

Section 3. Natural Gas

Physical units

Eight natural gas data series are used to derive the natural gas consumption estimates in the State Energy Data System (SEDS). Several of these data series are deliveries of natural gas to the end user by state and are used as consumption because actual consumption data at these levels are not available. The sources for the natural gas data are the *Natural Gas Annual* and *Electric Power Annual* published by the U.S. Energy Information Administration (EIA) and its predecessors. Data for recent years are also available on the EIA website. These series, in million cubic feet, for each state are as follows (the two-letter state code is represented by “ZZ” in the following variable names):

- NGCCPZZ = natural gas delivered to the commercial sector. Before 1996, includes gas used in agriculture, forestry, and fisheries;
- NGEIPZZ = natural gas consumed by the electric power sector;
- NGINPZZ = a portion of the natural gas delivered to the industrial sector (includes gas used as fuel and feedstock in chemical plants and to produce carbon black). Beginning in 1996, includes gas used in agriculture, forestry, and fisheries;
- NGLEPZZ = natural gas consumed as lease fuel;
- NGPLPZZ = natural gas consumed as plant fuel;
- NGPZPZZ = natural gas for pipeline and distribution use;
- NGRCPZZ = natural gas delivered to the residential sector; and
- NGVHPZZ = natural gas consumed as vehicle fuel.

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

The data are combined into the four major end-use sectors used in SEDS as closely as possible. However, natural gas data are collected using different aggregations of users. The industrial sector in SEDS is intended to contain energy used in agriculture, forestry, and fisheries. For natural gas, these categories are reported with commercial use of natural gas through 1995 and in the industrial sector for 1996 forward. These data cannot be separately identified and no adjustment for this end-use inconsistency is made in SEDS.

The residential sector’s consumption of natural gas is represented by the

variable for deliveries to the residential sector, NGRCPZZ.

The commercial sector’s consumption of natural gas is represented by the variable for deliveries to the commercial sector, NGCCPZZ.

The industrial sector’s consumption of natural gas in SEDS, NGICPZZ, is estimated to be the sum of natural gas delivered to the industrial sector, NGINPZZ, natural gas consumed as lease fuel, NGLEPZZ, and natural gas consumed as plant fuel, NGPLPZZ. SEDS contains lease and plant fuel data combined for 1960 through 1982; the combined data series is stored as NGLEPZZ. Beginning in 2001, federal offshore natural gas lease fuel for Alabama, Louisiana, and Texas are reported combined. See “Additional Notes” on page 25 for the method of estimating the individual state values.

$$\text{NGICPZZ} = \text{NGINPZZ} + \text{NGLEPZZ} + \text{NGPLPZZ}$$

The transportation sector’s consumption of natural gas, NGACPZZ, is the sum of natural gas consumed in pipeline operations (primarily in compressors) and for distribution use, NGPZPZZ, and natural gas consumed as vehicle fuel, NGVHPZZ. Before 1990, the small amounts of natural gas consumed as vehicle fuel are included in the commercial sector consumption and cannot be identified separately; therefore, NGVHPZZ is zero before 1990.

$$\text{NGACPZZ} = \text{NGPZPZZ} + \text{NGVHPZZ}$$

Electric power sector’s consumption of natural gas is represented by the data series NGEIPZZ.

The total consumption of natural gas, estimated for each state, is the sum of the consumption by the end-use sectors and for electricity generation:

$$\text{NGTCPZZ} = \text{NGRCPZZ} + \text{NGCCPZZ} + \text{NGICPZZ} + \text{NGACPZZ} + \text{NGEIPZZ}$$

The U.S. consumption estimates for each of the sectors and the U.S. total are calculated as the sum of the states’ values.

British thermal units (Btu)

Three state-level factors are used for converting the consumption of natural gas from physical units of million cubic feet to billion Btu. These factors are:

N A T U R A L G A S

- NGTCKZZ = factor for converting total natural gas consumed by all sectors from physical units to Btu;
- NGEIKZZ = factor for converting natural gas consumed by the electric power sector from physical units to Btu; and
- NGTXKZZ = factor for converting natural gas used by end-use sectors from physical units to Btu.

Total consumption of natural gas in billion Btu is calculated as follows:

$$\text{NGTCBZZ} = \text{NGTCPZZ} * \text{NGTCKZZ}$$

Before 2010, electric power sector consumption of natural gas in billion Btu is calculated as follows:

$$\text{NGEIBZZ} = \text{NGEIPZZ} * \text{NGEIKZZ}$$

From 2010 forward, NGEIBZZ is directly extracted from the data source to minimize rounding errors.

NGTXKZZ is derived as

$$\text{NGTXKZZ} = (\text{NGTCBZZ} - \text{NGEIBZZ}) / (\text{NGTCPZZ} - \text{NGEIPZZ})$$

NGTXKZZ is then used to convert individual end-use sector consumption of natural gas from physical units to Btu, such as

$$\text{NGRCBZZ} = \text{NGRCPZZ} * \text{NGTXKZZ}$$

The U.S. consumption estimates in Btu for each of the sectors and the U.S. total are calculated as the sum of the states' Btu values.

Before 1972, conversion factors for natural gas consumed for electricity generation were not collected; therefore, the factor for all natural gas consumed (NGTCKZZ) is used for electric power (NGEIKZZ) and for the end-use sectors (NGTXKZZ) for 1963 through 1971. Before 1963, state-level conversion factors for natural gas consumption were not collected and a standard factor of 1.035 thousand Btu per cubic foot is used for all sectors in all states.

Supplemental gaseous fuels

Natural gas consumption contains a small amount of supplemental gaseous fuels (SGF). These fuels are introduced into or commingled with natural gas, and increase the volume available for disposition. Such fuels include, but are not limited to, synthetic natural gas, propane-air, coke oven gas, refinery gas, biomass gas, air injected for Btu stabilization, and manufactured gas. Because

SGF are mostly derived from fossil fuels, which are already accounted for, they are removed from total energy consumption in Btu (see Sections 6 and 7) to eliminate any double counting.

Annual data on SGF supplies in physical units are available for each state from 1980 forward in EIA's *Natural Gas Annual*. For all states except North Dakota, this data series is used to approximate SGF contained in the natural gas delivered to users. See "Additional Note 2" on page 25 for the method of assigning North Dakota SGF supplies to North Dakota and other states for consumption. Unknown quantities of SGF are included in the Btu consumption data for 1979 and earlier years.

$$\text{NGSFPZZ} = \text{supplemental gaseous fuels supplies by state in million cubic feet.}$$

It is assumed that SGF are commingled with natural gas consumed by the commercial, other industrial, residential, and electric power sectors, but are not commingled with natural gas used for lease and plant fuel, pipelines, or vehicle fuel. The estimated consumption of SGF within each sector is calculated using the sector's natural gas consumption share.

$$\text{NGTZPZZ} = \text{NGRCPZZ} + \text{NGCCPZZ} + \text{NGINPZZ} + \text{NGEIPZZ}$$

$$\text{SFCCPZZ} = \text{NGSFPZZ} * (\text{NGCCPZZ} / \text{NGTZPZZ})$$

$$\text{SFINPZZ} = \text{NGSFPZZ} * (\text{NGINPZZ} / \text{NGTZPZZ})$$

$$\text{SFRCPZZ} = \text{NGSFPZZ} * (\text{NGRCPZZ} / \text{NGTZPZZ})$$

$$\text{SFEIPZZ} = \text{NGSFPZZ} * (\text{NGEIPZZ} / \text{NGTZPZZ})$$

To convert SGF from physical units to Btu, the appropriate natural gas conversion factors are used:

$$\text{SFCCBZZ} = \text{SFCCPZZ} * \text{NGTXKZZ}$$

$$\text{SFINBZZ} = \text{SFINPZZ} * \text{NGTXKZZ}$$

$$\text{SFRCBZZ} = \text{SFRCPZZ} * \text{NGTXKZZ}$$

$$\text{SFEIBZZ} = \text{SFEIPZZ} * \text{NGEIKZZ}$$

Total SGF consumed by state in Btu is equal to the sum of the four sectors with SGF:

$$\text{SFTCBZZ} = \text{SFRCBZZ} + \text{SFCCBZZ} + \text{SFINBZZ} + \text{SFEIBZZ}$$

The U.S. consumption estimates for each of the variables and sectors and the U.S. total are calculated as the sum of the states' values.

Natural gas excluding supplemental gaseous fuels in Btu

To facilitate data users who prefer the double-counting of SGF be removed from natural gas, a set of variables is introduced for consumption of natural gas excluding supplemental gaseous fuels in Btu:

$$\begin{aligned} \text{NNACBZZ} &= \text{NGACBZZ} \\ \text{NNCCBZZ} &= \text{NGCCBZZ} - \text{SFCCBZZ} \\ \text{NNICBZZ} &= \text{NGICBZZ} - \text{SFINBZZ} \\ \text{NNRCBZZ} &= \text{NGRCBZZ} - \text{SFRCBZZ} \\ \text{NNEIBZZ} &= \text{NGEIBZZ} - \text{SFEIBZZ} \\ \text{NNTCBZZ} &= \text{NGTCBZZ} - \text{SFTCBZZ} \end{aligned}$$

The U.S. total consumption is calculated as the sum of the states' values.

Total consumption of natural gas per capita

Total consumption of natural gas per capita is calculated by dividing total consumption by resident population ("TPOPP"). Information on residential population is presented in Appendix C of the Consumption Technical Notes at <https://www.eia.gov/state/seds/seds-technical-notes-complete.php>.

Estimated total consumption of natural gas per capita for each state and the United States, in thousand cubic feet, is represented by "NGTPP" and is calculated:

$$\text{NGTPP} = \text{NGTCP} / \text{TPOPP}$$

Estimated total consumption of natural gas per capita for each state and the United States, in million Btu, is represented by "NGTPB" and is calculated:

$$\text{NGTPB} = \text{NGTCB} / \text{TPOPP}$$

Additional calculations

Although SEDS does not use U.S.-level conversion factors for calculating natural gas consumption, these factors are calculated by SEDS for reference and are shown in the natural gas tables in Appendix B, <http://www.eia.gov/state/seds/seds-technical-notes-complete.php>:

$$\begin{aligned} \text{NGEIKUS} &= \text{NGEIBUS} / \text{NGEIPUS} \\ \text{NGTCKUS} &= \text{NGTCBUS} / \text{NGTCPUS} \\ \text{NGTXKUS} &= (\text{NGTCBUS} - \text{NGEIBUS}) / (\text{NGTCPUS} - \text{NGEIPUS}) \end{aligned}$$

To produce price and expenditure data, SEDS differentiates between natural gas used in the transportation sector as pipeline fuel, which is not sold and has no price, and natural gas purchased and consumed as vehicle fuel. SEDS also differentiates between natural gas used as lease and plant fuel by the natural

gas industry, which is not costed, and natural gas purchased by industrial consumers. Btu values for the price and expenditure tables are calculated in SEDS as follows:

$$\begin{aligned} \text{NGPZBZZ} &= \text{NGPZPZZ} * \text{NGTXKZZ} \\ \text{NGVHBZZ} &= \text{NGVHPZZ} * \text{NGTXKZZ} \\ \text{NGLPPZZ} &= \text{NGLEPZZ} + \text{NGPLPZZ} \\ \text{NGLPBZZ} &= \text{NGLPPZZ} * \text{NGTXKZZ} \end{aligned}$$

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

Additional notes

1. Beginning with 2001 data, federal offshore natural gas lease fuel consumption for Alabama, Louisiana, and Texas is reported combined under "Gulf of Mexico" in the source publication. To estimate each state's portion, data from the U.S. Department of Interior, Bureau of Ocean Energy Management (BOEM, formerly Minerals Management Service) on natural gas production for the Eastern Gulf, Central Gulf, and Western Gulf areas are totaled. Alabama's share of the Gulf of Mexico lease fuel consumption is calculated in proportion to the Eastern Gulf's share of the production total; Louisiana's share is the same proportion as the Central Gulf share, and the Texas share is in proportion to the Western Gulf share. Between 2015 and 2016, BOEM revised the historical data for production by planning area. There is no longer any production for the Eastern Gulf area and Western Gulf production is revised downward. The revised data from 2001 forward are incorporated into SEDS.
2. In general, SGF supplies are small relative to total natural gas consumption, and are assumed to be a good measure of SGF consumption. The only exception is North Dakota. Since 1985, North Dakota's volume of SGF supplies is significant and sometimes exceeds its total natural gas consumption. SEDS assumes that 10% of SGF produced in North Dakota is consumed in the state and the rest is distributed to Iowa, Illinois, and Indiana through the Northern Border Pipeline, according to the capacity of the pipeline going into each state. The percentage allocations of the supplemental gaseous fuels supplies in North Dakota are as follows:
 - From 1985 through 1998: North Dakota (10%), Iowa (90%).
 - From 1999 forward: North Dakota (10%), Iowa (62%), Illinois (22%), Indiana (6%).
3. Beginning in 2009, pipeline and distribution use volumes include line loss, defined as known volumes of natural gas that were the result of

leaks, damage, accidents, migration, and/or blow down.

Data sources

NGCCPZZ — Natural gas delivered to the commercial sector including natural gas consumed as vehicle fuel through 1989 and natural gas used in agriculture, forestry, and fisheries through 1995, by state.

- 1960 through 1966: U.S. Department of the Interior, Bureau of Mines, *Mineral Industry Surveys*, “Natural Gas Production and Consumption,” table titled “Number of consumers and volume of natural gas consumed by principal users in the United States,” column “Commercial.”
- 1967 through 1988: EIA, *Historical Natural Gas Annual 1930 Through 2000*, Table 16, <https://www.eia.gov/naturalgas/annual/archive>.
- 1989 forward: EIA, *Natural Gas Annual*, State Summaries tables, also available at http://www.eia.gov/dnav/ng/ng_cons_sum_a_EPGO_vcs_mmcf_a.htm.

NGEIBZZ — Natural gas consumed by the electric power sector, in billion Btu, by state.

- 1960 through 2009: computed in SEDS.
- 2010 forward: EIA, Form EIA-923, “Power Plant Operations Report,” <https://www.eia.gov/electricity/data/eia923/>.

NGEIKZZ — Factor for converting natural gas consumed by the electric power sector from physical units to Btu by state.

- 1960 through 1971: Assumed by EIA to be equal to the thermal conversion factor for the consumption of natural gas by all users (NGTCKZZ).
- 1972 through 1982: Calculated annually by EIA by dividing the total heat content of natural gas received at steam electric plants 25 megawatts or greater by the total quantity received at those electric plants. The heat contents and quantities received are from the FERC Form 423, “Monthly Report of Cost and Quality of Fuels for Electric Plants.”
- 1983 through 1988: The average heat content of natural gas received at steam electric plants 50 megawatts capacity or larger from FERC Form 423 and published from 1993 forward in Btu per cubic foot in the EIA, *Cost and Quality of Fuels for Electric Utility Plants*, Table 14. Note: For states that reported consumption on EIA-759 but were not large

enough to report on FERC Form 423, factors were estimated by using previous years’ factors or the factor for total natural gas consumption in the state.

- 1989 forward: Calculated by dividing the total heat content of natural gas received at electric power plants (including electric utilities and independent power producers) by the total quantity consumed in physical units collected by EIA on Form EIA-923, “Power Plant Operations Report,” and predecessor forms, <https://www.eia.gov/electricity/data/eia923/>.

NGEIPZZ — Natural gas consumed by the electric power sector by state.

- 1960 through 1975: Federal Power Commission, News Release, “Power Production, Fuel Consumption, and Installed Capacity Data,” table titled “Consumption of Fuel by Electric Utilities for Production of Electric Energy by state, Kind of Fuel, and Type of Prime Mover,” sum of columns, “steam and gas turbine” and “internal combustion” under column heading “gas.”
- 1976 through 1981: EIA, *Electric Power Annual* (1981), Table 67.
- 1982 through 1986: Unrounded data as published in rounded form in EIA, *Electric Power Annual*, 1986, Table 14.
- 1987: Unrounded data as published in rounded form in EIA, *Electric Power Annual* 1988, Table 13.
- 1988: Unrounded data as published in rounded form in EIA, *Electric Power Annual* 1989, Table 19.
- 1989 forward: EIA, Form EIA-923, “Power Plant Operations Report,” and predecessor forms, <https://www.eia.gov/electricity/data/eia923/>.

NGINPZZ — A portion of the natural gas delivered to the industrial sector, including natural gas used in agriculture, forestry, and fisheries beginning in 1996, by state.

- 1960 through 1966: U.S. Department of the Interior, Bureau of Mines, *Mineral Industry Surveys*, “Natural Gas Production and Consumption,” table titled “Number of consumers and volume of natural gas consumed by principal users in the United States.” Sum of data in columns “Carbon black,” “Refinery fuel,” and “Other industrial fuel” (which includes electric utility fuel) minus data in column “Fuel used at electric utility plants.”
- 1967 through 1992: EIA, *Historical Natural Gas Annual 1930 Through*

2000, Table 16, <https://www.eia.gov/naturalgas/annual/archive>.

- 1993 through 1996: Unpublished data comparable to data contained in the *Natural Gas Annual*, State Summaries tables.
- 1997 forward: EIA, *Natural Gas Annual*, State Summaries tables, also available at http://www.eia.gov/dnav/ng/ng_cons_sum_a_EPGO_vin_mmcf_a.htm.

NGLEPZZ — Natural gas consumed as lease fuel by state (includes natural gas consumed as plant fuel in 1960 through 1990).

- 1960 through 1966: U.S. Department of the Interior, Bureau of Mines, *Minerals Yearbook*, Natural Gas chapter. State data are not available from 1960 through 1966, although U.S. totals are available. State estimates were calculated by apportioning the U.S. totals to the states on the basis of each state's share of the U.S. total in 1967.
- 1967 through 1982: EIA, *Natural Gas Annual 1994 Volume II*, Table 14.
- 1983 forward: EIA, *Natural Gas Annual*, State Summaries tables, also available at http://www.eia.gov/dnav/ng/ng_cons_sum_a_EPGO_vcl_mmcf_a.htm.

NGPLPZZ — Natural gas consumed as plant fuel by state.

- 1960 through 1982: Included with natural gas consumed as lease fuel (see NGLEPZZ).
- 1983 forward: EIA, *Natural Gas Annual*, State Summaries tables, also available at http://www.eia.gov/dnav/ng/ng_cons_sum_a_EPGO_VCF_mmcf_a.htm.

NGPZPZZ — Natural gas consumed for pipeline and distribution use by state.

- 1960 through 1966: U.S. Department of the Interior, Bureau of Mines, *Mineral Industry Surveys*, "Natural Gas Production and Consumption," table titled "Number of consumers and volume of natural gas consumed by principal users in the United States," column "Used as pipeline fuel."
- 1967 through 1992: EIA, *Natural Gas Annual 1994 Volume II*, Table 14.
- 1993 through 1996: EIA, *Historical Natural Gas Annual 1930 Through 2000*, Table 15. This report is available only via the Internet at <https://www.eia.gov/naturalgas/annual/archive>.
- 1997 forward: EIA, *Natural Gas Annual*, State Summaries tables, also available at http://www.eia.gov/dnav/ng/ng_cons_sum_a_EPGO_vgp_mmcf_a.htm.

NGRCPZZ — Natural gas delivered to the residential sector, used as consumption, by state.

- 1960 through 1966: U.S. Department of the Interior, Bureau of Mines, *Mineral Industry Surveys*, "Natural Gas Production and Consumption," table titled "Number of consumers and volume of natural gas consumed by principal users in the United States," column "Residential."
- 1967 through 1988: EIA, *Historical Natural Gas Annual 1930 Through 2000*, Table 16, <https://www.eia.gov/naturalgas/annual/archive>.
- 1989 forward: EIA, *Natural Gas Annual*, State Summaries tables, also available at http://www.eia.gov/dnav/ng/ng_cons_sum_a_EPGO_vrs_mmcf_a.htm.

NGSFPZZ — Supplemental gaseous fuels supplies by state.

- 1980 forward: EIA, *Natural Gas Annual*, Table 8, also available at http://www.eia.gov/dnav/ng/ng_prod_ss_a_EPGO_ovi_mmcf_a.htm.

NGTCKZZ — Factor for converting natural gas consumed by all users from physical units to Btu by state.

- 1960 through 1962: EIA adopted the thermal conversion factor of 1,035 Btu per cubic foot as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*.
- 1963 through 1979: EIA adopted the thermal conversion factors calculated annually by the American Gas Association (AGA) and published in *Gas Facts*, an AGA annual.
- 1980 through 1996: EIA, *Historical Natural Gas Annual 1930 Through 2000*, Table 16, <https://www.eia.gov/naturalgas/annual/archive>.
- 1997 forward: EIA, *Natural Gas Annual*, Table 16, and unpublished revisions. Data from 2007 forward are also available at http://www.eia.gov/dnav/ng/ng_cons_heat_a_EPGO_VGTH_btucf_a.htm

NGVHPZZ — Natural gas delivered for use as vehicle fuel by state.

- 1960 through 1989: Included in natural gas consumed by the commercial sector (See NGCCPZZ).
- 1990 through 1991: EIA, *Historical Natural Gas Annual 1930 Through 2000*, Table 16, <https://www.eia.gov/naturalgas/annual/archive>.
- 1992 through 2000: EIA, unpublished data from the Office of Coal,

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Nuclear, Electric, and Alternate Fuels (U.S. totals for 1992 forward and state values for 1997 forward) and from the Office of Energy Markets and End Use (state values for 1992 through 1996).

- 2001 forward: EIA, *Natural Gas Annual*, State Summaries tables, also available at http://www.eia.gov/dnav/ng/ng_cons_sum_a_EPGO_vdv_mmcf_a.htm.