State Energy Data System 2023
CO2 Emissions Technical Notes

Contents

Introduction to the technical notes

Purpose

The U.S. Energy Information Administration (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, expenditures, carbon dioxide (CO2) emissions, and indicators. SEDS provides annual time series of CO2 emissions from energy consumption by state and sector to help users analyze state energy and its interaction with the economy and the environment.

The terms *CO2 emissions from energy consumption* and *energy-related CO2 emissions* are interchangeable and refer to emissions from primary energy consumption released at the location where fossil fuels are combusted (burned). In SEDS, we attribute CO2 emissions for electricity generation to the state where the fossil fuels are burned as primary energy, even if the electricity is later consumed in a different state. Therefore, SEDS does not estimate CO2 emissions for electricity sales, only primary energy used to generate electricity in the electric power, commercial, and industrial sectors. Similarly, for non-combustion (nonfuel) uses of fossil fuels, such as petroleum used to make plastics, we attribute that nonfuel energy consumption to the states where the petrochemicals are consumed as primary energy at production plants, even if the final products are later used in different states.

The SEDS energy-related CO2 emissions data are for fossil fuels only, and exclude any emissions from nuclear and renewable energy, including CO2 emissions from biomass such as biofuels, wood, and biomass waste. The underlying assumption is that biomass CO2 emissions are carbon neutral, meaning they are fully offset by land sinks in a sustainable biomass cycle and the natural processes by which trees, crops, and other biomass remove CO2 from the atmosphere to grow. EIA does not separately estimate other biofuels consumption by individual fuel (renewable jet fuel, renewable propane, renewable naphtha, etc.), so other biofuels product supplied is removed from EIA CO2 emissions data but not other unknown blended consumption. CO2 emissions data may underestimate actual CO2 emissions to the extent that actual biomass energy consumption may not be carbon neutral.

SEDS also does not estimate other emissions types, such as sulfur oxides (SOx), nitrogen oxides (NOx), or any other CO2 equivalent (CO2-eq) emissions from energy production or consumption. See EIA's published survey EIA-860 and EIA-923 data for sulfur dioxide and nitrogen dioxide emissions related to electricity and heat generation in the electric power, industrial and commercial sectors for 1990 forward https://www.eia.gov/electricity/data/state/.

Because of differences in how EIA collects and calculates national- and state-level energy consumption and CO2 emissions data, the sum of state CO2 emissions by fuel and sector may not equal the national total in the *Monthly Energy Review* (MER).

The report

The SEDS CO2 emissions tables, available on the EIA website at https://www.eia.gov/state/seds/seds-data-complete.php, provide annual time series estimates of state-level energy CO2 emissions by broad primary energy-consuming sectors. Companion tables containing state-level energy production, consumption, price, expenditure, and indicator estimates can be found at the same website. In addition, SEDS publishes the most recent year of data tables for state-level energy consumption, price, expenditure, and indicator estimates by source as they are updated at https://www.eia.gov/state/seds/seds-data-fuel.php.

SEDS provides the following technical notes to assist users in understanding and interpreting the energy-related CO2 emissions estimates. Each section describes how SEDS estimates each individual energy source and lists the sources of all data series.

Technical notes for state-level production, consumption, prices, expenditures, and energy indicators are available at https://www.eia.gov/state/seds/seds-technical-notes-complete.php.

Due to page-size constraints, most of the PDF time-series tables show estimates for only selected years. However, SEDS maintains energy-related CO2 emissions estimates for all years for 1960 forward and includes them in the HTML and PDF tables, as well as in CSV, XLSX, and ZIP data files available on EIA's website. The documentation in this report covers all years. In the published SEDS tables, all estimates with revisions since the last SEDS report that are large enough to be seen are

preceded with an "R."

Estimates

Energy consumption estimates. The energy-related CO2 estimates are based on the SEDS state-level primary energy consumption estimates. EIA develops estimates of energy consumption by energy sources, primary energy-consuming sectors, and by state for 1960 forward in SEDS. We estimate energy consumption using data from surveys of energy suppliers that report consumption, sales, or distribution of energy at the state level. Most SEDS estimates rely directly on collected state-level consumption data. When EIA state-level survey statistics are not available, then we use a variety of surrogate measures to estimate energy consumption. SEDS selects the surrogate measures based on the applicability as an indicator of consumption, availability, continuity over time, and consistency. For example, EIA uses "product supplied" as an approximation for petroleum consumption. EIA calculates "product supplied" as the sum of field and refinery production, plus net imports, plus net stock change. SEDS uses state-level sales survey data, regression models, and other proxies of consumption to allocate the national petroleum product supplied totals to the states. The measures of consumption and estimation methodologies are explained in detail under each energy source in the SEDS consumption technical notes https://www.eia.gov/state/seds/seds-technical-notes-complete.php.

Non-combustion (nonfuel) use of fossil fuels. EIA develops estimates of fossil fuels consumed but not combusted (burned), called non-combustion use of fossil fuels or nonfuel use. EIA assumes all nonfuel use occurs in the industrial sector, except for petroleum lubricants consumption in the transportation sector. EIA estimates nonfuel consumption shares at the national level for the *Monthly Energy Review* (MER) based on survey data and other assumptions as described in the MER Energy overview section endnotes. We assume the same national nonfuel shares at the state level for SEDS. See the MER Energy overview section for more information https://www.eia.gov/totalenergy/data/monthly/.

Carbon sequestration from nonfuel use. Some non-combustion (nonfuel) use of fossil fuels results in less CO2 released into the atmosphere than if the fuel were combusted (burned) during consumption. Some nonfuel uses still release CO2 emissions. EIA develops carbon sequestration factors, or the share of carbon that remains in the fossil fuel product or carbon sink during nonfuel use, at the national level for the *Monthly Energy Review* (MER) based on survey data and other assumptions as described in the MER Environment section endnotes. We assume the same national carbon sequestration factors at the state level for SEDS. See the MER Environment section for more information https://www.eia.gov/totalenergy/data/monthly/.

CO2 conversion factor estimates. EIA develops estimates of fossil fuel CO2 conversion factors that convert energy consumption and nonfuel consumption from British thermal units (Btu) to metric tons of CO2 emissions. EIA uses national CO2 conversion factors provided by the U.S. Environmental Protection Agency (EPA). We assume the same national CO2 conversion factors at the state level for SEDS. See EIA's CO2 emissions coefficients by fuel for more information https://www.eia.gov/environment/emissions/co2_vol_mass.php.

Data sources. The original source documents cited in the technical notes include descriptions of the data collection methods, imputation or adjustment techniques, and errors associated with the processes. Due to the many different collection forms and procedures associated with the source data and estimation methods, it is not possible to develop a meaningful numerical estimate of the errors of the integrated data published in SEDS.

It is difficult to develop reliable, consistent series for long periods of time—especially in the earlier years—and SEDS must make assumptions to fill data gaps and to maintain definitional consistency. Although SEDS incorporates the most consistent series and procedures possible, users of this report should recognize the limitations of the data that are due to changing and inadequate data sources.

For example, in reports prepared by the Bureau of Mines in the late 1960s and early 1970s, petroleum consumption was equated to demand. Later, consumption was equated to apparent demand and, more recently, to product supplied. Changes in surveys and reduction of data collections, especially after 1978, disturbed the continuity of some petroleum consumption series, most notably for distillate fuel oil, residual fuel oil, and kerosene. The SEDS consumption technical notes explain these and other data inconsistencies in detail for each energy source https://www.eia.gov/state/seds/seds-technical-notes-complete.php.

Energy-consuming sectors

SEDS bases its energy consumption and energy-related CO2 emissions estimates on data collected by various surveys that define the consuming sectors differently. The technical notes of this report describe how SEDS combines the collected data series for each energy source and assigns

them to the consuming sectors. To the degree possible, SEDS assigns energy consumption to the five sectors according to the following general definitions:

- **Residential sector:** An energy-consuming sector that consists of living quarters for private households. Common uses of energy associated with this sector include: space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a variety of other appliances. The residential sector excludes institutional living quarters.
- **Commercial sector:** An energy-consuming sector that consists of service-providing facilities and equipment of: businesses; federal, state, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters and sewage treatment facilities. Common uses of energy associated with this sector include: space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support commercial activities.
- **Industrial sector:** An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods. The industrial sector encompasses the following types of activity: manufacturing (NAICS codes 3133); agriculture, forestry, fishing, and hunting (NAICS code 11); mining, including oil and gas extraction (NAICS code 21); and construction (NAICS code 23). Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting. Fossil fuels are also used as raw material inputs to manufactured products. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support industrial activities.
- **Transportation sector:** An energy-consuming sector that consists of all vehicles whose primary purpose is transporting people and/or goods from one physical location to another. Included are automobiles; trucks; buses; motorcycles; trains, subways, and other rail vehicles; aircraft; and ships, barges, and other waterborne vehicles. Vehicles whose primary purpose is not transportation (such as, construction cranes and bulldozers, farming vehicles, and warehouse tractors and forklifts) are classified in the sector of their primary use. In this report, natural gas used in the operation of natural gas pipelines is included in the transportation sector.
- **Electric power sector:** An energy-consuming sector that consists of electricity-only and combined-heat-and-power plants within the NAICS (North American Industry Classification System) 22 category whose primary business is to sell electricity, or electricity and heat, to the public. Note: This sector includes electric utilities and independent power producers.

Although SEDS makes the sector allocations according to these aggregations as closely as possible, some data sources collect information using different classifications. For example, electric utilities may classify commercial and industrial users by the quantity of electricity purchased rather than by the business activity of the purchaser. Before 1996, EIA collected and reported natural gas used in agriculture, forestry, and fisheries in the commercial sector. For 1996 forward, EIA collects and reports natural gas used for agriculture, forestry, and fisheries in the industrial sector instead. Another example is master-metered condominiums and apartments and buildings with a combination of residential and commercial units. In many cases, the metering and billing practices cause residential energy use of electricity, natural gas, or fuel oil to be included in the commercial sector. SEDS makes no adjustments for these discrepancies.

SEDS does not provide further disaggregated sector estimates. For example, the industrial sector cannot be broken down into the chemical or rubber industries, all manufacturing, or agriculture. Additional disaggregated regional information, such as counties or cities, are also not available in SEDS.

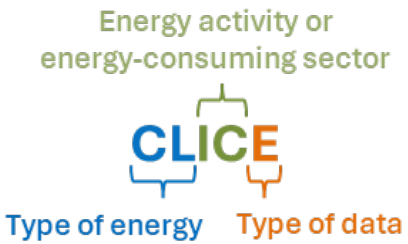
Section 1. Documentation guide

This section describes the common data identification codes used in the State Energy Data System (SEDS). Sections 2 through 5, one for each fossil fuel energy source and total energy, provide: descriptions of all SEDS data series, including all of the intermediate variable codes; and the SEDS formulas used to estimate additional data series.

The energy indicators technical notes provide the resident population data used in per capita calculations and gross domestic product (GDP) data used to calculate total energy CO2 emissions per dollar of GDP. Appendix A is an alphabetical listing of all the variable names and formulas used in CO2 emissions estimation.

There are thousands of variables in SEDS, each identified by a unique five-character mnemonic series name, or MSN. All published MSNs are listed in the Codes and Descriptions file on the SEDS website here: https://www.eia.gov/state/seds/CDF/Codes_and_Descriptions.xlsx.

In the following example, CLICE is the identifying code for data on coal CO2 emissions for the industrial sector in million metric tons:



The first two characters in the SEDS CO2 emissions variable names usually represent energy sources and products:

AB	=	aviation gasoline blending components
AR	=	asphalt and road oil
AV	=	aviation gasoline
BQ	=	normal butane
BY	=	butylene
CC	=	coal coke net imports (U.S. only)
CL	=	coal
CO	=	crude oil, including lease condensate
DM	=	distillate fuel oil, excluding biofuels
EQ	=	ethane
EY	=	ethylene
FF	=	fossil fuels
FN	=	petrochemical feedstocks, naphtha less than 401˚F
FO	=	petrochemical feedstocks, other oils equal to or greater than 401˚F
FS	=	petrochemical feedstocks, still gas
HL	=	hydrocarbon gas liquids
IQ	=	isobutane
IY	=	isobutylene
JF	=	jet fuel
KS	=	kerosene
LG	=	liquefied petroleum gases (LPG)
LU	=	lubricants
MB	=	motor gasoline blending components
MM	=	motor gasoline, excluding fuel ethanol
MS	=	miscellaneous petroleum products
NA	=	natural gasoline/isopentane (historical)
NN	=	natural gas, excluding supplemental gaseous fuels
OM	=	other petroleum products, excluding biofuels
PC	=	petroleum coke
PL	=	plant condensate (historical)
PM	=	all petroleum products, excluding biofuels
PP	=	natural gasoline
PQ	=	propane
PY	=	propylene
RF	=	residual fuel oil
SG	=	still gas
SN	=	special naphthas
TE	=	total energy
UO	=	unfinished oils
US	=	unfractionated streams (historical)
WX	=	waxes

The third and fourth characters in the SEDS variable names have several meanings and some are specific to only certain energy sources, but usually represent the energy-consuming sectors:

AC	=	transportation sector
CC	=	commercial sector

EI	=	electric power sector
IC	=	industrial sector
RC	=	residential sector
TC	=	total (all sectors)

Other third and fourth characters in the SEDS variable names represent fuel-specific activities:

KC	=	coke plants (coking coal) within the industrial sector
NF	=	non-combustion (nonfuel) use of fossil fuels
NI	=	net imports (U.S. industrial sector coal coke only)
OC	=	other than coal coke plants within the industrial sector
SQ	=	nonfuel carbon sequestration factor

The fifth character in the SEDS variable names identifies the units or type of data:

B	=	energy consumption in British thermal units (Btu)
E	=	CO2 emissions in metric tons
F	=	CO2 emissions factor in million metric tons CO2 per quadrillion Btu
S	=	share (number between 0 and 1)

There are a few special variables that do not follow the conventions above, such as:

CDEGR	=	carbon intensity of the economy (CO2 emissions divided by real GDP);
CDTCR	=	carbon intensity of energy supply (CO2 emissions divided by total energy consumption less interstate flow of electricity);
CDTPR	=	per capita energy-related CO2 emissions;
ELISB	=	net interstate flow of electricity and associated losses (negative indicates flow out of state);
GDPRX	=	real gross domestic product (GDP); and
TPOPP	=	resident population including Armed Forces.

Throughout the technical notes, SEDS often describes the variables with a two-character geographic identification attached to them (ZZ). Geographic areas used in SEDS are the 50 states and the District of Columbia (represented by the U.S. Postal Service state abbreviations) and the United States as a whole. In SEDS, the term “state” includes the District of Columbia. SEDS calculates some estimates of electricity sales and losses using only the contiguous 48 states and the District of Columbia, and the variables used in those calculations are identified by “48.”

Section 2. Coal

The State Energy Data System (SEDS) estimates energy-related carbon dioxide (CO2) emissions from coal using state-level primary energy consumption estimates from SEDS, as well as national-level non-combustion (nonfuel) consumption shares, carbon sequestration factors, and CO2 conversion factors from the U.S. Energy Information Administration's (EIA) *Monthly Energy Review* (MER).

The term energy-related CO2 emissions refers to emissions from primary energy consumption, released at the location where fossil fuels are combusted (burned). In SEDS, we attribute CO2 emissions for electricity generation to the state where the coal is combusted, even if the electricity is later consumed in a different state. Similarly, for industrial nonfuel consumption of coal, we attribute the carbon stored in products, such as cinderblocks, to the states where the products are consumed as primary energy at production plants, regardless of where the final products are used.

Energy consumption

The State Energy Data System (SEDS) estimates the amount of coal consumed, in thousand short tons, by the electric power sector and the end-use sectors. Most coal in the United States is consumed by the electric power sector to generate electricity and heat. Other uses of coal include: industrial sector electricity, coal coke manufacturing, other manufacturing, and non-combustion (nonfuel) uses; commercial sector heat and power; historical residential sector space heating (through 2008); and historical transportation sector steam engine trains (through 1977).

The U.S. Energy Information Administration (EIA) collects coal electricity data on survey Form EIA-923, "Power Plant Operations Report," and predecessor forms. SEDS uses these data directly as estimates for electric power sector coal consumption and any industrial and commercial generators greater than 1 megawatt capacity. For the industrial, commercial, residential, and transportation sectors, SEDS uses data from EIA's *Annual Coal Report* (and earlier publications), EIA-3, and EIA-6 to estimate state-level data. We convert physical unit data in thousand short tons into British thermal units (Btu) using state-level conversion factors by sector.

We use these state-level coal variables from the SEDS consumption database, in billion Btu:

CLACB	=	coal consumed by the transportation sector (through 1977);
CLCCB	=	coal consumed by the commercial sector;
CLEIB	=	coal consumed by the electric power sector;
CLKCB	=	coal consumed at coke plants (coking coal) in the industrial sector;
CLOCB	=	coal consumed by industrial users other than coke plants; and
CLRCB	=	coal consumed by the residential sector (through 2008).

See the SEDS consumption technical notes for all consumption variables, heat conversion factors, estimation methods, and data sources https://www.eia.gov/state/seds/seds-technical-notes-complete.php?sid=US.

Non-combustion (nonfuel) consumption

Most fossil fuels consumed in the United States are combusted (burned) to produce heat and power. However, some are used directly for non-combustion (nonfuel) uses such as construction materials, chemical feedstocks, lubricants, solvents, and waxes. The U.S. Energy Information Administration (EIA) assumes all non-combustion use of coal comes from the process of manufacturing coal coke (coking coal) in the industrial sector. Among the byproducts of the process are "coal tars" or "coal liquids," which typically are rich in aromatic hydrocarbons, such as benzene, and are used as chemical feedstock.

EIA's *Monthly Energy Review* (MER) estimates annual U.S.-level non-combustion use shares of coal tar for 1973 forward. A share of 0 means all fuel consumption was burned when used; a share of 1 means that all consumption was for non-combustion (nonfuel) purposes and not burned. Prior to 1998, the MER estimates nonfuel shares based on coal tar production data from the United States International Trade Commission's *Synthetic Organic Chemicals*. For 1998 forward, the MER estimates coal tar production using chemicals industry coal, coke, and breeze nonfuel use data from EIA, Form EIA-846, *Manufacturing Energy*

Consumption Survey (MECS). SEDS assumes years prior to 1973 to be equal to the 1973 share. SEDS assumes that the state-level nonfuel shares are equal to the national share from the MER each year. The U.S.-level coal non-combustion use share (number between 0 and 1) variable used in SEDS is:

CLNFSUS = coal non-combustion use share.

See the *Monthly Energy Review* (MER) Energy overview and Environment sections for more information on the data sources and methods https://www.eia.gov/totalenergy/data/monthly/.

Carbon sequestration from non-combustion use

In the non-combustion (nonfuel) use of fossil fuels, some of the carbon is stored (sequestered) in the final product and not emitted. We account for carbon sequestered by sector from nonfuel use by removing it from the final sector CO2 emissions, using an annual factor.

EIA's *Monthly Energy Review* (MER) estimates national-level carbon sequestration factors for nonfuel use. SEDS assumes the state-level sequestration factors are equal to the MER's national-level factor for all years. Sequestration factors range from 0 to 1. A factor of 0 indicates that the fuel does not sequester any carbon (all is emitted), while a factor of 1 indicates that the fuel sequesters all the carbon (none is emitted). EIA's carbon sequestration factor for coal at coking plants is 0.75 for all years. The U.S.-level coal sequestration factor (number between 0 and 1) variable used in SEDS is:

CLSQSUS = coal consumed at coke plants (coking coal) nonfuel carbon sequestration factor.

See the MER Environment section for more information https://www.eia.gov/totalenergy/data/monthly/.

Carbon dioxide (CO2) emissions

SEDS calculates coal carbon dioxide (CO2) emissions estimates in million metric tons (MMmt) as the product of the SEDS consumption values, the carbon sequestered by non-combustion use for the industrial sector, and the annual coal CO2 emissions factors by sector at https://www.eia.gov/environment/emissions/xls/CO2_coeffs_detailed.xls.

Except for plant condensate and unfractionated stream (which are EIA estimates), the CO2 emissions factors for fossil fuels are from the U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, Tables A-19, A-31, and A-215. EIA converts metric tons of carbon to metric tons of CO2 using the approximate molar mass (44/12)—see https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

There are four coal CO2 conversion factors, in million metric tons CO2 per quadrillion Btu:

CLEIFUS = coal CO2 emissions factor for the electric power sector;
CLHCFUS = coal CO2 emissions factor for the residential and commercial sectors;
CLKCFUS = coal coking plants CO2 emissions factor for the industrial sector; and
CLOCFUS = coal other than coke plants CO2 emissions factor for the industrial and transportation sectors.

For the residential, commercial, transportation, and electric power sectors, SEDS calculates state- and national-level CO2 emissions in million metric tons of CO2 (MMmt CO2) as the product of each sector's coal consumption and appropriate CO2 conversion factor, with unit conversions:

CLRCE = CLRCB * CLHCFUS / 1,000,000
CLCCE = CLCCB * CLHCFUS / 1,000,000
CLACE = CLACB * CLOCFUS / 1,000,000
CLEIE = CLEIB * CLEIFUS / 1,000,000

For the industrial sector, SEDS separately calculates state-level CO2 emissions from both coking coal (CLKCE) and coal other than coke plants (CLOCE) within the industrial sector in million metric tons of CO2 (MMmt CO2). For industrial coking coal, SEDS removes the CO2 emissions sequestered from nonfuel use (CLNFE). For industrial coal other than coke plants, we assume there is no CO2 emissions sequestered from nonfuel use. The equations are:

CLKCE = (CLKCB * CLKCFUS * (1 - CLNFSUS * CLSQSUS)) / 1,000,000
CLOCE = CLOCB * CLOCFUS / 1,000,000

State-level industrial sector total coal CO2 emissions (CLICEZZ) are the sum of CO2 emissions from coking coal and coal other than coke plants

by state, “ZZ” in the variable name is used to represent the two-letter state code:

CLICEZZ = CLKCEZZ + CLOCEZZ

State-level total coal CO2 emissions in all sectors (CLTCE) is the sum of the sectors:

CLTCEZZ = CLRCEZZ + CLCCEZZ + CLICEZZ + CLACEZZ + CLEIEZZ

Coal coke net imports

At the U.S.-level only, SEDS estimates CO2 emissions of coal coke net imports and assigns them to the industrial sector to align with national-level CO2 emissions published in EIA’s *Monthly Energy Review*. SEDS calculates coal coke net imports CO2 emissions for the United States in million metric tons of CO2 (CCNIEUS) as the product of coal coke net imports consumption in billion Btu (CCNIBUS) and the coal coke net imports CO2 emissions conversion factor in million metric tons of CO2 per quadrillion Btu (CCTCFUS), with unit conversion:

CCNIEUS = CCNIBUS * CCTCFUS / 1,000,000
CLICEUS = CLKCEUS + CLOCEUS + CCNIEUS

SEDS calculates U.S.-level total coal CO2 emissions, including coal coke net imports at the U.S.-level for the industrial sector, in million metric tons of CO2 as:

CLTCEUS = CLRCEUS + CLCCEUS + CLICEUS + CLACEUS + CLEIEUS

Data sources

State-level energy consumption estimates from EIA’s State Energy Data System (SEDS) https://www.eia.gov/state/seds/.

U.S.-level: non-combustion use shares, carbon sequestration factors, and CO2 emissions conversion factors from EIA’s *Monthly Energy Review* (MER) https://www.eia.gov/totalenergy/data/monthly/.

Section 3. Natural gas

The State Energy Data System (SEDS) estimates energy-related carbon dioxide (CO2) emissions from natural gas, excluding supplemental gaseous fuels, using state-level primary energy consumption estimates from SEDS, as well as national-level non-combustion (nonfuel) consumption shares, carbon sequestration factors, and CO2 conversion factors from the U.S. Energy Information Administration's (EIA) *Monthly Energy Review* (MER).

The term energy-related CO2 emissions refers to emissions from primary energy consumption, released at the location where fossil fuels are combusted (burned). In SEDS, we attribute CO2 emissions for electricity generation to the state where the natural gas is combusted, even if the electricity is later consumed in a different state. Similarly, for industrial nonfuel consumption of natural gas, we attribute the carbon stored in products, such as fertilizers, to the states where the products are consumed as primary energy at production plants, regardless of where the final products are used.

Energy consumption

The State Energy Data System (SEDS) estimates the amount of natural gas consumed, in million cubic feet for each primary energy-consuming sector: residential, commercial, industrial, transportation, and electric power. SEDS removes supplemental gaseous fuels (SGF) added to natural gas consumption. These supplemental 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 heat content stabilization, and manufactured gas. Because SGF are mostly derived from fossil fuels, which are already accounted for as primary energy consumption in their respective fuel categories, SEDS removes them from total energy consumption in British thermal units (Btu) to eliminate double counting.

The U.S. Energy Information Administration (EIA) collects natural gas electricity data on survey Form EIA-923, "Power Plant Operations Report," and predecessor forms. SEDS uses these data directly as estimates for electric power sector natural gas consumption and any industrial and commercial generators greater than 1 megawatt capacity.

For the industrial, commercial, residential, and transportation sectors, SEDS uses data from EIA's *Natural Gas Annual*. We convert physical unit data in short tons into British thermal units (Btu) using state-level conversion factors for the end-use sectors.

We use these state-level natural gas, excluding SGF, variables from the SEDS consumption database in billion Btu:

NNACB = natural gas, excluding supplemental gaseous fuels, consumed by the transportation sector;
NNCCB = natural gas, excluding supplemental gaseous fuels, consumed by the commercial sector;
NNEIB = natural gas, excluding supplemental gaseous fuels, consumed by the electric power sector;
NNICB = natural gas, excluding supplemental gaseous fuels, consumed by the industrial sector; and
NNRCB = natural gas, excluding supplemental gaseous fuels, consumed by the residential sector.

SEDS assumes that the transportation sector is the only sector that does not consume supplemental gaseous fuels, so the variable is equal to natural gas consumed by the transportation sector (NGACB) used in the SEDS consumption data:

NNACB = NGACB

See the SEDS consumption technical notes for all consumption variables, heat conversion factors, estimation methods, and data sources https://www.eia.gov/state/seds/seds-technical-notes-complete.php?sid=US.

Non-combustion (nonfuel) consumption

Most fossil fuels consumed in the United States are combusted (burned) to produce heat and power. However, some are used directly for non-combustion (nonfuel) uses such as construction materials, chemical feedstocks, lubricants, solvents, and waxes. The U.S. Energy Information Administration (EIA) assumes all non-combustion use of natural gas occurs in the industrial sector to make nitrogenous fertilizers and as chemical feedstocks, such as hydrogen.

EIA's *Monthly Energy Review* (MER) estimates annual U.S.-level non-combustion (nonfuel) use shares of natural gas for 1973 forward for manufacturing and hydrogen production. SEDS estimates nonfuel shares for manufacturing production only, because EIA assumes manufacturing is the only activity that sequesters carbon from natural gas nonfuel use. EIA assumes nonfuel use of natural gas for hydrogen production releases all carbon. SEDS estimates non-combustion shares of natural gas for manufacturing using total natural gas nonfuel use data from EIA, Form EIA-846, *Manufacturing Energy Consumption Survey* (MECS) and SEDS U.S.-level estimates of natural gas, excluding supplemental gaseous fuels, consumption (NNICBUS). For years prior to 1985 (the first year of MECS data), SEDS assumes the 1985 share. The variable for annual share of natural gas used for nonfuel manufacturing (number between 0 and 1), used in SEDS is:

NNNFSUS = natural gas excluding supplemental gaseous fuels, non-combustion share.

See the *Monthly Energy Review* (MER) Energy overview and Environment sections for more information on the data sources and methods https://www.eia.gov/totalenergy/data/monthly/.

Carbon sequestration from non-combustion use

In the non-combustion (nonfuel) use of fossil fuels, some of the carbon is stored (sequestered) in the final product and not emitted. We account for carbon sequestered by sector from nonfuel use by removing it from the final sector CO2 emissions, using an annual factor.

EIA's *Monthly Energy Review* (MER) estimates national-level carbon sequestration factors for nonfuel use. SEDS assumes the state-level sequestration factors are equal to the MER's national-level factor for all years. Sequestration factors range from 0 to 1. A factor of 0 indicates that the fuel does not sequester any carbon (all is emitted), while a factor of 1 indicates that the fuel sequesters all the carbon (none is emitted). EIA's carbon sequestration factor for natural gas used to produce hydrogen is 0 and natural gas used for other industrial manufacturing is 0.44 for all years. The U.S.-level natural gas sequestration factor (number between 0 and 1) variable used in SEDS is:

NNSQSUS = natural gas, excluding supplemental gaseous fuels, nonfuel carbon sequestration factor.

See the MER Environment section for more information https://www.eia.gov/totalenergy/data/monthly/.

Carbon dioxide (CO2) emissions

SEDS calculates natural gas, excluding supplemental gaseous fuels, carbon dioxide (CO2) emissions estimates in million metric tons (MMmt) by sector as the product of the SEDS consumption values, the carbon sequestered by non-combustion use for the industrial sector, and the annual natural gas CO2 emissions factor at https://www.eia.gov/environment/emissions/xls/CO2_coeffs_detailed.xls.

Except for plant condensate and unfractionated stream (which are EIA estimates), the CO2 emissions factors for fossil fuels are from the U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, Tables A-19, A-31, and A-215. EIA converts metric tons of carbon to metric tons of CO2 using the approximate molar mass (44/12)—see https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

The natural gas CO2 emissions factor used for all states and sectors in million metric tons CO2 per quadrillion Btu is:

NNTCFUS = natural gas, excluding supplemental gaseous fuels, CO2 emissions factor for all sectors.

EIA calculates state- and national-level natural gas, excluding supplemental gaseous fuels, CO2 emissions for the residential, commercial, transportation, and electric power sectors as the product of energy consumption and the CO2 factor, with unit adjustments:

NNRCE = NNRCB * NNTCFUS / 1,000,000
NNCCE = NNCCB * NNTCFUS / 1,000,000
NNACE = NNACB * NNTCFUS / 1,000,000
NNEIE = NNEIB * NNTCFUS / 1,000,000

For the industrial sector, SEDS removes the CO2 emissions sequestered from nonfuel use of natural gas manufacturing from the sector total:

NNICE = (NNICB * NNTCFUS * (1 - NNNFSUS * NNSQSUS)) / 1,000,000

Total natural gas, excluding supplemental gaseous fuels, CO2 emissions from all sectors are the sum of the sectors.

NNTCE = NNRCE + NNCCE + NNICE + NNACE + NNEIE

Data sources

State-level energy consumption estimates from EIA's State Energy Data System (SEDS) https://www.eia.gov/state/seds/.

U.S.-level: non-combustion use shares, carbon sequestration factors, and CO2 emissions conversion factors from EIA's *Monthly Energy Review* (MER) https://www.eia.gov/totalenergy/data/monthly/.

Section 4. Petroleum

The State Energy Data System (SEDS) estimates energy-related carbon dioxide (CO2) emissions from petroleum products using state-level primary energy consumption estimates from SEDS, as well as national-level non-combustion (nonfuel) consumption shares, carbon sequestration factors, and CO2 conversion factors from the U.S. Energy Information Administration's (EIA) *Monthly Energy Review* (MER).

The term energy-related CO2 emissions refers to emissions from primary energy consumption, released at the location where fossil fuels are combusted (burned). In SEDS, we attribute CO2 emissions for electricity generation to the state where the petroleum product is combusted, even if the electricity is later consumed in a different state. Similarly, for industrial nonfuel consumption of petroleum products, we attribute the carbon stored in products, such as plastics, to the states where the products are consumed as primary energy at production plants, regardless of where the final products are used.

Energy consumption

The State Energy Data System (SEDS) estimates the amount of petroleum products consumed in thousand barrels for each individual product by sector. At the national level, SEDS assumes consumption of each petroleum product is equal to the U.S. Energy Information Administration's (EIA) U.S. "product supplied" data series as published in the EIA *Petroleum Supply Annual*. Product supplied measures the disappearance of petroleum products from primary sources, such as: refineries, natural gas-processing plants, blending plants, pipelines, and bulk terminals. In general, EIA calculates product supplied of each product as follows: field production, plus refinery production, plus imports, plus unaccounted-for crude oil, minus stock change, minus crude oil losses, minus refinery inputs, and minus exports.

At the state level, no product supplied data by state or sector are available, so SEDS estimates state-level product supplied for each individual petroleum product by sector using many methods and sources. EIA collects petroleum electricity data on survey Form EIA-923, "Power Plant Operations Report," and predecessor forms. SEDS uses these data directly as estimates for electric power sector petroleum consumption and any industrial and commercial generators greater than 1 megawatt capacity. For the other sectors, we subtract the EIA-923 data from EIA's *Petroleum Supply Annual* total U.S. "product supplied" and allocate the remainder to the residential, commercial, industrial, and transportation sectors by state using the various methods for each individual fuel described in the SEDS consumption technical notes. Lastly, we convert physical unit data in barrels into British thermal units (Btu) for each individual fuel using various conversion factors each state and sector.

See the SEDS consumption technical notes for all consumption variables, heat conversion factors, estimation methods, and data sources https://www.eia.gov/state/seds/seds-technical-notes-complete.php?sid=US.

The individual petroleum product consumption variables SEDS uses for total petroleum, excluding biofuels, CO2 emissions calculations include:

- asphalt and road oil
- aviation gasoline
- distillate fuel oil, excluding biofuels
- hydrocarbon gas liquids (HGL)
  - For 1960 through 1983 including:
    - liquefied petroleum gases (LPG)
    - natural gasoline/isopentane mixtures
    - plant condensate
    - unfractionated streams
  - For 1984 through 2009 including:
    - liquefied petroleum gases (LPG)
    - natural gasoline (pentanes plus)
  - For 2010 forward including:
    - normal butane
    - butylene
    - ethane
    - ethylene
    - isobutane
    - isobutylene
    - natural gasoline (pentanes plus)
    - propane
    - propylene
- jet fuel
- kerosene

- lubricants
- motor gasoline, excluding fuel ethanol
- other petroleum products, excluding biofuels:
  - aviation gasoline blending components
  - crude oil, including lease condensate
  - miscellaneous petroleum products
  - motor gasoline blending components
  - petrochemical feedstocks, naphtha less than 401˚F
  - petrochemical feedstocks, other oils equal to or greater than 401˚F
  - petrochemical feedstocks, still gas
  - special naphthas
  - still gas
  - unfinished oils
  - waxes
- petroleum coke
- residual fuel oil

See Appendix A Table A2 of this report for all individual petroleum product consumption variables https://www.eia.gov/state/seds/sep_fuel/notes/CO2_a.pdf.

SEDS removes renewable energy in the form of biofuels blended with petroleum products consumption to estimate pure petroleum fossil fuels emissions, including fuel ethanol, biodiesel, renewable diesel, and other biofuels. The underlying assumption is that biofuels, which are a renewable energy source of biomass, CO2 emissions are carbon neutral, meaning they are fully offset by land sinks in a sustainable biomass cycle and the natural processes by which trees, crops, and other biomass remove CO2 from the atmosphere to grow. EIA does not separately estimate other biofuels consumption by individual fuel (renewable jet fuel, renewable propane, renewable naphtha, etc.), so other biofuels product supplied is removed from EIA CO2 emissions data but not other unknown blended consumption. CO2 emissions data may underestimate actual CO2 emissions to the extent that actual biomass energy consumption may not be carbon neutral.

Non-combustion (nonfuel) consumption

Most fossil fuels consumed in the United States are combusted (burned) to produce heat and power. However, some are used directly for non-combustion (nonfuel) uses such as construction materials, chemical feedstocks, lubricants, solvents, and waxes. The U.S. Energy Information Administration (EIA) assumes most non-combustion use of petroleum products occurs in the industrial sector for chemicals and plastics. EIA also assumes all lubricants consumption in the industrial and transportation sectors are nonfuel use.

EIA's *Monthly Energy Review* (MER) estimates annual U.S.-level non-combustion use shares of individual petroleum products for 1973 forward. Each share is a number between 0 and 1. A share of 0 means that the fuel is always burned when consumed, and a share of 1 means that none of the fuel is burned when consumed. For years prior to 1973, SEDS assumes the 1973 shares. All other petroleum products not listed below have a nonfuel share of 0. The U.S.-level petroleum non-combustion use share (number between 0 and 1) variables used in SEDS are:

ARNFSUS	=	asphalt and road oil non-combustion share;
BUNFSUS	=	normal butane/butylene non-combustion share;
DMNFSUS	=	distillate fuel oil, excluding biofuels, non-combustion share;
ETNFSUS	=	ethane/ethylene non-combustion share;
FNNFSUS	=	naphthas for petrochemical feedstock use non-combustion share;
FONFSUS	=	other oils for petrochemical feedstock use non-combustion share;
FSNFSUS	=	petrochemical feedstocks, still gas, non-combustion share (through 1985);
IBNFSUS	=	isobutane/isobutylene non-combustion share;
LUNFSUS	=	lubricants non-combustion share;
MSNFSUS	=	miscellaneous petroleum products non-combustion share;
NANFSUS	=	natural gasoline/isopentane non-combustion share (through 1983);
PCNFSUS	=	petroleum coke non-combustion share;
PLNFSUS	=	plant condensate non-combustion share (through 1983);
PPNFSUS	=	natural gasoline (pentanes plus) non-combustion share;
PQNFSUS	=	propane non-combustion share;
PYNFSUS	=	propylene non-combustion share;
RFNFSUS	=	residual fuel oil non-combustion share;
SGNFSUS	=	still gas and still gas for petrochemical feedstock non-combustion share;
SNNFSUS	=	special naphthas non-combustion share;
UONFSUS	=	unfinished oils non-combustion share;
USNFSUS	=	unfractionated streams non-combustion share (through 1983); and
WXNFSUS	=	waxes non-combustion share.

See the MER Energy overview section for the exact methods and sources for each fuel https://www.eia.gov/totalenergy/data/monthly/.

Carbon sequestration from non-combustion use

In the non-combustion use of fossil fuels, some of the carbon is stored (sequestered) in the final product, and we subtract this from the fuel consumption values. SEDS calculates the amount of carbon sequestered as the product of the non-combustion use of fossil fuels and the carbon sequestration factor. EIA's *Monthly Energy Review* (MER) estimates national-level sequestration factors. SEDS assumes the state-level sequestration factors are equal to the MER's national-level factor for all years.

Sequestration factors range from 0 to 1. A factor of 0 indicates that the fuel does not sequester any carbon (all is emitted), while a factor of 1 indicates that the fuel sequesters all of the carbon (none is emitted). All other petroleum products not listed below have a nonfuel carbon sequestration factor of 0. See the MER Environment section for more information on the data sources and methods https://www.eia.gov/totalenergy/data/monthly/. See Appendix Table A1 of this report for the exact carbon sequestration factors https://www.eia.gov/state/seds/sep_fuel/notes/CO2_a.pdf.

The U.S.-level petroleum nonfuel sequestration factor (number between 0 and 1) variables used in SEDS are:

ARSQSUS = asphalt and road oil nonfuel carbon sequestration factor;
BQSQSUS = normal butane nonfuel carbon sequestration factor;
BYSQSUS = butylene nonfuel carbon sequestration factor;
DMSQSUS = distillate fuel oil, excluding biofuels, nonfuel carbon sequestration factor;
EQSQSUS = ethane nonfuel carbon sequestration factor;
EYSQSUS = ethylene nonfuel carbon sequestration factor;
FNSQSUS = naphthas used for petrochemical feedstocks nonfuel carbon sequestration factor;
FOSQSUS = other oils used for petrochemical feedstocks nonfuel carbon sequestration factor;
FSSQSUS = still gas for petrochemical feedstock use sequestration factor;
IQSQSUS = isobutane nonfuel carbon sequestration factor;
IYSQSUS = isobutylene nonfuel carbon sequestration factor;
LUSQSUS = lubricants nonfuel carbon sequestration factor;
MSSQSUS = miscellaneous petroleum products nonfuel carbon sequestration factor;
NASQSUS = natural gasoline/isopentane nonfuel carbon sequestration factor (through 1983);
PCSQSUS = petroleum coke used for other manufacturing nonfuel carbon sequestration factor;
PLSQSUS = plant condensate nonfuel carbon sequestration factor (through 1983);
PPSQSUS = natural gasoline (pentanes plus) nonfuel carbon sequestration factor;
PQSQSUS = propane nonfuel carbon sequestration factor;
PYSQSUS = propylene nonfuel carbon sequestration factor;
RFSQSUS = residual fuel oil nonfuel carbon sequestration factor;
SGSQSUS = still gas nonfuel carbon sequestration factor;
SNSQSUS = special naphthas nonfuel carbon sequestration factor;
UOSQSUS = unfinished oils nonfuel carbon sequestration factor;
USSQSUS = unfractionated streams carbon sequestration factor (through 1983); and
WXSQSUS = waxes nonfuel carbon sequestration factor.

Carbon dioxide (CO2) emissions

SEDS calculates carbon dioxide (CO2) emissions estimates for each petroleum product in million metric tons (MMmt) as the product of the SEDS consumption values, the carbon sequestered by non-combustion use for the industrial and transportation sectors, and the respective annual CO2 emissions factors by sector at https://www.eia.gov/environment/emissions/xls/CO2_coeffs_detailed.xls.

Except for plant condensate and unfractionated stream (which are EIA estimates), the CO2 emissions factors for fossil fuels are from the U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, Tables A-19, A-31, and A-215. EIA converts metric tons of carbon to metric tons of CO2 using the approximate molar mass (44/12)—see https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

See Appendix A Table A1 of this report for all individual petroleum product CO2 emissions variables and formulas https://www.eia.gov/state/seds/sep_fuel/notes/CO2_a.pdf.

EIA only publishes total aggregate petroleum CO2 emissions data at the state level, and not individual petroleum product CO2 emissions data.

The aggregate petroleum CO2 emissions variables in million metric tons (MMmt) used in SEDS are:

PMACE = all petroleum products, excluding biofuels, CO2 emissions for the transportation sector;
PMCCE = all petroleum products, excluding biofuels, CO2 emissions for the commercial sector;
PMEIE = all petroleum products, excluding biofuels, CO2 emissions for the electric power sector;
PMICE = all petroleum products, excluding biofuels, CO2 emissions for the industrial sector;
PMRCE = all petroleum products, excluding biofuels, CO2 emissions for the residential sector; and
PMTCE = all petroleum products, excluding biofuels, total CO2 emissions.

SEDS calculates aggregate state- and national-level petroleum products, excluding biofuels, CO2 emissions for the residential (PMRCE), commercial (PMCCE), and electric power (PMEIE) sectors as the sum of each petroleum products' CO2 emissions within each sector:

PMRCE = DMRCE + KSRCE + HLRCE
PMCCE = DMCCE + KSCCE + HLCCE + MMCCE + PCCCE + RFCCE
PMEIE = DMEIE + JFEIE + PCEIE + RFEIE

For the industrial (PMICE) and transportation (PMACE) sectors, SEDS sums the CO2 emissions from each individual product in those sectors. When applicable, each individual product removes the CO2 emissions sequestered from nonfuel use:

PMICE = ARICE + DMICE + KSICE + HLICE + LUICE + MMICE + PCICE + RFICE + OMICE
PMACE = AVACE + DMACE + JFACE + HLACE + LUACE + MMACE + RFACE

Total petroleum product CO2 emissions from all sectors (PMTCE) is the sum of all petroleum products total (all sectors) emissions:

PMTCE = ARTCE + AVTCE + DMTCE + JFTCE + KSTCE + HLTCE + LUTCE + MMTCE + PCTCE + RFTCE + OMTCE

Data sources

State-level energy consumption estimates from EIA's State Energy Data System (SEDS) https://www.eia.gov/state/seds/.

U.S.-level: non-combustion use shares, carbon sequestration factors, and CO2 emissions conversion factors from EIA's *Monthly Energy Review* (MER) https://www.eia.gov/totalenergy/data/monthly/.

Section 5. Total energy

The preceding sections of this document describe how the U.S. Energy Information Administration (EIA) estimates state-level CO2 emissions from energy consumption by source in the State Energy Data System (SEDS). This section describes how SEDS sums all energy sources in million metric tons (MMmt) of CO2 to calculate total fossil fuel and total energy CO2 emissions estimates.

Total energy CO2 emissions by fuel

SEDS calculates total fossil fuels CO2 emissions in million metric tons (FFTCE) for each state and the United States as ("ZZ" in the variable name is used to represent the two-letter state code):

FFTCEZZ = CLTCEZZ + NNTCEZZ + PMTCEZZ
FFTCEUS = CLTCEUS + CCNIEUS + NNTCEUS + PMTCEUS

Total energy-related CO2 emissions in million metric tons (TETCE) for each state and the United States are equal to total fossil fuels CO2 emissions:

TETCE = FFTCE

Total energy CO2 emissions by sector

SEDS calculates total CO2 emissions of fossil fuels in million metric tons for each sector as the sum of all the fuels within the sector.

SEDS calculates residential sector total fossil fuel CO2 emissions in million metric tons (FFRCE) for each state and the United States as the sum of total CO2 emissions from each fossil fuel within the sector:

FFRCE = CLRCE + NNRCE + PMRCE

SEDS calculates commercial sector total fossil fuel CO2 emissions in million metric tons (FFCCE) for each state and the United States as the sum of total CO2 emissions from each fossil fuel within the sector:

FFCCE = CLCCE + NNCCE + PMCCE

SEDS calculates industrial sector total fossil fuel CO2 emissions in million metric tons (FFICE) for each state and the United States as the sum of total CO2 emissions from each fossil fuel within the sector using these formulas ("ZZ" in the variable name is used to represent the two-letter state code):

FFICEZZ = CLICEZZ + NNICEZZ + PMICEZZ
FFICEUS = CLICEUS + CCNIEUS + NNICEUS + PMICEUS

SEDS calculates transportation sector total fossil fuel CO2 emissions in million metric tons (FFACE) for each state and the United States as the sum of total CO2 emissions from each fossil fuel within the sector:

FFACE = CLACE + NNACE + PMACE

SEDS calculates electric power sector total fossil fuel CO2 emissions in million metric tons (FFEIE) for each state and the United States as the sum of total CO2 emissions from each fossil fuel within the sector:

FFEIE = CLEIE + NNEIE + PMEIE

For each sector, total energy-related CO2 emissions are equal to fossil fuel CO2 emissions:

TERCE = FFRCE
TECCE = FFCCE
TEICE = FFICE
TEACE = FFACE
TEEIE = FFEIE

Per capita energy-related CO2 emissions

We can divide the total CO2 emissions for a state by the state's population to examine the CO2 emissions on a per capita (per person) basis. In addition to population density, there are other factors that affect a state's per capita CO2 emissions, including: weather/climate, structure of the state economy, energy sources, building standards, and state policies to reduce emissions.

SEDS calculates per capita energy-related CO2 emissions in metric tons (CDTPR) for each state and the United States using the same formula:

CDTPR = TETCE / (TPOPP / 1000)

See the SEDS energy indicators technical notes for more information on residential population at https://www.eia.gov/state/seds/seds-technical-notes-complete.php.

Carbon intensity of energy supply

The carbon intensity of energy supply (total CO2 emissions per Btu of total energy consumption) reflects the energy fuel mix within a state. The states with more carbon-intensive energy consumption tend to be the states with high per capita emissions. The states with less carbon-intensive energy supply tend to be those states with relatively more carbon neutral electricity generation from sources like nuclear, wind, hydropower, and solar.

SEDS calculates carbon intensity of energy supply (CDTCR) in metric tons of CO2 emissions per billion Btu of total energy consumption (TETCB) less net interstate flow of electricity (ELISB), with unit conversion, for each state and the United States using the formula:

CDTCR = TETCE / ((TETCB - ELISB) / 1,000,000)

See the SEDS consumption technical notes for total energy consumption estimates at https://www.eia.gov/state/seds/seds-technical-notes-complete.php?sid=US.

Carbon intensity of the economy

Carbon intensity of the economy measures total CO2 emissions against the total sum output of the entire economy in terms of gross domestic product (GDP). States with the highest carbon intensity of their economies, as measured in metric tons of CO2 per real chained 2017 dollar of state GDP, are also the states with the highest values of energy intensity and carbon intensity of that energy supply. The states with the lowest carbon intensity of economic activity are also states that appear on the lower end of both energy intensity and the carbon intensity of that energy supply. We use inflation-adjusted (real) GDP data to compare across time series.

SEDS calculates carbon intensity of the economy in metric tons of CO2 per million chained (2017) dollars of state GDP (CDTCR) for each state and the United States using the formula:

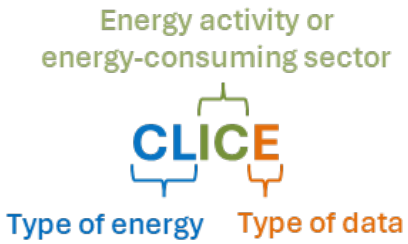
CDEGR = TETCE / (GDPRX / 1,000,000)

See the SEDS energy indicators technical notes for more information on GDP data at https://www.eia.gov/state/seds/seds-technical-notes-complete.php.

Appendix A. Mnemonic series names (MSN)

This appendix contains an alphabetical listing of the State Energy Data System (SEDS) energy-related CO2 emissions variables, called MSNs. For each variable, SEDS provides: a brief description; unit of measure; and the formulas used to create the variable. Variables that are entered directly from other sources, but not calculated by SEDS, are independent variables. Formulas for the state calculations have "ZZ" following the variable name, where "ZZ" represents the two-letter state code. The formulas for the United States have "US" following the variable name. If the formula for the states and the United States are the same, only one formula is shown.

The SEDS MSN variables have five-character names that generally consist of the following components:



See Section 1 of the SEDS technical notes for explanation of the five-character MSN code descriptions.

See Table A1 for all CO2 emissions, nonfuel, sequestration, and conversion variables.

Energy-related CO2 emissions estimates require SEDS consumption variables. See Table A2 for all SEDS consumption variables used directly in CO2 emissions equations. See the SEDS consumption technical notes for all of the underlying variables used to estimate those variables.

APPENDIX A

Table A1. CO2 emissions variables

MSN	Description	Unit	Formula
ABICE	Aviation gasoline blending components industrial sector CO2 emissions.	Million metric tons CO2	ABICE = (ABICB * ABTCFUS) / 1,000,000
ABTCE	Aviation gasoline blending components total CO2 emissions.	Million metric tons CO2	ABTCE = ABICE
ABTCFUS	Aviation gasoline blending components CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	ABTCFUS is independent.
ARICE	Asphalt and road oil industrial sector CO2 emissions.	Million metric tons CO2	ARICE = (ARICB * ARTCFUS * (1 - ARNFSUS * ARSQSUS)) / 1,000,000
ARNFSUS	Asphalt and road oil non-combustion share for the United States.	Share (number between 0 and 1)	ARNFSUS = 1
ARSQSUS	Asphalt and road oil nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	ARSQSUS = 1
ARTCE	Asphalt and road oil total CO2 emissions.	Million metric tons CO2	ARTCE = ARICE
ARTCFUS	Asphalt and road oil CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	ARTCFUS is independent.
AVACE	Aviation gasoline transportation sector CO2 emissions.	Million metric tons CO2	AVACE = AVACB * AVTCFUS / 1,000,000
AVTCE	Aviation gasoline total CO2 emissions.	Million metric tons CO2	AVTCE = AVACE
AVTCFUS	Aviation gasoline CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	AVTCFUS is independent.
BQICE	Normal butane industrial sector CO2 emissions.	Million metric tons CO2	BQICE = (BQICB * BQTCFUS * (1 - BUNFSUS * BQSQSUS)) / 1,000,000
BQSQSUS	Normal butane nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	BQSQSUS = 0.8
BQTCE	Normal butane total CO2 emissions.	Million metric tons CO2	BQTCE = BQICE
BQTCFUS	Normal butane CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	BQTCFUS is independent.
BUNFSUS	Normal butane/butylene non-combustion share for the United States.	Share (number between 0 and 1)	BUNFSUS is independent.
BYICE	Butylene industrial sector CO2 emissions.	Million metric tons CO2	BYICE = (BYICB * BYTCFUS * (1 - BUNFSUS * BYSQSUS)) / 1,000,000

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
BYSQSUS	Butylene nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	BYSQSUS = 0.8
BYTCE	Butylene total CO2 emissions.	Million metric tons CO2	BYTCE = BYICE
BYTCFUS	Butylene CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	BYTCFUS is independent.
CCNIEUS	Coal coke net imports CO2 emissions into the United States.	Million metric tons CO2	CCNIEUS = CCNIBUS * CCTCFUS / 1,000,000
CCTCFUS	Coal coke net imports CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	CCTCFUS is independent.
CDEGR	Carbon intensity of the economy (CO2 emissions divided by real GDP).	Metric tons CO2 per million chained (2017) dollars	CDEGR = TETCE / (GDPRX / 1,000,000)
CDTCR	Carbon intensity of energy supply (CO2 emissions divided by total energy consumption less interstate flow of electricity).	Metric tons CO2 per billion Btu	CDTCR = TETCE / ((TETCB - ELISB) / 1,000,000)
CDTPR	Per capita energy-related CO2 emissions.	Metric tons CO2	CDTPR = TETCE / (TPOPP / 1,000)
CLACE	Coal CO2 emissions for the transportation sector (through 1977).	Million metric tons CO2	CLACE = CLACB * CLOCFUS / 1,000,000
CLCCE	Coal CO2 emissions for the commercial sector.	Million metric tons CO2	CLCCE = CLCCB * CLHCFUS / 1,000,000
CLEIE	Coal CO2 emissions for the electric power sector.	Million metric tons CO2	CLEIE = CLEIB * CLEIFUS / 1,000,000
CLEIFUS	Coal CO2 emissions factor for the electric power sector for the United States.	Million metric tons CO2 per quadrillion Btu	CLEIFUS is independent.
CLHCFUS	Coal CO2 emissions factor for the residential and commercial sectors for the United States.	Million metric tons CO2 per quadrillion Btu	CLHCFUS is independent.
CLICE	Coal CO2 emissions for the industrial sector.	Million metric tons CO2	CLICEZZ = CLKCEZZ + CLOCEZZ CLICEUS = CLKCEUS + CLOCEUS + CCNIEUS
CLKCE	Coal consumed at coke plants (coking coal) CO2 emissions for the industrial sector.	Million metric tons CO2	CLKCE = (CLKCB * CLKCFUS * (1 - CLNFSUS * CLSQSUS)) / 1,000,000
CLKCFUS	Coal coking plants CO2 emissions factor for the industrial sector for the United States.	Million metric tons CO2 per quadrillion Btu	CLKCFUS is independent.

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
CLNFSUS	Coal consumed at coke plants (coking coal) non-combustion share for the United States.	Share (number between 0 and 1)	CLNFSUS is independent.
CLOCE	Coal other than coke plants CO2 emissions for the industrial sector.	Million metric tons CO2	CLOCE = CLOCB * CLOCFUS / 1,000,000
CLOCFUS	Coal other than coke plants CO2 emissions factor for the industrial and transportation sectors for the United States.	Million metric tons CO2 per quadrillion Btu	CLOCFUS is independent.
CLRCE	Coal CO2 emissions for the residential sector (through 2008).	Million metric tons CO2	CLRCE = CLRCB * CLHCFUS / 1,000,000
CLSQSUS	Coal consumed at coke plants (coking coal) nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	CLSQSUS = 0.75
CLTCE	Coal total CO2 emissions.	Million metric tons CO2	CLTCEZZ = CLRCEZZ + CLCCEZZ + CLICEZZ + CLACEZZ + CLEIEZZ CLTCEUS = CLRCEUS + CLCCEUS + CLICEUS + CLACEUS + CLEIEUS
COICE	Crude oil industrial sector CO2 emissions.	Million metric tons CO2	COICE = COICB * COTCFUS / 1,000,000
COTCE	Crude oil total CO2 emissions.	Million metric tons CO2	COTCE = COICE
COTCFUS	Crude oil CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	COTCFUS is independent.
DMACE	Distillate fuel oil, excluding biofuels, transportation sector CO2 emissions.	Million metric tons CO2	DMACE = DMACB * DMTCFUS / 1,000,000
DMCCE	Distillate fuel oil, excluding biofuels, commercial sector CO2 emissions.	Million metric tons CO2	DMCCE = DMCCB * DMTCFUS / 1,000,000
DMEIE	Distillate fuel oil, excluding biofuels, electric power sector CO2 emissions.	Million metric tons CO2	DMEIE = DMEIB * DMTCFUS / 1,000,000
DMICE	Distillate fuel oil, excluding biofuels, industrial sector CO2 emissions.	Million metric tons CO2	DMICE = (DMICB * DMTCFUS * (1 - DMNFSUS * DMSQSUS)) / 1,000,000
DMNFSUS	Distillate fuel oil, excluding biofuels, non-combustion share for the United States.	Share (number between 0 and 1)	DMNFSUS is independent.
DMRCE	Distillate fuel oil, excluding biofuels, residential sector CO2 emissions.	Million metric tons CO2	DMRCE = DMRCB * DMTCFUS / 1,000,000

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
DMSQSUS	Distillate fuel oil, excluding biofuels, nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	DMSQSUS = 0.5
DMTCE	Distillate fuel oil, excluding biofuels, total CO2 emissions.	Million metric tons CO2	DMTCE = DMACE + DMCCE + DMEIE + DMICE + DMRCE
DMTCFUS	Distillate fuel oil, excluding biofuels, CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	DMTCFUS is independent.
EQICE	Ethane industrial sector CO2 emissions.	Million metric tons CO2	EQICE = (EQICB * EQTCFUS * (1 - ETNFSUS * EQSQSUS)) / 1,000,000
EQSQSUS	Ethane nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	EQSQSUS = 0.8
EQTCE	Ethane total CO2 emissions.	Million metric tons CO2	EQTCE = EQICE
EQTCFUS	Ethane CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	EQTCFUS is independent.
ETNFSUS	Ethane/ethylene non-combustion share for the United States.	Share (number between 0 and 1)	ETNFSUS is independent.
EYICE	Ethylene industrial sector CO2 emissions.	Million metric tons CO2	EYICE = (EYICB * EYTCFUS * (1 - ETNFSUS * EYSQSUS)) / 1,000,000
EYSQSUS	Ethylene nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	EYSQSUS = 0.8
EYTCE	Ethylene total CO2 emissions.	Million metric tons CO2	EYTCE = EYICE
EYTCFUS	Ethylene CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	EYTCFUS is independent.
FFACE	Fossil fuel CO2 emissions for the transportation sector.	Million metric tons CO2	FFACE = CLACE + NNACE + PMACE
FFCCE	Fossil fuel CO2 emissions for the commercial sector.	Million metric tons CO2	FFCCE = CLCCE + NNCCE + PMCCE
FFEIE	Fossil fuel CO2 emissions for the electric power sector.	Million metric tons CO2	FFEIE = CLEIE + NNEIE + PMEIE
FFICE	Fossil fuel CO2 emissions for the industrial sector.	Million metric tons CO2	FFICEZZ = CLICEZZ + NNICEZZ + PMICEZZ FFICEUS = CLICEUS + CCNIEUS + NNICEUS + PMICEUS

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
FFRCE	Fossil fuel CO2 emissions for the residential sector.	Million metric tons CO2	FFRCE = CLRCE + NNRCE + PMRCE
FFTCE	Fossil fuel total CO2 emissions.	Million metric tons CO2	FFTCEZZ= CLTCEZZ + NNTCEZZ + PMTCEZZ FFTCEUS = CLTCEUS + CCNIEUS + NNTCEUS + PMTCEUS
FNICE	Naphthas for petrochemical feedstock use industrial sector CO2 emissions.	Million metric tons CO2	FNICE = (FNICB * FNTCFUS * (1 - FNNFSUS * FNSQSUS)) / 1,000,000
FNNFSUS	Naphthas for petrochemical feedstock use non-combustion share for the United States.	Share (number between 0 and 1)	FNNFSUS = 1
FNSQSUS	Naphthas used for petrochemical feedstocks nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	FNSQSUS = 0.75
FNTCE	Naphthas for petrochemical feedstock use total CO2 emissions.	Million metric tons CO2	FNTCE = FNICE
FNTCFUS	Naphthas for petrochemical feedstock use CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	FNTCFUS is independent.
FOICE	Other oils for petrochemical feedstock use industrial sector CO2 emissions.	Million metric tons CO2	FOICE = (FOICB * FOTCFUS * (1 - FONFSUS * FOSQSUS)) / 1,000,000
FONFSUS	Other oils for petrochemical feedstock use non-combustion share for the United States.	Share (number between 0 and 1)	FONFSUS = 1
FOSQSUS	Other oils used for petrochemical feedstocks nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	FOSQSUS = 0.5
FOTCE	Other oils for petrochemical feedstock use total CO2 emissions.	Million metric tons CO2	FOTCE = FOICE
FOTCFUS	Other oils for petrochemical feedstock use CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	FOTCFUS is independent.
FSICE	Still gas for petrochemical feedstock use industrial sector CO2 emissions (through 1985).	Million metric tons CO2	FSICE = (FSICB * SGTCFUS * (1 - FSNFSUS * FSSQSUS)) / 1,000,000
FSNFSUS	Petrochemical feedstocks, still gas, non-combustion share for the United States (through 1985).	Share (number between 0 and 1)	FSNFSUS = SGNFSUS

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
FSSQSUS	Still gas for petrochemical feedstock use sequestration factor for the United States (through 1985).	Share (number between 0 and 1)	FSSQSUS = 0.8
FSTCE	Still gas for petrochemical feedstock use total CO2 emissions (through 1985).	Million metric tons CO2	FSTCE = FSICE
GDPRX	Real gross domestic product (GDP).	Million chained (2017) dollars	GDPRXZZ is independent. GDPRXUS is independent.
HLACE	Hydrocarbon gas liquids transportation sector CO2 emissions.	Million metric tons CO2	Before 2010: HLACE = LGACE 2010 forward: HLACE = PQACE
HLCCE	Hydrocarbon gas liquids commercial sector CO2 emissions.	Million metric tons CO2	Before 2010: HLCCE = LGCCE 2010 forward: HLCCE = PQCCE
HLICE	Hydrocarbon gas liquids industrial sector CO2 emissions.	Million metric tons CO2	Before 1984: HLICE = LGICE + NAICE + PLICE + USICE 1984 through 2009: HLICE = LGICE + PPICE 2010 forward: HLICE = BQICE + BYICE + EQICE + EYICE + IQICE + IYICE + PPICE + PQICE + PYICE
HLRCE	Hydrocarbon gas liquids residential sector CO2 emissions.	Million metric tons CO2	Before 2010: HLRCE = LGRCE 2010 forward: HLRCE = PQRCE
HLTCE	Hydrocarbon gas liquids total CO2 emissions.	Million metric tons CO2	HLTCE = HLACE + HLCCE + HLICE + HLRCE
IBNFSUS	Isobutane/isobutylene non-combustion share for the United States.	Share (number between 0 and 1)	IBNFSUS is independent.
IQICE	Isobutane industrial sector CO2 emissions.	Million metric tons CO2	IQICE = (IQICB * IQTCFUS * (1 - IBNFSUS * IQSQSUS)) / 1,000,000
IQSQSUS	Isobutane nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	IQSQSUS = 0.8
IQTCE	Isobutane total CO2 emissions.	Million metric tons CO2	IQTCE = IQICE

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
IQTCFUS	Isobutane CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	IQTCFUS is independent.
IYICE	Isobutylene industrial sector CO2 emissions.	Million metric tons CO2	IYICE = (IYICB * IYTCFUS * (1 - IBNFSUS * IYSQSUS)) / 1,000,000
IYSQSUS	Isobutylene nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	IYSQSUS = 0.8
IYTCE	Isobutylene total CO2 emissions.	Million metric tons CO2	IYTCE = IYICE
IYTCFUS	Isobutylene CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	IYTCFUS is independent.
JFACE	Jet fuel transportation sector CO2 emissions.	Million metric tons CO2	JFACE = JFACB * JFTCFUS / 1,000,000
JFEIE	Jet fuel electric power sector CO2 emissions (through 1982).	Million metric tons CO2	JFEIE = JFEUB * JFTCFUS / 1,000,000
JFTCE	Jet fuel total CO2 emissions.	Million metric tons CO2	JFTCE =JFACE + JFEIE
JFTCFUS	Jet fuel CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	JFTCFUS is independent.
KSCCE	Kerosene commercial sector CO2 emissions.	Million metric tons CO2	KSCCE = KSCCB * KSTCFUS / 1,000,000
KSICE	Kerosene industrial sector CO2 emissions.	Million metric tons CO2	KSICE = KSICB * KSTCFUS / 1,000,000
KSRCE	Kerosene residential sector CO2 emissions.	Million metric tons CO2	KSRCE = KSRCB * KSTCFUS / 1,000,000
KSTCE	Kerosene total CO2 emissions.	Million metric tons CO2	KSTCE = KSCCE + KSICE + KSRCE
KSTCFUS	Kerosene CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	KSTCFUS is independent.
LGACE	LPG CO2 emissions in the transportation sector (through 2009).	Million metric tons CO2	LGACE = LGACB * PQTCFUS / 1,000,000
LGCCE	LPG CO2 emissions in the commercial sector (through 2009).	Million metric tons CO2	LGCCE = LGCCB * PQTCFUS / 1,000,000
LGICE	LPG CO2 emissions in the industrial sector (through 2009).	Million metric tons CO2	LGICEZZ = (LGICBZZ / LGICBUS) * LGICEUS LGICEUS is independent.
LGRCE	LPG CO2 emissions in the residential sector (through 2009).	Million metric tons CO2	LGRCE = LGRCB * PQTCFUS / 1,000,000
LGTCE	LPG total CO2 emissions (through 2009).	Million metric tons CO2	LGTCE = LGACE + LGCCE + LGICE + LGRCE

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
LUACE	Lubricants transportation sector CO2 emissions.	Million metric tons CO2	LUACE = (LUACB * LUTCFUS * (1 - LUNFSUS * LUSQSUS)) / 1,000,000
LUICE	Lubricants industrial sector CO2 emissions.	Million metric tons CO2	LUICE = (LUICB * LUTCFUS * (1 - LUNFSUS * LUSQSUS)) / 1,000,000
LUNFSUS	Lubricants non-combustion share for the United States.	Share (number between 0 and 1)	LUNFSUS = 1
LUSQSUS	Lubricants nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	LUSQSUS = 0.5
LUTCE	Lubricants total CO2 emissions.	Million metric tons CO2	LUTCE = LUACE + LUICE
LUTCFUS	Lubricants CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	LUTCFUS is independent.
MBICE	Motor gasoline blending components industrial sector CO2 emissions.	Million metric tons CO2	MBICE = MBICB * MBTCFUS / 1,000,000
MBTCE	Motor gasoline blending components total CO2 emissions.	Million metric tons CO2	MBTCE = MBICE
MBTCFUS	Motor gasoline blending components CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	MBTCFUS is independent.
MMACE	Motor gasoline, excluding ethanol, transportation sector CO2 emissions.	Million metric tons CO2	MMACE = MMACB * MMTCFUS / 1,000,000
MMCCE	Motor gasoline, excluding ethanol, commercial sector CO2 emissions.	Million metric tons CO2	MMCCE = MMCCB * MMTCFUS / 1,000,000
MMICE	Motor gasoline, excluding ethanol, industrial sector CO2 emissions.	Million metric tons CO2	MMICE = MMICB * MMTCFUS / 1,000,000
MMTCE	Motor gasoline, excluding ethanol, total CO2 emissions.	Million metric tons CO2	MMTCE = MMACE + MMCCE + MMICE
MMTCFUS	Motor gasoline, excluding fuel ethanol, CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	MMTCFUS is independent.
MSICE	Miscellaneous petroleum products industrial sector CO2 emissions.	Million metric tons CO2	MSICE = (MSICB * MSTCFUS * (1 - MSNFSUS * MSSQSUS)) / 1,000,000
MSNFSUS	Miscellaneous petroleum products non-combustion share for the United States.	Share (number between 0 and 1)	MSNFSUS = 1

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
MSSQSUS	Miscellaneous petroleum products nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	MSSQSUS = 1
MSTCE	Miscellaneous petroleum products total CO2 emissions.	Million metric tons CO2	MSTCE = MSICE
MSTCFUS	Miscellaneous petroleum products CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	MSTCFUS is independent.
NAICE	Natural gasoline/isopentane industrial sector CO2 emissions (through 1983).	Million metric tons CO2	NAICE = (NAICB * NATCFUS * (1 - NANFSUS * NASQFUS)) / 1,000,000
NANFSUS	Natural gasoline/isopentane non-combustion share for the United States (through 1983).	Share (number between 0 and 1)	NANFSUS = PPNFSUS
NASQSUS	Natural gasoline/isopentane nonfuel carbon sequestration factor for the United States (through 1983).	Share (number between 0 and 1)	NASQSUS = PPSQSUS
NATCE	Natural gasoline/isopentane total CO2 emissions (through 1983).	Million metric tons CO2	NATCE = NAICE
NATCFUS	Natural gasoline/isopentane CO2 emissions factor for the United States (through 1983).	Million metric tons CO2 per quadrillion Btu	NATCFUS = PPTCFUS
NNACE	Natural gas, excluding supplemental gaseous fuels, CO2 emissions for the transportation sector.	Million metric tons CO2	NNACE = NNACB * NNTCFUS / 1,000,000
NNCCE	Natural gas, excluding supplemental gaseous fuels, CO2 emissions for the commercial sector.	Million metric tons CO2	NNCCE = NNCCB * NNTCFUS / 1,000,000
NNEIE	Natural gas, excluding supplemental gaseous fuels, CO2 emissions for the electric power sector.	Million metric tons CO2	NNEIE = NNEIB * NNTCFUS / 1,000,000
NNICE	Natural gas, excluding supplemental gaseous fuels, CO2 emissions for the industrial sector.	Million metric tons CO2	NNICE = (NNICB * NNTCFUS * (1 - NNNFSUS * NNSQSUS)) / 1,000,000
NNNFSUS	Natural gas, excluding supplemental gaseous fuels, non-combustion share for the United States.	Share (number between 0 and 1)	NNNFSUS is independent.
NNRCE	Natural gas, excluding supplemental gaseous fuels, CO2 emissions for the residential sector.	Million metric tons CO2	NNRCE = NNRCB * NNTCFUS / 1,000,000

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
NNSQSUS	Natural gas, excluding supplemental gaseous fuels, carbon sequestration factor for the United States.	Share (number between 0 and 1)	NNSQSUS = 0.44
NNTCE	Natural gas, excluding supplemental gaseous fuels, total CO2 emissions.	Million metric tons CO2	NNTCE = NNRCE + NNCCE + NNICE + NNACE + NNEIE
NNTCFUS	Natural gas, excluding supplemental gaseous fuels, CO2 emissions factor for all sectors for the United States.	Million metric tons CO2 per quadrillion Btu	NNTCFUS is independent.
OMICE	Other petroleum products, excluding biofuels, industrial sector CO2 emissions.	Million metric tons CO2	OMICE = ABICE + COICE + FNICE + FOICE + FSICE + MBICE + MSICE + SGICE + SNICE + UOICE + WXICE
OMTCE	Other petroleum products, excluding biofuels, CO2 emissions.	Million metric tons CO2	OMTCE = OMICE
PCCCE	Petroleum coke commercial sector CO2 emissions.	Million metric tons CO2	PCCCE = PCCCB * PCTCFUS / 1,000,000
PCEIE	Petroleum coke electric power sector CO2 emissions.	Million metric tons CO2	PCEIE = PCEIB * PCTCFUS / 1,000,000
PCICE	Petroleum coke industrial sector CO2 emissions.	Million metric tons CO2	PCICE = (PCICB * PCTCFUS * (1 - PCNFSUS * PCSQSUS)) / 1,000,000
PCNFSUS	Petroleum coke non-combustion share for the United States.	Share (number between 0 and 1)	PCNFSUS is independent.
PCSQSUS	Petroleum coke used for other manufacturing nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	PCSQSUS = 0.5
PCTCE	Petroleum coke total CO2 emissions.	Million metric tons CO2	PCTCE = PCCCE + PCEIE + PCICE
PCTCFUS	Petroleum coke CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	PCTCFUS is independent.
PLICE	Plant condensate industrial sector CO2 emissions (through 1983).	Million metric tons CO2	PLICE = (PLICB * PLTCFUS * (1 - PLNFSUS * PLSQSUS)) / 1,000,000
PLNFSUS	Plant condensate non-combustion share for the United States (through 1983).	Share (number between 0 and 1)	PLNFSUS = PPNFSUS

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
PLSQSUS	Petroleum coke industrial sector CO2 emissions for the United States (through 1983).	Share (number between 0 and 1)	PLSQSUS = PPSQSUS
PLTCE	Plant condensate total CO2 emissions (through 1983).	Million metric tons CO2	PLTCE = PLICE
PLTCFUS	Plant condensate CO2 emissions factor for the United States (through 1983).	Million metric tons CO2 per quadrillion Btu	PLTCFUS is independent.
PMACE	All petroleum products, excluding biofuels, CO2 emissions for the transportation sector.	Million metric tons CO2	PMACE = AVACE + DMACE + JFACE + HLACE + LUACE + MMACE + RFACE
PMCCE	All petroleum products, excluding biofuels, CO2 emissions for the commercial sector.	Million metric tons CO2	PMCCE = DMCCE + KSCCE + HLCCE + MMCCE + PCCCE + RFCCE
PMEIE	All petroleum products, excluding biofuels, CO2 emissions for the electric power sector.	Million metric tons CO2	PMEIE = DMEIE + JFEIE + PCEIE + RFEIE
PMICE	All petroleum products, excluding biofuels, CO2 emissions for the industrial sector.	Million metric tons CO2	PMICE = ARICE + DMICE + KSICE + HLICE + LUICE + MMICE + PCICE + RFICE + OMICE
PMRCE	All petroleum products, excluding biofuels, CO2 emissions for the residential sector.	Million metric tons CO2	PMRCE = DMRCE + KSRCE + HLRCE
PMTCE	All petroleum products, excluding biofuels, CO2 emissions for all sectors.	Million metric tons CO2	PMTCE = ARTCE + AVTCE + DMTCE + JFTCE + KSTCE + HLTCE + LUTCE + MMTCE + PCTCE + RFTCE + OMTCE
PPICE	Natural gasoline (pentanes plus) industrial sector CO2 emissions.	Million metric tons CO2	PPICE = (PPICB * PPTCFUS * (1 - PPNFSUS * PPSQSUS)) / 1,000,000
PPNFSUS	Natural gasoline (pentanes plus) non-combustion share for the United States.	Share (number between 0 and 1)	PPNFSUS is independent.
PPSQSUS	Natural gasoline (pentanes plus) nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	PPSQSUS = 0.8
PPTCE	Natural gasoline (pentanes plus) total CO2 emissions.	Million metric tons CO2	PPTCE = PPICE
PPTCFUS	Natural gasoline (pentanes plus) CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	PPTCFUS is independent.
PQACE	Propane CO2 emissions in the transportation sector.	Million metric tons CO2	PQACE = PQACB * PRTCFUS / 1,000,000

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
PQCCE	Propane CO2 emissions in the commercial sector.	Million metric tons CO2	PQCCE = PQCCB * PRTCFUS / 1,000,000
PQICE	Propane CO2 emissions in the industrial sector.	Million metric tons CO2	PQICE = (PQICB * PRTCFUS * (1 - PQNFSUS * PQSQSUS)) / 1,000,000
PQNFSUS	Propane non-combustion share for the United States.	Share (number between 0 and 1)	PQNFSUS is independent.
PQRCE	Propane CO2 emissions in the residential sector.	Million metric tons CO2	PQRCE = PQRCB * PRTCFUS / 1,000,000
PQSQSUS	Propane nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	PQSQSUS = 0.8
PQTCE	Propane total CO2 emissions.	Million metric tons CO2	PQTCE = PQACE + PQCCE + PQICE + PQRCE
PQTCFUS	Propane CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	PQTCFUS is independent.
PYICE	Propylene CO2 emissions in the industrial sector.	Million metric tons CO2	PYICE = (PYICB * PYTCFUS * (1 - PYNFSUS * PYSQSUS)) / 1,000,000
PYNFSUS	Propylene non-combustion share for the United States.	Share (number between 0 and 1)	PYNFSUS = 1
PYSQSUS	Propylene nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	PYSQSUS = 0.8
PYTCE	Propylene total CO2 emissions.	Million metric tons CO2	PYTCE = PYICE
PYTCFUS	Propylene CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	PYTCFUS is independent.
RFACE	Residual fuel oil transportation sector CO2 emissions.	Million metric tons CO2	RFACE = RFACB * RFTCFUS / 1,000,000
RFCCE	Residual fuel oil commercial sector CO2 emissions.	Million metric tons CO2	RFCCE = RFCCB * RFTCFUS / 1,000,000
RFEIE	Residual fuel oil electric power sector CO2 emissions.	Million metric tons CO2	RFEIE = RFEIB * RFTCFUS / 1,000,000
RFICE	Residual fuel oil industrial sector CO2 emissions.	Million metric tons CO2	RFICE = (RFICB * RFTCFUS * (1 - RFNFSUS * RFSQSUS)) / 1,000,000
RFNFSUS	Residual fuel oil non-combustion share for the United States.	Share (number between 0 and 1)	RFNFSUS is independent.

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
RFSQSUS	Residual fuel oil nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	RFSQSUS = 0.5
RFTCE	Residual fuel oil total CO2 emissions.	Million metric tons CO2	RFTCE = RFACE + RFCCE + RFEIE + RFICE
RFTCFUS	Residual fuel oil CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	RFTCFUS is independent.
SGICE	Still gas industrial sector CO2 emissions.	Million metric tons CO2	SGICE = (SGICB * SGTCFUS * (1 - SGNFSUS * SGSQSUS)) / 1,000,000
SGNFSUS	Still gas non-combustion share for the United States.	Share (number between 0 and 1)	SGNFSUS is independent.
SGSQSUS	Still gas nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	SGSQSUS = 0.8
SGTCE	Still gas total CO2 emissions.	Million metric tons CO2	SGTCE = SGICE
SGTCFUS	Still gas and still gas for petrochemical feedstock use CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	SGTCFUS is independent.
SNICE	Special naphthas industrial sector CO2 emissions.	Million metric tons CO2	SNICE = (SNICB * SNTCFUS * (1 - SNNFSUS * SNSQSUS)) / 1,000,000
SNNFSUS	Special naphthas non-combustion share for the United States.	Share (number between 0 and 1)	SNNFSUS = 1
SNSQSUS	Special naphthas nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	SNSQSUS = 0
SNTCE	Special naphthas total CO2 emissions.	Million metric tons CO2	SNTCE = SNICE
SNTCFUS	Special naphthas CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	SNTCFUS is independent.
TEACE	Total energy CO2 emissions for the transportation sector.	Million metric tons CO2	TEACE = FFACE
TECCE	Total energy CO2 emissions for the commercial sector.	Million metric tons CO2	TECCE = FFCCE
TEEIE	Total energy CO2 emissions for the electric power sector.	Million metric tons CO2	TEEIE = FFEIE
TEICE	Total energy CO2 emissions for the industrial sector.	Million metric tons CO2	TEICE = FFICE

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
TERCE	Total energy CO2 emissions for the residential sector.	Million metric tons CO2	TERCE = FFRCE
TETCE	Total energy CO2 emissions.	Million metric tons CO2	TETCE = FFTCE
TPOPP	Resident population including Armed Forces.	Thousand population	TPOPPZZ is independent. TPOPPUS is independent.
UOICE	Unfinished oils industrial sector CO2 emissions.	Million metric tons CO2	UOICE = (UOICB * UOTCFUS * (1 - UONFSUS * UOSQSUS)) / 1,000,000
UONFSUS	Unfinished oils non-combustion share for the United States.	Share (number between 0 and 1)	UONFSUS = 1
UOSQSUS	Unfinished oils nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	UOSQSUS = 0
UOTCE	Unfinished oils total CO2 emissions.	Million metric tons CO2	UOTCE = UOICE
UOTCFUS	Unfinished oils CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	UOTCFUS is independent.
USICE	Unfractionated streams industrial sector CO2 emissions (through 1983).	Million metric tons CO2	USICE = (USICB * USTCFUS * (1 - USNFSUS * USSQSUS)) / 1,000,000
USNFSUS	Unfractionated streams non-combustion share for the United States (through 1983).	Share (number between 0 and 1)	USNFSUS = PPNFSUS
USSQSUS	Unfractionated streams carbon sequestration factor for the United States (through 1983).	Share (number between 0 and 1)	USSQSUS = PPSQSUS
USTCE	Unfractionated streams total CO2 emissions (through 1983).	Million metric tons CO2	USTCE = USICE
USTCFUS	Unfractionated streams CO2 emissions factor for the United States (through 1983).	Million metric tons CO2 per quadrillion Btu	USTCFUS is independent.
WXICE	Waxes industrial sector CO2 emissions.	Million metric tons CO2	WXICE = (WXICB * WXTCFUS * (1 - WXNFSUS * WXSQSUS)) / 1,000,000
WXNFSUS	Waxes non-combustion share for the United States.	Share (number between 0 and 1)	WXNFSUS = 1
WXSQSUS	Waxes nonfuel carbon sequestration factor for the United States.	Share (number between 0 and 1)	WXSQSUS = 1
WXTCE	Waxes total CO2 emissions.	Million metric tons CO2	WXTCE = WXICE

APPENDIX A

Table A1. CO2 emissions variables (cont.)

MSN	Description	Unit	Formula
WXTCFUS	Waxes CO2 emissions factor for the United States.	Million metric tons CO2 per quadrillion Btu	WXTCFUS is independent.

Table A2. Consumption adjustment variables

MSN	Description	Unit	Formula
ABICB	Aviation gasoline blending components consumed by the industrial sector.	Billion Btu	SEDS consumption variable
ARICB	Asphalt and road oil consumed by the industrial sector.	Billion Btu	SEDS consumption variable
AVACB	Aviation gasoline consumed by the transportation sector.	Billion Btu	SEDS consumption variable
BQICB	Normal butane consumed by the industrial sector.	Billion Btu	SEDS consumption variable
BYICB	Butylene from refineries consumed by the industrial sector.	Billion Btu	SEDS consumption variable
CCNIBUS	Coal coke net imports into the United States.	Billion Btu	SEDS consumption variable
CLACB	Coal consumed by the transportation sector.	Billion Btu	SEDS consumption variable
CLCCB	Coal consumed by the commercial sector.	Billion Btu	SEDS consumption variable
CLEIB	Coal consumed by the electric power sector.	Billion Btu	SEDS consumption variable
CLKCB	Coal consumed at coke plants (coking coal).	Billion Btu	SEDS consumption variable
CLOCB	Coal consumed by industrial users other than coke plants.	Billion Btu	SEDS consumption variable
CLRCB	Coal consumed by the residential sector.	Billion Btu	SEDS consumption variable
COICB	Crude oil consumed by the industrial sector.	Billion Btu	SEDS consumption variable
DMACB	Distillate fuel oil, excluding biodiesel and renewable diesel, consumed by the transportation sector.	Billion Btu	SEDS consumption variable
DMCCB	Distillate fuel oil, excluding biodiesel, consumed by the commercial sector.	Billion Btu	SEDS consumption variable
DMEIB	Distillate fuel oil, excluding biodiesel, consumed by the electric power sector.	Billion Btu	SEDS consumption variable
DMICB	Distillate fuel oil, excluding biofuels, consumed by the industrial sector.	Billion Btu	SEDS consumption variable
DMRCB	Distillate fuel oil, excluding biodiesel, consumed by the residential sector.	Billion Btu	SEDS consumption variable

Table A2. Consumption adjustment variables (cont.)

MSN	Description	Unit	Formula
ELISB	Net interstate flow of electricity and associated losses (negative indicates flow out of state).	Billion Btu	SEDS consumption variable
EQICB	Ethane consumed by the industrial sector.	Billion Btu	SEDS consumption variable
EYICB	Ethylene from refineries consumed by the industrial sector.	Billion Btu	SEDS consumption variable
FNICB	Petrochemical feedstocks, naphtha less than 401° F, consumed by the industrial sector.	Billion Btu	SEDS consumption variable
FOICB	Petrochemical feedstocks, other oils equal to or greater than 401° F, consumed by the industrial sector.	Billion Btu	SEDS consumption variable
FSICB	Petrochemical feedstocks, still gas, consumed by the industrial sector (through 1985).	Billion Btu	SEDS consumption variable
IQICB	Isobutane consumed by the industrial sector.	Billion Btu	SEDS consumption variable
IYICB	Isobutylene from refineries consumed by the industrial sector.	Billion Btu	SEDS consumption variable
JFACB	Jet fuel consumed by the transportation sector.	Billion Btu	SEDS consumption variable
JFEUB	Jet fuel consumed by the electric power sector (through 1982).	Billion Btu	SEDS consumption variable
KSCCB	Kerosene consumed by the commercial sector.	Billion Btu	SEDS consumption variable
KSICB	Kerosene consumed by the industrial sector.	Billion Btu	SEDS consumption variable
KSRCB	Kerosene consumed by the residential sector.	Billion Btu	SEDS consumption variable
LGACB	LPG consumed by the transportation sector (through 2009).	Billion Btu	SEDS consumption variable
LGCCB	LPG consumed by the commercial sector (through 2009).	Billion Btu	SEDS consumption variable
LGICB	LPG consumed by the industrial sector (through 2009).	Billion Btu	SEDS consumption variable
LGRCB	LPG consumed by the residential sector (through 2009).	Billion Btu	SEDS consumption variable
LUACB	Lubricants consumed by the transportation sector.	Billion Btu	SEDS consumption variable

Table A2. Consumption adjustment variables (cont.)

MSN	Description	Unit	Formula
LUICB	Lubricants consumed by the industrial sector.	Billion Btu	SEDS consumption variable
MBICB	Motor gasoline blending components consumed by the industrial sector.	Billion Btu	SEDS consumption variable
MMACB	Motor gasoline, excluding fuel ethanol, consumed by the transportation sector.	Billion Btu	SEDS consumption variable
MMCCB	Motor gasoline, excluding fuel ethanol, consumed by the commercial sector.	Billion Btu	SEDS consumption variable
MMICB	Motor gasoline, excluding fuel ethanol, consumed by the industrial sector.	Billion Btu	SEDS consumption variable
MSICB	Miscellaneous petroleum products consumed by the industrial sector.	Billion Btu	SEDS consumption variable
NAICB	Natural gasoline consumed by the industrial sector (through 1983).	Billion Btu	SEDS consumption variable
NNACB	Natural gas, excluding supplemental gaseous fuels, consumed by the transportation sector.	Billion Btu	SEDS consumption variable
NNCCB	Natural gas, excluding supplemental gaseous fuels, consumed by the commercial sector.	Billion Btu	SEDS consumption variable
NNEIB	Natural gas, excluding supplemental gaseous fuels, consumed by the electric power sector.	Billion Btu	SEDS consumption variable
NNICB	Natural gas, excluding supplemental gaseous fuels, consumed by the industrial sector.	Billion Btu	SEDS consumption variable
NNRCB	Natural gas, excluding supplemental gaseous fuels, consumed by the residential sector.	Billion Btu	SEDS consumption variable
PCCCB	Petroleum coke consumed by the commercial sector.	Billion Btu	SEDS consumption variable
PCEIB	Petroleum coke consumed by the electric power sector.	Billion Btu	SEDS consumption variable
PCICB	Petroleum coke consumed in the industrial sector.	Billion Btu	SEDS consumption variable
PLICB	Plant condensate consumed by the industrial sector (through 1983).	Billion Btu	SEDS consumption variable

Table A2. Consumption adjustment variables (cont.)

MSN	Description	Unit	Formula
PPICB	Natural gasoline (pentanes plus) consumed by the industrial sector.	Billion Btu	SEDS consumption variable
PQACB	Propane consumed by the transportation sector.	Billion Btu	SEDS consumption variable
PQCCB	Propane consumed by the commercial sector.	Billion Btu	SEDS consumption variable
PQICB	Propane consumed by the industrial sector.	Billion Btu	SEDS consumption variable
PQRCB	Propane consumed by the residential sector.	Billion Btu	SEDS consumption variable
PYICB	Propylene from refineries consumed by the industrial sector.	Billion Btu	SEDS consumption variable
RFACB	Residual fuel oil consumed by the transportation sector.	Billion Btu	SEDS consumption variable
RFCCB	Residual fuel oil consumed by the commercial sector.	Billion Btu	SEDS consumption variable
RFEIB	Residual fuel oil consumed by the electric power sector.	Billion Btu	SEDS consumption variable
RFICB	Residual fuel oil consumed by the industrial sector.	Billion Btu	SEDS consumption variable
SGICB	Still gas consumed by the industrial sector.	Billion Btu	SEDS consumption variable
SNICB	Special naphthas consumed by the industrial sector.	Billion Btu	SEDS consumption variable
TETCB	Total energy consumption.	Billion Btu	SEDS consumption variable
UOICB	Unfinished oils consumed by the industrial sector.	Billion Btu	SEDS consumption variable
USICB	Unfractionated streams consumed by the industrial sector (through 1983).	Billion Btu	SEDS consumption variable
WXICB	Waxes consumed by the industrial sector.	Billion Btu	SEDS consumption variable

Glossary

Asphalt: A dark brown-to-black cement-like material obtained by petroleum processing and containing bitumens as the predominant component; used primarily for road construction. It includes crude asphalt as well as the following finished products: cements, fluxes, the asphalt content of emulsions (exclusive of water), and petroleum distillates blended with asphalt to make cutback asphalts. *Note:* The conversion factor for asphalt is 5.5 barrels per short ton.

ASTM: American Society for Testing and Materials

Aviation gasoline (finished): A complex mixture of relatively volatile hydrocarbons with or without small quantities of additives, blended to form a fuel suitable for use in aviation reciprocating engines. Fuel specifications are provided in ASTM Specification D 910 and Military Specification MIL-G-5572. *Note:* Data on blending components are not counted in data on finished aviation gasoline.

Aviation gasoline blending components: Naphthas that will be used for blending or compounding into finished aviation gasoline (e.g., straight run gasoline, alkylate, reformate, benzene, toluene, and xylene). Excludes oxygenates (alcohols, ethers), butane, and pentanes plus. Oxygenates are reported as other hydrocarbons, hydrogen, and oxygenates.

Barrel (petroleum): A unit of volume equal to 42 U.S. gallons.

Barrels per calendar day: The amount of input that a distillation facility can process under usual operating conditions. The amount is expressed in terms of capacity during a 24-hour period and reduces the maximum processing capability of all units at the facility under continuous operation (see **Barrels per stream day**) to account for the following limitations that may delay, interrupt, or slow down production: 1. the capability of downstream processing units to absorb the output of crude oil processing facilities of a given refinery. No reduction is necessary for intermediate streams that are distributed to other than downstream facilities as part of a refinery's normal operation; 2. the types and grades of inputs to be processed; 3. the types and grades of products expected to be manufactured; 4. the environmental constraints associated with refinery operations; 5. the reduction of capacity for scheduled downtime due to such conditions as routine inspection, maintenance, repairs, and turnaround; and 6. the reduction of capacity for unscheduled downtime due to such conditions as mechanical problems, repairs, and slowdowns.

Barrels per stream day: The maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime.

Battery electric vehicle (BEV): An all-electric vehicle that receives power by plugging into an electric power source and storing the power in a battery pack. BEVs do not use any petroleum-based or other liquid- or gas-based fuel during operation and do not produce tailpipe emissions.

Biodiesel (B100): Renewable fuel consisting of mono alkyl esters (long chain fatty acids) that are produced through the conversion of animal fats, vegetable oils, and recycled grease feedstocks (transesterification) to produce biodiesel. Biodiesel is typically blended with petroleum diesel in concentrations of 2% to 20% biodiesel, or B2 to B20.

Biofuels: Liquid fuels and blending components produced from biomass feedstocks, used primarily for transportation.

Biomass: Organic non-fossil material of biological origin constituting a re-newable energy source.

Biomass waste: Organic non-fossil material of biological origin that is a byproduct or a discarded product. Biomass waste includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw, and other biomass solids, liquids, and gases; but excludes wood and wood-derived fuels (including black liquor), biofuels feedstock, biodiesel, and fuel ethanol. *Note:* EIA biomass waste data also include energy crops grown specifically for energy production, which would not normally constitute waste.

Black liquor: A byproduct of the paper production process, alkaline spent liquor, that can be used as a source of energy. Alkaline spent liquor is removed from the digesters in the process of chemically pulping wood. After evaporation, the residual "black" liquor is burned as a fuel in a recovery furnace that permits the recovery of certain basic chemicals.

British thermal unit (Btu): The quantity of heat required to raise the temperature of 1 pound of liquid water by 1 degree Fahrenheit at the temperature at which water has its greatest density (about 39 degrees

Fahrenheit).

Bunker fuels: Fuel supplied to ships and aircraft, both domestic and foreign, consisting primarily of residual and distillate fuel oil for ships and kerosene-based jet fuel for aircraft. The term “international bunker fuels” is used to de*Note* the consumption of fuel for international transport activities. *Note*: For the purposes of greenhouse gas emissions inventories, data on emissions from combustion of international bunker fuels are subtracted from national emissions totals. Historically, bunker fuels have meant only ship fuel.

Butane (C_4H_{10}): A straight-chain or branch-chain hydrocarbon extracted from natural gas or refinery gas streams, which is gaseous at standard temperature and pressure. It includes isobutane and normal butane and is designated in ASTM Specification D1835 and Gas Processors Association specifications for commercial butane.

Butylene (C_4H_8): An olefinic hydrocarbon recovered from refinery or petrochemical processes, which is gaseous at standard temperature and pressure. Butylene is used in the production of gasoline and various petrochemical products.

Carbon dioxide (CO2): A colorless, odorless, non-poisonous gas that is a normal part of Earth's atmosphere. Carbon dioxide is a product of fossil-fuel combustion as well as other processes. It is considered a greenhouse gas as it traps heat (infrared energy) radiated by the Earth into the atmosphere and thereby contributes to the potential for global warming. The global warming potential (GWP) of other greenhouse gases is measured in relation to that of carbon dioxide, which by international scientific convention is assigned a value of one (1).

Catalytic cracking: The refining process of breaking down the larger, heavier, and more complex hydrocarbon molecules into simpler and lighter molecules. Catalytic cracking is accomplished by the use of a catalytic agent and is an effective process for increasing the yield of gasoline from crude oil. Catalytic cracking processes fresh feeds and recycled feeds.

Chained dollar gross domestic product: A measure of gross domestic product using real prices. See **chained dollars** and **gross domestic product (GDP)**.

Chained dollars: A measure used to express real prices. Real prices are those that have been adjusted to remove the effect of changes in the purchasing power of the dollar; they usually reflect buying power relative to a reference year. Before 1996, real prices were expressed in constant dollars, a measure based on the weights of goods and services in a single year, usually a recent year. In 1996, the U.S. Department of Commerce introduced the chained-dollar measure. The new measure is based on the average weights of goods and services in successive pairs of years. It is “chained” because the second year in each pair, with its weights, becomes the first year of the next pair. The advantage of using the chained-dollar measure is that it is more closely related to any given period covered and is therefore subject to less distortion over time.

Coal: A readily combustible black or brownish-black rock whose composition, including inherent moisture, consists of more than 50% by weight and more than 70% by volume of carbonaceous material. It is formed from plant remains that have been compacted, hardened, chemically altered, and metamorphosed by heat and pressure over geologic time. Coals are classified according to their degree of progressive alteration from lignite to anthracite. In the U.S. classification, the ranks of coal include lignite, subbituminous coal, bituminous coal, and anthracite and are based on fixed carbon, volatile matter, heating value, and agglomerating (or caking) properties.

Coking coal: Bituminous coal suitable for making coke.

Steam coal: In this report, steam coal represents all noncoking coal.

Coal coke: A solid carbonaceous residue derived from low-ash, low-sulfur bituminous coal from which the volatile constituents are driven off by baking in an oven at temperatures as high as 2,000 degrees Fahrenheit so that the fixed carbon and residual ash are fused together. Coke is used as a fuel and as a reducing agent in smelting iron ore in a blast furnace. Coke from coal is gray, hard, and porous and has a heating value of 24.8 million Btu per ton.

Coke plants: Plants where coal is carbonized for the manufacture of coke in slot or beehive ovens.

Combined-heat-and-power (CHP) plant: A plant designed to produce both heat and electricity. If one or more units of the plant is a CHP unit, then the whole plant is designated as a CHP plant. *Note:* This term is being used in place of the term “cogenerator” that was used by EIA in the past. CHP better describes the facilities because some of the plants included do not produce heat and power in a sequential fashion and, as a result, do not meet the legal definition of cogeneration specified in the Public Utility Regulatory Polices Act (PURPA).

Commercial sector: An energy-consuming sector that consists of service-providing facilities and equipment of: businesses; federal, state,

and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. It also includes sewage treatment facilities. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment. *Note:* This sector includes generators that produce electricity and/or useful thermal output primarily to support the activities of the above-mentioned commercial establishments.

Conversion factor: A factor for converting data between one unit of measurement and another (such as between short tons and British thermal units, or between barrels and gallons). (See https://www.eia.gov/totalenergy/data/monthly/pdf/mer_a.pdf and https://www.eia.gov/totalenergy/data/monthly/pdf/mer_b.pdf for further information on conversion factors.)

Cord of wood: A cord of wood measures 4 feet by 4 feet by 8 feet, or 128 cubic feet.

Crude oil (including lease condensate): A mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Depending upon the characteristics of the crude stream, crude oil may also include: 1. small amounts of hydrocarbons that exist in gaseous phase in natural underground reservoirs but are liquid at atmospheric pressure after being recovered from oil well (casinghead) gas in lease separators and are subsequently comingled with the crude stream without being separately measured. Lease condensate recovered as a liquid from natural gas wells in lease or field separation facilities and later mixed into the crude stream is also included; 2. Small amounts of nonhydrocarbons produced with the oil, such as sulfur and various metals; 3. Drip gases, and liquid hydrocarbons produced from tar sands, gilsonite, and oil shale. Liquids produced at natural gas processing plants are excluded. Crude oil is refined to produce a wide array of petroleum products, including heating oils; gasoline, diesel and jet fuels; lubricants; asphalt; ethane, propane, and butane; and many other products used for their energy or chemical content.

Crude oil used directly: Crude oil consumed as fuel by crude oil pipelines and on crude oil leases.

Cubic foot (cf), natural gas: The amount of natural gas contained at standard temperature and pressure (60 degrees Fahrenheit and 14.73 pounds standard per square inch) in a cube whose edges are one foot long.

Current-dollar gross domestic product: A measure of gross domestic product using current price. See **gross domestic product (GDP)**.

Denaturant: Petroleum, typically pentanes plus or conventional motor gasoline, added to fuel ethanol to make it unfit for human consumption. Fuel ethanol is denatured, usually before transport from the ethanol production facility, by adding 2 to 5 volume percent denaturant.

Diesel fuel: A fuel composed of distillates obtained in petroleum refining operation or blends of such distillates with residual oil used in motor vehicles. The boiling point and specific gravity are higher for diesel fuels than for gasoline.

Distillate fuel oil: A general classification for one of the petroleum fractions produced in conventional distillation operations. It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation.

Electric power sector: An energy-consuming sector that consists of electricity only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public—i.e., North American Industry Classification System 22 plants. See combined-heat-and-power (CHP) plant and electricity only plant. The electric power sector consumes primary energy to generate electricity and heat (forms of secondary energy). Electricity is sold to the four end-use sectors (residential, commercial, industrial, and transportation), stored for future use, and exported to other countries.

Electrical system energy losses: The amount of energy lost during generation, transmission, and distribution of electricity, including plant and unaccounted-for uses.

Electricity sales to ultimate customers: Electricity sales that are consumed by the customer and not available for resale. Includes electric sales to end users by third-party owners of behind-the-meter PV solar systems.

Electric utility: A corporation, person, agency, authority, or other legal entity or instrumentality aligned with distribution facilities for delivery of electric energy for use primarily by the public. Included are investor-owned electric utilities, municipal and state utilities, federal electric

utilities, and rural electric cooperatives. A few entities that are tariff based and corporately aligned with companies that own distribution facilities are also included.

Electric vehicle (EV): A general term for any on-road licensed vehicle that can plug into an electric power source and uses electric power to move. EVs plug into a source of electricity and store power in a battery pack for all or part of their power needs. Includes Battery electric vehicles (BEVs) and Plug-in hybrid vehicles (PHEVs). Can also be referred to as Plug-in Electric Vehicles (PEV).

Electric vehicle charging location: A geographically distinct place, based on latitude and longitude with one or more Electric Vehicle (EV) charging ports. One charging location can include co-located public and private EV charging ports, networked and non-networked EV charging ports, and EV charging ports of various speeds such as Level 2 and DC fast chargers. Multiple EV charging locations can be associated with a common development area, such as a parking lot or parking garage serving a shopping center or office building.

Electric vehicle charging port: The electric vehicle (EV) charging equipment that connects to and charges an EV. The number of ports is the total number of vehicles that can charge simultaneously at an EV charging location. A single EV charging port can connect to and charge one vehicle at a time. If the EV charging equipment can connect to and charge more than one vehicle simultaneously than that would count as multiple charging ports.

Electrical system energy losses: The amount of energy lost during generation, transmission, and distribution of electricity, including plant and unaccounted for uses.

Electricity sales to ultimate customers: Electricity sales that are consumed by the customer and not available for resale. Includes electric sales to end users by third-party owners of behind-the-meter PV solar systems.

End-use energy consumption: End-use sector (residential, commercial, industrial, and transportation) consumption of primary energy plus electricity sales to ultimate customers. The energy associated with electrical system energy losses is not included.

End-use sectors: The residential, commercial, industrial, and transportation sectors of the economy.

Energy: The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy). Energy has several forms, some of which are easily convertible and can be changed to another form useful for work. Most of the world's convertible energy comes from fossil fuels that are burned to produce heat that is then used as a transfer medium to mechanical or other means to accomplish tasks. Electrical energy is usually measured in kilowatthours, while heat energy is usually measured in British thermal units (Btu).

Energy consumption: The use of energy as a source of heat or power or as a raw material input to a manufacturing process.

Energy expenditures: The money directly spent by consumers to purchase energy. Expenditures equal the amount of energy used by the consumer multiplied by the price per unit paid by the consumer. *Note:* In the calculation of the amount of energy used, process fuel and intermediate products are not included.

Energy-consuming sectors: The residential, commercial, industrial, transportation, and electric power sectors of the economy.

Ethane (C_2H_6): A straight-chain saturated (paraffinic) hydrocarbon extracted predominantly from the natural gas stream, which is gaseous at standard temperature and pressure. It is a colorless gas that boils at a temperature of -127 degrees Fahrenheit.

Ethanol (C_2H_5OH): A clear, colorless, flammable alcohol. Ethanol is typically produced biologically from biomass feedstocks such as agricultural crops and cellulosic residues from agricultural crops or wood. Ethanol can also be produced chemically from ethylene. See **fuel ethanol**.

Ethylene (C_2H_4): An olefinic hydrocarbon recovered from refinery or petrochemical processes, which is gaseous at standard temperature and pressure. Ethylene is used as a petrochemical feedstock for many chemical applications and the production of consumer goods.

Exports: Shipments of goods from within the 50 states and the District of Columbia to U.S. possessions and territories or to foreign countries.

f.a.s.: See **free alongside ship**.

Federal Energy Regulatory Commission (FERC): The federal agency with jurisdiction over interstate electricity sales, wholesale electric rates, hydroelectric licensing, natural gas pricing, oil pipeline rates, and gas pipeline certification. FERC is an independent regulatory agency within the Department of Energy and is the successor to the Federal Power Commission.

Federal Power Commission (FPC): The predecessor agency of the Federal Energy Regulatory Commission. The Federal Power Commission was created by an Act of Congress under the Federal Water Power Act on June 10, 1920. It was charged originally with regulating the electric power and natural gas industries. It was abolished on September 30, 1977, when the Department of Energy was created. Its functions were divided between the Department of Energy and the Federal Energy Regulatory Commission, an independent regulatory agency.

Fiscal year: The U.S. Government's fiscal year runs from October 1 through September 30. The fiscal year is designated by the calendar year in which it ends; e.g., fiscal year 2002 begins on October 1, 2001, and ends on September 30, 2002.

Fossil fuel: An energy source formed in the Earth's crust from decayed organic material. The common fossil fuels are petroleum, coal, and natural gas.

Free alongside ship (f.a.s.): The value of a commodity at the port of ex-portation, generally including the purchase price, plus all charges incurred in placing the commodity alongside the carrier at the port of exportation.

Fossil-fuel steam-electric power plant: An electricity generation plant in which the prime mover is a turbine rotated by high-pressure steam produced in a boiler by heat from burning fossil fuels.

Fuel ethanol: Ethanol intended for fuel use. Fuel ethanol in the United States must be anhydrous (less than 1% water). Fuel ethanol is denatured (made unfit for human consumption), usually before transport from the ethanol production facility, by adding 2 to 5 volume percent petroleum, typically pentanes plus or conventional motor gasoline. Fuel ethanol is used principally for blending in low concentrations with motor gasoline as an oxygenate or octane enhancer. In high concentrations, it is used to fuel alternative-fuel vehicles specially designed for its use.

Fuel ethanol excluding denaturant: See **fuel ethanol minus denaturant**.

Fuel ethanol minus denaturant: An unobserved quantity of anhydrous, biomass-derived, undenatured ethanol for fuel use. The quantity is obtained by subtracting the estimated denaturant volume from fuel ethanol volume. Fuel ethanol minus denaturant is counted as renewable energy, while denaturant is counted as nonrenewable fuel.

Gasohol: A blend of finished motor gasoline containing alcohol (generally ethanol but sometimes methanol) at a concentration between 5.7% and 10% by volume.

Geothermal energy: Hot water or steam extracted from geothermal reser-voirs in the Earth's crust. Water or steam extracted from geothermal reser-voirs can be used for geothermal heat pumps, water heating, or electricity generation.

Gross domestic product (GDP): The total value of goods and services produced by labor and property located in the United States. As long as the labor and property are located in the United States, the supplier (that is, the workers and, for property, the owners) may be either U.S. residents or residents of foreign countries.

Gross generation: The total amount of electric energy produced by generating units and measured at the generating terminal in kilowatthours (kWh) or megawatthours (MWh).

Heat content: The amount of heat energy available to be released by the transformation or use of a specified physical unit of an energy form (e.g., a ton of coal, a barrel of oil, a kilowatthour of electricity, a cubic foot of natural gas, or a pound of steam). The amount of heat energy is commonly expressed in British thermal units (Btu). *Note:* Heat content of combustible energy forms can be expressed in terms of either gross heat content (higher or upper heating value) or net heat content (lower heating value), depending upon whether or not the available heat energy includes or excludes the energy used to vaporize water (contained in the original energy form or created during the combustion process). The Energy Information Administration typically uses gross heat content values.

Heat rate: A measure of generating station thermal efficiency commonly stated as Btu per kilowatthour. *Note:* Heat rates can be expressed as either gross or net heat rates, depending on whether the electricity output is gross or net generation. Heat rates are typically expressed as net heat rates.

Heating degree days (HDD): A measure of how cold a location is over a period of time relative to a base temperature, most commonly specified as 65 degrees Fahrenheit. The measure is computed for each day by sub-tracting the average of the day's high and low temperatures from the base temperature (65 degrees), with negative values set equal to zero. Each day's heating degree days are summed to create a heating degree day measure for a specified reference period. Heating degree days are used in energy analysis as an indicator of space heating energy requirements or use.

Hydrocarbon gas liquids (HGL): A group of hydrocarbons including ethane, propane, normal butane, isobutane, and natural gasoline, and their associated olefins, including ethylene, propylene, butylene, and isobutylene. As marketed products, HGL represents all natural gas liquids (NGL) and olefins. EIA reports production of HGL from refineries (liquefied refinery gas, or LRG) and natural gas plants (natural gas plant liquids, or NGPL). Excludes liquefied natural gas (LNG).

Hydroelectric power: The use of flowing water to produce electrical energy.

Hydroelectric power, conventional: Hydroelectric power generated from flowing water that is not created by hydroelectric pumped storage.

Hydroelectric pumped storage: Hydroelectric power that is generated during peak load periods by using water previously pumped into an elevated storage reservoir during off-peak periods when excess generating capacity is available to do so. When additional generating capacity is needed, the water can be released from the reservoir through a conduit to turbine generators located in an electric power plant at a lower level.

Hydroelectric power plant: A plant in which the turbine generators are driven by falling water.

Imports: Receipts of goods into the 50 states and the District of Columbia from U.S. possessions and territories or from foreign countries.

Independent power producer: A corporation, person, agency, authority, or other legal entity or instrumentality that owns or operates facilities for the generation of electricity for use primarily by the public, and that is not an electric utility. *Note*: Independent power producers are included in the electric power sector.

Industrial sector: An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods. The industrial sector encompasses the following types of activity: manufacturing (NAICS codes 31-33); agriculture, forestry, fishing and hunting (NAICS code 11); mining, including oil and gas extraction (NAICS code 21); and construction (NAICS code 23). Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting. Fossil fuels are also used as raw material inputs to manufactured products. *Note*: This sector includes generators that produce electricity and/or useful thermal output primarily to support the above-mentioned industrial activities.

Isobutane (C_4H_{10}): A branch-chain saturated (paraffinic) hydrocarbon extracted from both natural gas and refinery gas streams, which is gaseous at standard temperature and pressure. It is a colorless gas that boils at a temperature of 11 degrees Fahrenheit.

Isobutylene (C_4H_8): A branch-chain olefinic hydrocarbon recovered from refinery or petrochemical processes, which is gaseous at standard temperature and pressure. Isobutylene is used in the production of gasoline and various petrochemical products.

Jet fuel: A refined petroleum product used in jet aircraft engines. It includes kerosene-type jet fuel and naphtha-type jet fuel.

Jet fuel, kerosene-type: A kerosene-based product having a maximum distillation temperature of 400 degrees Fahrenheit at the 10% recovery point and a final maximum boiling point of 572 degrees Fahrenheit and meeting ASTM Specification D 1655 and Military Specifications MIL-T-5624P and MIL-T-83133D (Grades JP-5 and JP-8). It is used for commercial and military turbo jet and turbo prop aircraft engines.

Jet fuel, naphtha-type: A fuel in the heavy naphtha boiling range having an average gravity of 52.8 degrees API, 20% to 90% distillation temperatures of 290 degrees to 470 degrees Fahrenheit, and meeting Military Specification MIL-T-5624L (Grade JP-4). It is used primarily for military turbojet and turboprop aircraft engines because it has a lower freeze point than other aviation fuels and meets engine requirements at high altitudes and speeds. *Note:* Beginning with January 2004 data, naphtha-type jet fuel is included in Miscellaneous Products.

Kerosene: A light petroleum distillate that is used in space heaters, cook stoves, and water heaters and is suitable for use as a light source when burned in wick-fed lamps. Kerosene has a maximum distillation temperature of 400 degrees Fahrenheit at the 10% recovery point, a final maximum boiling point of 572 degrees Fahrenheit, and a minimum flash point of 100 degrees Fahrenheit. Included are No. 1-K and No. 2-K, the two grades recognized by ASTM Specification D 3699 as well as all other grades of kerosene called range or stove oil, which have properties similar to those of No. 1 fuel oil. Also see **Jet Fuel, Kerosene-type**.

Kilowatthour (kWh): A measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for 1 hour. One kWh is equal to 3,412 Btu.

Lease and plant fuel: Natural gas used in well, field, and lease operations (such as gas used in drilling operations, heaters, dehydrators, and field compressors) and as fuel in natural gas processing plants.

Lease condensate: A mixture consisting primarily of hydrocarbons heavier than pentanes that is recovered as a liquid from natural gas in lease separation facilities. This category excludes natural gas plant liquids, such as butane and propane, which are recovered at downstream natural gas processing plants or facilities.

Liquefied petroleum gases (LPG): A group of hydrocarbon gases, primarily propane, normal butane, and isobutane, derived from crude oil refining or natural gas processing. These gases may be marketed individually or mixed. They can be liquefied through pressurization (without requiring cryogenic refrigeration) for convenience of transportation or storage. Excludes ethane and olefins. *Note*: In some EIA publications, LPG includes ethane and marketed refinery olefin streams, in accordance with definitions used prior to January 2014.

Lubricants: Substances used to reduce friction between bearing surfaces, or incorporated into other materials used as processing aids in the manufacture of other products, or used as carriers of other materials. Petroleum lubricants may be produced either from distillates or residues. Lubricants include all grades of lubricating oils, from spindle oil to cylinder oil to those used in greases.

Methanol (CH_3OH): A light, volatile alcohol eligible for gasoline blending.

Miscellaneous petroleum products: Includes all finished products not classified elsewhere (e.g., petrolatum lube refining by products (aromatic extracts and tars), absorption oils, ram-jet fuel, petroleum rocket fuels, synthetic natural gas feed stocks, and specialty oils).

Motor gasoline (finished): A complex mixture of relatively volatile hydrocarbons with or without small quantities of additives, blended to form a fuel suitable for use in spark-ignition engines. Motor gasoline, as defined in ASTM Specification D 4814 or Federal Specification VV-G-1690C, is characterized as having a boiling range of 122 to 158 degrees Fahrenheit at the 10% recovery point to 365 to 374 degrees Fahrenheit at the 90% recovery point. Motor Gasoline includes conventional gasoline; all types of oxygenated gasoline, including gasohol; and reformulated gasoline, but excludes aviation gasoline. *Note:* Volumetric data on blending components, such as oxygenates, are not counted in data on finished motor gasoline until the blending components are blended into the gasoline.

Motor gasoline blending components: Naphthas (e.g., straight-run gas-oline, alkylate, reformate, benzene, toluene, xylene) used for blending or compounding into finished motor gasoline. These components include re-formulated gasoline blendstock for oxygenate blending (RBOB) but exclude oxygenates (alcohols, ethers), butane, and pentanes plus. *Note:* Oxygenates are reported as individual components and are included in the total for other hydrocarbons, hydrogens, and oxygenates.

Natural gas: A gaseous mixture of hydrocarbon compounds, the primary one being methane.

Natural gas liquids (NGL): A group of hydrocarbons including ethane, propane, normal butane, isobutane, and natural gasoline. Generally include natural gas plant liquids and all liquefied refinery gases except olefins.

Natural gas, dry: Natural gas which remains after: 1) the liquefiable hydrocarbon portion has been removed from the gas stream (i.e., gas after lease, field, and/or plant separation); and 2) any volumes of nonhydrocarbon gases have been removed where they occur in sufficient quantity to render the gas unmarketable. *Note*: Dry natural gas is also known as consumer-grade natural gas. The parameters for measurement are cubic feet at 60 degrees Fahrenheit and 14.73 pounds per square inch absolute.

Natural gasoline: A commodity product commonly traded in natural gas liquids (NGL) markets that comprises liquid hydrocarbons (mostly pentanes and hexanes) and generally remains liquid at ambient temperatures and atmospheric pressure. Natural gasoline is equivalent to pentanes plus.

Net generation: The amount of **gross generation** less the electrical energy consumed at the generating station(s) for station service or auxiliaries. *Note*: Electricity required for pumping at pumped-storage plants is regarded as electricity for station service and is deducted from **gross generation**.

Net interstate flow of electricity: The difference between the sum of electricity sales and losses within a state and the total amount of electricity generated within that state. A positive number indicates that more electricity (including associated losses) came into the state than went out of the state during the year; conversely, a negative number indicates that more electricity (including associated losses) went out of the state than came into the state.

Net summer capacity: The maximum output, commonly expressed in thousand kilowatts (kW), that generating equipment can supply to system load, as demonstrated by a multi-hour test, at the time of summer peak demand (period of June 1 through September 30). This output reflects a reduction in capacity due to electricity use for station service or auxiliaries.

GLOSSARY

Nominal dollars: A measure used to express nominal price.

Nominal price: The price paid for a product or service at the time of the transaction. Nominal prices are those that have not been adjusted to remove the effect of changes in the purchasing power of the dollar; they reflect buying power in the year in which the transaction occurred.

Non-biomass waste: Material of non-biological origin that is a byproduct or a discarded product. "Non-biomass waste" includes municipal solid waste from non-biogenic sources, such as plastics, and tire-derived fuels.

Non-combustion use: Fossil fuels (coal, natural gas, and petroleum products) that are not burned to release energy and instead used directly as construction materials, chemical feedstocks, lubricants, solvents, waxes, and other products. Sometimes used synonymously with "nonfuel use (of energy)."

Nonutilities: See **nonutility power producer**.

Nonutility power producer: A corporation, person, agency, authority, or other legal entity or instrumentality that owns or operates facilities for electric generation and is not an electric utility. Nonutility power producers include qualifying cogenerators, qualifying small power producers, and other nonutility generators (including independent power producers). Nonutility power producers are without a designated franchised service area and do not file forms listed in the *Code of Federal Regulations*, Title 18, Part 141.

Normal butane (C_4H_{10}): A straight-chain saturated (paraffinic) hydrocarbon extracted from both natural gas and refinery gas streams, which is gaseous at standard temperature and pressure. It is a colorless gas that boils at a temperature of 31 degrees Fahrenheit.

North American Industry Classification System (NAICS): A classification scheme, developed by the Office of Management and Budget to replace the Standard Industrial Classification (SIC) System, that categorizes establishments according to the types of production processes they primarily use.

Nuclear electric power (nuclear power): Electricity generated by the use of the thermal energy released from the fission of nuclear fuel in a reactor.

Nuclear fuel: Fissionable materials that have been enriched to a composition that, when placed in a nuclear reactor, will support a self-sustaining fission chain reaction, producing heat in a controlled manner for process use.

Other biofuels: Fuels and fuel blending components, except biodiesel, renewable diesel fuel, and fuel ethanol, produced from renewable biomass.

Other energy losses: Energy losses throughout the energy system as they are consumed, usually in the form of heat, that are not separately identified by the U.S. Energy Information Administration. Examples include heat lost in the process of burning motor gasoline to move vehicles or in electricity used to power a lightbulb.

PAD Districts or PADD: Petroleum Administration for Defense Districts. A geographic aggregation of the 50 states and the District of Columbia into five Districts, with PADD 1 further split into three subdistricts. The PADDs include the states listed below:

- PADD 1 (East Coast):
  - PADD 1A (New England): Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.
  - PADD 1B (Central Atlantic): Delaware, District of Columbia, Maryland, New Jersey, New York, and Pennsylvania.
  - PADD 1C (Lower Atlantic): Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia.
- PADD 2 (Midwest): Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, and Wisconsin.
- PADD 3 (Gulf Coast): Alabama, Arkansas, Louisiana, Mississippi, New Mexico, and Texas.
- PADD 4 (Rocky Mountain): Colorado, Idaho, Montana, Utah, and Wyoming.
- PADD 5 (West Coast): Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington.

Pentanes plus: A mixture of liquid hydrocarbons, mostly pentanes and heavier, extracted from natural gas in a gas processing plant. Pentanes plus is equivalent to natural gasoline.

Petrochemical feedstocks: Chemical feedstocks derived from petroleum principally for the manufacture of chemicals, synthetic rubber, and a variety of plastics. In this report the categories reported are "Naphtha Less Than 401°F" and "Other Oils Equal to or Greater Than 401°F."

Petroleum: A broadly defined class of liquid hydrocarbon mixtures. Included are crude oil, lease condensate, unfinished oils, refined products obtained from the processing of crude oil, and natural gas plant liquids.

Note: Volumes of finished petroleum products include nonhydrocarbon compounds, such as additives and detergents, after they have been blended into the products.

Petroleum coke: A residue high in carbon content and low in hydrogen that is the final product of thermal decomposition in the condensation process in cracking. This product is reported as marketable coke or catalyst coke. The conversion is 5 barrels (of 42 U.S. gallons each) per short ton.

Petroleum coke, catalyst: The carbonaceous residue that is deposited on and deactivates the catalyst used in many catalytic operations (e.g., catalytic cracking). Carbon is deposited on the catalyst, thus deactivating the catalyst. The catalyst is reactivated by burning off the carbon, which is used as a fuel in the refining process. That carbon or coke is not recoverable in a concentrated form.

Petroleum coke, marketable: Those grades of coke produced in delayed or fluid cokers that may be recovered as relatively pure carbon. Marketable petroleum coke may be sold as is or further purified by calcining.

Petroleum consumption: The sum of all refined petroleum products sup-plied. See **products supplied (petroleum)**.

Petroleum products: Petroleum products are obtained from the processing of crude oil (including lease condensate), natural gas, and other hydrocarbon compounds. Petroleum products include unfinished oils, hydrocarbon gas liquids, aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, petrochemical feedstocks, special naphthas, lubricants, waxes, petroleum coke, asphalt, road oil, still gas, and miscellaneous products.

Photovoltaic energy: Direct-current electricity generated from photovoltaic cells. See **photovoltaic cells (PVC)**.

Photovoltaic cells (PVC): An electronic device consisting of layers of semiconductor materials fabricated to form a junction (adjacent layers of materials with different electronic characteristics) and electrical contacts and being capable of converting incident light directly into electricity (direct current).

Plant condensate: Liquid hydrocarbons recovered at inlet separators or scrubbers in natural gas processing plants at atmospheric pressure and ambient temperatures. Mostly pentanes and heavier hydrocarbons.

Plug-in hybrid electric vehicle (PHEV): A vehicle that can both (1) plug into an electric power source and store power in a battery pack and (2) use petroleum-based or other liquid- or gas-based fuel to power an internal combustion engine (ICE).

Primary energy consumption: Consumption of primary energy. EIA includes the following in U.S. primary energy consumption:

- Coal
- Coal coke net imports
- Petroleum (equal to petroleum products supplied, excluding biofuels)
- Dry natural gas, excluding supplemental gaseous fuels
- Nuclear electricity net generation (converted to Btu using the average annual heat rate of nuclear plants)
- Conventional hydroelectricity net generation (converted to Btu using the heat content of electricity)
- Geothermal electricity net generation (converted to Btu using the heat content of electricity), geothermal heat pump energy, and geothermal direct-use thermal energy
- Solar thermal and photovoltaic electricity net generation, both utility-scale and small-scale (converted to Btu using the heat content of electricity)
- Solar thermal direct-use energy
- Wind electricity net generation (converted to Btu using the heat content of electricity)
- Wood and wood-derived fuels
- Biomass waste
- Biofuels (fuel ethanol, biodiesel, renewable diesel, and other biofuels)
- Losses and co-products from the production of biofuels
- Electricity net imports (converted to Btu using the electricity heat content of electricity)

Primary energy consumption also includes all non-combustion uses of fossil fuels. Energy sources produced from other energy sources—for example, coal coke from coal—are included in primary energy consumption only if their energy content has not already been included as part of the original energy source. As a result, U.S. primary energy consumption does include net imports of coal coke, but it does not include the coal coke produced from domestic coal.

Primary energy expenditures: Expenditures for energy consumed in each of the four major end-use sectors, excluding energy in the form

of electricity, plus expenditures by the electric power sector for energy used to generate electricity. There are no fuel-associated expenditures for associated expenditures for hydroelectric power, geothermal energy, photovoltaic and solar energy, or wind energy. Also excluded are the quantifiable consumption expenditures that are an integral part of process fuel consumption.

Process fuel: All energy consumed in the acquisition, processing, and transportation of energy. Quantifiable process fuel includes three categories: natural gas lease and plant operations, natural gas pipeline operations, and oil refinery operations.

Product supplied (petroleum): Approximately represents consumption of petroleum products because it measures the disappearance of these products from primary sources, i.e., refineries, natural gas-processing plants, blending plants, pipelines, and bulk terminals. In general, product supplied of each product in any given period is computed as follows; field production, plus refinery production, plus imports, plus unaccounted-for crude oil (plus net receipts when calculated on a PAD District basis) minus stock change, minus crude oil losses, minus refinery inputs, and minus exports.

Propane (C_3H_8): A straight-chain saturated (paraffinic) hydrocarbon extracted from natural gas or refinery gas streams, which is gaseous at standard temperature and pressure. It is a colorless gas that boils at a temperature of -44 degrees Fahrenheit. It includes all products designated in ASTM Specification D1835 and Gas Processors Association specifications for commercial (HD-5) propane.

Propylene (C_3H_6): An olefinic hydrocarbon recovered from refinery or petrochemical processes, which is gaseous at standard temperature and pressure. Propylene is an important petrochemical feedstock.

Refinery (petroleum): An installation that manufactures finished petroleum products from crude oil, unfinished oils, natural gas liquids, other hydrocarbons, and alcohol.

Refinery olefins: Subset of olefinic hydrocarbons (olefins) produced at crude oil refineries, including ethylene, propylene, butylene, and isobutylene.

Renewable diesel fuel: Renewable fuel consisting of hydrocarbon molecules, produced through the hydrotreating of animal fats, vegetable oils, and recycled grease feedstocks. It is considered a drop-in replacement to petroleum-based diesel fuel (for example, it can be used in diesel engines without modification). Renewable diesel fuel reported on the EIA-819 is produced at dedicated biorefineries or co-processed at petroleum refineries.

Renewable energy: Energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. In this report, renewable sources of energy include biomass, hydroelectric power, geothermal, solar, and wind.

Residential sector: An energy-consuming sector that consists of living quarters for private households. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a variety of other appliances. The residential sector excludes institutional living quarters.

Residual fuel oil: A general classification for the heavier oils, known as No. 5 and No. 6 fuel oils, that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations. It conforms to ASTM Specifications D 396 and D 975 and Federal Specification VV-F-815C. No. 5, a residual fuel oil of medium viscosity, is also known as Navy Special and is defined in Military Specification MIL-F-859E, including Amendment 2 (NATO Symbol F-770). It is used in steam-powered vessels in government service and inshore powerplants. No. 6 fuel oil includes Bunker C fuel oil and is used for the production of electric power, space heating, vessel bunkering, and various industrial purposes.

Road oil: Any heavy petroleum oil, including residual asphaltic oil, used as a dust palliative and surface treatment on roads and highways. It is generally produced in six grades, from 0, the most liquid, to 5, the most viscous.

Short ton: A unit of weight equal to 2,000 pounds.

Solar energy: The radiant energy of the sun, which can be converted into other forms of energy, such as heat or electricity.

Special naphthas: All finished products within the naphtha boiling range that are used as paint thinners, cleaners, or solvents. These products are refined to a specified flash point. Special naphthas include all commercial hexane and cleaning solvents conforming to ASTM Specifications D1836 and D484, respectively. Naphthas to be blended or marketed as motor gasoline or aviation gasoline, or that are to be used as petrochemical and synthetic natural gas (SNG) feedstocks, are excluded.

Standard Industrial Classification (SIC): Replaced with North American Industry Classification System. See **NAICS**.

Steam coal: See **coal**.

Still gas: Any form or mixture of gases produced in refineries by distillation, cracking, reforming, and other processes. The principal constituents are methane and ethane. May contain hydrogen and small/trace amounts of other gases. Still gas is typically consumed as refinery fuel or used as petrochemical feedstock. Still gas burned for refinery fuel may differ in composition from marketed still gas sold to other users.

Supplemental gaseous fuels supplies: Synthetic natural gas, propane-air, coke oven gas, refinery gas, biomass gas, air injected for Btu stabilization, and manufactured gas commingled and distributed with natural gas.

Total energy consumption: Primary energy consumption, electricity sales to ultimate customers, and electrical system energy losses allocated to each end-use sector. Also includes other energy losses throughout the energy system.

Transportation sector: An energy-consuming sector that consists of all vehicles whose primary purpose is transporting people and/or goods from one physical location to another. Included are automobiles; trucks; buses; motorcycles; trains, subways, and other rail vehicles; aircraft; and ships, barges, and other waterborne vehicles. Vehicles whose primary purpose is not transportation (e.g., construction cranes and bulldozers, farming vehicles, and warehouse tractors and forklifts) are classified in the sector of their primary use. In this report, natural gas used in the operation of natural gas pipelines is included in the transportation sector.

Unfinished oils: All oils requiring further processing, except those requiring only mechanical blending. Unfinished oils are produced by partial refining of crude oil and include naphthas and lighter oils, kerosene and light gas oils, heavy gas oils, and residuum.

Unfractionated streams: Mixtures of unsegregated natural gas liquid components, excluding those in plant condensate. This product is extracted from natural gas.

United States: The 50 states and the District of Columbia. *Note*: The United States has varying degrees of jurisdiction over a number of territories and other political entities outside the 50 states and the District of Columbia, including Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, Johnston Atoll, Midway Islands, Wake Island, and the Northern Mariana Islands. EIA data programs may include data from some or all of these areas in U.S. totals. For these programs, data products will contain notes explaining the extent of geographic coverage included under the term “United States.”

Value added by manufacture: A measure of manufacturing activity that is derived by subtracting the cost of materials (which covers materials, supplies, containers, fuel, purchased electricity, and contract work) from the value of shipments. This difference is then adjusted by the net change in finished goods and work-in-progress between the beginning- and end-of-year inventories.

Vessel bunkering: Includes sales for the fueling of commercial or private boats, such as pleasure craft, fishing boats, tugboats, and ocean-going ves-sels, including vessels operated by oil companies. Excluded are volumes sold to the U.S. Armed Forces.

Waste energy: Municipal solid waste, landfill gas, methane, digester gas, liquid acetonitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed loop biomass, fish oil, and straw used as fuel. See **biomass waste** and **non-biomass waste**.

Wax: A solid or semi-solid material consisting of a mixture of hydrocarbons obtained or derived from petroleum fractions, or through a Fischer-Tropsch type process, in which the straight-chained paraffin series predominates. This includes all marketable wax, whether crude or refined, with a congealing point (ASTM D 938) between 100 and 200 degrees Fahrenheit and a maximum oil content (ASTM D 3235) of 50 weight percent.

Wind energy: Kinetic energy present in wind motion that can be converted to mechanical energy for driving pumps, mills, and electric power generators.

Wood energy: Wood and wood products used as fuel, including round wood (cord wood), limb wood, wood chips, bark, sawdust, forest residues, charcoal, pulp waste, and spent pulping liquor.