

Appendix A

Thermal Conversion Factors

Using Thermal Conversion Factors

The thermal conversion factors presented in the following tables can be used to estimate the heat content in British thermal units (Btu) of a given amount of energy measured in physical units, such as barrels or cubic feet. For example, 10 barrels of asphalt has a heat content of approximately 66.36 million Btu (10 barrels x 6.636 million Btu per barrel = 66.36 million Btu).

The heat content rates (i.e., thermal conversion factors) provided in this section represent the gross (or higher or upper) energy content of the fuels. Gross heat content rates are applied in all Btu calculations for the *Annual Energy Review* and are commonly used in energy calculations in the United States; net (or lower) heat content rates are typically used in European energy calculations. The difference between the two rates is the amount of energy that is consumed to vaporize water that is created during the combustion process. Generally, the difference ranges from 2 percent to 10 percent, depending on the specific fuel and its hydrogen content. Some fuels, such as unseasoned wood, can be more than 40 percent different in their gross and net heat content rates. See “Heat Content” and “British thermal unit (Btu)” in the Glossary for more information.

Thermal conversion factors for hydrocarbon mixes (Table A1) are weighted averages of the thermal conversion factors for each hydrocarbon included in the mix. For example, in calculating the thermal conversion factor for a 60-40 butane-propane mixture, the thermal conversion factor for butane is weighted 1.5 times the thermal conversion factor for propane.

In general, the annual thermal conversion factors presented in Tables A2 through A6 are computed from final annual data or from the best available data and are labeled “preliminary.” Often, the previous year’s factor is used as the preliminary value until data become available to calculate the factor appropriate to the year. The source of each factor is described in the section entitled “Thermal Conversion Factor Source Documentation,” which follows Table A6 in this appendix.

Table A1. Approximate Heat Content of Petroleum Products
(Million Btu per Barrel)

| | |
|--|-------|
| Asphalt | 6.636 |
| Aviation Gasoline | 5.048 |
| Butane | 4.326 |
| Butane-Propane Mixture (60 percent-40 percent) | 4.130 |
| Distillate Fuel Oil | 5.825 |
| Ethane | 3.082 |
| Ethane-Propane Mixture (70 percent-30 percent) | 3.308 |
| Isobutane | 3.974 |
| Jet Fuel, Kerosene-Type | 5.670 |
| Jet Fuel, Naphtha-Type | 5.355 |
| Kerosene | 5.670 |
| Lubricants | 6.065 |
| Motor Gasoline | |
| Conventional ¹ | 5.253 |
| Oxygenated ¹ | 5.150 |
| Reformulated ¹ | 5.150 |
| Fuel Ethanol ² | 3.539 |
| Natural Gasoline | 4.620 |
| Pentanes Plus | 4.620 |
| Petrochemical Feedstocks | |
| Naphtha less than 401° F | 5.248 |
| Other Oils equal to or greater than 401° F | 5.825 |
| Still Gas | 6.000 |
| Petroleum Coke | 6.024 |
| Plant Condensate | 5.418 |
| Propane | 3.836 |
| Residual Fuel Oil | 6.287 |
| Road Oil | 6.636 |
| Special Naphthas | 5.248 |
| Still Gas | 6.000 |
| Unfinished Oils | 5.825 |
| Unfractionated Stream | 5.418 |
| Waxes | 5.537 |
| Miscellaneous | 5.796 |

¹See Table A3 for motor gasoline annual weighted averages beginning in 1994.

²Fuel ethanol, which is derived from agricultural feedstocks (primarily corn), is not a petroleum product but is blended into motor gasoline.

Web Page: For related information, see http://www.eia.doe.gov/emeu/aer/append_a.html.

Sources: See “Thermal Conversion Factor Source Documentation,” which follows Table A6.

Table A2. Approximate Heat Content of Petroleum Production, Imports, and Exports, Selected Years, 1949-2007
(Million Btu per Barrel)

| Year | Production | | Imports | | | Exports | | |
|-------------------|------------------------|---------------------------|------------------------|--------------------|--------------------|------------------------|--------------------|--------------------|
| | Crude Oil ¹ | Natural Gas Plant Liquids | Crude Oil ¹ | Petroleum Products | Total | Crude Oil ¹ | Petroleum Products | Total |
| 1949 | 5.800 | 4.544 | 5.952 | 6.261 | 6.059 | 5.800 | 5.651 | 5.692 |
| 1950 | 5.800 | 4.522 | 5.943 | 6.263 | 6.080 | 5.800 | 5.751 | 5.766 |
| 1955 | 5.800 | 4.406 | 5.924 | 6.234 | 6.040 | 5.800 | 5.765 | 5.768 |
| 1960 | 5.800 | 4.295 | 5.911 | 6.161 | 6.021 | 5.800 | 5.835 | 5.834 |
| 1965 | 5.800 | 4.264 | 5.872 | 6.123 | 5.997 | 5.800 | 5.742 | 5.743 |
| 1970 | 5.800 | 4.146 | 5.822 | 6.088 | 5.985 | 5.800 | 5.811 | 5.810 |
| 1971 | 5.800 | 4.117 | 5.824 | 6.062 | 5.961 | 5.800 | 5.775 | 5.775 |
| 1972 | 5.800 | 4.070 | 5.809 | 6.045 | 5.935 | 5.800 | 5.741 | 5.741 |
| 1973 | 5.800 | 4.049 | 5.817 | 5.983 | 5.897 | 5.800 | 5.752 | 5.752 |
| 1974 | 5.800 | 4.011 | 5.827 | 5.959 | 5.884 | 5.800 | 5.773 | 5.774 |
| 1975 | 5.800 | 3.984 | 5.821 | 5.935 | 5.858 | 5.800 | 5.747 | 5.748 |
| 1976 | 5.800 | 3.964 | 5.808 | 5.980 | 5.856 | 5.800 | 5.743 | 5.745 |
| 1977 | 5.800 | 3.941 | 5.810 | 5.908 | 5.834 | 5.800 | 5.796 | 5.797 |
| 1978 | 5.800 | 3.925 | 5.802 | 5.955 | 5.839 | 5.800 | 5.814 | 5.808 |
| 1979 | 5.800 | 3.955 | 5.810 | 5.811 | 5.810 | 5.800 | 5.864 | 5.832 |
| 1980 | 5.800 | 3.914 | 5.812 | 5.748 | 5.796 | 5.800 | 5.841 | 5.820 |
| 1981 | 5.800 | 3.930 | 5.818 | 5.659 | 5.775 | 5.800 | 5.837 | 5.821 |
| 1982 | 5.800 | 3.872 | 5.826 | 5.664 | 5.775 | 5.800 | 5.829 | 5.820 |
| 1983 | 5.800 | 3.839 | 5.825 | 5.677 | 5.774 | 5.800 | 5.800 | 5.800 |
| 1984 | 5.800 | 3.812 | 5.823 | 5.613 | 5.745 | 5.800 | 5.867 | 5.850 |
| 1985 | 5.800 | 3.815 | 5.832 | 5.572 | 5.736 | 5.800 | 5.819 | 5.814 |
| 1986 | 5.800 | 3.797 | 5.903 | 5.624 | 5.808 | 5.800 | 5.839 | 5.832 |
| 1987 | 5.800 | 3.804 | 5.901 | 5.599 | 5.820 | 5.800 | 5.860 | 5.858 |
| 1988 | 5.800 | 3.800 | 5.900 | 5.618 | 5.820 | 5.800 | 5.842 | 5.840 |
| 1989 | 5.800 | 3.826 | 5.906 | 5.641 | 5.833 | 5.800 | 5.869 | 5.857 |
| 1990 | 5.800 | 3.822 | 5.934 | 5.614 | 5.849 | 5.800 | 5.838 | 5.833 |
| 1991 | 5.800 | 3.807 | 5.948 | 5.636 | 5.873 | 5.800 | 5.827 | 5.823 |
| 1992 | 5.800 | 3.804 | 5.953 | 5.623 | 5.877 | 5.800 | 5.774 | 5.777 |
| 1993 | 5.800 | 3.801 | 5.954 | 5.620 | 5.883 | 5.800 | 5.777 | 5.779 |
| 1994 | 5.800 | 3.794 | 5.950 | 5.534 | 5.861 | 5.800 | 5.777 | 5.779 |
| 1995 | 5.800 | 3.796 | 5.938 | 5.483 | 5.855 | 5.800 | 5.740 | 5.746 |
| 1996 | 5.800 | 3.777 | 5.947 | 5.468 | 5.847 | 5.800 | 5.728 | 5.736 |
| 1997 | 5.800 | 3.762 | 5.954 | 5.469 | 5.862 | 5.800 | 5.726 | 5.734 |
| 1998 | 5.800 | 3.769 | 5.953 | 5.462 | 5.861 | 5.800 | 5.710 | 5.720 |
| 1999 | 5.800 | 3.744 | 5.942 | 5.421 | 5.840 | 5.800 | 5.684 | 5.699 |
| 2000 | 5.800 | 3.733 | 5.959 | 5.432 | 5.849 | 5.800 | 5.651 | 5.658 |
| 2001 | 5.800 | 3.735 | 5.976 | 5.443 | 5.862 | 5.800 | 5.751 | 5.752 |
| 2002 | 5.800 | 3.729 | 5.971 | 5.451 | 5.863 | 5.800 | 5.687 | 5.688 |
| 2003 | 5.800 | 3.739 | 5.970 | 5.438 | 5.857 | 5.800 | 5.739 | 5.740 |
| 2004 | 5.800 | 3.724 | 5.981 | 5.475 | 5.863 | 5.800 | 5.753 | 5.754 |
| 2005 | 5.800 | 3.724 | 5.977 | 5.474 | 5.845 | 5.800 | 5.741 | 5.743 |
| 2006 | 5.800 | 3.712 | 5.980 | ^R 5.454 | ^R 5.842 | 5.800 | ^R 5.723 | ^R 5.724 |
| 2007 ^P | 5.800 | 3.701 | 5.981 | 5.500 | 5.858 | 5.800 | 5.745 | 5.746 |

¹ Includes lease condensate.
R=Revised. P=Preliminary.
Note: The values in this table are for gross heat contents. See "Heat Content" in Glossary.

Web Page: For all data beginning in 1949, see http://www.eia.doe.gov/emeu/aer/append_a.html.
Sources: See "Thermal Conversion Factor Source Documentation," which follows Table A6.

Table A3. Approximate Heat Content of Petroleum Consumption and Biofuels Production, Selected Years, 1949-2007
(Million Btu per Barrel)

| Year | Total Petroleum ¹ Consumption by Sector | | | | | | Liquefied Petroleum Gases Consumption ⁵ | Motor Gasoline Consumption ⁶ | Fuel Ethanol | Fuel Ethanol Feed-stock ⁷ | Biodiesel | Biodiesel Feed-stock ⁸ |
|------|--|-------------------------|-------------------------|-----------------------------|-------------------------------|--------------------|--|---|--------------|--------------------------------------|---------------------|-----------------------------------|
| | Residential | Commercial ² | Industrial ² | Transportation ² | Electric Power ^{3,4} | Total ² | | | | | | |
| 1949 | 5.493 | 5.858 | 5.946 | 5.465 | 6.254 | 5.649 | 4.011 | 5.253 | NA | NA | NA | NA |
| 1950 | 5.482 | 5.865 | 5.940 | 5.461 | 6.254 | 5.649 | 4.011 | 5.253 | NA | NA | NA | NA |
| 1955 | 5.480 | 5.832 | 5.867 | 5.408 | 6.254 | 5.591 | 4.011 | 5.253 | NA | NA | NA | NA |
| 1960 | 5.430 | 5.849 | 5.800 | 5.388 | 6.267 | 5.555 | 4.011 | 5.253 | NA | NA | NA | NA |
| 1965 | 5.380 | 5.837 | 5.728 | 5.387 | 6.267 | 5.532 | 4.011 | 5.253 | NA | NA | NA | NA |
| 1970 | 5.216 | 5.773 | 5.603 | 5.393 | 6.252 | 5.503 | ⁹ 3.779 | 5.253 | NA | NA | NA | NA |
| 1971 | 5.212 | 5.758 | 5.598 | 5.389 | 6.245 | 5.504 | 3.772 | 5.253 | NA | NA | NA | NA |
| 1972 | 5.193 | 5.733 | 5.563 | 5.388 | 6.233 | 5.500 | 3.760 | 5.253 | NA | NA | NA | NA |
| 1973 | 5.205 | 5.749 | 5.569 | 5.395 | 6.245 | 5.515 | 3.746 | 5.253 | NA | NA | NA | NA |
| 1974 | 5.196 | 5.740 | 5.538 | 5.394 | 6.238 | 5.504 | 3.730 | 5.253 | NA | NA | NA | NA |
| 1975 | 5.192 | 5.704 | 5.527 | 5.392 | 6.250 | 5.494 | 3.715 | 5.253 | NA | NA | NA | NA |
| 1976 | 5.215 | 5.726 | 5.536 | 5.395 | 6.251 | 5.504 | 3.711 | 5.253 | NA | NA | NA | NA |
| 1977 | 5.213 | 5.733 | 5.554 | 5.400 | 6.249 | 5.518 | 3.677 | 5.253 | NA | NA | NA | NA |
| 1978 | 5.213 | 5.716 | 5.554 | 5.404 | 6.251 | 5.519 | 3.669 | 5.253 | NA | NA | NA | NA |
| 1979 | 5.298 | 5.769 | 5.419 | 5.428 | 6.258 | 5.494 | 3.680 | 5.253 | NA | NA | NA | NA |
| 1980 | 5.245 | 5.803 | 5.374 | 5.440 | 6.254 | 5.479 | 3.674 | 5.253 | NA | NA | NA | NA |
| 1981 | 5.191 | 5.751 | 5.312 | 5.432 | 6.258 | 5.448 | 3.643 | 5.253 | 3.539 | 6.486 | NA | NA |
| 1982 | 5.167 | 5.751 | 5.263 | 5.422 | 6.258 | 5.415 | 3.615 | 5.253 | 3.539 | 6.428 | NA | NA |
| 1983 | 5.022 | 5.642 | 5.275 | 5.415 | 6.255 | 5.406 | 3.614 | 5.253 | 3.539 | 6.388 | NA | NA |
| 1984 | 5.184 | 5.705 | 5.223 | 5.418 | 6.251 | 5.395 | 3.599 | 5.253 | 3.539 | 6.356 | NA | NA |
| 1985 | 5.153 | 5.661 | 5.215 | 5.422 | 6.247 | 5.387 | 3.603 | 5.253 | 3.539 | 6.331 | NA | NA |
| 1986 | 5.169 | 5.694 | 5.283 | 5.425 | 6.257 | 5.418 | 3.640 | 5.253 | 3.539 | 6.310 | NA | NA |
| 1987 | 5.144 | 5.661 | 5.248 | 5.429 | 6.249 | 5.403 | 3.659 | 5.253 | 3.539 | 6.291 | NA | NA |
| 1988 | 5.165 | 5.661 | 5.241 | 5.433 | 6.250 | 5.410 | 3.652 | 5.253 | 3.539 | 6.275 | NA | NA |
| 1989 | 5.105 | 5.621 | 5.234 | 5.437 | ³ 6.240 | 5.410 | 3.683 | 5.253 | 3.539 | 6.260 | NA | NA |
| 1990 | 5.027 | 5.621 | 5.270 | 5.442 | 6.244 | 5.411 | 3.625 | 5.253 | 3.539 | 6.247 | NA | NA |
| 1991 | 4.968 | 5.599 | 5.186 | 5.440 | 6.246 | 5.384 | 3.614 | 5.253 | 3.539 | 6.235 | NA | NA |
| 1992 | 5.004 | 5.589 | 5.185 | 5.442 | 6.238 | 5.378 | 3.624 | 5.253 | 3.539 | 6.224 | NA | NA |
| 1993 | 4.975 | ² 5.580 | ² 5.196 | ² 5.436 | 6.230 | ² 5.379 | 3.606 | 5.253 | 3.539 | 6.214 | NA | NA |
| 1994 | 4.983 | 5.592 | 5.166 | 5.424 | 6.213 | 5.361 | 3.635 | ⁶ 5.230 | 3.539 | 6.204 | NA | NA |
| 1995 | 4.940 | 5.554 | 5.137 | 5.417 | 6.188 | 5.341 | 3.623 | 5.215 | 3.539 | 6.196 | NA | NA |
| 1996 | 4.869 | 5.498 | 5.133 | 5.420 | 6.195 | 5.336 | 3.613 | 5.216 | 3.539 | 6.187 | NA | NA |
| 1997 | 4.859 | 5.459 | 5.138 | 5.416 | 6.199 | 5.336 | 3.616 | 5.213 | 3.539 | 6.180 | NA | NA |
| 1998 | 4.837 | 5.446 | 5.155 | 5.413 | 6.210 | 5.349 | 3.614 | 5.212 | 3.539 | 6.172 | NA | NA |
| 1999 | 4.761 | 5.369 | 5.113 | 5.413 | 6.205 | 5.328 | 3.616 | 5.211 | 3.539 | 6.165 | NA | NA |
| 2000 | 4.761 | 5.394 | 5.082 | 5.421 | 6.189 | 5.326 | 3.607 | 5.210 | 3.539 | 6.159 | NA | NA |
| 2001 | 4.796 | 5.403 | 5.164 | 5.412 | 6.199 | 5.345 | 3.614 | 5.210 | 3.539 | 6.152 | ⁹ R5.359 | ⁹ R5.433 |
| 2002 | 4.742 | 5.364 | 5.116 | 5.410 | 6.173 | 5.324 | 3.613 | 5.208 | 3.539 | 6.146 | ⁹ R5.359 | ⁹ R5.433 |
| 2003 | 4.763 | 5.407 | 5.161 | 5.408 | 6.182 | 5.340 | 3.629 | 5.207 | 3.539 | 6.141 | ⁹ R5.359 | ⁹ R5.433 |
| 2004 | 4.807 | 5.434 | 5.164 | 5.420 | 6.192 | 5.350 | 3.618 | 5.215 | 3.539 | 6.135 | ⁹ R5.359 | ⁹ R5.433 |
| 2005 | ^R 4.783 | ^R 5.427 | ^R 5.200 | ^R 5.426 | 6.188 | 5.365 | 3.620 | 5.218 | 3.539 | 6.130 | ⁹ R5.359 | ⁹ R5.433 |
| 2006 | ^{RE} 4.667 | ^{RE} 5.343 | ^{RE} 5.197 | ^{RE} 5.430 | ^R 6.143 | ^R 5.353 | ^R 3.605 | 5.218 | 3.539 | 6.125 | ⁹ R5.359 | ⁹ R5.433 |
| 2007 | ^E 4.640 | ^E 5.340 | ^E 5.167 | ^E 5.432 | ^P 6.150 | ^P 5.347 | ^P 3.592 | ^P 5.219 | 3.539 | 5.987 | ⁹ R5.359 | ⁹ R5.433 |

¹ Petroleum products supplied, including natural gas plant liquids and crude oil burned directly as fuel. Quantity-weighted averages of the petroleum products included in each category are calculated by using heat content values shown in Table A1.

² Beginning in 1993, includes ethanol blended into motor gasoline.

³ Electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public. Through 1988, data are for electric utilities only; beginning in 1989, data are for electric utilities and independent power producers.

⁴ Electric power sector factors are weighted average heat contents for distillate fuel oil, petroleum coke, and residual fuel oil; they exclude other liquids.

⁵ There is a discontinuity in this time series between 1966 and 1967; beginning in 1967, the single constant factor is replaced by a quantity-weighted factor—quantity-weighted averages of the major components of liquefied petroleum gases are calculated by using heat content values shown in Table A1.

⁶ There is a discontinuity in this time series between 1993 and 1994; beginning in 1994, the single

constant factor is replaced by a quantity-weighted factor—quantity-weighted averages of the major components of motor gasoline, including fuel ethanol, are calculated by using heat content values shown in Table A1.

⁷ Corn input to the production of fuel ethanol (million Btu corn per barrel denatured ethanol), used as the approximate heat content for total biomass inputs to the production of fuel ethanol.

⁸ Soybean oil input to the production of biodiesel (million Btu soybean oil per barrel biodiesel), used as the approximate heat content for total biomass inputs to the production of biodiesel.

⁹ Gross heat content (higher heating value).

R=Revised. P=Preliminary. E=Estimate. NA=Not available.

Note: The values in this table are for gross heat contents. See "Heat Content" in Glossary.

Web Page: For all data beginning in 1949, see http://www.eia.doe.gov/emeu/aer/append_a.html.

Sources: See "Thermal Conversion Factor Source Documentation," which follows Table A6.

Table A4. Approximate Heat Content of Natural Gas, Selected Years, 1949-2007
(Btu per Cubic Foot)

| Year | Production | | Consumption ¹ | | | Imports | Exports |
|------|--------------------|--------------------|------------------------------|------------------------------------|--------------------|--------------------|--------------------|
| | Marketed | Dry | End-Use Sectors ² | Electric Power Sector ³ | Total | | |
| 1949 | 1,120 | 1,035 | 1,035 | 1,035 | 1,035 | -- | 1,035 |
| 1950 | 1,119 | 1,035 | 1,035 | 1,035 | 1,035 | -- | 1,035 |
| 1955 | 1,120 | 1,035 | 1,035 | 1,035 | 1,035 | 1,035 | 1,035 |
| 1960 | 1,107 | 1,035 | 1,035 | 1,035 | 1,035 | 1,035 | 1,035 |
| 1965 | 1,101 | 1,032 | 1,032 | 1,032 | 1,032 | 1,032 | 1,032 |
| 1970 | 1,102 | 1,031 | 1,031 | 1,031 | 1,031 | 1,031 | 1,031 |
| 1971 | 1,103 | 1,031 | 1,031 | 1,031 | 1,031 | 1,031 | 1,031 |
| 1972 | 1,100 | 1,027 | 1,027 | 1,027 | 1,027 | 1,027 | 1,027 |
| 1973 | 1,093 | 1,021 | 1,020 | 1,024 | 1,021 | 1,026 | 1,023 |
| 1974 | 1,097 | 1,024 | 1,024 | 1,022 | 1,024 | 1,027 | 1,016 |
| 1975 | 1,095 | 1,021 | 1,020 | 1,026 | 1,021 | 1,026 | 1,014 |
| 1976 | 1,093 | 1,020 | 1,019 | 1,023 | 1,020 | 1,025 | 1,013 |
| 1977 | 1,093 | 1,021 | 1,019 | 1,029 | 1,021 | 1,026 | 1,013 |
| 1978 | 1,088 | 1,019 | 1,016 | 1,034 | 1,019 | 1,030 | 1,013 |
| 1979 | 1,092 | 1,021 | 1,018 | 1,035 | 1,021 | 1,037 | 1,013 |
| 1980 | 1,098 | 1,026 | 1,024 | 1,035 | 1,026 | 1,022 | 1,013 |
| 1981 | 1,103 | 1,027 | 1,025 | 1,035 | 1,027 | 1,014 | 1,011 |
| 1982 | 1,107 | 1,028 | 1,026 | 1,036 | 1,028 | 1,018 | 1,011 |
| 1983 | 1,115 | 1,031 | 1,031 | 1,030 | 1,031 | 1,024 | 1,010 |
| 1984 | 1,109 | 1,031 | 1,030 | 1,035 | 1,031 | 1,005 | 1,010 |
| 1985 | 1,112 | 1,032 | 1,031 | 1,038 | 1,032 | 1,002 | 1,011 |
| 1986 | 1,110 | 1,030 | 1,029 | 1,034 | 1,030 | 997 | 1,008 |
| 1987 | 1,112 | 1,031 | 1,031 | 1,032 | 1,031 | 999 | 1,011 |
| 1988 | 1,109 | 1,029 | 1,029 | 1,028 | 1,029 | 1,002 | 1,018 |
| 1989 | 1,107 | 1,031 | 1,031 | ¹ 1,028 | 1,031 | 1,004 | 1,019 |
| 1990 | 1,105 | 1,029 | 1,030 | 1,027 | 1,029 | 1,012 | 1,018 |
| 1991 | 1,108 | 1,030 | 1,031 | 1,025 | 1,030 | 1,014 | 1,022 |
| 1992 | 1,110 | 1,030 | 1,031 | 1,025 | 1,030 | 1,011 | 1,018 |
| 1993 | 1,106 | 1,027 | 1,028 | 1,025 | 1,027 | 1,020 | 1,016 |
| 1994 | 1,105 | 1,028 | 1,029 | 1,025 | 1,028 | 1,022 | 1,011 |
| 1995 | 1,106 | 1,026 | 1,027 | 1,021 | 1,026 | 1,021 | 1,011 |
| 1996 | 1,109 | 1,026 | 1,027 | 1,020 | 1,026 | 1,022 | 1,011 |
| 1997 | 1,107 | 1,026 | 1,027 | 1,020 | 1,026 | 1,023 | 1,011 |
| 1998 | 1,109 | 1,031 | 1,033 | 1,024 | 1,031 | 1,023 | 1,011 |
| 1999 | 1,107 | 1,027 | 1,028 | 1,022 | 1,027 | 1,022 | 1,006 |
| 2000 | 1,107 | 1,025 | 1,026 | 1,021 | 1,025 | 1,023 | 1,006 |
| 2001 | 1,105 | 1,028 | 1,029 | 1,026 | 1,028 | 1,023 | 1,010 |
| 2002 | 1,106 | 1,027 | 1,029 | 1,020 | 1,027 | 1,022 | 1,008 |
| 2003 | 1,106 | 1,031 | 1,033 | 1,025 | 1,031 | 1,025 | 1,009 |
| 2004 | 1,105 | 1,027 | 1,027 | 1,027 | 1,027 | 1,025 | 1,009 |
| 2005 | ^R 1,105 | 1,029 | 1,029 | 1,028 | 1,029 | 1,025 | 1,009 |
| 2006 | ^R 1,103 | ^R 1,028 | ^R 1,028 | 1,028 | ^R 1,028 | 1,025 | 1,009 |
| 2007 | ^E 1,103 | ^E 1,028 | ^E 1,028 | ^P 1,028 | ^E 1,028 | ^E 1,025 | ^E 1,009 |

¹ Consumption factors are for natural gas, plus a small amount of supplemental gaseous fuels.

² Residential, commercial, industrial, and transportation sectors.

³ Electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public. Through 1988, data are for electric utilities only; beginning in 1989, data are for electric utilities and independent power producers.

R=Revised. P=Preliminary. E=Estimate. -- = Not applicable.

Note: The values in this table are for gross heat contents. See "Heat Content" in Glossary.

Web Page: For all data beginning in 1949, see http://www.eia.doe.gov/emeu/aer/append_a.html.

Sources: See "Thermal Conversion Factor Source Documentation," which follows Table A6.

Table A5. Approximate Heat Content of Coal and Coal Coke, Selected Years, 1949-2007
(Million Btu per Short Ton)

| Year | Coal | | | | | | | | | Coal Coke | |
|-------------------|-------------------------|----------------------------------|------------------------------------|-------------------|--------------------|--------------------------------------|---------------------|---------|---------|-----------|---------------------|
| | Production ¹ | Waste Coal Supplied ² | Consumption | | | | | Imports | Exports | | Imports and Exports |
| | | | Residential and Commercial Sectors | Industrial Sector | | Electric Power Sector ^{4,5} | Total | | | | |
| | | | | Coke Plants | Other ³ | | | | | | |
| 1949 | 24.916 | NA | 24.263 | 26.797 | 24.612 | 23.761 | 24.793 | 25.000 | 26.759 | 24.800 | |
| 1950 | 25.090 | NA | 24.461 | 26.798 | 24.820 | 23.937 | 24.989 | 25.020 | 26.788 | 24.800 | |
| 1955 | 25.201 | NA | 24.373 | 26.794 | 24.821 | 24.056 | 24.982 | 25.000 | 26.907 | 24.800 | |
| 1960 | 24.906 | NA | 24.226 | 26.791 | 24.609 | 23.927 | 24.713 | 25.003 | 26.939 | 24.800 | |
| 1965 | 24.775 | NA | 24.028 | 26.787 | 24.385 | 23.780 | 24.537 | 25.000 | 26.973 | 24.800 | |
| 1970 | 23.842 | NA | 23.203 | 26.784 | 22.983 | 22.573 | 23.440 | 25.000 | 26.982 | 24.800 | |
| 1971 | 23.507 | NA | 23.090 | 26.784 | 22.670 | 22.301 | 23.124 | 25.000 | 26.981 | 24.800 | |
| 1972 | 23.389 | NA | 22.998 | 26.782 | 22.550 | 22.204 | 23.036 | 25.000 | 26.979 | 24.800 | |
| 1973 | 23.376 | NA | 22.831 | 26.780 | 22.586 | 22.246 | 23.057 | 25.000 | 26.596 | 24.800 | |
| 1974 | 23.072 | NA | 22.479 | 26.778 | 22.419 | 21.781 | 22.677 | 25.000 | 26.700 | 24.800 | |
| 1975 | 22.897 | NA | 22.261 | 26.782 | 22.436 | 21.642 | 22.506 | 25.000 | 26.562 | 24.800 | |
| 1976 | 22.855 | NA | 22.774 | 26.781 | 22.530 | 21.679 | 22.498 | 25.000 | 26.601 | 24.800 | |
| 1977 | 22.597 | NA | 22.919 | 26.787 | 22.322 | 21.508 | 22.265 | 25.000 | 26.548 | 24.800 | |
| 1978 | 22.248 | NA | 22.466 | 26.789 | 22.207 | 21.275 | 22.017 | 25.000 | 26.478 | 24.800 | |
| 1979 | 22.454 | NA | 22.242 | 26.788 | 22.452 | 21.364 | 22.100 | 25.000 | 26.548 | 24.800 | |
| 1980 | 22.415 | NA | 22.543 | 26.790 | 22.690 | 21.295 | 21.947 | 25.000 | 26.384 | 24.800 | |
| 1981 | 22.308 | NA | 22.474 | 26.794 | 22.585 | 21.085 | 21.713 | 25.000 | 26.160 | 24.800 | |
| 1982 | 22.239 | NA | 22.695 | 26.797 | 22.712 | 21.194 | 21.674 | 25.000 | 26.223 | 24.800 | |
| 1983 | 22.052 | NA | 22.775 | 26.798 | 22.691 | 21.133 | 21.576 | 25.000 | 26.291 | 24.800 | |
| 1984 | 22.010 | NA | 22.844 | 26.799 | 22.543 | 21.101 | 21.573 | 25.000 | 26.402 | 24.800 | |
| 1985 | 21.870 | NA | 22.646 | 26.798 | 22.020 | 20.959 | 21.366 | 25.000 | 26.307 | 24.800 | |
| 1986 | 21.913 | NA | 22.947 | 26.798 | 22.198 | 21.084 | 21.462 | 25.000 | 26.292 | 24.800 | |
| 1987 | 21.922 | NA | 23.404 | 26.799 | 22.381 | 21.136 | 21.517 | 25.000 | 26.291 | 24.800 | |
| 1988 | 21.823 | NA | 23.571 | 26.799 | 22.360 | 20.900 | 21.328 | 25.000 | 26.299 | 24.800 | |
| 1989 | 21.765 | ² 10.391 | 23.650 | 26.800 | 22.347 | ⁴ 20.898 | 21.307 | 25.000 | 26.160 | 24.800 | |
| 1990 | 21.822 | 9.303 | 23.137 | 26.799 | 22.457 | 20.779 | 21.197 | 25.000 | 26.202 | 24.800 | |
| 1991 | 21.681 | 10.758 | 23.114 | 26.799 | 22.460 | 20.730 | 21.120 | 25.000 | 26.188 | 24.800 | |
| 1992 | 21.682 | 10.396 | 23.105 | 26.799 | 22.250 | 20.709 | 21.068 | 25.000 | 26.161 | 24.800 | |
| 1993 | 21.418 | 10.638 | 22.994 | 26.800 | 22.123 | 20.677 | 21.010 | 25.000 | 26.335 | 24.800 | |
| 1994 | 21.394 | 11.097 | 23.112 | 26.800 | 22.068 | 20.589 | 20.929 | 25.000 | 26.329 | 24.800 | |
| 1995 | 21.326 | 11.722 | 23.118 | 26.800 | 21.950 | 20.543 | 20.880 | 25.000 | 26.180 | 24.800 | |
| 1996 | 21.322 | 12.147 | 23.011 | 26.800 | 22.105 | 20.547 | 20.870 | 25.000 | 26.174 | 24.800 | |
| 1997 | 21.296 | 12.158 | 22.494 | 26.800 | 22.172 | 20.518 | 20.830 | 25.000 | 26.251 | 24.800 | |
| 1998 | 21.418 | 12.639 | 21.620 | 27.426 | 23.164 | 20.516 | 20.881 | 25.000 | 26.800 | 24.800 | |
| 1999 | 21.070 | 12.552 | 23.880 | 27.426 | 22.489 | 20.490 | 20.818 | 25.000 | 26.081 | 24.800 | |
| 2000 | 21.072 | 12.360 | 25.020 | 27.426 | 22.433 | 20.511 | 20.828 | 25.000 | 26.117 | 24.800 | |
| 2001 | ¹ 20.772 | 12.169 | 24.909 | 27.426 | 22.622 | 20.337 | 20.671 | 25.000 | 25.998 | 24.800 | |
| 2002 | 20.673 | 12.165 | 22.962 | 27.426 | 22.562 | 20.238 | 20.541 | 25.000 | 26.062 | 24.800 | |
| 2003 | 20.499 | ^R 12.360 | 22.242 | 27.425 | 22.468 | 20.082 | 20.387 | 25.000 | 25.972 | 24.800 | |
| 2004 | 20.424 | ^R 12.266 | 22.324 | 27.426 | 22.473 | 19.980 | 20.290 | 25.000 | 26.108 | 24.800 | |
| 2005 | ^R 20.348 | ^R 12.093 | 22.342 | 26.279 | 22.178 | 19.988 | ^R 20.246 | 25.000 | 25.494 | 24.800 | |
| 2006 | ^R 20.310 | ^R 12.080 | ^R 22.066 | 26.271 | 22.050 | ^R 19.931 | ^R 20.181 | 25.000 | 25.453 | 24.800 | |
| 2007 ^P | 20.341 | 12.616 | 22.034 | 26.329 | 22.371 | 19.911 | 20.169 | 25.000 | 25.466 | 24.800 | |

¹ Beginning in 2001, includes a small amount of refuse recovery (coal recaptured from a refuse mine, and cleaned to reduce the concentration of noncombustible materials).

² Waste coal (including fine coal, coal obtained from a refuse bank or slurry dam, anthracite culm, bituminous gob, and lignite waste) consumed by the electric power and industrial sectors. Beginning in 1989, waste coal supplied is counted as a supply-side item to balance the same amount of waste coal included in "Consumption."

³ Includes transportation. Excludes coal synfuel plants.

⁴ Electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose

primary business is to sell electricity, or electricity and heat, to the public. Through 1988, data are for electric utilities only; beginning in 1989, data are for electric utilities and independent power producers.

⁵ Electric power sector factors are for anthracite, bituminous coal, subbituminous coal, lignite, waste coal, and, beginning in 1998, coal synfuel.

R=Revised. P=Preliminary. NA=Not available.

Note: The values in this table are for gross heat contents. See "Heat Content" in Glossary.

Web Page: For all data beginning in 1949, see http://www.eia.doe.gov/emeu/aer/append_a.html.

Sources: See "Thermal Conversion Factor Source Documentation," which follows Table A6.

Table A6. Approximate Heat Rates for Electricity, and Heat Content of Electricity, Selected Years, 1949-2007
(Btu per Kilowatthour)

| Year | Approximate Heat Rates ¹ for Electricity Net | | | Heat Content ⁶ of Electricity ⁷ |
|------|---|-----------------------------|---|---|
| | Fossil-Fueled Plants ^{2,3} | Nuclear Plants ⁴ | Generation Geothermal Energy Plants ⁵ | |
| 1949 | 15,033 | -- | -- | 3,412 |
| 1950 | 14,030 | -- | -- | 3,412 |
| 1955 | 11,699 | -- | -- | 3,412 |
| 1960 | 10,760 | 11,629 | 23,200 | 3,412 |
| 1965 | 10,453 | 11,804 | 22,182 | 3,412 |
| 1970 | 10,494 | 10,977 | 21,606 | 3,412 |
| 1971 | 10,478 | 10,837 | 21,655 | 3,412 |
| 1972 | 10,379 | 10,792 | 21,668 | 3,412 |
| 1973 | 10,389 | 10,903 | 21,674 | 3,412 |
| 1974 | 10,442 | 11,161 | 21,674 | 3,412 |
| 1975 | 10,406 | 11,013 | 21,611 | 3,412 |
| 1976 | 10,373 | 11,047 | 21,611 | 3,412 |
| 1977 | 10,435 | 10,769 | 21,611 | 3,412 |
| 1978 | 10,361 | 10,941 | 21,611 | 3,412 |
| 1979 | 10,353 | 10,879 | 21,545 | 3,412 |
| 1980 | 10,388 | 10,908 | 21,639 | 3,412 |
| 1981 | 10,453 | 11,030 | 21,639 | 3,412 |
| 1982 | 10,454 | 11,073 | 21,629 | 3,412 |
| 1983 | 10,520 | 10,905 | 21,290 | 3,412 |
| 1984 | 10,440 | 10,843 | 21,303 | 3,412 |
| 1985 | 10,447 | 10,622 | 21,263 | 3,412 |
| 1986 | 10,446 | 10,579 | 21,263 | 3,412 |
| 1987 | 10,419 | 10,442 | 21,263 | 3,412 |
| 1988 | 10,324 | 10,602 | 21,096 | 3,412 |
| 1989 | 10,432 | 10,583 | 21,096 | 3,412 |
| 1990 | 10,402 | 10,582 | 21,096 | 3,412 |
| 1991 | 10,436 | 10,484 | 20,997 | 3,412 |
| 1992 | 10,342 | 10,471 | 20,914 | 3,412 |
| 1993 | 10,309 | 10,504 | 20,914 | 3,412 |
| 1994 | 10,316 | 10,452 | 20,914 | 3,412 |
| 1995 | 10,312 | 10,507 | 20,914 | 3,412 |
| 1996 | 10,340 | 10,503 | 20,960 | 3,412 |
| 1997 | 10,213 | 10,494 | 20,960 | 3,412 |
| 1998 | 10,197 | 10,491 | 21,017 | 3,412 |
| 1999 | 10,226 | 10,450 | 21,017 | 3,412 |
| 2000 | 10,201 | 10,429 | 21,017 | 3,412 |
| 2001 | ² 10,333 | 10,448 | 21,017 | 3,412 |
| 2002 | 10,173 | 10,439 | 21,017 | 3,412 |
| 2003 | 10,241 | 10,421 | 21,017 | 3,412 |
| 2004 | 10,022 | 10,427 | 21,017 | 3,412 |
| 2005 | 9,999 | 10,435 | 21,017 | 3,412 |
| 2006 | ^R 9,919 | ^R 10,434 | 21,017 | 3,412 |
| 2007 | ^E 9,919 | ^E 10,434 | ^E 21,017 | 3,412 |

¹ The values in columns 1-3 of this table are for net heat rates. See "Heat Rate" in Glossary.

² Used as the thermal conversion factor for hydro, solar/photovoltaic, and wind electricity net generation to approximate the quantity of fossil fuels replaced by these sources. Through 2000, also used as the thermal conversion factor for wood and waste electricity net generation at electric utilities; beginning in 2001, Btu data for wood and waste at electric utilities are available from surveys.

³ Through 2000, heat rates are for fossil-fueled steam-electric plants at electric utilities. Beginning in 2001, heat rates are for all fossil-fueled plants at electric utilities and independent power producers.

⁴ Used as the thermal conversion factor for nuclear electricity net generation.

⁵ Used as the thermal conversion factor for geothermal electricity net generation.

⁶ See "Heat Content" in Glossary.

⁷ The value of 3,412 Btu per kilowatthour is a constant. It is used as the thermal conversion factor for electricity retail sales, and electricity imports and exports.

R=Revised. E=Estimate. -- = Not applicable.

Web Page: For all data beginning in 1949, see http://www.eia.doe.gov/emeu/aer/append_a.html.

Sources: See "Thermal Conversion Factor Source Documentation," which follows this table.

Thermal Conversion Factor Source Documentation

Approximate Heat Content of Petroleum and Natural Gas Plant Liquids

Asphalt. The Energy Information Administration (EIA) adopted the thermal conversion factor of 6.636 million British thermal units (Btu) per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*.

Aviation Gasoline. EIA adopted the thermal conversion factor of 5.048 million Btu per barrel as adopted by the Bureau of Mines from the Texas Eastern Transmission Corporation publication *Competition and Growth in American Energy Markets 1947-1985*, a 1968 release of historical and projected statistics.

Butane. EIA adopted the Bureau of Mines thermal conversion factor of 4.326 million Btu per barrel as published in the *California Oil World and Petroleum Industry*, First Issue, April 1942.

Butane-Propane Mixture. EIA adopted the Bureau of Mines calculation of 4.130 million Btu per barrel based on an assumed mixture of 60 percent butane and 40 percent propane. See **Butane** and **Propane**.

Crude Oil Exports. Assumed by EIA to be 5.800 million Btu per barrel or equal to the thermal conversion factor for crude oil produced in the United States. See **Crude Oil Production**.

Crude Oil Imports. Calculated annually by EIA as the average of the thermal conversion factors for each type of crude oil imported weighted by the quantities imported. Thermal conversion factors for each type were calculated on a foreign country basis, by determining the average American Petroleum Institute (API) gravity of crude oil imported from each foreign country from Form ERA-60 in 1977 and converting average API gravity to average Btu content by using National Bureau of Standards, Miscellaneous Publication No. 97, *Thermal Properties of Petroleum Products*, 1933.

Crude Oil Production. EIA adopted the thermal conversion factor of 5.800 million Btu per barrel as reported in a Bureau of Mines internal memorandum, “Bureau of Mines Standard Average Heating Values of Various Fuels, Adopted January 3, 1950.”

Distillate Fuel Oil. EIA adopted the Bureau of Mines thermal conversion factor of 5.825 million Btu per barrel as reported in a Bureau of Mines internal

memorandum, “Bureau of Mines Standard Average Heating Values of Various Fuels, Adopted January 3, 1950.”

Ethane. EIA adopted the Bureau of Mines thermal conversion factor of 3.082 million Btu per barrel as published in the *California Oil World and Petroleum Industry*, First Issue, April 1942.

Ethane-Propane Mixture. EIA calculation of 3.308 million Btu per barrel based on an assumed mixture of 70 percent ethane and 30 percent propane. See **Ethane** and **Propane**.

Isobutane. EIA adopted the Bureau of Mines thermal conversion factor of 3.974 million Btu per barrel as published in the *California Oil World and Petroleum Industry*, First Issue, April 1942.

Jet Fuel, Kerosene-Type. EIA adopted the Bureau of Mines thermal conversion factor of 5.670 million Btu per barrel for “Jet Fuel, Commercial” as published by the Texas Eastern Transmission Corporation in the report *Competition and Growth in American Energy Markets 1947-1985*, a 1968 release of historical and projected statistics.

Jet Fuel, Naphtha-Type. EIA adopted the Bureau of Mines thermal conversion factor of 5.355 million Btu per barrel for “Jet Fuel, Military” as published by the Texas Eastern Transmission Corporation in the report *Competition and Growth in American Energy Markets 1947-1985*, a 1968 release of historical and projected statistics.

Kerosene. EIA adopted the Bureau of Mines thermal conversion factor of 5.670 million Btu per barrel as reported in a Bureau of Mines internal memorandum, “Bureau of Mines Standard Average Heating Values of Various Fuels, Adopted January 3, 1950.”

Liquefied Petroleum Gases Consumption. • 1949-1966: U.S. Department of the Interior, Bureau of Mines, Mineral Industry Surveys, “Crude Petroleum and Petroleum Products, 1956,” Table 4 footnote, constant value of 4.011 million Btu per barrel. • 1967 forward: Calculated annually by EIA as the average of the thermal conversion factors for all liquefied petroleum gases consumed (see Table A1) weighted by the quantities consumed. The component products of liquefied petroleum gases are ethane (including ethylene), propane (including propylene), normal-butane (including butylene), butane-propane mixtures, ethane-propane mixtures, and isobutane. For 1967-1980, quantities consumed are from EIA, Energy Data Reports, “Petroleum Statement, Annual,” Table 1. For 1981 forward, quantities consumed are from EIA, *Petroleum Supply Annual*, Table 2.

Lubricants. EIA adopted the thermal conversion factor of 6.065 million Btu per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*.

Miscellaneous Products. EIA adopted the thermal conversion factor of 5.796 million Btu per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*.

Motor Gasoline Consumption. • 1949-1993: EIA adopted the Bureau of Mines thermal conversion factor of 5.253 million Btu per barrel for “Gasoline, Motor Fuel” as published by the Texas Eastern Transmission Corporation in Appendix V of *Competition and Growth in American Energy Markets 1947-1985*, a 1968 release of historical and projected statistics. • 1994 forward: EIA calculated national annual quantity-weighted average conversion factors for conventional, reformulated, and oxygenated motor gasolines (see Table A3). The factor for conventional motor gasoline is 5.253 million Btu per barrel, as used for previous years. The factors for reformulated and oxygenated gasolines, both currently 5.150 million Btu per barrel, are based on data published in Environmental Protection Agency, Office of Mobile Sources, National Vehicle and Fuel Emissions Laboratory report EPA 420-F-95-003, “Fuel Economy Impact Analysis of Reformulated Gasoline.” See **Fuel Ethanol (Blended Into Motor Gasoline)**.

Natural Gas Plant Liquids Production. Calculated annually by EIA as the average of the thermal conversion factors for each natural gas plant liquid produced weighted by the quantities produced.

Natural Gasoline. EIA adopted the thermal conversion factor of 4.620 million Btu per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*.

Pentanes Plus. EIA assumed the thermal conversion factor to be 4.620 million Btu or equal to that for natural gasoline. See **Natural Gasoline**.

Petrochemical Feedstocks, Naphtha less than 401° F. Assumed by EIA to be 5.248 million Btu per barrel, equal to the thermal conversion factor for special naphthas. See **Special Naphthas**.

Petrochemical Feedstocks, Other Oils equal to or greater than 401° F. Assumed by EIA to be 5.825 million Btu per barrel, equal to the thermal conversion factor for distillate fuel oil. See **Distillate Fuel Oil**.

Petrochemical Feedstocks, Still Gas. Assumed by EIA to be 6.000 million Btu per barrel, equal to the thermal conversion factor for still gas. See **Still Gas**.

Petroleum Coke. EIA adopted the thermal conversion factor of 6.024 million Btu per barrel as reported in Btu per short ton in the Bureau of Mines internal memorandum, “Bureau of Mines Standard Average Heating Values of Various Fuels, Adopted January 3, 1950.” The Bureau of Mines calculated this factor by dividing 30.120 million Btu per short ton, as given in the referenced Bureau of Mines

internal memorandum, by 5.0 barrels per short ton, as given in the Bureau of Mines Form 6-1300-M and successor EIA forms.

Petroleum Consumption, Commercial Sector. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed by the commercial sector weighted by the estimated quantities consumed by the commercial sector. The quantities of petroleum products consumed by the commercial sector are estimated in the State Energy Data System—see documentation at http://www.eia.doe.gov/emeu/states/sep_use/notes/use_petrol.pdf.

Petroleum Consumption, Electric Power Sector. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed by the electric power sector weighted by the quantities consumed by the electric power sector. Data are from Form EIA-906, “Power Plant Report”; Form EIA-920, “Combined Heat and Power Plant Report”; and predecessor forms.

Petroleum Consumption, Industrial Sector. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed by the industrial sector weighted by the estimated quantities consumed by the industrial sector. The quantities of petroleum products consumed by the industrial sector are estimated in the State Energy Data System—see documentation at http://www.eia.doe.gov/emeu/states/sep_use/notes/use_petrol.pdf.

Petroleum Consumption, Residential Sector. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed by the residential sector weighted by the estimated quantities consumed by the residential sector. The quantities of petroleum products consumed by the residential sector are estimated in the State Energy Data System—see documentation at http://www.eia.doe.gov/emeu/states/sep_use/notes/use_petrol.pdf.

Petroleum Consumption, Total. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed weighted by the quantities consumed.

Petroleum Consumption, Transportation Sector. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed by the transportation sector weighted by the estimated quantities consumed by the transportation sector. The quantities of petroleum products consumed by the transportation sector are estimated in the State Energy Data System—see documentation at http://www.eia.doe.gov/emeu/states/sep_use/notes/use_petrol.pdf.

Petroleum Products Exports. Calculated annually by EIA as the average of the thermal conversion factors for each petroleum product exported weighted by the quantities exported.

Petroleum Products Imports. Calculated annually by EIA as the average of the thermal conversion factors for each petroleum product imported weighted by the quantities imported.

Plant Condensate. Estimated to be 5.418 million Btu per barrel by EIA from data provided by McClanahan Consultants, Inc., Houston, Texas.

Propane. EIA adopted the Bureau of Mines thermal conversion factor of 3.836 million Btu per barrel as published in the *California Oil World and Petroleum Industry, First Issue*, April 1942.

Residual Fuel Oil. EIA adopted the thermal conversion factor of 6.287 million Btu per barrel as reported in the Bureau of Mines internal memorandum, "Bureau of Mines Standard Average Heating Values of Various Fuels, Adopted January 3, 1950."

Road Oil. EIA adopted the Bureau of Mines thermal conversion factor of 6.636 million Btu per barrel, which was assumed to be equal to that of asphalt (see **Asphalt**) and was first published by the Bureau of Mines in the *Petroleum Statement, Annual, 1970*.

Special Naphthas. EIA adopted the Bureau of Mines thermal conversion factor of 5.248 million Btu per barrel, which was assumed to be equal to that of the total gasoline (aviation and motor) factor and was first published in the *Petroleum Statement, Annual, 1970*.

Still Gas. EIA adopted the Bureau of Mines estimated thermal conversion factor of 6.000 million Btu per barrel, first published in the *Petroleum Statement, Annual, 1970*.

Total Petroleum Exports. Calculated annually by EIA as the average of the thermal conversion factors for crude oil and each petroleum product exported weighted by the quantities exported. See **Crude Oil Exports** and **Petroleum Products Exports**.

Total Petroleum Imports. Calculated annually by EIA as the average of the thermal conversion factors for each type of crude oil and petroleum product imported weighted by the quantities imported. See **Crude Oil Imports** and **Petroleum Products Imports**.

Unfinished Oils. EIA assumed the thermal conversion factor to be 5.825 million Btu per barrel or equal to that for distillate fuel oil (see **Distillate Fuel Oil**) and first published it in EIA's *Annual Report to Congress, Volume 3, 1977*.

Unfractionated Stream. EIA assumed the thermal conversion factor to be 5.418 million Btu per barrel or equal to that for plant condensate (see **Plant Condensate**) and first published it in EIA's *Annual Report to Congress, Volume 2, 1981*.

Waxes. EIA adopted the thermal conversion factor of 5.537 million Btu per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*.

Approximate Heat Content of Biofuels

Biodiesel. EIA estimated the gross heat content (higher heating value) for biodiesel to be 5.359 million Btu per barrel.

Biodiesel Feedstock. EIA estimated the soybean oil input to the production of biodiesel to be 5.433 million Btu soybean oil per barrel biodiesel, which is used as the approximate gross heat content (higher heating value) for total biomass inputs to the production of biodiesel.

Fuel Ethanol. EIA adopted the thermal conversion factor of 3.539 million Btu per barrel published in "Oxygenate Flexibility for Future Fuels," a paper presented by William J. Piel of the ARCO Chemical Company at the National Conference on Reformulated Gasolines and Clean Air Act Implementation, Washington, D.C., October 1991.

Fuel Ethanol Feedstock. EIA estimated the corn input to the production of fuel ethanol (million Btu corn per barrel denatured ethanol), which is used as the approximate heat content for total biomass inputs to the production of ethanol.

Approximate Heat Content of Natural Gas

Natural Gas Consumption, Electric Power Sector. Calculated annually by EIA by dividing the heat content of natural gas consumed by the electric power sector by the quantity consumed. Data are from Form EIA-906, "Power Plant Report"; Form EIA-920, "Combined Heat and Power Plant Report"; and predecessor forms.

Natural Gas Consumption, End-Use Sectors. Calculated annually by EIA by dividing the heat content of natural gas consumed by the end-use sectors (residential, commercial, industrial, and transportation) by the quantity consumed. Data are from Form EIA-176, "Annual Report of Natural and Supplemental Gas Supply and Disposition."

Natural Gas Consumption, Total. • 1949-1962: EIA adopted the thermal conversion factor of 1,035 Btu per cubic foot as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*. • 1963-1979: EIA adopted the thermal conversion factor calculated annually by the American Gas Association (AGA) and published in *Gas Facts*, an AGA annual publication. • 1980 forward: Calculated annually by EIA by dividing the total heat content of natural gas consumed by the total quantity consumed.

Natural Gas Exports. • 1949-1972: Assumed by EIA to be equal to the thermal conversion factor for dry natural gas consumed (see **Natural Gas Consumption, Total**). • 1973 forward: Calculated annually by EIA by dividing the heat content of natural gas exported by the quantity exported. For 1973-1995, data are from Form FPC-14, “Annual Report for Importers and Exporters of Natural Gas.” Beginning in 1996, data are from U.S. Department of Energy, Office of Fossil Energy, *Natural Gas Imports and Exports*.

Natural Gas Imports. • 1949-1972: Assumed by EIA to be equal to the thermal conversion factor for dry natural gas consumed (see **Natural Gas Consumption, Total**). • 1973 forward: Calculated annually by EIA by dividing the heat content of natural gas imported by the quantity imported. For 1973-1995, data are from Form FPC-14, “Annual Report for Importers and Exporters of Natural Gas.” Beginning in 1996, data are from U.S. Department of Energy, Office of Fossil Energy, *Natural Gas Imports and Exports*.

Natural Gas Production, Dry. Assumed by EIA to be equal to the thermal conversion factor for dry natural gas consumed. See **Natural Gas Consumption, Total**.

Natural Gas Production, Marketed. Calculated annually by EIA by dividing the heat content of dry natural gas produced (see **Natural Gas Production, Dry**) and liquids produced (see **Natural Gas Plant Liquids Production**) by the total quantity of marketed natural gas produced.

Approximate Heat Content of Coal and Coal Coke

Coal Coke Imports and Exports. EIA adopted the Bureau of Mines estimate of 24.800 million Btu per short ton.

Coal Consumption, Electric Power Sector. Calculated annually by EIA by dividing the heat content of coal consumed by the electric power sector by the quantity consumed. Data are from Form EIA-906, “Power Plant Report”; Form EIA-920, “Combined Heat and Power Plant Report”; and predecessor forms.

Coal Consumption, Industrial Sector, Coke Plants. Calculated annually by EIA by dividing the heat content of coal consumed by coke plants by the quantity consumed. Data are from Form EIA-5, “Quarterly Coal Consumption and Quality Report—Coke Plants.”

Coal Consumption, Industrial Sector, Other. Calculated annually by EIA by dividing the heat content of coal consumed by manufacturing plants by the quantity consumed. Data are from Form EIA-3, “Quarterly Coal Consumption and Quality Report—Manufacturing Plants.”

Coal Consumption, Residential and Commercial Sectors. Calculated annually by EIA by dividing the heat content of coal consumed by the residential and

commercial sectors by the quantity consumed. Through 1999, data are from Form EIA-6, “Coal Distribution Report.” Beginning in 2000, data are for commercial combined-heat-and-power (CHP) plants from Form EIA-920, “Combined Heat and Power Plant Report,” and predecessor forms.

Coal Consumption, Total. Calculated annually by EIA by dividing the total heat content of coal consumed by all sectors by the total quantity consumed.

Coal Exports. Calculated annually by EIA by dividing the heat content of steam coal and metallurgical coal exported by the quantity exported. Data are from U.S. Department of Commerce, Bureau of the Census, “Monthly Report EM 545.”

Coal Imports. • 1949-1963: Calculated annually by EIA by dividing the heat content of coal imported by the quantity imported. • 1963 forward: Assumed by EIA to be 25.000 million Btu per short ton.

Coal Production. Calculated annually by EIA to balance the heat content of coal supply (production and imports) and the heat content of coal disposition (exports, stock change, and consumption).

Approximate Heat Rates for Electricity

Electricity Net Generation, Fossil-Fueled Plants. There is no generally accepted practice for measuring the thermal conversion rates for power plants that generate electricity from hydro, wind, photovoltaic, or solar thermal energy sources. Therefore, EIA calculates a rate factor that is equal to the annual average heat rate factor for fossil-fueled power plants in the United States. By using that factor, it is possible to evaluate fossil fuel requirements for replacing those sources during periods of interruption, such as droughts. The heat content of a kilowatthour of electricity produced, regardless of the generation process, is 3,412 Btu. • 1949-1955: The weighted annual average heat rate for fossil-fueled steam-electric power plants in the United States, as published by EIA in *Thermal-Electric Plant Construction Cost and Annual Production Expenses—1981* and *Steam-Electric Plant Construction Cost and Annual Production Expenses—1978*. • 1956-1988: The weighted annual average heat rate for fossil-fueled steam-electric power plants in the United States, as published in EIA, *Electric Plant Cost and Power Production Expenses 1991*, Table 9. • 1989-2000: Calculated annually by EIA by using heat rate data reported on Form EIA-860, “Annual Electric Generator Report” (and predecessor forms); and net generation data reported on Form EIA-759, “Monthly Power Plant Report.” The computation includes data for all electric utility steam-electric plants using fossil fuels. 2001 forward: Calculated annually by EIA by using fuel consumption and net generation data reported on Form EIA-906, “Power Plant Report,” and Form EIA-920, “Combined Heat and Power Plant Report.” The

computation includes data for all electric utilities and electricity-only independent power producers using fossil fuels.

Electricity Net Generation, Geothermal Energy Plants. • 1960-1981: Calculated annually by EIA by weighting the annual average heat rates of operating geothermal units by the installed nameplate capacities as reported on Form FPC-12, "Power System Statement." • 1982 forward: Estimated annually by EIA on the basis of an informal survey of relevant plants.

Electricity Net Generation, Nuclear Plants. • 1957-1984: Calculated annually by dividing the total heat content consumed in nuclear generating units by the total

(net) electricity generated by nuclear generating units. The heat content and electricity generation were reported on Form FERC-1, "Annual Report of Major Electric Utilities, Licensees, and Others"; Form EIA-412, "Annual Report of Public Electric Utilities"; and predecessor forms. For 1982, the factors were published in EIA, *Historical Plant Cost and Annual Production Expenses for Selected Electric Plants 1982*, page 215. For 1983 and 1984, the factors were published in EIA, *Electric Plant Cost and Power Production Expenses 1991*, Table 13. • 1985 forward: Calculated annually by EIA by using the heat rate reported on Form EIA-860, "Annual Electric Generator Report" (and predecessor forms); and the generation reported on Form EIA-906, "Power Plant Report," and Form EIA-920, "Combined Heat and Power Plant Report" (and predecessor forms).

