Section 5. Renewable Energy

Renewable energy sources included in the State Energy Data System (SEDS) comprise fuel ethanol, wood, waste, hydroelectric, geothermal, wind, photovoltaic, and solar thermal energy.

Fuel Ethanol

Fuel ethanol is used as a gasoline octane enhancer and oxygenate. A small amount of fuel ethanol is used as an alternative fuel, such as E85. It is typically produced biologically from biomass feedstocks such as agricultural crops and cellulosic residues from agricultural crops or wood. It can also be produced chemically from ethylene. For 1981 forward, fuel ethanol estimates are maintained separately from motor gasoline in SEDS and shown in the state energy consumption data tables to illustrate renewable energy use.

The U.S. total fuel ethanol consumption in SEDS is a series developed by the U.S. Energy Information Administration (EIA) from annual reports of field production of oxygenated gasoline (prior to 2005), finished motor gasoline and motor gasoline blending components adjustments (2005 forward), and refinery and blender net inputs of fuel ethanol (all years). The fuel ethanol series used in SEDS is denatured fuel ethanol, which includes a small amount of denaturant added to the fuel ethanol to make it unfit for human consumption.

Through 2004, the U.S. total is allocated to the states using data series on gasohol or fuel ethanol published by the U.S. Department of Transportation, Federal Highway Administration (FHWA).

For 2005 through 2009, the state estimates were calculated using the following EIA data series and assumptions:

– prime supplier sales of conventional (including oxygenated) gasoline and reformulated gasoline by state;
– production of conventional and reformulated gasoline, total and blended with alcohol, by Petroleum Administration for Defense (PAD) Refining District;
– a standard ethanol-to-motor gasoline "blend ratio" of 10% for all states except California (5.7%) and Minnesota (12%); and
– estimated use of fuel ethanol by PAD Refining District.

First, a set of preliminary estimates for fuel ethanol blended into motor gasoline is calculated by multiplying the prime supplier sales for both conventional and reformulated gasoline with the corresponding share of gasoline blended with alcohol and the "blend ratio," and summing them together for each state. Next, the use of fuel ethanol by refining district is estimated by adding fuel ethanol used as refinery and blender net inputs and an adjustment item derived from the supply and disposition of petroleum and other liquids. Finally, the preliminary state-level fuel ethanol estimates are scaled to the fuel ethanol use for each Refining District.

For 2010 forward, the estimation method is refined. Data series and assumptions used in the calculation include:

– motor gasoline consumption by state from SEDS;
– prime supplier sales of conventional gasoline and reformulated gasoline by state;
– production of conventional and reformulated gasoline, total and blended with fuel ethanol, by PAD Refining District;
– inter-PADD movements of conventional gasoline;
– net exports of conventional gasoline by PAD Refining District;
– a standard ethanol-to-motor gasoline "blend ratio" of 10% for all states except Iowa and Minnesota (12%); and
– U.S. fuel ethanol consumption.

First, state-level motor gasoline consumption is allocated to conventional and reformulated gasoline consumption using the corresponding prime supplier sales ratios. Next, the share of conventional gasoline blended with fuel ethanol is calculated for each Refining District. To better account for the amount of conventional gasoline in the denominator, it is adjusted by inter-PADD movements and net exports. The share of reformulated gasoline blended with fuel ethanol is also calculated for each Refining District. A set of preliminary fuel ethanol consumption estimates is calculated by multiplying the state-level conventional and reformulated gasoline consumption by the corresponding District-level shares of gasoline blended with fuel ethanol and then by the "blend ratio," and summing them together for each state. Finally, the preliminary estimates are adjusted to sum to the U.S. fuel ethanol total consumption.

The fuel ethanol data series are identified in SEDS by the following names ("ZZ" in the variable name represents the two-letter state code that differs for each state):

ENTCPUS   =   fuel ethanol total consumed in the United States, in thousand barrels;

ENTCBUS   =   fuel ethanol total consumed in the United States, in billion Btu; and

ENTRPZZ   =   fuel ethanol blended into motor gasoline (1993 forward) or total gasohol sales (1981 through 1992) by states, in thousand gallons.

The U.S. total of the state series, ENTRPUS, is calculated as the sum of the state data, ENTRPZZ. The U.S. value, ENTCPUS, is allocated to the states in proportion to the state estimates, ENTRPZZ:

$$\text{ENTRPUS} = \Sigma\text{ENTRPZZ}$$
$$\text{ENTCPZZ} = \Sigma(\text{ENTRPZZ} / \text{ENTRPUS}) * \text{ENTCPUS}$$

Fuel ethanol total consumed by state, ENTCPZZ, is allocated to the commercial, industrial, and transportation sectors according to the motor gasoline consumption share for each sector:

$$\text{ENACPZZ} = (\text{MGACPZZ} / \text{MGTCPZZ}) * \text{ENTCPZZ}$$
$$\text{ENCCPZZ} = (\text{MGCCPZZ} / \text{MGTCPZZ}) * \text{ENTCPZZ}$$
$$\text{ENICPZZ} = (\text{MGICPZZ} / \text{MGTCPZZ}) * \text{ENTCPZZ}$$

The U.S. consumption estimates for the three sectors are calculated as the sum of the states' values.

Fuel ethanol total consumed by state in Btu, ENTCBZZ, is calculated by multiplying U.S. fuel ethanol total consumed in Btu with the state share of fuel ethanol consumption in physical unit:

$$\text{ENTCBZZ} = (\text{ENTCPZZ} / \text{ENTCPUS}) * \text{ENTCBUS}$$

Fuel ethanol total consumed by state in Btu is allocated to the commercial, industrial, and transportation sectors according to the motor gasoline consumption share for each sector:

$$\text{ENACBZZ} = (\text{MGACPZZ} / \text{MGTCPZZ}) * \text{ENTCBZZ}$$
$$\text{ENCCBZZ} = (\text{MGCCPZZ} / \text{MGTCPZZ}) * \text{ENTCBZZ}$$
$$\text{ENICBZZ} = (\text{MGICPZZ} / \text{MGTCPZZ}) * \text{ENTCBZZ}$$
$$\text{ENACBUS} = \Sigma\text{ENACBZZ}$$
$$\text{ENCCBUS} = \Sigma\text{ENCCBZZ}$$
$$\text{ENICBUS} = \Sigma\text{ENICBZZ}$$

The U.S. fuel ethanol conversion factor is derived from the U.S. fuel ethanol

total consumed in Btu and in physical unit:

$$\text{ENTCKUS} = \text{ENTCBUS} / \text{ENTCPUS}$$

Fuel ethanol excluding denaturant

Fuel ethanol contains a small amount of denaturant, which is added to make the finished product unsuitable for human consumption. Fuel ethanol denaturant is typically natural gasoline (pentanes plus) or conventional gasoline. These volumes are already accounted for under petroleum. Therefore, to avoid double-counting, and to separately identify the renewable content of fuel ethanol, EIA estimates the Btu content of fuel ethanol excluding denaturant consumed by the United States. This is then allocated to the states based on the states shares of fuel ethanol consumption, as follows:

EMTCBUS   =   fuel ethanol, excluding denaturant, consumed in the United States, in billion Btu.

$$\text{EMTCBZZ} = (\text{ENTCBZZ} / \text{ENTCBUS}) * \text{EMTCBUS}$$

Similarly, fuel ethanol excluding denaturant is allocated to the commercial, industrial, and transportation sectors according to the motor gasoline consumption share for each sector:

$$\text{EMACBZZ} = (\text{MGACPZZ} / \text{MGTCPZZ}) * \text{EMTCBZZ}$$
$$\text{EMCCBZZ} = (\text{MGCCPZZ} / \text{MGTCPZZ}) * \text{EMTCBZZ}$$
$$\text{EMICBZZ} = (\text{MGICPZZ} / \text{MGTCPZZ}) * \text{EMTCBZZ}$$
$$\text{EMACBUS} = \Sigma\text{EMACBZZ}$$
$$\text{EMCCBUS} = \Sigma\text{EMCCBZZ}$$
$$\text{EMICBUS} = \Sigma\text{EMICBZZ}$$

Energy losses and co-products from fuel ethanol production

Beginning in 1981, energy losses and co-products from the production of fuel ethanol are incorporated into state and U.S. industrial sector energy consumption (TEICBZZ and TEICBUS). This concept is defined as the difference between the heat content of the biomass inputs to the production of fuel ethanol and the heat content of the fuel ethanol produced. Energy losses for the United States are allocated to the states according to the fuel ethanol production share for each state. Energy losses for each state and the U.S. are then added to state and U.S. industrial and total energy consumption.

EMLCBUS   =   energy losses and co-products from the production of fuel ethanol for the United States, in billion Btu;.

EMPRBUS = production of fuel ethanol, excluding denaturant, for the United States, in billion Btu; and

EMPRBZZ = production of fuel ethanol, excluding denaturant, by state, in billion Btu.

EMLCBZZ = (EMPRBZZ / EMPRBUS) * EMLCBUS

Additional notes

Fuel ethanol data blended into motor gasoline (ENTRPZZ) are published in FHWA *Highway Statistics* from 1993 through 2001, 2003, and 2004.

In 2002, fuel ethanol blended into motor gasoline is not available from *Highway Statistics*. The ratio of each state's fuel ethanol in gasohol to total gasohol consumption is calculated for 2001 and 2003. The two ratios for each state are averaged and the average is applied to each state's 2002 total gasohol consumption to derive the amount of fuel ethanol consumed in gasohol in 2002. Fuel ethanol and gasohol data for Florida, Massachusetts, and Rhode Island are available for only 2001 or 2003; in these instances, the ratio of only the available year is used.

Data sources

EMLCBUS — Energy losses and co-products from the production of fuel ethanol for the United States.

- 1981 forward: EIA, *Monthly Energy Review*, Table 10.3.

EMPRBUS — Production of fuel ethanol excluding denaturant for the United States.

- 1981 forward: EIA, *Monthly Energy Review*, Table 10.3.

EMPRBZZ — Production of fuel ethanol excluding denaturant by state.

- 1981 forward: EIA, State Energy Data System, production estimates.

EMTCBUS — Fuel ethanol excluding denaturant consumed in the United States in billion Btu.

- 1981 forward: EIA, *Monthly Energy Review*, Table 10.3.

ENTCBUS — Fuel ethanol including denaturant consumed in the United States in billion Btu.

- 1981 forward: EIA, *Monthly Energy Review*, Table 10.3.

ENTCPUS — Fuel ethanol, including denaturant, consumed in the United States.

- 1960 through 1980: No data are available. Values are assumed to be zero.
- 1981 through 1992:
  - 1981, 1984, 1987, and 1989: EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10.
  - 1982 and 1983: EIA, Office of Coal, Nuclear, Electric, and Alternate Fuels estimates.
  - 1985, 1986, 1988, and 1991: Values interpolated.
  - 1990 and 1992: EIA, *Estimates of U.S. Biomass Energy Consumption 1992*, Table D1.
- 1993 through 2004: EIA estimates based on data in the EIA *Petroleum Supply Annual, (PSA)* Tables 2 and 16. Ten percent of the "Field Production" of "Oxygenated Finished Motor Gasoline" from the *PSA* Table 2 is added to the "Refinery Input of Fuel Ethanol" from the *PSA* Table 16.
- 2005 through 2008: EIA estimates based on data in the EIA *PSA*, Tables 1 and 15. Motor gasoline blending components adjustments and finished motor gasoline adjustments from *PSA*, Table 1, are added to fuel ethanol refinery and blender net inputs from *PSA*, Table 15.
- 2009 forward: EIA estimates based on data in the EIA *PSA*, Table 1. Fuel Ethanol Stock Exchange and Fuel Ethanol Exports are subtracted from Fuel Ethanol Renewable Fuels and Oxygenate Plant Net Production and Fuel Ethanol Imports.

ENTRPZZ — Fuel ethanol blended into motor gasoline by state.

- 1960 through 1980: Values are set to be zero.
- 1981 through 1992: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics, Summary to 1995,* Table MF-233GLA.
- 1993 through 1995: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics, Summary to 1995,* Table MF-233E, column titled "Total Ethanol Used in Gasohol."
- 1996 through 2001, 2003, and 2004: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*, Table MF-33E, column titled "Total Ethanol Used in Gasohol."
- 2002: EIA estimates based on the 2001 and 2003 data from *Highway Statistics*. For an explanation of the estimation methodology, see the

"Additional Notes" on page 89.

- 2005 through 2009: EIA estimates based on Petroleum & Other Liquids data website, Prime Supplier Sales Volumes, Motor Gasoline http://www.eia.gov/dnav/pet/pet_cons_prim_a_epm0_p00_mgalpd_a.htm, Refinery and Blender Net Production for the finished motor gasoline products—http://www.eia.gov/dnav/pet/pet_pnp_refp_a_epm0f_ypr_mbbl_a.htm, supply of fuel ethanol—http://www.eia.gov/dnav/pet/pet_sum_snd_a_EPOOXE_mbbl_a_cur.htm. See explanation of estimation methodology on page 88.

- 2010 forward: EIA estimates based on Petroleum & Other Liquids data website, Prime Supplier Sales Volumes, Motor Gasoline http://www.eia.gov/dnav/pet/pet_cons_prim_a_epm0_p00_mgalpd_a.htm, Refinery and Blender Net Production for the finished motor gasoline products—http://www.eia.gov/dnav/pet/pet_pnp_refp_a_epm0f_ypr_mbbl_a.htm, movements of conventional gasoline between PAD Districts—http://www.eia.gov/dnav/pet/pet_move_ptb_a_EPM0C_TNR_mbbl_a.htm, and unpublished imports and exports of conventional gasoline by Refining District. See explanation of estimation methodology on page 88.

Geothermal Energy

Electricity generated from geothermal energy is included in the State Energy Data System (SEDS) for all years. Before 1989, it covered geothermal energy input at electric utilities only; for 1989 forward, it also includes geothermal energy input for independent power producers. The data series is identified in SEDS by the following names ("ZZ" in the variable name represents the two-letter state code that differs for each state):

GEEGPZZ = geothermal electricity net generation in the electric power sector by state, in million kilowatthours.

Geothermal energy is also used as direct heat or from heat pumps in the residential, commercial, and industrial sectors. National estimates of geothermal energy consumption for these three end-use sectors for 1989 through 2011 were developed by the Oregon Institute of Technology Geo-Heat Center, which also provided state estimates for selected years (see additional notes below). From 2012 forward, estimates are no longer available from the Geo-Heat Center. The U.S. consumption by sector, estimated by EIA and reported in the *Monthly Energy Review*, is allocated to the states using each state's average share of U.S. geothermal energy consumption for 2009 through 2011.

These data series are identified in SEDS by the following names ("ZZ" in the variable name represents the two-letter state code that differs for each state):

GECCBZZ = geothermal energy consumed by the commercial sector by state, in billion British thermal units (Btu);

GEICBZZ = geothermal energy consumed by the industrial sector by state, in billion Btu; and

GERCBZZ = geothermal energy consumed by the residential sector by state, in billion Btu.

The U.S. totals for the state-level series are calculated by summing the state data:

GEEGPUS = ΣGEEGPZZ
GECCBUS = ΣGECCBZZ
GEICBUS = ΣGEICBZZ
GERCBUS = ΣGERCBZZ

Geothermal electricity net generation in the electric power sector is converted from kilowatthours to British thermal units (Btu) by using the U.S. average heat content of fossil fuels consumed at steam-electric power plants,

FFETKUS, as a conversion factor. The annual values for this factor are shown in the Consumption Technical Notes, Appendix B, Table B1, http://www.eia.gov/state/seds/seds-technical-notes-complete.cfm.

FFETKUS = factor for converting geothermal electricity net generation from kilowatthours to Btu.

The values for the electric power sector in each state are converted to Btu and the U.S. total is the sum of the state data:

GEEGBZZ = GEEGPZZ * FFETKUS
GEEGBUS = ΣGEEGBZZ

The state totals for geothermal energy are the sum of the residential, commercial, and industrial sectors' use and the electric power sector's geothermal-based generation. The U.S. total is the sum of the state data.

GETCBZZ = GERCBZZ + GECCBZZ + GEICBZZ + GEEGBZZ
GETCBUS = ΣGETCBZZ

Additional notes

Consumption estimates of geothermal energy in the residential, commercial, and industrial sectors are from the Oregon Institute of Technology Geo-Heat Center. State data for 1989 and 1994 are based on surveys of geothermal equipment producers, distributors, and installers and state energy offices. State estimates from 1998 forward are developed by the Geo-Heat Center from discussions with industry sources.

The state data for 1989, 1994, and 1998 are used by the U.S. Energy Information Administration (EIA) to estimate the state values for intervening years. States with the same value in two survey years are assigned that value for each intervening year. For states with increases or decreases in the survey data, the difference is allocated evenly over the intervening years. If a state went from zero to a value or from a value to zero, it was given zero in the intervening years. The state data for each intervening year are summed and states with increasing or decreasing values are adjusted until the U.S. total equals the U.S. total estimated by the Oregon Institute of Technology Geo-Heat Center.

Data sources

FFETKUS — Fossil-fueled steam-electric power plant conversion factor.

- 1960 through 1988: Estimated by EIA as the weighted annual average heat rate for fossil-fueled steam-electric plants in the United States as published in the EIA, *Electric Plant Cost and Power Production Expenses 1991*, Table 9.
- 1989 through 2000: Calculated annually by EIA by using heat rate data reported on Form EIA-860, "Annual Electric Generator Report" (and predecessor forms); and net generation data reported on Form EIA-759, "Monthly Power Plant Report." The computation includes data for all electric utility steam-electric plants using fossil fuels.
- 2001 forward: Calculated annually by EIA by using fuel consumption and net generation data reported on Form EIA-923, "Power Plant Operations Report," and predeccessor forms. The computation includes data for all electric utilities and electricity-only independent power producers using fossil fuels.

GECCBZZ — Geothermal energy consumed by the commercial sector.

- 1960 through 1988: No data available. Values assumed to be zero.
- 1989: Oregon Institute of Technology Geo-Heat Center, unpublished tables (April 1999) based on a survey.
- 1990 through 1993: U.S. totals are estimates from the Oregon Institute of Technology Geo-Heat Center, unpublished tables. State data for 1989 and 1994 are used to estimate state values for the intervening years. For an explanation of the estimation methodology, see the "Additional Note" on page 91.
- 1994: Oregon Institute of Technology Geo-Heat Center, unpublished tables (April 1999) based on a survey.
- 1995 through 1997: U.S. totals are from the Oregon Institute of Technology Geo-Heat Center, unpublished tables. State data for 1994 and 1998 are used to estimate state values for the intervening years. For an explanation of the estimation methodology, see the "Additional Note" on page 91.
- 1998 through 2011: Oregon Institute of Technology Geo-Heat Center, unpublished tables based on informal surveys and estimations.
- 2012 forward: Estimated by EIA, based on Oregon Institute of Technology Geo-Heat Center data.

GEEGPZZ — Geothermal electricity net generation in the electric power sector for each state.

- 1960 forward: EIA, Form EIA-923, "Power Plant Operations Report," and predecessor forms.

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GEICBZZ — Geothermal energy consumed by the industrial sector.

- 1960 through 1988: No data available. Values assumed to be zero.
- 1989: Oregon Institute of Technology Geo-Heat Center, unpublished tables (April 1999) based on a survey.
- 1990 through 1993: U.S. totals are estimates from the Oregon Institute of Technology Geo-Heat Center, unpublished tables. State data for 1989 and 1994 are used to estimate state values for the intervening years. For an explanation of the estimation methodology, see the "Additional Note" on page 91.
- 1994: Oregon Institute of Technology Geo-Heat Center, unpublished tables, (April 1999) based on a survey.
- 1995 through 1997: U.S. totals are from the Oregon Institute of Technology Geo-Heat Center, unpublished tables. State data for 1994 and 1998 are used to estimate state values for the intervening years. For an explanation of the estimation methodology, see the "Additional Note" on page 91.
- 1998 through 2011: Oregon Institute of Technology Geo-Heat Center, unpublished tables based on informal surveys and estimations.
- 2012 forward: Estimated by EIA, based on Oregon Institute of Technology Geo-Heat Center data.

GERCBZZ — Geothermal energy consumed by the residential sector.

- 1960 through 1988: No data available. Values assumed to be zero.
- 1989: Oregon Institute of Technology Geo-Heat Center, unpublished tables (April 1999) based on a survey.
- 1990 through 1993: U.S. totals are estimates from the Oregon Institute of Technology Geo-Heat Center, unpublished tables. State data for 1989 and 1994 are used to estimate state values for the intervening years. For an explanation of the estimation methodology, see the "Additional Note" on page 91.
- 1994: Oregon Institute of Technology Geo-Heat Center, unpublished tables (April 1999) based on a survey.
- 1995 through 1997: U.S. totals are from the Oregon Institute of Technology Geo-Heat Center, unpublished tables. State data for 1994 and 1998 are used to estimate state values for the intervening years. For an explanation of the estimation methodology, see the "Additional Note" on page 91.
- 1998 through 2011: Oregon Institute of Technology Geo-Heat Center, unpublished tables based on informal surveys and estimations.

- 2012 forward: Estimated by EIA, based on Oregon Institute of Technology Geo-Heat Center data.

Hydroelectric Power

Electricity generated from hydropower is included in the State Energy Data System (SEDS) in the industrial and electric power sectors for all years, 1960 forward, and in the commercial sector for 1989 forward. In the electric power sector, there are two types of hydroelectricity: conventional hydroelectricity and pumped storage hydroelectricity. Conventional hydroelectricity uses falling water to drive turbines to produce electricity. Pumped storage hydroelectricity is generated by releasing water that has been pumped into an elevated storage reservoir during off-peak periods to drive the turbines during times of peak demand. Electricity produced from pumped storage, when it can be identified separately, is not included in energy consumption estimates because the energy that was used to pump the water is already accounted for. Hydroelectricity data series included in SEDS are identified by the following names ("ZZ" in the name represents the two-letter state code that differs for each state):

HVEGPZZ = conventional hydroelectricity net generation in the electric power sector by state, in million kilowatthours;

HVC5PZZ = conventional hydroelectricity net generation at commercial CHP and electricity-only facilities by state, in million kilowatthours; and

HVI5PZZ = conventional hydroelectricity net generation at industrial CHP and electricity-only facilities by state, in million kilowatthours.

The U.S. value for each of the series is the sum of the state data.

Total use of hydroelectricity in the commercial, industrial, and electric power sectors is assumed to be the electricity generated by conventional hydroelectricity. The U.S. total for each sector is the sum of the state values:

HYCCPZZ = HVC5PZZ
HYCCPUS = ΣHYCCPZZ
HYICPZZ = HVI5PZZ
HYICPUS = ΣHYICPZZ
HYEGPZZ = HVEGPZZ
HYEGPUS = ΣHYEGPZZ

Hydroelectricity net generation is converted from kilowatthours to British thermal units (Btu) by using the U.S. average heat content of fossil fuels consumed at steam-electric power plants, FFETKUS, as a conversion factor. The annual values for this factor are shown in the Consumption Technical

Notes, Appendix B, Table B1, http://www.eia.gov/state/seds/seds-technical-notes-complete.cfm.

HYCCBZZ = HYCCPZZ * FFETKUS
HYICBZZ = HYICPZZ * FFETKUS
HYEGBZZ = HYEGPZZ * FFETKUS

The U.S. value for each of the series is the sum of the state data.

Total hydroelectricity consumption for each state is the sum of the commercial, industrial, and electric power sectors' generation.

HYTCPZZ = HYCCPZZ + HYICPZZ + HYEGPZZ
HYTCPUS = ΣHYTCPZZ
HYTCBZZ = HYCCBZZ + HYICBZZ + HYEGBZZ
HYTCBUS = ΣHYTCBZZ

Data sources

FFETKUS — Fossil-fueled steam-electric power plant conversion factor.

- 1960 through 1988: Estimated by EIA as the weighted annual average heat rate for fossil-fueled steam-electric plants in the United States as published in the EIA, *Electric Plant Cost and Power Production Expenses 1991*, Table 9.
- 1989 through 2000: Calculated annually by EIA by using heat rate data reported on Form EIA-860, "Annual Electric Generator Report" (and predecessor forms); and net generation data reported on Form EIA-759, "Monthly Power Plant Report." The computation includes data for all electric utility steam-electric plants using fossil fuels.
- 2001 forward: Calculated annually by EIA by using fuel consumption and net generation data reported on Form EIA-923, "Power Plant Operations Report," and predeccessor forms. The computation includes data for all electric utilities and electricity-only independent power producers using fossil fuels.

HVC5PZZ — Conventional hydroelectricity net generation at commercial CHP and electricity-only facilities by state.

- 1960 through 1988: No data available. Values are assumed to be zero.
- 1989 forward: EIA, Form EIA-923, "Power Plant Operations Report," and predecessor forms.

HVI5PZZ — Conventional hydroelectricity net generation at industrial CHP

and electricity-only facilities by state.

- 1960 through 1978: Federal Power Commission, Form 4, "Monthly Power Plant Report."
- 1979 and 1980: EIA estimates based on previous years' data.
- 1981 through 1988: No data available. The 1980 data are repeated for each year.
- 1989 forward: EIA, Forms EIA-923, "Power Plant Operations Report," and predecessor forms.

HVEGPZZ — Conventional hydroelectricity net generation in the electric power sector (includes pumped storage hydroelectric power through 1989) by state.

- 1960 through 1977: Federal Power Commission, News Release, "Power Production, Fuel Consumption, and Installed Capacity Data."
- 1978 through 1980: EIA, *Energy Data Reports*, "Power Production, Fuel Consumption and Installed Capacity Data."
- 1981 through 1988: EIA, Form EIA-759, "Monthly Power Plant Report," and predecessor forms. The data rounded to gigawatthours are published in the following reports:
  – 1981 through 1985: EIA, *Electric Power Annual 1985*, Table 6.
  – 1986 and 1987: EIA, *Electric Power Annual 1987*, Table 18.
  – 1988: EIA, *Electric Power Annual 1989*, Table 14.
- 1989 forward: EIA, Forms EIA-923, "Power Plant Operations Report," and predecessor forms.

Solar Energy

Solar energy consumption includes photovoltaic electricity net generation and solar thermal energy consumption. Photovoltaic and solar thermal electricity net generation in the electric power sector is included in the State Energy Data System (SEDS) for 1984 forward. For 2008 forward, data on electricity generated from solar energy sources at commercial and industrial facilities with capacity of 1 megawatt or greater are also available from the U.S. Energy Information Administration's (EIA) survey on power plant operations. Solar thermal energy use for the residential, commercial, and industrial sectors not captured by the electric power plant survey is estimated by EIA and is included in SEDS for 1989 forward.

Electric power sector

The electric power sector includes estimates of electricity produced from photovoltaic and solar thermal energy sources by electric utilities for 1984 forward, and by both electric utilities and independent power producers for 1989 forward. The data series is identified in SEDS by the following name ("ZZ" in the variable name represents the two-letter state code that differs for each state):

SOEGPZZ   =   photovoltaic and solar thermal electricity net generation in the electric power sector, for each state, in million kilowatthours.

The U.S. total for this series is calculated as the sum of the state data:

SOEGPUS   =   ΣSOEGPZZ

Photovoltaic and solar thermal electricity net generation in the electric power sector is converted from kilowatthours to British thermal units (Btu) by using a conversion factor that is the U.S. average heat content of fossil fuels consumed at steam-electric power plants, FFETKUS. The annual values for this factor are shown in Appendix B, Table B1, http://www.eia.gov/state/seds/seds-technical-notes-complete.cfm.

FFETKUS   =   factor for converting photovoltaic and solar thermal electricity net generation from kilowatthours to Btu.

The values for the electric power sector in each state are converted to Btu and the U.S. total is the sum of the state data:

SOEGBZZ = SOEGPZZ * FFETKUS
SOEGBUS = ΣSOEGBZZ

Commercial and industrial sectors (utility scale)

Data for photovoltaic and solar thermal electricity generated at commercial and industrial combined-heat-and-power (CHP) and electricity-only plants with capacity of 1 megawatt or greater (utility scale) are available for 2008 forward. The SEDS data series are identified by the following names ("ZZ" in the name represents the two-letter state code that differs for each state):

SOC5PZZ = photovoltaic and solar thermal electricity net generation at utility scale commercial CHP and electricity-only facilities by state, in million kilowatthours; and

SOI5PZZ = photovoltaic and solar thermal electricity net generation at utility scale industrial CHP and electricity-only facilities by state, in million kilowatthours.

The U.S. value for each series is the sum of the state data.

Consumption in Btu is calculated by using the conversion factor FFETKUS:

SOC5BZZ = SOC5PZZ * FFETKUS
SOI5BZZ = SOI5PZZ * FFETKUS

Solar energy consumed by facilities with capacity under 1 megawatt is included in the combined residential/commercial/industrial data series (SOHCB) described in the next section. Currently, commercial and industrial sector solar energy consumption just covers consumption of the CHP and electricity-only plants with capacity of 1 megawatt or greater.

SOCCBZZ = SOC5BZZ
SOCCBUS = ΣSOCCBZZ
SOICBZZ = SOI5BZZ
SOICBUS = ΣSOICBZZ

Combined residential/commercial/industrial sector

Distributed photovoltaic (PV) electricity net generation and solar thermal direct-use energy consumed in the residential, commercial, and industrial sectors for the United States, not covered by EIA's electric power plant survey, are estimated by EIA in billion Btu and published in the EIA *Annual Energy Review or Monthly Energy Review* for 1989 forward. Until recently, a large portion of the distributed solar energy consumption is attributed to solar

Table TN5.1. Solar PV share of distributed solar energy consumption, 2005 forward

Year	Share	Year	Share
2005	0.03	2010	0.23
2006	0.07	2011	0.31
2007	0.09	2012	0.41
2008	0.13	2013	0.48
2009	0.17	2014	0.55

thermal energy used for water or space heating, mostly by the residential sector. So the data series is included in residential consumption.

SOHCBUS = distributed photovoltaic and solar thermal energy consumed (converted to Btu using the fossil-fueled plants heat rate) in the residential, commercial, and industrial sectors in the United States, in billion Btu (other than power generated at facilities with capacity of 1 megawatt or greater).

Through 2004, a state-level series for allocating the U.S. total to the states is developed by EIA from accumulated data on shipments of solar thermal collectors to states, measured in square feet, as collected on the EIA Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey," and predecessor forms. The data are published in the EIA *Renewable Energy Annual*. The assumption is made that the retirement/replacement period for solar thermal collectors is 20 years. See "Additional Notes on Solar Energy" on page 96 for more details. The data series are identified in SEDS by the following names ("ZZ" in the variable name represents the two-letter state code that differs for each state):

SOTTPZZ = rolling 20-year accumulation of shipments of solar thermal energy collectors by state, in square feet.

The U.S. total of shipments of solar thermal energy collectors is calculated as the sum of the state data, and the U.S. residential/commercial/industrial solar thermal energy use is allocated to the states as follows:

SOTTPUS = ΣSOTTPZZ
SOHCBZZ = (SOTTPZZ / SOTTPUS) * SOHCBUS

For 2005 forward, a new methodology is used to allocate the U.S. total to the states. Based on EIA's *Annual Energy Outlook*, photovoltaic energy share of distributed solar energy consumption, increased from 3% in 2005 to 55% in

2014, as shown in Table TN5.1, The data series is identified in SEDS by:

PVHCSUS = photovoltaic energy share of distributed solar energy consumption for the United States.

U.S. distributed photovoltaic energy consumption, PVHCBUS, and distributed solar thermal energy consumption, STHCBUS, are computed as follows:

PVHCBUS = SOHCBUS * PVHCSUS
STHCBUS = SOHCBUS - PVHCBUS

U.S. distributed photovoltaic energy consumption is allocated to the states using state-level cumulative installed capacity estimated by EIA based on capacity of PV installations in the residential and non-residential sectors published by the Interstate Renewable Energy Council through 2013 and the Solar Energy Industries Association for 2014.

PVCAPZZ = cumulative installed capacity of grid-connected photovoltaicmodule installation, in direct current megawatts.

PVCAPUS = ΣPVCAPZZ
PVHCBZZ = (PVCAPZZ / PVCAPUS) * PVHCBUS

U.S. distributed solar thermal consumption is allocated to the states using the state shares of the rolling 20-year cumulative shipments of solar thermal collectors. The survey on solar thermal collector shipments, EIA-63A, was terminated in 2012, and data for 2010 forward are not available from EIA or other sources. The 2009 state shares are used to allocate the U.S. total to the shares for 2010 forward.

STHCBZZ = (SOTTPZZ / SOTTPUS) * STHCBUS

Distributed solar energy consumption for each state is the sum of the two components:

SOHCBZZ = PVHCBZZ + STHCBZZ

Total consumption

Each state's total use of photovoltaic and solar thermal energy sources is the sum of the sectors' values, and the U.S. total is the sum of the states' totals:

SOTCBZZ = SOEGBZZ + SOCCBZZ + SOICBZZ + SOHCBZZ
SOTCBUS = ΣSOTCBZZ

Additional notes

Shipments of solar thermal collectors in the United States, in thousand square feet, for 1974 through 2009 are collected on the EIA Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey," (and predecessor forms) and used to develop this series for 1989 forward. The data are accumulated year to year on the assumption that the replacement/retirement period for solar thermal collectors is 20 years. Data for 1974 through 1985 are available for the U.S. total only and are allocated to the states by using an allocating series that is the average of the 1986 and 1987 shipments (the first years state-level data were collected). The ratios of the average 1986 and 1987 state values to the average 1986 and 1987 U.S. value are applied to the national annual values for each year, 1974 through 1985. Beginning in 1986, the U.S. data are adjusted to remove Puerto Rico and the Virgin Islands.

Shipments of solar thermal collectors include high-temperature parabolic dish or trough collectors used by the electric power sector. Data for California (1986 through 1996, 1998 through 2001, 2008, and 2009), Arizona (2005, 2009), and Nevada (2006) are reduced by the shipments of high-temperature parabolic dish or trough collectors to the electric power sector as shown in the *Renewable Energy Annual*. See SOTTPZZ Data Sources on page 95 for source table details.

Data sources

FFETKUS — Fossil-fueled steam-electric power plant conversion factor.

- 1960 through 1988: Estimated by EIA as the weighted annual average heat rate for fossil-fueled steam-electric plants in the United States as published in the EIA, *Electric Plant Cost and Power Production Expenses 1991*, Table 9.
- 1989 through 2000: Calculated annually by EIA by using heat rate data reported on Form EIA-860, "Annual Electric Generator Report" (and predecessor forms); and net generation data reported on Form EIA-759, "Monthly Power Plant Report." The computation includes data for all electric utility steam-electric plants using fossil fuels.
- 2001 forward: Calculated annually by EIA by using fuel consumption and net generation data reported on Form EIA-923, "Power Plant Operations Report," and its predecessor forms. The computation includes data for all electric utilities and electricity-only independent power producers using fossil fuels.

PVCAPZZ — Cumulative installed capacity of grid-connected photovoltaic module installation in each state, in direct current megawatts.

- 2005 forward: Estimated by EIA, based on capacity of grid-connected PV installations in the residential and non-residential sectors published by the Interstate Renewable Energy Council (http://www.irecusa.org/publications/) (through 2013) and the Solar Energy Industries Association (2014).

PVHCSUS — Photovoltaic energy share of distributed solar energy consumption for the United States.

- 2005 forward: Estimated by EIA, based on nonmarketed solar energy consumption by the residential and commercial sectors published in the *Annual Energy Outlook*. Recent history is available at http://www.eia.gov/analysis/projection-data.cfm#annualproj.

SOC5PZZ — Photovoltaic and solar thermal electricity net generation at utility scale commercial CHP and electricity-only facilities by state.

- 1960 through 2007: No data available. Values are assumed to be zero.
- 2008 forward: EIA, Forms EIA-923, "Power Plant Operations Report."

SOEGPZZ — Photovoltaic and solar thermal electricity net generation in the electric power sector by state.

- 1960 through 1983: No data available. Values are assumed to be zero.
- 1984 forward: EIA, Forms EIA-923, "Power Plant Operations Report," and predecessor forms.

SOI5PZZ — Photovoltaic and solar thermal electricity net generation at utility scale industrial CHP and electricity-only facilities by state.

- 1960 through 2007: No data available. Values are assumed to be zero.
- 2008 forward: EIA, Forms EIA-923, "Power Plant Operations Report."

SOHCBUS — Distributed photovoltaic and solar thermal energy consumed (converted to Btu using the fossil-fueled plants heat rate), in the residential, commercial, and industrial sectors combined in the United States.

- 1960 through 1988: No data available. Values are zero.
- 1989 through 2010: EIA, *Annual Energy Review,* Table 10.2a.
- 2011 forward: EIA, *Monthly Energy Review,* Table 10.2a.

SOTTPZZ — Rolling 20-year accumulation of shipments of solar thermal energy collectors by state.

- 1960 through 1988: Values are set to zero in SEDS for consistency with SOHCBUS.
- 1989 through 2009: Shipments of solar thermal collectors in the United States, in thousand square feet, for 1974 forward are collected on the EIA Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey," (and predecessor forms) and used to develop this series for 1989 forward. The sources for these data series are:
  – 1986 through 1993: EIA, *Solar Collector Manufacturing Activity* for each year. The specific table numbers are:
    - 1986 through 1988, 1990: Table 5.
    - 1989: Table 4.
    - 1991 and 1992: Table 13.
    - 1993: Table 12.
  – 1994 through 2009: EIA, *Renewable Energy Annual*. Data are from the report of the following year (i.e., 1994 data are published in the *Renewable Energy Annual 1995*) for 1994 through 2000. Beginning in 2001, data are from the report of the same year. The specific tables are:
    - 1994: Table 13.
    - 1995: Table F9.
    - 1996: Table 16.
    - 1997: Table 15.
    - 1998 and 1999: Table 12.
    - 2000: Unpublished data.
    - 2001 through 2003: Table 14.
    - 2004 and 2005: Table 34.
    - 2006 through 2009: Table 2.6.

Note: High-temperature parabolic dish or trough collectors shipped to the electric power sector are deducted from the solar thermal collector shipments. They are available in the following tables:

  – 1986 through 1993: EIA, *Renewable Energy Annual 1995,*Table 13.
  – 1994 through 2009: EIA, *Renewable Energy Annual*. Data are from the report of the following year (i.e., 1994 data are published in the *Renewable Energy Annual 1995*) for 1994 through 2000. Beginning in 2001, data are from the report of the same year. The specific tables are:
    - 1994: Table H3.
    - 1995: Table F10.
    - 1996: Table 17.
    - 1997: Table 19.
    - 1998 and 1999: Table 16.
    - 2000: Unpublished data.

- 2001 through 2003: Table 18.
- 2004 and 2005: Table 38.
- 2006: Table 2.10.
- 2007 through 2009: Table 2.13.

Wind Energy

Wind electricity net generation in the electric power sector is included in the State Energy Data System (SEDS) for 1983 forward. For 2009 forward, data for wind electricity net generation at utility scale commercial and industrial combined-heat-and-power (CHP) and electricity-only plants are available from the U.S. Energy Information Administration (EIA) electric power plant survey. The data are identified in SEDS by the following name ("ZZ" in the variable name represents the two-letter state code that differs for each state):

WYEGPZZ = wind electricity net generation in the electric power sector, by state, in million kilowatthours;

WYC5PZZ = wind electricity net generation at utility scale commercial CHP and electricity-only facilities by state, in million kilowatthours; and

WYI5PZZ = wind electricity net generation at utility scale industrial CHP and electricity-only facilities by state, in million kilowatthours.

Wind electricity net generation in the commercial and industrial sectors is represented by:

WYCCPZZ = WYC5PZZ
WYICPZZ = WYI5PZZ

The U.S. total is calculated as the sum of the state data for each series.

Wind electricity net generation is converted from kilowatthours to British thermal units (Btu) by using a conversion factor that is the U.S. average heat content of fossil fuels consumed at steam-electric power plants, FFETKUS. The annual values for this factor are shown in Appendix B, Table B1, http://www.eia.gov/state/seds/seds-technical-notes-complete.cfm.

FFETKUS = factor for converting wind electricity net generation from kilowatthours to Btu.

WYEGBZZ = WYEGPZZ * FFETKUS
WYC5BZZ = WYC5PZZ * FFETKUS
WYI5BZZ = WYI5PZZ * FFETKUS
WYCCBZZ = WYC5BZZ
WYICBZZ = WYI5BZZ

The U.S. value for each of the series is the sum of the state data.

Each state's total consumption of wind electricity is the sum of the sectors'

values, and the U.S. total is the sum of the states' totals:

$$
\begin{aligned}
\text{WYTCPZZ} &= \text{WYEGPZZ} + \text{WYCCPZZ} + \text{WYICPZZ} \\
\text{WYTCPUS} &= \Sigma\text{WYTCPZZ} \\
\text{WYTCBZZ} &= \text{WYEGBZZ} + \text{WYCCBZZ} + \text{WYICBZZ} \\
\text{WYTCBUS} &= \Sigma\text{WYTCBZZ}
\end{aligned}
$$

Data sources

FFETKUS — Fossil-fueled steam-electric power plant conversion factor.

- 1960 through 1988: Estimated by EIA as the weighted annual average heat rate for fossil-fueled steam-electric plants in the United States as published in the EIA, *Electric Plant Cost and Power Production Expenses 1991*, Table 9.
- 1989 through 2000: Calculated annually by EIA by using heat rate data reported on Form EIA-860, "Annual Electric Generator Report" (and predecessor forms); and net generation data reported on Form EIA-759, "Monthly Power Plant Report." The computation includes data for all electric utility steam-electric plants using fossil fuels.
- 2001 forward: Calculated annually by EIA by using fuel consumption and net generation data reported on Form EIA-923, "Power Plant Operations Report," and predecessor forms. The computation includes data for all electric utilities and electricity-only independent power producers using fossil fuels.

WYC5PZZ — Wind electricity net generation at utility scale commercial CHP and electricity-only facilities by state.

- 1960 through 2008: No data available. Values are assumed to be zero.
- 2009 forward: EIA, Forms EIA-923, "Power Plant Operations Report."

WYEGPZZ — Wind electricity net generation in the electric power sector by state.

- 1960 through 1982: No data available. Values are assumed to be zero.
- 1983 forward: EIA, Forms EIA-923, "Power Plant Operations Report," and predecessor forms.

WYI5PZZ — Wind electricity net generation at utility scale industrial CHP and electricity-only facilities by state.

- 1960 through 2009: No data available. Values are assumed to be zero.
- 2010 forward: EIA, Forms EIA-923, "Power Plant Operations Report."

Wood and Waste

Different forms of wood and waste are used by each consuming sector. The residential sector burns wood for space heating. The commercial sector uses wood for space heating, and it uses wood, municipal waste and landfill gas for steam heat and electricity generation. The industrial sector uses combustible industrial byproducts and wood chips for electricity generation and process steam. The electric power sector uses wood, industrial wood waste and waste gas, and municipal waste as cofiring or primary fuels to produce electricity. Consumption of wood and waste in all sectors is included in the State Energy Data System (SEDS) for 1960 forward. Wood includes wood and wood-derived fuels. Waste is biomass waste which includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, etc. Prior to 2001, waste also includes non-biomass waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).

Residential sector

Physical units

Estimates of wood consumed in the residential sector by state for 1960 through 1979 are from the U.S. Energy Information Administration (EIA) *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*. For 1980 forward, state estimates are developed from: (1) U.S. residential wood consumption estimates published in the EIA *Annual Energy Review* (*AER*) or *Monthly Energy Review* (*MER*), (2) U.S. total, Census division, and selected state data collected on the EIA triennial/quadrennial survey, Residential Energy Consumption Survey (RECS), and (3) U.S. Department of Commerce, Census Bureau, annual estimates of number of housing units by state from the Population Census or Annual Housing Survey (prior to 2005) or the number of occupied housing units that use wood as primary heating fuel from the American Community Survey (for 2005 forward).

RECS data are available for 1981, 1984, 1987, 1990, 1993, 1997, 2001, 2005, and 2009. The 1981 RECS provides wood consumption data for the national total and Census regions. For all other years, RECS provides data for the national total and Census divisions. From 1993 through 2005, data for the four largest consuming states—California, Florida, New York, and Texas are available. The regional totals for the rest of the states in each Census division are compiled. For 2009, data are available for 16 states (the top four states plus Arizona, Colorado, Georgia, Illinois, Massachusetts, Michigan, Missouri, New Jersey, Pennsylvania, Tennessee, Virginia, and Wisconsin) and 11 regions covering all the other states.

For the RECS data years prior to 2005, the regional values are allocated to the states within each region in proportion to the U.S. Census Bureau data on housing units by state, assuming that no wood is consumed in the residential sector in Hawaii. For the RECS data years from 2005 forward, the number of occupied housing units that use wood as primary heating fuel from the American Community Survey (3-Year Estimates) is used to allocate the regional values to the states. For the other years, the estimated state shares of the preceding available RECS year are used to allocate the U.S. total from the *AER/MER* to the states.

The state data derived above are used in SEDS as wood consumption in the residential sector, identified in the system as WDRCPZZ. "ZZ" in the following variable name represents the two-letter state code that differs for each state.

WDRCPZZ = wood consumed in the residential sector of each state, in thousand cords.

The state-level data are summed to a U.S. total:

WDRCPUS = ΣWDRCPZZ

British thermal units (Btu)

The residential sector data in cords are converted to Btu by using the conversion factor of 20 million Btu per cord:

WDRCBZZ = WDRCPZZ * 20
WDRCBUS = ΣWDRCBZZ

Data sources

WDRCPZZ — Wood energy consumed by the residential sector by state.

- 1960 through 1979: EIA, *Estimates of U.S. Wood Consumption from 1949 to 1981*, Table A4. Data published in thousand short tons are converted to thousand cords by using the factors of one short ton equals 17.2 million Btu (as published in the footnote of Table A4) and 20 million Btu equal one cord of wood, (as published in EIA, *Household Energy Consumption and Expenditures 1993*, page 314).
- 1980 forward: U.S. totals published in the EIA *Annual Energy Review* (*AER*) or *Monthly Energy Review* (*MER*), Table 10.2a, are converted from trillion Btu to thousand cords (by using the factor of 20 million Btu per cord) and allocated to the states as described below. Hawaii residential wood consumption is assumed to be zero through 2004.

– 1980 through 1983: U.S. Census region wood consumption in thousand cords from Form EIA-457, "1981 Residential Energy Consumption Survey" is allocated to the states within each region in proportion to the U.S. Department of Commerce, Census Bureau, *American Housing Survey*, "Total Housing Units for States, July 1, 1981." This derived 1981 state series is used to allocate the *AER* annual U.S. residential wood consumption to the states for 1980 through 1983.

– 1984 through 1986: U.S. Census division wood consumption in thousand cords from Form EIA-457, "1984 Residential Energy Consumption Survey" is allocated to the states within each division in proportion to the U.S. Department of Commerce, Census Bureau, *American Housing Survey*, "Total Housing Units for States, July 1, 1984." This derived 1984 state series is used to allocate the *AER* annual U.S. residential wood consumption to the states for 1984 through 1986.

– 1987 through 1989: U.S. Census division wood consumption in thousand cords from Form EIA-457, "1987 Residential Energy Consumption Survey" is allocated to the states within each division in proportion to the U.S. Department of Commerce, Census Bureau, *American Housing Survey*, "Total Housing Units for States, July 1, 1987." This derived 1987 series is used to allocate the *AER* annual U.S. residential wood consumption to the states for 1987 through 1989.

– 1990 through 1992: U.S. Census division wood consumption in thousand cords is from Form EIA-457, "1990 Residential Energy Consumption Survey." State-level estimates are available for 1993 for California, Florida, New York, and Texas from the Form EIA-457, "1993 Residential Energy Consumption Survey." Those four states' percentages of their respective Census division totals in the 1993 survey are applied to the 1990 Census division data to derive their 1990 values. Wood consumption by the other states in each division is estimated by allocating the remaining division data to the states in proportion to the U.S. Department of Commerce, Census Bureau, Internet file (ST-98-51) "Estimates of Housing Units,…Annual Time Series,… (includes revised April 1, 1990 census housing…)" column titled "4/1/90 Census" at http://www.census.gov/population/estimates/housing/sthuhh6.txt. This derived 1990 state series is used to allocate the *AER* annual U.S. residential wood consumption to the states for 1990 through 1992.

– 1993 through 1996: Residential wood consumption data for U.S. Census divisions and for California, Florida, New York, and Texas are from Form EIA-457, "1993 Residential Energy Consumption Survey." Data for the other states in each division are estimated by allocating

the remaining division data to the states in proportion to the U.S. Department of Commerce, Census Bureau, Internet file (ST-98-51) "Estimates of Housing Units,…Annual Time Series, July 1, 1991 to July 1, 1998…," column titled "7/1/93" at http://www.census.gov/population/estimates/housing/sthuhh6.txt. This derived 1993 state series is used to allocate the *AER* annual U.S. residential wood consumption to the states for 1993 through 1996.

– 1997 through 2000: Residential wood consumption data for U.S. Census divisions and for California, Florida, New York, and Texas are from Form EIA-457, "1997 Residential Energy Consumption Survey." Data for the other states in each division are estimated by allocating the remaining division data to the states in proportion to the U.S. Department of Commerce, Census Bureau, Internet file (ST-98-51) "Estimates of Housing Units,…Annual Time Series, July 1, 1991 to July 1, 1998…," column titled "7/1/97" at http://www.census.gov/population/estimates/housing/sthuhh6.txt. This derived 1997 state series is used to allocate the *AER* annual U.S. residential wood consumption to the states for 1997 through 2000.

– 2001 through 2004: Residential wood consumption data for U.S. Census divisions and for California, Florida, New York, and Texas are from Form EIA-457, "2001 Residential Energy Consumption Survey." Data for the other states in each division are estimated by allocating the remaining division data to the states in proportion to the U.S. Department of Commerce, Census Bureau, Internet file "Table 1. Annual Estimates of Housing Units for the United States and States: April 1, 2000 to July 1, 2007," column titled "July 1, 2001" at http://www.census.gov/popest/data/historical/index.html. This derived 2001 state series is used to allocate the *AER* annual U.S. residential wood consumption to the states for 2001 through 2004.

– 2005 through 2008: Residential wood consumption data for U.S. Census divisions and for California, Florida, New York, and Texas are from Form EIA-457, "2005 Residential Energy Consumption Survey." Data for the other states in each division are estimated by allocating the remaining division data to the states in proportion to the U.S. Department of Commerce, Census Bureau, 2005-2007 American Community Survey 3-Year Estimates, Series B25040, by state, Occupied Housing Units by House Heating Fuel," item titled "Wood," at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. This derived 2005 state series is used to allocate the *AER* annual U.S. residential wood consumption to the states for 2005 through 2008.

– 2009 forward: Residential wood consumption data for 16 states and 11 regions are from Form EIA-457, "2009 Residential Energy Consumption Survey." Data for the states in each region are estimated by allocating the regional data to the states in proportion to the U.S. Department of Commerce, Census Bureau, 2008-2010 American Community Survey 3-Year Estimates, Series B25040, by state, Occupied Housing Units by House Heating Fuel," item titled "Wood," at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. This derived 2009 state series is used to allocate the *AER/MER* annual U.S. residential wood consumption to the states for 2009 forward.

Commercial sector

Estimates of wood consumed in the commercial sector by state for 1960 through 1979 are from the EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*. The data published in thousand short tons are converted to billion Btu by using the conversion factor of one short ton equals 17.2 million Btu. The assumption was made in that report that wood is consumed in the commercial sector in proportion to consumption in the residential sector each year. For 1980 through 1988, national level commercial wood consumption estimates in trillion Btu are from the EIA, *Annual Energy Review (AER)*. Using the same methodology as for previous years, the national data are allocated to the states in proportion to residential sector wood use each year.

For 1989 forward, state-level data on wood and waste consumption by commercial combined-heat-and-power (CHP) and electricity-only plants are available from the EIA, Form EIA-923, "Power Plant Operations Report," and predecessor forms. The U.S. total wood consumption in the commercial sector is published in the *AER* or the *Monthly Energy Review* (*MER*). The U.S. total of the state commercial CHP and electricity-only plant wood consumption is subtracted from the *AER/MER* national commercial sector total, and the remainder is allocated to the states in proportion to each state's residential sector wood use each year from 1989 forward.

The data series described above, used to estimate SEDS wood and waste consumption in the commercial sector, are identified as follows ("ZZ" in the variable names represents the two-letter state code that differs for each state):

WDCCBUS = wood consumed by the commercial sector in the United States, in billion Btu;

WDC3BZZ = wood consumed by CHP and electricity-only facilities in the commercial sector of each state, in billion Btu; and

WSC3BZZ = waste consumed by CHP and electricity-only facilities in the commercial sector of each state, in billion Btu.

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The U.S. totals for the state-level series are calculated as the sum of the state data.

WDC3BUS = ΣWDC3BZZ
WSC3BUS = ΣWSC3BZZ

The national total wood consumed by commercial entities other than CHP and electricity-only facilities are calculated as shown below, and those volumes are allocated to the states in proportion to the residential wood consumption series as follows:

WDC4BUS = WDCCBUS - WDC3BUS
WDC4BZZ = (WDRCPZZ / WDRCPUS) * WDC4BUS

State totals of commercial wood consumption are calculated as the sum of consumption by CHP and electricity-only facilities and the remaining commercial sector:

WDCCBZZ = WDC3BZZ + WDC4BZZ

Total commercial consumption of waste is set equal to the commercial consumption of waste by CHP and electricity-only facilities, which are the only commercial facilities with waste consumption, and the U.S. total is calculated as the sum of the state values:

WSCCBZZ = WSC3BZZ
WSCCBUS = ΣWSCCBZZ

The total wood and waste consumption in the commercial sector is calculated as the sum of wood consumption and waste consumption, and the U.S. total is calculated as the sum of the state data:

WWCCBZZ = WDCCBZZ + WSCCBZZ
WWCCBUS = ΣWWCCBZZ

Data sources
WDC3BZZ — Wood energy consumed by CHP and electricity-only facilities in the commercial sector of each state.

- 1960 through 1988: No data available. Values are assumed to be zero.
- 1989 forward: EIA, Form EIA-923, "Power Plant Operations Report," and predecessor forms, http://www.eia.gov/electricity/data/eia923/index.html.

WDCCBUS — Wood consumed by the commercial sector in the United States.

- 1960 through 1979: EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A7. Data published in thousand short tons are converted to Btu using the factor of one short ton equals 17.2 million Btu.
- 1980 through 2010: EIA, data in billion Btu shown in trillion Btu in the *Annual Energy Review,* Table 10.2a.
- 2011 Forward: EIA, data in billion Btu shown in trillion Btu in the *Monthly Energy Review,* Table 10.2a.

WSC3BZZ — Waste energy consumed by CHP and electricity-only facilities in the commercial sector of each state.

- 1960 through 1988: No data available. Values are assumed to be zero.
- 1989 forward: EIA, Form EIA-923, "Power Plant Operations Report," and predecessor forms, http://www.eia.gov/electricity/data/eia923/index.html.

Industrial sector

For 1989 forward, state-level data on wood and waste consumption by industrial combined heat and power (CHP) and electricity-only facilities are available from the EIA, Form EIA-923, "Power Plant Operations Report," and predecessor forms. These data are used with the manufacturing data to estimate total industrial sector wood and waste consumption for each state.

Industrial wood and waste consumption is expressed in Btu because its components are physically measured in a variety of units (e.g., tons, cubic feet, and kilowatthours). Wood and waste consumed by industrial CHP and electricity-only facilities are identified in SEDS by the following names ("ZZ" in the variable name represents the two-letter state code that differs for each state):

WDI3BZZ = wood consumed by CHP and electricity-only facilities in the industrial sector in each state, in billion Btu; and

WSI3BZZ = waste consumed by CHP and electricity-only facilities in the industrial sector of each state, in billion Btu.

Before 1989, wood and waste consumed by industrial CHP and electricity-only facilities are assumed to be zero.

The U.S. totals of the state series are calculated as the sum of the state data:

WDI3BUS   =   ΣWDI3BZZ
WSI3BUS   =   ΣWDI3BZZ

Wood and waste consumed by all other industries (mainly the manufacturing sector) are identified in SEDS by the following names:

WDI4BZZ   =   wood consumed for other uses in the industrial sector of each state, in billion Btu; and

WSI4BZZ   =   waste consumed for other uses in the industrial sector of each state, in billion Btu.

Industrial sector wood and waste consumption estimates by state for 1960 through 1979 are from the EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*. The data, published in thousand short tons, are converted to billion Btu using the factor 1 short ton equals 17.2 million Btu.

Estimates for 1980 through 1995 are based on a national-level data series published in the EIA *Annual Energy Review (AER)* or *Monthly Energy Review (MER)*. National wood and waste consumption by type is collected by Standard Industrial Classification (SIC) on the EIA triennial survey Form EIA-846, "Manufacturing Energy Consumption Survey" (MECS) for 1985, 1988, 1991, and 1994. The assumption is made that wood and waste use in the manufacturing sector occurs primarily in the industries included in SIC series 2421 (sawmills and planing mills), 2511 (wood household furniture), 2621 (paper mills), 2046 (wet corn milling), and 2061 (raw cane sugar). The amount of wood and waste consumed by each of the SIC groups of industries is estimated from the MECS data, and the MECS proportions are used to allocate the U.S. totals from the *AER* to SIC groups for each year. The SIC annual subtotals are allocated to the states using state-level data on the value added in manufacturing processes for each of the SIC series listed above, as published in the U.S. Department of Commerce, Census Bureau, *Census of Manufactures, Industry Series*, for 1982, 1987, and 1992.

Estimates for 1996 forward use the same methodology used for 1980 through 1995 with the exception that the U.S. Census Bureau, *Economic Census* data for 1997 forward use North American Industry Classification System (NAICS) instead of SIC. Some categories used in the two classification systems are directly comparable and some are closely or roughly comparable. The NAICS codes used for estimating wood consumption are: 311221, 313, 321113, 3212, 322121, 322130, and 3372. The NAICS codes used for estimating waste consumption are: 311221, 311311 (for 2007 and earlier *Economic Census)* or 311314 (for 2012 *Economic Census*), 313, 32191, 322122, 322130, and 3372. The EIA survey Form EIA-846, MECS, also uses NAICS codes in the surveys for 1998 forward. The discontinuity in these state allocating series caused by the

change from SIC to NAICS categories is not significant in light of the broad assumptions of the estimation methodology.

Also beginning in 2006, data on value of shipments from the *Economic Censuses* are used instead of value added data.

For 2011 forward, the method of estimating WSI4B is refined. Two-thirds of the U.S. industrial waste consumption is assumed to be landfill gas, which is used to generate heat or electricity. To allocate landfill gas consumption to the states, data on landfill gas flow for all operational landfill projects with capacity under 1 megawatt from the Landfill Methane Outreach Program maintained by the U.S. Environmental Protection Agency are used to compile the state shares. The remaining one-third of WSI4B is allocated to the states using the MECS data and Economic Census data as explained above. The two components are then summed together to form WSI4B.

The U.S. totals of the state series are calculated as the sum of the state data:

WDI4BUS   =   ΣWDI4BZZ
WSI4BUS   =   ΣWSI4BZZ

Industrial sector wood and waste consumption is calculated as the sum of consumption by CHP and electricity-only facilities and consumption by other industries:

WDICBZZ   =   WDI3BZZ + WDI4BZZ
WDICBUS   =   ΣWDICBZZ

WSICBZZ   =   WSI3BZZ + WSI4BZZ
WSICBUS   =   ΣWSICBZZ

Total wood and waste consumed by other industries is calculated as the sum of wood consumption and the sum of waste consumption, and the U.S. total is calculated as the sum of the state data:

WWI4BZZ   =   WDI4BZZ + WSI4BZZ
WWI4BUS   =   ΣWWI4BZZ

The total industrial sector is calculated as the sum of wood consumption and the sum of waste consumption, and the U.S. total is calculated as the sum of the state data:

WWICBZZ   =   WDICBZZ + WSICBZZ
WWICBUS   =   ΣWWICBZZ

Data sources

WDI3BZZ — Wood consumed by CHP and electricity-only facilities in the industrial sector by state.

- 1960 through 1988: No data available. Values are assumed to be zero.
- 1989 forward: EIA, Form EIA-923, "Power Plant Operations Report," and predecessor forms.

WDI4BZZ — Wood consumed by the industrial sector other than CHP and electricity-only facilities by state.

- 1960 through 1979: EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A10. Data published in thousand short tons are converted to Btu by using the factor of one short ton equals 17.2 million Btu (as published in the footnote of Table A10).
- 1980 forward: EIA estimates developed by using three data sources. U.S. totals for each year are as published for selected years in the EIA, *Annual Energy Review (AER)*, Table 10.2b, or *Monthly Energy Review (MER)*, Table 10.2b.
  - 1980 through 1985: U.S. totals from the *AER* are allocated to Standard Industrial Classification (SIC) groups 20, 24, 25, and 26 based on data from the Form EIA-846, "Manufacturing Energy Consumption Survey 1985," Table 3, Columns "Major Byproducts" and "Other." These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1982 Census of Manufactures,* Table 2, column titled "Value Added by Manufacturer," from the publications for Industry 2061 Raw Cane Sugar, Industry 2046 Wet Corn Milling, Industry 2421 Sawmills and Planing Mills, Industry 2511 Wood Household Furniture, Industry 2621 Paper Mills, and Industry 2631 Paperboard Mills. The state values for each of the four SIC groups are summed to derive state total wood and waste industrial consumption estimates.
  - 1986 through 1989: U.S. totals from the *AER* are allocated to SIC groups 20, 24, 25, and 26 based on data from the Form EIA-846, "Manufacturing Energy Consumption Survey 1988," Tables 2 and 18, columns "Pulping Liquor," "Roundwood," and "Wood Chips." These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1987 Census of Manufactures,* Table 2, column titled "Value Added by Manufacturer," from the publications for Industry 2061 Raw Cane Sugar, Industry 2046 Wet Corn Milling, Industry 2421 Sawmills and Planing Mills, Industry 2511 Wood Household Furniture, Industry 2621 Paper Mills, and Industry 2631 Paperboard Mills. The state values for each of the four SIC groups are summed

to derive state total industrial wood consumption estimates. For 1989 only, state-level data on wood consumption by combined heat and power (CHP) and electricity-only facilities are available from the Form EIA-867, "Annual Nonutility Power Producer Report" in billion Btu. These CHP and electricity-only state data are summed and subtracted from the *AER* U.S. total. The remaining value is assumed to be the manufacturing sector and is allocated to the states using the method above. The state values for each of the four SIC groups and the CHP and electricity-only facilities are summed to derive state total industrial wood consumption estimates.

- 1990 through 1993: State-level data on wood consumption by CHP and electricity-only facilities from the Form EIA-867, "Annual Nonutility Power Producer Report" in billion Btu are summed and subtracted from the *AER* U.S. total. The remaining national value is allocated to SIC groups 20, 24, 25, and 26 based on unpublished data on pulping liquor, roundwood, and wood chips from the Form EIA-846, "Manufacturing Energy Consumption Survey 1991 (MECS)." SIC groups 20 and 26 are grouped as "Other" in MECS. The proportions of those two groups in the 1988 and 1994 MECS are averaged and used to estimate the breakout for 1991. These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1992 Census of Manufactures,* Table 2, column titled "Value Added by Manufacturer," from the publications for Industry 2061 Raw Cane Sugar, Industry 2046 Wet Corn Milling, Industry 2421 Sawmills and Planing Mills, Industry 2541 Wood Partitions and Fixtures, and Industry 2621 Paper Mills. The state values for each of the four SIC groups and the CHP and electricity-only facilities are summed to derive State total industrial wood consumption estimates.

- 1994 and 1995: State-level data on wood consumption by CHP and electricity-only facilities from the Form EIA-867, "Annual Nonutility Power Producer Report" in billion Btu are summed and subtracted from the *AER* U.S. total. The remaining national value is allocated to SIC groups 20, 24, 25, 26, and "Other" based on data from the Form EIA-846, "1994 Manufacturing Energy Consumption Survey," Table A7, columns "Pulping or Black Liquor," "Wood from Trees," and "Wood from Mills." These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1992 Census of Manufactures,* Table 2, column titled "Value Added by Manufacturer," from the publications for Industry 2061 Raw Cane Sugar, Industry 2046 Wet Corn Milling, Industry 2421 Sawmills and Planing Mills, Industry 2511 Wood Household Furniture, Industry 2621 Paper Mills, and Industry 2631 Paperboard

Mills. The state values for each of the five SIC groups and the CHP and electricity-only facilities are summed to derive state total industrial wood consumption estimates.

– 1996 and 1997: State-level data on wood consumption by CHP and electricity-only facilities from the Form EIA-867, "Annual Nonutility Power Producer Report," in billion Btu are summed and subtracted from the *AER* U.S. total. The remaining national value is allocated to SIC groups 20, 24, 25, 26, and "Other" based on data from the Form EIA-846, "1994 Manufacturing Energy Consumption Survey," Table A7, columns "Pulping or Black Liquor," "Wood from Trees," and "Wood from Mills." These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1997 Economic Census.* In the *Economic Census* the SIC groupings for the state data are replaced by North American Industry Classification System (NAICS) industry groups. The two industry classification systems are not identical, but NAICS groups are chosen that compare with SIC categories as closely as possible. The state series are from Table 2, column titled "Value Added by Manufacturer," from the publications for NAICS Industry 311221 Wet Corn Milling (for SIC 20 Food), Industry 321113 Sawmills, and Industry 3212 Engineered Wood Product Manufacturing (for SIC 24 Wood), Industry 3372 Office Furniture Manufacturing (for SIC 25 Furniture), Industry 322121 Paper Mills, and Industry 322130 Paperboard Mills (for SIC 26 Paper), and Industry 313 Textile Mills (for Other SIC). The state values for each of the five NAICS group subtotals and the CHP and electricity-only facilities are summed to derive state total industrial wood consumption estimates.

– 1998 forward: State-level data on wood consumption by CHP and electricity-only facilities from the Form EIA-923, "Power Plant Operations Report" and predecessor forms, in billion Btu are summed and subtracted from the *AER/MER* U.S. total. The remaining national value is allocated to NAICS industry groups 311, 321, 322, 337, and "Other" based on data from the Form EIA-846, "Manufacturing Energy Consumption Survey," 1998 (for 1998-2001), 2002 (for 2002-2005), 2006 (for 2006-2010), and 2010 (2011 forward), table entitled "Selected Wood and Wood-Related Products in Fuel Consumption," columns "Pulping or Black Liquor," "Wood from Trees," and "Wood from Mills." These NAICS subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *Economic Census* for 1997 (1998-2000), 2002 (2001-2005), 2007 (2006-2010), and 2012 (2011 forward). For 1997 and 2002, the state series are from Table 2, column titled "Value Added by Manufacturer," from the publications for NAICS

Industry 311221 Wet Corn Milling (for NAICS 311 Food), Industry 321113 Sawmills, and Industry 3212 Engineered Wood Product Manufacturing (for NAICS 321 Wood products), Industry 3372 Office Furniture Manufacturing (for NAICS 337 Furniture), Industry 322121 Paper Mills, and Industry 322130 Paperboard Mills (for NAICS 322 Paper), and Industry 313 Textile Mills (for Other NAICS). For 2007 forward, the state series are the "Value of Shipments" data for the specific industries. *Economic Census* data are available at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

WSI3BZZ — Waste consumed by CHP and electricity-only facilities in the industrial sector by state.

- 1960 through 1988: No data available. Values are assumed to be zero.
- 1989 forward: EIA, Form EIA-923, "Power Plant Operations Report" and predecessor forms, http://www.eia.gov/electricity/data/eia923/index.html.

WSI4BZZ — Waste consumed by the industrial sector other than CHP and electricity-only facilities by state.

- 1960 through 1980: No data available. Values assumed to be zero.
- 1981 forward: EIA estimates developed by using three data sources. U.S. totals for each year are as published for selected years in the EIA, *Annual Energy Review (AER)*, Table 10.2b, or *Monthly Energy Review (MER)*, Table 10.2b.
    – 1981 through 1985: U.S. totals from the *AER* are allocated to Standard Industrial Classifications (SIC) groups 20, 24, 25, and 26 based on data from the EIA "Manufacturing Energy Consumption Survey 1985 (MECS)," Table 3, columns "Major By-products" and "Other." These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1982 Census of Manufactures,* Table 2, column titled "Value Added by Manufacturer," from the publications for Industry 2061 Raw Cane Sugar, Industry 2046 Wet Corn Milling, Industry 2421 Sawmills and Planing Mills, Industry 2511 Wood Household Furniture, Industry 2621 Paper Mills, and Industry 2631 Paperboard Mills. The state values for each of the four SIC groups are summed to derive state total industrial waste consumption estimates.
    – 1986 through 1989: U.S. totals from the *AER* are allocated to SIC groups 20, 24, 25, and 26 based on data from the Form EIA-846, "Manufacturing Energy Consumption Survey 1988," Tables 2 and 18, columns "Waste" and "Biomass." These SIC subtotals are allocated

to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1987 Census of Manufactures,* Table 2, column titled "Value Added by Manufacturer," from the publications for Industry 2061 Raw Cane Sugar, Industry 2046 Wet Corn Milling, Industry 2421 Sawmills and Planing Mills, Industry 2511 Wood Household Furniture, Industry 2621 Paper Mills, and Industry 2631 Paperboard Mills. The state values for each of the four SIC groups are summed to derive state total industrial waste consumption estimates. For 1989 only, state-level data on waste consumption by CHP and electricity-only facilities are available from the Form EIA-867, "Annual Nonutility Power Producer Report" in billion Btu. These CHP and electricity-only state data are summed and subtracted from the *AER* U.S. total. The remaining value is assumed to be the manufacturing sector and is allocated to the states using the method above. The state values for each of the four SIC groups and the CHP and electricity-only facilities are summed to derive state total industrial waste consumption estimates.

- 1990 through 1993: State-level data on waste consumption by CHP and electricity-only facilities from the Form EIA-867, "Annual Nonutility Power Producer Report" in billion Btu are summed and subtracted from the *AER* U.S. total. The remaining national value is allocated to SIC groups 20, 24, 25, and 26 based on unpublished data on waste and biomass from the Form EIA-846, "Manufacturing Energy Consumption Survey 1991 (MECS)." SIC groups 20 and 26 are grouped as "Other" in MECS 1991. The proportions of those two groups in the 1988 and 1994 MECS are averaged and used to estimate the breakout for 1991. These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1992 Census of Manufactures,* Table 2, column titled "Value Added by Manufacturer," from the publications for Industry 2061 Raw Cane Sugar, Industry 2046 Wet Corn Milling, Industry 2421 Sawmills and Planing Mills, Industry 2541 Wood Partitions and Fixtures, and Industry 2621 Paper Mills. The state values for each of the four SIC groups and the CHP and electricity-only facilities are summed to derive state total industrial waste consumption estimates.

- 1994 and 1995: State-level data on waste consumption by CHP and electricity-only facilities from the Form EIA-867, "Annual Nonutility Power Producer Report" in billion Btu are summed and subtracted from the *AER* U.S. total. The remaining national value is allocated to SIC groups 20, 24, 25, 26, and "Other" based on data from the Form EIA-846, "1994 Manufacturing Energy Consumption Survey," Table A7, columns "Agricultural Waste" and "Wood and Paper

Refuse." These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1992 Census of Manufactures,* Table 2, column titled "Value Added by Manufacturer," from the publications for Industry 2061 Raw Cane Sugar, Industry 2046 Wet Corn Milling, Industry 2421 Sawmills and Planing Mills, Industry 2511 Wood Household Furniture, Industry 2621 Paper Mills, and Industry 2631 Paperboard Mills. The state values for each of the five SIC groups and the CHP and electricity-only facilities are summed to derive state total industrial waste consumption estimates.

- 1996 and 1997: State-level data on waste consumption by CHP and electricity-only facilities from the Form EIA-867, "Annual Nonutility Power Producer Report" or Form EIA-860, "Annual Electric Generator Report" in billion Btu are summed and subtracted from the *AER* U.S. total. The remaining national value is allocated to SIC groups 20, 24, 25, 26, and "Other" based on data from the Form EIA-846, "1994 Manufacturing Energy Consumption Survey," Table A7, columns "Agricultural Waste" and "Wood and Paper Refuse." These SIC subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *1997 Economic Census.* In the *Economic Census* the SIC groupings for the state data are replaced by North American Industry Classification System (NAICS) industry groups. The two industry classification systems are not identical, but NAICS groups are chosen that compare with SIC categories as closely as possible. The state series are from Table 2, column titled "Value Added by Manufacturer," from the publications for NAICS Industry 311311 Sugar Cane Mills, and Industry 311221 Wet Corn Milling (for SIC 20 Food), Industry 321912 Cut Stock, Resawing Lumber, and Planing (for SIC 24 Wood), Industry 3372 Office Furniture Manufacturing (for SIC 25 Furniture), Industry 322122 Newsprint Mills, and Industry 322130 Paperboard Mills (for SIC 26 Paper), and Industry 313 Textile Mills (for Other SIC). The state values for each of the five NAICS group subtotals and the CHP and electricity-only facilities are summed to derive state total industrial waste consumption estimates.

- 1998 through 2010: State-level data on waste consumption by CHP and electricity-only facilities from the Form EIA-923, "Power Plant Operations Report" and predecessor forms, in billion Btu are summed and subtracted from the *AER/MER* U.S. total. The remaining national value is allocated to NAICS industry groups 311, 321, 337, and 322, and "Other" based on data from the Form EIA-846, "Manufacturing Energy Consumption Survey," 1998 (for 1998-2001), 2002 (for 2002-2005), and 2006 (for 2006-2010), Table A7, columns

"Agricultural Waste" and "Wood and Paper Refuse." These NAICS subtotals are allocated to the states using state-level series from the U.S. Department of Commerce, Census Bureau, *Economic Census* for 1997 (1998-2000), 2002 (2001-2005), and 2007 (2006-2010). For 1997 and 2002, the state series are from Table 2, column titled "Value Added by Manufacturer," from the publications for NAICS Industry 311311 Sugar Cane Mills, and Industry 311221 Wet Corn Milling (for NAICS 311 Food), Industry 321912 Cut Stock, Resawing Lumber, and Planing (for NAICS 321 Wood), Industry 3372 Office Furniture Manufacturing (for NAICS 337 Furniture), Industry 322122 Newsprint Mills, and Industry 322130 Paperboard Mills (for NAICS 322 Paper), and Industry 313 Textile Mills (for Other NAICS). For 2007, the state series are the "Value of Shipments" data for the specific industries. *Economic Census* data are available at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

– 2011 forward: State-level data on waste consumption by CHP and electricity-only facilities from the Form EIA-923, "Power Plant Operations Report" and predecessor forms, in billion Btu are summed and subtracted from the *AER/MER* U.S. total. Two-thirds of the remaining national value is allocated using data from U.S. Environmental Protection Agency, Landfill Methane Outreach Program, http://www.epa.gov/lmop/. One-third of the remaining national value is allocated to NAICS industry groups 311, 321, 337, and 322, and "Other" based on data from the Form EIA-846, "Manufacturing Energy Consumption Survey," 2010, Table A7, columns "Agricultural Waste" and "Wood and Paper Refuse." These NAICS subtotals are allocated to the states using state-level data from the U.S. Department of Commerce, Census Bureau, *Economic Census* for 2012. The state series are the "Value of Shipments" data for the specific industries: 311314 Sugar Cane Manufacturing and 311221 Wet Corn Milling (for NAICS 311 Food), 321912 Cut Stock, Resawing Lumber, and Planing (for NAICS 321 Wood), 3372 Office Furniture Manufacturing (for NAICS 337 Furniture), 322122 Newsprint Mills and 322130 Paperboard Mills (for NAICS 322 Paper), and 313 Textile Mills (for Other NAICS). *Economic Census* data are available at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

Electric power sector

Electric power sector use of wood and waste to generate electricity is based on data series from EIA Form EIA-923, "Power Plant Operations Report," and predecessor forms and is estimated in SEDS. From 2001 forward, the Btu content of the wood and waste consumed by electric power plants is reported

on the data collection forms and used in SEDS. Prior to 2001, Btu data were not collected by the source data forms and data on electricity generation from wood and waste are used instead. Net generation of electricity is converted to equivalent Btu using the fossil-fueled steam-electric plant conversion factor, and the resulting Btu values are entered into SEDS. Rarely, power plants can use more electricity than they generate from wood and waste energy sources and a negative net generation (and, therefore, Btu consumption) value can be seen in SEDS. From 1960 through 1981, electricity generation from wood and waste are reported combined and from 1982 forward generation or Btu values from each source are reported separately.

The data series are identified in SEDS by the following names ("ZZ" in the variable name represents the two-letter state code that differs for each state):

WDEIBZZ = wood consumed by the electric power sector in each state (included in waste energy for 1960 through 1981), in million Btu; and

WSEIBZZ = waste consumed by the electric power sector in each state (included in wood energy for 1960 through 1981), in million Btu.

The U.S. totals are calculated as the sum of the state data, and wood and waste are summed to provide a total (WW) value:

WDEIBUS = ΣWDEIBZZ
WSEIBUS = ΣWSEIBZZ

WWEIBZZ = WDEIBZZ + WSEIBZZ
WWEIBUS = ΣWWEIBZZ

Data sources

WDEIBZZ — Wood consumed by the electric power sector by state.

- 1960 through 1981: Data included in waste energy sources, see WSEIBZZ.
- 1982 through 2000: EIA, Form EIA-759, "Monthly Power Plant Report," electricity generation from wood converted to Btu using the fossil-fueled steam-electric power plant conversion factor shown in Table B1 (http://www.eia.gov/state/seds/seds-technical-notes-complete.cfm).
- 2001 forward: EIA Form EIA-923, "Power Plant Operations Report" and predecessor forms, http://www.eia.gov/electricity/data/eia923/index.html.

WSEIBZZ — Waste consumed by the electric power sector by state.

- 1960 through 2000: EIA, Form EIA-759, "Monthly Power Plant Report" and predecessor forms, electricity generation from waste (includes wood energy sources from 1960 through 1981) converted to Btu using the fossil-fueled steam-electric power plant conversion factor shown in Table B1 (http://www.eia.gov/state/seds/seds-technical-notes-complete.cfm).
- 2001 forward: EIA, Form EIA-923, "Power Plant Operations Report" and predecessor forms, http://www.eia.gov/electricity/data/eia923/index.html.

Totals

State total consumption of wood and waste is calculated as the sum of the consumption in the residential, commercial, and industrial sectors as well as consumption by the electric power sector. The U.S. total is the sum of the state data:

WDTCBZZ = WDRCBZZ + WDCCBZZ + WDICBZZ + WDEIBZZ
WDTCBUS = ΣWDTCBZZ

WSTCBZZ = WSCCBZZ + WSICBZZ + WSEIBZZ
WSTCBUS = ΣWSTCBZZ

WWTCBZZ = WDTCBZZ + WSTCBZZ
WWTCBUS = ΣWWTCBZZ

Additional Calculations

Additional calculations are made in SEDS to aggregate some data series to be shown in the tables of this report. Wood and biomass waste, fuel ethanol, and losses and co-products generated during the production of fuel ethanol were combined to be shown under "biomass" in the summary tables titled "Energy Consumption Estimates by Source" as follows:

BMTCB = WWTCB + EMTCB + EMLCB

Renewable Energy Total

Renewable energy subtotals for each consuming sector in billion Btu are calculated for each state and the U.S. totals. In addition, the industrial sector includes energy losses and co-products from the production of fuel ethanol (EMLCB).

RERCB = GERCB + SOHCB + WDRCB
RECCB = EMCCB + GECCB + HYCCB + SOCCB + WWCCB + WYCCB
REICB = EMICB + EMLCB + GEICB + HYICB + SOICB + WWICB + WYICB
REACB = EMACB
REEIB = GEEGB + HYEGB + SOEGB + WWEIB + WYEGB

Total renewable energy consumption is also calculated for each state and the United States:

RETCB = EMLCB + EMTCB + GETCB + HYTCB + SOTCB + WWTCB + WYTCB

In the calculations of all aggregated series, data for any component series that are not available in the earlier years are assumed to be zero.