State Energy Data 2000: Consumption

Technical Notes

The **State Energy Data 2000** tables provide annual time series estimates of State-level energy consumption, prices and expenditures by major economic sectors. Separate tables are available for consumption, and formerly comprised the *State Energy Data Report (SEDR).* These tables are now available on EIA's website for each State via the U.S. Map which is located at http://www/eia.doe.gov/emeu/states/_states.html. Tables containing State-level price and expenditure data (formerly called the *State Energy Price and Expenditure Report*, or *SEPER*) also can be found here. In addition, new tables showing State-level consumption, price and expenditure estimates by energy source for the current year can be found at http://www/eia.doe.gov/emeu/states/_multi_states.html.

This document contains information on the data sources, estimation procedures and assumptions for the State-level consumption estimates. Technical notes for State-level prices and expenditures are also available at http://www.eia.doe.gov/emeu/seper/contents.htm

Purpose

All of the estimates contained in the **State Energy Data 2000** tables are developed using the State Energy Data System (SEDS), which is maintained and operated by the Energy Information Administration (EIA). The goal in maintaining SEDS is to create historical time series of energy consumption, prices and expenditures by State that are defined as consistently as possible over time and across sectors. SEDS exists for two principal reasons: (1) to provide State energy consumption, price and expenditure estimates to Members of Congress, Federal and State agencies, and the general public and (2) to provide the historical series necessary for EIA's energy models.

System and Report

Efforts are made to ensure that the sums of the State data equal the national totals as closely as possible for each energy type and end-use sector as published in other EIA publications. **State Energy Data 2000** consumption estimates for the year 2000 and previous years are generally comparable to the statistics in the *Annual Energy Review 2000* and the *Monthly Energy Review*, March 2002.

Due to page-size constraints, the **State Energy Data 2000** PDF tables show data for selected years from 1960 through 1990; however, data for all years from 1960 forward are maintained in SEDS, and are included in the data files available via EIA's website through the individual State tables (link to csv files are on the corresponding html tables). All years are covered by the documentation in this report.

Extensive documentation is included in the following Technical Notes (formerly Appendix A in the *State Energy Data Report*) and its appendices. The Technical Notes describe how the estimates were derived for each individual energy source and lists the sources of all data series. Appendix A (formerly Appendix B) lists alphabetically all of the variable names and formulas used. Appendix B (formerly Appendix C) lists the conversion factors used to convert physical units into British thermal units and cites the sources for those factors. Appendix C (formerly Appendix D) provides

the State resident population statistics that are used in per capita calculations. Appendix D (formerly Appendix E) provides metric and other physical conversion factors for measures used in energy analyses. Appendix E (formerly Appendix F)contains carbon dioxide emission factors. Appendix F (formerly Appendix G) summarizes the changes made since the last report, which was released in September 1999. Appendix G (formerly Appendix H) lists other EIA reports containing State-level data.

Collected Data and Estimated Values in CSEDS

Coal. U.S. total coal consumption data by sector are taken directly from EIA's *Quarterly Coal Report (QCR)* or are unpublished data from EIA's Weekly Coal Production database. Total coal consumption by State and for most sectors is from the *QCR*, except where values are withheld and must be estimated. The State-level disaggregation of the *QCR*'s combined residential and commercial sector and the combined anthracite and bituminous coal and lignite use in all sectors (except electric utilities) are estimates. Data on electric utility coal consumption by State and coal type are data from the Form EIA-759, "Monthly Power Plant Report," database.

Natural Gas. Natural gas consumption by State and sector come directly from the EIA's *Natural Gas Annual (NGA)*. Natural gas consumed as lease fuel and plant fuel and natural gas delivered to industrial consumers are combined in CSEDS as industrial sector consumption. Natural gas consumed as vehicle fuel and pipeline fuel are combined in CSEDS as transportation sector consumption.

Petroleum. U.S. total consumption for each petroleum product is the "product supplied" data from EIA's *Petroleum Supply Annual*. State values for distillate fuel and residual fuel consumption at electric utilities are unpublished data from EIA's Form EIA-759 database. All other State and sector values for consumption of petroleum products are estimates based on sales data from several sources.

Renewable Energy. Residential and commercial sectors consumption of wood, geothermal, and solar energy are estimated. Industrial consumption of hydroelectric power is data collected by the Federal Power Commission for 1960 through 1978, CSEDS' estimates for 1979 through 1989, and data collected by EIA on Form EIA-867, "Annual Nonutility Power Producer Report," for nonutility power production for 1989 through 1997 and Form EIA-860B, "Annual Electric Generator Report–Nonutility" for 2000. Industrial consumption of geothermal, wind, solar thermal, and photovoltaic energy is also collected on Form EIA-867 and Form EIA-860B. An additional portion of industrial consumption of wood, waste, and geothermal energy is estimated. State-level transportation use of ethanol is estimated, although the U.S. data are collected on several forms and reported in EIA's *Renewable Energy Annual*. All sources of renewable energy used for electricity generation at electric utilities (i.e., wood and waste, hydroelectric power, geothermal, wind, solar thermal, and photovoltaic energy) by State are from EIA's *Electric Power Annual (EPA)* or are unpublished data from the Form EIA-759 database.

Nuclear Electric Power. Nuclear electricity generation by State is from the *EPA*.

Electricity. Electricity consumption is sales data by sector and State from the *EPA* with one exception. The *EPA* "Other" category is allocated to the transportation and commercial sectors in each State by estimation.

Electrical System Energy Losses and Net Interstate Flow of Electricity. These series are estimated in SEDS.

Improvements

This year, a less complex methodology for estimating coal consumption was used. Previously, coal consumption was estimated for anthracite and bituminous separately for each sector, and then added together to obtain total coal consumption by sector. This breakout is no longer available. Therefore, from 1998-2000, total coal consumption by sector in physical units was estimated, and then converted using a total conversion factor.

Appendix F. Detailed information about all data revisions in this year's **State Energy Data 2000** tables is contained in Appendix F (formerly Appendix G). All data with revisions since the last edition of SEDS that are large enough to be seen in the published tables' level of rounding are preceded with an "R" in the published tables.

Data

Estimation Methodologies. Using SEDS, EIA develops estimates of energy consumption by principal energy sources and major end-use sectors, by State, for a 40-year period. Energy consumption is estimated by using data from existing surveys of energy suppliers that report

Energy Consumption Measures—Total and Site

Sources of energy can be categorized as primary and secondary. Primary sources of energy, such as coal, petroleum, and natural gas are consumed directly. Electricity is a secondary form of energy that is created from primary energy sources. The amount of electricity actually consumed by the end user (site consumption) does not include the energy lost in the generation and delivery of the electricity to the point of use.

Primary sources of energy are measured in applicable physical units. Coal is measured by the short ton (equal to 2,000 pounds); petroleum, by the barrel (equivalent to 42 gallons); and natural gas, by the cubic foot. Energy sources are also measured by their heat content, generally expressed in British thermal units (Btu). For example, in 2000, the average short ton of bituminous coal and lignite consumed at electric utilities contained 20.4 million Btu (Table B13), the average barrel of distillate fuel contained 5.825 million Btu (page 156), and the average cubic foot of natural gas consumed at electric utilities contained 1,019 Btu (Table B3).

Electricity, a secondary form of energy, can also be measured in physical units, commonly kilowatthours, and by heat content. The conventional thermal conversion factor for electricity consumed by the end user (site consumption) is 3,412 Btu per kilowatthour.

In 2000 electric utilities consumed 31.7 quadrillion Btu of primary energy in order to provide 11.7 quadrillion Btu of electricity for sale. These data indicate that 63 percent of the primary (embodied) energy in the fuels consumed to generate the electricity was used (or "lost") in converting the primary energy to electricity and transmitting and distributing the electricity to the consumers, and 37 percent was used as site (point-of-use) electricity by consumers.

In evaluating energy consumption in this report, tables titled "Total Energy Consumption" include all primary energy sources, including those used to generate electricity; the electricity generated is not included. Tables showing "Total End-Use Sector Consumption" include columns for the primary sources and electricity that are consumed by the sector, as well as a column for the estimated energy lost in the electrical system processes. The "Total" column in those tables includes all energy consumed by the sector and the associated energy lost in the generation and transmission of electricity. The column titled "Net" is site energy consumption—that is, the sum of the primary sources and electricity, excluding the electrical system energy losses.

consumption, sales, or distribution of energy at the State level. Most of the SEDS estimates rely directly on collected State-level consumption data. (See box below that summarizes the status of current data sources used.) Some consumption estimates in SEDS are based on a variety of surrogate measures. The measures were selected principally on the basis of applicability as an indicator of consumption, availability, continuity over time, and consistency. For instance, for petroleum, "product supplied" is a surrogate for consumption and is derived by summing field and refinery production, plus imports, minus exports, plus or minus changes in stocks. State-level sales survey data are used to disaggregate the national petroleum product supplied totals to the States. The measures of consumption and estimation methodologies are explained in detail under each energy source in the Technical Notes.

Methods are also applied to estimate State electrical system energy losses that are not available from any survey. See the box below for a discussion about losses and how they are reflected in the **State Energy Data 2000** tables. U.S. total electrical system energy losses are allocated to each individual State's end-use sectors in proportion to the sectors' electricity sales. The estimation method does not separately identify electrical system energy losses from interstate flow of electricity. Therefore, specific estimates are developed for Alaska and Hawaii and for the 48 contiguous States.

Data Sources. The original source documents cited in the Technical Notes include descriptions of the data collection methodologies, universes, imputation or adjustment techniques (if any), and errors associated with the processes. Due to the numerous collection forms and procedures associated with those reports, it is not possible to develop a meaningful numerical estimate of the overall errors of the integrated data published here.

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

For example, in reports prepared by the Bureau of Mines in the late 1960's and early 1970's, petroleum consumption was equated to demand. Later, consumption was equated to apparent demand and, more recently, to product supplied. Changes in surveys and reduction of data collections, especially after 1978, disturbed the continuity of some petroleum consumption series, most notably for distillate fuel, residual fuel, kerosene, and liquefied petroleum gases. These and other data inconsistencies are explained in detail for each energy source in the Technical Notes. All data series with recognized data inconsistencies are footnoted in the **State Energy Data 2000** tables.

Comparison with Other Energy Consumption Reports

EIA conducts numerous energy-related surveys. In general, the surveys can be divided into two broad groups. One group of surveys, called supply surveys, is directed to the suppliers and marketers of specific energy sources. Those surveys measure the quantities of specific fuels supplied to the market. The results of supply surveys are combined and published in a number of EIA publications, including the *Monthly Energy Review* and the **State Energy Data 2000** tables. The second group of surveys, called energy consumption surveys, gather information directly from end users of energy. Although there are some elements in common, the supply survey data and the consumption survey data have substantially different approaches, capabilities, and objectives. Thus, care must be taken in analyzing the **State Energy Data 2000** in conjunction with consumption survey data for the following reasons:

The **State Energy Data 2000** tables are designed to be a broad accounting of energy consumption, covering all energy use and splitting it into major sectors as clearly as possible. The energy consumption surveys are designed to be comprehensive and representative within individual sectors. However, the sectors are restricted for purposes of creating relatively homogeneous, well-defined populations and for aiding in sampling and data collection. For example, the Commercial Buildings Energy Consumption Survey covers only energy consumption in commercial buildings, while SEDS includes other commercial consumption, such as street lighting and public services; and the Manufacturing Energy Consumption Survey covers only manufacturing establishments, while SEDS includes other industrial energy consumption (i.e., mining, construction, agriculture, fisheries, and forestry). Further, the consumption surveys do not cover all energy-using sectors. Therefore, energy consumption surveys cannot be summed together to account for all energy use.

Energy consumption surveys provide user characteristics that allow for both macro-level (for major sectoral sub-populations) and micro-level (at the unit of data collection) interpretive analysis. The surveys of energy consumption by residential households from the Residential Energy Consumption Survey (Form EIA-457 series) and by commercial buildings from the Commercial Buildings Energy Consumption Survey (Form EIA-871 series) provide detailed information about the energy end users, their size, their stock of energy-consuming equipment and appliances, and their total energy consumption and expenditures. The Manufacturing Energy Consumption Survey (Form EIA-846 series) collects consumption by type of use and fuel switching capability from manufacturing establishments grouped by manufacturing classification. SEDS, on the other hand, provides limited characterization of the end users of energy but greater geographic and energy product detail, as well as annual historical time series.

Sectoral classification in SEDS is generally based on supplier classifications of customer accounts, by whatever means suppliers choose to use. (See discussion in next section.) Sectoral classification for the energy consumption surveys is based upon a categorization, verified by end user, of the primary economic activity of the data collection unit (household, building, or establishment).

The energy consumption surveys provide data at national and Census region and/or Census division levels, whereas the estimates in SEDS are on national and State levels.

The reference periods are also different in that SEDS covers calendar years from 1960 through 2000, while the consumption surveys are for selected years, and the residential end-use surveys taken prior to 1987 cover a heating season year (i.e., April through March). Beginning with the 1987 residential end-use survey, the reference period is a calendar year.

For a more detailed description of the differences between SEDS and the energy consumption surveys, see the EIA analysis report *Energy Consumption by End-Use Sector: A Comparison of Measures by Consumption and Supply Surveys*, DOE/EIA-0533, April 1990.

Energy Consuming Sectors

The consumption estimates in SEDS are based on data collected by various surveys that do not necessarily define the consuming sectors exactly the same way. The Technical Notes of this report describes in detail for each energy source how the collected data series are combined and assigned to SEDS consuming sectors. To the degree possible, energy consumption in this report has been assigned to the five sectors according to the following general definitions:

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

Commercial Sector: An energy-consuming sector that consists of service-providing facilities and equipment of: businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment.

Industrial Sector: An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods. The industrial sector encompasses the following types of activity: manufacturing; agriculture, forestry, and fisheries; mining; and construction. Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting. Fossil fuels are also used as raw material inputs to manufactured products. In this report, nonutility power producers are included in the industrial sector.

Transportation Sector: An energy-consuming sector that consists of all vehicles whose primary purpose is transporting people and/or goods from one physical location to another. Included are automobiles; trucks; buses; motorcycles; trains, subways, and other rail

vehicles; aircraft; and ships, barges, and other waterborne vehicles. Vehicles whose primary purpose is not transportation (e.g., construction cranes and bulldozers, farming vehicles, and warehouse tractors and forklifts) are classified in the sector of their primary use. In this report, natural gas used in the operation of natural gas pipelines is included in the transportation sector.

Electric Utility Sector: The electric utility sector consists of privately and publicly owned establishments that generate, transmit, distribute, or sell electricity primarily for use by the public and that meet the definition of an electric utility. Nonutility power producers are not included in the electric utility sector.

Sector Definition Discrepancies. Although the end-use allocations are made according to these aggregations as closely as possible, some data are collected by using different classifications. For example, electric utilities may classify commercial and industrial users by the quantity of electricity purchased rather than by the business activity of the purchaser. Natural gas used in agriculture, forestry, and fisheries was collected and reported in the commercial sector through 1995. Beginning with 1996 data, deliveries of natural gas for agriculture, forestry, and fisheries are reported in the industrial sector instead. Another example is master-metered condominiums and apartments and buildings with a combination of residential and commercial units. In many cases, the metering and billing practices cause residential energy usage of electricity, natural gas, or fuel oil to be included in the commercial sector. No adjustments for these discrepancies were made.

SEDS does not provide further disaggregated end-use consumption estimates. For example, the industrial sector cannot be broken down into the chemical or rubber industries, all manufacturing, or agriculture. The input series for the system are provided in broad end-use categories from the data collection forms and are not available by the individual components. Additional disaggregated regional information, such as counties or cities, are also not available from SEDS.