Section 6. Electricity

This section describes the energy sources that the electric power sector consumes; end-use electricity consumption (i.e., electricity sold to ultimate customers); estimates of the electrical system energy losses incurred in the generation, transmission, and distribution of electricity; and estimates of net interstate sales of electricity.

The electric power sector consists of electric utilities and independent power producers (electricity-only and combined-heat-and-power (CHP) plants) classified under Sector 22 of the North American Industry Classification System (NAICS) whose primary business is to sell electricity, or electricity and heat, to the public. It does not include commercial or industrial electricity-only or CHP plants that produce electricity and/or heat primarily to support the activities of the commercial or industrial establishments.

Electric power sector energy consumption

Physical units

The electric power sector uses many different energy sources to produce electricity and/or heat, including: coal, natural gas, petroleum, nuclear, and renewable energy. The State Energy Data System (SEDS) estimates physical units of coal in thousand short tons, natural gas in million cubic feet, and petroleum in thousand barrels, as the electric power sector consumes them. Because wood and waste are measured in a variety of physical units, EIA converts them into the equivalent heat content in British thermal units (Btu). Because comparable measures in physical units for nuclear power, hydroelectric power, wood, waste, geothermal, wind, photovoltaic, and solar thermal energy sources are not available, SEDS uses the energy output of electricity produced from these energy sources, in million kilowatthours. The variable names for these data are as follows ("ZZ" in the variable name represents the two-letter state code that differs for each state):

CLEIPZZ = coal consumed by the electric power sector (described in Section 2 of this report), in thousand short tons;

ELEXPZZ = electricity exported from the United States, in million kilowatthours;

ELIMPZZ = electricity imported into the United States, in million kilowatthours;

GEEGPZZ = electricity produced from geothermal energy by the electric power sector (described in Section 5), in million kilowatthours;

HYEGPZZ = electricity produced from hydroelectric power in the electric power sector (described in Section 5), in million kilowatthours;

NGEIPZZ = natural gas consumed by the electric power sector (described in Section 3), in million cubic feet;

NUEGPZZ = electricity produced from nuclear power in the electric power sector, in million kilowatthours;

PAEIPZZ = petroleum consumed by the electric power sector (described in Section 4), in thousand barrels;

SOEGPZZ = electricity produced from photovoltaic and solar thermal energy sources in the electric power sector (described in Section 5), in million kilowatthours;

WDEIBZZ = wood energy sources consumed by the electric power sector (described in Section 5), in billion Btu;

WSEIBZZ = waste energy sources consumed by the electric power sector (described in Section 5), in billion Btu; and

WYEGPZZ = electricity produced from wind energy by the electric power sector (described in Section 5), in million kilowatthours.

The U.S. totals are the sum of the state data.

British thermal units (Btu)

SEDS converts all energy sources to Btu to calculate the total amount of energy used to produce electricity and/or heat in the electric power sector. The methods SEDS uses to convert coal, natural gas, petroleum, and renewable energy sources are explained in their respective sections of the SEDS consumption technical notes. The methods for nuclear electric power are described in the following section.

Total energy consumed by the electric power sector is the sum of all primary energy used to generate electricity, including net imports of

electricity across U.S. borders (ELNIBZZ, see page 135). SEDS removes supplemental gaseous fuels from the total to prevent double counting, as they are already accounted for in the energy sources (such as coal) from which they are derived:

$$TEEIBZZ = CLEIBZZ + ELNIBZZ + GEEGBZZ + HYEGBZZ + NGEIBZZ + NUEGBZZ + PAEIBZZ + SOEGBZZ + WWEIBZZ + WYEGBZZ - SFEIBZZ$$
$$TEEIBUS = \Sigma TEEIBZZ$$

Nuclear electric power

SEDS estimates the amount of electricity generated from nuclear power in the electric power sector, in million kilowatthours, for both regulated electric utilities and independent power producers. In the following formulas, "ZZ" in the variable name represents the two-letter state code that differs for each state:

NUEGPZZ = nuclear electricity net generation in the electric power sector, in million kilowatthours.

The U.S. total is the sum of the state data:

$$NUEGPUS = \Sigma NUEGPZZ$$

Total nuclear energy consumption, NUETP, equals nuclear power used for generating electricity:

$$NUETPZZ = NUEGPZZ$$
$$NUETPUS = NUEGPUS$$

SEDS converts nuclear energy electricity generation, in kilowatthours, to British thermal units (Btu) using annual conversion factors (NUETKUS). SEDS calculates the average U.S. conversion factors reported by nuclear power plants. These U.S. average factors vary from year to year and can be found in the SEDS technical notes, Appendix B— Thermal conversion factors, Table B1, http://www.eia.gov/state/seds/sep_use/notes/use_b.pdf.

NUETKUS = factor for converting electricity generated from nuclear power from kilowatthours to Btu.

These formulas use the nuclear conversion factor:

$$NUEGBZZ = NUEGPZZ * NUETKUS$$
$$NUEGBUS = \Sigma NUEGBZZ$$
$$NUETBZZ = NUEGBZZ$$
$$NUETBUS = NUEGBUS$$

Data sources

NUEGPZZ — Nuclear electricity net generation in the electric power sector by state.

- 1960 through 1977: Federal Power Commission, News Release, "Power Production, Fuel Consumption, and Installed Capacity Data," table titled "Net Generation of Electric Utilities by State and Source."

- 1978 through 1980: U.S. Energy Information Administration (EIA), *Energy Data Reports*, "Power Production, Fuel Consumption and Installed Capacity Data," table titled "Net Generation of Electric Utilities by State and Source" (1978) and Table 36 (1979 and 1980).
- 1981 through 1985: EIA, Form EIA-759, "Monthly Power Plant Report," and predecessor forms. Data are published in the EIA, *Electric Power Annual 1985*, Table 6.
- 1986 forward: EIA, Form EIA-923, "Power Plant Operations Report," and predecessor forms, http://www.eia.gov/electricity/data/eia923/.

NUETKUS — Factor for converting electricity produced from nuclear power from physical units to Btu.

- 1960 through 1984: Calculated annually by EIA by dividing the total heat content consumed in reactors at nuclear plants by the total (net) electricity generated by nuclear plants. The heat content and electricity generation are reported on FERC Form 1, "Annual Report of Major Electric Utilities, Licensees, and Others" and Form EIA-412, "Annual Report of Public Electric Utilities," and predecessor forms. The factors for 1982 through 1984 are published in the following:
  - 1982: EIA, *Historical Plant Cost and Annual Production Expenses for Selected Electric Plants 1982*, page 215.
  - 1983 and 1984: EIA, *Electric Plant Cost and Power Production Expenses 1991*, Table 13.
- 1985 forward: Calculated annually by EIA using the heat rate reported on Form EIA-860, "Annual Electric Generator Report" (and predecessor forms), and the generation reported on Form EIA-923, "Power Plant Operations Report" (and predecessor forms). Also available in Table A6 of the EIA, *Monthly Energy Review*, http://www.eia.gov/totalenergy/data/monthly/index.php.

Electricity imports and exports

SEDS includes electricity transmitted across U.S. borders with Canada and Mexico in the electric power sector. The variable names for these data are as follows ("ZZ" in the variable name represents the two-letter state code that differs for each state):

ELEXPZZ = electricity exported from the United States by state, in million kilowatthours; and

ELIMPZZ = electricity imported into the United States by state, in million kilowatthours.

The U.S. totals are the sums of the state data:

ELIMPUS = ΣELIMPZZ
ELEXPUS = ΣELEXPZZ

SEDS calculates electricity net imports as electricity imports minus exports:

ELNIPZZ = ELIMPZZ - ELEXPZZ
ELNIPUS = ΣELNIPZZ

SEDS converts electricity imports and exports from million kilowatthours (kWh) to billion Btu using the conversion factor of 3.412 thousand Btu per kWh.

ELIMBZZ = ELIMPZZ * 3.412
ELIMBUS = ΣELIMBZZ
ELEXBZZ = ELEXPZZ * 3.412
ELEXBUS = ΣELEXBZZ

ELNIBZZ = ELIMBZZ - ELEXBZZ
ELNIBUS = ΣELNIBZZ

Data sources

ELEXPZZ — Electricity exported from the United States by state.

- 1960 through 1981: Economic Regulatory Administration, *Staff Reports*, "Report on Electric Energy Exchanges with Canada and Mexico." Source data are arranged by the Regional Reliability Council Areas and then by the electric utility. State data were tabulated by aggregating the data of all electric utilities within each state.
- 1982 and 1983: U.S. Energy Information Administration (EIA) state estimates are based on data from Economic Regulatory

Administration Form ERA-781R, "Annual Report of Electrical Export/Import Data." State estimates are consistent with national and regional totals published in the ERA, *Electricity Exchanges Across International Borders*.

- 1984 through 1987: EIA state estimates are based on data from Economic Regulatory Administration Form ERA-781R, "Annual Report of Electrical Export/Import Data," the Federal Energy Regulatory Commission (FERC) Form 1, and the Bonneville Power Administration Annual Report. State estimates are consistent with national and regional totals published in the ERA, *Electricity Transactions Across International Borders*.

- 1988 through 2018: EIA state estimates are based on data from National Energy Board of Canada; FERC Form 714, "Annual Electric Balancing Authority Area and Planning Report;" California Energy Commission; and EIA retail sales data. Data for 1990 forward are presented in EIA, *State Electricity Profiles*, Table 10 "Supply and disposition of electricity" for each state.

- 2019 forward: EIA, Form EIA-111, "Quarterly Electricity Imports and Exports Report," presented in EIA, *State Electricity Profiles*, Table 10 "Supply and disposition of electricity" for each state.

ELIMPZZ — Electricity imported into the United States by state.

- 1960 through 1981: Economic Regulatory Administration, *Staff Reports*, "Report on Electric Energy Exchanges with Canada and Mexico." Source data are arranged by the Regional Reliability Council Areas and then by the electric utility. State data were tabulated by aggregating the data of all electric utilities within each state.

- 1982 and 1983: EIA state estimates are based on data from Economic Regulatory Administration Form ERA-781R, "Annual Report of Electrical Export/Import Data." State estimates are consistent with national and regional totals published in the ERA, *Electricity Exchanges Across International Borders*.

- 1984 through 1987: EIA state estimates are based on data from Economic Regulatory Administration Form ERA-781R, "Annual Report of Electrical Export/Import Data," the FERC Form 1, and the Bonneville Power Administration Annual Report. State estimates are consistent with national and regional totals published in the ERA, *Electricity Transactions Across International Borders*.

- 1988 through 2018: EIA state estimates are based on data from National Energy Board of Canada; FERC Form 714, "Annual Electric Balancing Authority Area and Planning Report;" California Energy Commission; and EIA retail sales data. Data for 1990 forward are presented in EIA, *State Electricity Profiles*, Table 10 "Supply and disposition of electricity" for each state.

- 2019 forward: EIA, Form EIA-111, "Quarterly Electricity Imports and Exports Report," presented in EIA, *State Electricity Profiles*, Table 10 "Supply and disposition of electricity" for each state.

Electricity consumed by the end-use sectors

Physical units

SEDS assumes the amount of electricity sold to ultimate customers to be equal to consumption in the end-use sectors. The U.S. Energy Information Administration (EIA) collects electricity consumed by (sales to ultimate customers in) the four end-use sectors (commercial, industrial, residential, and transportation), in million kilowatthours. The variable names for these data are as follows ("ZZ" in the variable name represents the two-letter state code that differs for each state):

$$ESRCPZZ = \text{electricity consumed by (sales to ultimate customers in) the residential sector;}$$
$$ESCMPZZ = \text{electricity sold to a portion of the commercial sector;}$$
$$ESICPZZ = \text{electricity consumed by (sales to ultimate customers in) the industrial sector; and}$$
$$ESACPZZ = \text{electricity consumed by (sales to ultimate customers in) the transportation sector (2003 forward).}$$

For 2003 forward, SEDS assumes commercial sector electricity consumption to be equal to the electricity sold to the commercial sector:

$$ESCCPZZ = ESCMPZZ$$

Before 2003, the source did not have a data series for the transportation sector, and the coverage of the commercial sector was smaller in scope. Instead, EIA reported a data series for "Other" users:

$$ESOTPZZ = \text{electricity sold to "Other" users (including public street and highway lighting, other public authorities, railroads and railways, and interdepartmental sales).}$$

Before 2003, SEDS uses electricity consumed by transit systems from the U.S. Department of Transportation, Federal Transit Administration, to estimate transportation sector electricity consumption:

$$ESTRPZZ = \text{electricity consumed by transit systems.}$$

For 1960 through 2002, SEDS defines transportation and commercial electricity consumption as:

$$ESACPZZ = ESTRPZZ$$
$$ESCCPZZ = ESCMPZZ + (ESOTPZZ - ESTRPZZ)$$

For all years, SEDS calculates total electricity consumption (ESTCPZZ)

as the sum of the four end-use sectors:

$$ESTCPZZ = ESRCPZZ + ESCCPZZ + ESICPZZ + ESACPZZ$$

The U.S. totals are the sums of the state data.

British thermal units (Btu)

SEDS converts electricity consumption estimates into Btu using a factor of 3.412 thousand Btu per kilowatthour:

$$ESRCBZZ = ESRCPZZ * 3.412$$
$$ESTCBZZ = ESTCPZZ * 3.412$$

The U.S. totals are the sums of the state data.

Residential sector and total consumption of electricity per capita

SEDS calculates residential sector and total consumption of electricity per capita as electricity consumption divided by resident population (TPOPP). See energy indicators technical notes at http://www.eia.gov/state/seds/seds-technical-notes-complete.php.

Estimated electricity consumed by (sales to ultimate customers in) the residential sector per capita (ESRPP) for each state and the United States, in kilowatthours, is:

$$ESRPP = ESRCP / TPOPP * 1000$$

Estimated total consumption of electricity per capita (ESTPP) for each state and the United States, in kilowatthours, is:

$$ESTPP = ESTCP / TPOPP * 1000$$

Additional calculations

For 2003 forward, EIA has data available for electricity sold for transportation use. Before 2003, SEDS performs additional calculations to provide data for EIA's *Monthly Energy Review* and *Annual Energy Review* to use in estimating transportation electricity use. SEDS calculates the share of electricity sold to the "Other" category of consumers that is used for transportation as:

$$ESTRSUS = ESTRPUS / ESOTPUS$$

Additional notes on electricity sales

1. For 2003 forward, SEDS uses Form EIA-861, "*Annual Electric*

Power Industry Report" as its source for electricity consumed by the transportation sector. EIA began collecting separate data for the transportation sector in 2003 (previously EIA included these volumes in Commercial and "Other"). In 2003, SEDS uses information from the U.S. Department of Transportation, National Transit Database, http://www.transit.dot.gov/ntd/ntd-data, to supplement the EIA data for three states with missing or incomplete volumes: Missouri, Ohio, and Tennessee.

2. SEDS uses Form EIA-826, "Electric Utility Company Monthly Statement," and predecessor forms for the electricity sales data for 1960 through 1983. Electricity sales data from 1984 forward are from Form EIA-861, "*Annual Electric Utility Report.*" At the national level, data from both forms correspond closely (within 3%) for all end-use sectors. However, differences in the number of survey respondents and the reporting of commercial and industrial sales caused inconsistencies between 1983 and 1984 data in those end-use sectors for some states. See EIA *Electric Power Annual, 1991,* DOE/EIA-0348(91), p. 130, and *An Assessment of the Quality of Selected EIA Data Series, Electric Power Data*, DOE/EIA-0292(87), pp. 17-28, for detailed discussions of the reporting differences.

3. For 1960 through 1983, electricity sales data for the District of Columbia and Maryland are combined on the survey forms. SEDS estimates separate sales for the District of Columbia and Maryland by using electricity sales data by end-use sector by communities from the FERC Form 1, "Annual Report of Major Electric Utilities, Licensees, and Others," filed by the Potomac Electric Power Company (PEPCO). SEDS assumes PEPCO sales to the District of Columbia to be total electricity sales in the District of Columbia. SEDS subtracted electricity sales to the District of Columbia reported by PEPCO on the FERC Form 1 from the Form EIA-826 District of Columbia and Maryland aggregate figures to obtain estimates of Maryland electricity sales by sector. Beginning with 1981 data, electric utilities were no longer required to report sales to specific communities. SEDS obtained sales data for the District of Columbia for 1981 through 1983 which were obtained directly from PEPCO's accounting department.

Data sources

ESACPZZ — Electricity consumed by (sales to ultimate customers in) the transportation sector by state.

- 1960 through 2002: Equal to ESTRPZZ.

- 2003 forward: EIA, "Electricity Sales to Ultimate Customers by State by Sector by Provider (EIA-861)" spreadsheet at http://www.eia.gov/electricity/data/state/, sector name "Total Electric Industry," column "Transportation Sales."

ESCMPZZ — Electricity sold to a portion of the commercial sector by state.

Note: Data for Maryland and the District of Columbia were combined for 1960 through 1983. The method for disaggregating the data is explained in Additional Note 3 on this page.

- 1960 through 1975: Federal Power Commission, *Electric Power Statistics*, "Sales of Electric Energy to Ultimate Consumers."
- 1976 through 1980: EIA, *Electric Power Annual* (November 1982), Table 125.
- 1981 through 1983: EIA, Form EIA-826, "Electric Utility Company Monthly Statement," and predecessor forms. Published data rounded to gigawatthours in EIA, *Electric Power Annual 1983*, Table 51.
- 1984 through 1986: EIA, Form EIA-861, "Annual Electric Utility Report." Unpublished data.
- 1987: EIA, Form EIA-861, "Annual Electric Utility Report." Published in the EIA, *Electric Power Annual 1988,* Table 19.
- 1988 and 1989: EIA, Form EIA-861, "Annual Electric Utility Report." Published in the EIA, *Electric Power Annual,* Table 27.
- 1990 forward: EIA, "Electricity Sales to Ultimate Customers by State by Sector by Provider (EIA-861)" spreadsheet at http://www.eia.gov/electricity/data/state/, sector name "Total Electric Industry," column "Commercial Sales."

ESICPZZ — Electricity consumed by (sales to ultimate customers in) the industrial sector by state.

Note: Data for Maryland and the District of Columbia were combined for 1960 through 1983. The method for disaggregating the data is explained in Additional Note 3 on this page.

- 1960 through 1975: Federal Power Commission, Electric Power Statistics, "Sales of Electric Energy to Ultimate Consumers."
- 1976 through 1980: EIA, *Electric Power Annual* (November 1982), Table 126.
- 1981 through 1983: EIA, Form EIA-826, "Electric Utility Company

Monthly Statement," and predecessor forms. Published data rounded to gigawatthours in EIA, *Electric Power Annual 1983*, Table 51.

- 1984 through 1986: EIA, Form EIA-861, "Annual Electric Utility Report." Unpublished data.
- 1987: EIA, Form EIA-861, "Annual Electric Utility Report." Published in the EIA, *Electric Power Annual 1988*, Table 19.
- 1988 and 1989: EIA, Form EIA-861, "Annual Electric Utility Report." Published in the EIA, *Electric Power Annual,* Table 27.
- 1990 forward: EIA, "Electricity Sales to Ultimate Customers by State by Sector by Provider (EIA-861)" spreadsheet at http://www.eia.gov/electricity/data/state/, sector name "Total Electric Industry," column "Industrial Sales."

ESOTPZZ — Electricity sold to (consumed by) the "Other" sector (i.e., public street and highway lighting, sales to other public authorities, railroads and railways, and interdepartmental sales) by state (through 2002).

Note: Data for Maryland and the District of Columbia were combined for 1960 through 1983. The method for disaggregating the data is explained in Additional Note 3 on page 138.

- 1960 through 1975: Federal Power Commission, *Electric Power Statistics*, "Sales of Electric Energy to Ultimate Consumers."
- 1976 through 1980: EIA, *Electric Power Annual* (November 1982), Table 127.
- 1981 through 1983: EIA, Form EIA-826, "Electric Utility Company Monthly Statement," and predecessor forms. Published data rounded to gigawatthours in EIA, *Electric Power Annual 1983*, Table 51.
- 1984 through 1986: EIA, Form EIA-861, "Annual Electric Utility Report." Unpublished data.
- 1987: EIA, Form EIA-861, "Annual Electric Utility Report." Published in the EIA, *Electric Power Annual 1988*, Table 19.
- 1988 and 1989: EIA, Form EIA-861, "Annual Electric Utility Report." Published in the EIA, *Electric Power Annual,* Table 27.
- 1990 through 2002: EIA, "Electricity Sales to Ultimate Customers by State by Sector by Provider (EIA-861)" spreadsheet at http://www.eia.gov/electricity/data/state/, sector name "Total Electric Industry," column "Other Sales."

ESRCPZZ — Electricity consumed by (sales to ultimate customers in) the residential sector by state.

Note: Data for Maryland and the District of Columbia were combined for 1960 through 1983. The method for disaggregating the data is explained in Additional Note 3 on page 138.

- 1960 through 1975: Federal Power Commission, *Electric Power Statistics*, "Sales of Electric Energy to Ultimate Consumers."
- 1976 through 1980: EIA, *Electric Power Annual* (November 1982), Table 124.
- 1981 through 1983: EIA, Form EIA-826, "Electric Utility Company Monthly Statement," and predecessor forms. Published data rounded to gigawatthours in EIA, *Electric Power Annual 1983*, Table 51.
- 1984 through 1986: EIA, Form EIA-861, "Annual Electric Utility Report." Unpublished data.
- 1987: EIA, Form EIA-861, "Annual Electric Utility Report." Published in the EIA, *Electric Power Annual 1988*, Table 19.
- 1988 and 1989: EIA, Form EIA-861, "Annual Electric Utility Report." Published in the EIA, *Electric Power Annual,* Table 27.
- 1990 forward: EIA, "Electricity Sales to Ultimate Customers by State by Sector by Provider (EIA-861)" spreadsheet at http://www.eia.gov/electricity/data/state/, sector name "Total Electric Industry," column "Residential Sales."

ESTRPZZ — Electricity consumed by transit systems by state (through 2002).

Notes: The transit system data include electricity used to operate commuter rail, rapid rail, streetcars or light rail, cable cars, trolley-buses, motorbuses, automated guideways, inclined plane railways, and aerial tramways. These data do not include electricity used by Amtrak. These data are available on a fiscal year basis (July 1 through June 30) for 1979 through 1982 and for calendar years 1983 forward. Some data for 1979 through 1983 were adjusted by EIA on the basis of an analysis of historical trends. Electricity consumption for the District of Columbia for 1976 through 2002 is partially apportioned to Maryland and Virginia on the basis of electricity consumption data from the Washington Metropolitan Area Transit Authority.

- 1960 through 1978: EIA estimates are based on data from:

– The American Public Transit Association (formerly the American Transit Association) annual operating reports.
– Pushkarev, Boris S. and others, Urban Rail in America. (Bloomington, IN: Indiana University Press, 1982.)
– U.S. Department of Transportation, *A Directory of Regularly Scheduled, Fixed Route, Local Public Transportation Service in Urbanized Areas Over 50,000 Population*, 1980 and 1981.
• 1979 through 1989: U.S. Department of Transportation, Urban Mass Transportation Administration, *National Urban Mass Transportation Statistics, Section 15 Annual Report*, table titled "Energy Consumption: Details by Transit System."
– 1979 and 1980: Table 2.13.1.
– 1981 and 1982: Table 3.13.1.
– 1983 through 1989: Table 3.12.
• 1990 through 2002: U.S. Department of Transportation, Federal Transit Administration, *Data Tables for the Section 15 Report Year*, http://www.transit.dot.gov/ntd/ntd-data:
– 1990: Table 2.12.
– 1991: Table 13.
– 1992 through 1997: Table 15.
– 1998: Table 16.
– 1999 through 2002: Table 17.

Electrical system energy losses and net interstate flow of electricity

Electrical system energy losses, identified by "LO" in SEDS, include all losses incurred in the generation, transmission, and distribution of electricity, including plant use and unaccounted-for quantities. At the national level, SEDS defines total losses, LOTCBUS, as the difference between the heat content of all energy consumed by the electric power sector (TEEIBUS) and the heat content of electricity sold to the end-use sectors (ESTCBUS). SEDS calculates total losses for the United States in billion Btu as:

$$\text{LOTCBUS} = \text{TEEIBUS} - \text{ESTCBUS}$$

At the state level, however, this calculation does not yield losses because electricity can flow from one state to another. If information on bilateral flow of electricity across state lines is available, SEDS could compile a detailed account of the electricity flowing between states and the corresponding energy losses. However, EIA's surveys do not capture this information, and SEDS must make assumptions in the estimation of energy losses and interstate electricity flow.

For 1990 forward, EIA's *State Electricity Profiles* provide data on the supply and disposition of electricity in kilowatthours for each state. Net interstate trade is computed as the state's total electricity supply less all within-state electricity disposition (i.e., electricity sales to ultimate customers, direct use, international exports, and estimated losses).

Before 1990, SEDS continues to use the old method of first estimating electrical system energy losses and then deriving net interstate electricity flow (see "1960 through 1989" below).

1990 forward

EIA's *State Electricity Profiles* publish net interstate trade of electricity for each state. SEDS multiplies the series by -1 to convert to SEDS net interstate flow electricity:

ELISPZZ = net interstate flow of electricity for each state, ZZ, in million kilowatthours.

A positive value indicates net inflow of electricity, and a negative value indicates net outflow. The sum of net interstate flow for all states, ELISPUS, is zero.

To estimate the Btu value of net interstate flow (including attributed

energy losses), ELISBZZ, SEDS identifies states with net electricity outflow (i.e., negative ELISPZZ) and states with net electricity inflow (i.e., positive ELISPZZ). For states with net electricity outflow, SEDS assumes the average heat content of the outflow to be the same as the average heat content of the energy used to produce electricity for in-state use. That is, SEDS allocates total energy consumed by the electric power sector, TEEIBZZ, to in-state electricity sales and outflow according to their physical unit shares:

ELISBZZ   =   - (TEEIBZZ * (|ELISPZZ| / (|ELISPZZ| + ESTCPZZ)))
for states with net electricity outflow

SEDS derives an annual average outflow Btu-to-kilowatthour ratio as the sum of ELISBZZ for all states with net electricity outflow divided by the sum of their ELISPZZ. SEDS uses this ratio to estimate the Btu value of net inflow of electricity:

ELISBZZ   =   ELISPZZ * (Average outflow Btu-to-kilowatthour
             ratio)
for states with net electricity inflow

SEDS calculates total energy used to generate the electricity consumed in the state, TEESBZZ, by removing the outflow energy (for the states with net outflow) or adding the inflow energy (for the states with net inflow) from/to the total energy consumed by the electric power sector in the state. Because ELISBZZ is negative for the net outflow states, there is only one formula:

TEESBZZ   =   TEEIBZZ + ELISBZZ

Because the sum of net interstate flow is zero at the national level, TEESBUS, the sum of TEESBZZ, equals TEEIBUS. SEDS defines electrical system energy losses, LOTCBZZ, as the total energy used to generate the electricity consumed in the state less the heat content of the electricity sales to ultimate customers:

LOTCBZZ   =   TEESBZZ - ESTCBZZ

By definition, the sum of LOTCBZZ equals LOTCBUS. SEDS then allocates electrical system energy losses to the four end-use sectors according to the electricity sales shares:

LORCBZZ   =   LOTCBZZ * (ESRCBZZ / ESTCBZZ)
LOCCBZZ   =   LOTCBZZ * (ESCCBZZ / ESTCBZZ)
LOICBZZ   =   LOTCBZZ * (ESICBZZ / ESTCBZZ)
LOACBZZ   =   LOTCBZZ * (ESACBZZ / ESTCBZZ)

The U.S. totals are the sums of all the states' losses.

1960 through 1989

Because of insufficient data, efforts to estimate net interstate trade before 1990 were not successful. The earlier methodology created by SEDS continues to be used for data years 1960 through 1989. This methodology first estimates the electrical system energy losses for the states, and then calculates net interstate flow.

Because Alaska and Hawaii have no exchanges of electricity with other states, their electrical system energy losses are simply the difference between all energy consumed by the electric power sector and the heat content of the electricity sales to ultimate customers:

LOTCBAK   =   TEEIBAK - ESTCBAK
LOTCBHI   =   TEEIBHI - ESTCBHI

An annual losses-to-sales ratio is created for the aggregate of the contiguous 48 states plus the District of Columbia by dividing the aggregate electrical system energy losses with the aggregated electricity sales to ultimate customers:

LOTCB48   =   LOTCBUS - (LOTCBAK + LOTCBHI)
ESTCB48   =   ESTCBUS - (ESTCBAK + ESTCBHI)
ELLSS48   =   LOTCB48 / ESTCB48

This ratio is fairly constant over time, ranging from a minimum of 2.3 in 1987 to a maximum of 2.5 in 1960. The ratio is applied to total electricity sales to ultimate customers and to electricity sales to ultimate customers by end-use sector in each of the 48 contiguous states and the District of Columbia:

LOTCBZZ   =   ESTCBZZ * ELLSS48

Electrical system energy losses are allocated to the four end-use sectors according to the sales shares:

LORCBZZ   =   LOTCBZZ * (ESRCBZZ / ESTCBZZ)
LOCCBZZ   =   LOTCBZZ * (ESCCBZZ / ESTCBZZ)
LOICBZZ   =   LOTCBZZ * (ESICBZZ / ESTCBZZ)
LOACBZZ   =   LOTCBZZ * (ESACBZZ / ESTCBZZ)

Losses for the United States are the sums of all the states' losses.

Net interstate flow of electricity is then calculated as the difference between total electricity sales plus attributed losses and the total energy consumption by the electric power sector within each state.

ELISBZZ   =   (ESTCBZZ + LOTCBZZ) - TEEIBZZ

The sum of ELISBZZ is zero.

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Data sources

ELISPZZ — Net interstate flow of electricity for each state.

- 1960 through 1989: Not available.
- 1990 forward: EIA, *State Electricity Profiles*, http://www.eia.gov/electricity/state/, Table 10.