

State Energy Data System 2018 Production Technical Notes

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Section 1. Introduction

The U.S. Energy Information Administration's (EIA) State Energy Data System (SEDS) provides Members of Congress, federal and state agencies, and the general public with comparable state-level data on energy production, consumption, prices, and expenditures. The SEDS energy production database provides annual time series of the production of primary energy sources by state, generally from 1960 forward. Data are compiled by EIA's Office of Energy Demand and Integrated Statistics from information collected by EIA (and its predecessor agencies) and other publicly available sources.

Purpose

Energy production data are collected in physical units by various EIA surveys and are published in reports on the EIA website. However, most EIA data are only published for the latest time period or for a shorter time series, without historical data. Also, it is not possible to compare production across fuels that are reported in different physical units or to calculate total energy production. The SEDS energy production database converts physical unit production into a common unit and provides a standardized set of state energy production data for comparisons over time, across fuels, and across states.

Coverage

The primary energy sources used to calculate total energy production in the state energy production database include:

- Coal
- Crude oil
- Natural gas, marketed production¹
- Nuclear electric power
- Renewable energy

Production data for coal, crude oil, and natural gas are collected from EIA sources and earlier reports published by other agencies. They are converted from physical units (short tons, barrels, and cubic feet) to British thermal units (Btu) using estimated heat content conversion factors, so that different forms of energy can be compared. The heat content per unit of physical unit (i.e., thermal conversion factors) provided in SEDS represents the gross (or higher or upper) energy content of the fuel.

Nuclear electric power production in Btu, which also equals consumption, is the nuclear electricity net generation multiplied by the average heat rate of the nuclear power plants.

Renewable energy includes biofuels and other renewable energy (geothermal, hydroelectric power, solar, wind, wood, and biomass waste). Biofuels include fuel ethanol and biodiesel. State-level production of fuel ethanol and biodiesel, in thousand barrels, is estimated using data provided by some states and plant capacity data. Biofuel production in Btu is defined as the total heat content of biomass inputs (or feedstock) used in the production of fuel ethanol and biodiesel. That is, it includes the losses and co-products from the production of the biofuel. Production of other renewable energy is assumed to equal consumption except for wood production from 2016 forward. See Section 6 for the description of renewable energy concepts and estimation procedures.

To avoid double-counting, production (generation) of electricity, a secondary energy source, is not covered in this report (see the EIA [Electricity Data Browser](#) for state electricity generation data). Production of domestically produced fossil fuels used for electricity generation is counted as production in the producing state, whereas production of nuclear fuels and renewable energy used for electricity generation is counted as production in the electricity generating state.

Sections 2 through 6 of this documentation describe the data sources and the estimation methodologies used to derive the production series for each energy source.

¹ SEDS presents marketed production for natural gas, in contrast to the [Monthly Energy Review](#), EIA's national energy publication, which presents production data for dry natural gas and natural gas plant liquids. See discussion in Section 4.

Comparability

To maintain internal consistency, U.S. estimates are computed by summing the estimates for all states, the District of Columbia, and federal offshore production, if any. U.S. totals may not exactly equal the national data published in other EIA publications because of rounding differences or differences in estimation methodology. In particular, the differences between the U.S. production estimates in SEDS and the national data published in the [Monthly Energy Review](#) (MER) are summarized in the box below.

Differences between U.S. production estimates in SEDS and MER

Annual time series of production data at the national level are published in the [Monthly Energy Review](#) (MER) in both physical units and Btu. The differences between the physical unit production data in SEDS and MER are minor and mostly because of rounding. Because SEDS computes the Btu production of coal and natural gas using state conversion factors, the differences between the Btu production data are more noticeable for those fuels.

Coal

Using the state conversion factors from EIA's Office of Energy Production, Conversion, and Delivery, SEDS U.S. coal production estimates in Btu are usually within 1% of the MER estimates. Beginning in 1989, the MER's coal production in Btu also includes waste coal supplied, which is not included in the SEDS estimates.

Crude oil

There is no noticeable difference in the crude oil production data presented in SEDS and MER.

Natural gas

SEDS uses state-level thermal conversion factors for dry natural gas and regional-level thermal conversion factors for natural gas plant liquids to calculate natural gas marketed production in Btu. In contrast, MER uses national-level thermal conversion for dry natural gas and natural gas plant liquids. The differences between the SEDS U.S. series and the sum of the two MER series are less than 0.5% in most years. The maximum difference is 2.1% in 1997. No attempt has been made to reconcile the two sets of estimates.

Renewable and nuclear energy

The SEDS and MER U.S. production estimates are the same for the renewable energy sources and nuclear-generated electricity.

Section 2. Coal

Annual coal production in short tons is collected from U.S. coal producers on Form EIA-7A, “Annual Survey of Coal Production and Preparation” and its predecessor forms. State production data are available in the [Annual Coal Report](#) and its predecessor publications as described under Sources below. The state data for 1960 forward used in SEDS are provided by EIA’s Office of Energy Production, Conversion, and Delivery (EPCD). Beginning in 2001, coal production includes a small volume of refuse recovery, which is allocated to the states by EPCD.

The state-level thermal conversion factors, in Btu per pound, are also developed by EPCD. They are based on the heat contents of coal delivered to electric power plants (reported on Form EIA-923, “Power Plant Operations Report” and predecessor forms), beginning in 1972. For states that have a significant amount of their coal consumed in coke plants, other manufacturing industries, or exported, conversion factors are adjusted upward to reflect a higher Btu content of coal produced for such uses. Factors for 1960-1971 are derived from the 1972 data. Consequently, the resultant Btu production estimates for the earlier years deviate more from the [Monthly Energy Review](#) national Btu estimates, which are based on average thermal conversion factors computed at the national level.

Variable names and definitions

The independent data series identifying codes for coal data are as follows (the two-letter state code is represented by “ZZ” in the variable names):

- CLPRPZZ = Coal production, in thousand short tons, by state; and
- CLPRKZZ = Factor for converting coal production from thousand short tons to billion Btu, by state.

Coal production in billion Btu is calculated by the following formula:

$$\text{CLPRBZZ} = \text{CLPRPZZ} * \text{CLPRKZZ}$$

The U.S. total coal production, CLPRPUS and CLPRBUS, are calculated as the sum of the states’ values. And the average thermal conversion factor for the U.S. total is derived:

$$\text{CLPRKUS} = \text{CLPRBUS} / \text{CLPRPUS}$$

Data sources

CLPRPZZ — Coal production in thousand short tons by state.

- 1960-1975: Bureau of Mines, *Minerals Yearbook*, “Coal—Bituminous and Lignite” and “Coal—Pennsylvania Anthracite” chapters.
- 1976: U.S. Energy Information Administration (EIA), *Energy Data Reports*, “Coal—Bituminous and Lignite in 1976” and “Coal—Pennsylvania Anthracite 1976.”
- 1977 and 1978: EIA, *Energy Data Reports*, “Bituminous Coal and Lignite Production and Mine Operations,” “Coal—Pennsylvania Anthracite” and “Coal Production,” annual reports.
- 1979 and 1980: EIA, *Energy Data Reports*, “Weekly Coal Report and Coal Production,” annual reports.
- 1981-1988: EIA, *Weekly Coal Production and Coal Production*, annual reports.
- 1989-2000: EIA, [Coal Industry Annual](#), annual reports, Table 1.
- 2001 forward: EIA, [Annual Coal Report](#), annual reports, Table 1.

CLPRKZZ — Factor for converting coal production from thousand short tons to billion Btu, by state.

- 1960-1971: No data available; used 1972 factors.
- 1972-1988: Based on Federal Energy Regulatory Commission, Form FERC-423, “Monthly Report of Cost and Quality of Fuels for Electric Plants.”
- 1989 forward: Based on Forms FERC-423, “Monthly Report of Cost and Quality of Fuels for Electric Plants,”

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(1989-2001), EIA-423, "Monthly Cost and Quality of Fuels for Electric Plants Report," (2002-2007), and EIA-923, "Power Plant Operations Report," (2008 forward) (<http://www.eia.gov/electricity/data/eia923/>) and Platts COALdat database.

Section 3. Crude Oil

Production of crude oil (including lease condensate) in thousand barrels is compiled by EIA's Office of Energy Production, Conversion, and Delivery. Before 1976, production data were compiled by the U.S. Department of the Interior, Bureau of Mines. Annual data at the state level from 1981 forward are extracted from EIA, Petroleum Data, [Crude Oil Production](#). Data before 1981 are extracted from the publications described in Sources below.

Prior to 2015, crude oil production data in thousand barrels are converted to billion Btu using a fixed conversion factor of 5.8 million Btu per barrel.

For 2015 forward, EIA calculates the crude oil thermal conversion factors using gravity ranges of crude oil production data from the American Petroleum Institute (API).

Federal offshore production

For 1981 forward, federal offshore crude oil production data in the Petroleum Administration for Defense District (PADD) 3 (Gulf Coast) and PADD 5 (West Coast) regions are available from the EIA petroleum data source. Before 1981, in the data source, federal offshore crude oil production for PADD 3 was included with Alabama, Louisiana, and Texas, and that for PADD 5 with California.

To maintain compatibility of state-level production over time, crude oil production from the Outer Continental Shelf (OCS) of the Gulf of Mexico (GOM) Planning Areas from the U.S. Department of the Interior is assigned to PADD 3 before 1981. Similarly, crude oil production from the Federal Pacific Offshore area is assigned to PADD 5 before 1981. GOM Central Planning Area production is removed from Louisiana, GOM Western Planning Area production is removed from Texas, GOM Eastern Planning Area production, if any, is removed from Alabama, and the Pacific OCS production is removed from California.

Variable names and definitions

The independent data series identifying codes for crude oil data are as follows (the two-letter state code or federal offshore region is represented by "ZZ" in the variable names):

PAPRPZZ = Crude oil production (including lease condensate), in thousand barrels, by state or federal offshore region; and

COPRKUS = Factor for converting crude oil production from thousand barrels to billion Btu.

Crude oil production in billion Btu is calculated by the following formula:

$$\text{PAPRBZZ} = \text{PAPRPZZ} * \text{COPRKUS}$$

The U.S. total crude oil production, PAPRPUS and PAPRBUS, are calculated as the sum of the values for the states and federal offshore regions.

Data sources

PAPRPZZ — Crude oil production (including lease condensate), in thousand barrels, by state or federal offshore region.

- 1960-1965: U.S. Department of the Interior, Bureau of Mines, *Crude Petroleum and Petroleum Products*, Table 5, "Production of Crude Petroleum in the United States."
- 1966: U.S. Department of the Interior, Bureau of Mines, *Crude Petroleum, Petroleum Products and Natural Gas Liquids*, Table 5, "Production of Crude Petroleum in the United States."
- 1967-1980: EIA, Energy Data Reports, *Crude Petroleum, Petroleum Products and Natural Gas Liquids*, Table 5, "Production of Crude Petroleum (including Lease Condensate) by PAD District and State."
- 1960-1980: U.S. Department of the Interior, Bureau of Ocean Energy Management (Gulf of Mexico Planning Areas) and Bureau of Safety and Environmental Enforcement (Pacific OCS Region).

- 1981 forward: EIA *Petroleum Supply Annual*, table on “Production of Crude Oil by PAD District and State,” also available at http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbbl_a.htm.

COPRKUS — Factor for converting crude oil production from thousand barrels to billion Btu.

- 1960-2014: EIA, *Monthly Energy Review*, Table A2. EIA adopted the thermal conversion factor of 5.8 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.”
- 2015 forward: EIA, *Monthly Energy Review*, Table A2. Based on conversion of American Petroleum Institute (API) gravity ranges of crude oil production as reported on Form EIA-914, “Monthly Crude Oil, Lease Condensate, and Natural Gas Production Report.”

Section 4. Natural Gas (Marketed Production)

Natural gas production data in cubic feet are collected and compiled by EIA's Office of Energy Production, Conversion, and Delivery (EPCD).

Natural gas production can be measured at various stages of processing. *Gross withdrawals* cover the full well-stream volume extracted from oil and natural gas wells. *Marketed production* is defined as gross withdrawals less gas used for repressuring, quantities vented and flared, and nonhydrocarbon gases removed in treating and processing operations. At natural gas processing plants, some hydrocarbons are separated as liquids (called natural gas plant liquids or NGPL) from the marketed gas stream. NGPL are usually reported in barrels or gallons, but may also be reported in cubic feet for comparison with other natural gas concepts. The volume of NGPL extracted (previously known as *extraction loss*) is now called *NGPL production, gaseous equivalent*. *Dry natural gas* is the resultant product that is ready for pipeline transmission and distribution. Information on natural gas terms and definitions, sources, and explanatory notes can be found at http://www.eia.gov/dnav/ng/TblDefs/ng_prod_sum_tbldef2.asp.

SEDS uses the concept of marketed production, in contrast to EIA's *Monthly Energy Review* (MER), which presents production of dry natural gas and NGPL separately. Liquids extracted from natural gas are considered petroleum products, and MER's national NGPL production data come from EIA's petroleum surveys. The Btu content of NGPL is calculated using the weighted thermal conversion factors each NGPL component by its national production volume. This method is not used for SEDS because production data for the NGPL components are not available at the state level. Instead, SEDS presents state-level data for natural gas marketed production, which is the sum of NGPL production and dry natural gas.

To estimate the Btu content of natural gas marketed production, SEDS uses state-level thermal conversion factors of natural gas delivered to consumers to convert dry natural gas production data from cubic feet to Btu. For NGPL, SEDS uses regional-level thermal conversion factors, weighted by the production volume of each NGPL component, to convert state-level NGPL production data from cubic feet to Btu. They are then combined to form marketed production at the state level.

Dry production

From 1982 forward, annual dry natural gas production data at the state level are extracted from EIA, Natural Gas Data, Gross Withdrawals and Production, [Dry Production](#) table. Data for 1970 through 1981 are extracted from EIA, [Historical Natural Gas Annual 1930 Through 2000](#).

Federal offshore production

For 1997 forward, federal offshore production in the Gulf of Mexico (GOM) is available from the data source. Before 1997, GOM federal offshore production is included with Alabama, Louisiana, and Texas in the data source. To maintain compatibility of state-level production over time, EIA marketed production for Federal Offshore Gulf of Mexico (1992-1996), EIA gross withdrawals for Federal Offshore Gulf of Mexico (1967-1991), and Outer Continental Shelf (OCS) total gas production for the Gulf of Mexico (GOM) Planning Areas (1970-1977) from the U.S. Department of the Interior are used to represent federal offshore production for GOM before 1996. GOM Eastern Planning Area production is removed from Alabama, GOM Central Planning Area production is removed from Louisiana, and GOM Western Planning Area production is removed from Texas.

For all years, federal offshore production off the Pacific coast is included in California.

Conversion factors

State-level thermal conversion factors for natural gas delivered to consumers are compiled by EPCD. The factors are used to convert dry production of natural gas from million cubic feet to billion Btu, and are available in SEDS at http://www.eia.gov/state/seds/sep_use/total/csv/use_convfac.csv.

Average conversion factors for dry natural gas from the federal offshore GOM are calculated using the conversion factors of Alabama, Louisiana, and Texas, weighted by the production shares of the Eastern, Central, and Western GOM Planning Areas.

NGPL production, gaseous equivalent

Annual NGPL production, gaseous equivalent, data at the state level from 1970 forward are taken from EIA, Natural Gas Data, Gross Withdrawals and Production, [NGPL Production, Gaseous Equivalent table](#). From 2012 forward, NGPL production, gaseous equivalent, is reported for the GOM federal offshore production. Before 2012, it was allocated to the states that processed the GOM natural gas. No attempt was made to adjust the change in classification.

Conversion factors

The products covered in NGPL, such as propane and ethane, have very different thermal conversion factors. But state-level production data for the individual products are not available from the natural gas surveys. However, EIA collects production data in barrels for each NGPL product in its petroleum surveys and publishes the data for the Petroleum Administration for Defense District (PADD) refining districts². SEDS derives the thermal conversion factors for NGPL production, gaseous equivalent, in a multi-step process.

First, SEDS calculates production-weighted averages for NGPL using the thermal conversion factors of the five major products comprising NGPL at the PADD refining district level. The thermal conversion factors for the five NGPL products in million Btu per barrel are:

Ethane	2.783
Propane	3.841
Butane	4.353
Isobutane	4.183
Natural gasoline	4.638

Then, SEDS converts the PADD refining district factors from million Btu per barrel to thousand Btu per cubic foot, using an annual ratio of U.S. total NGPL production in thousand barrels from the petroleum surveys and U.S. total NGPL production (gaseous equivalent) in million cubic feet from the natural gas surveys. The district-level thermal conversion factors are then applied to the NGPL production, gaseous equivalent, for each state in the district to generate the Btu estimates.

Marketed production

For 1970 forward, marketed natural gas production, in cubic feet and Btu, is the sum of dry natural gas production and NGPL production.

For 1960 through 1969, marketed natural gas production data in cubic feet were extracted from the *Minerals Yearbook* published by the U.S. Department of the Interior Bureau of Mines. The data are converted to Btu using the 1970 derived state-level marketed production thermal conversion factors.

Federal offshore production

For 1960 through 1969, Outer Continental Shelf (OCS) total gas production for the Gulf of Mexico (GOM) Planning Areas from the U.S. Department of the Interior are used to represent federal offshore marketed production. GOM Eastern Planning Area production is removed from Alabama, GOM Central Planning Area production is removed from Louisiana, and GOM Western Planning Area production is removed from Texas.

Variable names and definitions

For 1970 forward, the independent data series identifying codes for natural gas data are as follows (the two-letter state code is represented by "ZZ" in the variable names):

²For a description and maps of PADD refinery districts, see [Appendix A of Petroleum Supply Monthly](#).

- NGPRPZZ = Dry natural gas production, in million cubic feet, by state or federal offshore GOM;
- NGTCKZZ = Factor for converting dry natural gas production from million cubic feet to billion Btu, by state or federal offshore GOM;
- NGELPZZ = NGPL production, gaseous equivalent, in million cubic feet, by state; and
- NGELKZZ = Factor for converting NGPL production, gaseous equivalent, from million cubic feet to billion Btu, by state.

Dry natural gas production and NGPL production in Btu are calculated:

- NGPRBZZ = NGPRPZZ * NGTCKZZ
- NGELBZZ = NGELPZZ * NGELKZZ

Marketed production is the sum of dry natural gas production and NGPL production:

- NGMPPZZ = Marketed natural gas production, in million cubic feet, by state
= NGPRPZZ + NGELPZZ
- NGMPBZZ = Marketed natural gas production, in billion Btu, by state
= NGPRBZZ + NGELBZZ
- NGMPKZZ = Derived thermal conversion factor for natural gas marketed production
= NGMPBZZ / NGMPPZZ

For 1960 through 1969, the independent data series is:

- NGMPPZZ = Marketed natural gas production, in million cubic feet, by state.

The Btu content of marketed production is estimated using the 1970 state-level thermal conversion factors:

- NGMPBZZ = NGMPPZZ * 1970's NGMPKZZ

The U.S. marketed production, NGMPPUS and NGMPBUS, are calculated as the sum of the values for the states and federal offshore GOM, and the U.S. conversion factor, NGMPKUS, is derived using the same formula for the states.

Additional note

Because of the complexity in accounting for interstate flow of "raw" (unprocessed) natural gas, there are a few cases in which NGPL production is greater than marketed production at the state level. Most of the cases are in Illinois in the early years. For these cases, a simple average of the thermal conversion factors for dry natural gas and NGPL for the specific state and year is used to convert the marketed production from cubic feet to Btu.

Data sources

NGPRPZZ — Dry natural gas production, in million cubic feet, by state or federal offshore GOM.

- 1970-2000: EIA, [Historical Natural Gas Annual 1930 Through 2000](#). Sources for the data are:
 - 1970-1975: Data are based on reports received from state agencies' responses to informal data requests and the United States Geological Survey (USGS).
 - 1980-1981: EIA, Form EIA-627, "Annual Quantity and Value of Natural Gas Report," and the USGS.
 - 1982-1995: EIA, Form EIA-627, and the United States Minerals Management Service; West Virginia.
 - 1995: EIA, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, 1996 Annual Report, DOE/EIA-0216(96); and EIA computations.
 - 1996-2000: Form EIA-895, "Monthly Quantity and Value of Natural Gas Report;" and the U.S. Minerals Management Service; West Virginia, 2000: EIA, *U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves, Annual Reports*, DOE/EIA-0216.
- 1970-1997: Sources for GOM federal offshore production are:
 - 1970-1976: U.S. Department of the Interior, Bureau of Ocean Energy Management.
 - 1977-1991: EIA, Natural Gas Data, [Offshore Gross Withdrawals](#).
 - 1992-1996: EIA, Natural Gas Data, [Marketed Production](#).

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- 2001 forward: EIA, [Natural Gas Annual](#), state summaries. Also available from Natural Gas Data Production, Gross Withdrawals and Production, [Dry Production](#) tables (including revised data for earlier years). Sources for the NGA data are: Form EIA-895, "Monthly Quantity and Value of Natural Gas Report;" and the U.S. Minerals Management Service; West Virginia, 2000: EIA, *U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves, Annual Reports*, DOE/EIA-0216.

NGELPZZ — Natural gas plant liquids production, gaseous equivalent, in million cubic feet, by state.

- 1970-2000: EIA, [Historical Natural Gas Annual 1930 Through 2000](#). Sources for the data are:
 - 1970-1975: Data are based on reports received from state agencies' responses to informal data requests and the United States Geological Survey (USGS).
 - 1980-1981: EIA, Form EIA-627, "Annual Quantity and Value of Natural Gas Report," and the USGS.
 - 1982-1995: EIA, Form EIA-627, and the United States Minerals Management Service; West Virginia.
 - 1995: EIA, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1996 Annual Report*, DOE/EIA-0216(96); and EIA computations.
 - 1996-2000: Form EIA-895, "Monthly Quantity and Value of Natural Gas Report;" and the U.S. Minerals Management Service; West Virginia, 2000: EIA, *U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves, Annual Reports*, DOE/EIA-0216.
- 2001 forward: EIA, [Natural Gas Annual](#), state summaries. Also available from Natural Gas Data Production, Natural Gas Plant Processing, [NGPL Production, Gaseous Equivalent](#) tables (including revised data for earlier years). Sources for the NGA data are: Form EIA-895, "Monthly Quantity and Value of Natural Gas Report;" and the U.S. Minerals Management Service; West Virginia, 2000: EIA, *U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves, Annual Reports*, DOE/EIA-0216.

NGMPPZZ — Marketed natural gas production, in million cubic feet, by state.

- 1960-1969: U.S. Department of the Interior, Bureau of Mines, *Minerals Yearbook*.
- 1960-1969: U.S. Department of the Interior, Bureau of Ocean Energy Management (GOM federal offshore production).

NGTCKZZ — Factor for converting dry natural gas production from million cubic feet to billion Btu, by state.

- 1970-1979: EIA adopted the thermal conversion factors calculated annually by the American Gas Association and published in *Gas Facts*.
- 1980-1996: EIA, [Historical Natural Gas Annual 1930 Through 2000](#), Table 16.
- 1997 forward: EIA, [Natural Gas Annual](#), Table 16, and unpublished revisions.

Section 5. Nuclear Energy

Nuclear energy is used for generating electric power, so production is assumed to equal consumption of nuclear energy for power generation.

Nuclear energy consumption in Btu is the nuclear electricity net generation multiplied by the average heat rate of the nuclear power plants. The definition, data sources, and estimation methodology are described in Section 6: Electricity, [SEDS Consumption Technical Notes](#).

Consumption estimates in billion Btu are extracted from the SEDS consumption database for incorporation into the production database.

Variable name and definition

The independent data series identifying codes for nuclear energy data are as follows (the two-letter state code is represented by "ZZ" in the variable names):

NUETBZZ = Nuclear electric power consumed, in billion Btu.

Data source

Btu consumption estimates from SEDS are available in comma-separated value (CSV) format: http://www.eia.gov/state/seds/sep_use/total/csv/use_all_btu.csv.

Additional note

Data for electric power generation are net generation data. Negative generation denotes that electric power consumed for plant use exceeds gross generation. A few such cases can be found in electric power generated by nuclear power plants.

Section 6. Renewable Energy

Renewable energy includes biofuels (biodiesel and fuel ethanol), wood and waste, and noncombustible renewable energy sources (hydroelectric power, and geothermal, solar, and wind energy).

Biofuels

SEDS covers two biofuels: biodiesel and fuel ethanol. State-level biodiesel and fuel ethanol production, as well as losses and co-products³ associated with each fuel, are estimated separately.

Biodiesel

Production in physical units

For 2001 forward, EIA publishes U.S.-level biodiesel production data in the [Monthly Energy Review](#). SEDS uses state reported biodiesel production data, when available. For states without reported biodiesel information, SEDS estimates state-level biodiesel production using data from EIA's [Monthly Biodiesel Production Report](#) and other sources.

Some states have published biodiesel production data for some years. These states include Iowa (2005 forward), Michigan (2018), Minnesota (2005-2009 and 2012-2016, with 2010 and 2011 assumed to equal the 2012 value), Montana (2016 forward), North Dakota (2016 and 2018), and Virginia (2008 forward).

For 2009 forward, SEDS uses published and unpublished data from EIA Form EIA-22M, "Monthly Biodiesel Production Survey" to estimate production of the states with no published data. The [Monthly Biodiesel Production Report](#), generated from the survey, publishes production data by Petroleum Administration for Defense District (PADD) and capacity data by state for 2009 forward. Because of the volatility of biodiesel production, instead of using nameplate capacity, SEDS uses unpublished monthly data on plant-level operating status to compute an annual average "operating capacity" for each plant and aggregate them to the state level. Operating capacity data for 2014 are used for 2013. To estimate missing state production, SEDS subtracts the available state biodiesel production data from the total production of the corresponding PADD and allocates the remainder to the other states in the PADD using the share of the state's operating capacity.

For 2001 through 2008, PADD-level production data do not exist and nameplate capacity data are sporadic. SEDS adopts the reported production data from specific states and estimates the rest as follows. First, SEDS computes a set of operating capacity estimates by state for 2001-2008 using the 2009 operating capacity data and information on start date and capacity expansion for individual plants. Then, the available state biodiesel production data are subtracted from the U.S. total and the remainder is allocated to the other states using the share of the state's operating capacity.

Heat content of biomass inputs to the production of biodiesel

To convert biodiesel production to British thermal units (Btu), SEDS uses a thermal conversion factor of 5.359 million Btu per barrel, as listed in the [Monthly Energy Review](#), Appendix A.

Because biodiesel is produced from soybeans, corn, and other biomass inputs, EIA defines the heat content of biodiesel to be the total biomass inputs (feedstock) used to produce biodiesel. At the national level, EIA uses soybean oil input to the production of biodiesel (million Btu soybean oil per barrel biodiesel) as the factor to estimate total biomass inputs to the production of biodiesel. The difference between total biomass inputs and biodiesel produced is the losses and co-products from biodiesel production.

SEDS takes the U.S. losses and co-products from biodiesel production from the [Monthly Energy Review](#) and allocates them to the states using the state-level biodiesel production estimates. The heat content of biomass inputs to the production of biodiesel is the sum of the Btu values of biodiesel production and losses and co-products.

Variable names and definitions

The independent data series identifying codes for biodiesel data are as follows (the two-letter state code is represented by "ZZ" in the variable names):

³ Losses and co-products are defined as the difference between the heat content of the biomass inputs to the production of biofuels and the heat content of the biofuels produced.

- BDPRPUS = Biodiesel production, in thousand barrels, United States;
- BDPRPZZ = Biodiesel production, in thousand barrels, by state; and
- BDLCBUS = Losses and co-products from biodiesel production, in billion Btu, United States.

The heat content data series are defined as follows:

- BDPRBZZ = Biodiesel production, in billion Btu, by state
= BDPRPZZ * 5.359
- BDLCBZZ = Losses and co-products from biodiesel production, in billion Btu, by state
= BDLCBUS * (BDPRBZZ / BDPRBUS)
- BDFDBZZ = Biomass inputs to the production of biodiesel, in billion Btu, by state
= BDPRBZZ + BDLCBZZ

The U.S. totals that are not from external sources are calculated as the sum of the states' values.

Data Sources

BDPRPUS — Biodiesel production, in thousand barrels, United States.

- 2001 forward: EIA, [Monthly Energy Review](#), Table 10.4.

BDPRP (PADD-level) — Biodiesel production, in million gallons, Petroleum Administration for Defense District.

- 2009 forward: EIA, [Monthly Biodiesel Production Report](#), Table 5.

BDPRPZZ — Biodiesel production, in thousand barrels, by state.

- 2001 forward: Production data from available state data sources and EIA estimates based on operating capacity data from EIA Form EIA-22M, "Monthly Biodiesel Production Survey" and other sources.

BDLCBUS — Losses and co-products from the production of biodiesel, in billion Btu, United States.

- 2001 forward: EIA, [Monthly Energy Review](#), Table 10.4.

Fuel ethanol

Production in physical units

For 1981 forward, EIA publishes U.S.-level fuel ethanol production data in the [Monthly Energy Review](#). In the 2007 data cycle, time-series data for fuel ethanol production were collected for Iowa, Minnesota, Nebraska, South Dakota, and Wisconsin through 2007.⁴ These five states accounted for about two-thirds of total U.S. fuel ethanol production in 2007. The remaining portion of fuel ethanol production was allocated to all other states using state-level operating production capacity estimates. For 2008 and 2009, production data were available for only two states, Iowa and Wisconsin. In 2010, production data for Iowa were no longer available. Operating production capacity for all states is used to allocate the national production data to the states from 2010 forward.

For 2005 forward, monthly operating production capacity data by company or plant, which excludes plants that are idled, is compiled by the Renewable Fuels Association.⁵ SEDS uses the version edited by the Nebraska Energy Office, which allocates multi-state production capacity reported by companies to the individual states. The average of the operating capacity reported monthly is used to represent capacity for the year. Capacity data for January 2005 are used for 2004.

Operating capacity data for January 1, 1993 through 1995 are published in the Petroleum Supply Annual, 1992 through 1994. They are used to represent production capacity for 1992 through 1994.

For the remaining years, data on individual plants are collected from various sources. When no information is available for a state, capacity data for 1995 through 2003 are estimated using linear interpolation, and capacity data before 1992

⁴ Some data in the earlier years for Minnesota, Nebraska, South Dakota, and Wisconsin are not available and are estimated using plant capacity information or by assumption.

⁵ Capacity data for 2002-2004 are also available but they cannot be used because they include capacity under construction.

are assumed to be the same as 1992.

To estimate missing state production, SEDS subtracts the available state fuel ethanol production data from total U.S. production and allocate the remainder to the other states using the share of the state's operating capacity. From 2010 forward, production for all states are estimated using their operating capacity shares.

Heat content of biomass inputs to the production of fuel ethanol

Because fuel ethanol is produced from corn and other biomass inputs, EIA defines the heat content of biofuel from fuel ethanol to be the total biomass inputs (feedstock) used to produce fuel ethanol. At the national level, EIA uses corn input to the production of fuel ethanol (million Btu corn per barrel fuel ethanol) as the factor to estimate total biomass inputs. The difference between total biomass inputs and fuel ethanol produced is the losses and co-products from fuel ethanol production.

Before computing the heat content of fuel ethanol produced, an adjustment is made to remove denaturant from the physical unit of fuel ethanol produced. From 2009 forward, the volume of denaturant for the United States is estimated from survey data and is available in the [Monthly Energy Review](#). Prior to 2009, it is assumed to be 2% of fuel ethanol production. The national adjustment ratio is applied to the states.

The adjusted fuel ethanol production in physical units is converted to Btu using a fixed thermal conversion factor of 3.539 million Btu for undenatured ethanol per barrel. Estimates for losses and co-products at the state level are calculated by applying the state fuel ethanol production shares to the national losses and co-products. The sum of the Btu values of fuel ethanol production and losses and co-products gives the heat content of the biomass inputs to the production of fuel ethanol.

Variable names and definitions

The independent data series identifying codes for fuel ethanol data are as follows (the two-letter state code is represented by "ZZ" in the variable names):

- ENRPUS = Fuel ethanol production, including denaturant, in thousand barrels, United States;
- ENRPZZ = Fuel ethanol production, including denaturant, in thousand barrels, by state;
- EMRPUS = Fuel ethanol production, excluding denaturant, in thousand barrels, United States; and
- EMLCBUS = Losses and co-products from the production of fuel ethanol, in billion Btu, United States.

The computed data series are defined as follows:

- EMRPZZ = Fuel ethanol production, excluding denaturant, in thousand barrels, by state
= ENRPZZ * (EMRPUS / ENRPUS)
- EMPRBZZ = Fuel ethanol production, excluding denaturant, in billion Btu, by state
= EMRPZZ * 3.539
- EMLCBZZ = Losses and co-products from fuel ethanol production, in billion Btu, by state
= EMLCBUS * (EMPRBZZ / EMRPBUS)
- EMFDBZZ = Biomass inputs to the production of fuel ethanol, in billion Btu, by state
= EMPRBZZ + EMLCBZZ

The U.S. totals that are not from external sources are calculated as the sum of the states' values.

Data sources

ENRPUS — Fuel ethanol production, including denaturant, in thousand barrels, United States.

EMRPUS — Fuel ethanol production, excluding denaturant, in thousand barrels, United States.

EMLCBUS — Losses and co-products from the production of fuel ethanol, in billion Btu, United States.

- 1981 forward: EIA, [Monthly Energy Review](#), Table 10.3.

ENRPZZ — Fuel ethanol production, including denaturant, in thousand barrels, by state.

- 1981 forward: Based on production capacity data from Nebraska Energy Office (https://neo.ne.gov/programs/stats/inf/122_archive.htm); production data (for selected years before 2010) supplied by Iowa, Minnesota, Nebraska, South Dakota, and Wisconsin; *Petroleum Supply Annual* (1992, 1993, and 1994); and other sources.

Total biofuels

Total biofuel data series are defined as follows:

- BFPRPZZ = Biofuel production, in thousand barrels, by state
= B DPRPZZ + EM PRPZZ
- BFFDBZZ = Biomass inputs to the production of biofuels, in billion Btu, by state
= BDFDBZZ + EMFDBZZ

The U.S. totals are calculated as the sum of the states' values.

Wood and waste

In general, wood and waste energy are produced when they are consumed as energy. In 2016, EIA started to collect data on densified biomass fuel (predominantly wood pellets) production and exports. Because about two-thirds of the U.S. produced densified biomass pellets are exported and not domestically consumed, wood energy production for 2016 forward is defined to equal wood energy consumption plus densified biomass exports.

Total U.S. densified biomass exports in British thermal units (Btu) are calculated by EIA with exports and heat content data collected from EIA survey Form-63C, "Densified Biomass Fuel Report" and are available as an intermediate data series in EIA's *Monthly Energy Review*.

To allocate the U.S. densified biomass exports to the states, it is assumed that all densified biomass exports are utility wood pellets produced in the South Census Region. First, the annual operating capacity of the plants in the South Central Region that generally export densified biomass are aggregated to the state-level, using EIA's *Monthly Densified Biomass Fuel Report*, Table 1. State-level exports are calculated by applying the state's operating capacity share to the U.S. total densified biomass exports. These export estimates are added to state-level wood energy consumption to derive the total state-level wood energy production estimates.

Before 2016, wood energy production is assumed to equal consumption.

Consumption estimates of wood and waste energy, in billion Btu, are from the SEDS consumption dataset.

Variable names and definitions

The independent data series identifying codes for renewable energy data are as follows (the two-letter state code is represented by "ZZ" in the variable names):

- WDEXBZZ = Densified biomass exports, in billion Btu, by state (available for 2016 forward);
- WDTCBZZ = Wood energy total consumption, in billion Btu, by state;
- WSTCBZZ = Biomass waste energy total consumption, in billion Btu, by state.

Other data series in billion Btu are defined as follows:

- WDPRBZZ = Wood energy production, in billion Btu, by state
= WDTCBZZ before 2016
= WDTCBZZ + WDEXBZZ for 2016 forward
- WWPRBZZ = Wood and waste energy production, in billion Btu, by state
= WDPRBZZ + WSTCBZZ

The U.S. totals are calculated as the sum of the states' values.

Data sources

WDEXBUS — Densified biomass exports, in billion Btu, United States.

- 2016 forward: Estimated by EIA based on EIA’s [Monthly Densified Biomass Fuel Report](#), exports and heat content values.

WDEXBZZ — Densified biomass exports, in billion Btu, by state.

- 2016 forward: Estimated by EIA using capacity data from EIA’s [Monthly Densified Biomass Fuel Report](#), Table 1 and information on the likelihood of exports.

Btu consumption estimates from SEDS are available in comma-separated value (CSV) format: http://www.eia.gov/state/seds/sep_use/total/csv/use_all_btu.csv.

Noncombustible renewable energy sources

Noncombustible renewable energy sources covered in SEDS include:

- Geothermal energy
- Conventional hydroelectric power
- Solar thermal and photovoltaic energy
- Wind energy

Production of noncombustible renewable energy is assumed to equal consumption. The estimation methods and data sources for renewable energy consumption are described in Section 5: Renewable Energy, [SEDS Consumption Technical Notes](#).

Variable names and definitions

The independent data series identifying codes for renewable energy data are as follows (the two-letter state code is represented by “ZZ” in the variable names):

- GETCBZZ = Geothermal energy total consumption, in billion Btu, by state;
- HYTCBZZ = Conventional hydroelectric power total consumption, in billion Btu, by state;
- SOTCBZZ = Solar thermal and photovoltaic energy total consumption, in billion Btu, by state; and
- WYTCBZZ = Wind energy total consumption, in billion Btu, by state.

The noncombustible renewable energy production series is defined as follows:

- NCPRBZZ = Noncombustible renewable energy production, in billion Btu, by state
- = GETCBZZ + HYTCBZZ + SOTCBZZ + WYTCBZZ

The U.S. totals are calculated as the sum of the states’ values.

Data sources

Btu consumption estimates from SEDS are available in comma-separated value (CSV) format: http://www.eia.gov/state/seds/sep_use/total/csv/use_all_btu.csv.

Additional Note

Noncombustible renewable energy sources are mostly consumed by the electric power sector. Data for electric power generation are net generation data. Negative generation denotes that electric power consumed for plant use exceeds gross generation. A few such cases can be found in electric power generated by hydroelectric power plants.

Total renewable energy

Total renewable energy production is defined as follows:

**R
E
N
E
W
A
B
L
E

E
N
E
R
G
Y**

REPRBZZ = Renewable energy production, in billion Btu, by state
= BFFDBZZ + WWPRBZZ + NCPRBZZ

The U.S. totals are calculated as the sum of the states' values.