 93.9                                    |
| 1991                                    | 4,123   | 12.8  | 2.2 <sup>e</sup>               | 30.2 <sup>e</sup>                               | 33.5  | 94.5                                    |
| <i>Average annual percentage change</i> |   |   |                                |   |   |   |
| 1970-91                                 | 5.1%  |   |                                |   |   |   |
| 1982-91                                 | 5.9%  |   |                                |   |   |   |

**Sources:**

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

1989-91: H. A. Stark (ed.), Ward's Communications, Inc., Ward's Automotive Reports, Factory Installation Report, Detroit, MI, 1992.

All other - Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '92, Detroit, MI, 1992, pp. 7, 16, 17, and annual.

<sup>a</sup>Includes domestic, domestic-sponsored import, and import trucks of 10,000 pounds gross vehicle weight and less.

<sup>b</sup>Includes transports.

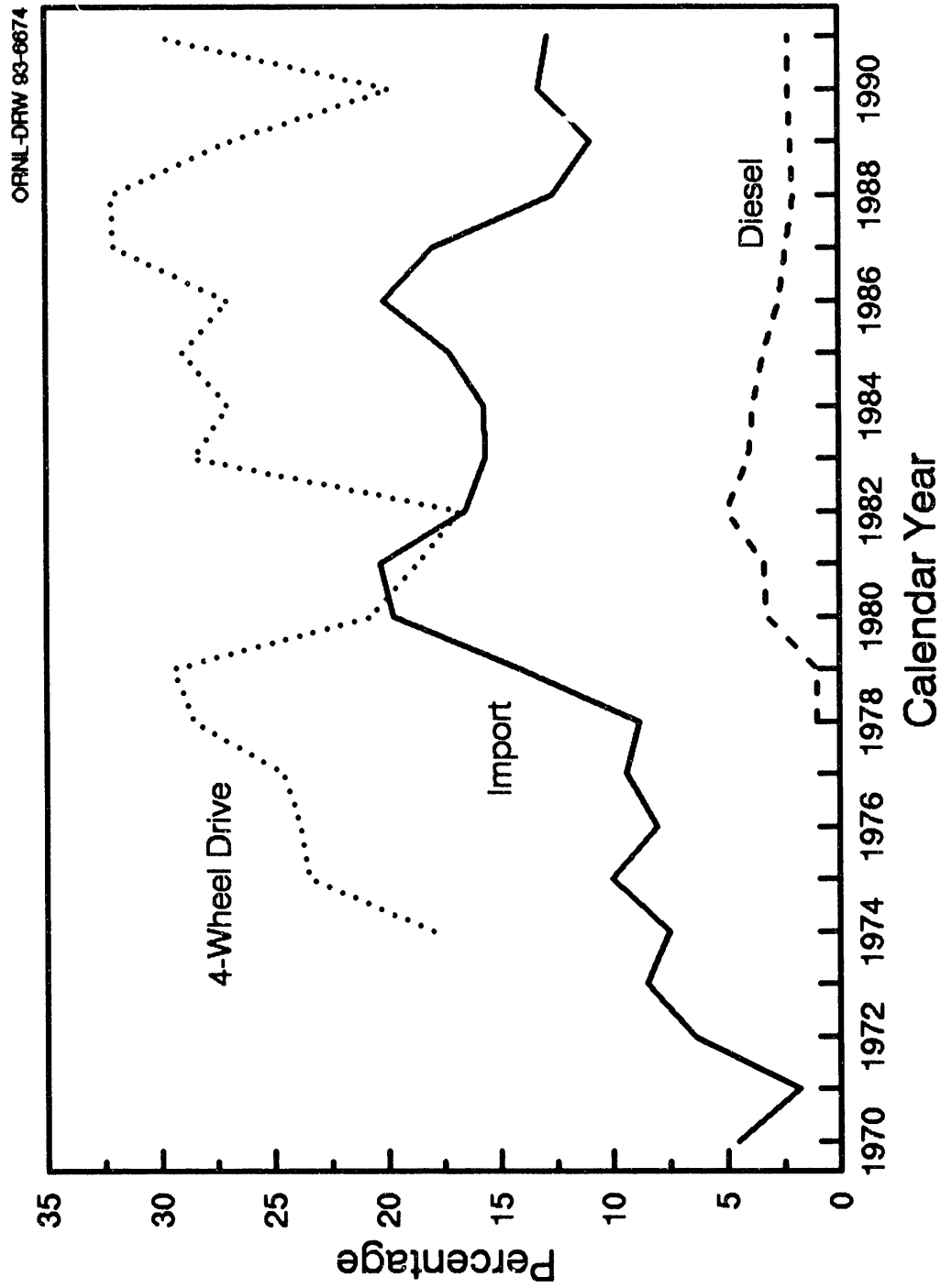
<sup>c</sup>Light-duty vehicles include cars and light trucks.

<sup>d</sup>Indicates less than 1 percent.

<sup>e</sup>Data are not available.

<sup>f</sup>Based on factory installations.

Figure 3.9. Import, Diesel, and Four-Wheel Drive Shares of Light Truck Sales, 1970-91



Source: See Table 3.19.

Table 3.20  
New Retail Domestic Truck Sales by Gross Vehicle Weight, 1970-91<sup>a</sup>  
(thousands)

| Calendar Year                           | Class 1<br>6,000 lbs.<br>or less | Class 2<br>6,001-<br>10,000 lbs. | Class 3<br>10,001-<br>14,000 lbs. | Class 4<br>14,001-<br>16,000 lbs. | Class 5<br>16,001-<br>19,500 lbs. | Class 6<br>19,501-<br>26,000 lbs. | Class 7<br>26,001-<br>33,000 lbs. | Class 8<br>33,001 lbs.<br>and over | Total <sup>b</sup> |
|---|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|--------------------|
| 1970 <sup>c</sup>                       | 1,049                            | 408                              | 6                                 | 12                                | 58                                | 133                               | 36                                | 89                                 | 1,791              |
| 1971                                    | 1,185                            | 488                              | 6                                 | 15                                | 46                                | 140                               | 34                                | 99                                 | 2,013              |
| 1972                                    | 1,498                            | 599                              | 55                                | 11                                | 29                                | 182                               | 35                                | 126                                | 2,535              |
| 1973                                    | 1,754                            | 758                              | 50                                | 3                                 | 16                                | 236                               | 37                                | 155                                | 3,009              |
| 1974                                    | 1,467                            | 696                              | 21                                | 3                                 | 14                                | 207                               | 31                                | 148                                | 2,587              |
| 1975                                    | 1,101                            | 952                              | 23                                | 1                                 | 9                                 | 159                               | 23                                | 83                                 | 2,351              |
| 1976                                    | 1,318                            | 1,401                            | 43                                | 4                                 | 9                                 | 153                               | 22                                | 97                                 | 3,043              |
| 1977                                    | 1,306                            | 1,803                            | 36                                | 3                                 | 5                                 | 163                               | 28                                | 141                                | 3,485              |
| 1978                                    | 1,334                            | 2,140                            | 73                                | 6                                 | 3                                 | 156                               | 41                                | 162                                | 3,915              |
| 1979                                    | 1,271                            | 1,574                            | 15                                | 3                                 | 3                                 | 146                               | 50                                | 174                                | 3,236              |
| 1980                                    | 985                              | 975                              | 4                                 | 4                                 | 2                                 | 90                                | 58                                | 117                                | 2,231              |
| 1981                                    | 896                              | 850                              | 1                                 | 4                                 | 2                                 | 72                                | 51                                | 100                                | 1,972              |
| 1982                                    | 1,102                            | 961                              | 1                                 | 4                                 | 1                                 | 44                                | 62                                | 76                                 | 2,248              |
| 1983                                    | 1,314                            | 1,207                            | 4                                 | 4                                 | 1                                 | 47                                | 59                                | 82                                 | 2,710              |
| 1984                                    | 2,031                            | 1,224                            | 6                                 | 4                                 | 5                                 | 55                                | 78                                | 138                                | 3,538              |
| 1985                                    | 2,408                            | 1,280                            | 11                                | 4                                 | 5                                 | 48                                | 97                                | 134                                | 3,983              |
| 1986                                    | 2,541                            | 1,214                            | 7                                 | 4                                 | 6                                 | 42                                | 98                                | 112                                | 4,020              |
| 1987                                    | 2,697                            | 1,175                            | 7                                 | 4                                 | 6                                 | 41                                | 98                                | 131                                | 4,155              |
| 1988                                    | 2,926                            | 1,333                            | 6                                 | 20                                | 6                                 | 51                                | 98                                | 148                                | 4,588              |
| 1989                                    | 2,809                            | 1,297                            | 7                                 | 26                                | 4                                 | 34                                | 81                                | 145                                | 4,403              |
| 1990                                    | 2,852                            | 1,097                            | 8                                 | 26                                | 2                                 | 33                                | 76                                | 121                                | 4,215              |
| 1991                                    | 2,719                            | 876                              | 11                                | 23                                | 4                                 | 19                                | 67                                | 98                                 | 3,813              |
| <i>Average annual percentage change</i> |                                  |                                  |                                   |                                   |                                   |                                   |                                   |                                    |                    |
| 1970-91                                 | 4.6%                             | 3.7%                             | 2.9%                              | 3.1%                              | -30.3%                            | -8.8%                             | 3.0%                              | 0.5%                               | 3.7%               |
| 1982-91                                 | 10.6%                            | -1.0%                            | 30.5%                             | 53.0%                             | -32.3%                            | -8.9%                             | 0.9%                              | 2.9%                               | 6.0%               |

## Source:

Motor Vehicle Manufacturers Association, *Motor Vehicle Facts and Figures '92*, Detroit, MI, 1992, p. 17, and annual.

<sup>a</sup>Sales include domestic-sponsored imports.

<sup>b</sup>Totals may not equal Motor Vehicle Manufacturers Association totals due to rounding.

<sup>c</sup>Data for 1970 is based on new truck registrations.

<sup>d</sup>Less than 500 trucks.

*Although the average age of trucks has increased by only 0.79 years from 1970 to 1990, the percentage of trucks ten years old or older has grown from 29.2% in 1970 to 35.0% in 1990.*

**Table 3.21**  
**Trucks in Use by Age, 1970 and 1991**

| Age<br>(years)             | 1970                    |                      |                          | 1991                    |                      |                          |
|----------------------------|-------------------------|----------------------|--------------------------|-------------------------|----------------------|--------------------------|
|                            | Vehicles<br>(thousands) | Actual<br>percentage | Cumulative<br>percentage | Vehicles<br>(thousands) | Actual<br>percentage | Cumulative<br>percentage |
| Under. 1 <sup>a</sup>      | 1,262                   | 7.1                  | 7.1                      | 2,919                   | 5.0                  | 5.0                      |
| 1                          | 1,881                   | 10.6                 | 17.8                     | 4,187                   | 7.2                  | 12.2                     |
| 2                          | 1,536                   | 8.7                  | 26.5                     | 4,913                   | 8.4                  | 20.7                     |
| 3                          | 1,428                   | 8.1                  | 34.6                     | 4,922                   | 8.5                  | 29.1                     |
| 4                          | 1,483                   | 8.4                  | 43.0                     | 4,414                   | 7.6                  | 36.7                     |
| 5                          | 1,339                   | 7.6                  | 50.5                     | 4,670                   | 8.0                  | 44.7                     |
| 6                          | 1,154                   | 6.5                  | 57.1                     | 4,041                   | 6.9                  | 51.7                     |
| 7                          | 975                     | 5.5                  | 62.6                     | 3,572                   | 6.1                  | 57.8                     |
| 8                          | 826                     | 4.7                  | 67.3                     | 2,279                   | 3.9                  | 61.7                     |
| 9                          | 621                     | 3.5                  | 70.8                     | 1,917                   | 3.3                  | 65.0                     |
| 10                         | 658                     | 3.7                  | 74.5                     | 1,708                   | 2.9                  | 68.0                     |
| 11                         | 583                     | 3.3                  | 77.8                     | 1,625                   | 2.8                  | 70.8                     |
| 12                         | 383                     | 2.2                  | 80.0                     | 2,854                   | 4.9                  | 75.7                     |
| 13                         | 417                     | 2.4                  | 82.3                     | 2,508                   | 4.3                  | 80.0                     |
| 14                         | 414                     | 2.3                  | 84.7                     | 2,094                   | 3.6                  | 83.6                     |
| 15 and older               | 2,710                   | 15.3                 | 100.0                    | 9,552                   | 16.4                 | 100.0                    |
| Subtotal                   | 17,670                  | 100.0                |                          | 58,175                  | 100.0                |                          |
| Age not given <sup>b</sup> | 15                      |                      |                          | 3                       |                      |                          |
| Total                      | 17,685                  |                      |                          | 58,178                  |                      |                          |
| Average age                |                         | 7.33                 |                          |                         | 8.12                 |                          |
| Median age                 |                         | 5.93                 |                          |                         | 6.76                 |                          |

**Source:**

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

<sup>a</sup>Trucks sold as of July 1 of each year.

<sup>b</sup>Approximately 15,000 trucks in 1970 and 3,000 in 1991 could not be classified by age.

*Data from the 1987 TIUS (the most recent data available on national truck population characteristics) were used to estimate 1991 truck travel patterns by vehicle age group. Trucks which were 10 years old or older accounted for 35% of the truck population but represented only 20.5% of total truck travel in 1991.*

**Table 3.22**  
**Trucks in Operation**  
**and Vehicle Travel by Age of Vehicle, 1991**

| Vehicle age (years)        | Number in operation  |                   |                       | Estimated vehicle travel |                       | Average annual miles per vehicle |
|----------------------------|----------------------|-------------------|-----------------------|--------------------------|-----------------------|----------------------------------|
|                            | Vehicles (thousands) | Actual percentage | Cumulative percentage | Actual percentage        | Cumulative percentage |                                  |
| Under 1 <sup>a</sup>       | 2,919                | 5.0               | 5.0                   | 6.3                      | 6.3                   | 14,900.5                         |
| 1                          | 4,187                | 7.2               | 12.2                  | 10.2                     | 16.5                  | 16,852.8                         |
| 2                          | 4,913                | 8.4               | 20.7                  | 11.9                     | 28.4                  | 16,719.0                         |
| 3                          | 4,922                | 8.5               | 29.1                  | 11.5                     | 39.9                  | 16,074.2                         |
| 4                          | 4,414                | 7.6               | 36.7                  | 8.9                      | 48.8                  | 14,005.1                         |
| 5                          | 4,670                | 8.0               | 44.7                  | 9.4                      | 58.2                  | 13,952.4                         |
| 6                          | 4,041                | 6.9               | 51.7                  | 8.0                      | 66.2                  | 13,687.0                         |
| 7                          | 3,572                | 6.1               | 57.8                  | 6.5                      | 72.8                  | 12,643.5                         |
| 8                          | 2,279                | 3.9               | 61.7                  | 3.8                      | 76.5                  | 11,387.2                         |
| 9                          | 1,917                | 3.3               | 65.0                  | 3.0                      | 79.5                  | 10,665.3                         |
| 10                         | <u>20,341</u>        | <u>35.0</u>       | 100.0                 | <u>20.5</u>              | 100.0                 | 6,960.1                          |
| Subtotal                   | 58,175               | 100.0             |                       | 100.0                    |                       |                                  |
| Age not given <sup>b</sup> | <u>3</u>             |                   |                       |                          |                       |                                  |
| Total                      | 58,178               |                   |                       |                          |                       |                                  |

**Sources:**

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

Vehicle travel - The average annual vehicle miles per truck by age were multiplied by the number of trucks in operation by age to estimate the vehicle travel. Average annual miles per truck by age were generated by ORNL from the 1987 Truck Inventory and Use Survey public use tape provided by U.S. Department of Commerce, Bureau of the Census, Washington, DC, 1990.

<sup>a</sup>Trucks sold as of July 1, 1991.

<sup>b</sup>Approximately 3,000 vehicles could not be classified by age.

Table 3.23  
Period Sales, Market Shares, and Sales-Weighted Fuel Economics  
of New Domestic and Import Light Trucks, Selected Sales Periods 1976-1992\*

|                      | 1976      | 1980      | 1982      | 1984      | 1986      | 1988      | 1989      | 1990      | 1991      | 1992 <sup>b</sup> |
|----------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------------------|
| <b>SMALL PICKUP</b>  |           |           |           |           |           |           |           |           |           |                   |
| Total sales, units   | 170,351   | 516,412   | 579,263   | 1,012,298 | 1,225,570 | 1,026,551 | 877,839   | 678,488   | 609,814   | 267,578           |
| Market share, %      | 7.1       | 23.3      | 27.2      | 28.0      | 27.0      | 21.6      | 18.4      | 15.0      | 14.9      | 13.6              |
| Fuel economy, mpg    | 23.9      | 25.5      | 28.1      | 27.2      | 26.1      | 26.1      | 25.7      | 25.2      | 25.6      | 25.2              |
| <b>LARGE PICKUP</b>  |           |           |           |           |           |           |           |           |           |                   |
| Total sales, units   | 1,586,020 | 1,115,248 | 1,000,772 | 1,218,972 | 1,325,547 | 1,453,255 | 1,580,916 | 1,573,729 | 1,364,940 | 651,670           |
| Market share, %      | 66.4      | 50.3      | 46.9      | 33.7      | 29.2      | 30.6      | 33.2      | 34.9      | 33.4      | 33.0              |
| Fuel economy, mpg    | 15.1      | 17.0      | 18.6      | 17.5      | 18.4      | 18.5      | 18.2      | 18.9      | 18.9      | 18.8              |
| <b>SMALL VAN</b>     |           |           |           |           |           |           |           |           |           |                   |
| Total sales, units   | 18,651    | 13,649    | 11,964    | 222,798   | 640,936   | 851,384   | 859,311   | 932,693   | 886,841   | 458,304           |
| Market share, %      | 0.8       | 0.6       | 0.6       | 6.2       | 14.1      | 18.0      | 18.0      | 20.7      | 21.7      | 23.2              |
| Fuel economy, mpg    | 19.5      | 19.6      | 22.5      | 25.0      | 23.8      | 22.9      | 22.9      | 23.1      | 22.6      | 22.2              |
| <b>LARGE VAN</b>     |           |           |           |           |           |           |           |           |           |                   |
| Total sales, units   | 574,745   | 328,065   | 379,110   | 545,595   | 510,558   | 486,981   | 471,762   | 398,877   | 308,317   | 148,166           |
| Market share, %      | 24.1      | 14.8      | 17.8      | 15.1      | 11.3      | 10.3      | 9.9       | 8.8       | 7.5       | 7.5               |
| Fuel economy, mpg    | 15.4      | 16.3      | 17.0      | 16.3      | 17.3      | 17.0      | 16.7      | 16.9      | 17.1      | 16.8              |
| <b>SMALL UTILITY</b> |           |           |           |           |           |           |           |           |           |                   |
| Total sales, units   | 4,716     | 75,875    | 28,376    | 398,000   | 598,652   | 701,005   | 747,550   | 738,294   | 782,125   | 394,008           |
| Market share, %      | 0.2       | 3.4       | 1.3       | 11.0      | 13.2      | 14.8      | 15.7      | 16.4      | 19.2      | 20.0              |
| Fuel economy, mpg    | 15.5      | 16.9      | 20.9      | 23.0      | 21.5      | 22.4      | 21.7      | 21.9      | 21.4      | 20.9              |
| <b>LARGE UTILITY</b> |           |           |           |           |           |           |           |           |           |                   |
| Total sales, units   | 32,427    | 167,288   | 133,355   | 215,271   | 233,625   | 223,824   | 228,664   | 192,544   | 131,740   | 54,230            |
| Market share, %      | 1.4       | 7.5       | 6.3       | 6.0       | 5.2       | 4.7       | 4.8       | 4.3       | 3.2       | 2.7               |
| Fuel economy, mpg    | 14.7      | 14.6      | 16.9      | 15.7      | 15.9      | 16.2      | 16.2      | 16.1      | 16.4      | 16.6              |
| <b>FLEET</b>         |           |           |           |           |           |           |           |           |           |                   |
| Total sales, units   | 2,386,910 | 2,216,537 | 2,132,840 | 3,612,934 | 4,534,888 | 4,743,000 | 4,766,042 | 4,514,625 | 4,083,777 | 1,973,956         |
| Market share, %      | 100.0     | 100.0     | 100.0     | 100.0     | 100.0     | 100.0     | 100.0     | 100.0     | 100.0     | 100.0             |
| Fuel economy, mpg    | 15.6      | 18.1      | 20.0      | 20.0      | 20.8      | 20.7      | 20.2      | 20.5      | 20.6      | 20.4              |

**Source:**

Hu, Patricia S. and An Lu, Light-Duty Vehicle Summary: First Six Months of Sales Period 1992,\* Working Paper, Oak Ridge National Laboratory, Oak Ridge, TN, July 1992, p. 20.

\*These figures represent only those sales that could be matched to corresponding EPA fuel economy values.

<sup>b</sup>These figures represent sales for the first six months of the 1992 sales period (October 91 through March 92).

*Two-axle, four-tire truck average fuel economy exceeded 14 mpg for the first time in 1990. Because the more fuel efficient trucks are entering the population, the fuel use for two-axle, four-tire trucks has grown at a slower rate than the vehicle travel. These trucks are being driven longer distances each year, as evidenced by a greater increase in travel than in registrations.*

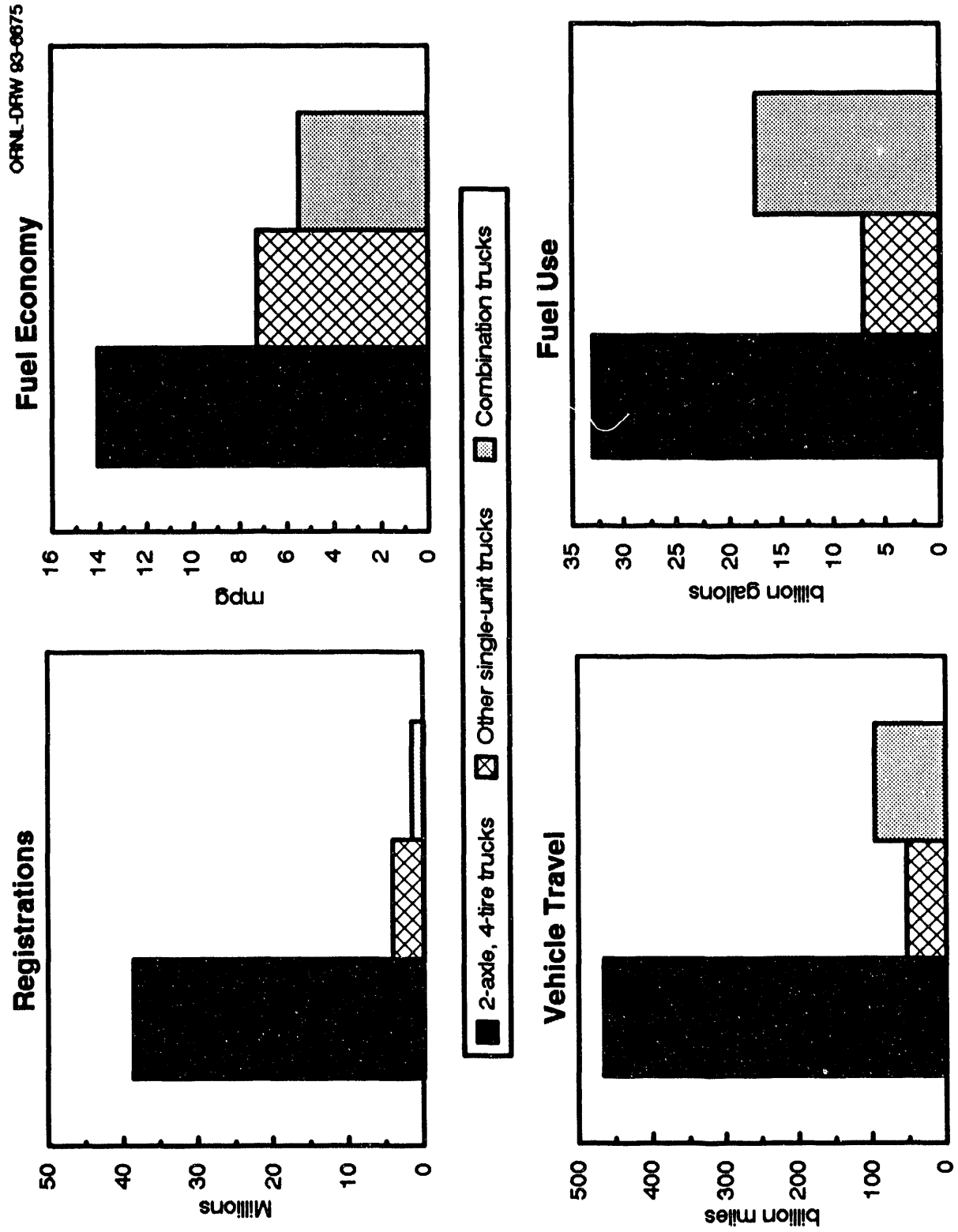
**Table 3.24**  
**Summary Statistics for Two-Axle, Four-Tire Trucks, 1970-90**

| Year                                    | Registrations<br>(thousands) | Vehicle travel<br>(million miles) | Fuel use<br>(million gallons) | Fuel economy<br>(miles per gallon) |
|---|------------------------------|-----------------------------------|-------------------------------|------------------------------------|
| 1970                                    | 14,211                       | 123,286                           | 12,313                        | 10.0                               |
| 1971                                    | 15,181                       | 137,870                           | 13,484                        | 10.2                               |
| 1972                                    | 16,428                       | 156,622                           | 15,150                        | 10.3                               |
| 1973                                    | 18,083                       | 176,833                           | 16,828                        | 10.5                               |
| 1974                                    | 19,335                       | 182,757                           | 16,657                        | 11.0                               |
| 1975                                    | 20,418                       | 200,700                           | 17,903                        | 11.2                               |
| 1976                                    | 22,301                       | 225,834                           | 20,164                        | 11.2                               |
| 1977                                    | 23,624                       | 250,591                           | 21,055                        | 11.4                               |
| 1978                                    | 25,476                       | 279,414                           | 24,055                        | 11.6                               |
| 1979                                    | 27,022                       | 291,905                           | 24,742                        | 11.8                               |
| 1980                                    | 27,876                       | 290,935                           | 23,594                        | 12.3                               |
| 1981                                    | 28,928                       | 296,343                           | 23,697                        | 12.5                               |
| 1982                                    | 29,792                       | 306,141                           | 23,845                        | 12.8                               |
| 1983                                    | 31,214                       | 327,643                           | 25,556                        | 12.8                               |
| 1984                                    | 32,106                       | 357,999                           | 27,687                        | 12.9                               |
| 1985                                    | 33,865                       | 373,072                           | 29,021                        | 12.9                               |
| 1986                                    | 34,820                       | 389,047                           | 30,265                        | 12.9                               |
| 1987                                    | 35,841                       | 415,449                           | 32,266                        | 12.9                               |
| 1988                                    | 37,096                       | 439,496                           | 32,803                        | 13.4                               |
| 1989                                    | 37,918                       | 454,339                           | 33,005                        | 13.8                               |
| 1990                                    | 38,652                       | 466,827                           | 33,140                        | 14.1                               |
| <i>Average annual percentage change</i> |                              |                                   |                               |                                    |
| 1970-90                                 | 5.1%                         | 6.9%                              | 5.1%                          | 1.7%                               |
| 1982-90                                 | 3.3%                         | 5.4%                              | 4.2%                          | 1.2%                               |

**Source:**

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table VM-1, p. 192, and annual.

Figure 3.10 Summary Statistics by Type of Truck, 1990



Source: See Tables 3.24 - 3.26.

*Although registrations and vehicle travel for other single-unit trucks rose from 1989 to 1990, fuel use declined slightly due to the increase in average fuel economy. The "other single-unit truck" sector has grown at slower rates than the two-axle, four-tire trucks and the combination trucks from 1970 to 1990. (See Figure 3.10.)*

**Table 3.25**  
**Summary Statistics for Other Single-Unit Trucks<sup>a</sup>, 1970-90**

| Year                                    | Registrations<br>(thousands) | Vehicle travel<br>(million miles) | Fuel use<br>(million gallons) | Fuel economy<br>(miles per gallon) |
|---|------------------------------|-----------------------------------|-------------------------------|------------------------------------|
| 1970                                    | 3,681                        | 27,081                            | 3,968                         | 6.8                                |
| 1971                                    | 3,770                        | 28,985                            | 4,212                         | 6.9                                |
| 1972                                    | 3,918                        | 31,414                            | 4,560                         | 6.9                                |
| 1973                                    | 4,131                        | 33,661                            | 4,859                         | 6.9                                |
| 1974                                    | 4,211                        | 33,441                            | 4,687                         | 7.1                                |
| 1975                                    | 4,232                        | 34,606                            | 4,825                         | 7.2                                |
| 1976                                    | 4,350                        | 36,390                            | 5,140                         | 7.1                                |
| 1977                                    | 4,450                        | 39,339                            | 5,559                         | 7.1                                |
| 1978                                    | 4,518                        | 42,727                            | 6,106                         | 7.0                                |
| 1979                                    | 4,505                        | 42,012                            | 6,036                         | 7.0                                |
| 1980                                    | 4,374                        | 39,813                            | 5,557                         | 7.2                                |
| 1981                                    | 4,455                        | 39,568                            | 5,574                         | 7.1                                |
| 1982                                    | 4,325                        | 40,212                            | 5,661                         | 7.1                                |
| 1983                                    | 4,204                        | 43,409                            | 6,118                         | 7.1                                |
| 1984                                    | 4,061                        | 46,560                            | 6,582                         | 7.1                                |
| 1985                                    | 3,927                        | 46,980                            | 6,735                         | 7.0                                |
| 1986                                    | 3,850                        | 48,308                            | 6,929                         | 7.0                                |
| 1987                                    | 3,884                        | 49,537                            | 7,091                         | 7.0                                |
| 1988                                    | 3,957                        | 51,239                            | 7,260                         | 7.1                                |
| 1989                                    | 4,103                        | 52,969                            | 7,413                         | 7.2                                |
| 1990                                    | 4,220                        | 53,522                            | 7,339                         | 7.3                                |
| <i>Average annual percentage change</i> |                              |                                   |                               |                                    |
| 1970-90                                 | 0.7%                         | 3.5%                              | 3.1%                          | 0.4%                               |
| 1982-90                                 | -0.3%                        | 3.6%                              | 3.3%                          | 0.3%                               |

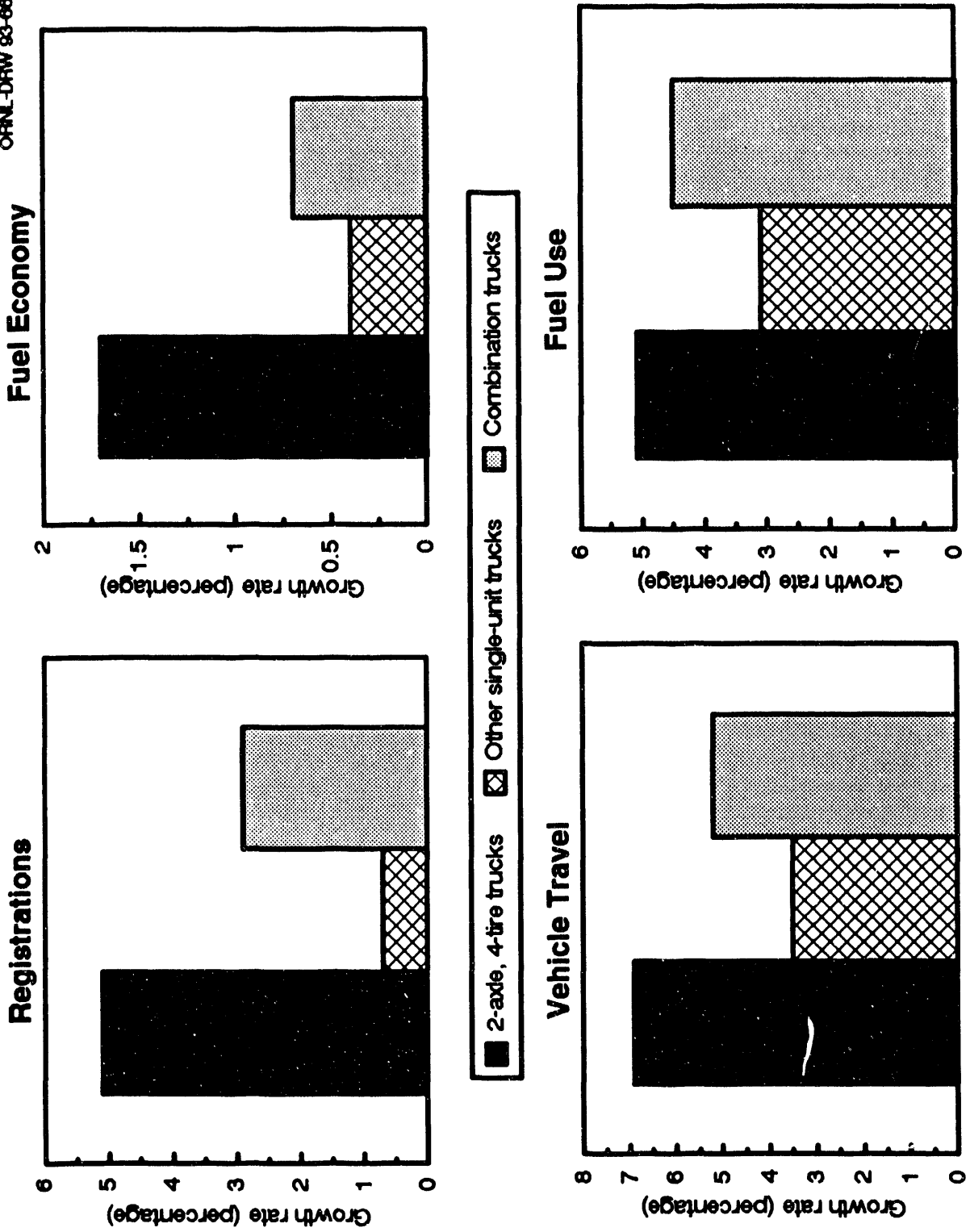
**Source:**

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table VM-1, p. 192, and annual.

<sup>a</sup>Other single-unit trucks are defined as all single-unit trucks with more than two axles or more than four tires.

Figure 3.11. Annual Growth Rates for Truck Statistics by Type of Truck, 1970-90

OFNL-DRW 83-8876



Source: See Table 3.24-3.26.

*The average miles traveled per combination truck (vehicle travel divided by registrations) has increased from 38,822 miles in 1970 to 60,039 miles in 1990. Since the fuel economy for combination trucks has increased by only 0.7 miles per gallon in this time period, fuel use has increased nearly as much as the vehicle travel.*

**Table 3.26**  
**Summary Statistics for Combination Trucks, 1970-90**

| Year                                    | Registrations<br>(thousands) | Vehicle travel<br>(million miles) | Fuel use<br>(million gallons) | Fuel economy <sup>a</sup><br>(miles per gallon) |
|---|------------------------------|-----------------------------------|-------------------------------|---|
| 1970                                    | 905                          | 35,134                            | 7,347                         | 4.8   |
| 1971                                    | 919                          | 37,217                            | 7,595                         | 4.9   |
| 1972                                    | 961                          | 40,706                            | 8,120                         | 5.0   |
| 1973                                    | 1,029                        | 45,649                            | 9,026                         | 5.1   |
| 1974                                    | 1,085                        | 45,966                            | 8,800                         | 5.2   |
| 1975                                    | 1,131                        | 46,724                            | 8,653                         | 5.4   |
| 1976                                    | 1,225                        | 49,680                            | 9,536                         | 5.2   |
| 1977                                    | 1,240                        | 55,683                            | 10,673                        | 5.2   |
| 1978                                    | 1,342                        | 62,992                            | 12,113                        | 5.2   |
| 1979                                    | 1,386                        | 66,992                            | 12,864                        | 5.2   |
| 1980                                    | 1,417                        | 68,678                            | 12,703                        | 5.4   |
| 1981                                    | 1,261                        | 69,134                            | 12,960                        | 5.3   |
| 1982                                    | 1,265                        | 66,668                            | 12,636                        | 5.3   |
| 1983                                    | 1,304                        | 69,754                            | 13,447                        | 5.2   |
| 1984                                    | 1,340                        | 77,367                            | 14,781                        | 5.2   |
| 1985                                    | 1,403                        | 79,600                            | 15,280                        | 5.2   |
| 1986                                    | 1,399                        | 81,833                            | 15,716                        | 5.2   |
| 1987                                    | 1,419                        | 86,064                            | 16,493                        | 5.2   |
| 1988                                    | 1,476                        | 90,158                            | 17,123                        | 5.3   |
| 1989                                    | 1,589                        | 95,349                            | 17,495                        | 5.5   |
| 1990                                    | 1,607                        | 96,482                            | 17,577                        | 5.5   |
| <i>Average annual percentage change</i> |                              |                                   |                               |   |
| 1970-90                                 | 2.9%                         | 5.2%                              | 4.5%                          | 0.7%  |
| 1982-90                                 | 3.0%                         | 4.7%                              | 4.2%                          | 0.5%  |

**Source:**

Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table VM-1, p. 192, and annual.

<sup>a</sup>The fuel economy for combination trucks is not the same as the fuel economy for Class 8 trucks. Fuel economy for Class 8 trucks is shown in Table 3.25.

**Table 3.27**  
**Truck Fuel Economy by Size Class, 1977, 1982, and 1987**  
 (miles per gallon)

| Size Class | Weight                | 1977<br>TIUS* | 1982<br>TIUS* | 1987<br>TIUS* |
|------------|-----------------------|---------------|---------------|---------------|
| Class 1    | 6,000 pounds and less | 13.2          | 14.2          | 15.0          |
| Class 2    | 6,001-10,000 pounds   | 11.5          | 11.1          | 10.9          |
| Class 3    | 10,000-14,000 pounds  | 9.4           | 8.1           | 8.1           |
| Class 4    | 14,001-16,000 pounds  | 6.9           | 7.5           | 7.5           |
| Class 5    | 16,001-19,500 pounds  | 7.6           | 7.2           | 7.1           |
| Class 6    | 19,501-26,000 pounds  | 6.1           | 6.9           | 6.4           |
| Class 7    | 26,001-33,000 pounds  | 5.3           | 6.2           | 6.1           |
| Class 8    | 33,001 and over       | 4.8           | 5.2           | 5.3           |

**Source:**

Estimates are based on data provided on the following public use tapes: U.S. Department of Commerce, Bureau of the Census, 1977 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1980; U.S. Department of Commerce, Bureau of the Census, 1982 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1985; and U.S. Department of Commerce, Bureau of the Census, 1987 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1990.

**Table 3.28**  
**Percentage of Trucks by Size Class, 1977, 1982, and 1987**  
 (percentage)

| Size Class | Weight                | 1977<br>TIUS* | 1982<br>TIUS* | 1987<br>TIUS* |
|------------|-----------------------|---------------|---------------|---------------|
| Class 1    | 6,000 pounds and less | 66.0          | 77.8          | 85.4          |
| Class 2    | 6,001-10,000 pounds   | 17.9          | 11.6          | 6.5           |
| Class 3    | 10,000-14,000 pounds  | 3.1           | 1.6           | 1.2           |
| Class 4    | 14,001-16,000 pounds  | 1.3           | 0.9           | 0.5           |
| Class 5    | 16,001-19,500 pounds  | 2.1           | 1.0           | 0.6           |
| Class 6    | 19,501-26,000 pounds  | 3.4           | 2.4           | 1.7           |
| Class 7    | 26,001-33,000 pounds  | 1.5           | 1.0           | 0.8           |
| Class 8    | 33,001 and over       | 4.6           | 3.8           | 3.3           |

**Source:**

Estimates are based on data provided on the following public use tapes: U.S. Department of Commerce, Bureau of the Census, 1977 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1980; U.S. Department of Commerce, Bureau of the Census, 1982 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1985; and U.S. Department of Commerce, Bureau of the Census, 1987 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1990.

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\*Truck Inventory and Use Survey.

## **Section 3.4**

### **Buses**

**Table 3.29**  
**Buses in Operation by Type, 1970-90**

| Year                                    | Transit <sup>a</sup> |                            | Intercity bus | School and other nonrevenue <sup>c</sup> | Other <sup>d</sup> | Total   |
|---|----------------------|----------------------------|---------------|--|--------------------|---------|
|   | Motor bus            | Trolley coach <sup>b</sup> |               |  |                    |         |
| 1970                                    | 49,700               | 1,050                      | 22,000        | 288,700                                  | 16,112             | 377,562 |
| 1971                                    | 49,150               | 1,037                      | 21,900        | 307,300                                  | 17,688             | 397,075 |
| 1972                                    | 49,075               | 1,030                      | 21,400        | 318,200                                  | 17,161             | 406,866 |
| 1973                                    | 48,286               | 794                        | 20,800        | 336,000                                  | 19,040             | 424,920 |
| 1974                                    | 48,700               | 718                        | 21,000        | 356,900                                  | 19,730             | 447,048 |
| 1975                                    | 50,811               | 703                        | 20,500        | 368,300                                  | 21,842             | 462,156 |
| 1976                                    | 52,382               | 685                        | 20,100        | 381,498                                  | 23,674             | 478,339 |
| 1977                                    | 51,968               | 645                        | 20,300        | 393,810                                  | 24,038             | 490,761 |
| 1978                                    | 52,866               | 593                        | 20,250        | 398,804                                  | 32,841             | 505,354 |
| 1979                                    | 54,490               | 725                        | 20,680        | 415,117                                  | 35,753             | 526,765 |
| 1980                                    | 59,411               | 823                        | 21,400        | 418,255                                  | 28,930             | 528,789 |
| 1981                                    | 60,393               | 751                        | 21,500        | 432,813                                  | 28,437             | 543,894 |
| 1982                                    | 62,114               | 763                        | 22,000        | 442,133                                  | 32,190             | 559,200 |
| 1983                                    | 62,093               | 686                        | 23,500        | 470,727                                  | 25,878             | 582,884 |
| 1984                                    | 67,294               | 664                        | 25,000        | 471,461                                  | 23,049             | 583,671 |
| 1985                                    | 64,258               | 676                        | 20,200        | 480,400                                  | 34,924             | 593,485 |
| 1986                                    | 66,218               | 680                        | 20,300        | 479,076                                  | 35,672             | 593,728 |
| 1987                                    | 63,017               | 671                        | 20,100        | 486,753                                  | 36,544             | 602,055 |
| 1988                                    | 62,572               | 710                        | 19,887        | 498,907                                  | 35,777             | 615,669 |
| 1989                                    | 58,919               | 725                        | 20,043        | 507,628                                  | 36,394             | 625,040 |
| 1990                                    | 59,753               | 832                        | 20,680        | 508,261                                  | 37,461             | 626,987 |
| <i>Average annual percentage change</i> |                      |                            |               |  |                    |         |
| 1970-90                                 | 0.9%                 | -1.2%                      | -0.3%         | 2.9%                                     | 4.3%               | 2.6%    |
| 1982-90                                 | -0.5%                | 1.1%                       | -0.8%         | 1.8%                                     | 1.9%               | 1.4%    |

**Sources:**

Transit buses - American Public Transit Association, 1991 Transit Fact Book, Washington, DC, October 1991, p. 76, and annual.

Intercity buses - 1970-84: American Bus Association, 1984 Annual Report, Washington, DC, and annual.

1985-88: U.S. Department of Transportation, Transportation Systems Center, National Transportation Statistics, Cambridge, MA, August 1990, Figure 5, p. 8, and annual.

1989-90: Estimated as 38% of commercial buses (less transit motor buses). Commercial bus total found in Highway Statistics 1990, Table MV-10, and annual.

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

School buses and Total buses - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table MV-10, p. 20, and annual.

\*Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

<sup>b</sup>Trolley coach - a rubber tired transit vehicle that usually draws its power from overhead wires.

<sup>c</sup>Includes some industrial and other private buses.

<sup>d</sup>Includes government buses, private buses, and other miscellaneous buses.

*Although school buses comprise 81% of the bus vehicle stock, only 55% of bus vehicle travel was attributed to school buses in 1990. Intercity buses were the only bus type to experience declines in passenger travel and vehicle travel from 1970-90 and 1982-90.*

**Table 3.30**  
**Passenger and Vehicle Travel by Bus Type, 1970-90**

| Year                                    | Passenger travel<br>(million miles) |               | Vehicle travel<br>(million miles) |               |            |
|---|-------------------------------------|---------------|-----------------------------------|---------------|------------|
|   | Transit bus*                        | Intercity bus | Transit bus*                      | Intercity bus | School bus |
| 1970                                    | 18,120                              | 25,300        | 1,409                             | 1,209         | 2,100      |
| 1971                                    | 16,810                              | 25,500        | 1,375                             | 1,202         | 2,212      |
| 1972                                    | 16,180                              | 25,600        | 1,308                             | 1,182         | 2,359      |
| 1973                                    | 16,170                              | 26,400        | 1,370                             | 1,178         | 2,412      |
| 1974                                    | 17,910                              | 27,700        | 1,431                             | 1,195         | 2,450      |
| 1975                                    | 18,300                              | 25,400        | 1,526                             | 1,126         | 2,500      |
| 1976                                    | 18,890                              | 25,100        | 1,581                             | 1,118         | 2,862      |
| 1977                                    | 19,730                              | 25,700        | 1,623                             | 1,102         | 2,950      |
| 1978                                    | 20,708                              | 25,400        | 1,631                             | 1,081         | 2,991      |
| 1979                                    | 21,393                              | 27,200        | 1,634                             | 1,132         | 2,980      |
| 1980                                    | 21,790                              | 27,400        | 1,677                             | 1,162         | 2,900      |
| 1981                                    | 21,012                              | 27,100        | 1,685                             | 1,134         | 2,960      |
| 1982                                    | 19,987                              | 26,900        | 1,669                             | 1,115         | 3,062      |
| 1983                                    | 20,047                              | 26,500        | 1,678                             | 1,120         | 3,058      |
| 1984                                    | 21,595                              | 27,100        | 1,845                             | 1,098         | 3,400      |
| 1985                                    | 21,161                              | 23,800        | 1,863                             | 933           | 3,448      |
| 1986                                    | 21,395                              | 23,700        | 2,002                             | 1,021         | 3,700      |
| 1987                                    | 20,970                              | 23,000        | 2,079                             | 991           | 3,900      |
| 1988                                    | 20,753                              | 23,100        | 2,097                             | 996           | 4,100      |
| 1989                                    | 20,768                              | 24,000        | 2,109                             | 1,034         | 4,000      |
| 1990                                    | 21,127                              | 23,000        | 2,153                             | 991           | 3,800      |
| <i>Average annual percentage change</i> |                                     |               |                                   |               |            |
| 1970-90                                 | 0.8%                                | -0.5%         | 2.1%                              | -1.0%         | 3.0%       |
| 1982-90                                 | 0.7%                                | -1.9%         | 3.2%                              | -1.5%         | 2.7%       |

**Sources:**

Transit buses - 1970-90: American Public Transit Association, 1991 Transit Fact Book, Washington, DC, October 1991, pp. 73, 74, and annual.

Intercity buses - 1970-84: American Bus Association, Annual Report, Washington, DC, Annual.

1985-90: Eno Transportation Foundation, Transportation in America, Ninth edition-December supplement, Washington, DC, 1991, p. 11.

1986-90 vehicle travel: Estimated using passenger travel and an average load factor of 23.2.

School buses - 1970-84: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1984, Washington, DC, Table VM-1, p. 175, and annual.

1985-87: U.S. Department of Transportation, Research and Special Programs Administration, National Transportation Statistics, 1989, Figure 2, p. 7, and annual.

1988-90: National Safety Council, Accident Facts, 1991 Edition, Chicago, IL, p. 71, and annual.

\*Transit bus statistics include motor bus only. Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

*The average annual miles per transit bus has been growing each year since 1982. School buses travel the least per bus, but travel more total vehicle miles than the other bus types.*

**Table 3.31**  
**Average Annual Miles per Bus by Type, 1970-90**  
(miles)

| Year                                    | Transit bus <sup>a</sup> | Intercity bus | School bus |
|---|--------------------------|---------------|------------|
| 1970                                    | 28,350                   | 54,955        | 7,274      |
| 1971                                    | 27,976                   | 54,886        | 7,198      |
| 1972                                    | 26,653                   | 55,234        | 7,414      |
| 1973                                    | 28,373                   | 56,635        | 7,179      |
| 1974                                    | 29,384                   | 56,905        | 6,865      |
| 1975                                    | 30,033                   | 54,927        | 6,788      |
| 1976                                    | 30,182                   | 55,622        | 7,502      |
| 1977                                    | 31,231                   | 54,286        | 7,491      |
| 1978                                    | 30,852                   | 53,383        | 7,500      |
| 1979                                    | 29,987                   | 54,739        | 7,179      |
| 1980                                    | 28,227                   | 54,299        | 6,934      |
| 1981                                    | 27,901                   | 52,744        | 6,839      |
| 1982                                    | 26,870                   | 50,682        | 6,926      |
| 1983                                    | 27,024                   | 47,660        | 6,581      |
| 1984                                    | 27,417                   | 43,920        | 7,212      |
| 1985                                    | 28,992                   | 46,188        | 7,177      |
| 1986                                    | 30,233                   | 50,296        | 7,723      |
| 1987                                    | 32,991                   | 49,304        | 8,012      |
| 1988                                    | 33,513                   | 50,083        | 8,218      |
| 1989                                    | 35,795                   | 51,589        | 7,880      |
| 1990                                    | 36,032                   | 47,921        | 7,476      |
| <i>Average annual percentage change</i> |                          |               |            |
| 1970-90                                 | 1.2%                     | -0.7%         | 0.1%       |
| 1982-90                                 | 3.7%                     | -0.7%         | 1.0%       |

**Source:**

Annual miles were obtained by dividing the total vehicles miles (from Table 3.30) by the number of vehicles (from Table 3.29).

<sup>a</sup>Transit bus statistics include motor bus only. Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

*Transit buses, which were the least efficient bus type on a Btu per vehicle-mile basis, accounted for nearly half of total bus energy use in 1990. School buses, which were the most efficient on a Btu per vehicle-mile basis, accounted for 38% of bus energy use in 1990.*

**Table 3.32**  
**Energy Consumption and Energy Intensities by Type of Bus, 1970-90**

| Year                                    | Energy use (trillion Btu) |               |            | Energy Intensity (Btu per vehicle-mile) |               |            |
|---|---------------------------|---------------|------------|---|---------------|------------|
|   | Transit bus <sup>a</sup>  | Intercity bus | School bus | Transit bus <sup>a</sup>                | Intercity bus | School bus |
| 1970                                    | 44.8                      | 26.6          | 37.5       | 31,796                                  | 22,002        | 17,857     |
| 1971                                    | 41.6                      | 26.5          | 39.5       | 30,255                                  | 22,047        | 17,857     |
| 1972                                    | 39.7                      | 26.0          | 40.0       | 30,352                                  | 21,997        | 16,956     |
| 1973                                    | 42.0                      | 25.9          | 40.9       | 30,657                                  | 21,986        | 16,957     |
| 1974                                    | 45.1                      | 26.3          | 41.6       | 31,516                                  | 22,008        | 16,980     |
| 1975                                    | 51.5                      | 24.8          | 42.6       | 33,748                                  | 22,025        | 17,040     |
| 1976                                    | 54.7                      | 25.0          | 48.8       | 34,598                                  | 22,361        | 17,051     |
| 1977                                    | 57.0                      | 24.7          | 50.1       | 35,120                                  | 22,414        | 16,983     |
| 1978                                    | 59.7                      | 24.2          | 50.9       | 36,603                                  | 22,387        | 17,018     |
| 1979                                    | 59.8                      | 26.2          | 50.6       | 36,597                                  | 23,145        | 16,980     |
| 1980                                    | 61.3                      | 29.3          | 47.5       | 36,553                                  | 25,215        | 16,379     |
| 1981                                    | 63.6                      | 31.3          | 48.5       | 37,745                                  | 27,601        | 16,385     |
| 1982                                    | 64.7                      | 30.9          | 49.9       | 38,766                                  | 27,713        | 16,296     |
| 1983                                    | 63.7                      | 31.1          | 50.3       | 37,962                                  | 27,768        | 16,236     |
| 1984                                    | 69.2                      | 33.8          | 50.7       | 37,507                                  | 30,783        | 14,912     |
| 1985                                    | 72.4                      | 31.5          | 57.0       | 38,862                                  | 31,722        | 16,531     |
| 1986                                    | 75.6                      | 20.6          | 57.8       | 39,873                                  | 20,176        | 15,622     |
| 1987                                    | 74.3                      | 21.6          | 60.9       | 38,557                                  | 21,796        | 15,615     |
| 1988                                    | 73.0                      | 22.3          | 63.9       | 39,121                                  | 22,390        | 15,585     |
| 1989                                    | 77.3                      | 23.1          | 62.3       | 36,583                                  | 22,340        | 15,575     |
| 1990                                    | 78.9                      | 21.7          | 62.2       | 36,647                                  | 21,897        | 16,368     |
| <i>Average annual percentage change</i> |                           |               |            |   |               |            |
| 1970-90                                 | 2.9%                      | -1.0%         | 2.6%       | 0.7%                                    | -0.5%         | 0.1%       |
| 1982-90                                 | 2.5%                      | -4.3%         | 2.8%       | -0.7%                                   | -7.6%         | -0.4%      |

**Source:**

Energy use - See Appendix A for Table 2.10.

Energy intensities by vehicle-mile were calculated by dividing energy use by vehicle-miles

<sup>a</sup>Transit bus statistics include motor bus only. Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

## **Section 3.5**

### **Fleets**

*Total new registrations of domestic non-household fleet vehicles rose over 2 million in 1991. Midsize autos accounted for half of new registrations in 1991. Although the share of large autos jumped to 19.6% in 1990, the share declined to 14.9% in 1991.*

**Table 3.33**  
Distribution of New Domestic Fleet\* Automobile Registrations by Size Class, 1975-91

| Model<br>Year                           | Percentage       |            |         |         |       | Total New<br>Registrations |
|---|------------------|------------|---------|---------|-------|----------------------------|
|   | Minicompact      | Subcompact | Compact | Midsize | Large |                            |
| 1975                                    | 0.0              | 14.3       | 12.9    | 39.3    | 33.2  | 966,099                    |
| 1976                                    | 0.0              | 14.7       | 12.9    | 47.4    | 24.7  | 1,044,485                  |
| 1977                                    | 0.0              | 12.2       | 15.1    | 43.2    | 29.2  | 1,182,292                  |
| 1978                                    | 2.6 <sup>b</sup> | 5.8        | 11.1    | 53.4    | 26.8  | 1,379,630                  |
| 1979                                    | 2.2              | 9.8        | 9.5     | 47.3    | 31.0  | 1,371,782                  |
| 1980                                    | 3.3              | 10.6       | 11.6    | 54.1    | 20.2  | 1,130,119                  |
| 1981                                    | 0.2              | 8.8        | 17.5    | 61.9    | 11.2  | 1,133,013                  |
| 1982                                    | 0.0              | 8.7        | 17.3    | 63.0    | 10.7  | 1,022,588                  |
| 1983                                    | 0.0              | 6.9        | 19.6    | 62.2    | 11.1  | 1,137,976                  |
| 1984                                    | 0.0              | 10.3       | 23.3    | 52.0    | 13.6  | 1,483,790                  |
| 1985                                    | 0.0              | 13.1       | 25.0    | 47.0    | 13.7  | 1,536,299                  |
| 1986                                    | 0.0              | 12.4       | 24.2    | 47.4    | 14.9  | 1,507,559                  |
| 1987                                    | 0.2              | 9.8        | 26.8    | 48.6    | 14.2  | 1,500,683                  |
| 1988                                    | 0.7              | 10.0       | 27.6    | 45.8    | 15.5  | 1,618,971                  |
| 1989                                    | 0.0              | 10.7       | 20.4    | 56.0    | 12.7  | 1,665,888                  |
| 1990                                    | 0.0              | 11.9       | 22.7    | 45.0    | 19.6  | 1,601,875                  |
| 1991                                    | 0.3              | 12.3       | 21.6    | 50.7    | 14.9  | 2,066,984                  |
| <i>Average annual percentage change</i> |                  |            |         |         |       |                            |
| 1975-91                                 |                  |            |         |         |       | 4.9%                       |
| 1982-91                                 |                  |            |         |         |       | 8.1%                       |

**Source:**

Bobit Publishing Company, Automotive Fleet Research Department, 1992 Automotive Fleet Factbook, Redondo Beach, C.A., 1992, pp. 24-26, and annual. Percentages were derived by classifying data into Environmental Protection Agency size classes.

\*A fleet consists of 10 or more vehicles.

<sup>b</sup>In 1978, Ford Pinto and Mercury Bobcat changed size classes from subcompact to minicompact. Both models were discontinued in 1982.

Table 3.34  
Automobile Fleets by Use, 1970-91  
(thousands)

| Year    | Cars in fleets of 10 or more |                   |                         |           |        |       |                    |            | Cars in fleets of 4 or more |
|---------|------------------------------|-------------------|-------------------------|-----------|--------|-------|--------------------|------------|-----------------------------|
|         | Business fleets <sup>a</sup> | Individual leased | Government <sup>b</sup> | Utilities | Police | Taxi  | Daily rental       | Total cars |                             |
| 1970    | 2,529                        | 803               | 674                     | 416       | 207    | 171   | 314                | 5,114      | 9,992                       |
| 1971    | 2,573                        | 834               | 695                     | 421       | 218    | 174   | 319                | 5,234      | 10,070                      |
| 1972    | 2,664                        | 925               | 670                     | 438       | 236    | 177   | 341                | 5,451      | 10,094                      |
| 1973    | 2,890                        | 974               | 686                     | 467       | 249    | 182   | 364                | 5,812      | 10,214                      |
| 1974    | 2,928                        | 1,008             | 701                     | 482       | 261    | 185   | 361                | 5,926      | 10,324                      |
| 1975    | 2,934                        | 1,072             | 715                     | 497       | 278    | 193   | 354                | 6,043      | 10,398                      |
| 1976    | 3,066                        | 1,217             | 727                     | 508       | 286    | 202   | 373                | 6,379      | 10,403                      |
| 1977    | 3,093                        | 1,385             | 735                     | 518       | 292    | 202   | 385                | 6,610      | 10,414                      |
| 1978    | 3,148                        | 1,610             | 747                     | 523       | 294    | 205   | 448                | 6,975      | 10,423                      |
| 1979    | 3,195                        | 1,6 <sup>c</sup>  | 752                     | 529       | 291    | 207   | 462                | 7,126      | 10,428                      |
| 1980    | 3,279                        | 1,6 <sup>c</sup>  | 752                     | 532       | 288    | 205   | 500                | 7,264      | 10,433                      |
| 1981    | 3,306                        | 1,6 <sup>c</sup>  | 757                     | 537       | 284    | 198   | 462                | 7,257      | 10,436                      |
| 1982    | 3,324                        | 1,645             | 603                     | 530       | 223    | 141   | 457                | 6,923      | 10,076                      |
| 1983    | 3,383                        | 1,653             | 606                     | 533       | 221    | 139   | 466                | 7,001      | 10,400                      |
| 1984    | 3,422                        | 1,657             | 638                     | 540       | 228    | 140   | 755 <sup>e</sup>   | 7,390      | 10,475                      |
| 1985    | 3,484                        | 1,800             | 643                     | 540       | 233    | 140   | 760                | 7,600      | 10,508                      |
| 1986    | 3,530                        | 1,975             | 647                     | 545       | 238    | 143   | 790                | 7,868      | 10,560                      |
| 1987    | 3,564                        | 2,098             | 650                     | 550       | 240    | 144   | 800                | 8,046      | 10,578                      |
| 1988    | 3,689                        | 2,160             | 658                     | 553       | 242    | 144   | 870                | 8,314      | 10,597                      |
| 1989    | 3,787                        | 2,140             | 658 <sup>d</sup>        | 553       | 244    | 144   | 907                | 8,431      | 10,592                      |
| 1990    | 3,823                        | 2,020             | 653 <sup>d</sup>        | 551       | 249    | 141   | 990                | 8,427      | 10,607                      |
| 1991    | 3,466                        | 2,008             | 619 <sup>d</sup>        | 544       | 250    | 141   | 1,160              | 8,188      | 10,514                      |
| 1970-91 | 1.5%                         | 4.5%              | -0.4%                   | 1.3%      | 0.9%   | -0.9% | 6.4% <sup>e</sup>  | 2.3%       | 0.2%                        |
| 1982-91 | 0.5%                         | 2.2%              | 0.3%                    | 0.3%      | 1.3%   | 0.0%  | 10.9% <sup>e</sup> | 1.9%       | 0.5%                        |

## Source:

Bobit Publishing Company, Automotive Fleet Research Department, 1992 Automotive Fleet Fact Book, Redondo Beach, CA, 1992, pp. 16, 20, and annual.

<sup>a</sup>Includes driver schools.

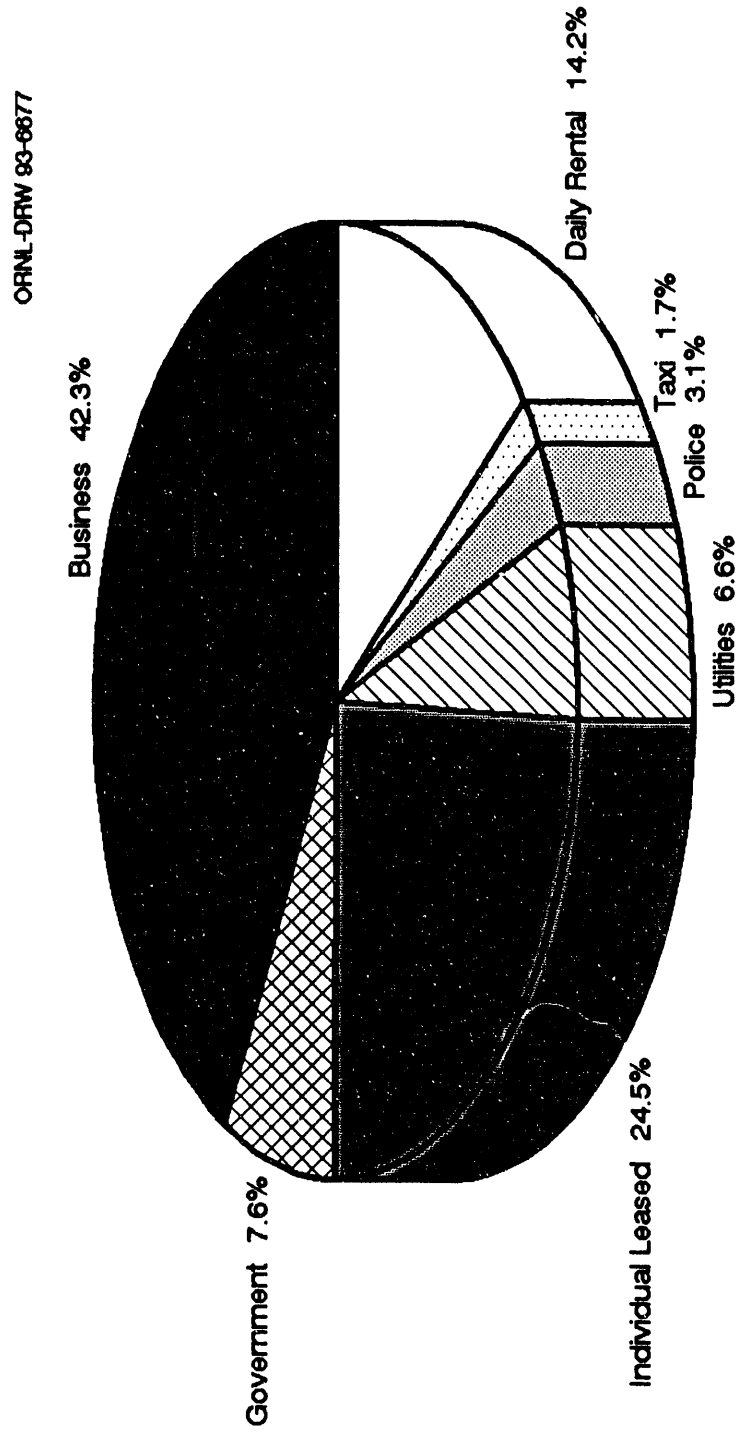
<sup>b</sup>Data from Automotive Fleet Fact Book does not include all Federal Government fleet vehicles. Federal fleet data are added from Federal Motor Vehicle Fleet Report, General Services Administration, Table 1 (all agencies - domestic sedans and station wagons).

<sup>c</sup>Major adjustment by Automotive Fleet Fact Book with new data for 1984. Daily rentals were underestimated from 1970 to 1983.

<sup>d</sup>Federal government data for 1989-91 are not available; therefore, the data are assumed to be equal to the 1988 federal government figures.

<sup>e</sup>Average annual percentage change is misleading due to the data change in daily rentals in 1984.

Figure 3.12. Distribution of Automobile Fleets by Use, 1991



Source: See Table 3.34.

**Table 3.35**  
**Federal Government Vehicles by Agency, Fiscal Year 1988**

| Department or Agency                        | Autos          | Buses        | Trucks and Truck Tractors <sup>a</sup> |                         |                        | Total          |
|---|----------------|--------------|--|-------------------------|------------------------|----------------|
|   |                |              | 8,500 lbs.<br>or less <sup>b</sup>     | 8,501 to<br>23,999 lbs. | 24,000 lbs.<br>or over |                |
| <b>CIVILIAN AGENCIES</b>                    | 86,884         | 2,393        | 96,866                                 | 13,884                  | 4,977                  | 205,004        |
| Government Printing Office                  | 6              | 0            | 59                                     | 0                       | 0                      | 65             |
| Library of Congress                         | 1              | 0            | 0                                      | 0                       | 0                      | 1              |
| Department of the State                     | 1,220          | 0            | 1,187                                  | 772                     | 67                     | 3,246          |
| Department of the Treasury                  | 8,559          | 11           | 1,485                                  | 51                      | 2                      | 10,108         |
| Department of Justice                       | 14,888         | 138          | 4,440                                  | 479                     | 92                     | 20,037         |
| Department of the Interior                  | 1,663          | 111          | 8,499                                  | 2,753                   | 1,674                  | 14,700         |
| Department of Agriculture                   | 3,911          | 41           | 24,049                                 | 4,154                   | 518                    | 32,673         |
| Department of Commerce                      | 93             | 14           | 376                                    | 189                     | 14                     | 686            |
| Department of Labor                         | 175            | 12           | 412                                    | 13                      | 6                      | 618            |
| Department of Health & Human Services       | 90             | 9            | 276                                    | 91                      | 55                     | 521            |
| Department of Transportation                | 80             | 8            | 394                                    | 126                     | 45                     | 653            |
| Department of Energy                        | 1,853          | 255          | 6,586                                  | 1,829                   | 751                    | 11,274         |
| Agency for International Development        | 370            | 22           | 204                                    | 57                      | 16                     | 979            |
| American Battle Monuments Commission        | 13             | 0            | 37                                     | 12                      | 0                      | 62             |
| Environmental Protection Agency             | 303            | 3            | 301                                    | 13                      | 9                      | 629            |
| Federal Communications Commission           | 61             | 0            | 34                                     | 4                       | 0                      | 99             |
| Federal Emergency Management Agency         | 35             | 14           | 76                                     | 9                       | 9                      | 143            |
| General Services Administration             | 50,869         | 1,605        | 44,230                                 | 2,001                   | 1,347                  | 100,052        |
| International Boundary & Water Commission   | 0              | 0            | 7                                      | 10                      | 23                     | 40             |
| Merit Systems Protection Board              | 0              | 0            | 1                                      | 0                       | 0                      | 1              |
| National Aeronautics & Space Administration | 135            | 11           | 714                                    | 219                     | 49                     | 1,155          |
| National Gallery of Art                     | 0              | 0            | 3                                      | 1                       | 0                      | 4              |
| National Science Foundation                 | 23             | 8            | 122                                    | 27                      | 2                      | 182            |
| Overseas Private Investment Corporation     | 1              | 0            | 0                                      | 0                       | 0                      | 1              |
| Panama Canal Commission                     | 186            | 13           | 524                                    | 79                      | 45                     | 847            |
| Peace Corps                                 | 147            | 9            | 214                                    | 3                       | 0                      | 373            |
| Railroad Retirement Board                   | 1              | 0            | 0                                      | 0                       | 0                      | 1              |
| Smithsonian Institution                     | 23             | 6            | 154                                    | 44                      | 24                     | 251            |
| Tennessee Valley Authority                  | 1,513          | 4            | 1,303                                  | 733                     | 159                    | 3,712          |
| United States Information Agency            | 455            | 12           | 323                                    | 29                      | 0                      | 819            |
| U.S. Soldiers' and Airmen's Home            | 12             | 6            | 25                                     | 6                       | 10                     | 59             |
| Veterans Administration                     | 198            | 81           | 494                                    | 180                     | 60                     | 1,103          |
| <b>UNITED STATES POSTAL SERVICE</b>         | 12,260         | 13           | 128,326                                | 10,805                  | 3,574                  | 154,978        |
| <b>MILITARY AGENCIES</b>                    | 22,937         | 6,417        | 102,105                                | 14,027                  | 8,214                  | 153,700        |
| Army  | 8,292          | 2,484        | 24,890                                 | 5,781                   | 2,147                  | 43,594         |
| Navy  | 3,624          | 997          | 23,728                                 | 2,707                   | 2,204                  | 33,260         |
| Marine Corps                                | 725            | 321          | 4,730                                  | 841                     | 607                    | 7,224          |
| Air Force                                   | 6,327          | 2,574        | 43,603                                 | 3,658                   | 3,034                  | 59,196         |
| Civil Works, Corps of Engineers             | 721            | 21           | 4,412                                  | 982                     | 204                    | 6,340          |
| Defense Agencies                            | 3,248          | 20           | 742                                    | 58                      | 18                     | 4,086          |
| <b>TOTAL</b>                                | <b>122,081</b> | <b>8,823</b> | <b>327,297</b>                         | <b>38,716</b>           | <b>16,765</b>          | <b>513,682</b> |

**Source:**

U.S. General Services Administration, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, September 1990, p. 27.

<sup>a</sup>Based on gross vehicle weight rating (GVWR).

<sup>b</sup>Includes ambulances.

## **Section 3.6**

# **Federal Standards and Motor Vehicle Fuel Economy**

*Except for the automobile fuel economy in model year 1984, the sales-weighted fuel economies of automobiles and light trucks have, on average, met the fuel economy standards set by the federal government. This does not mean, however, that each manufacturer is meeting the standards each year. Some manufacturers still fall short, while others exceed the standards. The domestic automobile CAFE estimate did not meet the 1992 standard, but the import estimate exceeded the standard, pulling the combined automobile CAFE estimate above the standard.*

**Table 3.36**  
**Corporate Average Fuel Economy (CAFE)**  
**Standards versus Sales-Weighted Fuel Economy Estimates**  
**for Automobiles and Light Trucks, 1978-92\***  
 (miles per gallon)

| Model<br>Year | Automobiles       |                             |        |          | Light Trucks <sup>b</sup> |                             |        |          |
|---------------|-------------------|-----------------------------|--------|----------|---------------------------|-----------------------------|--------|----------|
|               | CAFE<br>Standards | CAFE Estimates <sup>c</sup> |        |          | CAFE<br>Standards         | CAFE Estimates <sup>c</sup> |        |          |
|               |                   | Domestic                    | Import | Combined |                           | Domestic                    | Import | Combined |
| 1978          | 18.0              | 18.7                        | 27.3   | 19.9     | <sup>d</sup>              | •                           | •      | •        |
| 1979          | 19.0              | 19.3                        | 26.1   | 20.3     | 17.2                      | 17.7                        | 20.8   | 18.2     |
| 1980          | 20.0              | 22.6                        | 29.6   | 24.3     | <sup>d</sup>              | 16.8                        | 24.3   | 18.5     |
| 1981          | 22.0              | 24.2                        | 31.5   | 25.9     | <sup>d</sup>              | 18.3                        | 27.4   | 20.1     |
| 1982          | 24.0              | 25.0                        | 31.1   | 26.6     | 17.5                      | 19.2                        | 27.0   | 20.5     |
| 1983          | 26.0              | 24.4                        | 32.4   | 26.4     | 19.0                      | 19.6                        | 27.1   | 20.7     |
| 1984          | 27.0              | 25.5                        | 32.0   | 26.9     | 20.0                      | 19.3                        | 26.7   | 20.6     |
| 1985          | 27.5              | 26.3                        | 31.5   | 27.6     | 19.5                      | 19.6                        | 26.5   | 20.7     |
| 1986          | 26.0              | 26.9                        | 31.6   | 28.2     | 20.0                      | 19.9                        | 25.9   | 21.5     |
| 1987          | 26.0              | 27.0                        | 31.2   | 28.5     | 20.5                      | 20.5                        | 25.2   | 21.7     |
| 1988          | 26.0              | 27.4                        | 31.5   | 28.8     | 20.5                      | 20.6                        | 24.6   | 21.3     |
| 1989          | 26.5              | 27.2                        | 30.8   | 28.4     | 20.5                      | 20.4                        | 23.5   | 20.9     |
| 1990          | 27.5              | 26.9                        | 29.8   | 28.0     | 20.0                      | 20.2                        | 23.0   | 20.7     |
| 1991          | 27.5              | 27.4                        | 29.8   | 28.3     | 20.2                      | 20.9                        | 23.0   | 21.3     |
| 1992          | 27.5              | 26.9                        | 29.0   | 27.8     | 20.2                      | 20.4                        | 22.4   | 20.8     |

**Source:**

U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, March 1992.

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

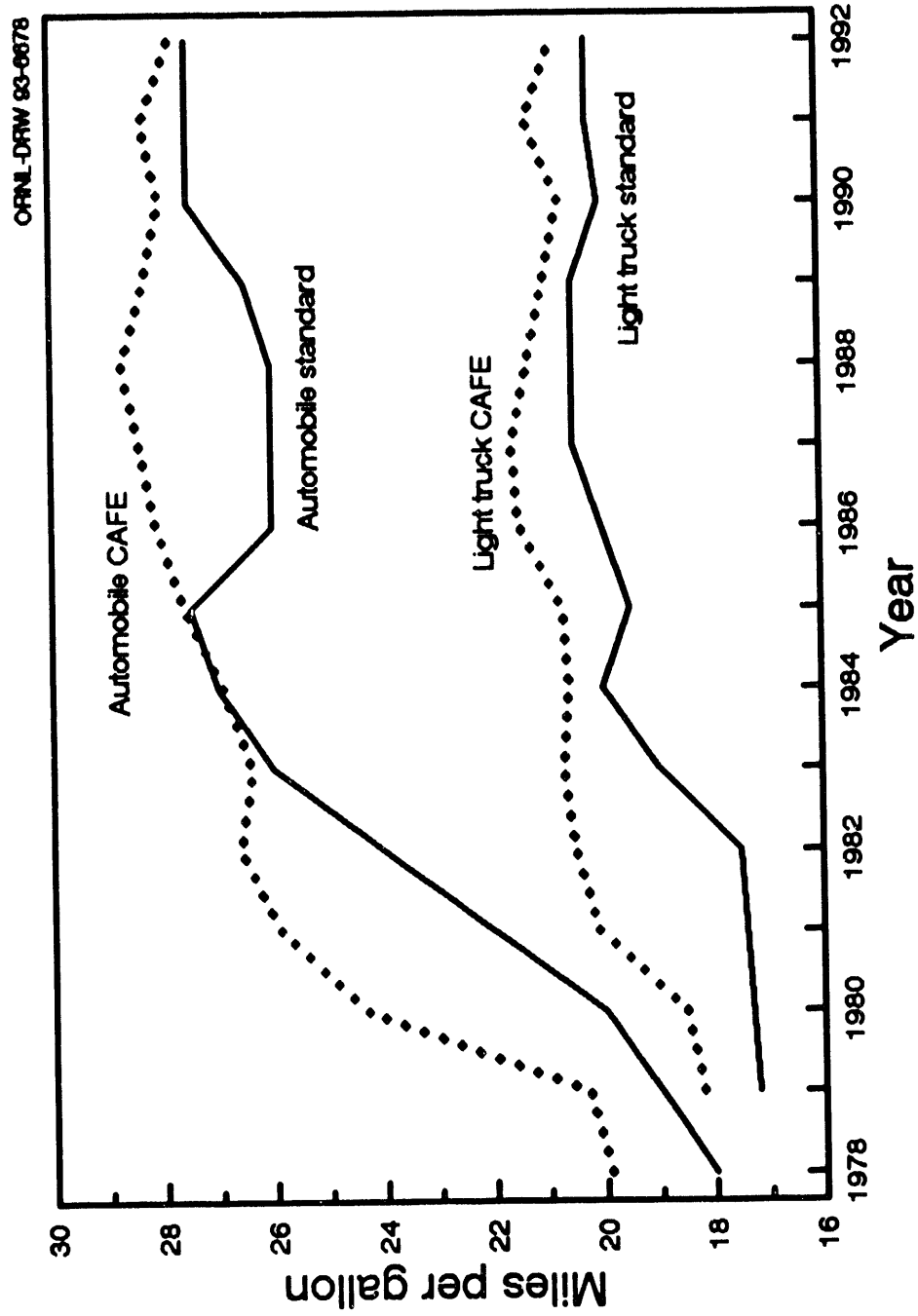
<sup>b</sup>Represents two- and four-wheel drive trucks combined. Gross vehicle weight of 0-6,000 pounds for model year 1979 and 0-8,500 pounds for subsequent years.

<sup>c</sup>All CAFE calculations are sales-weighted.

<sup>d</sup>Standards were set for two-wheel drive and four-wheel drive light trucks separately, but no combined standard was set in this year.

\*Data are not available.

Figure 3.13. Corporate Average Fuel Economy Standards and Sales-Weighted Fuel Economics for Automobiles and Light Trucks, 1978-92



Source: See Table 3.36.

**Table 3.37.**  
**Corporate Average Fuel Economy (CAFE) Fines Collected,**  
**1983-91**

| Model<br>year     | Thousands          |                                       |
|-------------------|--------------------|---------------------------------------|
|                   | Current<br>dollars | 1990 constant<br>dollars <sup>a</sup> |
| 1983              | 58                 | 76                                    |
| 1984              | 5,958              | 7,496                                 |
| 1985              | 15,565             | 18,908                                |
| 1986              | 29,872             | 35,603                                |
| 1987              | 30,981             | 35,623                                |
| 1988              | 43,622             | 48,190                                |
| 1989              | 46,122             | 48,619                                |
| 1990              | 47,582             | 47,582                                |
| 1991 <sup>b</sup> | 11,249             | 10,788                                |
| Total             | 231,009            | 252,885                               |

**Source:**

U.S. Department of Transportation, National Highway  
 Traffic Safety Administration, Office of Vehicle  
 Safety Compliance, Washington, DC, July 1992.

**Table 3.38**  
**Tax Receipts from the Sale of Gas Guzzlers, 1980-91**

| Fiscal<br>year | Thousands          |                                       |
|----------------|--------------------|---------------------------------------|
|                | Current<br>dollars | 1990 constant<br>dollars <sup>a</sup> |
| 1980           | 740                | 1,174                                 |
| 1981           | 780                | 1,121                                 |
| 1982           | 1,720              | 2,329                                 |
| 1983           | 4,020              | 5,273                                 |
| 1984           | 8,820              | 11,097                                |
| 1985           | 39,790             | 48,336                                |
| 1986           | 147,660            | 175,987                               |
| 1987           | 145,900            | 167,759                               |
| 1988           | 116,780            | 129,008                               |
| 1989           | 109,640            | 115,575                               |
| 1990           | 103,200            | 103,200                               |
| 1991           | 118,400            | 113,546                               |
| Total          | 797,450            | 874,405                               |

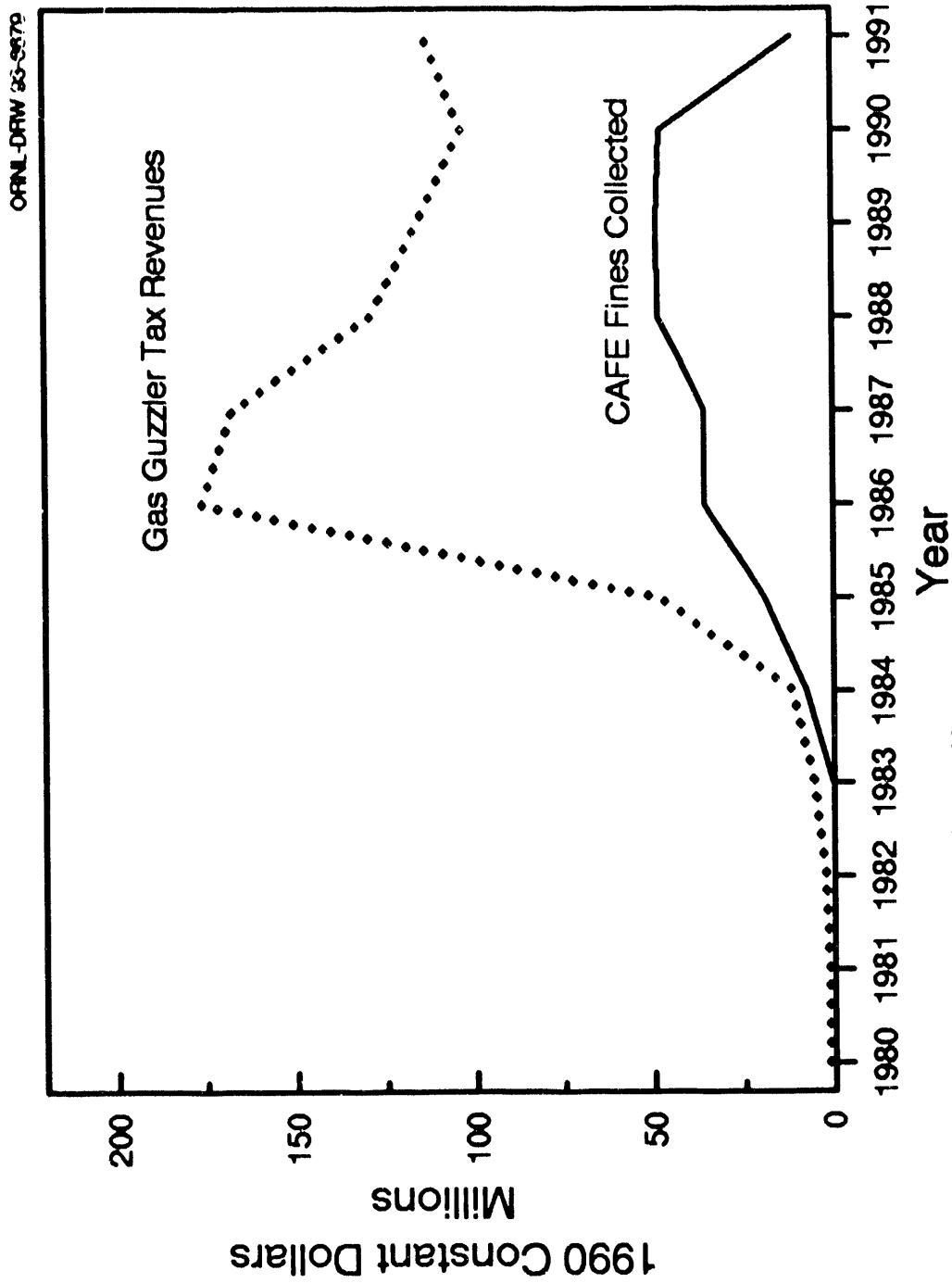
**Source:**

Motor Vehicle Manufacturers Association, Motor Vehicle  
 Facts and Figures '92, Detroit, MI, 1992, p. 87.

<sup>a</sup>Adjusted using the Consumer Price Inflation Index.

<sup>b</sup>Includes only those fines collected at time of publication.

Figure 3.14. CAFE Fines and Gas Guzzler Tax Revenues, 1980-91



Source: See Tables 3.37 and 3.38.

*Consumers must pay the Gas Guzzler Tax when purchasing an automobile that has an Environmental Protection Agency (EPA) fuel economy rating less than that stipulated in the table below. The Gas Guzzler Tax doubled in 1991 after remaining constant from 1986 to 1990.*

**Table 3.39**  
**The Gas Guzzler Tax on New Cars**  
(dollars per vehicle)

| Vehicle fuel economy (mpg) | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986-90 | 1991 + |
|----------------------------|------|------|------|------|------|------|---------|--------|
| Over 22.5                  | 0    | 0    | 0    | 0    | 0    | 0    | 0       | 0      |
| 22.0-22.5                  | 0    | 0    | 0    | 0    | 0    | 0    | 500     | 1000   |
| 21.5-22.0                  | 0    | 0    | 0    | 0    | 0    | 0    | 500     | 1000   |
| 21.0-21.5                  | 0    | 0    | 0    | 0    | 0    | 0    | 650     | 1300   |
| 20.5-21.0                  | 0    | 0    | 0    | 0    | 0    | 500  | 650     | 1300   |
| 20.0-20.5                  | 0    | 0    | 0    | 0    | 0    | 500  | 850     | 1700   |
| 19.5-20.0                  | 0    | 0    | 0    | 0    | 0    | 600  | 850     | 1700   |
| 19.0-19.5                  | 0    | 0    | 0    | 0    | 450  | 600  | 1050    | 2100   |
| 18.5-19.0                  | 0    | 0    | 0    | 350  | 450  | 800  | 1050    | 2100   |
| 18.0-18.5                  | 0    | 0    | 200  | 350  | 600  | 800  | 1300    | 2600   |
| 17.5-18.0                  | 0    | 0    | 200  | 500  | 600  | 1000 | 1300    | 2600   |
| 17.0-17.5                  | 0    | 0    | 350  | 500  | 750  | 1000 | 1500    | 3000   |
| 16.5-17.0                  | 0    | 200  | 350  | 650  | 750  | 1200 | 1500    | 3000   |
| 16.0-16.5                  | 0    | 200  | 450  | 650  | 950  | 1200 | 1850    | 3700   |
| 15.5-16.0                  | 0    | 350  | 450  | 800  | 950  | 1500 | 1850    | 3700   |
| 15.0-15.5                  | 0    | 350  | 600  | 800  | 1150 | 1500 | 2250    | 4500   |
| 14.5-15.0                  | 200  | 450  | 600  | 1000 | 1150 | 1800 | 2250    | 4500   |
| 14.0-14.5                  | 200  | 450  | 750  | 1000 | 1450 | 1800 | 2700    | 5400   |
| 13.5-14.0                  | 300  | 550  | 750  | 1250 | 1450 | 2200 | 2700    | 5400   |
| 13.0-13.5                  | 300  | 550  | 950  | 1250 | 1750 | 2200 | 3200    | 6400   |
| 12.5-13.0                  | 550  | 650  | 950  | 1550 | 1750 | 2650 | 3200    | 6400   |
| Under 12.5                 | 550  | 650  | 1200 | 1550 | 2150 | 2650 | 3850    | 7700   |

**Source:**

Internal Revenue Service, Form 6197, "Gas Guzzler Tax" and annual.

*Two separate studies by the Federal Highway Administration have measured the effects of speed on the fuel economy of automobiles. (The 1984 study also included light trucks.) The fuel economy loss will vary for each individual vehicle; these data are averages for the tested vehicles. Both studies indicated that maximum fuel efficiency was achieved at speeds of 35 to 40 mph.*

**Table 3.40**  
**Fuel Economy by Speed, 1973 and 1984**  
**(miles per gallon)**

| Speed<br>(miles per hour) | 1973 <sup>a</sup> | 1984 <sup>b</sup> |
|---------------------------|-------------------|-------------------|
| 15                        | c                 | 21.1              |
| 20                        | c                 | 25.5              |
| 25                        | c                 | 30.0              |
| 30                        | 21.1              | 31.8              |
| 35                        | 21.1              | 33.6              |
| 40                        | 21.1              | 33.6              |
| 45                        | 20.3              | 33.5              |
| 50                        | 19.5              | 31.9              |
| 55                        | 18.5              | 30.3              |
| 60                        | 17.5              | 27.6              |
| 65                        | 16.2              | 24.9              |
| 70                        | 14.9              | 22.5              |
| 75                        | c                 | 20.0              |
| <i>Fuel economy loss</i>  |                   |                   |
| 55-65 mph                 | 12.4%             | 17.8%             |
| 65-70 mph                 | 8.0%              | 9.6%              |
| 55-70 mph                 | 19.5%             | 25.7%             |

**Sources:**

1973- U.S. Department of Transportation, Federal Highway Administration, Office of Highway Planning, The Effect of Speed on Automobile Gasoline Consumption Rates, Washington, DC, October 1973.

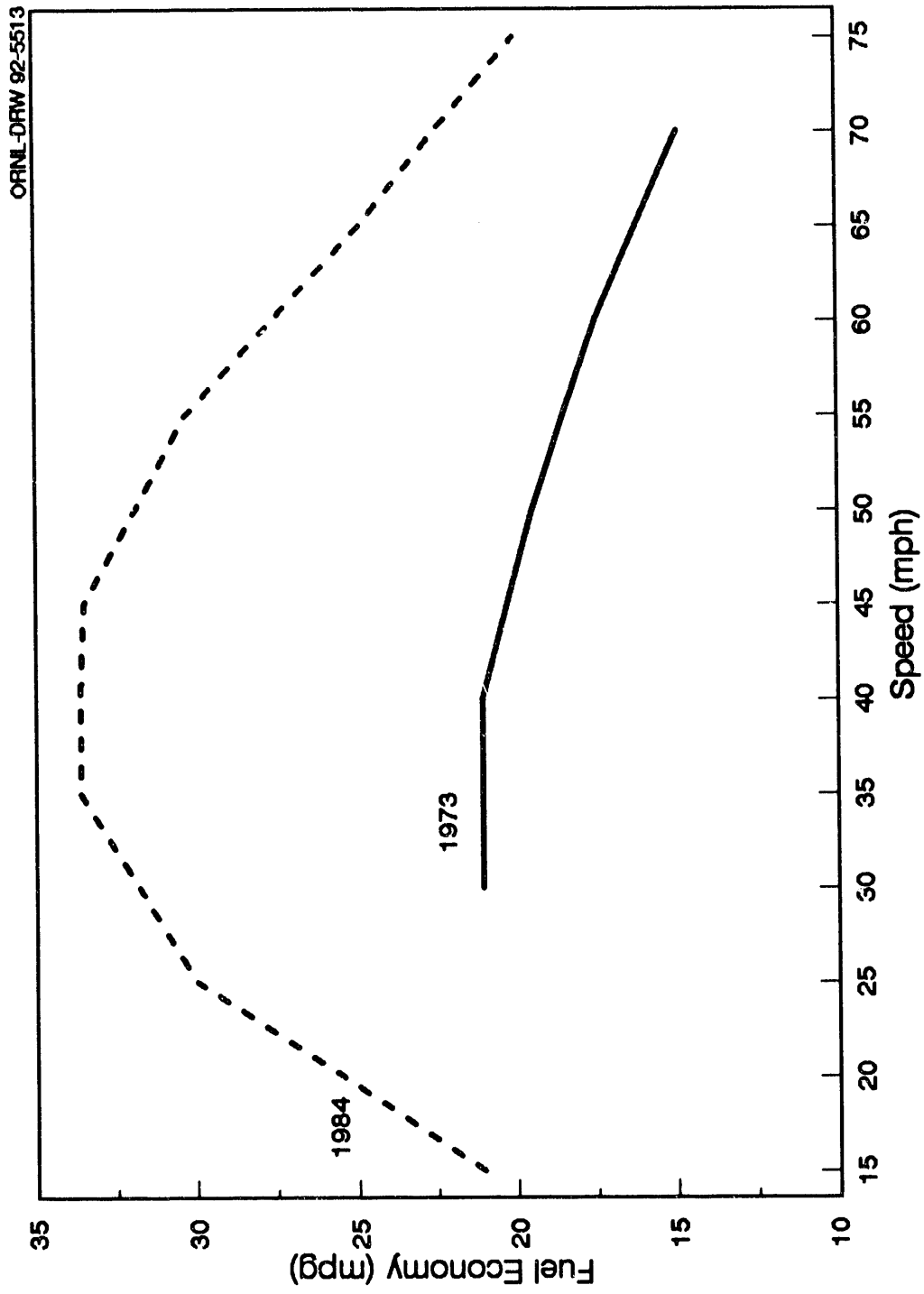
1984 - U.S. Department of Transportation, Federal Highway Administration, Fuel Consumption and Emission Values for Traffic Models, Washington, DC, May 1985.

<sup>a</sup>Model years 1970 and earlier automobiles.

<sup>b</sup>Model years 1981-84 automobiles and light trucks.

<sup>c</sup>Data are not available.

Figure 3.15. Fuel Economy by Speed, 1973 and 1984

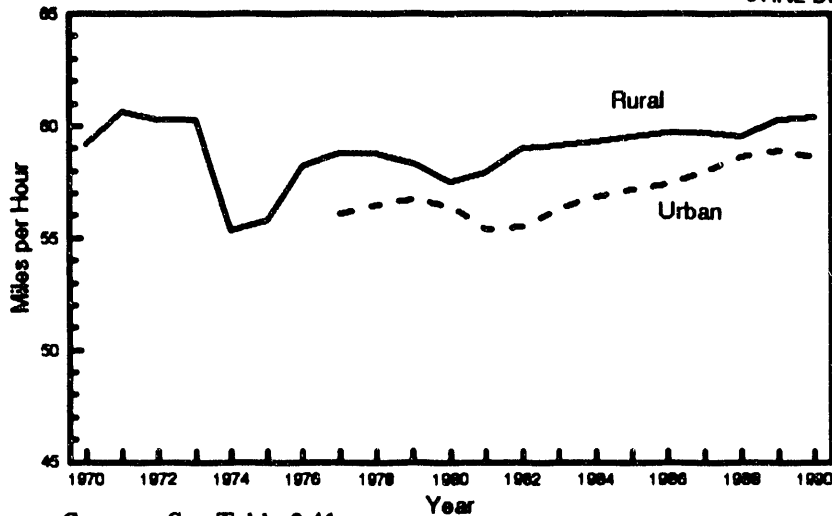


Source: See Table 3.40.

*For the first time since 1973, average rural Interstate speed rose to 60 miles per hour in 1989 and stayed at that speed in 1990. Average urban Interstate speed declined slightly in 1990 - the first decline in ten years.*

**Figure 3.16. Average Interstate Speeds, 1970-90**

ORNL-DRW 93-6680



Source: See Table 3.41

**Table 3.41**  
**Average Urban and Rural Interstate Speeds, 1970-90\***  
(miles per hour)

| Year | Urban Interstate | Rural Interstate |
|------|------------------|------------------|
| 1970 | <sup>b</sup>     | 59.2             |
| 1971 | <sup>b</sup>     | 60.6             |
| 1972 | <sup>b</sup>     | 60.3             |
| 1973 | <sup>b</sup>     | 60.3             |
| 1974 | <sup>b</sup>     | 55.3             |
| 1975 | <sup>b</sup>     | 55.8             |
| 1976 | 56.1             | 58.2             |
| 1977 | 56.5             | 58.8             |
| 1978 | 56.7             | 58.8             |
| 1979 | 56.4             | 58.3             |
| 1980 | 55.4             | 57.5             |
| 1981 | 55.5             | 57.9             |
| 1982 | 56.3             | 59.0             |
| 1983 | 56.8             | 59.1             |
| 1984 | 57.2             | 59.3             |
| 1985 | 57.2             | 59.5             |
| 1986 | 57.4             | 59.7             |
| 1987 | 58.0             | 59.7             |
| 1988 | 58.6             | 59.5             |
| 1989 | 58.9             | 60.3             |
| 1990 | 58.6             | 60.4             |

Source:

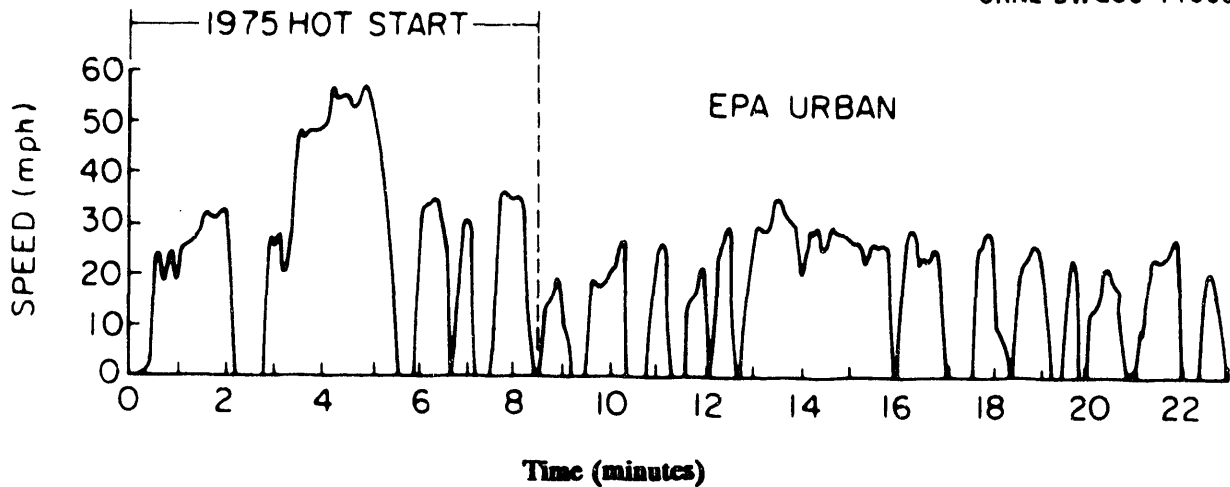
U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table VS-1, p. 199, and annual.

\*Data from 1970-79 represent only free-moving traffic, on level, straight, uncongested sections of Interstate. Beginning with fiscal year 1980, the data show the speeds of all vehicular traffic.

<sup>b</sup>Data are not available.

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

ORNL-DWG89-14608

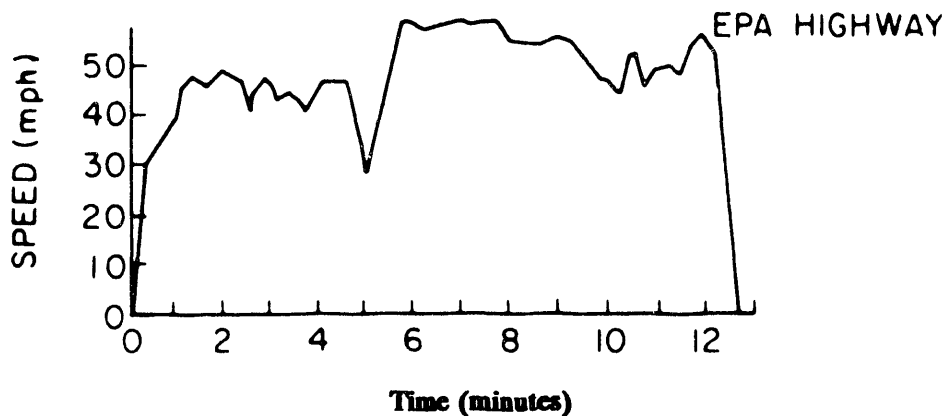


**Figure 3.17. Urban Driving Cycle**

Length of cycle: 1870 seconds, including idle time.

Average speed: 21.3 mph with idle; 26.5 mph without idle.

ORNL-DWG89-14609



**Figure 3.18. Highway Driving Cycle**

Length of cycle: 765 seconds.

Average speed: 48.5 mph.

**Source:**

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

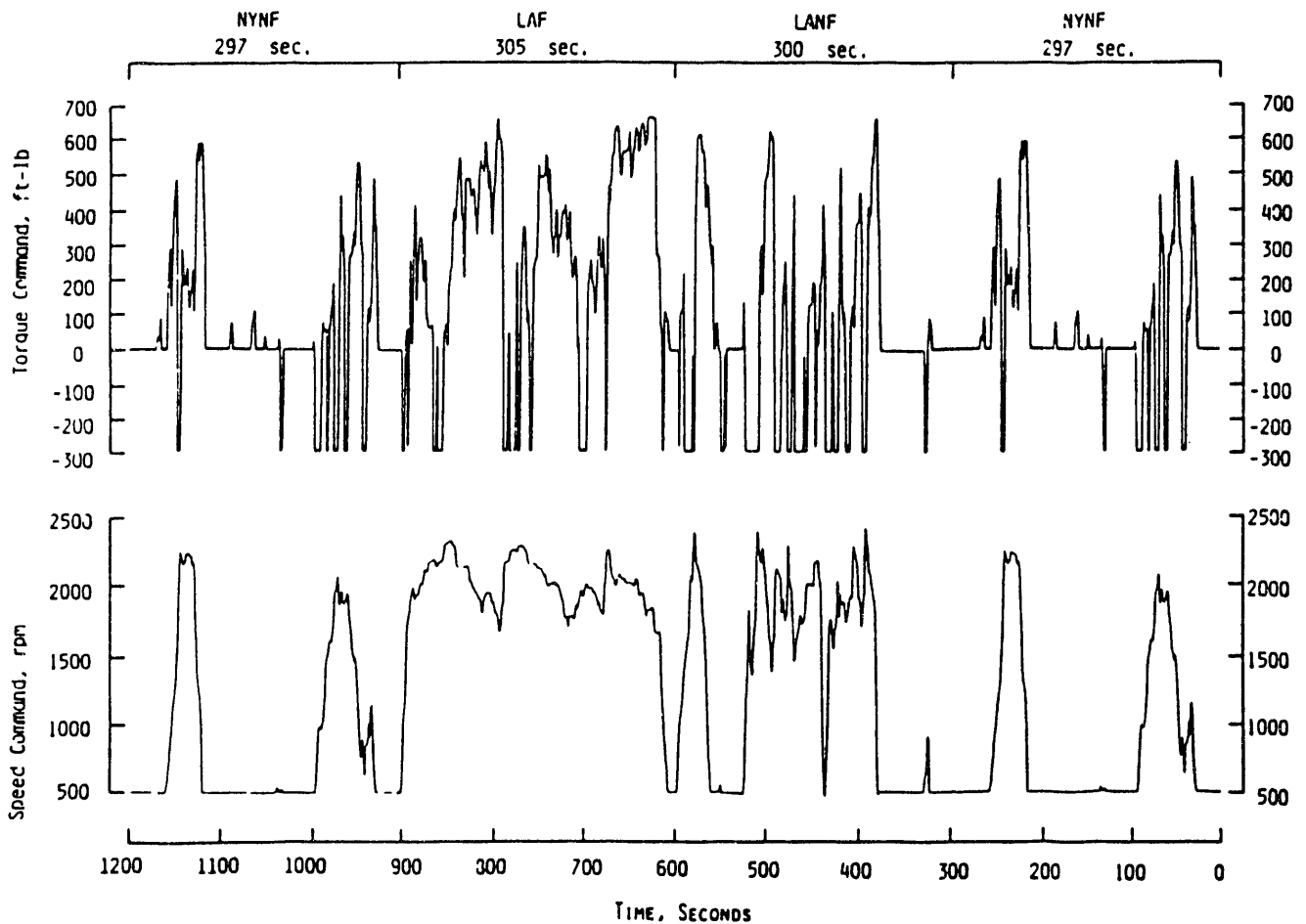
## **Section 3.7**

# **Vehicle Emissions**

*The Environmental Protection Agency (EPA) tests transient emissions from heavy-duty diesel engines using the 1984 Transient Federal Test Procedure. The engine is subjected to a cycle of varying speed and load for twenty minutes.*

**Figure 3.19. Torque and Speed Cycles for Transient Emissions Testing of a Typical Heavy-Duty Diesel Engine**

ORNL-DRW 93-6681



**Source:** Carroll, James N., et. al., "Emission Comparison of DDC 6V-92TA on Alcohol Fuels," Truck and Bus Meeting and Exposition, Detroit, MI, 1990, p.3.

*The Clean Air Act Amendment of 1990 established higher emission control standards. These standards will become effective in 1994.*

**Table 3.42**  
**Federal Emission Control Requirements for**  
**Automobiles and Light Trucks, 1976-94<sup>a</sup>**  
**(grams per mile)**

| Model<br>Year | Automobiles               |                            |  |                           | Light trucks <sup>b</sup> |                            |  |                           |
|---------------|---------------------------|----------------------------|--|---------------------------|---------------------------|----------------------------|--|---------------------------|
|               | Hydro-<br>carbons<br>(HC) | Carbon<br>monoxide<br>(CO) | Nitrogen<br>oxides<br>(NO <sub>x</sub> ) | Particulates <sup>c</sup> | Hydro-<br>carbons<br>(HC) | Carbon<br>monoxide<br>(CO) | Nitrogen<br>oxides<br>(NO <sub>x</sub> ) | Particulates <sup>c</sup> |
| 1976          | 1.50                      | 15.0                       | 3.1                                      | <sup>d</sup>              | 2.0                       | 20.0                       | 3.1                                      | <sup>d</sup>              |
| 1977          | 1.50                      | 15.0                       | 2.0                                      | <sup>d</sup>              | 2.0                       | 20.0                       | 3.1                                      | <sup>d</sup>              |
| 1978          | 1.50                      | 15.0                       | 2.0                                      | <sup>d</sup>              | 2.0                       | 20.0                       | 3.1                                      | <sup>d</sup>              |
| 1979          | 1.50                      | 15.0                       | 2.0                                      | <sup>d</sup>              | 1.7                       | 18.0                       | 2.3                                      | <sup>d</sup>              |
| 1980          | 0.41                      | 7.0                        | 2.0                                      | <sup>d</sup>              | 1.7                       | 18.0                       | 2.3                                      | <sup>d</sup>              |
| 1981          | 0.41                      | 3.4                        | 1.0                                      | <sup>d</sup>              | 1.7                       | 18.0                       | 2.3                                      | <sup>d</sup>              |
| 1982          | 0.41                      | 3.4                        | 1.0                                      | 0.6                       | 1.7                       | 18.0                       | 2.3                                      | 0.60                      |
| 1983          | 0.41                      | 3.4                        | 1.0                                      | 0.6                       | 1.7                       | 18.0                       | 2.3                                      | 0.60                      |
| 1984          | 0.41                      | 3.4                        | 1.0                                      | 0.6                       | 0.8                       | 10.0                       | 2.3                                      | 0.60                      |
| 1985          | 0.41                      | 3.4                        | 1.0                                      | 0.6                       | 0.8                       | 10.0                       | 2.3                                      | 0.60                      |
| 1986          | 0.41                      | 3.4                        | 1.0                                      | 0.6                       | 0.8                       | 10.0                       | 2.3                                      | 0.60                      |
| 1987          | 0.41                      | 3.4                        | 1.0                                      | 0.2                       | 0.8                       | 10.0                       | 2.3                                      | 0.26                      |
| 1988          | 0.41                      | 3.4                        | 1.0                                      | 0.2                       | 0.8                       | 10.0                       | 1.2 <sup>e</sup>                         | 0.26                      |
| 1989          | 0.41                      | 3.4                        | 1.0                                      | 0.2                       | 0.8                       | 10.0                       | 1.2 <sup>e</sup>                         | 0.26                      |
| 1990          | 0.41                      | 3.4                        | 1.0                                      | 0.2                       | 0.8                       | 10.0                       | 1.2 <sup>e</sup>                         | 0.26                      |
| 1991          | 0.41                      | 3.4                        | 1.0                                      | 0.2                       | 0.8                       | 10.0                       | 1.2 <sup>e</sup>                         | 0.26                      |
| 1992          | 0.41                      | 3.4                        | 1.0                                      | 0.2                       | 0.8                       | 10.0                       | 1.2 <sup>e</sup>                         | 0.26                      |
| 1993          | 0.41                      | 3.4                        | 1.0                                      | 0.2                       | 0.8                       | 10.0                       | 1.2 <sup>e</sup>                         | 0.26                      |
| 1994          | 0.25                      | 3.4                        | 0.4                                      | 0.08                      | 0.25 <sup>e</sup>         | 3.4 <sup>e</sup>           | 1.2 <sup>e</sup>                         | 0.26                      |
| 1995-on       | 0.25                      | 3.4                        | 0.4                                      | 0.08                      | 0.25 <sup>e</sup>         | 3.4 <sup>e</sup>           | 0.4 <sup>f</sup>                         | 0.08                      |

**Sources:**

1976-93: Code of Federal Regulations 40CFR86, "Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines: Certification and Testing Procedures," July 1, 1987 edition, p. 264.

1994-on: Clean Air Act Amendment of 1990.

<sup>a</sup>California standards not included.

<sup>b</sup>Applies to trucks under 6,000 pounds gross vehicle weight rating (GVWR) until model year 1978 and under 8,500 pounds GVWR beginning in model year 1979.

<sup>c</sup>Applies to diesel engines only.

<sup>d</sup>No standard was set for this year.

<sup>e</sup>Applies to light trucks up to and including 3,750 pounds loaded vehicle weight (LVW).

<sup>f</sup>Applies to light trucks up to and including 3,750 pounds loaded vehicle weight (LVW). Does not apply to diesel-fueled light trucks.

*The Clean Air Act Amendment of 1990 established higher emission control standards. These standards will become effective in 1994.*

**Table 3.43**  
**Federal Emission Control Requirements for**  
**Heavy-Duty Gasoline Trucks, 1976-94<sup>a</sup>**  
**(grams per brake horsepower hour)**

| Model Year | Hydrocarbons<br>(HC) | Carbon monoxide<br>(CO) | Nitrogen oxides<br>(NO <sub>x</sub> ) | Hydrocarbons +<br>nitrogen oxides<br>(HC + NO <sub>x</sub> ) |
|------------|----------------------|-------------------------|---------------------------------------|--|
| 1976       | b                    | 40.0                    | b                                     | 16.0   |
| 1977       | b                    | 40.0                    | b                                     | 16.0   |
| 1978       | b                    | 40.0                    | b                                     | 16.0   |
| 1979       | 1.5                  | 25.0                    | b                                     | 10.0   |
| 1980       | 1.5                  | 25.0                    | b                                     | 10.0   |
| 1981       | 1.5                  | 25.0                    | b                                     | 10.0   |
| 1982       | 1.5                  | 25.0                    | b                                     | 10.0   |
| 1983       | 1.5                  | 25.0                    | b                                     | 10.0   |
| 1984       | 1.3                  | 15.5                    | 10.7                                  | b  |
| 1985       | 2.5                  | 40.0                    | 10.7                                  | b  |
| 1986       | 2.5                  | 40.0                    | 10.7                                  | b  |
| 1987       | 1.9                  | 37.1                    | 10.6                                  | b  |
| 1988       | 1.9                  | 37.1                    | 10.6                                  | b  |
| 1989       | 1.9                  | 37.1                    | 10.6                                  | b  |
| 1990       | 1.9                  | 37.1                    | 6.0                                   | b  |
| 1991       | 1.9                  | 37.1                    | 5.0                                   | b  |
| 1992       | 1.9                  | 37.1                    | 5.0                                   | b  |
| 1993       | 1.9                  | 37.1                    | 5.0                                   | b  |
| 1994       | 1.9 <sup>c</sup>     | 37.1                    | 5.0 <sup>c</sup>                      | b  |
| 1995       | 1.9 <sup>c</sup>     | 37.1 <sup>c</sup>       | 5.0 <sup>c</sup>                      | b  |
| 1996       | 1.9 <sup>c</sup>     | 37.1 <sup>c</sup>       | 5.0 <sup>c</sup>                      | b  |
| 1997       | 1.9 <sup>c</sup>     | 37.1 <sup>c</sup>       | 5.0 <sup>c</sup>                      | b  |
| 1998       | 1.9 <sup>c</sup>     | 37.1 <sup>c</sup>       | 4.0 <sup>c</sup>                      | b  |

**Sources:**

1976-93: Code of Federal Regulations, 40CFR86, "Control of Air Pollution from New Motor Vehicles and New Motor Vehicles Engines: Certification and Testing Procedures," July 1, 1987 edition, p. 264.

1994-on: Clean Air Act Amendment of 1990.

<sup>a</sup>Applies to trucks greater than 6,000 pounds gross vehicle weight until model year 1978; greater than 8,500 pounds gross vehicle weight from model year 1979-1986; and greater than 14,000 pounds gross vehicle weight starting in 1987.

<sup>b</sup>No standard was set for this year.

<sup>c</sup>Heavy-duty trucks must meet these standards or standards which reflect the greatest degree of emission reduction achievable through the application of the technology available.

*The Clean Air Act Amendment of 1990 established higher emission control standards. These standards will become effective in 1994.*

**Table 3.44**  
**Federal Emission Control Requirements for**  
**Heavy-Duty Diesel Trucks, 1976-94\***  
**(grams per brake horsepower hour)**

| Model Year | Hydrocarbons (HC) | Carbon monoxide (CO) | Nitrogen oxides (NO <sub>x</sub> ) | Hydrocarbons + nitrogen oxides (HC + NO <sub>x</sub> ) | Particulates      |
|------------|-------------------|----------------------|------------------------------------|--|-------------------|
| 1976       | b                 | 40.0                 | b                                  | 16.0   | b                 |
| 1977       | b                 | 40.0                 | b                                  | 16.0   | b                 |
| 1978       | b                 | 40.0                 | b                                  | 16.0   | b                 |
| 1979       | 1.5               | 25.0                 | b                                  | 10.0   | b                 |
| 1980       | 1.5               | 25.0                 | b                                  | 10.0   | b                 |
| 1981       | 1.5               | 25.0                 | b                                  | 10.0   | b                 |
| 1982       | 1.5               | 25.0                 | b                                  | 10.0   | b                 |
| 1983       | 1.5               | 25.0                 | b                                  | 10.0   | b                 |
| 1984       | 1.3               | 15.5                 | 10.7                               | 5.0  | b                 |
| 1985       | 1.3               | 15.5                 | 10.7                               | b  | b                 |
| 1986       | 1.3               | 15.5                 | 10.7                               | b  | b                 |
| 1987       | 1.3               | 15.5                 | 10.7                               | b  | 0.60              |
| 1988       | 1.3               | 15.5                 | 10.7                               | b  | 0.60              |
| 1989       | 1.3               | 15.5                 | 10.7                               | b  | 0.60              |
| 1990       | 1.3               | 15.5                 | 6.0                                | b  | 0.25              |
| 1991       | 1.3               | 15.5                 | 5.0                                | b  | 0.25              |
| 1992       | 1.3               | 15.5                 | 5.0                                | b  | 0.25              |
| 1993       | 1.3               | 15.5                 | 5.0                                | b  | 0.10              |
| 1994       | 1.3 <sup>c</sup>  | 15.5                 | 5.0                                | b  | 0.10 <sup>c</sup> |
| 1995       | 1.3 <sup>c</sup>  | 15.5 <sup>c</sup>    | 5.0 <sup>c</sup>                   | b  | 0.10 <sup>c</sup> |
| 1996       | 1.3 <sup>c</sup>  | 15.5 <sup>c</sup>    | 5.0 <sup>c</sup>                   | b  | 0.10 <sup>c</sup> |
| 1997       | 1.3 <sup>c</sup>  | 15.5 <sup>c</sup>    | 5.0 <sup>c</sup>                   | b  | 0.10 <sup>c</sup> |
| 1998       | 1.3 <sup>c</sup>  | 15.5 <sup>c</sup>    | 4.0 <sup>c</sup>                   | b  | 0.10 <sup>c</sup> |

**Sources:**

1976-93: Code of Federal Regulations, 40CFR86, "Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines: Certification and Testing Procedures," July 1, 1987 edition, p. 264.

1994-on: Clean Air Act Amendment of 1990.

\*Applies to trucks greater than 6,000 pounds gross vehicle weight until model year 1978; greater than 8,500 pounds gross vehicle weight beginning in model year 1979.

<sup>b</sup>No standard was set for this year.

<sup>c</sup>Heavy-duty trucks must meet these standards or standards which reflect the greatest degree of emission reduction achievable through the application of the technology available.

Table 3.45  
Transportation's Contribution to U.S. Emissions, 1978-90

| Year                                    | Emission (million metric tons/year) |                         |              |                         |                 |                         |                 |                         |                           |                         |        |                         |
|---|-------------------------------------|-------------------------|--------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|---------------------------|-------------------------|--------|-------------------------|
|   | Suspended Particulate               |                         | Sulfur Oxide |                         | Carbon Monoxide |                         | Nitrogen Oxides |                         | Volatile Organic Compound |                         | Lead   |                         |
|   | Trans.                              | Percent trans. of total | Trans.       | Percent trans. of total | Trans.          | Percent trans. of total | Trans.          | Percent trans. of total | Trans.                    | Percent trans. of total | Trans. | Percent trans. of total |
| 1978                                    | 1.4                                 | 15.4%                   | 0.8          | 3.3%                    | 61.6            | 74.8%                   | 9.8             | 46.4%                   | 8.7                       | 37.0%                   | 0.1124 | 87.9%                   |
| 1979                                    | 1.4                                 | 15.7%                   | 0.9          | 3.6%                    | 59.1            | 72.3%                   | 10.1            | 46.8%                   | 8.0                       | 35.7%                   | 0.0946 | 87.0%                   |
| 1980                                    | 1.3                                 | 15.3%                   | 0.9          | 3.8%                    | 56.1            | 70.5%                   | 9.8             | 46.9%                   | 9.0                       | 39.6%                   | 0.0594 | 84.1%                   |
| 1981                                    | 1.3                                 | 16.3%                   | 0.9          | 4.0%                    | 55.4            | 71.6%                   | 10.0            | 47.8%                   | 8.9                       | 41.8%                   | 0.0469 | 83.2%                   |
| 1982                                    | 1.3                                 | 18.3%                   | 0.8          | 3.7%                    | 52.9            | 73.1%                   | 9.4             | 47.0%                   | 8.3                       | 42.6%                   | 0.0469 | 86.2%                   |
| 1983                                    | 1.3                                 | 18.3%                   | 0.8          | 3.9%                    | 52.4            | 70.3%                   | 8.9             | 46.1%                   | 8.2                       | 40.4%                   | 0.0408 | 87.9%                   |
| 1984                                    | 1.3                                 | 17.6%                   | 0.8          | 3.7%                    | 50.6            | 70.5%                   | 8.8             | 44.4%                   | 8.1                       | 38.4%                   | 0.0347 | 86.5%                   |
| 1985                                    | 1.4                                 | 19.2%                   | 0.9          | 4.3%                    | 47.9            | 68.8%                   | 8.9             | 44.7%                   | 7.6                       | 37.6%                   | 0.0155 | 74.2%                   |
| 1986                                    | 1.4                                 | 20.6%                   | 0.9          | 4.3%                    | 44.6            | 69.7%                   | 8.3             | 43.5%                   | 7.2                       | 37.7%                   | 0.0035 | 41.7%                   |
| 1987                                    | 1.4                                 | 20.0%                   | 0.9          | 4.3%                    | 43.3            | 67.4%                   | 8.1             | 41.8%                   | 7.1                       | 36.6%                   | 0.0030 | 37.5%                   |
| 1988                                    | 1.5                                 | 20.0%                   | 0.9          | 4.3%                    | 41.2            | 63.4%                   | 8.1             | 40.5%                   | 6.9                       | 35.4%                   | 0.0026 | 34.2%                   |
| 1989                                    | 1.5                                 | 20.8%                   | 1.0          | 4.7%                    | 40.0            | 65.7%                   | 7.9             | 39.7%                   | 6.4                       | 34.6%                   | 0.0022 | 30.6%                   |
| 1990                                    | 1.5                                 | 20.0%                   | 0.9          | 4.2%                    | 37.6            | 62.6%                   | 7.5             | 38.3%                   | 6.4                       | 34.2%                   | 0.0022 | 31.0%                   |
| <i>Average annual percentage change</i> |                                     |                         |              |                         |                 |                         |                 |                         |                           |                         |        |                         |
| 1978-90                                 | 0.6%                                |                         | 1.0%         |                         | -4.0%           |                         | -2.2%           |                         | -2.5%                     |                         | -27.9% |                         |
| 1982-90                                 | 1.8%                                |                         | 1.5%         |                         | -4.2%           |                         | -2.8%           |                         | -3.2%                     |                         | -31.8% |                         |

## Source:

United States Environmental Protection Agency, Office of Air Quality Planning and Standards, National Air Quality and Emissions Trends Report, 1990, Research Triangle Park, NC, 1991, pp. 3-4, 3-13, 3-18, 3-22, 3-27, 3-32, and annual.

**Table 3.46**  
**Exhaust Emission Standards for Clean-Fuel Vehicles in the California Pilot Test Program**  
**(50,000 mile standards in grams per mile)**

|   | LDV & LDT<br>≤6,000 GVWR<br>≤3,750 LVW | LDT<br>≤6,000 GVWR<br>>3,750 LVW<br>≤5,750 LVW | LDT *<br>>6,000 GVWR<br>≤3,750 TW | LDT *<br>>6,000 GVWR<br>>3,750 TW<br>≤5,750 TW | LDT *<br>>6,000 GVWR<br>>5,750 TW |
|---|--|--|-----------------------------------|--|-----------------------------------|
| <b>Conventional vehicles</b>                    |  |  |                                   |  |                                   |
| Non-methane hydrocarbons                        | 0.250                                  | 0.320  | 0.250                             | 0.320  | 0.390                             |
| Carbon monoxide                                 | 3.400                                  | 4.400  | 3.400                             | 4.400  | 5.000                             |
| Nitrogen oxides                                 | 0.400                                  | 0.700  | 0.400                             | 0.700  | 1.100                             |
| Formaldehyde                                    | 0.015                                  | 0.018  | 0.015                             | 0.018  | 0.022                             |
| <b>Transition low-emission vehicles (TLEVs)</b> |  |  |                                   |  |                                   |
| Non-methane organic gases                       | 0.125                                  | 0.160  | 0.125                             | 0.160  | 0.195                             |
| Carbon monoxide                                 | 3.400                                  | 4.400  | 3.400                             | 4.400  | 5.000                             |
| Nitrogen oxides                                 | 0.400                                  | 0.700  | 0.400                             | 0.700  | 1.100                             |
| Formaldehyde                                    | 0.015                                  | 0.018  | 0.015                             | 0.018  | 0.022                             |
| <b>Low-emission vehicles (LEVs)</b>             |  |  |                                   |  |                                   |
| Non-methane organic gases                       | 0.075                                  | 0.100  | 0.125                             | 0.160  | 0.195                             |
| Carbon monoxide                                 | 3.400                                  | 4.400  | 3.400                             | 4.400  | 5.000                             |
| Nitrogen oxides                                 | 0.200                                  | 0.400  | 0.400                             | 0.700  | 1.100                             |
| Formaldehyde                                    | 0.015                                  | 0.018  | 0.015                             | 0.018  | 0.022                             |
| <b>Ultra-low emission vehicles (ULEVs)</b>      |  |  |                                   |  |                                   |
| Non-methane organic gases                       | 0.040                                  | 0.050  | 0.075                             | 0.100  | 0.117                             |
| Carbon monoxide                                 | 1.700                                  | 2.200  | 1.700                             | 2.200  | 2.500                             |
| Nitrogen oxides                                 | 0.200                                  | 0.400  | 0.200                             | 0.400  | 0.600                             |
| Formaldehyde                                    | 0.008                                  | 0.009  | 0.008                             | 0.009  | 0.011                             |
| <b>Zero-emission vehicles (ZEVs)</b>            |  |  |                                   |  |                                   |
| Non-methane organic gases                       | 0.0                                    | 0.0  | 0.0                               | 0.0  | 0.0                               |
| Carbon monoxide                                 | 0.0                                    | 0.0  | 0.0                               | 0.0  | 0.0                               |
| Nitrogen oxides                                 | 0.0                                    | 0.0  | 0.0                               | 0.0  | 0.0                               |
| Formaldehyde                                    | 0.0                                    | 0.0  | 0.0                               | 0.0  | 0.0                               |

**Source:**

U.S. Environmental Protection Agency, Office of Mobile Sources, "California Pilot Test Program," Public Outreach Meeting, Ann Arbor, MI, May 17, 1991.

**Note:** LDV = light-duty vehicle  
 LDT = light-duty truck  
 GVWR = gross vehicle weight rating  
 LVW = loaded vehicle weight  
 TW = tare weight

\*The clean-fuel vehicle standards are not effective until the 1998 model year.

\*Not applicable.

\*There is no TLEV category for this vehicle class.

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

**Table 3.47**  
**California Air Resources Board Proposal for Meeting Emission Standards**

| Year              | Percent of<br>manufacturer's<br>fleet | Vehicle type <sup>a</sup> |
|-------------------|---------------------------------------|---------------------------|
| 1989              | 100                                   | CV                        |
| 1993              | 100                                   | CV                        |
| 1994              | 90                                    | CV                        |
|                   | 10                                    | TLEV                      |
| 1995              | 85                                    | CV                        |
|                   | 15                                    | TLEV                      |
| 1996              | 80                                    | CV                        |
|                   | 20                                    | TLEV                      |
| 1997              | 73                                    | CV                        |
|                   | 25                                    | LEV                       |
|                   | 2                                     | ULEV                      |
| 1998-2000         | 48                                    | CV                        |
|                   | 48                                    | LEV                       |
|                   | 2                                     | ULEV                      |
|                   | 2                                     | ZEV                       |
| 2001-2002         | 90                                    | LEV                       |
|                   | 5                                     | ULEV                      |
|                   | 5                                     | ZEV                       |
| 2003 <sup>b</sup> | 75                                    | LEV                       |
|                   | 15                                    | ULEV                      |
|                   | 10                                    | ZEV                       |

**Source:**

California Air Resources Board, Mobile Sources Division,  
El Monte, CA, 1990.

- <sup>a</sup> CV - Conventional vehicles
- TLEV - Transition low emission vehicles
- LEV - Low emission vehicles
- ULEV - Ultra low emission vehicles
- ZEV - Zero emission vehicles

<sup>b</sup>Fleet average of non-methane organic gases = 0.062 in 2003.

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

**Table 3.48**  
**Possible Fuel/Vehicles for Clean-Fuel Vehicles**

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**TRANSITIONAL LOW-EMISSION VEHICLES (TLEVs)**

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

**LOW-EMISSION VEHICLES (LEVs)**

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

**ULTRA-LOW EMISSION VEHICLES (ULEVs)**

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

**ZERO-EMISSION VEHICLES (ZEVs)**

- 
- *Electricity* - battery-powered vehicles
- 

**Source:**

U.S. Department of Energy, Office of Transportation Technologies, "Electric Vehicle Progress," Washington, DC, January 1991, p.3.

**Table 3.49**  
**Contribution of Transportation Fuel Use to Total Carbon Emission for Selected Countries**

| Country         | Year | End-Use Fuel<br>Consumption by<br>Transportation Sector<br>(quads) | Total Fossil Fuel<br>Consumption by<br>All Sectors<br>(quads) | Carbon from Total Fossil<br>Fuel Consumption<br>by all Sectors<br>(Tg) | Carbon from Fuel Consumption<br>by Transportation Sector |                       |                    | % of Total Fossil Fuel<br>Carbon Emitted by all<br>Sectors |                       |                       |
|-----------------|------|--|---|--|--|-----------------------|--------------------|--|-----------------------|-----------------------|
|                 |      |  |   |  | (Tg <sup>a</sup> )                                       |                       |                    |  |                       |                       |
|                 |      |  |   |  | From<br>End<br>Use                                       | From<br>Full<br>Cycle | From<br>End<br>Use | From<br>End<br>Use   | From<br>Full<br>Cycle | From<br>Full<br>Cycle |
| U.S.            | 1988 | 16.49  | 71.65   | 1,455.0  | 319.8  | 433.3                 | 22.0               | 22.0   | 29.8                  | 29.8                  |
| West<br>Germany | 1988 | 1.78   | 9.51  | 195.2  | 34.5   | 45.9                  | 17.7               | 17.7   | 23.5                  | 23.5                  |
| Norway          | 1988 | 0.11   | 0.46  | 9.0  | 2.1  | 2.9                   | 23.6               | 23.6   | 31.6                  | 31.6                  |
| Japan           | 1988 | 2.35   | 14.32   | 296.4  | 45.8   | 60.2                  | 15.4               | 15.4   | 20.3                  | 20.3                  |
| U.S.S.R.        | 1987 | 3.27   | 53.70   | 1,049.8  | 63.2   | 86.8                  | 6.0                | 6.0  | 8.3                   | 8.3                   |
| Mexico          | 1988 | 0.75   | 4.36  | 83.4   | 14.5   | 19.8                  | 17.4               | 17.4   | 23.8                  | 23.8                  |

3-73

**Source:**  
DeLuchi, M.A. Emissions of Greenhouse Gases from the Use of Transportation Fuels and Electricity, Volume 1, Argonne National Laboratory, Argonne, IL,  
November 1991, p.3.

<sup>a</sup>Teragrams (1Tg = 10<sup>12</sup>g).

## **Section 3.8**

# **High-Occupancy Vehicle Lanes**

*High-occupancy vehicle (HOV) lanes are special highway lanes meant for the exclusive use of vehicles with a specified number of passengers. Vehicles that use HOV lanes are usually guaranteed a shorter and less congested trip than those using regular traffic lanes. In 1990 there were 332 miles of HOV lanes in operation in the U.S. Eighteen areas had HOV facilities in 1990, and 6 more areas had HOV facilities in development at that time (see Figure 3.20).*

**Table 3.50**  
**Miles of High-Occupancy Vehicle Lanes, 1969-90**

| Year                                    | Miles <sup>a</sup> |
|---|--------------------|
| 1969                                    | 5                  |
| 1970                                    | 10                 |
| 1971                                    | 15                 |
| 1972                                    | 15                 |
| 1973                                    | 28                 |
| 1974                                    | 32                 |
| 1975                                    | 36                 |
| 1976                                    | 43                 |
| 1977                                    | 47                 |
| 1978                                    | 66                 |
| 1979                                    | 66                 |
| 1980                                    | 96                 |
| 1981                                    | 96                 |
| 1982                                    | 111                |
| 1983                                    | 129                |
| 1984                                    | 149                |
| 1985                                    | 168                |
| 1986                                    | 196                |
| 1987                                    | 209                |
| 1988                                    | 247                |
| 1989                                    | 278                |
| 1990                                    | 339                |
| <i>Average annual percentage change</i> |                    |
| 1969-90                                 | 22.2%              |
| 1982-90                                 | 15.0%              |

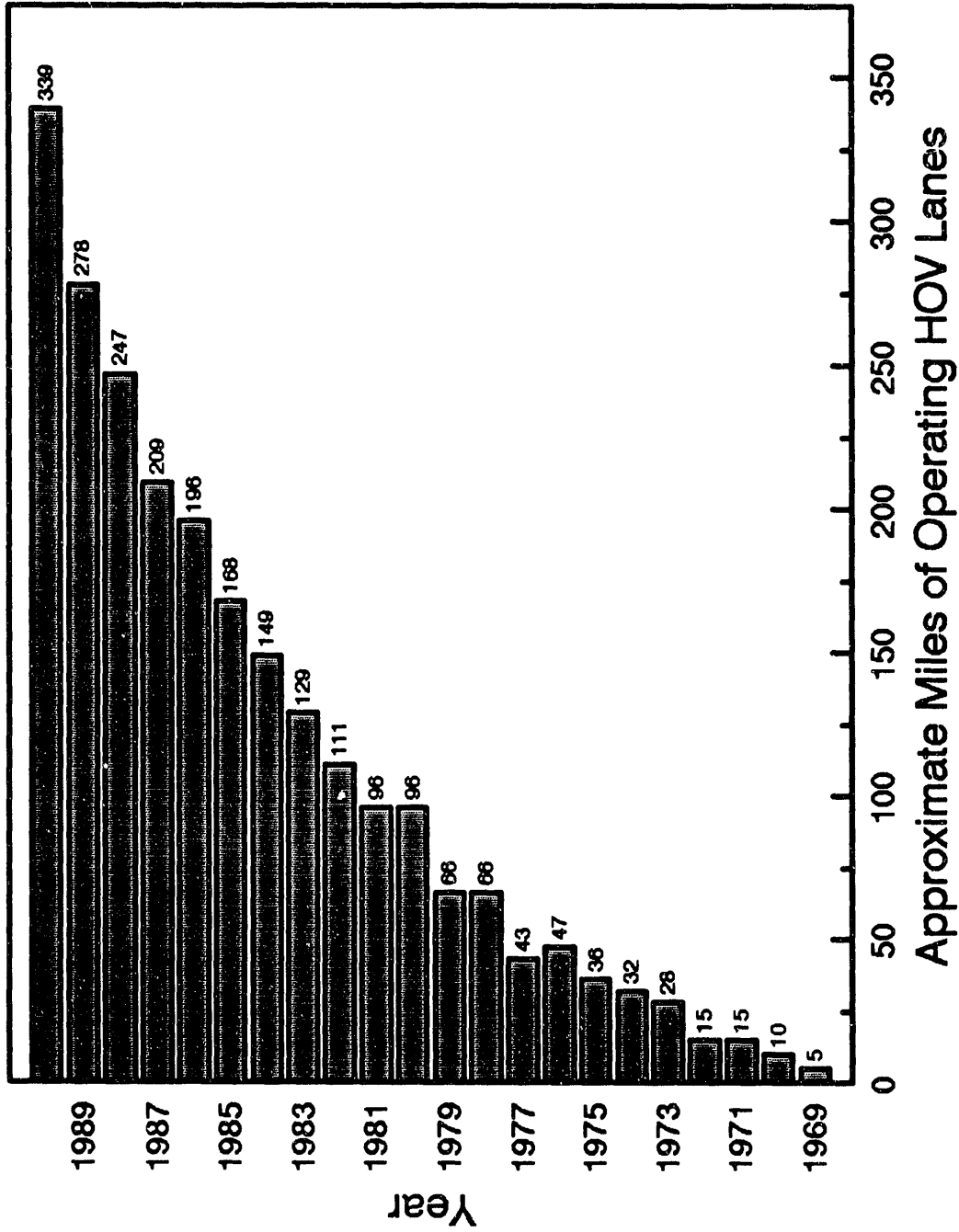
**Source:**

Texas Transportation Institute, High-Occupancy Vehicle System Development in the United States, College Station, TX, December 1990, p. 9.

<sup>a</sup>Data shown are for continuously operating HOV lanes located either on freeways or in separate rights-of-way in the U.S. Mileage is not shown for HOV lanes that have been discontinued.

Figure 3.20. Miles of High-Occupancy Vehicle Lanes, 1969-90

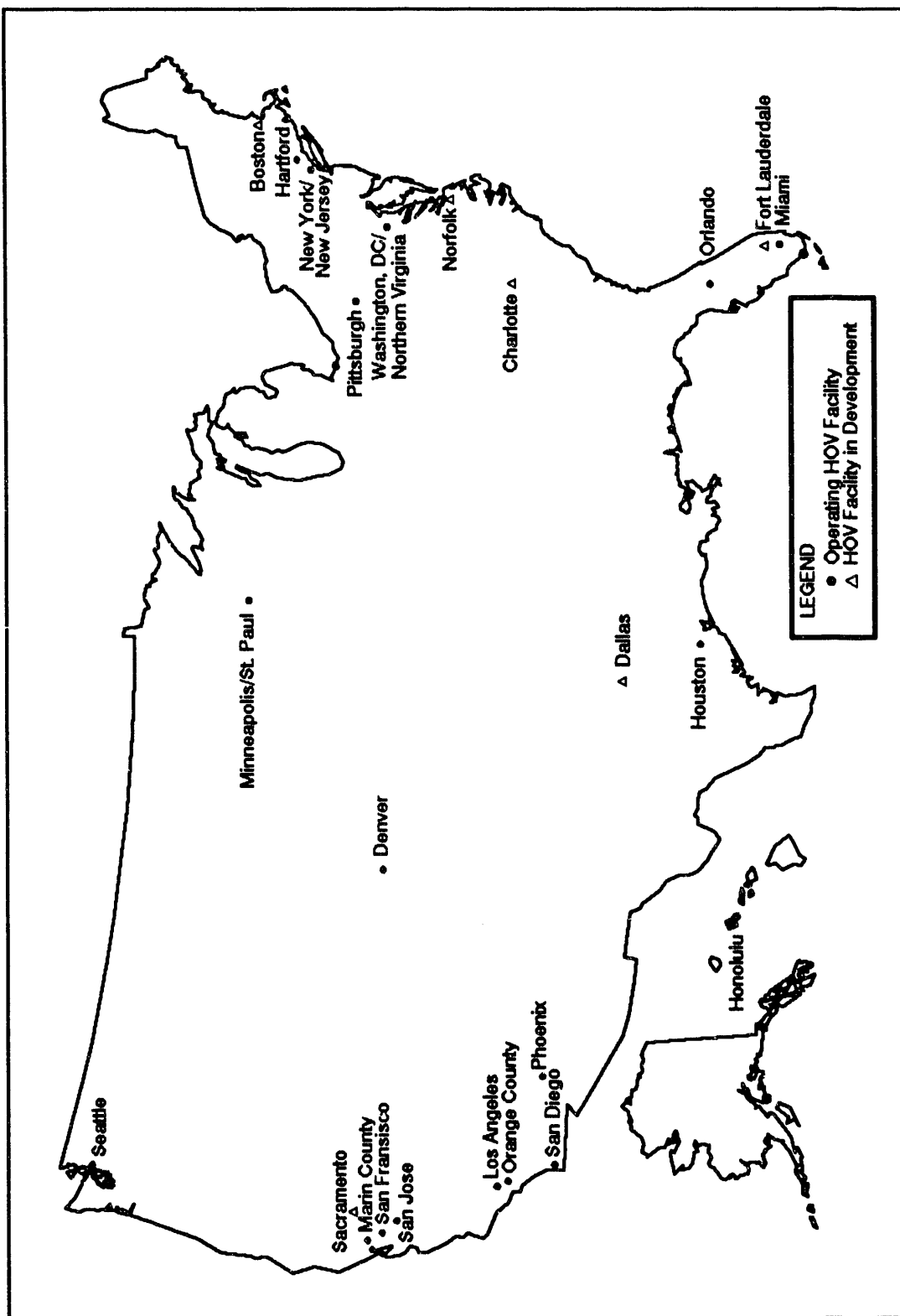
OFRAI-DRW 93-6682



Source: See Table 3.50.

Figure 3.21. U.S. Urban Areas Where HOV Facilities Were in Operation or Development as of 1990

ORNL-DRW 93-6683



Source:

Texas Transportation Institute, High-Occupancy Vehicle System Development in the United States, College Station, TX, December 1990, p.9.

## **CHAPTER 4**

### **PERSONAL TRAVEL STATISTICS**

From 19850 to 1990, the average annual increase in the number of vehicles surpasses the increases in population, households, licensed drivers, and employed persons. Since 1985 there has been more than one vehicle for every licensed driver in the U.S. (Table 4.1).

Each year since 1979 the U.S. Travel Data Center has conducted the National Travel Survey on a regular basis to provide timely and relevant information on major travel trends in the U.S. In this survey, a trip is defined as "each time one person goes to a place at least 100 miles away from home and returns." The following trips are excluded from the survey: travel as part of an operation crew on a train, airplane, truck, bus, or ship; commuting to a place of work; and student trips to or from school. Data from the 1990 National Travel Survey are contained in Tables 4.4-4.6. According to the survey, the average trip distance in 1990 was 72 miles shorter than in 1988 due to shorter trips taken by cars, trucks, and recreational vehicles. The average trip distance by airplane, however, was longer in 1990 than in 1988 (Table 4.4). Twenty percent of all vacation trips in 1990 were less than 300 miles (Table 4.5).

The majority of data on personal travel come from the Nationwide Personal Transportation Survey (NPTS). The NPTS is a national survey designed to collect data on the nature and characteristics of personal travel. Not to be confused with the National Travel Survey, the definition of a trip in the NPTS is "any one-way travel from one address (place) to another by private motor vehicle, public transportation, bicycle, or walking." Excluded from the survey are jogging and walking for exercise, as well as all bicycling and walking for individuals under 5 years of age. The survey collects detailed data on household trips, their purposes and the transportation modes used. The NPTS is sponsored by several agencies of the U.S. Department of Transportation and is conducted approximately every seven years. The data presented include information from surveys done in 1969, 1977, 1983, and 1990. Tables 4.7-4.20 and Figures 4.5-4.14 are taken directly from the U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends which was prepared by Oak Ridge National Laboratory

for the Federal Highway Administration. Since all of the NPTS surveys differ somewhat in terminology, survey procedure, and target population, one should be cautious when comparing statistics from one survey to the next.

Table 4.1  
Population and Vehicle Profile, 1950-90

| Year                             | Resident population <sup>a</sup> (thousands) | Total households (thousands) | Number of vehicles in operation (thousands) | Number of licensed drivers (thousands) | Number of civilian employed persons (thousands) | Vehicles per capita | Licensed drivers per household | Vehicles per licensed driver | Vehicles per civilian employed persons |
|----------------------------------|--|------------------------------|---|--|---|---------------------|--------------------------------|------------------------------|--|
| 1950                             | 151,868                                      | 43,554                       | 43,256                                      | 62,194                                 | 58,918  | 0.28                | 1.43                           | 0.70                         | 0.73                                   |
| 1955                             | 165,069                                      | 47,874                       | 55,804                                      | 74,686                                 | 62,170  | 0.34                | 1.56                           | 0.75                         | 0.90                                   |
| 1960                             | 179,979                                      | 52,799                       | 66,582                                      | 87,253                                 | 65,778  | 0.36                | 1.65                           | 0.76                         | 1.01                                   |
| 1965                             | 193,526                                      | 57,251                       | 82,067                                      | 98,502                                 | 71,088  | 0.42                | 1.72                           | 0.83                         | 1.15                                   |
| 1970                             | 203,984                                      | 63,401                       | 98,136                                      | 111,543                                | 78,678  | 0.48                | 1.76                           | 0.88                         | 1.25                                   |
| 1975                             | 215,465                                      | 71,120                       | 120,054                                     | 129,791                                | 85,846  | 0.56                | 1.82                           | 0.92                         | 1.40                                   |
| 1980                             | 227,719                                      | 80,776                       | 139,832                                     | 145,295                                | 99,303  | 0.61                | 1.80                           | 0.96                         | 1.41                                   |
| 1981                             | 229,945                                      | 82,368                       | 141,908                                     | 147,075                                | 100,397   | 0.62                | 1.79                           | 0.96                         | 1.41                                   |
| 1982                             | 232,171                                      | 83,527                       | 143,854                                     | 150,234                                | 99,526  | 0.62                | 1.80                           | 0.96                         | 1.45                                   |
| 1983                             | 234,296                                      | 83,918                       | 147,104                                     | 154,389                                | 100,834   | 0.63                | 1.83                           | 0.95                         | 1.46                                   |
| 1984                             | 236,343                                      | 85,407                       | 152,162                                     | 155,424                                | 105,005   | 0.64                | 1.82                           | 0.98                         | 1.45                                   |
| 1985                             | 238,466                                      | 86,789                       | 157,048                                     | 156,868                                | 107,150   | 0.66                | 1.81                           | 1.00                         | 1.47                                   |
| 1986                             | 240,658                                      | 88,458                       | 162,094                                     | 159,487                                | 109,597   | 0.67                | 1.80                           | 1.02                         | 1.48                                   |
| 1987                             | 242,820                                      | 89,479                       | 167,193                                     | 161,975                                | 112,440   | 0.69                | 1.81                           | 1.03                         | 1.49                                   |
| 1988                             | 245,051                                      | 91,061                       | 171,741                                     | 162,853                                | 114,968   | 0.70                | 1.79                           | 1.05                         | 1.49                                   |
| 1989                             | 247,350                                      | 92,830                       | 175,960                                     | 165,555                                | 117,342   | 0.71                | 1.78                           | 1.06                         | 1.50                                   |
| 1990                             | 249,975                                      | 93,347                       | 179,299                                     | 167,015                                | 117,342   | 0.72                | 1.79                           | 1.07                         | 1.50                                   |
| Average annual percentage change |  |                              |   |  |   |                     |                                |                              |  |
| 1950-90                          | 1.3%   | 1.9%                         | 3.6%  | 2.5%                                   | 1.8%  | 2.4%                | 0.6%                           | 1.1%                         | 1.9%                                   |
| 1970-90                          | 1.0%   | 2.0%                         | 3.1%  | 2.0%                                   | 2.1%  | 2.0%                | 0.1%                           | 1.0%                         | 1.0%                                   |
| 1982-90                          | 0.9%   | 1.4%                         | 2.8%  | 1.3%                                   | 2.4%  | 1.9%                | -0.1%                          | 1.4%                         | 0.5%                                   |

**Sources:**

Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 111th edition, 1991, Washington, DC, pp. 7, 45, 395, and annual.

Vehicles in operation - R. L. Polk and Company. **FURTHER REPRODUCTION PROHIBITED.**

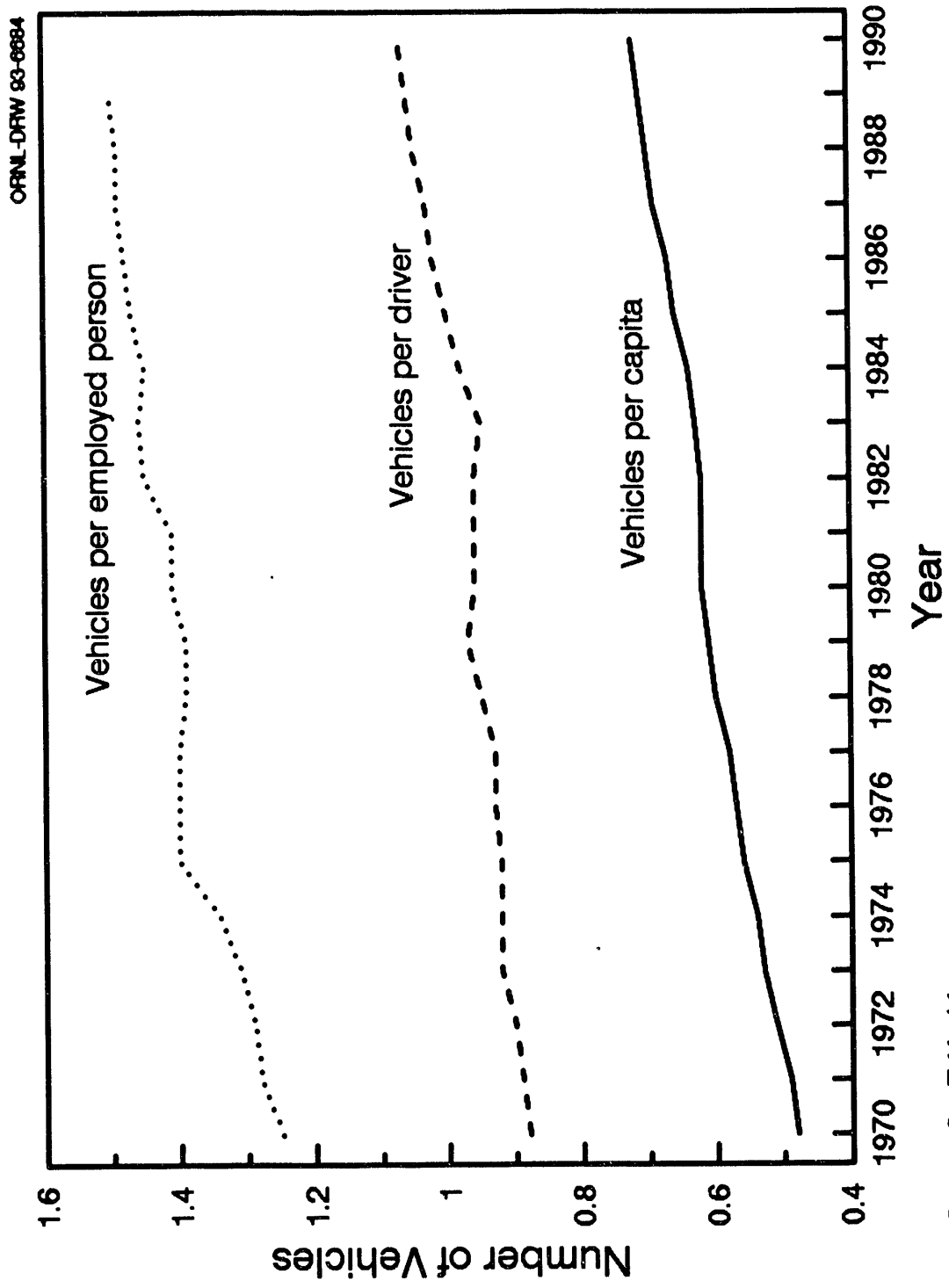
Licensed drivers - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Table DL-1, p. 30, and annual.

<sup>a</sup>Estimates as of July 1. Includes Armed Forces stationed in the United States.

<sup>b</sup>Data are not available.

<sup>c</sup>Average annual percentage changes are for years 1950-89, 1970-89 and 1982-89.

Figure 4.1. Population and Vehicle Profile, 1970-90



Source: See Table 4.1.

Table 4.2  
Financial Profile of the Population, 1970-89

| Year                             | Median household income |                                    | Household income per household vehicle <sup>a</sup> |                 | Disposable income per capita |                                    | Vehicles per capita | Disposable income per vehicle <sup>b</sup> |                                    |
|----------------------------------|-------------------------|------------------------------------|---|-----------------|------------------------------|------------------------------------|---------------------|--|------------------------------------|
|                                  | Current dollars         | Constant 1988 dollars <sup>c</sup> | Constant 1988 dollars <sup>c</sup>                  | Current dollars | Current dollars              | Constant 1988 dollars <sup>c</sup> |                     | Constant 1988 dollars <sup>c</sup>         | Constant 1988 dollars <sup>c</sup> |
| 1970                             | 8,734                   | 26,604                             | 17,164  | 3,489           |                              | 10,627                             | 0.48                | 22,141                                     |                                    |
| 1971                             | 9,028                   | 26,371                             | 16,690  | 3,740           |                              | 10,925                             | 0.49                | 22,295                                     |                                    |
| 1972                             | 9,697                   | 27,423                             | 17,579  | 4,000           |                              | 11,312                             | 0.51                | 22,180                                     |                                    |
| 1973                             | 10,512                  | 27,983                             | 17,599  | 4,481           |                              | 11,928                             | 0.53                | 22,506                                     |                                    |
| 1974                             | 11,197                  | 26,862                             | 16,480  | 4,855           |                              | 11,647                             | 0.54                | 21,569                                     |                                    |
| 1975                             | 11,800                  | 25,936                             | 15,347  | 5,291           |                              | 11,630                             | 0.56                | 20,767                                     |                                    |
| 1976                             | 12,686                  | 26,362                             | 15,599  | 5,744           |                              | 11,936                             | 0.57                | 20,940                                     |                                    |
| 1977                             | 13,572                  | 26,493                             | 15,314  | 6,262           |                              | 12,223                             | 0.58                | 21,075                                     |                                    |
| 1978                             | 15,064                  | 27,311                             | 15,518  | 6,968           |                              | 12,633                             | 0.60                | 21,055                                     |                                    |
| 1979                             | 16,461                  | 26,831                             | 15,783  | 7,682           |                              | 12,522                             | 0.61                | 20,527                                     |                                    |
| 1980                             | 17,710                  | 25,432                             | 14,700  | 8,421           |                              | 12,093                             | 0.61                | 19,504                                     |                                    |
| 1981                             | 19,074                  | 24,815                             | 14,427  | 9,243           |                              | 12,025                             | 0.62                | 19,395                                     |                                    |
| 1982                             | 20,171                  | 24,730                             | 14,378  | 9,724           |                              | 11,922                             | 0.62                | 19,228                                     |                                    |
| 1983                             | 21,018                  | 24,948                             | 14,256  | 10,340          |                              | 12,274                             | 0.63                | 19,482                                     |                                    |
| 1984                             | 22,415                  | 25,531                             | 14,343  | 11,257          |                              | 12,822                             | 0.64                | 20,034                                     |                                    |
| 1985                             | 23,618                  | 25,980                             | 14,353  | 11,863          |                              | 13,049                             | 0.66                | 19,772                                     |                                    |
| 1986                             | 24,897                  | 26,864                             | 14,680  | 12,496          |                              | 13,483                             | 0.67                | 20,124                                     |                                    |
| 1987                             | 26,061                  | 27,130                             | 14,508  | 13,128          |                              | 13,666                             | 0.69                | 19,806                                     |                                    |
| 1988                             | 27,225                  | 27,225                             | 14,559  | 14,107          |                              | 14,107                             | 0.70                | 20,153                                     |                                    |
| 1989                             | 28,906                  | 27,576                             | 14,514  | 14,948          |                              | 14,260                             | 0.71                | 20,085                                     |                                    |
| Average annual percentage change |                         |                                    |   |                 |                              |                                    |                     |  |                                    |
| 1970-89                          | 6.5%                    | 0.2%                               | -0.9%   | 8.0%            |                              | 1.6%                               | 2.1%                | -0.5%                                      |                                    |
| 1982-89                          | 5.3%                    | 1.6%                               | 0.1%  | 6.3%            |                              | 2.6%                               | 2.0%                | 0.6%                                       |                                    |

**Sources:**

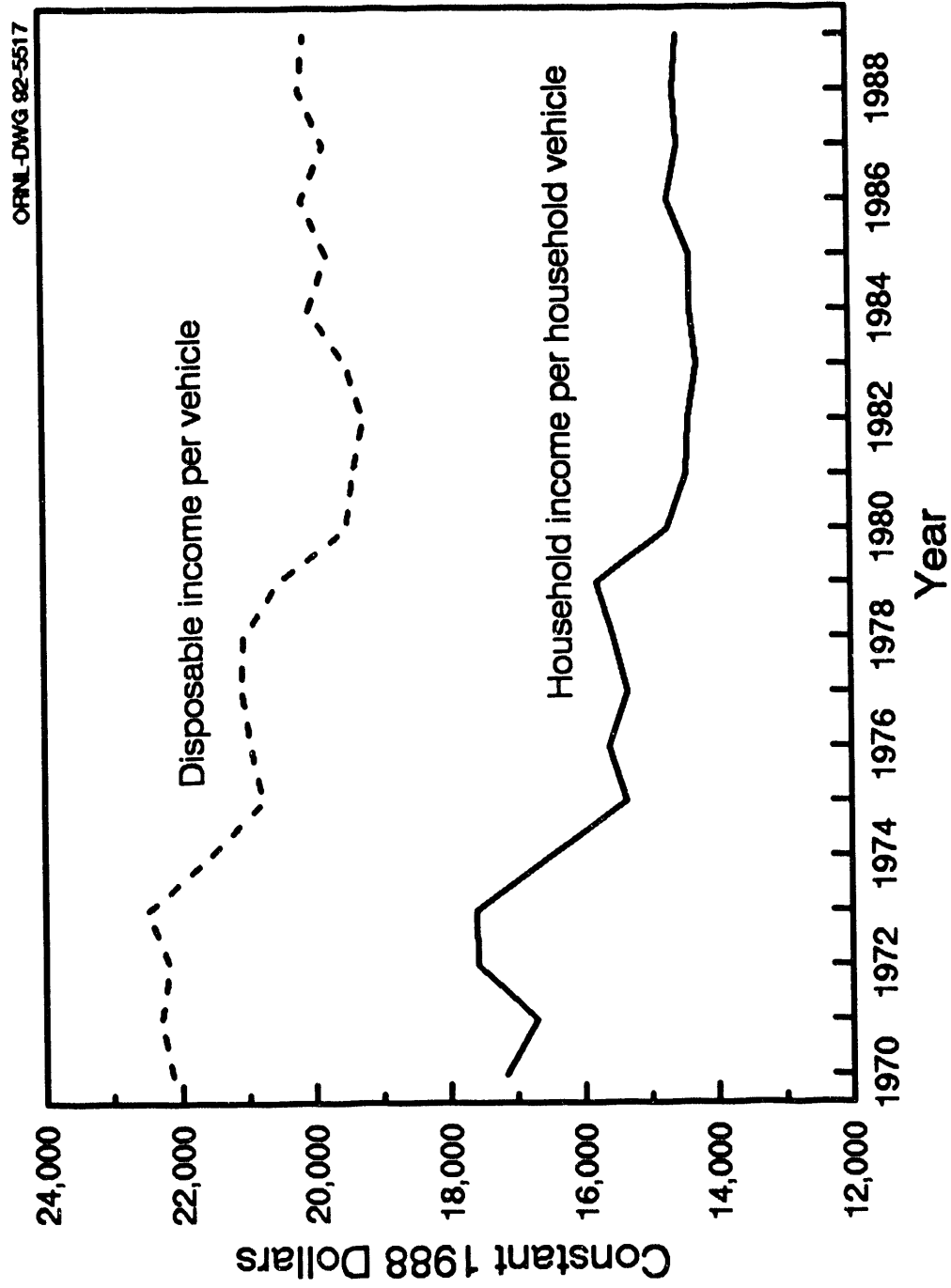
Median household income and disposable income per capita - U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, 111th ed., Washington, DC, 1991, pp. 440, 450, and annual.  
Vehicles per household and vehicles per capita - See Table 4.1.

<sup>a</sup>Median household income divided by the number of vehicles per household equals the household income per household vehicle.

<sup>b</sup>Disposable income per capita divided by the number of vehicles per capita equals disposable income per vehicle.

<sup>c</sup>Adjusted by the Consumer Price Inflation Index.

Figure 4.2. Financial Profile, 1970-89



Source: See Table 4.2.

*Transportation (17.9%) is second only to housing (30.6%) as the largest expenditure for the average household. In 1990, approximately 22% of total expenditures on transportation was for purchasing new vehicles, and 20% was on gasoline and motor oil.*

**Table 4.3**  
**Average Annual Expenditures of Households by Income, 1990<sup>a</sup>**

|  | All households | Income <sup>b</sup> |                    |                      |                      |                      |                      |                      | Percentage of total expenditures <sup>c</sup> |  |  |  |  |  |  |
|--|----------------|---------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---|--|--|--|--|--|--|
|  |                | Less than \$5,000   | \$5,000 to \$9,999 | \$10,000 to \$14,999 | \$15,000 to \$19,999 | \$20,000 to \$29,999 | \$30,000 to \$39,999 | \$40,000 to \$49,999 |   |  |  |  |  |  |  |
| Total expenditures                         | \$29,050       | \$12,381            | \$13,130           | \$16,429             | \$20,752             | \$24,535             | \$31,298             | \$38,398             | \$50,000 and over                             |  |  |  |  |  |  |
| Food <sup>d</sup>                          | 15.0           | 19.1                | 18.4               | 17.3                 | 16.6                 | 15.6                 | 14.8                 | 15.2                 | 12.7  |  |  |  |  |  |  |
| Housing                                    | 30.6           | 33.6                | 35.0               | 34.3                 | 30.8                 | 30.9                 | 28.8                 | 29.1                 | 30.1  |  |  |  |  |  |  |
| Apparel and services                       | 5.7            | 5.6                 | 5.1                | 5.0                  | 5.5                  | 5.4                  | 5.9                  | 5.1                  | 6.1   |  |  |  |  |  |  |
| Transportation                             | 17.9           | 15.8                | 15.4               | 17.1                 | 20.1                 | 18.6                 | 19.1                 | 18.7                 | 17.3  |  |  |  |  |  |  |
| Cars and trucks, new                       | 4.0            | 1.7                 | 1.8                | 2.7                  | 4.4                  | 3.4                  | 4.0                  | 4.0                  | 4.9   |  |  |  |  |  |  |
| Cars and trucks, used                      | 3.4            | 3.8                 | 4.1                | 3.9                  | 5.0                  | 3.8                  | 4.3                  | 3.4                  | 2.5   |  |  |  |  |  |  |
| Other vehicles                             | 0.1            | 0.1                 | 0.2                | 0.1                  | 0.0                  | 0.0                  | 0.1                  | 0.3                  | 0.1   |  |  |  |  |  |  |
| Vehicle finance charges                    | 1.0            | 0.5                 | 0.6                | 0.6                  | 1.1                  | 1.1                  | 1.2                  | 1.3                  | 1.1   |  |  |  |  |  |  |
| Gasoline & motor oil                       | 3.6            | 4.4                 | 3.9                | 4.1                  | 4.2                  | 4.4                  | 3.9                  | 3.7                  | 2.9   |  |  |  |  |  |  |
| Maintenance and repairs                    | 2.1            | 2.1                 | 2.0                | 2.2                  | 2.0                  | 2.2                  | 2.1                  | 2.4                  | 1.9   |  |  |  |  |  |  |
| Vehicle insurance                          | 2.0            | 1.6                 | 1.7                | 2.0                  | 2.1                  | 2.2                  | 2.0                  | 2.1                  | 1.9   |  |  |  |  |  |  |
| Public transportation                      | 1.0            | 1.2                 | 0.7                | 0.8                  | 0.8                  | 0.9                  | 0.9                  | 0.8                  | 1.4   |  |  |  |  |  |  |
| Vehicle rental, licenses and other charges | 0.7            | 0.5                 | 0.4                | 0.6                  | 0.6                  | 0.6                  | 0.6                  | 0.7                  | 0.8   |  |  |  |  |  |  |
| Health care                                | 5.2            | 6.8                 | 8.4                | 8.4                  | 7.2                  | 5.8                  | 4.8                  | 4.2                  | 3.7   |  |  |  |  |  |  |
| Entertainment                              | 5.0            | 4.0                 | 4.4                | 3.7                  | 4.0                  | 4.6                  | 4.8                  | 5.8                  | 5.6   |  |  |  |  |  |  |
| Personal insurance and pensions            | 10.1           | 2.5                 | 2.5                | 4.4                  | 5.6                  | 8.4                  | 10.6                 | 11.7                 | 13.7  |  |  |  |  |  |  |
| Others <sup>e</sup>                        | 10.6           | 12.5                | 10.8               | 9.7                  | 10.3                 | 10.7                 | 11.2                 | 10.1                 | 10.8  |  |  |  |  |  |  |

Source:

U.S. Department of Labor, Bureau of Labor Statistics, *Consumer Expenditure Survey: Interview Survey, 1990*, detailed computer printout, November 1991.

<sup>a</sup>In some cases average annual expenditures may exceed the reported amount of income. This is due to several factors such as incorrect reporting of income, indebtedness, student status, etc. Public assistance monies are included in reported income.

<sup>b</sup>Income before taxes.

<sup>c</sup>Percentages may not sum to totals due to rounding.

<sup>d</sup>Includes alcoholic beverages.

<sup>e</sup>Includes personal care, reading, education, tobacco and smoking supplies, cash contributions, and miscellaneous items.

**Table 4.4**  
**Demographic Characteristics of Auto/Truck/Recreational Vehicle (RV) and Air Travelers**  
**1988-90\* (percentage)**

|  |                     | Total travelers    |                    | Auto/truck/RV travelers |                 | Air travelers |                |
|--|---------------------|--------------------|--------------------|-------------------------|-----------------|---------------|----------------|
|  |                     | 1988               | 1990               | 1988                    | 1990            | 1988          | 1990           |
| <b>Sex</b>                                 |                     |                    |                    |                         |                 |               |                |
|  | Male                | 57                 | 54                 | 56                      | 54              | 60            | 57             |
|  | Female              | 43                 | 46                 | 44                      | 46              | 40            | 43             |
| <b>Age</b>                                 |                     |                    |                    |                         |                 |               |                |
|  | 18-24 years         | 15                 | 13                 | 16                      | 14              | 14            | 11             |
|  | 25-34 years         | 27                 | 27                 | 25                      | 27              | 28            | 27             |
|  | 35-44 years         | 23                 | 22                 | 24                      | 22              | 23            | 23             |
|  | 45-54 years         | 15                 | 15                 | 15                      | 15              | 18            | 15             |
|  | 55-64 years         | 10                 | 12                 | 11                      | 13              | 9             | 10             |
|  | 65 years and over   | 11                 | 11                 | 11                      | 10              | 9             | 12             |
| <b>Household size</b>                      |                     |                    |                    |                         |                 |               |                |
|  | One person          | 20                 | 20                 | 18                      | 18              | 24            | 24             |
|  | Two people          | 32                 | 35                 | 32                      | 34              | 32            | 36             |
|  | Three people        | 19                 | 18                 | 20                      | 19              | 17            | 14             |
|  | Four people         | 17                 | 17                 | 18                      | 18              | 17            | 14             |
|  | Five or more people | 12                 | 11                 | 12                      | 11              | 10            | 11             |
| <b>Family income</b>                       |                     |                    |                    |                         |                 |               |                |
|  | Less than \$10,000  | 6                  | 10 <sup>a</sup>    | 7                       | 10 <sup>a</sup> | 4             | 6 <sup>a</sup> |
|  | \$10,000 - \$19,999 | 16                 | 9 <sup>a</sup>     | 17                      | 9 <sup>a</sup>  | 11            | 6 <sup>a</sup> |
|  | \$20,000 - \$29,999 | 21                 | 22                 | 23                      | 24              | 15            | 14             |
|  | \$30,000 - \$39,999 | 20                 | 17                 | 21                      | 18              | 16            | 15             |
|  | \$40,000 - \$49,999 | 13                 | 13                 | 13                      | 13              | 14            | 14             |
|  | \$50,000 - \$74,999 | 14                 | 17                 | 13                      | 16              | 21            | 21             |
|  | \$75,000 - \$99,999 | 4                  | 6                  | 4                       | 5               | 7             | 9              |
|  | \$100,000 or more   | 5                  | 6                  | 3                       | 4               | 13            | 13             |
| <b>Region of origin of trip</b>            |                     |                    |                    |                         |                 |               |                |
|  | New England         | 5                  | 5                  | 4                       | 5               | 6             | 6              |
|  | Mid-Atlantic        | 13                 | 13                 | 12                      | 11              | 13            | 17             |
|  | South Atlantic      | 16                 | 17                 | 17                      | 17              | 16            | 17             |
|  | East South Central  | 6                  | 6                  | 6                       | 7               | 5             | 5              |
|  | East North Central  | 16                 | 18                 | 18                      | 18              | 12            | 15             |
|  | West South Central  | 13                 | 12                 | 13                      | 12              | 11            | 13             |
|  | West North Central  | 8                  | 8                  | 8                       | 9               | 8             | 7              |
|  | Mountain            | 7                  | 7                  | 6                       | 8               | 10            | 7              |
|  | Pacific             | 16                 | 13                 | 15                      | 13              | 19            | 14             |
| <b>Road trip distance</b>                  |                     |                    |                    |                         |                 |               |                |
|  | 200-299 miles       | 22                 | 22                 | 28                      | 29              | 3             | 2              |
|  | 300-399 miles       | 16                 | 15                 | 20                      | 19              | 4             | 1              |
|  | 400-499 miles       | 10                 | 11                 | 12                      | 13              | 5             | 4              |
|  | 500-599 miles       | 6                  | 7                  | 7                       | 8               | 4             | 4              |
|  | 600-999 miles       | 13                 | 14                 | 13                      | 15              | 14            | 11             |
|  | 1000-1999 miles     | 15                 | 14                 | 11                      | 9               | 25            | 30             |
|  | 2000 or more miles  | 12                 | 11                 | 5                       | 4               | 35            | 34             |
|  | Outside U.S.        | 6                  | 6                  | 4                       | 3               | 13            | 13             |
| Average trip distance (miles) <sup>d</sup> |                     | 970                | 898                | 680                     | 596             | 1980          | 2014           |
| Total miles (billions) <sup>e</sup>        |                     | 636                | 594                | 321                     | 288             | 306           | 292            |
| Total trips (millions)                     |                     | 656.1 <sup>f</sup> | 661.1 <sup>f</sup> | 472.6                   | 483.9           | 154.6         | 144.9          |

**Sources:**U.S. Travel Data Center, 1988 Travel Market Close-Up, Washington, DC, 1989, pp. 1, 29, 81, 89, and 93.U.S. Travel Data Center, 1990 Travel Market Report, Washington, DC, 1991, Appendix F, pp. 1, 29, 81, 89, and 93.

\*The sum of the components may not equal 100 percent due to rounding. A trip is defined as "each time a person goes to a place at least 100 miles from home and returns."

<sup>a</sup>Less than \$15,000<sup>a</sup>\$15,000-\$19,999.<sup>d</sup>Based on total trips taken in category, not total travelers.<sup>e</sup>Total number of trips multiplied by average trip distance.<sup>f</sup>The total exceeds the sum of automobile and air travel because some trips are made by bus and rail.

While the total number of trips has more than doubled from 1974 to 1990, the number of vacation trips has more than tripled in this period. More than half of all trips taken were less than 600 miles, while two-thirds of all weekend trips were less than 600 miles. The average distance of a business trip was the same in 1990 as in 1983. Trips for pleasure were the only trip type to have a decline in average distance from 1983 to 1990.

**Table 4.5**  
**Distribution of Trips for All Modes by Trip Purpose**  
**and Round-Trip Distance, 1974, 1983, and 1990\***  
(percentage)

| Round-trip distance<br>(miles) | Business/convention |         |         | Pleasure |         |         | Vacation |         |         | Weekend  |         |         | Total    |          |          |
|--------------------------------|---------------------|---------|---------|----------|---------|---------|----------|---------|---------|----------|---------|---------|----------|----------|----------|
|                                | 1974                | 1983    | 1990    | 1974     | 1983    | 1990    | 1974     | 1983    | 1990    | 1974     | 1983    | 1990    | 1974     | 1983     | 1990     |
| 200-299                        | 16                  | 16      | 21      | 21       | 21      | 22      | 14       | 18      | 20      | 22       | 30      | 26      | 20       | 22       | 22       |
| 300-399                        | 16                  | 11      | 12      | 18       | 16      | 16      | 13       | 15      | 14      | 21       | 21      | 17      | 18       | 15       | 15       |
| 400-599                        | 20                  | 20      | 19      | 20       | 16      | 19      | 18       | 14      | 18      | 25       | 20      | 23      | 20       | 17       | 18       |
| 600-999                        | 18                  | 15      | 13      | 16       | 13      | 15      | 18       | 14      | 15      | 18       | 14      | 15      | 16       | 14       | 14       |
| 1,000-1,999                    | 17                  | 20      | 18      | 11       | 13      | 13      | 16       | 15      | 14      | 8        | 8       | 10      | 13       | 14       | 14       |
| 2,000 or more                  | 11                  | 12      | 13      | 9        | 10      | 10      | 15       | 12      | 12      | 3        | 4       | 6       | 9        | 10       | 11       |
| Outside U.S.                   | 2                   | 6       | 5       | 5        | 9       | 7       | 8        | 10      | 8       | 2        | 3       | 4       | 4        | 8        | 6        |
| Total <sup>b</sup>             | 100                 | 100     | 100     | 100      | 100     | 100     | 100      | 100     | 100     | 100      | 100     | 100     | 100      | 100      | 100      |
| Average distance <sup>c</sup>  | 905                 | 1,020   | 1,020   | 751      | 870     | 867     | 998      | 940     | 953     | 546      | 580     | 689     | 791      | 860      | 898      |
| Total trips (millions)         | 67.8                | 103.6   | 155.6   | 163.9    | 371.5   | 460.9   | 113.9    | 307.8   | 422.3   | 109.4    | 225.5   | 280.0   | 280.7    | 540.9    | 661.1    |
| % of total                     | (24.2%)             | (19.2%) | (23.3%) | (58.4%)  | (68.7%) | (69.7%) | (40.6%)  | (56.9%) | (63.9%) | (38.97%) | (41.7%) | (42.4%) | (100.0%) | (100.0%) | (100.0%) |

• Data from 1974 are not comparable with data past 1981 because of a change in survey methodology.

Sources:

1974 data - U.S. Travel Data Center, 1974 National Travel Survey, Full Year Report, Washington, DC, 1975, pp. 34, 50, 58, 62, 66.

1983 data - U.S. Travel Data Center, 1983 National Travel Survey, Full Year Report, Washington, DC, 1984, pp. A3, A30, A39, A48, A57.

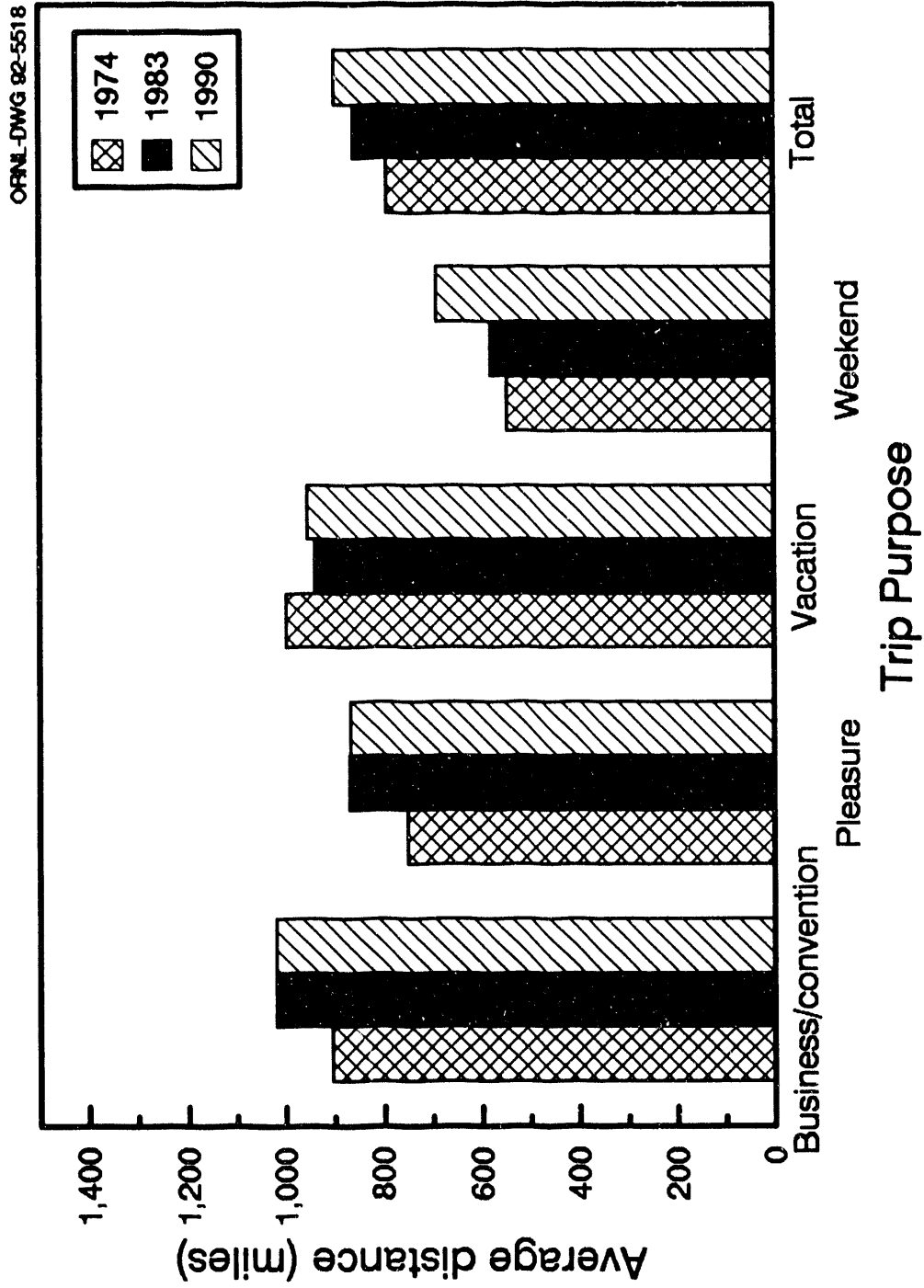
1990 data - U.S. Travel Data Center, 1990 Travel Market Report, Washington, DC, 1991, Appendix F, p. 1.

\*A trip is defined as "each time a person goes to a place at least 100 miles from home and returns." Trip types are not mutually exclusive.

<sup>b</sup>Totals may not equal the sum of the components due to rounding.

<sup>c</sup>Round trip straight-line distance for domestic travel only.

Figure 4.3. Average Distance of Trips by Trip Purpose, 1974, 1983, and 1990



Source: See Table 4.5.

Regardless of the trip purposes, the majority of trips in 1990 were taken using auto/truck/RV. Of the four trip purposes, business trips had the highest percentage of trips by airplane (37%), while weekend trips had the lowest percentage (13%). Since business trips are more likely to be taken by airplane, they have the longest average trip length (1,020 miles) while weekend trips have the shortest (689 miles).

**Table 4.6**  
**Mode of Travel by Trip Purpose, 1990<sup>a</sup>**

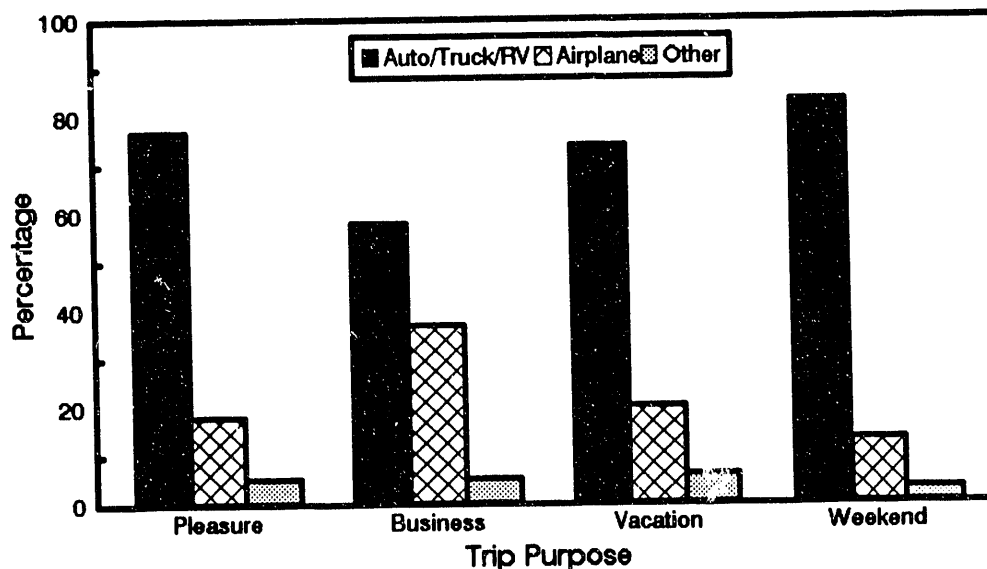
| Mode                             | Pleasure     | Business | Vacation | Weekend | Total              |
|----------------------------------|--------------|----------|----------|---------|--------------------|
|                                  | (percentage) |          |          |         |                    |
| Auto/truck/RV <sup>b</sup>       | 77           | 58       | 74       | 83      | 73                 |
| Airplane                         | 18           | 37       | 20       | 13      | 22                 |
| Bus                              | 3            | 2        | 3        | 2       | 3                  |
| Train                            | 1            | 1        | 1        | 1       | 1                  |
| Other                            | 1            | 2        | 1        | 1       | 2                  |
| Total number of trips (millions) | 460.9        | 155.6    | 422.3    | 280.2   | 661.1 <sup>d</sup> |
| Average trip distance (miles)    | 867.0        | 1020.0   | 953.0    | 689.0   | 898.0              |

**Source:**

U.S. Travel Data Center, 1990 Travel Market Report, Washington, D.C., 1991, Appendix F, pp. 1, 5.

**Figure 4.4. Mode of Travel by Trip Purpose, 1990**

ORNL-DRW 93-6685



Source: See Table 4.6.

<sup>a</sup>The sum of the components may not equal 100 percent due to rounding. A trip is defined as "each time a person goes to a place at least 100 miles from home and returns."

<sup>b</sup>This category also includes rental cars. RV = recreational vehicle.

<sup>c</sup>Less than 1 percent.

<sup>d</sup>The sum of the components may not equal the total number of trips due to multiple responses.

*According to the U.S. Census data, the percentage of workers who carpooled has dropped from 19.7% in 1980 to 13.4% in 1990. The percent of workers using public transit declined from 6.4% to 5.3% during the same time period. The average travel time increased by 0.7 minutes from 1980 to 1990.*

**Table 4.7**  
**Means of Transportation to Work for the United States: 1980 and 1990 Census**

| Means of Transportation               | 1980 Census       |              | 1990 Census       |            |
|---------------------------------------|-------------------|--------------|-------------------|------------|
|                                       | Number of Workers | Percentage   | Number of Workers | Percentage |
| Private vehicle                       | 81,258,496        | 84.1         | 99,592,932        | 86.5       |
| Drove alone                           | 62,193,449        | 64.4         | 84,215,298        | 73.2       |
| Carpooled                             | 19,065,047        | 19.7         | 15,377,634        | 13.4       |
| Public Transportation                 | 6,175,061         | 6.4          | 6,069,589         | 5.3        |
| Bus or trolley bus <sup>a</sup>       | 3,924,787         | 4.1          | 3,445,000         | 3.0        |
| Streetcar or trolley car <sup>a</sup> | <sup>b</sup>      | <sup>b</sup> | 78,130            | 0.1        |
| Subway or elevated                    | 1,528,852         | 1.6          | 1,755,476         | 1.5        |
| Railroad                              | 554,089           | 0.6          | 574,052           | 0.5        |
| Ferryboat                             | <sup>b</sup>      | <sup>b</sup> | 37,497            | 0.0        |
| Taxicab                               | 167,133           | 0.2          | 179,434           | 0.2        |
| Other Means                           | 703,273           | 0.7          | 808,582           | 0.7        |
| Motorcycle                            | 419,007           | 0.4          | 237,404           | 0.2        |
| Bicycle                               | 468,348           | 0.5          | 466,856           | 0.4        |
| Walked only                           | 5,413,248         | 5.6          | 4,488,886         | 3.9        |
| Worked at home                        | 2,179,863         | 2.3          | 3,406,025         | 3.0        |
| Total Workers                         | 96,617,296        | 100.0        | 115,070,274       | 100.0      |
| Average travel time (minutes)         | 21.7              |              | 22.4              |            |

**Source:**

Data provided by the Journey-to-Work and Migration Statistics Branch, Population Division, U.S. Bureau of the Census.

<sup>a</sup>This category was "Bus or streetcar" in 1980.

<sup>b</sup>Data are not available.

**Table 4.8**  
**Summary Statistics on Demographic Characteristics**  
**and Total Travel**  
**1969, 1977, 1983, and 1990 Series of the NPTS**

|   | 1969      | 1977      | 1983      | 1990                 | Change             |                    |
|---|-----------|-----------|-----------|----------------------|--------------------|--------------------|
|   |           |           |           |                      | 69-90 <sup>a</sup> | 69-90 <sup>b</sup> |
| <b>HOUSEHOLDS (000)</b>                             |           |           |           |                      |                    |                    |
| All   | 62,504    | 75,412    | 85,371    | 93,347               | 1.9                | 49                 |
| 1 person  | 10,980    | 16,214    | 19,354    | 22,999               | 3.6                | 109                |
| 2 persons   | 18,448    | 22,925    | 27,169    | 30,114               | 2.4                | 63                 |
| 3 persons   | 10,746    | 13,046    | 14,756    | 16,128               | 2.0                | 50                 |
| 4+ persons  | 22,330    | 23,227    | 24,092    | 24,106               | 0.4                | 8                  |
| <b>PERSONS (000)</b>                                |           |           |           |                      |                    |                    |
| All   | 197,213   | 213,141   | 229,453   | 239,416 <sup>c</sup> | 0.9                | 21                 |
| Under 16  | 60,100    | 54,958    | 53,682    | 54,303               | -0.5               | -10                |
| 16-19   | 14,598    | 16,552    | 15,268    | 13,831               | -0.2               | -5                 |
| 20-34   | 40,060    | 52,252    | 60,788    | 59,517               | 1.9                | 49                 |
| 35-64   | 62,982    | 66,988    | 75,353    | 82,480               | 1.3                | 31                 |
| 65+   | 19,473    | 22,391    | 24,362    | 26,955               | 1.6                | 38                 |
| All Male  | 94,465    | 102,521   | 111,514   | 114,441              | 0.8                | 21                 |
| All Male - 16 and older                             | 66,652    | 74,542    | 83,645    | 86,432               | 1.1                | 30                 |
| All Female  | 102,748   | 110,620   | 117,939   | 124,975              | 0.8                | 22                 |
| All Female - 16 and older                           | 73,526    | 83,721    | 92,080    | 96,371               | 1.1                | 31                 |
| All - 5 and older                                   | NA        | 198,434   | 212,932   | 222,101              | 0.9 <sup>d</sup>   | 12 <sup>d</sup>    |
| <b>LICENSED DRIVERS (000)</b>                       |           |           |           |                      |                    |                    |
| All   | 102,986   | 127,552   | 147,015   | 163,025 <sup>e</sup> | 2.2                | 58                 |
| Male  | 57,981    | 66,199    | 75,639    | 80,289               | 1.6                | 38                 |
| Female  | 45,005    | 61,353    | 71,376    | 82,707               | 2.9                | 84                 |
| <b>WORKERS (000)</b>                                |           |           |           |                      |                    |                    |
| All   | 75,758    | 93,019    | 103,244   | 118,343 <sup>e</sup> | 2.1                | 56                 |
| Male  | 48,487    | 55,625    | 58,849    | 63,996               | 1.3                | 32                 |
| Female  | 27,271    | 37,394    | 44,395    | 54,334               | 3.3                | 99                 |
| <b>HOUSEHOLD VEHICLES<sup>f</sup> (000)</b>         | 72,500    | 120,098   | 143,714   | 165,221              | 4.0                | 128                |
| <b>HOUSEHOLD VEHICLE TRIPS (000,000)</b>            | 87,284    | 108,826   | 126,874   | 158,927              | 2.9                | 82                 |
| <b>HOUSEHOLD VMT (000,000)</b>                      | 775,940   | 907,603   | 1,002,139 | 1,409,600            | 2.9                | 82                 |
| <b>PERSON TRIPS<sup>g</sup> (000,000)</b>           | 145,146   | 211,778   | 224,385   | 249,562              | 2.6                | 72                 |
| <b>PERSON MILES OF TRAVEL<sup>h</sup> (000,000)</b> | 1,404,137 | 1,879,215 | 1,946,662 | 2,315,300            | 2.4                | 65                 |

Source: U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Study: Summary of Travel Trends, Table 1, Washington, DC, March 1992.

<sup>a</sup>Compounded annual percentage change rate.

<sup>b</sup>Percentage change rate.

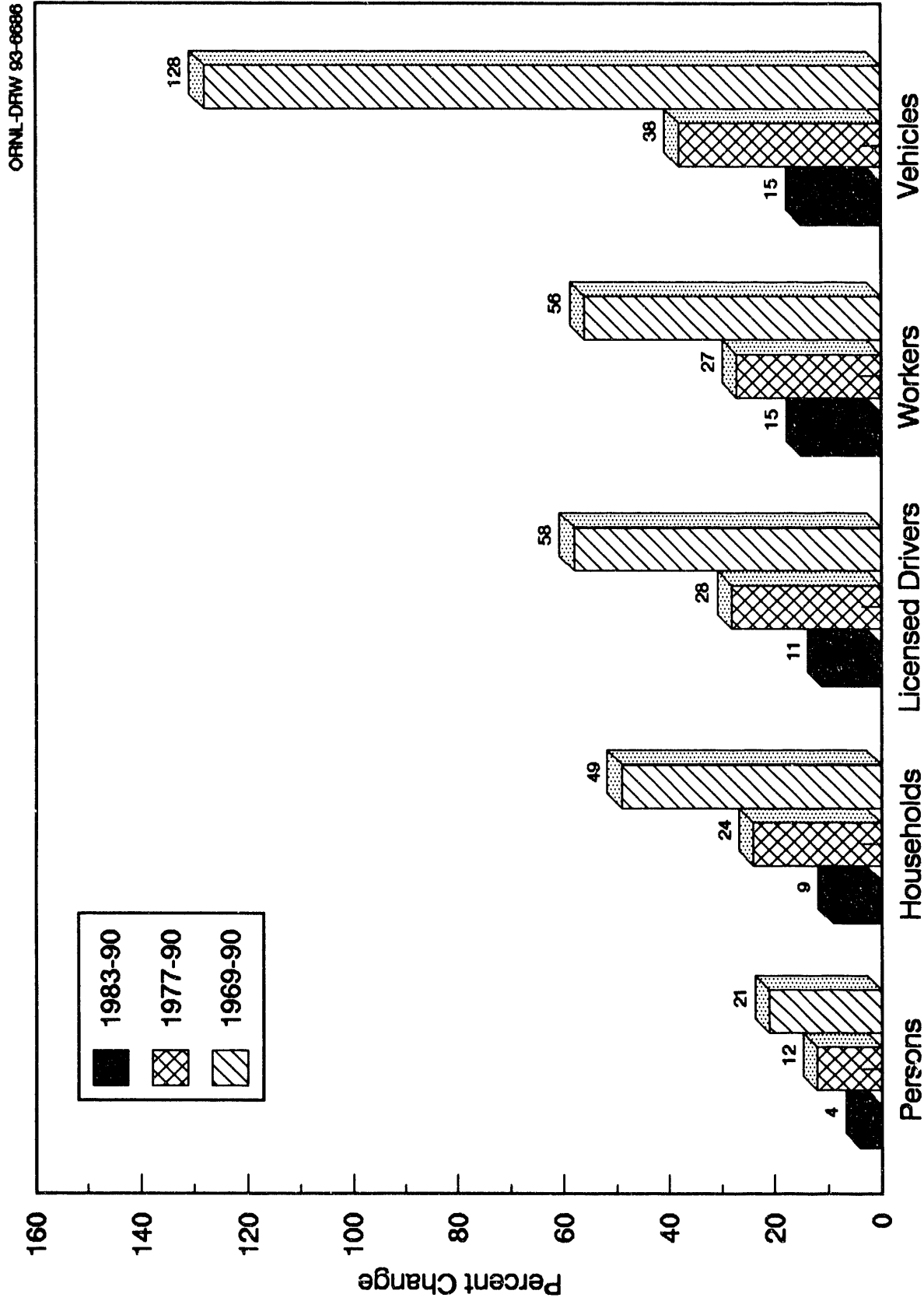
<sup>c</sup>Includes "don't know" and "refusals."

<sup>d</sup>For years 1977-1990.

<sup>e</sup>1969 survey includes only automobiles, station wagons, and vanbuses/minibuses as household vehicles.

<sup>f</sup>1969 survey does not include walk and bicycle trips.

Figure 4.5. Percent Change in Numbers of Individuals, Households, Drivers, Workers, and Vehicles  
1969, 1977, 1983, and 1990 Series of the NPTS



Source:  
U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, Figure 1,  
Washington, DC, March 1992.

*The percentage of households without a vehicle dropped from 20.6% in 1969 to 9.2% in 1990, while the percentage of households with three or more vehicles available quadrupled. Over the 1969 to 1990 period, the total number of households increased by 49% while the number of household vehicles increased by 128%.*

**Table 4.9**  
**Number of Households by Vehicles Available**  
**1969, 1977, 1983, and 1990 Series of the NPTS**  
**(thousands)**

| Number<br>of Vehicles<br>Owned        | 1969 <sup>a</sup> | 1977              | 1983              | 1990              | Change             |                    |
|---------------------------------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|
|                                       |                   |                   |                   |                   | 69-90 <sup>b</sup> | 69-90 <sup>c</sup> |
| No Vehicle                            | 12,876<br>(20.6%) | 11,538<br>(15.3%) | 11,548<br>(13.5%) | 8,573<br>(9.2%)   | -1.9               | -33                |
| 1 Vehicle                             | 30,252<br>(48.4%) | 26,092<br>(34.6%) | 28,780<br>(33.7%) | 30,654<br>(32.8%) | 0.1                | 1                  |
| 2 Vehicles                            | 16,501<br>(26.4%) | 25,942<br>(34.4%) | 28,632<br>(33.5%) | 35,872<br>(38.4%) | 3.8                | 117                |
| 3+ Vehicles                           | 2,875<br>(4.6%)   | 11,840<br>(15.7%) | 16,411<br>(19.2%) | 18,248<br>(19.5%) | 9.2                | 535                |
| <b>ALL<br/>HOUSEHOLDS</b>             | <b>62,504</b>     | <b>75,412</b>     | <b>85,371</b>     | <b>93,347</b>     | <b>1.9</b>         | <b>49</b>          |
| <b>ALL<br/>HOUSEHOLD<br/>VEHICLES</b> | <b>72,500</b>     | <b>120,098</b>    | <b>143,714</b>    | <b>165,221</b>    | <b>4.0</b>         | <b>128</b>         |
| <b>VEHICLES PER<br/>HOUSEHOLD</b>     | <b>1.16</b>       | <b>1.59</b>       | <b>1.68</b>       | <b>1.77</b>       | <b>2.0</b>         | <b>53</b>          |

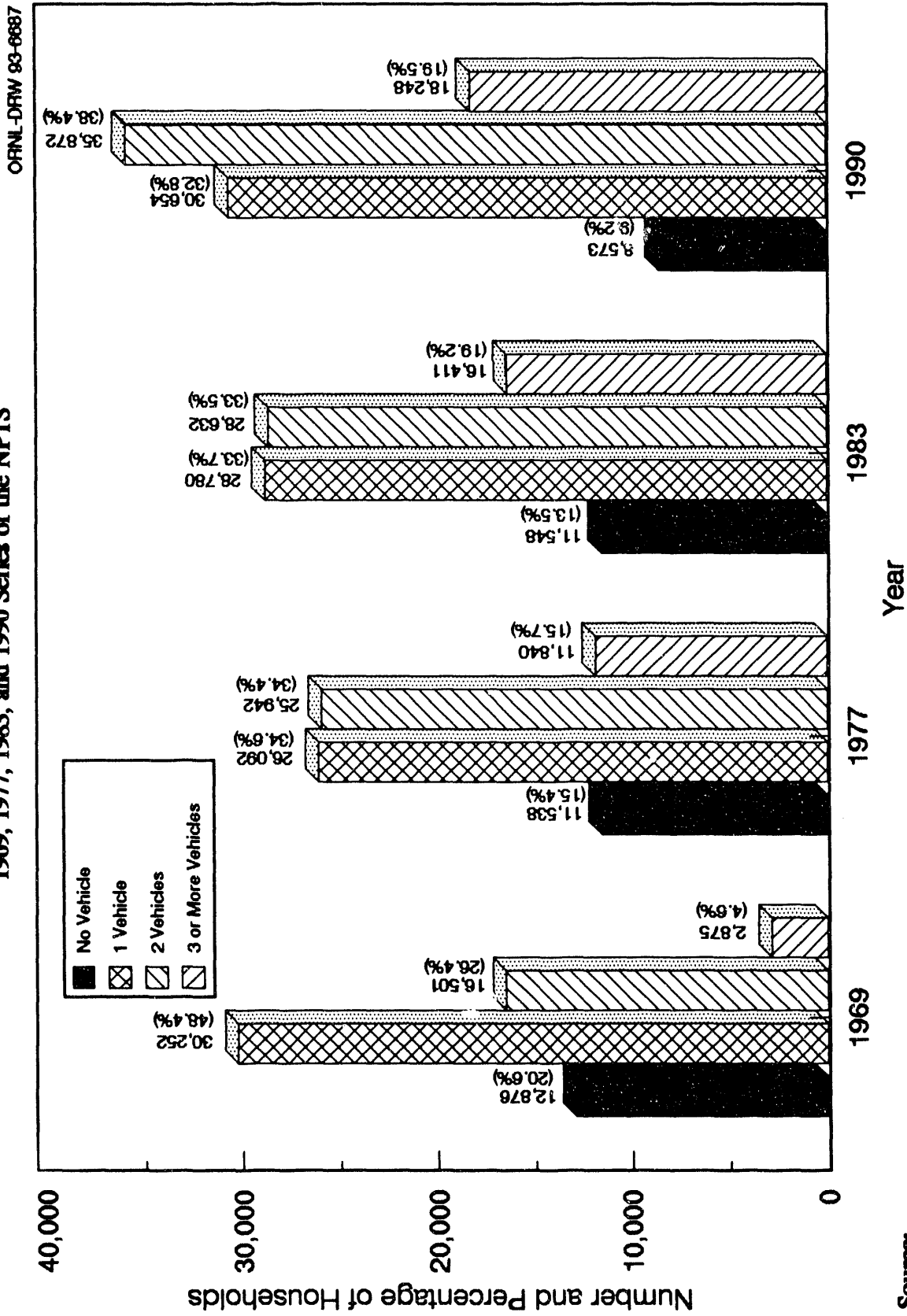
**Source:** U.S. Department of Transportation, Federal Highway Administration,  
1990 Nationwide Personal Transportation Survey: Summary of Travel Trends,  
 Table 4, Washington, DC, March 1992.

<sup>a</sup>The 1969 survey does not include pickups or other light trucks as household vehicles.

<sup>b</sup>Compounded annual percentage change rate.

<sup>c</sup>Percentage change rate.

Figure 4.6. Number and Percentage of Households by Number of Vehicles Available  
1969, 1977, 1983, and 1990 Series of the NPTS



Source:  
U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey:  
Summary of Travel Trends, Figure 3, Washington, DC, March 1992.

*Both annual VMT and annual vehicle trips per household increased by 22% between 1969 and 1990. Work trips continue to account for the largest proportion of household travel, both in terms of miles and in number of trips. Average vehicle trip lengths, which had been decreasing from 1969 to 1983, showed increases in 1990. The largest increase in trip length was in work trips.*

**Table 4.10**  
**Average Annual VMT, Vehicle Trips and Trip Length**  
**Per Household for Selected Trip Purposes**  
**1969, 1977, 1983, and 1990 Series of the NPTS**

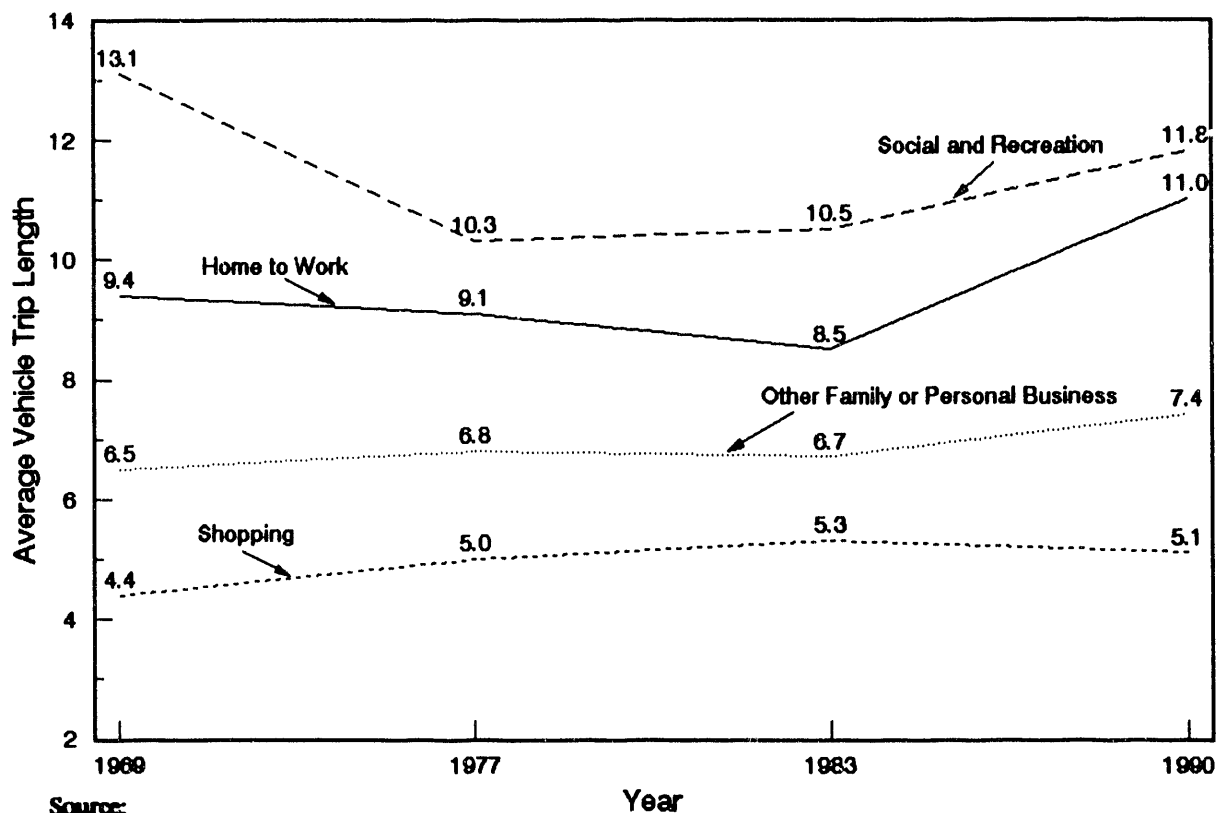
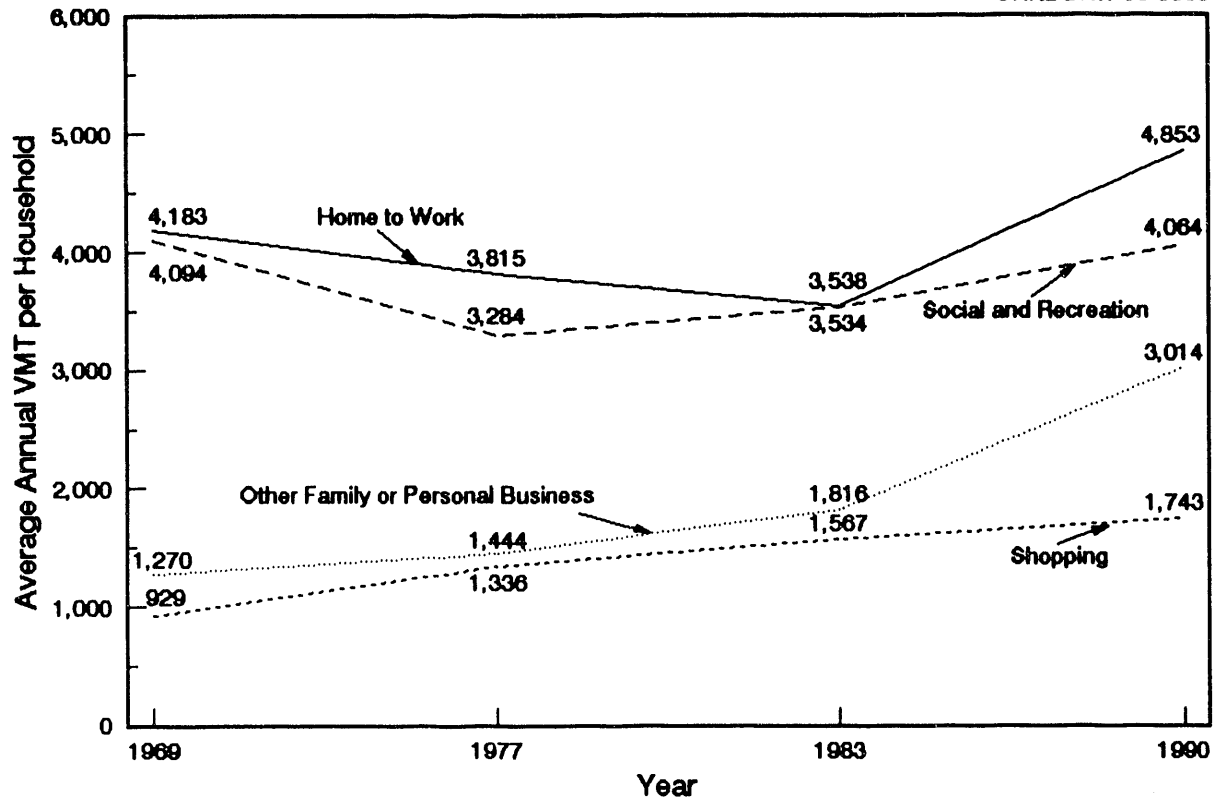
| Trip Purpose                               | 1969          | 1977          | 1983          | 1990          | Percent<br>Change<br>69-90 |
|--|---------------|---------------|---------------|---------------|----------------------------|
| <i>Average Annual VMT</i>                  |               |               |               |               |                            |
| Home to Work                               | 4,183         | 3,815         | 3,538         | 4,853         | 16                         |
| Shopping                                   | 929           | 1,336         | 1,567         | 1,743         | 88                         |
| Other Family or Personal Business          | 1,270         | 1,444         | 1,816         | 3,014         | 137                        |
| Social and Recreation                      | 4,094         | 3,286         | 3,534         | 4,060         | -1                         |
| <b>All*</b>                                | <b>12,423</b> | <b>12,036</b> | <b>11,739</b> | <b>15,100</b> | <b>22</b>                  |
| <i>Average Annual Vehicle Trips</i>        |               |               |               |               |                            |
| Home to Work                               | 445           | 423           | 414           | 448           | 0.7                        |
| Shopping                                   | 213           | 268           | 297           | 345           | 62                         |
| Other Family or Personal Business          | 195           | 215           | 272           | 411           | 111                        |
| Social and Recreation                      | 312           | 320           | 335           | 349           | 12                         |
| <b>All*</b>                                | <b>1,396</b>  | <b>1,442</b>  | <b>1,486</b>  | <b>1,702</b>  | <b>22</b>                  |
| <i>Average Vehicle Trip Length (Miles)</i> |               |               |               |               |                            |
| Home to Work                               | 9.4           | 9.1           | 8.5           | 11.0          | 17                         |
| Shopping                                   | 4.4           | 5.0           | 5.3           | 5.1           | 16                         |
| Other Family or Personal Business          | 6.5           | 6.8           | 6.7           | 7.4           | 14                         |
| Social and Recreation                      | 13.1          | 10.3          | 10.5          | 11.8          | -10                        |
| <b>All*</b>                                | <b>8.9</b>    | <b>8.4</b>    | <b>7.9</b>    | <b>9.0</b>    | <b>1</b>                   |

**Source:** U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, Table 7, Washington, DC, March 1992.

\*Includes trip purposes not shown above.

**Figure 4.7. Household Vehicle Travel for Selected Trip Purposes**  
**1969, 1977, 1983, and 1990 Series of NPTS**

ORNL-DRW 93-0688



Source:

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, Figure 5, Washington, DC, March 1992.

*The average vehicle occupancy, calculated as person miles per vehicle mile, was at its lowest level since 1977 for every trip purpose. Several factors contributed to this decline in the vehicle occupancy rate, including the increased number of vehicles per household and the decrease in average household size.*

**Table 4.11**  
**Average Vehicle Occupancy for Selected Trip Purposes**  
**1977, 1983, and 1990 Series of the NPTS**  
 (person miles per vehicle mile)

| Trip Purpose                         | 1977       | 1983       | 1990       | Change             |                    |
|--------------------------------------|------------|------------|------------|--------------------|--------------------|
|                                      |            |            |            | 77-90 <sup>a</sup> | 77-90 <sup>b</sup> |
| Home to Work                         | 1.3        | 1.3        | 1.1        | -1.3               | -15                |
| Shopping                             | 2.1        | 1.8        | 1.7        | -1.6               | -19                |
| Other Family or<br>Personal Business | 2.0        | 1.8        | 1.8        | -0.8               | -10                |
| Social and Recreation                | 2.4        | 2.1        | 2.1        | -1.0               | -13                |
| <b>All Purposes<sup>c</sup></b>      | <b>1.9</b> | <b>1.7</b> | <b>1.6</b> | <b>-1.3</b>        | <b>-16</b>         |

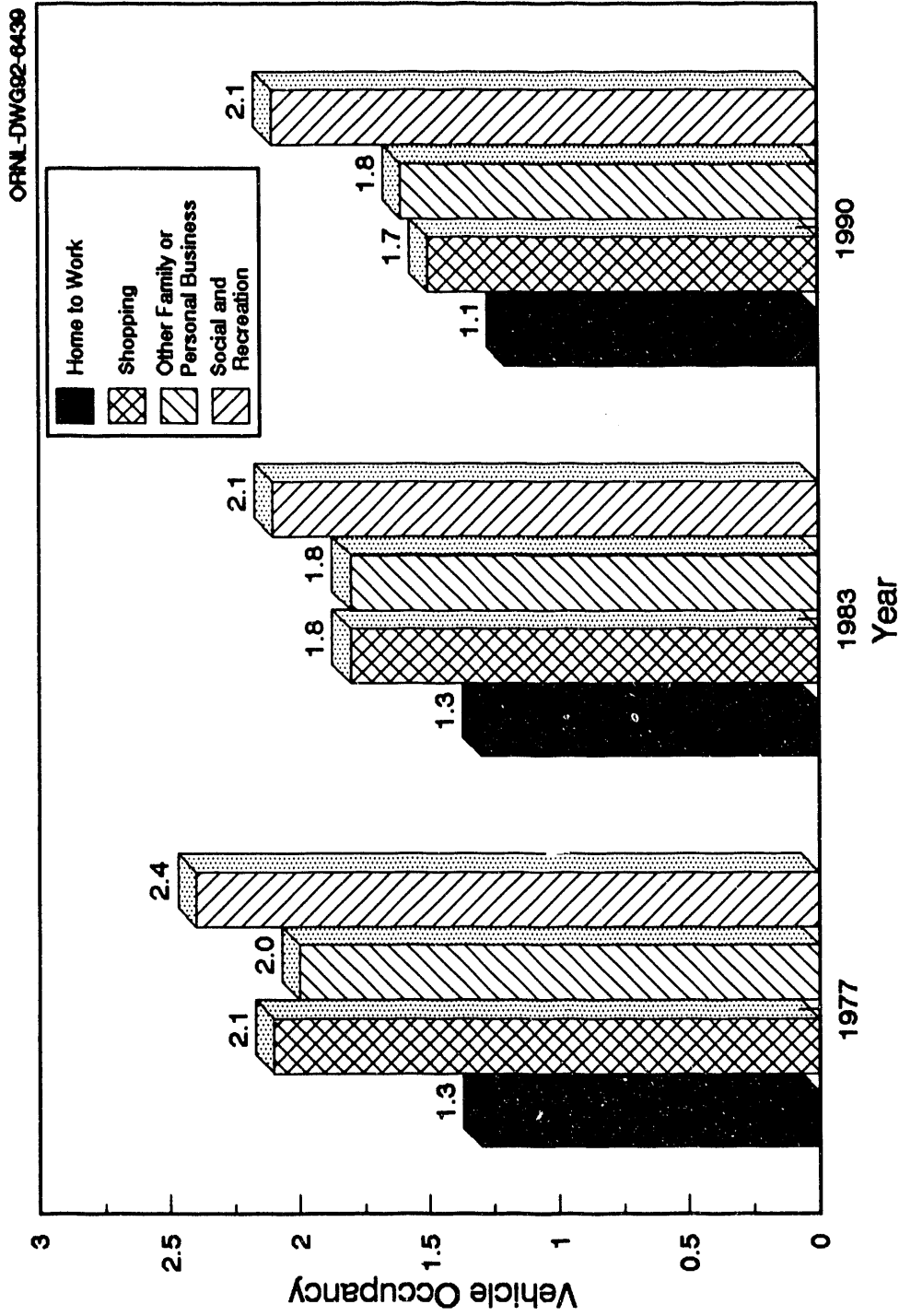
**Source:** U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, Table 8, Washington, DC, March 1992.

<sup>a</sup>Compounded annual percentage change rate.

<sup>b</sup>Percentage change rate.

<sup>c</sup>Includes other purposes not shown above such as trips to school, church, doctor, dentist, and work-related business trips.

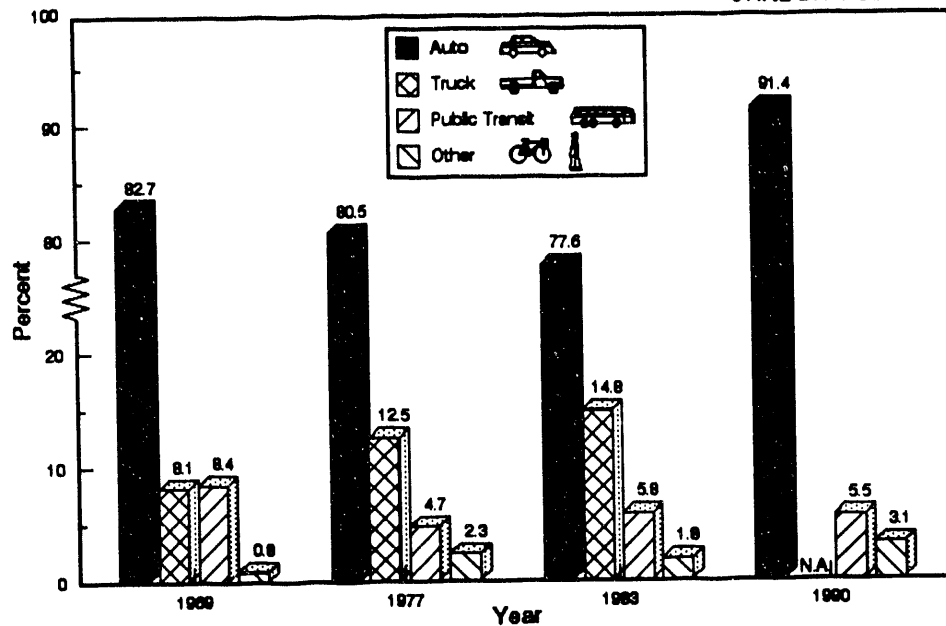
Figure 4.8. Average Vehicle Occupancy  
(persons per vehicle mile)



Source:  
U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey. Summary of Travel Trends, Figure 6, Washington, DC, March 1992.

**Figure 4.9. Distribution of Journey-to-Work Trips by Usual Mode<sup>a</sup>**

ORNL-DRW 93-0689



Source:

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, Figure 7, Washington, DC, March 1992.

**Table 4.12**  
**Distribution of Journey-to-Work Trips by Usual Mode<sup>a</sup>**  
**1969, 1977, 1983, and 1990 Series of the NPTS**  
**(percentage)**

| Mode               | 1969             | 1977  | 1983  | 1990  |
|--------------------|------------------|-------|-------|-------|
| Auto               | 82.7             | 80.5  | 77.6  | 91.4  |
| Truck <sup>b</sup> | 8.1              | 12.5  | 14.8  | -     |
| Public Transit     | 8.4              | 4.7   | 5.8   | 5.5   |
| Other              | 0.8 <sup>c</sup> | 2.3   | 1.8   | 3.1   |
| Total              | 100.0            | 100.0 | 100.0 | 100.0 |

Source: U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, Table 9, Washington, DC, March 1992.

<sup>a</sup>Usual mode is defined as the main means of transportation to work during the week preceding the interview. 1990 survey combines automobile and truck as a single mode.

<sup>b</sup>Household-based trucks, primarily pickups.

<sup>c</sup>Excludes walk trips.

*The average commute trip length increased by 7% from 1983 to 1990, from 9.9 miles to 10.6 miles. Yet the commute time declined by 3% during the same period. This observation might be partially due to the fact that a greater number of suburban and exurban residential areas and employment centers were developed. The resulting commutes are longer but are travelled at faster speeds. The decline in travel time is also influenced by changes in commuting modes, with a decrease in transit and carpooling and an increase in driving alone.*

**Table 4.13**  
**Commuting Patterns of Journey-to-Work Trips by Mode**  
**1969, 1977, 1983, and 1990 Series of the NPTS**

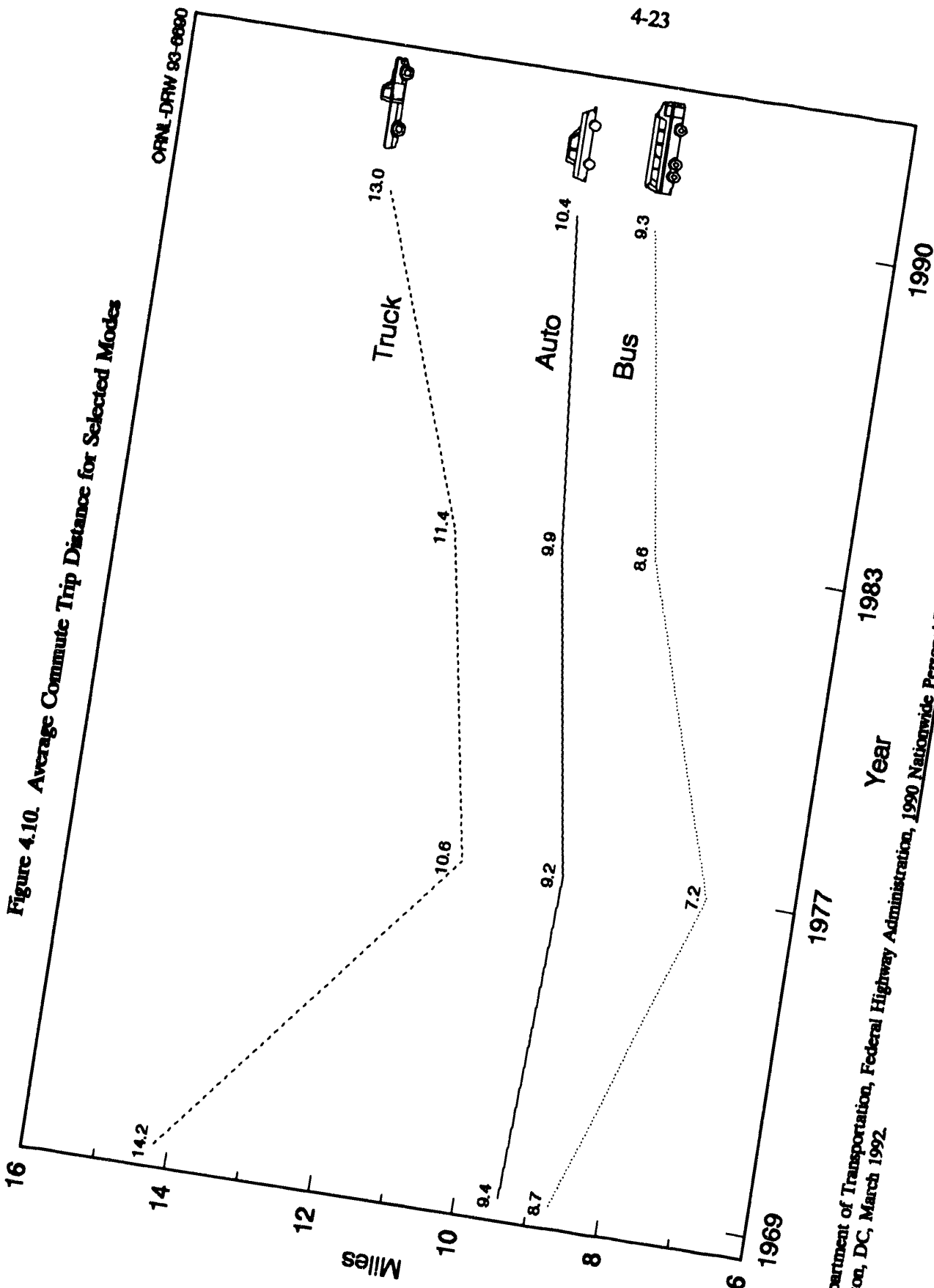
| Mode                                  | 1969 | 1977 | 1983 | 1990 | Change             |                    |
|---------------------------------------|------|------|------|------|--------------------|--------------------|
|                                       |      |      |      |      | 69-90 <sup>a</sup> | 69-90 <sup>b</sup> |
| Average Commute Trip Distance (Miles) |      |      |      |      |                    |                    |
| Auto                                  | 9.4  | 9.2  | 9.9  | 10.4 | 0.5                | 11                 |
| Truck <sup>c</sup>                    | 14.2 | 10.6 | 11.4 | 13.0 | -0.4               | -8                 |
| Bus                                   | 8.7  | 7.2  | 8.6  | 9.3  | 0.3                | 7                  |
| ALL                                   | 9.9  | 9.2  | 9.9  | 10.6 | 0.3                | 7                  |
| Average Commute Travel Time (Minutes) |      |      |      |      |                    |                    |
| ALL                                   | 22   | 20.4 | 20.4 | 19.7 | -0.5               | -10                |

Source: U.S. Department of Transportation, Federal Highway Administration,  
1990 Nationwide Personal Transportation Survey: Summary of Travel Trends,  
 Table 10, Washington, DC, March 1992

<sup>a</sup>Compounded annual percentage change rate.

<sup>b</sup>Percentage change rate.

<sup>c</sup>Household-based trucks, primarily pickups.



4-23

Source:  
U.S. Department of Transportation, Federal Highway Administration, *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends*, Figure 8, Washington, DC, March 1992

**Table 4.14**  
**Distribution of Journey-to-Work Trips by Household Income and Mode, 1990**  
 (percentage)

| Income<br>(thousands) | Automobile  | Truck       | Van        | Bus        | Train <sup>a</sup> | Walk       | Other <sup>b</sup> | Total      |
|-----------------------|-------------|-------------|------------|------------|--------------------|------------|--------------------|------------|
| Under \$10            | 65.4        | 11.8        | 4.9        | 5.0        | 0.8                | 10.6       | 1.5                | 100        |
| \$10-19.9             | 70.5        | 14.8        | 2.9        | 3.9        | 1.2                | 5.1        | 1.6                | 100        |
| \$20-29.9             | 68.2        | 18.1        | 4.5        | 2.4        | 1.7                | 4.4        | 0.8                | 100        |
| \$30-39.9             | 67.9        | 19.4        | 4.6        | 2.1        | 1.3                | 4.0        | 0.8                | 100        |
| \$40 and over         | 73.1        | 15.8        | 4.6        | 1.3        | 2.0                | 2.5        | 0.7                | 100        |
| <b>Total</b>          | <b>70.5</b> | <b>16.6</b> | <b>4.4</b> | <b>2.2</b> | <b>1.6</b>         | <b>3.9</b> | <b>0.9</b>         | <b>100</b> |

**Source:**

Generated from the U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Study, Public Use tape, March 1992.

<sup>a</sup>Includes Amtrak, commuter train, streetcar, trolley, elevated rail, and subway.

<sup>b</sup>Includes recreational vehicle, motorcycle, moped, bicycle, taxi, and other.

**Table 4.15**  
**Distribution of Journey-To-Work Trips by Worker Age and Mode, 1990**  
 (percentage)

| Age<br>(years) | Automobile  | Truck       | Van        | Bus        | Train <sup>a</sup> | Walk       | Other <sup>b</sup> | Total      |
|----------------|-------------|-------------|------------|------------|--------------------|------------|--------------------|------------|
| 5 - 15         | 56.5        | 8.8         | 6.4        | 6.7        | 0.0                | 12.3       | 9.3                | 100        |
| 16 - 19        | 76.3        | 10.0        | 1.5        | 2.7        | 1.1                | 6.6        | 1.8                | 100        |
| 20 - 29        | 72.3        | 15.0        | 2.2        | 2.5        | 2.3                | 4.6        | 1.1                | 100        |
| 30 - 39        | 69.2        | 16.7        | 5.9        | 1.8        | 2.0                | 3.7        | 0.8                | 100        |
| 40 - 49        | 70.4        | 16.8        | 5.4        | 2.4        | 1.1                | 3.0        | 0.9                | 100        |
| 50 - 59        | 67.1        | 20.2        | 4.6        | 2.2        | 1.4                | 3.6        | 0.9                | 100        |
| 60 - 64        | 71.5        | 17.3        | 2.9        | 3.3        | 0.9                | 3.6        | 0.4                | 100        |
| 65 and over    | 71.1        | 13.8        | 2.1        | 6.2        | 2.2                | 3.6        | 1.0                | 100        |
| <b>Total</b>   | <b>70.4</b> | <b>16.3</b> | <b>4.3</b> | <b>2.4</b> | <b>1.7</b>         | <b>4.0</b> | <b>1.0</b>         | <b>100</b> |

**Source:**

Generated from the U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Study, Public Use tape, March 1992.

<sup>a</sup>Includes Amtrak, commuter train, streetcar, trolley, elevated rail, and subway.

<sup>b</sup>Includes recreational vehicle, motorcycle, moped, bicycle, taxi, and other.

Table 4.16  
Distribution of Journey-To-Work Trips by Trip Distance and Mode, 1990  
(percentage)

| Trip Distance<br>(miles) | Automobile | Truck | Van  | Bus | Train <sup>a</sup> | Walk | Other <sup>b</sup> | Total |
|--------------------------|------------|-------|------|-----|--------------------|------|--------------------|-------|
| Less than 1/2            | 45.8       | 7.7   | 2.3  | 1.6 | 1.1                | 40.0 | 1.6                | 100   |
| 1/2 - 5                  | 73.2       | 15.1  | 4.2  | 2.4 | 0.9                | 2.5  | 1.7                | 100   |
| 6 - 10                   | 74.7       | 16.6  | 4.0  | 2.6 | 1.3                | 0.3  | 0.6                | 100   |
| 11 - 15                  | 74.3       | 18.0  | 4.0  | 2.1 | 1.2                | 0.0  | 0.4                | 100   |
| 16 - 20                  | 70.3       | 20.3  | 5.1  | 2.0 | 1.9                | 0.3  | 0.1                | 100   |
| 21 - 30                  | 69.9       | 19.7  | 5.9  | 1.5 | 2.7                | 0.0  | 0.3                | 100   |
| 31 - 40                  | 66.1       | 23.5  | 4.7  | 0.9 | 4.1                | 0.2  | 0.5                | 100   |
| 41 - 50                  | 65.9       | 21.0  | 4.3  | 1.6 | 6.4                | 0.2  | 0.7                | 100   |
| 51 - 60                  | 55.1       | 19.7  | 17.1 | 4.5 | 2.0                | 0.0  | 1.6                | 100   |
| 61 - 70                  | 64.9       | 23.4  | 7.9  | 0.0 | 3.8                | 0.0  | 0.0                | 100   |
| 71 - 80                  | 51.4       | 27.6  | 10.7 | 4.2 | 6.1                | 0.0  | 0.0                | 100   |
| 81 - 90                  | 82.0       | 4.9   | 0.0  | 0.0 | 13.1               | 0.0  | 0.0                | 100   |
| 91 - 100                 | 59.0       | 18.9  | 14.4 | 0.0 | 7.7                | 0.0  | 0.0                | 100   |
| Over 100                 | 47.7       | 43.7  | 5.3  | 1.4 | 1.9                | 0.0  | 0.0                | 100   |
| Total                    | 70.6       | 16.4  | 4.3  | 2.2 | 1.5                | 4.0  | 1.0                | 100   |

Source:

Generated from the U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Study, Public Use tape, March 1992.

<sup>a</sup>Includes Amtrak, commuter train, streetcar, trolley, elevated rail, and subway.

<sup>b</sup>Includes recreational vehicle, motorcycle, moped, bicycle, taxi, and other.

*The trend continued that American households keep their vehicles for a longer period of time, both for cars and trucks. The percent of household automobiles that were 10 or more years old increased from 10.8 in 1969 to 29.9 by 1990.*

**Table 4.17**  
**Distribution of Vehicles by Age**  
**1969, 1977, 1983, and 1990 Series of the NPTS**  
**(percentage)**

| Vehicle Age (Years)        | 1969*        | 1977         |              | 1983         |              | 1990         |              |
|----------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                            |              | Auto         | Truck/ Van   | Auto         | Truck/ Van   | Auto         | Truck/ Van   |
| 0-2                        | 31.4         | 27.3         | 29.9         | 19.9         | 16.2         | 15.6         | 19.7         |
| 3-5                        | 33.2         | 30.4         | 25.6         | 27.8         | 26.0         | 27.7         | 27.2         |
| 6-9                        | 24.6         | 26.7         | 21.1         | 27.1         | 24.5         | 26.8         | 20.9         |
| 10 or more                 | 10.8         | 15.6         | 23.4         | 25.1         | 33.2         | 29.9         | 32.2         |
| <b>TOTAL</b>               | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> |
| <b>Average Age (Years)</b> | <b>5.1</b>   | <b>5.5</b>   | <b>6.4</b>   | <b>7.2</b>   | <b>8.8</b>   | <b>7.6</b>   | <b>8.0</b>   |
|                            |              |              |              |              |              |              | <b>7.7</b>   |

Source:

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation

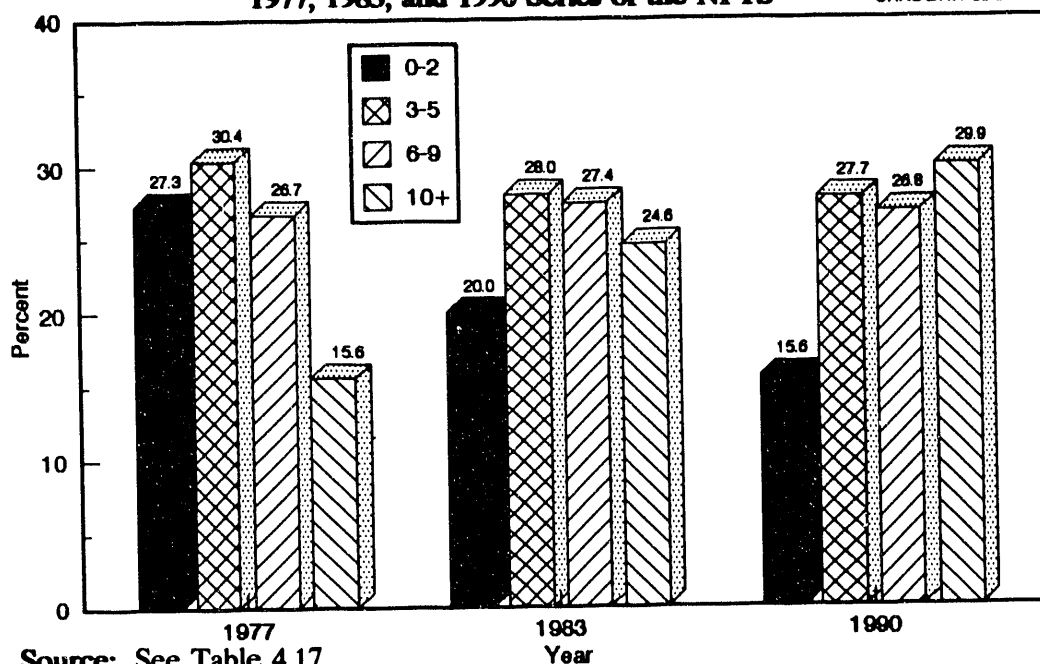
Study: Summary of Travel Trends, Washington, DC, March 1992.

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\*1969 survey includes automobiles and vanbus/minibus only.

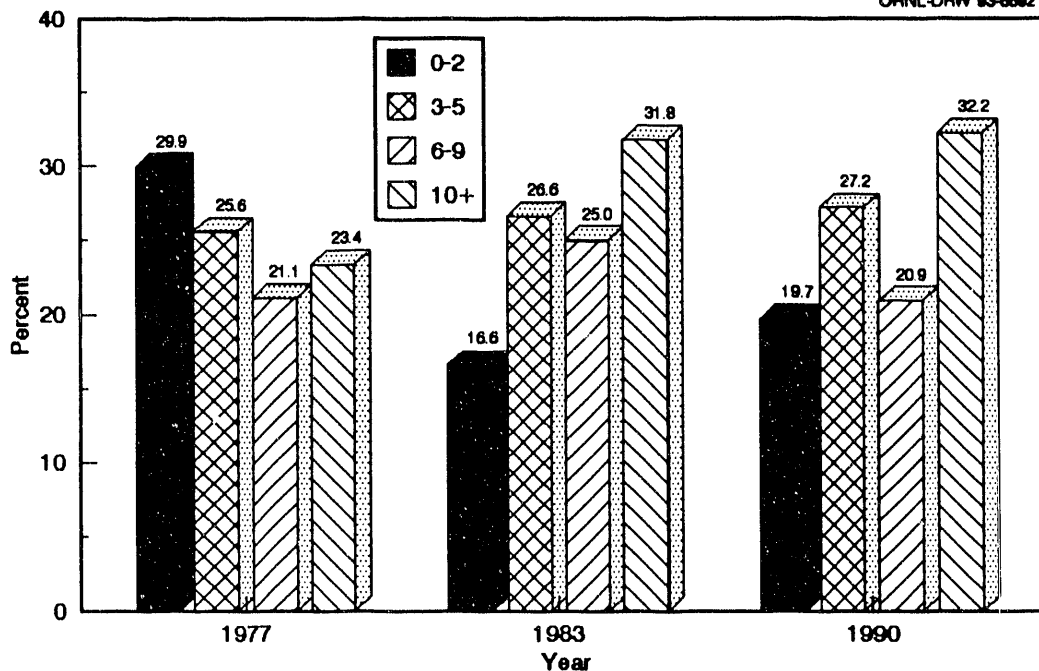
**Figure 4.11. Distribution of Automobiles by Vehicle Age  
1977, 1983, and 1990 Series of the NPTS**

ORNL-DRAW 93-6601



**Figure 4.12. Distribution of Household-Based Trucks by Vehicle Age  
1977, 1983, and 1990 Series of the NPTS**

ORNL-DRAW 93-6602



**Table 4.18**  
**Average Annual Miles per Vehicle by Number of Vehicles Available**  
**1969, 1977, 1983, and 1990 Series of the NPTS**

| Number of Vehicles | 1969 <sup>a</sup> | 1977          | 1983          | 1990          | Change             |                    |
|--------------------|-------------------|---------------|---------------|---------------|--------------------|--------------------|
|                    |                   |               |               |               | 69-90 <sup>b</sup> | 69-90 <sup>c</sup> |
| One                | 10,800            | 10,051        | 10,257        | 12,125        | 0.6                | 12                 |
| Two                | 12,000            | 10,874        | 10,854        | 12,978        | 0.4                | 8                  |
| Three or more      | 12,800            | 10,791        | 9,793         | 11,972        | -0.3               | -6                 |
| <b>TOTAL</b>       | <b>11,600</b>     | <b>10,679</b> | <b>10,315</b> | <b>12,458</b> | <b>0.3</b>         | <b>7</b>           |

<sup>a</sup>1969 survey includes autos, vanbus/minibus only.

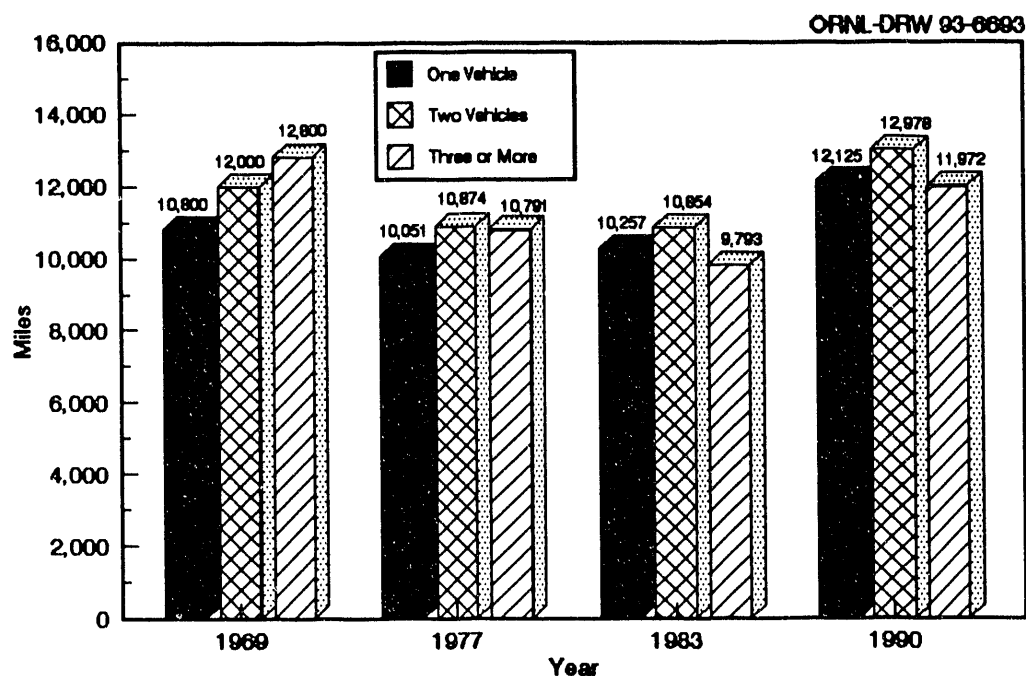
<sup>b</sup>Compounded annual percentage change rate.

<sup>c</sup>Percentage change rate.

**Source:**

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Study: Summary of Travel Trends, Table 13, Washington, DC, March 1992.

**Figure 4.13. Average Annual Miles Per Vehicle by Number of Vehicles Available**  
**1969, 1977, 1983, and 1990 Series of the NPTS**



**Source:**

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, Figure 12, Washington, DC, March 1992.

**Table 4.19**  
**Average Annual Miles Per Vehicle by Number of Adults in Household**  
**1977, 1983, and 1990 Series of the NPTS**

| Number of Adults | 1977          | 1983          | 1990          | Change             |                    |
|------------------|---------------|---------------|---------------|--------------------|--------------------|
|                  |               |               |               | 77-90 <sup>a</sup> | 77-90 <sup>b</sup> |
| One              | 9,423         | 9,517         | 11,416        | 1.5                | 21                 |
| Two              | 10,785        | 10,303        | 12,573        | 1.2                | 17                 |
| Three or more    | 10,943        | 10,679        | 13,084        | 1.4                | 20                 |
| <b>ALL</b>       | <b>10,679</b> | <b>10,315</b> | <b>12,458</b> | <b>1.2</b>         | <b>17</b>          |

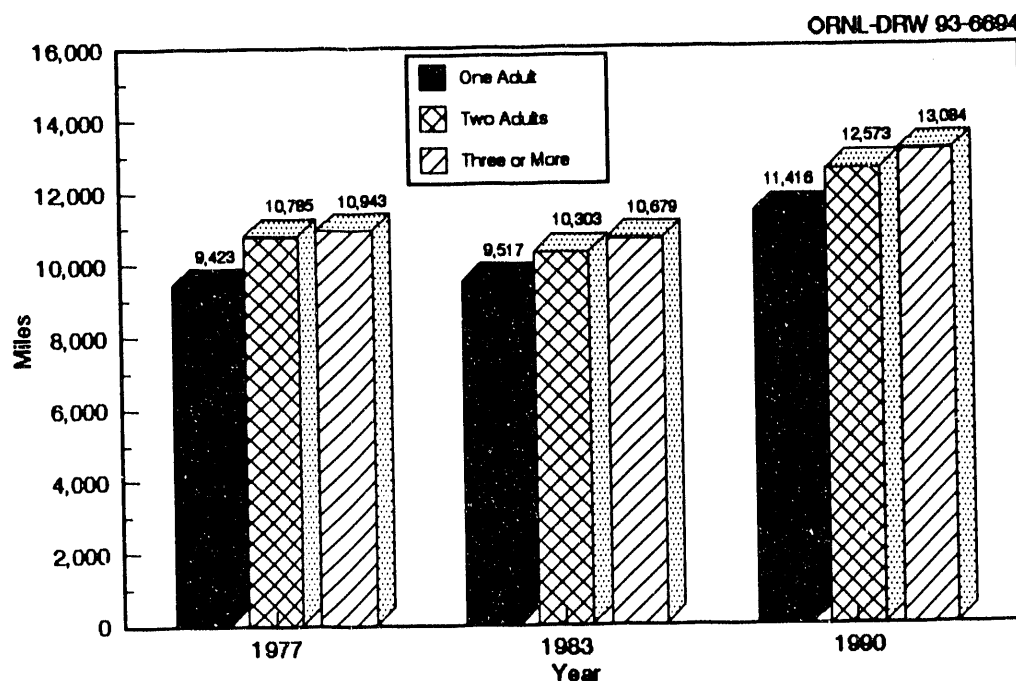
<sup>a</sup>Compounded annual percentage change rate.

<sup>b</sup>Percentage change rate.

**Source:**

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Study: Summary of Travel Trends, Table 14, Washington, DC, March 1992.

**Figure 4.14. Average Annual Miles Per Vehicle by Number of Adults in Household**  
**1977, 1983, and 1990 Series of the NPTS**



**Source:**

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, Figure 1, Washington, DC, March 1992.

*Although travel by males still accounts for a majority of the total travel, travel by females continues to increase. A significant jump in the share of travel by females was observed in the past 20 years - from 26.8% in 1969 to 35.4% in 1990. From 1983 to 1990, the share of travel by males, compared across all age groups, either remained relatively constant or decreased. In contrast, travel by females increased across all age groups, except for the 55 to 64 age group.*

**Table 4.20**  
**Distribution of Annual Miles by Driver Age and Sex**  
**1969, 1977, 1983, and 1990 Series of the NPTS**  
**(percentage)**

| Age           | 1969        | 1977        | 1983        | 1990        |
|---------------|-------------|-------------|-------------|-------------|
| <b>MALE</b>   |             |             |             |             |
| 16-19         | 3.1         | 3.2         | 2.0         | 2.0         |
| 20-34         | 27.0        | 29.7        | 28.6        | 24.3        |
| 35-54         | 30.1        | 27.2        | 27.0        | 27.1        |
| 55-64         | 9.3         | 8.5         | 9.3         | 6.8         |
| 65+           | 3.7         | 3.7         | 3.8         | 4.4         |
| <b>TOTAL</b>  | <b>73.2</b> | <b>72.3</b> | <b>70.7</b> | <b>64.6</b> |
| <b>FEMALE</b> |             |             |             |             |
| 16-19         | 1.5         | 1.6         | 1.1         | 1.5         |
| 20-34         | 9.9         | 11.9        | 12.4        | 14.6        |
| 35-54         | 11.3        | 10.1        | 10.9        | 14.3        |
| 55-64         | 2.9         | 2.8         | 3.4         | 2.9         |
| 65+           | 1.2         | 1.3         | 1.5         | 2.1         |
| <b>TOTAL</b>  | <b>26.8</b> | <b>27.7</b> | <b>29.3</b> | <b>35.4</b> |

**Source:**

U.S. Department of Transportation, Federal Highway Administration, 1990  
Nationwide Personal Transportation Survey: Summary of Travel Trends, Washington, DC, March  
 1992.

*As households owned more vehicles, the average annual miles for the most frequently driven vehicle increased. For example, the most frequently driven vehicle in five-vehicle households was driven 31% more per year than the one in two-vehicle households (20,300 miles vs. 15,500 miles).*

**Table 4.21**  
**Average Annual Miles per Vehicle by**  
**Household Vehicle Ownership, 1990**

| Total number of<br>vehicles owned<br>by household | Vehicle <sup>a</sup> |        |       |       |       | All<br>vehicles |
|---|----------------------|--------|-------|-------|-------|-----------------|
|   | #1                   | #2     | #3    | #4    | #5    |                 |
| 1   | 11,500               | -      | -     | -     | -     | 11,500          |
| 2   | 15,500               | 8,400  | -     | -     | -     | 12,200          |
| 3   | 17,500               | 9,900  | 4,900 | -     | -     | 11,200          |
| 4   | 18,800               | 11,600 | 7,100 | 3,800 | -     | 10,900          |
| 5   | 20,300               | 12,800 | 8,900 | 5,100 | 2,900 | 10,600          |

**Source:**

Generated from the U.S. Department of Transportation, Federal Highway Administration,  
1990 Nationwide Personal Transportation Survey, Public Use tape, March 1992.

<sup>a</sup>Vehicles are ranked by descending annual miles driven.

## **CHAPTER 5**

### **ALTERNATIVE FUELS STATISTICS**

In 1991, the transportation sector alone consumed 21.4 quads of petroleum fuels, accounting for 65.4% of total petroleum consumed in the United States. With decreasing in domestic oil production and rising demand, the amount of imported crude oil and petroleum products has increased at an average rate of 6.8% per year since 1985. In 1991, 47% of the U.S. petroleum consumed was imported. These statistics suggest that addressing the nation's dependence on petroleum will require reducing the dependence of the transportation sector on petroleum fuels.

Conventional petroleum fuels in motor vehicles are among the major contributors to environmental pollution around the world. Typically, motor vehicles emissions account for 30-50% of urban hydrocarbon, 80-90% of carbon monoxide and 40-60% of nitrogen oxide emissions. Alternative and reformulated fuels may offer the potential to reduce these pollutants significantly.

Because of increasing concerns about environmental pollution and the growing U.S. dependence on petroleum, the policy-makers began to search for ways of diversifying energy sources by switching from conventional to alternative and reformulated fuels<sup>a</sup>. "The Clean Air Act Amendments of 1990 (CAAA) include programs for oxygenated gasoline and for reformulated gasoline (RFG). The oxygenated gasoline program requires that, beginning November 1, 1992, gasoline with a minimum oxygen content of 2.7 weight percent must be sold during winter months in about 40 cities not in compliance with carbon monoxide (CO) standards. RFGs are required by January 1, 1995, in nine areas with extreme or severe ozone pollution problems ("covered ozone nonattainment areas"). About 100 other cities with marginal, moderate, or serious ozone problems may "opt-in" to the RFG program.

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<sup>a</sup>Information about the California emission standards is contained in Chapter 3, Section 3.7 **Vehicle Emissions**.

"The law specifies both a formula and also emissions performance standards for RFG. The nine areas in the extreme and serious ozone nonattainment categories currently comprise about 25 percent of the nation's gasoline market. However, because of the gasoline distribution system, surrounding areas will probably receive RFG as well. Taking these surrounding areas into consideration, the minimum market for RFG in 1995 is expected to be 30 percent of the current market.

"Other areas are allowed to petition the EPA to opt-in to the oxygenated and RFG programs. The most likely areas to request clean gasolines are the other less severe ozone and CO non-attainment areas, which account for 20 to 35 percent of current gasoline demand. A significant motivation to enter the programs will come in November 1993, when State Implementation Plans (SIPs) are required. In the SIPs, states will have to demonstrate their strategies for achieving compliance with clean air standards. Using clean gasolines to reduce vehicular emissions could be more attractive than other alternatives. The total market for clean gasolines is uncertain, but it could exceed 50 percent by 1996-1997.

"Besides requiring RFG in the covered ozone nonattainment areas, the CAAA requires that gasoline in all other areas not be any more polluting than it was in 1990. Without this "anti-dumping" provision, the potential exists for emissions from conventional gasoline to worsen as polluting fuel components are removed from and environmentally beneficial components are added to gasoline to be sold as RFG.

"In addition to constraints on the quality of gasoline, the CAAA also limits highway diesel fuel to a maximum sulfur content of 0.05 weight percent and a minimum cetane index of 40, effective October 1, 1993.

"With the passage of the CAAA, environmental regulations will dictate the market, define product composition and performance, influence technology, change consumer expectations of performance, and determine the feasibility of various production and supply options<sup>1</sup>."

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<sup>1</sup>G.R. Hadder, Oak Ridge National Laboratory, Reformulated Gasoline: Costs and Refinery Impacts, (ORNL-6747, Draft), Oak Ridge, TN, March 1993, pp. 1-1 & 1-2.

In 1988 the Alternative Motor Fuels Act (AMFA) was established to encourage the use of alternative fuels in the U.S. transportation sector. As a result of the AMFA, the Alternative Fuels Data Center (AFDC) was established by the Department of Energy. Information about the AFDC and statistics and maps generated by the AFDC are presented in this chapter, as well as information about the U.S. Advanced Battery Consortium. Also presented in this chapter are the characteristics of selected alternative fuels and statistics on the use of gasohol, a blend of gasoline and ethanol.

## THE ALTERNATIVE FUELS DATA CENTER

The Department of Energy (DOE) has established the Alternative Fuels Data Center (AFDC) in support of its work aimed at fulfilling the Alternative Motor Fuels Act (AMFA) directives. The AFDC is operated and managed by the National Renewable Energy Laboratory (NREL) in Golden, Colorado.

The purposes of the AFDC are:

- to gather and analyze information on the fuel consumption, emissions, operation, and durability of alternative fuel vehicles; and
- to provide unbiased, accurate information on alternative fuels and alternative fuel vehicles to government agencies, private industry, research institutions, and other interested organizations.

The data are collected for three specific vehicle types: (1) light-duty vehicles, including automobiles, light trucks, and mini-vans; (2) heavy-duty vehicles such as tractor trailers and garbage trucks; and (3) urban transit buses. An Oracle Relational Database Management System is used to manage the data, along with a statistical software package capable of providing statistical, graphic, and textual information to users. The next two tables and four graphs contain statistics which were generated by the AFDC. Future editions of the Transportation Energy Data Book will continue to present graphical and statistical information from the AFDC.

The Department of Energy is now sponsoring the **National Alternative Fuels Hotline** for Transportation Technologies in order to assist the general public and interested organizations in improving their understanding of alternative transportation fuels. The Hotline can be reached by dialing 1-800-423-1DOE.

*In fiscal year (FY) 1991, there were 81 AMFA Federal vehicles at four geographic locations in the U.S. Of these 81 vehicles, 16 are conventional gasoline fuel vehicles (control vehicles) and 65 are alternative fuel vehicles (AFVs) which are capable of operating on any mixture of gasoline and methanol, up to a mixture of 85% methanol. For comparative purposes, the vehicles were categorized into three groups:*

**M85 AFVs** 57 vehicles which operated on M85 (85% methanol, 15% unleaded gasoline) predominantly  
**Gasoline AFVs** 8 alternative fuel vehicles which operated on unleaded gasoline predominantly  
**Conventional gasoline vehicles** 16 conventional vehicles which operated only on unleaded gasoline

**Table 5.1**  
**On-Road Fuel/Energy Economy Summary for the AMFA Federal Vehicles, FY 1991**

| Vehicle site and type                       | Number of vehicles | miles per gallon | mpg-gasoline energy equivalent <sup>a</sup> | Btu/mile           |
|---|--------------------|------------------|---|--------------------|
| <b>Washington, DC</b>                       |                    |                  |   |                    |
| M85 AFVs                                    | 21                 | 10.9             | 19.3  | 5,959              |
| Gasoline AFVs                               | 2                  | 19.1             |   | 6,243 <sub>6</sub> |
| Conventional gasoline vehicles <sup>b</sup> | 4                  |                  |   |                    |
| <b>Detroit, MI</b>                          |                    |                  |   |                    |
| M85 AFVs                                    | 18                 | 14.1             | 24.8  | 4,536 <sub>6</sub> |
| Gasoline AFVs <sup>b</sup>                  | 2                  |                  |   |                    |
| Conventional gasoline vehicles              | 4                  | 22.5             |   | 5,404              |
| <b>Los Angeles, CA</b>                      |                    |                  |   |                    |
| M85 AFVs                                    | 9                  | 13.5             | 23.7  | 4,672 <sub>6</sub> |
| Gasoline AFVs <sup>b</sup>                  | 2                  |                  |   |                    |
| Conventional gasoline vehicles              | 4                  | 24.6             |   | 4,771              |
| <b>San Diego, CA</b>                        |                    |                  |   |                    |
| M85 AFVs                                    | 9                  | 14.7             | 25.9  | 4,265 <sub>6</sub> |
| Gasoline AFVs <sup>b</sup>                  | 2                  |                  |   |                    |
| Conventional gasoline vehicles              | 4                  | 21.6             |   | 5,249              |

**Source:**

Office of Transportation Technologies, U.S. Department of Energy, Federal Alternative Fuel Program Light Duty Vehicle Operations, Washington, DC, March 1992, pp. 2, 13. Generated by the Alternative Fuel Data Center, Golden, CO.

<sup>a</sup>Because gasoline has almost twice the energy content per gallon as M85, regular mpg data are not comparable in terms of energy efficiency.

<sup>b</sup>No information was collected on these vehicles in FY 1991.

*As of August 1992 there were 3,691 alternative refuel sites in the United States. This list includes public and private refuel sites, however, not all of these sites are available to the public.*

**Table 5.2**  
**Number of Alternative Refuel Sites by State and Fuel Type, 1992**

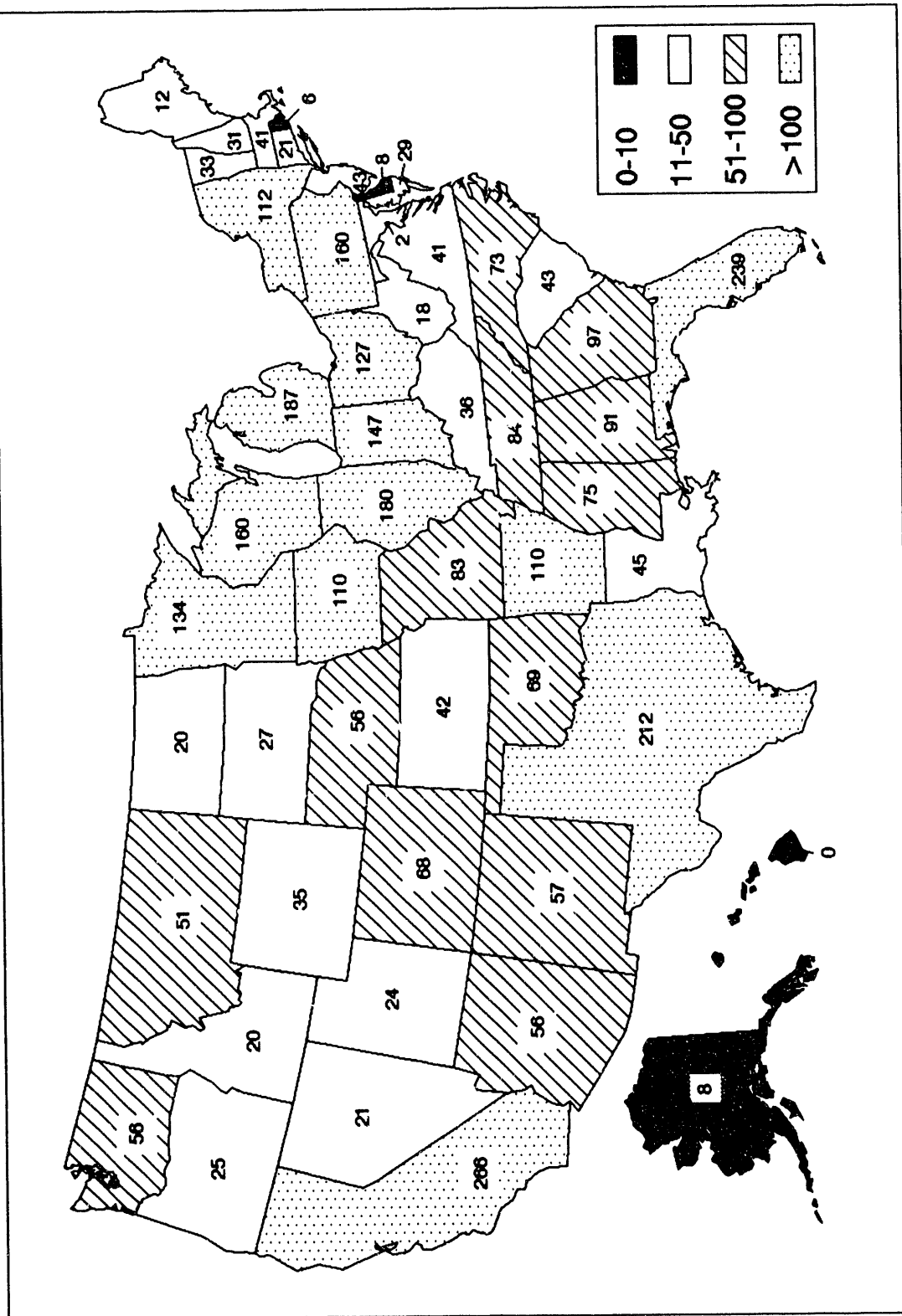
| State                | M85 Sites | NG Sites | LPG Sites | E85 Sites | TOTAL |
|----------------------|-----------|----------|-----------|-----------|-------|
| Alabama              |           | 6        | 85        |           | 91    |
| Alaska               |           |          | 8         |           | 8     |
| Arizona              | 1         | 10       | 45        |           | 56    |
| Arkansas             |           | 6        | 104       |           | 110   |
| California           | 27        | 24       | 214       | 1         | 266   |
| Colorado             | 1         | 20       | 47        |           | 68    |
| Connecticut          |           | 2        | 19        |           | 21    |
| Delaware             |           | 2        | 6         |           | 8     |
| District of Columbia | 1         | 1        |           |           | 2     |
| Florida              | 1         | 16       | 222       |           | 239   |
| Georgia              |           | 17       | 80        |           | 97    |
| Idaho                |           |          | 20        |           | 20    |
| Illinois             | 1         | 14       | 165       |           | 180   |
| Indiana              |           | 23       | 124       |           | 147   |
| Iowa                 |           | 2        | 108       |           | 110   |
| Kansas               |           | 4        | 38        |           | 42    |
| Kentucky             |           | 1        | 35        |           | 36    |
| Louisiana            |           | 1        | 44        |           | 45    |
| Maine                |           |          | 12        |           | 12    |
| Maryland             | 1         | 7        | 21        |           | 29    |
| Massachusetts        |           |          | 41        |           | 41    |
| Michigan             | 1         | 4        | 182       |           | 187   |
| Minnesota            |           | 9        | 125       |           | 134   |
| Mississippi          |           |          | 75        |           | 75    |
| Missouri             |           |          | 83        |           | 83    |
| Montana              |           | 3        | 48        |           | 51    |
| Nebraska             |           | 9        | 47        |           | 56    |
| Nevada               |           | 1        | 20        |           | 21    |
| New Hampshire        |           |          | 31        |           | 31    |
| New Jersey           |           | 7        | 36        |           | 43    |
| New Mexico           |           | 11       | 46        |           | 57    |
| New York             | 4         | 8        | 100       |           | 112   |
| N. Carolina          |           | 1        | 72        |           | 73    |
| N. Dakota            |           | 3        | 17        |           | 20    |
| Ohio                 | 2         | 27       | 98        |           | 127   |
| Oklahoma             |           | 13       | 56        |           | 69    |
| Oregon               |           | 4        | 21        |           | 25    |
| Pennsylvania         |           | 28       | 132       |           | 160   |
| Rhode Island         |           | 1        | 5         |           | 6     |
| S. Carolina          |           |          | 43        |           | 43    |
| S. Dakota            |           | 2        | 24        | 1         | 27    |
| Tennessee            | 1         | 3        | 80        |           | 84    |
| Texas                |           | 10       | 202       |           | 212   |
| Utah                 |           | 4        | 20        |           | 24    |
| Vermont              |           |          | 33        |           | 33    |
| Virginia             |           | 3        | 38        |           | 41    |
| Washington           | 1         | 18       | 37        |           | 56    |
| W. Virginia          | 1         | 1        | 16        |           | 18    |
| Wisconsin            |           | 21       | 139       |           | 160   |
| Wyoming              |           | 2        | 33        |           | 35    |
| United States        | 43        | 349      | 3,297     | 2         | 3,691 |

**Source:**

Data provided by Alternative Fuels Data Center, National Renewable Energy Laboratory, Golden, CO, August 1992.

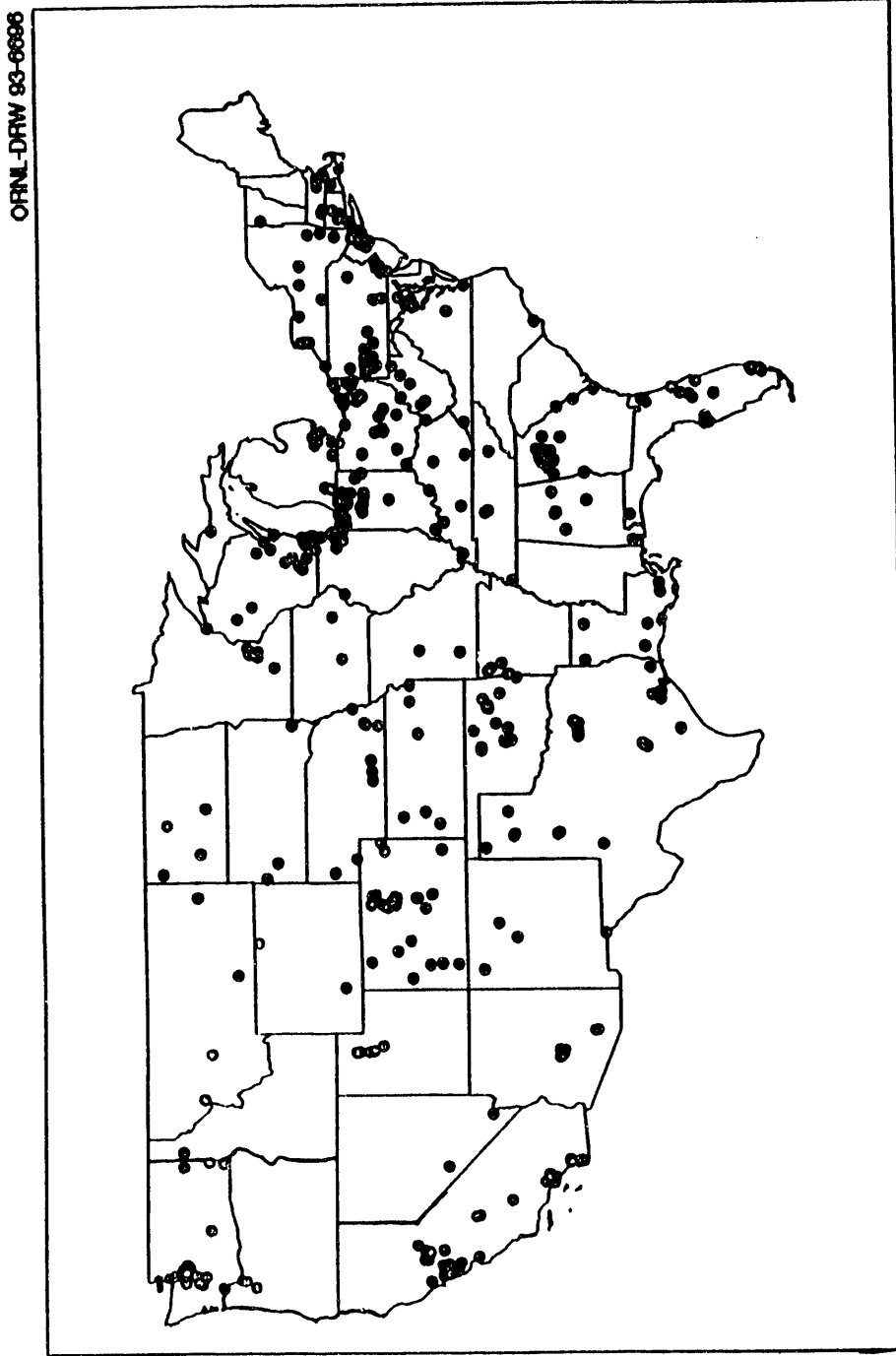
Figure 5.1. Number of Alternative Refuel Sites by State

ORNL-DRTW 93-6895



Source: See Table 5.2.

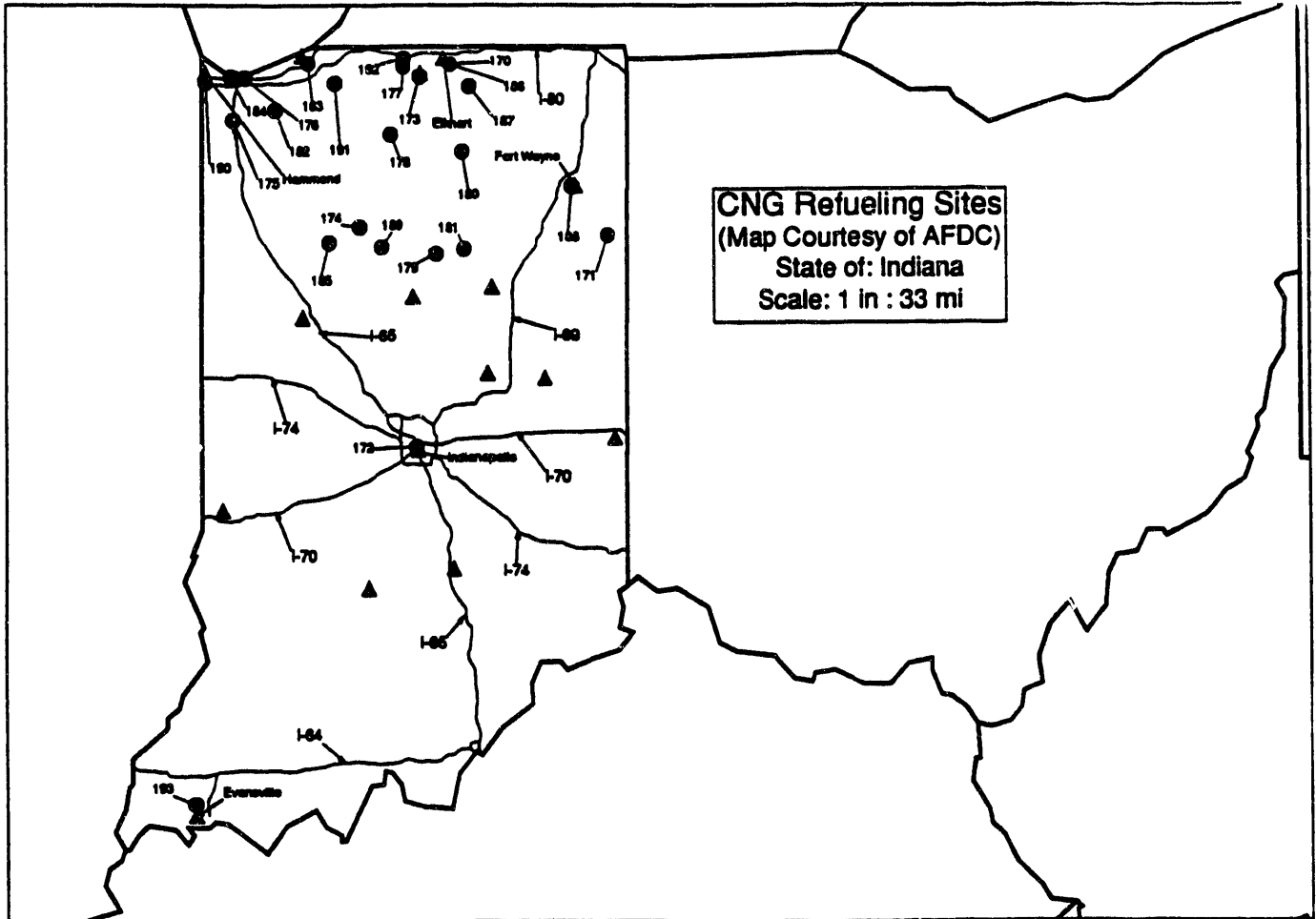
Figure 5.2. Compressed Natural Gas Refueling Sites in the United States



Source: Alternative Fuels Data Center, Golden, CO. "Refueling Site Maps", October 25, 1992.

Figure 5.3. A Map Example of Compressed Natural Gas Refueling Sites for the State of Indiana

ORNL-DRW 93-0897



**SYMBOLS:**

- = Refueling Site
- ▲ = City Location

**DESIGNATIONS:**

- I-80 = Interstate 80, for example
- 123 = Refueling Site Map Number

Source: Alternative Fuels Data Center, Golden, CO, "Refueling Site Maps", October 25, 1992.

ORNL-DRW 83-6698



Executive Order 12759 of April 17, 1991, Federal Energy Management, Section 11, "Procurement of Alternative Fueled Vehicles" requires that the "maximum number practicable of vehicles acquired annually are alternative fueled vehicles." The guidance document developed by DOE with interagency consultation established goals for the Federal procurement of alternative fueled vehicles (AFVs) (Figure 5.5). The breakdown of Federal agency requests for AFVs in the 1993 fiscal year by vehicle type and fuel type is shown in Figure 5.6.

Figure 5.5. Target Acquisition of Alternative Fuel Vehicles for Federal Fleets

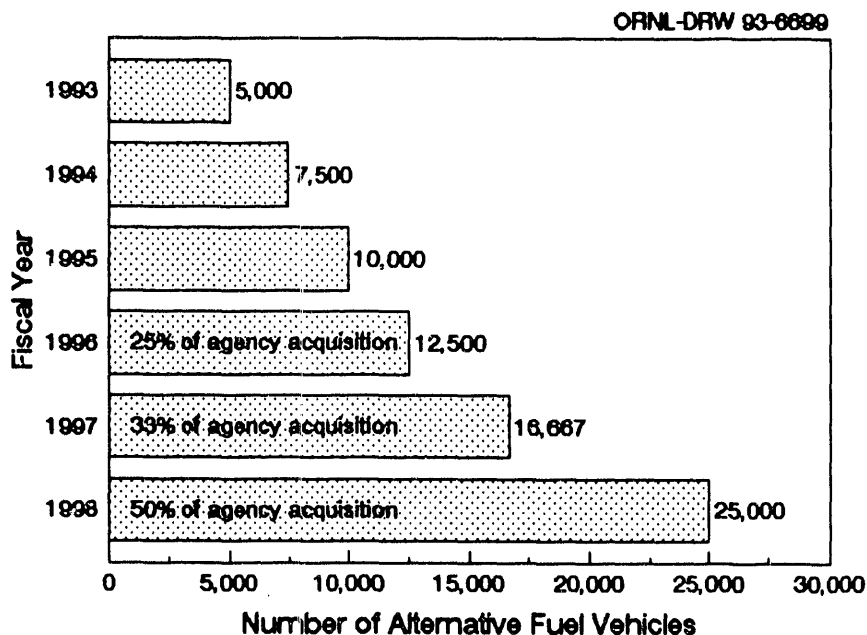
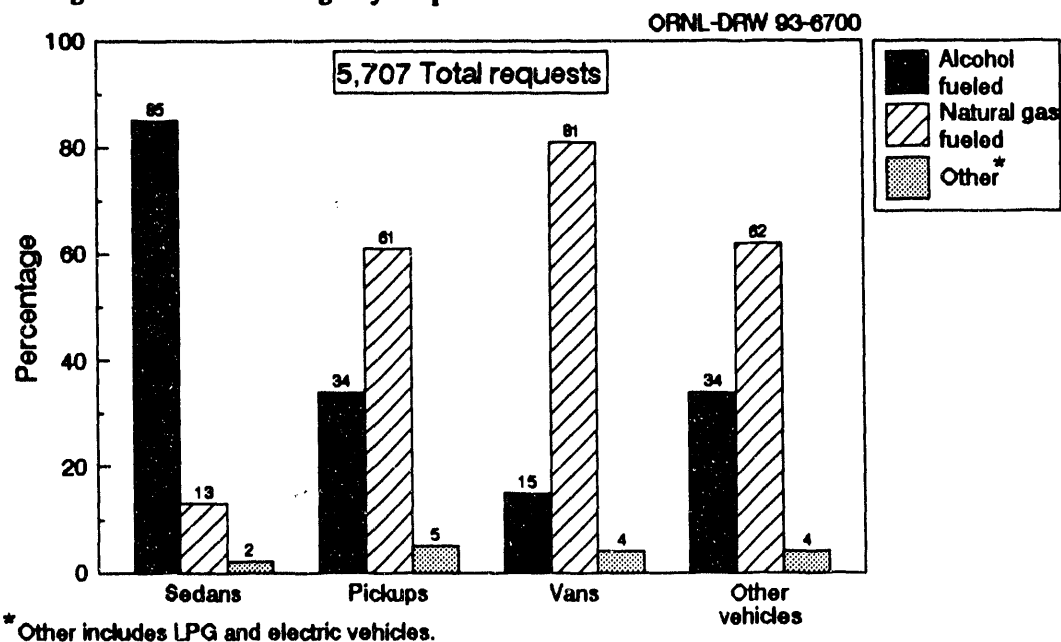


Figure 5.6. FY 1993 Agency Requests for Alternative Fuel Vehicles



Source:

Office of Transportation Technologies, U.S. Department of Energy, "Alternative Fuel Vehicles for the Federal Fleet: Results of the 5-Year Planning Process," Washington, DC, August 1992, pp. 4, 13.

### **U.S. ADVANCED BATTERY CONSORTIUM**

Electric vehicles are the subject of intense research and development because they are required to be sold in California in 1998 (2%) rising to 10% in 2003 under the California Low-Emission Vehicle (LEV) program. Other states have indicated that they will also enforce the LEV program. One of the greatest advantages in using electric vehicles is that there are no vehicle emissions. The U.S. Advanced Battery Consortium (USABC) was established in January 1991 to concentrate efforts on battery development for future electric vehicles. The USABC consists of: the Big Three U.S. auto manufacturers (Chrysler, Ford, General Motors); the Electric Power Research Institute; the electric utility industry; and the U.S. Department of Energy.

In FY 1992, the USABC has focused on establishing agreements for the development of advanced batteries. The USABC also entered a series of Cooperative Research and Development Agreements (CRADAs) with several DOE National Laboratories during this period. The following agreements have been concluded:

- the development of nickel metal hydride battery by to Ovonic Battery Company
- CRADA with National Renewable Energy Laboratory to develop advanced insulation for high temperature batteries
- CRADA with Lawrence Berkeley Laboratory for lithium polymer battery technology development
- the development of lithium polymer battery jointly with W.R. Grace Consortium
- CRADAs with Argonne National Laboratory for development of lithium iron disulfide battery technology and testing of advanced batteries
- CRADA with Idaho National Engineering Laboratory for testing of advanced batteries
- CRADA with Sandia National Laboratory for development of lithium polymer battery technology and battery reclamation.

*In FY 1992 the USABC reviewed the development criteria for mid-term goals. Reassessment of these criteria, which were originally defined in early 1991, resulted in no significant changes. Concerns about the potential for advanced batteries to meet the high power requirements demanded by the automotive customer and the ability of batteries to rapidly recharge are reflected in the revised goals.*

**Table 5.3**  
**Advanced Battery Technology Goals of the U.S. Advanced Battery Consortium**

|   | Mid-term goal<br>(1995-1998)      | Long-term goal <sup>a</sup> |
|---|-----------------------------------|-----------------------------|
| Power density W/L                                     | 250                               | 600                         |
| Specific power (charge) W/kg<br>(80% DoD/30 sec)      | 150<br>(200 desired)              | 400                         |
| Specific power (recharge) W/kg<br>(20% DOD/10 sec)    | 75                                |                             |
| Energy density Wh/L<br>(C/3 discharge rate)           | 135                               | 300                         |
| Specific energy Wh/kg<br>(C/3 discharge rate)         | 80<br>(100 desired)               | 200                         |
| Power/energy ratio                                    | 1.5-2.5                           |                             |
| Life (years)  | 5                                 | 10                          |
| Cycle life (cycles)<br>(80% DoD)                      | 600                               | 1000                        |
| Power and capacity degradation<br>(% of rated spec)   | 20%                               | 20%                         |
| Ultimate price (\$/kWh)<br>(10,000 units @ 40 kWh)    | <\$150                            | <\$100                      |
| Operating environment                                 | -30 to 65° C                      | -40 to 85° C                |
| Normal recharge time                                  | <6 hours                          | 3 to 6 hours                |
| Fast recharge time                                    | 50% of capacity<br>in <30 minutes |                             |
| Continuous discharge in 1 hour<br>(no failure) energy | 75%<br>(of rated energy capacity) | 75%<br>(of rated capacity)  |

**Source:**

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

<sup>a</sup>Competitive with today's internal combustion engine vehicles.

*While properties such as Reid vapor pressure and octane number can be determined for neat oxygenates, these values do not represent their behavior in a final gasoline blend. Blending numbers are therefore used for this purpose. The blending numbers vary by oxygenate type, concentration, and basestock composition. The blending numbers on this table are directly related to the basestock tested and should not be used out of context.*

**Table 5.4**  
**Basic Chemistry of Various Transportation Fuels**

**Chemical Formulae**

|                                  |   |
|----------------------------------|---|
| <b>Ethanol (Ethyl Alcohol)</b>   | $\text{CH}_3\text{CH}_2\text{OH}$ (or $\text{C}_2\text{H}_5\text{OH}$ ) |
| <b>Methanol (Methyl Alcohol)</b> | $\text{CH}_3\text{OH}$  |
| <b>Ethane</b>                    | $\text{CH}_3\text{CH}_3$ (or $\text{C}_2\text{H}_6$ )                   |
| <b>Methane</b>                   | $\text{CH}_4$   |
| <b>Gasoline</b>                  | $\text{C}_4\text{H}_{10}$ to $\text{C}_{12}\text{H}_x$                  |

**Physical Properties**

|  | <b><u>Ethanol</u></b> | <b><u>Methanol</u></b> | <b><u>Gasoline</u></b> |
|--|-----------------------|------------------------|------------------------|
| <b>Molecular Weight (MW)</b>               | 46.07                 | 32.04                  | *                      |
| <b>Specific Gravity (60°F/60°F)</b>        | 0.794                 | 0.796                  | 0.72-0.78              |
| <b>Density (lb/gal @ 60°F)</b>             | 6.61                  | 6.63                   | 6.0-6.5                |
| <b>Boiling Point</b>                       | 78°C (173°F)          | 65°C (149°F)           | 27-225°C (80-437°F)    |
| <b>Reid Vapor Pressure (RVP)</b>           |                       |                        | *                      |
| Neat (psi)                                 | 2.3                   | 4.6                    |                        |
| Blending number (psi)                      | 12-27                 | 93-98                  | 8-15                   |
| <b>Octane Number</b>                       |                       |                        | *                      |
| Neat                                       | 97                    | 98                     |                        |
| Blending number                            | 111 <sup>b</sup>      | 115 <sup>c</sup>       | 84-93                  |
| <b>Water solubility (volume % @ 70°F)</b>  | 100%                  | 100%                   | <sup>d</sup>           |
| <b>Latent heat of vaporization</b>         |                       |                        |                        |
| Btu/gal @ 60°F                             | 2,378                 | 3,340                  | 900                    |
| Btu/lb @ 60°F                              | 396                   | 506                    | 150                    |
| <b>Heating Value (lower)</b>               |                       |                        |                        |
| Btu/lb                                     | 11,500                | 8,570                  | 18,000-19,000          |
| Btu/gal @ 60°F                             | 76,000                | 56,800                 | 109,000-119,000        |
| <b>Energy Release (Btu/ft<sup>3</sup>)</b> | 94.7                  | 94.5                   | 95.2                   |
| <b>Stoichiometric air/fuel weight</b>      | 9.00                  | 6.45                   | 14.7                   |

**Source:**

Tshiteya, Rene M. and Ezio N. Vermiglio, Properties of Alcohol Transportation Fuels, Alcohol Fuels Reference Work #1, prepared for the Biofuels Systems Division, U.S. Department of Energy, by Meridian Corporation, Alexandria, VA, July 1991, pp. 2-i, 2-8.

\*Not applicable.

<sup>b</sup>For 10% ethanol blending with gasoline.

<sup>c</sup>For 5% methanol blending with gasoline.

<sup>d</sup>Negligible.

*The warranties of most passenger vehicles sold in the United States cover up to the following fuel concentrations in gasoline: Ethanol, 10%; ETBE, 17%; Methanol, 3-5%; MTBE, up to 15%.*

**Table 5.5.**  
**Reid Vapor Pressure of Various Alcohol/Ether/Gasoline Blends**

| % of Gasoline | % of Alcohol/Ether | Blending Agent    |                   |                   |                   |
|---------------|--------------------|-------------------|-------------------|-------------------|-------------------|
|               |                    | Ethanol           | ETBE <sup>a</sup> | Methanol          | MTBE <sup>b</sup> |
| 100           | 0                  | 9.00              | 9.00              | 9.00              | 9.00              |
| 95            | 5                  | 10.10             | 8.80              | 12.30             | 9.40              |
| 90            | 10                 | 10.00             | 8.60              | 12.40             | 9.20              |
| 85            | 15                 | 9.90              | 8.30              | 12.30             | 9.10              |
| 80            | 20                 | 9.75              | 8.10              | 12.20             | 9.10              |
| 75            | 25                 | c                 | 7.90              | c                 | c                 |
| 70            | 30                 | 9.50              | c                 | 12.05             | c                 |
| 50            | 50                 | 8.70              | c                 | 11.40             | 8.80              |
| 30            | 70                 | 7.00              | c                 | 10.00             | c                 |
| 15            | 85                 | 5.00 <sup>d</sup> | c                 | 7.90 <sup>d</sup> | c                 |
| 10            | 90                 | 4.30              | c                 | 7.20              | 8.10              |
| 0             | 100                | 2.30              | 4.40              | 4.60              | 7.80              |

**Source:**

Tshiteya, Rene M. and Ezio N. Vermiglio, Properties of Alcohol Transportation Fuels, Alcohol Fuels Reference Work #1, prepared for the Biofuels Systems Division, U.S. Department of Energy, by Meridian Corporation, Alexandria, VA, July 1991, p. 4-i.

<sup>a</sup>Ethyl-tertiary-butyl ether.

<sup>b</sup>Methyl-tertiary-butyl ether.

<sup>c</sup>Data are not available.

<sup>d</sup>Estimated.

**Table 5.6.**  
**U.S. Production of Methanol and Ethanol, 1978-1991**  
**(million gallons)**

| Year                                    | Ethanol | Methanol           |
|---|---------|--------------------|
| 1978                                    | 20      | <sup>a</sup>       |
| 1979                                    | 40      | 1,111              |
| 1980                                    | 80      | 1,079              |
| 1981                                    | 85      | 1,294              |
| 1982                                    | 234     | 1,139              |
| 1983                                    | 443     | 1,204              |
| 1984                                    | 567     | 1,239              |
| 1985                                    | 793     | 760                |
| 1986                                    | 798     | 1,110              |
| 1987                                    | 825     | 1,108              |
| 1988                                    | 800     | 1,237              |
| 1989                                    | 750     | 1,085              |
| 1990                                    | 756     | 1,214              |
| 1991                                    | 875     | 1,307 <sup>b</sup> |
| <i>Average annual percentage change</i> |         |                    |
| 1978-91                                 | 33.7%   | 1.4% <sup>c</sup>  |
| 1982-91                                 | 15.8%   | 1.5%               |

**Sources:**

Ethanol - Information Resources, Inc., Washington, DC, 1991.

Methanol - EA-Mueller, Inc., Baltimore, MD, 1992.

1991 estimate - Crocco and Associates, Houston, TX, 1992.

<sup>a</sup>Data are not available

<sup>b</sup>Estimate.

<sup>c</sup>Average annual percentage change is for years 1979-90.

*As of September 1992, nine states offered tax exemptions to encourage the use of gasohol for transportation purposes. Alaska offered the greatest exemption of eight cents per gallon, while Iowa and Connecticut both had the lowest exemption of one cent per gallon. Some states, such as Minnesota, New Jersey, and New Mexico, have discontinued the exemption of gasohol in recent years.*

**Table 5.7.**  
**State Tax Exemptions for Gasohol**  
**September 1992**

| State        | Exemption<br>(cents/gallon of gasohol) |
|--------------|--|
| Alaska       | 8.0                                    |
| Connecticut  | 1.0                                    |
| Idaho        | 4.0                                    |
| Iowa         | 1.0                                    |
| Nebraska     | 2.0                                    |
| Oregon       | 5.0                                    |
| South Dakota | 2.0                                    |
| Washington   | 2.3                                    |
| Wyoming      | 4.0                                    |

**Source:**

U.S. Department of Transportation, Federal Highway Administration,  
"Monthly Motor Fuel Reported by the States, June 1992,"  
October 1992, Washington, DC, Table MF-121T.

**Table 5.8**  
**Gasohol Consumption by Reporting States, 1980-91\***  
 (thousands of gallons)

|                      | 1980           | 1982             | 1984             | 1986             | 1988             | 1989             | 1990             | 1991 <sup>b</sup>            |
|----------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------------------|
| Alabama              |                | 11,522           | 34,899           | 261,286          | 416,308          | 195,725          | 197,856          | 194,733                      |
| Alaska               |                |                  |                  | 171              | 215              | 12               |                  |                              |
| Arizona              | 2,798          | 5,096            |                  |                  |                  |                  |                  |                              |
| Arkansas             | 8,250          | 8,462            | 28,871           |                  |                  |                  | 62,004           | 38,638                       |
| California           | 147,795        | 464,004          | 401,837          | 189,046          | 489,235          | 369,185          | 479,716          | 596,859                      |
| Colorado             | 3              | 23,990           | 82,233           | 70,462           | 50,707           | 70,522           | 97,263           | 100,844                      |
| Connecticut          | 15,849         | 4,461            | 5,421            | 5,323            |                  |                  |                  | 13,520                       |
| Delaware             | 1,512          |                  |                  |                  |                  |                  |                  |                              |
| District of Columbia | 124            | 34               | 84               | 205              | 446              | 333              |                  | 324                          |
| Florida              | 14,359         | 103,053          | 506,751          | 334,041          | 76,312           | 77,657           | 77,558           | 95,556                       |
| Georgia              | 11,063         | 148              | 18               |                  | 6,291            | 30,265           | 88,672           | 94,980                       |
| Hawaii               | 1,095          | 368              |                  |                  |                  |                  |                  |                              |
| Idaho                |                | 2,464            | 8,067            | 22,016           | 45,012           | 64,830           | 70,199           | 78,432                       |
| Illinois             | 15,088         | 251,200          | 562,036          | 1,286,828        | 1,406,620        | 1,278,517        | 1,341,148        | 1,374,728                    |
| Indiana              |                | 120,569          | 587,396          | 668,638          | 651,544          | 610,320          | 638,337          | 170,607                      |
| Iowa                 | 155,947        | 498,636          | 457,125          | 385,130          | 402,844          | 385,991          | 374,897          | 461,975                      |
| Kansas               | 37,786         | 7,448            | 273,077          | 232,604          | 120,763          | 98,844           | 73,971           | 71,242                       |
| Kentucky             | 4,763          | 18,872           | 328,238          | 736,349          | 656,845          | 403,859          | 355,987          | 346,130                      |
| Louisiana            |                |                  | 24,424           | 336,187          | 79,635           | 52,698           | 38,760           | 71,470                       |
| Maine                | 2,634          |                  |                  |                  |                  |                  |                  |                              |
| Maryland             | 18,549         | 107              | 82               | 501              |                  |                  |                  |                              |
| Massachusetts        | 16,209         | 290              |                  |                  |                  |                  |                  |                              |
| Michigan             | 29,924         | 206,794          | 577,723          | 382,010          | 499,565          | 402,714          | 510,447          | 662,986                      |
| Minnesota            | 11,776         | 4,653            | 2,707            | 374,032          | 171,929          | 170,499          | 244,336          | 461,613                      |
| Missouri             |                | 9,000            | 13,860           | 14,316           | 134,832          | 157,056          | 267,408          | 219,120                      |
| Montana              | 158            | 10,170           | 10,181           | 3,454            | 257              | 80               | 1,423            | 5,626                        |
| Nebraska             | 30,067         | 89,698           | 208,455          | 216,356          | 258,073          | 271,082          | 300,632          | 350,616                      |
| Nevada               | 641            | 964              |                  | 18,650           | 56,716           | 37,342           | 49,167           | 66,229                       |
| New Hampshire        | 3,642          |                  |                  |                  |                  |                  |                  |                              |
| New Jersey           | 6,567          |                  |                  |                  |                  |                  |                  |                              |
| New Mexico           |                | 1,082            | 63,756           | 58,752           | 147,656          | 171,297          | 156,935          | 152,856                      |
| N. Carolina          | 10,688         | 7,456            | 34,037           |                  |                  |                  |                  | 50,574                       |
| N. Dakota            | 13,491         | 6,499            | 5,469            | 65,327           | 44,317           | 37,966           | 35,821           | 53,356                       |
| Ohio                 | 16,726         | 91,679           | 495,595          | 814,579          | 981,874          | 958,123          | 1,072,040        | 1,116,757                    |
| Oklahoma             | 28,910         | 155,053          | 23,620           | 26,994           |                  |                  |                  |                              |
| Oregon               |                | 2,073            | 296              |                  |                  |                  |                  |                              |
| Rhode Island         | 1,763          | 22               |                  |                  |                  |                  |                  |                              |
| S. Carolina          | 11,608         | 59,688           | 154              | 15,550           | 102,333          | 82,454           | 62,549           | 72                           |
| S. Dakota            | 10,507         | 13,808           | 41,343           | 63,484           | 58,150           | 56,524           | 60,000           | 136,249                      |
| Tennessee            |                |                  | 264,167          | 394,469          | 580,227          | 373,391          | 246,713          | 178,373                      |
| Texas                |                | 38,142           | 207,152          | 362,243          | 341,682          | 216,607          | 247,384          | 244,095                      |
| Utah                 |                | 500              | 26,358           | 2,409            | 358              | 427              | 485              | 300                          |
| Virginia             | 1,991          | 30,834           | 131,618          | 423,709          | 282,181          | 251,793          | 161,202          | 152,968                      |
| Washington           | 14,063         | 7,230            | 9,143            | 26,797           | 54,519           | 64,169           | 86,847           | 101,009                      |
| W. Virginia          | 692            |                  |                  |                  |                  |                  |                  |                              |
| Wisconsin            |                | 2,718            | 1,962            | 15,312           | 20,175           | 47,620           | 82,961           | 204,978                      |
| Wyoming              | 611            | 259              | 309              | 55               | 62               | 2,668            | 9,513            | 34,498                       |
| <b>Total</b>         | <b>497,222</b> | <b>2,259,046</b> | <b>5,420,464</b> | <b>7,807,285</b> | <b>8,137,683</b> | <b>6,940,615</b> | <b>7,492,231</b> | <b>7,902,313<sup>b</sup></b> |

**Sources:**

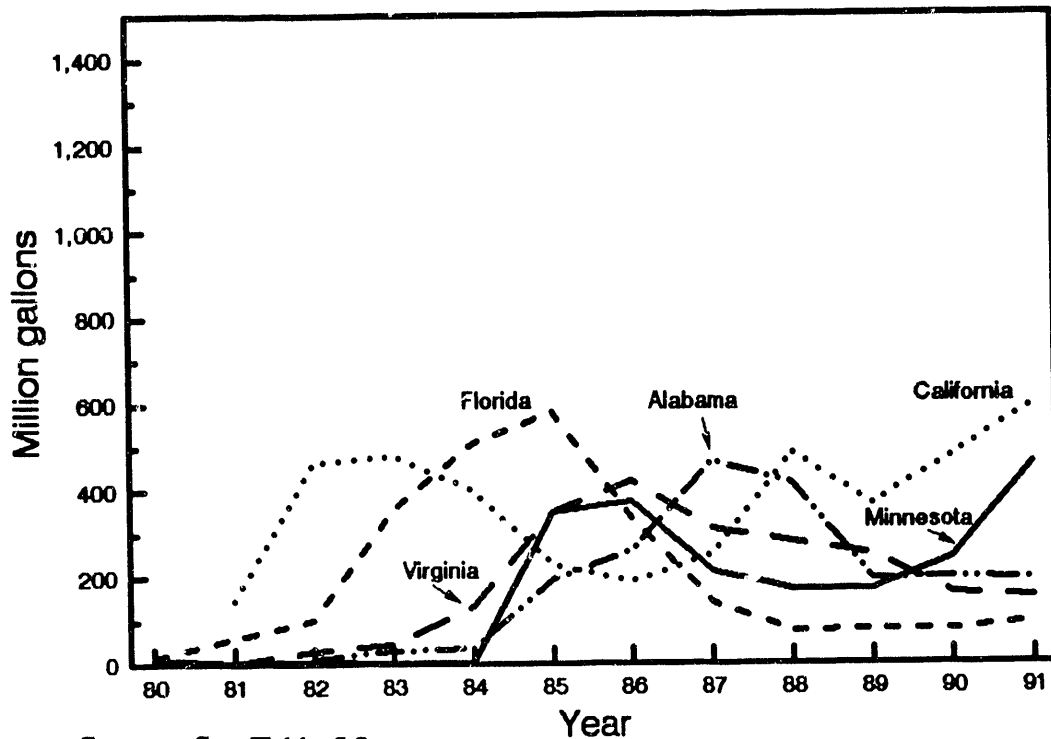
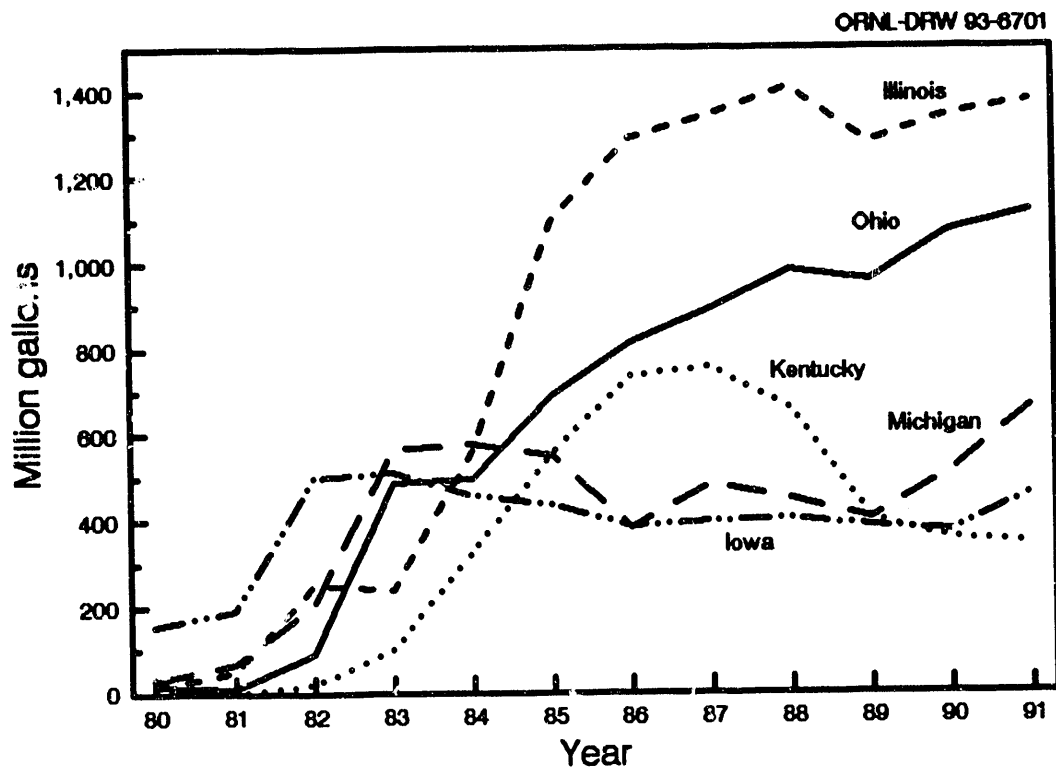
1980-1990: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1990, Washington, DC, 1991, Table MF-33GLA, p. 11, and annual.

1991: U.S. Department of Transportation, Federal Highway Administration, "Monthly Motor Fuel Reported by States, April 1992," Washington, DC, July 1992, Table MF-33GLA.

\*The data reflect gallons of gasohol reported by the distributors in each of the selected states. Blanks indicate data were not reported for the state that year.

<sup>b</sup>Preliminary data.

Figure 5.7. Gasohol Consumption of Selected States, 1980-91



Source: See Table 5.8.

## **CHAPTER 6**

### **NONHIGHWAY MODES**

**This chapter presents statistics for four major nonhighway transportation modes: air, water, pipeline, and rail. The combined energy use for these four modes accounted for over 22% of the total energy use in the transportation sector in 1990 (Table 6.1). Air transportation accounted for the largest share (41%) of nonhighway transportation energy consumption (Figure 6.1).**

**Section 6.1 discusses data on air transportation. Statistics on water transportation are included in Section 6.2; pipeline data in Section 6.3; and rail data in Section 6.4.**

**Table 6.1**  
**Nonhighway Energy Use by Mode, 1970-90**

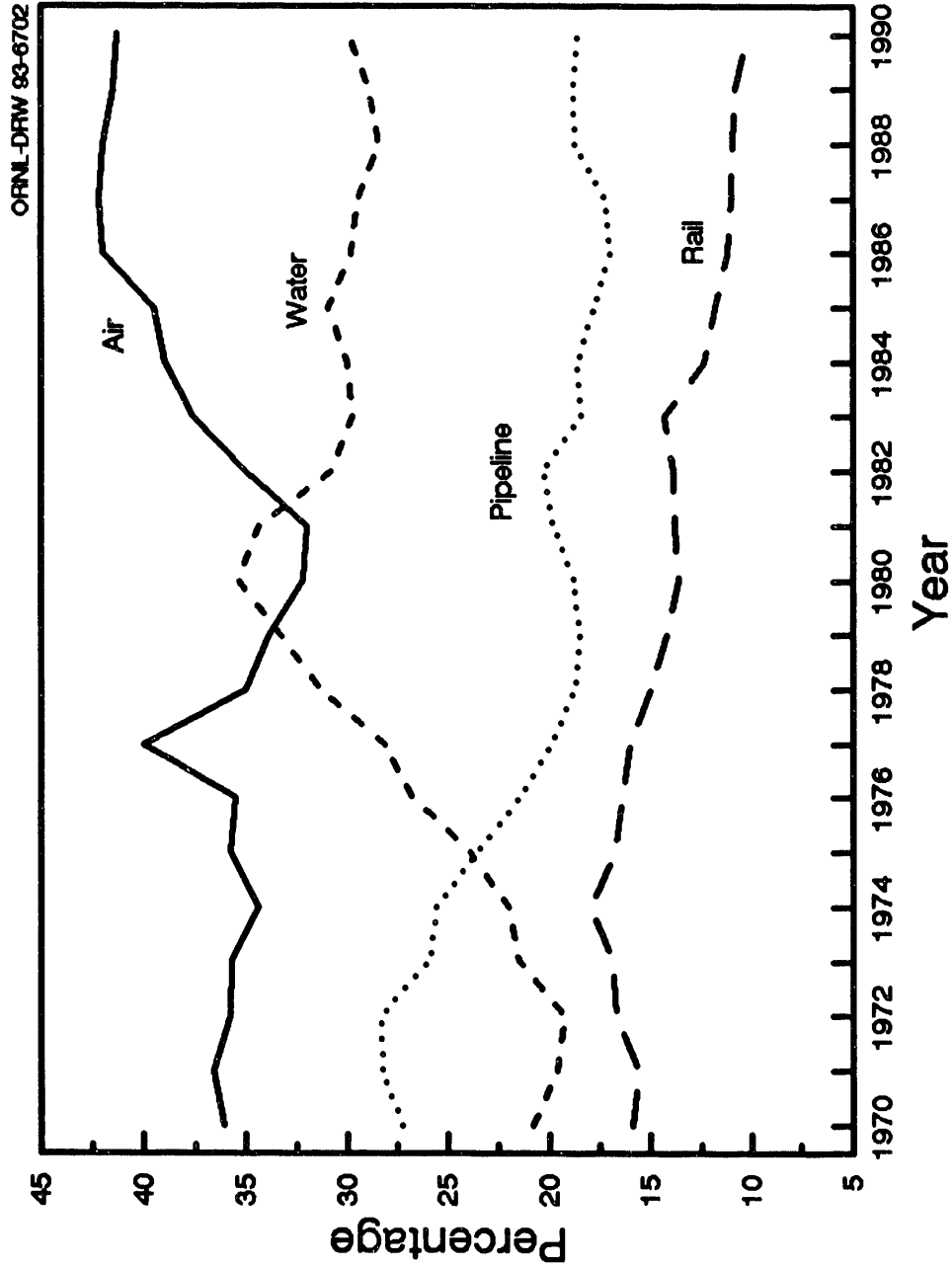
| Year | Air                | Water | Pipeline | Rail | Nonhighway<br>transportation<br>energy use | Transportation<br>energy use <sup>a</sup><br>(trillion Btu) |
|------|--------------------|-------|----------|------|--|---|
|      | (percent of total) |       |          |      |  |   |
| 1970 | 8.5%               | 4.9%  | 6.4%     | 3.8% | 23.7%                                      | 15,305  |
| 1971 | 8.2%               | 4.4%  | 6.3%     | 3.5% | 22.4%                                      | 15,907  |
| 1972 | 7.8%               | 4.1%  | 6.1%     | 3.6% | 21.7%                                      | 16,949  |
| 1973 | 7.7%               | 4.6%  | 5.6%     | 3.7% | 21.6%                                      | 17,813  |
| 1974 | 7.3%               | 4.7%  | 5.5%     | 3.8% | 21.3%                                      | 17,088  |
| 1975 | 7.4%               | 4.9%  | 4.8%     | 3.4% | 20.5%                                      | 17,329  |
| 1976 | 7.2%               | 5.4%  | 4.4%     | 3.4% | 20.4%                                      | 18,389  |
| 1977 | 7.4%               | 5.8%  | 4.1%     | 3.3% | 20.6%                                      | 19,071  |
| 1978 | 7.3%               | 6.5%  | 3.9%     | 3.1% | 20.9%                                      | 20,035  |
| 1979 | 7.8%               | 7.7%  | 4.3%     | 3.3% | 23.0%                                      | 20,101  |
| 1980 | 7.9%               | 8.7%  | 4.6%     | 3.3% | 24.5%                                      | 19,317  |
| 1981 | 7.6%               | 8.2%  | 4.7%     | 3.3% | 23.8%                                      | 19,065  |
| 1982 | 7.9%               | 6.9%  | 4.6%     | 3.1% | 22.6%                                      | 18,589  |
| 1983 | 8.0%               | 6.3%  | 3.9%     | 3.1% | 21.4%                                      | 18,728  |
| 1984 | 8.5%               | 6.5%  | 4.0%     | 2.7% | 21.7%                                      | 19,310  |
| 1985 | 8.5%               | 6.7%  | 3.9%     | 2.5% | 21.6%                                      | 19,659  |
| 1986 | 9.0%               | 6.4%  | 3.6%     | 2.4% | 21.5%                                      | 20,229  |
| 1987 | 9.2%               | 6.4%  | 3.7%     | 2.4% | 21.7%                                      | 20,704  |
| 1988 | 9.3%               | 6.3%  | 4.1%     | 2.4% | 22.1%                                      | 21,278  |
| 1989 | 9.2%               | 6.4%  | 4.1%     | 2.4% | 22.1%                                      | 21,598  |
| 1990 | 9.5%               | 6.8%  | 4.3%     | 2.3% | 22.9%                                      | 21,778  |

**Source:**

See Appendix A for Table 2.10.

<sup>a</sup>Does not include off-highway and military transportation energy use.

Figure 6.1. Percentages of Nonhighway Energy Use by Mode, 1970-90



Source: See Table 6.1.

## Section 6.1

### Air

Air transportation activities can be categorized into two types: air carrier and general aviation. General aviation aircraft serve a variety of purposes, such as business and flight instruction, and include all aircraft which do not belong to the air carrier fleet. Since most of the aircraft in this category are used for personal activities, they do not provide commercial passenger or freight services. Although general aviation aircraft account for the majority of the number of aircraft in operation and fly almost five times as many hours as their counterparts in the air carrier category, the lower speeds and the smaller loads of general aviation aircraft resulted in a significantly smaller share of total aircraft energy use than that of the air carrier fleet, 5.7% and 94.3%, respectively (Tables 6.2 and 6.4).

Aircraft-miles for domestic and international certificated route air carriers increased by 6.4% from 1989 to 1990, while revenue cargo ton-miles increased by 9.5% in the same time period. The movement of cargo by air carriers has been rapidly growing, evidenced by the average annual increase of 9.8% from 1982 to 1990. Revenue passenger-miles continued to increase in 1990; the passenger load factor, however, declined to 62.7% from a high of 63.6% in 1989. The average passenger trip length for scheduled domestic services increased in 1990 to more than 800 miles (Table 6.2).

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

| <b>Carrier Group</b> | <b>Operating Revenue<br/>(millions of dollars)</b> |
|----------------------|--|
| Major                | Over \$1,000                                       |
| National             | \$100 - 1,000                                      |
| Large regional       | \$10 - 99.9  |
| Medium regional      | \$0 - 9.99   |

International<sup>a</sup> certificated route air carriers more than doubled their revenue aircraft-miles, revenue passenger-miles, available seat-miles, and revenue cargo ton-miles from 1982 to 1990. The energy use for international air carriers did not quite double in this time period due to increased aircraft efficiency. The domestic carriers also experienced an increase in all types of activity from 1982 to 1990, but not as great an increase as the international air carriers (Table 6.3).

Intercity passenger travel by general aviation was 13 billion passenger-miles in 1990, which is only a slight decline from 1989. The hours flown by general aviation aircraft and the number of aircraft also declined from 1989 to 1990. These declines most likely led to the decline in energy use, which fell from 134 trillion Btu in 1989 to 132 trillion Btu in 1990.

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<sup>a</sup>Operating outside the territory of the U.S., including operations between the U.S. and foreign countries and the U.S. and its territories or possessions.

Table 6.2  
Summary Statistics for Domestic and International Certificated Route Air Carriers (Combined Totals), 1970-90

| Year    | Number of aircraft | Revenue aircraft-miles (millions) | Average passenger trip length <sup>b</sup> (miles) | Revenue passenger-miles (millions) | Available seat-miles (millions) | Available seats per aircraft <sup>c</sup> | Passenger load factor (percentage) <sup>d</sup> | Revenue cargo ton-miles (millions) | Energy use (trillion Btu) <sup>e</sup> |
|---------|--------------------|-----------------------------------|--|------------------------------------|---------------------------------|---|---|------------------------------------|--|
| 1970    | 2,437              | 2,383                             | 678  | 131,719*                           | 264,904*                        | 111                                       | 49.7*   | 4,994                              | 1,363.4                                |
| 1971    | 2,389              | 2,344                             | 681  | 135,658*                           | 279,823*                        | 119                                       | 48.5*   | 5,120                              | 1,370.5                                |
| 1972    | 2,361              | 2,337                             | 685  | 152,406*                           | 287,411*                        | 122                                       | 53.0*   | 5,506                              | 1,374.3                                |
| 1973    | 2,361              | 2,402                             | 689  | 174,352                            | 322,992                         | 129                                       | 54.0  | 6,046                              | 1,444.5                                |
| 1974    | 2,237              | 2,351                             | 684  | 174,052                            | 310,130                         | 126                                       | 56.1  | 6,133                              | 1,289.8                                |
| 1975    | 2,261              | 2,241                             | 698  | 173,324                            | 315,823                         | 135                                       | 54.9  | 5,944                              | 1,283.4                                |
| 1976    | 2,261              | 2,320                             | 704  | 191,823                            | 338,349                         | 139                                       | 56.7  | 6,222                              | 1,324.1                                |
| 1977    | 2,254              | 2,418                             | 704  | 206,082                            | 361,172                         | 143                                       | 57.1  | 6,587                              | 1,386.2                                |
| 1978    | 2,346              | 2,608                             | 719  | 236,998                            | 381,113                         | 147                                       | 62.2  | 7,395                              | 1,436.3                                |
| 1979    | 2,466              | 2,859                             | 714  | 269,719                            | 425,411                         | 146                                       | 63.4  | 7,580                              | 1,534.8                                |
| 1980    | 2,425              | 2,924                             | 736  | 267,722                            | 448,479                         | 148                                       | 59.7  | 7,515                              | 1,489.6                                |
| 1981    | 2,523              | 2,703                             | 749  | 260,063                            | 438,778                         | 157                                       | 59.3  | 7,917                              | 1,429.3                                |
| 1982    | 2,468              | 2,804                             | 766  | 272,435                            | 455,938                         | 157                                       | 59.8  | 7,807                              | 1,406.6                                |
| 1983    | 2,618              | 2,923                             | 765  | 295,144                            | 480,977                         | 159                                       | 61.4  | 8,497                              | 1,439.2                                |
| 1984    | 2,692              | 3,264                             | 759  | 319,504                            | 534,104                         | 164                                       | 59.8  | 9,328                              | 1,607.4                                |
| 1985    | 2,860              | 3,462                             | 758  | 351,073                            | 565,677                         | 163                                       | 62.1  | 9,048                              | 1,701.5                                |
| 1986    | †                  | 3,873                             | 767  | 378,923                            | 623,073                         | 161                                       | 60.8  | 10,987                             | 1,847.1                                |
| 1987    | †                  | 4,182                             | 779  | 417,830                            | 670,871                         | 160                                       | 62.3  | 13,130                             | 1,945.4                                |
| 1988    | †                  | 4,355                             | 786  | 437,649                            | 696,337                         | 160                                       | 62.9  | 14,633                             | 2,049.4                                |
| 1989    | †                  | 4,442                             | 792  | 447,480                            | 703,888                         | 158                                       | 63.6  | 16,347                             | 2,087.4                                |
| 1990    | †                  | 4,725                             | 803  | 472,154                            | 753,111                         | 159                                       | 62.7  | 16,502                             | 2,191.3                                |
| 1970-90 | 1.1% <sup>f</sup>  | 3.5%                              | 0.8%   | 6.6%                               | 5.4%                            | 1.8%                                      |   | 6.2%                               | 2.4%                                   |
| 1982-90 | 5.0% <sup>g</sup>  | 6.7%                              | 0.6%   | 7.1%                               | 6.5%                            | 0.2%                                      |   | 9.8%                               | 5.7%                                   |

## Sources:

U.S. Department of Transportation, Federal Aviation Administration, FAA Statistical Handbook of Aviation, 1990 Edition, Washington, DC, 1992, pp. 6-4, 6-7, 6-8, and annual 1970-81 Energy Use - Department of Transportation, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, DC, 1981, and annual.

1982-90 Energy Use - Department of Transportation, Research and Special Programs Administration, "Fuel Cost and Consumption Tables," Washington, DC, monthly. Annual totals are derived by summing monthly totals for domestic and international air carrier.

\*Scheduled services of domestic operations only. The average passenger trip length for international operations is approximately three times longer than for domestic operations.

<sup>b</sup>Available seats per aircraft is calculated as the ratio of available seat-miles to revenue aircraft-miles.

<sup>c</sup>Passenger load factor is calculated as the ratio of revenue passenger-miles to available seat-miles for scheduled and nonscheduled services.

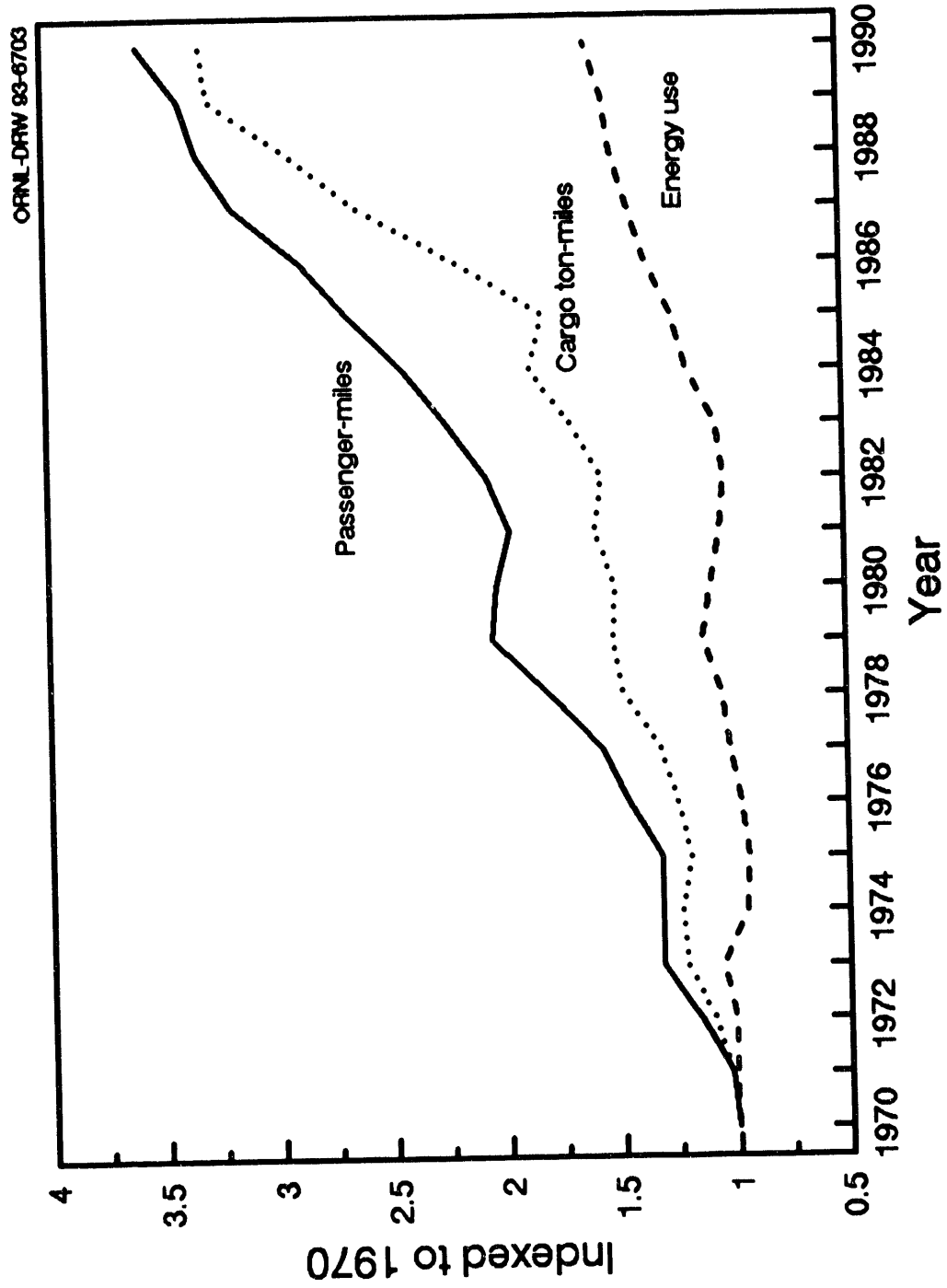
<sup>d</sup>Energy use includes fuel purchased abroad for international flights.

<sup>e</sup>Scheduled services only.

<sup>f</sup>The Federal Aviation Administration has discontinued the publication of these estimates. No comparable data are available.

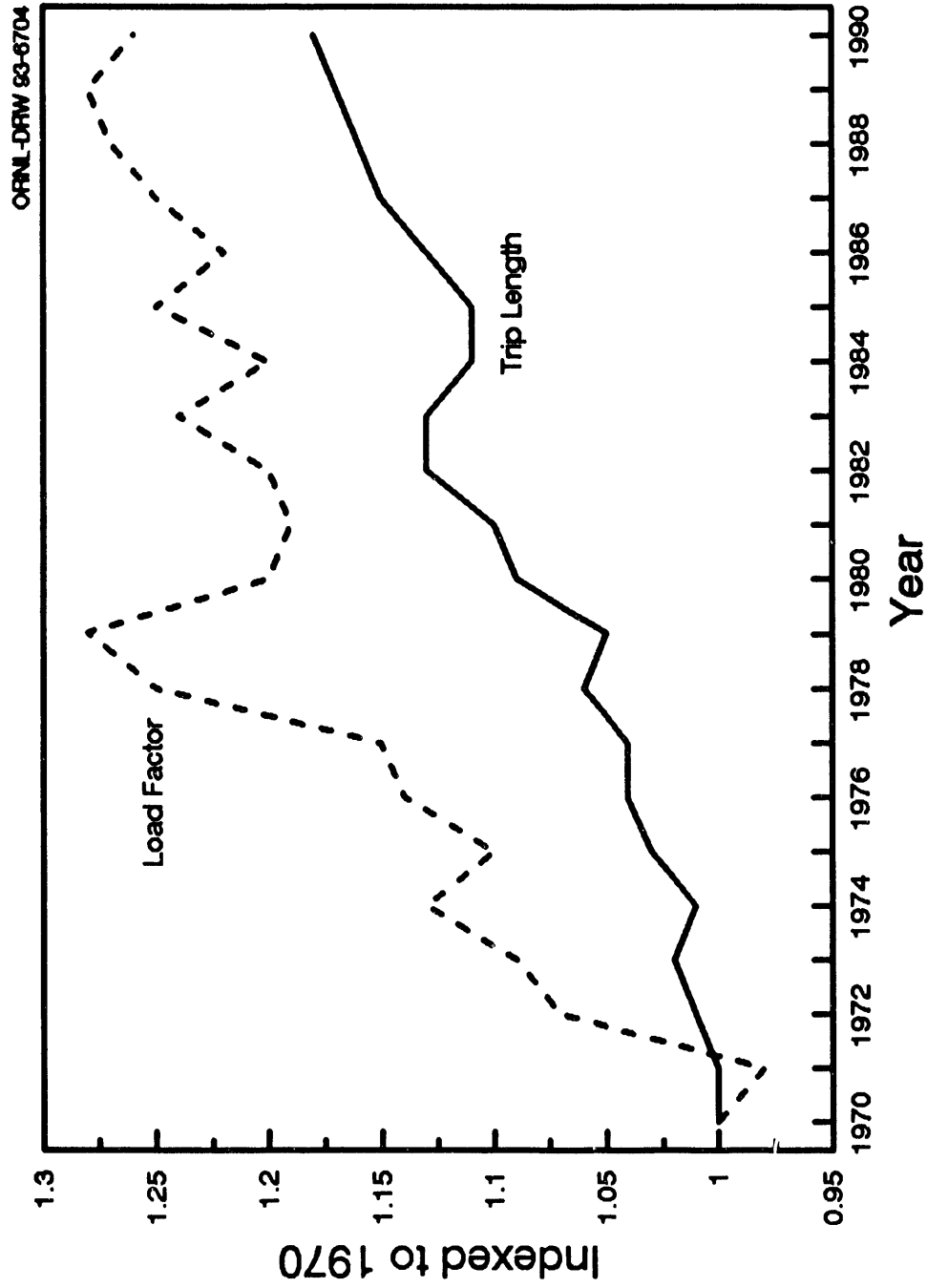
<sup>g</sup>Average annual percentage change is for years 1970-85 and 1982-85.

Figure 6.2. Passenger-Miles, Cargo Ton-Miles, and Energy Use for Certificated Route Air Carriers, 1970-90



Source: See Table 6.2.

Figure 6.3. Average Trip Length and Load Factor for Certificated Route Air Carriers, 1970-90



Source: See Table 6.2.

*Although domestic air carrier activity (in terms of aircraft-miles, seat-miles, and ton-miles) has always been much greater than international, the international activity increased as a faster rate from 1982 to 1991.*

**Table 6.3**  
**Traffic Data for Large Certificated Route Air Carriers By Carrier Group, Scheduled and Nonscheduled Services, 1982 and 1991<sup>1</sup>**

| Carrier Group <sup>2</sup>   | Revenue aircraft-miles <sup>3</sup><br>(millions) |              | Revenue passenger-miles<br>(millions) |                | Available seat-miles <sup>4</sup><br>(millions) |                | Revenue passenger load factor <sup>5</sup><br>(percentage) |                   | Revenue cargo ton-miles <sup>6</sup><br>(millions) |               | Energy use<br>(trillion Btu) |                |
|------------------------------|---|--------------|---------------------------------------|----------------|---|----------------|--|-------------------|--|---------------|------------------------------|----------------|
|                              | 1982  | 1991         | 1982                                  | 1991           | 1982  | 1991           | 1982   | 1991              | 1982   | 1991          | 1982                         | 1991           |
| <b>Majors</b>                | 2,183   | 4,122        | 227,379                               | 436,148        | 384,279   | 693,553        | 59.2   | 62.8              | 4,983  | 11,972        | 1,167.6                      | 1,167.6        |
| <b>Nationals</b>             | 448   | 400          | 36,582                                | 22,638         | 57,845  | 37,887         | 63.2   | 58.1              | 2,480  | 2,632         | 198.6                        | 198.6          |
| <b>Regionals<sup>7</sup></b> | 158   | 127          | 7,532                                 | 3,706          | 12,181  | 5,392          | 63.0 <sup>8</sup>  | 57.1 <sup>9</sup> | 303  | 1,491         | 37.8                         | 37.8           |
| <b>Total Air Carriers</b>    | <b>2,789</b>                                      | <b>4,649</b> | <b>271,493</b>                        | <b>462,492</b> | <b>454,305</b>                                  | <b>736,832</b> | <b>59.0</b>  | <b>62.6</b>       | <b>7,766</b>                                       | <b>16,095</b> | <b>1,404.0</b>               | <b>2,069.2</b> |
| <b>Domestic</b>              | 2,430   | 3,844        | 213,003                               | 337,526        | 363,106   | 550,763        | 51.7   | 61.2              | 4,459  | 8,784         | 1,138.4                      | 1,541.6        |
| <b>International</b>         | 359   | 804          | 58,490                                | 124,966        | 91,199  | 186,070        | 61.4   | 67.3              | 3,307  | 7,312         | 265.6                        | 527.6          |

**Sources:**

1982 - Civil Aeronautics Board, Air Carrier Traffic Statistics, Washington, D.C., December 1982.

1991 - U.S. Department of Transportation, Transportation Systems Center, Air Carrier Traffic Statistics Monthly, December 1990/91 and Twelve Months Ending December 31, Cambridge, Massachusetts, 1992, pp.1, 2, 3, 53, 89, 143.

Energy Use - 1982: Fuel Cost and Consumption, Twelve Months Ended December 31, 1982 and 1981, Washington, D.C., 1983.

1991 - Department of Transportation, Research and Special Programs Administration, "Fuel Cost and Consumption Tables," Washington, D.C., monthly. Annual totals are derived by summing monthly totals for domestic and international air carriers.

<sup>1</sup>The data presented in this table represent all international carrier operations, and domestic air carriers that hold a Section 401 certificate and operate aircraft designed to have a maximum passenger capacity of more than 60 or a maximum payload capacity of more than 18,000 pounds.

<sup>2</sup>Calculated as the sum of scheduled and nonscheduled services.

<sup>3</sup>Load factor applies to scheduled services only.

<sup>4</sup>Cargo includes freight, express, and mail shipments.

<sup>5</sup>Large certificated air carriers are classified according to their total annual operating revenue as listed:

Majors - \$1,000,000,000 and up; Nationals - \$100,000,000 to \$999,999,999; Large Regionals - \$10,000,000 to \$99,999,999; Medium Regionals - \$0 to \$9,999,999.

<sup>6</sup>Data are not available.

<sup>7</sup>Calculated as the sum of Large Regionals and Medium Regionals.

<sup>8</sup>Load factor was calculated as the sum of Large and Medium Regionals' scheduled revenue passenger-miles divided by the sum of Large and Medium Regionals' scheduled available seat-miles.

**Table 6.4**  
**Summary Statistics for General Aviation, 1970-90**

| Calendar year                           | Percentage of total aircraft |           |          |             |       | Total number of aircraft | Hours flown (thousands) | Intercity passenger travel (billion passenger-miles) | Energy use (trillion btu) |
|---|------------------------------|-----------|----------|-------------|-------|--------------------------|-------------------------|--|---------------------------|
|   | Piston                       | Turboprop | Turbojet | Rotary wing | Other |                          |                         |  |                           |
| 1970                                    | *                            | *         | *        | *           | *     | 131,700 <sup>a</sup>     | 26,030 <sup>c</sup>     | 9.1  | 94.4                      |
| 1971                                    | *                            | *         | *        | *           | *     | 131,100 <sup>a</sup>     | 25,512 <sup>c</sup>     | 9.2  | 91.6                      |
| 1972                                    | *                            | *         | *        | *           | *     | 145,000 <sup>a</sup>     | 26,974 <sup>c</sup>     | 10.0   | 103.4                     |
| 1973                                    | *                            | *         | *        | *           | *     | 148,000 <sup>a</sup>     | 28,599                  | 10.7   | 90.4                      |
| 1974                                    | 93.9                         | 1.3       | 1.0      | 2.2         | 1.6   | 161,502                  | 29,758                  | 11.2   | 101.4                     |
| 1975                                    | 93.4                         | 1.5       | 1.1      | 2.4         | 1.7   | 168,475                  | 30,298                  | 11.4   | 121.5                     |
| 1976                                    | 93.3                         | 1.4       | 1.1      | 2.5         | 1.8   | 177,964                  | 31,950                  | 12.1   | 130.3                     |
| 1977                                    | 92.7                         | 1.6       | 1.2      | 2.6         | 2.0   | 184,294                  | 33,679                  | 12.8   | 149.7                     |
| 1978                                    | 92.5                         | 1.6       | 1.2      | 2.7         | 2.0   | 199,178                  | 36,844                  | 14.1   | 159.4                     |
| 1979                                    | 92.0                         | 1.7       | 1.3      | 2.8         | 2.3   | 210,339                  | 40,432                  | 15.5   | 167.2                     |
| 1980                                    | 91.5                         | 1.9       | 1.4      | 2.8         | 2.3   | 211,045                  | 41,016                  | 14.7   | 169.0                     |
| 1981                                    | 90.7                         | 2.2       | 1.5      | 3.3         | 2.4   | 213,226                  | 40,704                  | 14.6   | 162.4                     |
| 1982                                    | 90.2                         | 2.5       | 1.9      | 2.9         | 2.5   | 209,779                  | 36,457                  | 13.1   | 170.5                     |
| 1983                                    | 89.8                         | 2.6       | 1.8      | 3.1         | 2.8   | 213,293                  | 35,249                  | 12.7   | 143.9                     |
| 1984                                    | 89.4                         | 2.6       | 2.0      | 3.2         | 2.8   | 220,943                  | 36,119                  | 13.0   | 148.9                     |
| 1985                                    | 89.3                         | 2.6       | 2.1      | 3.0         | 3.0   | 210,654                  | 34,063                  | 12.3   | 144.0                     |
| 1986                                    | 88.9                         | 2.7       | 2.0      | 3.2         | 3.2   | 220,044                  | 34,416                  | 12.4   | 148.0                     |
| 1987                                    | 89.5                         | 2.4       | 2.0      | 2.9         | 3.1   | 217,183                  | 33,443                  | 12.1   | 139.1                     |
| 1988                                    | 89.2                         | 2.5       | 2.0      | 3.0         | 3.3   | 210,266                  | 33,593                  | 12.6   | 148.6                     |
| 1989                                    | 88.2                         | 2.9       | 2.0      | 3.4         | 3.5   | 219,737                  | 35,012                  | 13.1   | 134.0                     |
| 1990                                    | 88.5                         | 2.7       | 2.1      | 3.5         | 3.3   | 212,211                  | 34,756                  | 13.0   | 131.9                     |
| <i>Average Annual Percentage Change</i> |                              |           |          |             |       |                          |                         |  |                           |
| 1970-90                                 |                              |           |          |             |       | 2.4%                     | 1.5%                    | 1.8%   | 1.7%                      |
| 1982-90                                 |                              |           |          |             |       | 0.7%                     | -0.6%                   | -0.1%  | -3.2%                     |

**Sources:**

Aircraft and hours flown - U.S. Department of Transportation, Federal Aviation Administration, FAA Statistical Handbook of Aviation, Calendar Year 1990, Washington, DC, 1992, pp. 8-4, 8-6, and annual.

Intercity passenger miles - Eno Foundation for Transportation, Transportation in America, 10th edition, Washington, DC, 1992, p.47.

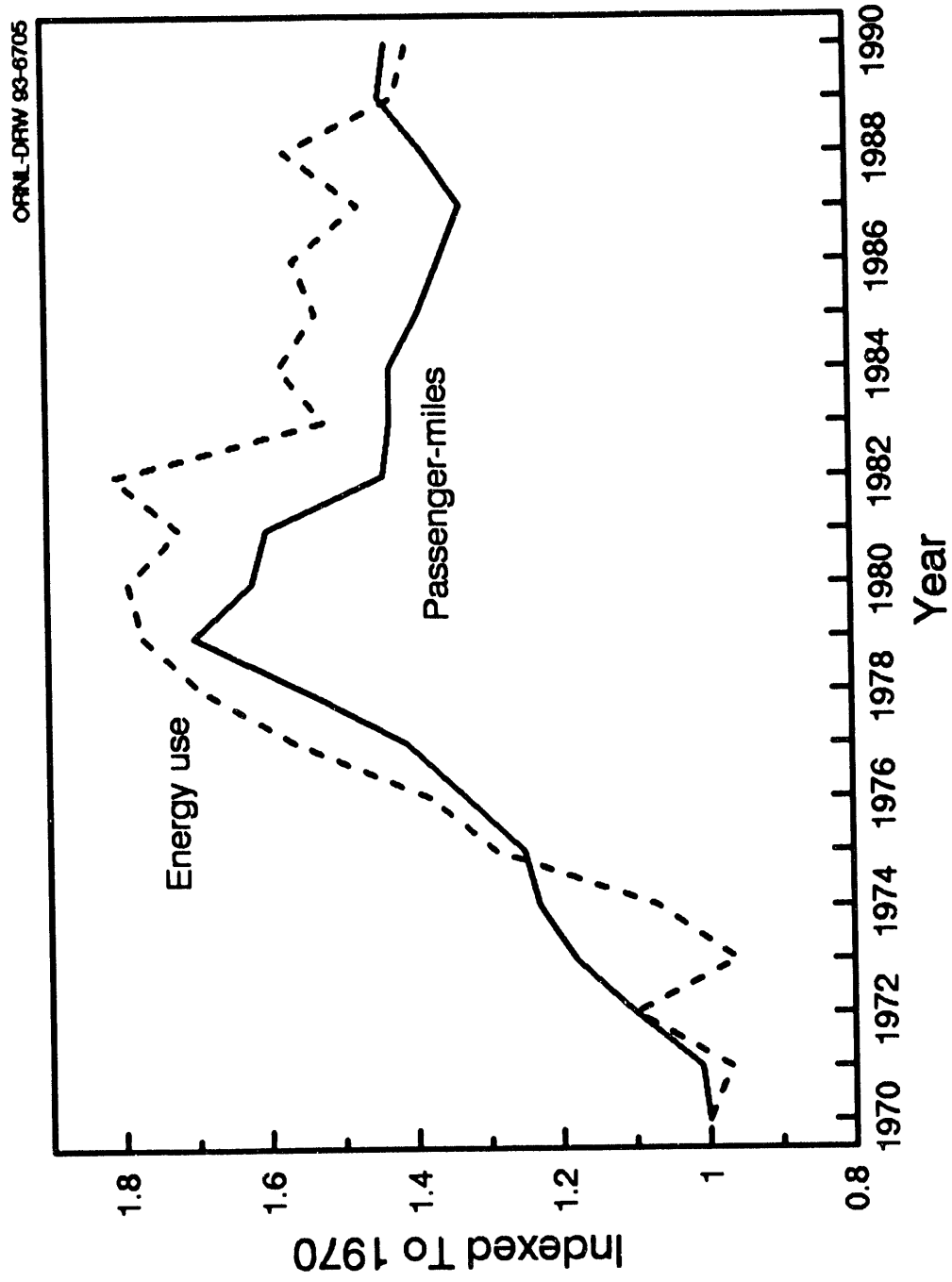
Energy use - U.S. Department of Transportation, Federal Aviation Administration, General Aviation Activity and Avionics Survey, Calendar Year 1990, Table 5.1, p. 5-6.

\*Data are not available.

<sup>a</sup>Active fixed-wing general aviation aircraft only.

<sup>c</sup>Include rotocraft.

Figure 6.4. Passenger-Miles and Energy Use in General Aviation, 1970-90



Source: See Table 6.4.

## Section 6.2

### Water

Due to delays in the release of 1990 data from the U.S. Department of the Army, Corps of Engineers, the data in this chapter were not able to be updated. The latest available data are presented.

Domestic marine traffic includes all movements between points in the United States, Puerto Rico, and the Virgin Islands. All movements between the United States and foreign countries are classified as foreign traffic. Although declining since 1986, domestic traffic still accounted for more than half of the total tons shipped in waterborne commerce. The combined foreign and domestic tonnage in 1989 reached a record high of 2,140 million tons (Table 6.5).

The average length of haul for domestic waterborne commerce dropped in 1989 to its lowest point since 1977. This decline in average length of haul, together with a decline in tons shipped in 1989, resulted in a 8.3% decline in ton-miles. Despite these declines, energy use for domestic waterborne commerce rose 2.3% from 1988 to 1989 (Table 6.6).

The commodities most often moved by domestic commerce in 1989 were petroleum and products (41.8%) and coal and coke (19.2%). The longest average haul per ton for total domestic commerce in 1989 was grain, which had an average of 1,072 miles (Table 6.7).

Over 1 billion tons were shipped in international waterborne commerce in 1989. Domestic commerce accounted for 51.5% of total tonnage, which is only 0.5% above the lowest domestic share in 1977.

**Table 6.5**  
**Tonnage Statistics for Domestic and**  
**International Waterborne Commerce, 1970-89**  
**(million tons shipped)**

| Year                                    | Foreign and domestic total | Foreign total <sup>a</sup> | Domestic total <sup>b</sup> | Percent domestic of total |
|---|----------------------------|----------------------------|-----------------------------|---------------------------|
| 1970                                    | 1,532                      | 581                        | 951                         | 62.1%                     |
| 1971                                    | 1,513                      | 566                        | 947                         | 62.6%                     |
| 1972                                    | 1,617                      | 630                        | 987                         | 61.0%                     |
| 1973                                    | 1,761                      | 767                        | 994                         | 56.4%                     |
| 1974                                    | 1,747                      | 764                        | 983                         | 56.3%                     |
| 1975                                    | 1,695                      | 749                        | 946                         | 55.8%                     |
| 1976                                    | 1,835                      | 856                        | 979                         | 53.4%                     |
| 1977                                    | 1,908                      | 935                        | 973                         | 51.0%                     |
| 1978                                    | 2,021                      | 946                        | 1,075                       | 53.2%                     |
| 1979                                    | 2,073                      | 993                        | 1,080                       | 52.1%                     |
| 1980                                    | 1,999                      | 921                        | 1,078                       | 53.9%                     |
| 1981                                    | 1,942                      | 887                        | 1,055                       | 54.3%                     |
| 1982                                    | 1,777                      | 820                        | 957                         | 53.9%                     |
| 1983                                    | 1,708                      | 751                        | 957                         | 56.0%                     |
| 1984                                    | 1,836                      | 803                        | 1,033                       | 56.3%                     |
| 1985                                    | 1,788                      | 774                        | 1,014                       | 56.7%                     |
| 1986                                    | 1,874                      | 837                        | 1,037                       | 55.3%                     |
| 1987                                    | 1,967                      | 891                        | 1,076                       | 54.7%                     |
| 1988                                    | 2,088                      | 976                        | 1,112                       | 53.3%                     |
| 1989                                    | 2,140                      | 1,038                      | 1,103                       | 51.5%                     |
| <i>Average annual percentage change</i> |                            |                            |                             |                           |
| 1970-89                                 | 1.8%                       | 3.1%                       | 0.8%                        |                           |
| 1982-89                                 | 2.7%                       | 3.4%                       | 2.0%                        |                           |

**Source:**

U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1989, Part 5: National Summaries, New Orleans, Louisiana, 1991, p. 5.

<sup>a</sup>All movements between the U.S. and foreign countries and between Puerto Rico and Virgin Islands and foreign countries are classified as foreign trade.

<sup>b</sup>All movements between U.S. ports, continental and noncontiguous, and on the inland rivers, canals, and connecting channels of the U.S., Puerto Rico, and the Virgin Islands, excluding the Panama Canal.

*The average length of haul dropped in 1989 to its lowest point since 1977. Although the tons shipped and ton-miles also declined in 1989, the number of vessels and energy use increased slightly from 1988 to 1989.*

**Table 6.6**  
**Summary Statistics for Domestic Waterborne Commerce, 1970-89**

| Year                                    | Number of vessels <sup>a</sup> | Ton-miles (billions) | Tons shipped (millions) <sup>b</sup> | Average length of haul (miles) | Energy intensity (Btu/ton-mile) | Energy use (trillion Btu) |
|---|--------------------------------|----------------------|--------------------------------------|--------------------------------|---------------------------------|---------------------------|
| 1970                                    | 25,832                         | 596                  | 949                                  | 628.2                          | 545                             | 324.8                     |
| 1971                                    | 26,063                         | 593                  | 944                                  | 628.1                          | 506                             | 300.0                     |
| 1972                                    | 27,347                         | 604                  | 985                                  | 612.8                          | 522                             | 315.1                     |
| 1973                                    | 28,431                         | 585                  | 990                                  | 590.7                          | 576                             | 337.0                     |
| 1974                                    | 29,328                         | 586                  | 979                                  | 599.1                          | 483                             | 283.3                     |
| 1975                                    | 31,666                         | 566                  | 944                                  | 599.9                          | 549                             | 311.0                     |
| 1976                                    | 33,204                         | 592                  | 976                                  | 606.3                          | 468                             | 277.3                     |
| 1977                                    | 35,333                         | 599                  | 969                                  | 618.0                          | 458                             | 274.3                     |
| 1978                                    | 35,723                         | 827                  | 1,072                                | 771.6                          | 383                             | 316.6                     |
| 1979                                    | 36,264                         | 829                  | 1,076                                | 770.0                          | 457                             | 378.7                     |
| 1980                                    | 38,792                         | 922                  | 1,074                                | 856.4                          | 358                             | 329.8                     |
| 1981                                    | 42,079                         | 929                  | 1,051                                | 884.0                          | 360                             | 334.5                     |
| 1982                                    | 42,079                         | 886                  | 954                                  | 929.0                          | 310                             | 274.9                     |
| 1983                                    | 41,784                         | 920                  | 953                                  | 964.6                          | 319                             | 293.7                     |
| 1984                                    | 41,784                         | 888                  | 1,029                                | 862.5                          | 346                             | 307.3                     |
| 1985                                    | 41,672                         | 893                  | 1,011                                | 883.5                          | 446                             | 398.6                     |
| 1986                                    | 40,308                         | 873                  | 1,033                                | 845.3                          | 463                             | 404.0                     |
| 1987                                    | 40,000                         | 895                  | 1,072                                | 835.0                          | 402                             | 370.7                     |
| 1988                                    | 39,192                         | 890                  | 1,112                                | 804.3                          | 361                             | 321.3                     |
| 1989                                    | 39,209                         | 816                  | 1,097                                | 743.2                          | 403                             | 328.6                     |
| <i>Average annual percentage change</i> |                                |                      |                                      |                                |                                 |                           |
| 1970-89                                 | 2.2%                           | 1.7%                 | 0.8%                                 | 0.9%                           | -1.6%                           | 0.1%                      |
| 1982-89                                 | -1.0%                          | -1.2%                | 2.0%                                 | -3.1%                          | 3.8%                            | 2.6%                      |

**Sources:**

1970-88 Number of vessels - Personal communication with the U.S. Department of the Army, Corps of Engineers, New Orleans, Louisiana, 1988.

1989 Number of vessels - U.S. Department of the Army, Corps of Engineers, Waterborne Transportation Lines of the United States, 1989, New Orleans, Louisiana, 1991.

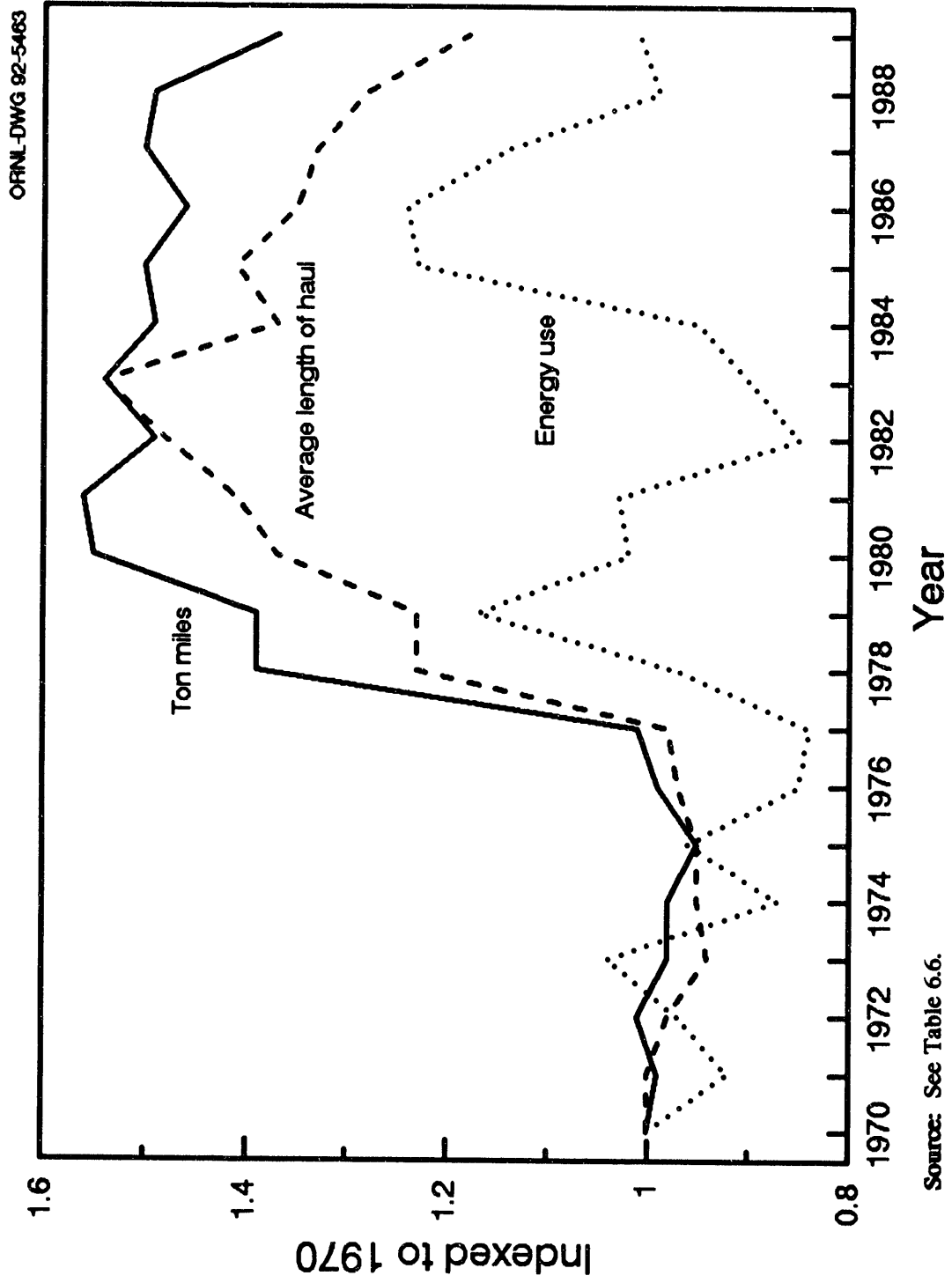
1970-89 Ton-miles, tons shipped, average length of haul - U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1989, Part 5: National Summaries, New Orleans, Louisiana, 1991, p. 89, and annual.

Energy Use - See Appendix A for Table 2.7.

<sup>a</sup>Grand total for self-propelled and nonself-propelled.

<sup>b</sup>These figures are not consistent with the figures on Table 6.5 because intraterritory tons are not included in this table.

Figure 6.5. Ton-Miles, Average Length of Haul, and Energy Use for Domestic Waterborne Commerce, 1970-89



*Sixty-one percent of all domestic marine cargo in 1989 were energy-related products (petroleum, coal, coke). The majority of the energy-related products were shipped internal and local (58%) and coastwise (39%). Barge traffic accounted for 94% of all internal and local waterborne commerce.*

**Table 6.7**  
**Breakdown of Domestic Marine Cargo by Commodity Class, 1989**

| Commodity class                | Coastwise <sup>a</sup>  |                              |                              | Lakewise <sup>b</sup>   |                              |                              | Internal and local <sup>c</sup> |                              |                              | Total domestic          |            |                              |
|--------------------------------|-------------------------|------------------------------|------------------------------|-------------------------|------------------------------|------------------------------|---------------------------------|------------------------------|------------------------------|-------------------------|------------|------------------------------|
|                                | Tons shipped (millions) | Average haul per ton (miles) | Average haul per ton (miles) | Tons shipped (millions) | Average haul per ton (miles) | Average haul per ton (miles) | Tons shipped (millions)         | Average haul per ton (miles) | Average haul per ton (miles) | Tons shipped (millions) | Percentage | Average haul per ton (miles) |
| Petroleum and products         | 245                     | 1,733                        | 234                          | 2                       | 234                          | 192                          | 211                             | 192                          | 459                          | 41.8                    | 1,016      |                              |
| Chemicals and related products | 15                      | 1,333                        | 268                          | 4                       | 268                          | 592                          | 52                              | 592                          | 68                           | 6.2                     | 760        |                              |
| Iron, iron ore, and steel      | 4                       | 1,431                        | 643                          | 57                      | 643                          | 914                          | 13                              | 914                          | 70                           | 6.4                     | 699        |                              |
| Coal and coke                  | 13                      | 533                          | 552                          | 19                      | 552                          | 432                          | 179                             | 432                          | 211                          | 19.2                    | 450        |                              |
| Sand, gravel, and stone        | 3                       | 142                          | 325                          | 24                      | 325                          | 145                          | 64                              | 145                          | 90                           | 8.2                     | 192        |                              |
| Shells                         | 4                       | 1,572                        | 4                            | 4                       | 4                            | 112                          | 3                               | 112                          | 3                            | 0.3                     | 107        |                              |
| Grains                         | 1                       | 1,623                        | 977                          | 1                       | 977                          | 1,078                        | 55                              | 1,078                        | 57                           | 5.2                     | 1,072      |                              |
| Logs and lumber                | 2                       | 1,410                        | 61                           | 4                       | 61                           | 95                           | 19                              | 95                           | 21                           | 1.9                     | 197        |                              |
| All others                     | 23                      | 1,199                        | 326                          | 6                       | 326                          | 468                          | 90                              | 468                          | 119                          | 10.8                    | 602        |                              |
| Total                          | 302                     | 1,602                        | 535.0                        | 109                     | 535.0                        | 399                          | 686                             | 399                          | 1,097                        | 100.0                   | 743        |                              |
| Barge traffic (million tons)   | 89.9                    |                              |                              | 3.9                     |                              |                              | 644.8                           |                              | 743.2                        |                         |            |                              |
| Percentage by barge            | 29.8%                   |                              |                              | 3.6%                    |                              |                              | 94.0%                           |                              | 67.7%                        |                         |            |                              |

Source: U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1989, Part 5: National Summaries, New Orleans, Louisiana, 1991, pp. 32, 93.

<sup>a</sup>Applies to domestic traffic receiving a carriage over the ocean or between the Great Lakes ports and seacoast ports when having a carriage over the ocean.

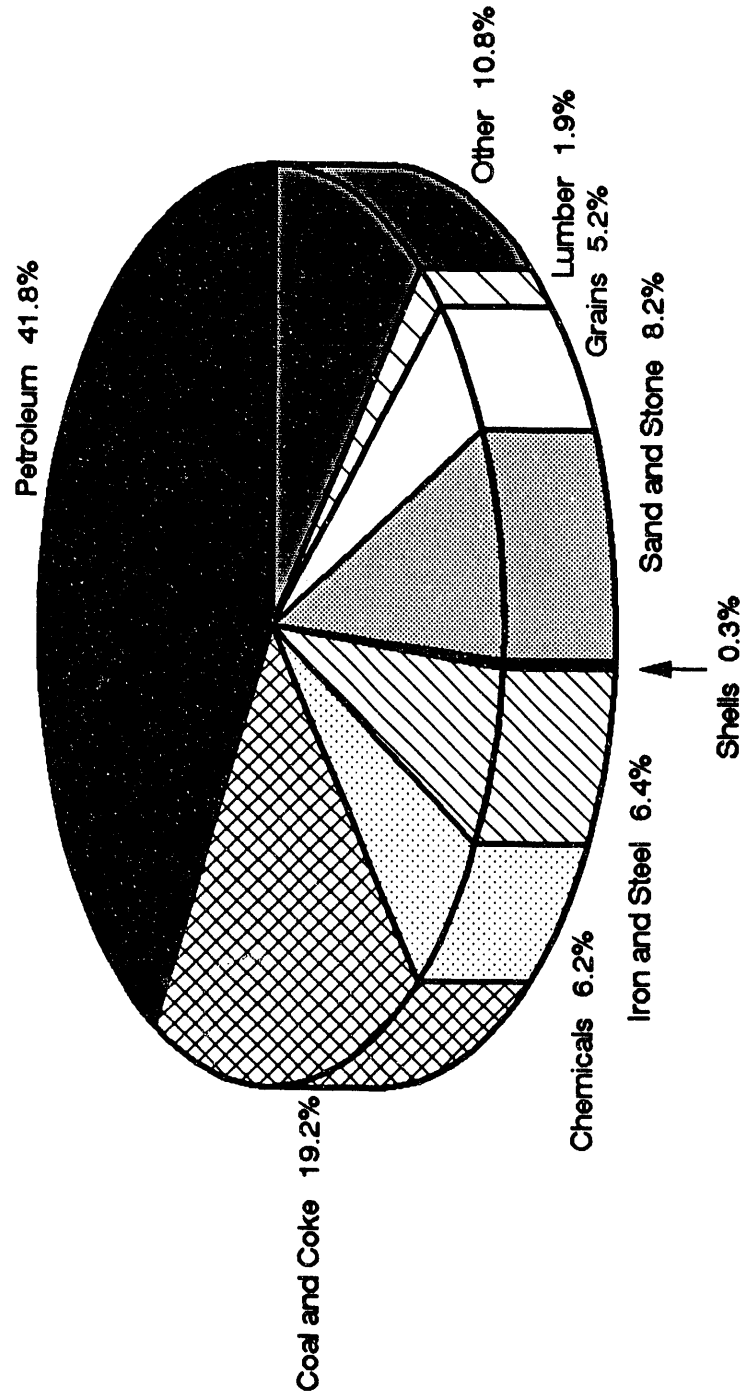
<sup>b</sup>Applies to traffic between United States ports on the Great Lakes.

<sup>c</sup>Internal applies to traffic between ports or landing wherein the entire movement takes place on inland waterways. Local applies to movements of freight within the confines of a port.

<sup>d</sup>Negligible.

Figure 6.6. Breakdown of Domestic Marine Cargo by Commodity Class, 1989

ORNL-DRW 93-6708



Source: See Table 6.7.

## **Section 6.3**

### **Pipeline**

*Although the tons of petroleum transported by pipeline fell slightly from 1989 to 1990, the ton-miles stayed constant, indicating a slight increase in the distance the petroleum was moved. This increase in transport distance was probably due to an increase in the movement of refined petroleum products, since crude petroleum had a slight decline in ton-miles from 1989 to 1990.*

**Table 6.8**  
**Pipeline Shipments of Energy, 1972-90**

| Year                                    | Domestic natural gas consumption <sup>a</sup><br>(billion cubic feet) | Total petroleum transported |                     | Crude petroleum<br>(billion ton-miles) | Refined petroleum products<br>(billion ton-miles) | Energy use <sup>b</sup><br>(trillion Btu) |
|---|---|-----------------------------|---------------------|--|---|---|
|   |   | (million tons)              | (billion ton-miles) |  |   |   |
| 1972                                    | 22,100  | 876                         | 476                 | 285                                    | 191   | 985.3                                     |
| 1973                                    | 22,049  | 912                         | 507                 | 302                                    | 205   | 942.2                                     |
| 1974                                    | 21,223  | 879                         | 506                 | 303                                    | 203   | 877.9                                     |
| 1975                                    | 19,538  | 879                         | 507                 | 288                                    | 219   | 781.2                                     |
| 1976                                    | 19,946  | 934                         | 515                 | 303                                    | 212   | 749.0                                     |
| 1977                                    | 19,521  | 986                         | 546                 | 327                                    | 219   | 727.5                                     |
| 1978                                    | 19,627  | 982                         | 586                 | 360                                    | 226   | 680.0                                     |
| 1979                                    | 20,241  | 978                         | 608                 | 372                                    | 236   | 793.4                                     |
| 1980                                    | 19,877  | 961                         | 588                 | 363                                    | 226   | 838.5                                     |
| 1981                                    | 19,404  | 943                         | 564                 | 333                                    | 231   | 848.1                                     |
| 1982                                    | 18,001  | 964                         | 566                 | 335                                    | 231   | 798.8                                     |
| 1983                                    | 16,835  | 983                         | 556                 | 332                                    | 224   | 684.6                                     |
| 1984                                    | 17,951  | 1,007                       | 568                 | 333                                    | 235   | 726.2                                     |
| 1985                                    | 17,281  | 1,019                       | 564                 | 334                                    | 230   | 704.7                                     |
| 1986                                    | 16,221  | 1,035                       | 578                 | 335                                    | 243   | 684.1                                     |
| 1987                                    | 17,211  | 1,045                       | 587                 | 342                                    | 245   | 721.3                                     |
| 1988                                    | 18,030  | 1,067                       | 601                 | 351                                    | 250   | 824.0                                     |
| 1989                                    | 18,801  | 1,053                       | 584                 | 339                                    | 246   | 841.6                                     |
| 1990                                    | 18,721  | 1,046                       | 584                 | 335                                    | 249   | 873.9                                     |
| <i>Average annual percentage change</i> |   |                             |                     |  |   |   |
| 1972-90                                 | -0.9%   | 1.0%                        | 1.1%                | 0.9%                                   | 1.5%  | -0.7%                                     |
| 1982-90                                 | 0.5%  | 1.0%                        | 0.4%                | 0.0%                                   | 0.9%  | 1.1%                                      |

**Sources:**

Natural gas consumption - U.S. Department of Energy, Energy Information Administration, Natural Gas Annual 1990, Washington, DC, December 1991, p. 20, and annual.

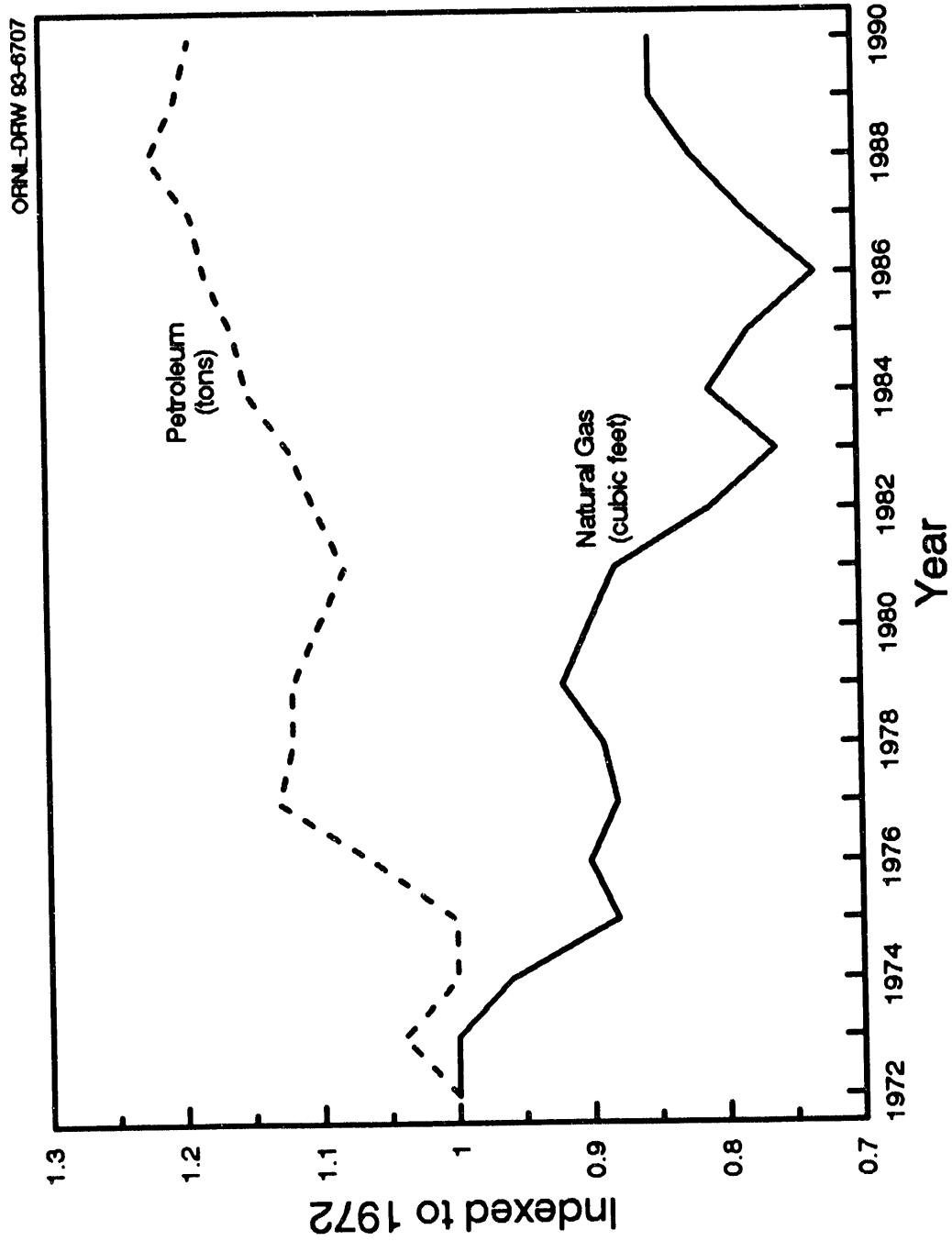
Petroleum transport, crude petroleum, and refined petroleum products - Transportation Policy Associates, Transportation in America, Tenth edition, Washington, DC, 1992, pp. 46, 59.

Energy use - See Appendix A for Table 2.7.

<sup>a</sup>Natural gas consumption is the best available indicator for the amount of natural gas transported by pipeline.

<sup>b</sup>Represents energy use for natural gas, crude petroleum, and refined petroleum pipelines.

Figure 6.7. Natural Gas and Petroleum Shipped by Pipeline, 1972-90



Source: See Table 6.8.

## **Section 6.4**

### **Railroad**

Fourteen railroad systems in 1990 were designated by the Interstate Commerce Commission (ICC) as Class I freight railroads (Table 6.9). This designation was assigned on the basis of the annual gross revenue of the railroad. A railroad whose revenues were 93.5 million dollars or more in 1989 was designated as a Class I railroad in 1990. The threshold for 1990 was set at 94.4 million dollars. The Class I designation is dropped if the railroad fails to meet the annual earnings threshold for three consecutive years.

The revenue ton-miles for Class I freight railroads continued to be over 1 trillion ton-miles in 1990, as the average length of haul rose slightly and ton-miles remained relatively constant from 1989 to 1990. Train-miles and car-miles declined slightly from 1989 to 1990, while the number of Class I railroad locomotives and freight cars declined to the lowest point in the twenty-year series.

The railroad freight industry experienced a 22% drop in its revenue carloadings from 1974 to 1990. During this 16-year period, coal has not only remained the major commodity being hauled by the railroads, but its share of revenue carloads also increased by 30% from 1974 to 1990. The largest decline, on the other hand, was for metallic ores, which dropped 78% during the period (Table 6.11).

The National Railroad Passenger Corporation (Amtrak) reached over 6 billion passenger-miles in 1990 and continued to increase in 1991. Car-miles increased to more than 300 million and train-miles to 33 million in 1990. The average trip length increased by 11 miles from 1989 to 1991. Even with the increased activity of Amtrak, energy use declined slightly from 16 trillion Btu in 1989 to 15.7 trillion Btu in 1991 (Table 6.12).

Rail transit operations experienced increases in vehicle-miles and average trip length, but passenger-miles declined from 1989 to 1990 because of the drop in the number of passenger trips. Energy use also declined from 1989 to 1990, possibly due to improvement in transit rail efficiency (Table 6.13).

**Table 6.9**  
**Class I Railroad Freight Systems in the United States**  
**Ranked by Revenue Ton-Miles, 1990**

| Railroad   | Revenue<br>ton-miles<br>(millions) | Percent      |
|--|------------------------------------|--------------|
| Burlington Northern Railroad Company             | 234,291                            | 22.7         |
| Union Pacific Railroad                           | 189,599                            | 18.3         |
| CSX Transportation, Incorporation                | 149,362                            | 14.5         |
| Norfolk Southern Corporation                     | 108,641                            | 10.5         |
| Southern Pacific Transportation Company          | 86,094                             | 8.3          |
| Consolidated Rail Corporation (Conrail)          | 84,106                             | 8.1          |
| Atchison, Topeka and Santa Fe Railway            | 77,929                             | 7.5          |
| Chicago and North Western Transportation Company | 28,495                             | 2.8          |
| Soo Line Railroad                                | 22,928                             | 2.2          |
| Illinois Central Railroad                        | 17,518                             | 1.7          |
| Denver and Rio Grande Western Railroad           | 13,695                             | 1.3          |
| Kansas City Southern Railway                     | 12,014                             | 1.2          |
| Grand Trunk Corporation                          | 5,024                              | 0.5          |
| Florida East Coast Railway                       | 4,274                              | 0.4          |
| <b>Total</b>                                     | <b>1,033,969</b>                   | <b>100.0</b> |

**Source:**

Association of American Railroads, Analysis of Class I Railroads 1990, July 1991, p. 163.

Table 6.10  
Summary Statistics for Class I Freight Railroads, 1970-90

| Year                             | Number of locomotives in service <sup>a</sup> | Number of freight cars (thousands) <sup>c</sup> | Train-miles (millions) | Car-miles (millions) | Revenue tons (millions) | Average length of haul (miles) | Revenue ton-miles (millions) | Energy intensity (Btu/ton-mile) | Energy use (trillion Btu) |
|----------------------------------|---|---|------------------------|----------------------|-------------------------|--------------------------------|------------------------------|---------------------------------|---------------------------|
| 1970                             | 27,077 <sup>a</sup>                           | 1,424   | 427                    | 29,890               | 2,616                   | 515                            | 764,809                      | 655                             | 500.6                     |
| 1971                             | 27,160 <sup>a</sup>                           | 1,422   | 430                    | 29,181               | 2,458                   | 507                            | 739,723                      | 697                             | 515.6                     |
| 1972                             | 27,044  | 1,411   | 451                    | 30,309               | 2,543                   | 511                            | 776,746                      | 706                             | 548.2                     |
| 1973                             | 27,438  | 1,395   | 469                    | 31,248               | 2,701                   | 531                            | 851,809                      | 662                             | 563.9                     |
| 1974                             | 27,627  | 1,375   | 469                    | 30,719               | 2,732                   | 527                            | 850,961                      | 665                             | 565.9                     |
| 1975                             | 27,855  | 1,359   | 403                    | 27,636               | 2,437                   | 541                            | 754,252                      | 682                             | 514.5                     |
| 1976                             | 27,233  | 1,332   | 425                    | 28,530               | 2,452                   | 540                            | 794,059                      | 677                             | 537.6                     |
| 1977                             | 27,298  | 1,287   | 428                    | 28,749               | 2,439                   | 549                            | 826,292                      | 667                             | 551.4                     |
| 1978                             | 26,959  | 1,226   | 433                    | 29,076               | 2,312                   | 617                            | 858,105                      | 637                             | 546.7                     |
| 1979                             | 27,660  | 1,217   | 438                    | 29,436               | 2,463                   | 611                            | 913,669                      | 616                             | 562.6                     |
| 1980                             | 28,094  | 1,168   | 428                    | 29,277               | 2,434                   | 616                            | 918,621                      | 592                             | 544.1                     |
| 1981                             | 27,421  | 1,111   | 408                    | 27,968               | 2,386                   | 626                            | 910,169                      | 571                             | 519.7                     |
| 1982                             | 26,795  | 1,039   | 345                    | 23,952               | 1,990                   | 629                            | 797,759                      | 547                             | 436.5                     |
| 1983                             | 25,448  | 1,007   | 346                    | 24,358               | 1,936                   | 641                            | 828,275                      | 521                             | 431.6                     |
| 1984                             | 24,117  | 948   | 369                    | 26,409               | 2,119                   | 645                            | 921,542                      | 508                             | 468.5                     |
| 1985                             | 22,548  | 867   | 347                    | 24,920               | 1,985                   | 664                            | 876,984                      | 487                             | 426.9                     |
| 1986                             | 20,790  | 799   | 347                    | 24,414               | 1,938                   | 664                            | 867,722                      | 474                             | 411.5                     |
| 1987                             | 19,358  | 749   | 361                    | 25,627               | 1,926                   | 688                            | 943,747                      | 443                             | 417.9                     |
| 1988                             | 19,364  | 725   | 379                    | 26,339               | 2,001                   | 697                            | 996,182                      | 434                             | 432.3                     |
| 1989                             | 19,015  | 682   | 383                    | 26,196               | 1,988                   | 723                            | 1,013,841                    | 427                             | 432.9                     |
| 1990                             | 18,835  | 659   | 380                    | 26,159               | 1,987                   | 726                            | 1,033,969                    | 411                             | 425.2                     |
| Average annual percentage change |   |   |                        |                      |                         |                                |                              |                                 |                           |
| 1970-90                          | -1.8%   | -3.8%   | -0.6%                  | -0.7%                | -1.4%                   | 1.7%                           | 1.5%                         | -2.3%                           | -0.8%                     |
| 1982-90                          | -4.3%   | -5.5%   | 1.2%                   | 1.1%                 | 0.0%                    | 1.8%                           | 3.3%                         | -3.5%                           | -0.3%                     |

**Sources:**

Association of American Railroads, Railroad Facts, 1991 Edition, Washington, DC, September 1991, pp. 27, 33, 34, 36, 48, 50.

Revenue tons - Association of American Railroads, *Analysis of Class I Railroads 1990*, July 1991, p. 109, and annual.

Energy use - See Appendix A for Table 2.7.

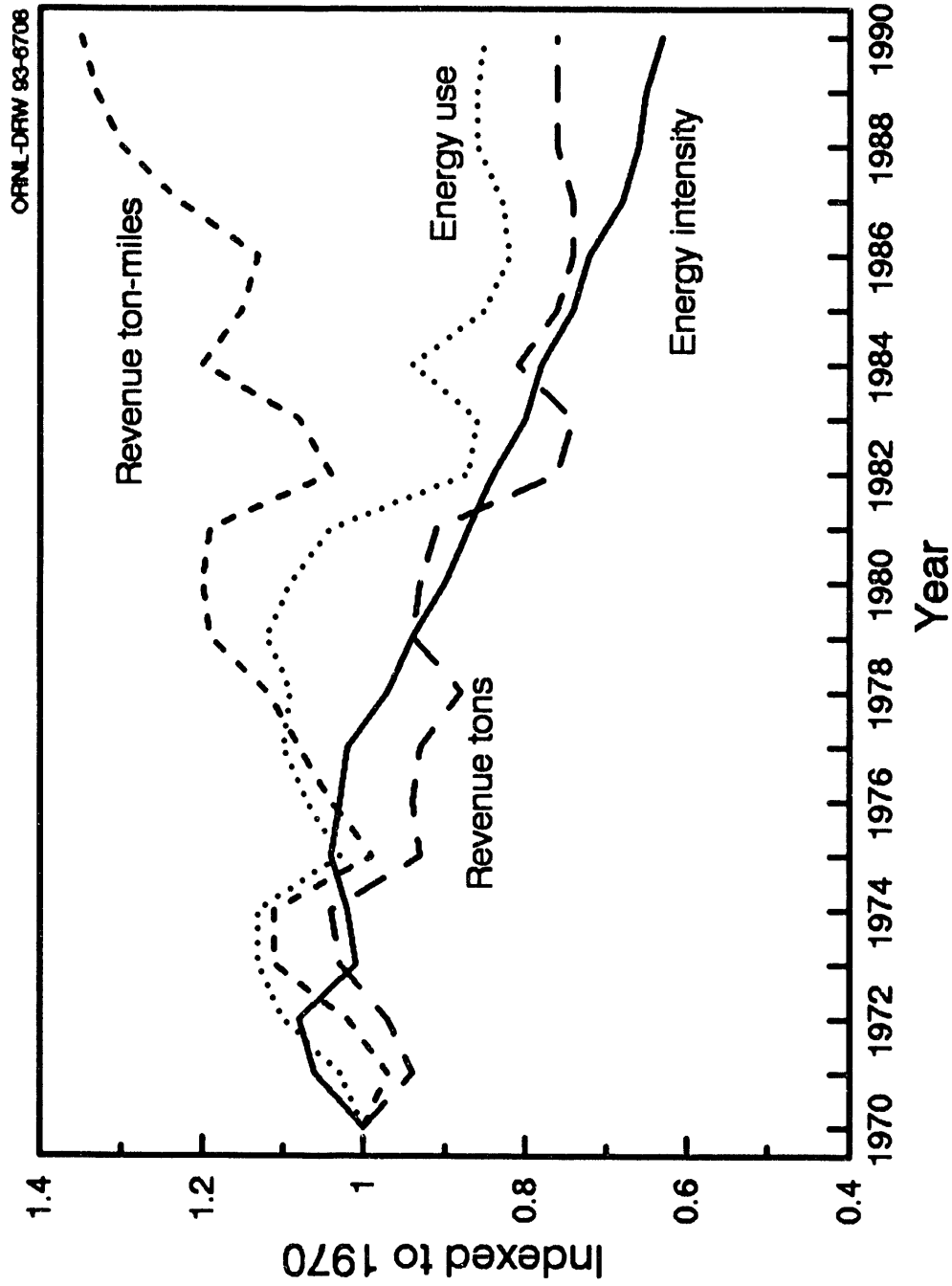
<sup>a</sup>Class I railroads are defined by the Interstate Commerce Commission as having annual operating revenues equal to or more than \$93.5 million in 1989. Operating Class I railroads account for more than 95 percent of the industry's freight.

<sup>b</sup>Does not include self-powered units. From 1972-79, the number of locomotives used in AMTRAK passenger operations (See Table 6.12) are subtracted from the total locomotives used in passenger and freight service to calculate the number of Class I locomotives in service.

<sup>c</sup>Does not include private or shipper-owned cars.

<sup>d</sup>Data represent total locomotives used in freight and passenger service. Separate estimates are not available.

Figure 6.8. Revenue Tons, Revenue Ton-Miles, Energy Intensity, and Energy Use for Class I Freight Railroads, 1970-90



Source: See Table 6.10.

*Although revenue carloadings declined by 20% from 1974 to 1990, coal is still the commodity with the highest share of carloadings. Many commodities drastically reduced rail shipments from 1974 to 1990, such as stone, clay and glass; metallic ores; primary metal products; and lumber and wood products.*

**Table 6.11**  
**Railroad Revenue Carloadings by Commodity Group, 1974 and 1990**

| Commodity group                 | Carloadings<br>(thousands) |        | 1990<br>Percent<br>distribution | Percentage<br>change<br>1974-90 |
|---------------------------------|----------------------------|--------|---------------------------------|---------------------------------|
|                                 | 1974                       | 1990   |                                 |                                 |
| Coal                            | 4,544                      | 5,912  | 27.6                            | 30.1                            |
| Farm products                   | 3,021                      | 1,690  | 7.9                             | -44.1                           |
| Chemicals and allied products   | 1,464                      | 1,531  | 7.2                             | 4.6                             |
| Nonmetallic minerals            | 821                        | 1,202  | 5.6                             | 46.4                            |
| Food and kindred products       | 1,777                      | 1,307  | 6.1                             | -26.4                           |
| Lumber and wood products        | 1,930                      | 780    | 3.6                             | -59.6                           |
| Metallic ores                   | 1,910                      | 508    | 2.4                             | -73.4                           |
| Stone, clay and glass           | 2,428                      | 539    | 2.5                             | -77.8                           |
| Pulp, paper, and allied product | 1,180                      | 611    | 2.9                             | -48.2                           |
| Petroleum products              | 877                        | 573    | 2.7                             | -34.7                           |
| Primary metal products          | 1,366                      | 477    | 2.2                             | -65.1                           |
| Waste and scrap material        | 889                        | 439    | 2.1                             | 50.6                            |
| Transportation equipment        | 1,126                      | 1,091  | 5.1                             | -3.1                            |
| Others                          | 3,451                      | 4,741  | 22.2                            | 37.4                            |
| Total                           | 26,784                     | 21,401 | 100.0                           | -20.1                           |

**Sources:**

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

1990 - Association of American Railroads, Railroad Facts, 1991 Edition, Washington, DC, September 1991, p. 25.

**Table 6.12**  
**Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971-91**

| Year                                    | Number of locomotives in service | Number of passenger cars | Train-miles (thousands) | Car-miles (thousands) | Revenue passenger-miles (millions) | Average trip length (miles) | Energy intensity (Btu per revenue passenger mile) | Energy use (trillion Btu) |
|---|----------------------------------|--------------------------|-------------------------|-----------------------|------------------------------------|-----------------------------|---|---------------------------|
| 1971                                    | •                                | 1,165                    | 16,537                  | 140,147               | 1,993                              | 188                         | •   | •                         |
| 1972                                    | 285                              | 1,571                    | 26,302                  | 213,261               | 3,039                              | 183                         | •   | •                         |
| 1973                                    | 352                              | 1,777                    | 27,151                  | 239,775               | 3,807                              | 224                         | 3,756   | 14.3                      |
| 1974                                    | 457                              | 1,848                    | 29,538                  | 260,060               | 4,259                              | 233                         | 3,240   | 13.8                      |
| 1975                                    | 355                              | 1,913                    | 30,166                  | 253,898               | 3,753                              | 224                         | 3,677   | 13.8                      |
| 1976                                    | 379                              | 2,062                    | 30,885                  | 263,589               | 4,268                              | 229                         | 3,397   | 14.5                      |
| 1977                                    | 369                              | 2,154                    | 33,200                  | 261,325               | 4,204                              | 221                         | 3,568   | 15.0                      |
| 1978                                    | 441                              | 2,084                    | 32,451                  | 255,214               | 4,154                              | 217                         | 3,683   | 15.3                      |
| 1979                                    | 437                              | 2,026                    | 31,379                  | 255,129               | 4,867                              | 226                         | 3,472   | 16.9                      |
| 1980                                    | 448                              | 2,128                    | 29,487                  | 235,235               | 4,503                              | 217                         | 3,176   | 14.3                      |
| 1981                                    | 398                              | 1,830                    | 30,380                  | 222,753               | 4,397                              | 226                         | 2,979   | 13.1                      |
| 1982                                    | 396                              | 1,929                    | 28,833                  | 217,385               | 3,993                              | 220                         | 3,156   | 12.6                      |
| 1983                                    | 388                              | 1,880                    | 28,805                  | 223,509               | 4,227                              | 223                         | 2,957   | 12.5                      |
| 1984                                    | 387                              | 1,844                    | 29,133                  | 234,537               | 4,427                              | 227                         | 3,027   | 13.4                      |
| 1985                                    | 382                              | 1,818                    | 30,038                  | 250,642               | 4,765                              | 238                         | 2,800   | 13.4                      |
| 1986                                    | 369                              | 1,793                    | 28,604                  | 249,665               | 5,011                              | 249                         | 2,574   | 12.9                      |
| 1987                                    | 381                              | 1,850                    | 29,515                  | 261,054               | 5,361                              | 259                         | 2,537   | 13.6                      |
| 1988                                    | 391                              | 1,845                    | 30,221                  | 277,774               | 5,686                              | 265                         | 2,462   | 14.0                      |
| 1989                                    | 312                              | 1,742                    | 31,000                  | 285,255               | 5,859                              | 274                         | 2,731   | 16.0                      |
| 1990                                    | 318                              | 1,863                    | 33,000                  | 300,996               | 6,057                              | 273                         | 2,609   | 15.8                      |
| 1991                                    | 316                              | 1,786                    | 34,000                  | 312,484               | 6,273                              | 285                         | 2,503   | 15.7                      |
| <i>Average annual percentage change</i> |                                  |                          |                         |                       |                                    |                             |   |                           |
| 1971-91                                 | 0.5% <sup>a</sup>                | 2.2%                     | 3.7%                    | 4.1%                  | 5.9%                               | 2.1%                        | -2.2% <sup>a</sup>                                | 0.5% <sup>a</sup>         |
| 1982-91                                 | -2.5%                            | -0.9%                    | 1.8%                    | 4.1%                  | 5.1%                               | 2.9%                        | -2.5%   | 2.5%                      |

**Sources:**

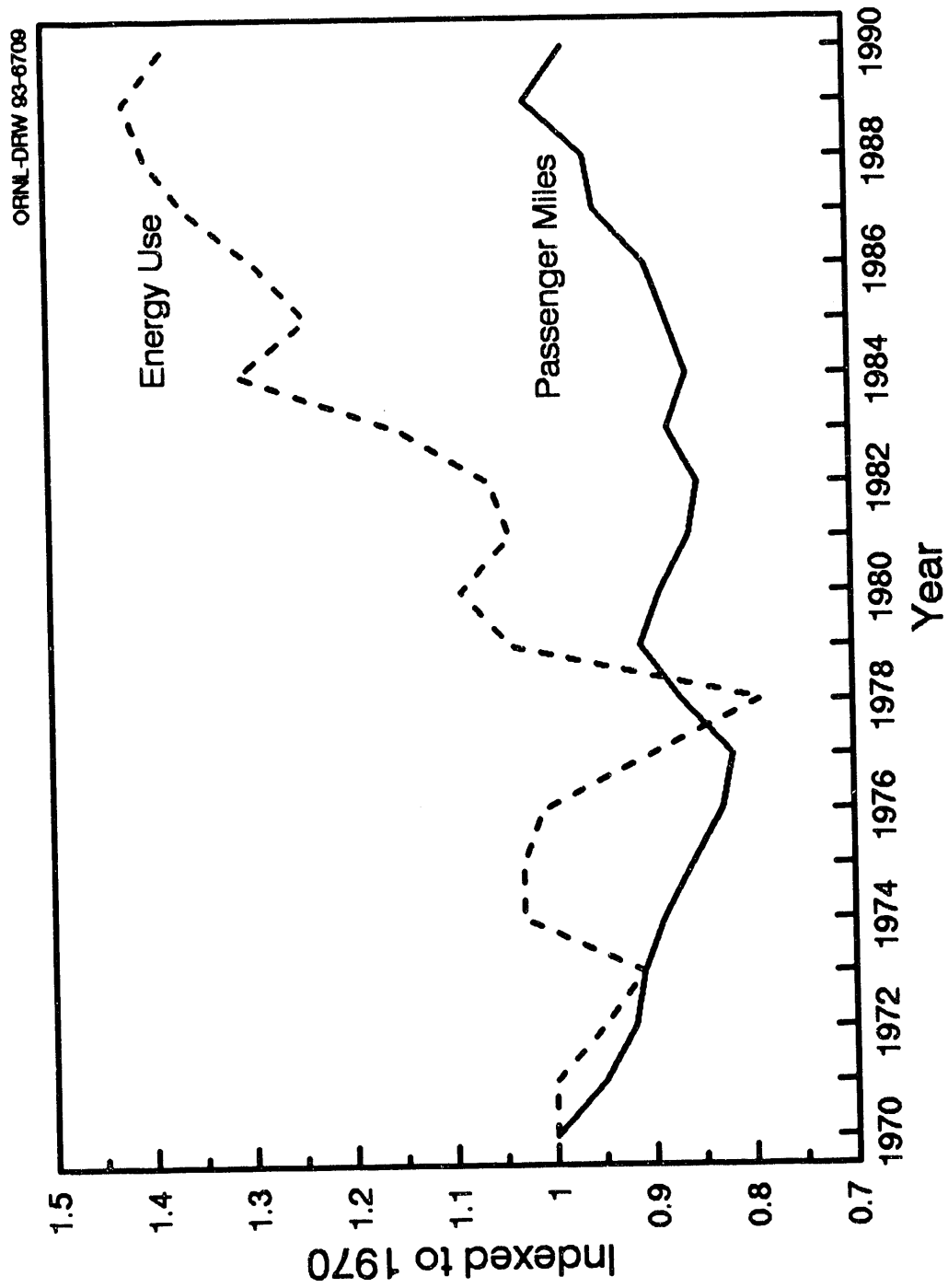
1971-83 - Association of American Railroads, Economics and Finance Department, Statistics of Class I Railroads, Washington, DC, and annual.  
 1984-88 - Association of American Railroads, Railroad Facts, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.  
 1989-91 - Personal communication with the Corporate Accounting Office of Amtrak, Washington, D.C.  
 Energy use - 1971-84: Association of American Railroads, Railroad Facts, 1984 Edition, Washington, DC, 1984, and annual.  
 1985-91: Personal communication with the Corporate Accounting Office of Amtrak, Washington, DC.

<sup>a</sup>Data are not available.

<sup>b</sup>Average annual percentage change is for years 1972-91.

<sup>c</sup>Average annual percentage change is for years 1973-91.

Figure 6.9. Energy Use and Passenger-Miles for Amtrak and Rail Transit, 1970-91



Source: See Tables 6.12 and 6.13.

Table 6.13  
Summary Statistics for Rail Transit Operations, 1970-90<sup>a</sup>

| Year    | Number of<br>passenger<br>vehicles | Vehicle-<br>miles<br>(millions) | Passenger<br>trips<br>(millions) <sup>b</sup> | Estimated<br>passenger-miles<br>(millions) <sup>c</sup> | Average trip<br>length<br>(miles) <sup>d</sup> | Energy<br>intensity<br>(Btu/passenger-mile) <sup>e</sup> | Energy<br>use<br>(trillion Btu) |
|---------|------------------------------------|---------------------------------|---|---|--|--|---------------------------------|
| 1970    | 10,548                             | 440.8                           | 2,116   | 12,273 <sup>f</sup>                                     | 5.8  | 2,453  | 30.1                            |
| 1971    | 10,550                             | 440.4                           | 2,000   | 11,600 <sup>f</sup>                                     | 5.9  | 2,595  | 30.1                            |
| 1972    | 10,599                             | 417.8                           | 1,942   | 11,264 <sup>f</sup>                                     | 5.9  | 2,540  | 28.6                            |
| 1973    | 10,510                             | 438.5                           | 1,921   | 11,142 <sup>f</sup>                                     | 5.9  | 2,460  | 27.4                            |
| 1974    | 10,471                             | 458.8                           | 1,876   | 10,881 <sup>f</sup>                                     | 5.8  | 2,840  | 30.9                            |
| 1975    | 10,617                             | 446.9                           | 1,797   | 10,423 <sup>f</sup>                                     | 5.8  | 2,962  | 31.1                            |
| 1976    | 10,625                             | 428.1                           | 1,744   | 10,115 <sup>f</sup>                                     | 5.8  | 2,971  | 30.3                            |
| 1977    | 10,579                             | 381.7                           | 1,713   | 10,071  | 5.8  | 2,691  | 27.1                            |
| 1978    | 10,459                             | 383.0                           | 1,810   | 10,722  | 5.9  | 2,210  | 23.7                            |
| 1979    | 10,429                             | 399.6                           | 1,884   | 11,167  | 5.9  | 2,794  | 31.2                            |
| 1980    | 10,654                             | 402.2                           | 2,241   | 10,939  | 4.9  | 3,008  | 32.9                            |
| 1981    | 10,824                             | 436.6                           | 2,217   | 10,590  | 4.8  | 2,946  | 31.2                            |
| 1982    | 10,831                             | 445.2                           | 2,201   | 10,428  | 4.6  | 3,069  | 32.0                            |
| 1983    | 10,904                             | 423.5                           | 2,304   | 10,741  | 4.7  | 3,212  | 34.5                            |
| 1984    | 10,848                             | 452.7                           | 2,388   | 10,531  | 4.4  | 3,732  | 39.3                            |
| 1985    | 11,109                             | 467.8                           | 2,422   | 10,777  | 4.4  | 3,461  | 37.3                            |
| 1986    | 11,083                             | 492.8                           | 2,467   | 11,018  | 4.5  | 3,531  | 38.9                            |
| 1987    | 10,934                             | 508.6                           | 2,535   | 11,603  | 4.6  | 3,534  | 41.0                            |
| 1988    | 11,370                             | 538.3                           | 2,462   | 11,836  | 4.8  | 3,565  | 42.2                            |
| 1989    | 11,261                             | 553.4                           | 2,704   | 12,539  | 4.6  | 3,397  | 42.6                            |
| 1990    | 11,332                             | 561.0                           | 2,522   | 12,046  | 4.8  | 3,453  | 41.6                            |
| 1970-90 | 0.4%                               | 1.2%                            | Average annual percentage change              | change  | -1.4% <sup>g</sup>                             | 1.7%   | 1.6%                            |
| 1982-90 | 0.6%                               | 2.9%                            | 0.9%  | -0.1%   | 0.5%   | 1.5%   | 3.3%                            |

Sources:  
American Public Transit Association, 1991 *Transit Fact Book*, Washington, DC, October 1991, pp. 24, 25.  
Energy use - See Appendix A for Table 2.7.

<sup>a</sup>Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

<sup>b</sup>1970-79 data represents total passenger rides; after 1979, data represents unlinked passenger trips.

<sup>c</sup>Estimated by ORNL for years 1970-76 based on an average trip length of 5.8 miles.

<sup>d</sup>Calculated as the ratio of passenger miles to passenger trips.

<sup>e</sup>Large system-to-system variations exist within this category.

<sup>f</sup>Data are not available.

<sup>g</sup>Average annual percentage change is calculated for years 1977-90.

## APPENDIX A

### SOURCES

This appendix, first included in Edition 10 of the Transportation Energy Data Book, contains documentation of the estimation procedures used by ORNL. The reader can examine the methodology behind the estimates and form an opinion as to their utility.

The appendix is arranged by table number and subject heading. Only tables which contain ORNL estimations are documented in Appendix A; all other tables have sources listed at the bottom of the table. Abbreviations are used throughout the appendix; so a list of abbreviations is also included.

## List of Abbreviations Used in Appendix A

|               |   |
|---------------|---|
| <b>AAR</b>    | <b>Association of American Railroads</b>                    |
| <b>APTA</b>   | <b>American Public Transit Association</b>                  |
| <b>Amtrak</b> | <b>National Railroad Passenger Corporation</b>              |
| <b>Btu</b>    | <b>British thermal unit</b>                                 |
| <b>DOC</b>    | <b>Department of Commerce</b>                               |
| <b>DOE</b>    | <b>Department of Energy</b>                                 |
| <b>DOT</b>    | <b>Department of Transportation</b>                         |
| <b>EIA</b>    | <b>Energy Information Administration</b>                    |
| <b>EPA</b>    | <b>Environmental Protection Agency</b>                      |
| <b>FAA</b>    | <b>Federal Aviation Administration</b>                      |
| <b>FHWA</b>   | <b>Federal Highway Administration</b>                       |
| <b>gvw</b>    | <b>gross vehicle weight</b>                                 |
| <b>lpg</b>    | <b>liquefied petroleum gas</b>                              |
| <b>MIC</b>    | <b>Motorcycle Industry Council</b>                          |
| <b>mpg</b>    | <b>miles per gallon</b>                                     |
| <b>MVMA</b>   | <b>Motor Vehicle Manufacturers Association</b>              |
| <b>NHTSA</b>  | <b>National Highway Traffic Safety Administration</b>       |
| <b>NPTS</b>   | <b>Nationwide Personal Transportation Study</b>             |
| <b>ORNL</b>   | <b>Oak Ridge National Laboratory</b>                        |
| <b>pmt</b>    | <b>passenger-miles traveled</b>                             |
| <b>RECS</b>   | <b>Residential Energy Consumption Survey</b>                |
| <b>RTECS</b>  | <b>Residential Transportation Energy Consumption Survey</b> |
| <b>TIUS</b>   | <b>Truck Inventory and Use Survey</b>                       |
| <b>TPA</b>    | <b>Transportation Policy Associates</b>                     |
| <b>TSC</b>    | <b>Transportation Systems Center</b>                        |
| <b>vmt</b>    | <b>vehicle-miles traveled</b>                               |

**Table 2.7**  
**Domestic Consumption of Transportation Energy by Mode**  
**and Fuel Type, 1990**

Most of the source data were given in gallons. It was converted to Btu by using the conversion factors in Appendix B.

## **Highway**

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### **Automobiles**

Total gallons of fuel taken from DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192. These were distributed as follows: 98.8% gasoline and 1.2% diesel. Percentages were derived from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Household Vehicles Energy Consumption 1988, March 1990, p. 65.

### **Motorcycles**

DOT, FHWA, Highway Statistics 1990, Table VM-1, p.192. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

### **Buses**

#### ***Transit:***

Diesel: APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93.

Gasoline: Total gallons of gasoline used by transit vehicles taken from APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93. According to APTA's Research and Statistics Department, motor bus accounts for approximately 5% of total transit gasoline use.

#### ***Intercity:***

Estimate provided by Frank Smith, Transportation Policy Associates, Washington, DC.

#### ***School:***

Estimate provided by Frank Smith, Transportation Policy Associates, Washington, DC.

### **Trucks**

#### ***Total:***

Sum of light trucks and other trucks.

***Light Trucks:***

DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192, for single-unit, 2-axle, 4-tire trucks. 96.6% of fuel assumed to be gasoline, 3.3% diesel, and 0.1% lpg; percentages were generated from the 1987 TIUS Public Use Tape.

***Other Trucks:***

DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These gallons were distributed as follows based on data from the 1987 TIUS Public Use Tape: 19.4% of fuel assumed to be gasoline, 80.4% diesel, and 0.2% lpg.

## **Off Highway**

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

## **Non-Highway**

### **Air**

***General Aviation:***

DOT, FAA, General Aviation Activity and Avionics Survey: Annual Summary Report Calendar Year 1990, Table 5.1, p. 5-6. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

***Domestic and International Air Carrier:***

DOT, Research and Special Programs Administration, Data Administration Division, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel purchases for international flights.

### **Water**

***Freight:***

Total - DOE, EIA, Fuel Oil and Kerosene Sales, 1990, p.42. Adjusted sales of distillate and residual fuel oil for vessel bunkering.

*Domestic and Foreign* - Total freight energy use was distributed as follows:

Distillate fuel - 77.5% domestic, 22.5% foreign

Residual fuel - 9.3% domestic, 90.7% foreign

Percentages were derived from the DOC, U.S. Foreign Trade, Bunker Fuels, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988. This report was discontinued in 1989.

#### ***Recreational Boating:***

Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, Off-Highway Use of Gasoline in the United States (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation was found in Boating Industry Magazine, Annual Report, "The Boating Business 1990" (Communication Channels, Inc., Chicago, IL). The total was the sum of inboard, outboard and inboard/outdrive boats.

#### **Pipeline**

##### ***Natural Gas:***

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, Natural Gas Annual 1990, Table 1, p. 20. Cubic feet were converted to Btu using 1,031 Btu/ft<sup>3</sup>. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., End Use Energy Consumption DataBase: Transportation Sector. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10<sup>-5</sup> kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

***Crude petroleum and petroleum product:***

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

***Coal slurry and water:***

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

**Rail**

***Total:***

DOE, EIA, Fuel Oil and Kerosene Sales, 1990, p.42. Adjusted sales of deliveries of distillate fuel oil for railroad.

***Freight:***

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

***Passenger:***

*Transit and Commuter* - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93. Transit was defined as the sum of "heavy rail" and "all other."

*Intercity* - Sum of fuel used by Amtrak and Class I passenger trains. Source for Amtrak was personal communication with the Corporate Accounting Office of Amtrak, Washington, DC. Source for fuel use by Class I passenger trains was the AAR, Statistics of Class I Railroads 1990, July 1991, p. 157. Fuel use for Class I passenger was derived as follows: fuel use for passenger locomotive, including weighted percent of fuel for yard switching. Diesel fuel consumed by work train was not included as it was considered to be indirect energy.

**Military Operations**

Defense Logistics Agency, Defense Fuel Supply Center, Fact Book Fiscal Year 1990, "Barrels and Dollars per Barrel," p. 33. For conversion purposes, estimates of jet fuel purchases were 64% JP4, 22% JP5, and 14% JP8, based on the breakdown from "Petroleum Procurement," p. 31. The purchases were the best estimates available for fuel consumption, both domestic and abroad. An estimate of 68.9% was purchased in the United States.

**Table 2.10**  
**Transportation Energy Consumption by Mode, 1970-90**

## **Highway**

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### **Automobiles**

Total gallons of fuel for automobiles was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A; and Table VM-1 in the 1986-90 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

- 1970-80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980, p. 10.
- 1981-82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981, pp. 11, 13.
- 1983-84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983, Jan., 1985, pp. 7, 9.
- 1985-87 - 98.5% gasoline, 1.5% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles 1985, April 1987, pp. 25, 27.
- 1988-90 - 98.8% gasoline and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Household Vehicles Energy Consumption 1988, March 1990, p. 65.

### **Motorcycles**

Department of Transportation, Federal Highway Administration, Highway Statistics Summary to 1985, Table VM-201A; and Table VM-1 in the 1986-90 annual editions. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

### **Buses**

Sum of transit, intercity and school.

***Transit:***

*Diesel* - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93, and annual.

*Gasoline* - Total gallons of gasoline used by transit vehicles taken from APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93.

According to APTA's Research and Statistics Department, motor bus accounts for approximately 5% of total transit gasoline use.

***Intercity:***

1970-84 - American Bus Association, Annual Report, Washington, DC, annual.

1985-86 - Eno Transportation Foundation, Transportation in America, Seventh edition, Washington, DC, p. 9.

1987-90 - Personal communication with Frank Smith, TPA, Washington, DC.

***School:***

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

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

1987-90 - Personal communication with Frank Smith, TPA, Washington, DC.

**Trucks**

***Light Trucks:***

Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1986-90 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-1987 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1990 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg.

***Other Trucks:***

Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1986-90 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-1987 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988-90 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg.

## **Total Highway**

Sum of autos, motorcycles, buses, light trucks, and other trucks.

## **Non-Highway**

### **Air**

Sum of fuel use by General Aviation and Certificated Route Air Carrier.

#### ***General Aviation:***

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

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

1985-90 - DOT, FAA, General Aviation Activity and Avionics Survey: Annual Summary Report, Calendar Year 1990, Table 5.1, p. 5-6. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

#### ***Certificated Route Air Carrier:***

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

1982-90 - DOT, Research and Special Programs Administration, Data Administration Division, "Fuel Cost and Consumption Tables," annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel purchases for international flights.

### **Water**

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

#### ***Freight:***

*Total* - DOE, EIA, Fuel Oil and Kerosene Sales, 1990, p.42. Adjusted sales of distillate and residual fuel oil for vessel bunkering.

*Domestic and Foreign* - 1970-88 - DOC, U.S. Foreign Trade, Bunker Fuels, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988, annual. In this were fuel oil (i.e., residual) and diesel oil laden in the U.S. on vessels engaged in foreign trade. The totals for residual and diesel used by foreign vessels and American vessels for foreign trade were subtracted from the EIA totals for residual and diesel deliveries to obtain the value for domestic trade.

1989-90 - Total freight energy use was distributed as follows:

Distillate fuel - 77.5% domestic, 22.5% foreign

Residual fuel - 9.3% domestic, 90.7% foreign

Percentages were derived from the DOC, U.S. Foreign Trade, Bunker Fuels, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988. This report was discontinued in 1989.

***Recreational Boating:***

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

1985-1990 - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, Off-Highway Use of Gasoline in the United States (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation was found in Boating Industry Magazine, Annual Report, "The Boating Business 1990" (Communication Channels, Inc., Chicago, IL). The total was the sum of inboard, outboard and inboard/outdrive boats.

**Pipeline**

***Natural Gas:***

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, Natural Gas Annual 1990, Table 1, p. 20. Cubic feet were converted to Btu using 1,031 Btu/ft<sup>3</sup>. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., End Use Energy Consumption DataBase: Transportation Sector. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor  $29.305 \times 10^{-5}$  kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

***Crude petroleum and petroleum product:***

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

***Coal slurry and water:***

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

**Rail**

***Total:***

DOE, EIA, Fuel Oil and Kerosene Sales, 1990, p.42, annual. Adjusted sales of distillate fuel oil for railroad.

***Freight:***

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

***Passenger:***

*Transit and Commuter* - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93, annual. Transit was defined as the sum of "heavy rail" and "all other."

*Intercity* - Sum of fuel used by Amtrak and Class I passenger trains. Source for Amtrak was personal communication with the Corporate Accounting Office of Amtrak, Washington, DC. Source for fuel use by Class I passenger trains was the AAR, Statistics of Class I Railroads 1990, July 1991, p. 157, annual. Fuel use for Class I passenger was derived as follows: fuel use for passenger locomotive, including weighted percent of fuel for yard switching. Diesel fuel consumed by work train was not included as it was considered to be indirect energy.

**Table 2.12**  
**Passenger Travel and Energy Use in the United States, 1990**

## **Highway**

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### **Automobiles**

*Number of Vehicles* - DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192.

*Vmt* - DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192.

*Pmt* - Calculated by ORNL (load factor times vmt).

*Load Factor* - DOT, FHWA, Office of Highway Information Management, 1990 NPTS, Public Use Tape, 1992.

*Energy Use* - Total gallons of fuel taken from DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192. These were distributed as follows: 98.8% gasoline and 1.2% diesel. Percentages were derived from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Household Vehicles Energy Consumption 1988, March 1990, p. 65.

### **Personal Trucks**

*Number of Vehicles* - Based on the 1987 TIUS, 68.6% of total 2-axle, 4-tire trucks and 11.1% of total other trucks were for personal use. Therefore, 68.6% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1990, Table VM-1, p. 192) and 11.1% of total other trucks were estimated to be for personal use.

*Vmt* - 62.7% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1990, Table VM-1, p. 192) and 2.3% of total vehicle miles traveled by other trucks were for personal use. The percentages were derived by ORNL from the 1987 TIUS public use tape.

*Pmt* - Calculated by ORNL as vmt multiplied by load factor.

*Load Factor* - DOT, FHWA, Office of Highway Information Management, 1990 NPTS, Public Use Tape, 1992.

*Energy Use* - Assuming that there is no difference in fuel economy (measured in miles per gallon) between personal-use trucks and non-personal use trucks, 62.7% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1990, Table VM-1, p. 192) and 2.3% of total other truck fuel consumption was for personal use. These percentages were derived by ORNL from the 1987 TIUS Public Use tape. Total truck energy use was the sum of light truck and other truck energy use.

Light Trucks: DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192, for single-unit, 2-axle, 4-tire trucks. 96.6% of fuel assumed to be gasoline, 3.3% diesel, and 0.1% lpg; percentages were generated from the 1987 TIUS Public Use Tape.

Other Trucks: DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192.  
Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These values were distributed based on data from the 1987 TIUS Public Use Tape: 19.4% of fuel assumed to be gasoline, 80.4% diesel, and 0.2% lpg.

### **Motorcycles**

*Number of Vehicles and Vmt* - DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192.  
*Pmt* - Calculated by ORNL as vmt multiplied by load factor.  
*Load Factor* - DOT, FHWA, Office of Highway Information Management, 1990 NPTS, Public Use Tape, 1992.  
*Energy Use* - DOT, FHWA, Highway Statistics 1990, Table VM-1, p. 192. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

### **Buses**

#### ***Transit:***

*Number of Vehicles, Vmt, Pmt, and Energy Use* - Motor bus only. APTA, 1991 Transit Fact Book, October 1991, Washington, DC, pp. 24-26.  
*Load Factor* - Calculated by ORNL as pmt/vmt.

#### ***Intercity:***

*Number of Vehicles* - Estimated by ORNL as 18% of commercial bus registrations, DOT, FHWA, Highway Statistics 1990, p. 20.  
*Pmt* - Eno Transportation Foundation, Transportation in America, Tenth Edition, Washington, DC, 1992, p. 47.  
*Energy Use* - Personal communication with Frank Smith, TPA, Washington, DC.

#### ***School:***

*Number of Vehicles* - School and other nonrevenue as reported in DOT, FHWA, Highway Statistics 1990, p. 20.  
*Energy Use* - Personal communication with Frank Smith, TPA, Washington, DC.  
*Load Factor* - Calculated by ORNL as pmt/vmt.  
*Pmt* - National Safety Council, Accident Facts, 1991 Edition, Chicago, IL, p. 70.

## **Non-Highway**

### **Air**

#### ***Large Certified Route Air Carriers:***

*Vmt* - Revenue aircraft miles flown, DOT, FAA, FAA Statistical Handbook of Aviation Calendar Year 1990, p. 6-4.

*Pmt* - Revenue pmt of domestic operations, scheduled and unscheduled, DOT, FAA, FAA Statistical Handbook of Aviation Calendar Year 1990, p. 6-4.

*Load Factor* - Calculated by ORNL as pmt/vmt.

*Energy Use* - DOT, Research and Special Programs Administration, Data Administration Division, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided by two to estimate domestic fuel purchases for international flights.

#### ***General Aviation:***

*Number of Vehicles, Vmt, Energy Use* - DOT, FAA, General Aviation Activity and Avionics, Survey: Calendar Year 1990, pp. 2-8, 3-13, 5-6.

*Pmt* - Eno Transportation Foundation, Transportation in America, Tenth Edition, Washington, DC, 1992, p. 47.

*Load Factor* - Calculated by ORNL as pmt/vmt.

### **Recreational Boating**

*Number of Vehicles* - Whitney Communications, Boating Industry Magazine, Annual Report, "The Boating Business 1990." The total was the sum of inboard, outboard, and inboard/outdrive boats.

*Energy Use* - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, Off-Highway Use of Gasoline in the United States (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation was found in Boating Industry Magazine, Annual Report, "The Boating Business 1990" (Communication Channels, Inc., Chicago, IL). The total was the sum of inboard, outboard and inboard/outdrive boats.

**Rail**

***Intercity:***

*Number of Vehicles, Vmt and Pmt* - Personal communication with the Corporate Accounting Office of Amtrak, Washington, DC.

*Load Factor* - Calculated by ORNL as  $pmt/vmt$ .

*Energy Use* - Personal communication with the Accounting Division of Amtrak, Washington, DC.

***Transit and Commuter:***

*Number of Vehicles, Vmt and Pmt* - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, pp. 24-26.

*Load Factor* - Calculated by ORNL as  $pmt/vmt$ .

*Energy Use* - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93. Transit was defined as the sum of "heavy rail" and "all other."

**Table 2.13**  
**Energy Intensities of Passenger Modes, 1970-90**

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios in Table 2.14 were calculated for each passenger mode using the following data sources:

## Highway

### **Automobiles**

*Vmt* - DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1987-90 editions.

*Pmt* - vmt times load factor.

*Energy Use* - Total gallons of fuel for automobiles was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A; and Table VM-1 in the 1986-90 annual editions. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

1970-80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980, p. 10.

1981-82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981, pp. 11, 13.

1983-84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983, Jan., 1985, pp. 7, 9.

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

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

### **Buses**

#### ***Transit:***

*Vmt and Pmt* - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, pp. 24-26 and annual.

*Energy Use* - Diesel: APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93, and annual.

Gasoline: Total gallons of gasoline used by transit vehicles taken from APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93. According to APTA's Research and Statistics Department, motor bus accounts for approximately 5% of total transit gasoline use.

***Intercity:***

- Pmt* - 1970-84 - American Bus Association, Annual Report, Washington, DC, annual.
- 1985-90 - Eno Transportation Foundation, Transportation in America, Tenth edition, Washington, DC, 1992, p. 47.
- Energy Use* - 1970-1984 - American Bus Association, Annual Report, Washington, DC, annual.
- 1985-86 - Eno Transportation Foundation, Transportation in America, Seventh edition, Washington, DC, p. 9.
- 1987-90 - Personal communication with Frank Smith, TPA, Washington, DC.

***School:***

- Vmt* - 1970-84 - DOT, FHWA, Highway Statistics 1984, Washington, DC, Table VM-1, p. 175, and annual.
- 1985-87 - DOT, TSC, National Transportation Statistics, 1989, Figure 2, p. 7, and annual.
- 1988-90 - National Safety Council, Accident Facts, 1991 Edition, Chicago, IL, p. 71, and annual.
- Energy Use* - 1970-1984 - DOT, FHWA, Highway Statistics 1984, Washington, DC, Table VM-1, and annual.
- 1985-86 - DOT, TSC, National Transportation Statistics, Figure 2, p. 5, and annual.
- 1987-90 - Personal communication with Frank Smith, TPA, Washington, DC.

## **Non-Highway**

### **Air**

***Certificated Air Carriers:***

- Pmt* - DOT, FAA, FAA Statistical Handbook of Aviation, Calendar Year 1990, Washington, DC, 1992, p. 6-4, and annual.
- Energy Use* - 1970-81 - DOT, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, DC, annual.
- 1982-90 - DOT, Research and Special Programs Administration, Data Administration Division, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel purchases for international flights.

***General Aviation:***

*Pmt* - Eno Transportation Foundation, Transportation In America, Tenth edition, Washington, DC, 1992, p.47.

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

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

1985-90 - DOT, FAA, General Aviation Activity and Avionics Survey: Calendar Year 1990, Table 5.1, p. 5-6. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

**Rail**

***Passenger (Amtrak):***

*Pmt* - 1971-83 - AAR, Statistics of Class I Railroads, Washington, DC, annual.

1984-88 - AAR, Railroad Facts, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.

1989-90 - Personal communication with the Corporate Accounting Office of Amtrak.

*Energy Use* - Personal communication with the Corporate Accounting Office of Amtrak.

***Transit:***

*Pmt* - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 25.

*Energy Use - Transit and Commuter* - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93, annual. Transit was defined as the sum of "heavy rail" and "all other."

**Table 2.14**  
**Intercity Freight Movement and Energy Use in the**  
**United States, 1990**

## **Highway**

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### **Trucks**

*Vehicles* - 7.5% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1990, Table VM-1, p. 192) and 22.1% of total other trucks were engaged in intercity freight movement. These percentages were derived by ORNL from the 1987 TIUS public use tape.

*Vmt* - 13.7% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1990, Table VM-1, p. 192) and 50.2% of total vehicle miles traveled by other trucks were used in intercity freight movement. These percentages were derived by ORNL from the 1987 TIUS public use tape.

*Ton Miles, Tons Shipped and Average Length of Haul* - Eno Transportation Foundation, Transportation in America, Tenth Edition, Washington, DC, 1992 pp. 44, 46, 71.

*Energy Intensity* - Energy use divided by ton-miles.

*Energy Use* - 16% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in Highway Statistics 1990, Table VM-1, p. 192) and 53.2% of total other truck fuel consumption were used in intercity freight movement. These percentages were derived by ORNL from the 1987 TIUS public use tape.

## **Non-Highway**

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### **Waterborne Commerce**

*Vehicles* - U.S. Department of the Army, Army Corps of Engineers, Waterborne Transportation Lines of the United States, 1989, New Orleans, LA, 1991.

*Ton Miles, Tons Shipped, and Average Length of Haul* - U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1989, Part 5: National Summaries, New Orleans, LA, 1990, p. 89.

*Energy Intensity* - Energy use divided by ton miles.

*Energy Use* - DOE, EIA, Fuel Oil and Kerosene Sales, 1990, p.42. Adjusted sales of distillate and residual fuel oil for vessel bunkering.

Domestic freight energy use was calculated as:

Distillate fuel - 77.5% domestic, 22.5% foreign

Residual fuel - 9.3% domestic, 90.7% foreign

Percentages were derived from the DOC, U.S. Foreign Trade, Bunker Fuels, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988. This report was discontinued in 1989.

## Pipeline

### ***Natural Gas:***

*Tons shipped* - DOE, EIA, Natural Gas Annual 1990, Washington, DC, 1991, p. 20. Total natural gas disposition divided by 44,870 ft<sup>3</sup>/ton.

*Energy use* - The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, Natural Gas Annual 1990, Table 1, p. 20. Cubic feet were converted to Btu using 1,031 Btu/ft<sup>3</sup>. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., End Use Energy Consumption DataBase: Transportation Sector. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horsepower was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor  $29.305 \times 10^{-5}$  kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

### ***Crude Oil and Petroleum Product:***

*Ton Miles and Tons Shipped* - Eno Transportation Foundation, Transportation in America, Tenth Edition, Washington, DC, 1992, pp. 44, 46.

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

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

## **Rail**

*Vehicles, Vmt, Ton Miles, Tons Shipped, Average Length of Haul* - AAR, Railroad Facts, 1991 Edition, Washington, DC, September 1991, pp. 27, 33, 34, 36, 48, 50.

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

Total - DOE, EIA, Fuel Oil and Kerosene Sales, 1990, p. 42. . Adjusted sales of distillate fuel oil for railroad.

Passenger - Transit and Commuter - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93. Transit was defined as the sum of "heavy rail" and "all other." Intercity - Sum of fuel used by Amtrak and Class I passenger trains. Source for Amtrak was personal communication with the Accounting Division of Amtrak, Washington, DC. Source for fuel use by Class I passenger trains was the AAR, Statistics of Class I Railroads 1990, July 1991, p. 157. Fuel use for Class I passenger was derived as follows: fuel use for passenger locomotive, including weighted percent of fuel for yard switching. Diesel fuel consumed by work train was not included as it was considered to be indirect energy.

**Table 2.15**  
**Energy Intensities of Freight Modes, 1970-90**

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios in Table 2.16 were calculated for each freight mode using the following data sources:

## Highway

### **Trucks**

*Vmt* - DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1987-90 editions. Light trucks were defined as 2-axle, 4-tire trucks. Other trucks were defined as the difference between total trucks and 2-axle, 4-tire trucks. See Table 3.15 for light truck vmt.

*Energy Use* - Light Trucks - Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1986-90 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-1987 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988-90 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg.

Other Trucks - Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, Highway Statistics Summary to 1985, Table VM-201A, and Table VM-1 of the 1986-90 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-1987 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988-90 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg.

## Non-Highway

### **Water**

*Ton Miles* - U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1989, Part 5: National Summaries, New Orleans, LA, 1991, p. 89, and annual.

*Energy Use* - Calculated as the difference between total water freight energy use and foreign water freight energy use.

Total - DOE, EIA, Fuel Oil and Kerosene Sales, 1990, p. 42. Adjusted sales of distillate and residual fuel oil for vessel bunkering.

Domestic and Foreign - 1970-88 - DOC, U.S. Foreign Trade, Bunker Fuels, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988, annual. In this were fuel oil (i.e., residual) and diesel oil laden in the U.S. on vessels engaged in foreign trade. The totals for residual and diesel used by foreign vessels and American vessels for foreign trade were subtracted from the EIA totals for residual and diesel deliveries to obtain the value for domestic trade.

1989-90 - Total freight energy use was distributed as follows:

Distillate fuel - 77.5% domestic, 22.5% foreign

Residual fuel - 9.3% domestic, 90.7% foreign

Percentages were derived from the DOC, U.S. Foreign Trade, Bunker Fuels, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988. This report was discontinued in 1989.

## Rail

*Freight Car Miles and Ton Miles* - AAR, Railroad Facts, 1991 Edition, Washington, DC, September 1991, pp. 27, 36, and annual.

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

Total - DOE, EIA, Fuel Oil and Kerosene Sales, 1990, p. 42. Adjusted sales of distillate fuel oil for railroad.

Passenger - Transit and Commuter - APTA, 1991 Transit Fact Book, October 1991, Washington, DC, p. 93. Transit was defined as the sum of "heavy rail" and "all other." Intercity - Sum of fuel used by Amtrak and Class I passenger trains. Source for Amtrak was personal communication with the Accounting Division of Amtrak, Washington, DC. Source for fuel use by Class I passenger trains was the AAR, Statistics of Class I Railroads 1990, July 1991, p. 157. Fuel use for Class I passenger was derived as follows: fuel use for passenger locomotive, including weighted percent of fuel for yard switching. Diesel fuel consumed by work train was not included as it was considered to be indirect energy.

**Table 3.3**  
**Vehicle Stock, New Sales and New Registrations**  
**in the United States, 1990 Calendar Year**

## Highway

### **Automobiles**

#### ***Vehicle Stock:***

The number of vehicles in use by EPA size class were derived as follows: Market Shares by EPA size class for new car sales from 1970-1975 were taken from the DOT, NHTSA, Automotive Characteristics Historical DataBase, Washington, DC. Market shares for the years 1976-1990 were found in Linda S. Williams and Patricia S. Hu, Highway Vehicle MPG and Market Shares Report: Model Year 1990, ORNL-6672, April 1991, Table 7. These data were assumed to represent the number of cars registered in each size class for each year. These percentages were applied to the automobiles in operation for that year as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED) and summed to calculate the total mix for 1990. This method assumed that all vehicles, large and small, were scrapped at the same rate.

#### ***Sales:***

Domestic, import, and total sales were from MVMA, Facts and Figures '92, p. 15. The domestic sales were distributed by size class according to the following percentages: Two seater, 0.5%; Minicompact, 0%; Subcompact, 14.7%; Compact 33.9%; Midsize, 32.1%; and Large, 18.8%. The import sales were distributed by size class according to the following percentages: Two-seater, 5.8%; Minicompact, 3.4%; Subcompact, 41.9%; Compact, 35.2%; Midsize, 13.4%; and Large, 0.4%. These percentages were derived from the ORNL Light-Duty Vehicle Market Shares Data System. Domestic-sponsored imports (captive imports) were included in the import figure only.

#### ***New Registrations:***

**Domestic** - The number of registrations for new automobiles was derived as follows: new car registrations by make (as reported in H. A. Stark (ed.), Ward's Communication, Inc., 1992 Ward's Automotive Yearbook, Detroit, MI, p. 241), were classified by ORNL into EPA size classes. Totals included Federal Government registrations. Van registrations were not included.

**Import** - Calculated by ORNL as the difference between total and domestic.

**Total** - MVMA, Facts and Figures '92, p. 21.

*See Glossary for definition of Automobile Size Classifications.*

## **Fleet**

### ***Fleets of ten or more:***

*Stock and Registrations* - E. J. Bobit (ed.), Bobit Publishing Company, 1992 Automotive Fleet Fact Book, Redondo Beach, CA, 1992, pp. 16, 22. Vehicle stock was equal to the sum of business fleets 25 or more, business fleets 10-24, individually leased, and "other" fleets. This number did not include all cars in Federal Government fleets. Federal Government fleet data were from Federal Motor Vehicle Fleet Report, General Services Administration, Table 1 (all agencies - domestic sedans and station wagons.)

### ***Personal Autos:***

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

## **Motorcycles**

*Stock* - DOT, FHWA, Highway Statistics 1990, Table VM-1 p. 192.

*Sales and Registrations* - MIC, 1991 Motorcycle Statistical Annual, PP. 12 and 13. Domestic sales were assumed to equal U.S. production (p. 13), and included sales of motorcycles, scooters, and all-terrain vehicles for on- and off-highway use. Import was the difference between total sales (p. 12) and domestic.

## **Recreational Vehicles**

*Sales* - Recreation Vehicle Industry Association, 1991... The Year in Review, p. 4, "Total Shipments."

## **Trucks**

*Stock* - Vehicles in use by weight class were determined by applying the percentage in use by weight class as reported in DOC, Bureau of the Census, 1987 TTUS, (0-10,000 lbs, 91.9%; 10,001-19,500 lbs, 2.3%; 19,501-26,000 lbs, 1.7%; 26,001 lbs and over, 4.1%) to the total number of trucks in use as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED).

*Sales* - MVMA, Facts and Figures '92, p. 17.

*Registrations* - H. A. Stark (ed.), Ward's Communications, Inc., 1991 Ward's Automotive Yearbook, Detroit, MI, p. 250.

## **APPENDIX B**

### **CONVERSIONS**

#### **A Note About Heating Values**

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

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

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

**Table B.1**  
**Approximate Heat Content for Various Fuels**

---

|                             |   |
|-----------------------------|---|
| <b>Automotive gasoline</b>  | 125,000 Btu/gal(gross) = 115,400 Btu/gal(net)   |
| <b>Diesel motor fuel</b>    | 138,700 Btu/gal (gross) = 128,700 Btu/gal (net) |
| <b>Methanol</b>             | 64,600 Btu/gal (gross) = 56,560 Btu/gal (net)   |
| <b>Ethanol</b>              | 84,600 Btu/gal (gross) = 75,670 Btu/gal (net)   |
| <b>Gasohol</b>              | 120,900 Btu/gal (gross) = 112,417 Btu/gal (net) |
| <b>Aviation gasoline</b>    | 120,200 Btu/gal (gross) = 112,000 Btu/gal (net) |
| <b>Propane</b>              | 91,300 Btu/gal (gross) = 83,500 Btu/gal (net)   |
| <b>Butane</b>               | 103,000 Btu/gal (gross) = 93,000 Btu/gal (net)  |
| <b>Jet fuel (naphtha)</b>   | 127,500 Btu/gal (gross) = 118,700 Btu/gal (net) |
| <b>Jet fuel (kerosene)</b>  | 135,000 Btu/gal (gross) = 128,100 Btu/gal (net) |
| <b>Lubricants</b>           | 144,400 Btu/gal (gross) = 130,900 Btu/gal (net) |
| <b>Waxes</b>                | 131,800 Btu/gal (gross) = 120,200 Btu/gal (net) |
| <b>Asphalt and road oil</b> | 158,000 Btu/gal (gross) = 157,700 Btu/gal (net) |
| <b>Petroleum coke</b>       | 143,400 Btu/gal (gross) = 168,300 Btu/gal (net) |
| <b>Natural gas</b>          |   |
| Wet                         | 1,112 Btu/ft <sup>3</sup>                       |
| Dry                         | 1,031 Btu/ft <sup>3</sup>                       |
| Liquid                      | 90,800 Btu/gal (gross) = 87,600 Btu/gal (net)   |
| <b>Crude petroleum</b>      | 138,100 Btu/gal (gross) = 131,800 Btu/gal (net) |
| <b>Fuel Oils</b>            |   |
| Residual                    | 149,700 Btu/gal (gross) = 138,400 Btu/gal (net) |
| Distillate                  | 138,700 Btu/gal (gross) = 131,800 Btu/gal (net) |
| <b>Coal</b>                 |   |
| Anthracite                  | 23.268 x 10 <sup>6</sup> Btu/short ton          |
| Bituminous and lignite      | 21.772 x 10 <sup>6</sup> Btu/short ton          |
| Production average          | 21.776 x 10 <sup>6</sup> Btu/short ton          |
| Consumption average         | 21.266 x 10 <sup>6</sup> Btu/short ton          |

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**Table B.2**  
**Fuel Equivalents**

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|   |   |
|---|---|
| <b>1 million bbl/day crude oil</b>                | = 0.3650 billion bbl/year crude oil<br>= 5.800 trillion Btu/day<br>= 2.117 quadrillion Btu/year<br>= 90.09 million short tons coal/year<br>= 2.074 trillion ft <sup>3</sup> natural gas/year<br>= 22.33 x 10 <sup>11</sup> MJ/year          |
| <b>1 billion bbl/year crude oil</b>               | = 2.740 million bbl/day crude oil<br>= 15.89 trillion Btu/day<br>= 5.800 quadrillion Btu/year<br>= 246.8 million short ton coal/year<br>= 5.68 trillion ft <sup>3</sup> /year natural gas/day<br>= 61.19 x 10 <sup>11</sup> MJ/year         |
| <b>1 trillion Btu/day</b>                         | = 172.4 thousand bbl/day crude oil<br>= 62.93 million bbl/year crude oil<br>= 0.3650 quadrillion Btu/year<br>= 15.53 million short tons coal/year<br>= 357.5 billion ft <sup>3</sup> natural gas/year<br>= 38.51 x 10 <sup>10</sup> MJ/year |
| <b>1 quadrillion Btu/year</b>                     | = 0.4724 million bbl/day crude oil<br>= 172.4 million bbl/year crude oil<br>= 2.740 trillion Btu/day<br>= 42.55 million short tons coal/year<br>= 979.4 billion ft <sup>3</sup> natural gas/year<br>= 10.55 x 10 <sup>11</sup> MJ/year      |
| <b>1 billion short tons coal/year</b>             | = 11.10 million bbl/day crude oil<br>= 4.052 billion bbl/year crude oil<br>= 64.38 trillion Btu/day<br>= 23.50 quadrillion Btu/year<br>= 23.02 trillion ft <sup>3</sup> natural gas/year<br>= 24.79 x 10 <sup>12</sup> MJ/year              |
| <b>1 trillion ft<sup>3</sup> natural gas/year</b> | = 0.4823 million bbl/day crude oil<br>= 0.1760 billion bbl/year crude oil<br>= 2.797 trillion Btu/day<br>= 1.021 quadrillion Btu/year<br>= 43.45 million short tons coal/year<br>= 10.77 x 10 <sup>11</sup> MJ/year                         |
| <b>1 mega joule/year</b>                          | = 44.78 x 10 <sup>-8</sup> bbl/day crude oil<br>= 16.34 x 10 <sup>-5</sup> bbl/year crude oil<br>= 2.597 Btu/day<br>= 947.9 Btu/year<br>= 4.034 x 10 <sup>-5</sup> short tons coal/year<br>= 0.9285 ft <sup>3</sup> natural gas/year        |

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**Table B.3**  
**Energy Unit Conversions**

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|               |  |                      |  |
|---------------|--|----------------------|--|
| <b>1 Btu</b>  | <b>= 778.2 ft-lb</b>                         | <b>1 kWhr</b>        | <b>= 3412 Btu*</b>                           |
|               | <b>= 107.6 kg-m</b>                          |                      | <b>= 2.655 x 10<sup>6</sup> ft-lb</b>        |
|               | <b>= 1055 J</b>                              |                      | <b>= 3.671 x 10<sup>5</sup> kg-m</b>         |
|               | <b>= 39.30 x 10<sup>-5</sup> hp-h</b>        |                      | <b>= 3.600 x 10<sup>6</sup> J</b>            |
|               | <b>= 39.85 x 10<sup>-5</sup> metric hp-h</b> |                      | <b>= 1.341 hp-h</b>                          |
|               | <b>= 29.31 x 10<sup>-5</sup> kWhr</b>        |                      | <b>= 1.360 metric hp-h</b>                   |
|               |  |                      |  |
| <b>1 kg-m</b> | <b>= 92.95 x 10<sup>-4</sup> Btu</b>         | <b>1 Joule</b>       | <b>= 94.78 x 10<sup>-5</sup> Btu</b>         |
|               | <b>= 7.233 ft-lb</b>                         |                      | <b>= 0.7376 ft-lb</b>                        |
|               | <b>= 9.806 J</b>                             |                      | <b>= 0.1020 kg-m</b>                         |
|               | <b>= 36.53 x 10<sup>-7</sup> hp-h</b>        |                      | <b>= 37.25 x 10<sup>-8</sup> hp-h</b>        |
|               | <b>= 37.04 x 10<sup>-7</sup> metric hp-h</b> |                      | <b>= 37.77 x 10<sup>-8</sup> metric hp-h</b> |
|               | <b>= 27.24 x 10<sup>-7</sup> kWhr</b>        |                      | <b>= 27.78 x 10<sup>-8</sup> kWhr</b>        |
|               |  |                      |  |
| <b>1 hp-h</b> | <b>= 2544 Btu</b>                            | <b>1 metric hp-h</b> | <b>= 2510 Btu</b>                            |
|               | <b>= 1.98 x 10<sup>6</sup> ft-lb</b>         |                      | <b>= 1.953 x 10<sup>6</sup> ft-lb</b>        |
|               | <b>= 2.738 x 10<sup>6</sup> kgm</b>          |                      | <b>= 27.00 x 10<sup>4</sup> kg-m</b>         |
|               | <b>= 2.685 x 10<sup>6</sup> J</b>            |                      | <b>= 2.648 x 10<sup>6</sup> J</b>            |
|               | <b>= 1.014 metric hp-h</b>                   |                      | <b>= 0.9863 hp-h</b>                         |
|               | <b>= 0.7475 kWhr</b>                         |                      | <b>= 0.7355 kWhr</b>                         |

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

**Table B.4**  
**Distance and Velocity Conversions**

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|       |                                 |      |                                 |
|-------|---------------------------------|------|---------------------------------|
| 1 in. | = 83.33 x 10 <sup>-3</sup> ft   | 1 ft | = 12.0 in.                      |
|       | = 27.78 x 10 <sup>-3</sup> yd   |      | = 0.33 yd                       |
|       | = 15.78 x 10 <sup>-6</sup> mile |      | = 189.4 x 10 <sup>-3</sup> mile |
|       | = 25.40 x 10 <sup>-3</sup> m    |      | = 0.3048 m                      |
|       | = 0.2540 x 10 <sup>-6</sup> km  |      | = 0.3048 x 10 <sup>-3</sup> km  |

|        |             |      |               |
|--------|-------------|------|---------------|
| 1 mile | = 63360 in. | 1 km | = 39370 in.   |
|        | = 5280 ft   |      | = 3281 ft     |
|        | = 1760 yd   |      | = 1093.6 yd   |
|        | = 1609 m    |      | = 0.6214 mile |
|        | = 1.609 km  |      | = 1000 m      |

$$1 \text{ ft/sec} = 0.3048 \text{ m/s} = 0.6818 \text{ mph} = 1.0972 \text{ km/h}$$

$$1 \text{ m/sec} = 3.281 \text{ ft/s} = 2.237 \text{ mph} = 3.600 \text{ km/h}$$

$$1 \text{ km/h} = 0.9114 \text{ ft/s} = 0.2778 \text{ m/s} = 0.6214 \text{ mph}$$

$$1 \text{ mph} = 1.467 \text{ ft/s} = 0.4469 \text{ m/s} = 1.609 \text{ km/h}$$


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**Table B.5**  
**Volume and Flow Rate Conversions\***

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|   |                               |         |   |
|---|-------------------------------|---------|---|
| 1 U.S. gal  | = 231 in. <sup>3</sup>        | 1 liter | = 61.02 in. <sup>3</sup>                    |
|   | = 0.1337 ft <sup>3</sup>      |         | = 3.531 x 10 <sup>-2</sup> ft <sup>3</sup>  |
|   | = 3.785 liters                |         | = 0.2624 U.S. gal                           |
|   | = 0.8321 imperial gal         |         | = 0.2200 imperial gal                       |
|   | = 0.0238 bbl                  |         | = 6.29 x 10 <sup>-3</sup> bbl               |
|   | = 0.003785 m <sup>3</sup>     |         | = 0.001 m <sup>3</sup>                      |
| <b>A U.S. gallon of gasoline weighs 6.2 pounds</b>          |                               |         |   |
|   |                               |         |   |
| 1 imperial gal  | = 277.4 in. <sup>3</sup>      | 1 bbl   | = 9702 in. <sup>3</sup>                     |
|   | = 0.1606 ft <sup>3</sup>      |         | = 5.615 ft <sup>3</sup>                     |
|   | = 4.545 liters                |         | = 158.97 liters                             |
|   | = 1.201 U.S. gal              |         | = 42 U.S. gal                               |
|   | = 0.0286 bbl                  |         | = 34.97 imperial gal                        |
|   | = 0.004546 m <sup>3</sup>     |         | = 0.15897 m <sup>3</sup>                    |
|   |                               |         |   |
| 1 U.S. gal/hr   | = 3.209 ft <sup>3</sup> /day  |         | = 1171 ft <sup>3</sup> /year                |
|   | = 90.84 liter/day             |         | = 33157 liter/year                          |
|   | = 19.97 imperial gal/day      |         | = 7289 imperial gal/year                    |
|   | = 0.5712 bbl/day              |         | = 207.92 bbl/year                           |
| <b>For Imperial gallons, multiply above values by 1.201</b> |                               |         |   |
|   |                               |         |   |
| 1 liter/hr  | = 0.8474 ft <sup>3</sup> /day |         | = 309.3 ft <sup>3</sup> /year               |
|   | = 6.298 U.S. gal/day          |         | = 2299 U.S. gal/year                        |
|   | = 5.28 imperial gal/day       |         | = 1927 imperial gal/year                    |
|   | = 0.1510 bbl/day              |         | = 55.10 bbl/year                            |
|   |                               |         |   |
| 1 bbl/hr  | = 137.8 ft <sup>3</sup> /year |         | = 49187 ft <sup>3</sup> year                |
|   | = 1008 U.S. gal/day           |         | = 3.679 x 10 <sup>5</sup> U.S. gal/year     |
|   | = 839.3 imperial gal/day      |         | = 3.063 x 10 <sup>5</sup> imperial gal/year |
|   | = 3815 liter/day              |         | = 1.393 x 10 <sup>6</sup> liter/day         |

---

\*The conversions for flow rates are identical to those for volume measures, if the time units are identical.

**Table B.6**  
**Power Conversions**

| FROM                 | TO                    |                        |                       |               |                         |                        |
|----------------------|-----------------------|------------------------|-----------------------|---------------|-------------------------|------------------------|
|                      | Horsepower            | Kilowatts              | Metric horsepower     | Ft-lb per sec | Kilocalories per sec    | Btu per sec            |
| Horsepower           | 1                     | 0.7457                 | 1.014                 | 550           | 0.1781                  | 0.7068                 |
| Kilowatts            | 1.341                 | 1                      | 1.360                 | 737.6         | 0.239                   | 0.9478                 |
| Metric horsepower    | 0.9863                | 0.7355                 | 1                     | 542.5         | 0.1757                  | 0.6971                 |
| Ft-lb per sec        | $1.36 \times 10^{-3}$ | $1.356 \times 10^{-3}$ | $1.84 \times 10^{-3}$ | 1             | $0.3238 \times 10^{-3}$ | $1.285 \times 10^{-3}$ |
| Kilocalories per sec | 5.615                 | 4.184                  | 5.692                 | 3088          | 1                       | 3.968                  |
| Btu per sec          | 1.415                 | 1.055                  | 1.434                 | 778.2         | 0.2520                  | 1                      |

**Table B.7**  
**Mass Conversions**

| FROM       | TO    |          |                         |                         |
|------------|-------|----------|-------------------------|-------------------------|
|            | Pound | Kilogram | Short ton               | Long ton                |
| Pound      | 1     | 0.4536   | $5.0 \times 10^{-4}$    | $4.4643 \times 10^{-4}$ |
| Kilogram   | 2.205 | 1        | $1.1023 \times 10^{-3}$ | $9.8425 \times 10^{-4}$ |
| Short ton  | 2000  | 907.2    | 1                       | 0.8929                  |
| Long ton   | 2240  | 1016     | 1.12                    | 1                       |
| Metric ton | 2205  | 1000     | 1.102                   | 0.9842                  |
|            |       |          |                         | 1                       |

**Table B.8**  
**Fuel Efficiency Conversions\***

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

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

**Table B.9**  
**SI Prefixes and Their Values**

|                                | Value      | Prefix | Symbol |
|--------------------------------|------------|--------|--------|
| One million million millionth  | $10^{-18}$ | atto   | a      |
| One thousand million millionth | $10^{-15}$ | femto  | f      |
| One million millionth          | $10^{-12}$ | pico   | p      |
| One thousand millionth         | $10^{-9}$  | nano   | n      |
| One millionth                  | $10^{-6}$  | micro  | $\mu$  |
| One thousandth                 | $10^{-3}$  | milli  | m      |
| One hundredth                  | $10^{-2}$  | centi  | c      |
| One tenth                      | $10^{-1}$  | deci   |        |
| One                            | $10^0$     |        |        |
| Ten                            | $10^1$     | deca   |        |
| One hundred                    | $10^2$     | hecto  |        |
| One thousand                   | $10^3$     | kilo   | k      |
| One million                    | $10^6$     | mega   | M      |
| One billion <sup>a</sup>       | $10^9$     | giga   | G      |
| One trillion <sup>a</sup>      | $10^{12}$  | tera   | T      |
| One quadrillion <sup>a</sup>   | $10^{15}$  | peta   | P      |
| One quintillion <sup>a</sup>   | $10^{18}$  | exa    | E      |

<sup>a</sup>Care should be exercised in the use of this nomenclature, especially in foreign correspondence, as it is either unknown or carries a different value in other countries. A "billion," for example, signifies a value of  $10^{12}$  in most other countries.

**Table B.10**  
**Metric Units and Abbreviations**

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

### **Conversion of Constant Dollar Values**

Many types of information in this data book are expressed in dollars. Generally, constant dollars are used--that is, dollars of a fixed value for a specific year, such as 1990 dollars. Converting current dollars to constant dollars, or converting constant dollars for one year to constant dollars for another year, requires conversion factors (Table B.11 and B.12). Table B.11 shows conversion factors using the Gross National Product inflation factors. Table B.12 shows conversion factors for the Consumer Price Index inflation factors.

Table B.12  
Consumer Price Inflation (CPI) Index

| From | To    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|      | 1970  | 1971  | 1972  | 1973  | 1974  | 1975  | 1976  | 1977  | 1978  | 1979  | 1980  | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  | 1991  |
| 1970 | 1.000 | 1.043 | 1.078 | 1.144 | 1.270 | 1.386 | 1.466 | 1.561 | 1.680 | 1.869 | 2.122 | 2.342 | 2.486 | 2.566 | 2.675 | 2.770 | 2.824 | 2.927 | 3.046 | 3.193 | 3.365 | 3.508 |
| 1971 | 0.958 | 1.000 | 1.033 | 1.097 | 1.217 | 1.328 | 1.405 | 1.496 | 1.609 | 1.791 | 2.035 | 2.245 | 2.382 | 2.458 | 2.563 | 2.654 | 2.708 | 2.806 | 2.921 | 3.061 | 3.227 | 3.364 |
| 1972 | 0.928 | 0.968 | 1.000 | 1.062 | 1.179 | 1.286 | 1.361 | 1.448 | 1.559 | 1.735 | 1.971 | 2.174 | 2.307 | 2.381 | 2.482 | 2.571 | 2.620 | 2.717 | 2.828 | 2.963 | 3.124 | 3.256 |
| 1973 | 0.874 | 0.911 | 0.941 | 1.000 | 1.110 | 1.211 | 1.281 | 1.364 | 1.467 | 1.633 | 1.856 | 2.047 | 2.173 | 2.243 | 2.338 | 2.421 | 2.469 | 2.558 | 2.662 | 2.790 | 2.941 | 3.065 |
| 1974 | 0.787 | 0.821 | 0.848 | 0.901 | 1.000 | 1.091 | 1.154 | 1.229 | 1.322 | 1.472 | 1.672 | 1.844 | 1.956 | 2.019 | 2.105 | 2.180 | 2.224 | 2.305 | 2.399 | 2.514 | 2.650 | 2.762 |
| 1975 | 0.721 | 0.752 | 0.777 | 0.826 | 0.916 | 1.000 | 1.058 | 1.126 | 1.212 | 1.349 | 1.532 | 1.690 | 1.792 | 1.850 | 1.929 | 1.997 | 2.038 | 2.112 | 2.198 | 2.303 | 2.428 | 2.531 |
| 1976 | 0.682 | 0.712 | 0.736 | 0.781 | 0.866 | 0.945 | 1.000 | 1.065 | 1.145 | 1.275 | 1.449 | 1.598 | 1.696 | 1.750 | 1.824 | 1.889 | 1.926 | 1.997 | 2.078 | 2.178 | 2.296 | 2.393 |
| 1977 | 0.641 | 0.668 | 0.690 | 0.733 | 0.814 | 0.888 | 0.939 | 1.000 | 1.076 | 1.198 | 1.361 | 1.501 | 1.594 | 1.645 | 1.715 | 1.776 | 1.809 | 1.876 | 1.952 | 2.046 | 2.156 | 2.248 |
| 1978 | 0.595 | 0.621 | 0.642 | 0.682 | 0.756 | 0.825 | 0.873 | 0.929 | 1.000 | 1.113 | 1.265 | 1.395 | 1.479 | 1.527 | 1.592 | 1.648 | 1.681 | 1.742 | 1.813 | 1.900 | 2.003 | 2.088 |
| 1979 | 0.535 | 0.558 | 0.576 | 0.612 | 0.679 | 0.741 | 0.784 | 0.835 | 0.898 | 1.000 | 1.135 | 1.253 | 1.330 | 1.373 | 1.431 | 1.482 | 1.511 | 1.566 | 1.630 | 1.708 | 1.800 | 1.877 |
| 1980 | 0.471 | 0.491 | 0.508 | 0.539 | 0.598 | 0.653 | 0.690 | 0.735 | 0.791 | 0.881 | 1.000 | 1.103 | 1.171 | 1.209 | 1.260 | 1.305 | 1.331 | 1.379 | 1.436 | 1.504 | 1.586 | 1.653 |
| 1981 | 0.427 | 0.445 | 0.460 | 0.489 | 0.542 | 0.592 | 0.626 | 0.666 | 0.717 | 0.798 | 0.907 | 1.000 | 1.062 | 1.096 | 1.142 | 1.183 | 1.206 | 1.250 | 1.301 | 1.363 | 1.437 | 1.498 |
| 1982 | 0.402 | 0.420 | 0.434 | 0.460 | 0.511 | 0.558 | 0.590 | 0.628 | 0.676 | 0.752 | 0.853 | 0.942 | 1.000 | 1.032 | 1.075 | 1.114 | 1.136 | 1.178 | 1.226 | 1.284 | 1.354 | 1.411 |
| 1983 | 0.390 | 0.406 | 0.420 | 0.446 | 0.495 | 0.540 | 0.571 | 0.608 | 0.655 | 0.728 | 0.827 | 0.913 | 0.970 | 1.000 | 1.043 | 1.080 | 1.100 | 1.141 | 1.187 | 1.244 | 1.312 | 1.367 |
| 1984 | 0.374 | 0.390 | 0.403 | 0.428 | 0.475 | 0.518 | 0.548 | 0.584 | 0.628 | 0.699 | 0.793 | 0.876 | 0.930 | 0.960 | 1.000 | 1.036 | 1.056 | 1.094 | 1.139 | 1.194 | 1.258 | 1.311 |
| 1985 | 0.361 | 0.376 | 0.389 | 0.413 | 0.458 | 0.500 | 0.529 | 0.564 | 0.606 | 0.675 | 0.766 | 0.846 | 0.898 | 0.926 | 0.966 | 1.000 | 1.019 | 1.057 | 1.100 | 1.152 | 1.215 | 1.266 |
| 1986 | 0.354 | 0.369 | 0.382 | 0.405 | 0.450 | 0.491 | 0.519 | 0.553 | 0.595 | 0.662 | 0.751 | 0.829 | 0.880 | 0.909 | 0.947 | 0.981 | 1.000 | 1.037 | 1.079 | 1.131 | 1.192 | 1.242 |
| 1987 | 0.342 | 0.356 | 0.368 | 0.391 | 0.434 | 0.474 | 0.501 | 0.533 | 0.574 | 0.639 | 0.725 | 0.800 | 0.849 | 0.876 | 0.914 | 0.946 | 0.964 | 1.000 | 1.041 | 1.091 | 1.150 | 1.199 |
| 1988 | 0.328 | 0.342 | 0.354 | 0.376 | 0.417 | 0.455 | 0.481 | 0.512 | 0.552 | 0.614 | 0.697 | 0.769 | 0.816 | 0.842 | 0.878 | 0.909 | 0.927 | 0.961 | 1.000 | 1.048 | 1.105 | 1.152 |
| 1989 | 0.313 | 0.327 | 0.337 | 0.358 | 0.398 | 0.434 | 0.459 | 0.489 | 0.526 | 0.586 | 0.665 | 0.734 | 0.779 | 0.804 | 0.838 | 0.868 | 0.884 | 0.917 | 0.954 | 1.000 | 1.054 | 1.099 |
| 1990 | 0.297 | 0.310 | 0.320 | 0.340 | 0.377 | 0.412 | 0.436 | 0.464 | 0.499 | 0.555 | 0.631 | 0.696 | 0.739 | 0.762 | 0.795 | 0.823 | 0.839 | 0.870 | 0.905 | 0.949 | 1.000 | 1.042 |
| 1991 | 0.285 | 0.297 | 0.307 | 0.326 | 0.362 | 0.395 | 0.418 | 0.445 | 0.479 | 0.533 | 0.605 | 0.668 | 0.709 | 0.731 | 0.762 | 0.790 | 0.805 | 0.834 | 0.868 | 0.910 | 0.959 | 1.000 |

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

Table B.11  
Gross National Product (GNP) Implicit Price Deflator

| From | To    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|      | 1970  | 1971  | 1972  | 1973  | 1974  | 1975  | 1976  | 1977  | 1978  | 1979  | 1980  | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  | 1991  |
| 1970 | 1.000 | 1.051 | 1.095 | 1.159 | 1.260 | 1.377 | 1.448 | 1.534 | 1.646 | 1.789 | 1.953 | 2.141 | 2.270 | 2.356 | 2.454 | 2.531 | 2.600 | 2.667 | 2.763 | 2.867 | 2.985 | 3.120 |
| 1971 | 0.951 | 1.000 | 1.041 | 1.101 | 1.198 | 1.310 | 1.377 | 1.457 | 1.566 | 1.701 | 1.859 | 2.035 | 2.157 | 2.241 | 2.334 | 2.412 | 2.475 | 2.535 | 2.625 | 2.724 | 2.836 | 2.966 |
| 1972 | 0.913 | 0.960 | 1.000 | 1.058 | 1.150 | 1.257 | 1.323 | 1.400 | 1.504 | 1.634 | 1.786 | 1.955 | 2.072 | 2.151 | 2.240 | 2.315 | 2.375 | 2.435 | 2.522 | 2.617 | 2.725 | 2.849 |
| 1973 | 0.863 | 0.908 | 0.945 | 1.000 | 1.087 | 1.188 | 1.250 | 1.323 | 1.421 | 1.544 | 1.688 | 1.848 | 1.958 | 2.033 | 2.118 | 2.189 | 2.242 | 2.301 | 2.383 | 2.473 | 2.575 | 2.692 |
| 1974 | 0.794 | 0.834 | 0.869 | 0.920 | 1.000 | 1.094 | 1.150 | 1.218 | 1.307 | 1.421 | 1.551 | 1.700 | 1.802 | 1.871 | 1.948 | 2.014 | 2.062 | 2.117 | 2.193 | 2.276 | 2.370 | 2.477 |
| 1975 | 0.726 | 0.763 | 0.795 | 0.841 | 0.915 | 1.000 | 1.051 | 1.114 | 1.195 | 1.299 | 1.418 | 1.554 | 1.648 | 1.711 | 1.782 | 1.841 | 1.887 | 1.936 | 2.006 | 2.081 | 2.167 | 2.265 |
| 1976 | 0.691 | 0.726 | 0.756 | 0.800 | 0.871 | 0.952 | 1.000 | 1.058 | 1.137 | 1.235 | 1.350 | 1.478 | 1.566 | 1.628 | 1.696 | 1.752 | 1.795 | 1.840 | 1.906 | 1.978 | 2.059 | 2.153 |
| 1977 | 0.652 | 0.686 | 0.714 | 0.756 | 0.822 | 0.898 | 0.945 | 1.000 | 1.074 | 1.167 | 1.273 | 1.396 | 1.479 | 1.536 | 1.600 | 1.654 | 1.695 | 1.738 | 1.800 | 1.868 | 1.945 | 2.033 |
| 1978 | 0.608 | 0.639 | 0.665 | 0.704 | 0.766 | 0.837 | 0.880 | 0.931 | 1.000 | 1.087 | 1.187 | 1.300 | 1.378 | 1.432 | 1.492 | 1.542 | 1.580 | 1.619 | 1.677 | 1.740 | 1.812 | 1.894 |
| 1979 | 0.559 | 0.588 | 0.612 | 0.648 | 0.704 | 0.770 | 0.810 | 0.857 | 0.920 | 1.000 | 1.092 | 1.196 | 1.268 | 1.317 | 1.372 | 1.418 | 1.453 | 1.490 | 1.543 | 1.601 | 1.667 | 1.743 |
| 1980 | 0.512 | 0.539 | 0.560 | 0.592 | 0.645 | 0.705 | 0.741 | 0.784 | 0.842 | 0.915 | 1.000 | 1.095 | 1.160 | 1.206 | 1.256 | 1.298 | 1.332 | 1.363 | 1.412 | 1.465 | 1.525 | 1.595 |
| 1981 | 0.467 | 0.491 | 0.512 | 0.541 | 0.588 | 0.643 | 0.677 | 0.717 | 0.770 | 0.837 | 0.912 | 1.000 | 1.061 | 1.100 | 1.146 | 1.184 | 1.214 | 1.247 | 1.291 | 1.340 | 1.395 | 1.459 |
| 1982 | 0.441 | 0.464 | 0.483 | 0.511 | 0.556 | 0.607 | 0.639 | 0.676 | 0.726 | 0.789 | 0.861 | 0.944 | 1.000 | 1.040 | 1.082 | 1.118 | 1.145 | 1.175 | 1.217 | 1.263 | 1.315 | 1.375 |
| 1983 | 0.424 | 0.446 | 0.464 | 0.491 | 0.534 | 0.584 | 0.614 | 0.651 | 0.698 | 0.759 | 0.828 | 0.907 | 0.962 | 1.000 | 1.040 | 1.075 | 1.104 | 1.130 | 1.171 | 1.215 | 1.265 | 1.322 |
| 1984 | 0.408 | 0.428 | 0.445 | 0.471 | 0.514 | 0.562 | 0.589 | 0.624 | 0.670 | 0.728 | 0.797 | 0.870 | 0.922 | 0.961 | 1.000 | 1.035 | 1.059 | 1.083 | 1.122 | 1.164 | 1.212 | 1.267 |
| 1985 | 0.395 | 0.415 | 0.433 | 0.458 | 0.498 | 0.544 | 0.572 | 0.606 | 0.645 | 0.707 | 0.772 | 0.846 | 0.897 | 0.931 | 0.944 | 1.000 | 1.027 | 1.054 | 1.092 | 1.133 | 1.180 | 1.233 |
| 1986 | 0.385 | 0.404 | 0.421 | 0.446 | 0.485 | 0.530 | 0.557 | 0.590 | 0.633 | 0.688 | 0.751 | 0.824 | 0.873 | 0.906 | 0.944 | 0.974 | 1.000 | 1.026 | 1.062 | 1.103 | 1.148 | 1.200 |
| 1987 | 0.375 | 0.395 | 0.411 | 0.435 | 0.472 | 0.517 | 0.544 | 0.575 | 0.618 | 0.671 | 0.734 | 0.802 | 0.851 | 0.885 | 0.923 | 0.949 | 0.975 | 1.000 | 1.036 | 1.075 | 1.119 | 1.170 |
| 1988 | 0.362 | 0.381 | 0.397 | 0.420 | 0.456 | 0.499 | 0.525 | 0.556 | 0.596 | 0.648 | 0.708 | 0.774 | 0.822 | 0.854 | 0.891 | 0.916 | 0.941 | 0.966 | 1.000 | 1.038 | 1.081 | 1.130 |
| 1989 | 0.349 | 0.367 | 0.382 | 0.404 | 0.439 | 0.480 | 0.506 | 0.535 | 0.575 | 0.624 | 0.683 | 0.746 | 0.792 | 0.823 | 0.859 | 0.883 | 0.907 | 0.930 | 0.963 | 1.000 | 1.041 | 1.088 |
| 1990 | 0.335 | 0.353 | 0.367 | 0.388 | 0.422 | 0.461 | 0.486 | 0.514 | 0.552 | 0.600 | 0.656 | 0.717 | 0.760 | 0.790 | 0.825 | 0.848 | 0.871 | 0.894 | 0.925 | 0.960 | 1.000 | 1.046 |
| 1991 | 0.320 | 0.337 | 0.351 | 0.371 | 0.404 | 0.441 | 0.465 | 0.492 | 0.528 | 0.574 | 0.627 | 0.685 | 0.727 | 0.756 | 0.789 | 0.811 | 0.833 | 0.855 | 0.885 | 0.919 | 0.956 | 1.000 |

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

## **GLOSSARY**

**Acceleration power** - Measured in kilowatts. Pulse power obtainable from a battery used to accelerate a vehicle. This is based on a constant current pulse for 30 seconds at no less than 2/3 of the maximum open-circuit-voltage, at 80% depth-of-discharge relative to the battery's rated capacity and at 20° C ambient temperature.

**Air Carrier** - The commercial system of air transportation consisting of certificated air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

**Certificated route air carrier:** An air carrier holding a Certificate of Public Convenience and Necessity issued by the Department of Transportation to conduct scheduled interstate services. Nonscheduled or charter operations may also be conducted by these carriers. These carriers operate large aircraft (30 seats or more, or a maximum payload capacity of 7,500 pounds or more) in accordance with Federal Aviation Regulation part 121.

**Domestic air operator:** Commercial air transportation within and between the 50 States and the District of Columbia. Includes operations of certificated route air carriers, Pan American, local service, helicopter, intra-Alaska, intra-Hawaii, all-cargo carriers and other carriers. Also included are transborder operations conducted on the domestic route segments of U.S. air carriers. Domestic operators are classified based on their operating revenue as follows:

- Majors - over \$1 billion
- Nationals - \$100-1,000 million
- Large Regionals - \$10-99.9 million
- Medium Regionals - \$0-9.99 million

**International air operator:** Commercial air transportation outside the territory of the United States, including operations between the U.S. and foreign countries and between the U.S. and its territories and possessions.

**Supplemental air carrier:** A class of air carriers which hold certificates authorizing them to perform passenger and cargo charter services supplementing the scheduled service of the certificated route air carriers. Supplemental air carriers are often referred to as nonscheduled air carriers or "nonskeds".

**Amtrak** - See *Rail*.

**Automobile size classifications** - Size classifications of automobiles are established by the Environmental Protection Agency (EPA) as follows:

Minicompact - less than 85 cubic feet of passenger and luggage volume.

Subcompact - between 85 to 100 cubic feet of passenger and luggage volume.

Compact - between 100 to 110 cubic feet of passenger and luggage volume.

Midsize - between 110 to 120 cubic feet of passenger and luggage volume.

Large - more than 120 cubic feet of passenger and luggage volume.

Two seater - automobiles designed primarily to seat only two adults.

Station wagons are included with the size class for the sedan of the same name.

**Aviation** - See *General aviation*.

**Aviation gasoline** - All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) Specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range which will be used for blending or compounding into aviation gasoline.

**Barges** - Shallow, nonself-propelled vessels used to carry bulk commodities on the rivers and the Great Lakes.

**Battery efficiency** - Measured in percentage. Net DC energy delivered on discharge, as a percentage of the total DC energy required to restore the initial state-of-charge. The efficiency value must include energy losses resulting from self-discharge, cell equalization, thermal loss compensation, and all battery-specific auxiliary equipment.

**Btu** - The amount of energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit at or near 39.2 degrees Fahrenheit. An average Btu content of fuel is the heat value per quantity of fuel as determined from tests of fuel samples.

**Bunker** - A storage tank.

**Bunkering fuels** - Fuels stored in ship bunkers.

**Bus -**

**Intercity bus:** A standard size bus equipped with front doors only, high backed seats, luggage compartments separate from the passenger compartment and usually with restroom facilities, for high-speed long distance service.

**Motor bus:** Rubber-tired, self-propelled, manually-steered bus with fuel supply on board the vehicle. Motor bus types include intercity, school, and transit.

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

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

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

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

**Captive imports -** Products produced overseas specifically for domestic manufacturers.

**Carbon dioxide (CO<sub>2</sub>) -** A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion.

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

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

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

**Certificated route air carriers -** See *Air carriers*.

**Class I freight railroad -** See *Rail*.

**Clean Fuel Vehicle -** Vehicle meeting the clean fuel vehicle exhaust emissions standards with no restriction on fuel type.

**Coal slurry** - Finely crushed coal mixed with sufficient water to form a fluid.

**Combination trucks** - Consist of a power unit (a truck tractor) and one or more trailing units (a semi-trailer or trailer). The most frequently used combination is popularly referred to as a "tractor-semitrailer" or "tractor trailer".

**Commercial sector** - See *Residential and Commercial sector*.

**Commuter railroad** - See *Rail*.

**Compact car** - See *Automobile size classifications*.

**Constant dollars** - A series of figures is expressed in constant dollars when the effect of change in the purchasing power of the dollar has been removed. Usually the data are expressed in terms of dollars of a selected year or the average of a set of years.

**Consumer Price Index (CPI)** - An index issued by the U.S. Department of Labor, Bureau of Labor Statistics. The CPI is designed to measure changes in the prices of goods and services bought by wage earners and clerical workers in urban areas. It represents the cost of a typical consumption bundle at current prices as a ratio to its cost at a base year.

**Continuous discharge capacity** - Measured as percent of rated energy capacity. Energy delivered in a constant power discharge required by an electric vehicle for hill climbing and/or high-speed cruise, specified as the percent of its rated energy capacity delivered in a one hour constant-power discharge.

**Corporate Average Fuel Economy (CAFE) standards** - CAFE standards were originally established by Congress for new automobiles, and later for light trucks, in Title V of the Motor Vehicle Information and Cost Savings Act (15 U.S.C.1901, et seq.) with subsequent amendments. Under CAFE, automobile manufacturers are required by law to produce vehicle fleets with a composite sales-weighted fuel economy which cannot be lower than the CAFE standards in a given year, or for every vehicle which does not meet the standard, a fine of \$5.00 is paid for every one-tenth of a mpg below the standard.

**Crude oil** - A mixture of hydrocarbons that exists in the liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities.

**Crude oil imports** - The volume of crude oil imported into the 50 States and the District of Columbia, including imports from U.S. territories, but excluding imports of crude oil into the Hawaiian Foreign Trade Zone.

**Current dollars** - Represents dollars current at the time designated or at the time of the transaction. In most contexts, the same meaning would be conveyed by the use of the term "dollars".

**Disposable personal income** - See *Income*.

**Distillate fuel oil** - The lighter fuel oils distilled off during the refining process. Included are products known as ASTM grades numbers 1 and 2 heating oils, diesel fuels, and number 4 fuel oil. The major uses of distillate fuel oils include heating, fuel for on- and off-highway diesel engines, and railroad diesel fuel.

**Domestic air operator** - See *Air carrier*.

**Domestic water transportation** - See *Internal water transportation*.

**Electric utilities sector** - Consists of privately and publicly owned establishments which generate electricity primarily for resale.

**Emission standards** - Standards for the levels of pollutants emitted from automobiles and trucks. Congress established the first standards in the Clean Air Act of 1963. Currently, standards are set for four vehicle classes - automobiles, light trucks, heavy-duty gasoline trucks, and heavy-duty diesel trucks.

**Energy capacity** - Measured in kilowatt hours. The energy delivered by the battery, when tested at C/3 discharge rate, up to termination of discharge specified by the battery manufacturer. The required acceleration power must be delivered by the battery at any point up to 80% of the battery's energy capacity rating.

**Energy efficiency** - In reference to transportation, the inverse of energy intensiveness: the ratio of outputs from a process to the energy inputs; for example, miles traveled per gallon of fuel (mpg).

**Energy intensity** - In reference to transportation, the ratio of energy inputs to a process to the useful outputs from that process; for example, gallons of fuel per passenger-mile or Btu per ton-mile.

**Fixed operating cost** - See *Operating cost*.

**Fleet vehicles** -

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

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

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

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

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

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

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

**Gasoline** - See *Motor gasoline*.

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

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

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

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

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

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

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

**Income** -

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

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

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

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

**Intercity bus** - See *Bus*.

**Internal water transportation** - Includes all local (intraport) traffic and traffic between ports or landings wherein the entire movement takes place on inland waterways. Also termed internal are movements involving carriage on both inland waterways and the water of the Great Lakes, and inland movements that cross short stretches of open water that link inland systems.

**International air operator** - See *Air carrier*.

**International freight** - See *Foreign freight*.

**Jet fuel** - Includes both naphtha-type and kerosene-type fuels meeting standards for use in aircraft turbine engines. Although most jet fuel is used in aircraft, some is used for other purposes such as generating electricity in gas turbines.

**Kerosene-type jet fuel:** A quality kerosene product with an average gravity of 40.7 degrees API and 10% to 90% distillation temperatures of 217 and 261 degrees centigrade. Used primarily as fuel for commercial turbojet and turboprop aircraft engines. It is a relatively low freezing point distillate of the kerosene type.

**Naphtha-type jet fuel:** A fuel in the heavy naphtha boiling range with an average gravity of 52.8 degrees API and 10% to 90% distillation temperatures of 117 to 233 degrees centigrade used for turbojet and turboprop aircraft engines, primarily by the military. Excludes ramjet and petroleum.

**Kerosene** - A petroleum distillate in the 300 to 500 degrees Fahrenheit boiling range and generally having a flash point higher than 100 degrees Fahrenheit by the American Society of Testing and Material (ASTM) Method D56, a gravity range from 40 to 46 degrees API, and a burning point in the range of 150 to 175 degrees Fahrenheit. It is a clean-burning product suitable for use as an illuminant when burned in wick lamps. Includes grades of kerosene called range oil having properties similar to Number 1 fuel oil, but with a gravity of about 43 degrees API and an end point of 625 degrees Fahrenheit. Used in space heaters, cooking stoves, and water heaters.

**Kerosene-type jet fuel** - See *Jet fuel*.

**Large car** - See *Automobile size classifications*.

**Light duty vehicles** - Automobiles and light trucks combined.

**Light truck** - Unless otherwise noted, light trucks are defined in this publication as two-axle, four-tire trucks. The U.S. Bureau of Census classifies all trucks with a gross vehicle weight less than 10,000 pounds as light trucks (*See Truck size classifications*).

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

**Liquified petroleum gas (lpg)** - Consists of propane and butane and is usually derived from natural gas. In locations where there is no natural gas and the gasoline consumption is low, naphtha is converted to lpg by catalytic reforming.

**Load factor** - A term relating the potential capacity of a system relative to its actual performance. Is often calculated as total passenger miles divided by total vehicle miles.

**Low-emission vehicle** - A clean fuel vehicle meeting the low-emission vehicle standards.

**Medium truck** - *See Truck size classifications.*

**Midsized car** - *See Automobile size classifications.*

**Minicompact car** - *See Automobile size classifications.*

**Model year** - In this publication, model year is referring to the "sales" model year, the period from October 1 to the next September 31.

**Motor bus** - *See Bus.*

**Motor Gasoline** - A mixture of volatile hydrocarbons suitable for operation of an internal combustion engine whose major components are hydrocarbons with boiling points ranging from 78 to 217 degrees centigrade and whose source is distillation of petroleum and cracking, polymerization, and other chemical reactions by which the naturally occurring petroleum hydrocarbons are converted into those that have superior fuel properties.

**Naphtha-type jet fuel** - *See Jet fuel.*

**National income** - *See Income.*

**Nationwide Personal Transportation Study (NPTS)** - A nationwide home interview survey of households that provides information on the characteristics and personal travel patterns of the U.S. population. Surveys were conducted in 1969, 1977, 1983 and 1990 by the U.S. Bureau of Census for the U.S. Department of Transportation.

**Natural gas** - A mixture of hydrocarbon compounds and small quantities of various non-hydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions.

**Nitrogen Oxides (NO<sub>x</sub>)** - A product of combustion of fossil fuels whose production increases with the temperature of the process. It can become an air pollutant if concentrations are excessive.

**Operating cost -**

**Fixed operating cost:** In reference to passenger car operating cost, refers to those expenditures that are independent of the amount of use of the car, such as insurance costs, fees for license and registration, depreciation and finance charges.

**Variable operating cost:** In reference to passenger car operating cost, expenditures which are dependent on the amount of use of the car, such as the cost of gas and oil, tires, and other maintenance.

**Organization for Petroleum Exporting Countries (OPEC)** - Includes Saudi Arabia, Iran, Venezuela, Libya, Indonesia, United Arab Emirates, Algeria, Nigeria, Ecuador, Gabon, Iraq, Kuwait, and Qatar. Data for Saudi Arabia and Kuwait include their shares from the Partitioned Zone (formerly the Neutral Zone).

**Other single-unit truck** - See *Single-unit truck*.

**Particulates** - Carbon particles formed by partial oxidation and reduction of the hydrocarbon fuel. Also included are trace quantities of metal oxides and nitrides, originating from engine wear, component degradation, and inorganic fuel additives. In the transportation sector, particulates are emitted mainly from diesel engines.

**Passenger-miles traveled (PMT)** - One person traveling the distance of one mile. Total passenger-miles traveled, thus, give the total mileage traveled by all persons.

**Passenger rail** - See *Rail*, "*Amtrak*" and "*Transit Railroad*".

**Personal Consumption Expenditures (PCE)** - As used in the national accounts, the market value of purchases of goods and services by individuals and nonprofit institutions and the value of food, clothing, housing, and financial services received by them as income in kind. It includes the rental value of owner-occupied houses but excludes purchases of dwellings, which are classified as capital goods (investment).

**Personal income** - See *Income*.

**Petroleum** - A generic term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oil, refined petroleum products, natural gas plant liquids, and non-hydrocarbon compounds blended into finished petroleum products.

**Petroleum consumption** - A calculated demand for petroleum products obtained by summing domestic production, imports of crude petroleum and natural gas liquids, imports of petroleum products, and the primary stocks at the beginning of the period and then subtracting the exports and the primary stocks at the end of the period.

**Petroleum exports** - Shipments of petroleum products from the 50 States and the District of Columbia to foreign countries, Puerto Rico, the Virgin Islands, and other U.S. possessions and territories.

**Petroleum imports** - All imports of crude petroleum, natural gas liquids, and petroleum products from foreign countries and receipts from Guam, Puerto Rico, the Virgin Islands, and the Hawaiian Trade Zone. The commodities included are crude oil, unfinished oils, plant condensate, and refined petroleum products.

**Petroleum inventories** - The amounts of crude oil, unfinished oil, petroleum products, and natural gas liquids held at refineries, at natural gas processing plants, in pipelines, at bulk terminals operated by refining and pipeline companies, and at independent bulk terminals. Crude oil held in storage on leases is also included; these stocks are known as primary stocks. Secondary stocks - those held by jobbers, dealers, service station operators, and consumers - are excluded. Prior to 1975, stock held at independent bulk terminals were classified as secondary stocks.

**Petroleum products supplied** - For each petroleum product, the amount supplied is calculated by summing production, crude oil burned directly, imports, and net withdrawals from primary stocks and subtracting exports.

**Quad** - Quadrillion,  $10^{15}$ . In this publication, a Quad refers to Quadrillion Btu.

**Rail -**

**Amtrak (American Railroad Tracks):** Operated by the National Railroad Passenger Corporation of Washington, DC. This rail system was created by President Nixon in 1970, and was given the responsibility for the operation of intercity, as distinct from suburban, passenger trains between points designated by the Secretary of Transportation.

**Class I freight railroad:** Defined by the Interstate Commerce Commission each year based on annual operating revenue. For 1988, the threshold for Class I railroads was \$87.9 million. A railroad is dropped from the Class I list if it fails to meet the annual earnings threshold for three consecutive years.

**Commuter railroad:** Those portions of mainline railroad (not electric railway) transportation operations which encompass urban passenger train service for local travel between a central city and adjacent suburbs. Commuter railroad service - using both locomotive-hauled and self-propelled railroad passenger cars - is characterized by multi-trip tickets, specific station-to-station fares, and usually only one or two stations in the central business district. Also known as suburban railroad.

**Transit railroad:** Includes "heavy" and "light" transit rail. **Heavy transit rail** is characterized by exclusive rights-of-way, multi-car trains, high speed rapid acceleration, sophisticated signaling, and high platform loading. Also known as subway, elevated railway, or metropolitan railway (metro). **Light transit rail** may be on exclusive or shared rights-of-way, high or low platform loading, multi-car trains or single cars, automated or manually operated. In generic usage, light rail includes streetcars, trolley cars, and tramways.

**Residential and Commercial sector** - Consists of housing units, non-manufacturing business establishments (e.g., wholesale and retail businesses), health and educational institutions, and government offices.

**Residential Transportation Energy Consumption Survey (RTECS)** - This survey was designed by the Energy Information Administration of the Department of Energy to provide information on how energy is used by households for personal vehicles. It was conducted in 1983, 1985, and 1987. Data for the 1987 RTECS are not yet available.

**Residual fuel oil** - The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations. Included are products known as ASTM grade numbers 5 and 6 oil, heavy diesel oil, Navy Special Fuel Oil, Bunker C oil, and acid sludge and pitch used as refinery fuels. Residual fuel oil is used for the production of electric power, for heating, and for various industrial purposes.

**Rural** - Usually refers to areas with population less than 5,000.

**Sales-weighted miles per gallon (mpg)** - Calculation of a composite vehicle fuel economy based on the distribution of vehicle sales.

**Scrapage rate** - As applied to motor vehicles, it is usually expressed as the percentage of vehicles of a certain type in a given age class that are retired from use (lacking registration) in a given year.

**School and other nonrevenue bus** - See *Bus*.

**Single unit truck** - Includes two-axle, four-tire trucks and other single unit trucks.

**Two-axle, four tire truck:** A motor vehicle consisting primarily of a single motorized device with two axles and four tires.

**Other single-unit truck:** A motor vehicle consisting primarily of a single motorized device with more than two axles or more than four tires.

**Special fuels** - Consist primarily of diesel fuel with small amount of liquified petroleum gas, as defined by the Federal Highway Administration.

**Specific acceleration power** - Measured in watts per kilogram. Acceleration power divided by the battery system weight. Weight must include the total battery system.

**Specific energy** - Measured in watt hours per kilogram. The rated energy capacity of the battery divided by the total battery system weight.

**Subcompact car** - See *Automobile size classifications*.

**Supplemental air carrier** - See *Air carrier*.

**Ton-mile** - The movement of one ton of freight the distance of one mile. Ton-miles are computed by multiplying the weight in tons of each shipment transported by the distance hauled.

**Transmission types -**

- A3 - Automatic three speed
- A4 - Automatic four speed
- A5 - Automatic five speed
- L4 - Automatic lockup four speed
- M5 - Manual five speed

**Transit bus** - See *Bus*.

**Transit railroad** - See *Rail*.

**Transportation sector** - Consists of both private and public passenger and freight transportation, as well as government transportation, including military operations.

**Truck Inventory and Use Survey (TIUS)** - Survey designed to collect data on the characteristics and operational use of the nation's truck population. It is conducted every five years by the U.S. Bureau of the Census. Surveys were conducted in 1963, 1967, 1972, 1977, 1982, and 1987.

**Trolley coach** - See *Bus*.

**Truck size classifications** - U.S. Bureau of the Census has categorized trucks by gross vehicle weight (gvw) as follows:

- Light - Less than 10,000 pounds gvw (Also see *Light Truck*.)
- Medium - 10,001 to 20,000 pounds gvw
- Light-heavy - 20,001 to 26,000 pounds gvw
- Heavy-heavy - 26,001 pounds gvw or more.

**Two-axle, four-tire truck** - See *Single-unit truck*.

**Two seater car** - See *Automobile size classifications*.

**Ultra-low emission vehicle** - A clean fuel vehicle meeting the more stringent Ultra-low emission standards.

**Urban** - Usually refers to areas with population of 5,000 or greater.

**Variable operating cost** - See *Operating cost*.

**Vehicle-miles traveled (vmt)** - One vehicle traveling the distance of one mile. Total vehicle miles, thus, is the total mileage traveled by all vehicles.

**Zero-emission vehicle** - A clean fuel vehicle meeting even more stringent zero-emission vehicle standards.

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