

# Appendix A

## British Thermal Unit Conversion Factors

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## British Thermal Unit 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 *Monthly 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% to 10%, depending on the specific fuel and its hydrogen content. Some fuels, such as unseasoned wood, can be more than 40% different in their gross and net heat content rates. See "Heat Content" and "British Thermal Unit (Btu)" in the Glossary for more information.

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 labeled "preliminary." Often, the current year's factors are labeled "estimate," and are set equal to the previous year's values until data become available to calculate the factors. 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 and Biofuels**

(Million Btu per Barrel, Except as Noted)

Commodity	Heat Content	Commodity	Heat Content
Asphalt and Road Oil	6.636	Motor Gasoline (Finished)—see Tables A2 and A3	
Aviation Gasoline (Finished)	5.048	Motor Gasoline Blending Components (MGBC)	
Aviation Gasoline Blending Components	5.048	Through 2006	5.253
Crude Oil—see Table A2		Beginning in 2007	5.222
Distillate Fuel Oil—see Table A3 for averages		Oxygenates (excluding Fuel Ethanol)	4.247
15 ppm sulfur and under	5.770	Petrochemical Feedstocks	
Greater than 15 ppm to 500 ppm sulfur	5.817	Naphtha Less Than 401°F	5.248
Greater than 500 ppm sulfur	5.825	Other Oils Equal to or Greater Than 401°F	5.825
Hydrocarbon Gas Liquids		Petroleum Coke—see Table A3 for averages	
Natural Gas Liquids		Total, through 2003	6.024
Ethane	2.783	Catalyst, beginning in 2004	<sup>a</sup> 6.287
Propane	3.841	Marketable, beginning in 2004	5.719
Normal Butane	4.353	Residual Fuel Oil	6.287
Isobutane	4.183	Special Naphthas	5.248
Natural Gasoline (Pentanes Plus)	4.638	Still Gas	
Refinery Olefins		Through 2015	<sup>b</sup> 6.000
Ethylene	2.436	Beginning in 2016	<sup>a</sup> 6.287
Propylene	3.835	Unfinished Oils	5.825
Butylene	4.377	Waxes	5.537
Isobutylene	4.355	Miscellaneous Products	5.796
Hydrogen	<sup>c</sup> 6.287	Other Hydrocarbons	5.825
Jet Fuel, Kerosene Type	5.670	Biofuels, Fuel Ethanol—see Table A3	
Jet Fuel, Naphtha Type	5.355	Biofuels, Biodiesel	5.359
Kerosene	5.670	Biofuels, Renewable Diesel Fuel	5.494
Lubricants	6.065	Biofuels, Other	5.359

<sup>a</sup> Per residual fuel oil equivalent barrel (6.287 million Btu per barrel).

<sup>b</sup> Per fuel oil equivalent barrel (6.000 million Btu per barrel).

<sup>c</sup> Hydrogen has a gross heat content of 323.6 Btu per standard cubic foot (at 60 degrees Fahrenheit and 1 atmosphere), and 6.287 million Btu per residual fuel oil equivalent barrel. For hydrogen, barrels can be converted to standard cubic feet by multiplying by 19,426 standard cubic feet per barrel of residual fuel oil equivalent.

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

Web Page: <http://www.eia.gov/totalenergy/data/monthly/#appendices>.

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

**Table A2. Approximate Heat Content of Petroleum Production, Imports, and Exports**  
(Million Btu per Barrel)

	Production		Imports				Exports			
			Crude Oil <sup>a</sup>	Petroleum Products		Total <sup>d</sup>	Crude Oil <sup>a</sup>	Petroleum Products		Total <sup>d</sup>
	Crude Oil <sup>a</sup>	Natural Gas Plant Liquids <sup>b</sup>		Motor Gasoline <sup>c</sup>	Total Products <sup>d</sup>			Motor Gasoline <sup>c</sup>	Total Products <sup>d</sup>	
1950 .....	5.800	4.470	5.943	5.253	6.263	6.080	5.800	5.253	5.751	5.766
1955 .....	5.800	4.346	5.924	5.253	6.234	6.040	5.800	5.253	5.765	5.768
1960 .....	5.800	4.253	5.911	5.253	6.161	6.021	5.800	5.253	5.835	5.834
1965 .....	5.800	4.197	5.872	5.253	6.123	5.997	5.800	5.253	5.742	5.743
1970 .....	5.800	4.090	5.822	5.253	6.088	5.985	5.800	5.253	5.811	5.810
1975 .....	5.800	3.923	5.821	5.253	5.935	5.858	5.800	5.253	5.747	5.748
1980 .....	5.800	<sup>b</sup> 3.864	5.812	5.253	5.748	5.796	5.800	5.253	5.841	5.820
1981 .....	5.800	3.860	5.818	5.253	5.659	5.775	5.800	5.253	5.837	5.821
1982 .....	5.800	3.798	5.826	5.253	5.664	5.775	5.800	5.253	5.829	5.820
1983 .....	5.800	3.755	5.825	5.253	5.677	5.774	5.800	5.253	5.800	5.800
1984 .....	5.800	3.745	5.823	5.253	5.613	5.745	5.800	5.253	5.867	5.850
1985 .....	5.800	3.752	5.832	5.253	5.572	5.736	5.800	5.253	5.819	5.814
1986 .....	5.800	3.733	5.903	5.253	5.624	5.808	5.800	5.253	5.839	5.832
1987 .....	5.800	3.742	5.901	5.253	5.599	5.820	5.800	5.253	5.860	5.858
1988 .....	5.800	3.751	5.900	5.253	5.618	5.820	5.800	5.253	5.842	5.840
1989 .....	5.800	3.764	5.906	5.253	5.641	5.833	5.800	5.253	5.869	5.857
1990 .....	5.800	3.758	5.934	5.253	5.614	5.849	5.800	5.253	5.838	5.833
1991 .....	5.800	3.740	5.948	5.253	5.636	5.873	5.800	5.253	5.827	5.823
1992 .....	5.800	3.739	5.953	5.253	5.623	5.877	5.800	5.253	5.774	5.777
1993 .....	5.800	3.735	5.954	5.253	5.539	5.866	5.800	5.253	5.681	5.693
1994 .....	5.800	3.728	5.950	5.253	5.416	5.835	5.800	5.253	5.693	5.704
1995 .....	5.800	3.728	5.938	5.253	5.345	5.830	5.800	5.253	5.692	5.703
1996 .....	5.800	3.703	5.947	5.253	5.373	5.828	5.800	5.253	5.663	5.678
1997 .....	5.800	3.686	5.954	5.253	5.333	5.836	5.800	5.253	5.663	5.678
1998 .....	5.800	3.694	5.953	5.253	5.314	5.833	5.800	5.253	5.505	5.539
1999 .....	5.800	3.663	5.942	5.253	5.291	5.815	5.800	5.253	5.530	5.564
2000 .....	5.800	3.648	5.959	5.253	5.309	5.823	5.800	5.253	5.529	5.542
2001 .....	5.800	3.652	5.976	5.253	5.330	5.838	5.800	5.253	5.637	5.641
2002 .....	5.800	3.646	5.971	5.253	5.362	5.845	5.800	5.253	5.517	5.519
2003 .....	5.800	3.659	5.970	5.253	5.381	5.845	5.800	5.253	5.628	5.630
2004 .....	5.800	3.636	5.981	5.253	5.429	5.853	5.800	5.253	5.532	5.539
2005 .....	5.800	3.638	5.977	5.253	5.436	5.835	5.800	5.253	5.504	5.513
2006 .....	5.800	3.622	5.980	5.253	5.431	5.836	5.800	<sup>e</sup> 5.219	5.415	5.423
2007 .....	5.800	3.609	5.985	5.222	5.483	5.857	5.800	5.188	5.465	5.471
2008 .....	5.800	3.614	5.990	5.222	5.459	5.861	5.800	5.215	5.587	5.591
2009 .....	5.800	3.598	5.988	5.222	5.509	5.878	5.800	5.221	5.674	5.677
2010 .....	5.800	3.573	5.989	5.222	5.545	5.892	5.800	5.214	5.601	5.604
2011 .....	5.800	3.573	6.008	5.222	5.538	5.905	5.800	5.216	5.526	5.530
2012 .....	5.800	3.588	6.165	5.222	5.501	6.035	5.800	5.217	5.520	5.526
2013 .....	5.800	3.629	6.010	5.222	5.497	5.899	5.800	5.216	5.470	5.482
2014 .....	5.800	3.640	6.035	5.222	5.518	5.929	5.800	5.218	5.369	5.406
2015 .....	5.717	3.669	6.065	5.222	5.504	5.941	5.682	5.218	5.279	5.319
2016 .....	5.722	3.632	6.053	5.222	5.491	5.929	5.724	5.218	5.184	5.245
2017 .....	5.723	3.612	6.050	5.222	5.489	5.930	5.738	<sup>e</sup> 5.222	5.151	5.258
2018 .....	5.706	3.591	6.063	5.222	<sup>d</sup> 5.491	<sup>d</sup> 5.938	5.721	5.222	<sup>d</sup> 5.088	<sup>d</sup> 5.259
2019 .....	5.698	3.607	6.061	5.222	5.464	5.908	5.708	5.222	5.022	5.263
2020 .....	5.691	3.593	6.066	5.222	5.513	5.927	5.709	5.222	4.924	5.220
2021 .....	5.690	3.585	6.067	5.222	5.508	5.905	5.725	5.222	4.861	5.161
2022 .....	5.684	3.575	6.085	5.222	5.519	5.928	5.721	5.222	4.866	5.187
2023 .....	5.689	3.575	6.064	5.222	5.471	5.922	5.729	5.222	4.805	5.174
2024 .....	<sup>E</sup> 5.689	<sup>E</sup> 3.575	<sup>E</sup> 6.064	<sup>E</sup> 5.222	<sup>E</sup> 5.471	<sup>E</sup> 5.922	<sup>E</sup> 5.729	<sup>E</sup> 5.222	<sup>E</sup> 4.805	<sup>E</sup> 5.174

<sup>a</sup> Includes lease condensate.

<sup>b</sup> Natural gas processing plant production of natural gas liquids (ethane, propane, normal butane, isobutane, and natural gasoline). Through 1980, also includes natural gas processing plant production of finished petroleum products (aviation gasoline, distillate fuel oil, jet fuel, kerosene, motor gasoline, special naphthas, and miscellaneous products).

<sup>c</sup> Excludes fuel ethanol, methyl tertiary butyl ether (MTBE), and other oxygenates blended into motor gasoline.

<sup>d</sup> Through 2017, the imports and exports factors are developed using old hydrocarbon gas liquids heat content values shown in Table A1 of the September 2019 *Monthly Energy Review* (MER). Beginning in 2018, the factors are developed using heat content values shown in Table A1 of the current MER.

<sup>e</sup> For 2006–2016, includes MTBE blended into motor gasoline; excludes MTBE in other years. For all years, excludes fuel ethanol and other non-MTBE oxygenates blended into motor gasoline.

<sup>E</sup>=Estimate.

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

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#appendices> (Excel and CSV files) for all available annual data beginning in 1949.

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

**Table A3. Approximate Heat Content of Petroleum Consumption and Fuel Ethanol**  
(Million Btu per Barrel)

	Total Petroleum <sup>a</sup> Consumption by Sector						Distillate Fuel Oil Consumption <sup>i</sup>	Hydrocarbon Gas Liquids Consumption <sup>g</sup>	Motor Gasoline (Finished) Consumption <sup>h</sup>	Petroleum Coke Consumption <sup>j</sup>	Fuel Ethanol <sup>k</sup>	Fuel Ethanol Feedstock Factor <sup>k</sup>
	Residential	Commercial <sup>b</sup>	Industrial <sup>b</sup>	Transportation <sup>b,c</sup>	Electric Power <sup>d,e</sup>	Total <sup>b,c</sup>						
1950 .....	5.473	5.817	5.927	5.461	6.254	5.642	5.825	3.810	5.253	6.024	NA	NA
1955 .....	5.470	5.781	5.847	5.407	6.254	5.581	5.825	3.810	5.253	6.024	NA	NA
1960 .....	5.418	5.781	5.772	5.387	6.267	5.542	5.825	3.810	5.253	6.024	NA	NA
1965 .....	5.365	5.761	5.695	5.386	6.267	5.517	5.825	3.810	5.253	6.024	NA	NA
1970 .....	5.262	5.709	5.579	5.393	6.252	5.499	5.825	3.731	5.253	6.024	NA	NA
1975 .....	5.255	5.649	5.490	5.392	6.250	5.489	5.825	3.671	5.253	6.024	NA	NA
1980 .....	5.322	5.752	5.340	5.441	6.254	5.472	5.825	3.669	5.253	6.024	3.564	6.586
1981 .....	5.284	5.693	5.268	5.433	6.258	5.440	5.825	3.632	5.253	6.024	3.564	6.562
1982 .....	5.267	5.699	5.211	5.423	6.258	5.406	5.825	3.588	5.253	6.024	3.564	6.539
1983 .....	5.141	5.592	5.214	5.416	6.255	5.396	5.825	3.535	5.253	6.024	3.564	6.515
1984 .....	5.308	5.658	5.167	5.418	6.251	5.385	5.825	3.580	5.253	6.024	3.564	6.492
1985 .....	5.264	5.598	5.159	5.423	6.247	5.377	5.825	3.584	5.253	6.024	3.564	6.469
1986 .....	5.269	5.632	5.237	5.426	6.257	5.410	5.825	3.631	5.253	6.024	3.564	6.446
1987 .....	5.241	5.594	5.203	5.429	6.249	5.395	5.825	3.663	5.253	6.024	3.564	6.423
1988 .....	5.259	5.598	5.196	5.433	6.250	5.402	5.825	3.643	5.253	6.024	3.564	6.400
1989 .....	5.195	5.549	5.190	5.438	6.240	5.403	5.825	3.679	5.253	6.024	3.564	6.377
1990 .....	5.146	5.554	5.219	5.442	6.244	5.403	5.825	3.630	5.253	6.024	3.564	6.355
1991 .....	5.096	5.529	5.130	5.441	6.246	5.375	5.825	3.626	5.253	6.024	3.564	6.332
1992 .....	5.126	5.514	5.133	5.443	6.238	5.369	5.825	3.643	5.253	6.024	3.564	6.309
1993 .....	5.103	5.505	5.140	5.413	6.230	5.354	5.825	3.628	5.217	6.024	3.564	6.287
1994 .....	5.097	5.513	5.115	5.413	6.213	5.344	5.820	3.657	5.214	6.024	3.564	6.264
1995 .....	5.062	5.476	5.084	5.409	6.187	5.326	5.820	3.641	5.204	6.024	3.564	6.242
1996 .....	4.997	5.431	5.076	5.416	6.194	5.323	5.820	3.629	5.211	6.024	3.564	6.220
1997 .....	4.988	5.389	5.083	5.410	6.198	5.322	5.820	3.627	5.205	6.024	3.564	6.198
1998 .....	4.974	5.363	5.101	5.406	6.210	5.335	5.819	3.619	5.203	6.024	3.564	6.176
1999 .....	4.902	5.289	5.052	5.406	6.204	5.313	5.819	3.628	5.202	6.024	3.564	6.167
2000 .....	4.908	5.313	5.015	5.415	6.188	5.311	5.819	3.610	5.201	6.024	3.564	6.159
2001 .....	4.936	5.323	5.104	5.405	6.199	5.331	5.819	3.604	5.201	6.024	3.564	6.151
2002 .....	4.885	5.291	5.053	5.404	6.172	5.309	5.819	3.588	5.199	6.024	3.564	6.143
2003 .....	4.920	5.313	5.108	5.400	6.182	5.326	5.819	3.610	5.197	6.024	3.564	6.106
2004 .....	4.952	5.324	5.106	5.407	6.134	5.330	5.818	3.591	5.196	5.982	3.564	6.069
2005 .....	4.915	5.360	5.143	5.408	6.126	5.342	5.818	3.589	5.192	5.982	3.564	6.032
2006 .....	4.886	5.296	5.120	5.405	6.038	5.323	5.803	3.551	5.185	5.987	3.564	5.995
2007 .....	4.833	5.270	5.079	5.376	6.064	5.293	5.784	3.544	5.142	5.996	3.564	5.959
2008 .....	4.772	5.156	5.103	5.342	6.013	5.268	5.780	3.549	5.106	5.992	3.564	5.922
2009 .....	4.664	5.217	4.959	5.320	5.987	5.218	5.781	3.487	5.090	6.017	3.564	5.901
2010 .....	4.664	5.195	4.920	5.316	5.956	5.204	5.778	3.489	5.067	6.059	3.562	5.880
2011 .....	4.657	5.176	4.887	5.315	5.900	5.193	5.776	3.423	5.063	6.077	3.561	5.859
2012 .....	4.714	5.126	4.843	5.306	5.925	5.176	5.774	3.440	5.062	6.084	3.560	5.838
2013 .....	4.648	5.053	4.801	5.302	5.892	5.157	5.774	3.468	5.060	6.089	3.560	5.831
2014 .....	4.664	5.016	4.804	5.300	5.906	5.161	5.773	3.439	5.059	6.100	3.559	5.825
2015 .....	4.721	5.050	4.767	5.302	5.915	5.154	5.773	3.461	5.057	6.085	3.558	5.818
2016 .....	4.631	5.022	4.799	5.303	5.885	5.161	5.773	3.424	5.055	6.104	3.558	5.811
2017 .....	4.623	5.006	4.769	5.305	5.893	5.153	5.772	3.400	5.053	6.132	3.556	5.804
2018 .....	4.620	4.971	4.664	5.309	5.896	5.122	5.772	3.381	5.054	6.122	3.553	5.797
2019 .....	4.540	4.962	4.646	5.307	5.900	5.111	5.771	3.401	5.052	6.132	3.555	5.790
2020 .....	4.536	4.889	4.534	5.301	5.883	5.054	5.770	3.349	5.052	6.130	3.557	5.784
2021 .....	4.611	4.909	4.524	5.306	5.883	5.067	5.770	3.369	5.050	6.135	3.555	5.777
2022 .....	4.596	4.942	4.441	5.314	5.902	5.058	5.770	3.229	5.049	6.164	3.553	5.777
2023 .....	E 4.623	E 4.956	E 4.388	E 5.309	E 5.931	E 5.039	E 5.770	E 3.224	E 5.049	E 6.153	E 3.554	E 5.777
2024 .....	E 4.623	E 4.956	E 4.388	E 5.309	E 5.931	E 5.039	E 5.770	E 3.224	E 5.049	E 6.153	E 3.554	E 5.777

<sup>a</sup> 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 for individual products shown in Tables A1 and A3.

<sup>b</sup> Beginning in 1993, includes fuel ethanol blended into motor gasoline.

<sup>c</sup> Beginning in 2009, includes biodiesel and renewable diesel fuel blended into distillate fuel oil.

<sup>d</sup> 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.

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

<sup>f</sup> 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 sulfur-content categories of distillate fuel oil are calculated by using heat content values shown in Table A1. Excludes biodiesel and renewable diesel fuel blended into distillate fuel oil.

<sup>g</sup> Quantity-weighted averages of the major components of hydrocarbon gas liquids are calculated by using heat content values shown in Table A1. The factor for 1967 is used as the estimated factor for 1949–1966.

<sup>h</sup> Through 1992, excludes oxygenates. Beginning in 1993, includes fuel ethanol blended into motor gasoline; and for 1993–2006, also includes methyl tertiary butyl ether (MTBE) and other oxygenates blended into motor gasoline.

<sup>i</sup> There is a discontinuity in this time series between 2003 and 2004; beginning in 2004, the single constant factor is replaced by a quantity-weighted factor.

Quantity-weighted averages of the two categories of petroleum coke are calculated by using heat content values shown in Table A1.

<sup>j</sup> Includes denaturant (petroleum added to ethanol to make it undrinkable). Fuel ethanol factors are weighted average heat contents for undenatured ethanol (3.539 million Btu per barrel) and products used as denaturant (natural gasoline, finished motor gasoline, and motor gasoline blending components—see Tables A1 and A3 for factors). The factor for 2009 is used as the estimated factor for 1980–2008.

<sup>k</sup> Corn input to the production of undenatured ethanol (million Btu corn per barrel undenatured ethanol), used as the factor to estimate total biomass inputs to the production of undenatured ethanol. Observed ethanol yields (gallons undenatured ethanol per bushel of corn) are 2.5 in 1980, 2.666 in 1998, 2.68 in 2002, 2.78 in 2008, and 2.82 in 2012; yields in other years are estimated. Corn is assumed to have a gross heat content of 0.392 million Btu per bushel. Undenatured ethanol is assumed to have a gross heat content of 3.539 million Btu per barrel.

E=Estimate. NA=Not available.

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

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#appendices> (Excel and CSV files) for all available annual data beginning in 1949.

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

**Table A4. Approximate Heat Content of Natural Gas**  
(Btu per Cubic Foot)

	Production		Consumption <sup>a</sup>			Imports	Exports
	Marketed	Dry	End-Use Sectors <sup>b</sup>	Electric Power Sector <sup>c</sup>	Total		
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
1975 .....	1,095	1,021	1,020	1,026	1,021	1,026	1,014
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	1,032	<sup>c</sup> 1,028	1,031	1,004	1,019
1990 .....	1,105	1,029	1,029	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	1,027	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 .....	1,103	1,024	1,025	1,020	1,024	1,022	1,008
2003 .....	1,103	1,028	1,029	1,025	1,028	1,025	1,009
2004 .....	1,104	1,026	1,026	1,027	1,026	1,025	1,009
2005 .....	1,104	1,028	1,028	1,028	1,028	1,025	1,009
2006 .....	1,103	1,028	1,028	1,028	1,028	1,025	1,009
2007 .....	1,102	1,027	1,027	1,027	1,027	1,025	1,009
2008 .....	1,100	1,027	1,027	1,027	1,027	1,025	1,009
2009 .....	1,101	1,025	1,025	1,025	1,025	1,025	1,009
2010 .....	1,098	1,023	1,023	1,022	1,023	1,025	1,009
2011 .....	1,142	1,022	1,022	1,021	1,022	1,025	1,009
2012 .....	1,091	1,024	1,025	1,022	1,024	1,025	1,009
2013 .....	1,101	1,027	1,028	1,025	1,027	1,025	1,009
2014 .....	1,116	1,032	1,033	1,029	1,032	1,025	1,009
2015 .....	1,124	1,037	1,038	1,035	1,037	1,025	1,009
2016 .....	1,128	1,037	1,039	1,034	1,037	1,025	1,009
2017 .....	1,129	1,036	1,037	1,034	1,036	1,025	1,009
2018 .....	1,134	1,036	1,038	1,033	1,036	1,025	1,009
2019 .....	1,140	1,038	1,040	1,034	1,038	1,025	1,009
2020 .....	1,145	1,037	1,039	1,034	1,037	1,025	1,009
2021 .....	1,146	1,037	1,039	1,034	1,037	1,025	1,009
2022 .....	1,149	1,036	1,038	1,033	1,036	1,025	1,009
2023 .....	1,156	1,036	1,038	1,033	1,036	1,025	1,009
2024 .....	<sup>E</sup> 1,156	<sup>E</sup> 1,036	<sup>E</sup> 1,038	<sup>E</sup> 1,033	<sup>E</sup> 1,036	<sup>E</sup> 1,025	<sup>E</sup> 1,009

<sup>a</sup> Consumption factors are for natural gas, plus a small amount of supplemental gaseous fuels.

<sup>b</sup> Residential, commercial, industrial, and transportation sectors.

<sup>c</sup> 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.

<sup>E</sup>=Estimate. -- =Not applicable.

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

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#appendices> (Excel and CSV files) for all available annual data beginning in 1949.

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

**Table A5. Approximate Heat Content of Coal and Coal Coke**  
(Million Btu per Short Ton)

	Coal									Coal Coke
	Production <sup>a</sup>	Waste Coal Supplied <sup>b</sup>	Consumption					Imports	Exports	Imports and Exports
			Residential and Commercial Sectors <sup>c</sup>	Industrial Sector		Electric Power Sector <sup>e,f</sup>	Total			
				Coke Plants	Other <sup>d</sup>					
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
1975 .....	22.897	NA	22.261	26.782	22.436	21.642	22.506	25.000	26.562	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	<sup>b</sup> 10.391	23.650	26.800	22.347	<sup>e</sup> 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 .....	<sup>a</sup> 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	12.360	22.242	27.425	22.468	20.082	20.387	25.000	25.972	24.800
2004 .....	20.424	12.266	22.324	27.426	22.473	19.980	20.290	25.000	26.108	24.800
2005 .....	20.348	12.093	22.342	26.279	22.178	19.988	20.246	25.000	25.494	24.800
2006 .....	20.310	12.080	22.066	26.271	22.050	19.931	20.181	25.000	25.453	24.800
2007 .....	20.340	12.090	22.069	26.329	22.371	19.909	20.168	25.000	25.466	24.800
2008 .....	20.208	12.121	<sup>c</sup> 23.035	26.281	22.304	19.713	19.979	25.000	25.399	24.800
2009 .....	19.963	12.076	22.852	26.334	21.823	19.521	19.741	25.000	25.633	24.800
2010 .....	20.173	11.960	22.611	26.295	21.846	19.623	19.870	25.000	25.713	24.800
2011 .....	20.142	11.604	22.099	26.299	21.568	19.341	19.600	25.000	25.645	24.800
2012 .....	20.215	11.539	21.300	28.636	21.449	19.211	19.544	23.128	24.551	24.800
2013 .....	20.182	11.103	21.233	28.705	21.600	19.174	19.513	22.379	24.605	24.800
2014 .....	20.146	11.474	21.307	28.458	21.525	19.290	19.611	22.187	25.032	24.800
2015 .....	19.880	11.527	20.699	28.526	21.258	19.146	19.482	22.633	25.048	24.800
2016 .....	19.977	11.496	20.078	28.608	21.055	19.153	19.459	22.327	25.655	24.800
2017 .....	20.025	11.438	19.467	28.673	20.802	18.981	19.303	21.489	24.628	24.800
2018 .....	20.160	11.419	19.269	28.608	20.739	18.915	19.258	20.415	24.294	24.800
2019 .....	20.053	11.513	19.084	28.629	20.721	18.903	19.292	20.558	24.584	24.800
2020 .....	19.845	11.268	18.297	28.717	20.425	18.882	19.260	20.347	24.969	24.800
2021 .....	19.933	11.268	18.399	28.666	20.578	18.941	19.331	20.295	24.216	24.800
2022 .....	20.100	11.268	18.083	28.669	20.388	18.792	19.180	21.447	24.346	24.800
2023 .....	20.172	11.268	17.375	28.859	20.490	18.717	19.185	21.929	24.055	24.800
2024 .....	<sup>E</sup> 20.172	<sup>E</sup> 11.268	<sup>E</sup> 17.375	<sup>E</sup> 28.859	<sup>E</sup> 20.490	<sup>E</sup> 18.717	<sup>E</sup> 19.185	<sup>E</sup> 21.929	<sup>E</sup> 24.055	<sup>E</sup> 24.800

<sup>a</sup> 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).

<sup>b</sup> 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."

<sup>c</sup> Through 2007, used as the thermal conversion factor for coal consumption by the residential and commercial sectors. Beginning in 2008, used as the thermal conversion factor for coal consumption by the commercial sector only.

<sup>d</sup> Includes transportation. Excludes coal synfuel plants.

<sup>e</sup> 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.

<sup>f</sup> Electric power sector factors are for anthracite, bituminous coal, subbituminous coal, lignite, waste coal, and, beginning in 1998, coal synfuel.

E=Estimate. NA=Not available.

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

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#appendices> (Excel and CSV files) for all available annual data beginning in 1949.

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

**Table A6. Approximate Heat Rates for Electricity, and Heat Content of Electricity**  
(Btu per Kilowatthour)

	Approximate Heat Rates <sup>a</sup> for Electricity Net Generation					Thermal Conversion Factor for Noncombustible Renewable Energy <sup>k</sup>	Heat Content <sup>l</sup> of Electricity <sup>k</sup>
	Fossil Fuels <sup>b</sup>				Nuclear <sup>h</sup>		
	Coal <sup>c</sup>	Petroleum <sup>d</sup>	Natural Gas <sup>e</sup>	Total Fossil Fuels <sup>f,g</sup>			
1950 .....	NA	NA	NA	14,030	--	3,412	3,412
1955 .....	NA	NA	NA	11,699	--	3,412	3,412
1960 .....	NA	NA	NA	10,760	11,629	3,412	3,412
1965 .....	NA	NA	NA	10,453	11,804	3,412	3,412
1970 .....	NA	NA	NA	10,494	10,977	3,412	3,412
1975 .....	NA	NA	NA	10,406	11,013	3,412	3,412
1980 .....	NA	NA	NA	10,388	10,908	3,412	3,412
1981 .....	NA	NA	NA	10,453	11,030	3,412	3,412
1982 .....	NA	NA	NA	10,454	11,073	3,412	3,412
1983 .....	NA	NA	NA	10,520	10,905	3,412	3,412
1984 .....	NA	NA	NA	10,440	10,843	3,412	3,412
1985 .....	NA	NA	NA	10,447	10,622	3,412	3,412
1986 .....	NA	NA	NA	10,446	10,579	3,412	3,412
1987 .....	NA	NA	NA	10,419	10,442	3,412	3,412
1988 .....	NA	NA	NA	10,324	10,602	3,412	3,412
1989 .....	NA	NA	NA	10,432	10,583	3,412	3,412
1990 .....	NA	NA	NA	10,402	10,582	3,412	3,412
1991 .....	NA	NA	NA	10,436	10,484	3,412	3,412
1992 .....	NA	NA	NA	10,342	10,471	3,412	3,412
1993 .....	NA	NA	NA	10,309	10,504	3,412	3,412
1994 .....	NA	NA	NA	10,316	10,452	3,412	3,412
1995 .....	NA	NA	NA	10,312	10,507	3,412	3,412
1996 .....	NA	NA	NA	10,340	10,503	3,412	3,412
1997 .....	NA	NA	NA	10,213	10,494	3,412	3,412
1998 .....	NA	NA	NA	10,197	10,491	3,412	3,412
1999 .....	NA	NA	NA	10,226	10,450	3,412	3,412
2000 .....	NA	NA	NA	10,201	10,429	3,412	3,412
2001 .....	10,378	10,742	10,051	10,333	10,443	3,412	3,412
2002 .....	10,314	10,641	9,533	10,173	10,442	3,412	3,412
2003 .....	10,297	10,610	9,207	10,125	10,422	3,412	3,412
2004 .....	10,331	10,571	8,647	10,016	10,428	3,412	3,412
2005 .....	10,373	10,631	8,551	9,999	10,436	3,412	3,412
2006 .....	10,351	10,809	8,471	9,919	10,435	3,412	3,412
2007 .....	10,375	10,794	8,403	9,884	10,489	3,412	3,412
2008 .....	10,378	11,015	8,305	9,854	10,452	3,412	3,412
2009 .....	10,414	10,923	8,160	9,760	10,459	3,412	3,412
2010 .....	10,415	10,984	8,185	9,756	10,452	3,412	3,412
2011 .....	10,444	10,829	8,152	9,716	10,464	3,412	3,412
2012 .....	10,498	10,991	8,039	9,516	10,479	3,412	3,412
2013 .....	10,459	10,713	7,948	9,541	10,449	3,412	3,412
2014 .....	10,428	10,814	7,907	9,509	10,459	3,412	3,412
2015 .....	10,495	10,687	7,869	9,314	10,458	3,412	3,412
2016 .....	10,493	10,811	7,863	9,228	10,459	3,412	3,412
2017 .....	10,465	10,834	7,803	9,208	10,459	3,412	3,412
2018 .....	10,481	11,095	7,811	9,098	10,455	3,412	3,412
2019 .....	10,551	11,205	7,725	8,899	10,442	3,412	3,412
2020 .....	10,655	11,259	7,725	8,767	10,446	3,412	3,412
2021 .....	10,583	11,224	7,689	8,844	10,429	3,412	3,412
2022 .....	10,689	11,166	7,740	8,813	10,448	3,412	3,412
2023 .....	10,745	11,465	7,721	8,630	10,452	3,412	3,412
2024 .....	E 10,745	E 11,465	E 7,721	E 8,630	E 10,452	3,412	3,412

- <sup>a</sup> The values in columns 1–5 of this table are for net heat rates. See "Heat Rate" in Glossary.
- <sup>b</sup> 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 electricity-only independent power producers.
- <sup>c</sup> Includes anthracite, bituminous coal, subbituminous coal, lignite, and, beginning in 2002, waste coal and coal synfuel.
- <sup>d</sup> Includes distillate fuel oil, residual fuel oil, jet fuel, kerosene, petroleum coke, and waste oil.
- <sup>e</sup> Includes natural gas and supplemental gaseous fuels.
- <sup>f</sup> Includes coal, petroleum, natural gas, and, beginning in 2001, other fossil gases (blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels).
- <sup>g</sup> Through 2000, 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.
- <sup>h</sup> Used as the thermal conversion factor for nuclear electricity net generation.
- <sup>i</sup> Technology-based geothermal heat rates are no longer used in Btu calculations in this report. For technology-based geothermal heat rates for 1960–2010, see the *Annual Energy Review 2010*, Table A6.
- <sup>j</sup> See "Heat Content" in Glossary.
- <sup>k</sup> The value of 3,412 Btu per kilowatthour, which is the heat content of electricity, is a constant. It is used as the thermal conversion factor for electricity net generation from noncombustible renewable energy (hydro, geothermal, solar thermal, photovoltaic, and wind), electricity sales to ultimate customers, and electricity imports and exports.
- <sup>l</sup> E=Estimate. NA=Not available. —=Not applicable.
- Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#appendices> (Excel and CSV files) for all available annual data beginning in 1949.
- Sources: See "Thermal Conversion Factor Source Documentation," which follows this table.