# TRANSPORTATION ENERGY DATA BOOK: EDITION 17 

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Users of the Transportation Energy Data Book are encouraged to comment on errors， omissions，emphases，and organization of this report to one of the persons listed below．Requests for additional complementary copies of this report，additional data，or information on an existing table should be referred to Ms．Stacy Davis，Oak Ridge National Laboratory．

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This edition of the Transportation Energy Data Book can be found on the web at： http：／／www－cta．ornl．gov／data／tedb．htm
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## FOREWORD

This twentieth anniversary edition of the Data Book breaks new ground by providing the Internet addresses for many of the sources used to supply the data for this book. Of course, this book itself is available at www.cta.ornl.gov/data/tedb.htm which also be found through the analytic homepage for the Office of Transportation Technologies (www.ott.doe.gov/fact.html). This issue drops the commentary at the beginning of each chapter.

As shown in Table 2.2, the transportation sector in 1996 consumed $72.7 \%$ more petroleum than the U.S. produced. One reason this figure keeps rising is that the cost to fuel the average car in the U.S. keeps falling (Table 2.23) due to lo w fuel process (Table 2.19) and increasing overall fleet fuel economy (Table 3.9).

Vehicles are now being built in such a way that the fuel economy losse s resulting from traveling over 55 mph are less than for vehicles from the 80's an d the 70's (Table 3.43). A lot of changes have occurred in the transportation sector over the last 20 years. This data book allows you to see many of these changes . Unfortunately, the transportation sector's dependence on oil has not changed. That is the challenge that faces us.

Philip D. Patterson<br>Office of Transportation Technologies

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#### Abstract

The Transportation Energy Data Book: Edition 17 is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under cont ract with the Office of Transportation Technologies in the Department of Energ y (DOE). Designed for use as a desk-top reference, the data book represents a n 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 is treated in separat e chapters or sections. Chapter 1 compares U.S. transportation data with data from other countries. Aggregate energy use and energy supply data for all modes ar e presented in Chapter 2. The highway mode, which accounts for over th ree-fourths of total transportation energy consumption, is dealt with in Chapter 3. Topics in this chapter include automobiles, trucks, buses, fleet vehicles, federal standards, fuel economies, and high-occupancy vehicle lane data. Househol d travel behavior characteristics are displayed in Chapter 4. Chapter 5 contains information on alternative fuels and alternative fuel vehicles. Chapter 6 covers the major nonhighway modes: air, water, and rail. The last chapter, Chapter 7, present s data on environmental issues relating to transportation.


## INTRODUCTION

In January 1976，the Transportation Energy Conservation（TEC）Divisio n of the Energy Research and Development Administration contracted with Oa k Ridge National Laboratory（ORNL）to prepare a Transportation Energy 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 resolv e 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 17.

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 17 updates muc $h$ 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 selected countries in Asia，Europe，and North America．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：a utomobiles，trucks，and buses．Also contained in this chapter is information on fleets，federal standards， fuel economies of highway vehicles，and high－occupancy vehicle lanes．Househol d travel behavior characteristics are displayed in Chapter 4．Chapter 5 presents data on alternative fuels and alternative fuel vehicles，and Chapter 6 consists of $d$ ata for the major nonhighway modes：air，water，and rail．Chapter 7 contains
informationon environmental issues which are pertinent to the transportation industry. 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 inaccur acies 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 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 case s 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 endorses the validity of thes e data.

## CHAPTER 1

## INTERNATIONAL TRANSPORTATION STATISTICS

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Table 1.1
Automobile Registrations for Selected Countries, 1950-95 (thousands)

| Year | China | India | Japan | France | United Kingdom | Germany ${ }^{\text {a }}$ | Canada ${ }^{\text {b }}$ | United States ${ }^{\text {c }}$ | U.S. percentage of world ${ }^{\text {c }}$ | World total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1950 | d | d | 43 | d | 2,307 | d | 1,913 | 40,339 | 76.0\% | 53,051 |
| 1955 | d | d | 153 | d | 360 | d | 2,961 | 52,145 | 71.4\% | 73,036 |
| 1960 | d | d | 457 | 4,950 | 5,650 | 4,856 | 4,104 | 61,671 | 62.7\% | 98,305 |
| 1965 | d | d | 2,181 | 8,320 | 9,131 | 9,719 | 5,279 | 75,258 | 53.8\% | 139,776 |
| 1970 | d | 550 | 8,779 | 11,860 | 11,802 | 14,376 | 6,602 | 89,244 | 46.1\% | 193,479 |
| 1975 | d | 674 | 17,236 | 15,180 | 14,061 | 18,161 | 8,870 | 106,706 | 41.0\% | 260,201 |
| 1980 | 351 | 928 | 23,660 | 18,440 | 15,438 | 23,236 | 10,256 | 121,601 | 38.0\% | 320,390 |
| 1981 | 400 | 998 | 24,612 | 19,130 | 15,633 | 23,681 | 10,199 | 123,098 | 37.2\% | 330,799 |
| 1982 | 450 | 1,066 | 25,539 | 19,750 | 17,644 | 24,036 | 10,530 | 123,702 | 36.4\% | 340,266 |
| 1983 | 478 | 1,197 | 26,385 | 20,300 | 18,108 | 24,689 | 10,732 | 126,444 | 35.9\% | 352,032 |
| 1984 | 563 | 1,218 | 27,114 | 20,600 | 18,532 | 25,378 | 10,781 | 128,158 | 35.1\% | 365,105 |
| 1985 | 795 | 1,339 | 27,845 | 20,800 | 18,953 | 26,099 | 11,118 | 131,864 | 35.2\% | 374,483 |
| 1986 | 966 | 1,522 | 28,654 | 21,090 | 19,415 | 27,224 | 11,586 | 135,431 | 35.1\% | 386,350 |
| 1987 | 1,112 | 1,628 | 29,478 | 21,500 | 20,108 | 28,304 | 11,686 | 137,324 | 34.9\% | 394,030 |
| 1988 | 1,304 | 1,869 | 30,776 | 21,970 | 20,977 | 29,190 | 12,086 | 141,252 | 34.2\% | 412,907 |
| 1989 | 1,464 | 2,086 | 32,621 | 22,520 | 21,919 | 30,152 | 12,380 | 143,081 | 33.7\% | 424,366 |
| 1990 | 1,622 | 2,300 | 34,924 | 23,010 | 22,528 | 30,695 | 12,622 | 143,550 | 32.3\% | 444,900 |
| 1991 | 1,852 | 2,491 | 37,076 | 23,550 | 22,744 | 31,309 | 12,578 | 142,956 | 31.3\% | 456,033 |
| 1992 | 2,262 | 2,807 | 38,963 | 24,020 | 23,008 | 37,579 | 12,781 | 144,213 | 30.7\% | 469,943 |
| 1993 | 2,860 | 3,100 | 40,772 | 24,385 | 23,402 | 39,202 | 12,927 | 146,314 | 31.2\% | 469,460 |
| 1994 | 3,497 | 3,300 | 42,678 | 24,900 | 23,832 | 39,918 | 13,122 | 133,929 | 27.9\% | 479,533 |
| 1995 | 4,179 | 3,500 | 44,680 | 25,100 | 24,307 | 40,499 | 13,183 | 134,981 | 28.3\% | 477,010 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |
| 1970-95 | $18.0 \%^{\text {e }}$ | 7.7\% | 6.7\% | 3.0\% | 2.9\% | d | d | d |  | $3.7 \%$ |
| 1985-95 | 18.1\% | 10.1\% | 4.8\% | 1.9\% | 2.5\% | d | d | d |  | 2.4\% |

Source:
Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1997 Edition, Detroit, MI, 1997, pp. 8, 23, 28, 42, 87, 100, 173, 209, 234 and annual. (Additional resources: http://www.aama.com)

[^0]Table 1.2
Truck and Bus Registrations for Selected Countries, 1950-95
(thousands)

| Year | China | India | Japan | France | United Kingdom | Germany ${ }^{\text {a }}$ | Canada ${ }^{\text {b }}$ | United States ${ }^{\text {c }}$ | U.S. percentage of world ${ }^{\text {c }}$ | World total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1950 | d | d | 183 | d | 1,060 | d | 643 | 8,823 | 50.9\% | 17,349 |
| 1955 | d | d | 318 | d | 1,244 | d | 952 | 10,544 | 46.1\% | 22,860 |
| 1960 | d | d | 896 | 1,540 | 1,534 | 786 | 1,056 | 12,186 | 42.6\% | 28,583 |
| 1965 | d | d | 4,119 | 1,770 | 1,748 | 1,021 | 1,232 | 15,100 | 39.6\% | 38,118 |
| 1970 | d | 492 | 8,803 | 1,850 | 1,769 | 1,228 | 1,481 | 19,175 | 36.2\% | 52,899 |
| 1975 | 811 | 542 | 10,854 | 2,210 | 1,934 | 1,337 | 2,158 | 26,243 | 38.8\% | 67,698 |
| 1980 | 1,480 | 739 | 14,197 | 2,550 | 1,920 | 1,617 | 2,955 | 34,195 | 37.7\% | 90,592 |
| 1981 | 1,630 | 799 | 15,009 | 2,575 | 1,890 | 1,646 | 3,192 | 35,188 | 36.5\% | 96,405 |
| 1982 | 1,767 | 892 | 15,797 | 2,716 | 3,022 | 1,648 | 3,293 | 35,941 | 36.4\% | 98,787 |
| 1983 | 1,908 | 980 | 16,546 | 2,890 | 3,106 | 1,674 | 3,363 | 37,306 | 35.9\% | 103,888 |
| 1984 | 2,070 | 1,035 | 17,380 | 3,230 | 3,230 | 1,693 | 3,099 | 38,091 | 35.3\% | 107,925 |
| 1985 | 2,402 | 1,198 | 18,313 | 3,310 | 3,278 | 1,723 | 3,149 | 39,790 | 35.2\% | 113,024 |
| 1986 | 2,884 | 1,294 | 19,319 | 3,980 | 3,336 | 1,760 | 3,213 | 40,760 | 35.9\% | 113,436 |
| 1987 | 3,247 | 1,480 | 20,424 | 4,200 | 3,452 | 1,801 | 3,576 | 41,714 | 34.4\% | 121,176 |
| 1988 | 3,716 | 1,705 | 21,674 | 4,370 | 3,621 | 1,846 | 3,766 | 43,145 | 34.0\% | 126,882 |
| 1989 | 4,118 | 1,885 | 22,472 | 4,570 | 3,754 | 1,914 | 3,889 | 44,179 | 33.3\% | 132,566 |
| 1990 | 4,496 | 2,020 | 22,773 | 4,748 | 3,774 | 1,989 | 3,931 | 45,106 | 32.7\% | 138,082 |
| 1991 | 4,721 | 2,177 | 22,839 | 4,910 | 3,685 | 2,114 | 3,402 | 45,416 | 32.6\% | 139,274 |
| 1992 | 5,177 | 2,397 | 22,694 | 5,040 | 3,643 | 2,672 | 3,413 | 46,149 | 32.1\% | 143,587 |
| 1993 | 5,316 | 2,600 | 22,490 | 5,065 | 3,604 | 2,842 | 3,409 | 47,749 | 32.3\% | 147,627 |
| 1994 | 5,922 | 2,875 | 22,333 | 5,140 | 3,605 | 2,960 | 3,466 | 64,116 | 42.9\% | 149,545 |
| 1995 | 6,221 | 3,050 | 22,173 | 5,195 | 3,635 | 3,062 | 3,485 | 65,465 | 38.6\% | 169,749 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |
| 1970-95 | $10.0 \%^{\text {e }}$ | 9.8\% | 3.8\% | 4.2\% | 2.9\% | d | d | d |  | 4.8\% |
| 1985-95 | 12.0\% | 10.8\% | 1.9\% | 4.6\% | 1.0\% | d | d | d |  | 4.2\% |

Source:
Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1997 Edition, Detroit, MI, 1997, pp. 8, 23, 28, 42, 87, 100, 173 , 209 , and 234. (Additional resources: http://www.aama.com)

[^1]Table 1.3
Gasoline Prices for Selected Countries, 1978-96

|  | Current dollars per gallon |  |  |  |  |  |  |  | Average annual percentage change |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $1978{ }^{\text {a }}$ | $1982^{\text {a }}$ | $1986^{\text {a }}$ | $1990{ }^{\text {b }}$ | $1992^{\text {b }}$ | $1994{ }^{\text {b }}$ | $1995{ }^{\text {b }}$ | $1996{ }^{\text {b }}$ | 1978-96 | 1986-96 |
| China | d | d | d | d | d | d | 1.08 | $0.93{ }^{\text {c }}$ | d | d |
| India | d | d | d | 1.92 | 2.59 | 2.28 | 2.32 | $2.25{ }^{\text {c }}$ | d | d |
| Japan | $2.00^{\text {c }}$ | $2.60{ }^{\text {c }}$ | $2.79^{\text {c }}$ | $3.05^{\text {c }}$ | $3.78{ }^{\text {c }}$ | 4.14 | 4.56 | 3.77 | 3.6\% | $3.1 \%$ |
| France | 2.15 | 2.56 | 2.58 | 3.40 | 3.69 | 3.31 | 4.02 | 4.41 | 4.1\% | 5.5\% |
| United Kingdom | 1.22 | 2.42 | 2.07 | 2.55 | 3.28 | 2.86 | 3.21 | 3.47 | 6.0\% | 5.3\% |
| Germany | 1.75 | 2.17 | 1.88 | 2.72 | 3.84 | 3.34 | 3.91 | 4.32 | 5.1\% | 8.7\% |
| Canada | $0.69{ }^{\text {c }}$ | $1.37{ }^{\text {c }}$ | $1.31{ }^{\text {c }}$ | $1.92{ }^{\text {c }}$ | $2.11^{\text {c }}$ | 1.57 | 1.68 | 1.80 | 5.5\% | $3.2 \%$ |
| United States ${ }^{\text {e }}$ | $0.66{ }^{\text {c }}$ | $1.32^{\text {c }}$ | $0.93{ }^{\text {c }}$ | $1.04{ }^{\text {c }}$ | $1.07{ }^{\text {c }}$ | 1.24 | 1.32 | 1.28 | 3.7\% | 3.2\% |
|  |  |  |  | nstant 1 | ars ${ }^{\text {f }}$ per |  |  |  | Averag percent | nnual change |
|  | $1978{ }^{\text {a }}$ | $1982^{\text {a }}$ | $1986^{\text {a }}$ | $1990^{\text {b }}$ | $1992^{\text {b }}$ | $1994{ }^{\text {b }}$ | $1995{ }^{\text {b }}$ | $1996{ }^{\text {b }}$ | 1978-96 | 1986-96 |
| China | d | d | d | d | d | d | 0.93 | 0.77 | d | d |
| India | d | d | d | 1.92 | 2.41 | 2.01 | 1.99 | 1.87 | d | d |
| Japan | $4.01^{\text {c }}$ | $3.52^{\text {c }}$ | $3.33{ }^{\text {c }}$ | $3.05^{\text {c }}$ | $3.52^{\text {c }}$ | 3.65 | 3.91 | 3.14 | -1.3\% | -0.6\% |
| France | 4.31 | 3.47 | 3.07 | 3.40 | 3.44 | 2.92 | 3.45 | 3.67 | -0.9\% | 1.8\% |
| United Kingdom | 2.44 | 3.28 | 2.47 | 2.55 | 3.05 | 2.52 | 2.75 | 2.89 | 0.9\% | 1.6\% |
| Germany | 3.51 | 2.94 | 2.24 | 2.72 | 3.58 | 2.95 | 3.35 | 3.60 | 0.1\% | 4.9\% |
| Canada | $1.38{ }^{\text {c }}$ | $1.85{ }^{\text {c }}$ | $1.56{ }^{\text {c }}$ | $1.92^{\text {c }}$ | $1.96{ }^{\text {c }}$ | 1.38 | 1.44 | 1.50 | 0.5\% | -0.4\% |
| United States ${ }^{\text {e }}$ | $1.32^{\text {c }}$ | $1.79^{\text {c }}$ | $1.11^{\text {c }}$ | $1.04{ }^{\text {c }}$ | $1.00^{\text {c }}$ | 1.09 | 1.13 | 1.07 | -1.0\% | -0.4\% |

Source:
U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, Washington, DC, December 1996, pp.102, 103, and annual. (Additional resources: http://www.eia.doe.gov)
Note: Comparisons between prices and price trends in different countries require care. They are of limited validity because of fluctuations in exchange rates; differences in product quality, marketing practices, and market structures; and the extent to which the standard categories of sales are representative of total national sales for a given period.

[^2]Figure 1.1 Gasoline Prices for Selected Countries, 1985 and 1995


## Source:

Table 1.3, and International Energy Agency, Energy Prices and Taxes, Fourth Quarter, 1995 Edition, Paris, France, 1996. (Additional resources: http:www.iea.org)

Table 1.4
Diesel Fuel Prices for Selected Countries, 1978-96

|  | Current dollars per gallon |  |  |  |  |  |  |  | Average annual percentage change |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $1978{ }^{\text {a }}$ | $1982^{\text {a }}$ | $1986^{\text {a }}$ | $1990^{\text {b }}$ | $1992^{\text {b }}$ | $1994{ }^{\text {b }}$ | $1995{ }^{\text {b }}$ | $1996{ }^{\text {b }}$ | 1978-96 | 1982-96 |
| China | c | c | c | c | c | c | 0.94 | 0.88 | ${ }^{\text {c }}$ | c |
| India | c | c | c | 0.78 | 0.73 | 0.74 | 0.84 | 0.92 | c | c |
| Japan | c | 1.78 | 1.90 | 1.75 | c | 2.48 | 3.00 | 2.51 | c | 2.5\% |
| France | 1.30 | 1.88 | 1.69 | 1.78 | c | 2.10 | 2.37 | 3.10 | 4.9\% | 3.6\% |
| United Kingdom | 1.24 | 2.05 | 1.71 | 2.04 | c | 2.46 | 2.75 | 3.26 | 5.5\% | 3.4\% |
| Germany | 1.48 | 1.81 | 1.51 | 2.72 | 2.81 | 2.16 | 2.48 | 3.02 | 4.0\% | 3.7\% |
| Canada | c | 1.27 | 1.27 | 1.55 | 1.78 | 1.47 | 1.38 | 1.43 | c | 0.9\% |
| United States ${ }^{\text {d }}$ | 0.54 | 1.16 | 0.94 | 0.99 | 1.06 | 0.96 | 0.97 | 1.15 | 4.3\% | -0.1\% |
|  |  |  |  | nt 1990 | ars ${ }^{\text {e }}$ per |  |  |  | Avera percen | nnual <br> change |
|  | $1978{ }^{\text {a }}$ | $1982^{\text {a }}$ | $1986^{\text {a }}$ | $1990^{\text {b }}$ | $1992^{\text {b }}$ | $1994{ }^{\text {b }}$ | 1995 | 1996 | 1978-96 | 1986-96 |
| China | c | c | c | c | c | c | c | c | c | c |
| India | c | c | c | 0.78 | 0.68 | 0.65 | 0.72 | 0.77 | c | c |
| Japan | c | 2.41 | 2.26 | 1.75 | c | 2.19 | 2.57 | 2.09 | c | -1.0\% |
| France | 2.60 | 2.55 | 2.01 | 1.78 | c | 1.85 | 2.03 | 2.58 | 0.0\% | 0.1\% |
| United Kingdom | 2.48 | 2.78 | 2.04 | 2.04 | c | 2.17 | 2.36 | 2.72 | 0.5\% | -0.2\% |
| Germany | 2.96 | 2.45 | 1.80 | 2.72 | 2.62 | 1.91 | 2.13 | 2.52 | 0.9\% | 0.2\% |
| Canada | c | 1.72 | 1.51 | 1.55 | 1.66 | 1.30 | 1.18 | 1.19 | c | -2.6\% |
| United States ${ }^{\text {d }}$ | 1.08 | 1.57 | 1.12 | 0.99 | 0.99 | 0.85 | 0.83 | 0.96 | 0.7\% | -3.5\% |

## Source:

U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, Washington, DC, December 1996, pp.102, 103, and annual. (Additional resources: http://www.eia.doe.gov)

Note: Comparisons between prices and price trends in different countries require care. They are of limited validity because of fluctuations in exchange rates; differences in product quality, marketing practices, and market structures; and the extent to which the standard categories of sales are representative of total national sales for a given period.

[^3]Figure 1.2. Diesel Prices for Selected Countries, 1985 and 1995


## Source:

Table 1.4, and International Energy Agency, Energy Prices and Taxes, Fourth Quarter, 1995 Edition, Paris, France, 1996. (Additional resources: http:www.iea.org)

According to the best available data, new cars in Denmark 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 1.5
New Gasoline Personal Vehiclea
(miles per gallon)

| Year | Japan | France | Italy | Sweden | Norway | Denmark | West <br> Germany | United <br> States | United <br> Kingdom |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1975 | 21.2 | 27.5 | b | b | 25.0 | 28.1 | b | 15.3 | b |
| 1980 | 28.2 | 30.2 | 30.6 | 26.1 | 26.7 | 29.0 | 26.4 | 22.5 | 27.1 |
| 1981 | 28.9 | 31.8 | 31.4 | 27.0 | 27.4 | 29.0 | 27.6 | 24.1 | 27.7 |
| 1982 | 30.6 | 32.9 | 32.7 | 27.4 | 28.3 | 29.0 | 28.5 | 24.7 | 29.0 |
| 1983 | 30.1 | 33.6 | 34.1 | 27.4 | 29.0 | 29.6 | 28.8 | 24.6 | 29.8 |
| 1984 | 30.1 | 34.4 | 35.6 | 27.7 | 30.2 | 30.9 | 30.8 | 24.6 | 31.0 |
| 1985 | 29.2 | 34.9 | 36.2 | 27.7 | 30.6 | 31.0 | 31.1 | 25.0 | 31.2 |
| 1986 | 28.2 | 35.1 | 36.8 | 28.0 | 31.4 | 31.7 | 31.7 | 25.7 | 31.5 |
| 1987 | 27.5 | 35.5 | 36.8 | 28.7 | 31.8 | 31.9 | 31.0 | 25.9 | 31.8 |
| 1988 | 27.1 | 35.9 | 36.8 | 28.3 | 31.8 | 32.4 | 30.1 | 25.9 | 31.6 |
| 1989 | 26.6 | 36.1 | 36.8 | 28.3 | 31.8 | 32.3 | 29.4 | 25.4 | 31.0 |
| 1990 | 26.6 | 36.1 | 35.1 | 28.3 | 31.8 | 32.8 | 29.4 | 25.1 | 30.7 |
| 1991 | 26.1 | 36.4 | 35.1 | 28.3 | 31.8 | 33.1 | 29.1 | 25.4 | 30.7 |
| 1992 | 25.7 | 36.1 | 34.6 | 28.7 | 31.8 | 33.7 | 29.9 | 24.5 | 30.6 |
| 1993 | 25.7 | 35.5 | 34.1 | 28.3 | 32.2 | 33.1 | 30.2 | 25.3 | 30.4 |
| 1994 | 26.1 | 35.9 | b | 28.0 | 32.2 | 32.2 | 30.8 | 25.0 | 30.6 |
| 1995 | 25.9 | 36.1 | b | 28.3 | 31.8 | b | b | 24.9 | 31.2 |
|  |  |  | Average | annual percentage change |  |  |  |  |  |
| $1975-95$ | $1.0 \%$ | $1.4 \%$ | b | b | $1.2 \%$ | $0.7 \%^{\mathrm{c}}$ | b | $2.5 \%$ | b |
| $1985-95$ | $-1.2 \%$ | $0.3 \%$ | b | $0.2 \%$ | $0.4 \%$ | $0.4 \%^{\mathrm{c}}$ | $-0.1 \% \mathrm{c}$ | $0.0 \%$ | $0.0 \%$ |
| S |  |  |  |  |  |  |  |  |  |

## Source:

International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

## Note:

Revisions in the data series are the result of newly available data.

[^4]Because each country may use different methods of calculating fuel economies, caution should be used when comparing fuel economy data among countries. The data for the United States were generated specifically for internationd comparisons and should be used only for that purpose; they are not consistent with other domestic fuel economy figures.

Table 1.6
Fuel Economy of the Gasoline Personal Vehicle ${ }^{\text {a }}$ Population for Selected Countries, 1970-95 (miles per gallon)

| Year | Japan | France | Italy | Sweden | Finland | Norway | Denmark | United <br> Kingdom | West <br> Germany | United <br> States | Nether- <br> lands | Australia |
| :--- | :---: | ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |

## Source:

International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

Note:
Revisions in the data series are the result of newly available data.

[^5]"There is a relatively consistent shortfall or gap between tested fuel economy and that actually achieved by consumers on the road ... a gap which changes over time." The International Energy Studies Program a Lawrence Berkeley Laboratory (LBL) has studied this gap and discovered that "despite differences in te measurement methods and data collection and analysis techniques, significant similarities exist betwean countries on the gap problem." a The gap arises for several reasons, including driver behavior, seasond differences, and city to highway driving proportion.

Table 1.7
Fuel Economy Gap for Selected Countries (miles per gallon)

| Country | Year | Test | Actual | $\begin{gathered} \text { Average } \\ \text { gap } \\ \hline \end{gathered}$ | $\begin{gathered} \text { Percent } \\ \text { gap } \\ \hline \end{gathered}$ | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Canada | 1988 | 29.4 | 23.5 | 5.9 | 20.0 | Actual fuel efficiency from driver surveys. Test from laboratory tests. |
| Individual car models | 1985 | 27.4 | 22.0 | 5.4 | 19.6 |  |
| France | 1988 | 36.2 | 28.0 | 8.2 | 23.0 | Travel diaries compared to $1 / 3$ city, $1 / 3$ highway, $1 / 3$ road test values. |
| Germany | 1987 | 30.6 | 24.0 | 6.5 | 21.4 | DIN (test) vs. DIW (actual) |
| Sweden | 1987 | 28.7 | 27.7 | 1.0 | 3.5 | KOV compared with consumer reported survey data. |
| U.S. | 1985 |  |  |  |  |  |
| Cars |  | 24.3 | 19.8 | 4.5 | 18.5 | RTECS survey vs. EPA fleet average |
| Trucks |  | 20.3 | 16.2 | 4.1 | 20.0 | from dynamometer test. |
| U.K. | 1989 | 32.7 | 25.3 | 7.4 | 22.6 | Test value for registration-weighted average. |

## Source:

Schipper, Lee, and Wienke Tax, "New Car Test and Actual Fuel Economy: Yet Another Gap?" Transport Policy, 1994.

## Note:

DIN = Deutsches Institut fur Normug
DIW $=$ Deutsches Institut fur Wirtschaftsforschung
$\mathrm{KOV}=$ Kosumentverket
RTECS $=$ Residential Transportation Consumption Survey
EPA = Environmental Protection Agency
${ }^{\text {a }}$ Schipper, Lee, and Wienke Tax, "New Car Test and Actual Fuel Economy: Yet Another Gap?" Lawrence Berkeley Laboratory, Berkeley, CA, Fall 1993.

Table 1.8

## Annual Vehicle-Miles Traveled per Vehicle by Personal Vehicles for Selected Countries, 1970-95

| Year | Japan | France | Italy | Sweden | Finland | Norway | Denmark | United Kingdom | West Germany | United States | Netherlands |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 10,34 | 8,415 | 8,525 | 8,912 | 12,231 | 7,782 | 9,464 | 9,110 | 9,484 | 11,173 | 9,665 |
| 1975 | 7,515 | 8,204 | 6,375 | 8,910 | 12,797 | 8,280 | 10,061 | 8,499 | 9,044 | 10,749 | 9,316 |
| 1980 | 7,088 | 8,092 | 6,051 | 9,147 | 11,521 | 8,048 | 9,660 | 8,600 | 8,423 | 10,605 | 8,988 |
| 1981 | 6,947 | 8,247 | 5,851 | 9,052 | 11,243 | 7,850 | 9,614 | 8,654 | 7,832 | 10,625 | 8,784 |
| 1982 | 6,922 | 7,850 | 5,716 | 9,109 | 11,100 | 7,790 | 9,690 | 8,729 | 8,047 | 10,825 | 8,991 |
| 1983 | 6,775 | 7,843 | 5,598 | 9,088 | 10,936 | 7,808 | 9,837 | 8,457 | 8,155 | 10,924 | 9,185 |
| 1984 | 6,711 | 7,980 | 5,810 | 9,159 | 10,866 | 7,956 | 10,017 | 8,660 | 8,196 | 10,966 | 9,381 |
| 1985 | 6,741 | 7,937 | 5,664 | 9,021 | 10,886 | 8,284 | 9,723 | 8,715 | 7,995 | 10,997 | 9,162 |
| 1986 | 6,750 | 8,160 | 5,909 | 9,321 | 10,897 | 8,449 | 10,022 | 8,918 | 8,301 | 11,108 | 9,501 |
| 1987 | 6,742 | 8,247 | 6,089 | 9,484 | 11,133 | 8,571 | 10,110 | 9,283 | 8,546 | 11,351 | 9,670 |
| 1988 | 6,765 | 8,378 | 6,166 | 9,444 | 11,413 | 8,535 | 10,248 | 9,493 | 8,732 | 11,775 | 9,540 |
| 1989 | 6,687 | 8,254 | 6,274 | 9,439 | 11,502 | 8,704 | 10,399 | 9,821 | 8,677 | 12,029 | 9,441 |
| 1990 | 6,733 | 8,479 | 6,533 | 9,030 | 11,340 | 8,784 | 10,547 | 9,593 | 8,740 | 12,243 | 9,204 |
| 1991 | 6,791 | 8,504 | 6,604 | 9,100 | 11,122 | 8,720 | 10,668 | 9,612 | 8,677 | 12,159 | 9,254 |
| 1992 | 6,845 | 8,699 | 6,790 | 9,239 | 11,129 | 8,686 | 10,726 | 9,445 | 8,557 | 12,860 | 9,398 |
| 1993 | 6,700 | 8,736 | 6,947 | 9,075 | 11,087 | 8,744 | 10,789 | 9,467 | 8,401 | 13,213 | 9,329 |
| 1994 | 6,648 | 8,878 | 7,009 | b | 11,442 | 8,771 | b | 9,476 | 8,047 | 12,809 | 9,410 |
| 1995 | b | 8,914 | 7,067 | b | 11,473 | 8,667 | b | b | b | 12,957 | 9,494 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |  |
| 1970-95 | -1.8\% ${ }^{\text {c }}$ | 0.2\% | -0.7\% | b | -0.3\% | 0.4\% | b | 0.2\% ${ }^{\text {c }}$ | $-0.7 \%^{\text {c }}$ | 0.6\% | -0.1\% |
| 1985-95 | -0.2\% ${ }^{\text {c }}$ | 1.2\% | 2.2\% | b | 0.5\% | 0.5\% | b | $0.9 \%^{\text {c }}$ | $0.1 \%^{\text {c }}$ | 1.7\% | 0.4\% |

## Source:

International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

## Note:

Revisions in the data series are the result of newly available data.

[^6]Table 1.9
Personal Vehicles ${ }^{\text {a }}$ Passenger Travel for Selected Countries, 1970-95 (billion passenger-miles)

| Year | Japan | France | Italy | Sweden | Finland | Norway | Denmark | United <br> Kingdom | West <br> Germany | United States | Netherlands | Australia |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 141 | 189 | 132 | 38 | 15 | 11 | 28 | 180 | 228 | 2,110 | 38 | b |
| 1975 | 200 | 233 | 179 | 44 | 19 | 17 | 34 | 201 | 271 | 2,227 | 52 | 130 |
| 1980 | 286 | 281 | 201 | 44 | 22 | 19 | 34 | 245 | 310 | 2,275 | 62 | 149 |
| 1981 | 292 | 291 | 209 | 43 | 22 | 19 | 33 | 249 | 293 | 2,280 | 62 | 151 |
| 1982 | 302 | 291 | 223 | 43 | 23 | 19 | 33 | 252 | 303 | 2,317 | 63 | 159 |
| 1983 | 306 | 297 | 208 | 44 | 24 | 20 | 34 | 255 | 311 | 2,357 | 65 | 159 |
| 1984 | 315 | 306 | 221 | 45 | 26 | 20 | 35 | 269 | 317 | 2,419 | 68 | 166 |
| 1985 | 325 | 307 | 232 | 44 | 27 | 23 | 36 | 274 | 316 | 2,479 | 68 | 174 |
| 1986 | 335 | 321 | 256 | 46 | 28 | 25 | 37 | 289 | 337 | 2,548 | 71 | 179 |
| 1987 | 346 | 332 | 275 | 48 | 29 | 26 | 38 | 311 | 353 | 2,648 | 74 | 182 |
| 1988 | 369 | 345 | 289 | 48 | 30 | 26 | 38 | 333 | 370 | 2,783 | 78 | 189 |
| 1989 | 388 | 355 | 306 | 50 | 31 | 26 | 39 | 361 | 375 | 2,865 | 82 | 196 |
| 1990 | 415 | 364 | 330 | 49 | 32 | 26 | 39 | 365 | 393 | 2,926 | 81 | 200 |
| 1991 | 439 | 372 | 343 | 49 | 31 | 26 | 39 | 363 | 397 | 2,949 | 82 | 197 |
| 1992 | 460 | 384 | 365 | 50 | 31 | 26 | 39 | 365 | 400 | 3,050 | 82 | 199 |
| 1993 | 468 | 392 | 375 | 48 | 31 | 26 | 40 | 364 | 400 | 3,139 | 84 | 204 |
| 1994 | 482 | 405 | b | b | 31 | 27 | 41 | 370 | 493 | 3,091 | 86 | b |
| 1995 | 526 | 413 | b | b | 31 | 27 | 42 | b | b | 3,155 | b | b |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |  |  |
| 1970-95 | 5.4\% | 3.2\% | b | b | 2.9\% | 3.7\% | 1.6\% | $3.0 \%{ }^{\text {c }}$ | $3.3 \%^{\text {c }}$ | 1.6\% | $3.5 \%{ }^{\text {c }}$ | b |
| 1985-95 | 4.9\% | 3.0\% | b | b | 3.2\% | 1.6\% | 1.6\% | $3.4 \%^{\text {c }}$ | 5.1\% ${ }^{\text {c }}$ | 2.4\% | 2.6\% ${ }^{\text {c }}$ | b |

## Source:

International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

## Note:

Revisions in the data series are the result of newly available data.

[^7]Table 1.10
Personal Vehicles ${ }^{\text {a }}$ Energy Use for Selected Countries, 1970-95
(trillion Btu)

| Year | Japan | France | Italy | Sweden | Finland | Norway | Denmark | United <br> Kingdom | West Germany | $\begin{aligned} & \text { United } \\ & \text { States } \end{aligned}$ | Netherlands | Australia |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 452 | 431 | 366 | 99 | 40 | 30 | 52 | 500 | 626 | 9,230 | 111 | b |
| 1975 | 663 | 540 | 404 | 122 | 54 | 40 | 59 | 609 | 796 | 10,73 | 146 | 304 |
| 1980 | 946 | 651 | 458 | 133 | 59 | 51 | 58 | 719 | 979 | 10,57 | 174 | 361 |
| 1981 | 949 | 704 | 458 | 132 | 59 | 51 | 56 | 705 | 929 | 10,47 | 172 | 365 |
| 1982 | 970 | 720 | 481 | 134 | 61 | 53 | 56 | 725 | 965 | 10,38 | 176 | 381 |
| 1983 | 982 | 733 | 490 | 135 | 65 | 54 | 58 | 752 | 997 | 10,45 | 182 | 379 |
| 1984 | 981 | 744 | 516 | 140 | 67 | 56 | 58 | 793 | 1,026 | 10,48 | 186 | 394 |
| 1985 | 1,002 | 735 | 544 | 140 | 70 | 59 | 60 | 801 | 1,022 | 10,62 | 183 | 410 |
| 1986 | 1,031 | 763 | 586 | 146 | 75 | 62 | 63 | 845 | 1,097 | 10,97 | 187 | 419 |
| 1987 | 1,077 | 776 | 619 | 151 | 80 | 63 | 64 | 896 | 1,155 | 11,04 | 194 | 426 |
| 1988 | 1,118 | 804 | 649 | 154 | 84 | 64 | 66 | 944 | 1,211 | 11,29 | 195 | 445 |
| 1989 | 1,189 | 815 | 679 | 157 | 89 | 65 | 66 | 978 | 1,220 | 11,45 | 199 | 466 |
| 1990 | 1,286 | 821 | 723 | 153 | 87 | 64 | 69 | 1,005 | 1,262 | 11,42 | 193 | 480 |
| 1991 | 1,391 | 828 | 748 | 151 | 87 | 63 | 70 | 1,018 | 1,264 | 11,47 | 195 | 483 |
| 1992 | 1,487 | 848 | 793 | 154 | 87 | 62 | 71 | 1,013 | 1,269 | 11,98 | 201 | 489 |
| 1993 | 1,532 | 857 | 808 | 149 | 82 | 62 | 70 | 1,001 | 1,273 | 12,21 | 203 | 497 |
| 1994 | 1,593 | 876 | b | b | 82 | 62 | b | 1,001 | 1,216 | 12,22 | b | b |
| 1995 | 1,688 | 888 | b | b | 81 | 62 | b | b | , | 12,39 | b | b |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |  |  |
| 1970-95 | 5.4\% | 2.9\% | b | b | 2.9\% | 2.9\% | - | 2.9\% ${ }^{\text {c }}$ | 2.8\% ${ }^{\text {c }}$ | 1.2\% | b | b |
| 1985-95 | 5.4\% | 1.9\% | b | b | 1.5\% | 0.5\% | b | 2.5\% ${ }^{\text {c }}$ | 1.9\% ${ }^{\text {c }}$ | 1.6\% | b | b |

## Source:

International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

## Note:

Revisions in the data series are the result of newly available data.

[^8]Table 1.11
Freight Energy Use by Mode for Selected Countries by Mode, 1970-93 (trillion Btu)

|  | Truck | Ship | Rail | Truck | Ship | Rail | Truck | Ship | Rail | Truck | Ship | Rail |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Japan |  |  | France |  |  | Italy |  |  | Sweden |  |  |
| 1970 | 652 | 136 | 15.2 | 262 | 6.2 | a | 175 | 9.3 | 8.0 | 36 | 5.4 | 4.2 |
| 1975 | 707 | 208 | 12.6 | 344 | 5.2 | 17.4 | 221 | 11.9 | 5.2 | 41 | 2.8 | 4.0 |
| 1980 | 952 | 166 | 10.2 | 397 | 5.0 | 17.8 | 285 | 14.8 | 5.8 | 49 | 3.1 | 3.8 |
| 1985 | 1,066 | 100 | 6.2 | 373 | 3.1 | 14.4 | 368 | 14.6 | 6.9 | 56 | 3.3 | 4.6 |
| 1990 | 1,331 | 117 | 5.2 | 541 | 2.7 | 13.2 | 484 | 15.5 | 6.9 | 63 | 2.7 | 4.4 |
| 1991 | 1,403 | 118 | 5.3 | 562 | 2.5 | 13.5 | 479 | 15.8 | 6.9 | 61 | 2.5 | 4.3 |
| 1992 | 1,439 | 117 | 5.3 | 575 | 2.5 | 13.1 | a | 16.3 | 7.7 | 60 | 2.4 | 4.4 |
| 1993 | 1,452 | 112 | 5.3 | 575 | 2.7 | 12.2 | a | a | a | a | a | a |
|  | Finland |  |  | Norway |  |  | Denmark |  |  | United Kingdom |  |  |
| 1970 | 27 | 1.1 | 2.7 | 17 | 21.0 | 1.2 | a | a | a | 275 | 50.5 | 20.2 |
| 1975 | 30 | 1.0 | 2.8 | 18 | 22.3 | 1.1 | 23 | 4.1 | 1.3 | 295 | 51.9 | 14.8 |
| 1980 | 35 | 2.4 | 2.9 | 21 | 23.0 | 1.5 | 34 | 3.0 | 1.5 | 318 | 50.1 | 9.8 |
| 1985 | 37 | 2.2 | 2.8 | 27 | 23.7 | 1.4 | 45 | 3.0 | 1.4 | 325 | 49.8 | 6.9 |
| 1990 | 44 | 1.5 | 2.4 | 31 | 21.2 | 1.3 | 47 | 3.5 | 0.9 | 420 | 54.1 | 8.2 |
| 1991 | 42 | 1.3 | 2.2 | 31 | 22.4 | 1.3 | 48 | 3.6 | 0.9 | 418 | 56.5 | 8.4 |
| 1992 | 41 | 1.3 | 2.2 | 31 | 22.9 | 1.4 | 49 | 3.5 | 0.9 | 418 | 54.6 | 8.7 |
| 1993 | 41 | 2.9 | 2.5 | 32 | 28.5 | 1.4 | 48 | 3.2 | 0.9 | 415 | 53.8 | 8.1 |
|  | West Germany |  |  | United States |  |  | Netherlands |  |  | Australia |  |  |
| 1970 | 218 | 35.1 | 52.4 | 2,338 | 325 | 501 | a | a | a | a | a | a |
| 1975 | 224 | 36.0 | 24.4 | 2,908 | 311 | 515 | a | a | a | 119 | 38.0 | 17.8 |
| 1980 | 320 | 34.1 | 20.5 | 3,843 | 330 | 544 | 73 | 16.0 | 0.9 | 164 | 45.8 | 22.2 |
| 1985 | 299 | 28.4 | 19.3 | 4,598 | 399 | 427 | 76 | 15.0 | 1.0 | 196 | 29.1 | 23.7 |
| 1990 | 336 | 25.6 | 18.0 | 5,133 | 323 | 425 | 98 | 18.0 | 0.9 | 212 | 22.3 | 22.4 |
| 1991 | 412 | 25.6 | 17.6 | 4,970 | 328 | 399 | 100 |  | a | 197 | 17.9 | 22.3 |
| 1992 | 413 | 27.5 | 19.4 | 5,034 | 341 | 425 | 105 | a | a | 207 | 20.9 | 22.8 |
| 1993 | 387 | 27.5 | 19.7 | 5,243 | 307 | 382 | a | a | a | 216 | 20.9 | 24.0 |

## Source:

International Energy Studies, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA, 1995. Data were compiled from country sources, such as oil companies, energy economics institutes, and government ministries. See Appendix C.

## Note:

Revisions in the data series are the result of newly available data.
${ }^{a}$ Data are not available.

Table 1.12
Automobile Travel Statistics by Trip Purpose for Selected Countries

|  | Work | Work- <br> related | Total <br> work |  <br> personal |  <br> educational | Total <br>  <br> civic |  <br> recreational | Total |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | ---: |
|  | Number of weekly vehicle trips per automobile |  |  |  |  |  |  |  |
| United States (1990) | 3.49 | 0.24 | 3.73 | 6.01 | 0.70 | 6.72 | 2.71 | 13.15 |
| Germany (1989) | 2.81 | 0.61 | 3.41 | 1.83 | 0.19 | 2.02 | 2.26 | 7.69 |
| Sweden (1984/85) | 2.32 | 0.83 | 3.15 | 2.56 | 0.07 | 2.62 | 4.29 | 10.06 |
| U.K. (1989/91) | 1.71 | 0.56 | 2.27 | 2.79 | 0.24 | 3.03 | 1.59 | 6.88 |
| Netherlands (1990) | 2.03 | 1.05 | 3.08 | 1.82 | 0.14 | 1.96 | 3.85 | 8.89 |
| Norway (1992) | 2.29 | 0.62 | 2.91 | 5.06 | 0.11 | 5.17 | 3.54 | 11.62 |
| Denmark (1992/93) | 3.01 | 0.08 | 3.09 | 3.66 | 0.00 | 3.66 | 3.35 | 10.10 |
|  |  | Weekly vehicle-miles traveled per automobile |  |  |  |  |  |  |
| United States (1990) | 98.22 | 11.27 | 109.49 | 104.02 | 13.71 | 117.73 | 119.49 | 346.70 |
| Germany (1989) | 72.03 | 48.09 | 120.12 | 22.59 | 5.69 | 28.28 | 66.20 | 214.60 |
| Sweden (1984/85) | 45.20 | 40.79 | 86.00 | 32.82 | 1.72 | 34.54 | 108.28 | 228.82 |
| U.K. (1989/91) | 39.64 | 26.49 | 66.13 | 38.74 | 2.74 | 41.48 | 46.01 | 153.62 |
| Netherlands (1990) | 56.78 | 33.01 | 89.79 | 18.70 | 4.73 | 23.43 | 89.11 | 202.33 |
| Norway (1992) | a | a | a | a | a | $a$ | $a$ | a |
| Denmark (1992/93) | 82.17 | 2.86 | 85.02 | 46.36 | 0.00 | 46.36 | 115.27 | 246.65 |

## Source:

Compiled by Lawrence Berkeley Lab from: U. S. National Personal Transportation Survey (NPTS) for year 1990; United Kingdom National Travel Survey 1989/91; Swedish Travel Patterns Survey, Resvaneundersokningen, 1984; The German Kontiv, 1987; Dutch National Mobility Survey, De Mobiliteit van de Nederlandse bevolking, 1992 RVU Denmark. See Appendix C.

## Note:

The U. S. NPTS survey excludes persons under 5 years old ( $7.6 \%$ of the U. S. population for 1990); German Kontiv excludes persons under 6 years ( $5 \%$ of total pop. by 1989); Dutch NTS excludes persons under 12 years ( $19 \%$ of Dutch pop. by 1990); Danish NTS excludes persons under 15 years of age (17\% of pop. by 1992); Swedish NTS excludes persons under 15 years of age ( $18 \%$ of pop. by 1984).

## Special Note:

The way in which the Norwegian Travel Survey data was arranged in its final report did not report vehicle-miles by mode and purpose.
${ }^{\text {a }}$ Data are not available.

Table 1.13
Automobile Passenger Travel Statistics by Trip Purpose for Selected Countries

|  | Work | Workrelated | Total work | Family \& personal | Civic \& educational | Total family \& civic | Social \& recreational | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Number of weekly trips by automobile as a passenger |  |  |  |  |  |  |  |  |
| United States (1990) | 0.34 | 0.03 | 0.37 | 1.94 | 0.76 | 2.70 | 1.71 | 4.77 |
| Germany (1989) | 0.30 | 0.05 | 0.35 | 0.51 | 0.10 | 0.61 | 1.15 | 2.12 |
| Sweden (1984/85) | 0.37 | 0.11 | 0.48 | 0.84 | 0.05 | 0.89 | 2.04 | 3.41 |
| U.K. (1989/91) | 0.46 | 0.08 | 0.53 | 1.83 | 0.29 | 2.12 | 1.66 | 4.31 |
| Netherlands (1990) | 0.35 | 0.14 | 0.49 | 0.70 | 0.07 | 0.77 | 2.03 | 3.29 |
| Norway (1992) | 0.27 | 0.05 | 0.31 | 0.79 | 0.05 | 0.85 | 1.48 | 2.64 |
| Denmark (1992/93) | 0.41 | 0.00 | 0.42 | 0.48 | 0.00 | 0.48 | 1.11 | 2.02 |
| Weekly miles traveled per automobile passenger |  |  |  |  |  |  |  |  |
| United States (1990) | 9.93 | 2.40 | 12.33 | 48.49 | 9.80 | 58.29 | 100.63 | 171.24 |
| Germany (1989) | 7.46 | 1.75 | 9.21 | 8.60 | 1.68 | 10.28 | 42.10 | 61.59 |
| Sweden (1984/85) | 6.55 | 6.69 | 13.24 | 14.55 | 1.08 | 15.63 | 64.30 | 93.17 |
| U.K. (1989/91) | 8.32 | 3.98 | 12.30 | 29.48 | 2.74 | 32.22 | 56.42 | 100.94 |
| Netherlands (1990) | 11.60 | 5.52 | 17.12 | 10.03 | 2.25 | 12.28 | 65.68 | 95.08 |
| Denmark (1992/93) | 11.50 | 0.41 | 11.91 | 9.28 | 0.00 | 9.28 | 40.32 | 61.51 |

## Source:

Compiled by Lawrence Berkeley Lab from: U. S. National Personal Transportation Survey (NPTS) for year 1990; United Kingdom National Travel Survey 1989/91; Swedish Travel Patterns Survey, Resvaneundersokningen, 1984; The German Kontiv, 1987; Dutch National Mobility Survey, De Mobiliteit van de Nederlandse bevolking, 1992 RVU Denmark. See Appendix C.

## Note:

The U. S. NPTS survey excludes persons under 5 years old (7.6\% of the U. S. population for 1990); German Kontiv excludes persons under 6 years ( $5 \%$ of total pop. by 1989); Dutch NTS excludes persons under 12 years ( $19 \%$ of Dutch pop. by 1990); Danish NTS excludes persons under 15 years of age (17\% of pop. by 1992); Swedish NTS excludes persons under 15 years of age ( $18 \%$ of pop. by 1984.)

## Special Note:

The way in which the Norwegian Travel Survey data was arranged in its final report did not report vehicle-miles by mode and purpose.

## CHAPTER 2

## TRANSPORTATION ENERGY CHARACTERISTICS

## Table 2.1 Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978-96

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Due to gains during the processing of crude oil, the product yield from a barrel of crude oil is more than $100 \%$.

Table 2.1
Refinery Yield of Petroleum Products from a Barrel of Crude Oil, 1978-96
(percentage)

|  | Motor <br> Gasoline | Distillate <br> fuel oil | Jet fuel | Liquified <br> petroleum gas | Other $^{\text {b }}$ |
| :--- | :---: | :---: | :---: | :---: | :---: |

## Source:

Department of Energy, Energy Information Administration, Petroleum Supply Annual 1996, Vol. 1, June 1997, Table 19, p. 54, and annual. (Additional resources: http://www.eia.doe.gov)

[^9]Table 2.2
United States Petroleum Production and Consumption, 1973-96
(million barrels per day)

| Year | Domestic crude oil production | Net imports |  |  | Exports |  | U.S. petroleum consumption ${ }^{\text {a }}$ | World petroleum consumption | Net imports as a percentage of U.S. petroleum consumption | U.S. petroleum consumption as a percentage of world consumption | Transportation petroleum use as a percentage of domestic production ${ }^{\text {b }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{gathered} \text { Crude } \\ \text { oil } \end{gathered}$ | Petroleum products | Total | Crude oil | Petroleum products |  |  |  |  |  |
| 1973 | 9.21 | 3.24 | 2.78 | 6.03 | 0.00 | 0.23 | 17.31 | 56.39 | 34.8\% | 30.7\% | 91.5\% |
| 1974 | 8.77 | 3.47 | 2.42 | 5.89 | 0.00 | 0.22 | 16.65 | 55.91 | 35.4\% | 29.8\% | 93.7\% |
| 1975 | 8.37 | 4.10 | 1.75 | 5.85 | 0.00 | 0.20 | 16.32 | 55.48 | 35.8\% | 29.4\% | 99.4\% |
| 1976 | 8.13 | 5.28 | 1.81 | 7.09 | 0.00 | 0.22 | 17.46 | 58.74 | 40.6\% | 29.7\% | 107.6\% |
| 1977 | 8.25 | 6.57 | 2.00 | 8.57 | 0.05 | 0.19 | 18.43 | 61.63 | 46.5\% | 29.9\% | 110.2\% |
| 1978 | 8.71 | 6.20 | 1.80 | 8.00 | 0.16 | 0.20 | 18.85 | 63.30 | 42.4\% | 29.8\% | 108.7\% |
| 1979 | 8.55 | 6.28 | 1.70 | 7.99 | 0.24 | 0.24 | 18.51 | 65.17 | 43.2\% | 28.4\% | 109.6\% |
| 1980 | 8.60 | 4.98 | 1.39 | 6.37 | 0.29 | 0.26 | 17.06 | 63.07 | 37.3\% | 27.0\% | 104.4\% |
| 1981 | 8.57 | 4.17 | 1.23 | 5.40 | 0.23 | 0.37 | 16.06 | 60.87 | 33.6\% | 26.4\% | 103.7\% |
| 1982 | 8.65 | 3.25 | 1.05 | 4.30 | 0.24 | 0.58 | 15.30 | 59.50 | 28.1\% | 25.7\% | 100.6\% |
| 1983 | 8.69 | 3.17 | 1.15 | 4.31 | 0.16 | 0.58 | 15.23 | 58.74 | 28.3\% | 25.9\% | 101.1\% |
| 1984 | 8.88 | 3.25 | 1.47 | 4.72 | 0.18 | 0.54 | 15.73 | 59.84 | 30.0\% | 26.3\% | 102.3\% |
| 1985 | 8.97 | 3.00 | 1.29 | 4.29 | 0.20 | 0.58 | 15.73 | 60.10 | 27.3\% | 26.2\% | 102.6\% |
| 1986 | 8.68 | 4.02 | 1.41 | 5.44 | 0.15 | 0.63 | 16.28 | 61.76 | 33.4\% | 26.4\% | 110.3\% |
| 1987 | 8.35 | 4.52 | 1.39 | 5.91 | 0.15 | 0.61 | 16.67 | 63.00 | 35.5\% | 26.5\% | 118.1\% |
| 1988 | 8.14 | 4.95 | 1.63 | 6.59 | 0.16 | 0.66 | 17.28 | 64.82 | 38.1\% | 26.7\% | 125.4\% |
| 1989 | 7.61 | 5.70 | 1.50 | 7.20 | 0.14 | 0.72 | 17.33 | 65.92 | 41.5\% | 26.3\% | 135.7\% |
| 1990 | 7.36 | 4.79 | 1.38 | 6.17 | 0.11 | 0.75 | 16.99 | 65.99 | 42.1\% | 25.7\% | 140.0\% |
| 1991 | 7.42 | 5.67 | 0.96 | 6.63 | 0.12 | 0.89 | 16.71 | 66.58 | 39.7\% | 25.1\% | 136.6\% |
| 1992 | 7.17 | 5.99 | 0.94 | 6.94 | 0.09 | 0.86 | 17.03 | 66.74 | 40.8\% | 25.5\% | 143.7\% |
| 1993 | 6.85 | 6.69 | 0.93 | 7.62 | 0.10 | 0.90 | 17.24 | 67.04 | 44.2\% | 25.7\% | 153.1\% |
| 1994 | 6.66 | 6.96 | 1.09 | 8.05 | 0.10 | 0.84 | 17.72 | 68.31 | 45.4\% | 25.9\% | 161.9\% |
| 1995 | 6.56 | 7.13 | 0.75 | 7.88 | 0.10 | 0.86 | 17.73 | 69.38 | 44.4\% | 25.6\% | 167.1\% |
| 1996 | 6.47 | 7.37 | 1.05 | 8.42 | 0.11 | 0.87 | 18.23 |  | 46.2\% |  | 172.7\% |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |  |
| 1973-96 | -1.5\% | 3.6\% | -4.1\% | 1.5\% | - | 6.0\% | 0.2\% | 0.9\% ${ }^{\text {d }}$ |  |  |  |
| 1986-96 | -2.9\% | 6.2\% | -2.9\% | 4.5\% | -3.1\% | 3.3\% | 1.1\% | 1.3\% ${ }^{\text {d }}$ |  |  |  |

## Source:

U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, February 97, pp. 42-47

World petroleum consumption - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, December1996, p. 7.
(Additional resources: http://www.eia.doe.gov)
${ }^{\text {a }}$ Best estimate for U.S. petroleum consumption is the amount of petroleum products supplied to the U.S. in a given year. This is not the sum of crude oil production and net imports due to processing gain and stock changes.
${ }^{\mathrm{b}}$ Transportation petroleum use can be found on Table 2.5
${ }^{\text {c }}$ Data are not available.
${ }^{\text {d }}$ Average annual percentage change is for years 1973-93 and 1985-93.

Figure 2.1. United States Petroleum Production and Consumption, 1973-96


Source:
See Tables 2.2 and 2.5

Table 2.3
U. S. Imported Crude Oil and Petroleum Products by Country of Origin, 1990-95

| Country | 1990 |  | 1994 |  | 1995 |  | Percent of total 1995 |  | Percent change 1990-95 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Crude oil | Petroleum products | Crude oil | Petroleum products | Crude oil | Petroleum products | Crude oil | Petroleum products | Crude oil | Petroleum products |
| Arab OPEC | 680,248 | 138,964 | 597,174 | 122,055 | 549,471 | 109,741 | 20.8\% | 18.7\% | -19.2\% | -21.0\% |
| Algeria | 23,035 | 79,280 | 7,714 | 81,030 | 9,789 | 75,686 | 0.4\% | 12.9\% | -57.5\% | -4.5\% |
| Iraq | 187,485 | 1,620 | 0 | 0 | 0 | 0 | 0.0\% | 0.0\% | -100.0\% | -100.0\% |
| Kuwait | 28,942 | 2,576 | 112,073 | 1,891 | 77,903 | 1,765 | 3.0\% | 0.3\% | 169.2\% | -31.5\% |
| Qatar | 1,293 | 0 | 0 | 0 | 0 | 0 | 0.0\% | 0.0\% | -100.0\% | 0.0\% |
| Saudi Arabia | 436,193 | 52,625 | 473,356 | 38,555 | 459,826 | 30,661 | 17.4\% | 5.2\% | 5.4\% | -41.7\% |
| United Arab Emirates | 3,300 | 2,863 | 4,031 | 579 | 1,953 | 1,629 | 0.1\% | 0.3\% | -40.8\% | -43.1\% |
| Other OPEC | $\mathbf{6 0 2 , 1 8 3}$ | 146,698 | 709,495 | 121,429 | 753,470 | 131,550 | 28.6\% | 22.5\% | $\mathbf{2 5 . 1 \%}$ | -10.3\% |
| Ecuador | 13,886 | 3,845 | a | a | a | a | a | a | a | a |
| Gabon | 23,349 | 105 | 70,806 | 111 | 83,642 | 0 | 3.2\% | 0.0\% | 258.2\% | -100.0\% |
| Indonesia | 35,912 | 5,836 | 33,526 | 7,033 | 23,258 | 8,840 | 0.9\% | 1.5\% | -35.2\% | 51.5\% |
| Iran | 0 | 0 | 0 | 0 | 0 | 0 | 0.0\% | 0.0\% | 0.0\% | 0.0\% |
| Nigeria | 286,126 | 5,833 | 227,638 | 5,002 | 226,574 | 2,410 | 8.6\% | 0.4\% | -20.8\% | -58.7\% |
| Venezuela | 242,910 | 131,079 | 377,525 | 109,283 | 419,996 | 120,300 | 15.9\% | 20.5\% | 72.9\% | -8.2\% |
| Non-OPEC | 868,956 | 489,346 | 1,271,403 | 462,065 | 1,335,869 | 344,652 | 50.6\% | 58.8\% | 53.7\% | -29.6\% |
| Total | 2,151,387 | 775,008 | 2,578,072 | 705,549 | 2,638,810 | 585,943 | 100.0\% | 100.0\% | 22.7\% | -24.4\% |
| Persian Gulf ${ }^{\text {b }}$ | 657,213 | 59,684 | 589,460 | 41,271 | 539,682 | 34,350 | 20.5\% | 5.9\% | -17.9\% | -42.4\% |

## Source:

Energy Information Administration, Petroleum Supply Annual 1995, Volume 1, May 1996, p. 56, and annual.
(Additional resources: http://www.eia.doe.gov)

[^10]Table 2.4
World Crude Oil Production by Country of Origin, 1980-95
(thousand barrels per day)

| Country | 1980 | 1985 | 1987 | 1990 | 1991 | 1993 | 1994 | 1995 | Percent of total 1995 | Percent change 1990-95 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Arab OPEC | 17,357 | 8,375 | 10,811 | 13,323 | 12,621 | 14,296 | 14,486 | 14,812 | 23.7\% | -11.2\% |
| Algeria | 1,106 | 1,037 | 1,048 | 1,175 | 1,230 | 1,162 | 1,180 | 1,202 | 1.9\% | 2.3\% |
| Iraq | 2,514 | 1,433 | 2,079 | 2,040 | 305 | 512 | 553 | 560 | 0.9\% | -72.5\% |
| Kuwait | 1,656 | 1,023 | 1,585 | 1,175 | 190 | 1,852 | 2,025 | 2,057 | 3.3\% | 75.1\% |
| Qatar | 472 | 301 | 293 | 406 | 395 | 413 | 415 | 483 | 0.8\% | 19.0\% |
| Saudi Arabia | 9,900 | 3,388 | 4,265 | 6,410 | 8,115 | 8,198 | 8,120 | 8,231 | 13.2\% | 28.4\% |
| United Arab Emirates | 1,709 | 1,193 | 1,541 | 2,117 | 2,386 | 2,159 | 2,193 | 2,279 | 3.6\% | 7.7\% |
| Other OPEC ${ }^{\text {a }}$ | 7,666 | 7,028 | 6,908 | 8,782 | 9,470 | 9,807 | 10,012 | 10,281 | 16.5\% | 17.1\% |
| Ecuador | 204 | 281 | 174 | 285 | 299 | 346 | 365 | 392 | 0.6\% | 37.5\% |
| Indonesia | 1,577 | 1,325 | 1,343 | 1,462 | 1,592 | 1,511 | 1,510 | 1,503 | 2.4\% | 2.8\% |
| Iran | 1,662 | 2,250 | 2,298 | 3,088 | 3,312 | 3,540 | 3,618 | 3,643 | 5.8\% | 18.0\% |
| Nigeria | 2,055 | 1,495 | 1,341 | 1,810 | 1,892 | 1,960 | 1,931 | 1,993 | 3.2\% | 10.1\% |
| Venezuela | 2,168 | 1,677 | 1,752 | 2,137 | 2,375 | 2,450 | 2,588 | 2,750 | 4.4\% | 28.7\% |
| North America | 11,968 | 13,187 | 12,432 | 11,461 | 11,644 | 11,199 | 11,093 | 10,982 | 17.6\% | 4.2\% |
| All others | 22,608 | 25,391 | 26,515 | 27,000 | 26,472 | 24,945 | 25,412 | 26,371 | 42.2\% | -2.3\% |
| Total | 59,599 | 53,981 | 56,666 | 60,566 | 60,207 | 60,247 | 61,003 | 62,446 | 100.0\% | 3.1\% |
| Persian Gulf ${ }^{\text {b }}$ | 16,299 | 7,380 | 9,805 | 12,190 | 11,429 | 13,233 | 13,347 | 13,651 | 21.9\% | 12.0\% |

## Source:

U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, December 1996, pp. 25-26.
(Additional resources: http://www.eia.doe.gov)

[^11]Table 2.5
Consumption of Petroleum by End-Use Sector, 1973-96
(quadrillion Btu)

| Year | Transportation | Percentage | Residential and commercial | Percentage | Industrial | Percentage | Electric utilities | Percentage | Total | Total in million barrels per day ${ }^{\text {a }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1973 | 17.83 | 51.2\% | 4.39 | 12.6\% | 9.10 | 26.1\% | 3.52 | 10.1\% | 34.84 | 16.46 |
| 1974 | 17.40 | 52.0\% | 4.00 | 12.0\% | 8.69 | 26.0\% | 3.37 | 10.1\% | 33.46 | 15.81 |
| 1975 | 17.61 | 53.8\% | 3.81 | 11.6\% | 8.15 | 24.9\% | 3.17 | 9.7\% | 32.74 | 15.47 |
| 1976 | 18.51 | 52.6\% | 4.18 | 11.9\% | 9.01 | 25.6\% | 3.48 | 9.9\% | 35.18 | 16.62 |
| 1977 | 19.24 | 51.8\% | 4.21 | 11.3\% | 9.77 | 26.3\% | 3.90 | 10.5\% | 37.12 | 17.53 |
| 1978 | 20.04 | 52.8\% | 4.07 | 10.7\% | 9.87 | 26.0\% | 3.99 | 10.5\% | 37.97 | 17.94 |
| 1979 | 19.83 | 53.4\% | 3.45 | 9.3\% | 10.57 | 28.5\% | 3.28 | 8.8\% | 37.13 | 17.54 |
| 1980 | 19.01 | 55.6\% | 3.04 | 8.9\% | 9.53 | 27.9\% | 2.63 | 7.7\% | 34.21 | 16.16 |
| 1981 | 18.81 | 58.9\% | 2.63 | 8.2\% | 8.29 | 26.0\% | 2.20 | 6.9\% | 31.93 | 15.08 |
| 1982 | 18.42 | 60.9\% | 2.45 | 8.1\% | 7.79 | 25.8\% | 1.57 | 5.2\% | 30.23 | 14.28 |
| 1983 | 18.59 | 61.9\% | 2.50 | 8.3\% | 7.42 | 24.7\% | 1.54 | 5.1\% | 30.05 | 14.19 |
| 1984 | 19.22 | 61.9\% | 2.54 | 8.2\% | 8.01 | 25.8\% | 1.29 | 4.2\% | 31.06 | 14.67 |
| 1985 | 19.50 | 63.1\% | 2.52 | 8.2\% | 7.81 | 25.3\% | 1.09 | 3.5\% | 30.92 | 14.61 |
| 1986 | 20.27 | 63.0\% | 2.56 | 8.0\% | 7.92 | 24.6\% | 1.45 | 4.5\% | 32.20 | 15.21 |
| 1987 | 20.87 | 63.5\% | 2.59 | 7.9\% | 8.15 | 24.8\% | 1.26 | 3.8\% | 32.87 | 15.53 |
| 1988 | 21.63 | 63.2\% | 2.60 | 7.6\% | 8.43 | 24.6\% | 1.56 | 4.6\% | 34.22 | 16.16 |
| 1989 | 21.87 | 63.9\% | 2.53 | 7.4\% | 8.13 | 23.8\% | 1.69 | 4.9\% | 34.22 | 16.16 |
| 1990 | 21.81 | 65.0\% | 2.17 | 6.5\% | 8.32 | 24.8\% | 1.25 | 3.7\% | 33.55 | 15.85 |
| 1991 | 21.46 | 65.3\% | 2.15 | 6.5\% | 8.06 | 24.5\% | 1.18 | 3.6\% | 32.85 | 15.52 |
| 1992 | 21.81 | 65.0\% | 2.13 | 6.4\% | 8.64 | 25.8\% | 0.95 | 2.8\% | 33.53 | 15.84 |
| 1993 | 22.20 | 65.6\% | 2.14 | 6.3\% | 8.45 | 25.0\% | 1.05 | 3.1\% | 33.84 | 15.98 |
| 1994 | 22.82 | 65.7\% | 2.09 | 6.0\% | 8.85 | 25.5\% | 0.97 | 2.8\% | 34.73 | 16.41 |
| 1995 | 23.20 | 66.9\% | 2.12 | 6.1\% | 8.69 | 25.1\% | 0.66 | 1.9\% | 34.67 | 16.38 |
| 1996 | 23.66 | 66.2\% | 2.22 | 6.2\% | 9.11 | 25.5\% | 0.73 | 2.0\% | 35.72 | 16.87 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |
| 1973-96 | 1.2\% |  | -3.1\% |  | 0.0\% |  | -6.6\% |  | 0.1\% | 0.1\% |
| 1986-96 | 1.6\% |  | -1.4\% |  | 1.4\% |  | -6.6\% |  | 1.0\% | 1.0\% |

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, pp. 27, 29, 31, 33.
(Additional resources: http://www.eia.doe.gov)

[^12]Pipeline fuel, which is included in the transportation sector energy use, has grown at an annual rate of 3.4\% from 1985-95. Natural gas vehicle fuel consumption was first reported in 1990 and has shown growth in recent years.

Table 2.6 Natural Gas Consumption in the United States, 1970-95
(quadrillion Btu)

| Year | Lease and plant fuel | Pipeline fuel | Delivered to consumers |  |  |  |  |  | Total consumption |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Residential | Commercial | Industrial | Vehicle fuel | Electric utilities | Total |  |
| 1970 | 1.428 | 0.737 | 4.939 | 2.449 | 8.016 | a | 4.014 | 19.418 | 21.583 |
| 1975 | 1.426 | 0.595 | 5.028 | 2.561 | 7.115 | a | 3.224 | 17.927 | 19.948 |
| 1980 | 1.048 | 0.648 | 4.852 | 2.666 | 7.322 | a | 3.759 | 18.599 | 20.295 |
| 1981 | 0.947 | 0.656 | 4.642 | 2.573 | 7.277 | a | 3.717 | 18.208 | 19.811 |
| 1982 | 1.133 | 0.609 | 4.730 | 2.660 | 5.954 | a | 3.293 | 16.637 | 18.379 |
| 1983 | 0.999 | 0.500 | 4.473 | 2.484 | 5.761 | a | 2.972 | 15.689 | 17.188 |
| 1984 | 1.099 | 0.540 | 4.651 | 2.577 | 6.283 | a | 3.177 | 16.688 | 18.327 |
| 1985 | 0.986 | 0.514 | 4.526 | 2.483 | 6.025 | a | 3.108 | 16.143 | 17.644 |
| 1986 | 0.942 | 0.495 | 4.405 | 2.367 | 5.696 | a | 2.657 | 15.125 | 16.562 |
| 1987 | 1.174 | 0.530 | 4.405 | 2.481 | 6.078 | a | 2.904 | 15.869 | 17.572 |
| 1988 | 1.119 | 0.627 | 4.728 | 2.727 | 6.517 | a | 2.691 | 16.663 | 18.408 |
| 1989 | 1.092 | 0.643 | 4.881 | 2.775 | 6.959 | ${ }^{\text {a }}$ | 2.846 | 17.461 | 19.196 |
| 1990 | 1.262 | 0.674 | 4.484 | 2.678 | 7.166 | 0.000 | 2.845 | 17.172 | 19.108 |
| 1991 | 1.153 | 0.614 | 4.651 | 2.786 | 7.383 | 0.000 | 2.848 | 17.668 | 19.435 |
| 1992 | 1.195 | 0.600 | 4.789 | 2.862 | 7.685 | 0.001 | 2.824 | 18.159 | 19.955 |
| 1993 | 1.197 | 0.637 | 5.061 | 2.922 | 8.149 | 0.001 | 2.739 | 18.871 | 20.705 |
| 1994 | 1.147 | 0.700 | 4.950 | 2.956 | 8.339 | 0.002 | 3.050 | 19.269 | 21.143 |
| 1995 | 1.246 | 0.715 | 4.952 | 3.095 | 8.760 | 0.003 | 3.264 | 20.073 | 22.034 |
|  |  |  |  | Average annu | rcentage ch |  |  |  |  |
| 1970-95 | -0.5\% | -0.1\% | 0.0\% | 0.9\% | 0.4\% | a | -0.8\% | 0.1\% | 0.1\% |
| 1985-95 | 2.4\% | 3.4\% | 0.9\% | 2.2\% | 3.8\% | a | 0.5\% | 1.5\% | 2.2\% |

U. S. Department of Energy, Energy Information Administration, Natural Gas Annual 1995, Washington, DC, Table 101, p. 205.
(Additional resources: http://www.eia.doe.gov)
Note:
All volumes are for standard conditions of atmospheric pressure and 60 degrees Fahrenheit converted to Btu using 1,021 Btu/cubic foot.
${ }^{a}$ Data are not available.

Table 2.7
Distribution of Energy Consumption by Source, 1973 and 1996 (percentage)

| Energy source | Transportation |  | Residential \& Commercial |  | Industrial |  | Electric utilities |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1973 | 1996 | 1973 | 1996 | 1973 | 1996 | 1973 | 1995 |
| Petroleum | 95.8 | 96.8 | 18.2 | 6.8 | 28.9 | 28.0 | 17.7 | 2.3 |
| Natural gas ${ }^{\text {a }}$ | 4.0 | 3.0 | 31.6 | 26.6 | 32.9 | 31.6 | 18.9 | 8.6 |
| Coal | 0.0 | 0.0 | 1.1 | 0.4 | 12.8 | 7.4 | 43.6 | 55.1 |
| Hydroelectric | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 15.0 | 11.6 |
| Nuclear | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.6 | 22.0 |
| Electricity ${ }^{\text {b }}$ | 0.2 | 0.2 | 49.2 | 66.2 | 25.2 | 32.9 | 0.0 | 0.0 |
| Other ${ }^{\text {c }}$ | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.4 |
| Total | 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 1997, Washington, DC, pp. 27, 29, 31, 33.
(Additional resources: http:/www.eia.doe.gov)

[^13]Total energy use was nearly 90 quads in 1996. The transportation sector continues to account for more than $27 \%$ of total energy use.

Table 2.8
Consumption of Total Energy by End-Use Sector, 1970-96
(quadrillion Btu)

| Year | Transportation | Percentage transportation of total | Residential and commercial | Industrial | Total |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 16.07 | 24.2\% | 21.71 | 28.65 | 66.43 |
| 1971 | 16.70 | 24.6\% | 22.59 | 28.59 | 67.88 |
| 1972 | 17.70 | 24.8\% | 23.69 | 29.88 | 71.27 |
| 1973 | 18.61 | 25.1\% | 24.14 | 31.53 | 74.28 |
| 1974 | 18.12 | 25.0\% | 23.73 | 30.69 | 72.54 |
| 1975 | 18.24 | 25.9\% | 23.90 | 28.40 | 70.54 |
| 1976 | 19.10 | 25.7\% | 25.02 | 30.24 | 74.36 |
| 1977 | 19.82 | 26.0\% | 25.39 | 31.08 | 76.29 |
| 1978 | 20.61 | 26.4\% | 26.08 | 31.39 | 78.09 |
| 1979 | 20.47 | 25.9\% | 25.81 | 32.62 | 78.90 |
| 1980 | 19.70 | 25.9\% | 25.66 | 30.61 | 75.96 |
| 1981 | 19.51 | 26.4\% | 25.24 | 29.24 | 73.99 |
| 1982 | 19.07 | 26.9\% | 25.63 | 26.15 | 70.85 |
| 1983 | 19.13 | 27.1\% | 25.63 | 25.76 | 70.52 |
| 1984 | 19.80 | 26.7\% | 26.47 | 27.87 | 74.14 |
| 1985 | 20.07 | 27.1\% | 26.70 | 27.21 | 73.98 |
| 1986 | 20.81 | 28.0\% | 26.85 | 26.63 | 74.30 |
| 1987 | 21.45 | 27.9\% | 27.62 | 27.83 | 76.89 |
| 1988 | 22.31 | 27.8\% | 28.93 | 28.99 | 80.22 |
| 1989 | 22.56 | 27.7\% | 29.40 | 29.35 | 81.33 |
| 1990 | 22.54 | 27.7\% | 28.79 | 29.94 | 81.27 |
| 1991 | 22.12 | 27.3\% | 29.42 | 29.57 | 81.12 |
| 1992 | 22.46 | 27.3\% | 29.10 | 30.58 | 82.14 |
| 1993 | 22.88 | 27.3\% | 30.23 | 30.75 | 83.86 |
| 1994 | 23.57 | 27.5\% | 30.43 | 31.58 | 85.59 |
| 1995 | 23.96 | 27.5\% | 31.31 | 31.92 | 87.19 |
| 1996 | 24.44 | 27.2\% | 32.84 | 32.58 | 89.89 |
| Average annual percentage change |  |  |  |  |  |
| 1970-96 | 1.6\% |  | 1.6\% | 0.5\% | 1.2\% |
| 1986-96 | 1.6\% |  | 2.0\% | 2.0\% | 1.9\% |

## Source:

U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 2.2, p. 25. (Additional resources: http://www.eia.doe.gov)
${ }^{\text {a }}$ Electrical energy losses have been distributed among the sectors.

Although the automobile energy use for 1995 is lower than in 1994 [Edition 16], it is due to a reclassification of minivans and sport utility vehicles by the Federal Highway Administraion rather than a real usage decline. The sum of automobiles and light trucks will stil produce a consistent trend. LPG shares from the 1992 Truck Inventory and Use Survey indicate an increase in truck LPG use.

Table 2.9
Domestic Consumption of Transportation Energy by Mode and Fuel Type, 1995 (trillion Btu)

|  | Gasoline | Diesel fuel | Liquified petroleum gas | Jet fuel | Residual fuel oil | Natural <br> gas | Electricity | Methanol |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HIGHWAY | 14,492.0 | 3,820.3 | 25.5 |  |  | 3.0 | 1.2 | 0.7 |
| Automobiles | 8,434.3 ${ }^{\text {b }}$ | 113.7 |  |  |  | 1.9 |  | 0.0 |
| Motorcycles | 24.5 |  |  |  |  |  |  |  |
| Buses | 44.0 | 168.8 | 0.2 |  |  | 1.0 | 1.2 | 0.7 |
| Transit | 5.4 | 79.0 | 0.2 |  |  | 1.0 | 1.2 | 0.7 |
| Intercity ${ }^{\text {c }}$ |  | 25.4 |  |  |  |  |  |  |
| School ${ }^{\text {c }}$ | 38.6 | 64.4 |  |  |  |  |  | 0.0 |
| Trucks | 5,989.2 | 3,537.8 | 25.3 |  |  | 0.1 |  | 0.0 |
| Light trucks ${ }^{\text {d }}$ | 5,405.2 | 205.7 | 12.2 |  |  | 0.1 |  | 0.0 |
| Other trucks | 584.0 | 3,332.1 | 13.1 |  |  | 0.0 |  | 0.0 |
| OFF-HIGHWAY | 150.8 | $570.1{ }^{\text {e }}$ |  |  |  |  |  |  |
| Construction | 35.0 | $178.5{ }^{\text {e }}$ |  |  |  |  |  |  |
| Agriculture | 115.8 | $391.6{ }^{\text {e }}$ |  |  |  |  |  |  |
| NONHIGHWAY | 318.0 | 778.1 |  | 2,084.0 | 962.7 | 722.1 | 310.0 |  |
| Air | 33.2 |  |  | 2,084.0 |  |  |  |  |
| General aviation | 33.2 |  |  | 73.4 |  |  |  |  |
| Domestic air carriers |  |  |  | 1,710.7 |  |  |  |  |
| International air carriers ${ }^{\text {f }}$ |  |  |  | 299.9 |  |  |  |  |
| Water | 284.8 | 274.3 |  |  | 962.7 |  |  |  |
| Freight |  | 274.3 |  |  | 962.7 |  |  |  |
| Recreational | 284.8 |  |  |  |  |  |  |  |
| Pipeline |  |  |  |  |  | 722.1 | 248.4 |  |
| Rail |  | 503.8 |  |  |  |  | 61.6 |  |
| Freight (Class I) |  | 485.9 |  |  |  |  |  |  |
| Passenger |  | 17.9 |  |  |  |  | 61.6 |  |
| Transit |  |  |  |  |  |  | 43.6 |  |
| Commuter |  | 8.7 |  |  |  |  | 14.7 |  |
| Intercity ${ }^{\text {c }}$ |  | 9.2 |  |  |  |  | 3.3 |  |
| TOTAL | 14,960.8 | 5,168.5 | 25.5 | 2,084.0 | 962.7 | 725.1 | 311.2 | 0.7 |

Source:
See Appendix A for Table 2.9.

[^14]Table 2.10
Transportation Energy Use by Mode, 1994-95

|  | Trillion Btu |  | Thousand barrels per day crude oil equivalent ${ }^{\text {b }}$ |  | Percentage of total |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1994 | 1995 | 1994 | 1995 | 1994 | 1995 |
| HIGHWAY | 18,010.3 | 18,342.7 | 8,507.5 | 8,664.5 | 76.0\% | 75.7\% |
| Automobiles | 8,449.3 | 8,549.9 | 3,991.2 | 4,038.7 | 35.7\% | 35.3\% |
| Motorcycles | 25.6 | 24.5 | 12.1 | 11.6 | 0.1\% | 0.1\% |
| Buses | 202.1 | 215.9 | 95.5 | 102.0 | 0.9\% | 0.9\% |
| Transit | 86.7 | 87.5 | 41.0 | 41.3 | 0.4\% | 0.4\% |
| Intercity | 24.7 | $25.4{ }^{\text {c }}$ | 11.7 | 12.0 | 0.1\% | 0.1\% |
| School | 90.7 | $103.0^{\text {c }}$ | 42.8 | 48.7 | 0.4\% | 0.4\% |
| Trucks | 9,333.3 | 9,552.4 | 4,408.7 | 4,512.2 | 39.4\% | 39.4\% |
| Light trucks ${ }^{\text {d }}$ | 5,557.4 ${ }^{\text {c }}$ | 5,623.2 | 2,625.1 | 2,656.2 | 23.5\% | 23.2\% |
| Other trucks | 3,775.9 | 3,929.2 | 1,783.6 | 1,856.0 | 15.9\% | 16.2\% |
| OFF-HIGHWAY | 716.4 | 720.9 | 338.4 | 340.5 | 3.0\% | 3.0\% |
| Construction | 211.8 | 213.5 | 100.0 | 100.9 | 0.9\% | 0.9\% |
| Agriculture | 504.6 | 507.4 | 238.4 | 239.7 | 2.1\% | 2.1\% |
| NONHIGHWAY | 4,971.3 | 5,174.9 | 2,348.3 | 2,444.4 | 21.0\% | 21.3\% |
| Air | 2,056.0 | 2,117.2 | 971.2 | 1,000.1 | 8.7\% | 8.7\% |
| General aviation | 95.3 | 106.6 | 45.0 | 50.4 | 0.4\% | 0.4\% |
| Domestic air carriers | 1,671.9 | 1,710.7 | 789.7 | 808.1 | 7.1\% | 7.1\% |
| International air carriers | 288.8 | 299.9 | 136.4 | 141.7 | 1.2\% | 1.2\% |
| Water | 1,413.8 | 1,521.8 | 667.8 | 718.8 | 6.0\% | 6.3\% |
| Freight | 1,171.1 | 1,237.0 | 553.2 | 584.3 | 4.9\% | 5.1\% |
| Recreational | 242.7 | 284.8 | 114.6 | 134.5 | 1.0\% | 1.2\% |
| Pipeline | 955.2 | 970.5 | 451.2 | 458.4 | 4.0\% | 4.0\% |
| Rail | 546.3 | 565.4 | 258.1 | 267.1 | 2.3\% | 2.3\% |
| Freight | 465.4 | 485.9 | 219.8 | 229.5 | 2.0\% | 2.0\% |
| Passenger | 80.9 | 79.5 | 38.2 | 37.6 | 0.3\% | 0.3\% |
| Transit | 43.9 | 43.6 | 20.7 | 20.6 | 0.2\% | 0.2\% |
| Commuter | 23.2 | 23.4 | 11.0 | 11.1 | 0.1\% | 0.1\% |
| Intercity | 13.8 | $12.5{ }^{\text {c }}$ | 6.5 | 5.9 | 0.1\% | 0.1\% |
| TOTAL | 23,698.0 | 24,238.5 | 11,194.1 | 11,449.5 | 100.0\% | 100.0\% |

Source: See Appendix A for Table 2.9.

[^15]Starting with the 1993 data, the automobile and light truck categories were redefined to include minivans andsport utility vehicles in the light truck category.
The sum of these categories will still produce a consistent trend.

Table 2.11
Transportation Energy Consumption by Mode, 1970-95 (trillion Btu)

|  |  |  |  |  |  | ilion |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Year | Automobiles | Motorcycles | Buses ${ }^{\text {a }}$ | Light trucks ${ }^{\text {b }}$ | Other trucks | Total highway | Air | Water | Pipeline | Rail ${ }^{\text {c }}$ | Total nonhighway | Total transportation ${ }^{\text {d }}$ |
| 1970 | 8,527 | 7 | 109 | 1,540 | 1,503 | 11,688 | 1,307 | 753 | 985 | 558 | 3,603 | 15,291 |
| 1971 | 8,971 | 9 | 108 | 1,687 | 1,568 | 12,343 | 1,304 | 698 | 1,007 | 560 | 3,569 | 15,912 |
| 1972 | 9,583 | 11 | 106 | 1,895 | 1,684 | 13,279 | 1,314 | 703 | 1,039 | 583 | 3,639 | 16,918 |
| 1973 | 9,891 | 13 | 109 | 2,105 | 1,844 | 13,962 | 1,377 | 827 | 996 | 619 | 3,819 | 17,781 |
| 1974 | 9,440 | 14 | 113 | 2,083 | 1,791 | 13,441 | 1,254 | 804 | 932 | 624 | 3,614 | 17,055 |
| 1975 | 9,611 | 14 | 119 | 2,239 | 1,789 | 13,772 | 1,274 | 851 | 835 | 563 | 3,523 | 17,295 |
| 1976 | 10,020 | 15 | 129 | 2,522 | 1,949 | 14,635 | 1,333 | 1,001 | 803 | 585 | 3,722 | 18,357 |
| 1977 | 10,108 | 16 | 132 | 2,739 | 2,156 | 15,151 | 1,411 | 1,103 | 781 | 595 | 3,890 | 19,041 |
| 1978 | 10,267 | 18 | 135 | 3,009 | 2,408 | 15,837 | 1,467 | 1,311 | 781 | 589 | 4,148 | 19,985 |
| 1979 | 9,719 | 22 | 137 | 3,095 | 2,510 | 15,483 | 1,568 | 1,539 | 856 | 613 | 4,576 | 20,059 |
| 1980 | 9,037 | 26 | 139 | 2,951 | 2,425 | 14,578 | 1,528 | 1,677 | 889 | 596 | 4,690 | 19,268 |
| 1981 | 8,927 | 27 | 143 | 2,964 | 2,461 | 14,522 | 1,455 | 1,562 | 899 | 565 | 4,481 | 19,003 |
| 1982 | 8,814 | 25 | 146 | 2,982 | 2,430 | 14,397 | 1,468 | 1,290 | 853 | 488 | 4,096 | 18,493 |
| 1983 | 8,762 | 22 | 145 | 3,196 | 2,598 | 14,723 | 1,505 | 1,187 | 738 | 482 | 3,912 | 18,635 |
| 1984 | 8,613 | 22 | 154 | 3,463 | 2,837 | 15,089 | 1,633 | 1,251 | 780 | 523 | 4,187 | 19,276 |
| 1985 | 8,673 | 23 | 161 | 3,630 | 2,924 | 15,411 | 1,678 | 1,311 | 758 | 487 | 4,234 | 19,645 |
| 1986 | 8,917 | 23 | 154 | 3,785 | 3,007 | 15,885 | 1,823 | 1,295 | 738 | 423 | 4,329 | 20,214 |
| 1987 | 8,836 | 24 | 157 | 4,036 | 3,132 | 16,185 | 1,894 | 1,326 | 775 | 485 | 4,480 | 20,665 |
| 1988 | 9,005 | 25 | 159 | 4,114 | 3,315 | 16,618 | 1,978 | 1,338 | 878 | 498 | 4,692 | 21,310 |
| 1989 | 9,106 | 26 | 163 | 4,139 | 3,386 | 16,820 | 1,981 | 1,376 | 895 | 501 | 4,753 | 21,573 |
| 1990 | 9,010 | 24 | 163 | 4,130 | 3,366 | 16,693 | 2,059 | 1,487 | 928 | 492 | 4,966 | 21,659 |
| 1991 | 8,845 | 23 | 174 | 4,080 | 3,302 | 16,424 | 1,926 | 1,567 | 864 | 463 | 4,820 | 21,244 |
| 1992 | 9,237 | 24 | 182 | 4,155 | 3,381 | 16,971 | 1,971 | 1,641 | 849 | 476 | 4,937 | 21,908 |
| 1993 | 9,204 | 25 | 192 | 4,563 | 3,542 | 17,527 | 1,996 | 1,473 | 889 | 513 | 4,871 | 22,399 |
| 1994 | 8,449 | 26 | 202 | 5,557 | 3,776 | 18,010 | 2,056 | 1,414 | 955 | 546 | 4,971 | 22,981 |
| 1995 | 8,550 | 25 | 216 | 5,623 | 3,929 | 18,343 | 2,117 | 1,522 | 971 | 565 | 5,174 | 23,517 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |  |  |
| 1970-95 | 0.0\% | 5.2\% | 2.8\% | 5.3\% | 3.9\% | 1.8\% | 1.9\% | 2.9\% | -0.1\% | 0.0\% | 1.5\% | 1.7\% |
| 1985-95 | -0.1\% | 0.8\% | 3.0\% | 4.5\% | 3.0\% | 1.8\% | 2.4\% | 1.5\% | 2.5\% | 1.5\% | 2.0\% | 1.8\% |

Source:
See Appendix A for Table 2.11.
${ }^{\text {a }}$ Beginning in 1992 data became available on alternative fuel use by transit buses.
${ }^{\text {b }}$ Light trucks include only those trucks which have two-axles and four-tires. Starting in 1993, this category includes minivans and sport utility vehicles.
${ }^{\circ}$ This data have changed from previous editions due to a change in source for Class I freight railroad energy use. Previous estimates were based on sales.
${ }^{\mathrm{d}}$ 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 Federal Highway Administration cautions that data from 1993-on may not be directly comparable $D$ earlier years. Some states have improved reporting procedures in recent years, and the estimation procedures were revised in 1994.

Table 2.12
Highway Usage of Gasoline and Special Fuels, 1973-95
(million gallons)

| Year | Gasoline | Gasohol | Total gasoline and gasohol | Special fuels ${ }^{\text {a }}$ | Percent special fuels | Total highway fuel use |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1973 | ${ }^{\text {b }}$ | ${ }^{\text {b }}$ | 100,636 | 9,837 | 8.9\% | 110,473 |
| 1974 | ${ }^{\text {b }}$ | ${ }^{\text {b }}$ | 96,505 | 9,796 | 9.2\% | 106,301 |
| 1975 | ${ }^{\text {b }}$ | ${ }^{\text {b }}$ | 99,354 | 9,631 | 8.8\% | 108,985 |
| 1976 | ${ }^{\text {b }}$ | b | 104,978 | 10,721 | 9.3\% | 115,699 |
| 1977 | b | b | 107,978 | 11,646 | 9.7\% | 119,624 |
| 1978 | b | b | 112,239 | 12,828 | 10.3\% | 125,067 |
| 1979 | b | b | 108,126 | 13,989 | 11.5\% | 122,115 |
| 1980 | 100,686 | 497 | 101,183 | 13,777 | 12.0\% | 114,960 |
| 1981 | 98,884 | 713 | 99,597 | 14,856 | 13.0\% | 114,453 |
| 1982 | 96,220 | 2,259 | 98,479 | 14,905 | 13.1\% | 113,384 |
| 1983 | 95,852 | 4,254 | 100,106 | 15,975 | 13.8\% | 116,081 |
| 1984 | 95,996 | 5,420 | 101,416 | 17,320 | 14.6\% | 118,736 |
| 1985 | 95,567 | 8,004 | 103,571 | 17,751 | 14.6\% | 121,322 |
| 1986 | 98,618 | 8,138 | 106,756 | 18,427 | 14.7\% | 125,183 |
| 1987 | 101,790 | 6,912 | 108,702 | 19,046 | 14.9\% | 127,748 |
| 1988 | 101,678 | 8,138 | 109,816 | 20,070 | 15.5\% | 129,886 |
| 1989 | 103,691 | 6,941 | 110,632 | 21,232 | 16.1\% | 131,864 |
| 1990 | 102,645 | 7,539 | 110,184 | 21,399 | 16.3\% | 131,583 |
| 1991 | 99,304 | 8,644 | 107,948 | 20,676 | 16.1\% | 128,624 |
| 1992 | 102,119 | 8,831 | 110,950 | 21,988 | 16.5\% | 132,938 |
| 1993 | 103,417 | 10,287 | 113,704 | 23,490 | 17.1\% | 137,194 |
| 1994 | 103,997 | 11,010 | 115,007 | 25,124 | 17.9\% | 140,131 |
| 1995 | 103,968 | 13,093 | 117,061 | 26,206 | 18.3\% | 143,267 |
| Average annual percentage change |  |  |  |  |  |  |
| 1973-95 |  |  | 0.7\% | 4.6\% |  | 1.2\% |
| 1985-95 | 0.8\% | 5.0\% | 1.2\% | 4.0\% |  | 1.7\% |

## Source:

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, pp. I-3, I-6, and annual. (Additional resources: http://www.fhwa.dot.gov)
${ }^{\text {a }}$ Special fuels consist primarily of diesel fuel, with small quantities of liquified petroleum gas.
${ }^{b}$ Data for gasoline and gasohol cannot be separated in this year.

Comparing energy intensity data between modes should be done with caution. These national estimates are generated from the bet available data, but individual circumstances play a major role in energy intensity. Influences such as locality and equipment can significantly change energy intensity.

Table 2.13
Passenger Travel and Energy Use in the United States, 1995

|  | Number of vehicles (thousands) | $\begin{aligned} & \text { Vehicle- } \\ & \text { miles } \\ & \text { (millions) } \\ & \hline \end{aligned}$ | Passengermiles (millions) | Load factor (persons/vehicle) | Energy intensities |  | Energy use (trillion Btu) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | (Btu per vehicle-mile) | (Btu per passenger-mile) |  |
| Automobiles | 136,066.0 | 1,541,458 | 2,466,333 | 1.6 | 5,547 | 3,467 | 8,549.9 |
| Personal trucks | 43,592.8 | 477,092 | 715,638 | 1.5 | 8,067 | 5,378 | 3,848.8 |
| Motorcycles | 3,767.0 | 9,797 | 13,716 | 1.4 | 2,501 | 1,786 | 24.5 |
| Buses | 647.6 | 8,428 | 142,818 | 16.9 | 24,063 | 1,420 | 202.8 |
| Transit | 67.1 | 2,178 | 18,818 | 8.6 | 40,175 | 4,650 | 87.5 |
| Intercity | 20.1 | 1,250 | 29,000 | 23.2 | 20,320 ${ }^{\text {a }}$ | $876^{\text {a }}$ | $25.4{ }^{\text {a }}$ |
| School | 560.4 | 5,000 | 95,000 | 19.0 | $18,120^{\text {a }}$ | $954{ }^{\text {a }}$ | $103.0^{\text {a }}$ |
| Air | b | 7,927 | 415,188 | 52.4 | 229,254 | 4,377 | 1,817.3 |
| Certificated route | b | 4,629 | 403,888 | 87.3 | 369,562 | 4,236 | 1,710.7 |
| General aviation | 181.3 | 3,298 ${ }^{\text {c }}$ | 11,300 | 3.4 | 32,323 | 9,434 | 106.6 |
| Recreational boats | 11,700.0 | b | b | ${ }^{\text {b }}$ | b | b | 284.8 |
| Rail | 18.1 | 1,193 | 25,067 | 21.0 | 66,639 | 3,172 | 79.5 |
| Intercity ${ }^{\text {d }}$ | $2.3{ }^{\text {e }}$ | $283{ }^{\text {f }}$ | 5,401 ${ }^{\text {g }}$ | 19.1 | 44,170 | 2,315 | $12.5{ }^{\text {a }}$ |
| Transit ${ }^{\text {h }}$ | 11.2 | 572 | 11,419 | 20.0 | 76,224 | 3,818 | 43.6 |
| Commuter | 4.6 | 238 | 8,247 | 34.7 | 98,319 | 2,837 | 23.4 |

## Source:

See Appendix A for Table 2.13.

[^16]Comparing energy intensity data between modes should be done with caution. These national estimates are generated from the bet available data, but individual circumstances play a major role in energy intensity. Influences such as locality, equipment, and commodity can significantly change energy intensity.

Table 2.14
Intercity Freight Movement and Energy Use in the United States, 1995

|  | Number of vehicles (thousands) | $\begin{gathered} \text { Vehicle- } \\ \text { miles } \\ \text { (millions) } \end{gathered}$ | Ton-miles (millions) | Tons shipped (millions) | Average length of haul (miles) | Energy intensity (Btu/ton-mile) | Energy use (trillion Btu) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Truck ${ }^{\text {a }}$ | 1,825 | 110,127 | 921,000 | 3,373 | $646{ }^{\text {b }}$ | 2,922 | 2,691.0 |
| Waterborne commerce ${ }^{\text {c }}$ | 40 | ${ }^{\text {d }}$ | 807,728 | 1,086 | 744 | 374 | 302.2 |
| Coastwise | d | d | 440,345 | 267 | 1,652 | d | d |
| Lakewise | d | d | 59,704 | 116 | 514 | ${ }^{\text {d }}$ | ${ }^{\text {d }}$ |
| Internal and local | d | d | 307,679 | 703 | 437 | d | d |
| Pipeline | d | d | d | 1,672 | d | d | 917.8 |
| Natural gas | d | d | d | 554 | d | d | 759.4 |
| Crude oil and products | d | d | 599,000 | 1,118 | d | 264 | 158.4 |
| Class I railroads ${ }^{\text {e }}$ | 583 | 30,383 | 1,305,688 | 2,322 | 843 | 372 | 485.9 |

## Source:

See Appendix A for Table 2.14.

[^17]Comparing energy intensity data among modes should be done with caution. These national estimates are generated from the best availabk data, but individual circumstances play a major role in energy intensity. Influences such as locality and equipment can significantly chage energy intensity.

Table 2.15
Energy Intensities of Passenger Modes, 1970-95

| Year |  |  | Buses |  |  |  | Air |  | Rail |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Automobiles |  | Transit ${ }^{\text {a }}$ |  | Intercity (Btu per passengermile) | School (Btu per vehiclemile) | Certificated air carriers (Btu per passenger-mile) | General aviation (Btu per passenger-mile) | Intercity <br> Amtrak <br> (Btu per passenger-mile) | Rail <br> transit <br> (Btu per passenger-mile) |
|  | (Btu per vehiclemile) | (Btu per passengermile) | (Btu per vehiclemile) | (Btu per passengermile) |  |  |  |  |  |  |
| 1970 | 9,302 | 5,472 | 31,796 | 2,472 | 1,051 | 17,857 | 10,351 | 10,374 | b | 2,453 |
| 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 | 1,069 | 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 | 1,324 | 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 | 6,519 | 3,835 | 38,557 | 3,542 | 939 | 15,615 | 4,753 | 11,218 | 2,537 | 3,534 |
| 1988 | 6,299 | 3,705 | 39,121 | 3,415 | 965 | 15,585 | 4,814 | 11,966 | 2,462 | 3,585 |
| 1989 | 6,162 | 3,851 | 36,583 | 3,711 | 963 | 15,575 | 4,796 | 10,984 | 2,731 | 3,397 |
| 1990 | 5,954 | 3,721 | 36,647 | 3,735 | 944 | 16,368 | 4,811 | 10,146 | 2,609 | 3,453 |
| 1991 | 5,768 | 3,605 | 36,939 | 3,811 | 978 | 16,419 | 4,560 | 9,556 | 2,503 | 3,710 |
| 1992 | 5,770 | 3,606 | 40,472 ${ }^{\text {c }}$ | 4,303 ${ }^{\text {c }}$ | 978 | 16,386 | 4,482 | 8,582 | 2,610 | 3,575 |
| 1993 | 5,948 | 3,418 | 39,005 | 4,257 | 972 | 19,093 | 4,304 | 9,343 | 2,646 | 3,687 |
| 1994 | 5,628 | 3,517 | 40,102 | 4,604 | 876 | 20,591 | 4,455 | 9,825 | 2,351 | 3,828 |
| 1995 | 5,547 | 3,467 | 40,175 | 4,650 | 876 | 20,600 | 4,236 | 9,434 | 2,341 | 3,818 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |
| 1970-95 | -2.0\% | -1.8\% | 0.9\% | 2.6\% | -0.7\% | 0.6\% | -3.5\% | -0.4\% | $-2.1 \%{ }^{\text {d }}$ | 1.8\% |
| 1985-95 | -2.1\% | -1.5\% | 0.3\% | 6.7\% | -4.0\% | 2.2\% | -2.9\% | -1.8\% | -1.8\% | 1.0\% |

Source:
See Appendix A for Table 2.15.

[^18]Comparing energy intensity data among modes should be done with caution. These nationd estimates are generated from the best available data, but individual ciramstances play a major role in energy intensity. Influences such as locality, equipment, and commodity can significantly change energy intensity.

Table 2.16
Energy Intensities of Freight Modes, 1970-95

| Year | Trucks |  |  | Class I freight railroad |  | Domestic waterborne commerce (Btu per ton-mile) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Light truck ${ }^{\text {a }}$ (Btu per vehicle-mile) | Other trucks (Btu per vehicle-mile) | Total trucks (Btu per vehicle-mile) | (Btu per freight carmile) | (Btu per ton-mile) |  |
| 1970 | 12,491 | 24,158 | 16,404 | 17,668 | 691 | 545 |
| 1971 | 12,236 | 23,685 | 15,950 | 18,814 | 717 | 506 |
| 1972 | 12,099 | 23,350 | 15,646 | 18,292 | 714 | 522 |
| 1973 | 11,904 | 23,251 | 15,417 | 18,468 | 677 | 576 |
| 1974 | 11,398 | 22,555 | 14,777 | 18,852 | 681 | 483 |
| 1975 | 11,156 | 21,997 | 14,282 | 18,741 | 687 | 549 |
| 1976 | 11,167 | 22,644 | 14,334 | 18,938 | 680 | 468 |
| 1977 | 10,930 | 22,690 | 14,163 | 19,225 | 669 | 458 |
| 1978 | 10,769 | 22,773 | 14,064 | 18,930 | 641 | 383 |
| 1979 | 10,603 | 23,027 | 13,981 | 19,187 | 618 | 457 |
| 1980 | 10,143 | 22,352 | 13,459 | 18,742 | 597 | 358 |
| 1981 | 10,002 | 22,640 | 13,394 | 18,628 | 572 | 360 |
| 1982 | 9,741 | 22,736 | 13,103 | 18,403 | 553 | 310 |
| 1983 | 9,755 | 22,958 | 13,144 | 17,863 | 525 | 319 |
| 1984 | 9,673 | 22,893 | 13,073 | 17,797 | 510 | 346 |
| 1985 | 9,730 | 23,100 | 13,117 | 17,500 | 497 | 446 |
| 1986 | 9,729 | 23,106 | 13,082 | 17,265 | 486 | 463 |
| 1987 | 9,715 | 23,097 | 13,008 | 16,791 | 456 | 402 |
| 1988 | 9,361 | 23,445 | 12,789 | 16,758 | 443 | 361 |
| 1989 | 9,110 | 22,829 | 12,486 | 16,896 | 437 | 403 |
| 1990 | 8,861 | 22,468 | 12,171 | 16,618 | 420 | 388 |
| 1991 | 8,629 | 21,907 | 11,838 | 15,834 | 391 | 386 |
| 1992 | 8,689 | 22,127 | 11,943 | 16,044 | 393 | 398 |
| 1993 | 7,960 ${ }^{\text {b }}$ | 22,150 | 11,054 | 16,055 | 389 | 389 |
| 1994 | 8,303 ${ }^{\text {b }}$ | 22,183 | 11,117 | 16,338 | 388 | 369 |
| 1995 | $8,185^{\text {b }}$ | 22,054 | 11,042 | 15,993 | 372 | 374 |
| Average annual percentage change |  |  |  |  |  |  |
| 1970-95 | -1.7\% | -0.4\% | -1.6\% | -0.4\% | -2.4\% | -1.5\% |
| 1985-95 | -1.7\% | -0.5\% | -1.7\% | -0.9\% | -2.9\% | -1.7\% |

## Source:

See Appendix A for Table 2.16.
${ }^{\text {a }}$ All two-axle, four-tire trucks (which would include trucks which may not carry freight).
${ }^{\text {b }}$ These data include minivans and sport utility vehicles, which were not previously included in this category.

Table 2.17
Retail Prices for Motor Fuel, 1978-96 (cents per gallon, including tax)

| Year | Diesel fuel ${ }^{\text {a }}$ |  | Unleaded regular gasoline ${ }^{\text {b }}$ ( 87 to 88.9 octane) |  | Unleaded premium gasoline ${ }^{\text {b }}$ <br> (91 octane and above) |  | Average for all gasoline types ${ }^{\text {b }}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Current | $\begin{gathered} \text { Constant } \\ 1990^{\mathrm{c}} \end{gathered}$ | Current | $\begin{gathered} \text { Constant } \\ 1990^{\mathrm{c}} \end{gathered}$ | Current | $\begin{gathered} \text { Constant } \\ 1990^{\mathrm{c}} \end{gathered}$ | Current | $\begin{gathered} \text { Constant } \\ 1990^{\mathrm{c}} \end{gathered}$ |
| 1978 | d | d | 67.0 | 134.2 | d | d | 65.2 | 130.6 |
| 1979 | d | d | 90.3 | 162.6 | d | d | 88.2 | 158.8 |
| 1980 | 101.0 | 160.2 | 124.5 | 197.4 | d | d | 122.1 | 193.6 |
| 1981 | 118.0 | 169.5 | 137.8 | 198.0 | 147.0 | 211.2 | 135.3 | 194.4 |
| 1982 | 116.0 | 157.0 | 129.6 | 175.5 | 141.5 | 191.6 | 128.1 | 173.4 |
| 1983 | 120.0 | 157.4 | 124.1 | 162.8 | 138.3 | 181.4 | 122.5 | 160.7 |
| 1984 | 122.0 | 153.5 | 121.2 | 152.5 | 136.6 | 171.9 | 119.8 | 150.7 |
| 1985 | 122.0 | 148.2 | 120.2 | 146.0 | 134.0 | 162.8 | 119.6 | 145.3 |
| 1986 | 94.0 | 112.0 | 92.7 | 110.5 | 108.5 | 129.3 | 93.1 | 111.0 |
| 1987 | 96.0 | 110.4 | 94.8 | 109.0 | 109.3 | 125.7 | 95.7 | 110.0 |
| 1988 | 95.0 | 104.9 | 94.6 | 104.5 | 110.7 | 122.3 | 96.3 | 106.4 |
| 1989 | 102.0 | 107.5 | 102.1 | 107.6 | 119.7 | 126.2 | 106.0 | 111.7 |
| 1990 | 99.0 | 99.0 | 116.4 | 116.4 | 134.9 | 134.9 | 121.7 | 121.7 |
| 1991 | 91.0 | 87.3 | 114.0 | 109.3 | 132.1 | 126.7 | 119.6 | 114.7 |
| 1992 | 106.0 | 98.7 | 112.7 | 104.9 | 131.6 | 122.5 | 119.0 | 110.8 |
| 1993 | 98.0 | 88.7 | 110.8 | 100.3 | 130.2 | 117.8 | 117.3 | 106.2 |
| 1994 | 96.0 | 84.7 | 111.2 | 98.1 | 130.5 | 115.1 | 117.4 | 103.6 |
| 1995 | 97.0 | 83.1 | 114.7 | 98.3 | 133.6 | 114.5 | 120.5 | 103.3 |
| 1996 | 115.0 | 95.8 | 123.1 | 102.5 | 141.3 | 117.7 | 128.8 | 107.3 |
| Average annual percentage change |  |  |  |  |  |  |  |  |
| 1978-96 | 0.8\% ${ }^{\text {e }}$ | -3.2\% ${ }^{\text {e }}$ | 3.4\% | -1.5\% | -0.3\% ${ }^{\text {f }}$ | -3.8\% ${ }^{\text {f }}$ | 3.9\% | -1.1\% |
| 1986-96 | 2.0\% ${ }^{\text {e }}$ | $-1.6 \%{ }^{\text {e }}$ | 2.9\% | -0.7\% | 2.7\% | -0.9\% | 3.3\% | -0.3\% |

Source:
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.4, p. 114.
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.4, p. 114 .
Diesel - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1995, Washington, DC, December 1996, p. 102
(Additional resources: http://www.eia.doe.gov)
${ }^{a}$ Collected from a survey of prices on January 1 of the current year.
${ }^{6}$ 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.
${ }^{\text {c }}$ Adjusted by the Consumer Price Inflation Index.
${ }^{\mathrm{d}}$ Data are not available.
${ }^{\text {}}$ Average annual percentage change is for years 1980-94 and 1985-94.
${ }^{\mathrm{f}}$ Average annual percentage change is for years 1981-95.

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 countedas sales to end users. Prices for alternative fuels are found in Chapter 5

Table 2.18
Prices for Selected Transportation Fuels, 1978-96
(cents per gallon, excluding tax)

| Year | Propane ${ }^{\text {a }}$ |  | Finished aviation gasoline |  | Kerosene-type jet fuel |  | No. 2 diesel fuel |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Current | $\begin{gathered} \text { Constant } \\ 1990^{\mathrm{b}} \end{gathered}$ | Current | $\begin{aligned} & \text { Constant } \\ & 1990 \end{aligned}$ | Current | $\begin{gathered} \text { Constant } \\ 1990^{\mathrm{b}} \end{gathered}$ | Current | $\begin{gathered} \hline \text { Constant } \\ 1990^{\mathrm{b}} \end{gathered}$ |
| 1978 | 33.5 | 67.1 | 51.6 | 103.4 | 38.7 | 77.5 | 37.7 | 75.5 |
| 1979 | 35.7 | 64.3 | 68.9 | 124.0 | 54.7 | 98.5 | 58.5 | 105.3 |
| 1980 | 48.2 | 76.4 | 108.4 | 171.9 | 86.6 | 137.3 | 81.8 | 129.7 |
| 1981 | 56.5 | 81.2 | 130.3 | 187.2 | 102.4 | 147.1 | 99.5 | 143.0 |
| 1982 | 59.2 | 80.1 | 131.2 | 177.6 | 96.3 | 130.4 | 94.2 | 127.5 |
| 1983 | 70.9 | 93.0 | 125.5 | 164.6 | 87.8 | 115.2 | 82.6 | 108.4 |
| 1984 | 73.7 | 92.7 | 123.4 | 155.3 | 84.2 | 105.9 | 82.3 | 103.5 |
| 1985 | 71.7 | 87.1 | 120.1 | 145.9 | 79.6 | 96.7 | 78.9 | 95.9 |
| 1986 | 74.5 | 88.8 | 101.1 | 120.5 | 52.9 | 63.0 | 47.8 | 57.0 |
| 1987 | 70.1 | 80.6 | 90.7 | 104.3 | 54.3 | 62.4 | 55.1 | 63.4 |
| 1988 | 71.4 | 78.9 | 89.1 | 98.4 | 51.3 | 56.7 | 50.0 | 55.3 |
| 1989 | 61.5 | 64.8 | 99.5 | 104.9 | 59.2 | 62.4 | 58.5 | 61.7 |
| 1990 | 74.5 | 74.5 | 112.0 | 112.0 | 76.6 | 76.6 | 72.5 | 72.5 |
| 1991 | 73.0 | 70.0 | 104.7 | 100.4 | 65.2 | 62.6 | 64.8 | 62.1 |
| 1992 | 64.3 | 59.9 | 102.7 | 95.6 | 61.0 | 58.3 | 61.9 | 57.6 |
| 1993 | 67.3 | 60.9 | 99.0 | 89.6 | 58.0 | 52.5 | 60.2 | 54.5 |
| 1994 | 53.0 | 46.7 | 95.7 | 84.3 | 53.4 | 47.1 | 55.4 | 48.9 |
| 1995 | 49.2 | 42.2 | 100.5 | 86.1 | 54.0 | 46.2 | 56.0 | 48.0 |
| 1996 | 62.1 | 51.7 | 111.1 | 92.5 | 65.1 | 54.2 | 68.1 | 56.7 |
| Average annual percentage change |  |  |  |  |  |  |  |  |
| 1978-96 | 3.5\% | -1.4\% | 4.4\% | -0.6\% | 2.9\% | -2.0\% | 3.3\% | -1.6\% |
| 1986-96 | -1.8\% | -5.3\% | 0.9\% | -2.6\% | 2.1\% | -1.5\% | 3.6\% | -0.1\% |

Source:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.7, p. 117.
(Additional resources: http://www.eia.doe.gov)
${ }^{a}$ Consumer grade.
${ }^{\mathrm{b}}$ Adjusted by the Consumer Price Inflation Index.

Though the average price of a barrel of crude oil (in constant 1990 dollars) declined by $7 \%$ from 1990 to 1996, the average price of a gallon of gasoline declined $12 \%$ in this same time period. There could be many reasons for this difference-for example, changes in Federal and State gasoline taxes and differences in crude oil processing cost.

Table 2.19
Prices for a Barrel of Crude Oil and a Gallon of Gasoline, 1978-96

| Year | Crude oil ${ }^{\text {a }}$ (dollars per barrel) |  | Gasoline ${ }^{\text {b }}$ (cents per gallon) |  | Ratio of gasoline to crude oil |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Current | Constant 1990 ${ }^{\text {c }}$ | Current | Constant 1990 ${ }^{\text {c }}$ |  |
| 1978 | 12.46 | 24.96 | 65.2 | 130.6 | 0.22 |
| 1979 | 17.72 | 31.90 | 88.2 | 158.8 | 0.21 |
| 1980 | 28.07 | 44.52 | 122.1 | 193.6 | 0.18 |
| 1981 | 35.24 | 50.63 | 135.3 | 194.4 | 0.16 |
| 1982 | 31.87 | 43.15 | 128.1 | 173.4 | 0.17 |
| 1983 | 28.99 | 38.03 | 122.5 | 160.7 | 0.18 |
| 1984 | 28.63 | 36.02 | 119.8 | 150.7 | 0.18 |
| 1985 | 26.75 | 32.50 | 119.6 | 145.3 | 0.19 |
| 1986 | 14.55 | 17.34 | 93.1 | 111.0 | 0.27 |
| 1987 | 17.90 | 20.58 | 95.7 | 110.0 | 0.23 |
| 1988 | 14.67 | 16.21 | 96.3 | 106.4 | 0.28 |
| 1989 | 17.97 | 18.94 | 106.0 | 111.7 | 0.25 |
| 1990 | 22.22 | 22.22 | 121.7 | 121.7 | 0.23 |
| 1991 | 19.06 | 18.28 | 119.6 | 114.7 | 0.26 |
| 1992 | 18.43 | 17.16 | 119.0 | 110.8 | 0.27 |
| 1993 | 16.41 | 14.85 | 117.3 | 106.2 | 0.30 |
| 1994 | 15.59 | 13.75 | 117.4 | 103.6 | 0.32 |
| 1995 | 17.24 | 14.77 | 120.5 | 103.3 | 0.34 |
| 1996 | 20.65 | 17.20 | 128.8 | 107.3 | 0.38 |
| Average annual percentage change |  |  |  |  |  |
| 1978-96 | 2.8\% | -2.0\% | 3.9\% | -1.1\% |  |
| 1986-96 | 3.6\% | -0.1\% | 3.3\% | -0.3\% |  |

## Sources:

Crude oil - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.1, p. 111.
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1997, Washington, DC, Table 9.4, p. 114.
(Additional resources: http://www.eia.doe.gov)
${ }^{\text {a }}$ Refiner acquisition cost of composite (domestic and imported) crude oil.
${ }^{\mathrm{b}}$ Average for all types. 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.
${ }^{\mathrm{c}}$ Adjusted by the Consumer Price Inflation Index.

Table 2.20
Economic Indicators, 1970-96
(billion dollars)

| Year | Gross National Product |  | Total transportation outlays |  | Transportation as a percent of GNP |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Current | $\begin{gathered} \text { Constant } \\ 1990^{\mathrm{a}} \end{gathered}$ | Current | $\begin{gathered} \text { Constant } \\ 1990^{\mathrm{a}} \end{gathered}$ |  |
| 1970 | 1,015.5 | 3,031.3 | 195.2 | 583 | 19.2\% |
| 1980 | 2,732.0 | 4,167.4 | 542.9 | 828 | 19.8\% |
| 1990 | 5,567.8 | 5,567.8 | 964.6 | 965 | 17.3\% |
| 1995 | 7,246.7 | 6,224.9 | 1,150.5 | 988 | 15.9\% |
|  | Personal Consumption Expenditures |  | Transportation Personal Consumption Expenditures ${ }^{\text {b }}$ |  | Transportation PCE as a percent of total PCE |
| 1970 | 640.0 | 1,910.4 | 81.5 | 243.3 | 12.7\% |
| 1980 | 1,732.6 | 2,642.9 | 238.5 | 363.8 | 13.8\% |
| 1990 | 3,761.2 | 3,761.2 | 453.9 | 453.7 | 12.1\% |
| 1996 | 5,152.0 | 4,291.6 | 578.3 | 481.7 | 11.2\% |

## Sources:

GNP - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, April 1997, Table 1.9, p. D-4, and annual. (Additional resources: http://www.bea.doc.gov)
Transportation outlays - Eno Transportation Foundation, Transportation in America, Thirteenth Edition, Washington, DC, 1995, p. 38.
PCE - U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July 1995, Table 2.2, p. 12, and annual. (Additional resources: http://www.bea.doc.gov/bea/scbinf.html)

Table 2.21
Consumer Price Indices, 1970-96
( $1970=1.000$ )

| Year | Consumer Price Index | Transportation Consumer Price Index ${ }^{\text {c }}$ | New car Consumer Price Index | Used car Consumer Price Index | Gross National Product |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 1980 | 2.122 | 2.216 | 1.667 | 1.995 | 2.690 |
| 1990 | 3.365 | 3.213 | 2.283 | 3.769 | 5.483 |
| 1996 | 4.040 | 3.813 | 2.668 | 5.032 | 7.452 |

## Source:

Bureau of Labor Statistics, Consumer Price Index Table 1A for 1996, and annual.
(Additional resources: http://stats.bls.gov/cpihome.htm)

[^19]Table 2.22
Average Price of a New Car, 1970-95

|  | Domestic ${ }^{\text {a }}$ |  | Import |  | Total |  | Estimated Average New Car Price for a 1967 "Comparable Car" |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Year | Current dollars | Constant 1990 dollars $^{\text {b }}$ | Current dollars | Constant 1990 dollars $^{\text {b }}$ | Current dollars | Constant 1990 dollars ${ }^{\text {b }}$ | With added safety \& emissions equipment ${ }^{\text {c }}$ | Without added safety \& emissions equipment ${ }^{\text {d }}$ |
| 1970 | 3,708 | 12,479 | 2,648 | 8,912 | 3,542 | 11,920 | 3,601 | 3,459 |
| 1971 | 3,919 | 12,645 | 2,769 | 8,935 | 3,742 | 12,074 | 3,777 | 3,601 |
| 1972 | 4,034 | 12,601 | 2,994 | 9,352 | 3,879 | 12,117 | 3,789 | 3,570 |
| 1973 | 4,181 | 12,295 | 3,344 | 9,834 | 4,052 | 11,915 | 3,903 | 3,572 |
| 1974 | 4,524 | 11,988 | 4,206 | 11,146 | 4,440 | 11,766 | 4,237 | 3,779 |
| 1975 | 5,084 | 12,344 | 4,384 | 10,645 | 4,950 | 12,019 | 4,686 | 4,103 |
| 1976 | 5,506 | 12,640 | 4,923 | 11,301 | 5,418 | 12,438 | 4,988 | 4,362 |
| 1977 | 5,985 | 12,906 | 5,072 | 10,938 | 5,814 | 12,538 | 5,272 | 4,593 |
| 1978 | 6,478 | 12,976 | 5,934 | 11,886 | 6,379 | 12,778 | 5,687 | 4,944 |
| 1979 | 6,889 | 12,403 | 6,704 | 12,070 | 6,847 | 12,327 | 6,176 | 5,337 |
| 1980 | 7,609 | 12,067 | 7,482 | 11,886 | 7,574 | 12,012 | 6,863 | 5,764 |
| 1981 | 8,912 | 12,805 | 8,896 | 12,782 | 8,910 | 12,802 | 7,700 | 6,115 |
| 1982 | 9,865 | 13,356 | 9,957 | 13,480 | 9,890 | 13,390 | 8,078 | 6,350 |
| 1983 | 10,516 | 13,797 | 10,868 | 14,259 | 10,606 | 13,915 | 8,387 | 6,544 |
| 1984 | 11,172 | 14,054 | 12,354 | 15,541 | 11,450 | 14,404 | 8,685 | 6,742 |
| 1985 | 11,589 | 14,081 | 12,853 | 15,616 | 11,902 | 14,461 | 8,984 | 6,958 |
| 1986 | 12,526 | 14,931 | 13,815 | 16,467 | 12,894 | 15,370 | 9,395 | 7,259 |
| 1987 | 12,922 | 14,860 | 14,470 | 16,641 | 13,386 | 15,394 | 9,743 | 7,518 |
| 1988 | 13,542 | 14,964 | 15,378 | 16,993 | 14,065 | 15,542 | 9,995 | 7,668 |
| 1989 | 14,193 | 14,959 | 15,829 | 16,684 | 14,645 | 15,436 | 10,248 | 7,825 |
| 1990 | 14,886 | 14,886 | 17,164 | 17,164 | 15,472 | 15,472 | 10,581 | 7,938 |
| 1991 | 15,773 | 15,126 | 17,019 | 16,321 | 16,083 | 15,424 | 11,152 | 8,224 |
| 1992 | 16,389 | 15,258 | 19,601 | 18,249 | 18,141 | 16,889 | 11,458 | 8,424 |
| 1993 | 16,673 | 15,089 | 21,477 | 19,437 | 17,678 | 15,999 | 11,806 | 8,631 |
| 1994 | 17,575 | 15,501 | 23,211 | 20,472 | 18,657 | 16,455 | 12,427 | 8,925 |
| 1995 | 17,174 | 14,718 | 23,995 | 20,564 | 18,360 | 15,735 | 12,857 | 9,115 |
| 1996 | 16,998 | 14,159 | 27,427 | 22,847 | 18,563 | 15,463 | 13,196 | 9,281 |
| Average annual percentage change |  |  |  |  |  |  |  |  |
| 1970-96 | 6.0\% | 0.5\% | 9.4\% | 3.7\% | 6.6\% | 1.0\% | 5.1\% | 3.9\% |
| 1986-96 | 3.1\% | -0.5\% | 7.1\% | 3.3\% | 3.7\% | 0.1\% | 3.5\% | 2.5\% |

Source:
American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p. 60
1996 Data: American Automobile Manufacturers Association, Economic Indicators, Fourth Quarter 1996 Detroit, MI, February 1997, p. 24
(Additional resources: http://www.aama.com )

[^20]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 1996 (constant 1990 cents) wasapproximately 43 cents per mile. Gas and oil accounted for less than $12 \%$ of total cost per mile in 1996, the lowest percentage in the 20-year series.

Table 2.23
Automobile Operating Cost per Mile, 1975-96

| Model year ${ }^{\text {c }}$ | Variable costs (constant 1990 cents per mile ${ }^{\text {a }}$ ) |  |  |  | Constant 1990 dollars per 10,000 miles ${ }^{\text {a }}$ |  |  | Total cost per mile ${ }^{\text {b }}$ (constant 1990 cents ${ }^{\text {a }}$ ) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 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 | 44.46 |
| 1977 | 8.86 | 20.3\% | 2.22 | 1.42 | 1,251 | 3,103 | 4,354 | 43.54 |
| 1979 | 7.40 | 17.1\% | 1.98 | 1.17 | 1,055 | 3,260 | 4,315 | 43.15 |
| 1980 | 9.29 | 21.0\% | 1.78 | 1.01 | 1,208 | 3,224 | 4,433 | 44.33 |
| 1981 | 9.01 | 19.6\% | 1.70 | 1.03 | 1,174 | 3,413 | 4,586 | 45.86 |
| 1982 | 9.12 | 21.5\% | 1.35 | 0.97 | 1,133 | 3,145 | 4,243 | 42.43 |
| 1983 | 8.71 | 19.9\% | 1.36 | 0.89 | 1,097 | 3,287 | 4,384 | 43.84 |
| 1984 | 7.79 | 19.8\% | 1.31 | 0.79 | 989 | 2,952 | 3,940 | 39.40 |
| 1985 | 7.48 | 22.6\% | 1.49 | 0.79 | 977 | 2,328 ${ }^{\text {d }}$ | 3,304 ${ }^{\text {d }}$ | $33.04{ }^{\text {d }}$ |
| 1986 | 5.34 | 15.1\% | 1.63 | 0.80 | 777 | 2,750 ${ }^{\text {d }}$ | 3,577 ${ }^{\text {d }}$ | $35.27{ }^{\text {d }}$ |
| 1987 | 5.52 | 14.7\% | 1.84 | 0.92 | 828 | 2,925 ${ }^{\text {d }}$ | 3,753 ${ }^{\text {d }}$ | $37.53{ }^{\text {d }}$ |
| 1988 | 5.74 | 15.6\% | 1.77 | 0.88 | 840 | 2,851 ${ }^{\text {d }}$ | 3,691 ${ }^{\text {d }}$ | $36.91{ }^{\text {d }}$ |
| 1989 | 5.48 | 13.6\% | 2.00 | 0.84 | 833 | 3,194 ${ }^{\text {d }}$ | 4,027 ${ }^{\text {d }}$ | $40.27{ }^{\text {d }}$ |
| 1990 | 5.40 | 13.2\% | 2.10 | 0.90 | 840 | 3,256 ${ }^{\text {d }}$ | 4,096 ${ }^{\text {d }}$ | $40.96{ }^{\text {d }}$ |
| 1991 | 6.43 | 15.4\% | 2.11 | 0.86 | 940 | 3,245 ${ }^{\text {d }}$ | 4,185 ${ }^{\text {d }}$ | $41.85{ }^{\text {d }}$ |
| 1992 | 5.59 | 13.1\% | 2.05 | 0.84 | 847 | 3,414 ${ }^{\text {d }}$ | 4,261 ${ }^{\text {d }}$ | $42.61{ }^{\text {d }}$ |
| 1993 | 5.43 | 13.3\% | 2.17 | 0.81 | 842 | 3,244 ${ }^{\text {d }}$ | 4,085 ${ }^{\text {d }}$ | $40.85{ }^{\text {d }}$ |
| 1994 | 4.94 | 12.0\% | 2.21 | 0.97 | 811 | 3,303 ${ }^{\text {d }}$ | 4,115 ${ }^{\text {d }}$ | $41.15{ }^{\text {d }}$ |
| 1995 | 5.14 | 12.3\% | 2.23 | 1.20 | 857 | 3,335 ${ }^{\text {d }}$ | 4,192 ${ }^{\text {d }}$ | $41.92{ }^{\text {d }}$ |
| 1996 | 4.91 | 11.5\% | 2.33 | 1.17 | 841 | 3,443 ${ }^{\text {d }}$ | 4,284 | $42.84{ }^{\text {d }}$ |
| Average annual percentage change |  |  |  |  |  |  |  |  |
| 1975-84 | -4.4\% |  | -6.3\% | -7.5\% | -5.0\% | 0.3\% | -1.3\% | -1.3\% |
| 1986-96 | -0.8\% |  | 3.6\% | 3.9\% | 0.8\% | 2.3\% | 1.8\% | 1.8\% |

Source:
American Automobile Association, "Your Driving Costs," 1996 Edition, Heathrow, FL, and annual. (Additional resources: http://www.aaa.com, http://www.runzheimer.com)
${ }^{\text {a }}$ Adjusted by the Consumer Price Inflation Index.
${ }^{\mathrm{b}}$ Based on 10,000 miles per year.
${ }^{\text {c }}$ Data for 1976 and 1978 are not available.
${ }^{\text {d }}$ Fixed and total operating costs preceding 1985 are not comparable with 1985 and later data. 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.

Table 2.24
Fixed Automobile Operating Costs per Year, 1975-96 (constant 1990 dollars)

| Model Year | Fire \& Theft ${ }^{\text {a }}$ | Collision ${ }^{\text {b }}$ | Property Damage \& Liability ${ }^{\text {c }}$ | License, Registration \& Taxes | Depreciation | Finance Charge | Total | Average Fixed Cost Per Day |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1975 | 129 | 342 | 459 | 73 | 1,877 | - | 2,880 | 7.89 |
| 1977 | 172 | 405 | 539 | 160 | 1,826 | - | 3,102 | 8.49 |
| 1978 | 114 | 276 | 459 | 148 | 1,791 | - | 2,788 | 7.63 |
| 1979 | 133 | 302 | 434 | 162 | 1,696 | 533 | 3,260 | 8.93 |
| 1980 | 111 | 273 | 393 | 130 | 1,646 | 671 | 3,224 | 8.83 |
| 1981 | 109 | 259 | 365 | 126 | 1,849 | 704 | 3,413 | 9.35 |
| 1982 | 72 | 207 | 329 | 73 | 1,836 | 730 | 3,247 | 8.90 |
| 1983 | 105 | 264 | 291 | 134 | 1,762 | 732 | 3,288 | 9.01 |
| 1984 | 101 | 252 | 283 | 133 | 1,518 | 664 | 2,951 | 8.09 |
| 1985 | 112 | 241 | 259 | 140 | 1,522 | 693 | 2,966 | 8.13 |
| 1986 | 103 | 228 | 277 | 155 | 1,573 | 759 | 3,094 | 8.48 |
| 1987 | 100 | 225 | 290 | 161 | 1,732 | 691 | 3,199 | 8.76 |
| 1988 | 95 | 224 | 314 | 154 | 1,971 | 624 | 3,382 | 9.27 |
| 1989 | 115 | 258 | 326 | 159 | 2,207 | 660 | 3,725 | 10.20 |
| 1990 | 110 | 247 | 318 | 165 | 2,357 | 680 | 3,877 | 10.62 |
| 1991 | 110 | 247 | 339 | 162 | 2,439 | 747 | 4,044 | 11.08 |
| 1992 | 105 | 243 | 347 | 167 | 2,588 | 775 | 4,225 | 11.57 |
| 1993 | 97 | 210 | 348 | 166 | 2,609 | 630 | 4,060 | 11.12 |
| 1994 | 80 | 182 | 353 | 180 | 2,635 | 613 | 4,043 | 11.08 |
| 1995 | 81 | 181 | 351 | 181 | 2,656 | 625 | 4,075 | 11.17 |
| 1996 | 91 | 206 | 355 | 191 | 2,672 | 648 | 4,163 | 11.40 |

## Source:

American Automobile Association, "Your Driving Costs," 1996 Edition, Heathrow, FL, and annual. (Additional resources: http://www.aaa.com, http://www.runzheimer.com)

[^21]Table 2.25
Motor Vehicle Manufacturing Employment Statistics, 1972-95
$\left.\begin{array}{cccccccc}\hline & \begin{array}{c}\text { Motor vehicle } \\ \text { manufacturing } \\ \text { employees } \\ \text { (thousands) }\end{array} & \begin{array}{c}\text { Sales of } \\ \text { domestic } \\ \text { automobiles }{ }^{\text {a }} \\ \text { (thousands) }\end{array} & \begin{array}{c}\text { Sales of } \\ \text { domestic } \\ \text { light trucks } \\ \text { (thousands) }\end{array} & \begin{array}{c}\text { Employees } \\ \text { per hundred } \\ \text { vehicles sold }\end{array} & \begin{array}{c}\text { Expenditure per } \\ \text { new domestic } \\ \text { vehicle }\end{array} & \begin{array}{c}\text { Total domestic } \\ \text { vehicle } \\ \text { expenditures } \\ \text { (millions) }\end{array} & \begin{array}{c}\text { Employees per } \\ \text { million dollar } \\ \text { expenditure } \\ \text { (current) }\end{array}\end{array} \begin{array}{c}\text { Employees per } \\ \text { million dollar } \\ \text { expenditure } \\ \text { (constant 1990 })\end{array}\right]$

## Source:

Employees - American Automobile Manufacturers Association, Economic Indicators, Second Quarter,1995, Detroit, MI, 1996, p. 18.
Sales and expenditures - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, pp. 20, 21, 60, and annual.
${ }^{a}$ Vehicles produced in North America.
${ }^{\mathrm{b}}$ Less than 10,000 pounds gross vehicle weight.
${ }^{\text {c }}$ Estimated as vehicle sales multiplied by average expenditure. Adjusted by the implicit Gross National Product price deflator, estimated as vehicle sales multiplied by average expenditure.

Table 2.26
Employees of Motor Vehicle and Related Industries, 1990 and 1993

| Industry | 1990 |  |  | 1993 |  |  | Percent change 1990-93 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Employees | Percent of total motor vehicle | Percent of total U.S. employment ${ }^{\text {a }}$ | Employees | Percent of total motor vehicle | Percent of total U.S. employment ${ }^{\text {a }}$ |  |
| Motor vehicle and equipment manufacturing | 1,055,595 | 15.0\% | 1.1\% | 1,055,968 | 15.1\% | 1.1\% | 0.0\% |
| Motor vehicles and equipment | 707,160 | 10.0\% | 0.8\% | 722,563 | 10.3\% | 0.8\% | -2.2\% |
| Travel trailers and campers | 14,301 | 0.2\% | 0.0\% | 16,613 | 0.2\% | 0.0\% | 16.2\% |
| Transportation equipment not elsewhere classified | 17,263 | 0.2\% | 0.0\% | 21,510 | 0.3\% | 0.0\% | 24.6\% |
| Automotive stampings | 111,548 | 1.6\% | 0.1\% | 107,161 | 1.5\% | 0.1\% | -3.9\% |
| Carburetors, pistons, piston rings, and valves | 19,674 | 0.3\% | 0.0\% | 17,615 | 0.3\% | 0.0\% | -10.5\% |
| Vehicular lighting equipment | 15,586 | 0.2\% | 0.0\% | 15,830 | 0.2\% | 0.0\% | -1.6\% |
| Storage batteries | 23,518 | 0.3\% | 0.0\% | 21,805 | 0.3\% | 0.0\% | -7.3\% |
| Electrical equipment for internal combustion engines | 61,675 | 0.9\% | 0.1\% | 49,947 | 0.7\% | 0.1\% | -19.0\% |
| Tires and inner tubes | 68,505 | 1.0\% | 0.1\% | 65,281 | 0.9\% | 0.1\% | -4.7\% |
| Cold-rolled steel sheet, strip, and bars | 16,365 | 0.2\% | 0.0\% | 17,643 | 0.3\% | 0.0\% | 7.8\% |
| Road construction and maintenance | 261,461 | 3.7\% | 0.3\% | b | b | b | b |
| Motor freight transportation and related services | 1,662,836 | 23.6\% | 1.8\% | 1,629,611 | 23.3\% | 1.7\% | -2.0\% |
| Trucking and courier services, except by air or by the U.S. Postal Service | 1,458,847 | 20.7\% | 1.6\% | 1,529,227 | 21.8\% | 1.6\% | 4.8\% |
| Petroleum refining and wholesale distribution | 264,820 | 3.8\% | 0.3\% | 259,620 | 3.7\% | 0.3\% | -2.0\% |
| Passenger transportation | 672,271 | 9.5\% | 0.7\% | 754,477 | 10.8\% | 0.8\% | 12.2\% |
| Automotive sales and servicing | 3,135,783 | 44.5\% | 3.4\% | 3,300,096 | 47.1\% | 3.5\% | 5.2\% |
| Total of motor vehicle and related industries | 7,052,766 | 100.0\% | 7.5\% | 6,999,772 | 100.0\% | 7.4\% | -0.8\% |
| U.S. Total ${ }^{\text {a }}$ | 93,476,087 |  | 100.0\% | 94,789,444 |  | 100.0\% | 1.4\% |

## Source:

American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p. 71, and annual. (Additional resources: http://www.aama.com)

[^22]Table 2.27
Employees of Class I Railroads, 1975-95

|  |  |  |  | Percent change |  |
| :--- | ---: | ---: | ---: | ---: | ---: |
|  | 1975 | 1985 | 1995 | $1975-95$ | $-1985-95$ |
| Executive, officials \& staff assistants | 16,704 | 13,619 | 10,708 | $-35.9 \%$ | $-21.4 \%$ |
| Professional \& administrative | 102,645 | 56,901 | 26,904 | $-73.8 \%$ | $-52.7 \%$ |
| Maintenance of way \& structures | 81,507 | 62,508 | 40,033 | $-50.9 \%$ | $-35.5 \%$ |
| Maintenance of equipment \& stores | 104,578 | 56,104 | 37,106 | $-64.5 \%$ | $-33.9 \%$ |
| Transportation, other than train \& engine | 35,790 | 19,796 | 9,597 | $-73.2 \%$ | $-51.5 \%$ |
| Transportation, train \& engine | 146,565 | 93,401 | 63,831 | $-56.4 \%$ | $-31.7 \%$ |
| Total | 487,789 | 301,879 | 188,215 | $-61.4 \%$ | $-37.7 \%$ |
| Number of Class I Railroads | 52 | 22 | 11 | $-78.8 \%$ | $-50.0 \%$ |

## Source:

Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, September 1996, p. 56, and annual.
(Additional resources: http://www.aar.org)

## CHAPTER 3 <br> HIGHWAY MODE

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Table 3.1
Highway Vehicle Miles Traveled by Mode, 1970-95
(million miles)

| Year | Automobiles | Motorcycles | Two-axle, four-tire trucks | Other single-unit trucks | Combination trucks | Buses ${ }^{\text {a }}$ | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 916,700 | 2,979 | 123,286 | 27,081 | 35,134 | 4,544 | 1,109,724 |
| 1971 | 966,340 | 3,607 | 137,870 | 28,985 | 37,217 | 4,792 | 1,178,811 |
| 1972 | 1,021,365 | 4,331 | 156,622 | 31,414 | 40,706 | 5,348 | 1,259,786 |
| 1973 | 1,045,981 | 5,194 | 176,833 | 33,661 | 45,649 | 5,792 | 1,313,110 |
| 1974 | 1,007,251 | 5,445 | 182,757 | 33,441 | 45,966 | 5,684 | 1,280,544 |
| 1975 | 1,033,950 | 5,629 | 200,700 | 34,606 | 46,724 | 6,055 | 1,327,664 |
| 1976 | 1,078,215 | 6,003 | 225,834 | 36,390 | 49,680 | 6,258 | 1,402,380 |
| 1977 | 1,109,243 | 6,349 | 250,591 | 39,339 | 55,682 | 5,823 | 1,467,027 |
| 1978 | 1,146,508 | 7,158 | 279,414 | 42,747 | 62,992 | 5,885 | 1,544,704 |
| 1979 | 1,113,640 | 8,637 | 291,905 | 42,012 | 66,992 | 5,947 | 1,529,133 |
| 1980 | 1,111,596 | 10,214 | 290,935 | 39,813 | 68,678 | 6,059 | 1,527,295 |
| 1981 | 1,130,827 | 10,690 | 296,343 | 39,568 | 69,134 | 6,241 | 1,552,803 |
| 1982 | 1,166,256 | 9,910 | 306,141 | 40,212 | 66,668 | 5,823 | 1,595,010 |
| 1983 | 1,198,023 | 8,760 | 327,643 | 43,409 | 69,754 | 5,199 | 1,652,788 |
| 1984 | 1,224,919 | 8,784 | 357,999 | 46,560 | 77,367 | 4,640 | 1,720,269 |
| 1985 | 1,260,565 | 9,086 | 373,072 | 46,980 | 79,600 | 4,876 | 1,774,179 |
| 1986 | 1,301,214 | 9,397 | 389,047 | 48,308 | 81,833 | 5,073 | 1,834,872 |
| 1987 | 1,355,330 | 9,506 | 415,449 | 49,537 | 86,064 | 5,318 | 1,921,204 |
| 1988 | 1,429,579 | 10,024 | 439,496 | 51,239 | 90,158 | 5,466 | 2,025,962 |
| 1989 | 1,477,769 | 10,371 | 454,339 | 52,969 | 95,349 | 5,659 | 2,096,456 |
| 1990 | 1,513,184 | 9,557 | 466,092 | 53,443 | 96,367 | 5,719 | 2,144,362 |
| 1991 | 1,533,552 | 9,178 | 472,848 | 53,787 | 96,942 | 5,743 | 2,172,050 |
| 1992 | 1,600,839 | 9,557 | 478,193 | 53,691 | 99,112 | 5,759 | 2,247,151 |
| 1993 | 1,547,366 | 9,906 | 573,398 ${ }^{\text {b }}$ | 56,781 | 103,123 | 6,126 | 2,296,700 |
| 1994 | 1,501,402 | 10,240 | 669,321 ${ }^{\text {b }}$ | 61,284 | 108,932 | 6,409 | 2,357,588 |
| 1995 | 1,541,458 | 9,797 | 686,977 ${ }^{\text {b }}$ | 62,706 | 115,454 | 6,383 | 2,422,775 |
| Average annual percentage change |  |  |  |  |  |  |  |
| 1970-95 | 2.1\% | 4.9\% | 7.1\% | $3.4 \%$ | 4.9\% | 1.4\% | 3.2\% |
| 1985-95 | 2.0\% | 0.8\% | 6.3\% | 2.9\% | 3.8\% | 2.7\% | 3.2\% |

## Source:

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995,

Washington, DC, 1996, Table VM-1, p. V-115, and annual.
(Additional resources: http://www.fhwa.dot.gov)
${ }^{\text {a }}$ The data does not correspond with vehicle-miles of travel presented in the "Bus" section of this chapter due to differing data sources.
${ }^{\mathrm{b}}$ Some minivans and sport utility vehicles are included in two-axle, four-tire trucks that were previously included with the automobiles.

The data on automobile stock by size class are estimations based on historical sales data. This method assumes a constant scrappage rate for all size classes.

Table 3.2
Vehicle Stock and New Sales in United States, 1995 Calendar Year

|  | $\begin{gathered} \text { Vehicle } \\ \text { stock }^{\mathrm{a}} \\ \text { (thousands) } \end{gathered}$ | New sales |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Domestic (thousands) | Import ${ }^{\text {b }}$ (thousands) | Total (thousands) |
| Autos | 123,242 | 7,129 (82.6\%) | 1,506 (17.4\%) | 8,635 (100.0\%) |
| Two seaters | 2,414 | 21 (40.3\%) | 32 (59.7\%) | 53 (100.0\%) |
| Minicompact | 1,888 | 0 (0.0\%) | 44 (100.0\%) | 44 (100.0\%) |
| Subcompact | 30,301 | 962 (64.3\%) | 535 (35.7\%) | 1,497 (100.0\%) |
| Compact | 35,956 | 2,766 (84.9\%) | 492 (15.1\%) | 3,259 (100.0\%) |
| Midsize | 35,486 | 2,096 (84.6\%) | 381 (15.4\%) | 2,477 (100.0\%) |
| Large | 17,197 | 1,283 (98.3\%) | 23 (1.7\%) | 1,306 (100.0\%) |
| Motorcycles | 3,767 ${ }^{\text {c }}$ | c | c | c |
| Recreational vehicles | c | 475 (100.0\%) | 0 (0.0\%) | 475 (100.0\%) |
| Trucks | 70,199 | 6064 (93.6\%) | 417 (6.4\%) | 6,482 (100.0\%) |
| Light (0-10,000 lbs) | 65,496 | 5,663 (93.5\%) | 390 (6.5\%) | 6,054 (100.0\%) |
| Medium (10,001-19,500 lbs) | 1,474 | 76 (78.4\%) | 21 (21.6\%) | 97 (100.0\%) |
| Light-heavy (19,501-26,000 lbs) | 842 | 20 (83.3\%) | 4 (16.7\%) | 24 (100.0\%) |
| Heavy-heavy ( $26,001 \mathrm{lbs}$ and over) | 2,387 | 305 (99.3\%) | 2 (0.7\%) | 307 (100.0\%) |

## Source:

See Appendix A for Table 3.3. (Additional resources: http://www.aama.com, http://www.polk.com)
${ }^{\text {a }}$ Vehicle stock as of July 1.
${ }^{\mathrm{b}}$ Includes domestic-sponsored imports.
${ }^{\text {c Includes mostly on-highway motorcycles. Many states do not require registration for off-highway }}$ vehicles.

## VEHICLES IN USE

Both the Federal Highway Administration (FHWA) and R. L. Polk and Company report figures on the automobile and truck population each year. The two estimates, however, differ by as much as $25.6 \%$ for trucks (1992). The differences can be attributed to several factors:

- 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.
- The classification of mini-vans, station wagons on truck chasses, and utility vehicles as passenger cars or trucks has proven to make differences in the two estimates. The R. L. Polk data included passenger vans in the automobile count until 1980; since 1980 all vans have been counted as trucks. Recently, the Federal Highway Administration adjusted their definition of automobiles and trucks. Starting in 1993, some minivans and sport utility vehicles that were previously included with automobiles were included with trucks. This change produced a dramatic change in the individual percentage differences of cars and trucks. The difference in total vehicles has been less than $5 \%$ each year since 1990 and does not appear to be significantly affected by the FHWA reclassifications.
- The FHWA data include all non-military Federal vehicles, while the R.L. Polk data include only those Federal vehicles which are registered within a state. Federal vehicles are not required to have State registrations, and, according to the General Services Administration, most Federal Vehicles are not registered.

According to the R. L. Polk statistics, the number of passenger cars in use in the U.S. declined from 1991 to 1992. This is the first decline in vehicle stock since the figures were first reported in 1924. However, the data should be viewed with caution. A redesign of Polk's approach in 1992 allowed a national check for duplicate registrations, which was not possible in earlier years. Polk estimates that, due to processing limitations, its vehicle population counts may have been inflated by as much as $1 \frac{1}{2}$ percent. Assuming that percentage is correct, the number of passenger cars in use would have declined from 1991 to 1992 under the previous Polk method. Meanwhile, the FHWA estimates indicated growth in both the number of passenger cars and trucks from 1991 to 1992.

Table 3.3
Automobiles and Trucks in Use, 1970-95
(thousands)

| Year | 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 | 143,453 | 123,276 | 16.4\% | 44,717 | 56,023 | -20.2\% | 188,170 | 179,299 | 4.9\% |
| 1991 | 142,569 | 123,268 | 15.7\% | 44,936 | 58,179 | -22.8\% | 187,505 | 181,438 | 3.3\% |
| 1992 | 144,213 | 120,347 | 19.8\% | 45,504 | 61,172 | -25.6\% | 189,717 | 181,519 | 4.5\% |
| 1993 | 131,581 ${ }^{\text {a }}$ | 121,055 | 8.7\% | 61,828 ${ }^{\text {a }}$ | 65,260 | -5.3\% | 193,409 | 186,315 | 3.8\% |
| 1994 | 133,930 ${ }^{\text {a }}$ | 121,997 | 9.8\% | 63,445 ${ }^{\text {a }}$ | 66,717 | -4.9\% | 197,375 | 188,714 | 4.6\% |
| 1995 | 136,066 | 123,242 | 9.4\% | 64,778 | 70,199 | -8.4\% | 200,844 | 193,441 | 3.7\% |

## Source:

FHWA - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, Table VM-1, p. V-92, and annual. (Additional resources: http://www.fhwa.dot.gov)
R. L. Polk - R. L. Polk and Company, Detroit, Michigan. FURTHER REPRODUCTION PROHIBITED. (Additional resources: http://www.polk.com)

The average age of automobiles in 1995 is greater than that of trucks for the first time in the 25-year series. Most likely, it is the high sales of light-duty trucks in recent years that has influenced the average age of the truck population.

Table 3.4
Average Age of Automobiles and Trucks in Use, 1970-95 (years)

| Calendar year | Automobiles |  | Trucks |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Mean | Median | Mean | Median |
| 1970 | 5.6 | 4.9 | 7.3 | 5.9 |
| 1971 | 5.7 | 5.1 | 7.4 | 6.1 |
| 1972 | 5.7 | 5.1 | 7.2 | 6.0 |
| 1973 | 5.7 | 5.1 | 6.9 | 5.8 |
| 1974 | 5.7 | 5.2 | 7.0 | 5.6 |
| 1975 | 6.0 | 5.4 | 6.9 | 5.8 |
| 1976 | 6.2 | 5.5 | 7.0 | 5.8 |
| 1977 | 6.2 | 5.6 | 6.9 | 5.7 |
| 1978 | 6.3 | 5.7 | 6.9 | 5.8 |
| 1979 | 6.4 | 5.9 | 6.9 | 5.9 |
| 1980 | 6.6 | 6.0 | 7.1 | 6.3 |
| 1981 | 6.9 | 6.0 | 7.5 | 6.5 |
| 1982 | 7.2 | 6.2 | 7.8 | 6.8 |
| 1983 | 7.4 | 6.5 | 8.1 | 7.2 |
| 1984 | 7.5 | 6.7 | 8.2 | 7.4 |
| 1985 | 7.6 | 6.9 | 8.1 | 7.6 |
| 1986 | 7.6 | 7.0 | 8.0 | 7.7 |
| 1987 | 7.6 | 6.9 | 8.0 | 7.8 |
| 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 |
| 1992 | 8.1 | 7.0 | 8.4 | 7.2 |
| 1993 | 8.3 | 7.3 | 8.6 | 7.5 |
| 1994 | 8.4 | 7.5 | 8.4 | 7.5 |
| 1995 | 8.5 | 7.7 | 8.4 | 7.6 |

## Source:

R. L. Polk and Co., Detroit, MI. FURTHER REPRODUCTION PROHIBITED.
(Additional resources: http://www.polk.com)

1990 model year (MY) automobiles will be in service an average of three years longer than their 1970 counterparts. The average lifetime of autos increased by 1.4 years fromMY 1970 to MY 1980, then rose another 1.6 years in MY 1990.

Table 3.5

## Scrappage and Survival Rates for Automobiles 1970, 1980 and 1990 Model Years

|  | 1970 model year |  | 1980 model year |  | 1990 model year |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Scrappage rate ${ }^{\text {a }}$ | Survival rate ${ }^{\text {b }}$ | Scrappage rate ${ }^{\text {a }}$ | Survival rate ${ }^{\text {b }}$ | Scrappage rate ${ }^{\text {a }}$ | Survival rate ${ }^{\text {b }}$ |
| 0 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 |
| 1 | 0.006050 | 0.993950 | 0.005553 | 0.994447 | 0.005255 | 0.994745 |
| 2 | 0.009650 | 0.984359 | 0.007636 | 0.986854 | 0.007538 | 0.987246 |
| 3 | 0.014590 | 0.969997 | 0.011011 | 0.975988 | 0.010522 | 0.976858 |
| 4 | 0.022892 | 0.947792 | 0.013567 | 0.962746 | 0.014414 | 0.962778 |
| 5 | 0.030522 | 0.918864 | 0.020498 | 0.943011 | 0.019623 | 0.943885 |
| 6 | 0.040956 | 0.881231 | 0.034718 | 0.910272 | 0.025096 | 0.920197 |
| 7 | 0.057029 | 0.830975 | 0.047366 | 0.867156 | 0.032690 | 0.890116 |
| 8 | 0.084560 | 0.760708 | 0.055299 | 0.819204 | 0.042014 | 0.852719 |
| 9 | 0.118527 | 0.670543 | 0.071153 | 0.760915 | 0.053468 | 0.807126 |
| 10 | 0.151858 | 0.568716 | 0.092931 | 0.690202 | 0.066230 | 0.753669 |
| 11 | 0.166996 | 0.473743 | 0.117300 | 0.609241 | 0.081338 | 0.692367 |
| 12 | 0.171955 | 0.392280 | 0.158696 | 0.512557 | 0.096959 | 0.625236 |
| 13 | 0.201774 | 0.313128 | 0.187663 | 0.416369 | 0.114297 | 0.553773 |
| 14 | 0.198887 | 0.250851 | 0.208822 | 0.329422 | 0.131169 | 0.481135 |
| 15 | 0.233611 | 0.192250 | 0.228359 | 0.254196 | 0.149005 | 0.409444 |
| 16 | 0.271810 | 0.139994 | 0.238412 | 0.193592 | 0.166710 | 0.341186 |
| 17 | 0.283363 | 0.100325 | 0.250547 | 0.145088 | 0.183826 | 0.278467 |
| 18 | 0.283078 | 0.071925 | 0.261438 | 0.107157 | 0.199477 | 0.222919 |
| 19 | 0.287708 | 0.051232 | 0.270527 | 0.078168 | 0.211449 | 0.175783 |
| 20 | 0.292908 | 0.036226 | 0.277234 | 0.056497 | 0.223461 | 0.136502 |
| Average lifetime | 10.7 years |  | 12.1 years |  | 13.7 years |  |

## Source:

Miaou, Shaw-Pin, "Factors Associated with Aggregated Car Scrappage Rate in the United States: 1966-1992," Oak Ridge National Laboratory, Oak Ridge, TN, January 1995.
(Additional resources: http://www-cta.ornl.gov)

[^23]Table 3.6
Scrappage and Survival Rates for Trucks

| Vehicle age (years) | All trucks |  |  |  |  |  | $\frac{\text { Light trucks }}{(1978-89)^{\mathrm{a}}}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $(1966-73)^{\text {a }}$ |  | $(1973-78)^{\text {a }}$ |  | $(1978-89)^{\text {a }}$ |  |  |  |
|  | Scrappage rate | Survival rate | Scrappage rate | Survival rate | Scrappage rate | Survival rate | Scrappage rate | Survival rate |
| 0 | 0.00000 | 1.00000 | 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 | 0.00249 | 0.99751 |
| 2 | 0.00814 | 0.98608 | 0.00698 | 0.98801 | 0.00461 | 0.99228 | 0.00383 | 0.99369 |
| 3 | 0.01129 | 0.97495 | 0.00958 | 0.97854 | 0.00676 | 0.98557 | 0.00583 | 0.98790 |
| 4 | 0.01550 | 0.95983 | 0.01306 | 0.96576 | 0.00980 | 0.97591 | 0.00877 | 0.97923 |
| 5 | 0.02101 | 0.93967 | 0.01762 | 0.94873 | 0.01399 | 0.96226 | 0.01296 | 0.96654 |
| 6 | 0.02798 | 0.91337 | 0.02347 | 0.92647 | 0.01957 | 0.94343 | 0.01869 | 0.94848 |
| 7 | 0.03649 | 0.88005 | 0.03073 | 0.89800 | 0.02663 | 0.91830 | 0.02606 | 0.92376 |
| 8 | 0.04638 | 0.83923 | 0.03943 | 0.86260 | 0.03507 | 0.88609 | 0.03488 | 0.89154 |
| 9 | 0.05730 | 0.79114 | 0.04940 | 0.81999 | 0.04445 | 0.84671 | 0.04454 | 0.85182 |
| 10 | 0.06863 | 0.73685 | 0.06026 | 0.77058 | 0.05408 | 0.80092 | 0.05416 | 0.80569 |
| 11 | 0.07970 | 0.67812 | 0.07147 | 0.71551 | 0.06320 | 0.75030 | 0.06285 | 0.75505 |
| 12 | 0.08987 | 0.61718 | 0.08239 | 0.65656 | 0.07121 | 0.69687 | 0.07006 | 0.70215 |
| 13 | 0.09872 | 0.55625 | 0.09247 | 0.59585 | 0.07776 | 0.64268 | 0.07562 | 0.64905 |
| 14 | 0.10605 | 0.49726 | 0.10130 | 0.53548 | 0.08285 | 0.58944 | 0.07967 | 0.59734 |
| 15 | 0.11189 | 0.44162 | 0.10871 | 0.47727 | 0.08662 | 0.53838 | 0.08251 | 0.54805 |
| 16 | 0.11638 | 0.39023 | 0.11468 | 0.42254 | 0.08932 | 0.49029 | 0.08443 | 0.50178 |
| 17 | 0.11976 | 0.34349 | 0.11936 | 0.37210 | 0.09122 | 0.44557 | 0.08571 | 0.45877 |
| 18 | 0.12225 | 0.30150 | 0.12294 | 0.32636 | 0.09253 | 0.40434 | 0.08655 | 0.41907 |
| 19 | 0.12406 | 0.26410 | 0.12562 | 0.28536 | 0.09343 | 0.36656 | 0.08710 | 0.38257 |
| 20 | 0.12536 | 0.23099 | 0.12761 | 0.24894 | 0.09403 | 0.33209 | 0.08745 | 0.34911 |
| 21 | 0.12629 | 0.20182 | 0.12906 | 0.21681 | 0.09444 | 0.30073 | 0.08768 | 0.31850 |
| 22 | 0.12696 | 0.17620 | 0.13012 | 0.18860 | 0.09471 | 0.27225 | 0.08783 | 0.29052 |
| 23 | 0.12743 | 0.15374 | 0.13089 | 0.16392 | 0.09490 | 0.24641 | 0.08793 | 0.26498 |
| 24 | 0.12776 | 0.13410 | 0.13144 | 0.14237 | 0.09502 | 0.22300 | 0.08799 | 0.24166 |
| 25 | 0.12799 | 0.11694 | 0.13183 | 0.12360 | 0.09510 | 0.20179 | 0.08803 | 0.22039 |
| Average lifetime | 14.0 years |  | 14.6 years |  | 15.8 years |  | 16.0 years |  |

## Source:

Miaou, Shaw-Pin, "Study of Vehicle Scrappage Rates," Oak Ridge National Laboratory, Oak Ridge, TN, August 1990. (Additional resources: http://www-cta.ornl.gov)

[^24]Table 3.7
New Retail Automobile Sales in the United States, 1970-96

| Calendar year | Domestic ${ }^{\text {a }}$ | Import ${ }^{\text {b }}$ | Total | Percentage imports | Percentage transplants ${ }^{\text {c }}$ on model year basis | Percentage imports and transplants | Percentage diesel |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | (thousands) |  |  |  |  |  |  |
| 1970 | 7,119 | 1,285 | 8,404 | 15.3\% | d | d | d |
| 1971 | 8,681 | 1,568 | 10,249 | 15.3\% | d | d | 0.06\% |
| 1972 | 9,327 | 1,623 | 10,950 | 14.8\% | d | d | 0.05\% |
| 1973 | 9,676 | 1,763 | 11,439 | 15.4\% | d | d | 0.06\% |
| 1974 | 7,454 | 1,399 | 8,853 | 15.8\% | d | d | 0.20\% |
| 1975 | 7,053 | 1,571 | 8,624 | 18.2\% | d | d | 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\% | 0.02\% |
| 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\% | 0.10\% |
| 1992 | 6,277 | 1,937 | 8,213 | 23.6\% | 14.1\% | 37.7\% | 0.06\% |
| 1993 | 6,742 | 1,776 | 8,518 | 20.9\% | 14.9\% | 35.8\% | 0.03\% |
| 1994 | 7,255 | 1,735 | 8,990 | 19.3\% | 16.5\% | 35.8\% | 0.04\% |
| 1995 | 7,129 | 1,506 | 8,635 | 17.4\% | 18.9\% | 36.3\% | 0.04\% |
| 1996 | 7,254 | 1,273 | 8,527 | 14.9\% | d | d | d |
|  | Average annual percentage change |  |  |  |  |  |  |
| 1970-96 | 0.1\% | 1.3\% | 0.3\% |  |  |  |  |
| 1986-96 | -0.9\% | -3.3\% | -1.4\% |  |  |  |  |

Source:
Domestic and import data - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p. 16, and annual. 1996 data from "Economic Indicators, 4th Quarter 1996."
Diesel data - H. A. Stark (ed), Ward's Communications, Inc., Ward's Automotive Yearbook, Detroit, MI, 1996, p. 49, and annual.
Transplant data - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares Data System, Oak Ridge, TN, 1996. (Additional resources: http://www.aama.com, http://www.wardsauto.com)

[^25]Table 3.8
Automobiles in Operation and Vehicle Travel by Age, 1970 and 1995

| $\begin{gathered} \text { Age } \\ \text { (years) } \end{gathered}$ | 1970 |  |  | 1995 |  |  | 1995 Estimated vehicle travel |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Vehicles (thousands) | Percentage | Cumulative percentage | Vehicles (thousands) | Percentage | Cumulative percentage | Percentage | Cumulative percentage |
| Under $1^{\text {a }}$ | 6,288 | 7.8\% | 7.8\% | 6,038 | 4.9\% | 4.9\% | 6.4\% | 6.4\% |
| 1 | 9,299 | 11.6\% | 19.4\% | 8,150 | 6.6\% | 11.5\% | 8.1\% | 14.5\% |
| 2 | 8,816 | 11.0\% | 30.3\% | 8,219 | 6.7\% | 18.2\% | 7.8\% | 22.3\% |
| 3 | 7,878 | 9.8\% | 40.1\% | 7,651 | 6.2\% | 24.4\% | 7.0\% | 29.2\% |
| 4 | 8,538 | 10.6\% | 50.8\% | 7,942 | 6.4\% | 30.8\% | 6.9\% | 36.1\% |
| 5 | 8,506 | 10.6\% | 61.3\% | 8,151 | 6.6\% | 37.5\% | 7.1\% | 43.3\% |
| 6 | 7,116 | 8.8\% | 70.2\% | 8,957 | 7.3\% | 44.7\% | 7.6\% | 50.9\% |
| 7 | 6,268 | 7.8\% | 78.0\% | 9,146 | 7.4\% | 52.2\% | 7.6\% | 58.5\% |
| 8 | 5,058 | 6.3\% | 84.3\% | 8,839 | 7.2\% | 59.3\% | 6.7\% | 65.3\% |
| 9 | 3,267 | 4.1\% | 88.3\% | 8,665 | 7.0\% | 66.4\% | 6.6\% | 71.8\% |
| 10 | 2,776 | 3.5\% | 91.8\% | 7,823 | 6.3\% | 72.7\% | 5.3\% | 77.2\% |
| 11 | 1,692 | 2.1\% | 93.9\% | 6,843 | 5.6\% | 78.3\% | 4.6\% | 81.8\% |
| 12 | 799 | 1.0\% | 94.9\% | 4,527 | 3.7\% | 81.9\% | 3.1\% | 84.9\% |
| 13 | 996 | 1.2\% | 96.1\% | 3,430 | 2.8\% | 84.7\% | 2.3\% | 87.2\% |
| 14 | 794 | 1.0\% | 97.1\% | 3,024 | 2.5\% | 87.2\% | 2.1\% | 89.3\% |
| 15 and older | 2,336 | 2.9\% | 100.0\% | 15,796 | 12.8\% | 100.0\% | 10.7\% | 100.0\% |
| Subtotal | 80,427 | 100.0\% |  | 123,201 | 100.0\% |  | 100.0\% |  |
| Age not given | 22 |  |  | 41 |  |  |  |  |
| Total | 80,449 |  |  | 123,242 |  |  |  |  |
| Average age |  | 5.6 |  |  | 8.5 |  |  |  |
| Median age |  | 4.9 |  |  | 7.7 |  |  |  |

## Source:

R. L. Polk and Co., 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 Household Vehicle Energy Consumption, 1994, provided by the U.S.
Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division, 1996.
(Additional resources: http://www.polk.com, http://www.eia.doe.gov)
${ }^{\text {a }}$ Automobiles sold as of July 1 of each year.

Starting in 1993, the Federal Highway Administration (FHWA) revised their definitionsof passenger cars and two-axle, four-tire trucks. The result was a dramatic decrease in cars and an increase in two-axle, four-tire trucks. The sum of these two categories will still produce a consistent trend. ${ }^{a}$ The FHWA plans to release revised historical data for each of these categories in 1997.

Table 3.9
Summary Statistics for Passenger Cars, 1970-95

| Year | Registrations ${ }^{\text {b }}$ (thousands) | Vehicle travel (million miles) | Fuel use (million gallons) | Fuel economy ${ }^{\text {c }}$ (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 | 1,355,330 | 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 | 143,453 | 1,513,184 | 71,989 | 21.0 |
| 1991 | 142,569 | 1,533,552 | 70,692 | 21.7 |
| 1992 | 144,213 | 1,600,839 | 73,823 | 21.7 |
| $1993{ }^{\text {d }}$ | 131,581 | 1,547,366 | 73,553 | 21.0 |
| $1994{ }^{\text {d }}$ | 133,930 | 1,501,402 | 67,517 | 22.2 |
| $1995{ }^{\text {d }}$ | 136,066 | 1,541,458 | 68,318 | 22.6 |
| Average annual percentage change |  |  |  |  |
| 1970-95 | 1.7\% | 2.1\% | 0.0\% | 2.1\% |
| 1985-95 | 0.3\% | 2.0\% | 0.1\% | 2.2\% |

## Source:

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Washington, DC, 1996, Table VM-1, p. V-92, and annual.
(Additional resources: http://www.fhwa.dot.gov)
${ }^{\text {a }}$ See Table 3.21 for truck data.
${ }^{\mathrm{b}}$ This number differs from R. L. Polk's estimates of "number of automobiles in use." See Table 3.3.
${ }^{\text {c }}$ Fuel economy for automobile population.
${ }^{\mathrm{d}}$ Some minivans and sport utility vehicles that were previously classified as passenger cars are classified as two-axle, four-tire trucks.

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

Table 3.10
Average Annual Miles Per Automobile by Automobile Age

| Vehicle age (years) | National Personal Transportation Study ${ }^{\text {a }}$ |  | Residential Transportation Energy Consumption Survey ${ }^{\text {b }}$ |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1983 | 1990 | 1983 | 1985 | 1988 | 1991 | 1994 |
| Under 1 | 14,200 | 19,800 | 13,400 | 12,700 | 12,900 | 13,400 | 15,220 |
| 1 | 17,000 | 16,900 | 13,000 | 13,000 | 13,400 | 14,100 | 14,250 |
| 2 | 14,000 | 16,300 | 12,700 | 12,600 | 12,600 | 12,600 | 13,740 |
| 3 | 12,500 | 14,400 | 12,100 | 12,400 | 12,100 | 13,200 | 13,080 |
| 4 | 11,400 | 13,800 | 11,300 | 11,100 | 11,500 | 13,300 | 12,500 |
| 5 | 11,000 | 12,600 | 9,700 | 10,600 | 10,600 | 12,200 | 12,560 |
| 6 | 9,900 | 12,900 | 9,700 | 10,000 | 10,800 | 11,200 | 12,290 |
| 7 | 9,400 | 12,400 | 9,500 | 9,700 | 10,000 | 10,700 | 12,030 |
| 8 | 8,700 | 12,300 | 8,700 | 8,900 | 10,300 | 11,400 | 10,915 |
| 9 | 8,100 | 11,200 | 8,400 | 8,600 | 8,900 | 10,000 | 10,950 |
| 10 and older | 6,900 | 9,300 | 8,700 | 8,400 | 7,500 | 7,200 | 9,780 |
| All vehicles | 10,400 | 12,600 | 9,400 | 9,900 | 10,200 | 10,600 | 11,400 |

## Source:

Nationwide Personal Transportation Study-1983: D. Klinger and J. Richard Kuzmyak, COMSIS Corporation, Personal Travel in the United States, Volume 1: 1983-84 Nationwide Personal Travel Study, prepared for the U.S. Department of Transportation, Washington, DC, August 1986, Table 4-22, p.4-21.
1990: Generated from the 1990 Nationwide Personal Transportation Study Public Use Tape, March 1992.

Residential Transportation Energy Consumption Survey-Personnal communication with Energy Information Agency, Office of Markets and End Use, Energy End Use Division.
(Additional resources: http://www.fhwa.dot.gov, http://www.eia.doe.gov)
${ }^{\text {a }}$ Includes only passenger vehicles (standard auto, station wagon, taxi, and van-bus/minibus) owned by or available to the household on a regular basis.
${ }^{\mathrm{b}}$ Includes all household vehicles-automobiles, station wagons, pickup trucks, vans, and utility vehicles.

The average auto lost over 300 pounds from 1978 to 1985, but gained a few pounds back since then Much of the 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 predominart component of automobiles in 1996 with a $43.5 \%$ share of total materials. As conventional steel use has been decreasing, use of high-strength steel has increased.

Table 3.11
Average Material Consumption for a Domestic Automobile, 1978, 1985, and 1996

| Material | 1978 |  | 1985 |  | 1996 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Pounds | Percentage | Pounds | Percentage | Pounds | Percentage |
| Conventional steel ${ }^{\text {a }}$ | 1,880.0 | 53.8\% | 1,481.5 | 46.5\% | 1,409.0 | 43.5\% |
| High-strength steel | 127.5 | 3.6\% | 217.5 | 6.8\% | 287.0 | 8.9\% |
| Stainless steel | 25.0 | 0.7\% | 29.0 | 0.9\% | 46.5 | 1.4\% |
| Other steels | 56.0 | 1.6\% | 54.5 | 1.7\% | 38.5 | 1.2\% |
| Iron | 503.0 | 14.4\% | 468.0 | 14.7\% | 389.0 | 12.0\% |
| Aluminum | 112.0 | 3.2\% | 138.0 | 4.3\% | 195.5 | 6.0\% |
| Rubber | 141.5 | 4.1\% | 136.0 | 4.3\% | 139.0 | 4.3\% |
| Plastics/composites | 176.0 | 5.0\% | 211.5 | 6.6\% | 245.0 | 7.6\% |
| Glass | 88.0 | 2.5\% | 85.0 | 2.7\% | 94.0 | 2.9\% |
| Copper | 39.5 | 1.1\% | 44.0 | 1.4\% | 45.0 | 1.4\% |
| Zinc die castings | 28.0 | 0.8\% | 18.0 | 0.5\% | 15.5 | 0.5\% |
| Power metal parts | 16.0 | 0.5\% | 19.0 | 0.6\% | 29.5 | 0.9\% |
| Fluids \& lubricants | 189.0 | 5.4\% | 184.0 | 5.8\% | 197.5 | 6.1\% |
| Other materials | 112.5 | $3.2 \%$ | 101.5 | 3.2\% | 105.0 | 3.2\% |
| Total | 3,494.0 | 100.0\% | 3,187.5 | 100.0\% | 3,236.0 | 100.0\% |

## Source:

H. A. Stark (ed.), Ward's Communications, Inc., Wards Automotive Yearbook, Detroit, MI, 1996, p. 24, and annual. (Additional resources: http://www.wardsauto.com)

[^26]Table 3.12
Sales-Weighted Engine Size of New Domestic and Import Automobiles by Size Class, Sales Periods 1976-96
( liters ${ }^{\text {a }}$ )

| Model <br> year | Minicompact | Subcompact | Compact | Midsize | Large | Two seater | Fleet |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1976 | b | 2.67 | 5.00 | 5.85 | 6.79 | 2.89 | 4.89 |
| 1977 | 1.98 | 2.73 | 4.79 | 5.47 | 6.02 | 2.81 | 4.56 |
| 1978 | 2.06 | 2.67 | 3.95 | 4.89 | 6.17 | 3.01 | 4.33 |
| 1979 | 1.86 | 2.39 | 3.74 | 4.41 | 5.56 | 2.77 | 3.78 |
| 1980 | 1.90 | 2.10 | 3.03 | 3.90 | 5.12 | 2.79 | 3.22 |
| 1981 | 1.57 | 2.04 | 2.20 | 3.63 | 5.00 | 2.49 | 2.98 |
| 1982 | 1.53 | 2.08 | 2.12 | 3.47 | 4.73 | 2.41 | 2.89 |
| 1983 | 1.60 | 2.19 | 2.20 | 3.45 | 4.95 | 2.52 | 2.98 |
| 1984 | 2.17 | 2.22 | 2.21 | 3.40 | 4.87 | 2.50 | 2.97 |
| 1985 | 1.95 | 2.29 | 2.27 | 3.37 | 4.65 | 2.47 | 2.92 |
| 1986 | 1.45 | 2.19 | 2.21 | 3.19 | 4.38 | 2.83 | 2.76 |
| 1987 | 1.48 | 2.19 | 2.20 | 2.99 | 4.36 | 2.57 | 2.68 |
| 1988 | 1.52 | 2.05 | 2.21 | 3.00 | 4.32 | 2.75 | 2.66 |
| 1989 | 2.54 | 2.08 | 2.11 | 3.01 | 4.31 | 2.81 | 2.68 |
| 1990 | 2.42 | 1.96 | 2.25 | 3.13 | 4.33 | 2.57 | 2.72 |
| 1991 | 2.17 | 1.97 | 2.23 | 3.16 | 4.40 | 2.67 | 2.72 |
| 1992 | 1.89 | 2.01 | 2.33 | 3.16 | 4.34 | 3.01 | 2.76 |
| 1993 | 1.96 | 2.07 | 2.28 | 3.16 | 4.27 | 3.47 | 2.78 |
| 1994 | 2.21 | 2.27 | 2.23 | 3.15 | 4.17 | 3.82 | 2.79 |
| 1995 | 2.42 | 2.26 | 2.23 | 3.12 | 4.12 | 3.76 | 2.79 |
| $1996^{\text {c }}$ | 2.61 | 2.23 | 2.19 | 2.99 | 4.09 | 3.69 | 2.72 |
|  |  | Average annual percentage change |  |  |  |  |  |
| $1976-96$ | $1.5 \%$ d | $-0.9 \%$ | $-4.0 \%$ | $-3.3 \%$ | $-2.5 \%$ | $1.2 \%$ | $-2.9 \%$ |
| $1986-96$ | $6.1 \%$ | $0.2 \%$ | $-0.1 \%$ | $-0.6 \%$ | $-0.7 \%$ | $2.7 \%$ | $-0.1 \%$ |
|  |  |  |  |  |  |  |  |

## Source:

Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1996.
(Additional resources: http://www-cta.ornl.gov)
${ }^{\text {a }} 1$ liter $=61.02$. cubic inches.
${ }^{\mathrm{b}}$ There were no minicompact automobiles sold in 1976.
${ }^{c}$ Preliminary.
${ }^{\text {d }}$ Average annual percentage change is for years 1977-95.

Table 3.13
Sales-Weighted Curb Weight of New Domestic and Import Automobiles by Size Class, Sales Periods 1976-96 (pounds)

| Model <br> year | Minicompact | Subcompact | Compact | Midsize | Large | Two <br> seater | Fleet |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1976 | a | 2,577 | 3,609 | 4,046 | 4,562 | 2,624 | 3,608 |
| 1977 | 2,228 | 2,586 | 3,550 | 3,900 | 4,026 | 2,608 | 3,424 |
| 1978 | 2,200 | 2,444 | 3,138 | 3,427 | 3,956 | 2,763 | 3,197 |
| 1979 | 2,120 | 2,367 | 3,048 | 3,287 | 3,763 | 2,699 | 3,000 |
| 1980 | 2,154 | 2,270 | 2,813 | 3,081 | 3,667 | 2,790 | 2,790 |
| 1981 | 1,920 | 2,370 | 2,382 | 2,996 | 3,672 | 2,744 | 2,744 |
| 1982 | 2,002 | 2,302 | 2,422 | 2,992 | 3,703 | 2,525 | 2,730 |
| 1983 | 2,072 | 2,334 | 2,441 | 3,027 | 3,779 | 2,663 | 2,788 |
| 1984 | 2,376 | 2,380 | 2,454 | 2,990 | 3,734 | 2,559 | 2,788 |
| 1985 | 2,211 | 2,392 | 2,464 | 2,954 | 3,575 | 2,539 | 2,743 |
| 1986 | 2,120 | 2,415 | 2,432 | 2,857 | 3,451 | 2,575 | 2,675 |
| 1987 | 1,960 | 2,423 | 2,474 | 2,857 | 3,483 | 2,602 | 2,689 |
| 1988 | 1,933 | 2,346 | 2,558 | 2,880 | 3,487 | 2,693 | 2,717 |
| 1989 | 2,576 | 2,357 | 2,517 | 2,985 | 3,496 | 2,735 | 2,760 |
| 1990 | 2,651 | 2,368 | 2,637 | 3,065 | 3,594 | 2,656 | 2,828 |
| 1991 | 2,584 | 2,406 | 2,652 | 3,085 | 3,650 | 2,707 | 2,848 |
| 1992 | 2,395 | 2,444 | 2,674 | 3,131 | 3,670 | 2,770 | 2,879 |
| 1993 | 2,449 | 2,478 | 2,659 | 3,142 | 3,615 | 2,967 | 2,894 |
| 1994 | 2,719 | 2,571 | 2,639 | 3,171 | 3,657 | 3,035 | 2,921 |
| 1995 | 2,831 | 2,552 | 2,647 | 3,179 | 3,648 | 2,947 | 2,937 |
| $1996^{\text {b }}$ | 2,951 | 2,530 | 2,667 | 3,203 | 3,671 | 2,981 | 2,950 |
|  |  | Average annual percentage change |  |  |  |  |  |
| $1976-9$ | $1.5 \%$ | $-1.5 \%$ | $-1,2 \%$ | $-1,1 \%$ | $0.6 \%$ | $-1,0 \%$ |  |
| $1986-9$ | $3,4 \%$ | $-0.1 \%$ | $0.5 \%$ | $0,9 \%$ | $1,1 \%$ | $0,6 \%$ | $1.5 \%$ |

## Source:

Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1997. (Additional resources: http://www-cta.ornl.gov)
${ }^{\text {a }}$ There were no minicompact automobiles sold in 1976.
${ }^{\mathrm{b}}$ Preliminary.
${ }^{\text {c }}$ Average annual percentage change is for years 1977-96.

Table 3.14
Sales-Weighted Interior Space of New Domestic and Import Automobiles by Size Class, Sales Periods 1976-96 (cubic feet)

| Model <br> year | Minicompact <br> $(<85)$ | Subcompact <br> $(85-99)$ | Compact <br> $(100-109)$ | Midsize <br> $(110-119)$ | Large <br> $(>120)$ | Fleet $^{\mathrm{a}}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1977 | 78.8 | 89.8 | 107.1 | 113.0 | 128.0 | 107.9 |
| 1978 | 79.4 | 89.8 | 105.3 | 112.9 | 128.5 | 107.9 |
| 1979 | 80.0 | 90.2 | 105.8 | 113.4 | 130.1 | 106.9 |
| 1980 | 82.4 | 89.9 | 105.4 | 113.5 | 130.8 | 104.9 |
| 1981 | 83.3 | 90.2 | 103.6 | 113.7 | 130.6 | 105.5 |
| 1982 | 83.1 | 91.3 | 102.9 | 113.9 | 130.4 | 106.0 |
| 1983 | 82.7 | 93.3 | 103.0 | 113.1 | 131.3 | 107.3 |
| 1984 | 77.0 | 93.8 | 103.0 | 113.3 | 130.4 | 108.0 |
| 1985 | 77.8 | 94.1 | 103.1 | 113.5 | 129.7 | 107.9 |
| 1986 | 80.1 | 94.5 | 102.8 | 113.8 | 127.6 | 107.0 |
| 1987 | 81.6 | 93.1 | 103.0 | 113.9 | 127.5 | 106.9 |
| 1988 | 81.0 | 93.5 | 103.3 | 113.6 | 127.2 | 107.0 |
| 1989 | 75.0 | 93.3 | 102.7 | 113.8 | 127.4 | 107.5 |
| 1990 | 79.9 | 93.9 | 103.2 | 113.8 | 127.8 | 107.3 |
| 1991 | 79.6 | 94.4 | 103.2 | 113.8 | 128.3 | 107.1 |
| 1992 | 79.1 | 94.0 | 104.2 | 114.0 | 129.2 | 107.5 |
| 1993 | 79.2 | 94.5 | 104.0 | 114.0 | 128.9 | 108.0 |
| 1994 | 79.4 | 94.4 | 103.8 | 113.8 | 128.8 | 108.0 |
| 1995 | 78.5 | 93.8 | 103.9 | 114.3 | 128.1 | 108.7 |
| $1996^{\text {b }}$ | 77.0 | 94.9 | 103.4 | 114.2 | 128.0 | 108.7 |
| $1977-96$ | $-0.1 \%$ | $0.4 \%$ | $0.0 \%$ | $0.1 \%$ | $0.0 \%$ | $0.0 \%$ |
| $1986-96$ | $-0.4 \%$ | $-0.2 \%$ | $0.1 \%$ | $0.0 \%$ | $0.0 \%$ |  |

## Source:

Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System,
Oak Ridge, TN, 1997. (Additional resources: http://www-cta.ornl.gov)

[^27]Figure 3.1. Engine Size, Curb Weight, and Interior Space of New Domestic and Import Automobiles, 1976-96


Source: See Tables 3.12, 3.13, and 3.14.

Table 3.15
Period Sales, Market Shares, and Sales-Weighted Fuel Economies of New Domestic and Import Automobiles, Selected Sales Periods 1976-96

|  | 1976 | 1980 | 1984 | 1988 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 ${ }^{\text {b }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MINICOMPACT |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units |  | 428,346 | 41,368 | 84,186 | 76,698 | 96,290 | 107,634 | 84,345 | 57,198 | 44,752 | 37,580 |
| Market share, \% |  | 4.7 | 0.4 | 0.8 | 0.8 | 1.1 | 1.3 | 1.0 | 0.6 | 0.5 | 0.4 |
| Fuel economy, mpg |  | 29.4 | 29 | 37.8 | 26.4 | 29.3 | 30.6 | 29.9 | 27.8 | 27.0 | 26.8 |
| SUBCOMPACT |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 2,625,929 | 3,441,480 | 2,510,929 | 1,983,353 | 2,030,22 | 2,256,293 | 2,074,35 | 1,944,892 | 2,015,280 | 1,518,209 | 1,312,741 |
| Market share, \% | 27.1 | 37.8 | 24.6 | 19.1 | 22 | 26.9 | 25.6 | 23.2 | 22.6 | 17.4 | 15.2 |
| Fuel economy, mpg | 23.5 | 27.3 | 30.5 | 31.7 | 31.3 | 31.6 | 31.8 | 31.9 | 31.3 | 31.7 | 32.3 |
| COMPACT |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 2,839,603 | 599,423 | 2,768,056 | 4,199,638 | 3,156,48 | 2,425,398 | 2,451,49 | 2,655,378 | 3,077,203 | 3,289,735 | 3,489,048 |
| Market share, \% | 29.3 | 6.6 | 27.1 | 40.5 | 34.2 | 28.9 | 30.2 | 31.7 | 34.5 | 37.7 | 40.3 |
| Fuel economy, mpg | 17.1 | 22.3 | 30.6 | 29.8 | 28.9 | 28.8 | 28.7 | 29.3 | 29.8 | 30.2 | 30.4 |
| MIDSIZE |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 1,815,505 | 3,073,103 | 3,059,647 | 2,550,964 | 2,511,50 | 2,305,773 | 2,249,55 | 2,445,842 | 2,359,898 | 2,498,521 | 2,491,734 |
| Market share, \% | 18.7 | 33.8 | 30 | 24.6 | 27.2 | 27.5 | 27.7 | 29.2 | 26.5 | 28.6 | 28.8 |
| Fuel economy, mpg | 15.3 | 21.3 | 24.1 | 26.9 | 25.9 | 25.9 | 25.8 | 25.7 | 25.6 | 25.9 | 26.4 |
| LARGE |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 2,206,102 | 1,336,190 | 1,502,097 | 1,368,717 | 1,279,09 | 1,161,319 | 1,140,77 | 1,186,991 | 1,339,863 | 1,320,608 | 1,258,996 |
| Market share, \% | 22.8 | 14.7 | 14.7 | 13.2 | 13.9 | 13.9 | 14.1 | 14.2 | 15.0 | 15.1 | 14.6 |
| Fuel economy, mpg | 13.9 | 19.3 | 20.2 | 24.2 | 23.5 | 23.3 | 23.7 | 24.0 | 24.2 | 24.1 | 24.2 |
| TWO SEATER |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 199,716 | 215,964 | 328,968 | 186,127 | 170,465 | 134,890 | 83,192 | 70,480 | 67,020 | 53,045 | 61,479 |
| Market share, \% | 2.1 | 2.4 | 3.2 | 1.8 | 1.8 | 1.6 | 1.0 | 0.8 | 0.8 | 0.6 | 0.7 |
| Fuel economy, mpg | 20.1 | 21 | 26.5 | 27.3 | 28 | 27.3 | 25.9 | 24.8 | 23.9 | 24.7 | 25.5 |
| FLEET |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 9,686,855 | 9,094,506 | 10,211,06 | 10,372,98 | 9,224,46 | 8,379,963 | 8,107,00 | 8,387,928 | 8,916,462 | 8,724,870 | 8,651,578 |
| Market share, \% | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Fuel economy, mpg | 17.2 | 23.2 | 26.3 | 28.5 | 27.6 | 27.7 | 27.7 | 27.8 | 27.8 | 28.0 | 28.3 |

## Source:

Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1997. (Additional resources: http://www-cta.ornl.gov)

[^28]Table 3.16
New Retail Sales of Trucks $\mathbf{1 0 , 0 0 0}$ Pounds GVW and Less in the United States, 1970-95

| Calendar year | Light truck sales ${ }^{\text {a }}$ (thousands) | Percentages |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Import ${ }^{\text {b }}$ | Transplants ${ }^{\text {c }}$ | Diesel | Four-wheel drive of domestic light trucks | Light trucks of light-duty vehicle sales ${ }^{\text {d }}$ | Light trucks of total truck sales |
| 1970 | 1,463 | 4.5\% | e | ${ }^{\text {f }}$ | e | 14.8\% | 80.4\% |
| 1971 | 1,757 | 4.8\% | e | f | e | 14.6\% | 83.4\% |
| 1972 | 2,239 | 6.4\% | e | f | e | 17.0\% | 83.3\% |
| 1973 | 2,745 | 8.5\% | e | f | e | 19.4\% | 84.2\% |
| 1974 | 2,338 | 7.5\% | e | f | 18.0\% | 20.9\% | 84.2\% |
| 1975 | 2,281 | 10.0\% | e | f | 23.4\% | 20.9\% | 87.9\% |
| 1976 | 2,956 | 8.0\% | 0.0\% | f | 23.8\% | 22.6\% | 89.8\% |
| 1977 | 3,430 | 9.4\% | 0.0\% | ${ }^{\text {f }}$ | 24.6\% | 23.5\% | 89.7\% |
| 1978 | 3,808 | 8.8\% | 0.0\% | 1.0\% | 28.5\% | 25.2\% | 89.2\% |
| 1979 | 3,311 | 14.1\% | 0.0\% | 1.0\% | 29.4\% | 23.7\% | 88.7\% |
| 1980 | 2,440 | 19.7\% | 0.9\% | 3.2\% | 20.7\% | 21.4\% | 88.9\% |
| 1981 | 2,189 | 20.3\% | 0.0\% | 3.3\% | 18.6\% | 20.4\% | 89.8\% |
| 1982 | 2,470 | 16.5\% | 0.0\% | 5.0\% | 16.8\% | 23.6\% | 92.8\% |
| 1983 | 2,984 | 15.6\% | 0.0\% | 4.0\% | 28.5\% | 24.5\% | 93.6\% |
| 1984 | 3,863 | 15.7\% | 2.0\% | 3.8\% | 27.0\% | 27.1\% | 93.0\% |
| 1985 | 4,458 | 17.2\% | 2.6\% | 3.3\% | 29.1\% | 28.8\% | 93.6\% |
| 1986 | 4,594 | 20.1\% | 2.3\% | 2.6\% | 27.0\% | 28.6\% | 94.3\% |
| 1987 | 4,610 | 17.9\% | 1.7\% | 2.3\% | 32.0\% | 31.0\% | 93.9\% |
| 1988 | 4,800 | 12.6\% | 2.4\% | 2.0\% | 32.1\% | 31.1\% | 93.2\% |
| 1989 | 4,610 | 10.9\% | 2.6\% | 2.1\% | $31.4 \%{ }^{\text {g }}$ | 31.8\% | 93.3\% |
| 1990 | 4,548 | 13.2\% | 3.4\% | $2.2 \%^{\text {g }}$ | $31.6 \%{ }^{\text {g }}$ | 32.8\% | 93.9\% |
| 1991 | 4,123 | 12.8\% | 4.5\% | $2.2 \%{ }^{\text {g }}$ | 34.4\% ${ }^{\text {g }}$ | 33.5\% | 94.5\% |
| 1992 | 4,629 | 8.6\% | 5.5\% | 2.5\% ${ }^{\text {g }}$ | 31.6\% ${ }^{\text {g }}$ | 36.0\% | 94.4\% |
| 1993 | 5,351 | 6.8\% | 7.1\% | 2.3\% ${ }^{\text {g }}$ | $32.6 \%{ }^{\text {g }}$ | 38.6\% | 94.2\% |
| 1994 | 6,033 | 6.5\% | 8.1\% | 2.7\% ${ }^{\text {g }}$ | 34.4\% ${ }^{\text {g }}$ | 40.2\% | 94.0\% |
| 1995 | 6,053 | 6.5\% | 7.5\% | 3.8\% ${ }^{\text {g }}$ | $39.1 \%^{\mathrm{g}}$ | 41.2\% | 93.4\% |
| Average annual percentage change |  |  |  |  |  |  |  |
| 1970-95 | 5.8\% |  |  |  |  |  |  |
| 1985-95 | 3.1\% |  |  |  |  |  |  |

## Source:

Four-wheel drive - 1970-88: H. A. Stark (ed.), Ward's Communications, Inc., Ward's Automotive Yearbook, Detroit, MI, 1989, p. 168, and annual. 1989-95: H. A. Stark (ed.), Ward's Communications, Inc., Ward's Automotive Yearbook, Factory Installation Reports, Detroit, MI, 1996.
Transplants - Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1996.

All other - American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, pp. 8, 20, 21, and annual. (Additional resources: http:/www.aama.com, http://www.wardsauto.com)

[^29]Table 3.17
New Retail Truck Sales by Gross Vehicle Weight, 1970-95' (thousands)

| Calendar year | $\begin{gathered} \text { Class } 1 \\ 6,000 \text { lbs. } \\ \text { or less } \\ \hline \end{gathered}$ | $\begin{gathered} \text { Class } 2 \\ 6,001- \\ 10,000 \mathrm{lbs} . \end{gathered}$ | $\begin{gathered} \text { Class } 3 \\ 10,001- \\ 14,000 \mathrm{lbs} . \end{gathered}$ | $\begin{gathered} \text { Class } 4 \\ 14,001- \\ 16,000 \text { lbs. } \end{gathered}$ | $\begin{gathered} \text { Class } 5 \\ 16,001- \\ 19,500 \mathrm{lbs} . \end{gathered}$ | $\begin{gathered} \text { Class } 6 \\ 19,501- \\ 26000 \mathrm{lbs} . \end{gathered}$ | $\begin{gathered} \text { Class } 7 \\ 26,001- \\ 33,000 \mathrm{lbs} . \end{gathered}$ | $\begin{gathered} \text { Class } 8 \\ 33,001 \mathrm{lbs} . \\ \text { and over } \end{gathered}$ | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Domestic sales (import data are not available) |  |  |  |  |  |  |  |  |  |
| $1970^{\text {b }}$ | 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 | c | 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 | c | 2 | 90 | 58 | 117 | 2,231 |
| 1981 | 896 | 850 | 1 | c | 2 | 72 | 51 | 100 | 1,972 |
| 1982 | 1,102 | 961 | 1 | c | 1 | 44 | 62 | 76 | 2,248 |
| 1983 | 1,314 | 1,207 | c | c | 1 | 47 | 59 | 82 | 2,710 |
| 1984 | 2,031 | 1,224 | 6 | c | 5 | 55 | 78 | 138 | 3,538 |
| 1985 | 2,408 | 1,280 | 11 | c | 5 | 48 | 97 | 134 | 3,983 |
| Domestic and import sales |  |  |  |  |  |  |  |  |  |
| 1986 | 3,380 | 1,214 | 12 | c | 6 | 45 | 101 | 113 | 4,870 |
| 1987 | 3,435 | 1,175 | 14 | 2 | 8 | 44 | 103 | 131 | 4,912 |
| 1988 | 3,467 | 1,333 | 14 | 21 | 8 | 54 | 103 | 148 | 5,149 |
| 1989 | 3,313 | 1,297 | 19 | 27 | 7 | 39 | 93 | 145 | 4,942 |
| 1990 | 3,451 | 1,097 | 21 | 27 | 5 | 38 | 85 | 121 | 4,846 |
| 1991 | 3,246 | 876 | 21 | 24 | 3 | 22 | 73 | 99 | 4,365 |
| 1992 | 3,608 | 1,021 | 26 | 26 | 4 | 28 | 73 | 119 | 4,903 |
| 1993 | 4,119 | 1,232 | 27 | 33 | 4 | 27 | 81 | 158 | 5,681 |
| 1994 | 4,527 | 1,506 | 35 | 44 | 4 | 20 | 98 | 186 | 6,421 |
| 1995 | 4,422 | 1,631 | 40 | 53 | 4 | 23 | 106 | 201 | 6,481 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |
| 1970-85 | 5.7\% | 7.9\% | 4.1\% | - | -15.1\% | -6.6\% | 6.8\% | 2.8\% | 5.5\% |
| 1986-95 | 3.0\% | 3.3\% | 14.3\% | - | -4.4\% | -7.2\% | 0.5\% | 6.6\% | 3.2\% |

American Automobile Manufacturers Association, Motor Vehicle Facts and Figures '96, Detroit, MI, 1996, p. 21, and annual. (Additional resources: http://www.aama.com)

[^30]Table 3.18
Trucks in Operation and Vehicle Travel by Age, 1970 and 1995

| $\begin{gathered} \text { Age } \\ \text { (years) } \end{gathered}$ | 1970 |  |  | 1995 |  |  | 1995 Estimated vehicle travel |  | Average annual miles per vehicle |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Vehicles (thousands) | Percentage | Cumulative percentage | Vehicles (thousands) | Percentage | Cumulative percentage | Percentage | Cumulative percentage |  |
| Under $1^{\text {a }}$ | 1,262 | 7.1\% | 7.1\% | 4,094 | 5.8\% | 5.8\% | 6.5\% | 6.5\% | 14,288 |
| 1 | 1,881 | 10.6\% | 17.8\% | 6,096 | 8.7\% | 14.5\% | 11.1\% | 17.6\% | 16,439 |
| 2 | 1,536 | 8.7\% | 26.5\% | 5,176 | 7.4\% | 21.9\% | 10.6\% | 28.2\% | 18,388 |
| 3 | 1,428 | 8.1\% | 34.6\% | 4,228 | 6.0\% | 27.9\% | 8.3\% | 36.4\% | 17,601 |
| 4 | 1,483 | 8.4\% | 43.0\% | 4,136 | 5.9\% | 33.8\% | 7.7\% | 44.1\% | 16,775 |
| 5 | 1,339 | 7.6\% | 50.5\% | 4,033 | 5.7\% | 39.6\% | 7.2\% | 51.3\% | 16,020 |
| 6 | 1,154 | 6.5\% | 57.1\% | 4,620 | 6.6\% | 46.2\% | 7.5\% | 58.7\% | 14,574 |
| 7 | 975 | 5.5\% | 62.6\% | 4,523 | 6.4\% | 52.6\% | 6.9\% | 65.6\% | 13,710 |
| 8 | 826 | 4.7\% | 67.3\% | 3,972 | 5.7\% | 58.3\% | 5.8\% | 71.4\% | 13,255 |
| 9 | 621 | 3.5\% | 70.8\% | 4,134 | 5.9\% | 64.2\% | 5.6\% | 77.1\% | 12,237 |
| 10 | 658 | 3.7\% | 74.5\% | 3,509 | 5.0\% | 69.2\% | 3.2\% | 80.3\% | 8,224 |
| 11 | 583 | 3.3\% | 77.8\% | 3,030 | 4.3\% | 73.5\% | 2.8\% | 83.0\% | 8,224 |
| 12 | 383 | 2.2\% | 80.0\% | 1,873 | 2.7\% | 76.1\% | 1.7\% | 84.7\% | 8,224 |
| 13 | 417 | 2.4\% | 82.3\% | 1,528 | 2.2\% | 78.3\% | 1.4\% | 86.1\% | 8,224 |
| 14 | 414 | 2.3\% | 84.7\% | 1,344 | 1.9\% | 80.2\% | 1.2\% | 87.4\% | 8,224 |
| 15 and older | 2,710 | 15.3\% | 100.0\% | 13,869 | 19.8\% | 100.0\% | 12.6\% | 100.0\% | 8,224 |
| Subtotal | 17,670 | 100.0\% |  | 70,167 | 100.0\% |  | 100.0\% |  |  |
| Age not given | 15 |  |  | 32 |  |  |  |  |  |
| Total | 17,685 |  |  | 70,199 |  |  |  |  |  |
| Average age |  | 7.3 |  |  | 8.4 |  |  |  |  |
| Median age |  | 5.9 |  |  | 7.6 |  |  |  |  |

## Source:

R. L. Polk and Co., 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 1992 Truck Inventory and Use Survey public use tape provided by U.S. Department of Commerce, Bureau of the Census, Washington, DC, 1995.
(Additional resources: http://www.polk.com, http://www.census.gov)

[^31]Table 3.19
Sales-Weighted Engine Size of New Domestic and Import Light Trucks by Size Class Sales Periods 1976-96
(liters ${ }^{\text {a }}$ )

| Model <br> year | Small <br> pickup | Large <br> pickup | Small <br> van | Large <br> van | Small <br> utility | Large <br> utility | Fleet |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1976 | 1.91 | 5.57 | 1.97 | 5.39 | 5.39 | 4.97 | 5.23 |
| 1977 | 2.01 | 5.48 | 1.97 | 5.32 | 5.46 | 4.95 | 5.03 |
| 1978 | 2.03 | 5.45 | 1.97 | 5.29 | 5.09 | 5.40 | 5.02 |
| 1979 | 2.05 | 5.15 | 1.97 | 5.13 | 4.52 | 5.30 | 4.62 |
| 1980 | 2.05 | 5.05 | 1.97 | 5.03 | 4.29 | 5.39 | 4.33 |
| 1981 | 2.14 | 4.82 | 1.97 | 4.84 | 3.94 | 5.15 | 4.15 |
| 1982 | 2.34 | 4.99 | 1.79 | 4.92 | 3.88 | 5.27 | 4.24 |
| 1983 | 2.35 | 4.97 | 1.87 | 5.06 | 3.05 | 5.34 | 4.00 |
| 1984 | 2.38 | 4.95 | 2.23 | 5.06 | 2.81 | 5.39 | 3.87 |
| 1985 | 2.38 | 4.77 | 2.65 | 5.12 | 2.83 | 5.37 | 3.77 |
| 1986 | 2.43 | 4.68 | 2.78 | 5.13 | 2.78 | 5.55 | 3.65 |
| 1987 | 2.44 | 4.69 | 2.96 | 5.21 | 2.80 | 5.42 | 3.65 |
| 1988 | 2.56 | 4.68 | 3.15 | 5.21 | 3.14 | 5.51 | 3.82 |
| 1989 | 2.64 | 4.70 | 3.11 | 5.22 | 3.50 | 5.45 | 3.93 |
| 1990 | 2.90 | 4.49 | 3.29 | 5.21 | 3.38 | 5.48 | 3.93 |
| 1991 | 2.91 | 4.57 | 3.29 | 5.23 | 3.62 | 5.40 | 3.94 |
| 1992 | 3.07 | 4.57 | 3.32 | 5.28 | 3.69 | 5.47 | 4.00 |
| 1993 | 3.25 | 4.32 | 3.30 | 5.21 | 3.80 | 5.58 | 4.02 |
| 1994 | 3.10 | 4.45 | 3.48 | 5.31 | 3.77 | 5.54 | 4.10 |
| 1995 | 2.95 | 4.44 | 3.40 | 5.15 | 3.75 | 5.49 | 4.06 |
| $1996^{\text {b }}$ | 2.90 | 4.64 | 3.43 | 5.19 | 3.65 | 5.12 | 4.15 |
|  |  | Average annual percentage change |  |  |  |  |  |
| $1976-96$ | $2.1 \%$ | $-0.9 \%$ | $2.8 \%$ | $-0.2 \%$ | $-1.9 \%$ | $0.1 \%$ | $-1.1 \%$ |
| $1986-96$ | $1.8 \%$ | $-0.1 \%$ | $2.1 \%$ | $0.1 \%$ | $2.8 \%$ | $-0.8 \%$ | $1.3 \%$ |

## Source:

Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge,TN, 1996. (Additional resources: http://www-cta.ornl.gov)

[^32]Table 3.20
Period Sales, Market Shares, and Sales-Weighted Fuel Economies
of New Domestic and Import Light Trucks, Selected Sales Periods 1976-96

|  | 1976 | 1980 | 1984 | 1988 | 1990 | $1991{ }^{\text {b }}$ | 1992 ${ }^{\text {b }}$ | $1993{ }^{\text {b }}$ | $1994{ }^{\text {b }}$ | $1995{ }^{\text {b }}$ | 1996 ${ }^{\text {c }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SMALL PICKUP |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 170,351 | 516,412 | 1,012,298 | 1,026,551 | 678,488 | 628,098 | 586,752 | 332,470 | 365,322 | 356,856 | 390,792 |
| Market share, \% | 7.1 | 23.3 | 28.0 | 21.6 | 15.0 | 15.5 | 13.4 | 6.6 | 6.4 | 6.0 | 6.3 |
| Fuel economy, mpg | 23.9 | 25.5 | 27.2 | 26.1 | 25.2 | 25.7 | 25.0 | 24.9 | 25.3 | 25.6 | 26.3 |
| LARGE PICKUP |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 1,586,02 | 1,115,248 | 1,218,972 | 1,453,255 | 1,573,729 | 1,309,283 | 1,452,192 | 1,877,806 | 2,199,224 | 2,183,793 | 2,202,455 |
| Market share, \% | 66.4 | 50.3 | 33.7 | 30.6 | 34.9 | 32.3 | 33.1 | 37.1 | 38.4 | 36.8 | 35.4 |
| Fuel economy, mpg | 15.1 | 17 | 17.5 | 18.5 | 18.9 | 18.8 | 18.9 | 19.6 | 20.1 | 19.4 | 19.0 |
| SMALL VAN |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 18,651 | 13,649 | 222,798 | 851,384 | 932,693 | 888,165 | 968,361 | 1,129,459 | 1,263,933 | 1,257,116 | 1,229,648 |
| Market share, \% | 0.8 | 0.6 | 6.2 | 18.0 | 20.7 | 21.9 | 22.0 | 22.3 | 22.1 | 21.2 | 19.8 |
| Fuel economy, mpg | 19.5 | 19.6 | 25.0 | 22.9 | 23.1 | 22.6 | 22.5 | 22.9 | 22.1 | 22.8 | 22.7 |
| LARGE VAN |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 574,745 | 328,065 | 545,595 | 486,981 | 398,877 | 308,317 | 350,013 | 388,435 | 407,737 | 401,056 | 370,126 |
| Market share, \% | 24.1 | 14.8 | 15.1 | 10.3 | 8.8 | 7.6 | 8.0 | 7.7 | 7.1 | 6.8 | 6.0 |
| Fuel economy, mpg | 15.4 | 16.3 | 16.3 | 17.0 | 16.9 | 17.4 | 16.9 | 17.3 | 17.4 | 17.1 | 17.2 |
| SMALL UTILITY |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 4,716 | 75,875 | 398,000 | 701,005 | 738,294 | 782,588 | 867,934 | 948,797 | 1,042,584 | 1,225,131 | 1,378,715 |
| Market share, \% | 0.2 | 3.4 | 11.0 | 14.8 | 16.4 | 19.3 | 19.8 | 18.8 | 18.2 | 20.6 | 22.2 |
| Fuel economy, mpg | 15.5 | 16.9 | 23.0 | 22.4 | 21.9 | 21.1 | 20.9 | 21.3 | 20.7 | 20.8 | 21.3 |
| LARGE UTILITY |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 32,427 | 167,288 | 215,271 | 223,824 | 192,544 | 131,740 | 167,199 | 378,710 | 445,601 | 509,914 | 641,252 |
| Market share, \% | 1.4 | 7.5 | 6.0 | 4.7 | 4.3 | 3.3 | 3.8 | 7.5 | 7.8 | 8.6 | 10.3 |
| Fuel economy, mpg | 14.7 | 14.6 | 15.7 | 16.2 | 16.1 | 16.4 | 16.9 | 17.5 | 17.8 | 17.4 | 18.1 |
| FLEET |  |  |  |  |  |  |  |  |  |  |  |
| Total sales, units | 2,386,91 | 2,216,537 | 3,612,934 | 4,743,000 | 4,514,625 | 4,048,191 | 4,392,451 | 5,055,677 | 5,724,401 | 5,933,866 | 6,212,988 |
| Market share, \% | 100.0 | 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 | 20.7 | 20.5 | 20.6 | 20.4 | 20.5 | 20.4 | 20.2 | 20.3 |

## Source:

Oak Ridge National Laboratory, Light-Duty Vehicle MPG and Market Shares System, Oak Ridge, TN, 1997. (Additional resources: http://www-cta.ornl.gov)

[^33]Starting in 1993, the Federal Highway Administration (FHWA) revised their definitions of passenger cars and 2-axle, 4-tire trucks. The result was a dramatic decrease in carsand increase in 2-axle, 4-tire trucks. The sum of these two categories will still produce a consistent trend.(See Table 3.9 for car data.) The FHWA plans to release revised historical data for each of these categories in 1997.

Table 3.21
Summary Statistics for Two-Axle, Four-Tire Trucks, 1970-95

| 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 | 21,895 | 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 | 38,864 | 466,092 | 32,937 | 14.2 |
| 1991 | 39,067 | 472,848 | 32,531 | 14.5 |
| 1992 | 39,533 | 478,193 | 33,127 | 14.4 |
| $1993^{\text {a }}$ | 55,710 | 573,398 | 36,476 | 15.7 |
| $1994^{\text {a }}$ | 57,142 | 669,321 | 44,422 | 15.1 |
| $1995^{\text {a }}$ | 57,897 | 686,977 | 44,949 | 15.3 |
| $1970-95$ | $5.8 \%$ | $7.1 \%$ | $5.3 \%$ | $1.7 \%$ |
| $1985-95$ | $5.5 \%$ | $6.3 \%$ | $4.5 \%$ | $1.7 \%$ |
|  |  |  |  |  |
|  |  |  |  |  |

## Source:

U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995,

Washington, DC, 1996, Table VM-1, p. V-92, and annual.
(Additional resources: http://www.fhwa.dot.gov)

[^34]Table 3.22
Summary Statistics for Other Single-Unit and Combination Trucks, 1970-95

| Year | Other single-unit trucks ${ }^{\text {b }}$ |  |  |  | Combination trucks ${ }^{\text {c }}$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Registrations (thousands) | Vehicle travel (million miles) | Fuel use (million gallons) | Fuel economy (miles per gallon) | Registrations (thousands) | Vehicle travel (million miles) | Fuel use (million gallons) | Fuel economy (miles per gallon) |
| 1970 | 3,681 | 27,081 | 3,968 | 6.8 | 905 | 35,134 | 7,348 | 4.8 |
| 1971 | 3,770 | 28,985 | 4,212 | 6.9 | 919 | 37,217 | 7,595 | 4.9 |
| 1972 | 3,918 | 31,414 | 4,560 | 6.9 | 961 | 40,706 | 8,120 | 5.0 |
| 1973 | 4,131 | 33,661 | 4,859 | 6.9 | 1,029 | 45,649 | 9,026 | 5.1 |
| 1974 | 4,211 | 33,441 | 4,687 | 7.1 | 1,085 | 45,966 | 8,800 | 5.2 |
| 1975 | 4,232 | 34,606 | 4,815 | 7.2 | 1,131 | 46,724 | 8,654 | 5.4 |
| 1976 | 4,350 | 36,390 | 5,140 | 7.1 | 1,225 | 49,680 | 9,536 | 5.2 |
| 1977 | 4,450 | 39,339 | 5,559 | 7.1 | 1,240 | 55,683 | 10,673 | 5.2 |
| 1978 | 4,518 | 42,727 | 6,106 | 7.0 | 1,342 | 62,992 | 12,113 | 5.2 |
| 1979 | 4,505 | 42,012 | 6,036 | 7.0 | 1,386 | 66,992 | 12,864 | 5.2 |
| 1980 | 4,374 | 39,813 | 5,557 | 7.2 | 1,417 | 68,678 | 12,703 | 5.4 |
| 1981 | 4,455 | 39,568 | 5,574 | 7.1 | 1,261 | 69,134 | 12,960 | 5.3 |
| 1982 | 4,325 | 40,212 | 5,661 | 7.1 | 1,265 | 66,668 | 12,636 | 5.3 |
| 1983 | 4,204 | 43,409 | 6,118 | 7.1 | 1,304 | 69,754 | 13,447 | 5.2 |
| 1984 | 4,061 | 46,560 | 6,582 | 7.1 | 1,340 | 77,367 | 14,781 | 5.2 |
| 1985 | 3,927 | 46,980 | 6,735 | 7.0 | 1,403 | 79,600 | 15,280 | 5.2 |
| 1986 | 3,850 | 48,308 | 6,929 | 7.0 | 1,399 | 81,833 | 15,716 | 5.2 |
| 1987 | 3,884 | 49,537 | 7,091 | 7.0 | 1,419 | 86,064 | 16,493 | 5.2 |
| 1988 | 3,957 | 51,239 | 7,260 | 7.1 | 1,476 | 90,158 | 17,123 | 5.3 |
| 1989 | 4,103 | 52,969 | 7,412 | 7.2 | 1,589 | 95,349 | 17,495 | 5.5 |
| 1990 | 4,243 | 53,443 | 7,294 | 7.3 | 1,611 | 96,367 | 17,469 | 5.5 |
| 1991 | 4,265 | 53,787 | 7,134 | 7.5 | 1,604 | 96,942 | 17,157 | 5.7 |
| 1992 | 4,316 | 53,691 | 7,179 | 7.5 | 1,655 | 99,112 | 17,691 | 5.6 |
| 1993 | 4,526 | 56,781 | 8,277 | 6.9 | 1,592 | 103,123 | 17,719 | 5.8 |
| 1994 | 4,725 | 61,284 | 9,041 | 6.8 | 1,579 | 108,932 | 18,674 | 5.8 |
| 1995 | 5,204 | 62,706 | 9,178 | 6.8 | 1,677 | 115,454 | 19,662 | 5.9 |
| Average annual percentage change |  |  |  |  |  |  |  |  |
| 1970-95 | 1.4\% | 3.4\% | 3.4\% | 0.0\% | 2.5\% | 4.9\% | 4.0\% | 0.8\% |
| 1985-95 | 2.9\% | 2.9\% | $3.1 \%$ | -0.3\% | 1.8\% | 3.8\% | 2.6\% | 1.3\% |

Source:
U. S. Department of Transportation, Federal Highway Adminstration, Highway Statistics 1995, Washington, DC, 1996, Table VM1, p. V-92 and annual. (Additional resources: http://www.fhwa.dot.gov)

[^35]
## Truck Inventory and Use Survey

The Truck Inventory and Use Survey (TIUS) provides data on the physical and operational characteristics of the Nation's truck population. It is based on a probability sample of private and commercial trucks registered (or licensed) in each state. Data for 1992 have been released in a report, as well as on CD-ROM. Copies may be obtained by contacting the U.S. Bureau of the Census, Transportation Characteristics Surveys Branch (301)457-2797. Internet site http://www. census.gov/svsd/www/tius.view.html is the location of the TIUS on-line.

The 1987 and 1992 surveys, in addition to trucks, included minivans, vans, station wagons on truck chassis, and jeep-like vehicles. The 1977 and 1982 surveys did not include those vehicle types. The estimated number of trucks that were within the scope of the 1992 TIUS and registered in the U.S. as of July 1, 1992, was 59.2 million. These trucks were estimated to have been driven a total of 786.3 billion miles during 1992, an increase of $33.7 \%$ from 1987. The average annual miles traveled per truck was estimated at 11,900 miles.

In the 1992 TIUS, there are several ways to classify a truck by weight. The survey respondent was asked the average weight of the vehicle or vehicle-trailer combination when carrying a typical payload; the empty weight (truck minus cargo) of the vehicle as it was usually operated; and the maximum gross weight at which the vehicle or vehicle-trailer combination was operated. The Census Bureau also collected information on the Gross Vehicle Weight Class of the vehicles (decoded from the vehicle identification number) and the registered weight of the vehicles from the State registration files. Some of these weights are only provided in categories, while others are exact weights. Since all these weights could be quite different for a single truck, the tabulations by weight can be quite confusing. For illustration of this, see Tables 3.25 and 3.26. The first set of data are based on the average weight as reported by the respondent; the data on Table 3.26 are based on the Gross Vehicle Weight Class of the vehicle when it was manufactured. There is a $22.8 \%$ difference in the number of Class 1 trucks. In most tables, the Gross Vehicle Weight Class was used. However, on the tables comparing different survey estimates, average weight must be used, as the older surveys did not include data on the Gross Vehicle Weight rating.

Table 3.23
Truck Fuel Economy by Size Class, 1977, 1982, 1987, and 1992 (miles per gallon)

|  | Average weight as <br> reported by respondent | 1977 <br> Size class | 1982 <br> TIUS | 1987 | 1992 |
| :---: | :--- | :--- | :---: | :---: | :---: |
| Class 1 | 6,000 lbs and less | 13.2 | 14.2 | 15.0 | 16.1 |
| Class 2 | $6,001-10,000 \mathrm{lbs}$ | 11.5 | 11.1 | 10.9 | 12.2 |
| Class 3 | $10,000-14,000 \mathrm{lbs}$ | 9.4 | 8.1 | 8.1 | 9.2 |
| Class 4 | $14,001-16,000 \mathrm{lbs}$ | 6.9 | 7.5 | 7.5 | 8.5 |
| Class 5 | $16,001-19,500 \mathrm{lbs}$ | 7.6 | 7.2 | 7.1 | 8.1 |
| Class 6 | $19,501-26,000 \mathrm{lbs}$ | 6.1 | 6.9 | 6.4 | 7.2 |
| Class 7 | $26,001-33,000 \mathrm{lbs}$ | 5.3 | 6.2 | 6.1 | 6.8 |
| Class 8 | $33,001 \mathrm{lbs}$ and over | 4.8 | 5.2 | 5.3 | 5.5 |

## 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; U.S. Department of Commerce, Bureau of the Census, 1987 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1990; and U.S. Department of Commerce, Bureau of the Census, 1992 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1995.
(Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 3.24
Percentage of Trucks by Fleet Size and Primary Refueling Facility, 1992

|  | Primary refueling facility |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Truck <br> fleet size | Central <br> company-owned <br> fueling facility | Single contract fueling <br> facility <br> located off-site | Public fueling <br> stations | Other | Total |
| 1 | $7.91 \%$ | $2.52 \%$ | $84.55 \%$ | $5.02 \%$ | $100 \%$ |
| $2-5$ | $16.41 \%$ | $4.44 \%$ | $72.51 \%$ | $6.64 \%$ | $100 \%$ |
| $6-9$ | $31.40 \%$ | $7.73 \%$ | $55.53 \%$ | $5.33 \%$ | $100 \%$ |
| $10-24$ | $43.90 \%$ | $9.44 \%$ | $43.70 \%$ | $2.96 \%$ | $100 \%$ |
| $25-99$ | $56.98 \%$ | $7.39 \%$ | $33.50 \%$ | $2.13 \%$ | $100 \%$ |
| $100-499$ | $58.34 \%$ | $7.50 \%$ | $31.18 \%$ | $2.98 \%$ | $100 \%$ |
| $500-999$ | $57.93 \%$ | $7.26 \%$ | $30.89 \%$ | $3.92 \%$ | $100 \%$ |
| $1,000-4,999$ | $60.71 \%$ | $3.28 \%$ | $32.65 \%$ | $3.36 \%$ | $100 \%$ |
| $5,000-9,999$ | $58.90 \%$ | $5.05 \%$ | $29.09 \%$ | $6.96 \%$ | $100 \%$ |
| $10,000 \&$ up | $59.96 \%$ | $4.68 \%$ | $25.69 \%$ | $9.66 \%$ | $100 \%$ |
| Total | $\mathbf{3 3 . 2 6 \%}$ | $\mathbf{5 . 7 6 \%}$ | $\mathbf{5 6 . 1 5 \%}$ | $\mathbf{4 . 8 3 \%}$ | $\mathbf{1 0 0 \%}$ |

Source:
U.S. Department of Commerce, Bureau of the Census, 1992 Truck Inventory and Use Survey, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

These tables illustrate the difference between two weight variables in the Truck Inventory and Use Survey. The manufacturer's gross vehicle weight class is likely to be a more accurate representaton.

Table 3.25
Truck Statistics by Gross Vehicle Weight Class, 1992

| Manufacturer's <br> gross vehicle <br> weight class | Number of <br> trucks | Percentage of <br> trucks | Average <br> annual miles <br> per truck | Average <br> fuel <br> economy | Gallons of <br> fuel used <br> (millions) | Percentage <br> of fuel use |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: |
| 6,000 lbs and less | $37,068,163$ | $62.61 \%$ | 12,739 | 17.23 | 27,397 | $44.76 \%$ |
| $6,001-10,000 \mathrm{lbs}$ | $17,519,216$ | $29.59 \%$ | 11,610 | 13.00 | 15,646 | $25.56 \%$ |
| $10,001-14,000 \mathrm{lbs}$ | 349,301 | $5.90 \%$ | 15,814 | 9.48 | 583 | $0.95 \%$ |
| $14,001-16,000 \mathrm{lbs}$ | 127,219 | $0.21 \%$ | 14,420 | 9.19 | 200 | $0.33 \%$ |
| $16,001-19,500 \mathrm{lbs}$ | 209,158 | $0.35 \%$ | 4,876 | 8.21 | 124 | $0.20 \%$ |
| $19,501-26,000 \mathrm{lbs}$ | $1,859,529$ | $3.14 \%$ | 11,746 | 7.26 | 3,008 | $4.91 \%$ |
| $26,001-33,000 \mathrm{lbs}$ | 197,985 | $0.33 \%$ | 30,074 | 6.64 | 897 | $1.46 \%$ |
| $33,001 \mathrm{lbs}$ and up | $1,870,183$ | $3.16 \%$ | 39,832 | 5.58 | 13,353 | $21.82 \%$ |
| Total | $\mathbf{5 9 , 2 0 0 , 7 5 5}$ | $\mathbf{1 0 0 . 0 0 \%}$ | $\mathbf{1 3 , 2 8 1}$ | $\mathbf{1 2 . 8 5}$ | $\mathbf{6 1 , 2 0 6}$ | $\mathbf{1 0 0 . 0 0 \%}$ |
| Souren |  |  |  |  |  |  |

Source:
U.S. Department of Commerce, Bureau of the Census, 1992 Truck Inventory and Use Survey, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www.tiusview.html)

Table 3.26
Percentage of Trucks by Size Class, 1977, 1982, 1987, and 1992
(percentage)

|  | Average weight as <br> reported by respondent | 1977 <br> TIUS | 1982 <br> TIUS class | 1987 <br> TIUS | TIUS |
| :---: | :--- | :---: | :---: | :---: | :---: |
| Class 1 | 6,000 lbs and less | $66.0 \%$ | $77.8 \%$ | $85.4 \%$ | $85.4 \%$ |
| Class 2 | $6,001-10,000 \mathrm{lbs}$ | $17.9 \%$ | $11.6 \%$ | $6.5 \%$ | $7.9 \%$ |
| Class 3 | $10,000-14,000 \mathrm{lbs}$ | $3.1 \%$ | $1.6 \%$ | $1.2 \%$ | $1.2 \%$ |
| Class 4 | $14,001-16,000 \mathrm{lbs}$ | $1.3 \%$ | $0.9 \%$ | $0.5 \%$ | $0.5 \%$ |
| Class 5 | $16,001-19,500 \mathrm{lbs}$ | $2.1 \%$ | $1.0 \%$ | $0.6 \%$ | $0.5 \%$ |
| Class 6 | $19,501-26,000 \mathrm{lbs}$ | $3.4 \%$ | $2.4 \%$ | $1.7 \%$ | $1.2 \%$ |
| Class 7 | $26,001-33,000 \mathrm{lbs}$ | $1.5 \%$ | $1.0 \%$ | $0.8 \%$ | $0.7 \%$ |
| Class 8 | $33,001 \mathrm{lbs}$ and over | $4.6 \%$ | $3.8 \%$ | $3.3 \%$ | $2.8 \%$ |

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; U.S. Department of Commerce, Bureau of the Census, 1987 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1990; and U.S. Department of Commerce, Bureau of the Census, 1992 Census of Transportation, Truck Inventory and Use Survey, Washington, DC, 1995.
(Additional resources: http://www.census.gov/svsd/www/tiusview.html)

The fuel economies for "Total" gasoline and diesel trucks illustrate the great differences in the truck types by fuel. Gasoline trucks are mainly light-duty vehicles with high fuel economies, while diesel trucks are mainly heavy-duty.

Table 3.27
Truck Fuel Economy by Fuel Type and Size Class, 1992
(miles per gallon)

|  | Manufacturer's <br> gross vehicle <br> weight class | Gasoline <br> trucks | Diesel <br> trucks |
| :---: | :---: | :---: | :---: |
| Class 1 | 6,000 lbs and less | 17.2 | 18.8 |
| Class 2 | $6,001-10,000 \mathrm{lbs}$ | 12.9 | 15.0 |
| Class 3 | $10,001-14,000 \mathrm{lbs}$ | 9.3 | 9.5 |
| Class 4 | $14,001-16,000 \mathrm{lbs}$ | 8.3 | 10.1 |
| Class 5 | $16,001-19,500 \mathrm{lbs}$ | 7.6 | 10.0 |
| Class 6 | $19,501-26,000 \mathrm{lbs}$ | 7.3 | 7.3 |
| Class 7 | $26,001-33,000 \mathrm{lbs}$ | 6.1 | 6.7 |
| Class 8 | $33,001 \mathrm{lbs}$ and up | 5.5 | 5.5 |
| Total |  | 15.4 | 6.5 |

## Source:

U.S. Department of Commerce, Bureau of the Census, 1992 Truck Inventory and Use Survey, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 3.28
Truck Statistics by Size, 1992

|  | Manufacturer's gross vehicle weight class |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { Light } \\ (<10,000 \mathrm{lbs}) \end{gathered}$ | $\begin{gathered} \text { Medium } \\ (10,001- \\ 26,000 \mathrm{lbs}) \\ \hline \end{gathered}$ | $\begin{gathered} \text { Heavy } \\ (>26,000 \mathrm{lbs}) \\ \hline \end{gathered}$ | Total |
| Trucks | 54,587,379 | 685,679 | 3,927,697 | 59,200,755 |
| Trucks (\%) | 92.21\% | 1.16\% | 6.63\% | 100\% |
| Miles per truck | 12,377 | 12,219 | 26,044 | 13,281 |
| Total miles (\%) | 85.92\% | 1.07\% | 13.01\% | 100\% |
| Fuel use (\%) | 70.32\% | 1.48\% | 28.20\% | 100\% |
| Fuel economy (mpg) | 15.70 | 9.24 | 5.93 | 12.85 |
|  | Range of operation |  |  |  |
| Under 50 miles | 75.84\% | 68.55\% | 56.47\% | 74.49\% |
| 50-100 miles | 11.33\% | 14.40\% | 14.55\% | 11.57\% |
| 100-200 miles | 3.31\% | 4.43\% | 6.53\% | 3.53\% |
| 200-500 miles | 2.14\% | 1.68\% | 6.33\% | 2.41\% |
| Over 500 miles | 2.17\% | 1.36\% | 7.51\% | 2.51\% |
| Off-road | 5.21\% | 9.59\% | 8.61\% | 5.48\% |
| Total | 100\% | 100\% | 100\% | 100\% |
|  | Primary refueling facility |  |  |  |
| Central company-owned | 15.83\% | 23.56\% | 36.73\% | 32.06\% |
| Single off-site contract | 3.51\% | 4.34\% | 6.30\% | 5.65\% |
| Pubic station | 77.05\% | 66.72\% | 51.86\% | 57.37\% |
| Other | 3.61\% | 5.39\% | 5.10\% | 4.93\% |
| Total | 100\% | 100\% | 100\% | 100\% |

## Source:

U.S. Department of Commerce, Bureau of the Census, 1992 Truck Inventory and Use Survey, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 3.29
Percentage of Trucks by Major Use and Primary Refueling Facility, 1992

| Major Use | Primary refueling facility |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Central company-owned fueling facility | Single contract fueling facility located off-site | Public fueling stations | Other |  |
| Agricultural services | $32.66 \%$ | 2.73\% | 51.68\% | 12.93\% | 100\% |
| Forestry or Lumbering Activities | 26.34\% | 6.43\% | 63.71\% | 3.52\% | 100\% |
| Construction work | 35.79\% | 4.93\% | 56.71\% | 2.57\% | 100\% |
| Contractor Activities or special trades | 16.62\% | 4.93\% | 77.01\% | 1.44\% | 100\% |
| Manufacturing, refining or processing activities | 37.54\% | 11.21\% | 49.05\% | 2.20\% | 100\% |
| Wholesale trade | 35.55\% | 12.72\% | 49.99\% | 1.74\% | 100\% |
| Retail trade | 31.35\% | 8.18\% | 58.67\% | 1.81\% | 100\% |
| Business and Personal services | 23.48\% | 5.94\% | 68.24\% | 2.34\% | 100\% |
| Utilities | 58.68\% | 2.31\% | 36.42\% | 2.58\% | 100\% |
| Mining or quarryng activities | 53.75\% | 5.82\% | 38.05\% | 2.38\% | 100\% |
| Daily rental | 49.95\% | 2.79\% | 44.75\% | 2.50\% | 100\% |
| Not in use | 14.42\% | 3.64\% | 46.70\% | 35.24\% | 100\% |
| For-hire transportation | 37.80\% | 5.22\% | 53.65\% | 3.33\% | 100\% |
| One-way rental | 5.28\% | 0.07\% | 93.05\% | 1.60\% | 100\% |
| Personal transportation | 1.51\% | 0.68\% | 93.14\% | 4.67\% | 100\% |
| Total | 32.06\% | 5.65\% | 57.37\% | 4.93\% | 100\% |

## Source:

U.S. Department of Commerce, Bureau of the Census, 1992 Truck Inventory and Use Survey, Microdata File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

Table 3.30
Percentage of Trucks by Size Ranked by Major Use, 1992

| Rank | $\begin{gathered} \text { Light } \\ (<\mathbf{1 0 , 0 0 0} \mathrm{lbs}) \\ \hline \end{gathered}$ | Medium $(\mathbf{1 0 , 0 0 1}-\mathbf{2 6 , 0 0 0} \mathbf{~ l b s})$ | $\begin{gathered} \text { Heavy } \\ (>26,000 \mathrm{lbs}) \\ \hline \end{gathered}$ |
| :---: | :---: | :---: | :---: |
| 1 | Personal | Agriculture | For Hire |
|  | 73.54\% | 21.12\% | 18.21\% |
| 2 | Construction | Construction | Construction |
|  | 7.57\% | 20.59\% | 18.17\% |
| 3 | Services ${ }^{\text {a }}$ | Services ${ }^{\text {a }}$ | Agriculture |
|  | 5.12\% | 12.32\% | 17.42\% |
| 4 | Agriculture | Retail | Wholesale |
|  | 4.99\% | 9.05\% | 8.73\% |
| 5 | Retail | Utilities | Retail |
|  | 2.94\% | 6.44\% | 7.22\% |
| 6 | Not in Use | Wholesale | Personal |
|  | 1.50\% | 6.04\% | 6.56\% |
| 7 | Wholesale | For Hire | Services ${ }^{\text {a }}$ |
|  | 1.38\% | 5.90\% | 6.20\% |
| 8 | Manufacturing | Personal | Manufacturing |
|  | 1.02\% | 5.86\% | 5.53\% |
| 9 | Utilities | Manufacturing | Not in Use |
|  | 0.72\% | $3.51 \%$ | 3.49\% |
| 10 | Daily Rental | Not in Use | Utilities |
|  | 0.40\% | 3.43\% | 2.66\% |
| 11 | Forestry | Daily Rental | Forestry |
|  | 0.31\% | 2.89\% | 2.16\% |
| 12 | Mining | Forestry | Daily Rental |
|  | 0.27\% | 1.48\% | 1.70\% |
| 13 | For Hire | Mining | Mining |
|  | 0.24\% | 1.00\% | 1.69\% |
| 14 | One-Way Rental | One-Way Rental | One-Way Rental |
|  | 0.01\% | 0.36\% | 0.26\% |
| 15 | Other | Other | Other |
|  | 0.00\% | 0.00\% | 0.00\% |

## Source:

U.S. Department of Commerce, Bureau of the Census, 1992 Truck Inventory and Use Survey, Micro data File on CD, 1995. (Additional resources: http://www.census.gov/svsd/www/tiusview.html)

[^36]
## 1993 Commodity Flow Survey

The Commodity Flow Survey (CFS) is designed to provide data on the flow of goods and materials by mode of transport. The CFS is a continuation of statistics collected in the Commodity Transportation Survey from 1963 through 1977, and includes major improvements in methodology, sample size, and scope. A sample of 200,000 domestic establishments randomly selected from a universe of about 900,000 establishments engaged in mining, manufacturing, wholesale, auxiliary establishments (warehouses) of multi-establishment companies, and some selected activities in retail and service was used. Each selected establishment reported a sample of approximately 30 outbound shipments for a twoweek period in each of the four calendar quarters of 1993. This will produce a total sample of about 20 million shipments. For each sampled shipment, zip codes of origin and destination, 5-digit Standard Transportation Commodity Classification (STCC) code, weight, value, and modes of transport, were provided. Establishments were also asked to indicate whether the shipment was containerized, a hazardous material, or an export were also obtained.

The 1993 CFS differs from previous surveys in its greatly expanded coverage of intermodalism. Earlier surveys reported only the principal mode. The 1993 survey reports all modes used for the shipment (for-hire truck, private truck, rail, inland water, deep sea water, pipeline, air, parcel delivery or U.S. Postal Service, other mode, unknown). Route distance for each mode for each shipment as imputed from a mode-distance table developed by Oak Ridge National Laboratory. Distance, in turn, was used to compute ton-mileage by mode of transport.

For more information about the Commodity Flow Survey, contact John L. Fowler of the Census Bureau at (301) 457-2805 or (301) 457-2114, or visit the following Internet site:

## http://www.bts.gov/cfs/cfs.html

Table 3.31
Shipment Characteristics by Mode of Transportation, 1993

| Mode of transportation | Monetary value |  | Weight |  | Ton-miles ${ }^{\text {a }}$ |  | Average miles per shipment ${ }^{\text {a }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Million dollars | Percentage | Thousand tons | Percentage | Millions | Percentage |  |
| Single modes |  |  |  |  |  |  |  |
| Parcel, U.S. Postal Service, or courier | 563,277 | 9.6\% | 18,892 | 0.2\% | 13,151 | 0.5\% | 734 |
| Private truck | 1,755,837 | 30.0\% | 3,543,513 | 36.6\% | 235,897 | 9.7\% | 52 |
| For-hire truck | 2,625,093 | 44.9\% | 2,808,279 | 29.0\% | 629,000 | 26.0\% | 472 |
| Air | 5,200 | 0.1\% | 148 | ${ }^{\text {b }}$ | 139 | ${ }^{\text {b }}$ | 1,180 |
| Rail | 247,394 | 4.2\% | 1,544,148 | 15.9\% | 942,561 | 38.9\% | 766 |
| Inland water | 40,707 | 0.7\% | 362,454 | 3.7\% | 164,371 | 6.8\% | c |
| Great Lakes | 1,173 | b | 33,041 | 0.3\% | 12,395 | 0.5\% | 534 |
| Deep sea water | 67 | b | c | ${ }^{\text {b }}$ | c | b | c |
| Pipeline ${ }^{\text {d }}$ | 89,849 | 1.5\% | 483,645 | 5.0\% | 。 | c | c |
| Multiple modes |  |  |  |  |  |  |  |
| Private truck and for-hire truck | 22,565 | 0.4\% | 34,123 | 0.4\% | 4,639 | 0.2\% | 197 |
| Truck and air | 133,887 | 2.3\% | 2,991 | ${ }^{\text {b }}$ | 3,870 | 0.2\% | 1,423 |
| Truck and rail | 83,082 | 1.4\% | 40,624 | 0.4\% | 37,675 | 1.6\% | 1,403 |
| Truck and water | 9,392 | 0.2\% | 67,995 | 0.7\% | 40,610 | 1.7\% | 1,417 |
| Truck and pipeline ${ }^{\text {d }}$ | 349 | - |  | b | ,610 | b |  |
| Rail and water | 3,636 | 0.1\% | 79,222 | 0.8\% | 70,219 | 2.9\% | 627 |
| Inland water and Great Lakes | 2,448 | ${ }^{\text {b }}$ | 13,501 | ${ }^{\text {b }}$ | ${ }^{\text {c }}$ | ${ }^{\text {c }}$ | ${ }^{\text {c }}$ |
| Inland water and deep sea | 19,682 | 0.3\% | 109,916 | 1.1\% | 95,215 | 3.9\% | 1,903 |
| Other modes |  |  |  |  |  |  |  |
| Other and unknown modes | 242,691 | 4.2\% | 544,335 | 5.6\% | 96,972 | 4.0\% | 229 |
| All modes | 5,846,334 | 100.0 | 9,688,493 | 100.0 | 2,420,915 | 100.0 | 424 |

## Source:

U.S. Department of Commerce, Bureau of the Census, 1993 Commodity Flow Survey, Washington, DC, October 1996, p. 3.
(Additional resources: http://www.bts.gov/cfs/cfs.html)

[^37]Table 3.32
Summary Statistics on Buses by Type, 1970-95

| Year | Transit motor bus ${ }^{\text {a }}$ | Intercity bus | School bus |
| :---: | :---: | :---: | :---: |
| Number in operation |  |  |  |
| 1970 | 49,700 | 22,000 | 288,700 |
| 1975 | 50,811 | 20,500 | 368,300 |
| 1980 | 59,411 | 21,400 | 418,255 |
| 1985 | 64,258 | 20,200 | 480,400 |
| 1990 | 58,714 | 20,680 | 508,261 |
| 1992 | 63,080 | 19,904 | 525,838 |
| 1993 | 64,850 | 19,119 | 534,872 |
| 1994 | 68,123 | 19,146 | 547,718 |
| 1995 | 67,086 | 20,138 | 560,447 |
| Vehicle-miles (millions) |  |  |  |
| 1970 | 1,409 | 1,209 | 2,100 |
| 1975 | 1,526 | 1,126 | 2,500 |
| 1980 | 1,677 | 1,162 | 2,900 |
| 1985 | 1,863 | 933 | 3,448 |
| 1990 | 2,123 | 991 | 3,800 |
| 1992 | 2,178 | 974 | 4,400 |
| 1993 | 2,210 | 1,065 | 4,300 |
| 1994 | 2,162 | 1,216 | 4,400 |
| 1995 | 2,178 | 1,250 | 5,000 |
| Passenger-miles (millions) |  |  |  |
| 1970 | 18,210 | 25,300 | b |
| 1975 | 18,300 | 25,400 | b |
| 1980 | 21,790 | 27,400 | b |
| 1985 | 21,161 | 23,800 | b |
| 1990 | 20,981 | 23,000 | 74,200 |
| 1992 | 20,336 | 22,600 | 90,000 |
| 1993 | 20,247 | 24,700 | 94,200 |
| 1994 | 18,832 | 28,200 | 85,000 |
| 1995 | 18,818 | 29,000 | 95,000 |
| Energy use (trillion Btu) |  |  |  |
| 1970 | 44.8 | 26.6 | 37.5 |
| 1975 | 51.5 | 24.8 | 42.6 |
| 1980 | 61.3 | 29.3 | 47.5 |
| 1985 | 72.4 | 31.5 | 57.0 |
| 1990 | 78.9 | 21.7 | 62.2 |
| 1992 | $87.5{ }^{\text {c }}$ | 22.1 | 72.1 |
| 1993 | 86.2 | 24.0 | 82.1 |
| 1994 | 86.7 | 24.7 | 90.6 |
| 1995 | 87.5 | $25.4{ }^{\text {d }}$ | $103.0{ }^{\text {d }}$ |

## Source:

See Appendix A for Table 3.31. (Additional resources: http://www.apta.com, http://www.fhwa.dot.gov, http://www.schoolbusfleet.com)

[^38]Table 3.33
Federal Government Vehicles by Agency, Fiscal Year 1995

| Department or Agency | Autos | Buses | Light trucks ${ }^{\text {a }}$ | Medium trucks ${ }^{\text {b }}$ | Heavy trucks ${ }^{\text {c }}$ | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Department of Agriculture | 3,375 | 72 | 25,174 | 5,231 | 577 | 34,429 |
| Department of Commerce | 260 | 2 | 445 | 214 | 15 | 936 |
| Department of Energy | 828 | 235 | 3,862 | 810 | 292 | 6,027 |
| Department of Health \& Human Services | 94 | 9 | 277 | 133 | 70 | 583 |
| Department of Justice | 18,256 | 269 | 9,569 | 837 | 176 | 29,107 |
| Department of Labor | 22 | 2 | 129 | 13 | 3 | 169 |
| Department of State | 1,206 | 0 | 1,225 | 1,249 | 84 | 3,764 |
| Department of Interior | 1,724 | 130 | 9,781 | 4,316 | 1,971 | 17,922 |
| Department of Treasury | 11,138 | 16 | 3,200 | 351 | 31 | 14,736 |
| Department of Transportation | 30 | 17 | 328 | 113 | 40 | 528 |
| Department of Veterans Affairs | 317 | 114 | 866 | 102 | 65 | 1,464 |
| American Battle Monuments Comm. | 17 | 0 | 36 | 12 | 0 | 65 |
| Environmental Protection Agency | 36 | 0 | 245 | 193 | 2 | 476 |
| Federal Communications Comm | 66 | 0 | 53 | 3 | 0 | 122 |
| Federal Emergency Mgmt Agency | 27 | 7 | 255 | 26 | 0 | 315 |
| General Services Administration | 53,136 | 2,821 | 84,310 | 3,711 | 3,823 | 147,801 |
| Government Printing Office | 2 | 0 | 40 | 0 | 0 | 42 |
| International Boundary \& Water Comm. | 2 | 0 | 17 | 14 | 27 | 60 |
| Merit System Protection Board | 0 | 0 | 1 | 0 | 0 | 1 |
| Natl Aeronautics \& Space Admin. | 90 | 18 | 626 | 234 | 51 | 1,019 |
| National Gallery of Art | 0 | 0 | 5 | 3 | 2 | 10 |
| National Science Foundation | 25 | 6 | 116 | 21 | 2 | 170 |
| Panama Canal Commission | 186 | 13 | 370 | 217 | 64 | 850 |
| Peace Corps | 20 | 45 | 450 | 0 | 0 | 515 |
| Smithsonian Institute | 61 | 4 | 228 | 54 | 14 | 361 |
| Tennessee Valley Authority | 1,591 | 4 | 1,117 | 1,158 | 264 | 4,134 |
| U.S. Agency for International Develop. | 213 | 17 | 499 | 50 | 17 | 796 |
| U.S. Soldiers' \& Airmen's Home | 5 | 5 | 23 | 6 | 9 | 48 |
| U.S. Information Agency | 402 | 9 | 357 | 20 | 8 | 796 |
| CIVILIAN AGENCIES | $\mathbf{9 3 , 1 2 9}$ | 3,815 | 143,604 | 19,091 | 7,607 | 267,246 |
| U.S. POSTAL SERVICE | 7,786 | 11 | 187,043 | 6,496 | 4,827 | 206,163 |
| Department of the Navy | 2,771 | 889 | 25,963 | 2,262 | 2,423 | 34,308 |
| Department of the Army | 1,422 | 585 | 8,922 | 1,288 | 1,131 | 13,348 |
| Department of the Air Force | 4,278 | 2,065 | 35,212 | 3,106 | 2,840 | 47,501 |
| Other Defense Agencies | 2,521 | 39 | 1,365 | 164 | 131 | 4,220 |
| Corps of Engineers | 358 | 4 | 3,760 | 722 | 235 | 5,079 |
| U.S. Marine Corps | 641 | 425 | 4,789 | 791 | 381 | 7,027 |
| MILITARY AGENCIES | 11,991 | 4,007 | 80,011 | 8,333 | 7,141 | 111,483 |
| TOTAL | 112,906 | 7,833 | 410,658 | 33,920 | 19,575 | 584,892 |

## Source:

U.S. General Services Administration, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1997. (Additional resources: http://policyworks.gov/org/main/mt/homepage/mtv/mtvhp.htm)

[^39]Table 3.34
Operating and Cost Data for Large Domestic Federal Fleets, 1986-95 ${ }^{\text {a }}$

| Fiscal year | Number of vehicles | Miles operated (thousands) | Average annual miles per vehicle | Fleet average cost per mile (dollars) |
| :---: | :---: | :---: | :---: | :---: |
| Sedans |  |  |  |  |
| 1986 | 86,069 | 1,130,843 | 13,139 | \$0.21 |
| 1987 | 89,894 | 1,069,124 | 11,893 | \$0.20 |
| 1988 | 85,928 | 1,119,343 | 13,027 | \$0.19 |
| 1989 | 90,254 | 1,170,370 | 12,968 | \$0.20 |
| 1990 | 93,510 | 1,226,674 | 13,118 | \$0.22 |
| 1991 | 98,259 | 1,297,651 | 13,206 | \$0.23 |
| 1992 | 97,680 | 1,261,954 | 12,940 | \$0.20 |
| 1993 | 98,144 | 1,251,348 | 12,750 | \$0.23 |
| 1994 | 96,386 | 1,216,385 | 12,620 | \$0.18 |
| 1995 | 97,777 | 1,214,877 | 12,425 | \$0.21 |
| Trucks |  |  |  |  |
| 1986 | 292,256 | 2,095,079 | 7,168 | \$0.43 |
| 1987 | 303,275 | 2,195,017 | 8,238 | \$0.45 |
| 1988 | 316,443 | 2,242,075 | 7,085 | \$0.44 |
| 1989 | 336,617 | 2,292,593 | 6,811 | \$0.43 |
| 1990 | 354,392 | 2,423,131 | 6,837 | \$0.44 |
| 1991 | 366,471 | 2,498,190 | 6,818 | \$0.45 |
| 1992 | 381,721 | 2,645,979 | 6,932 | \$0.40 |
| 1993 | 392,796 | 2,627,759 | 6,690 | \$0.41 |
| 1994 | 400,564 | 2,659,631 | 6,640 | \$0.40 |
| 1995 | 413,328 | 2,754,750 | 6,665 | \$0.37 |
| All Vehicles ${ }^{\text {b }}$ |  |  |  |  |
| 1986 | 403,855 | 3,477,730 | 8,611 | \$0.36 |
| 1987 | 414,575 | 3,461,332 | 8,349 | \$0.37 |
| 1988 | 424,286 | 3,576,421 | 8,429 | \$0.36 |
| 1989 | 448,836 | 3,681,314 | 8,202 | \$0.35 |
| 1990 | 467,678 | 3,855,984 | 8,245 | \$0.38 |
| 1991 | 484,552 | 3,984,175 | 8,222 | \$0.38 |
| 1992 | 495,257 | 4,061,255 | 8,200 | \$0.35 |
| 1993 | 504,877 | 4,010,354 | 7,943 | \$0.36 |
| 1994 | 509,483 | 3,995,161 | 7,842 | \$0.34 |
| 1995 | 522,959 | 4,076,990 | 7,796 | \$0.34 |

## Source:

U.S. General Services Administrations, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1997. (Additional resources: http://policyworks.gov/main/mt/homepage/mtv/mtvhp.htm)

[^40]Significant changes have been made in recent years, to fleet vehicle estimations. Newly available data improve the accuracy of fleet vehicles estimates but, at the same time, make it impossible to compare the data historically. Therefore, only the 1996 data are presented here.

Figure 3.2. Fleet Vehicles in Service as of January 1, 1996


## Source:

Bobit Publishing Company, Automotive Fleet Research Department, Automotive Fleet Factbook 1996, Redondo Beach, CA, 1996, p. 12.

Table 3.35
Fleet Vehicle Composition by Vehicle Type
(percent)

| Fleet type | Cars | Light trucks $^{\mathrm{a}}$ <br> and vans | Medium <br> trucks $^{\mathrm{b}}$ | Heavy <br> trucks $^{\mathrm{c}}$ | Total |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Business | $24.2 \%$ | $21.1 \%$ | $45.8 \%$ | $8.9 \%$ | $100 \%$ |
| Utility | $22.6 \%$ | $39.0 \%$ | $15.0 \%$ | $23.4 \%$ | $100 \%$ |
| Government | $48.5 \%$ | $42.8 \%$ | $6.8 \%$ | $1.8 \%$ | $100 \%$ |

Table 3.36
Average Length of Time Fleet Vehicles are Kept Before Sold to Others (months)

|  |  |  |  |
| :--- | :---: | ---: | :---: |
|  | Business | Utility | Government |
| Cars | 35 | 68 | 81 |
| Light trucks $^{\text {a }}$ | 56 | 60 | 82 |
| Medium trucks $^{\text {b }}$ | 83 | 86 | 96 |
| Heavy trucks $^{\text {}}$ | 103 | 132 | 117 |

Table 3.37
Average Annual and Daily Vehicle-Miles of Travel for Fleet Vehicles

| Vehicle type | Business |  | Utility |  | Government |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Miles/year (thousands) | Miles/day <br> @ 250 <br> days/year | Miles/year (thousands) | $\begin{gathered} \hline \text { Miles/day } \\ \text { @250 } \\ \text { days/year } \\ \hline \end{gathered}$ | Miles/year (thousands) | Miles/day <br> @ 250 <br> days/year |
| Cars | 29.2 | 117 | 14.5 | 58 | 13.7 | 55 |
| Light trucks ${ }^{\text {a }}$ | 26.6 | 106 | 17.5 | 70 | 13.9 | 56 |
| Medium trucks ${ }^{\text {b }}$ | 17.5 | 70 | 11.8 | 47 | 11.9 | 48 |
| Heavy trucks ${ }^{\text {c }}$ | 64.4 | 258 | 13.8 | 55 | 10.7 | 43 |

## Source:

Miaou, S. P., et. al., "Fleet Vehicles in the United States: Composition, Operating Characteristics, and Fueling Practices," (ORNL-6717), Oak Ridge National Laboratory, Oak Ridge, TN, May 1992.
(Additional resources: http://www-cta.ornl.gov)

[^41]
## Profile of Metropolitan Motor-Vehicle Fleets

Because of concerns about energy security and clean air, the Energy Policy Act of 1992 directed the Energy Information Administration (EIA) to colle ct data that would be useful in assessing the market for vehicles powered by alternatives to motor gasoline and diesel fuel. Two surveys were designed to draw a profile of private company and local government fleets in a major metropolitan area. The two metropolitan areas surveye d were the Atlanta Metropolitan Statistical Area (MSA) [1994] and the Denver MS A [1995].

The results of the Atlanta survey are publ ished in Profile of Motor-Vehicle Fleets in Atlanta 1994, DOE/EIA-0601, November 1995; the results of the Denver survey can be found on the Internet at the following site: http://www.eia.doe.gov/ emeu/eeuisd/htm/denver1.htm

Selected statistics from the surveys are presented in Tables 3.37 and 3.38.

A private company fleet for this survey was defined as any group of six or more vehicles owned or operated by private companies and operated out of a base location/locations in the 13-county nonattainment area of Atlanta. Employee-owned vehicles and short-term rental vehicles were excluded. Vehicle leasing companies were excluded to avoid double counting leased vehicles operated by private companies.

Table 3.38

## Number of Gasoline and Diesel Vehicles in Private Company Fleets in Atlanta by Vehicle-Size Class and Selected Characteristics

| Selected characteristics | $\begin{gathered} \hline \text { Light-duty } \\ \text { vehicles } \\ (\leq 8,500 \\ \text { GVWR) } \\ \hline \end{gathered}$ | $\begin{aligned} & \hline \text { Light trucks/ } \\ & \text { step vans } \\ & (8,501-19,500 \\ & \text { GVWR) } \\ & \hline \end{aligned}$ | Medium trucks $(19,501-26,000$ GVWR $)$ | $\begin{gathered} \hline \text { Heavy } \\ \text { trucks } \\ (>26,000 \\ \text { GVWR) } \\ \hline \end{gathered}$ | Total ${ }^{\text {a }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| SIC Code | 100\% | 100\% | 100\% | 100\% | 100\% |
| Ag./For./Fish. | b | 12\% | b | b | b |
| Mining | b | b | c |  |  |
| Construction | 21\% | 23\% | 14\% | 8\% | 18\% |
| Manufacturing | 4\% | 10\% | 7\% | 6\% | 5\% |
| Trans./Com./Utilities. | 13\% | 15\% | 26\% | 51\% | 22\% |
| Wholesale trade | 14\% | 12\% | 23\% | 16\% | 15\% |
| Retail trade | , | 4\% | 6\% | $3 \%$ | , |
| Fin./Ins./Re. | b | c | c |  | b |
| Services | b | 14\% | 3\% | b | b |
| Not classified | 12\% | 10\% | 6\% | 12\% | 11\% |
| Fleet Size (\# of vehicles) | 100\% | 100\% | 100\% | 100\% | 100\% |
| 6 to 9 | 14\% | 20\% | 9\% | 12\% | 13\% |
| 10 to 19 | 17\% | 27\% | 14\% | 15\% | 17\% |
| 20 to 49 | 21\% | 17\% | 22\% | 31\% | 23\% |
| 50 or more | 49\% | 37\% | 55\% | 42\% | 47\% |
| Annual miles traveled | 100\% | 100\% | 100\% | 100\% | 100\% |
| 0 to 10,000 | 7\% | 10\% | 22\% | b | 6\% |
| 10,001 to 20,000 | b | 33\% | 31\% | 11\% | ${ }^{\text {b }}$ |
| 20,001 to 50,000 | 37\% | 32\% | 25\% | 18\% | 35\% |
| 50,001 or more | 6\% | b | 8\% | 53\% | 16\% |
| No answer | ${ }^{\text {b }}$ | 13\% | ${ }^{\text {b }}$ | 11\% | 17\% |
| Miles before replacement | 100\% | 100\% | 100\% | 100\% | 100\% |
| 0 to 50,000 | b | b | 0\% | b | b |
| 50,001 to 100,000 | ${ }^{\text {b }}$ | 13\% | 9\% | 4\% | ${ }^{\text {b }}$ |
| 100,001 to 250,000 | 24\% | 42\% | 35\% | 12\% | 22\% |
| 250,001 or more | b | ${ }^{\text {b }}$ | 19\% | 65\% | 17\% |
| No answer | b | 23\% | 34\% | 19\% | 28\% |
| Total vehicles | 55,794 | 5,257 | 4,951 | 15,400 | 82,613 |
| Percent vehicles by type | 68\% | 6\% | 6\% | 19\% | 100\% |

Source:
Energy Information Administration, Office of Energy Markets and End Use, Profile of Motor-Vehicle Fleets in Atlanta, 1994, DOE/EIA-0601, Washington, DC, November 1995, p. 16, (http://www.eia.doe.gov/emeu/eeuisd/htm/atlanta1.htm).
Note:Ag./For./Fish. = Agriculture, Forestry, Fishing. Trans./Com./Utilities = Transportation, Communications, Electric, Gas, and Sanitary Services. Fin./Ins./Re. = Finance, Insurance, and Real Estate.

[^42]A private company fleet for this survey was defined as any group of ten or more vehicles owned or operated by private companies and operated out of a base location/locations in the 6-ounty nonattainment area of Denver. Employee-owned vehicles and short-term rental vehicles were excluded. Vehicle leasing companies were excluded to avoid double counting leased vehicles operated by private companies

Table 3.39

## Number of Gasoline and Diesel Vehicles in Private Company Fleets in Denver by Vehicle-Size Class and Selected Characteristics

|  | Light-duty <br> vehicles <br> $(\leq 8,500$ | Light trucks/ <br> step vans <br> $(8,501-19,500$ | Medium <br> trucks <br> $(19,501-26,000$ | Heavy <br> (trucks <br> $(>26,000$ |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Selected characteristics | GVWR) |  |  |  |  |

## Source:

Energy Information Administration, Office of Energy Markets and End Use, (http://www.eia.doe.gov/emeu/eeuisd/htm/denver1.htm).
Note: Ag./For./Fish. = Agriculture, Forestry, Fishing. Trans./Com./Utilities = Transportation, Communications, Electric, Gas, and Sanitary Services. Fin./Ins./Re. = Finance, Insurance, and Real Estate.

[^43]Table 3.40
Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates for Automobiles and Light Trucks, 1978-97 ${ }^{\text {a }}$ (miles per gallon)

| Model <br> Year | Automobiles |  |  |  | Light Trucks ${ }^{\text {b }}$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | CAFE <br> Standards | CAFE Estimates ${ }^{\text {c }}$ |  |  | CAFE <br> Standards | CAFE Estimates ${ }^{\text {c }}$ |  |  |
|  |  | Domestic | Import | Combined |  | Domestic | Import | Combined |
| 1978 | 18.0 | 18.7 | 27.3 | 19.9 | d | e | e | e |
| 1979 | 19.0 | 19.3 | 26.1 | 20.3 | d | 17.7 | 20.8 | 18.2 |
| 1980 | 20.0 | 22.6 | 29.6 | 24.3 | d | 16.8 | 24.3 | 18.5 |
| 1981 | 22.0 | 24.2 | 31.5 | 25.9 | d | 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 | 20.0 | 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 | 29.9 | 28.0 | 20.0 | 20.3 | 23.0 | 20.8 |
| 1991 | 27.5 | 27.3 | 30.0 | 28.4 | 20.2 | 20.9 | 23.0 | 21.3 |
| 1992 | 27.5 | 27.0 | 29.2 | 27.9 | 20.2 | 20.5 | 22.7 | 20.8 |
| 1993 | 27.5 | 27.8 | 29.6 | 28.4 | 20.4 | 20.7 | 22.8 | 21.0 |
| 1994 | 27.5 | 27.5 | 29.6 | 28.3 | 20.5 | 20.5 | 22.0 | 20.7 |
| 1995 | 27.5 | 27.7 | 30.3 | 28.6 | 20.6 | 20.3 | 21.5 | 20.5 |
| 1996 | 27.5 | 28.3 | 29.7 | 28.7 | 20.7 | 20.5 | 22.1 | 20.7 |
| 1997 | 27.5 | 27.9 | 30.1 | 28.6 | 20.7 | 20.2 | 22.2 | 20.4 |

## Source:

U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, March 1997. (Additional resources: http://www.nhtsa.dot.gov)

[^44]Table 3.41
Corporate Average Fuel Economy (CAFE) Fines Collected, 1983-95
(thousands)

| Model <br> year |  |  |
| ---: | ---: | ---: |
| 1983 | Current <br> dollars | 1990 constant <br> dollars $^{\text {b }}$ |
| 1984 | 58 | 76 |
| 1985 | 5,958 | 7,496 |
| 1986 | 15,565 | 18,908 |
| 1987 | 29,872 | 35,603 |
| 1988 | 31,261 | 35,945 |
| 1989 | 44,519 | 49,181 |
| 1990 | 47,381 | 49,946 |
| 1991 | 48,449 | 48,449 |
| 1992 | 42,243 | 40,511 |
| 1993 | 38,287 | 35,645 |
| 1994 | 28,688 | 25,963 |
| 1995 | 31,474 | 27,760 |
| Total | 39,985 | 34,267 |

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, March, 1997.
(Additional resources: http://www.nhtsa.dot.gov)
Table 3.42
Tax Receipts from the Sale of Gas Guzzlers, 1980-95
(thousands)

| (thousands) |  |  |
| :---: | ---: | ---: |
| Fiscal <br> year | Current <br> dollars | 1990 constant <br> dollars $^{\mathrm{b}}$ |
| 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 |
| 1992 | 144,200 | 134,250 |
| 1993 | 111,600 | 100,998 |
| 1994 | 64,100 | 56,536 |
| 1995 | 74,600 | 63,932 |
| Total | $1,191,950$ | $1,266,682$ |

Source:
Motor Vehicle Manufacturers Association, Motor Vehicle Facts and
Figures '96, Detroit, MI, 1996, p. 87.
(Additional resources: http://www.aama.com)
${ }^{a}$ These are fines which are actually collected. Fines which are assessed in a certain year may not have been collected in that year.
${ }^{\mathrm{b}}$ Adjusted using the Consumer Price Inflation Index.

Table 3.43

## The Gas Guzzler Tax on New Cars

(dollars per vehicle)

| Vehicle fuel <br> economy <br> (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 | 1,000 |
| $21.5-22.0$ | 0 | 0 | 0 | 0 | 0 | 0 | 500 | 1,000 |
| $21.0-21.5$ | 0 | 0 | 0 | 0 | 0 | 0 | 650 | 1,300 |
| $20.5-21.0$ | 0 | 0 | 0 | 0 | 0 | 500 | 650 | 1,300 |
| $20.0-20.5$ | 0 | 0 | 0 | 0 | 0 | 500 | 850 | 1,700 |
| $19.5-20.0$ | 0 | 0 | 0 | 0 | 0 | 600 | 850 | 1,700 |
| $19.0-19.5$ | 0 | 0 | 0 | 0 | 450 | 600 | 1,050 | 2,100 |
| $18.5-19.0$ | 0 | 0 | 0 | 350 | 450 | 800 | 1,050 | 2,100 |
| $18.0-18.5$ | 0 | 0 | 200 | 350 | 600 | 800 | 1,300 | 2,600 |
| $17.5-18.0$ | 0 | 0 | 200 | 500 | 600 | 1,000 | 1,300 | 2,600 |
| $17.0-17.5$ | 0 | 0 | 350 | 500 | 750 | 1,000 | 1,500 | 3,000 |
| $16.5-17.0$ | 0 | 200 | 350 | 650 | 750 | 1,200 | 1,500 | 3,000 |
| $16.0-16.5$ | 0 | 200 | 450 | 650 | 950 | 1,200 | 1,850 | 3,700 |
| $15.5-16.0$ | 0 | 350 | 450 | 800 | 950 | 1,500 | 1,850 | 3,700 |
| $15.0-15.5$ | 0 | 350 | 600 | 800 | 1,150 | 1,500 | 2,250 | 4,500 |
| $14.5-15.0$ | 200 | 450 | 600 | 1,000 | 1,150 | 1,800 | 2,250 | 4,500 |
| $14.0-14.5$ | 200 | 450 | 750 | 1,000 | 1,450 | 1,800 | 2,700 | 5,400 |
| $13.5-14.0$ | 300 | 550 | 750 | 1,250 | 1,450 | 2,200 | 2,700 | 5,400 |
| $13.0-13.5$ | 300 | 550 | 950 | 1,250 | 1,750 | 2,200 | 3,200 | 6,400 |
| $12.5-13.0$ | 550 | 650 | 950 | 1,550 | 1,750 | 2,650 | 3,200 | 6,400 |
| Under 12.5 | 550 | 650 | 1,200 | 1,550 | 2,150 | 2,650 | 3,850 | 7,700 |

## Source:

Internal Revenue Service, Form 6197, (Rev. 1-91), "Gas Guzzler Tax."
(Additional resources: http://www.irs.ustreas.gov)

## New Data by Vehicle Speed

ORNL has developed fuel consumption and emissions lookup tables for the Federal Highway Administration, for use in their TRAF series of traffic models (NETSIM, CORSIM, FRESIM), although more generic uses are also possible. To develop the data-based models, vehicles are tested both on-road and on a chassis dynamometer. Engine parameters are measured on-road under real-world driving conditions that cover the vehicle's entire operating envelope. Emissions and fuel consumption are then measured on the chassis dynamometer as functions of engine conditions. The two data sets are merged to produce the final three-dimensional maps as functions of vehicle speed and acceleration. Eight wellfunctioning, late-model, vehicles have been tested thus far in fully warmed- up conditions.

Similar continuing work is planned for the Department of Energy as well as FHWA, which will include more well-functioning, late-model vehicles, pre-control (1960's) vehicles, malfunctioning highemitter vehicles, light-duty diesel vehicles (cars and pickup trucks), alternative fuel vehicles, and possibly heavy-duty diesel vehicles. ORNL will also be developing cold-start algorithms to enhance the existing models, since emissions and fuel economy generally improve as vehicles warm up to normal operating temperatures.

For further information regarding this study please contact:

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Table 3.44
Vehicle Specifications for Tested Vehicles

| Vehicle | Curb weight | Engine | Fuel delivery system ${ }^{\text {a }}$ | Transmission | EPA fuel economy |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | City | Highway |
| 1988 Chevrolet Corsica | 2,665 | 2.8 liter V6 | PFI | M5 | 19 | 29 |
| 1994 Olds Cutlass Supreme | 3,290 | 3.4 liter V6 | PFI | L4 | 17 | 26 |
| 1994 Oldsmobile 88 | 3,433 | 3.8 literV6 | PFI | L4 | 19 | 29 |
| 1994 Mercury Villager | 4,020 | 3.0 liter V6 | PFI | L4 | 17 | 23 |
| 1995 Geo Prizm | 2,359 | 1.6 liter I-4 | PFI | L3 | 26 | 30 |
| 1994 Jeep Grand Cherokee | 3,820 | 4.0 liter I-6 | PFI | L4 | 15 | 20 |
| 1994 Chevrolet Pickup | 4,020 | 5.7 liter V8 | TBI | L4 | 14 | 18 |
| 1993 Subaru Legacy | 2,800 | 2.2 liter H4 | PFI | L4 | 22 | 29 |

## Source:

West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, Development and Verification of LightDuty Modal Emissions and Fuel Consumption Values forTraffic Models, FHWA Report (in press), Washington, DC, April 1997.

[^45]The two earlier studies by the Federal Highway Administration (FHWA) indicate maximum fud efficiency was achieved at speeds of 35 to 40 mph . The recent FHWA study indicates greater fud efficiency at higher speeds. Note that the 1973 study did not include light trucks.

Table 3.45
Fuel Economy by Speed, 1973, 1984, and 1997

| (miles per gallon) |  |  |  |
| :---: | :---: | :---: | :---: |
| Speed <br> (miles per hour) | $1973^{\mathrm{a}}$ <br> $(13$ vehicles $)$ | $1984^{\mathrm{b}}$ <br> $(15$ vehicles $)$ | $1997^{\mathrm{c}}$ <br> $(8$ vehicles $)$ |
| 15 | d | 21.1 | 22.3 |
| 20 | d | 25.5 | 25.5 |
| 25 | d | 30.0 | 27.5 |
| 30 | 21.1 | 31.8 | 29.0 |
| 35 | 21.1 | 33.6 | 28.8 |
| 40 | 21.1 | 33.6 | 30.0 |
| 45 | 20.3 | 33.5 | 29.9 |
| 50 | 19.5 | 31.9 | 30.2 |
| 55 | 18.5 | 30.3 | 30.4 |
| 60 | 17.5 | 27.6 | 28.8 |
| 65 | 16.2 | 24.9 | 27.4 |
| 70 | 14.9 | 22.5 | 25.3 |
| 75 | d | 20.0 | 23.3 |

Fuel economy loss

| $55-65 \mathrm{mph}$ | $12.4 \%$ | $17.8 \%$ | $9.9 \%$ |
| :--- | ---: | ---: | :--- |
| $65-70 \mathrm{mph}$ | $8.0 \%$ | $9.6 \%$ | $7.7 \%$ |
| $55-70 \mathrm{mph}$ | $19.5 \%$ | $25.7 \%$ | $16.8 \%$ |

## Source:

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.

1997 - West, B.H., R.N. McGill, J.W. Hodgson, S.S. Sluder, and D.E. Smith, Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models, FHWA Report (in press), Washington, DC, April 1997. (Additional resources: http://www.fhwa-tsis.com)
${ }^{\text {a }}$ Model years 1970 and earlier automobiles.
${ }^{\text {b }}$ Model years 1981-84 automobiles and light trucks.
${ }^{\text {c }}$ Model years 1988-95 automobiles and light trucks.
${ }^{\mathrm{d}}$ Data are not available.

Figure 3.3. Fuel Economy by Speed, 1973, 1984, and 1997


Source: See Table 3.43.

Table 3.46
Steady Speed Fuel Economy for Tested Vehicles
(miles per gallon)

| Speed (mph) | 1988 Chevrolet <br> Corsica | $\begin{gathered} 1993 \\ \text { Subaru } \\ \text { Legacy } \end{gathered}$ | $\begin{gathered} 1994 \\ \text { Oldsmobile } \\ \text { Olds } 88 \end{gathered}$ | 1994 Oldsmobile Cutlass | $\begin{gathered} 1995 \\ \text { Geo } \\ \text { Prizm } \end{gathered}$ | 1994 <br> Chevrolet Pickup | $1994 \text { Jeep }$ <br> Grand Cherokee |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5 | 10.0 | 14.5 | 10.5 | 5.1 | 18.1 | 7.9 | 8.2 | 12.3 |
| 10 | 16.8 | 24.7 | 14.9 | 7.9 | 23.1 | 16.0 | 11.2 | 19.0 |
| 15 | 17.7 | 31.9 | 22.2 | 11.4 | 38.9 | 16.3 | 17.5 | 22.4 |
| 20 | 21.7 | 34.4 | 26.3 | 12.5 | 39.4 | 19.9 | 24.7 | 25.8 |
| 25 | 23.9 | 37.4 | 28.3 | 15.6 | 41.7 | 22.7 | 21.8 | 30.8 |
| 30 | 28.7 | 39.7 | 29.0 | 19.0 | 40.0 | 26.3 | 21.6 | 30.3 |
| 35 | 28.6 | 38.0 | 30.9 | 21.2 | 39.1 | 24.3 | 25.0 | 26.1 |
| 40 | 29.2 | 37.0 | 33.2 | 23.0 | 38.9 | 26.7 | 25.5 | 29.0 |
| 45 | 28.8 | 33.7 | 32.4 | 23.0 | 42.3 | 27.3 | 25.4 | 27.8 |
| 50 | 31.2 | 33.7 | 34.2 | 27.3 | 39.1 | 26.3 | 24.8 | 30.1 |
| 55 | 29.1 | 37.7 | 34.6 | 29.1 | 37.7 | 25.1 | 24.0 | 31.7 |
| 60 | 28.2 | 35.9 | 32.5 | 28.2 | 36.7 | 22.6 | 23.2 | 27.3 |
| 65 | 28.7 | 33.4 | 30.0 | 25.0 | 34.1 | 21.8 | 21.3 | 25.3 |
| 70 | 26.1 | 31.0 | 26.7 | 22.9 | 31.7 | 20.1 | 20.0 | 23.9 |
| 75 | 23.7 | 28.8 | 24.0 | 21.6 | 28.3 | 18.1 | 19.1 | 22.4 |
| Fuel economy loss |  |  |  |  |  |  |  |  |
| 55-65 mph | 1.4\% | 11.4\% | 13.3\% | 14.1\% | 9.5\% | 13.1\% | 11.3\% | 20.2\% |
| $65-75 \mathrm{mph}$ | 17.4\% | 13.8\% | 20.0\% | 13.6\% | 17.0\% | 17.0\% | 10.3\% | 11.5\% |
| 55-75 mph | 18.6\% | 23.6\% | 30.6\% | 25.8\% | 24.9\% | 27.9\% | 20.4\% | 29.3\% |

Source:
B.H. West, R.N. McGill, J.W. Hodgson, S.S. Sluder, D.E. Smith, Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models, FWHA Report (in press), Washington, DC, April 1997.
(Additional resources: http://www.fhwa-tsis.com)

## Note:

For specifications of the tested vehicles, please see page 3-49.

Figure 3.4. Fuel Economy by Speed for Selected Vehicles


Source: See Table 3.44. 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 and on the highway. Once the urban cycle is completed, the engine is stopped, then started again for the 8.5 minute hot start cycle.

Figure 3.5. Urban Driving Cycle


Figure 3.6. Highway Driving Cycle


Source:
Code of Federal Regulations, 40CFR, "Subpart B - Fuel Economy Regulations for 1978 and Later Model Year Automobiles - Test Procedures, " July 1, 1998 edition, p. 676.

The New York Test Cycle was developed in the 1970's in order to simulate driving in downtown congested areas. The Representative Number Five Test Cycle was developed recently to better represent actual on-road driving by combining modern urban and freeway driving.

Figure 3.7. New York City Driving Cycle


Figure 3.8. Representative Number Five Driving Cycle


## Source:

Data obtained from Michael Wang, Argonne National Laboratory, Argonne, IL, 1997.

High-occupancy vehicle (HOV) lanes are special highway lanes meant for the exclusive use of vehicles with a specified minimum number of passengers. Vehicles that use HOV lanes are usually guaranteed a shorter and less congested trip than those using regular traffic lanes. Twenty-five areas in the U.S and Canada had HOV facilities in 1994, and 4 more areas had HOV facilities in development at that time.

Figure 3.9. Miles of High-Occupancy Vehicle Lanes, 1969-94


## Source:

Texas Transportation Institute, College Station, TX, February 1996. (Additional resources: http://tti.tamu.edu)

## Note:

1993-94 includes Canadian HOV lanes for three cities.

## CHAPTER 4

## PERSONAL TRAVEL STATISTICS

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Table 4.1
Population and Vehicle Profile, 1950-95

| Year | Resident population ${ }^{\text {a }}$ (thousands) | Total households (thousands) | Number of vehicles in operation (thousands) | Number of licensed drivers (thousands) | Number of civilian employed persons (thousands) | Vehicles <br> per capita | Vehicle miles per capita | Licensed drivers per household | Vehicles per licensed driver | Vehicles per civilian employed persons |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1950 | 151,271 | 43,554 | 43,256 | 62,194 | 58,918 | 0.29 | 3,029 | 1.43 | 0.70 | 0.73 |
| 1955 | 165,069 | 47,874 | 55,804 | 74,686 | 62,170 | 0.34 | 3,656 | 1.56 | 0.75 | 0.90 |
| 1960 | 179,979 | 52,799 | 66,582 | 87,253 | 65,778 | 0.36 | 3,994 | 1.65 | 0.76 | 1.01 |
| 1965 | 193,526 | 57,251 | 82,067 | 98,502 | 71,088 | 0.42 | 4,587 | 1.72 | 0.83 | 1.15 |
| 1970 | 203,984 | 63,401 | 98,136 | 111,543 | 78,678 | 0.48 | 5,440 | 1.76 | 0.88 | 1.25 |
| 1975 | 215,465 | 71,120 | 120,054 | 129,791 | 85,846 | 0.56 | 6,162 | 1.82 | 0.92 | 1.40 |
| 1980 | 227,225 | 80,776 | 139,832 | 145,295 | 99,303 | 0.62 | 6,722 | 1.80 | 0.96 | 1.41 |
| 1981 | 229,466 | 82,368 | 141,908 | 147,075 | 100,397 | 0.62 | 6,767 | 1.79 | 0.96 | 1.41 |
| 1982 | 231,664 | 83,527 | 143,854 | 150,234 | 99,526 | 0.62 | 6,885 | 1.80 | 0.96 | 1.45 |
| 1983 | 233,792 | 83,918 | 147,104 | 154,389 | 100,834 | 0.63 | 7,069 | 1.83 | 0.95 | 1.46 |
| 1984 | 235,825 | 85,407 | 152,162 | 155,424 | 105,005 | 0.65 | 7,295 | 1.82 | 0.98 | 1.45 |
| 1985 | 237,924 | 86,789 | 157,048 | 156,868 | 107,150 | 0.66 | 7,457 | 1.81 | 1.00 | 1.47 |
| 1986 | 240,133 | 88,458 | 162,094 | 159,487 | 109,597 | 0.68 | 7,655 | 1.80 | 1.02 | 1.48 |
| 1987 | 242,289 | 89,479 | 167,193 | 161,975 | 112,440 | 0.69 | 7,929 | 1.81 | 1.03 | 1.49 |
| 1988 | 244,499 | 91,061 | 171,741 | 162,853 | 114,968 | 0.70 | 8,286 | 1.79 | 1.05 | 1.49 |
| 1989 | 246,819 | 92,830 | 175,960 | 165,555 | 117,342 | 0.71 | 8,494 | 1.78 | 1.06 | 1.50 |
| 1990 | 249,398 | 93,347 | 179,299 | 167,015 | 118,793 | 0.72 | 8,598 | 1.79 | 1.07 | 1.51 |
| 1991 | 252,131 | 94,312 | 181,438 | 168,995 | 117,718 | 0.72 | 8,614 | 1.79 | 1.07 | 1.54 |
| 1992 | 255,011 | 95,689 | 181,519 | 173,125 | 118,492 | 0.71 | 8,781 | 1.81 | 1.05 | 1.53 |
| 1993 | 257,783 | 96,391 | 186,315 | 173,149 | 120,259 | 0.72 | 8,909 | 1.80 | 1.08 | 1.55 |
| 1994 | 260,372 | 97,107 | 188,714 | 175,403 | $123,060^{\text {b }}$ | 0.72 | 9,055 | 1.81 | 1.08 | 1.53 |
| 1995 | 262,890 | 98,990 | 193,441 | 176,628 | $124,900^{\text {b }}$ | 0.74 | 9,216 | 1.78 | 1.10 | 1.55 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |  |
| 1950-95 | 1.2\% | 1.8\% | 3.4\% | 2.3\% | 1.7\% | 2.1\% | 2.5\% | 0.5\% | 1.0\% | 1.7\% |
| 1985-95 | 1.0\% | 1.3\% | 2.1\% | 1.2\% | 1.5\% | 1.2\% | 2.1\% | -0.2\% | 1.0\% | 0.5\% |

## Source:

Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 116 th edition, Washington, DC, 1996, pp. 8, 58, 393, and annual. (Additional resources: http://www.census.gov)
Vehicles in operation - The Polk Company. FURTHER REPRODUCTION PROHIBITED. (Additional resources: http://www.polk.com)
Licensed drivers and vehicle-miles - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1995, Tables DL-1C and VM-1, and annual.
(Additional resources: http://www.fhwa.dot.gov)
${ }^{\text {a }}$ Estimates as of July 1. Includes Armed Forces stationed in the United States.
${ }^{\mathrm{b}}$ Data are not comparable to earlier years due to changes in definitions and methodology. See original source for more details.

Transportation (18.2\%) is second only to housing (31.5\%) as the largest expenditure for the average household. In 1995, approximately $17 \%$ of transportation expenditures were for purchasing gasoline and motor oil.

Table 4.2
Average Annual Expenditures of Households by Income, 1995

|  |  |  |  |  |  |  |  |
| :--- | :---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |

[^46]Table 4.3
Average Number of Vehicles and Vehicle Travel per Household, 1991 and 1994 RTECS

| Number of Drivers | Average number of vehicles per household |  | Average vehicle-miles traveled per household |  |
| :---: | :---: | :---: | :---: | :---: |
|  | 1991 | 1994 | 1991 | 1994 |
| 1 | 1.2 | 1.2 | 10,900 | 12,300 |
| 2 | 2.0 | 2.0 | 21,400 | 23,200 |
| 3 | 2.6 | 2.8 | 30,700 | 33,100 |
| 4 or more | 3.1 | 3.4 | 36,700 | 43,000 |
| Household size |  |  |  |  |
| 1 person | 1.2 | 1.2 | 10,600 | 11,600 |
| 2 persons | 1.8 | 1.8 | 17,700 | 20,000 |
| 3 persons | 2.0 | 2.1 | 22,300 | 25,200 |
| 4 persons | 2.2 | 2.2 | 26,200 | 26,600 |
| 5 persons | 2.1 | 2.2 | 23,600 | 26,300 |
| 6 or more persons | 1.9 | 2.3 | 22,600 | 30,900 |
| Household urban status |  |  |  |  |
| Urban | 1.8 | 1.8 | 18,800 | 20,700 |
| Central city | 1.6 | 1.7 | 15,900 | 18,000 |
| Suburban | 1.9 | 1.9 | 20,400 | 22,300 |
| Rural | 1.9 | 1.9 | 19,500 | 22,500 |
| Household composition |  |  |  |  |
| With children | 2.0 | 2.0 | 22,800 | 24,800 |
| Without children | 1.7 | 1.7 | 16,500 | 18,900 |
| Total | 1.8 | 1.8 | 18,900 | 21,100 |

## Source:

1991-U.S. Department of Energy, Energy Information Administration, Household Vehicles Energy Consumption 1994, Washington, DC, 1996, pp. 48, 49.
1994-Personal Communication, U.S. Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division. (Additional resources: http://www.eia.doe.gov)

Table 4.4
Statistics for Household Vehicles by Vehicle Type, 1985, 1988, 1991, and 1994 RTECS

| Type of vehicle | Number of vehicles ${ }^{a}$ (millions) |  |  |  | Average annual miles per vehicle (thousands) |  |  |  | Average fuel economy (mpg) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1985 | 1988 | 1991 | 1994 | 1985 | 1988 | 1991 | 1994 | $1985{ }^{\text {b }}$ | 1988 | 1991 | 1994 |
| Passenger car | 106.6 | 109.3 | 108.3 | 106.4 | 9.9 | 10.4 | 10.6 | 11.3 | 17.2 | 19.7 | 21.1 | 21.9 |
| Pickup truck | 21.2 | 25.9 | 25.9 | 28.8 | 9.4 | 9.4 | 10.0 | 11.1 | 13.5 | 15.3 | 15.8 | 16.3 |
| Mini van | c | 2.2 | 5.1 | 8.1 | c | 12.7 | 12.7 | 13.4 | c | 19.4 | 19.6 | 19.7 |
| Large van | 4.7 | 4.7 | 2.6 | 3.4 | 10.5 | 9.8 | 10.1 | 11.7 | 13.2 | 13.1 | 13.7 | 13.8 |
| Utility vehicle | 3.7 | 4.8 | 7.3 | 9.5 | 10.6 | 11.8 | 11.6 | 12.7 | 12.7 | 15.4 | 16.2 | 16.3 |
| Other ${ }^{\text {d }}$ | 1.1 | 0.7 | c | c | 6.0 | 4.9 | c | c | 9.6 | 8.3 | c | c |

## Source:

1985 and 1988 estimates are based on data provided on the following public use tapes: U.S. Department of Energy, Energy Information Administration, 1985 Residential Transportation Energy Consumption Survey, and 1988 Residential Transportation Energy Consumption Survey, Washington, DC, 1987 and 1990. 1991 estimates: U.S. Department of Energy, Energy Information Administration, Household Vehicles Energy Consumption 1991, Washington, DC, 1993, pp. 29, 46, 52.
1994 estimates: Personal Communication, U.S. Department of Energy, Energy Information Administration, Office of Markets and End Use, Energy End Use Division.
(Additional resources: http://www.eia.doe.gov)

[^47]As households owned more vehicles, the average annual miles for the most frequently driven vehick increased. For example, the most frequently driven vehicle in five-vehicle households was driven $9 \%$ more per year than the one in two-vehicle households (16,542 miles vs. 15,172 miles).

Table 4.5
Average Annual Miles per Vehicle by Household Vehicle Ownership, 1994 RTECS

| Vehicle $^{\text {a }}$ | One-vehicle <br> household | Two-vehicle <br> household | Three-vehicle <br> household | Four-vehicle <br> household | Five-vehicle <br> household |
| :---: | :---: | :---: | :---: | :---: | :---: |
| \#1 | 11,284 | 15,172 | 15,599 | 17,410 | 16,542 |
| $\# 2$ | - | 7,694 | 9,057 | 10,270 | 10,160 |
| $\# 3$ | - | - | 5,188 | 6,693 | 7,620 |
| $\# 4$ | - | - | - | 5,036 | 5,219 |
| \#5 | - | - | $\mathbf{1 1 , 3 2 9}$ | $\mathbf{1 1 , 7 2 8}$ | $\mathbf{1 1 , 1 4 4}$ |

## Source:

Generated from the Department of Energy, Energy Information Administration, 1994 Residential Transportation Energy Consumption Survey Public Use Files, Washington, DC, May 1997.
(Additional resources: http://www.eia.doe.gov)
Table 4.6
Average Age of Vehicles by Household Vehicle Ownership, 1994 RTECS

| Vehicle $^{\mathrm{a}}$ | One-vehicle <br> household | Two-vehicle <br> household | Three-vehicle <br> household | Four-vehicle <br> household | Five-vehicle <br> household |
| :---: | :---: | :---: | :---: | :---: | :---: |
| \#1 | 7.63 | 6.67 | 7.16 | 6.33 | 6.76 |
| $\# 2$ | - | 8.75 | 8.52 | 7.76 | 7.92 |
| \#3 | - | - | 10.80 | 10.61 | 10.68 |
| $\# 4$ | - | - | - | 11.68 | 15.86 |
| \#5 | - | - | - | - | 24.64 |
| Average | $\mathbf{7 . 6 3}$ | $\mathbf{7 . 5 5}$ | $\mathbf{8 . 2 9}$ | $\mathbf{8 . 1 5}$ | $\mathbf{9 . 2 9}$ |

## Source:

Generated from the Department of Energy, Energy Information Administration, 1994 Residential Transportation Energy Consumption Survey Public Use Files, Washington, DC, May 1997.
(Additional resources: http://www.eia.doe.gov)

[^48]Table 4.7
Distribution of Vehicles by Vehicle Age and Household Vehicle Ownership, 1994 RTECS

| Vehicle age | One-vehicle households | Two-vehicle households | Three-vehicle households | Four-vehicle households | Five-vehicle households | Total households |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Vehicle 1 |  |  |  |  |  |  |
| New | 1.45\% | 2.28\% | 0.76\% | 0.56\% | 0.14\% | 5.23\% |
| 2-5 | 5.81\% | 8.18\% | 3.97\% | 1.34\% | 0.56\% | 20.10\% |
| 6-10 | 7.02\% | 8.49\% | 4.06\% | 1.69\% | 0.44\% | 21.84\% |
| 11-15 | 2.54\% | 2.58\% | 1.46\% | 0.42\% | 0.12\% | 7.17\% |
| 16-20 | 1.20\% | 0.98\% | 0.57\% | 0.17\% | 0.14\% | 3.09\% |
| 21+ | 0.46\% | 0.35\% | 0.16\% | 0.03\% | 0.02\% | 1.05\% |
| Vehicle 2 |  |  |  |  |  |  |
| New |  | 1.11\% | 0.35\% | 0.25\% | 0.05\% | 1.84\% |
| 2-5 |  | 4.45\% | 2.88\% | 1.05\% | 0.26\% | 8.80\% |
| 6-10 |  | 6.29\% | 3.72\% | 1.79\% | 0.61\% | 12.46\% |
| 11-15 |  | 2.55\% | 1.59\% | 0.51\% | 0.19\% | 4.96\% |
| 16-20 |  | 1.28\% | 0.62\% | 0.20\% | 0.08\% | 2.19\% |
| 21+ |  | 1.02\% | 0.42\% | 0.10\% | 0.00\% | 1.60\% |
| Vehicle 3 |  |  |  |  |  |  |
| New |  |  | 0.13\% | 0.06\% | 0.02\% | 0.21\% |
| 2-5 |  |  | 1.06\% | 0.47\% | 0.21\% | 1.82\% |
| 6-10 |  |  | 1.00\% | 0.97\% | 0.34\% | 2.45\% |
| 11-15 |  |  | 0.85\% | 0.49\% | 0.10\% | 1.47\% |
| 16-20 |  |  | 0.66\% | 0.21\% | 0.14\% | 1.01\% |
| 21+ |  |  | 0.40\% | 0.26\% | 0.10\% | 0.85\% |
| Vehicle 4 |  |  |  |  |  |  |
| New |  |  |  | 0.02\% | 0.00\% | 0.02\% |
| 2-5 |  |  |  | 0.28\% | 0.02\% | 0.36\% |
| 6-10 |  |  |  | 0.14\% | 0.05\% | 0.29\% |
| 11-15 |  |  |  | 0.15\% | 0.23\% | 0.42\% |
| 16-20 |  |  |  | 0.12\% | 0.12\% | 0.30\% |
| 21+ |  |  |  | 0.15\% | 0.08\% | 0.27\% |
| Vehicle 5 |  |  |  |  |  |  |
| New |  |  |  |  | 0.00\% | 0.03\% |
| 6-10 |  |  |  |  | 0.02\% | 0.05\% |
| 11-15 |  |  |  |  | 0.00\% | 0.05\% |
| 21+ |  |  |  |  | 0.03\% | 0.07\% |
| Total | 18.47\% | 39.57\% | 24.65\% | 11.44\% | 4.07\% | 100.00\% |

## Source:

Generated from the Department of Energy, Energy Information Administration, 1994 Residential Transportation Energy Consumption Survey Public Use Files, Washington, DC, May 1997.
(Additional resources: http://www.eia.doe.gov)

Household vehicle ownership shows a dramatic increase from 1960 to 1990. In 1960, nearly $79 \% ~ g$ households owned less than two vehicles; by 1990, it declined to $45 \%$. Census data prior to 1990 indicated that the majority of households owned one vehicle; in 1990 that changed to two vehicles.

Table 4.8
Household Vehicle Ownership, 1960-90 Census
(percentage)

|  | No <br> vehicles | One <br> vehicle | Two <br> vehicles | Three or <br> more <br> vehicles | Total <br> vehicles |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1960 | $21.53 \%$ | $56.94 \%$ | $19.00 \%$ | $2.53 \%$ | $54,766,718$ |
| 1970 | $17.47 \%$ | $47.71 \%$ | $29.32 \%$ | $5.51 \%$ | $79,002,052$ |
| 1980 | $12.92 \%$ | $35.53 \%$ | $34.02 \%$ | $17.52 \%$ | $129,747,911$ |
| 1990 | $11.53 \%$ | $33.74 \%$ | $37.35 \%$ | $17.33 \%$ | $152,380,479$ |

## Source:

U. S. Department of Transportation, Volpe National Transportation Systems Center, Journey-to-Work Trends in the United States and its Major Metropolitan Area, 1960-1990, Cambridge, MA, 1994, p. 2-2. (Additional resources: http://www.census.gov)
${ }^{a}$ Compiled by the Census Bureau, these data on the total number of vehicles do not match the figures on Table 4.1. The figures on Table 4.1, from R.L. Polk and Company, are the preferred data.
"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." ${ }^{\text {a }}$

Table 4.9
Average Annual Vehicle-Miles, Vehicle Trips and Trip Length
Per Household for Selected Trip Purposes $1969,1977,1983$, and 1990 NPTS

| Trip purpose | 1969 | 1977 | 1983 | 1990 | Percent change 69-90 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Average annual vehicle-miles per household |  |  |  |  |  |
| 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\% |
| All ${ }^{\text {b }}$ | 12,423 | 12,036 | 11,739 | 15,100 | 22\% |
| Average annual vehicle trips per household |  |  |  |  |  |
| 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\% |
| All ${ }^{\text {b }}$ | 1,396 | 1,442 | 1,486 | 1,702 | 22\% |
| Average vehicle trip length (miles) |  |  |  |  |  |
| Home to work | 9.4 | 9.1 | 8.5 | 11 | 17\% |
| Shopping | 4.4 | 5 | 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\% |
| All ${ }^{\text {b }}$ | 8.9 | 8.4 | 7.9 | 9.0 | 1\% |

## Source:

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary of Travel Trends, FHWA-PL-92-027, Washington, DC, March 1992, Table 7.
(Additional resources: http://www.fhwa.dot.gov)
${ }^{\text {a }}$ Reference source document, p. 18.
${ }^{\mathrm{b}}$ Includes trip purposes not shown above.

Figure 4.1. Average Vehicle Occupancy by Vehicle Type, 1990 NPTS


## Source:

U.S. Department of Transportation, Federal Highway Administration, Nationwide Personal Transportation Survey, 1990 NPTS Databook, Volume II, FHWA-PL-94-010B, Washington, DC, November 1994, p. 7-6.
(Additional resources: http://www.fhwa.dot.gov)

The average vehicle occupancy, calculated as person-miles per vehicle-mile, was at its lowest level since 1977 for every trip uppose.
The increased number of vehicles per household and the decrease in average household size could have contributed to the decline.

Figure 4.2. Average Vehicle Occupancy by Trip Purpose 1977, 1983, and 1990 NPTS


## Source:

U.S. Department of Transportation, Federal Highway Administration, 1990 Nationwide Personal Transportation Survey: Summary o Travel Trends, FHWA-PL-92-027, Washington, DC, March 1992, Figure 6. (Additional resources: http://www.fhwa.dot.gov)

According to the U.S. Census data, the percentage of workers who car pooled has dropped from $19.7 \%$ in 1980 to $13.4 \%$ in 1990. The percent of workers using public transitdeclined 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 4.10
Means of Transportation to Work, 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\% |
| Car pooled | 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 ${ }^{\text {a }}$ | 3,924,787 | 4.1\% | 3,445,000 | 3.0\% |
| Streetcar or trolley car ${ }^{\text {a }}$ | b | b | 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 | b | b | 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. (Additional resources: http://www.census.gov)
${ }^{\text {a }}$ This category was "Bus or streetcar" in 1980.
${ }^{\mathrm{b}}$ Data are not available.

Table 4.11
National and Metropolitan Area Comparisons of Journey-to-Work Statistics, 1990 Census

|  | National | Metropolitan areas $^{\text {a }}$ |
| :--- | :---: | :---: |
| Workers per household | 1.25 | 1.31 |
| Workers per vehicle | 0.76 | 0.82 |
| Average travel time (minutes) | 22.38 | 25.20 |
| Commute length (percentage) |  |  |
| Less than 15 minutes | $15.87 \%$ | $11.45 \%$ |
| 15-29 minutes | $51.64 \%$ | $49.22 \%$ |
| 30-39 minutes | $14.66 \%$ | $17.48 \%$ |
| $40-59$ minutes | $9.01 \%$ | $11.77 \%$ |
| 60 minutes or more | $5.86 \%$ | $7.52 \%$ |
| Mode (percentage) | $73.19 \%$ |  |
| Drive alone | $13.36 \%$ | $70.75 \%$ |
| Percentage car pooled | $5.27 \%$ | $12.69 \%$ |
| Public transit | $0.21 \%$ | $8.98 \%$ |
| Motorcycle | $3.90 \%$ | $0.21 \%$ |
| Walk | $0.41 \%$ | $3.76 \%$ |
| Bicycle | $0.70 \%$ | $0.43 \%$ |
| Other | $2.96 \%$ | $0.62 \%$ |
| Work at home | $41.87 \%$ | $2.57 \%$ |
| Time workers leave home (percentage) | $10.28 \%$ | $42.49 \%$ |
| 5:00 AM-6.59 AM |  | $11.57 \%$ |
| $7: 00$ AM-8:29 AM |  |  |
| 8:30 AM-9:59 AM |  |  |
| All other departures |  |  |

## Source:

U. S. Department of Transportation, Volpe National Transportation Systems Center, Journey-to-Work Trends in theUnited States and its Major Metropolitan Area, 1960-1990, FHWA-PL-94-012, Cambridge, MA, 1994, p. 2-6. (Additional resources: http://www.census.gov)
${ }^{a}$ Metropolitan areas over 1 million population. There were 39 such areas in the 1990 Census.

## CHAPTER 5

## ALTERNATIVE FUELS STATISTICS

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Fuel type abbreviations are used throughout this chapter. $\quad L P G=$ liquified petroleum gas $C N G=$ compressed natural gas. $M-85=85 \%$ methanol, $15 \%$ gasoline. $E-85=85 \%$ ethanol, $15 \%$ gasoline. $\quad M-100=100 \%$ methanol. $E-95=95 \%$ ethanol, $5 \%$ gasoline. $L N G=$ liquified natural gas.

## THE ALTERNATIVE FUELS DATA CENTER

The Department of Energy (DOE) has established the Alternative Fuels Data Cente r (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 Energ y 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 institu tions, and other interested organizations.

The data are collected for three specific vehicle types: (1) light-duty vehicles, includin $g$ automobiles, light trucks, and mini-vans; (2) heavy-duty vehicles such as tractor-trailers an d 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. Several tables and graphs in this chapter 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 intereste d organizations in improving their understanding of alternative transportation fuels. Th e Hotline can be reached by dialing $\mathbf{1 - 8 0 0 - 4 2 3 - 1 D O E}$, or on the Internet at http://www.afdc.nrel.gov.

Table 5.1
Estimates of Light-Duty Alternative Fuel Vehicles, 1993, 1995, and 1997

| Fuel type | Private |  |  | State and local government |  |  | Federal Government |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1993 | 1995 | 1997 | 1993 | 1995 | 1997 | 1993 | 1995 | 1997 |
| LPG | 173,000 | 166,000 | 174,000 | 43,000 | 42,000 | 44,000 | 32 | 139 | 256 |
| CNG | 16,932 | 22,950 | 30,950 | 8,692 | 10,670 | 17,134 | 3,090 | 9,432 | 22,278 |
| LNG | 2 | 49 | 48 | 29 | 47 | 49 | 0 | 47 | 64 |
| M-85 | 2,737 | 5,198 | 7,766 | 1,900 | 3,569 | 5,427 | 5,518 | 9,552 | 6,594 |
| M-100 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| E-85 | 52 | 54 | 109 | 273 | 1,084 | 2,164 | 114 | 389 | 3,586 |
| E-95 | 4 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Electricity | 1,657 | 2,400 | 2,966 | 14 | 160 | 257 | 0 | 191 | 519 |
| Total | 194,384 | 196,652 | 215,840 | 53,909 | 57,530 | 69,032 | 8,754 | 19,750 | 33,297 |

## Source:

U. S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels, 1995,

Washington, DC, December 1996, pp. 17-18.
(Additional resources: http://www.eia.doe.gov)

Table 5.2
Estimates of Heavy-Duty Alternative Fuel Vehicles, 1993, 1995, and 1997

| Fuel type | Private |  |  | State and local government |  |  | Federal government |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1993 | 1995 | 1997 | 1993 | 1995 | 1997 | 1993 | 1995 | 1997 |
| LPG | 43,000 | 41,000 | 44,000 | 10,000 | 10,000 | 11,000 | 0 | 2 | 2 |
| CNG | 1,719 | 3,981 | 6,001 | 2,281 | 3,185 | 5,384 | 0 | 0 | 0 |
| LNG | 3 | 34 | 61 | 265 | 426 | 727 | 0 | 0 | 6 |
| M85 | 0 | 0 | 0 | 108 | 0 | 0 | 0 | 0 | 0 |
| M100 | 2 | 0 | 0 | 412 | 386 | 129 | 0 | 0 | 0 |
| E85 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| E95 | 4 | 1 | 1 | 18 | 134 | 339 | 0 | 0 | 0 |
| Electricity | 0 | 26 | 28 | 19 | 83 | 155 | 0 | 0 | 0 |
| Total | 44,728 | 45,042 | 50,091 | 13,105 | 14,214 | 17,734 | 0 | 2 | 8 |

## Source:

U. S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation

Fuels,1995, Washington, DC, December 1996, pp. 17-18.
(Additional resources: http://www.eia.doe.gov)

The Energy Policy Act of 1992 (EPACT) set alternative fuel vehicle purchase requirements for Federal and State Governments, fuel providers and the private sector. Additional rule making has adjusted the original purchase requirements. State government and fuel providers requirements begin in 1997.

Table 5.3
Energy Policy Act Purchase Requirements of Light-Duty Alternative Fuel Vehicles

| Year | Federal | State | Fuel <br> providers | Private $^{\text {a }}$ |
| :--- | :---: | :---: | :---: | :---: |
| 1993 | 5,000 | - | - | - |
| 1994 | 7,500 | - | - | - |
| 1995 | 10,000 | - | - | - |
| 1996 | $25 \%$ | - | - | - |
| 1997 | $33 \%$ | $10 \%$ | $30 \%$ | - |
| 1998 | $50 \%$ | $15 \%$ | $50 \%$ | - |
| 1999 | $75 \%$ | $25 \%$ | $70 \%$ | - |
| 2000 | $75 \%$ | $50 \%$ | $90 \%$ | - |
| 2001 | $75 \%$ | $75 \%$ | $90 \%$ | - |
| 2002 | $75 \%$ | $75 \%$ | $90 \%$ | $20 \%$ |
| 2003 | $75 \%$ | $75 \%$ | $90 \%$ | $40 \%$ |
| 2004 | $75 \%$ | $75 \%$ | $90 \%$ | $60 \%$ |
| 2005 | $75 \%$ | $75 \%$ | $90 \%$ | $70 \%$ |
| $2006-$ on | $75 \%$ | $75 \%$ | $90 \%$ | $70 \%$ |

## Source:

Final rule for the alternative fuels transportation programs, Federal Register, Vol. 61, p. 10622, March 14, 1996.
Private alternative fueled vehicle acquisition requirements for private and local government fleets, Federal Register, vol. 62, p. 19701, April 23, 1997.
${ }^{\text {a }}$ Additional rule making is required by January 1, 2000, for private AFV requirements to take effect.

Table 5.4
Fleet Vehicles Operated by Propane, Electricity, and Natural Gas Providers, 1993

|  | Passenger cars | Light trucks | Medium/ heavy-duty truck | Total |
| :---: | :---: | :---: | :---: | :---: |
|  | Propane providers |  |  |  |
| Conventional fuel vehicles | 2,080 | 10,771 | 27,640 | 43,699 |
| Gasoline | 2,080 | 9,060 | 9,941 | 24,288 |
| Diesel | 0 | 0 | 17,700 | 19,412 |
| Alternative fuel vehicles | 237 | 11,082 | 26,540 | 38,267 |
| Propane-dedicated | 130 | 8,162 | 25,102 | 33,800 |
| Propane-multifuel | 80 | 2,847 | 1,434 | 4,374 |
| Total | 2,251 | 22,359 | 54,274 | 81,967 |
| Electric utility providers |  |  |  |  |
| Conventional fuel vehicles | 37,802 | 88,940 | 69,499 | 196,241 |
| Gasoline | 37,775 | 84,708 | 32,587 | 155,070 |
| Diesel | 27 | 4,232 | 36,912 | 41,171 |
| Alternative fuel vehicles | 641 | 4,005 | 949 | 5,595 |
| CNG-dedicated | 7 | 788 | 26 | 821 |
| CNG-multifuel | 341 | 2,193 | 401 | 2,935 |
| Propane-dedicated | 1 | 170 | 318 | 489 |
| Propane-multifuel | 1 | 149 | 19 | 169 |
| Methanol/ethanol blends-dedicated | 84 | 317 | 122 | 523 |
| Methanol/ethanol blends-multifuel | 140 | 246 | 26 | 412 |
| Electricity-dedicated | 67 | 134 | 36 | 237 |
| Electricity-multifuel | 0 | 0 | 0 | 0 |
| Other alternative fuels-dedicated | 0 | 8 | 1 | 9 |
| Other alternative fuels-multifuel | 0 | 0 | 0 | 0 |
| Total | 38,443 | 92,945 | 70,448 | 201,836 |
| Natural gas providers |  |  |  |  |
| Conventional fuel vehicles | 25,694 | 62,510 | 5,731 | 34,072 |
| Gasoline | 25,674 | 60,738 | 5,440 | 18,022 |
| Diesel | 20 | 1,772 | 291 | 16,050 |
| Alternative fuel vehicles | 1,711 | 11,929 | 638 | 2,408 |
| CNG-dedicated | 57 | 2,070 | 31 | 96 |
| CNG-multifuel | 1,614 | 8,630 | 602 | 1,565 |
| Propane-dedicated | 23 | 391 | 3 | 591 |
| Propane-multifuel | 8 | 802 | 2 | 138 |
| Electricity-dedicated | 8 | 28 | 0 | 1 |
| Electricity-multifuel | 0 | 0 | 0 | 0 |
| Other alternative fuels-dedicated | 1 | 8 | 0 | 17 |
| Other alternative fuels-multifuel | 0 | 0 | 0 | 0 |
| Total | 27,405 | 74,439 | 6,369 | 36,480 |

## Source:

Energy Information Administration, Office of Energy Markets and End Use, Describing Current and Potential Markets for Alternative-Fuel Vehicles, DOE/EIA-604, Washington, DC, 1996.
(Additional resources: http://www.eia.gov)

## Note:

"Multifuel" refers to all AFV's capable of operating on more than one fuel (i.e., bi-fuel, flex-fuel, hybrid, and dual-fuel vehicles).

These data, collected as a result of the Natural Gas Suppliers Fleet Survey (EIA-176 Schedule B), indicate that over $90 \%$ of the flee vehicles travel less than 100 miles each day.

Table 5.5
Natural Gas Supplier Fleet Daily Vehicle-Miles Traveled Range, 1993
(number of vehicles)

| Daily miles traveled | Passenger cars |  |  | Light-duty vans/trucks ( $\leq 8,500 \mathrm{lbs}$. GVW) |  |  |  |  | Medium/ heavyduty trucks |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Subcompact/ compact | Mid-size | Large | Minivan | Full-size <br> van | Small pickup | Large pickup | Sport/ utility |  | Total |
| 0 to 50 | 56.1\% | 48.4\% | 34.5\% | 51.9\% | 48.5\% | 54.0\% | 40.8\% | 57.7\% | $72.1 \%$ | 54.3\% |
| 51 to 100 | 42.1\% | 44.7\% | 41.9\% | 39.5\% | 45.6\% | 40.4\% | 42.7\% | $32.9 \%$ | 23.5\% | 37.2\% |
| 101 to 150 | 1.5\% | 5.3\% | 12.8\% | 6.1\% | 4.9\% | 3.7\% | 10.6\% | 7.2\% | 3.0\% | 5.7\% |
| 151 to 200 | 0.2\% | 0.8\% | 2.3\% | 2.3\% | 0.8\% | 1.6\% | 3.4\% | 1.6\% | 0.8\% | 1.6\% |
| 201 to 300 | 0.1\% | 0.7\% | 7.8\% | 0.1\% | 0.2\% | 0.2\% | 1.7\% | 0.5\% | 0.2\% | 0.8\% |
| More than 300 | 0.0\% | 0.1\% | 0.8\% | 0.1\% | 0.0\% | 0.0\% | 0.8\% | 0.1\% | 0.4\% | 0.3\% |
| Total vehicles | 11,001 | 12,417 | 3,987 | 5,636 | 15,416 | 15,527 | 31,491 | 6,369 | 36,480 | 138,324 |

## Source:

Energy Information Administration, Office of Energy Markets and End Use, Describing Current and Potential Markets for Alternative-Fuel Vehicles, DOE/EIA-604, Washington, DC, 1996.
(Additional resources: http://www.eia.doe.gov)
"Section 501 of the Energy Policy Act mandates that certain percentages of new light-duty vehicles acquired by alternative fuel providers be alternative fuel vehicles (AFV). The first step in estimating the effects of these mandates entails identifying affected fleets that are covered by the Act. This assessment concludes that a limited number of companies in the methanol, ethanol propane, and hydrogen industries are likely to be covered by thismandate. On the other hand, many of the large crude oilproducers, petroleum refiners, natural gas producers and transporters and natural gas and electric utilities are likely to be subject to this mandate."

Table 5.6
Summary of EPACT Section 501 Coverage by Industry, 1994
\(\left.$$
\begin{array}{lccc}\hline & \begin{array}{c}\text { Percentage of } \\
\text { companies likely to } \\
\text { be "covered" }\end{array} & \begin{array}{c}\text { Estimated number of } \\
\text { light-duty vehicles } \\
\text { "covered" }\end{array} & \begin{array}{c}\text { Current AFV } \\
\text { percentage of total } \\
\text { "covered" } \\
\text { Fuel }\end{array}
$$ <br>

\hline Methanol-duty vehicles\end{array}\right]\)| Ethanol | $10 \%$ | 60 | $0 \%$ |
| :--- | :---: | :---: | :---: |
| Natural gas | $0 \%$ | 0 | $0 \%$ |
| Propane $^{\text {b }}$ | $23 \%$ | $73,000^{\mathrm{a}}$ | $20 \%$ |
| Electricity $^{\text {Petroleum }}$ c | $8 \%$ | 420 | $78 \%$ |
| Hydrogen | $5 \%$ | 59,000 | $2 \%$ |

## Source:

P. Hu, M. Wang, A. Vyas, M. Mintz, and S. Davis, Transportation Research Record No. 1520, Washington, DC, 1996, p. 155.
${ }^{\text {a }}$ Among these vehicles, 30,000 are owned/operated by gas-only companies, 33,000 by dual utilities and 10,000 by gas producers and transporters.
'Of the top 35 propane providers only.
'Those with production capability of at least 50,000 barrels per day.

## U.S. ADVANCED BATTERY CONSORTIUM

Electric and hybrid-electric vehicles are the subject of intense research and development because they are required to be sold in California ( $10 \%$ in 2003) under the California Low-Emission Vehicle (LEV) program. Other states, such as New York and Massachusetts, have indicated that they will also enforce the LEV program. One of the greatest advantages in using electric vehicles is that there are no tailpipe 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, and the U.S. Department of Energy. Five major U.S. electric utilities are also direct participants in USABC.

The USABC has established research contracts with several companies for the development of advanced batteries. Also, a series of Cooperative Research and Development Agreements (CRADAs) with several DOE National Laboratories have been established.

Table 5.7
U.S. Advanced Battery Consortium Research Agreements, Phase II

| Research contracts |  |
| :--- | :--- |
| General Motors-Ovonic Joint Venture | Cost reduction program for nickel-metal hydride <br> battery and testing of nickel-metal hydride pilot <br> production modules |
| SAFT | Cost reduction program for nickel-metal hydride <br> battery |
| 3M Hydro-Quebec | Phase II development of lithium-polymer battery |
| CRADAs for advanced battery testing |  |
| Argonne National Laboratory, Argonne, IL |  |
| Sandia National Laboratory, Albuquerque, NM |  |

## Source:

U.S. Advanced Battery Consortium, April 1997.

Today's lead acid batteries provide 30-40 watt hours per kilogram, cost between \$50-150 per kilowatt hour, and have a two- to three-year lifetime. However, the batteries currently used in electric vehicles do not provide the energy or performance sufficient to make these vehicles competitive with gasoline fueled vehicles. When attained, the mid-term Advanced BatteryTechnology goals will effectively double the range and performance of electric vehicles compared to the range and performance possible wih today's battery technology.

Table 5.8
Advanced Battery Technology Goals of the U.S. Advanced Battery Consortium

|  | Mid-term goal (1995-1998) | Long-term goal ${ }^{\text {a }}$ |
| :---: | :---: | :---: |
| Power density W/L | 250 | 600 |
| Specific power (charge) W/kg ( $80 \%$ DoD/30 sec) | 150-200 | 400 |
| Specific power (recharge) W/kg ( $20 \% \mathrm{DoD} / 10 \mathrm{sec}$ ) | 75 |  |
| Energy density Wh/L (C/3 discharge rate) | 135 | 300 |
| Specific energy Wh/kg (C/3 discharge rate) | 80-100 | 200 |
| Power/energy ratio | 1.5-2.5 |  |
| Life (years) | 5 | 10 |
| Cycle life (cycles) <br> ( $80 \%$ DoD) | 600 | 1000 |
| Power and capacity degradation (\% of rated spec) | 20\% | 20\% |
| Ultimate price ( $\$ / \mathrm{kWh}$ ) (10,000 units @ 40 kWh ) | <\$150 | <\$100 |
| Operating environment | -30 to $65^{\circ} \mathrm{C}$ | -40 to $85^{\circ} \mathrm{C}$ |
| Normal recharge time | $<6$ hours | 3 to 6 hours |
| Fast recharge time | $50 \%$ of capacity in $<30$ minutes |  |
| Continuous discharge in 1 hour (no failure) energy | $\begin{aligned} & 75 \% \\ & \text { (of rated energy capacity) } \end{aligned}$ | $\begin{aligned} & 75 \% \\ & \text { (of rated capacity) } \end{aligned}$ |

## Source:

U.S. Department of Energy, Office of Transportation Technologies, Washington, DC, 1995.

## Note:

w=watt; kg=kilogram; L=liter; DoD=depth of discharge; wh=watt-hour; kwh=kilowatt-hour.
${ }^{\text {a }}$ Competitive with today's internal combustion engine vehicles.

Table 5.9
Alternative Fuel Vehicles Available by Manufacturer

| Manufacturer | Model | Body style | Fuel | Emission class |
| :---: | :---: | :---: | :---: | :---: |
| 1997 model year |  |  |  |  |
| Chrysler | EPIC | Minivan | Electric-lead acid | ZEV |
| Ford | Contour (QMV) | Compact sedan | CNG/gasoline bi-fuel | Gasoline equivalent |
| Ford | Crown Victoria | Full-size sedan | CNG | ULEV |
| Ford | Econoline | Full-size van | CNG | SULEV |
| Ford | F-Series | Light-duty truck | CNG | SULEV |
| Ford | F700 | Mid-duty truck | LPG | California gasoline equivalent |
| Ford | Ranger | Light-duty truck | Electric-lead acid | ZEV |
| Ford | Taurus | Mid-size sedan | M85/gasoline or E85/gasoline | TLEV |
| GM | EV1 | Sedan/two seater | Electric-lead acid | ZEV (target) |
| Chevrolet | S-10 | Light-duty truck | Electric-lead acid | California ZEV |
| Honda | EV | Sedan | Electric-nickel metal hydride | ZEV |
| GMC | Sierra 2500 | mid-duty truck | CNG/gasoline bi-fuel | LEV |
| 1998 model year |  |  |  |  |
| GMC | Sierra 2500 | Light-duty pickup | CNG/gasoline bi-fuel | California LEV (target) |
| Chevrolet | C 2500 | Light-duty pickup | CNG/gasoline bi-fuel | California LEV (target) |
| Honda | Civic GX | Compact sedan | CNG | California ULEV, <br> Federal ILEV |
| Nissan | Prairie EV | Minivan | Electric-lithium ion | ZEV |
| Toyota | RAV4-EV | Sports utility vehicle | Electric-lead acid/nickel metal hydride | ZEV |
| Chrysler | Minivan | Minivan | Ethanol | To be determined |
| Model year to be determined |  |  |  |  |
| Mazda | 626 Wagon | Mid-size wagon | Hydrogen | ULEV |
| Mazda | Miata MX-5 | Sedan/two seater | Electric-nickel cadmium | ZEV |
| Volvo | Volvo | Station wagon | CNG/gasoline bi-fuel | ULEV |
| Mazda | Titan | Light-duty truck | CNG | Gasoline-equivalent |

## Source:

U.S. Department of Energy, Light-Duty Vehicle Resource Guide, Washington, DC, March 31, 1997. (Additional resources: http://www.afdc.nrel.gov)

## Note:

LEV=low emission vehicle. ILEV=inherently low emission vehicle. ULEV=ultra low emission vehicle.
ZEV=zero emission vehicle. TLEV=transitional low emission vehicle. SULEV=super ultra low emission vehicle.

The Alternative Fuels Data Center collects data on alternative fuel vehicks around the country. The wide ranges of variability in fuel economy can be attributed in part to the variability $\dot{n}$ driving cycles and driving styles.

Table 5.10
Alternative Fuel Vehicle Fuel Economies
by Vehicle Type

| Vehicle model | Fuel type ${ }^{\text {a }}$ | Model years | Gasoline equivalent (GE) MPG ${ }^{\text {b }}$ | In-use GE MPG |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Low | High |
| Chevrolet Pickup | CNG | 1992 | 12.0 | 7 | 14 |
|  | Gasoline | 1993 | 14.0 | 10 | 16 |
| Chevrolet Lumina | E85 | 1992, 1993 | 20.2 | 9 | 29 |
|  | M85 | 1993 | 19.5 | 14 | 30 |
|  | Gasoline | 1993 | 19.1 | 14 | 28 |
| Dodge Caravan | CNG | 1994 |  | 8 | 13 |
| Dodge Ram Van | CNG | 1992, 1994 | 12.5 | 8 | 15 |
|  | Gasoline | 1992, 1994 | 13.5 | 6 | 17 |
| Dodge Spirit | M85 | 1993, 1994 | 22.3 | 15 | 31 |
|  | Gasoline | 1993 | 24.0 | 21 | 32 |
| Dodge Intrepid | M85 | 1995 | 21.6 | c | c |
|  | Gasoline | 1995 | 20.1 | c | c |
| Ford Econoline ${ }^{\text {d }}$ | M85 | 1992, 1993 | 13.9 | 8 | 19 |
|  | Gasoline | 1993 | 15.0 | 9 | 18 |
| Ford Taurus | E85 | 1994 | 22.0 | 11 | 28 |
|  | M85 | 1993 | 20.7 | 18 | 31 |
|  | Gasoline | 1993 | 21.4 | 21 | 34 |
| Ford Taurus | M85 | 1995 | 22.2 | c | c |
|  | E85 | 1995 | 22.0 | c | c |
|  | Gasoline | 1995 | 22.5 | c | c |

## Source:

National Renewable Energy Laboratory, Alternative Fuels Data Center, April 1997.
Note: All alternative fuel values are in gasoline equivalent miles per gallon.

[^49]This list includes public and private refuel sites; therefore, not all of these sites are available to the public.

Table 5.11
Number of Alternative Refuel Sites by State and Fuel Type, 1997

| State | $\begin{aligned} & \text { M85 } \\ & \text { sites } \end{aligned}$ | CNG sites | $\begin{aligned} & \text { E85 } \\ & \text { sites } \end{aligned}$ | $\begin{aligned} & \text { LPG } \\ & \text { sites } \end{aligned}$ | LNG sites | Electric sites | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Alabama | 0 | 17 | 0 | 114 | 2 | 0 | 133 |
| Alaska | 0 | 0 | 0 | 9 | 0 | 0 | 9 |
| Arizona | 1 | 31 | 0 | 71 | 3 | 10 | 19 |
| Arkansas | 0 | 7 | 0 | 156 | 0 | 0 | 164 |
| California | 66 | 200 | 0 | 219 | 18 | 103 | 612 |
| Colorado | 2 | 45 | 1 | 48 | 3 | 0 | 99 |
| Connecticut | 0 | 22 | 0 | 18 | 0 | 1 | 40 |
| Delaware | 0 | 6 | 0 | 6 | 0 | 0 | 14 |
| District of Columbia | 1 | 8 | 1 | 0 | 0 | 1 | 10 |
| Florida | 3 | 60 | 0 | 222 | 0 | 4 | 285 |
| Georgia | 1 | 89 | 0 | 80 | 3 | 2 | 174 |
| Hawaii | 0 | 0 | 0 | 0 | 0 | 3 | 3 |
| Idaho | 0 | 7 | 0 | 20 | 1 | 1 | 28 |
| Illinois | 2 | 24 | 14 | 163 | 0 | 2 | 203 |
| Indiana | 0 | 47 | 2 | 125 | 4 | 1 | 178 |
| Iowa | 0 | 5 | 10 | 107 | 0 | 1 | 122 |
| Kansas | 0 | 18 | 2 | 38 | 1 | 0 | 64 |
| Kentucky | 0 | 13 | 3 | 35 | 0 | 0 | 51 |
| Louisiana | 0 | 21 | 0 | 44 | 2 | 0 | 68 |
| Maine | 0 | 0 | 0 | 12 | 0 | 0 | 12 |
| Maryland | 2 | 31 | 0 | 21 | 3 | 3 | 58 |
| Massachusetts | 0 | 18 | 0 | 42 | 0 | 4 | 60 |
| Michigan | 2 | 39 | 1 | 182 | 2 | 10 | 226 |
| Minnesota | 0 | 17 | 11 | 125 | 2 | 0 | 149 |
| Mississippi | 0 | 3 | 0 | 75 | 0 | 0 | 78 |
| Missouri | 0 | 11 | 3 | 83 | 0 | 0 | 97 |
| Montana | 0 | 13 | 0 | 48 | 1 | 0 | 62 |
| Nebraska | 0 | 11 | 6 | 47 | 1 | 0 | 66 |
| Nevada | 0 | 11 | 0 | 20 | 0 | 0 | 31 |
| New Hampshire | 0 | 1 | 0 | 31 | 0 | 1 | 32 |
| New Jersey | 0 | 24 | 0 | 37 | 0 | 0 | 62 |
| New Mexico | 0 | 18 | 0 | 46 | 1 | 0 | 65 |
| New York | 7 | 59 | 0 | 100 | 0 | 5 | 166 |
| N. Carolina | 0 | 11 | 0 | 72 | 0 | 1 | 83 |
| N. Dakota | 0 | 5 | 1 | 17 | 0 | 0 | 23 |
| Ohio | 2 | 70 | 0 | 98 | 1 | 1 | 171 |
| Oklahoma | 0 | 56 | 0 | 56 | 0 | 0 | 111 |
| Oregon | 0 | 9 | 0 | 21 | 1 | 0 | 31 |
| Pennsylvania | 1 | 61 | 0 | 141 | 1 | 1 | 195 |
| Rhode Island | 0 | 3 | 0 | 6 | 0 | 0 | 8 |
| S. Carolina | 0 | 3 | 0 | 67 | 0 | 1 | 47 |
| S. Dakota | 0 | 5 | 10 | 30 | 0 | 0 | 39 |
| Tennessee | 2 | 7 | 0 | 95 | 0 | 1 | 89 |
| Texas | 0 | 92 | 0 | 864 | 15 | 2 | 313 |
| Utah | 0 | 67 | 0 | 23 | 1 | 0 | 91 |
| Vermont | 0 | 1 | 0 | 40 | 0 | 9 | 34 |
| Virginia | 0 | 30 | 0 | 51 | 3 | 19 | 72 |
| Washington | 2 | 32 | 0 | 69 | 1 | 6 | 72 |
| W. Virginia | 1 | 42 | 0 | 21 | 0 | 1 | 59 |
| Wisconsin | 0 | 29 | 3 | 190 | 0 | 0 | 171 |
| Wyoming | 0 | 19 | 0 | 47 | 2 | 0 | 54 |
| Total | 95 | 1,418 | 68 | 4,252 | 72 | 194 | 5,200 |

Source:
U.S. Department of Energy's Alternative Fuels Data Center web site, http://www.afdc.nrel.gov/newrefuel/state_tot.cgi and the

Electric Vehicle Association of the Americas web site, http://www.evaa.org/events_info/evdirectory.html, July 1997.

Table 5.12
U.S. Production of MTBE ${ }^{\text {a }}$ and Fuel Ethanol, 1978-96 (million gallons)

| Year | Fuel ethanol | MTBE $^{\mathrm{a}}$ |
| :---: | :---: | :---: |
| 1978 | 20 | b |
| 1979 | 40 | b |
| 1980 | 80 | b |
| 1981 | 85 | 122 |
| 1982 | 234 | 132 |
| 1983 | 443 | 134 |
| 1984 | 567 | 235 |
| 1985 | 793 | 302 |
| 1986 | 798 | 359 |
| 1987 | 825 | b |
| 1988 | 800 | b |
| 1989 | 750 | b |
| 1990 | 756 | b |
| 1991 | 875 | b |
| 1992 | 1,080 | 1,542 |
| 1993 | 1,156 | 2,081 |
| 1994 | 1,280 | 2,205 |
| 1995 | 1,355 | 2,506 |
| 1996 | 974 | 2,846 |
| Average annual percentage change |  |  |
| $1978-96$ | $24.1 \%$ | b |
| $1986-96$ | $2.0 \%$ | $23.0 \%$ |
|  |  |  |

## Source:

1992-96 Ethanol and MTBE - U.S. Department of Energy,
Energy Information Administration, Petroleum
Supply Monthly, January 1996, Table D1.
1978-90 Ethanol - Information Resources, Inc., Washington, DC, 1991.
1981-86 MTBE - EA-Mueller,Inc., Baltimore, MD, 1992.

[^50]Table 5.13
Alternative Vehicle Fuel Consumption 1992-96
(thousand gasoline equivalent gallons)

| Alternative fuel | 1992 | 1993 | 1994 | 1995 | 1996 |
| :--- | ---: | ---: | ---: | ---: | ---: |
| Liquified petroleum gas | 208,142 | 264,655 | 248,467 | 232,701 | 238,681 |
| Compressed natural gas | 16,823 | 21,603 | 24,160 | 35,162 | 50,884 |
| Liquified natural gas | 585 | 1,900 | 2,345 | 2,759 | 3,233 |
| M85 ${ }^{\text {a }}$ (85\% methanol, 15\% gasoline) | 1,069 | 1,593 | 2,340 | 3,575 | 3,832 |
| M100 | 2,547 | 3,166 | 3,190 | 2,150 | 360 |
| E85 ${ }^{\text {a (85\% ethanol, 15\% gasoline) }}$ | 21 | 48 | 80 | 190 | 436 |
| E95 (85\% ethanol, 5\% gasoline) | 85 | 80 | 140 | 709 | 1,803 |
| Electricity | 359 | 288 | 430 | 663 | 815 |
| Total | $\mathbf{2 2 9 , 6 3 1}$ | $\mathbf{2 9 3 , 3 3 4}$ | $\mathbf{2 8 1 , 1 5 2}$ | $\mathbf{2 7 7 , 9 0 9}$ | $\mathbf{3 0 0 , 0 4 4}$ |

## Source:

U.S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels, 1995,

Washington, DC, December 1996, p. 20.
(Additional resources: http://www.eia.doe.gov)

[^51]Table 5.14
Gasohol Consumption by Reporting States, 1980-95
(thousands of gallons)

${ }^{a}$ The data reflect gallons of gasohol reported by the distributors in each of the selected states. Blanks indicate data were not reported for the state that year.

The prices of CNG and unleaded gasoline vary from place to place. A comparisonof fuel prices by "Natural Gas Fuels" in January 1997 showed that CNG is less expensive than unleaded gasoline, as much as $53 \%$ less in Salt Lake City, UT.

Table 5.15
Comparison of Station Prices: Compressed Natural Gas and Regular Unleaded Gasoline, January 1997

| Region | Station | CNG | Unleaded gasoline | Percentage CNG to gasoline |
| :---: | :---: | :---: | :---: | :---: |
| Dollars per gallon or equivalent gallon |  |  |  |  |
| 1 | Amoco/Minneapolis, MN | \$0.899 | \$1.279 | 70.3\% |
|  | Exxon/Billings, MT | \$0.829 | \$1.399 | 59.3\% |
| 2 | Unocal Vista, CA | \$0.999 | \$1.239 | 80.6\% |
|  | Total/Denver, CO | \$0.849 | \$1.379 | 61.6\% |
|  | Sinclair/Salt Lake City, UT | \$0.577 | \$1.239 | 46.6\% |
| 3 | Mobil/Garland, TX | \$0.799 | \$1.179 | 67.8\% |
|  | Shell/Houston, TX | \$0.899 | \$1.189 | 75.6\% |
|  | Chevron/Houston, TX | \$0.799 | \$1.169 | 68.3\% |
|  | Sav-a-Stop/Oklahoma City, | \$0.679 | \$0.159 | 58.6\% |
| 4 | Conoco/Mobile, AL | \$0.799 | \$1.189 | 67.2\% |
|  | Shell/Palm Beach Gardens, | \$0.999 | \$1.379 | 72.4\% |
|  | Petroleum Source | \$0.999 | \$1.149 | 86.9\% |
| 5 | Texaco/Hartford, CT | \$0.999 | \$1.539 | 64.9\% |
|  | Mobil/Brooklyn, NY | \$1.299 | \$1.499 | 86.7\% |
| Canadian dollars per liter or equivalent liter |  |  |  |  |
| Canada | Petro-Canada/Vancouver, BC | \$0.348 | \$0.595 | 58.5\% |
|  | Shell/Etobicoke, Ontario | \$0.361 | \$0.556 | 64.9\% |

## Source:

R.P. Publishing, Inc., Natural Gas Fuels, February 1997, p. 10.

Table 5.16
State Taxes on Motor Fuels, 1997
(dollars per gallon or gasoline equivalent gallon)
(Footnotes for this table appear on page 5-19)

| State | Gasoline | Diesel fuel | Gasohol | CNG | Propane | Methanol | Ethanol |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Alabama | 0.16 | 0.17 | 0.16 | a |  | $0.16{ }^{\text {b }}$ | $0.16^{\text {b }}$ |
| Alaska | 0.08 | 0.08 | 0.00 | 0.08 | 0.00 | $0.08{ }^{\text {b }}$ | $0.08{ }^{\text {b }}$ |
| Arizona | 0.18 | 0.18 | 0.00 | $0.10{ }^{\text {c }}$ | 0.18 | 0.18 | 0.00 |
| Arkansas | 0.185 | 0.185 | 0.185 | $0.05{ }^{\text {d }}$ | 0.165 | 0.185 | 0.185 |
| California | 0.18 | 0.18 | 0.18 | 0.07 | 0.06 | 0.09 | 0.09 |
| Colorado | 0.22 | 0.205 | 0.22 | 0.205 | 0.205 | 0.205 | 0.205 |
| Connecticut | 0.39 | 0.18 | 0.38 | $0.18{ }^{\text {e }}$ | $0.18{ }^{\text {e }}$ | $0.37{ }^{\text {b }}$ | $0.37{ }^{\text {b }}$ |
| Delaware | 0.23 | 0.22 | 0.23 | 0.22 | 0.22 | 0.22 | 0.23 |
| District of Columbia | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Florida | 0.04 | 0.04 | 0.04 |  | a | $0.04{ }^{\text {b }}$ | $0.04{ }^{\text {b }}$ |
| Georgia | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| Hawaii (Honolulu) ${ }^{\text {f }}$ | 0.325 | 0.325 | 0.325 | 0.325 | 0.22 | 0.325 | 0.325 |
| Idaho | 0.25 | 0.25 | 0.25 | $0.197^{\text {g }}$ | 0.181 | $0.25{ }^{\text {b }}$ | $0.25{ }^{\text {b }}$ |
| Illinois | 0.19 | 0.215 | 0.19 | 0.19 | 0.19 | $0.19{ }^{\text {b }}$ | $0.19{ }^{\text {b }}$ |
| Indiana | 0.15 | 0.16 | 0.15 | a | a | 0.15 | 0.15 |
| Iowa | 0.20 | 0.225 | 0.19 | $0.16{ }^{\text {d }}$ | 0.20 | $0.19{ }^{\text {b }}$ | $0.19{ }^{\text {b }}$ |
| Kansas | 0.18 | 0.20 | 0.18 | 0.17 | 0.17 | 0.20 | 0.20 |
| Kentucky | 0.15 | 0.12 | 0.15 | 0.12 | 0.15 | 0.15 | 0.15 |
| Louisiana | 0.20 | 0.20 | 0.20 | $0.16^{\text {h }}$ | $0.16{ }^{\text {h }}$ | $0.20{ }^{\text {b }}$ | $0.20{ }^{\text {b }}$ |
| Maine | 0.19 | 0.20 | 0.19 | 0.18 | 0.18 | 0.18 | 0.18 |
| Maryland | 0.235 | 0.2425 | 0.235 | 0.235 | 0.235 | 0.235 | 0.235 |
| Massachusetts | 0.21 | 0.21 | 0.21 | 0.089 | 0.089 | 0.21 | 0.21 |
| Michigan | 0.15 | 0.15 | 0.15 | 0.0 | 0.15 | $0.15{ }^{\text {b }}$ | $0.025^{\text {b }}$ |
| Minnesota | 0.20 | 0.20 | 0.20 | $0.001739^{\text {i }}$ | 0.15 | NA | $0.20{ }^{\text {b }}$ |
| Mississippi | 0.18 | 0.18 | 0.18 | $0.18{ }^{\text {d }}$ | 0.17 | $0.18{ }^{\text {b }}$ | $0.18{ }^{\text {b }}$ |
| Missouri | 0.17 | 0.17 | 0.17 |  |  | $0.17^{\text {b }}$ | $0.17^{\text {b }}$ |
| Montana | 0.27 | 0.2775 | 0.27 | $0.07{ }^{\text {j }}$ | a | 0.27 | 0.27 |
| Nebraska | 0.253 | 0.253 | 0.253 | 0.253 | 0.253 | 0.253 | $0.253^{\text {b }}$ |
| Nevada | 0.23 | 0.27 | 0.23 | $0.23{ }^{\text {d }}$ | $0.23{ }^{\text {d }}$ | 0.23 | 0.23 |
| New Hampshire | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | $0.18{ }^{\text {b }}$ | $0.18{ }^{\text {b }}$ |
| New Jersey | 0.105 | 0.135 | 0.105 | 0.0525 | 0.0525 | $0.105^{\text {b }}$ | $0.105^{\text {b }}$ |
| New Mexico | 0.22 | 0.18 | 0.22 | $0.03^{\text {h }}$ | $0.03^{\text {h }}$ | $0.22{ }^{\text {b }}$ | $0.22^{\text {b }}$ |
| New York | $0.08^{\text {k }}$ | $0.10^{\text {k }}$ | $0.08{ }^{\text {k }}$ | $0.08{ }^{\text {k }}$ | $0.08^{\text {k }}$ | $0.08^{\text {k }}$ | $0.08{ }^{\text {k }}$ |
| North Carolina | 0.217 | 0.217 | 0.217 | 0.217 | 0.217 | 0.217 | 0.217 |
| North Dakota | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | $0.20{ }^{\text {b }}$ | $0.20{ }^{\text {b }}$ |
| Ohio | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | $0.22{ }^{\text {b }}$ | $0.22{ }^{\text {b }}$ |
| Oklahoma | 0.16 | 0.13 | 0.16 |  | 0.16 | $0.16^{\text {b }}$ | $0.16{ }^{\text {b }}$ |
| Oregon | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| Pennsylvania | $0.12{ }^{1}$ | $0.12{ }^{1}$ | $0.12{ }^{1}$ | $0.12{ }^{1}$ | $0.12{ }^{1}$ | $0.12{ }^{1}$ | $0.12{ }^{1}$ |
| Rhode Island | 0.28 | 0.28 | 0.28 | 0.0 | 0.28 | 0.28 | 0.28 |
| South Carolina | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 |
| South Dakota | 0.18 | 0.18 | 0.16 | 0.06 | 0.16 | 0.06 | 0.06 |

Table 5.16 (continued)
State Taxes on Motor Fuels, 1997
(dollars per gallon or gasoline equivalent gallon)

| State | Gasoline | Diesel fuel | Gasohol | CNG | Propane | Methanol | Ethanol |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tennessee | 0.20 | 0.17 | 0.17 | 0.13 | 0.17 | 0.17 | 0.17 |
| Texas | 0.20 | 0.20 | 0.20 | 0.15 | 0.15 | $0.20^{\mathrm{b}}$ | $0.20^{\mathrm{b}}$ |
| Utah | 0.19 | 0.19 | 0.19 | $0.19^{1}$ | $0.19^{1}$ | 0.19 | 0.19 |
| Vermont | 0.16 | 0.17 | 0.16 | 0.16 |  | 0.16 | 0.16 |
| Virginia | 0.175 | 0.16 | 0.175 | 0.10 | 0.10 | $0.175^{\mathrm{b}}$ | $0.175^{\mathrm{b}}$ |
| Washington | 0.23 | 0.23 | 0.23 | a | a | 0.23 | 0.23 |
| West Virginia | 0.205 | 0.205 | 0.205 | 0.205 | 0.205 | 0.205 | 0.205 |
| Wisconsin | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 |
| Wyoming | 0.08 | 0.08 | 0.00 | 0.00 | 0.00 | $0.08^{\mathrm{b}}$ | $0.08^{\mathrm{b}}$ |

## Source:

J. E. Sinor Consultants, Inc., The Clean Fuels Report, April 1997, pp. 47, 48.
(Additional resources: http://phidias,colorado.edu/sinor)
${ }^{\mathrm{a}}$ Annual flat fee.
${ }^{\mathrm{b}}$ Blends with gasoline only.
${ }^{\text {c }}$ Per 1.25 therm.
${ }^{\mathrm{d}}$ Per $100 \mathrm{ft}^{3}$.
${ }^{e}$ CNG, LNG, and LPG are exempt from motor fuel taxes when used as vehicle fuel until July 1, 2001.
${ }^{\mathrm{f}}$ For County of Honolulu; for County of Maui LPG tax is $\$ 0.20 / \mathrm{gal}$. and all other fuels are taxed at $\$ 0.18 / \mathrm{gal}$.; other counties have all fuels taxed at $\$ 0.26 / \mathrm{gal}$.
${ }^{\mathrm{g}}$ Per therm.
${ }^{\text {h }}$ Optional: flat fee may be paid instead.
${ }^{1}$ Per cubic foot; LNG is taxed at $\$ 0.12 / \mathrm{gal}$.
${ }^{j}$ Per $120 \mathrm{ft}^{3}$.
${ }^{\mathrm{k}}$ Plus a petroleum business tax; the amount varies but is usually in the ballpark of \$0.12-\$0.14.
${ }^{1}$ Plus 0.1035 oil franchise tax.

As of February 1997, only five states offered tax exemptions to encourage the use of gasohol for transpotation purposes. This list is quite short compared to the 30 states which offered gasohol tax exemptions ten years ago. Still, theFederal Government encourages gasohol use via a difference in the Federal tax rates of gasoline and gasohol.

Table 5.17
State Tax Exemptions for Gasohol, February 1997

| State | Exemption <br> (cents/gallon of gasohol) |
| :--- | :---: |
| Alaska | 8.0 |
| Connecticut | 1.0 |
| Idaho | 2.5 |
| Iowa | 1.0 |
| South Dakota | 2.0 |

Source:
U.S. Department of Transportation, Federal Highway Administration, "Monthly Motor Fuel Reported by the States, November 1996," February 1996, Washington, DC, Table MF-121T.
(Additional resources: http://www.fhwa.dat.gov)

Table 5.18
Federal Excise Taxes on Motor Fuels

| Fuel | Dollars per gallon |  |
| :--- | :--- | :--- |
| Gasoline $^{\text {Diesel }} \mathrm{a}$ |  | 0.1830 |
| Gasohol | 10\% Ethanol | 0.2430 |
|  | $7.7 \%$ Ethanol | 0.1290 |
|  | 5.7\% Ethanol | 0.1414 |
| Gasohol | $10 \%$ Methanol | 0.1522 |
|  | $7.7 \%$ Methanol | 0.1230 |
|  | 5.7\% Methanol | 0.1368 |
|  | Qualified $^{\mathrm{b}}$ | 0.1488 |
| Methanol | Partially Exempt $^{\mathrm{c}}$ | 0.1290 |
|  | Qualified $^{\mathrm{b}}$ | 0.1130 |
| Ethanol | Partially Exempt $^{\mathrm{c}}$ | 0.1290 |
|  |  | 0.11 |
| CNG |  | $0.4844 / \mathrm{mcf}^{\mathrm{d}}$ |
| LNG |  | 0.1830 |
| Propane |  | 0.1830 |

## Source:

J. E. Sinor Consultants, Inc., "The Clean Fuels Report," April 1997, p. 48. (Additional resources: http://phidias.colorado.edu/sinor)
${ }^{a}$ Reduced diesel rates are specified for marine fleets, trains and certain intercity buses. Diesel rates are also reduced for diesel/alcohol blends. Diesel used exclusively in state and local government fleets, nonprofit organization vehicles, school buses and qualified local buses is exempt from Federal taxes.
${ }^{\mathrm{b}}$ Qualified - contains at least 85 percent methanol or ethanol or other alcohol produced from a substance other than petroleum or natural gas.
${ }^{\text {c Partially exempt }-\geq 85}$ percent alcohol and produced from natural gas.
${ }^{\mathrm{d}}$ Thousand cubic feet.

## Table 5.19

States With Ethanol Tax Incentives

| State | Ethanol tax incentives |
| :---: | :---: |
| AK | \$0.08/ethanol gallon (blender) |
| CA | E85 and M85 excise tax is half of the gasoline tax. Neat alcohol fuels are exempt from fuel taxes. |
| FL | County governments receive waste reduction credits for using yard trash, wood, or paper waste as feed stocks for fuel. |
| HI | $4 \%$ ethanol sales tax exemption |
| ID | \$0.21 excise tax exemption for ethanol or biodiesel |
| IN | $10 \%$ gross income tax deduction for improvements to ethanol producing facilities. |
| IL | $2 \%$ sales tax exemption for $10 \%$ volume ethanol blends |
| IA | \$0.01 (blender) |
| MN | \$0.25 (producer), \$0.005 (blender) until Oct. 1, 1997 |
| MO | \$0.20 (producer) |
| MT | \$0.30 (producer) |
| NE | \$0.20 (producer), \$0.50 ETBE (producer) |
| NC | Individual income and corporate tax credit of $20 \%$ for the construction of an ethanol plant using agricultural or forestry products; an additional $10 \%$ if the distillery is powered with alternative fuels. |
| ND | \$0.40 (producer) |
| OH | \$0.01 (blender), income tax credit |
| SD | \$0.20 (blender), \$0.20 (producer) Alternative fuels are taxed at \$0.06/gal |
| WY | \$0.40 (producer) |
| Source: |  |
|  | Department of Energy, Clean Cities Guide to Alternative Fuel Vehicle Incentives and Laws, 2nd edition, Washington, DC, November 1996. <br> (Additional resources: http://www.ccities.gov) |

## CHAPTER 6 <br> NON HIGHWAY MODES

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Table 6.1
Summary Statistics for Domestic and International Certificated Route Air Carriers (Combined Totals), 1970-96

| Year | Revenue aircraft-miles (millions) | Average passenger trip length ${ }^{\text {a }}$ (miles) | Revenue passenger-miles (millions) | Available seat-miles (millions) | Available seats per aircraft ${ }^{\text {b }}$ | Passenger load factor (percentage) ${ }^{\text {c }}$ | Revenue cargo ton-miles (millions) | $\underset{\text { (trillion Btu) }}{\text { Energy use }}$ | Percent domestic of total energy use (percentage) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 2,383 | 678 | 131,719 ${ }^{\text {e }}$ | 264,904 ${ }^{\text {e }}$ | 111 | 49.7\% ${ }^{\text {e }}$ | 4,994 | 1,363.4 | $\mathrm{f}^{\text {f }}$ |
| 1975 | 2,241 | 698 | 173,324 | 315,823 | 135 | 54.9\% | 5,944 | 1,283.4 | f |
| 1976 | 2,320 | 704 | 191,823 | 338,349 | 139 | 56.7\% | 6,222 | 1,324.1 | f |
| 1977 | 2,418 | 704 | 206,082 | 361,172 | 143 | 57.1\% | 6,587 | 1,386.2 | f |
| 1978 | 2,608 | 719 | 236,998 | 381,113 | 147 | 62.2\% | 7,395 | 1,436.3 | 82.0\% |
| 1979 | 2,859 | 714 | 269,719 | 425,411 | 146 | 63.4\% | 7,580 | 1,534.8 | 82.5\% |
| 1980 | 2,924 | 736 | 267,722 | 448,479 | 148 | 59.7\% | 7,515 | 1,489.6 | 82.4\% |
| 1981 | 2,703 | 749 | 260,063 | 438,778 | 157 | 59.3\% | 7,917 | 1,429.3 | f |
| 1982 | 2,804 | 766 | 272,435 | 455,938 | 157 | 59.8\% | 7,807 | 1,406.6 | 81.1\% |
| 1983 | 2,923 | 765 | 295,144 | 480,977 | 159 | 61.4\% | 8,497 | 1,439.2 | 84.4\% |
| 1984 | 3,264 | 759 | 319,504 | 534,104 | 164 | 59.8\% | 9,328 | 1,607.4 | f |
| 1985 | 3,462 | 758 | 351,073 | 565,677 | 163 | 62.1\% | 9,048 | 1,701.5 | f |
| 1986 | 3,873 | 767 | 378,923 | 623,073 | 161 | 60.8\% | 10,987 | 1,847.1 | 81.4\% |
| 1987 | 4,182 | 779 | 417,830 | 670,871 | 160 | 62.3\% | 13,130 | 1,945.4 | 80.4\% |
| 1988 | 4,355 | 786 | 437,649 | 696,337 | 160 | 62.9\% | 14,633 | 2,049.4 | 78.5\% |
| 1989 | 4,442 | 792 | 447,480 | 703,888 | 158 | 63.6\% | 16,347 | 2,087.4 | 77.0\% |
| 1990 | 4,724 | 803 | 472,236 | 753,211 | 159 | 62.7\% | 16,411 | 2,191.3 | 75.9\% |
| 1991 | 4,661 | 806 | 463,296 | 738,030 | 158 | 62.8\% | 16,149 | 2,069.2 | 74.5\% |
| 1992 | 4,899 | 806 | 493,715 | 772,869 | 158 | 63.9\% | 17,306 | 2,144.2 | 74.1\% |
| 1993 | 5,118 | 799 | 505,996 | 793,959 | 155 | 63.7\% | 19,083 | 2,168.8 | 74.4\% |
| 1994 | 5,360 | 787 | 537,506 | 809,240 | 151 | 66.4\% | 21,773 | 2,249.5 | 74.3\% |
| 1995 | 5,627 | 791 | 558,757 | 845,012 | 150 | 66.1\% | 23,375 | 2,310.4 | 74.0\% |
| 1996 | 5,850 | 802 | 595,784 | 859,077 | 147 | 69.4\% | 24,810 | 2,396.6 | 74.0\% |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |
| 1970-96 | 3.5\% | 0.6\% | 6.0\% | 4.6\% | 1.1\% |  | 6.4\% | 2.2\% |  |
| 1986-96 | 4.2\% | 0.4\% | 4.6\% | 3.3\% | -0.9\% |  | 8.5\% | 2.6\% |  |

## Source:

U.S. Department of Transportation, Bureau of Transportation Statistics, Air Carrier Traffic Statistics Monthly, December 1996/1995, Washington, DC, pp. 1-2, and annual

1970-81 Energy Use - Department of Transportation, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, DC, 1981, and annual.
1982-96 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 carriers. (Additional resources: http://www.bts.gov, http://www.faa.gov)

[^52]Table 6.2 Summary Statistics for General Aviation, 1970-95

| Calendar year | Total number of aircraft | Hours flown (thousands) | Intercity passenger travel (billion passenger-miles) | Energy use (trillion btu) |
| :---: | :---: | :---: | :---: | :---: |
| 1970 | 131,700 ${ }^{\text {a }}$ | 26,030 ${ }^{\text {b }}$ | 9.1 | 94.4 |
| 1971 | $131,100^{\text {a }}$ | 25,512 ${ }^{\text {b }}$ | 9.2 | 91.6 |
| 1972 | $145,000^{\text {a }}$ | 26,974 ${ }^{\text {b }}$ | 10.0 | 103.4 |
| 1973 | 148,000 ${ }^{\text {a }}$ | 28,599 | 10.7 | 90.4 |
| 1974 | 161,502 | 29,758 | 11.2 | 101.4 |
| 1975 | 168,475 | 30,298 | 11.4 | 121.5 |
| 1976 | 177,964 | 31,950 | 12.1 | 130.3 |
| 1977 | 184,294 | 33,679 | 12.8 | 149.7 |
| 1978 | 199,178 | 36,844 | 14.1 | 159.4 |
| 1979 | 210,339 | 40,432 | 15.5 | 167.2 |
| 1980 | 211,045 | 41,016 | 14.7 | 169.0 |
| 1981 | 213,226 | 40,704 | 14.6 | 162.4 |
| 1982 | 209,779 | 36,457 | 13.1 | 170.5 |
| 1983 | 213,293 | 35,249 | 12.7 | 143.9 |
| 1984 | 220,943 | 36,119 | 13.0 | 148.9 |
| 1985 | 196,500 | 31,456 | 12.3 | 144.0 |
| 1986 | 205,300 | 31,782 | 12.4 | 148.0 |
| 1987 | 202,700 | 30,883 | 12.1 | 139.1 |
| 1988 | 196,200 | 31,114 | 12.6 | 148.6 |
| 1989 | 205,000 | 32,332 | 13.1 | 134.0 |
| 1990 | 198,000 | 32,096 | 13.0 | 131.9 |
| 1991 | 198,475 | 30,067 | 12.2 | 120.4 |
| 1992 | 184,434 | 26,493 | 10.7 | 104.7 |
| 1993 | 176,006 | 24,340 | 10.9 | 97.5 |
| 1994 | 170,600 | 23,866 | 11.1 | 95.3 |
| 1995 | 181,341 | 25,447 | 11.3 | 106.6 |
| Average Annual Percentage Change |  |  |  |  |
| 1970-95 | 1.3\% | -0.1\% | 0.9\% | 0.5\% |
| 1985-95 | -0.8\% | 2.1\% | -0.8\% | -3.0\% |

## Sources:

Intercity passenger-miles - Eno Foundation for Transportation, Transportation in America,
Fourteenth edition, Washington, DC, 1996, p. 47, and annual.
All other- U.S. Department of Transportation, Federal Aviation Administration, General Aviation
Activity and Avionics Survey: Calendar Year 1995, pp. 1-7, 1-14, 5-3, and annual.
(Additional resources: http://www.faa.gov)

[^53]In the early seventies, domestic waterborne commerce accounted for over $60 \%$ of total tonnage, but
by 1995 foreign tonnage grew to more than half of all waterborne tonnage.

Table 6.3
Tonnage Statistics for Domestic and International Waterborne Commerce, 1970-95 (million tons shipped)

| Year | Foreign and domestic total | Foreign total ${ }^{\text {a }}$ | Domestic total ${ }^{\text {b }}$ | Percent domestic $\qquad$ of total |
| :---: | :---: | :---: | :---: | :---: |
| 1970 | 1,532 | 581 | 951 | 62.1\% |
| 1971 | 1,513 | 566 | 947 | 62.6\% |
| 1972 | 1,617 | 630 | 987 | 61.0\% |
| 1973 | 1,762 | 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 | 1,077 | 53.9\% |
| 1981 | 1,942 | 887 | 1,054 | 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\% |
| 1990 | 2,164 | 1,042 | 1,122 | 51.8\% |
| 1991 | 2,092 | 1,014 | 1,079 | 51.6\% |
| 1992 | 2,132 | 1,037 | 1,095 | 51.4\% |
| 1993 | 2,128 | 1,060 | 1,068 | 50.2\% |
| 1994 | 2,215 | 1,116 | 1,099 | 49.6\% |
| 1995 | 2,240 | 1,147 | 1,093 | 48.8\% |
| Average annual percentage change |  |  |  |  |
| 1970-95 | 1.5\% | 2.8\% | 0.6\% |  |
| 1985-95 | 2.3\% | 4.0\% | 0.8\% |  |

Source:
U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1995, Part 5: National Summaries, New Orleans, Louisiana, 1997, Table 1-1, p. 1-3, and annual. (Additional resources: http://www.wrc-ndc.usace.army.mil/ndc)
${ }^{\text {a }}$ All movements between the U.S. and foreign countries and between Puerto Rico and the Virgin Islands and foreign countries are classified as foreign trade.
${ }^{\mathrm{b}}$ All movements between U.S. ports, continental and noncontiguous, and on the inland rivers, canals, and connecting channels of the U.S., Puerto Rico, and the Virgin Islands, excluding the Panama Canal.

Table 6.4 Summary Statistics for Domestic Waterborne Commerce, 1970-95

| Year | Number of vessels ${ }^{\text {a }}$ | Ton-miles (billions) | Tons shipped ${ }^{\text {b }}$ (millions) | 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 | 1,106 | 804.3 | 361 | 321.3 |
| 1989 | 39,209 | 816 | 1,097 | 743.2 | 403 | 328.6 |
| 1990 | 39,233 | 834 | 1,118 | 745.7 | 388 | 323.2 |
| 1991 | 39,233 | 848 | 1,074 | 789.9 | 386 | 327.5 |
| 1992 | 39,210 | 857 | 1,090 | 785.7 | 398 | 341.0 |
| 1993 | 39,064 | 790 | 1,063 | 742.7 | 389 | 307.0 |
| 1994 | 39,064 | 815 | 1,093 | 745.5 | 369 | 300.7 |
| 1995 | 39,641 | 808 | 1,086 | 743.6 | 374 | 302.2 |
| Average annual percentage change |  |  |  |  |  |  |
| 1970-95 | 1.7\% | 1.2\% | 0.5\% | 0.7\% | -1.5\% | -0.3\% |
| 1985-95 | -0.5\% | -1.0\% | 0.7\% | -1.7\% | -1.7\% | -2.7\% |

## Source:

Number of Vessels -
1970-92, 1995 - U.S. Department of the Army, Corps of Engineers, "Summary of U.S. Flag
Passenger and Cargo Vessels, 1995," New Orleans, LA, 1997, and annual.
1993-94 - U.S. Dept of the Army, Corps of Engineers, The U.S. Waterway System-Facts,
Navigation Data Center, New Orleans, Louisiana, January 1996.
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 1995, Part 5: National Summaries,
New Orleans, LA, 1997, Table 1-4, pp. 1-6, 1-7, and annual.
Energy Use - See Appendix A for Table 2.7.
(Additional resources: http://www.wrc-ndc.usace.army.mil/ndc)
${ }^{\mathrm{a}}$ Grand total for self-propelled and non-self-propelled.
${ }^{\text {b }}$ These figures are not consistent with the figures on Table 6.4 because intra-territory tons are not included in this table. Intra-territory traffic is traffic between ports in Puerto Rico and the Virgin Islands.

Fifty-seven percent of all domestic marine cargo in 1995 were energy-related products (petroleum, coal, coke). The majority of the energy-related products were shipped internally and locally (62\%). Barge traffic accounted for $97 \%$ of all internal and local waterborne commerce.

## Table 6.5

Breakdown of Domestic Marine Cargo by Commodity Class, 1995

| Commodity class | Coastwise |  | Lakewise |  | Internal and local |  | Total domestic |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Tons shipped (millions) | Average haul ${ }^{a}$ (miles) | Tons shipped (millions) | Average haul ${ }^{\text {a }}$ (miles) | Tons shipped (millions) | Average haul ${ }^{\text {a }}$ (miles) | Tons shipped (millions) | Percentage | Average haul ${ }^{\text {a }}$ (miles) |
| Petroleum and products | 201 | 1,812 | 2 | 660 | 194 | 193 | 397 | 36.6\% | 1,014 |
| Chemicals and related products | 15 | 1,790 | $0^{\text {b }}$ | 322 | 64 | 496 | 79 | 7.3\% | 739 |
| Crude materials | 17 | 605 | 89 | 521 | 121 | 350 | 226 | 20.8\% | 436 |
| Coal and coke | 12 | 659 | 21 | 535 | 191 | 408 | 224 | 20.6\% | 433 |
| Primary manufactured goods | 7 | 804 | 4 | 300 | 26 | 835 | 37 | 3.4\% | 775 |
| Food and farm products | 8 | 1,817 | 1 | 980 | 94 | 1,006 | 103 | 9.5\% | 1,071 |
| Manufactured equipment | 7 | 1,496 | b | 0 | 8 | 111 | 14 | 1.3\% | 762 |
| Waste and scrap | b | 2,826 | 0 | 0 | 5 | 55 | 5 | 0.5\% | 91 |
| Unknown | b | 2,185 | b | b | b | b | b | 0.0\% | 1,827 |
| Total | 267 | 1,652 | 116 | 514 | 704 | 437 | 1,086 | 100.0\% | 744 |
| Barge traffic (million tons) | 101 |  | 8 |  | 677 |  |  |  |  |
| Percentage by barge | 37.8\% |  |  |  |  |  |  |  |  |

## Source

U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1995, Part 5: National Summaries, New Orleans, Louisiana, 1997, Tables 2-1, 2-2, and 2-3, pp. 2-1, 2-2, 2-3, 2-6, 2-11, 2-12, and annual.
(Additional resources: http://www.wrc-ndc.usace.army.mil/ndc)
Note:
Coastwise 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. Lake wise applies to traffic between United States ports on the Great Lakes. Internal applies to traffic between ports or landings wherein the entire movement
takesplace on inland waterways. Local applies to movements of freight within the confines of a port.
${ }^{\text {a }}$ Calculated as ton-miles divided by tons shipped.
${ }^{\mathrm{b}}$ Negligible.

The Interstate Commerce Commission designates Class I railroads on the basis of annual gross revenues. In 1995, eleven railroads were given this classification(see note below).

Table 6.6
Class I Railroad Freight Systems in the United States
Ranked by Revenue Ton-Miles, 1995

| Railroad | Revenue ton-miles <br> (billions) | Percent |
| :--- | :---: | :---: |
| Union Pacific Railroad Company | 307 | $23.5 \%$ |
| Burlington Northern Railroad Company | 293 | $22.5 \%$ |
| CSX Transportation | 160 | $12.3 \%$ |
| Southern Pacific Transportation Company | 146 | $11.2 \%$ |
| Norfolk Southern Corporation | 127 | $9.7 \%$ |
| Atchison, Topeka and Santa Fe Railway Company | 104 | $8.0 \%$ |
| Consolidated Rail Corporation (Conrail) | 93 | $7.1 \%$ |
| Soo Line Railroad Company | 25 | $1.9 \%$ |
| Illinois Central Railroad Company | 25 | $1.9 \%$ |
| Kansas City Southern Railway Company | 19 | $1.5 \%$ |
| Grand Trunk Western Railroad Company | 6 | $0.5 \%$ |
|  |  | $\mathbf{1 , 3 0 5}$ |

## Source:

Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, September 1996, p. 66. (Additional resources: http:/www.aar.org)

## Note:

Union Pacific Railroad Company figures include revenue ton-miles for the Chicago and Northwestern Transportation Company for all of 1995, even though the acquisition was completed in early 1995. The Burlington Northern Railroad Company and the Atchison, Topeka, and Santa Fe Railway Company data are separate for 1995, even though they merged in September 1995 to create the Burlington Northern Santa Fe Corporation.

Table 6.7
Summary Statistics for Class I Freight Railroads, 1970-95

| Year | Number of locomotives in service ${ }^{\text {a }}$ | Number of freight cars (thousands) ${ }^{\text {b }}$ | Train-miles (millions) | Car-miles (millions) | $\begin{aligned} & \text { Revenue } \\ & \text { tons } \\ & \text { (millions) } \end{aligned}$ | Average length of haul (miles) | Revenue ton-miles (millions) | Energy intensity (Btu/tonmile) ${ }^{\text {c }}$ | Energy use (trillion Btu) ${ }^{\text {c }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 27,077 ${ }^{\text {d }}$ | 1,424 | 427 | 29,890 | 2,616 | 515 | 764,809 | 691 | 528.1 |
| 1971 | 27,160 ${ }^{\text {d }}$ | 1,422 | 430 | 29,181 | 2,458 | 507 | 739,723 | 717 | 530.2 |
| 1972 | 27,044 | 1,411 | 451 | 30,309 | 2,543 | 511 | 776,746 | 714 | 554.4 |
| 1973 | 27,438 | 1,395 | 469 | 31,248 | 2,701 | 531 | 851,809 | 677 | 577.1 |
| 1974 | 27,627 | 1,375 | 469 | 30,719 | 2,732 | 527 | 850,961 | 681 | 579.1 |
| 1975 | 27,855 | 1,359 | 403 | 27,656 | 2,437 | 541 | 754,252 | 687 | 518.3 |
| 1976 | 27,233 | 1,332 | 425 | 28,530 | 2,452 | 540 | 794,059 | 680 | 540.3 |
| 1977 | 27,298 | 1,287 | 428 | 28,749 | 2,439 | 549 | 826,292 | 669 | 552.7 |
| 1978 | 26,959 | 1,226 | 433 | 29,076 | 2,312 | 617 | 858,105 | 641 | 550.4 |
| 1979 | 27,660 | 1,217 | 438 | 29,436 | 2,463 | 611 | 913,669 | 618 | 564.8 |
| 1980 | 28,094 | 1,168 | 428 | 29,277 | 2,434 | 616 | 918,621 | 597 | 548.7 |
| 1981 | 27,421 | 1,111 | 408 | 27,968 | 2,386 | 626 | 910,169 | 572 | 521.0 |
| 1982 | 26,795 | 1,039 | 345 | 23,952 | 1,990 | 629 | 797,759 | 553 | 440.8 |
| 1983 | 25,448 | 1,007 | 346 | 24,358 | 1,936 | 641 | 828,275 | 525 | 435.1 |
| 1984 | 24,117 | 948 | 369 | 26,409 | 2,119 | 645 | 921,542 | 510 | 470.0 |
| 1985 | 22,548 | 867 | 347 | 24,920 | 1,985 | 664 | 876,984 | 497 | 436.1 |
| 1986 | 20,790 | 799 | 347 | 24,414 | 1,938 | 664 | 867,722 | 486 | 421.5 |
| 1987 | 19,647 | 749 | 361 | 25,627 | 1,926 | 688 | 943,747 | 456 | 430.3 |
| 1988 | 19,364 | 725 | 379 | 26,339 | 2,001 | 697 | 996,182 | 443 | 441.4 |
| 1989 | 19,015 | 682 | 383 | 26,196 | 1,988 | 723 | 1,013,841 | 437 | 442.6 |
| 1990 | 18,835 | 659 | 380 | 26,159 | 2,024 | 726 | 1,033,969 | 420 | 434.7 |
| 1991 | 18,344 | 633 | 375 | 25,628 | 1,987 | 751 | 1,038,875 | 391 | 405.8 |
| 1992 | 18,004 | 605 | 390 | 26,128 | 2,016 | 763 | 1,066,781 | 393 | 419.2 |
| 1993 | 18,161 | 587 | 405 | 26,883 | 2,047 | 794 | 1,109,309 | 389 | 431.6 |
| 1994 | 18,505 | 591 | 441 | 28,485 | 2,185 | 817 | 1,200,701 | 388 | 465.4 |
| 1995 | 18,812 | 583 | 458 | 30,383 | 2,322 | 843 | 1,305,688 | 372 | 485.9 |
| Average annual percentage change |  |  |  |  |  |  |  |  |  |
| 1970-95 | -1.4\% | -3.5\% | 0.3\% | 0.1\% | -0.5\% | 2.0\% | 2.2\% | -2.4\% | -0.3\% |
| 1985-95 | -1.8\% | -3.9\% | 2.8\% | 2.0\% | 1.6\% | 2.4\% | 4.1\% | -2.9\% | 1.1\% |

Source:
Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, September 1996, pp. 27, 33, 34, 36, 48, 50, 60
Revenue tons - Association of American Railroads, Analysis of Class I Railroads 1995, 1996, p. 31, and annual.
(Additional resources: http://www.aar.org)

[^54]Coal, which was the predominate commodity shipped by rail in 1974 (17\%), accounted for $25 \%$ of car loadings in 1995. The fastest growing commodity group from 1974 to 1995 was the "other" categony (81\%).

Table 6.8 Railroad Revenue Car loadings by Commodity Group, 1974 and 1995

| Commodity group | Car loadings (thousands) |  | Percent distribution |  | Percentage change 1974-95 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1974 | 1995 | 1974 | 1995 |  |
| Coal | 4,544 | 6,095 | 17.0\% | 25.7\% | 34.1\% |
| Farm products | 3,021 | 1,692 | 11.3\% | 7.1\% | -44.0\% |
| Chemicals and allied products | 1,464 | 1,667 | 5.5\% | 7.0\% | 13.9\% |
| Nonmetallic minerals | 821 | 1,159 | 3.1\% | 4.9\% | 41.2\% |
| Food and kindred products | 1,777 | 1,377 | 6.6\% | 5.8\% | -22.5\% |
| Lumber and wood products | 1,930 | 719 | 7.2\% | 3.0\% | -62.7\% |
| Metallic ores | 1,910 | 463 | 7.1\% | 2.0\% | -75.8\% |
| Stone, clay and glass | 2,428 | 516 | 9.1\% | 2.2\% | -78.7\% |
| Pulp, paper, and allied products | 1,180 | 628 | 4.4\% | 2.6\% | -46.8\% |
| Petroleum products | 877 | 571 | 3.3\% | 2.4\% | -34.9\% |
| Primary metal products | 1,366 | 607 | 5.1\% | 2.6\% | -55.6\% |
| Waste and scrap material | 889 | 623 | 3.3\% | 2.6\% | -29.9\% |
| Transportation equipment | 1,126 | 1,374 | 4.2\% | 5.8\% | 22.0\% |
| Others | 3,451 | 6,236 | 12.9\% | 26.3\% | 80.7\% |
| Total | 26,784 | 23,727 | 100.0\% | 100.0\% | -11.4\% |

## Source:

1974 - Association of American Railroads, Railroad Facts, 1976 Edition, Washington, DC, 1975, p. 26. 1995 - Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC,

September 1996, p. 25.
(Additional resources: http://www.aar.org)

The number of trailers and containers moved by railroads has increased more than four-fold from 1965 to 1995. Since 1988, the growth in containers moved by the railroad has increased by an average of $10.2 \%$ per year.

Table 6.9
Intermodal Rail Traffic, 1965-95

| Year | Trailers \& containers | Trailers | Containers |
| :---: | :---: | :---: | :---: |
| 1965 | 1,664,929 | a | a |
| 1970 | 2,363,200 | a | a |
| 1975 | 2,238,117 | a | a |
| 1980 | 3,059,402 | a | a |
| 1981 | 3,150,522 | a | a |
| 1982 | 3,396,973 | a | a |
| 1983 | 4,090,078 | a | a |
| 1984 | 4,565,743 | a | a |
| 1985 | 4,590,952 | a | a |
| 1986 | 4,997,229 | a | a |
| 1987 | 5,503,819 | a | a |
| 1988 | 5,779,547 | 3,481,020 | 2,298,527 |
| 1989 | 5,987,355 | 3,496,262 | 2,491,093 |
| 1990 | 6,206,782 | 3,451,953 | 2,754,829 |
| 1991 | 6,246,134 | 3,201,560 | 3,044,574 |
| 1992 | 6,627,841 | 3,264,597 | 3,363,244 |
| 1993 | 7,156,628 | 3,464,126 | 3,692,502 |
| 1994 | 8,128,228 | 3,752,502 | 4,375,726 |
| 1995 | 8,070,309 | 3,519,664 | 4,550,645 |
| Average annual percentage change |  |  |  |
| 1965-95 | 5.4\% | a | a |
| 1988-95 | 4.9\% | 0.2\% | 10.2\% |

## Source:

Association of American Railroads, Railroad Facts,
1996 edition, Washington, DC, September 1996 p. 26.
(Additional resources: http://www.aar.org)

[^55]Table 6.10
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971-95

| Year | Number of locomotives in service | Number of passenger cars | Train-miles (thousands) | Car-miles (thousands) | Revenue passenger-miles (millions) | Average trip length (miles) | Energy intensity (Btu per revenue passenger mile) | Energy use (trillion Btu) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1971 | a | 1,165 | 16,537 | 140,147 | 1,993 | 188 | a | a |
| 1972 | 285 | 1,571 | 26,302 | 213,261 | 3,039 | 183 | a | a |
| 1973 | 352 | 1,777 | 27,151 | 239,775 | 3,807 | 224 | 3,756 | 14.3 |
| 1974 | 457 | 1,848 | 29,538 | 260,060 | 4,259 | 233 | 3,240 | 13.8 |
| 1975 | 355 | 1,913 | 30,166 | 253,898 | 3,753 | 224 | 3,677 | 13.8 |
| 1976 | 379 | 2,062 | 30,885 | 263,589 | 4,268 | 229 | 3,397 | 14.5 |
| 1977 | 369 | 2,154 | 33,200 | 261,325 | 4,204 | 221 | 3,568 | 15.0 |
| 1978 | 441 | 2,084 | 32,451 | 255,214 | 4,154 | 217 | 3,683 | 15.3 |
| 1979 | 437 | 2,026 | 31,379 | 255,129 | 4,867 | 226 | 3,472 | 16.9 |
| 1980 | 448 | 2,128 | 29,487 | 235,235 | 4,503 | 217 | 3,176 | 14.3 |
| 1981 | 398 | 1,830 | 30,380 | 222,753 | 4,397 | 226 | 2,979 | 13.1 |
| 1982 | 396 | 1,929 | 28,833 | 217,385 | 3,993 | 220 | 3,156 | 12.6 |
| 1983 | 388 | 1,880 | 28,805 | 223,509 | 4,227 | 223 | 2,957 | 12.5 |
| 1984 | 387 | 1,844 | 29,133 | 234,557 | 4,427 | 227 | 3,027 | 13.4 |
| 1985 | 382 | 1,818 | 30,038 | 250,642 | 4,785 | 238 | 2,800 | 13.4 |
| 1986 | 369 | 1,793 | 28,604 | 249,665 | 5,011 | 249 | 2,574 | 12.9 |
| 1987 | 381 | 1,850 | 29,515 | 261,054 | 5,361 | 259 | 2,537 | 13.6 |
| 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 |
| 1992 | 336 | 1,796 | 34,000 | 307,282 | 6,091 | 286 | 2,610 | 15.9 |
| 1993 | 360 | 1,853 | 34,936 | 302,739 | 6,199 | 280 | 2,646 | 16.4 |
| 1994 | 411 | 1,874 | 34,940 | 305,600 | 5,869 | 276 | 2,351 | $13.8{ }^{\text {b }}$ |
| 1995 | 422 | 1,907 | 31,579 | 282,579 | 5,401 | 266 | 2,314 ${ }^{\text {c }}$ | $12.5{ }^{\text {c }}$ |
| Average annual percentage change |  |  |  |  |  |  |  |  |
| 1971-95 | 1.7\% ${ }^{\text {c }}$ | 2.1\% | 2.7\% | 3.0\% | 4.2\% | 1.5\% | $-2.2 \%{ }^{\text {d }}$ | -0.6\% ${ }^{\text {d }}$ |
| 1985-95 | 1.0\% | 0.5\% | 0.5\% | 1.2\% | 1.2\% | 1.1\% | -1.9\% ${ }^{\text {d }}$ | -0.7\% ${ }^{\text {d }}$ |

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.
1989-93- Personal communication with the Corporate Accounting Office of Amtrak, Washington, D.C.
1994-95- Number of locomotives in service, number of passenger cars, train-miles, car-miles, revenue passenger-miles, and average trip length - Association of American Railroads, Railroad Facts, 1996 Edition, Washington, DC, 1996, p. 78.
Energy use - Personal communication with the Amtrak, Washington, DC. (Additional resources: http://www.amtrak.com, http://www.aar.org)

[^56]Table 6.11
Summary Statistics for Rail Transit Operations, 1970-95'

| Year | Number of passenger vehicles | Vehicle-miles (millions) | Passenger trips (millions) ${ }^{\text {b }}$ | Estimated passenger-miles (millions) ${ }^{\text {c }}$ | Average trip length (miles) ${ }^{\text {d }}$ | Energy intensity (Btu/passenger-mile) ${ }^{\text {e }}$ | Energy use (trillion Btu) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1970 | 10,548 | 440.8 | 2,116 | 12,273 | $f$ | 2,453 | 30.1 |
| 1971 | 10,550 | 440.4 | 2,000 | 11,600 | ${ }^{\text {f }}$ | 2,595 | 30.1 |
| 1972 | 10,599 | 417.8 | 1,942 | 11,264 | f | 2,540 | 28.6 |
| 1973 | 10,510 | 438.5 | 1,921 | 11,142 | f | 2,460 | 27.4 |
| 1974 | 10,471 | 458.8 | 1,876 | 10,881 | f | 2,840 | 30.9 |
| 1975 | 10,617 | 446.9 | 1,797 | 10,423 | f | 2,962 | 31.1 |
| 1976 | 10,625 | 428.1 | 1,744 | 10,115 | f | 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 | 560.9 | 2,521 | 12,046 | 4.8 | 3,453 | 41.6 |
| 1991 | 11,426 | 554.8 | 2,356 | 11,190 | 4.7 | 3,727 | 41.7 |
| 1992 | 11,303 | 554.1 | 2,396 | 11,441 | 4.8 | 3,575 | 40.9 |
| 1993 | 11,286 | 549.8 | 2,234 | 10,936 | 4.9 | 3,687 | 42.2 |
| 1994 | 11,192 | 565.8 | 2,453 | 11,501 | 4.8 | 3,828 | 44.0 |
| 1995 | 11,156 | 571.8 | 2,284 | 11,419 | 5.0 | 3,818 | 43.6 |
| Average annual percentage change |  |  |  |  |  |  |  |
| 1970-95 | 0.2\% | 1.0\% | 0.3\% | -0.3\% | -0.8\% ${ }^{\text {g }}$ | 1.8\% | 1.5\% |
| 1985-95 | 0.0\% | 2.0\% | -0.6\% | 0.6\% | 1.3\% | 1.0\% | 1.6\% |

Source: an Public Transit Association, 1997 Transit
Energy use - See Appendix A for Table 2.7

[^57]
## CHAPTER 7 EMISSIONS AND TRANSPORTATION

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Table 7.1
Total National Emissions by Sector, 1995 (millions of short tons/percentage)

| Sector | $\mathbf{C O}$ | $\mathbf{N O}_{\mathbf{x}}$ | $\mathbf{V O C}$ | $\mathbf{P M - 1 0}$ | $\mathbf{S O}_{2}$ | $\mathbf{C O}_{2}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Highway vehicles | $\mathbf{5 8 . 6 2}$ | $\mathbf{7 . 6 1}$ | $\mathbf{6 . 1 0}$ | $\mathbf{0 . 1 0}$ | $\mathbf{0 . 3 0}$ | $\mathbf{a}$ |
|  | $63.6 \%$ | $34.9 \%$ | $26.7 \%$ | $0.7 \%$ | $1.4 \%$ | $a$ |
| Aircraft | $\mathbf{1 . 0 5}$ | $\mathbf{0 . 1 5}$ | $\mathbf{0 . 2 1}$ | $\mathbf{0 . 0 5}$ | $\mathbf{0 . 0 0}$ | $\mathbf{a}$ |
| Railroads | $1.1 \%$ | $0.7 \%$ | $0.9 \%$ | $0.1 \%$ | $0.0 \%$ | $a$ |
|  | $\mathbf{0 . 1 3}$ | $\mathbf{0 . 9 9}$ | $\mathbf{0 . 0 4}$ | $\mathbf{0 . 0 5}$ | $\mathbf{0 . 0 7}$ | $\mathbf{a}$ |
| Vessels | $0.1 \%$ | $4.5 \%$ | $0.2 \%$ | $0.1 \%$ | $0.3 \%$ | $a$ |
|  | $\mathbf{0 . 0 7}$ | $\mathbf{0 . 1 9}$ | $\mathbf{0 . 0 4}$ | $\mathbf{0 . 0 3}$ | $\mathbf{0 . 2 1}$ | $\mathbf{a}$ |
| Other off-highway | $0.1 \%$ | $0.9 \%$ | $0.2 \%$ | $0.1 \%$ | $1.0 \%$ | $a$ |
|  | $\mathbf{1 4 . 3 8}$ | $\mathbf{1 . 6 6}$ | $\mathbf{1 . 9 5}$ | $\mathbf{0 . 2 7}$ | $\mathbf{0 . 0 0}$ | $\mathbf{a}$ |
|  | $15.6 \%$ | $7.6 \%$ | $8.5 \%$ | $0.6 \%$ | $0.0 \%$ | $a$ |
| Transportation total | $\mathbf{7 4 . 2 6}$ | $\mathbf{1 0 . 6 0}$ | $\mathbf{8 . 3 4}$ | $\mathbf{0 . 7 0}$ | $\mathbf{0 . 5 8}$ | $\mathbf{1 , 8 4 7 . 4 0}$ |
|  | $80.6 \%$ | $48.6 \%$ | $36.5 \%$ | $1.6 \%$ | $2.7 \%$ | $35.4 \%$ |
| Stationary source fuel combustion | $\mathbf{3 . 2 3}$ | $\mathbf{1 0 . 0 8}$ | $\mathbf{0 . 7 1}$ | $\mathbf{0 . 9 1}$ | $\mathbf{1 5 . 6 6}$ | $\mathbf{a}$ |
|  | $3.5 \%$ | $46.3 \%$ | $3.1 \%$ | $2.1 \%$ | $87.6 \%$ | $a$ |
| Industrial processes | $\mathbf{5 . 6 7}$ | $\mathbf{0 . 7 9}$ | $\mathbf{1 0 . 9 4}$ | $\mathbf{0 . 6 9}$ | $\mathbf{2 . 0 2}$ | $\mathbf{a}$ |
|  | $6.2 \%$ | $3.6 \%$ | $47.8 \%$ | $1.6 \%$ | $9.4 \%$ | $a$ |
| Waste disposal and recycling total | $\mathbf{1 . 7 7}$ | $\mathbf{0 . 0 9}$ | $\mathbf{2 . 4 1}$ | $\mathbf{0 . 2 5}$ | $\mathbf{0 . 0 4}$ | $\mathbf{a}$ |
|  | $1.9 \%$ | $0.4 \%$ | $10.5 \%$ | $0.6 \%$ | $0.2 \%$ | $a$ |
| Miscellaneous | $\mathbf{6 . 4 5}$ | $\mathbf{0 . 2 3}$ | $\mathbf{0 . 4 5}$ | $\mathbf{3 7 . 9 3}$ | $\mathbf{0 . 0 1}$ | $\mathbf{a}$ |
|  | $7.0 \%$ | $1.1 \%$ | $2.0 \%$ | $94.0 \%$ | $0.0 \%$ | $a$ |
| Total of all sources | $\mathbf{9 2 . 1 0}$ | $\mathbf{2 1 . 7 8}$ | $\mathbf{2 2 . 8 7}$ | $\mathbf{4 2 . 6 4}$ | $\mathbf{1 8 . 3 2}$ | $\mathbf{5 , 2 8 8 . 5 0}$ |
|  | $100.0 \%$ | $100.0 \%$ | $100.0 \%$ | $100.0 \%$ | $100.0 \%$ | $100.0 \%$ |

## Source:

All other-U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1995, 1996, Appendix A.
Carbon dioxide-U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1995, Washington, DC, October 1996, pp. 11, 12, 20.
(Additional resources: http://www.eia.doe.gov, www.epa.gov/oar/oaqps)

## Note:

$\mathrm{CO}=$ Carbon monoxide. $\mathrm{NO}_{\mathrm{x}}=$ Nitrogen oxides. $\mathrm{PM}-10=$ Particulate matter less than 10 microns.
$\mathrm{SO}_{2}=$ Sulfur dioxide. VOC $=$ Volatile organic compounds. $\mathrm{CO}_{2}=$ Carbon dioxide.

[^58]Table 7.2
Total National Emissions of Carbon Monoxide, 1940-95 ${ }^{\text {a }}$ (million short tons)

| Source category | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 | 1993 | 1994 | 1995 | Percent of total, 1995 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Highway vehicles | 30.12 | 45.20 | 64.27 | 88.03 | 78.05 | 62.86 | 60.20 | 61.83 | 58.62 | 63.6\% |
| Aircraft | 0.00 | 0.93 | 1.76 | 0.51 | 0.74 | 0.97 | 1.02 | 1.06 | 1.05 | 1.1\% |
| Railroads | 4.08 | 3.08 | 0.33 | 0.07 | 0.10 | 0.12 | 0.12 | 0.12 | 0.13 | 0.1\% |
| Vessels ${ }^{\text {b }}$ | 0.06 | 0.12 | 0.52 | 0.98 | 1.10 | 1.21 | 1.25 | 0.06 | 0.07 | 0.1\% |
| Other off-highway | 3.91 | 7.48 | 8.96 | 9.06 | 10.74 | 12.35 | 12.88 | 14.41 | 14.38 | 15.6\% |
| Transportation total | 38.17 | 56.81 | 69.87 | 98.64 | 90.73 | 77.5 | 75.47 | 77.48 | 74.26 | 80.6\% |
| Stationary fuel combustion total | 15.33 | 11.32 | 7.02 | 4.63 | 7.30 | 5.06 | 4.95 | 4.88 | 3.23 | 3.5\% |
| Industrial processes total | 7.28 | 11.64 | 10.28 | 9.84 | 6.95 | 5.23 | 5.28 | 5.42 | 5.67 | 6.2\% |
| Waste disposal and recycling total | 3.63 | 4.72 | 5.60 | 7.06 | 2.3 | 1.69 | 1.73 | 1.75 | 1.77 | 1.9\% |
| Miscellaneous total | 29.21 | 18.14 | 11.01 | 7.91 | 8.34 | 11.17 | 6.70 | 9.25 | 6.45 | 7.0\% |
| Total of all sources | 93.62 | 102.61 | 109.75 | 128.08 | 115.63 | 100.65 | 94.13 | 98.78 | 92.10 | 100.0\% |

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1995, 1996, pp. A-6-A-9, and annual.
(Additional resources: http://www.epa/oar/oaqps)
Note:
Emission estimation methodology changes indicated by shaded areas. Transportation methodologies changed in 1970, while all others changed in 1990.

[^59]Table 7.3
Total National Emissions of Nitrogen Oxides, 1940-95 ${ }^{\text {a }}$ (million short tons)

| Source category | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 | 1993 | 1994 | 1995 | Percent of total, 1995 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Highway vehicles | 1.33 | 2.14 | 3.98 | 7.39 | 8.62 | 7.49 | 7.51 | 7.67 | 7.61 | 34.9\% |
| Railroads | 0.66 | 0.99 | 0.77 | 0.50 | 0.73 | 0.93 | 0.95 | 0.95 | 0.99 | 4.5\% |
| Other off-highway | 0.33 | 0.55 | 0.67 | 1.13 | 1.69 | 1.91 | 2.04 | 2.15 | 2.00 | 9.2\% |
| Transportation total | 2.32 | 3.68 | 5.43 | 9.02 | 11.04 | 10.33 | 10.50 | 10.77 | 10.60 | 48.6\% |
| Stationary fuel combustion total | 3.73 | 5.16 | 7.37 | 10.06 | 11.32 | 11.48 | 11.70 | 11.63 | 10.08 | 46.3\% |
| Industrial processes total | 0.22 | 0.38 | 0.57 | 0.78 | 0.56 | 0.77 | 0.78 | 0.80 | 0.79 | 3.6\% |
| Waste disposal and recycling total | 0.11 | 0.22 | 0.33 | 0.44 | 0.11 | 0.08 | 0.08 | 0.09 | 0.09 | 0.4\% |
| Miscellaneous total | 0.99 | 0.67 | 0.44 | 0.33 | 0.25 | 0.38 | 0.22 | 0.37 | 0.23 | 1.1\% |
| Total of all sources | 7.37 | 10.09 | 14.14 | 20.63 | 23.28 | 23.04 | 23.30 | 23.66 | 21.78 | 100.0\% |

## Source:

U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1995, 1996, pp. A-6-A-9, and annual. (Additional resources: http://www.epa/oar/oaqps)

## Note:

Emission estimation methodology changes indicated by shaded areas. Transportation methodologies changed in 1970, while all others changed in 1990.

[^60]Table 7.4
Emissions of Nitrogen Oxides from Highway Vehicles, 1970-95 ${ }^{\text {a }}$ (million short tons)

| Source category | 1970 | 1980 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | Percent of total, 1995 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Gasoline powered |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Light-duty vehicles \& motorcycles | 4.16 | 4.42 | 3.81 | 3.60 | 3.50 | 3.50 | 3.49 | 3.44 | 3.46 | 3.61 | 3.68 | 3.57 | 3.61 | 47.4\% |
| Light-duty trucks ${ }^{\text {b }}$ | 1.28 | 1.41 | 1.53 | 1.46 | 1.44 | 1.42 | 1.39 | 1.34 | 1.34 | 1.36 | 1.42 | 1.66 | 1.62 | 21.3\% |
| Heavy-duty vehicles | 0.28 | 0.30 | 0.33 | 0.33 | 0.33 | 0.34 | 0.34 | 0.34 | 0.33 | 0.31 | 0.32 | 0.35 | 0.35 | 4.6\% |
| Total | 5.72 | 6.13 | 5.67 | 5.39 | 5.27 | 5.26 | 5.22 | 5.12 | 5.13 | 5.28 | 5.42 | 5.58 | 5.58 | 73.3\% |
| Diesel powered |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Light-duty vehicles | c | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.5\% |
| Light-duty trucks ${ }^{\text {b }}$ | c | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1\% |
| Heavy-duty vehicles | 1.68 | 2.46 | 2.39 | 2.35 | 2.35 | 2.37 | 2.42 | 2.33 | 2.20 | 2.12 | 2.01 | 2.04 | 1.97 | 25.9\% |
| Total | 1.68 | 2.50 | 2.43 | 2.39 | 2.39 | 2.41 | 2.47 | 2.38 | 2.25 | 2.17 | 2.06 | 2.09 | 2.02 | 26.5\% |
| Total |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Highway vehicle total | 7.39 | 8.62 | 8.09 | 7.77 | 7.65 | 7.66 | 7.68 | 7.49 | 7.37 | 7.44 | 7.51 | 7.67 | 7.61 | 100.0\% |
| Percent diesel | 18.7\% | 29.0\% | 30.0\% | 30.8\% | $31.2 \%$ | 31.5\% | $32.2 \%$ | 31.8\% | 30.5\% | 29.2\% | 27.4\% | 27.2\% | 26.5\% |  |

## Source:

U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1995, 1996, p. A-8 and annual.
(Additional resources: http://www.epa.gov/oar/oaqps)

[^61]Table 7.5
Total National Emissions of Volatile Organic Compounds, 1940-95 ${ }^{\text {a }}$ (million short tons)

|  |  |  |  |  |  |  |  | Percent of total, |  |  |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Source category | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 | 1993 | 1994 | 1995 | 1995 |
| Highway vehicles | 4.82 | 7.25 | 10.51 | 12.97 | 8.98 | 6.85 | 6.10 | 6.40 | 6.10 | $26.7 \%$ |
| Off-highway | 0.78 | 1.21 | 1.22 | 1.54 | 1.87 | 2.12 | 2.21 | 2.26 | 2.24 | $9.8 \%$ |
| Transportation total | 5.60 | 8.46 | 11.73 | 14.51 | 10.85 | 8.97 | 8.31 | 8.66 | 8.34 | $36.5 \%$ |
| Stationary fuel combustion total | 1.98 | 1.44 | 0.88 | 0.72 | 1.05 | 0.92 | 0.90 | 0.89 | 0.71 | $3.1 \%$ |
| Industrial processes total | 4.52 | 7.40 | 8.73 | 12.33 | 12.10 | 10.38 | 10.58 | 10.78 | 10.94 | $47.8 \%$ |
| Waste disposal and recycling total | 0.99 | 1.10 | 1.55 | 1.98 | 0.76 | 2.26 | 2.27 | 2.27 | 2.41 | $10.5 \%$ |
| Miscellaneous total | 4.08 | 2.53 | 1.57 | 1.10 | 1.13 | 1.07 | 0.52 | 0.69 | 0.45 | $2.0 \%$ |
|  |  |  |  |  |  |  |  |  |  |  |
| Total of all sources | $\mathbf{1 7 . 1 6}$ | $\mathbf{2 0 . 9 4}$ | $\mathbf{2 4 . 4 6}$ | $\mathbf{3 0 . 6 5}$ | $\mathbf{2 5 . 8 9}$ | $\mathbf{2 3 . 6 0}$ | $\mathbf{2 2 . 5 8}$ | $\mathbf{2 3 . 2 8}$ | $\mathbf{2 2 . 8 7}$ | $\mathbf{1 0 0 . 0 \%}$ |

## Source:

U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1995, 1996, pp. A-10-A-16, and annual. (Additional resources: http://www.epa.gov/oar/oaqps)

## Note:

Emission estimation methodology changes indicated by shaded areas. Transportation methodologies changed in 1970, while all others changed in 1990.
${ }^{\text {a }}$ The sum of subcategories may not equal total due to rounding. The EPA's definition of volatile organic compounds excludes methane, ethane, and certain other nonphotochemically reactive organic compounds.

Table 7.6
Total National Emissions of Particulate Matter (PM-10), 1940-95 ${ }^{\text {a }}$ (million short tons)

| Source category | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 | 1993 | 1994 | 1995 | Percent of total, 1995 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Highway vehicles | 0.21 | 0.31 | 0.55 | 0.44 | 0.40 | 0.36 | 0.32 | 0.32 | 0.30 | 0.7\% |
| Off-highway | 2.48 | 1.79 | 0.20 | 0.22 | 0.33 | 0.37 | 0.40 | 0.41 | 0.40 | 0.9\% |
| Transportation total | 2.69 | 2.10 | 0.76 | 0.66 | 0.73 | 0.73 | 0.72 | 0.73 | 0.70 | 1.6\% |
| Stationary fuel combustion total | 4.01 | 3.75 | 3.56 | 2.87 | 2.45 | 1.08 | 1.04 | 1.03 | 0.91 | 2.1\% |
| Industrial processes total | 5.90 | 8.85 | 9.24 | 7.67 | 2.75 | 0.66 | 0.66 | 0.69 | 0.69 | 1.6\% |
| Waste disposal and recycling total | 0.39 | 0.51 | 0.76 | 1.00 | 0.27 | 0.24 | 0.25 | 0.25 | 0.25 | 0.6\% |
| Miscellaneous total | 2.97 | 1.93 | 1.24 | 0.84 | 0.85 | $40.63{ }^{\text {b }}$ | $39.88{ }^{\text {b }}$ | $41.93{ }^{\text {b }}$ | $40.09^{\text {b }}$ | 94.0\% |
| Total of all sources | 15.96 | 17.13 | 15.56 | 13.04 | 7.05 | 43.34 | 42.55 | 44.62 | 42.64 | 100.0\% |

## Source:

U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1995, 1996, pp. A-21-A-25, and annual. (Additional resources: http:/www.epa.gov/oar/oaqps)

## Note:

Emission estimation methodology changes indicated by shaded areas. Transportation methodologies changed in 1970, while all others changed in 1990.

[^62]Table 7.7

## Estimates of Particulate Matter, 1990 <br> $\mathbf{P M}_{2.5}$ versus $\mathbf{P M}_{10}$ (tons)

| Source category | $\mathrm{PM}_{2.5}$ | $\mathrm{PM}_{10}$ | $\begin{gathered} \mathrm{PM}_{2.5} / \mathrm{PM}_{10} \\ \text { Ratio } \end{gathered}$ |
| :---: | :---: | :---: | :---: |
| Electric utility-coal | 99,402 | 268,779 | 37\% |
| Electric utility-oil \& gas | 6,539 | 11,413 | 57\% |
| Fuel combustion-industrial | 176,607 | 248,974 | 71\% |
| Fuel combustion-commercial \& institutional | 14,763 | 35,079 | 42\% |
| Residential wood combustion | 477,431 | 477,431 | 100\% |
| Chemical \& allied product manufacturing | 41,811 | 61,537 | 68\% |
| Metals processing | 96,429 | 138,096 | 70\% |
| Petroleum \& related industries | 20,797 | 30,112 | 69\% |
| Other industrial processes ${ }^{\text {a }}$ | 250,536 | 408,632 | 61\% |
| Solvent use | 1,807 | 2,134 | 85\% |
| Storage \& transport (oil/chemicals) | 26,489 | 64,319 | 41\% |
| Waste disposal \& recycling ${ }^{\text {b }}$ | 197,251 | 226,085 | 87\% |
| Highway vehicles-gasoline | 66,467 | 106,720 | 62\% |
| Highway vehicles-diesel | 226,207 | 250,018 | 90\% |
| Nonroad gas engines | 35,034 | 42,141 | 83\% |
| Nonroad diesel engines | 170,787 | 185,638 | 92\% |
| Boats, aircraft \& railroads | 86,303 | 108,564 | 79\% |
| Agricultural \& prescribed burning | 464,836 | 541,570 | 86\% |
| Other combustion ${ }^{\text {c }}$ | 563,643 | 624,825 | 90\% |
| Wind erosion-agricultural lands | 777,715 | 8,184,785 | 15\% |
| Paved roads | 1,497,964 | 8,991,858 | 25\% |
| Unpaved roads | 1,700,367 | 11,335,782 | 15\% |
| Construction | 1,662,280 | 8,311,402 | 20\% |
| Agricultural tilling | 1,382,009 | 6,910,045 | 20\% |
| Agricultural feedlots | 60,257 | 401,715 | 15\% |
| Miscellaneous fugitive dust | 667 | 3,571 | 19\% |
| Biogenic | 0 | 0 | 0\% |
| Total | 10,122,486 | 41,991,504 | 24\% |

Source:
E. H. Pechan \& Associates, National PM Study: OPPE Particulate Programs Implementation Evaluation System, Final Report to EPA, September 1994; and E.H. Pechan \& Associates, Updates to Fugitive Emission Components of the National Particulate Inventory, January 1996.
(Additional resources: http://www.pechan.com)
Note: Selected source categories appear in this table, therefore, total is not the sum of the column.

[^63]Table 7.8

## National Lead Emission Estimates, 1970-95

(thousand short tons per year)

| Source category | 1970 | 1975 | 1980 | 1985 | 1990 | 1993 | 1994 | 1995 | Percent of total, 1995 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Highway vehicles | 171.96 | 130.21 | 62.19 | 15.98 | 1.69 | 1.40 | 1.39 | 1.39 | 27.9\% |
| Off-highway | 8.34 | 5.01 | 3.32 | 0.23 | 0.20 | 0.18 | 0.19 | 0.19 | 3.8\% |
| Transportation total | 180.30 | 135.22 | 65.51 | 16.21 | 1.89 | 1.58 | 1.58 | 1.58 | 31.7\% |
| Stationary source fuel combustion | 10.62 | 10.35 | 4.30 | 0.52 | 0.50 | 0.49 | 0.49 | 0.49 | 9.8\% |
| Industrial processes | 26.36 | 11.38 | 3.94 | 2.53 | 2.47 | 2.04 | 2.13 | 2.07 | 41.5\% |
| Waste disposal and recycling total | 2.20 | 1.60 | 1.21 | 0.87 | 0.80 | 0.83 | 0.83 | 0.84 | 16.8\% |
| Total of all sources | 219.47 | 158.54 | 74.96 | 20.12 | 5.67 | 4.95 | 5.03 | 4.99 | 100.0\% |

Source:
U. S. Environmental Protection Agency, National Air Pollutant Emission Trends, 1900-1995, 1996, pp. A-26-A-27, and annual. (Additional resources: http://www.epa.gov/oar/oaqps)

[^64]Table 7.9
U.S. Carbon Dioxide Emissions from Energy Use in the Transportation Sector, 1980-95 (million metric tons of carbon)

| Fuel | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Petroleum |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Motor gasoline | 238.1 | 238.1 | 236.6 | 239.9 | 241.6 | 245.1 | 252.8 | 259.0 | 264.9 | 264.2 | 260.9 | 259.5 | 263.4 | 270.1 | 274.7 | 280.7 |
| LPG ${ }^{\text {a }}$ | 0.3 | 0.6 | 0.5 | 0.6 | 0.7 | 0.5 | 0.4 | 0.3 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.5 | 0.5 |
| Jet fuel | 42.0 | 39.7 | 40.4 | 41.2 | 46.5 | 48.0 | 51.6 | 54.6 | 57.3 | 58.8 | 60.1 | 58.1 | 57.6 | 58.1 | 60.4 | 60.0 |
| Distillate fuel | 55.3 | 57.4 | 55.1 | 57.4 | 62.1 | 63.3 | 65.3 | 66.9 | 72.9 | 75.8 | 75.7 | 72.6 | 75.3 | 77.3 | 82.5 | 83.8 |
| Residual fuel | 30.0 | 26.1 | 21.7 | 17.5 | 17.2 | 16.7 | 18.5 | 19.2 | 19.6 | 20.8 | 21.9 | 22.0 | 23.0 | 19.4 | 19.1 | 18.5 |
| Lubricants | 1.8 | 1.7 | 1.5 | 1.6 | 1.7 | 1.6 | 1.5 | 1.7 | 1.7 | 1.7 | 1.8 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 |
| Aviation gas | 1.2 | 1.1 | 0.9 | 0.9 | 0.8 | 0.9 | 1.1 | 0.9 | 0.9 | 0.9 | 0.8 | 0.8 | 0.8 | 0.7 | 0.7 | 0.7 |
| Total | 368.7 | 364.6 | 356.7 | 359.0 | 370.5 | 376.1 | 391.2 | 402.7 | 417.6 | 422.6 | 421.5 | 414.8 | 421.9 | 427.6 | 439.6 | 445.9 |
| Other energy |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Natural gas | 9.4 | 9.5 | 8.8 | 7.3 | 7.8 | 7.5 | 7.2 | 7.7 | 9.1 | 9.4 | 9.8 | 8.9 | 8.8 | 9.3 | 10.2 | 10.6 |
| Electricity | 0.3 | 0.3 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 |
| Total | 378.4 | 374.4 | 366.2 | 366.9 | 379.0 | 384.4 | 399.1 | 411.1 | 427.5 | 432.7 | 432.1 | 424.5 | 431.4 | 437.5 | 450.4 | 457.2 |

Source:
U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1995, Washington, DC, October 1996, p. 92, and annual.
(Additional resources: http://www.eia.doe.gov)

[^65]Table 7.10
Estimated U.S. Emissions of Greenhouse Gases, 1994-95

| Greenhouse gas | Unit of measure ${ }^{\text {a }}$ | 1994 | 1995 |
| :---: | :---: | :---: | :---: |
| Carbon dioxide | million metric tons of gas | 5248.6 | 5288.5 |
|  | million metric tons of carbon | b | 1442.3 |
| Methane | million metric tons of gas | 31.0 | b |
|  | million metric tons of carbon (gwp) ${ }^{\text {c }}$ | 178.0 | b |
| Nitrous oxide | million metric tons of gas | 0.5 | 0.5 |
|  | million metric tons of carbon (gwp) ${ }^{\text {c }}$ | 40.0 | 39.0 |
| Carbon monoxide | million metric tons of gas | 88.9 | b |
| Nitrogen oxide | million metric tons of gas | 21.4 | b |
| Nonmethane VOCs ${ }^{\text {d }}$ | million metric tons of gas | 21.0 | b |
| CFC-11,12,113 ${ }^{\text {d }}$ | million metric tons of gas | 0.1 | 0.1 |
| HCFC-22 ${ }^{\text {d }}$ | million metric tons of gas | 0.1 | 0.1 |
| HCFC-23 and PFCs ${ }^{\text {d }}$ | million metric tons of gas | e | e |
|  | million metric tons of carbon (gwp) ${ }^{\text {c }}$ | 23 | 25 |

## Source:

U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1995, Washington, DC, October 1996, pp. ix, xi.
(Additional resources: http://www.eia.doe.gov)

[^66]Table 7.11
U.S. Carbon Dioxide Emissions from Fossil Energy Consumption by End-Use Sector, 1984-95 ${ }^{\text {a }}$
(million metric tons of carbon)

| End use | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Energy consumption sectors |  |  |  |  |  |  |  |  |  |  |  |  |
| Residential | 241.1 | 245.8 | 244.0 | 251.0 | 264.8 | 267.5 | 253.0 | 257.1 | 255.9 | 271.6 | 268.6 | 270.9 |
| Commercial | 188.8 | 189.6 | 190.4 | 197.2 | 207.6 | 210.0 | 206.7 | 206.4 | 205.5 | 212.1 | 214.1 | 218.4 |
| Industrial | 434.4 | 424.1 | 409.0 | 422.7 | 444.1 | 445.6 | 452.4 | 436.6 | 453.6 | 453.7 | 463.3 | 462.9 |
| Transportation | 379.0 | 384.4 | 399.1 | 411.1 | 427.5 | 432.7 | 432.1 | 424.5 | 431.4 | 437.5 | 450.4 | 457.2 |
| Total energy | 1,243.3 | 1,243.9 | 1,242.5 | 1,282.0 | 1,344.0 | 1,355.8 | 1,344.2 | 1,324.6 | 1,346.3 | 1,374.9 | 1,396.4 | 1,409.4 |
| Electric utility sector |  |  |  |  |  |  |  |  |  |  |  |  |
| Electric utility | 427.9 | 438.9 | 435.4 | 452.6 | 475.9 | 483.5 | 476.9 | 473.5 | 472.9 | 490.6 | 494.8 | 493.8 |

## Source:

U.S. Department of Energy, Energy Information Administration, Emissions of Greenhouse Gases in the United States, 1995, Washington, DC, October 1996, p. 12, and annual.
(Additional resources: http://www.eia.doe.gov)

[^67]The Clean Air Act of 1963 and its subsequent amendments set national air quality standards for all new cars and light trucks sold. The most recent amendments in 1990 established more restrictive emission control standards which became effective in 1994.

Table 7.12
Federal Emission Control Requirements for Automobiles and Light Trucks, 1976-95 ${ }^{\text {a }}$ (grams per mile)

| Model <br> Year | Automobiles |  |  |  | $\text { Light trucks }{ }^{\text {b }}$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Hydrocarbons (HC) | Carbon monoxide (CO) | Nitrogen oxides $\left(\mathrm{NO}_{\mathrm{x}}\right)$ | Particulates ${ }^{\text {c }}$ | Hydrocarbons (HC) | Carbon monoxide (CO) | Nitrogen oxides $\left(\mathrm{NO}_{\mathrm{x}}\right)$ | Particulates ${ }^{\text {c }}$ |
| 1968-71 | 4.10 | 34.0 | d | d | 8.0 | 102.0 | 3.6 | d |
| 1972-74 | 3.00 | 28.0 | 3.1 | d | 8.0 | 102.0 | 3.6 | d |
| 1975-76 | 1.50 | 15.0 | 3.1 | d | 2.0 | 20.0 | 3.1 | d |
| 1977-78 | 1.50 | 15.0 | 2.0 | d | 2.0 | 20.0 | 3.1 | d |
| 1979 | 1.50 | 15.0 | 2.0 | d | 1.7 | 18.0 | 2.3 | d |
| 1980 | 0.41 | 7.0 | 2.0 | d | 1.7 | 18.0 | 2.3 | d |
| 1981 | 0.41 | 3.4 | 1.0 | d | 1.7 | 18.0 | 2.3 | d |
| 1982-83 | 0.41 | 3.4 | 1.0 | 0.60 | 1.7 | 18.0 | 2.3 | 0.60 |
| 1984-86 | 0.41 | 3.4 | 1.0 | 0.60 | 0.8 | 10.0 | 2.3 | 0.60 |
| 1987 | 0.41 | 3.4 | 1.0 | 0.20 | 0.8 | 10.0 | 2.3 | 0.26 |
| 1988-93 | 0.41 | 3.4 | 1.0 | 0.20 | 0.8 | 10.0 | $1.2{ }^{\text {e }}$ | 0.26 |
| 1994 | 0.25 | 3.4 | 0.4 | 0.08 | 0.25 | $3.4{ }^{\text {e }}$ | $1.2{ }^{\text {e }}$ | 0.26 |
| 1995-on | 0.25 | 3.4 | 0.4 | 0.08 | 0.25 | $3.4{ }^{\text {e }}$ | $0.4{ }^{\text {f }}$ | 0.08 |

## Source:

1968-75: Motor Vehicle Manufacturers Association, Motor Vehicle Facts \& Figures '85, 1985, p. 88.
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 Amendments of 1990.
${ }^{\text {a }}$ California standards not included.
${ }^{\mathrm{b}}$ 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.
${ }^{c}$ Applies to diesel engines only.
${ }^{\mathrm{d}}$ No standard was set for this year.
${ }^{\mathrm{e}}$ Applies to light trucks up to and including 3,750 pounds loaded vehicle weight (LVW).
${ }^{\mathrm{f}}$ Applies to light trucks up to and including 3,750 pounds LVW. Does not apply to diesel-fueled light trucks.

Table 7.13
Federal Emission Control Requirements for Heavy-Duty Gasoline Trucks, 1976-95 ${ }^{\text {a }}$ (grams per brake horsepower hour)

| Model Year | Hydrocarbons <br> $(\mathrm{HC})$ | Carbon monoxide <br> $(\mathrm{CO})$ | Nitrogen oxides <br> $\left(\mathrm{NO}_{\mathrm{x}}\right)$ | Hydrocarbons + <br> nitrogen oxides <br> $\left(\mathrm{HC}+\mathrm{NO}_{\mathrm{x}}\right)$ |
| :--- | :---: | :---: | :---: | :---: |
| $1974-78$ | b | 40.0 | b | 16.0 |
| $1979-83$ | 1.5 | 25.0 | b | 10.0 |
| 1984 | 1.3 | 15.5 | 10.7 | b |
| $1985-86$ | 2.5 | 40.0 | 10.7 | b |
| $1987-89$ | 1.9 | 37.1 | 10.6 | b |
| 1990 | 1.9 | 37.1 | 6.0 | b |
| $1991-93$ | 1.9 | 37.1 | 5.0 | b |
| 1994 | $1.9^{\mathrm{c}}$ | $37.1^{\mathrm{c}}$ | $37.1^{\mathrm{c}}$ | $5.0^{\mathrm{c}}$ |
| $1995-97$ | $1.9^{\mathrm{c}}$ | $37.1^{\mathrm{c}}$ | $5.0^{\mathrm{c}}$ | b |
| $1998-\mathrm{on}$ | $1.9^{\mathrm{c}}$ | $4.0^{\mathrm{c}}$ | b |  |

Source:
1974-75: MVMA, Motor Vehicle Facts \& Figures '85, 1985, p. 88.
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, p. 264.
1994-on: Clean Air Act Amendments of 1990.

Table 7.14
Federal Emission Control Requirements for
Heavy-Duty Diesel Trucks, 1976-95 ${ }^{\text {d }}$ (grams per brake horsepower hour)

|  | Hydrocarbons <br> $(\mathrm{HC})$ | Carbon <br> monoxide <br> $(\mathrm{CO})$ | Nitrogen <br> oxides <br> $\left(\mathrm{NO}_{\mathrm{x}}\right)$ | Hydrocarbons + <br> nitrogen oxides <br> $\left(\mathrm{HC}+\mathrm{NO}_{\mathrm{x}}\right)$ | Particulates |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Model Year | b | 40.0 | b | 16.0 | b |
| $1976-78$ | 1.5 | 25.0 | b | 10.0 | b |
| $1979-83$ | 1.3 | 15.5 | 10.7 | 5.0 | b |
| 1984 | 1.3 | 15.5 | 10.7 | b | b |
| $1985-87$ | 1.3 | 15.5 | 10.7 | b | 0.60 |
| $1988-89$ | 1.3 | 15.5 | 6.0 | b | 0.60 |
| 1990 | 1.3 | 15.5 | 5.0 | b | 0.25 |
| $1991-93$ | $1.3^{\mathrm{c}}$ | 15.5 | 5.0 | b | 0.10 |
| $1994-97$ | $1.3^{\mathrm{c}}$ | $15.5^{\mathrm{c}}$ | $4.0^{\mathrm{c}}$ | b | $0.10^{\mathrm{c}}$ |
| $1998-$-n |  |  |  |  |  |

Source:
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, p. 264.
1994-on: Clean Air Act Amendments of 1990.

[^68]Table 7.15
Light-Duty Vehicles and Trucks Exhaust Emission Certification Standards, Federal and California Programs (grams per mile)

|  | Useful Life 5 years/50,000 miles |  |  |  |  | Useful Life 10 years/100,000 miles |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Effective Dates | NMOG | $\text { NMHC }^{\text {b }, \mathbf{c}}$ | CO | NOx | PM | NMOG | $\mathrm{NMHC}^{\mathrm{b}, \mathrm{c}}$ | CO | NOx | PM |
| Through 1993 | d | d | 3.4 | 1.0 | 0.2 | --- | --- | --- | --- | --- |
| Federal Tier 1 Standards (1994-2002) | d | d |  | c |  |  |  |  |  | d |
| Gasoline \& Methanol | (0.257) | 0.25 | 3.4 | 0.4 | 0.08 | (0.319) | 0.31 | 4.2 | 0.6 | 0.10 |
| Diesel | (0.257) | 0.25 | 3.4 | 1.0 | 0.08 | (0.319) | 0.31 | 4.2 | 1.25 | 0.10 |
| Cold CO (all vehicles) | d | d | 10 | e | f |  |  |  | f | f |
| Federal Tier 2 Standards (2003+) ${ }^{\text {g }}$ | --- | --- | --- | --- | --- | (0.128) | 0.125 | 1.7 | 0.2 | 0.10 |
| California Tier 1 (1994-1999) | 0.257 | (0.25) | 3.4 | 0.4 | 0.08 | 0.319 | (0.31) | 4.2 | 0.6 | 0.10 |
| California TLEV (1994-1996) | 0.125 | (0.121) | 3.4 | 0.4 | --- | 0.156 | (0.151) | 4.2 | 0.6 | 0.08 |
| California LEV (1997-2003) | 0.075 | (0.073) | 3.4 | 0.2 | --- | 0.09 | (0.087) | 4.2 | 0.3 | 0.08 |
| California ULEV (1997-2003) | 0.04 | (0.039) | 1.7 | 0.2 | --- | 0.055 | (0.053) | 2.1 | 0.3 | 0.04 |
| Federal Clean Fuel Fleet LEV (1998) | 0.075 | (0.073) | 3.4 | 0.2 | 0.08 | 0.09 | (0.087) | 4.2 | 0.3 | 0.08 |
| Federal Clean Fuel Fleet ULEV (1998) | 0.04 | (0.039) | 1.7 | 0.2 | 0.08 | 0.055 | (0.053) | 2.1 | 0.3 | 0.04 |
| Calif. Pilot Program TLEV (1994-1996) | 0.125 | (0.121) | 3.4 | 0.4 | 0.08 | 0.156 | (0.151) | 4.2 | 0.6 | 0.08 |
| California Pilot Program LEV (2001) | 0.075 | (0.073) | 3.4 | 0.2 | 0.08 | 0.09 | (0.087) | 4.2 | 0.3 | 0.08 |
| California Pilot Program ULEV (2001) | 0.04 | (0.039) | 1.7 | 0.2 | 0.08 | 0.055 | (0.053) | 2.1 | 0.3 | 0.04 |

## Source:

Http://www.epa.gov/OMSWWW/gopher/Cert/Veh-cert/stands95.pdf
Note:
Standards are reported for non-methane organic gas (NMOG), non-methane hydrocarbons (NMHC), carbon monoxide (CO), oxides of nitrogen (NOx), and particulate matter (PM),
${ }^{\text {a }}$ Light-duty vehicle- passenger car or passenger car derivative capable of seating 12 passengers or less. Light-duty truck - any motor vehicle rated at $8,500 \mathrm{lbs}$. GVWR or less with vehicle curb weight of $6,000 \mathrm{lbs}$. or less and a basic frontal area $45 \mathrm{sq} . \mathrm{ft}$. or less, which is 1) designed primarily for purposes of transportation of property or is a derivation of such a vehicle, or 2 ) designed primarily for transportation of persons and has a capacity of more than 12 persons; or 3) available with special features enabling off-street or off-highway operation and use. Loaded Vehicle Weight (LVW) - vehicle curb weight plus 300 lbs . Gross Vehicle Weight Rating (GVWR ) - minimum loaded weight for which the vehicle is designed, as specified by the manufacturer.
${ }^{\text {b }}$ California Tier 1 and LEV standards are for NMOG; Federal Tier 1 and Tier 2 standards are for NMHC. The figures indicated in parenthesis are for comparison purposes only; there are no California NHMC standards and there are no Federal NMOG standards for Tier 1 and Tier 2. Standards for Federal Clean Fuel vehicles (Fleet program and California Pilot Program) are in terms of NMOG. However, NMHC also applies as the Clean Air Act Amendments of 1990 did not delete NMHC requirements. California LEVs can be certified on California reformulated phase-2 gasoline, and California allows the use of reactivity adjustment factors. Although these effects are complex, an approximate conversion from NMOG to NMHC is obtained using the following conversion factor: NMOG $\times 10^{6}\left(1 /\left(1.0160 \times 10^{4} * 1.0144\right)\right)=$ NMOG (memo from Richard Cox to Phil Lorang. "Procedure for generating MOBILE 4.1 Exhaust TOG Correction Factors," 6/18/91). There are two factors: 1.0160, which accounts for the additional aldehydes that are included in NMOG emissions on non-oxygenated gasoline; and 1.0144 , which accounts for the additional aldehydes associated with the use of oxygenated fuel. The second factor is required since the California LEVs will be certified on oxygenated fuel.
${ }^{\mathrm{c}}$ For methanol-fueled light-duty vehicles, organic gas standards are expressed on an organic material nonmethane hydrocarbon equivalent (OMNMHCE) basis. This standard controls carbon emissions from methanol vehicles to a level which is equivalent on a total carbon basis to that allowed from gasoline-fueled vehicles under their respective hydrocarbon standards.
${ }^{\mathrm{c}}$ Total exhaust hydrocarbons not to exceed 0.41 gpm . For methanol-fueled light-duty vehicles, this standard is expressed on an organic material hydrocarbon equivalent (OMHCE) basis.
${ }^{\mathrm{e}}$ The Federal Tier 1 diesel NOx standard will be eliminated after Model Year 2003. The 0.4 gpm standard will then apply to diesel vehicles.
${ }^{\mathrm{f}}$ The Federal Tier 1 PM standard is effective beginning the Model Year 1994 for light-duty vehicles and Model Year 1995 for light-duty trucks.
${ }^{\mathrm{g}}$ The promulgation of Federal Tier 2 standards is subject to the Administrator's discretion, both in terms of their levels and effective date.

California's Low-Emission Vehicle regulations provide for reduced emission vehicles to be available $D$ consumers. Vehicles meeting these standards have even lower emissions than the stringent basic standards for all new vehicles sold in California. Currently, there is a wide array of TLEVs and LEVs, and a fow ULEVs and ZEVs on the market. For a listing of the available low emissionvehicles, see the California Air Resources Board web site referenced below.

Table 7.16
California Vehicle Emissions Reduction for Passenger Cars and Light-Duty Trucks

|  | Emission Reduction |  |  |
| :--- | :---: | :---: | :---: |
|  | HC | CO | NOx |
| Transitional Low-Emission Vehicle (TLEV) | $50 \%$ | $=$ | $=$ |
| Low-Emission Vehicle (LEV) | $70 \%$ | $=$ | $50 \%$ |
| Ultra-Low-Emission Vehicle (ULEV) | $85 \%$ | $50 \%$ | $50 \%$ |
| Zero-Emission Vehicles (ZEV) | $100 \%$ | $100 \%$ | $100 \%$ |

## Source:

California Air Resources Board web site, http://www.arb.ca.gov/msprog/ccbg/ccbg.htm (Additional resources: http://www.arb.ca.gov)
$=$ equivalent emissions to vehicles meeting the basic California standard.

The California Air Resources Board adopted requirements in 1991 for fleet mixture in orderto meet the emission standards. By the year 2001, it is proposed that $90 \%$ of each vehicle manufacturer's feet be lowemission vehicles. In March 1996, an amendment to the plan allows the marketplace to determine the number of zero emission vehicles from 1998 to 2002.

Table 7.17
California Air Resources Board Requirements for Meeting Emission Standards

| Year | Percent of manufacturers' fleet | Vehicle type $^{\text {a }}$ |
| :---: | :---: | :---: |
| 1989 | 100 | CV |
| 1993 | 100 | CV |
| 1994 | 90 | CV |
|  | 1995 | 10 |
|  | 85 | TLEV |
| 1996 | 15 | CVEV |
|  | 80 | CV |
| 1997 | 20 | TLEV |
|  | 73 | CV |
|  | 25 | LEV |
| $1998-2000$ | 2 | ULEV |
|  | 48 | CV |
|  | 48 | LEV |
|  | 2 | ULEV |
|  | b | ZEV |
|  | 90 | LEV |
|  | 5 | ULEV |
|  | b | ZEV |
|  | 75 | LEV |
|  | 15 | ULEV |
|  | 10 | ZEV |

## Source:

California Air Resources Board, Mobile Sources Division, El Monte, CA, 1996.
(Additional resources: http://www.arb.ca.gov)

[^69]Clean Cities is a locally-based government/industry partnership, coordinated by the U.S. Department of Energy to expand the use of alternatives to gasoline and diesel fuel. By combining the decision-making with voluntary action by partners, the "grass-roots" approachof Clean Cities departs from traditional "topdown" Federal programs. It establishes a plan, carried out at the local level, for creating a sustainable, nationwide alternative fuels market.

Table 7.18
List of Clean Cities as of 2/24/97

| 1. | Atlanta, GA - 9/8/93 | 28. | St. Louis, MO-11/18/94 |
| :---: | :---: | :---: | :---: |
| 1. | Denver, CO-9/13/93 | 29. | Norwalk, CT-11/21/94 |
| 2. | Philadelphia, PA - 9/22/93 | 30. | Waterbury, CT-11/21/94 |
| 3. | Wilmington, DE - 10/12/93 | 31. | Norwich, CT - 11/22/94 |
| 4. | Las Vegas, NV - 10/18/93 | 32. | New London, CT-11/22/94 |
| 5. | Washington, DC - 10/21/93 | 33. | Peoria, IL-11/22/94 |
| 6. | Boston, MA - 3/18/94 | 34. | Kansas - SW Area - 3/30/95 |
| 7. | Austin, TX - 4/18/94 | 35. | Central New York - 6/15/95 |
| 8. | Florida Gold Coast - 5/3/94 | 36. | Dallas/Ft. Worth, TX - 7/25/95 |
| 9. | Chicago, IL - 5/13/94 | 37. | Honolulu, HI - 8/29/95 |
| 10. | Albuquerque, NM - 6/1/94 | 38. | Missoula, MT - 9/21/95 |
| 11. | Wisconsin - SE Area - 6/30/94 | 39. | New Haven, CT - 10/5/95 |
| 12. | Colorado Springs, CO-7/13/94 | 40. | Central Arkansas - 10/25/95 |
| 13. | Long Beach, CA - 8/31/94 | 41. | Paso Del Norte - 11/17/95 |
| 14. | Lancaster, CA - 9/22/94 | 42. | Pittsburgh, PA - 12/5/95 |
| 15. | Salt Lake City, UT - 10/3/94 | 43. | S. California Assn. Gov. - 3/1/96 |
| 16. | White Plains, NY - 10/4/94 | 44. | Los Angeles, CA - 3/22/96 |
| 17. | Baltimore, MD - 10/7/94 | 45. | Coachella Valley, CA - 4/22/96 |
| 18. | Louisville, KY - 10/18/94 | 46. | Weld/Larimer/Rocky Mountain |
| 19. | Rogue Valley, OR - 10/18/94 |  | National Park - 5/21/96 |
| 20. | State of WV - 10/18/94 | 47. | Central Oklahoma - 5/29/96 |
| 21. | Sacramento, CA - 10/21/94 | 48. | Hampton Roads, VA -10/4/96 |
| 22. | Oakland, CA - 10/21/94 | 49. | Long Island, NY -10/18/96 |
| 23. | San Joaquin Valley, CA - 10/21/94 | 50. | San Diego, CA 12/12/96 |
| 24. | San Francisco, CA - 10/21/94 | 51. | Detroit, MI/Toronto,ON -12/18/96 |
| 25. | South Bay (San Jose), CA - 10/21/94 | 52. | Evansville, IL - 1/30/97 |
| 26. | Western New York - 11/4/94 | 53. | Red River,Valley/Grand Forks, ND |
| 27. | Portland, OR - 11/10/94 |  |  |

## Cities Nearing Designation

| 54. | Florida Suncoast | 58. | Riverside, CA |
| :--- | :--- | :--- | :--- |
| 55. | Genesee Region, NY | 59. | Santa Barbara, CA |
| 56. | Houston, TX | 60. | Santa Monica, CA |

57. Redwood Empire/San Rosa, CA

For more information, contact the Clean Cities Hotline at (800) CCITIES, or write to: U.S. Department of Energy, EE-33, Clean Cities Program, 1000 Independence Avenue SW, Washington, DC 20585.

## Source:

U.S. Department of Energy, Alternative Fuel Information, Clean Cities: Guide to Alternative Fuel Vehicle Incentives \& Laws, Washington, DC, November 1996, and updates from web site.
(Additional resources: http://www.ccities.doe.gov)

Figure 7.1. Map of Clean Cites as of $2 / 24 / 97$


## Source:

U.S. Department of Energy, Alternative Fuel Information, Clean Cites: Guide to Alternative fuel Vehicle Incentives \& Laws, Washington, DC, November 1996, and updates from web sites.
(Additional resources: http://www.ccities.doe.gov)

## APPENDIX A

## SOURCES

This appendix 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．Since abbreviations are used throughout the appendix，a list of abbreviations is also included．

## List of Abbreviations Used in Appendix A

| AAMA | American Automobile Manufacturers Association |
| :--- | :--- |
| AAR | Association of American Railroads |
| APTA | American Public Transit Association |
| Amtrak | National Railroad Passenger Corporation |
| Btu | British thermal unit |
| DOC | Department of Commerce |
| DOE | Department of Energy |
| DOT | Department of Transportation |
| EIA | Energy Information Administration |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FHWA | Federal Highway Administration |
| gvw | gross vehicle weight |
| lpg | liquefied petroleum gas |
| mpg | miles per gallon |
| NHTSA | National Highway Traffic Safety Administration |
| NPTS | Nationwide Personal Transportation Study |
| ORNL | Oak Ridge National Laboratory |
| pmt | passenger－miles traveled |
| RECS | Residential Energy Consumption Survey |
| RTECS | Residential Transportation Energy Consumption Survey |
| TIUS | Truck Inventory and Use Survey |
| TSC | Transportation Systems Center |
| vmt | vehicle－miles traveled |

Table 2.9
Domestic Consumption of Transportation Energy by Mode and Fuel Type， 1995

Most of the source data were given in gallons．It was converted to Btu by using the conversion factors in Appendix B．

## Highway

## Automobiles

Total gallons of fuel taken from DOT，FHWA，Highway Statistics 1995，Table VM－1．These were distributed as follows： $97.8 \%$ gasoline， $1.0 \%$ gasohol，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 1991，December 1993，p． 46．Natural gas data are from the DOE，EIA Natural Gas Annual，1995，Table 1；transit bus and truck natural gas were subtracted from total and the remainder was assumed to be automobile use．Methanol use was estimated using data from DOE，EIA，Alternatives to Traditional Transportation Fuels，Washington，DC，December 1996，p． 23.

## Motorcycles

DOT，FHWA，Highway Statistics 1995，Table VM－1．For conversion purposes，fuel for all motorcycles was assumed to be gasoline．

## Buses

## Transit：

APTA， 1997 Transit Fact Book，February 1997，Washington，DC，pp．132－135．
Non－diesel fossil fuel consumption was assumed to be used by motor buses．

## Intercity：

Eno Transportation Foundation，Transportation in America，Fourteenth Edition，1996， Washington，DC，p．56．For conversion purposes，fuel for all intercity buses was assumed to be diesel fuel．（1995 data were estimated using vehicle travel information．）

## School：

Gasoline and Diesel－Eno Transportation Foundation，Transportation in America， Fourteenth Edition，1996，Washington，DC，p．56．For conversion purposes，fuel for school buses was assumed to be $60 \%$ diesel fuel and $40 \%$ gasoline．
Methanol－Methanol use was estimated using data from DOE，EIA，Alternatives to Traditional Transportation Fuels，Washington DC，December 1996，p． 23.

## Trucks

## Total：

Sum of light trucks and other trucks．

## Light Trucks：

DOT，FHWA，Highway Statistics 1995，Table VM－1，for single－unit，2－axle，4－tire trucks． $96.2 \%$ of fuel assumed to be gasoline， $3.3 \%$ diesel， $0.3 \% \mathrm{lpg}$ ，and $0.2 \%$ cng；percentages were generated from the 1992 TIUS Public Use Tape．

Other Trucks：
DOT，FHWA，Highway Statistics 1995，Table VM－1．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 1992 TIUS Public Use Tape： $16.2 \%$ of fuel assumed to be gasoline， $83.3 \%$ diesel，and $0.5 \% \mathrm{lpg}$ ．

## Off Highway

## Diesel：

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

## Gasoline：

DOT，FHWA，Highway Statistics 1995，Table MF－24．Agriculture and Construction totals．

## Non－Highway

## Air

## General Aviation：

DOT，FAA，General Aviation Activity and Avionics Survey：Annual Summary Report Calendar Year 1995，Table 5．1．Jet fuel was converted from gallons to Btu using $135,000 \mathrm{Btu} /$ gallon（kerosene－type jet fuel）．

## Domestic and International Air Carrier：

DOT，Bureau of Transportation Statistics，＂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 use for international flights．

## Water

## Freight：

Total－DOE，EIA，Fuel Oil and Kerosene Sales，1995，Table 23．Adjusted sales of distillate and residual fuel oil for vessel bunkering．

## 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 $=0.95(\mathrm{Gal} / \mathrm{boat})$（number of boats）．An estimate of number of recreational boats in operation is from the U．S．Coast Guard， Boating Statistics（numbered boats）．

## Pipeline

The sum of natural gas，crude petroleum and petroleum product，and coal slurry and water．

## 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 1995，Table 1．Cubic feet were converted to Btu using $1,031 \mathrm{Btu} / \mathrm{ft}^{3}$ ．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 $29.305 \times 10^{-5} \mathrm{kWhr} / \mathrm{Btu}$ ．Electricity generation and distribution efficiency was $29 \%$ ．When generation and distribution efficiency are taken into account， 1 kWhr equals $11,765 \mathrm{Btu}$ ．

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：

Sum of freight and passenger rail．

## Freight：

AAR，Railroad Facts， 1996 Edition，Washington，DC，p． 60.

## Passenger：

Transit and Commuter－APTA， 1997 Transit Fact Book，February 1997，Washington， DC，p．102－104．Transit was defined as the sum of＂heavy rail，＂＂light rail，＂and ＂other．＂
Intercity－Personal communication with Amtrak，Washington，DC．（1995 data were estimated using train－mile information．）

Table 2.11
Transportation Energy Consumption by Mode，1970－95

## Highway

## Automobiles

Total gallons of fuel for automobiles was taken from DOT，FHWA，Highway Statistics Summary to 1985，Table VM－201A；and Table VM－1 in the 1986－94 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.
1991－95－97．8\％gasoline， $1.0 \%$ gasohol，and 1．2\％diesel as reported in the DOE，EIA， Office of Markets and End Use，Energy End Use Division，Household Vehicles Energy Consumption 1991，December 1993，p． 46.
1993－95－Methanol use was estimated using data from DOE，EIA，Alternatives to Traditional Transportation Fuels，Washington，DC，December 1996，p． 23.

## Motorcycles

Department of Transportation，Federal Highway Administration，Highway Statistics Summary to 1985，Table VM－201A；and Table VM－1 in the 1986－95 annual editions．For conversion purposes，fuel for all motorcycles was assumed to be gasoline．

## Buses

Sum of transit，intercity and school．

## Transit：

APTA， 1997 Transit Fact Book，February 1997，Washington，DC，pp．102－104，and annual．
Non－diesel fossil fuel consumption was assumed to be used by motor buses．For the years 1988－92，motor bus gasoline use was estimated as $5 \%$ of＂other＂fuels，based on personal communication with the APTA Research and Statistics Department．

## Intercity：

1970－84－American Bus Association，Annual Report，Washington，DC，annual．
1985－95－Eno Transportation Foundation，Transportation in America，Fourteenth Edition，1996，Washington，DC，p．56．For conversion purposes，fuel for all intercity buses was assumed to be diesel fuel．（1995 data were estimated using vehicle travel information．）

## 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．
1987－95－Eno Transportation Foundation，Transportation in America，Fourteenth Edition，1996，Washington，DC，p．56．For conversion purposes，fuel for school buses was assumed to be $60 \%$ diesel fuel and $40 \%$ gasoline．（1995 data were estimated using vehicle travel information．）

## 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－ 95 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 1988－1993 was distributed based on the 1987 TIUS： $96.6 \%$ gasoline； $3.3 \%$ diesel；and $0.1 \% \mathrm{lpg}$ ．Fuel use for $1994-95$ was distributed based on the 1992 TIUS： $96.2 \%$ gasoline； $3.3 \%$ diesel； $0.3 \% \mathrm{lpg}$ ；and $0.2 \%$ cng．

## 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 1986－95 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 $1.0 \% \mathrm{lpg}$ ．Fuel use for $1988-93$ was distributed based on the 1987 TIUS： $19.4 \%$ gasoline； $80.4 \%$ diesel；and $0.2 \% \mathrm{lpg}$ ． Fuel use for 1994－95 was distributed based on the 1992 TIUS： $16.2 \%$ gasoline； $83.3 \%$ diesel；and $0.5 \% \mathrm{lpg}$ ．

## 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．
1985－94－DOT，FAA，General Aviation Activity and Avionics Survey：Annual Summary Report，Calendar Year 1995，Table 5．1．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．
1982－95－DOT，Bureau of Transportation Statistics，＂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 use 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，1995，Table 23．Adjusted sales of distillate and residual fuel oil for vessel bunkering．

## Recreational Boating：

1970－84－DOT，FHWA，Highway Statistics，Washington，DC，Table MF－24，annual．
1985－95－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 $=0.95(\mathrm{Gal} / \mathrm{boat})$ （number of boats）．An estimate of number of recreational boats in operation is from the U．S．Coast Guard，Boating Statistics（numbered boats）．

## Pipeline

The sum of natural gas，crude petroleum and petroleum product，and coal slurry and water．

## 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 1995，Table 1．Cubic feet were converted to Btu using $1,031 \mathrm{Btu} / \mathrm{ft}^{3}$ ．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 $29.305 \times 10^{-5} \mathrm{kWhr} /$ 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：

Sum of freight and passenger rail．

## Freight：

AAR，Railroad Facts， 1996 Edition，Washington，DC，p． 60.

## Passenger：

Transit and Commuter－APTA， 1997 Transit Fact Book，February 1997，Washington，DC， p．102－104，annual．Transit was defined as the sum of＂heavy rail，＂＂light rail，＂and ＂other．＂
Intercity－Personal communication with Amtrak，Washington，DC．（1995 data were estimated using train－mile information．）

Table 2.13
Passenger Travel and Energy Use in the United States， 1995

## Highway

## Automobiles

Number of Vehicles－DOT，FHWA，Highway Statistics 1995，Table VM－1．
Vmt－DOT，FHWA，Highway Statistics 1995，Table VM－1．
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 1995，Table VM－1．These were distributed as follows： $97.8 \%$ gasoline， $1.0 \%$ gasohol，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 1991，December 1993，p．46．Methanol use was estimated using data from DOE，EIA，Alternatives to Traditional Transportation Fuels，Washington，DC，December 1996，p．23．

## Personal Trucks

Number of Vehicles－Based on the 1992 TIUS， $73.9 \%$ of total 2－axle，4－tire trucks and $15.5 \%$ of total other trucks were for personal use．Therefore， $73.9 \%$ of total 2 －axle， 4 －tire trucks（as reported by DOT，FHWA in Highway Statistics 1995，Table VM－1）and $15.5 \%$ of total other trucks were estimated to be for personal use．
Vmt $-68.8 \%$ of total vehicle miles traveled by 2 －axle， 4 －tire trucks（as reported by DOT，FHWA in Highway Statistics 1995，Table VM－1）and $7.1 \%$ of total vehicle miles traveled by other trucks were for personal use．The percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD．
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， $66.0 \%$ of total fuel consumption by 2－axle，4－tire trucks（as reported by DOT，FHWA in Highway Statistics 1995，Table VM－1）and $3.5 \%$ of total other truck fuel consumption was for personal use．These percentages were derived by ORNL from the 1992 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 1995，Table VM－1，for single－unit，2－ axle，4－tire trucks． $96.2 \%$ of fuel assumed to be gasoline， $3.3 \%$ diesel， $0.3 \% \mathrm{lpg}$ ，and $0.2 \% \mathrm{cng}$ ；percentages were generated from the 1992 TIUS Micro Data File on CD．

Other Trucks：DOT，FHWA，Highway Statistics 1995，Table VM－1．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 1992 TIUS Public Use Tape： $16.2 \%$ of fuel assumed to be gasoline， $83.3 \%$ diesel，and $0.5 \% \mathrm{lpg}$ ．

## Motorcycles

Number of Vehicles and Vmt－DOT，FHWA，Highway Statistics 1995，Table VM－1．
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 1995，Table VM－1．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， 1997 Transit Fact Book，February 1997，Washington，DC，pp．71，78，83，102， 104.
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 1995，Table MV－10．
Pmt－Eno Transportation Foundation，Transportation in America，Fourteenth Edition， Washington，DC，1996，p． 47.
Vmt－Estimated using passenger travel and an average load factor of 23.2 persons／vehicle．
Load Factor－Estimated as 23.2 based on historical data．
Energy Use－Eno Transportation Foundation，Transportation in America，Fourteenth Edition，1996，Washington，DC，p．56．For conversion purposes，fuel for all intercity buses was assumed to be diesel fuel．（1995 data were estimated using vehicle travel information．）

## School：

Number of Vehicles－School and other nonrevenue as reported in DOT， FHWA，Highway Statistics 1995，Table MV－10．
Vmt，Pmt－National Safety Council，Accident Facts， 1996 Edition，Chicago，IL， pp．94－95．
Load Factor－Calculated by ORNL as pmt／vmt．
Energy Use－Eno Transportation Foundation，Transportation in America，Fourteenth Edition，1996，Washington，DC，p．56．For conversion purposes，fuel for school buses was assumed to be $60 \%$ diesel fuel and $40 \%$ gasoline．（1995 data were estimated using vehicle travel information．）

## Non－Highway

## Air

## Large Certified Route Air Carriers：

Vmt，Pmt－DOT，Bureau of Transportation Statistics，Air Carrier Traffic Statistics Monthly，December 1996／1995，Washington，DC，p．2．
Load Factor－Calculated by ORNL as pmt／vmt．
Energy Use－DOT，Bureau of Transportation Statistics，＂Fuel Cost and Consumption
Tables；＂annual figures were obtained by summing monthly totals for domestic only．

## General Aviation：

Number of Vehicles，Vmt，Energy Use－DOT，FAA，General Aviation Activity and Avionics，Survey：Calendar Year 1995，pp．1－7，3－11，5－3．
Pmt－Eno Transportation Foundation，Transportation in America，Fourteenth Edition， Washington，DC，1996，p． 47.
Load Factor－Calculated by ORNL as pmt／vmt．

## Recreational Boating

Number of Vehicles－U．S．Coast Guard，Boating Statistics 1995，Washington，DC， September， 1996.
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 $=0.95(\mathrm{Gal} / \mathrm{boat})$ （number of boats）．An estimate of number of recreational boats in operation is from the U．S．Coast Guard，Boating Statistics（numbered boats）．

## Rail

## Intercity：

Number of Vehicles，Vmt and Pmt－AAR，Railroad Facts， 1996 Edition，Washington，DC， p． 78.
Load Factor－Calculated by ORNL as pmt／vmt．
Energy Use－Personal communication with Amtrak，Washington，DC．（1995 data estimated using train－mile information．）

Transit and Commuter：
Number of Vehicles，Vmt and Pmt－APTA， 1997 Transit Fact Book，February 1997， Washington，DC，pp．71，78， 83.
Load Factor－Calculated by ORNL as pmt／vmt．
Energy Use－APTA， 1997 Transit Fact Book，February 1997，Washington，DC，pp．102－ 104．Transit was defined as the sum of＂heavy rail，＂＂light rail，＂and＂other．＂

Table 2.14

## Intercity Freight Movement and Energy Use in the

 United States， 1995
## Highway

## Trucks

Vehicles－ $0.3 \%$ of total 2－axle，4－tire trucks（as reported by DOT，FHWA in Highway Statistics 1995，Table VM－1）and $24 \%$ of total other trucks were engaged in intercity freight movement．These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD．Intercity freight trucks were defined as any truck whose：
－greatest share of miles were traveled more than 50 miles away from the vehicle＇s home base；and
－principal use was not personal or passenger transportation；and
－body type was not pickup，minivan，or utility vehicle．
$V m t-0.6 \%$ of total vehicle miles traveled by 2 －axle， 4 －tire trucks（as reported by DOT，FHWA in Highway Statistics 1995，Table VM－1）and $59.5 \%$ of total vehicle miles traveled by other trucks were used in intercity freight movement．These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD．
Ton Miles，Tons Shipped and Average Length of Haul－Eno Transportation Foundation， Transportation in America，Fourteenth Edition，Washington，DC，1996，pp．44，46， 71.
Energy Intensity－Energy use divided by ton－miles．
Energy Use $-0.9 \%$ of total fuel consumption by 2－axle，4－tire trucks（as reported by DOT， FHWA in Highway Statistics 1995，Table VM－1）and $67.2 \%$ of total other truck fuel consumption were used in intercity freight movement．These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD．

## Non－Highway

## Waterborne Commerce

Vehicles－U．S．Department of the Army，Army Corps of Engineers，＂Summary of U．S．Flag Passenger and Cargo Vessels，1992，＂New Orleans，LA， 1997.
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 1995，Part 5： National Summaries，New Orleans，LA，1997，pp．1－6，1－7．
Energy Intensity－Energy use divided by ton miles．
Energy Use－DOE，EIA，Fuel Oil and Kerosene Sales，1995，Table 23．Adjusted sales of distillate and residual fuel oil for vessel bunkering．
Domestic freight energy use was calculated as：
Distillate fuel－ $77.5 \%$ domestic
Residual fuel $-9.3 \%$ domestic．
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．No other source for these data has been located．

## Pipeline

## Natural Gas：

Tons shipped－DOE，EIA，Natural Gas Annual 1995，Washington，DC，1996，Table 1．Total natural gas disposition divided by $44,870 \mathrm{ft}^{3} / \mathrm{ton}$ ．
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 1995，Table 1．Cubic feet were converted to Btu using $1,031 \mathrm{Btu} / \mathrm{ft}^{3}$ ．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 $29.305 \times 10^{-5} \mathrm{kWhr} /$ Btu．Electricity generation and distribution efficiency was $29 \%$ ．When generation and distribution efficiency are taken into account， 1 kWhr equals $11,765 \mathrm{Btu}$ ．

## Crude Oil and Petroleum Product：

Ton Miles and Tons Shipped－Eno Transportation Foundation，Transportation in America， Fourteenth Edition，Washington，DC，1996，pp．44， 46.
Energy Use－W．F．Banks，Systems，Science，and Software，Inc．，Energy Consumption in the Pipeline Industry，LaJolla，CA， 1977.

## Rail

Vehicles，Vmt，Ton Miles，Average Length of Haul－AAR，Railroad Facts， 1996 Edition， Washington，DC，1996，pp．27，34，36， 50.
Tons shipped－AAR，Analysis of Class I Railroads 1995，1996，p． 31.
Energy Use－AAR，Railroad Facts， 1996 Edition，Washington，DC，1996，p． 60.

Table 2.15
Energy Intensities of Passenger Modes，1970－95
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 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 1987－95 editions．
Pmt－vmt multiplied by the 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 1986－94 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.
1991－95－97．8\％gasoline， $1.0 \%$ gasohol，and $1.2 \%$ diesel as reported in the DOE，EIA， Office of Markets and End Use，Energy End Use Division，Household Vehicles Energy Consumption 1991，December 1993，p． 46.
1993－95－Methanol use was estimated using data from DOE，EIA，Alternatives to Traditional Transportation Fuels，Washington，DC，December 1996，p． 23.

## Buses

## Transit：

Vmt，Pmt，Energy Use－APTA， 1997 Transit Fact Book，February 1997， Washington，DC，pp．71，78，102－104，and annual．
Non－diesel fossil fuel consumption was assumed to be used by motor buses．For the years 1988－94，motor bus gasoline use was estimated as $5 \%$ of＂other＂fuels，based on personal communication with the APTA Research and Statistics Department．

## Intercity：

Pmt－1970－84－American Bus Association，Annual Report，Washington，DC， annual．
1985－95－Eno Transportation Foundation，Transportation in America， Fourteenth Edition，Washington，DC，1996，p． 47.
Energy Use－1970－1984－American Bus Association，Annual Report，Washington， DC，annual．
1985－95－Eno Transportation Foundation，Transportation in America，Fourteenth Edition，Washington，DC，p．56，and annual．For conversion purposes，fuel for all intercity buses was assumed to be diesel fuel．（1995 data were estimated using vehicle travel information．）

## 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．
1988－95－National Safety Council，Accident Facts， 1996 Edition，Chicago，IL，p．95， 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． 1987－95－Eno Transportation Foundation，Transportation in America，Fourteenth Edition，Washington，DC，p．56，and annual．For conversion purposes，fuel for school buses was assumed to be $60 \%$ diesel fuel and $40 \%$ gasoline．（1995 data were estimated using vehicle travel information．）

## Non－Highway

Air

## Certificated Air Carriers：

Pmt－DOT，Bureau of Transportation Statistics，Air Carrier Traffic Statitistics Monthly， December 1996／95，Washington，DC，p． 2.

Energy Use - 1970-81 - DOT, Civil Aeronautics Board, Fuel Cost and Consumption, Washington, DC, annual.
1982-95 - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals for domestic only.

## General Aviation:

Pmt - Eno Transportation Foundation, Transportation In America, Fourteenth Edition, Washington, DC, 1996, p. 47.
Energy Use - 1970-74 - DOT, TSC, National Transportation Statistics, Cambridge, MA, 1981.
1975-85 - DOT, FAA, FAA Aviation Forecasts, Washington, DC, annual.
1985-95 - DOT, FAA, General Aviation Activity and Avionics Survey: Calendar
Year 1995, Table 5.1. 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, 1995 - AAR, Railroad Facts, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.
1989-94 - Personal communication with Amtrak.
Energy Use - Personal communication with Amtrak. (1995 data were estimated using train-mile information.)

## Transit:

Pmt and Energy Use - APTA, 1997 Transit Fact Book, February 1997, Washington, DC, pp. 71, 102-104. Transit was defined as the sum of "heavy rail," "light rail,"and "other."

Table 2.16
Energy Intensities of Freight Modes，1970－95
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 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 1987－95 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．
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 1986－95 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 1988－93 was distributed based on the 1987 TIUS： $96.6 \%$ gasoline； $3.3 \%$ diesel；and $0.1 \% \mathrm{lpg}$ ．Fuel use for $1994-95$ was distributed based on the 1992 TIUS： $96.2 \%$ gasoline； $3.3 \%$ diesel； $0.3 \% \mathrm{lpg}$ ；and $0.2 \%$ cng．
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 1986－95 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 $1.0 \% \mathrm{lpg}$ ．Fuel use for $1988-93$ was distributed based on the 1987 TIUS： $19.4 \%$ gasoline； $80.4 \%$ diesel；and $0.2 \% \mathrm{lpg}$ ．Fuel use for 1994－95 was distributed based on the 1992 TIUS： $16.2 \%$ gasoline； $83.3 \%$ diesel； and $0.5 \% \mathrm{lpg}$ ．

## Non－Highway

## Water

Ton Miles－U．S．Department of the Army，Corps of Engineers，Waterborne Commerce of the United States，Calendar Year 1995，Part 5：National Summaries，New Orleans，LA，1997， p．1－6，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，1995，Table 23．Adjusted sales of distillate and residual fuel oil for vessel bunkering．

## Rail

Freight Car Miles，Ton Miles and Energy Use－AAR，Railroad Facts， 1996 Edition， Washington，DC，1996，pp．27，36，60，and annual．

Table 3.2
Vehicle Stock and New Sales in the United States， 1995 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，and Table 7 and the ORNL MPG and Market Shares Database，thereafter．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．This method assumed that all vehicles，large and small，were scrapped at the same rate．

## Sales：

Domestic，import，and total sales were from AAMA，Facts and Figures＇96，p．16．The domestic sales were distributed by size class according to the following percentages：Two seater， $0.3 \%$ ；Minicompact， $0 \%$ ；Subcompact， $13.5 \%$ ；Compact $38.8 \%$ ；Midsize，29．4\％； and Large， $18.0 \%$ ．The import sales were distributed by size class according to the following percentages：Two－seater，2．1\％；Minicompact，2．9\％；Subcompact，35．5\％； Compact， $32.7 \%$ ；Midsize， $25.3 \%$ ；and Large， $1.5 \%$ ．These percentages were derived from the ORNL MPG and Market Shares Database and were based on the sales period instead of the calendar year．Domestic－sponsored imports（captive imports）were included in the import figure only．

## See Glossary for definition of Automobile Size Classifications．

## Motorcycles

Stock－DOT，FHWA，Highway Statistics 1995，Table VM－1， 1996.

## Recreational Vehicles

Sales－Ward＇s Automotive Yearbook 1996，U．S．Recreation Vehicle Shipments by Type， ＂Total，＂p． 204.

## 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， 1992 TIUS，（ $0-10,000 \mathrm{lbs}, 93.3 \%$ ； $10,001-19,500 \mathrm{lbs}, 2.1 \% ; 19,501-26,000 \mathrm{lbs}, 1.2 \% ; 26,001 \mathrm{lbs}$ and over， $3.4 \%$ ）to the total number of trucks in use as reported by R．L．Polk and Company（FURTHER REPRODUCTION PROHIBITED）．
Sales－AAMA，Facts and Figures＇96，p． 21.

Table 3.32
Summary Statistics on Buses by Type，1970－95

## Number in Operation

## Transit buses：

American Public Transit Association， 1997 Transit Fact Book，Washington，DC，February 1997，p．83，and annual．

## Intercity buses：

1970－80 American Bus Association， 1984 Annual Report，Washington，DC，and annual． 1985 －U．S．Department of Transportation，Transportation Systems Center，National Transportation Statistics，Cambridge，MA，August 1990，Figure 5，p．8，and annual． 1990－95－Estimated as $38 \%$ of commercial buses（less transit motor buses）．Commercial bus total found in Highway Statistics 1995，Table MV－10，and annual．

## School buses：

U．S．Department of Transportation，Federal Highway Administration，Highway Statistics 1995，Washington，DC，1996，Table MV－10，p．II－6，and annual．

## Vehicle－miles and Passenger－miles

## Transit buses：

American Public Transit Association， 1997 Transit Fact Book，Washington，DC，February 1997，pp．71，78，and annual．

## Intercity buses：

1970－80－American Bus Association，Annual Report，Washington，DC，annual． 1985－95－Eno Transportation Foundation，Transportation in America，Fourteenth edition， Washington，DC，1996，p． 47.
1990－95 vehicle travel－Estimated using passenger travel and an average load factor of 23．2．

## School buses：

1970－80 U．S．Department of Transportation，Federal Highway Administration，Highway Statistics 1984，Washington，DC，Table VM－1，p．175，and annual．
1985 －U．S．Department of Transportation，Research and Special Programs Administration， National Transportation Statistics，1989，Figure 2，p．7，and annual．
1990－95－National Safety Council，Accident Facts， 1996 Edition，Chicago，IL，pp．94－95， and annual．

## Energy Use

## Transit buses：

American Public Transit Association， 1997 Transit Fact Book，February 1997， Washington，DC，pp．102－104．Non－diesel fossil fuel consumption was assumed to be used by motor buses．For the years 1988－92，motor bus gasoline use was estimated as $5 \%$ of＂other＂fuels，based on personal communication with the APTA Research and Statistics Department．

## Intercity buses：

1970－80－American Bus Association，Annual Report，Washington，DC，annual．
1985－95－Eno Transportation Foundation，Transportation in America，Fourteenth edition， Washington，DC，p．56．For conversion purposes，fuel for all intercity buses was assumed to be diesel fuel．（1995 data were estimated using vehicle travel information．）

## School buses：

1970－80－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．
1987－95－Eno Transportation Foundation，Transportation in America，Fourteenth edition， Washington，DC，p．56．For conversion purposes，fuel for school was assumed to be $60 \%$ diesel fuel and $40 \%$ gasoline．（1995 data were estimated using vehicle travel information．）

## APPENDIX B CONVERSIONS

## A Note About Heating Values

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

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

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

Table B． 1 Approximate Heat Content for Various Fuels

| Automotive gasoline | 125，000 Btu／gal（gross）$=115,400 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| :---: | :---: |
| Diesel motor fuel | $138,700 \mathrm{Btu} / \mathrm{gal}($ gross $)=128,700 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Methanol | $64,600 \mathrm{Btu} / \mathrm{gal}($ gross $)=56,560 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Ethanol | $84,600 \mathrm{Btu} / \mathrm{gal}($ gross $)=75,670 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Gasohol | $120,900 \mathrm{Btu} / \mathrm{gal}($ gross $)=112,417 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Aviation gasoline | $120,200 \mathrm{Btu} / \mathrm{gal}($ gross $)=112,000 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Propane | 91，300 Btu／gal（gross）$=83,500 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Butane | $103,000 \mathrm{Btu} / \mathrm{gal}($ gross $)=93,000 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Jet fuel（naphtha） | $127,500 \mathrm{Btu} / \mathrm{gal}($ gross $)=118,700 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Jet fuel（kerosene） | $135,000 \mathrm{Btu} / \mathrm{gal}($ gross $)=128,100 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Lubricants | $144,400 \mathrm{Btu} / \mathrm{gal}($ gross $)=130,900 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Waxes | $131,800 \mathrm{Btu} / \mathrm{gal}($ gross $)=120,200 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Asphalt and road oil | $158,000 \mathrm{Btu} / \mathrm{gal}($ gross $)=157,700 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Petroleum coke | $143,400 \mathrm{Btu} / \mathrm{gal}($ gross $)=168,300 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Natural gas |  |
| Wet | 1，112 Btu／ft ${ }^{3}$ |
| Dry | 1，031 Btu／ft ${ }^{3}$ |
| Compressed | 20，551 Btu／pound |
| Liquid | $90,800 \mathrm{Btu} / \mathrm{gal}($ gross $)=87,600 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Crude petroleum | $138,100 \mathrm{Btu} / \mathrm{gal}($ gross $)=131,800 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Fuel Oils |  |
| Residual | $149,700 \mathrm{Btu} / \mathrm{gal}($ gross $)=138,400 \mathrm{Btu} / \mathrm{gal}($ net $)$ |
| Distillate | $138,700 \mathrm{Btu} / \mathrm{gal}($ gross $)=131,800 \mathrm{Btu} / \mathrm{gal}($ net $)$ |

## Coal

| Anthracite－Consumption | $21.711 \times 10^{6} \mathrm{Btu} /$ short ton |
| :--- | :--- |
| Bituminous and lignite－Consumption | $21.012 \times 10^{6} \mathrm{Btu} /$ short ton |
| Production average | $21.352 \times 10^{6} \mathrm{Btu} /$ short ton |
| Consumption average | $21.015 \times 10^{6} \mathrm{Btu} /$ short ton |

Table B． 2
Fuel Equivalents

| 1 million bbl／day crude oil | $\begin{aligned} & =0.3650 \text { billion bbl/year crude oil } \\ & =5.800 \text { trillion } \mathrm{Btu} / \text { day } \\ & =2.117 \text { quadrillion Btu/year } \\ & =90.09 \text { million short tons coal/year } \\ & =2.074 \text { trillion } \mathrm{ft}^{3} \text { natural gas/year } \\ & =22.33 \times 10^{11} \mathrm{MJ} / \text { year } \end{aligned}$ |
| :---: | :---: |
| 1 billion bbl／year crude oil | $\begin{aligned} & =2.740 \text { million bbl/day crude oil } \\ & =15.89 \text { trillion Btu/day } \\ & =5.800 \text { quadrillion Btu/year } \\ & =246.8 \text { million short ton coal/year } \\ & =5.68 \text { trillion } \mathrm{ft}^{3} / \mathrm{year} \text { natural gas } / \text { day } \\ & =61.19 \times 10^{11} \mathrm{MJ} / \text { year } \end{aligned}$ |
| 1 trillion Btu／day | $\begin{aligned} & =172.4 \text { thousand } \mathrm{bbl} / \text { day crude oil } \\ & =62.93 \text { million } \mathrm{bbl} / \text { year crude oil } \\ & =0.3650 \text { quadrillion Btu/year } \\ & =15.53 \text { million short tons coal/year } \\ & =357.5 \text { billion } \mathrm{ft}^{3} \text { natural gas/year } \\ & =38.51 \times 10^{10} \mathrm{MJ} / \text { year } \end{aligned}$ |
| 1 quadrillion Btu／year | $\begin{aligned} & =0.4724 \text { million } \mathrm{bbl} / \text { day crude oil } \\ & =172.4 \text { million } \mathrm{bbl} / \text { year crude oil } \\ & =2.740 \text { trillion } \mathrm{Btu} / \text { day } \\ & =42.55 \text { million short tons coal/year } \\ & =979.4 \text { billion } \mathrm{ft}^{3} \text { natural gas/year } \\ & =10.55 \times 10^{11} \mathrm{MJ} / \text { year } \end{aligned}$ |
| 1 billion short tons coal／year | $\begin{aligned} & =11.10 \text { million } \mathrm{bbl} / \text { day crude oil } \\ & =4.052 \text { billion } \mathrm{bbl} / \text { year crude oil } \\ & =64.38 \text { trillion } \mathrm{Btu} / \text { day } \\ & =23.50 \text { quadrillion Btu/year } \\ & =23.02 \text { trillion } \mathrm{ft}^{3} \text { natural gas } / \text { year } \\ & =24.79 \times 10^{12} \mathrm{MJ} / \text { year } \end{aligned}$ |
| 1 trillion $\mathrm{ft}^{3}$ natural gas／year | $\begin{aligned} & =0.4823 \text { million } \mathrm{bbl} / \text { day crude oil } \\ & =0.1760 \text { billion } \mathrm{bbl} / \text { year crude oil } \\ & =2.797 \text { trillion } \mathrm{Btu} / \text { day } \\ & =1.021 \text { quadrillion Btu/year } \\ & =43.45 \text { million short tons coal/year } \\ & =10.77 \times 10^{11} \mathrm{MJ} / \text { year } \end{aligned}$ |
| 1 mega joule／year | $\begin{aligned} & =44.78 \times 10^{-8} \mathrm{bbl} / \text { day crude oil } \\ & =16.34 \times 10^{-5} \mathrm{bbl} / \text { year crude oil } \\ & =2.597 \mathrm{Btu} / \text { day } \\ & =947.9 \mathrm{Btu} / \text { year } \\ & =4.034 \times 10^{-5} \text { short tons coal } / \text { year } \\ & =0.9285 \mathrm{ft}^{3} \text { natural gas } / \text { year } \end{aligned}$ |

Table B． 3
Energy Unit Conversions

| 1 Btu | $=778.2 \mathrm{ft}-\mathrm{lb}$ | 1 kWhr | $=3412 \mathrm{Btu}^{\text {a }}$ |
| :---: | :---: | :---: | :---: |
|  | $=107.6 \mathrm{~kg}-\mathrm{m}$ |  | $=2.655 \times 10^{6} \mathrm{ft}-\mathrm{lb}$ |
|  | $=1055 \mathrm{~J}$ |  | $=3.671 \times 10^{5} \mathrm{~kg}-\mathrm{m}$ |
|  | $=39.30 \times 10^{-5} \mathrm{hp}-\mathrm{h}$ |  | $=3.600 \times 10^{6} \mathrm{~J}$ |
|  | $=39.85 \times 10^{-5}$ metric hp－h |  | $=1.341 \mathrm{hp}-\mathrm{h}$ |
|  | $=29.31 \times 10^{-5} \mathrm{kWhr}$ |  | $=1.360$ metric hp－h |
| $1 \mathrm{~kg}-\mathrm{m}$ | $=92.95 \times 10^{-4} \mathrm{Btu}$ | 1 Joule | $=94.78 \times 10^{-5} \mathrm{Btu}$ |
|  | $=7.233 \mathrm{ft}-\mathrm{lb}$ |  | $=0.7376 \mathrm{ft}-\mathrm{lb}$ |
|  | $=9.806 \mathrm{~J}$ |  | $=0.1020 \mathrm{~kg}-\mathrm{m}$ |
|  | $=36.53 \times 10^{-7} \mathrm{hp}-\mathrm{h}$ |  | $=37.25 \times 10^{-8} \mathrm{hp}-\mathrm{h}$ |
|  | $=37.04 \times 10^{-7}$ metric hp－h |  | $=37.77 \times 10^{-8}$ metric hp－h |
|  | $=27.24 \times 10^{-7} \mathrm{kWhr}$ |  | $=27.78 \times 10^{-8} \mathrm{kWhr}$ |
| $1 \mathrm{hp-h}$ | $=2544 \mathrm{Btu}$ | 1 metric hp－h | $=2510 \mathrm{Btu}$ |
|  | $=1.98 \times 10^{6} \mathrm{ft}-\mathrm{lb}$ |  | $=1.953 \times 10^{6} \mathrm{ft}-\mathrm{lb}$ |
|  | $=2.738 \times 10^{6} \mathrm{kgm}$ |  | $=27.00 \times 10^{4} \mathrm{~kg}-\mathrm{m}$ |
|  | $=2.685 \times 10^{6} \mathrm{~J}$ |  | $=2.648 \times 10^{6} \mathrm{~J}$ |
|  | $=1.014$ metric hp－h |  | $=0.9863 \mathrm{hp}-\mathrm{h}$ |
|  | $=0.7475 \mathrm{kWhr}$ |  | $=0.7355 \mathrm{kWhr}$ |

${ }^{\text {a }}$ This figure does not take into account the fact that electricity generation and distribution efficiency is approximately $29 \%$ ．If generation and distribution efficiency are taken into account， $1 \mathrm{kWhr}=11,765 \mathrm{Btu}$ ．

Table B． 4
Distance and Velocity Conversions

$$
\begin{array}{rlrl}
1 \mathrm{in} . & =83.33 \times 10^{-3} \mathrm{ft} & 1 \mathrm{ft} & \\
& =12.0 \mathrm{in} . \\
& =27.78 \times 10^{-3} \mathrm{yd} & & =0.33 \mathrm{yd} \\
& =15.78 \times 10^{-6} \mathrm{mile} & & =189.4 \times 10^{-3} \mathrm{mile} \\
& =25.40 \times 10^{-3} \mathrm{~m} & & =0.3048 \mathrm{~m} \\
& =0.2540 \times 10^{-6} \mathrm{~km} & & =0.3048 \times 10^{-3} \mathrm{~km} \\
1 \mathrm{mile} & =63360 \mathrm{in} . & 1 \mathrm{~km} & \\
& =59370 \mathrm{in} . \\
& =5280 \mathrm{ft} & & =3281 \mathrm{ft} \\
& =1760 \mathrm{yd} & & =1093.6 \mathrm{yd} \\
& =1609 \mathrm{~m} & & =0.6214 \mathrm{mile} \\
& =1.609 \mathrm{~km} & & =1000 \mathrm{~m} \\
& & & \\
& & & \\
& & & \\
& & & \\
& 1 \mathrm{ft} / \mathrm{sec}=0.3048 \mathrm{~m} / \mathrm{sec}=3.281 \mathrm{ft} / \mathrm{s}=2.237 \mathrm{mph}=3.600 \mathrm{~km} / \mathrm{h} & & \\
& 1 \mathrm{~km} / \mathrm{h}=0.9114 \mathrm{ft} / \mathrm{s}=0.2778 \mathrm{~m} / \mathrm{s}=0.6214 \mathrm{mph} & &
\end{array}
$$

Table B． 5
Alternative Measures of Greenhouse Gases

| 1 pound methane，measured in carbon $=$1.333 pounds methane，measured at full molecular <br> weight $\left(\mathrm{CH}_{4}\right)$ |
| :--- |
| units $\left(\mathrm{CH}_{4}\right)$ |


| 1 pound carbon dioxide，measured in $=$3.6667 pounds carbon dioxide，measured at full <br> molecular weight $\left(\mathrm{CO}_{2}\right)$ |
| :--- |
| carbon units $\left(\mathrm{CO}_{2}-\mathrm{C}\right)$ |


| 1 pound carbon monoxide，measured in $=$2.333 pounds carbon monoxide，measured at full <br> molecular weight $(\mathrm{CO})$ |
| :--- |
| 1 pound nitrous oxide，measured in $(\mathrm{CO}-\mathrm{C})$ |
| 1.571 pounds nitrous oxide，measured at full <br> molecular weight $\left(\mathrm{N}_{2} \mathrm{O}\right)$ |$.$| nitrogen units $\left(\mathrm{N}_{2} \mathrm{O}-\mathrm{N}\right)$ |
| :--- |

Table B． 6 Volume and Flow Rate Conversions ${ }^{\text {a }}$

| 1 U．S．gal | $=231 \mathrm{in.}^{3}$ | 1 liter | $=61.02 \mathrm{in}^{3}$ |
| ---: | :--- | ---: | :--- |
|  | $=0.1337 \mathrm{ft}^{3}$ |  | $=3.531 \times 10^{-2} \mathrm{ft}^{3}$ |
|  | $=3.785$ liters |  | $=0.2624 \mathrm{U} . S$. gal |
|  | $=0.8321$ imperial gal |  | $=0.2200 \mathrm{imperial}$ gal |
|  | $=0.0238 \mathrm{bbl}$ |  | $=6.29 \times 10^{-3} \mathrm{bbl}$ |
|  | $=0.003785 \mathrm{~m}^{3}$ |  | $=0.001 \mathrm{~m}^{3}$ |

A U．S．gallon of gasoline weighs 6.2 pounds

$$
\begin{array}{rlrl}
1 \text { imperial gal } & =277.4 \mathrm{in}^{3} & 1 \mathrm{bbl} & =9702 \mathrm{in}^{3} \\
& =0.1606 \mathrm{ft}^{3} & & =5.615 \mathrm{ft}^{3} \\
& =4.545 \text { liters } & & =158.97 \text { liters } \\
& =1.201 \mathrm{U} . S . \text { gal } & & =42 \mathrm{U} . S . \text { gal } \\
& =0.0286 \mathrm{bbl} & & =34.97 \mathrm{imperial} \text { gal } \\
& =0.004546 \mathrm{~m}^{3} & & =0.15897 \mathrm{~m}^{3} \\
& & \\
\text { 1 U.S. gal/hr } & =3.209 \mathrm{ft}^{3} / \text { day } & & =1171 \mathrm{ft}^{3} / \text { year } \\
& =90.84 \text { liter/day } & & =33157 \text { liter } / \mathrm{year} \\
& =19.97 \text { imperial gal/day } & & =7289 \mathrm{imperial} \text { gal } / \text { year } \\
& =0.5712 \mathrm{bbl} / \text { day } & & =207.92 \mathrm{bbl} / \text { year }
\end{array}
$$

## For Imperial gallons，multiply above values by 1.201

$$
\begin{aligned}
1 \mathrm{liter} / \mathrm{hr} & =0.8474 \mathrm{ft}^{3} / \text { day } \\
& =6.298 \mathrm{U} . \mathrm{S} . \text { gal } / \text { day } \\
& =5.28 \mathrm{imperial} \text { gal } / \text { day } \\
& =0.1510 \mathrm{bbl} / \text { day } \\
1 \mathrm{bbl} / \mathrm{hr} & \\
& =137.8 \mathrm{ft}^{3} / \text { year } \\
& =1008 \mathrm{U} . \mathrm{S} . \text { gal } / \text { day } \\
& =839.3 \text { imperial gal } / \text { day }
\end{aligned}
$$

$$
=309.3 \mathrm{ft}^{3} / \text { year }
$$

$$
\text { = } 2299 \text { U.S. gal/year }
$$

$$
=1927 \text { imperial gal/year }
$$

$$
=55.10 \mathrm{bbl} / \text { year }
$$

$$
=49187 \mathrm{ft}^{3} \text { year }
$$

$$
=3.679 \times 10^{5} \mathrm{U} . \mathrm{S} . \mathrm{gal} / \mathrm{year}
$$

$$
=3.063 \times 10^{5} \text { imperial gal/year }
$$

$$
=3815 \text { liter/day } \quad=1.393 \times 10^{6} \text { liter } / \text { day }
$$

${ }^{\text {a }}$ The conversions for flow rates are identical to those for volume measures，if the time units are identical．

Table B. 7
Power Conversions

| FROM | TO |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  | Horsepower | Kilowatts | Metric <br> horsepower | Ft-lb <br> per sec | Kilocalories <br> 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. 8 Mass Conversions

|  | TO |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| FROM | Pound | Kilogram | Short ton | Long ton | Metric ton |
| Pound | 1 | 0.4536 | $5.0 \times 10^{-4}$ | $4.4643 \times 10^{-4}$ | $4.5362 \times 10^{-4}$ |
| Kilogram | 2.205 | 1 | $1.1023 \times 10^{-3}$ | $9.8425 \times 10^{-4}$ | $1.0 \times 10^{-3}$ |
| Short ton | 2000 | 907.2 | 1 | 0.8929 | 0.9072 |
| Long ton | 2240 | 1016 | 1.12 | 1 | 1.016 |
| Metric ton | 2205 | 1000 | 1.102 | 0.9842 | 1 |

Table B． 9
Fuel Efficiency Conversions ${ }^{\text {a }}$

| MPG | Miles／liter | Kilometers／L | L／100 kilometers |
| :---: | :---: | :---: | :---: |
| 10 | 2.64 | 4.25 | 23.52 |
| 15 | 3.96 | 6.38 | 15.68 |
| 20 | 5.28 | 8.50 | 11.76 |
| 25 | 6.60 | 10.63 | 9.41 |
| 30 | 7.92 | 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 |
| 60 | 15.85 | 25.51 | 3.92 |
| 65 | 17.17 | 27.63 | 3.62 |
| 70 | 18.49 | 29.76 | 3.36 |
| 75 | 19.81 | 31.88 | 3.14 |
| 80 | 21.13 | 34.01 | 2.94 |
| 85 | 22.45 | 36.13 | 2.77 |
| 90 | 23.77 | 38.26 | 2.61 |
| 95 | 25.09 | 40.38 | 2.48 |
| 100 | 26.42 | 42.51 | 2.35 |
| 105 | 27.74 | 44.64 | 2.24 |
| 110 | 29.06 | 46.76 | 2.14 |
| 115 | 30.38 | 48.89 | 2.05 |
| 120 | 31.70 | 51.01 | 1.96 |
| 125 | 33.02 | 53.14 | 1.88 |
| 130 | 34.34 | 55.26 | 1.81 |
| 135 | 35.66 | 57.39 | 1.74 |
| 140 | 36.98 | 59.51 | 1.68 |
| 145 | 38.30 | 61.64 | 1.62 |
| 150 | 39.62 | 63.76 | 1.57 |

${ }^{a}$ To convert fuel efficiency from miles per gallon（mpg）to liters per hundred kilometers，divide mpg into 235．24．

Table B． 10

## 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 | $10^{9}$ | giga | G |
| One trillion | $10^{\mathrm{a}}$ | $10^{15}$ | tera |
| One quadrillion | peta | P |  |
| One quintillion |  | E |  |

${ }^{a}$ Care should be exercised in the use of this nomenclature，especially in foreign correspondence，as it is either unknown or carries a different value in other countries．A＂billion，＂for example，signifies a value of $10^{12} \mathrm{in}$ most other countries．

Table B． 11
Metric Units and Abbreviations

| Quantity | Unit name | Symbol |
| :---: | :---: | :---: |
| Energy | joule | J |
| Specific energy | joule／kilogram | J／kg |
| Specific energy consumption | joule／kilogram•kilometer | $\mathrm{J} /(\mathrm{kg} \cdot \mathrm{km})$ |
| 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 ${ }^{3}$ | $\mathrm{W} / \mathrm{m}^{3}$ |
| Speed | kilometer／hour | km／h |
| Acceleration | meter／second ${ }^{2}$ | $\mathrm{m} / \mathrm{s}^{2}$ |
| Range（distance） | kilometer | km |
| Weight | kilogram | kg |
| Torque | newton•meter | $\mathrm{N} \cdot \mathrm{m}$ |
| Volume | meter ${ }^{3}$ | $\mathrm{m}^{3}$ |
| Mass；payload | kilogram | kg |
| Length；width | meter | m |
| Brake specific fuel consumption | kilogram／joule | kg／J |
| Fuel economy（heat engine） | liters／100 km | L／100 km |

## Conversion of Constant Dollar Values

Many types of information in this data book are expressed in dollars．Generally，constant dollars are used－－that is，dollars of a fixed value for a specific year，such as 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． 12 and B．13）．Table B． 12 shows conversion factors for the Consumer Price Index inflation factors．Table B． 13 shows conversion factors using the Gross National Product 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 | 1992 | 1993 | 1994 | 1995 | 1996 |
| 1970 | 1.00 | 1.04 | 1.08 | 1.14 | 1.27 | 1.39 | 1.47 | 1.56 | 1.68 | 1.87 | 2.12 | 2.34 | 2.49 | 2.57 | 2.68 | 2.77 | 2.82 | 2.93 | 3.05 | 3.19 | 3.37 | 3.51 | 3.61 | 3.72 | 3.82 | 3.93 | 4.04 |
| 1971 | 0.96 | 1.00 | 1.03 | 1.10 | 1.22 | 1.33 | 1.41 | 1.50 | 1.61 | 1.79 | 2.04 | 2.25 | 2.38 | 2.46 | 2.56 | 2.65 | 2.71 | 2.81 | 2.92 | 3.06 | 3.23 | 3.36 | 3.47 | 3.57 | 3.66 | 3.76 | 3.87 |
| 1972 | 0.93 | 0.97 | 1.00 | 1.06 | 1.18 | 1.29 | 1.36 | 1.45 | 1.56 | 1.74 | 1.97 | 2.17 | 2.31 | 2.38 | 2.48 | 2.57 | 2.62 | 2.72 | 2.83 | 2.96 | 3.12 | 3.26 | 3.35 | 3.45 | 3.54 | 3.64 | 3.75 |
| 1973 | 0.87 | 0.91 | 0.94 | 1.00 | 1.11 | 1.21 | 1.28 | 1.36 | 1.47 | 1.63 | 1.86 | 2.05 | 2.17 | 2.24 | 2.34 | 2.42 | 2.47 | 2.56 | 2.66 | 2.79 | 2.94 | 3.07 | 3.16 | 3.25 | 3.34 | 3.43 | 3.53 |
| 1974 | 0.79 | 0.82 | 0.85 | 0.90 | 1.00 | 1.09 | 1.15 | 1.23 | 1.32 | 1.47 | 1.67 | 1.84 | 1.96 | 2.02 | 2.11 | 2.18 | 2.22 | 2.31 | 2.40 | 2.51 | 2.65 | 2.76 | 2.85 | 2.93 | 3.01 | 3.09 | 3.18 |
| 1975 | 0.72 | 0.75 | 0.78 | 0.83 | 0.92 | 1.00 | 1.06 | 1.13 | 1.21 | 1.35 | 1.53 | 1.69 | 1.79 | 1.85 | 1.93 | 2.00 | 2.04 | 2.11 | 2.20 | 2.30 | 2.43 | 2.53 | 2.61 | 2.68 | 2.75 | 2.83 | 2.92 |
| 1976 | 0.68 | 0.71 | 0.74 | 0.78 | 0.87 | 0.95 | 1.00 | 1.07 | 1.15 | 1.28 | 1.45 | 1.60 | 1.70 | 1.75 | 1.82 | 1.89 | 1.93 | 2.00 | 2.08 | 2.18 | 2.30 | 2.39 | 2.47 | 2.54 | 2.60 | 2.68 | 2.76 |
| 1977 | 0.64 | 0.67 | 0.69 | 0.73 | 0.81 | 0.89 | 0.94 | 1.00 | 1.08 | 1.20 | 1.36 | 1.50 | 1.59 | 1.65 | 1.72 | 1.78 | 1.81 | 1.88 | 1.95 | 2.05 | 2.16 | 2.25 | 2.32 | 2.38 | 2.45 | 2.52 | 2.59 |
| 1978 | 0.60 | 0.62 | 0.64 | 0.68 | 0.76 | 0.83 | 0.87 | 0.93 | 1.00 | 1.11 | 1.27 | 1.40 | 1.48 | 1.53 | 1.59 | 1.65 | 1.68 | 1.74 | 1.81 | 1.90 | 2.00 | 2.09 | 2.15 | 2.21 | 2.27 | 2.34 | 2.40 |
| 1979 | 0.54 | 0.56 | 0.58 | 0.61 | 0.68 | 0.74 | 0.78 | 0.84 | 0.90 | 1.00 | 1.14 | 1.25 | 1.33 | 1.37 | 1.43 | 1.48 | 1.51 | 1.57 | 1.63 | 1.71 | 1.80 | 1.88 | 1.93 | 1.99 | 2.04 | 2.10 | 2.16 |
| 1980 | 0.47 | 0.49 | 0.51 | 0.54 | 0.60 | 0.65 | 0.69 | 0.74 | 0.79 | 0.88 | 1.00 | 1.10 | 1.17 | 1.21 | 1.26 | 1.31 | 1.33 | 1.38 | 1.44 | 1.50 | 1.59 | 1.65 | 1.70 | 1.75 | 1.80 | 1.85 | 1.90 |
| 1981 | 0.43 | 0.45 | 0.46 | 0.49 | 0.54 | 0.59 | 0.63 | 0.67 | 0.72 | 0.80 | 0.91 | 1.00 | 1.06 | 1.10 | 1.14 | 1.18 | 1.21 | 1.25 | 1.30 | 1.36 | 1.44 | 1.50 | 1.54 | 1.59 | 1.63 | 1.68 | 1.73 |
| 1982 | 0.40 | 0.42 | 0.43 | 0.46 | 0.51 | 0.56 | 0.59 | 0.63 | 0.68 | 0.75 | 0.85 | 0.94 | 1.00 | 1.03 | 1.08 | 1.11 | 1.14 | 1.18 | 1.23 | 1.28 | 1.35 | 1.41 | 1.45 | 1.50 | 1.54 | 1.58 | 1.63 |
| 1983 | 0.39 | 0.41 | 0.42 | 0.45 | 0.50 | 0.54 | 0.57 | 0.61 | 0.66 | 0.73 | 0.83 | 0.91 | 0.97 | 1.00 | 1.04 | 1.08 | 1.10 | 1.14 | 1.19 | 1.24 | 1.31 | 1.37 | 1.41 | 1.45 | 1.49 | 1.53 | 1.57 |
| 1984 | 0.37 | 0.39 | 0.40 | 0.43 | 0.48 | 0.52 | 0.55 | 0.58 | 0.63 | 0.70 | 0.79 | 0.88 | 0.93 | 0.96 | 1.00 | 1.04 | 1.06 | 1.09 | 1.14 | 1.19 | 1.26 | 1.31 | 1.35 | 1.39 | 1.43 | 1.47 | 1.51 |
| 1985 | 0.36 | 0.38 | 0.39 | 0.41 | 0.46 | 0.50 | 0.53 | 0.56 | 0.61 | 0.68 | 0.77 | 0.85 | 0.90 | 0.93 | 0.97 | 1.00 | 1.02 | 1.06 | 1.10 | 1.15 | 1.22 | 1.27 | 1.30 | 1.34 | 1.38 | 1.42 | 1.46 |
| 1986 | 0.35 | 0.37 | 0.38 | 0.41 | 0.45 | 0.49 | 0.52 | 0.55 | 0.60 | 0.66 | 0.75 | 0.83 | 0.88 | 0.91 | 0.95 | 0.98 | 1.00 | 1.04 | 1.08 | 1.13 | 1.19 | 1.24 | 1.28 | 1.32 | 1.35 | 1.39 | 1.43 |
| 1987 | 0.34 | 0.36 | 0.37 | 0.39 | 0.43 | 0.47 | 0.50 | 0.53 | 0.57 | 0.64 | 0.73 | 0.80 | 0.85 | 0.88 | 0.91 | 0.95 | 0.96 | 1.00 | 1.04 | 1.09 | 1.15 | 1.20 | 1.24 | 1.27 | 1.30 | 1.34 | 1.38 |
| 1988 | 0.33 | 0.34 | 0.35 | 0.38 | 0.42 | 0.46 | 0.48 | 0.51 | 0.55 | 0.61 | 0.70 | 0.77 | 0.82 | 0.84 | 0.88 | 0.91 | 0.93 | 0.96 | 1.00 | 1.05 | 1.11 | 1.15 | 1.19 | 1.22 | 1.25 | 1.29 | 1.33 |
| 1989 | 0.31 | 0.33 | 0.34 | 0.36 | 0.40 | 0.43 | 0.46 | 0.49 | 0.53 | 0.59 | 0.67 | 0.73 | 0.78 | 0.80 | 0.84 | 0.87 | 0.88 | 0.92 | 0.95 | 1.00 | 1.05 | 1.10 | 1.13 | 1.17 | 1.20 | 1.23 | 1.27 |
| 1990 | 0.30 | 0.31 | 0.32 | 0.34 | 0.38 | 0.41 | 0.44 | 0.46 | 0.50 | 0.56 | 0.63 | 0.70 | 0.74 | 0.76 | 0.80 | 0.82 | 0.84 | 0.87 | 0.91 | 0.95 | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.17 | 1.20 |
| 1991 | 0.29 | 0.30 | 0.31 | 0.33 | 0.36 | 0.40 | 0.42 | 0.45 | 0.48 | 0.53 | 0.61 | 0.67 | 0.71 | 0.73 | 0.76 | 0.79 | 0.81 | 0.83 | 0.87 | 0.91 | 0.96 | 1.00 | 1.03 | 1.06 | 1.09 | 1.12 | 1.15 |
| 1992 | 0.28 | 0.29 | 0.30 | 0.32 | 0.35 | 0.38 | 0.41 | 0.43 | 0.47 | 0.52 | 0.59 | 0.65 | 0.69 | 0.71 | 0.74 | 0.77 | 0.78 | 0.81 | 0.84 | 0.88 | 0.93 | 0.97 | 1.00 | 1.03 | 1.06 | 1.09 | 1.12 |
| 1993 | 0.27 | 0.28 | 0.29 | 0.31 | 0.34 | 0.37 | 0.39 | 0.42 | 0.45 | 0.50 | 0.57 | 0.63 | 0.67 | 0.69 | 0.72 | 0.75 | 0.76 | 0.79 | 0.82 | 0.86 | 0.91 | 0.94 | 0.97 | 1.00 | 1.03 | 1.06 | 1.09 |
| 1994 | 0.26 | 0.27 | 0.28 | 0.30 | 0.33 | 0.36 | 0.38 | 0.41 | 0.44 | 0.49 | 0.56 | 0.61 | 0.65 | 0.67 | 0.70 | 0.73 | 0.74 | 0.77 | 0.80 | 0.84 | 0.88 | 0.92 | 0.95 | 0.98 | 1.00 | 1.03 | 1.06 |
| 1995 | 0.26 | 0.27 | 0.27 | 0.29 | 0.32 | 0.35 | 0.37 | 0.40 | 0.43 | 0.48 | 0.54 | 0.60 | 0.63 | 0.65 | 0.68 | 0.71 | 0.72 | 0.75 | 0.78 | 0.81 | 0.86 | 0.89 | 0.92 | 0.95 | 0.97 | 1.00 | 1.03 |
| 1996 | 0.25 | 0.26 | 0.27 | 0.28 | 0.31 | 0.34 | 0.36 | 0.39 | 0.42 | 0.46 | 0.53 | 0.58 | 0.62 | 0.64 | 0.66 | 0.69 | 0.70 | 0.72 | 0.75 | 0.79 | 0.83 | 0.87 | 0.89 | 0.92 | 0.94 | 0.97 | 1.00 |
| Sou <br> Pers | ce: | conta | ct w | h the | ure | au of | abor | Stati | ics. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Table B. 13
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 | 1992 | 1993 | 1994 | 1995 | 1996 |
| 1970 | 1.00 | 1.05 | 1.10 | 1.16 | 1.26 | 1.38 | 1.45 | 1.53 | 1.65 | 1.79 | 1.95 | 2.14 | 2.27 | 2.36 | 2.45 | 2.53 | 2.60 | 2.67 | 2.76 | 2.87 | 2.99 | 3.12 | 3.23 | 3.29 | 3.36 | 3.47 | 3.54 |
| 1971 | 0.95 | 1.00 | 1.04 | 1.10 | 1.20 | 1.31 | 1.38 | 1.46 | 1.57 | 1.70 | 1.86 | 2.04 | 2.16 | 2.24 | 2.33 | 2.41 | 2.48 | 2.54 | 2.63 | 2.72 | 2.84 | 2.97 | 3.07 | 3.13 | 3.19 | 3.30 | 3.37 |
| 1972 | 0.91 | 0.96 | 1.00 | 1.06 | 1.15 | 1.26 | 1.32 | 1.40 | 1.50 | 1.63 | 1.79 | 1.96 | 2.07 | 2.15 | 2.24 | 2.32 | 2.38 | 2.44 | 2.52 | 2.62 | 2.73 | 2.85 | 2.95 | 3.01 | 3.07 | 3.17 | 3.24 |
| 1973 | 0.86 | 0.91 | 0.95 | 1.00 | 1.09 | 1.19 | 1.25 | 1.32 | 1.42 | 1.54 | 1.69 | 1.85 | 1.96 | 2.03 | 2.12 | 2.19 | 2.24 | 2.30 | 2.38 | 2.47 | 2.58 | 2.69 | 2.79 | 2.84 | 2.90 | 3.00 | 3.06 |
| 1974 | 0.79 | 0.83 | 0.87 | 0.92 | 1.00 | 1.09 | 1.15 | 1.22 | 1.31 | 1.42 | 1.55 | 1.70 | 1.80 | 1.87 | 1.95 | 2.01 | 2.06 | 2.12 | 2.19 | 2.28 | 2.37 | 2.48 | 2.56 | 2.61 | 2.67 | 2.76 | 2.81 |
| 1975 | 0.73 | 0.76 | 0.80 | 0.84 | 0.92 | 1.00 | 1.05 | 1.11 | 1.20 | 1.30 | 1.42 | 1.55 | 1.65 | 1.71 | 1.78 | 1.84 | 1.89 | 1.94 | 2.01 | 2.08 | 2.17 | 2.27 | 2.34 | 2.39 | 2.44 | 2.52 | 2.57 |
| 1976 | 0.69 | 0.73 | 0.76 | 0.80 | 0.87 | 0.95 | 1.00 | 1.06 | 1.14 | 1.24 | 1.35 | 1.48 | 1.57 | 1.63 | 1.70 | 1.75 | 1.80 | 1.84 | 1.91 | 1.98 | 2.06 | 2.15 | 2.23 | 2.27 | 2.32 | 2.40 | 2.44 |
| 1977 | 0.65 | 0.69 | 0.71 | 0.76 | 0.82 | 0.90 | 0.95 | 1.00 | 1.07 | 1.17 | 1.27 | 1.40 | 1.48 | 1.54 | 1.60 | 1.65 | 1.70 | 1.74 | 1.80 | 1.87 | 1.95 | 2.03 | 2.11 | 2.15 | 2.19 | 2.26 | 2.31 |
| 1978 | 0.61 | 0.64 | 0.67 | 0.70 | 0.77 | 0.84 | 0.88 | 0.93 | 1.00 | 1.09 | 1.19 | 1.30 | 1.38 | 1.43 | 1.49 | 1.54 | 1.58 | 1.62 | 1.68 | 1.74 | 1.81 | 1.89 | 1.96 | 2.00 | 2.04 | 2.11 | 2.15 |
| 1979 | 0.56 | 0.59 | 0.61 | 0.65 | 0.70 | 0.77 | 0.81 | 0.86 | 0.92 | 1.00 | 1.09 | 1.20 | 1.27 | 1.32 | 1.37 | 1.42 | 1.45 | 1.49 | 1.54 | 1.60 | 1.67 | 1.74 | 1.80 | 1.84 | 1.88 | 1.94 | 1.98 |
| 1980 | 0.51 | 0.54 | 0.56 | 0.59 | 0.65 | 0.71 | 0.74 | 0.78 | 0.84 | 0.92 | 1.00 | 1.10 | 1.16 | 1.21 | 1.26 | 1.30 | 1.33 | 1.36 | 1.41 | 1.47 | 1.53 | 1.60 | 1.65 | 1.68 | 1.72 | 1.78 | 1.81 |
| 1981 | 0.47 | 0.49 | 0.51 | 0.54 | 0.59 | 0.64 | 0.68 | 0.72 | 0.77 | 0.84 | 0.91 | 1.00 | 1.06 | 1.10 | 1.15 | 1.18 | 1.21 | 1.25 | 1.29 | 1.34 | 1.40 | 1.46 | 1.51 | 1.54 | 1.57 | 1.62 | 1.66 |
| 1982 | 0.44 | 0.46 | 0.48 | 0.51 | 0.56 | 0.61 | 0.64 | 0.68 | 0.73 | 0.79 | 0.86 | 0.94 | 1.00 | 1.04 | 1.08 | 1.12 | 1.15 | 1.18 | 1.22 | 1.26 | 1.32 | 1.38 | 1.42 | 1.45 | 1.48 | 1.53 | 1.56 |
| 1983 | 0.42 | 0.45 | 0.46 | 0.49 | 0.53 | 0.58 | 0.61 | 0.65 | 0.70 | 0.76 | 0.83 | 0.91 | 0.96 | 1.00 | 1.04 | 1.08 | 1.10 | 1.13 | 1.17 | 1.22 | 1.27 | 1.32 | 1.37 | 1.40 | 1.42 | 1.47 | 1.50 |
| 1984 | 0.41 | 0.43 | 0.45 | 0.47 | 0.51 | 0.56 | 0.59 | 0.62 | 0.67 | 0.73 | 0.80 | 0.87 | 0.92 | 0.96 | 1.00 | 1.04 | 1.06 | 1.08 | 1.12 | 1.16 | 1.21 | 1.27 | 1.31 | 1.34 | 1.37 | 1.41 | 1.44 |
| 1985 | 0.40 | 0.42 | 0.43 | 0.46 | 0.50 | 0.54 | 0.57 | 0.61 | 0.65 | 0.71 | 0.77 | 0.85 | 0.90 | 0.93 | 0.94 | 1.00 | 1.03 | 1.05 | 1.09 | 1.13 | 1.18 | 1.23 | 1.28 | 1.30 | 1.33 | 1.37 | 1.40 |
| 1986 | 0.39 | 0.40 | 0.42 | 0.45 | 0.49 | 0.53 | 0.56 | 0.59 | 0.63 | 0.69 | 0.75 | 0.82 | 0.87 | 0.91 | 0.94 | 0.97 | 1.00 | 1.03 | 1.06 | 1.10 | 1.15 | 1.20 | 1.24 | 1.27 | 1.29 | 1.34 | 1.36 |
| 1987 | 0.38 | 0.40 | 0.41 | 0.44 | 0.47 | 0.52 | 0.54 | 0.58 | 0.62 | 0.67 | 0.73 | 0.80 | 0.85 | 0.89 | 0.92 | 0.95 | 0.98 | 1.00 | 1.04 | 1.08 | 1.12 | 1.17 | 1.21 | 1.24 | 1.26 | 1.30 | 1.33 |
| 1988 | 0.36 | 0.38 | 0.40 | 0.42 | 0.46 | 0.50 | 0.53 | 0.56 | 0.60 | 0.65 | 0.71 | 0.77 | 0.82 | 0.85 | 0.89 | 0.92 | 0.94 | 0.97 | 1.00 | 1.04 | 1.08 | 1.13 | 1.17 | 1.19 | 1.22 | 1.26 | 1.28 |
| 1989 | 0.35 | 0.37 | 0.38 | 0.40 | 0.44 | 0.48 | 0.51 | 0.54 | 0.58 | 0.62 | 0.68 | 0.75 | 0.79 | 0.82 | 0.86 | 0.88 | 0.91 | 0.93 | 0.96 | 1.00 | 1.04 | 1.09 | 1.13 | 1.15 | 1.17 | 1.21 | 1.24 |
| 1990 | 0.34 | 0.35 | 0.37 | 0.39 | 0.42 | 0.46 | 0.49 | 0.51 | 0.55 | 0.60 | 0.66 | 0.72 | 0.76 | 0.79 | 0.83 | 0.85 | 0.87 | 0.89 | 0.93 | 0.96 | 1.00 | 1.05 | 1.08 | 1.10 | 1.13 | 1.16 | 1.19 |
| 1991 | 0.32 | 0.34 | 0.35 | 0.37 | 0.40 | 0.44 | 0.47 | 0.49 | 0.53 | 0.57 | 0.63 | 0.69 | 0.73 | 0.76 | 0.79 | 0.81 | 0.83 | 0.86 | 0.89 | 0.92 | 0.96 | 1.00 | 1.04 | 1.06 | 1.08 | 1.11 | 1.14 |
| 1992 | 0.31 | 0.33 | 0.34 | 0.36 | 0.39 | 0.43 | 0.45 | 0.48 | 0.51 | 0.55 | 0.61 | 0.66 | 0.70 | 0.73 | 0.76 | 0.78 | 0.81 | 0.83 | 0.86 | 0.89 | 0.92 | 0.97 | 1.00 | 1.02 | 1.04 | 1.08 | 1.10 |
| 1993 | 0.30 | 0.32 | 0.33 | 0.35 | 0.38 | 0.42 | 0.44 | 0.47 | 0.50 | 0.54 | 0.59 | 0.65 | 0.69 | 0.72 | 0.75 | 0.77 | 0.79 | 0.81 | 0.84 | 0.87 | 0.91 | 0.95 | 0.98 | 1.00 | 1.02 | 1.05 | 1.08 |
| 1994 | 0.30 | 0.31 | 0.33 | 0.35 | 0.38 | 0.41 | 0.43 | 0.46 | 0.49 | 0.53 | 0.58 | 0.64 | 0.68 | 0.70 | 0.73 | 0.75 | 0.77 | 0.79 | 0.82 | 0.85 | 0.89 | 0.93 | 0.96 | 0.98 | 1.00 | 1.03 | 1.05 |
| 1995 | 0.29 | 0.30 | 0.32 | 0.33 | 0.36 | 0.40 | 0.42 | 0.44 | 0.47 | 0.52 | 0.56 | 0.62 | 0.65 | 0.68 | 0.71 | 0.73 | 0.75 | 0.77 | 0.80 | 0.83 | 0.86 | 0.90 | 0.93 | 0.95 | 0.97 | 1.00 | 1.02 |
| 1996 | 0.28 | 0.30 | 0.31 | 0.33 | 0.36 | 0.39 | 0.41 | 0.43 | 0.46 | 0.51 | 0.55 | 0.60 | 0.64 | 0.67 | 0.69 | 0.71 | 0.73 | 0.75 | 0.78 | 0.81 | 0.84 | 0.88 | 0.91 | 0.93 | 0.95 | 0.98 | 1.00 |

## Source:

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

## APPENDIX C

# ACTIVITY AND ENERGY USE IN TRANSPORTATION： DATA SOURCES FOR THE LBNL ANALYSES OF OECD COUNTRIES 

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## 1．NOTES ON THE UPDATE

During 1995 and 1996，LBNL continued to analyze international trends in transportation．This brief note summarizes key new findings and revisions．Previous notes and references can be found in Section 3 of this Appendix．Country specific revisions can be found in Section 2．Details of methodology can be found in Indicators of Energy Use and Efficiency：Linking Energy Use to Human Activity，published by the International Energy Agency．It is hoped that freight data（including significant revisions for France and Japan）can be provided next year．

Several points made in earlier editions must be emphasized．
－Derivations of miles driven，fuel use per mile，and total fuel use are，in general，based on circularities that are resolved when occasional surveys record fuel use per mile and miles driven per vehicle independently，then aggregate up to national totals．At present，only the Dutch government carries out such surveys every year．Australia surveys approximately every three years；France has surveys for most of the last ten years；Japan surveys every year．For other countries，the general order of calculation is to start with gasoline use，subtract off what is believed used by trucks，buses and motorcycles，and allocate the rest to cars and light trucks． Using estimates of mileage driven by cars and light trucks，miles per gallon is derived．For diesel fuel，automobile fuel is usually removed by assumption，with average mileage relatively well

[^70]known．Buses are removed by assumption and using data from local and intercity operators for mileage and even fuel consumption．The remaining fuel is allocated to trucks and＂special vehicles，＂such as fire engines，cranes，etc．LBNL has tried to remove these from the data whenever possible，and will hopefully present revised freight data in the next edition．
－＂Cars＂are for every country cars in use，not total registrations．Data from The Polk Company is used for the U．S．This may reduce the number of cars by as much as $15 \%$ ．Wherever possible， the mid－year averages are used as well．However，total distance driven is usually derived from either surveys（cars in use xdistance per car per ，year）or from a combination of traffic counts and travel surveys．Therefore，for some countries，notably the U．S．，distance per car per year may seem higher than what is customary．But fuel per distance is always measured or derived as such， and is independent of the number of cars counted．
－Gasoline and diesel fuel continue to be aggregated using the energy content of fuels．This gives an aggregate miles per gallon figure that is somewhat different than those published by many countries that count only volumes．Where possible，the fuel economies have been disaggregated into gasoline，diesel，and LPG．
－Measures of passenger travel for a number of countries（i．e．Sweden，Japan，Denmark，Italy）do not agree with national sources because load factors are interpolated between years of travel surveys or load factors are assumed for some vehicles for which none are published（i．e．light trucks for Denmark，mini－cars for Japan）．
－With few exceptions，data on fuel use for domestic air travel are unreliable．Most countries continue to record purchases of fuel by domestic airlines for both travel within each country and departures abroad．Only Australia，Denmark，Italy（since the late 1980s），Japan，Norway（since 1993），and the U．S．report fuel use for domestic and foreign air traffic separately．

## 2. REVISIONS REFLECTED IN THE PRESENT DATA

From time to time our national sources revise data as better estimates of the components of energy use and transportation activity are made available. Information about these revisions follows.

- Australia - Data for 1994 and 1995 were not available at the time of publication.
- Denmark- No official Transport Statistics Volumes were published for 1994 or 1995. The few data we have included for these years should be considered provisional. Data on domestic airline fuel fluctuate significantly and cannot be considered reliable. New car fuel economy are taken from a newly-revised time series prepared by Danmarks Miljoeundersoegeise (H. Gudmunsson, private communication).
- Finland- VTT, the Technical Research Center of Espoo, Finland, provided a throughly revised set of mileage, car stocks, and fuel consumption data for all road vehicles. The recent dramatic improvements in the fuel economy of the stock may reflect inconsistencies with older data, particularly, the stated fuel economy of diesel cars which jumps in 1990.
- France - Data for 1994 and 1995 come from the same sources as previous data, with few revisions. However, a typographical error in the previous data provided listed the fuel economy of new vehicles incorrectly. This has been corrected.
- Germany (West) - With the publication of the traditional data sources, East and West Germany can no longer be separated. The data which do exist for West Germany alone for 1994 are included in the present revisions. It is hoped that data for united Germany can be presented in future editions with historical data to 1991. Distances traveled by cars have been significantly revised back to 1970. The drop in car miles driven in 1994 may be a result of the difficulties of splitting East and West Germany. Fuel economy has been revised as well, typically by five to seven percent. Fuel economy is used to determine distance traveled. Deutsches Institut fuer Wirtschaftsforschung (DIW) updated the firues on new car fuel economy as well as provided the revised car mileage and fuel use data for West Germany economy.
－Italy－New authoritative data on car stocks，car use，and fuel use for gasoline and diesel were provided by the Automobile Club of Italy（ACI）（L．Penissi，private communication）and by Fiat． These were used to recalculate all figures from 1980 onward．A load factor of 1.7 was used for cars for all years after 1988．（Official data from the yearly National Accounts of Transport include only intercity automobile use and travel．）Distance and assumed fuel use per kilometer are used to determine total fuel by type．New car fuel economy for recent years was provided by ACI as well．
－Japan－With assistance from the Ministry of Transport（H．Sasaki，private communication），the Japan Auto Research Institute（K．Minato，private communication），Energy Economic Institute， and Energy Data and Modeling Center publications，the estimates of automobile fuel use and kilometers traveled have been revised．Fuel economy is calculated as total fuel divided by total distance and cannot easily be broken down by fuel type．The Ministry of Transport has provided yearly car use surveys which will be explored in future editions of the data．New data on fuel economy averages reflect a new 15 mode consumption test（H．Sasaki，private communication） which were chained to previous years for compatibility．
－Netherlands－Data from the Bureau of Statistics，the Adviesdiesnt Verkeer en Vervoer，and the fuel consumption per car use surveys were used to revise all of the automobile data．Driving of Dutch drivers outside of Holland is excluded as is the fuel consumed on these trips．Driving done by foreign drivers visiting Holland is also excluded．Fuel data was received on bus and rail use from the University of Utrecht and from the Bureau of Statistics surveys，but we had to estimate these for the period 1980 to 1984．The car fleet data shown are for cars in use．Where known， these are shown by fuel type．
－Norway－Norsk Esso provided their reliable breakdown of road fuel use by vehicle type and fuel． Most of the other data for 1994 were provided by the Institutt for Energiteknik，near Oslo，as part of a project funded by the Norwegian Water and Energy Authority．The Institutt for Energiteknik revised information on fuel use for domestic air travel only．
－Sweden－As a complete revision of automobile fuel use and driving data is still not complete，we have not been able to update any information for Sweden on travel，vehicle use，or fuel use．

However, we do include revised figures for the sales-weighted fuel economy of new cars, correcting a typographical error in the previous data.

- United Kingdom - A revised series of fuel use and car use from the U.K. Department of Transportation and updated information on sales-weighed fuel economy of new gasoline cars were received. It is noted that diesel cars have risen in popularity; however no data on these cars' new test fuel consumption are available. Information on rail energy use and on fuel for domestic air travel was incomplete.
- United States - The transportation data come from ORNL and from various U.S. Department of Transportation publications. The reader is reminded that for purposes of international comparisons, automobiles and personal light trucks are aggregated. The classification of some vans and sport utility vehicles was shifted by DOT in 1993 and are reflected in the 1994 and 1995 data. This makes comparisons involving numbers of vehicles, mileage, and fuel use in previous years slightly uncertain.

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Italy - Lucia Penissi, Automobile Club of Italy, Roma
Japan - H. Sasaski, Ministry of Transport
Netherlands - Jan van der Waard, AVV, Rotterdam and Jacco Farla, University of Utrecht
Norway - Norsk Esso
United Kingdom - Deryck Jones, United Kingdom Department of Transport

## 3. BRIEF REVIEW OF SOURCES AND EXPLANATION

This note explains the most recent LBNL collection and analysis of data covering the structure of travel and freight energy use in twelve OECD countries. In general the LBNL analyses follow major sources from each country. Where these are incomplete, we proceed bottom-up using each country's main data sources on vehicle activity, as well as travel (passenger-kilometers) and freight (tonnekilometers). Aggregate data on traffic, travel and freight by mode (including data for car travel derived usually from travel surveys) are split where possible by fuel, i.e., into activity for gasoline, diesel, and liquified petroleum gas (LPG). Fuel data are developed by each country source, typically by first parsing reported data (rail, bus, some trucking, domestic shipping, domestic air travel) and then splitting the remaining road fuels into modes. Usually we follow our sources, but important exceptions are Sweden, Denmark, and Italy, where we have tried to resolve often conflicting information from a number of experts and published sources. For rail energy use, we assume (unless data show otherwise) that electricity is used only for passenger travel (as well as for local rail transit) and split the diesel fuel according to a formula where two passenger-km traveled are equal to one tonne-km of freight hauled. (For air freight, we parse according to weight, approximately seven passengers (with baggage) equals one tonne. We usually do not analyze minor modes (motorcycles and mopeds, and waterborne travel in most countries) and omit pipelines for most countries because of a lack of data on volume (tonne-km) or energy consumed, or both. We omit international shipping and try to eliminate fuel use for international passenger and freight air transport because there are virtually no data on activity by country of traveler. We also use each country's travel surveys to check modal distributions with the aggregate sources.

To insure comparability with the U.S. we have taken these precautions with "cars." First, we count U.S. personal light trucks (approximately $2 / 3$ of all light trucks and light truck travel) with automobiles, since these are clearly used as household vehicles and now make up more than $20 \%$ of the household vehicle stock. Light trucks and vans in Australia, Denmark and Britain are also counted with automobiles, making up about 3-5\% of the stock. Light trucks and vans in the other Nordic countries (roughly $2 \%$ of the household vehicle stock), however, cannot easily be separated from other trucks, so are not counted as "cars." Mini-cars in Japan are counted as cars. Light trucks or vans are not important as household vehicles in Italy, Germany, and France.


#### Abstract

Australia

We present for the first time a complete set of data for Australian travel and energy use，covering the period 1971 to 1993．The figures were worked out by the Bureau of Transport and Communications Economics（BTCE）of the Australian Government，Canberra，and transmitted by Leo Dobes，David Gargett，and David Cosgrove．These officials provide some unpublished estimates to complement the data found in publications listed below．The original sources of the data were the Australian government＇s Survey of Motor Vehicle Use，taken every three years since 1976，with BTCE interpolating the missing years，and The Motor Vehicles Census，both published by the Australian Bureau of Statistics．


BTCE estimated traffic，travel or freight output，and energy use for each kind of road vehicle（cars by fuel，light trucks by fuel，heavy trucks by fuel and type，buses by fuel），for urban light rail and heavy rail and for interurban passenger and freight rail．Rail energy use data were published for 1976，1985， 1988 and 1991，with other years interpolated．Electricity was given as final demand．Bus is estimated with constant vehicle intensities（MJ／vehicle－km）for urban and inter－urban buses and estimates of vkt for each type of travel．They also estimated travel and energy use for domestic air transport，for domestic air freight，for domestic（coastal）shipping，and estimated travel for ferries as well．We modified these figures only to split activity and energy use of light trucks into a component for travel （according to BTCE＇s unpublished estimates）．We extrapolated the split of rail travel and freight activity and energy use by electric and diesel traction for 1971－1973 assuming constant shares of each energy source and constant intensities for those years at the 1974 levels．

Fuel prices were given by BTCE back to 1975 for LPG and diesel，and for gasoline back to 1971．We estimated diesel prices for 1971－1974 from a price index provided by BTCE，and assume LPG followed the same trends．Until the late 1970s gasoline totally dominated the mix of fuels for automobiles．

## Denmark

Data come from a variety of government and automobile industry sources．Through an earlier contract with the Danish Energy Agency，an LBNL team helped authorities revise data for energy and transportation．Data for vehicle use and fuel consumption are provided for each type of vehicle by
fuel type：cars，light trucks（under one tonne），buses，various sizes of trucks．Data on passenger travel are provided by the Ministry of Transport publications，with one important exception．Official sources use a constant automobile load factor for the entire 1970－1993 period to convert vehicle－km to passenger－km．After reviewing a number of studies of travel and load factor，we concluded that this was incorrect We start with a figure of 1.85 for 1970 and，using surveys for 1975，1981，1986，and 1992 and estimating the impact of including children and older people not counted in these surveys， arrive at a load factor close to 1.6 for 1992，using interpolation for years not surveyed．As a result，our data show lower total travel in Denmark than Danish data，and significantly less growth in travel． Light trucks（＂vaerebiler＂）under 1 tonne capacity are counted with automobiles．Foreign（transit） truck traffic is excluded from both tonne－km and energy consumption calculations．

New car fuel economy data are tabulated from sales weighted data for the 20 best selling cars （through 1987），the ten best selling cars（1989），and all new cars（1991 and 1993）．Comparison of results from only the ten or twenty best sellers of 1991 or 1993 show little deviation from the complete sample．The jump in fuel consumption in the 1993 new cars appears real，as it followed a significant decrease in fuel prices．

Published Sources－Denmark
Trafikministeriet（Danish Ministry of Transport）．1990．Transportstatistik 1980－1991［Transport statistics 1980－1991］Copenhagen，Denmark：Trafikministeriet．Now Published Yearly

Automobil－importoerernes Sammenslutning（VIS），1994．Vejtransporten i tal og tekst（Road transportation statistics）Hellerup：VIS．Editions from 1975 onward

Tofte，E．，and Joergensen，J．，1992．Befolknings Rejsevaner（The Travel Habits of the Population）． Copenhagen：Trafikministeriet

Trafik－og Kommunikationsministeriet（Danish Ministry of Transport and Communications）． 1988. Persontrafik i 1975， 1981 og 1986 （Personal travel in 1975，1981，and 1986）Copenhagen，Denmark： Trafik－og Kommunikationsministeriet

Vejdirektoratet，1994．Tal om Vejtrafik（Data on road traffic）．Copenhagen：Veijdirektorat Sektorplanafdelingen

For further information see L．Schipper et al．Energy Use in Denmark in an International Perspective， LBL 32362．Berkeley：Lawrence Berkeley Laboratory．

## Finland

The figures were first worked out as part of an LBNL project undertaken for the Ministry of Trade and Industry．O．Koskonen of the Ministry of Transport provided the ministry＇s estimates of road vehicle activity and fuel use by mode，while almost all other data come from the annual：Transport and Communications Statistical Yearbook for Finland 1993 （and previous years）of the Finnish Bureau of Statistics．

Aviation．Energy consumption data for aviation come from statistics from Finnair（including Finnair， Finnaviation and Karair）．Passenger－km and tonne－km of freight are from Civil Aviation Administration（Statistics of Finnish Civil Aviation 1970－1980 and 1980－1993）．Domestic fuel use for 1989－1993 was provided by Finnair．For earlier years，we took the total fuel supplied to Finnish aircraft flying within Finland or leaving Finland（from the Transport Statistics）and related this to all domestic passenger travel and $1 / 2$ of the passenger travel flown by the same Finnish airlines to give outbound traffic only and therefore corresponding to outbound fuel use．Using the ratio of total outbound energy use to total outbound traffic，we formed an energy intensity（in MJ／passenger－km） which we multiplied by domestic－only travel to get domestic fuel use．For the years after 1989 this result came very close to the intensity given by Finnair．

Rail．Almost all data for the rail traffic are derived from the yearbook of Valtion Rautatiet（State Railways）．This includes passenger－km，tonne－km，train－km and consumption of both electricity and diesel．In addition to this we took the metro and trams in Helsinki into account．This information（both activity and energy data）refers to Helsingin Kaupungin Liikennelaitos（Helsingfors Trafikverket， Helsinki Transportation Company）．

Road Traffic．Information about the vehicle stock comes from the Stat．Yearbook．Activity data are partly from a database maintained by the Ministry of Transport（O．Koskinen，priv．comm．），which includes vehicle－km for both travel and freight by vehicle type and fuel．To this data we added information on buses in Helsinki（Helsingfors Trafikverket）．Vehicle－km for cars for the years 1970 － 1974 come from the Ministry database，but for the remaining years we used information from National Road Administration．The published statistics of the Road Administration use 12000 km as their length of street network in 1975－1991 and after that switch to 15000 km ．To avoid this discrepancy
in the data set we used a continuous times series based on a 15000 km long street network recently processed by the Road Administration．Passenger－km for cars are from Road Administration． Passenger－km for buses and motorcycles refer to the source＂Transport and Communications Statistical Yearbook of Finland 1993．＂Passenger－km for the buses in Helsinki are from Helsingfors Trafikverket．

Activity for freight is derived from Tavaraliikenteen Tavarankuljetustilasto，Road Administration （Statistics of freight）．No published data exist for tonne－km for vans，which we refer to as light trucks in our analyses．Therefore we had to use the estimate 0.33 tonne－km／vehicle－km．

Information on energy consumption for road traffic is based on the earlier mentioned database from the Ministry of Transport．We complemented these data with the information on specific consumption of new cars sold each year estimated by Harri Kallberg of Neste，the State Oil Company（priv．comm．）． Fuel intensity for cars is derived；fuel economy for new cars was estimated by Kallberg through 1988 only．

Water traffic．For water traffic energy consumption data come from the Energy Statistics．Activity （both passenger－km and tonne－km）come from the Statistical Yearbook for the years 1971－1993． Data for 1970 are from Tie－ja Vesirakennus Hallitus（Road and Water Administration）．

## Published Sources－Finland

Central Bureau of Statistics，1994．Transport and Communications Statistical Yearbook for Finland 1993．Helsinki．

For further information see L．Schipper，L Peraelae et al．，1995．Energy Use in Finland in an International Perspective，LBL 35XXX．Berkeley：Lawrence Berkeley Laboratory．

## France

Energy use data are both derived from the following sources：Tableaux des Consommations d＇Energie en France（Observatoire de l＇Energie），Les Comptes des Transports，（INSEE，the National Statistical Office，in their series Resultats），and Didier Bosseboeuf of ADEME，l＇Agence d＂Environment et de la Maitrise de l＇Energie．

Activity data are mainly from INSEE，complemented by a few other sources．Air passenger （passenger－km）and seat activity（seat－km）data refer to Air Inter，which handles approximately 95\％ of all domestic flights．Rail activity data for both intercity（passenger－km）travel and freight（tonne－ km ）refers to SNCF．Bus activity（passenger－km）assumes a load factor（LF）of 23 for years 1970－ 1980 （which is about the 1983－87 average）．It is estimated by multiplying this LF with known vehicle－ km numbers．

Vehicle use data are based on the following assumptions：（a）automobile use（km／car／yr）for years 1970，1971，and 1973 is estimated assuming a load－factor（LF）of 1.85 and using activity（passenger－ km ）and stock data；and（b）gasoline－powered automobile use was estimated，assuming that diesel cars in 1970 went 2.4 times as far as the average car，which narrowed to 2.0 times by 1988 （refer to Observatoire de l＇Energie）．

Automobile energy use includes liquid petroleum gas（LPG）．The 1970－1972 data for both gasoline and diesel powered automobiles are estimated by multiplying toe／vehicle and stock of vehicles．Air energy use is fuel used for domestic flights by Air Inter．After 1985，a new means of accounting for diesel energy use for buses was adopted．Rail electricity use data of SNCF and RATP are converted from primary to delivered energy．

Assumptions for energy use include：（a）1970－1972 data for gasoline－powered automobiles are based on the 1974 ratio of tons of oil equivalent（toe）and vehicle－kilometers；（b）for these same years，it is assumed that fuel economies（ $\mathrm{MJ} /$ vehicle－km）were about constant for both diesel and gasoline cars in years 1970 and 1973．This assumption was made to approximate average fuel economy estimates supplied by Didier Bosseboeuf；（c） $95 \%$ of air energy use is for passenger use（which is derived from Air Inter＇s energy intensity figures（MJ／passenger－km）for domestic flights；and（d）passenger share of rail transport assumes one passenger－kilometer（passenger－km）uses as much energy as 1.25 ton－
kilometers（tonne－km），which coincides with 1988 data．After 1988 there is a slight series break in the accounting for automotive diesel．

New car fuel economy for diesel and for gasoline are published in the Tableaux and in Les Comptes en Transports．

Didier Bosseboeuf of the Agence d＇Environment et Maitrise d＇Energie provided essential data， interpretation，and comments on the analysis．

## Published Sources－France

INSEE and OEST（Institut National de la Statistique et des Etudes Economiques and Observatoire Economique et Statistique des Transport）．1987－1994．Les Comptes des Transports（Transport accounts）Paris，France：INSEE．（Published Yearly）

Ministry of Industry，1975－1994．Tableaux des Consummation d＇Energie en France（Tables of Energy Consumption in France）．Paris：Ministry of Industry

## Germany（West）

The primary source of data on transportation and energy use is：Deutsches Institut fuer Wirtschaftsforschung：Verkehr in Zahlen（various editions）．This handbook contains a nearly complete set of data for traffic，travel and freight activity and energy use from 1950 to 1993．We had to assume，however，that $1 / 3$ of air fuel was for domestic travel，and form our own split of rail energy into travel and freight components．Additional supporting data for rail and air travel are from： Deutsches Institut fuer Wirtschaftsforschung：Detaillierung des Energieverbrauchs in der BRD im HuK，Industrie und Verkehr nach Verwendungswecken；and Deutsches Institut fuer Wirtschaftsforschung，Der Endenergieverbrauch im Sektor Verkehr nach Subsektoren sowie nach Verwendungsarten und Verkehrsbereichen（1984）．

Estimates of new car fuel economy（using static tests and using road tests）are published by DIW in their Wochenblatt series．We show the static test values，for both gasoline and diesel．The latest data available were for 1991.

## Published Sources－West Germany

Deutsches Institut fuer Wirtschaftsforschung（DIW）1972－1994．Verkehr in Zahlen 1994．（Traffic in Figures）．Bonn，Germany：Bundesministerium fuer Verkehr

Vergleichende Auswertungen von Haushaltsbefragungewn zum Personennahverkehr（KONTIV 1976， 1982，1989）．Berlin，West Germany：Deutsches Institut fuer Wirtschaftsforschung（DIW）．Original is Emnid－Institut GMBH \＆Co．1990．KONTIV 1989．（Four Volumes．）Bielefeld，West Germany

## Italy

Major sources data include：ANFIA，L＇automobile in cifre，1988；AGIP Petroli；Ministero dei Trasporti，Conto Nationale Trasporti（Anno 1988 e prime anticiazioni per il 1989 and subsequent years）；Ministero dei Trasporti，Piano Generale Trasporti；ISTAT：Sommario di Statistiche Storiche； and International Road Federation（IRF），World Road Statistics．

Energy use data come from the following sources：AGIP Petroli；Unione Petrolifera；Ministero dei Trasporti，Piano Generale Trasporti；Ministero dell＇Industria，Commerciol ed Artigianato，Bilancio Energetico Nazionale．

Automobile vehicle use data include average kilometers traveled by both gasoline，LPG，and diesel cars．Truck vehicle use data include 3 －wheeled trucks．These are estimated for urban and intercity activity，the latter of which refers to freeways and trunk roads．Pipeline activity data include pipelines greater than 50 kilometers．

Intracity passenger and freight movement data exist only for rail．All other intracity movement（bus， car，truck）are estimates by AGIP Petroli．

Energy use from coal in rail transport applies the conversion factor of $7500 \mathrm{kcal} / \mathrm{kg}$（except for 1970 and 1972 ，which applies 7410 and $6500 \mathrm{kcal} / \mathrm{kg}$ ，respectively．Assumptions in energy use include： （a）diesel passenger share used in calculating total energy use in rail transport assumes transporting 1.25 persons is equivalent to 1 ton；（b）passenger share of jet fuel use is estimated at $97 \%$ which is
similarly used for other countries；and（c）jet fuel domestic share energy use is estimated at $18 \%$ for 1973 and grows at $1 \%$ per year．This assumption allows consistency with AGIP Petroli＇s modal intensity figures．

There are some inconsistencies in the energy use data：（a）the public sector diesel consumption drops significantly from 1978 and 1979，suggesting that the 1970－1978 time series may include diesel fuel consumption for heating purposes；（b）truck energy use data，which come from Ministry of Transport， are missing for a number of years（1970－1971，1973－1977，1979－1986，and 1988）and therefore have been interpolated．If one tries to calculate energy use，weighted by activity（vehicle－km），different numbers result．The question concerns how the Ministry of Transport arrived at their calculations；（c） data on energy consumption of jet fuel in air transport for years 1976－1978 were adjusted to correct for inconsistency；and（d）end－use energy data from the Ministry of Industry appear to be high．It is uncertain if the data include other uses，like heating or cooking．

Data on new car fuel intensity were provided by Agip Petroli（through 1988）．No more recent data were available．

Allesandro Liberati Oof Agip Petroli and Romeo Dines of the Univ．of Trieste provided data and helpful comments．

## Japan

Two sources publish data on transportation energy consumption in Japan：（1）the Ministry of Transport（MOT）and（2）the Ministry of International Trade and Industry（MITI）in cooperation with the Energy and Data Modeling Center（EDMC）of the Institute of Energy Economics（IEE）．However， only the MOT collects data through direct surveys，whereas MITI and IEE derive figures for energy consumption through indirect calculation．MITI assumes average fuel－intensity levels and derives energy consumption in a top－down fashion，a practice criticized as unreliable in an earlier study done at LBNL．In addition，of these agencies only the EDMC performs detailed energy analyses of the country＇s transportation sector，but few of these studies are published outside of Japan．

We use MOT data as the most accurate，bearing in mind the following changes in the data series： before 1981，road vehicle fuel consumption figures are based only on fuel sales data；since 1981，the

MOT has conducted surveys，with more modes included in a consistent manner；since 1987，mini－car and mini－truck transport has been counted．We have extrapolated data on the use of mini－cars from after 1987 to prior years using a constant yearly driving distance and the known number of these small vehicles．We assume a load factor of 1．5．The Japanese sources show a significant increase in all automobile load factor after 1987，which boosts passenger travel in this mode by over $10 \%$ in one year．We can find no explanation for this rapid change．Although some uncertainties still remain，the characteristics of energy use in Japanese transportation are so striking，and the changes observed so large，compared with the uncertainties，that we feel any conclusions drawn from our data are robust．

New car fuel consumption according to the＂ 10 Mode test＂are provided in the EDMC yearly Energy Handbook．

Naoto Sagawa of the Institute for Energy Economics and K．Minato of the Japan Auto Research Institute provided helpful comments．

## Published Sources－Japan

The Institute of Energy Economics．（1992）．Energy Data and Demand of Transportation Sector in Japan，Tokyo：The Energy Data and Modeling Center，The Institute of Energy Economics．

The Institute of Energy Economics，yearly．Enerugii Keizai Toukei Youran（Energy Economics Statistical Survey）．Tokyo：Energy Data and Modeling Center，IEE．

Institute of Energy Economics Energy Data Modeling Center．Annual Energy Statistics．（Also known as the＂Red Book＂）．

Ministry of Transport，1993．Jidosha Unso Tokei Nenjo（＂Automobile Transportation Statistical Yearbook＂），various years．

Japan Automobile Association，Rikuun Tokei Yoran（Land Transport Statistical Handbook），various years．

Ministry of Transport，Statistics of Automobile Transportation，Energy Handbook on Transportation， various years．

Ministry of Transport，Unyu Kankei Enerugi Yoran（＂Transportation Energy Statistics Handbook＂）， various years．

## Netherlands

Principal source of data is the yearbook of the Ministry of Transport, Public Works, and Water Management, Zakboek verkeers en vervoersstatistieken. This contains traffic and energy use data by fuel type and mode and travel by mode from 1985. Earlier years are estimated from a variety of sources, with automobile fuel use data back to 1970. Many sources do not distinguish between travel on city trams/subway or bus, but tram/metro travel can be separated out using passenger travel statistics for bus. However, local and intercity rail services are both provided by NS, the National Railway, so these cannot be distinguished. Erna Schol of Energieunderzoek Centrum Nederlands (ECN) and Jacco Farla of the Univ. of Utrecht assisted in the analysis of a large number of data sources.

From the mid 1970s, CBS provides data on car ownership and vehicle-km by fuel type, and fuel consumption as well. We exclude the use of Dutch vehicles outside of Holland (since the energy use is not included) and we also exclude foreigner's driving and fuel use in Holland. Thus the figures given underestimate the auto-mobility and fuel use of the Dutch by about 5\% (early 1970s) up to $10 \%$ (early 1990s). Bus and rail activity data, however include passengers of all nationalities and include the domestic portions of foreign trips. Accurate data on fuel use for rail and bus were not available for all years. No data are available for the small amount of domestic air travel or its fuel use.

For freight, the activity data include imports and exports but not freight carried by foreign trucks transiting Holland. Accurate splits of fuel use for all modes were not available for all years.

The sales-weighted new-car fuel economy was not available.

## Published Sources－Netherlands

Ministry of Transport，1992．Verkeer en Ciffers．（Transportation in Figures．）The Hague：Min．of Transport

Centraal Bureau voor de statistiek（CBS），1991．De mobiliteit van de nederlandse bevolking 1990. （Mobility of the Dutch population in 1990．）（The Mobility of the Dutch Population．Every year from 1979．）The Netherlands：Voorburg／Heerlen

CBS，various years．Het bezit en gebruik van personauto＇s．（Ownership and Use of Private Cars．）． Vorburg：CBS．

CBS，various years．Statistiek van de motovoertuigen．（Statistics of Motor Vehicles．）Voorburg： CBS

CBS，various years．Statistiek van het Personevervoer．（Statistics of Personal Travel．）Voorburg： CBS

CBS，various years．Zakboek verkeers en verfoersstatistieken．（Handbook of Transportation and Travel Statistics．）Voorburg：CBS．

## Norway

Estimates of passenger－and tonne－km activity are published in Samferdsel Statistikk（Transportation Statistics）and in publications from Transport Oekonomisk Institute（TOI）in Oslo．Estimates of automobile use stem from surveys taken in 1967，1973，1981，and 1985－88，＂Eie og Bruk av Bil．＂ Numbers of vehicles are published in Samferdsel statistikk and in Bil og Vei，the publication of the Norwegian Road Authority（Veg Direktorat）．＂Cars＂（biler）includes virtually all vehicles，but＂person biler＂represents automobiles for private and business use．

Energy use by mode is poorly documented in public literature．The Bureau of Statistics publishes ＂Road＂，＂Rail＂，＂Ship＂，and＂Air＂energy use by fuel in their yearly Energistatistikk and Energiregnskap．Data from 1976 to 1980 and 1980 to 1986 contain many detailed breakdowns of individual transportation mode＇s energy use（and activity）．Esso（A．Kvamme，priv．comm．）has made their own research into the matter，breaking both the automobile and truck fuel markets into considerable detail．Because the Esso data cover the longest period（1970 to present）and make the
most detailed attempt to balance all the various liquid fuels markets，we use the data they kindly provided to match energy use，activity，and energy use per vehicle－km．

Transport Economics Institute has estimated the fuel economy of new cars by examining the most popular models sold and their test fuel consumption．

## Published Sources－Norway

Central Bureau of Statistics（SSB），1970－1994．Samferdsel Statistikk（Transport statistics） Kongsviner：SSB

OFV，1994．Bil og Vei：Statistikk 1994 （Car and Road Statistics for 1994）．Oslo：Opplysnings raadet for Veitraffikken．

Rideng，A．，1993．（Transport Oekeonomisk Institutt，various years）．Transportytelser i Norge （Transport in Norway）1946－1992．TOI Rapport 187／1993．Oslo：Transport Economic Institute

Transport Oekeonomisk Institutt．1993．Norsk reisevaner．Dokumentasjonsrapport for den landsomfattande reisevaneundersoekelsen 1991－2（National survey of travel habits 1991－2）．Report 183．Oslo：Transport Economic Institute

Vibe，N．，1993．Vaare Daglige reiser．Endringer i Nordmenns reisevaner fra 1985 til 1992 （Our Daily Travel．Changes in Norwegians＇Daily Travel 1985－1992）．TOE rapport 171．Oslo：Transport Economics

## Sweden

The data on energy use come from two sources：the National Energy Administration（STEP，now GNATHIC）；and the Transportation Council（TAR，now taken over by the Highway Institute in Linköping）．In 1977 SIND（the predecessor to STEP）prepared a forecast of energy use in Sweden that was based in part upon detailed breakdowns of energy use in the transportation sector provided by the predecessor of TAR．These were＂updated＂in subsequent energy studies published by STEP． TAR has continually published data on passenger－and tonne－km，as well as on vehicle－km．The Central Bureau of Statistics publishes data on the characteristics of the vehicle stock．The Swedish Automobile Association and AB Bilstatistik publish a yearbook with other details of the vehicle stock，
such as the number of cars by weight. New car fuel economy, based on tests, is weighted by sales by the car industry and provided by the Ministry of Trade.

In the 1980s J. Wajsmann of TAR began a systematic bottom-up analysis of energy use in the transportation sector. His unpublished analyses have been provided to STEP for their own yearly breakdowns of Swedish energy use. In these he examines the number of vehicles, km driven and consumption of fuel per km for four types of cars (gasoline private cars and taxis, and diesel private cars and taxis), buses, and trucks. He covers domestic air travel and inland shipping, as well as many smaller users of liquid fuels. Data on electricity use for the railways and local transit are published by the Central Bureau of Statistics' El och Fjaerrvaerme Försörining (Electricity Supply Statistics). Wajsmann's analyses cover 1980, and 1983 to 1989. The match with the 1970-76 data is not perfect, but acceptable for our purposes. Using data on the stock of vehicles and modal activity, we have reconstructed 1978 and 1981-82 energy use patterns and interpolated remaining years between 1976 and 1983. We have also estimated automobile vehicle-km and fuel economy for 1970-1976, since the SIND data and their TAR source contain very little information on these two parameters. However, Energiprognosutredning (1974) provides a detailed breakdown of transportation energy use in 1970 and some information for 1973. Assembling these together we believe we have created a reasonable picture of the 1970-76 period that can be compared with the period from 1980 to the present. Finally, a large number of smaller official and unofficial publications reviewed in Appendix 3 of Schipper L.J. and Johnson F., with Howarth R., Andersson B.E., Anderson B.G., and Price LK. 1993. Energy Use in Sweden: An International Perspective. Lawrence Berkeley Laboratory Report LBL-33819. Berkeley, CA: Lawrence Berkeley Laboratory. Published as Schipper and Price 1994 in Nat. Res. Forum (May)

## Published Sources - Sweden

Bilindustriförening, 1994 (each year). Bilism i Sverige 1993.(Driving in Sweden 1993) Stockholm: AB Bilstatistik.

National Central Bureau of Statistics (Sweden). 1984/5 Resavanorundersökning. Statistiska meddelanden (1984/5 Survey of travel habits). Stockholm, Sweden: Statistics Sweden

VTI, 1993. VTI Transportstatistik. Swedish Road Institute Transport Statistics.) Appears Quarterly. Stockholm: DPU (Delegation för prognos och utvecklingsverksamhet inom transportsektorn, Dept. of Communications). These are now produced by SIKA (Statens Institut för Kommunikations Analyser).

## United Kingdom (Great Britain)

Transportation activity and energy data are taken from the U.K. Digest of Transportation Statistics, published yearly by the Department of Transport. These contain data covering Great Britain (England, Wales, and Scotland), and, for a few tables, the United Kingdom (ie., including N. Ireland) as well. Most data are taken directly from this source. Fuel use for road vehicles from 1981 was re-analyzed by B.Oelman, Dept. of Transport (priv. comm.). Light trucks and small vans are counted with automobiles. Oelman also estimates fuel economy of new cars.

Published Sources - United Kingdom
Department of Transport (DOT). 1970-1994. Transport Statistics: Great Britain. London, UK: Her Majesty's Stationery Office

Transport Department, various years. National Travel Survey. (1972/3, 1982/3, 1985/6, 1990/91) London, UK: Her Majesty's Stationery Office

## United States

The transportation data come from three major sources：Oak Ridge National Laboratory（ORNL）and the US Department of Transportation（DOT）．Virtually all of the time－series data beginning from 1970 to the present are extracted from ORNL＇s Transportation Energy Data Book：Editions 11－14，1991－ 1994．and subsequent editions，and FHWA Statistical Summary to 1985.

Energy use data are from ORNL＇s Data Books．

Assumptions for vehicle use（vehicle－km）and energy use include：（a）light trucks have the same mileage as automobiles，and the share used as personal vehicles is taken from the ORNL data book （for example Table 2.12 of Edition 12．）；（b）all light freight vehicle use is assumed to be for intracity transport；（c）domestic air is estimated at $87 \%$ of total vehicle－km．Load factor（LF）estimates include the following：（a）automobile LF is estimated at 2.2 persons from 1960 to 1970．It then decreased to 1.87 by 1977， 1.7 by 1983，and 1.59 in 1990．（b）motorcycle LF（motorcycles are not shown in this work）is estimated at 1.1 persons；（c）personal truck LF is estimated at the same as that of the automobile LF；（d）intracity light truck LF is estimated at 0.25 tons／truck；（e）intracity mid－size trucks is estimated at 5 tons／truck；and（f）school bus load is estimated at 20 persons．

Two areas of concern are：（a）a discrepancy exists between automobile stock cited in ORNL（Polk） and DOT FHWA．The former survey shows fewer cars than FHWA；and（b）there is a growing population of light trucks used solely for personal travel．TIUS survey data（reported in ORNL and used in the time－series data on stock and activity）show the share of trucks used for personal travel growing from approximately $25 \%$ in 1960 to $65 \%$ in 1988，which we extrapolate to $68 \%$ by 1993 ．

## Published Sources－United States

Davis，S．C．，1994．Transportation Energy Data Book：Edition 15．Oak Ridge，TN：Oak Ridge National Laboratory，ORNL－6710（and previous editions）．

U．S．FHWA（Federal Highway Administration）． 1994 （and previous years）．Highway Statistics 1993. Washington，DC：U．S．Department of Transportation，Federal Highway Administration，FHWA－PL－ 93－023

U．S．Department of Transportation．1992．U．S．Nationwide Personal Transportation Survey 1990. Washington，DC：U．S．Dept．of Transportation

## 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 $20^{\circ} \mathrm{C}$ 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（ $\mathbf{C O}_{2}$ ）－A colorless，odorless，non－poisonous gas that is a normal part of the ambient air．Carbon dioxide is a product of fossil fuel combustion．

Carbon monoxide（CO）－A colorless，odorless，highly toxic gas that is a normal by－product of incomplete fossil fuel combustion．Carbon monoxide，one of the major air pollutants，can be harmful in small amounts if breathed over a certain period of time．

Car－mile（railroad）－A single railroad car moved a distance of one mile．

Cargo ton－mile－See Ton－mile．

Certificated route air carriers－See Air carriers．

## Class I freight railroad－See Rail．

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．

Curb weight－The weight of a vehicle including all standard equipment，spare tire and wheel，all fluids and lubricants to capacity，full tank of fuel，and the weight of major optional accessories normally found on the vehicle．

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．

Ethanol（ $\mathbf{C}_{2} \mathbf{H}_{5} \mathbf{O H}$ ）－Otherwise known as ethyl alcohol，alcohol，or grain－spirit．A clear，colorless， flammable oxygenated hydrocarbon with a boiling point of 78.5 degrees Celsius in the
anhydrous state．In transportation，ethanol is used as a vehicle fuel by itself（E100），blended with gasoline（E85），or as a gaoline octane enhancer and oxygenate（ $10 \%$ concentration）．

## 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 to 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．

Methanol $\left(\mathbf{C H}_{3} \mathbf{O H}\right)$－A colorless poisonous liquid with essentially no odor and very little taste．It is the simplest alcohol and boils at 64.7 degrees Celsius．In transportation，methanol is used as a vehicle fuel by itself（M100），or blended with gasoline（M85）．

Midsize car－See Automobile size classifications．

Minicompact car－See Automobile size classifications．
Model year－In this publication，model year is referring to the＂sales＂model year，the period from October 1 to the next September 31.

Motor bus－See Bus．

Motor Gasoline－A mixture of volatile hydrocarbons suitable for operation of an internal combustion engine whose major components are hydrocarbons with boiling points ranging from 78 to 217 degrees centigrade and whose source is distillation of petroleum and cracking，polymerization， and other chemical reactions by which the naturally occurring petroleum hydrocarbons are converted into those that have superior fuel properties．

## Naphtha－type jet fuel－See Jet fuel．

National income－See Income．

Nationwide Personal Transportation Study（NPTS）－A nationwide home interview survey of households that provides information on the characteristics and personal travel patterns of the U．S．population．Surveys were conducted in 1969，1977， 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 $\left(\mathbf{N O}_{\mathbf{x}}\right)$－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．

Oxygenate－A substance which，when added to gasoline，increases the amount of oxygen in that gasoline blend．Includes fuel ethanol，methanol，and methyl tertiary butyl ether（MTBE）．

Particulates－Carbon particles formed by partial oxidation and reduction of the hydrocarbon fuel． Also included are trace quantities of metal oxides and nitrides，originating from engine wear， component degradation，and inorganic fuel additives．In the transportation sector，particulates are emitted mainly from diesel engines．

Passenger－miles traveled（PMT）－One person traveling the distance of one mile．Total passenger－ miles traveled，thus，give the total mileage traveled by all persons．

## Passenger rail－See Rail，＂Amtrak＂and＂Transit Railroad＂．

Personal Consumption Expenditures（PCE）－As used in the national accounts，the market value of purchases of goods and services by individuals and nonprofit institutions and the value of food，clothing，housing，and financial services received by them as income in kind．It
includes the rental value of owner－occupied houses but excludes purchases of dwellings， which are classified as capital goods（investment）．

## Personal income－See Income．

Petroleum－A generic term applied to oil and oil products in all forms，such as crude oil，lease condensate，unfinished oil，refined petroleum products，natural gas plant liquids，and non－ hydrocarbon compounds blended into finished petroleum products．

Petroleum consumption－A calculated demand for petroleum products obtained by summing domestic production，imports of crude petroleum and natural gas liquids，imports of petroleum products，and the primary stocks at the beginning of the period and then subtracting the exports and the primary stocks at the end of the period．

Petroleum exports－Shipments of petroleum products from the 50 States and the District of Columbia to foreign countries，Puerto Rico，the Virgin Islands，and other U．S．possessions and territories．

Petroleum imports－All imports of crude petroleum，natural gas liquids，and petroleum products from foreign countries and receipts from Guam，Puerto Rico，the Virgin Islands，and the Hawaiian Trade Zone．The commodities included are crude oil，unfinished oils，plant condensate，and refined petroleum products．

Petroleum inventories－The amounts of crude oil，unfinished oil，petroleum products，and natural gas liquids held at refineries，at natural gas processing plants，in pipelines，at bulk terminals operated by refining and pipeline companies，and at independent bulk terminals． Crude oil held in storage on leases is also included；these stocks are know as primary stocks． Secondary stocks－those held by jobbers dealers，service station operators，and consumers－ are excluded．Prior to 1975，stock held at independent bulk terminals were classified as secondary stocks．

Petroleum products supplied－For each petroleum product，the amount supplied is calculated by summing production，crude oil burned directly，imports，and net withdrawals from primary stocks and subtracting exports．

Quad－Quadrillion， $10^{15}$ ．In this publication，a Quad refers to Quadrillion Btu．

## Rail－

Amtrak（American Railroad Tracks）：Operated by the National Railroad Passenger Corporation of Washington，DC．This rail system was created by President Nixon in 1970， and was given the responsibility for the operation of intercity，as distinct from suburban， passenger trains between points designated by the Secretary of Transportation．

Class I freight railroad：Defined by the Interstate Commerce Commission each year based on annual operating revenue．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 has been conducted five times since 1979，the most recent being 1991.

Residual fuel oil－The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations．Included are products know as ASTM grade numbers 5 and 6 oil，heavy diesel oil，Navy Special Fuel Oil，Bunker C oil，and acid sludge and pitch used as refinery fuels．Residual fuel oil is used for the production of electric power，for heating，and for various industrial purposes．

Rural－Usually refers to areas with population less than 5,000 ．

Sales period－October 1 of the previous year to September 30 of the given year．Approximately the same as a model year．

Sales－weighted miles per gallon（mpg）－Calculation of a composite vehicle fuel economy based on the distribution of vehicle sales．

Scrappage rate－As applied to motor vehicles，it is usually expressed as the percentage of vehicles of a certain type in a given age class that are retired from use（lacking registration）in a given year．

School and other nonrevenue bus－See Bus．

Single unit truck－Includes two－axle，four－tire trucks and other single unit trucks．

Two－axle，four tire truck：A motor vehicle consisting primarily of a single motorized device with two axles and four tires．

Other single－unit truck：A motor vehicle consisting primarily of a single motorized device with more than two axles or more than four tires．

Special fuels－Consist primarily of diesel fuel with small amount of liquified petroleum gas，as defined by the Federal Highway Administration．

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, 1987, and 1992. The 1992 data have not yet been released.

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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[^0]:    ${ }^{\text {a }}$ Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles.
    ${ }^{\mathrm{b}}$ Data from 1991 and later are not comparable to prior data.
    ${ }^{\text {c }}$ Data from 1994 and later are not comparable to prior data.
    ${ }^{\mathrm{d}}$ Data are not available.
    ${ }^{\mathrm{e}}$ Average annual percentage change is from earliest year possible to 1995.

[^1]:    ${ }^{\text {a }}$ Data for 1991 and prior include West Germany only. Kraftwagen are included with automobiles (Table 1.1).
    ${ }^{\mathrm{b}}$ Data from 1991 and later are not comparable to prior data.
    ${ }^{\text {c }}$ Data from 1994 and later are not comparable to prior data.
    ${ }^{\mathrm{d}}$ Data are not available.
    ${ }^{\text {e }}$ Average annual percentage change is from earliest year possible to 1995.

[^2]:    ${ }^{\text {a }}$ Prices represent the retail prices (including taxes) for premium leaded gasoline. Prices are representative for each country based on quarterly data averaged for the year.
    ${ }^{b}$ Prices represent the retail prices (including taxes) for premium gasoline on January 1 of the year, or the available time period closest to January 1 .
    ${ }^{\mathrm{c}}$ Regular gasoline.
    ${ }^{\mathrm{d}}$ Data are not available.
    ${ }^{\mathrm{e}}$ These estimates are for international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.
    ${ }^{\mathrm{f}}$ Adjusted by the U.S. Consumer Price Inflation Index.

[^3]:    ${ }^{\text {a }}$ Prices represent the retail prices (including taxes) for diesel fuel. Prices are representative for each country based on quarterly data averaged for the year.
    ${ }^{\text {b }}$ Prices represent the retail prices (including taxes) for diesel fuel on January 1 of the year, or the available time period closest to January 1.
    ${ }^{\text {c }}$ Data are not available.
    ${ }^{\mathrm{d}}$ These estimates are for international comparisons only and do not necessarily correspond to gasoline price estimates in other sections of the book.
    ${ }^{\mathrm{e}}$ Adjusted by the U.S. Consumer Price Inflation Index.

[^4]:    ${ }^{a}$ Includes automobiles and light trucks.
    ${ }^{\mathrm{b}}$ Data are not available
    ${ }^{\mathrm{c}}$ Average annual percentage change is for years 1975-94 and 1985-94.

[^5]:    ${ }^{\text {a }}$ Includes automobiles and light trucks.
    ${ }^{\mathrm{b}}$ Data are not available.
    ${ }^{\text {c }}$ Average annual percentage change is for years 1970-94 and 1985-94.

[^6]:    ${ }^{\text {a }}$ Calculated as total vehicle-miles of travel divided by the number of vehicles in use. Includes privately owned automobiles and light trucks.
    ${ }^{\mathrm{b}}$ Data are not available.
    ${ }^{\text {c }}$ Average annual percentage change is for years 1970-94 and 1985-94.

[^7]:    ${ }^{\text {a }}$ Includes privately owned automobiles and light trucks.
    ${ }^{\mathrm{b}}$ Data are not available.
    ${ }^{\text {c }}$ Average annual percentage change is for years 1970-94 and 1985-94.

[^8]:    ${ }^{\text {a }}$ Includes privately owned automobiles and light trucks.
    ${ }^{\mathrm{b}}$ Data are not available.
    ${ }^{\text {c }}$ Average annual percentage change is for years 1970-94 and 1985-94.

[^9]:    ${ }^{\text {a }}$ Products sum greater than $100 \%$ due to processing gain. The processing gain for years 1978 to 1980 is assumed to be $4 \%$.
    ${ }^{\mathrm{b}}$ 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.

[^10]:    ${ }^{a}$ On December 31, 1992, Ecuador withdrew as a member of OPEC. As of January 1, 1994, imports of petroleum from Ecuador are included with Non-OPEC countries.
    ${ }^{\text {b }}$ Includes Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.

[^11]:    ${ }^{a}$ Gabon withdrew from OPEC effective December 31, 1994. For consistency, Gabon is not included in the historical OPEC data.
    ${ }^{\text {b }}$ Includes Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.

[^12]:    ${ }^{\text {a }}$ Calculated from Total column. One million barrels per day of petroleum is approximately 2.117 quadrillion Btu per year.

[^13]:    ${ }^{\text {a }}$ Includes supplemental gaseous fuels. Transportation sector includes pipeline fuel and natural gas vehicle use.
    ${ }^{\mathrm{b}}$ Includes electrical system energy losses.
    ${ }^{\text {c }}$ Energy generated from geothermal, wood, waste, wind, photovoltaic, and solar thermal energy sources.

[^14]:    ${ }^{\text {a }}$ Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
    ${ }^{\mathrm{b}}$ Includes gasohol.
    ${ }^{\text {c }}$ Estimated using vehicle travel information.
    ${ }^{\mathrm{d}}$ Two-axle, four-tire trucks.
    ${ }^{\text {e }} 1985$ data.
    ${ }^{\text {f }}$ Represents an estimate of energy purchased in the U.S. for international air carrier consumption.

[^15]:    ${ }^{\text {a }}$ Civilian consumption only. Totals may not include all possible uses of fuels for transportation (e.g., snowmobiles).
    ${ }^{\mathrm{b}}$ Thousand barrels per day crude oil equivalents based average on Btu content of a barrel of crude oil.
    ${ }^{\text {c }}$ Estimated using vehicle travel information.
    ${ }^{\mathrm{d}}$ Two-axle, four-tire trucks.

[^16]:    ${ }^{a}$ Estimated using vehicle travel data.
    ${ }^{\mathrm{b}}$ Data are not available.
    ${ }^{\text {c }}$ Nautical miles.
    ${ }^{\mathrm{d}}$ Amtrak only.
    ${ }^{\mathrm{e}}$ Sum of passenger train cars and locomotive units.
    ${ }^{\text {f }}$ Passenger train car-miles.
    ${ }^{\text {8 }}$ Revenue passenger miles.
    ${ }^{\mathrm{h}}$ Light and heavy rail.

[^17]:    ${ }^{\text {a }}$ The definition of intercity truck was "tightened" to exclude smaller trucks. See Appendix A for details.
    ${ }^{\mathrm{b}} 646$ miles is for general freight (less than truckload). Based on data from the Eno Transportation Foundation, the average length of haul for specialized freight (truckload) was 274 miles.
    ${ }^{\text {c Includes commerce by foreign and domestic carriers in the U.S. }}$
    ${ }^{\mathrm{d}}$ Data are not available.
    ${ }^{\mathrm{e}}$ Railroad measures are: number vehicles $=$ number freight cars, vehicle-miles $=$ car-miles, ton-miles $=$ revenue ton-miles.

[^18]:    ${ }^{\text {a }}$ Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA).
    Data are not available.
    ${ }^{\text {c}}$ Beginning in 1992 data became available on alternative fuel use by transit buses.
    ${ }^{\mathrm{d}}$ Average annual percentage change is for years 1973-95.

[^19]:    ${ }^{\text {a }}$ Adjusted by the implicit GNP price deflator.
    ${ }^{\mathrm{b}}$ 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, insurance premiums, tires, tubes and other parts); purchased intercity transportation; and purchased local transportation.
    ${ }^{\text {c }}$ Transportation Consumer Price Index includes new and used cars, gasoline, auto insurance rates, intracity mass transit, intracity bus fare, and airline fares.

[^20]:    ${ }^{\text {a }}$ Includes transplants
    ${ }^{\mathrm{b}}$ Adjusted by the Consumer Price Inflation Index.
    1967 "Average Transaction Price" plus the value of added safety and emissions equipment as determined by the U.S. Bureau of Labor Statistics (BLS), all inflated to current dollars, using the U.S. BLS, "New Car Consumer Price Index - All Urban Consumers." For example, 1969 is equal to the 1968 value plus the BLS stated value of added safety and emissions equipment for the 1969 model year multiplied by 1968-1969 monthly changes in the New Car Consumer Price Index.
    ${ }^{\text {d }} 1967$ "Average Transaction Price" inflated to current dollars.

[^21]:    a $\$ 50$ deductible 1975 through 1977; \$100 deductible 1978 through 1992; $\$ 250$ deductible for 1993 through 1996.
    ${ }^{\mathrm{b}}$ \$100 deductible through 1977; \$250 deductible 1978 through 1992; \$500 deductible for 1993 through 1996.
    ${ }^{\text {c }}$ Coverage: $\$ 100,000 / \$ 300,000$.

[^22]:    ${ }^{\text {a }}$ Data for employees of establishments totally exempt from FICA are excluded, as are self-employed persons, domestic service workers, railroad employees, agricultural production workers and most government employees.
    ${ }^{b}$ Data are not available.

[^23]:    ${ }^{\text {a }}$ The probability that a $1970 / 80 / 90$ model year automobile will be retired from use within a given year.
    ${ }^{\text {b }}$ The probability that a 1970/80/90 model year automobile will be in use at the end of a given year.

[^24]:    ${ }^{\text {a }}$ Average scrappage and survival rates for all vehicles registered within this time period.

[^25]:    ${ }^{\text {a }}$ North American built.
    ${ }^{\mathrm{b}}$ Does not include import tourist deliveries.
    ${ }^{\text {c }}$ 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.
    ${ }^{\mathrm{d}}$ Data are not available.

[^26]:    ${ }^{\text {a }}$ Includes cold-rolled and pre-coated steel.

[^27]:    ${ }^{\text {a }}$ Interior volumes of two seaters are not reported to EPA.
    ${ }^{\mathrm{b}}$ Preliminary.

[^28]:    ${ }^{\text {a }}$ These figures represent only those sales that could be matched to corresponding EPA fuel economy values.
    ${ }^{\mathrm{b}}$ Preliminary.

[^29]:    ${ }^{\text {a }}$ Includes all trucks of 10,000 pounds gross vehicle weight and less sold in the U.S.
    ${ }^{\mathrm{b}}$ Excluding transplants.
    ${ }^{\text {c Based on model year data. A transplant is a light truck which was built in the U.S. by a foreign firm. Also }}$ included are joint ventures built in the U.S.
    ${ }^{\text {d }}$ Light-duty vehicles include cars and light trucks.
    ${ }^{\text {e }}$ Data are not available.
    ${ }^{\text {f }}$ Indicates less than 1 percent.
    ${ }^{\text {g }}$ Based on factory installations or factory sales.

[^30]:    ${ }^{a}$ Sales include domestic-sponsored imports.
    ${ }^{\mathrm{b}}$ Data for 1970 is based on new truck registrations.
    'Less than 500 trucks.

[^31]:    ${ }^{\mathrm{a}}$ Trucks sold as of July 1 of each year.

[^32]:    ${ }^{\text {a }} 1$ liter $=61.02$ cubic inches.
    ${ }^{\mathrm{b}}$ Preliminary.

[^33]:    ${ }^{a}$ These figures represent only those sales that could be matched to corresponding EPA fuel economy values.
    ${ }^{\text {b }}$ Estimates from 1991 through 1995 were revised on EPA truck classification.
    ${ }^{c}$ Preliminary.

[^34]:    ${ }^{\text {a }}$ Some minivans and sport utility vehicles that were previously classified as automobiles are classified as trucks.

[^35]:    ${ }^{a}$ The Federal Highway Administration changed the combination truck travel methodology in 1993.
    ${ }^{\mathrm{b}}$ Other single-unit trucks are defined as all single-unit trucks with more than two axles or more than four tires.
    ${ }^{c}$ 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 3.24 .

[^36]:    ${ }^{a}$ Business and personal services.

[^37]:    ${ }^{\text {a }}$ Average miles and ton-miles are based on the estimated distance traveled, not on Great Circle Distance
    ${ }^{\mathrm{b}}$ Represents zero or less than 1 unit of measure.
    ${ }^{c}$ Data do not meet publication standards due to high sampling variability or other reasons.
    ${ }^{\mathrm{d}}$ CFS data for pipelines exclude most shipments of crude oil.

[^38]:    ${ }^{\text {a }}$ Data for transit buses after 1983 are not comparable with prior data. Data for prior years were provided voluntarily and statistically expanded; in 1984 reporting became mandatory.
    ${ }^{\mathrm{b}}$ Data are not available.
    ${ }^{\text {c }}$ Beginning in 1992, data became available on alternative fuel use by transit buses.
    ${ }^{\mathrm{d}}$ Estimated using vehicle-miles.

[^39]:    ${ }^{\mathrm{a}}$ Less than 8,500 lbs GVWR. Includes ambulances.
    ${ }^{\mathrm{b}} 8,501-23,999 \mathrm{lbs}$ GVWR.
    ${ }^{\mathrm{c}} 24,000 \mathrm{lbs}$. Or more GVWR.

[^40]:    ${ }^{\text {a }}$ Agencies or bureaus with 2,000 or more vehicles.
    ${ }^{\mathrm{b}}$ Includes sedans, station wagons, ambulances, buses, and all trucks.

[^41]:    ${ }^{\text {a }}$ In this study, light trucks are $<8,500 \mathrm{lbs}$ gross vehicle weight.
    ${ }^{\mathrm{b}}$ In this study, medium trucks are between $8,500-26,000 \mathrm{lbs}$ gross vehicle weight.
    ${ }^{\text {c }}$ In this study, heavy trucks are $>26,000$ lbs gross vehicle weight.

[^42]:    ${ }^{\text {a }}$ Buses are included in totals but are not shown because the Relative Standard Error is equal to or greater than $50 \%$, or data were reported for fewer than five fleets.
    ${ }^{\mathrm{b}}$ Withheld because Relative Standard Error is equal to or greater than $50 \%$, or data were reported for fewer than five fleets.
    ${ }^{c}$ No case reported.

[^43]:    ${ }^{\text {a }}$ Buses are included in totals but are not shown because the Relative Standard Error is equal to or greater than $50 \%$ or data were reported for fewer than five fleets.
    ${ }^{b}$ Withheld because Relative Standard Error is equal to or greater than $50 \%$, or data were reported for fewer than five fleets.
    ${ }^{\text {c }}$ No case reported.

[^44]:    ${ }^{\text {a }}$ Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer.
    ${ }^{\text {b }}$ Represents two- and four-wheel drive trucks combined. Gross vehicle weight of $0-6,000$ pounds for model year 1978-1979 and 0-8,500 pounds for subsequent years.
    ${ }^{\mathrm{c}}$ All CAFE calculations are sales-weighted.
    ${ }^{\mathrm{d}}$ Standards were set for two-wheel drive and four-wheel drive light trucks separately, but no combined standard was set in this year.
    ${ }^{\mathrm{e}}$ Data are not available.

[^45]:    ${ }^{\text {a }} \mathrm{PFI}=$ port fuel injection. TBI $=$ throttle- body fuel injection.

[^46]:    ${ }^{\text {a }}$ Public assistance monies are included in reported income.
    ${ }^{\mathrm{b}}$ Percentages may not sum to totals due to rounding.
    ${ }^{c}$ Includes alcoholic beverages.
    ${ }^{\mathrm{d}}$ Includes personal care, reading, education, tobacco and smoking supplies, cash contributions, and miscellaneous items .

[^47]:    ${ }^{\text {a }}$ These data are survey estimates; data are not the same as R. L. Polk estimates of the number of vehicles.
    ${ }^{\mathrm{b}}$ Fuel economy data from the 1985 RTECS is not directly comparable to data from later years because of a change in methodology.
    ${ }^{\text {c }}$ Data are not available.
    ${ }^{\mathrm{d}}$ Includes motor homes.

[^48]:    ${ }^{\text {a }}$ Vehicles are ranked by descending annual miles driven.

[^49]:    ${ }^{\text {a }}$ Reformulated gasoline was used for all emissions tests.
    ${ }^{\mathrm{b}}$ Average fuel economy measurements during emissions tests.
    ${ }^{\text {c }}$ Data not available.
    ${ }^{\mathrm{d}}$ Not a production vehicle, part of a vehicle demonstration fleet.

[^50]:    ${ }^{\text {a }}$ Methyl tertiary-butyl ether.
    ${ }^{\mathrm{b}}$ Data are not available.

[^51]:    ${ }^{a}$ Consumption includes gasoline portion of the mixture.

[^52]:    ${ }^{\text {a }}$ Scheduled services of domestic operations only. The average passenger trip length for international operations is more than three and a half times longer than for domestic operations.
    ${ }^{\text {b }}$ Available seats per aircraft is calculated as the ratio of available seat-miles to revenue aircraft-miles.
    ${ }^{\text {A Passenger load factor is calculated as the ratio of revenue passenger-miles to available seat-miles for scheduled and nonscheduled services. }}$
    ${ }^{\mathrm{d}}$ Energy use includes fuel purchased abroad for international flights.
    ${ }^{\text {e }}$ Scheduled services only
    'Data are not available.

[^53]:    ${ }^{\text {a }}$ Active fixed-wing general aviation aircraft only.
    ${ }^{\mathrm{b}}$ Include rotocraft.

[^54]:    ${ }^{\text {a }}$ Does not include self-powered units. From 1972 to 1979, the number of locomotives used in Amtrak passenger operations are subtracted from the total locomotives used in passenger and freight service to calculate the number of Class I locomotives in service.
    ${ }^{\mathrm{b}}$ Does not include private or shipper-owned cars.
    ${ }^{\mathrm{c}}$ These data have changed from previous editions due to a change in source. Previous estimates were based on sales.
    ${ }^{\mathrm{d}}$ Data represent total locomotives used in freight and passenger service. Separate estimates are not available.

[^55]:    ${ }^{a}$ Data are not available.

[^56]:    ${ }^{\text {a }}$ Data are not available
    ${ }^{\text {b }}$ Energy use for 1994 on is not directly comparable to earlier years. Some commuter rail energy use may have been inadvertently included in earlier years.
    ${ }^{\text {c }}$ Estimated using train-miles.
    ${ }^{\mathrm{d}}$ Average annual percentage change is from earliest year available to 1995.

[^57]:    ${ }^{\text {a }}$ Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically
    ${ }^{\text {b }} 1970-79$ data represents total passenger rides; after 1979, data represents unlinked pasenger trips
    ${ }^{\text {c }}$ Estimated for years 1970-76 based on an average trip length of 5.8 miles.
    ${ }^{d}$ Calculated as the ratio of passenger-miles to passenger trips.
    ${ }^{\mathrm{e}}$ Large system-to-system variations exist within this category.
    ${ }^{\text {f }}$ Data are not available.
    ${ }^{\mathrm{g}}$ Average annual percentage change is calculated for years 1977-95.

[^58]:    ${ }^{\mathrm{a}}$ Data are not available.
    ${ }^{\mathrm{b}}$ Includes a small amount of electric utility emissions.

[^59]:    ${ }^{\text {a }}$ The sums of subcategories may not equal total due to rounding.
    ${ }^{\mathrm{b}}$ Recreational marine vessels.

[^60]:    ${ }^{\mathrm{a}}$ The sums of subcategories may not equal total due to rounding.

[^61]:    ${ }^{\text {a }}$ The sums of subcategories may not equal total due to rounding.
    ${ }^{\mathrm{b}}$ Less than 8,500 pounds.
    ${ }^{\mathrm{c}}$ Data are not available.

[^62]:    ${ }^{\text {a }}$ Fine particle matter less than 10 microns. The sums of subcategories may not equal total due to rounding.
    ${ }^{\mathrm{b}}$ Includes fugitive dust estimates which were not available before 1990.

[^63]:    ${ }^{\text {a }}$ Other Industrial Processes includes the wood, pulp and paper industry, and mineral products industries, and other categories.
    ${ }^{\mathrm{b}}$ Waste Disposal and Recycling includes incineration and open burning.
    ${ }^{\mathrm{c}}$ Other Combustion includes wildfires and prescribed burning.

[^64]:    ${ }^{\text {a }}$ The sums of subcategories may not equal due to rounding.

[^65]:    ${ }^{\mathrm{a}}$ Liquified petroleum gas.

[^66]:    ${ }^{\mathrm{a}}$ Gases that contain carbon can be measured either in terms of the full molecular weight of the gas or just in terms of their carbon content. See Appendix B for details.
    ${ }^{\mathrm{b}}$ Data are not available.
    ${ }^{\text {c }}$ Based on global warming potential.
    ${ }^{\mathrm{d}}$ VOC=volatile organic compounds. CFC=chlorofluorocarbons. HCFC=hydrochlorofluorocarbons. $\mathrm{HFC}=$ hydrofluorocarbons. $\mathrm{PFC}=$ perfluorocarbons.
    ${ }^{\mathrm{e}}$ Less than 50,000 tons of gas.

[^67]:    ${ }^{\text {a }}$ Includes energy from petroleum, coal, and natural gas. Electric utility emissions are distributed across consumption sectors.

[^68]:    ${ }^{\text {a }}$ Applies to trucks greater than 6,000 pounds gross vehicle weight until model year 1978, greater than 8,500 pounds gross vehicle weight for model years 1979-1986, and greater than 14,000 pounds gross vehicle weight starting in 1987.
    ${ }^{b}$ No standard was set for this year.
    ${ }^{\mathrm{c}}$ 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.
    ${ }^{\mathrm{d}}$ Applies to trucks greater than 6,000 pounds gross vehicle weight through model year 1978 and to trucks greater than 8,500 pounds gross vehicle weight beginning in model year 1979.

[^69]:    ${ }^{\mathrm{a}} \mathrm{CV}=$ Conventional vehicles
    TLEV = Transitional low-emission vehicles
    LEV = Low-emission vehicles
    ULEV = Ultra-low-emission vehicles
    ZEV = Zero emission vehicles
    ${ }^{\mathrm{b}}$ According to revised regulations, the marketplace is to determine the amount of ZEVs that are offered for sale.
    ${ }^{\mathrm{c}}$ Fleet average of non-methane organic gases $=0.062$ in 2003.

[^70]:    ${ }^{1}$ This update was produced with assistance from Roger Gorham，LBNL，and Celine Marie，International Energy Agency．

