

# State Energy Data System 2016 Production Technical Notes



## Contents

---

Section 1. Introduction	1
Section 2. Coal	3
Section 3. Crude Oil	5
Section 4. Natural Gas (Marketed Production)	7
Section 5. Renewable Energy and Nuclear Energy	11



## 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 Survey Development and Statistical Integration from information collected by EIA (and its predecessor agencies) and other publicly available sources.

### Purpose

Energy production data in physical units are collected by various Offices in EIA that conduct energy surveys. Data are published in various EIA reports and on the EIA website. They are, however, usually presented for the latest time period or a shorter time series; data for earlier years may not be available, even electronically. Furthermore, it is not possible to compare across fuels that are reported in different units or to calculate total energy production within a state. The integrated state energy production database is developed to provide a standardized set of production data that allows 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 production<sup>1</sup>
- Renewable energy and nuclear electric power

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, so that different forms of energy can be compared.

Renewable energy includes biofuels and other renewable energy (geothermal, hydroelectric power, solar, wind, wood, and biomass waste). Biofuels generally comprise fuel ethanol and biodiesel, but the latter is yet to be covered in SEDS. State-level production of fuel ethanol in thousand barrels is estimated using data provided by some states and ethanol 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. That is, it includes the losses and co-products from the production of fuel ethanol. Production of other renewable energy is assumed to equal consumption except for wood production from 2016 forward. See Section 5 for the description of renewable energy concepts and estimation procedures.

Nuclear electric power in Btu is taken from the SEDS consumption database and input into the production database.

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

### 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

---

<sup>1</sup> 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.

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 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 very minor and are due mostly to rounding. Because SEDS computes the Btu production of coal and natural gas using state conversion factors and also excludes biodiesel in renewable energy production, the differences between the Btu production data are more noticeable.

#### *Coal*

Using the state conversion factors from EIA's Office of Oil, Gas and Coal Supply Statistics, SEDS coal production estimates in Btu are, on average, 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 presents marketed production for natural gas using state-level conversion factors, in contrast to the MER, EIA's national energy publication, which presents production data for dry natural gas and natural gas plant liquids using national-level conversion factors. The differences between the SEDS 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 production estimates are either identical or very similar for the renewable energy sources and nuclear-generated electricity. The only exception is the production of biofuels. MER covers both fuel ethanol and biodiesel in biofuels, whereas SEDS covers only fuel ethanol. Similarly, the heat content of biofuels production in MER includes biomass inputs to the production of fuel ethanol and biodiesel, while SEDS includes only biomass inputs to the production of fuel ethanol.

## Section 2. Coal

Annual coal production in short tons is collected from U.S. coal producers on Form EIA-7A 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 Electricity, Renewables and Uranium Statistics (ERUS) Coal Statistics Team. Beginning in 2001, coal production includes a small volume of refuse recovery, which is allocated to the states by ERUS.

The state-level conversion factors in Btu per pound are also developed by ERUS. Factors are based on the heat contents of coal delivered to electric power plants (reported on Form EIA-923 and predecessor forms), beginning in 1972. For states that have a significant amount of their coal consumed in coke plants or 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 conversion factors computed at the national level.

The conversion factors are converted from Btu per pound to million Btu per thousand short ton before they are imported into the database.

### 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, 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 production, CLPRPUS and CLPRBUS, are calculated as the sum of the states' values. And the average 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.

# COAL

- 1989 forward: Based on Forms FERC-423 (1989-2001), EIA-423 (2002-2007), and EIA-923 (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 Oil, Gas and Coal Supply Statistics. 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, data in thousand barrels are converted into billion Btu using a fixed conversion factor of 5.8 million Btu per barrel.

For 2015 forward, the heat content of crude oil is calculated by EIA based on conversion of American Petroleum Institute (API) gravity ranges of crude oil production.

### Federal offshore production

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

To maintain compatibility of state-level production over time, Outer Continental Shelf (OCS) total oil production for the Gulf of Mexico (GOM) Planning Areas and the Federal Pacific Offshore area before 1981 from the U.S. Department of the Interior are used to represent federal offshore production for PAD Districts 3 and 5. GOM Central Planning Area production is removed from Louisiana, GOM Western Planning Area production is removed from Texas, 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), 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 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), 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](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 Oil, Gas and Coal Supply Statistics (OGCSS).

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 (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 terms and definitions, sources, and explanatory notes can be found at [http://www.eia.gov/dnav/ng/TblDefs/ng\\_prod\\_sum\\_tbldef2.asp](http://www.eia.gov/dnav/ng/TblDefs/ng_prod_sum_tbldef2.asp).

The SEDS state energy production database 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 by weighting the heat content of each NGPL component by its 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 data for natural gas marketed production, which is the sum of NGPL production and dry natural gas.

To estimate the heat content of marketed production, state-level dry natural gas production data in cubic feet are converted to Btu using state-level heat content factors of natural gas delivered to consumers, and state-level NGPL production data in cubic feet are converted to Btu using regional weighted average heat content factors for the five major NGPL components. They are then combined to form marketed production at the state level.

### Dry production

Annual dry natural gas production data at the state level from 1982 forward 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 separately 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 with California.

### *Conversion factors*

State-level heat content factors for natural gas delivered to consumers are compiled by OGCS. They 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](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.

### *Conversion factors*

To convert NGPL production, gaseous equivalent, to Btu, a set of conversion factors is calculated in two steps.

The first step is to calculate production-weighted averages of the heat content factors of the five major products comprising NGPL. Because EIA only publishes production data in barrels for each NGPL product for the PAD districts and refining districts,<sup>2</sup> the weighted averages can only be calculated at the PAD district level. The heat content factors for the five NGPL products in million Btu per barrel are:

Ethane	3.082
Propane	3.836
Butane	4.326
Isobutane	3.974
Natural gasoline	4.620

The second step is to convert the weighted averages from million Btu per barrel to thousand Btu per cubic foot. 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 is compiled. Annual PAD district-level conversion factors in thousand Btu per cubic foot are computed by multiplying the PAD district weighted averages with the ratio. They are then applied to each state's NGPL production, gaseous equivalent, 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. They were converted to Btu using the 1970 derived state-level marketed production 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):

- NGPRPZZ = Dry natural gas production, 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, million cubic feet, by state; and
- NGELKZZ = Factor for converting NGPL production, gaseous equivalent, from million cubic feet to billion Btu, by state.

<sup>2</sup> For a description and maps of PAD districts and refining districts, see [Appendix A of Petroleum Supply Monthly](#).

Dry production and NGPL production in Btu are calculated:

$$\begin{aligned} \text{NGPRBZZ} &= \text{NGPRPZZ} * \text{NGTCKZZ} \\ \text{NGELBZZ} &= \text{NGELPZZ} * \text{NGELKZZ} \end{aligned}$$

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

$$\begin{aligned} \text{NGMPPZZ} &= \text{Marketed natural gas production, million cubic feet, by state} \\ &= \text{NGPRPZZ} + \text{NGELPZZ} \\ \text{NGMPBZZ} &= \text{Marketed natural gas production, billion Btu, by state} \\ &= \text{NGPRBZZ} + \text{NGELBZZ} \\ \text{NGMPKZZ} &= \text{Derived conversion factor for marketed production} \\ &= \text{NGMPBZZ} / \text{NGMPPZZ} \end{aligned}$$

For 1960 through 1969, the independent data series is:

$$\text{NGMPPZZ} = \text{Marketed natural gas production, million cubic feet, by state.}$$

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

$$\text{NGMPBZZ} = \text{NGMPPZZ} * \text{1970's NGMPKZZ}$$

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 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, 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](#).
- 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, million cubic feet, by state.

# N A T U R A L G A S

- 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, 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. Renewable Energy and Nuclear Energy

Renewable energy includes biofuels and “other renewable energy,” which covers wood, biomass waste, and other noncombustible renewable energy sources. The coverage and estimation of biofuel production are explained below. Other renewable energy is mainly used in heat and power generation, so, in general, production is assumed to equal consumption—that is, energy is produced when it is consumed. One exception is wood pellet production, which about two-thirds is exported to other countries and not domestically consumed. EIA began collecting information on densified biomass (predominantly wood pellets) in 2016. For 2016 forward, wood energy production is defined to be the sum of wood energy consumption and densified biomass exports.

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

### Biofuels

Biofuels generally comprise fuel ethanol and biodiesel, but only fuel ethanol is covered in SEDS. State-level fuel ethanol production and losses and co-products<sup>3</sup> from fuel ethanol production are estimated separately. The physical unit of fuel ethanol available in EIA is denatured, that is, it includes a small amount of denaturant (mostly natural gasoline) that makes it unfit for human consumption.

#### *Fuel ethanol production in physical unit*

National fuel ethanol production data from 1981 forward are published in the [Monthly Energy Review](#) and on the EIA petroleum data website. State-level production data are scarce, however. In the 2007 data cycle, time-series data for fuel ethanol production were collected for Iowa, Minnesota, Nebraska, South Dakota, and Wisconsin through 2007.<sup>4</sup> These five states accounted for about two-thirds of total U.S. fuel ethanol production. The remaining portion of fuel ethanol production is 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. It was decided that operating production capacity for all states would be used to allocate the national production data to the states from 2010 forward.

Monthly information on operating production capacity by plant, which excludes plants that are idled, is compiled by the Renewable Fuels Association from 2005 forward.<sup>5</sup> SEDS uses the version edited by the Nebraska Energy Office, which allocates multi-state production capacity reported by companies to the individual states. Average monthly operating capacity data are 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 straight-line interpolation, and capacity data before 1992 are assumed to be the same as 1992.

With a complete set of production capacity estimates for states with no production data, a set of annual state shares are calculated and applied onto the residual production data (national production less the available state production data) to compute production estimates for those states. From 2010 forward, this method is used for all states.

#### *Heat content of biomass used in fuel ethanol production*

Because fuel ethanol is produced from corn and other biomass inputs, EIA defines the heat content of biofuels 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.<sup>6</sup>

<sup>3</sup> Losses and co-products are defined as the difference between the heat content of the biomass inputs to the production of fuel ethanol and the heat content of the fuel ethanol produced.

<sup>4</sup> 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.

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

<sup>6</sup> See footnotes in Table 10.3 of [Monthly Energy Review](#).

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 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):

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

The heat content data series in billion Btu are defined as follows:

- EMPRPZZ = Fuel ethanol production, excluding denaturant, thousand barrels, by state  
= ENPRPZZ \* (EMPRPUS / ENPRPUS)
- EMPRBZZ = Fuel ethanol production, excluding denaturant, billion Btu, by state  
= EMPRPZZ \* 3.539
- EMLCBZZ = Losses and co-products from fuel ethanol production, billion Btu, by state  
= EMLCBUS \* (EMPRBZZ / EMPRBUS)
- EMFDBZZ = Biomass inputs to the production of fuel ethanol  
= EMPRBZZ + EMLCBZZ

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

### *Data sources*

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

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

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

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

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

- 1981 forward: Based on production capacity data from Nebraska Energy Office ([http://www.neo.ne.gov/statshtml/122\\_archive.htm](http://www.neo.ne.gov/statshtml/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.

## **Other renewable energy**

Other renewable energy sources covered in SEDS include:

- Geothermal energy
- Conventional hydroelectric power
- Solar thermal and photovoltaic energy
- Wind energy
- Wood energy
- Biomass waste energy



With the exception of wood, production of all other renewable energy sources 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](#).

### **Wood**

For 2016 forward, wood energy production equals wood energy consumption plus exports of densified biomass exports, which are predominantly wood pellets for utility use. 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.

### **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, billion Btu;
- HYTCBZZ = Conventional hydroelectric power total consumption, billion Btu;
- SOTCBZZ = Solar thermal and photovoltaic energy total consumption, billion Btu;
- WDEXBZZ = Densified biomass exports, billion Btu (available for 2016 forward);
- WDTCBZZ = Wood energy total consumption, billion Btu;
- WSTCBZZ = Biomass waste energy total consumption, billion Btu; and
- WYTCBZZ = Wind energy total consumption, billion Btu.

Renewable energy production series in billion Btu are defined as follows:

- WDPRBZZ = Wood energy production, billion Btu
  - = WDTCBZZ before 2016
  - = WDTCBZZ + WDEXBZZ for 2016 forward
- ROPRBZZ = Renewable energy production, other than fuel ethanol, billion Btu
  - = GETCBZZ + HYTCBZZ + SOTCBZZ + WDPRBZZ + WSTCBZZ + WYTCBZZ
- REPRBZZ = Renewable energy production, billion Btu
  - = EMFDBZZ + ROPRBZZ

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

### **Data sources**

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

- 2016 forward: Estimated by EIA based on EIA Form-63C, “Monthly Densified Biomass Fuel Report,” <http://www.eia.gov/biofuels/biomass/>, exports and heat content values.

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

- 2016 forward: EIA Form-63C, “Monthly Densified Biomass Fuel Report,” <http://www.eia.gov/biofuels/biomass/>, Table 1.

Renewable energy consumption, billion Btu, by state.

- 1960 forward: EIA State Energy Data System, Btu consumption data file, [http://www.eia.gov/state/seds/sep\\_use/total/csv/use\\_all\\_btu.csv](http://www.eia.gov/state/seds/sep_use/total/csv/use_all_btu.csv).

## Nuclear energy

State-level electricity net generation from nuclear power plants are used to represent nuclear energy production. Nuclear energy consumption in Btu is net generation multiplied by the nuclear heat rate factors. 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, 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](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 and hydroelectric power plants.