DOE/EIA-0603(2001)

# Renewable Energy Annual 2001

## With Preliminary Data For 2001

**November 2002**

**Energy Information Administration**
Office of Coal, Nuclear, Electric and Alternate Fuels
U.S. Department of Energy
Washington, DC 20585

This report is available on the Web at:
http://www.eia.doe.gov/cneaf/solar.renewables/page/rea_data/rea_sum.html

# Contacts

This report was prepared by the staff of the Renewable Information Team, Coal, Nuclear, and Renewables Division, Office of Coal, Nuclear, Electric and Alternate Fuels. General information regarding this publication may be obtained from Fred Mayes, Team Leader (202/287-1750, e-mail fred.mayes@eia.doe.gov). Questions about the preparation and content of the report should be directed to Louise Guey-Lee, project coordinator (202/287-1731, e-mail louise.guey-lee@eia.doe.gov).

Questions regarding specific information in the report should be directed as follows:

| | | | |
|---|---|---|---|
| 1. Renewable Data Overview | Fred Mayes | 202/287-1750 | fred.mayes@eia.doe.gov |
| | Louise Guey-Lee | 202/287-1731 | louise.guey-lee@eia.doe.gov |
| 2. Biomass Energy | John Carlin | 202/287-1734 | john.carlin@eia.doe.gov |
| 3. Municipal Solid Waste | John Carlin | 202/287-1734 | john.carlin@eia.doe.gov |
| 4. Geothermal Energy | Mark Gielecki | 202/287-1729 | mark.gielecki@eia.doe.gov |
| 5. Geothermal Heat Pumps | Peter Holihan | 202/287-1735 | james.holihan@eia.doe.gov |
| 6. Wind Energy | Louise Guey-Lee | 202/287-1731 | louise.guey-lee@eia.doe.gov |
| 7. Solar Thermal and Photovoltaic | Peter Holihan | 202/287-1735 | james.holihan@eia.doe.gov |
| 8. Legislation | Chris Buckner | 202/287-1751 | chris.buckner@ia.doe.gov |
| 9. References | Mark Gielecki | 202/287-1729 | mark.gielecki@eia.doe.gov |

# Preface

The *Renewable Energy Annual 2001* is the seventh annual report that the Energy Information Administration (EIA) has published on U.S. renewable energy. It covers energy consumption and electricity generation, as well as solar thermal, photovoltaic, and geothermal heat pump manufacturing activities. The report provides considerably more detail on biomass energy consumption than previous reports.

The energy consumption and electricity generation shown in this report reflect extensive reassessments of EIA's published historical data from 1989-2000. This report also provides, for the first time, information for 2001.

The renewable energy resources in the report include: biomass (wood, wood waste, municipal solid waste, landfill gas, ethanol, and other waste); geothermal; wind; solar (solar thermal and photovoltaic); and hydropower. However, hydropower is also regarded as a "conventional" energy source because it has furnished a significant amount of electricity for more than a century. Therefore, the contribution of hydropower to total renewable energy consumption is discussed, but not in great detail. Since EIA collects data only on terrestrial (land-based) solar energy systems, satellite and some military applications are not included in this report.

The first chapter provides an overview of renewable energy use and capability from 1997 through 2001. It discusses renewable energy consumption, electric capability and generation, and energy consumption for nonelectric use. Chapter 2 presents current (through 2001) information on the U.S. solar energy industry. EIA collected this information on the Form EIA-63A, "Annual Survey of Solar Collector Manufacturers," and the Form EIA-63B, "Annual Survey of Photovoltaic Module / Cell Manufacturers." Chapter 3 presents information on the U.S. geothermal heat pump industry. This information was collected on the Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey," and covers the calendar years 1996 through 2000.

Appendix A describes EIA surveys that include information on renewable energy resources. Appendix B is new for this year's edition, and provides detailed tables of historical data back to 1989. Appendix C provides State-level renewable electricity generation, market share, and electric capacity information for 1999 and 2000. Appendix D discusses factors affecting the quality of EIA's renewable data. Appendix E is new and provides a description of all legislation introduced into the 107$^{th}$ session of the U.S. Congress (through September 24, 2002) that affects renewable energy. Appendix F is new and explains revisions to the EIA methodology for presenting sectors and estimating electric power producers' energy consumption. Appendix G provides internet addresses for information by renewable energy resource. Finally, Appendix H lists State agencies that provide energy information. A glossary of renewable energy terms concludes the report.

The EIA was established formally by the Department of Energy Organization Act of 1977 (Public Law 95-91). The legislation requires EIA to carry out a comprehensive, timely, and accurate program of energy data collection and analysis. It also vests EIA with considerable independence in fulfilling its mission.

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# Highlights

## Renewable Energy Consumption

Renewable energy consumption declined more than 12 percent in 2001 to just 5.7 quadrillion Btu, its lowest level in over 12 years (Table H1 and Figure H1). As a result, renewable energy's share of U.S. energy consumption dropped to 6 percent, mainly due to a 23-percent drop in hydropower. This steep decline resulted in biomass becoming the leading source of renewable energy. However, biomass energy itself also declined to 2.9 quadrillion Btu in 2001, 3 percent below the 2000 level. In fact, consumption of all principal renewable energy resources decreased in 2001, except for wind.

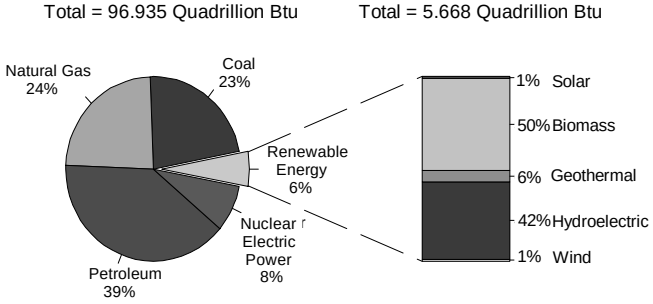
Trends in generation from renewable energy closely mirrored energy consumption patterns. Hydroelectric generation decreased 23 percent; biomass generation decreased nearly 2 percent; geothermal generation decreased 1 percent, while generation from wind power increased more than 3 percent. Solar-based generation remained essentially flat from 2000 to 2001.

Renewable electric generating capacity increased modestly in 2001, rising from 94,938 megawatts in 2000 to 96,741 megawatts in 2001 (Table 5). Wind power provided most of the 1,803-megawatt capacity increase.

The five leading States for renewable generation during 2000 were: Washington, California, Oregon, New York, and Idaho. Hydroelectric generation dominated renewable generation in each State. Despite the decline in hydropower output, these States accounted for over two-thirds of total renewable electricity generated in the United States.

Nonelectric use of renewable energy decreased nearly 3 percent between 2000 and 2001. Ninety-six percent of nonelectric renewable energy consumption came from biomass.

**Figure H1. The Role of Renewable Energy Consumption in the Nation's Energy Supply, 2001**




Source: Table 1 of this report.

**Table H1. U.S. Renewable Energy Consumption by Energy Source, 1997-2001**
(Quadrillion Btu)

| Energy Source | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|
| **Renewable Energy** | **7.306** | **6.771** | **6.778** | **6.451** | **5.668** |
| Conventional Hydroelectric | 3.881 | 3.518 | 3.472 | 3.077 | 2.376 |
| Geothermal Energy | 0.325 | 0.329 | 0.332 | 0.317 | 0.315 |
| Biomass | 2.996 | 2.823 | 2.860 | 2.934 | 2.854 |
| Solar Energy | 0.070 | 0.070 | 0.069 | 0.066 | 0.064 |
| Wind Energy | 0.034 | 0.031 | 0.046 | 0.057 | 0.059 |

R=Revised.
P=Preliminary.
Notes: Totals may not equal sum of components due to independent rounding.
Source: Table 1 of this report.

## Solar Manufacturing Activities

Shipments of solar thermal collectors surged 34 percent in 2001 to 11.2 million square feet. The gain was entirely due to increases in low-temperature collector shipments, which accounted for 98 percent of total shipments.

Total solar thermal collector shipments were valued at $32.4 million in 2001, up 18 percent from 2000. The average per-square-foot price dropped from $3.28 to $2.90.

Nearly three-fourths of solar thermal collectors were shipped to Florida and California. This is consistent with the high percentage of collectors shipped to residences (90 percent) and that were reported to be used for pool heating (96 percent).

There were dramatic changes in the patterns of photovoltaic (PV) cell and module shipments. Domestic shipments shot up nearly 80 percent in 2001 to 36.3 peak megawatts, while exports declined 10 percent. This reverses a 10-year history of largely modest growth in domestic shipments and strong gains in exports. Overall, total PV cell and module shipments rose 11 percent in 2001 to 98 peak megawatts.

There were also substantial changes in the type of module produced. For example, thin-film silicon, which had never had more than 4 peak megawatts shipped in a single year, had almost 13 peak megawatts of cells and modules shipped in 2001. This was partially at the expense of cast-and-ribbon cells and modules, whose shipments decreased from 33 peak megawatts in 2000 to 30 peak megawatts in 2001.

Module manufacturers purchased substantially less product in 2001, receiving shipments of 14 peak megawatts of cells and modules, compared with 19 peak megawatts in 2000. Despite this trend, total module shipments rose from 55,007 peak kilowatts to 67,033 peak kilowatts.

The total value of PV cell and module shipments rose to $305 million in 2001, a 13-percent gain over 2000. The average price per peak megawatt held fairly steady for both cells and modules during 2001 at $2.46 and $3.42, respectively.

A 34-percent surge in shipments to the residential market enabled it to regain its ranking as the top market for PV cells and modules in 2001. Manufacturers shipped 33 peak megawatts of cells and modules to the residential market in 2001, compared with 25 in 2000. Shipments to the second-largest market sector, industrial, declined slightly from 29 to 28 peak megawatts.

Shipments for electricity generation rose sharply. Shipments for grid-interactive and remote application markets increased 25 and 43 percent, respectively, to combine for a total of 49 peak megawatts in 2001. In contrast, sales to original equipment manufacturers dropped nearly 50 percent from year-ago levels.

The drop in exports was due mainly to decreased shipments to Japan (68 percent) and India (98 percent). Since 1999, exports to Japan have decreased 83 percent. Germany remained the leading importer of U.S. PV cells and modules during 2001 with nearly 35 peak megawatts, or 57 percent of total U.S. exports.

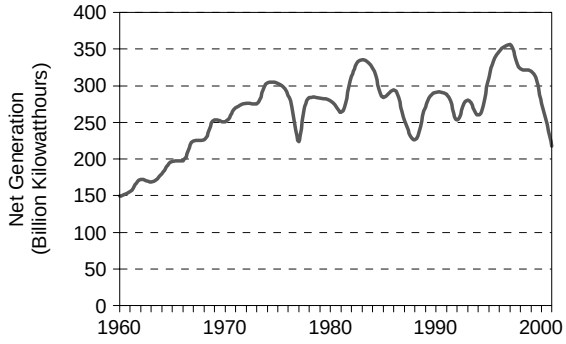
## Geothermal Heat Pumps

Shipments of geothermal heat pumps (GHPs) decreased 15 percent between 1999 and 2000 to less than 36,000 units. The total capacity of units shipped fell at a similar rate. Although all models of GHPs suffered shipment declines, ARI 325/330 model shipments dropped the most, from 32,000 units to 26,000 units.

# 1. U.S. Renewable Energy Consumption

Renewable energy consumption for 2001 dropped to its lowest level in over 12 years, accounting for just 6 percent of total U.S. energy consumption (Tables 1 and B1). Renewable consumption was 5.7 quadrillion Btu. A 12-percent decrease from 2000. The principal reason for the decline was a 23-percent drop in conventional hydropower to just 2.4 quadrillion Btu, the lowest level since 1967 (Figure 1). Bonneville Power Authority reported snowpack levels 59 percent below normal for May 2001, as well as lower than normal rainfall.

**Figure 1. Conventional Hydroelectric Net Generation, 1960-2001**

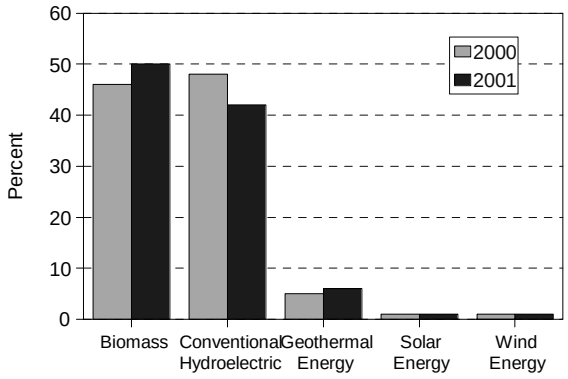



Notes: Excludes imports. Before 1990 includes pumped storage.
Sources: **1960-1988:** Energy Information Administration, *Annual Energy Review 2000*, DOE/EIA-0384(2000) (Washington, DC, August 2001), Table 8.2; **1989-2001:** Table 4 of this report.

Non-hydro renewables also declined, by 2 percent to 3.3 quadrillion Btu in 2001, led by a 3-percent decline in biomass energy consumption (0.08 quadrillion Btu). This represents the lowest level of non-hydro consumption since 1993. The majority of non-hydro renewables is biomass waste from paper and wood product production, which is a function of economic activity (Figure 2). The decline in hydropower was so steep that biomass became the leading source of renewable energy in 2001—the first time since 1989, when EIA began surveying nonutilities, which consume more biomass energy than electric utilities.

The consumption of renewables for energy production decreased for all renewable energy sources except ethanol and wind (Table 2). Efforts to phase out use of the gasoline oxygenate MTBE aided ethanol consumption in 2001, while the reinstatement of the wind energy Production Tax Credit boosted wind electricity production 3 percent.

**Figure 2. Market Share of Renewable Energy Sources, 2000 and 2001**

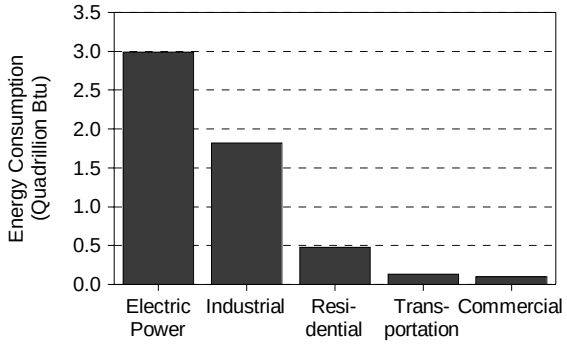



Source: Table 1 of this report.

Over half (53 percent) of total renewable energy consumption was by the Electric Power sector in 2001, whether to produce electricity or useful thermal output (Figure 3).[1] Forty-two percent was consumed in other domestic sectors. About 3 percent of total renewable energy consumption in 2001 was from net electricity imports. Of the 2.7 quadrillion Btu of renewable energy consumed outside the electric sector, 1.8 quadrillion Btu (32 percent of total renewable energy consumption) occurred in the industrial sector. The residential sector consumed nearly 0.5 quad (8 percent), the commercial sector 0.1 quad (2 percent), and the transportation sector 0.13 quad (2 percent). The second-largest amount of renewable energy consumed within a sector was wood and wood waste in the Industrial sector, where 1.6 quadrillion Btu was consumed.

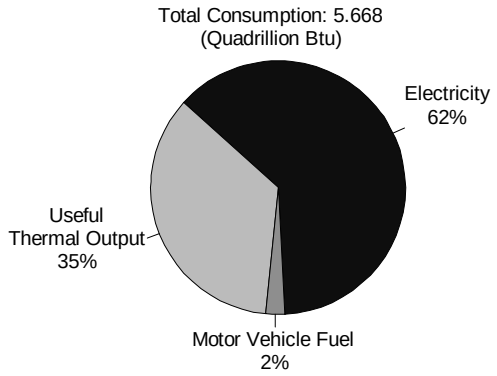
[1] The EIA has changed its definitions of the electric power, industrial, and commercial sectors and revised its historical electricity data. See Appendix F for details.

**Figure 3. Renewable Energy Consumption by Energy Use Sector, 2001**




Source: Table 2 of this report.

**Figure 4. Renewable Energy Patterns of Use, 2001**




Source: Tables 3 and 6 of this report.

Just 62 percent (3.5 quadrillion Btu) of renewable energy was used to generate electricity in 2001, (Table 3). Two-thirds (2.4 quadrillion Btu) of this energy was provided by hydropower, while biomass contributed 22 percent (0.8 quads). Within the electric power sector, nearly three-fourths of consumption was for hydropower in 2001.

Renewable electricity generation trends closely mirrored the trends in renewable energy consumption (Table 4). Total renewable electricity generation declined 18 percent to 313 billion kWh in 2001. The decline was led by hydropower, which dropped 23 percent to 233 billion kWh in 2001. Generation from geothermal and biomass declined 1 and 2 percent, respectively, in 2001, while solar electricity generation remained essentially unchanged, and wind electricity generation increased 3 percent. Net renewable electricity imports decreased 40 percent in 2001, owing to a substantial decrease in imports of Canadian hydropower. The percentage of renewable electricity generation provided by each sector was as follows: electric power, 84; industrial, 10; and commercial, 1. Trade accounted for 5 percent

Renewable electric generating capacity increased modestly in 2001, rising from 94,938 megawatts in 2000 to 96,741 megawatts in 2001 (Table 5). Wind power provided most of the 1,803-megawatt capacity increase.

Although renewable energy is usually associated with electricity, only 62 percent of renewable energy was consumed to generate electricity in 2001 (Figure 4). Most of the remainder was for useful thermal output, while 2 percent was ethanol consumed in the transportation sector. Two-thirds of biomass (1.9 quadrillion Btu) was used to produce useful thermal output, as opposed to electricity (Tables 3 and 6).

Biomass was the leading provider of renewable energy in 2001 with 2.9 quadrillion Btu. Wood and wood wastes provided three-fourths (2.2 quadrillion Btu) of biomass consumed for energy in 2001 (Table 7). Wood energy consumption fell 4 percent from 2001, with declines in the residential, commercial, and industrial sectors.

Waste energy (excluding wood waste) provided nearly 20 percent of biomass consumed for energy. Consumption of waste energy by MSW/landfill facilities decreased slightly in 2001, while other biomass waste consumption (largely in the food processing industry) increased 6 percent (Table B3). Ethanol consumed by the transportation sector accounted for 5 percent of biomass energy consumption in 2001. Ethanol consumption has increased each year since 1997.

Most biomass consumed in the industrial sector is black liquor, a waste product of the paper-making process (Tables 8 and B3). Consumption of industrial wood/wood waste, which includes black liquor, amounted to 1.6 quadrillion Btu in 2001, a 3-percent decline from 2000. In the short term, changes in the amount of waste product used to produce energy is generally tied to production changes of the principal product's output (e.g., paper). In the mid and long terms, technological process change and efficiency also become strong drivers of waste output. Over the past 5 years, biomass energy consumption has declined at a 1-percent annualized rate.

MSW and landfill gas consumption by independent power producers accounted for slightly more than half of waste energy (excluding wood waste) in 2000 (Table 9).

## Table 1. U.S. Energy Consumption by Energy Source, 1997-2001

(Quadrillion Btu)

| Energy Source | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|
| **Total Energy Consumption** | **94.957** | **95.326** | **96.957** | **99.302** | **96.935** |
| **Fossil Fuels** | 81.203 | 81.650 | 82.751 | 85.184 | 83.476 |
| Coal | 21.445 | 21.656 | 21.623 | 22.580 | 21.928 |
| Coal Coke (Net Imports) | 0.057 | 0.080 | 0.070 | 0.077 | 0.043 |
| Natural Gas [a] | 23.327 | 22.934 | 23.008 | 24.042 | 23.224 |
| Petroleum [b] | 36.266 | 36.934 | 37.960 | 38.404 | 38.232 |
| Electricity Net Imports [c] | 0.107 | 0.047 | 0.091 | 0.082 | 0.049 |
| **Nuclear Electric Power** | **6.597** | **7.068** | **7.610** | **7.862** | **8.028** |
| **Hydroelectric Pumped Storage** [d] | **-0.041** | **-0.046** | **-0.062** | **-0.057** | **-0.090** |
| **Renewable Energy** | **7.306** | **6.771** | **6.778** | **6.451** | **5.668** |
| Conventional Hydroelectric | 3.881 | 3.518 | 3.472 | 3.077 | 2.376 |
| Geothermal Energy | 0.325 | 0.329 | 0.332 | 0.317 | 0.315 |
| Biomass | 2.996 | 2.823 | 2.860 | 2.934 | 2.854 |
| Solar Energy | 0.070 | 0.070 | 0.069 | 0.066 | 0.064 |
| Wind Energy | 0.034 | 0.031 | 0.046 | 0.057 | 0.059 |

[a] Includes supplemental gaseous fuels.
[b] Petroleum products supplied, including natural gas plant liquids and crude oil burned as fuel.
[c] Electricity net imports from fossil fuels. May include some nuclear-generated electricity.
[d] Pumped storage facility production minus energy used for pumping.
R=Revised. Electricity data is revised. See Appendix F for details.
P=Preliminary.
Note: Totals may not equal sum of components due to independent rounding.
Sources: **Non-renewable energy:** Energy Information Administration (EIA), *Annual Energy Review 2001*, DOE/EIA-0384 (2001) (Washington, DC, October 2002), Table 1.3. **Renewable Energy:** Table 2 of this report.

## Table 2. Renewable Energy Consumption by Energy Use Sector and Energy Source, 1997-2001

(Quadrillion Btu)

| Sector and Source | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|
| **Total** | **7.306** | **6.771** | **6.778** | **6.451** | **5.668** |
| **Residential** | **0.506** | **0.459** | **0.486** | **0.503** | **0.475** |
| Biomass | 0.433 | 0.387 | 0.414 | 0.433 | 0.407 |
| Geothermal | 0.008 | 0.008 | 0.009 | 0.009 | 0.009 |
| Solar [a] | 0.065 | 0.065 | 0.064 | 0.061 | 0.059 |
| **Commercial** | **0.113** | **0.111** | **0.114** | **0.109** | **0.098** |
| Biomass | 0.107 | 0.102 | 0.106 | 0.100 | 0.089 |
| Wood/Wood Waste | 0.049 | 0.048 | 0.052 | 0.053 | 0.043 |
| MSW/Landfill Gas | 0.051 | 0.050 | 0.049 | 0.041 | 0.040 |
| Other Biomass [b] | 0.006 | 0.005 | 0.005 | 0.006 | 0.006 |
| Geothermal | 0.006 | 0.007 | 0.007 | 0.008 | 0.008 |
| Conventional Hydroelectric | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| **Industrial** | **1.976** | **1.841** | **1.830** | **1.869** | **1.816** |
| Biomass | 1.915 | 1.784 | 1.777 | 1.822 | 1.774 |
| Wood/Wood Waste | 1.731 | 1.603 | 1.606 | 1.636 | 1.580 |
| MSW/Landfill Gas | 0.083 | 0.092 | 0.094 | 0.105 | 0.104 |
| Other Biomass [b] | 0.101 | 0.088 | 0.077 | 0.081 | 0.090 |
| Geothermal | 0.003 | 0.003 | 0.004 | 0.004 | 0.005 |
| Conventional Hydroelectric | 0.058 | 0.055 | 0.049 | 0.042 | 0.037 |
| **Transportation** | | | | | |
| Alcohol Fuels [c] | **0.096** | **0.105** | **0.110** | **0.126** | **0.133** |
| **Electric Power** [d] | **4.375** | **4.032** | **4.034** | **3.579** | **2.987** |
| Biomass | 0.446 | 0.444 | 0.453 | 0.453 | 0.451 |
| Wood/Wood Waste | 0.137 | 0.137 | 0.138 | 0.134 | 0.140 |
| MSW/Landfill Gas | 0.290 | 0.288 | 0.292 | 0.295 | 0.290 |
| Other Biomass [b] | 0.019 | 0.020 | 0.023 | 0.023 | 0.021 |
| Geothermal | 0.309 | 0.311 | 0.312 | 0.296 | 0.290 |
| Conventional Hydroelectric | 3.581 | 3.241 | 3.218 | 2.768 | 2.181 |
| Solar | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| Wind | 0.034 | 0.031 | 0.046 | 0.057 | 0.059 |
| **Net Renewable Energy Imports** | **0.241** | **0.221** | **0.205** | **0.266** | **0.159** |

[a] Includes small amounts of distributed solar thermal and photovoltaic energy used in the commercial, industrial and electric power sectors.
[b] Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.
[c] Ethanol primarily derived from corn.
[d] Includes electric utilities and independent power producers.
R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.
P=Preliminary.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Analysis conducted by Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels and specific sources described as follows. **Residential:** Energy Information Administration, Form EIA-457A/G, "Residential Energy Consumption Survey;" Oregon Institute of Technology, Geo-Heat Center; and Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey" and Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey." **Commercial:** Energy Information Administration, Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," Form EIA-906, "Power Plant Report," and Oregon Institute of Technology, Geo-Heat Center. **Industrial:** Energy Information Administration, Form EIA-846 (A,B,C) "Manufacturing Energy Consumption Survey," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, " Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;" Oregon Institute of Technology, Geo-Heat Center; and Government Advisory Associates, Resource Recovery Yearbook and Methane Recovery Yearbook. **Transportation:** Energy Information Administration, Form-EIA-819M, "Monthly Oxygenate Telephone Report," and Form EIA-814, "Monthly Imports Report." **Electric Power:** Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;" **Net Imports:** National Energy Board of Canada and California Energy Commission.

**Table 3. Renewable Energy Consumption for Electricity Generation by Energy Use Sector and Energy Source, 1997-2001**

(Quadrillion Btu)

| Sector and Source | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|
| **Total** | **5.052** | **4.672** | **4.657** | **4.261** | **3.541** |
| Biomass | 0.823 | 0.807 | 0.822 | 0.826 | 0.808 |
| Wood/Wood Waste | 0.484 | 0.475 | 0.490 | 0.496 | 0.483 |
| MSW/Landfill Gas | 0.306 | 0.299 | 0.301 | 0.297 | 0.292 |
| Other Biomass [a] | 0.033 | 0.033 | 0.031 | 0.033 | 0.033 |
| Geothermal | 0.309 | 0.311 | 0.312 | 0.296 | 0.292 |
| Conventional Hydroelectric | 3.881 | 3.518 | 3.472 | 3.077 | 2.376 |
| Solar | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| Wind | 0.034 | 0.031 | 0.046 | 0.057 | 0.059 |
| **Commercial** | **0.035** | **0.034** | **0.035** | **0.028** | **0.027** |
| Biomass | 0.034 | 0.033 | 0.033 | 0.026 | 0.026 |
| Wood/Wood Waste | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| MSW/Landfill Gas | 0.029 | 0.029 | 0.029 | 0.021 | 0.021 |
| Other Biomass [a] | 0.004 | 0.003 | 0.004 | 0.005 | 0.005 |
| Conventional Hydroelectric | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| **Industrial** | **0.439** | **0.417** | **0.422** | **0.421** | **0.402** |
| Biomass | 0.381 | 0.362 | 0.373 | 0.379 | 0.365 |
| Wood/Wood Waste | 0.367 | 0.349 | 0.364 | 0.369 | 0.354 |
| MSW/Landfill Gas | 0.002 | 0.000 | 0.000 | 0.000 | 0.001 |
| Other Biomass [a] | 0.012 | 0.012 | 0.008 | 0.009 | 0.011 |
| Conventional Hydroelectric | 0.058 | 0.055 | 0.049 | 0.042 | 0.037 |
| **Electric Power [b]** | **4.337** | **4.000** | **3.996** | **3.547** | **2.953** |
| Biomass | 0.408 | 0.412 | 0.416 | 0.421 | 0.417 |
| Wood/Wood Waste | 0.117 | 0.125 | 0.125 | 0.126 | 0.130 |
| MSW/Landfill Gas | 0.275 | 0.270 | 0.271 | 0.275 | 0.271 |
| Other Biomass [a] | 0.017 | 0.017 | 0.019 | 0.020 | 0.017 |
| Geothermal | 0.309 | 0.311 | 0.312 | 0.296 | 0.290 |
| Conventional Hydroelectric | 3.581 | 3.241 | 3.218 | 2.768 | 2.181 |
| Solar | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| Wind | 0.034 | 0.031 | 0.046 | 0.057 | 0.059 |
| **Net Renewable Energy Imports** | **0.241** | **0.221** | **0.205** | **0.266** | **0.159** |
| Geothermal | 0.000 | 0.001 | 0.001 | 0.000 | 0.002 |
| Conventional Hydroelectric | 0.277 | 0.265 | 0.277 | 0.321 | 0.241 |
| Conventional Hydroelectric (Exports) | 0.036 | 0.045 | 0.072 | 0.055 | 0.084 |

[a] Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

[b] Includes electric utilities and independent power producers.

R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.

P=Preliminary.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Analysis conducted by Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels and the following specific sources. **Domestic Sectors:** Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;" **Net Imports:** National Energy Board of Canada and Calfornia Energy Commission.

## Table 4. Electricity Net Generation From Renewable Energy by Energy Use Sector and Energy Source, 1997-2001

(Thousand Kilowatthours)

| Sector and Source | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|
| **Total** | **457,181,198** | **422,093,324** | **419,006,721** | **382,512,277** | **312,767,216** |
| Biomass | 58,657,514 | 58,786,319 | 59,612,909 | 60,727,650 | 59,640,051 |
| Wood/Wood Waste | 36,948,441 | 36,338,384 | 37,040,734 | 37,594,866 | 36,871,734 |
| MSW/Landfill Gas | 19,276,887 | 19,930,525 | 20,072,515 | 20,304,943 | 20,018,830 |
| Other Biomass [a] | 2,432,186 | 2,517,410 | 2,499,660 | 2,827,841 | 2,749,487 |
| Geothermal | 14,742,595 | 14,819,063 | 14,857,542 | 14,093,158 | 13,901,229 |
| Conventional Hydroelectric | 379,981,886 | 344,959,773 | 339,553,190 | 301,604,833 | 232,949,965 |
| Solar | 511,168 | 502,473 | 495,082 | 493,375 | 494,158 |
| Wind | 3,288,035 | 3,025,696 | 4,487,998 | 5,593,261 | 5,781,813 |
| **Commercial** | **2,505,414** | **2,493,233** | **2,527,119** | **2,111,620** | **2,063,254** |
| Biomass | 2,385,222 | 2,372,765 | 2,412,456 | 2,011,871 | 1,963,505 |
| Wood/Wood Waste | 43,193 | 37,716 | 19,671 | 26,958 | 19,523 |
| MSW/Landfill Gas | 1,992,309 | 2,020,757 | 2,041,934 | 1,601,152 | 1,539,085 |
| Other Biomass [a] | 349,720 | 314,292 | 350,851 | 383,761 | 404,897 |
| Conventional Hydroelectric | 120,192 | 120,468 | 114,663 | 99,749 | 99,749 |
| **Industrial** | **34,792,639** | **33,920,823** | **33,505,006** | **33,626,304** | **32,361,740** |
| Biomass | 29,107,498 | 28,572,250 | 28,746,698 | 29,491,149 | 28,739,925 |
| Wood/Wood Waste | 28,225,019 | 27,692,538 | 28,060,358 | 28,651,835 | 27,735,132 |
| MSW/Landfill Gas | 104,281 | 15,637 | 20,516 | 30,858 | 61,286 |
| Other Biomass [a] | 778,198 | 864,075 | 665,824 | 808,456 | 943,507 |
| Conventional Hydroelectric | 5,685,141 | 5,348,573 | 4,758,308 | 4,135,155 | 3,621,815 |
| **Electric Power [b]** | **396,338,061** | **364,010,011** | **362,926,906** | **320,742,117** | **262,853,221** |
| Biomass | 27,164,794 | 27,841,304 | 28,453,755 | 29,224,630 | 28,936,621 |
| Wood/Wood Waste | 8,680,229 | 8,608,130 | 8,960,705 | 8,916,073 | 9,117,079 |
| MSW/Landfill Gas | 17,180,297 | 17,894,131 | 18,010,065 | 18,672,933 | 18,418,459 |
| Other Biomass [a] | 1,304,268 | 1,339,043 | 1,482,985 | 1,635,624 | 1,401,083 |
| Geothermal | 14,726,102 | 14,773,918 | 14,827,013 | 14,093,158 | 13,812,908 |
| Conventional Hydroelectric | 350,647,962 | 317,866,620 | 314,663,058 | 271,337,693 | 213,827,721 |
| Solar | 511,168 | 502,473 | 495,082 | 493,375 | 494,158 |
| Wind | 3,288,035 | 3,025,696 | 4,487,998 | 5,593,261 | 5,781,813 |
| **Net Renewable Energy Imports** | **23,545,084** | **21,669,257** | **20,047,690** | **26,032,236** | **15,489,001** |
| Geothermal | 16,493 | 45,145 | 30,529 | -- | 88,321 |
| Conventional Hydroelectric | 27,095,696 | 26,025,972 | 27,042,653 | 31,422,294 | 23,610,560 |
| Conventional Hydroelectric (Exports) | 3,567,105 | 4,401,860 | 7,025,492 | 5,390,058 | 8,209,880 |

[a] Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.
[b] Includes electric utilities and independent power producers.
R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.
P=Preliminary.
-- = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Sources: **Domestic Sectors**: Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;" **Net Imports**: National Energy Board of Canada and Calfornia Energy Commission.

**Table 5. U.S. Electric Net Summer Capacity, 1997-2001**
(Megawatts)

| Source | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|
| **Total** | **778,649** | **775,868** | **785,927** | **812,667** | **854,655** |
| **Renewable Total** | **94,766** | **94,599** | **95,339** | **94,939** | **96,741** |
| Biomass | 10,515 | 10,500 | 10,459 | 10,024 | 10,120 |
| Wood/Wood Waste | 6,924 | 6,802 | 6,795 | 6,141 | 6,230 |
| MSW/Landfill Gas | 3,153 | 3,253 | 3,214 | 3,381 | 3,387 |
| Other Biomass (a) | 438 | 446 | 451 | 502 | 504 |
| Geothermal | 2,893 | 2,893 | 2,846 | 2,793 | 2,793 |
| Conventional Hydroelectric | 79,415 | 79,151 | 79,393 | 79,359 | 79,379 |
| Solar | 334 | 335 | 389 | 386 | 387 |
| Wind | 1,610 | 1,720 | 2,252 | 2,377 | 4,062 |
| **Nonrenewable Total** | **683,884** | **681,269** | **690,587** | **717,728** | **757,914** |

[a] Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.
R=Revised.
P=Preliminary.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-860, "Annual Electric Generator Report," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860A, "Annual Electric Generator Report - Utility," and Form EIA-860B, " Annual Electric Generator Report - Nonutility."

## Table 6. Renewable Energy Consumption for Nonelectric Use by Energy Use Sector and Energy Source, 1997-2001

(Quadrillion Btu)

| Sector and Source | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|
| **Total** | **2.254** | **2.099** | **2.121** | **2.190** | **2.127** |
| Biomass | 2.172 | 2.016 | 2.038 | 2.108 | 2.046 |
| Wood/Wood Waste | 1.865 | 1.701 | 1.720 | 1.761 | 1.687 |
| MSW/Landfill Gas | 0.118 | 0.131 | 0.135 | 0.145 | 0.142 |
| Other Biomass [a] | 0.093 | 0.079 | 0.074 | 0.077 | 0.084 |
| Alcohol Fuels [b] | 0.096 | 0.105 | 0.110 | 0.126 | 0.133 |
| Geothermal | 0.016 | 0.018 | 0.019 | 0.021 | 0.022 |
| Solar | 0.065 | 0.065 | 0.064 | 0.061 | 0.059 |
| **Residential** | **0.506** | **0.459** | **0.486** | **0.503** | **0.475** |
| Biomass | 0.433 | 0.387 | 0.414 | 0.433 | 0.407 |
| Wood | 0.433 | 0.387 | 0.414 | 0.433 | 0.407 |
| Geothermal | 0.008 | 0.008 | 0.009 | 0.009 | 0.009 |
| Solar [b c] | 0.065 | 0.065 | 0.064 | 0.061 | 0.059 |
| **Commercial** | **0.078** | **0.077** | **0.079** | **0.082** | **0.072** |
| Biomass | 0.072 | 0.070 | 0.073 | 0.074 | 0.063 |
| Wood/Wood Waste | 0.048 | 0.048 | 0.052 | 0.053 | 0.043 |
| MSW/Landfill Gas | 0.022 | 0.021 | 0.020 | 0.020 | 0.019 |
| Other Biomass [a] | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 |
| Geothermal | 0.006 | 0.007 | 0.007 | 0.008 | 0.008 |
| **Industrial** | **1.537** | **1.425** | **1.408** | **1.448** | **1.414** |
| Biomass | 1.534 | 1.422 | 1.404 | 1.443 | 1.409 |
| Wood/Wood Waste | 1.364 | 1.254 | 1.241 | 1.267 | 1.227 |
| MSW/Landfill Gas | 0.081 | 0.092 | 0.094 | 0.105 | 0.103 |
| Other Biomass [a] | 0.089 | 0.076 | 0.069 | 0.072 | 0.079 |
| Geothermal | 0.003 | 0.003 | 0.004 | 0.004 | 0.005 |
| **Transportation** | | | | | |
| **Alcohol Fuels [b]** | **0.096** | **0.105** | **0.110** | **0.126** | **0.133** |
| **Electric Power [c d]** | **0.038** | **0.032** | **0.038** | **0.032** | **0.034** |
| Biomass | 0.038 | 0.032 | 0.038 | 0.032 | 0.034 |
| Wood/Wood Waste | 0.020 | 0.012 | 0.013 | 0.008 | 0.011 |
| MSW/Landfill Gas | 0.016 | 0.018 | 0.021 | 0.020 | 0.020 |
| Other Biomass [a] | 0.002 | 0.003 | 0.004 | 0.004 | 0.004 |

[a] Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.
[b] Ethanol primarily derived from corn.
[c] Includes small amounts of distributed solar thermal and photovoltaic energy used in the commercial, industrial, and electric power sectors.
[d] Includes electric utilities and independent power producers.

R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and combined-heat-and-power data is revised. See Appendix F for details.

P=Preliminary.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Analysis conducted by Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels and specific sources described as follows. **Residential:** Energy Information Administration, Form EIA-457A/G, "Residential Energy Consumption Survey;" Oregon Institute of Technology, Geo-Heat Center; and Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey" and Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey." **Commercial:** Energy Information Administration, Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," Form EIA-906, "Power Plant Report," and Oregon Institute of Technology, Geo-Heat Center. **Industrial:** Energy Information Administration, Form EIA-846 (A,B,C) "Manufacturing Energy Consumption Survey," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, " Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;" Oregon Institute of Technology, Geo-Heat Center; and Government Advisory Associates, Resource Recovery Yearbook and Methane Recovery Yearbook. **Transportation:** Energy Information Administration, Form-EIA-819M, "Monthly Oxygenate Telephone Report," and Form EIA-814, "Monthly Imports Report." **Electric Power:** Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;" **Net Imports:** National Energy Board of Canada and California Energy Commission.

## Table 7. Biomass Energy Consumption by Energy Source and Energy Use Sector, 1997-2001

(Trillion Btu)

| Source and Sector | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|
| **Total** | **2,996** | **2,823** | **2,860** | **2,934** | **2,854** |
| **Wood Energy Total** | **2,349** | **2,175** | **2,210** | **2,257** | **2,170** |
| Residential | 433 | 387 | 414 | 433 | 407 |
| Commercial | 49 | 48 | 52 | 53 | 43 |
| Industrial | 1,731 | 1,603 | 1,606 | 1,636 | 1,580 |
| Electric Power [a] | 137 | 137 | 138 | 134 | 140 |
| **Waste Energy Total** | **551** | **542** | **540** | **552** | **551** |
| MSW/Landfill Gas | 425 | 430 | 435 | 441 | 434 |
| Commercial | 51 | 50 | 49 | 41 | 40 |
| Industrial | 83 | 92 | 94 | 105 | 104 |
| Electric Power [a] | 290 | 288 | 292 | 295 | 290 |
| Other Biomass [b] | 126 | 112 | 105 | 111 | 117 |
| Commercial | 6 | 5 | 5 | 6 | 6 |
| Industrial | 101 | 88 | 77 | 81 | 90 |
| Electric Power [a] | 19 | 20 | 23 | 23 | 21 |
| **Alcohol Fuels [c]** | | | | | |
| **Transportation** | **96** | **105** | **110** | **126** | **133** |

[a] Includes electric utilities and independent power producers.
[b] Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.
[c] Ethanol primarily derived from corn.
R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.
P=Preliminary.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Table 2 of this report.

## Table 8. Industrial Biomass Energy Consumption and Electricity Net Generation by Primary Purpose of Business, 2000

| Industry | Biomass Energy Consumption (Trillion Btu) | | | Net Generation (Million Kilowatthours) |
|---|---|---|---|---|
| | Total | For Electricity | For Useful Thermal Output | |
| **Total** | **1,822.103** | **378.751** | **1,443.352** | **29,491** |
| Agriculture, Forestry and Mining | 10.252 | 3.189 | 7.063 | 239 |
| Manufacturing | 1,708.997 | 375.561 | 1,333.436 | 29,253 |
| Food and Kindred Products | 48.959 | 3.203 | 45.756 | 246 |
| Lumber [a] | 267.358 | 19.915 | 247.443 | 1,485 |
| Paper and Allied Products | 1,340.620 | 351.358 | 989.262 | 27,453 |
| Chemicals and Allied Products | 21.589 | 0.703 | 20.886 | 37 |
| Other [b] | 30.471 | 0.382 | 30.089 | 31 |
| Nonspecified [c] | 102.854 | - | 102.854 | - |

[a] Lumber biomass energy consumption includes a small amount of sludge waste, which was less than 50 billion Btu.
[b] Other includes Apparel; Petroleum Refining; Rubber and Misc. Plastic Products; Transportation Equipment; Stone, Clay, Glass, and Concrete Products; Furniture and Fixtures; and related industries.
[c] Primary purpose of business is not specified.
-- = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-860B, "Annual Electric Generator Report - Nonutility;" Government Advisory Associates, *Resource Recovery Yearbook* and *Methane Recovery Yearbook*; analysis conducted by the Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels.

## Table 9. Waste Energy Consumption by Type and Energy Use Sector, 2000

(Trillion Btu)

| Type | Sector | | | | |
|---|---|---|---|---|---|
| | | | Electric Power | | |
| | Commercial | Industrial | Electric Utilities | Independent Power Producers | Total |
| **Total** | **47** | **186** | **14** | **305** | **552** |
| MSW and Landfill Gas | 41 | 105 | 10 | 285 | 441 |
| MSW | 39 | 48 | NA | 227 | NA |
| Landfill Gas | 2 | 57 | NA | 58 | NA |
| Other Biomass [a] | 6 | 81 | 4 | 20 | 111 |

[a] Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

NA = Not available.

MSW = Municipal Solid Waste.

Note: Totals may not equal sum of components due to independent rounding. Excludes wood waste.

Sources: Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," and Form EIA-860B, "Annual Electric Generator Report - Nonutility;" Government Advisory Associates, Resource Recovery Yearbook and Methane Recovery Yearbook; analysis conducted by the Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels.

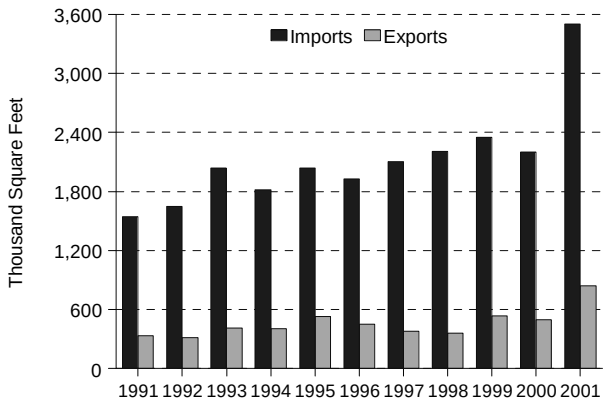
# 2. Solar Thermal and Photovoltaic Collector Manufacturing Activities

## Introduction

Material in this chapter is based upon manufacturing shipment information reported on Form EIA-63A ("Annual Solar Thermal Collector Manufacturers Survey") and Form EIA-63B ("Annual Photovoltaic Module / Cell Manufacturers Survey "). Domestic shipments of photovoltaic cells and modules have increased by a factor of six since 1993 (Table 10), while solar thermal collector shipments have grown 58 percent during the same time frame (Table 11).

By far, the largest increase in domestic shipments of photovoltaic cells and modules occurred between 2000 and 2001. This growth is attributed to changes in product activity at five of the major photovoltaic companies. These companies increased their product line and expanded into new end-use markets. In addition, one company entered the domestic market for the first time.

**Figure 5. Import and Export Shipments of Solar Thermal Collectors, 1991-2001**




Notes: Total shipments as reported by respondents include all domestic and export shipments and may include imports that subsequently were shipped to domestic or foreign customers.
Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Solar Thermal Collector Manufacturing Activities

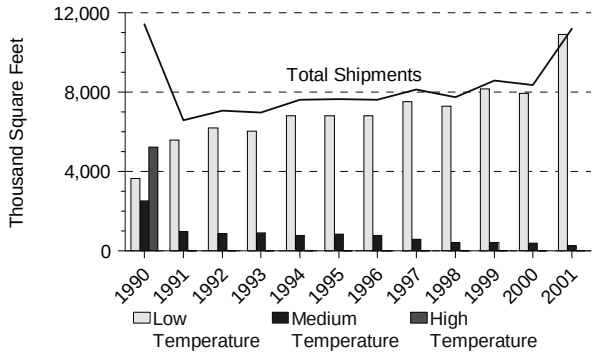
Total shipments of solar thermal collectors[2] were 11.2 million square feet in 2001. This represented an increase of 34 percent from the 2000 total of 8.4 million square feet. There were 26 companies shipping solar collectors in 2001, the same as in 2000. Import shipments totaled 3.5 million square feet, while export shipments were 0.8 million square feet (Figure 5).

Low-temperature solar collectors represented 98 percent of total shipments, while medium-temperature collectors were responsible for 2 percent (Table 12). High-temperature collectors—used by utilities and nonutilities in experimental grid electricity programs—represented less than 1 percent of total shipments (Table 12, Figure 6). U.S. firms in six States (California, New Jersey, Florida, Hawaii, Texas, and New York) and Puerto Rico manufactured nearly all U.S. solar thermal collectors in 2001 (Table 13). Shipments included both components and integrated solar collector systems.

Domestic shipments were sent to 46 States, the District of Columbia, Puerto Rico, and the Virgin Islands (Table 14). Exports went mainly to Canada (31 percent), Mexico (24 percent), Austria (10 percent), France (9 percent), Brazil (8 percent), and Czechoslovakia (5 percent) (Table 15). Fifty-four percent of total shipments were sent directly to wholesale distributors, 36 percent to retail distributors, 4 percent to exporters, 3 percent to other end users, and 2 percent to installers (Table 16). Compared with 2000, retail distributors gained at the expense of installers.

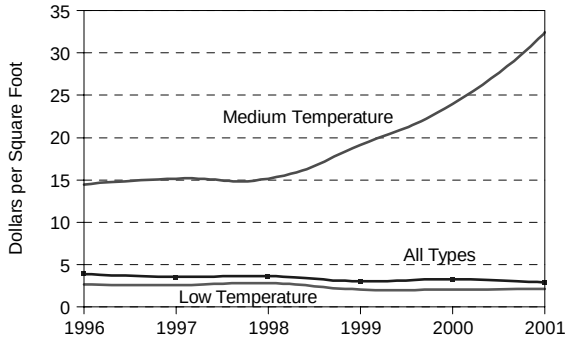
[2] Solar thermal collectors are divided into three categories: low-, medium-, and high-temperature collectors. The type is usually determined by the level of heat generated.

**Figure 6. Solar Thermal Collector Shipments by Collector Type, 1990-2001**




Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

**Figure 7. Average Price of Solar Thermal Collector Shipments by Collector Type, 1996-2001**




Note: The average price of high-temperature collectors, not shown in this figure, increased dramatically in 1999 from 1998. However, shipments of high-temperature collectors represented less than 0.25 percent of total shipments and thus had little impact on the overall trend.

Source: Energy Information Administration, Form EIA-63A,"Annual Solar Thermal Collector Manufacturers Survey."

The value of total shipments was $32.4 million in 2001, an increase of 18 percent from 2000. (Table 17). The average price for total shipments decreased 12 percent, from $3.28 per square foot in 2000 to $2.90 per square foot in 2001. The value of low-temperature collectors jumped from $17 million in 2000 to $23.5 million in 2001, an increase of 42 percent (Figure 7, Table 17).

The residential sector continues to be the prime market for solar collectors, totaling nearly 10.1 million square feet, or 90 percent of total shipments (Table 18). The commercial sector was the second largest, with 1.0 million square feet (9 percent). The largest end use for solar collectors shipped in 2001 was for heating swimming pools, consuming 10.8 million square feet (97 percent) of total shipments. The second-largest use was for domestic hot water heating (2 percent). This marked a decline from 2000, when domestic hot water heating represented approximately 4 percent of total shipments. The value of shipments of complete systems decreased from $13.4 million in 2000 to $8.9 million in 2000 (Table 19).

Of the 26 active companies shipping solar collectors, four are planning to introduce new low-temperature collectors, three are planning new medium-temperature collectors, and two expect to introduce high-temperature collectors (Table 20). In 2001, the industry remained highly concentrated—the 10 largest companies accounted for 99 percent of total shipments (Table 21). Employment decreased 10 percent in 2001 from 2000 (Table 22). A total of 21 firms were involved in the design of collectors or systems, 12 were involved in prototype collector development, and 11 were active in prototype system development (Table 23). Twenty companies had 90 percent or more of their total company-wide sales in solar collectors, while four companies had 50 to 89 percent, and 2 companies had less than 10 percent (Table 24).

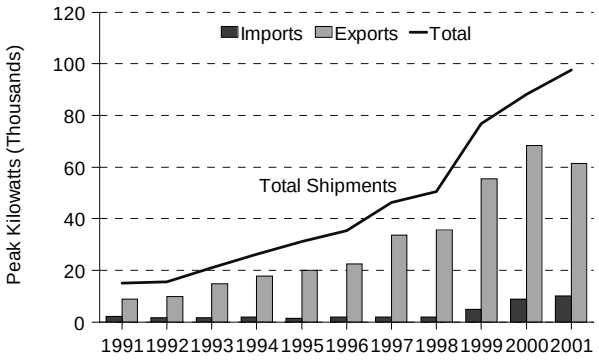
## Photovoltaic Module and Cell Manufacturing Activities [3]

Photovoltaic (PV) cell and module shipments reached 97.7 peak megawatts in 2001, a 11-percent increase from the 2000 total of 88.2 peak megawatts (Table 25). For the first time in more than 8 years, exports declined, dropping 10 percent to 61.4 peak megawatts (Table 26 and Figure 8). Exports accounted for 63 percent of total shipments in 2001 compared with 78 percent in 2000.

Trends in sales to different groups of recipients varied. Sales to wholesale distributers, the largest recipient category, rose nearly 20 percent to 59.8 peak megawatts, or 61 percent of total shipments (Table 27). In contrast, sales to the second-largest category, module manufacturers, declined 28 percent to 14.0 peak megawatts in 2001.

[3] Data for cells and modules are for terrestrial use only (i.e., excludes space applications).

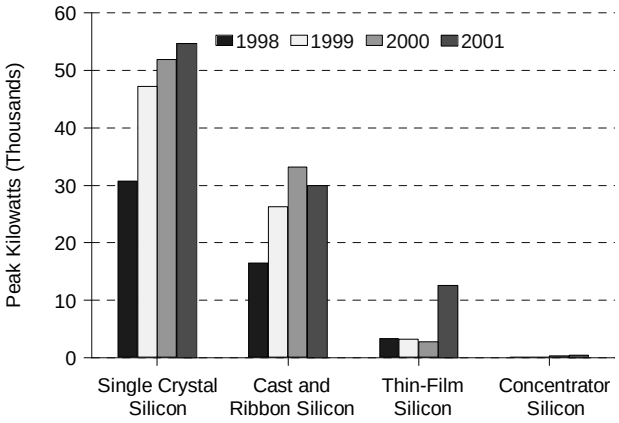
**Figure 8. Import and Export Shipments of Photovoltaic Cells and Modules, 1991-2001**




Note: Total shipments as reported by respondents include all domestic and export shipments and may include imports that subsequently were shipped to domestic or foreign customers.

Source: Energy Information Administration, Form EIA-63B,"Annual Photovoltaic Module/Cell Manufacturers Survey."

**Figure 9. Photovoltaic Cell and Module Shipments by Type, 1998-2001**




Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

These trends imply a tremendous rise in domestic PV cell and module shipments between 2000 and 2001—from 19.8 peak megawatts to 36.3 peak megawatts. Although EIA only collects information on total shipments and exports, further research into the sales of the five largest manufacturers of PV cells and modules indicates the following causes for the large increase in 2001 domestic shipments:

- New product lines, which achieved sizable penetration into the U.S. market
- One company's new entry into the residential market in 2001
- One company's new entry into domestic market in 2001
- Sizable increases in domestic sales to a wide variety of sectors.

Crystalline silicon cells[4] and modules continued to dominate the PV industry in 2001, accounting for 87 percent of total shipments (Table 28). Single-crystal shipments in 2001 totaled 54.7 peak megawatts, or 56 percent of total shipments, compared to 51.9 peak megawatts in 2000. Cast and ribbon silicon shipments totaled 29.9 peak megawatts in 2001, or 31 percent of total shipments. By comparison, cast and ribbon totaled 33.2 peak megawatts or 38 percent of total shipments in 2000. Thin-film shipments increased substantially to 12.5 peak megawatts in 2001 and represented 13 percent of total shipments (Figure 9).

The total value of photovoltaic cell and module shipments grew 13 percent to $305 million in 2001 from $270 million in 2000 (Table 29). The average price for modules (dollars per peak watt) decreased 1 percent, from $3.46 in 2000 to $3.42 in 2001. For cells, the average price increased 3 percent, from $2.40 in 2000 to $2.46 in 2001.

The residential sector replaced the industrial sector as the largest market for PV cells and modules in 2001. Shipments to this sector totaled 33.3 megawatts and grew at a rate of 34 percent from 2000 to 2001. (Table 30). The industrial sector totaled 28.1 megawatts in 2001, declining 3 percent. Internationally, the United States photovoltaics markets have benefitted from new government-sponsored programs and loan subsidies in Japan and Germany over the past several years. Recently, however, U.S. exports to Japan have dropped sharply. Japan and Germany have increased the residential and industrial demand for PVs with subsidies for PV systems, as well as favorable tax credits and favorable loan repayment timeframes. In developing countries like Indonesia and Brazil, the World Bank has made low interest energy loans with long term pay-back schedules for the installation of residential applications for PVs. The United States also has implemented a "Million Solar Roofs Initiative" program at the State and

[4] Photovoltaic (PV) components are divided into three categories by product type: (1) crystalline silicon cells and modules which include single-crystal, cast silicon, and ribbon silicon; (2) thin-film cells and modules made from a number of layers of photosensitive materials such as amorphous silicon; and (3) concentrator cells and modules in which a lens is used to gather and converge sunlight onto the cell or module surface.

national levels as well as various loan programs. Also, an increasing number of utilities have sponsored programs such as net metering, portfolio standards, and green pricing. In general, a growing group of industries and residential sector customers appears willing to pay for PV-based installations.[5]

The commercial sector, the third largest sector in peak kilowatts shipped, increased by 15 percent its use of PV cells and modules in 2001.

Electricity generation, which consists of both grid-interactive and remote applications, continues to be the predominant end use for PV cells and modules. In 2001, electric generation accounted for 50 percent of total shipments with remote usage growing 43 percent. In 2001, communication and transportation end uses were the second- and third-largest end uses, respectively, totaling 28 percent. Shipments for water pumping increased 32 percent, while modules sold to Original Equipment Manufacturers, who fabricate products for sale to end users, decreased 48 percent to 6.3 peak megawatts in 2001.

Export shipments decreased 11 percent to 61.4 peak megawatts in 2001 from 68.4 peak megawatts in 2000 (Table 31). This decrease in exports is mainly attributed to U.S. companies' increasing production abroad instead of manufacturing domestically and exporting to a foreign market. Germany and Hong Kong were the largest export markets in 2001, accounting for 57 percent and 8 percent of exports, percent of shipments, respectively (Table 32). Exports to Japan decreased from 8.2 peak megawatts in 2000 to 2.6 peak megawatts in 2001. India decreased from 3.3 peak megawatts in 2000 to 0.1 peak megawatts in 2001.

While complete PV systems[6] shipped decreased by 37 percent in 2001, the total value of complete systems increased 14 percent to $50.5 million, as the systems shipped in 2001 were larger and more expensive compared to 2000 (Table 33). Employment in the PV manufacturing industry increased by 39 percent in 2001 (Table 34). Nine companies plan to introduce crystalline silicon products, and four companies plan to introduce thin-film products (Table 35) in 2002. Many companies that are engaged in the manufacture and/or importation of PV modules and cells reported their involvement in other PV-related activities including: 11 in cell manufacturing and 14 in module or system design; 12 in prototype module development and 12 in prototype systems development; 14 in wholesale distribution, 7 in retail distribution, and 7 in installation (Table 36).

[5] National Renewable Energy Laboratory (NREL), *Willingness to Pay For Electricity from Renewable Resources: A Review of Utility Market Research,* NREL/TP.550.26148 (Golden, CO, July 1999). The report contains the results of a survey, indicating that the majority of residential utility customers said that they were willing to pay at least a modest amount more per month on their electric bills for power from renewable sources. PVs were among the most favored renewable sources of electricity.

[6] A complete PV system is defined as a power supply unit that satisfies all the power requirements of an application. Such a system is generally made up of one or more modules, a power conditioning unit to process the electricity into the form needed by the application, wires, and other electrical connectors. Batteries for back-up power supply are an option that can be included.

## Table 10. Annual Photovoltaic and Solar Thermal Domestic Shipments, 1993-2001

| Year | Photovoltaic Cells and Modules [a] (Peak Kilowatts) | Solar Thermal Collectors [a] (Thousand Square Feet) |
|---|---|---|
| 1993 | 6,137 | 6,557 |
| 1994 | 8,363 | 7,222 |
| 1995 | 11,188 | 7,136 |
| 1996 | 13,016 | 7,162 |
| 1997 | 12,561 | 7,759 |
| 1998 | 15,069 | 7,396 |
| 1999 | 21,225 | 8,046 |
| 2000 | 19,839 | 7,857 |
| 2001 | 36,310 | 10,349 |
| **Total** | **143,708** | **69,484** |

[a] Total shipments minus export shipments.

Notes: Totals may not equal sum of components due to independent rounding. Total shipments include those made to U.S. Territories.

Sources: Energy Information Administration, Form EIA-63A,"Annual Solar Thermal Collector Manufacturers Survey, " and Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 11. Annual Shipments of Solar Thermal Collectors, 1993-2001

| Year | Number of Companies | Collector Shipments [a] (Thousand Square Feet) | | |
|---|---|---|---|---|
| | | Total [b] | Imports | Exports |
| 1993 | 41 | 6,968 | 2,039 | 411 |
| 1994 | 41 | 7,627 | 1,815 | 405 |
| 1995 | 36 | 7,666 | 2,037 | 530 |
| 1996 | 28 | 7,616 | 1,930 | 454 |
| 1997 | 29 | 8,138 | 2,102 | 379 |
| 1998 | 28 | 7,756 | 2,206 | 360 |
| 1999 | 29 | 8,583 | 2,352 | 537 |
| 2000 | 26 | 8,354 | 2,201 | 496 |
| 2001 | 26 | 11,189 | 3,502 | 840 |

[a] Includes imputation of shipment data to account for nonrespondents.

[b] Includes shipments of solar thermal collectors to the government, including some military, but excluding space applications.

Note: Total shipments as reported by respondents include all domestic and export shipments and may include imported collectors that subsequently were shipped to domestic or foreign customers.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 12. Annual Shipments of Solar Thermal Collectors by Type, 1993-2001

(Thousand Square Feet)

| Year | Low-Temperature | | Medium-Temperature | | High-Temperature Total Shipments [a, c] |
|---|---|---|---|---|---|
| | Total Shipments [a, b] | Average per Manufacturer | Total Shipments [a] | Average per Manufacturer | |
| 1993 | 6,025 | 464 | 931 | 28 | 12 |
| 1994 | 6,823 | 426 | 803 | 26 | 2 |
| 1995 | 6,813 | 487 | 840 | 32 | 13 |
| 1996 | 6,821 | 487 | 785 | 41 | 10 |
| 1997 | 7,524 | 579 | 606 | 29 | 7 |
| 1998 | 7,292 | 607 | 443 | 23 | 21 |
| 1999 | 8,152 | 627 | 427 | 21 | 4 |
| 2000 | 7,948 | 723 | 400 | 25 | 5 |
| 2001 | 10,919 | 1,092 | 268 | 16 | 2 |

[a] Includes imputation of shipment data to account for nonrespondents.
[b] Includes shipments of solar thermal collectors to the government, including some military, but excluding space applications.
[c] For high-temperature collectors, average annual shipments per manufacturer are not disclosed.
Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 13. Domestic Shipments of Solar Collectors Ranked by Top Five Origins and Destinations, 2000 and 2001

| Origin/Destination | 2000 Shipments | | 2001 Shipments | |
|---|---|---|---|---|
| | Thousand Square Feet | Percent of U.S. Total | Thousand Square Feet | Percent of U.S. Total |
| **Origin** | | | | |
| New Jersey, New York, and Hawaii | 3,030 | 36 | 3,646 | 33 |
| California | 2,455 | 29 | 3,413 | 31 |
| Florida | 547 | 7 | 503 | 4 |
| Puerto Rico | 85 | 1 | 90 | 1 |
| Texas | 26 | * | 29 | * |
| **Top Five Total** | **6,144** | **74** | **7,681** | **69** |
| **Other States** | **9** | **0** | **7** | ***** |
| **Imported** | **2,201** | **26** | **3,502** | **31** |
| **U.S. Total** | **8,354** | **100** | **11,189** | **100** |
| **Destination** [a] | | | | |
| Florida, Connecticut | 4,168 | 50 | 5,132 | 46 |
| California | 2,441 | 29 | 3,290 | 29 |
| Arizona | 417 | 5 | 450 | 4 |
| Nevada | 147 | 2 | 198 | 2 |
| Oregon | 27 | 0 | 154 | 1 |
| **Top Five Total** | **7,200** | **86** | **9,224** | **82** |
| **Other States** | **658** | **8** | **1,126** | **10** |
| **Exported** | **496** | **6** | **840** | **8** |
| **U.S. Total** | **8,354** | **100** | **11,189** | **100** |

[a] Represents all domestic shipments, including imported solar collectors.
* = Less than 0.5 percent.
Notes: Totals may not equal sum of components due to independent rounding. U.S. total includes territories.
Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 14. Shipments of Solar Thermal Collectors by Destination, 2001 (Square Feet)

| Destination | Shipments |
|---|---|
| Alabama | 58 |
| Arizona | 450,195 |
| Arkansas | 328 |
| California | 3,289,616 |
| Colorado | 14,665 |
| Connecticut | 155,213 |
| District of Columbia | 29 |
| Florida | 4,976,654 |
| Georgia | 42,619 |
| Hawaii | 142,361 |
| Idaho | 1,607 |
| Illinois | 134,639 |
| Indiana | 10,310 |
| Iowa | 576 |
| Kansas | 2,291 |
| Kentucky | 1,359 |
| Louisiana | 12,021 |
| Maine | 928 |
| Maryland | 6,407 |
| Massachusetts | 4,096 |
| Michigan | 48,349 |
| Minnesota | 27,748 |
| Mississippi | 29 |
| Missouri | 2,627 |
| Nebraska | 1,222 |
| Nevada | 197,664 |
| New Hampshire | 533 |
| New Jersey | 121,531 |
| New Mexico | 21,480 |
| New York | 67,706 |
| North Carolina | 7,945 |
| Ohio | 4,245 |
| Oklahoma | 1,843 |
| Oregon | 154,446 |
| Pennsylvania | 67,974 |
| Puerto Rico | 96,493 |
| Rhode Island | 29 |
| South Carolina | 3,237 |
| South Dakota | 29 |
| Tennessee | 9,748 |
| Texas | 102,178 |
| Utah | 1,468 |
| Vermont | 3,571 |
| Virgin Islands | 790 |
| Virginia | 72,263 |
| Washington | 52,147 |
| West Virginia | 1,786 |
| Wisconsin | 34,130 |
| Wyoming | 122 |
| **Shipments to United States/Territories** | **10,349,303** |
| **Exports** | **839,822** |
| **Total Shipments** | **11,189,125** |

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 15. Distribution of U.S. Solar Thermal Collector Exports by Country, 2001

| Country | Percent of U.S. Exports |
|---|---|
| **Asia and the Middle East** | |
| India | 0.4 |
| Japan | 0.2 |
| Philippines | 0.1 |
| Taiwan | 1.1 |
| **Total** | **1.9** |
| **Europe** | |
| Austria | 9.8 |
| Belgium & Luxembourg | 1.4 |
| Czechoslovakia | 4.6 |
| Denmark | 0.1 |
| France | 9.4 |
| Germany | 1.8 |
| Spain | 0.8 |
| Sweden | 2.8 |
| Switzerland | 0.4 |
| **Total** | **31.0** |
| **North America** | |
| Antigua and Barbuda | 0.1 |
| Bahamas | 0.1 |
| Barbados | 0.1 |
| Bermuda | 0.1 |
| Canada | 31.4 |
| Costa Rica | 0.1 |
| Dominican Republic | 0.2 |
| Mexico | 23.5 |
| Panama | 1.1 |
| **Total** | **56.8** |
| **South America** | |
| Bolivia | 0.4 |
| Brazil | 8.3 |
| Chile | 1.3 |
| Ecuador | 0.3 |
| Peru | 0.2 |
| **Total** | **10.4** |
| **Total** | **100.0** |

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 16. Distribution of Solar Thermal Collector Shipments, 2000 and 2001

| Recipient | Shipments (Thousand Square Feet) 2000 | 2001 |
|---|---|---|
| Wholesale Distribution | 4,633 | 6,086 |
| Retail Distributors | 745 | 4,076 |
| Exporters | 276 | 473 |
| Installers | 2,527 | 266 |
| End Users and Other [a] | 173 | 288 |
| **Total** | **8,354** | **11,189** |

[a] Other includes minimal shipments not explained on form EIA-63A.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration. Form EIA-63A. "Annual Solar Thermal Collector Manufacturers Survey."

## Table 17. Solar Thermal Collector Shipments by Type, Quantity, Value, and Average Price, 2000 and 2001

| Type | 2,000 | | | 2,001 | | |
|---|---|---|---|---|---|---|
| | Quantity (Thousand Square Feet) | Value (Thousand Dollars) | Average Price (Dollars per Square Foot) | Quantity (Thousand Square Feet) | Value (Thousand Dollars) | Average Price (Dollars per Square Foot) |
| Low-Temperature | | | | | | |
| Liquid and Air | 7,948 | 16,597 | 2.09 | 10,919 | 23,498 | 2.15 |
| Medium-Temperature | | | | | | |
| Air | 6 | 154 | 26.55 | 4 | 57 | 15.77 |
| Liquid | | | | | | |
| ICS/Thermosiphon | 172 | 4,714 | 27.43 | 81 | 3,799 | 46.65 |
| Flat Plate | 212 | 4,572 | 21.54 | 181 | 4,707 | 25.98 |
| Evacuated Tube | 10 | 150 | 15 | 2 | 116 | 71.81 |
| Concentrator | 0 | 0 | 0 | * | 1 | -- |
| All Medium-Temperature | 400 | 9,590 | 23.98 | 268 | 8,680 | 32.4 |
| High-Temperature | | | | | | |
| Parabolic Dish and Trough | 5 | 1,207 | 223.26 | 2 | 261 | 107.76 |
| **Total** | **8,354** | **[a] 27,393** | **3.28** | **11,189** | **32,438** | **2.9** |

[a] Total includes institutional research project.
ICS = Integral collector storage.
* = Less than 0.5 thousand square feet.
-- = Does not apply.
Notes: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 18. Shipments of Solar Collectors by Market Sector, End Use, and Type, 2000 and 2001
(Thousand Square Feet)

| Type | Low-Temperature | Medium-Temperature | | | | | High-Temperature | | |
|---|---|---|---|---|---|---|---|---|---|
| | Liquid/Air | | Liquid | | | | | | |
| | Metallic and Nonmetallic | Air | ICS/Thermosiphon | Flat-Plate (Pumped) | Evacuated Tube | Concentrator | Parabolic Dish/Trough | 2001 Total | 2000 Total |
| **Market Sector** | | | | | | | | | |
| Residential | 9,885 | 3 | 80 | 154 | 1 | * | 0 | **10,125** | **7,473** |
| Commercial | 987 | 1 | * | 22 | * | 0 | 1 | **1,012** | **810** |
| Industrial | 12 | 0 | 0 | 5 | 0 | 0 | 0 | **17** | **57** |
| Utility | 0 | 0 | 0 | 0 | 0 | 0 | 1 | **1** | **5** |
| Other [a] | 34 | 0 | 1 | 0 | 0 | 0 | 0 | **35** | **10** |
| **Total** | **10,919** | **4** | **81** | **181** | **2** | ***** | **2** | **11,189** | **8,354** |
| **End use** | | | | | | | | | |
| Pool Heating | 10,782 | 0 | 0 | 16 | 0 | 0 | 0 | **10,797** | **7,863** |
| Hot Water | 42 | 0 | 81 | 149 | 1 | * | 0 | **274** | **367** |
| Space Heating | 61 | 4 | 0 | 5 | * | 0 | 0 | **70** | **99** |
| Space Cooling | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Combined Space and Water | 0 | 0 | 0 | 12 | 0 | 0 | 0 | **12** | **2** |
| Process Heating | 34 | 0 | 0 | 0 | 0 | 0 | 0 | **34** | **20** |
| Electricity Generation | 0 | 0 | 0 | 0 | 0 | 0 | 2 | **2** | **3** |
| Other [b] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| **Total** | **10,919** | **4** | **81** | **181** | **2** | ***** | **2** | **11,189** | **8,354** |

[a] Other market sector include shipments of solar thermal collectors to sectors such as government, including the military but excluding space applications.
[b] Other end use includes shipments of solar thermal collectors for other uses such as cooking, water pumping, water purification, desalinization, distillation, etc.
* = Less than 500 square feet.
ICS= Integral Collector Storage.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 19. Shipments of Complete Solar Thermal Collector Systems, 2000 and 2001

| Shipment Information | 2000 | 2001 |
|---|---|---|
| Complete Collector Systems | | |
| Shipped | 13,383 | 4,455 |
| Thousand Square Feet | 1,363 | 466 |
| Percent of Total Shipments | 16 | 4 |
| Number of Companies | 26 | 26 |
| Value of Systems (Thousand Dollars) | 13,388 | 8,863 |

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 20. Number of Companies Expecting to Introduce New Solar Thermal Collector Products in 2002

| New Product Type | Number of Companies |
|---|---|
| Low-Temperature Collectors | 4 |
| Medium-Temperature Collectors | 3 |
| High-Temperature Collectors | 2 |
| Noncollector Components | 3 |

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 21. Percent of Solar Collector Shipments by the 10 Largest Companies, 1993-2001

| Year | Company Rank | Shipments (Thousand Square Feet) | Percent of Total Shipments |
|---|---|---|---|
| 1993 | 37260 | 6,135 | 88 |
| | 37416 | 551 | 8 |
| 1994 | 37260 | 6,401 | 84 |
| | 37416 | 861 | 12 |
| 1995 | 37260 | 6,525 | 85 |
| | 37416 | 806 | 11 |
| 1996 | 37260 | 6,452 | 85 |
| | 37416 | 910 | 12 |
| 1997 | 37260 | 7,183 | 88 |
| | 37416 | 731 | 9 |
| 1998 | 37260 | 6,938 | 89 |
| | 37416 | 613 | 8 |
| 1999 | 37260 | 7,813 | 91 |
| | 37416 | 563 | 7 |
| 2000 | 37260 | 7,521 | 90 |
| | 37416 | 567 | 7 |
| 2001 | 37260 | 10,732 | 96 |
| | 37416 | 325 | 3 |

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration: Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 22. Employment in the Solar Thermal Collector Industry, 1993-2001

| Year | Person Years |
|---|---|
| 1993 | 392 |
| 1994 | 402 |
| 1995 | 386 |
| 1996 | 239 |
| 1997 | 184 |
| 1998 | 207 |
| 1999 | 289 |
| 2000 | 284 |
| 2001 | 256 |

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 23. Companies Involved in Solar Thermal Activities by Type, 2000 and 2001

| Type of Activity | 2000 | 2001 |
|---|---|---|
| Collector or System Design | 20 | 21 |
| Prototype Collector Development | 10 | 12 |
| Prototype System Development | 10 | 11 |
| Wholesale Distribution | 16 | 17 |
| Retail Distribution | 13 | 16 |
| Installation | 10 | 10 |
| Noncollector System Component Manufacture | 8 | 9 |

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 24. Solar-Related Sales as a Percentage of Total Sales, 2000 and 2001

| Percent of Total Sales | Number of Companies | |
|---|---|---|
| | 2000 | 2001 |
| 90-100 | 18 | 20 |
| 50-89 | 3 | 4 |
| 10-49 | 1 | 0 |
| Less than 10 | 4 | 2 |
| **Total** | **26** | **26** |

Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

## Table 25. Annual Shipments of Photovoltaic Cells and Modules, 1999-2001

(Peak Kilowatts)

| Item | 1999 | 2000 | 2001 |
|---|---|---|---|
| Cells | 33,714 | 33,213 | 30,633 |
| Modules | 43,073 | 55,007 | 67,033 |
| **Total** | **76,787** | **88,221** | **97,666** |

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 26. Annual Shipments of Photovoltaic Cells and Modules, 1993-2001

| Year | Number of Companies | Photovoltaic Cell and Module Shipments [a] (Peak Kilowatts) | | |
|---|---|---|---|---|
| | | Total | Imports | Exports |
| 1993 | 19 | 20,951 | 1,767 | 14,814 |
| 1994 | 22 | 26,077 | 1,960 | 17,714 |
| 1995 | 24 | 31,059 | 1,337 | 19,871 |
| 1996 | 25 | 35,464 | 1,864 | 22,448 |
| 1997 | 21 | 46,354 | 1,853 | 33,793 |
| 1998 | 21 | 50,562 | 1,931 | 35,493 |
| 1999 | 19 | 76,787 | 4,784 | 55,562 |
| 2000 | 21 | 88,221 | 8,821 | 68,382 |
| 2001 | [b]19 | 97,666 | 10,204 | 61,356 |

[a] Does not include shipments of cells and modules for space/satellite applications.

[b] British Petroleum (BP) purchased Solarex in 2000. In 2000, they submitted individual forms; in 2001, they submitted one merged form, decreasing the total number of companies that submitted forms.

Note: Total shipments as reported by respondents include all domestic and export shipments and may include imported collectors that subsequently were shipped to domestic or foreign customers.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 27. Distribution of Photovoltaic Cells and Modules, 1999-2001

| Recipient | Shipments (Peak Kilowatts) | | |
|---|---|---|---|
| | 1999 | 2000 | 2001 |
| Wholesale Distributers | 39,629 | 50,568 | 59,799 |
| Retail Distributers | 6,605 | 4,345 | 5,302 |
| Exporters | 11,152 | 2,648 | 4,441 |
| Installers | 1,054 | 6,055 | 10,810 |
| End-Users | 425 | 2,600 | 1,482 |
| Module manufacturers | 16,302 | 19,451 | 14,045 |
| Other [a] | 1,619 | 2,553 | 1,787 |
| **Total** | **76,787** | **88,221** | **97,666** |

[a] Other includes categories not identified by reporting companies.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-63B, " Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 28. Photovoltaic Cell and Module Shipments by Type, 1999-2001

| Type | Shipments (Peak Kilowatts) | | | Percent of Total | | |
|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 |
| Crystalline Silicon | | | | | | |
| Single Crystal | 47,220 | 51,922 | 54,736 | 61 | 59 | 56 |
| Cast and Ribbon | 26,241 | 33,234 | 29,915 | 34 | 38 | 31 |
| Subtotal | 73,461 | 85,155 | 84,651 | 96 | 97 | 87 |
| Thin-Film Silicon | 3,269 | 2,736 | 12,541 | 4 | 3 | 13 |
| Concentrator Silicon | 57 | 329 | 474 | * | 0 | * |
| Other [a] | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **76,787** | **88,221** | **97,666** | **100** | **100** | **100** |

[a] Includes categories not identified by reporting companies.
* = Less than 0.5 percent.
Notes: Data do not include shipments of cells and modules for space/satellite applications. Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 29. Photovoltaic Cell and Module Shipment Values by Type, 2000 and 2001

| Type | Value (Thousand Dollars) | 2000 Average Price (Dollars per Peak Watt) | | Value (Thousand Dollars) | 2001 Average Price (Dollars per Peak Watt) | |
|---|---|---|---|---|---|---|
| | | Modules | Cells | | Modules | Cells |
| Crystalline Silicon | | | | | | |
| Single-Crystal | 155,643 | 3.48 | 2.55 | 160,677 | 3.48 | 2.48 |
| Cast and Ribbon | 103,005 | 3.41 | 1.72 | 100,126 | 3.39 | 1.92 |
| Subtotal | 258,648 | 3.45 | 2.4 | 260,804 | 3.43 | 2.46 |
| Thin-Film Silicon | W | W | W | W | W | W |
| Concentrator Silicon | W | W | W | W | W | W |
| Other [a] | 0 | -- | -- | 0 | -- | -- |
| **Total** | **269,855** | **3.46** | **2.4** | **304,810** | **3.42** | **2.46** |

[a] Includes categories not identified by reporting companies.
W = Data withheld to avoid disclosure of proprietary company data.
-- = Does not apply.
Notes: Data do not include shipments of cells and modules for space/satellite applications. Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 30. Shipments of Photovoltaic Cells and Modules by Market Sector, End Use, and Type, 2000 and 2001

(Peak Kilowatts)

| Sector and End Use | Crystalline Silicon [a] | Thin-Film Silicon | Concentrator Silicon | Other | 2001 Total | 2000 Total |
|---|---|---|---|---|---|---|
| **Market** | | | | | | |
| Industrial | 24,754 | 3,135 | 174 | 0 | 28,063 | 28,808 |
| Residential | 28,307 | 4,955 | * | 0 | 33,262 | 24,814 |
| Commercial | 13,440 | 2,270 | 0 | 0 | 15,710 | 13,692 |
| Transportation | 7,525 | 961 | 0 | 0 | 8,486 | 5,502 |
| Utility | 4,799 | 747 | 300 | 0 | 5,846 | 6,298 |
| Government [b] | 5,375 | 353 | 0 | 0 | 5,728 | 4,417 |
| Other [c] | 451 | 120 | 0 | 0 | 571 | 4,690 |
| **Total** | **84,651** | **12,541** | **474** | **0** | **97,666** | **88,221** |
| **End Use** | | | | | | |
| Electricity Generation | | | | | | |
| Grid Interactive | 22,444 | 4,482 | 300 | 0 | 27,226 | 21,713 |
| Remote | 18,772 | 2,501 | 174 | 0 | 21,447 | 14,997 |
| Communications | 12,974 | 1,769 | 0 | 0 | 14,743 | 12,269 |
| Consumer Goods | 3,664 | 395 | 0 | 0 | 4,059 | 2,870 |
| Transportation | 10,803 | 1,833 | 0 | 0 | 12,636 | 12,804 |
| Water Pumping | 6,737 | 708 | 0 | 0 | 7,444 | 5,644 |
| Cells/Modules To OEM [d] | 5,778 | 490 | 0 | 0 | 6,268 | 12,153 |
| Health | 2,931 | 272 | 0 | 0 | 3,203 | 2,742 |
| Other [e] | 549 | 92 | 0 | 0 | 641 | 3,028 |
| **Total** | **84,651** | **12,541** | **474** | **0** | **97,666** | **88,221** |

[a] Includes single-crystal and cast and ribbon types.
[b] Includes Federal, State, local governments, excluding military.
[c] Other includes shipments that are manufactured for private contractors for research.
[d] Original equipment manufacturer.
[e] Other uses include shipments of photovoltaic and modules for other uses, such as cooking food, desalinization, distillation, etc.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 31. Export Shipments of Photovoltaic Cells and Modules by Type, 2000 and 2001

(Peak Kilowatts)

| | Type | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Crystalline Silicon | | Thin-Film Silicon | | Concentrator Silicon | | Total | |
| Item | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 |
| Cells | 32,019 | 26,899 | 0 | 0 | 86 | 174 | 32,105 | 27,073 |
| Modules | 35,440 | 29,660 | 837 | 4,622 | 0 | 0 | 36,277 | 34,282 |
| **Total** | **67,460** | **56,559** | **837** | **4,622** | **86** | **174** | **68,382** | **61,356** |

Notes: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 32. Destination of U.S. Photovoltaic Cell and Module Export Shipments by Country, 2001

| Country | Peak Kilowatts | Percent of U.S. Exports |
|---|---|---|
| **Africa** | | |
| Angola | 0.2 | * |
| Egypt | 356.7 | 0.6 |
| Kenya | 147.7 | 0.2 |
| Morocco | 151.5 | 0.2 |
| Namibia | 68.3 | 0.1 |
| Nigeria | 141.0 | 0.2 |
| Other Africa | 12.2 | * |
| South Africa, Republic of | 1,982.0 | 3.2 |
| Uganda | 72.2 | 0.1 |
| **Total** | **2,931.7** | **4.8** |
| **Asia and the Middle East** | | |
| Bangladesh | 72.2 | 0.1 |
| Cambodia | 72.2 | 0.1 |
| China | 72.2 | 0.1 |
| Guam | 11.3 | * |
| Hong Kong | 4,721.4 | 7.7 |
| India | 72.2 | 0.1 |
| Israel | 83.5 | 0.1 |
| Japan | 2,599.8 | 4.2 |
| Korea, Republic of | 355.6 | 0.6 |
| Philippines | 22.7 | * |
| Singapore | 1,093.0 | 1.8 |
| South Korea | 136.6 | 0.2 |
| Taiwan | 208.7 | 0.3 |
| Thailand | 276.3 | 0.5 |
| Vietnam | 72.2 | 0.1 |
| **Total** | **9,869.7** | **16.1** |
| **Australia** | | |
| Australia | 799.7 | 1.3 |
| New Zealand | 1.1 | * |
| **Total** | **800.8** | **1.3** |
| **Europe** | | |
| France | 83.5 | 0.1 |
| Germany | 34,693.9 | 56.5 |
| Greece | 72.2 | 0.1 |
| Italy | 103.2 | 0.2 |
| Norway | 128.8 | 0.2 |
| Portugal | 22.7 | * |
| Russia | 34.0 | 0.1 |
| Spain | 3,683.0 | 6.0 |
| Switzerland | 155.6 | 0.3 |
| United Kingdom | 190.6 | 0.3 |
| **Total** | **39,167.5** | **63.8** |

## Table 32. Destination of U.S. Photovoltaic Cell and Module Export Shipments by Country, 2001 (Continued)

| Country | Peak Kilowatts | Percent of U.S. Exports |
|---|---|---|
| **North America** | | |
| Bermuda | 0.1 | * |
| Canada | 1,709.6 | 2.8 |
| Costa Rica | 273.2 | 0.4 |
| French West Indies | 72.2 | 0.1 |
| Guatemala | 293.9 | 0.5 |
| Haiti | 30.2 | * |
| Mexico | 1,639.2 | 2.7 |
| Netherlands Antilles | 445.0 | 0.7 |
| Nicaragua | 68.3 | 0.1 |
| Panama | 68.3 | 0.1 |
| Trinidad & Tobago | 0.1 | * |
| **Total** | **4,600.0** | **7.6** |
| **South America** | | |
| Argentina | 557.8 | 0.9 |
| Bolivia | 72.2 | 0.1 |
| Brazil | 2,512.7 | 4.1 |
| Chile | 113.6 | 0.2 |
| Colombia | 136.1 | 0.2 |
| Ecuador | 0.1 | * |
| Other Latin America | 171.2 | 0.3 |
| Peru | 363.9 | 0.6 |
| Venezuela | 11.3 | * |
| **Total** | **3,938.9** | **6.4** |
| **Other** | **46.8** | **0.1** |
| **Total U.S. Exports** | **61,355.7** | **100.0** |

Notes: "Other" represents shipments to countries not disaggregated by companies on Form EIA-63B. Totals may not equal sum of components due to independent rounding.

* = Value less than 0.05 percent.

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 33. Shipments of Complete Photovoltaic Module Systems, 1999-2001

| Shipment Information | 1999 | 2000 | 2001 |
|---|---|---|---|
| Complete Photovoltaic Module Systems Shipped | 6,317 | 10,737 | 6,759 |
| Peak Kilowatts | 3,221 | 4,099 | 10,075 |
| Percent of Total Module Shipments | 7 | 7 | 15 |
| Value of Systems (Thousand Dollars) | 23,299 | 44,263 | 50,467 |

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 34. Employment in the Photovoltaic Manufacturing Industry,1993-2001

| Year | Number of Companies | Number of Person-Years |
|---|---|---|
| 1993 | 19 | 1,431 |
| 1994 | 22 | 1,312 |
| 1995 | 24 | 1,578 |
| 1996 | 25 | 1,280 |
| 1997 | 21 | 1,736 |
| 1998 | 21 | 1,988 |
| 1999 | 19 | 2,013 |
| 2000 | 21 | 1,913 |
| 2001 | 19 | 2,666 |

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 35. Companies Expecting to Introduce New Photovoltaic Products in 2002

| New Product Type | Number of Companies |
|---|---|
| Crystalline Silicon | |
| Single-Crystal Silicon Modules | 4 |
| Cast Silicon Modules | 2 |
| Ribbon Silicon Modules | 3 |
| Thin-Film | |
| Amorphous Silicon Modules | 3 |
| Other (Thin-Film) | 1 |
| Other (Flat Plate) | 0 |
| Concentrators | 0 |
| NonModule System Components | 0 |

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

## Table 36. Number of Companies Involved in Photovoltaic-Related Activities, 2000 and 2001

| Type of Activity | Number of Companies | |
|---|---|---|
| | 2000 | 2001 |
| Cell Manufacturing | 12 | 11 |
| Module or System Design | 17 | 14 |
| Prototype Module Development | 17 | 12 |
| Prototype Systems Development | 15 | 12 |
| Wholesale Distribution | 15 | 14 |
| Retail Distribution | 7 | 7 |
| Installation | 7 | 7 |
| **Noncollector System** | | |
| Component Manufacturing | 5 | 4 |

Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

# 3. Survey of Geothermal Heat Pump Shipments

This chapter provides information on geothermal heat pump shipments, based on the Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey." The survey shows that manufacturers shipped 35,581 geothermal heat pumps in 2000, a decrease of 15 percent from the 1999 total of 41,679. Of those shipped in 2000, 7,808 were ARI-320 rated,[7] a decrease of 102 from 1999. The total shipments of ARI-325 and ARI-330 were 26,219 in 2000, a decrease of 17 percent. Non-ARI-rated units shipped in 2000 numbered 1,554, a decrease of 27 percent from 1999 (Table 37).

The total rated capacity of heat pumps shipped in 2000 was 164,191 tons, compared to 191,651 tons in 1999 (Table 38). The proportion of geothermal heat pumps shipped to each Census Region in 2000 was as follows: the South (49 percent), the Midwest (30 percent), Export (3 percent), the Northeast (12 percent), and the West (6 percent) (Table 39). Fifty-eight percent of geothermal heat pumps were shipped to installers, and 28 percent to wholesale distributors. Six percent were shipped to retail distributors, while 2 percent went to exporters (Table 40).

**Table 37. Geothermal Heat Pump Shipments by Model Type, 1996-2000**
(Number of Units)

| Model | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|
| ARI-320 | 4,697 | 7,772 | 10,510 | R7,910 | 7,808 |
| ARI-325/330 | 25,697 | 28,335 | 26,042 | R31,631 | 26,219 |
| Other Non-ARI Rated | 991 | 1,327 | 1,714 | R2,138 | 1,554 |
| **Totals** | **31,385** | **37,434** | **38,266** | **R41,679** | **35,581** |

R=Revised.
Source: Energy Information Administration, Form EIA-902 "Annual Geothermal Heat Pump Manufacturers Survey."

**Table 38. Capacity of Geothermal Heat Pump Shipments by Model Type, 1996-2000**
(Total Rated Capacity Tons)

| Model | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|
| ARI-320 | 15,060 | 24,708 | 35,776 | R27,970 | 26,469 |
| ARI-325/330 | 92,819 | 110,186 | 98,912 | R153,947 | 130,132 |
| Other Non-ARI Rated | 5,091 | 6,662 | 6,758 | R9,735 | 7,590 |
| **Totals** | **112,970** | **141,556** | **141,446** | **R191,651** | **164,191** |

R=Revised.
Note: One ton of capacity is equal to 12,000 Btu.
Source: Energy Information Administration, Form EIA-902 "Annual Geothermal Heat Pump Manufacturers Survey."

[7] For a detailed explanation of the Air-Conditioning & Refrigeration Institute (ARI) system of rating geothermal heat pumps see: http://www.eia.doe.gov/cneaf/solar.renewables/rea_issues/geo_hp_art.pdf, October 28, 2002

**Table 39. Geothermal Heat Pump Shipments by Export, Census Region, and Model Type, 2000**
(Number of Units)

| Export and Census Region | ARI-320 | ARI-325/330 | Other Non-ARI Rated GHPs | Total |
|---|---|---|---|---|
| Export | 103 | 882 | 235 | 1,220 |
| Midwest | 1,315 | 8,976 | 458 | 10,749 |
| Northeast | 630 | 3,273 | 235 | 4,138 |
| South | 5,092 | 11,823 | 488 | 17,403 |
| West | 668 | 1,265 | 138 | 2,071 |
| **Total** | **7,808** | **26,219** | **1,554** | **35,581** |

Note: The **Midwest Census Region** consists of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The **Northeast Census Region** consists of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The **South Census Region** consists of Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The **West Census Region** consists of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
'Export" in Table 39 and "Exporter" in Table 40 are different. "Export" refers to shipments outside of the country, while "Exporter" is the type of customer.
Source: Energy Information Administration, Form EIA-902 "Annual Geothermal Heat Pump Manufacturers Survey."

**Table 40. Geothermal Heat Pump Shipments by Customer Type and Model Type, 2000**
(Number of Units)

| Customer Type | ARI-320 | ARI-325/330 | Other Non-ARI Rated GHPs | Total |
|---|---|---|---|---|
| Exporter | 103 | 454 | 227 | 784 |
| Wholesale Distributor | 1,556 | 8,194 | 54 | 9,804 |
| Retail Distributor | 250 | 1,482 | 540 | 2,272 |
| Installer | 5,796 | 14,112 | 583 | 20,491 |
| End-User | 0 | 20 | 43 | 63 |
| Others | 103 | 1,957 | 107 | 2,167 |
| **Total** | **7,808** | **26,219** | **1,554** | **35,581** |

Note: 'Export" in Table 39 and "Exporter" in Table 40 are different. "Export" refers to shipments outside of the country, while "Exporter" is the type of customer.
Source: Energy Information Administration, Form EIA-902 "Annual Geothermal Heat Pump Manufacturers Survey."

# Appendix A

# EIA Renewable Energy Data Sources

The Energy Information Administration (EIA) develops renewable energy information from a wide variety of sources, cutting across different parts of the organization. This appendix provides a list of all sources that EIA uses to obtain renewable energy information. While most data come from EIA data collection forms, some are derived from secondary sources. For EIA data collections, additional information is available on the EIA website: http://www.eia.doe.gov/oss/forms.html:

## EIA-63A/B, "Annual Solar Thermal Collector Manufacturers Survey" and "Annual Photovoltaic Module/Cell Manufacturers Survey"

**Energy Sources:** Solar energy.
**Energy Functions:** Disposition.
**Frequency of Collection:** Annually.
**Respondent Categories:** Solar thermal collector manufacturers and/or importers; photovoltaic module/cell manufacturers and/or importers;
**Reporting Requirement:** Mandatory.
**Description:** Forms EIA-63A/B are designed to gather for publication data on shipments of solar thermal collectors and photovoltaic modules. Data are collected by end use and market sector. Collector types include low-temperature, medium-temperature air, medium-temperature liquid, thermosiphon, flat plate, concentrator, integral collector storage, and evacuated tube and concentrators. Respondents are manufacturers, importers, and exporters of solar thermal collectors and photovoltaic modules. These forms were formerly known as CE-63A/B.

## EIA-457A/H, "Residential Energy Consumption Survey"

**Energy Sources:** Coal and coal products; electricity; natural gas; petroleum and petroleum products; wood.
**Energy Functions:** Consumption costs and/or prices.
**Frequency of Collection:** Quadrennially.
**Respondent Categories:** Electric utilities; natural gas distributors (including importers/exporters); petroleum and petroleum product distributors; institutions (non-profit); individuals/households.
**Reporting Requirement:** Voluntary and mandatory.
**Description:** Forms EIA-457A through G are used to collect comprehensive national and regional data on both the consumption of and expenditures for energy in the residential sector of the economy. Data are used for analyzing and forecasting residential energy consumption. Housing, appliance, and demographic characteristics data are collected via personal interviews with households, and consumption and expenditure billing data are collected from the energy suppliers. End-use intensities are produced for space heating, water heating, air conditioning, refrigerators, and appliances. Rental agents are contacted by telephone to check on fuels used in rented apartments. Surveys were conducted in 1978, 1979, 1980, 1981, 1982, 1984, 1987, 1990, 1993, and 1997. Form EIA-457H is used to collect detailed lighting usage information for a subsample.

## EIA-819M, "Monthly Oxygenate Telephone Report"

**Energy Sources:** Petroleum and petroleum products.
**Energy Functions:** Production, Supply.
**Frequency of Collection:** Monthly.
**Respondent Categories:** Oxygenate producers; petroleum and petroleum product distributors; petroleum and petroleum product processors; petroleum and petroleum product storers.
**Reporting Requirement:** Mandatory.
**Legal Citation:** Public Law 93-275 (FEAA), 13(b), 5(a), 5(b), 52.
**Description:** Form EIA-819M is designed to obtain information on oxygenate production, imports, and end-of-month stocks. Data was previously collected using the EIA-819, Monthly Oxygenate Telephone Survey Data are reported by oxygenate type and PAD District. Respondents are a sample of: operators of facilities that produce oxygenates; operators of petroleum refineries; operators of bulk terminals, bulk stations, blending plants, and other non-refinery facilities that store or blend oxygenates; and importers of oxygenates.

## EIA-846 (A,B,C), "Manufacturing Energy Consumption Survey"

**Energy Sources:** Coal and coal products; electricity; natural gas; petroleum and petroleum products; wood.
**Energy Functions:** Consumption; disposition; financial; and/or management; production; research and development; other energy functions.
**Frequency of Collection:** Quadrennially.
**Respondent Categories:** Manufacturing.
**Reporting Requirement:** Mandatory.
**Description:** Forms EIA-846A through D are used to collect information on energy consumption, energy usage patterns, and fuel-switching capabilities of the manufacturing sector of the U.S. economy. The information from this survey is used to publish aggregate statistics on the consumption of energy for fuel and nonfuel purposes, fuel-switching capabilities, and certain energy-related issues such as energy prices, on-site electricity generation, and purchases of electricity from nonutilities. Since 1991, the survey has also collected information on end users of energy, participation in energy management programs, and penetration of new technology. Respondents are a sample of manufacturing establishments. Surveys were conducted for 1985, 1988, 1991, 1994, and 1998 although data for 1998 was not ready to be included in the preparation of this report.

## EIA-860, "Annual Electric Generator Report"

**Energy Sources:** Electricity.
**Energy Functions:** Financial and/or management; production.
**Frequency of Collection:** Annually through 1997 and beginning again in 2000.
**Respondent Categories:** Electric utilities.
**Reporting Requirement:** Mandatory.
**Description:** Form EIA-860 is used to collect data on the status of electric generating plants and associated equipment in operation and those scheduled to be in operation in the United States within 10 years of filing of the report. These data are used to maintain and update EIA's electric power plant frame data base. Data are collected on power plant sites, and the design data of electric generators. Respondents include each electric utility that operates, or plans to operate, a power plant in the United States within 10 years of the report.

## EIA-860A, "Annual Electric Generator Report – Utility"

**Energy Sources:** Electricity.
**Energy Functions:** Financial and/or management, Production.
**Frequency of Collection:** Annually from 1998 through 2000.
**Respondent Categories**: Electric utilities.
**Reporting Requirement:** Mandatory.
**Description:** Form EIA-860A is used to collect data on the status of electric generating plants and associated equipment in operation and those scheduled to be in operation in the United States within 5 years of filing of the report. These data are used to maintain and update EIA's electric power plant frame data base. Data are collected on power plant sites, and the design data of electric generators. Respondents include each electric utility that operates, or plans to operate, a power plant in the United States within 5 years of the report.

## EIA-860B, "Annual Electric Generator Report – Nonutility"

**Energy Sources:** Electricity.
**Energy Functions:** Production.
**Frequency of Collection:** Annually from 1998 through 2000.
**Respondent Categories:** Nonutility power producers.
**Reporting Requirement:** Mandatory.
**Description:** EIA-860B collects data annually from nonutility power producers who own or plan on installing electric generation equipment with a total capacity of 1 megawatt or more at an existing or proposed site. Electricity generation, installed capacity, and energy consumption data are collected. These data are used to augment existing electric utility data and for electric power forecasts and analyses.

## EIA-861, "Annual Electric Utility Report"

**Energy Sources:** Electricity.
**Energy Functions:** Disposition; financial and/or management; production.
**Frequency of Collection:** Annually.
**Respondent Categories:** Electric utilities.
**Reporting Requirement:** Mandatory.
**Description:** Form EIA-861 is a mandatory collection of data filed annually by each electric utility in the United States, its territories, and Puerto Rico. The survey collects data on generation, wholesale purchases, and sales and revenue by class of consumer and State. These data are used to maintain and update EIA's electric utility frame data base. This data base provides information to answer questions from the Executive Branch, Congress, other public agencies, and the general public. Respondents include each electric utility that is a corporation, person, agency, authority, or other legal entity or instrumentality that owns or operates facilities within the United States, its territories, or Puerto Rico

for the generation, transmission, distribution, or sale of electric energy primarily for use by the public.

## EIA-867, "Annual Nonutility Power Producer Report"

**Energy Sources:** Electricity.
**Energy Functions:** Production.
**Frequency of Collection:** Annually through 1997.
**Respondent Categories:** Nonutility power producers.
**Reporting Requirement:** Mandatory.
**Description:** Form EIA-867 is used to collect data annually from nonutility power producers who own or plan on installing electric generation equipment with a total capacity of 1 megawatt or more at an existing or proposed site. Electricity generation, installed capacity, and energy consumption data are collected. These data will be used to augment existing electric utility data and for electric power forecasts and analyses.

## EIA-871A/F, "Commercial Buildings Energy Consumption Survey"

**Energy Sources:** Electricity; natural gas; natural gas products; petroleum and petroleum products; wood; other energy sources.
**Energy Functions:** Consumption; costs and / or prices.
**Frequency of Collection:** Quadrennially.
**Respondent Categories:** Commercial buildings; electric utilities; natural gas distributors (including importers / exporters); petroleum and petroleum product distributors; other (industry); Federal government institutions (nonprofit).
**Reporting Requirement:** Voluntary and mandatory.
**Description:** Forms EIA-871A through F are used to collect information for the Commercial Buildings Energy Consumption Survey (CBECS). The survey provides comprehensive national and regional information on the consumption of, and expenditures for, energy in the commercial sector of the economy. Data are used in EIA models and published in statistical and analytical reports. Physical characteristics information for commercial buildings is collected by personal interviews with building owners and managers using Form EIA-871A. Billing and consumption data for the buildings are collected by mail from individual energy suppliers by using Forms EIA-871C through F (depending upon the energy source). Supplemental information on construction improvements, maintenance, and repairs is collected for the Bureau of the Census by using Form EIA-871G. This survey was renamed the CBECS in 1989. Previously it was conducted under the name of Nonresidential Buildings Energy Consumption Survey.

## EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey"

**Energy Sources:** Geothermal.
**Energy Functions:** Disposition.
**Frequency of Collection:** Annually.
**Respondent Categories:** Geothermal heat pump manufacturers and importers.
**Reporting Requirement:** Mandatory.
**Description:** The Form EIA-902 collects information on shipments of geothermal heat pumps. The survey tracks shipments of the following three main types of geothermal heat pumps, as classified by the Air-Conditioning & Refrigeration Institute (ARI), and the much smaller shipped volume of non-ARI rated systems. A brief description of the ARI-classified system is as follows:

**ARI 320—Water-Source Heat Pumps** (WSHP)—These systems are installed in commercial buildings, where a central chiller or boiler supplies chilled or heated water, respectively, to heat pumps installed in series. The heat pumps transfer building heat to chilled water during the cooling season and, during the heating season, remove heat from boiler water.

**ARI 325—Ground Water-Source Heat Pumps** (GWHP)—The GWHP is an open-loop system in which ground water is drawn from an aquifer or other natural body of water into piping. At the heat pump, heat is drawn from or dumped to the water through a heat exchanger to the refrigerant in the heat pump. The heated or cooled water returns to its source.

**ARI 330—Ground Source Closed-Loop Heat Pumps** (GSHP)—A water or water / glycol (antifreeze) solution flows continuously through a closed loop of pipe buried underground. Ground heat is absorbed into or rejected from the solution flowing in the closed loop. At the heat pump, heat is drawn from or dumped to the closed loop solution via heat transfer through a heat exchanger, which passes heat to or removes heat from the refrigerant in the heat pump. Depending on the type of ground and land area, systems can either be installed horizontally or vertically.

Data are collected by model type, heat pump capacity, region of destination, customer type, and economic sector. Respondents are manufacturers and importers.

## EIA-906, "Power Plant Report"

**Energy Sources:** Electricity.
**Energy Functions:** Supply.
**Frequency of Collection:** Monthly for a sample of electric generators and annually for generators not in the sample beginning in 2001.
**Respondent Categories:** Electric power plants.
**Reporting Requirement:** Mandatory.
**Description:** Form EIA-906 collects information from all regulated and unregulated electric power plants in the United States. Data collected include electric power generation, energy source consumption, end of reporting period fossil fuel stocks, and useful thermal output from cogenerators. Form EIA-906 monthly respondents are a representative sample of electric power plants by State and by energy source. Electric power plants that do not report data monthly submit data annually.

## Appendix B

# Renewable Energy Historical Statistics and Detailed Characteristics

## Table B1. Historical Renewable Energy Consumption by Sector and Energy Source, 1989-2001

(Quadrillion Btu)

| Sector and Energy Source | R1989 | R1990 | R1991 | R1992 | R1993 | R1994 | R1995 | R1996 | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | **6.441** | **6.228** | **6.275** | **6.122** | **6.393** | **6.390** | **6.950** | **7.442** | **7.306** | **6.771** | **6.778** | **6.451** | **5.668** |
| **Residential Sector** | **0.976** | **0.642** | **0.677** | **0.711** | **0.616** | **0.607** | **0.667** | **0.667** | **0.506** | **0.459** | **0.486** | **0.503** | **0.475** |
| Biomass | 0.918 | 0.581 | 0.613 | 0.645 | 0.548 | 0.537 | 0.596 | 0.595 | 0.433 | 0.387 | 0.414 | 0.433 | 0.407 |
| Wood | 0.918 | 0.581 | 0.613 | 0.645 | 0.548 | 0.537 | 0.596 | 0.595 | 0.433 | 0.387 | 0.414 | 0.433 | 0.407 |
| Geothermal | 0.005 | 0.006 | 0.006 | 0.006 | 0.007 | 0.006 | 0.007 | 0.007 | 0.008 | 0.008 | 0.009 | 0.009 | 0.010 |
| Solar [a] | 0.053 | 0.056 | 0.058 | 0.060 | 0.062 | 0.064 | 0.065 | 0.065 | 0.065 | 0.065 | 0.064 | 0.061 | 0.059 |
| **Commercial Sector** | **0.061** | **0.071** | **0.072** | **0.081** | **0.084** | **0.086** | **0.092** | **0.110** | **0.113** | **0.111** | **0.114** | **0.109** | **0.098** |
| Biomass | 0.058 | 0.066 | 0.068 | 0.076 | 0.079 | 0.081 | 0.086 | 0.103 | 0.107 | 0.102 | 0.106 | 0.100 | 0.089 |
| Wood | 0.036 | 0.039 | 0.041 | 0.044 | 0.046 | 0.046 | 0.046 | 0.050 | 0.049 | 0.048 | 0.052 | 0.053 | 0.043 |
| Waste [b] | 0.022 | 0.028 | 0.026 | 0.032 | 0.033 | 0.035 | 0.040 | 0.053 | 0.058 | 0.054 | 0.054 | 0.047 | 0.046 |
| Geothermal | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 | 0.005 | 0.005 | 0.006 | 0.007 | 0.007 | 0.008 | 0.008 |
| Hydroelectric | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| **Industrial Sector** | **1.812** | **1.671** | **1.625** | **1.672** | **1.697** | **1.844** | **1.905** | **1.971** | **1.976** | **1.841** | **1.830** | **1.869** | **1.816** |
| Biomass | 1.784 | 1.640 | 1.595 | 1.640 | 1.665 | 1.779 | 1.847 | 1.907 | 1.915 | 1.784 | 1.777 | 1.822 | 1.774 |
| Wood | 1.584 | 1.447 | 1.410 | 1.461 | 1.484 | 1.580 | 1.652 | 1.683 | 1.731 | 1.603 | 1.606 | 1.636 | 1.580 |
| Waste [b] | 0.200 | 0.194 | 0.185 | 0.179 | 0.181 | 0.199 | 0.195 | 0.224 | 0.184 | 0.180 | 0.171 | 0.186 | 0.194 |
| Geothermal | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 | 0.005 |
| Hydroelectric | 0.026 | 0.028 | 0.028 | 0.031 | 0.030 | 0.062 | 0.055 | 0.061 | 0.058 | 0.055 | 0.049 | 0.042 | 0.037 |
| **Transportation Sector** | | | | | | | | | | | | | |
| Alcohol Fuels [c] | 0.071 | 0.082 | 0.065 | 0.078 | 0.088 | 0.097 | 0.105 | 0.076 | 0.096 | 0.105 | 0.110 | 0.126 | 0.133 |
| **Electric Power Sector** | **3.351** | **3.653** | **3.684** | **3.360** | **3.662** | **3.420** | **3.889** | **4.305** | **4.375** | **4.032** | **4.034** | **3.579** | **2.987** |
| Electric Utilities | 2.983 | 3.151 | 3.114 | 2.712 | 2.953 | 2.714 | 3.173 | 3.553 | 3.620 | 3.279 | 3.123 | 2.607 | 2.041 |
| Biomass | 0.020 | 0.022 | 0.021 | 0.022 | 0.021 | 0.021 | 0.017 | 0.020 | 0.020 | 0.021 | 0.020 | 0.021 | 0.019 |
| Wood | 0.010 | 0.008 | 0.008 | 0.008 | 0.009 | 0.008 | 0.007 | 0.008 | 0.008 | 0.007 | 0.007 | 0.007 | 0.006 |
| Waste [b] | 0.010 | 0.013 | 0.014 | 0.013 | 0.011 | 0.013 | 0.010 | 0.012 | 0.013 | 0.013 | 0.013 | 0.014 | 0.013 |
| Geothermal | 0.197 | 0.181 | 0.170 | 0.169 | 0.158 | 0.145 | 0.099 | 0.110 | 0.115 | 0.109 | 0.036 | 0.003 | 0.003 |
| Hydroelectric | 2.765 | 2.948 | 2.923 | 2.521 | 2.774 | 2.549 | 3.056 | 3.423 | 3.485 | 3.149 | 3.067 | 2.582 | 2.018 |
| Solar | * | * | * | * | * | * | * | * | * | * | * | * | * |
| Wind | * | * | * | * | * | * | * | * | * | * | * | * | 0.001 |
| Independent Power Producers | 0.368 | 0.502 | 0.570 | 0.648 | 0.709 | 0.705 | 0.716 | 0.752 | 0.754 | 0.753 | 0.910 | 0.972 | 0.945 |
| Biomass | 0.211 | 0.289 | 0.333 | 0.381 | 0.394 | 0.413 | 0.405 | 0.418 | 0.426 | 0.424 | 0.433 | 0.432 | 0.432 |
| Wood | 0.089 | 0.115 | 0.118 | 0.132 | 0.141 | 0.144 | 0.119 | 0.130 | 0.129 | 0.129 | 0.131 | 0.127 | 0.134 |
| Waste [b] | 0.122 | 0.174 | 0.215 | 0.249 | 0.253 | 0.269 | 0.286 | 0.288 | 0.296 | 0.294 | 0.302 | 0.305 | 0.298 |
| Geothermal | 0.099 | 0.134 | 0.155 | 0.168 | 0.193 | 0.180 | 0.181 | 0.191 | 0.194 | 0.202 | 0.276 | 0.293 | 0.287 |
| Hydroelectric | 0.036 | 0.051 | 0.049 | 0.065 | 0.087 | 0.072 | 0.093 | 0.104 | 0.096 | 0.092 | 0.151 | 0.185 | 0.163 |
| Solar | 0.003 | 0.004 | 0.005 | 0.004 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| Wind | 0.019 | 0.024 | 0.027 | 0.030 | 0.031 | 0.036 | 0.033 | 0.033 | 0.034 | 0.031 | 0.046 | 0.057 | 0.058 |
| **Electricity Trade** | | | | | | | | | | | | | |
| **Total Net Imports** | **0.171** | **0.110** | **0.153** | **0.219** | **0.246** | **0.337** | **0.293** | **0.313** | **0.241** | **0.221** | **0.205** | **0.266** | **0.159** |
| Hydroelectric Imports | 0.200 | 0.099 | 0.138 | 0.201 | 0.238 | 0.309 | 0.291 | 0.306 | 0.277 | 0.265 | 0.277 | 0.321 | 0.241 |

See footnotes at end of table.

## Table B1. Historical Renewable Energy Consumption by Sector and Energy Source, 1989-2001 (Continued)

| Sector and Energy Source | R1989 | R1990 | R1991 | R1992 | R1993 | R1994 | R1995 | R1996 | R1997 | R1998 | R1999 | 2000 | P2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Electricity Trade** (continued) | | | | | | | | | | | | | |
| Hydroelectric Exports . . . | 0.040 | * | * | * | 0.011 | * | 0.017 | 0.007 | 0.036 | 0.045 | 0.072 | 0.055 | 0.084 |
| Geothermal Imports . . . . | 0.011 | 0.011 | 0.015 | 0.019 | 0.018 | 0.027 | 0.019 | 0.014 | 0.000 | 0.001 | 0.001 | -- | 0.002 |

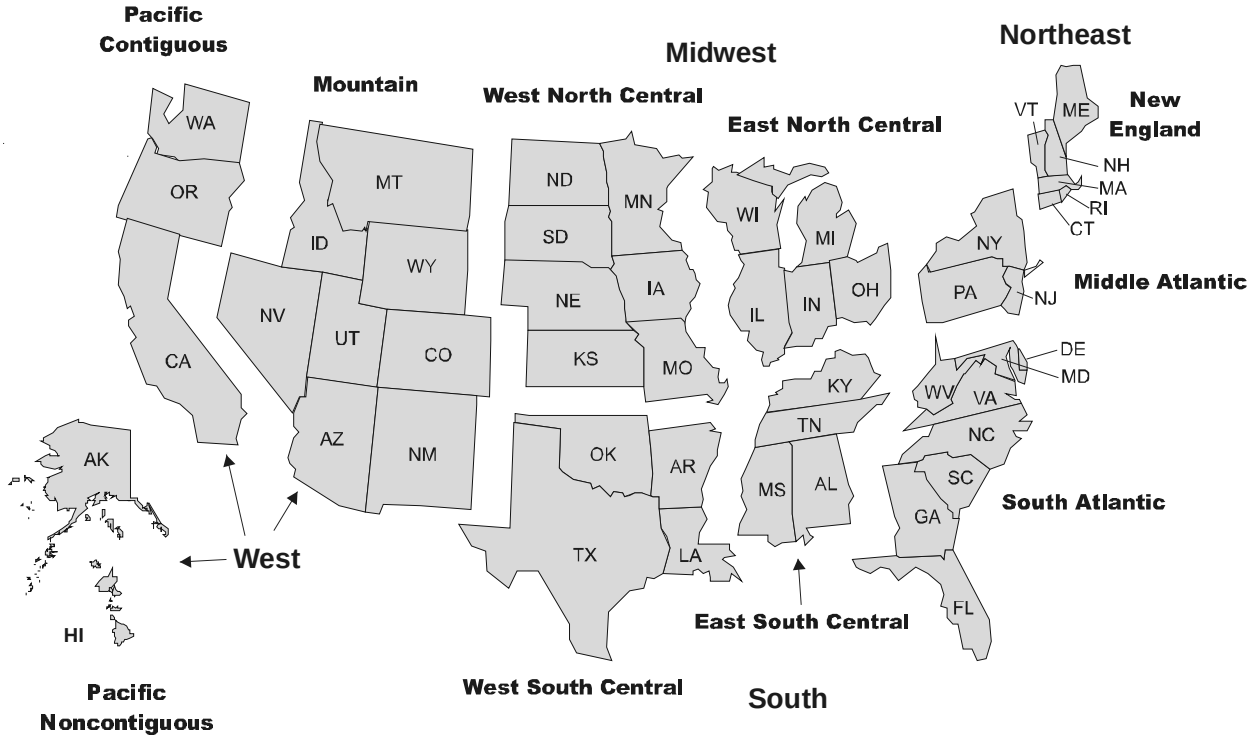
[a] Includes small amounts of distributed solar thermal and photovoltaic energy used in the commercial, industrial and electric power sectors.
[b] Municipal solid waste, landfill gases, agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.
[c] Ethanol primarily derived from corn.
R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.
P=Preliminary.
-- = Not Applicable.
* = Less than 500 Billion Btu.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Anaylsis conducted by Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels and specific sources described as follows. **Residential**: Energy Information Administration, Form EIA-457A/G, "Residential Energy Consumption Survey;" Oregon Institute of Technology, Geo-Heat Center; and Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey" and Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey." **Commercial**: Energy Information Administration, Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," Form EIA-906, "Power Plant Report," and Oregon Institute of Technology, Geo-Heat Center. **Industrial**: Energy Information Administration, Form EIA-846 (A,B,C) "Manufacturing Energy Consumption Survey," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;" Oregon Institute of Technology, Geo-Heat Center; and Government Advisory Associates, *Resource Recovery Yearbook* and *Methane Recovery Yearbook*. **Transportation**: Bureau of Alcohol, Tobacco and Firearms, fuel ethanol production and import data, U.S. Bureau of the Census, Schedule B, Commodity Number 2207.20.0000, "Ethyl Alcohol, Denatured of Any Strength," Energy Information Administration, Form-EIA-819M, "Monthly Oxygenate Telephone Report," and Form EIA-814, "Monthly Imports Report." **Electric Power**: Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," Form EIA-867, "Annual Nonutility Power Producer Report," Form EIA-860B, "Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;" Net Imports: National Energy Board of Canada and California Energy Commission.

**Table B2. Renewable Electricity Net Generation by Energy Source and Census Division, 2000**
(Thousand Kilowatthours)

| Census Division | Geothermal | Conventional Hydroelectric | MSW/Landfill Gas | Other Biomass [a] | Solar | Wind | Wood/Wood Waste | Total |
|---|---|---|---|---|---|---|---|---|
| **Total** | **14,093,158** | **275,572,599** | **20,304,947** | **2,827,839** | **493,375** | **5,593,261** | **37,594,867** | **356,480,046** |
| East North Central | -- | 4,728,465 | 2,018,383 | 455,556 | -- | 2,728 | 3,252,241 | 10,457,373 |
| East South Central | -- | 14,538,408 | 40,660 | 27,375 | -- | -- | 6,500,376 | 21,106,819 |
| Middle Atlantic | -- | 27,213,840 | 5,531,781 | 92,807 | -- | 20,158 | 1,332,313 | 34,190,899 |
| Mountain | 1,522,634 | 34,806,363 | 9,110 | 32,431 | -- | 245,911 | 530,181 | 37,146,630 |
| New England | -- | 7,835,457 | 4,786,840 | 381,385 | -- | 12,249 | 4,573,016 | 17,588,947 |
| Pacific Contiguous | 12,308,471 | 156,712,305 | 2,238,216 | 718,083 | 493,334 | 3,584,722 | 5,355,756 | 181,410,887 |
| Pacific Noncontiguous | 262,053 | 1,105,277 | 349,904 | 188,445 | -- | 17,003 | -- | 1,922,682 |
| South Atlantic | -- | 10,834,377 | 4,333,872 | 703,869 | -- | -- | 9,946,484 | 25,818,602 |
| West North Central | -- | 11,789,438 | 933,310 | 59,816 | -- | 1,218,344 | 522,348 | 14,523,256 |
| West South Central | -- | 6,008,669 | 62,871 | 168,072 | 41 | 492,146 | 5,582,152 | 12,313,951 |

[a] Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.
-- = Not Applicable.
Note: Totals may not add due to independent rounding.
Sources: Energy Information Administration, Form EIA-860B, "Annual Electric Generator Report - Nonutility," and Form EIA-906, "Power Plant Report;"

**Figure B1. U.S. Census Regions and Divisions**




Source: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels.

## Table B3. Industrial Biomass Energy Consumption and Electricity Net Generation by Primary Purpose of Business and Energy Source, 2000

| Industry | Energy Source | Biomass Energy Consumption (Trillion Btu) | | | Net Generation (Million Kilowatthours) |
|---|---|---|---|---|---|
| | | Total | For Electricity | For Useful Thermal Output | |
| **Total** | | **1,822.103** | **378.751** | **1,443.352** | **29,491** |
| **Agriculture, Forestry and Mining** | **Agricultural Byproducts/Crops** | **10.252** | **3.189** | **7.063** | **239** |
| **Manufacturing** | **Total** | **1,708.997** | **375.561** | **1,333.436** | **29,253** |
| Food and Kindred Products | Total | 48.959 | 3.203 | 45.756 | 246 |
| | Agricultural Byproducts/Crops | 45.251 | 1.770 | 43.481 | 160 |
| | Other Biomass Gases | 0.525 | 0.162 | 0.363 | 19 |
| | Other Biomass Solids | 0.020 | 0.005 | 0.015 | 1 |
| | Tires | 0.72 | 0.284 | 0.436 | 24 |
| | Wood/Wood Waste Solids | 2.443 | 0.983 | 1.461 | 42 |
| Lumber [a] | Wood/Wood Waste Solids | 267.358 | 19.915 | 247.443 | 1,485 |
| Paper and Allied Products | Total | 1,340.620 | 351.358 | 989.262 | 27,453 |
| | Agricultural Byproducts/Crops | 0.077 | 0.017 | 0.060 | 2 |
| | Black Liquor | 914.242 | 234.195 | 680.047 | 18,405 |
| | Landfill Gas | 0.289 | 0.066 | 0.223 | 7 |
| | Other Biomass Liquids | 0.047 | 0.022 | 0.025 | 1 |
| | Other Biomass Solids | 1.663 | 0.642 | 1.020 | 62 |
| | Sludge Waste | 5.391 | 1.777 | 3.614 | 164 |
| | Tires | 5.940 | 1.328 | 4.612 | 136 |
| | Wood/Wood Waste Liquids | 26.331 | 7.605 | 18.726 | 684 |
| | Wood/Wood Waste Solids | 386.639 | 105.706 | 280.934 | 7,993 |
| Chemicals and Allied Products | Total | 21.589 | 0.703 | 20.886 | 37 |
| | Landfill Gas | 0.236 | 0.046 | 0.190 | 4 |
| | Municipal Solid Waste | 1.331 | 0.105 | 1.226 | 10 |
| | Other Biomass Liquids | 0.114 | 0.017 | 0.097 | 2 |
| | Other Biomass Solids | 0.005 | 0.002 | 0.003 | * |
| | Wood/Wood Waste Solids | 19.904 | 0.533 | 19.371 | 22 |
| Other [b] | Total | 30.471 | 0.382 | 30.089 | 31 |
| **Nonspecified [c]** | **Total** | **102.854** | **NA** | **102.854** | **NA** |
| | Landfill Gas | 56.49 | NA | 56.490 | NA |
| | Municipal Solid Waste | 46.364 | NA | 46.364 | NA |

Notes:
[a] Lumber biomass energy consumption includes a small amount of sludge waste less that 50 billion Btu.
[b] Other includes Apparel; Petroleum Refining; Rubber and Misc. Plastic Products; Transportation Equipment; Stone, Clay, Glass, and Concrete Products; Furniture and Fixtures; and related industries.
[c] Primary purpose of business is not specified.
NA = Not Applicable.
* = Less than 0.5 million kilowatthours.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-860B, "Annual Electric Generator Report - Nonutility;" Government Advisory Associates, *Resource Recovery Yearbook* and *Methane Recovery Yearbook*; analysis conducted by the Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels.

## Table B4. Industrial Biomass Electricity Net Generation by Census Division and Energy Source, 2000

(Thousand Kilowatthours)

| Energy Source | East North Central | East South Central | Middle Atlantic | Mountain | New England | Pacific Contiguous | Pacific Non-contiguous | South Atlantic | West North Central | West South Central | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | **2,044,061** | **6,389,211** | **842,845** | **491,105** | **1,972,026** | **2,246,201** | **188,445** | **9,097,249** | **546,271** | **5,673,735** | **29,491,148** |
| Agricultural Byproducst/Crops | -- | – | – | – | -- | 26,441 | 188,445 | 162,585 | 7,975 | 14,255 | 399,700 |
| Black Liquor | 1,485,409 | 4,008,975 | 584,100 | 260,117 | 721,307 | 836,478 | -- | 6,549,799 | 249,381 | 3,709,383 | 18,404,948 |
| Landfill Gases | 7,437 | 4,018 | -- | -- | -- | -- | -- | 7,223 | -- | -- | 18,678 |
| Municipal Solid Waste | -- | -- | -- | -- | -- | -- | -- | 9,749 | -- | 2,431 | 12,180 |
| Other Biomass Gases | -- | -- | 11,691 | -- | -- | -- | -- | -- | 7,577 | -- | 19,268 |
| Other Biomass Liquids | -- | -- | 1,736 | -- | 667 | 455 | -- | -- | -- | -- | 2,858 |
| Other Biomass Solids | 4,932 | -- | 53,273 | -- | 1,595 | -- | -- | -- | 664 | 1,956 | 62,421 |
| Sludge Waste | 7,704 | 15,939 | 6,233 | -- | 26,414 | 15,574 | -- | 55,982 | 7,707 | 28,756 | 164,309 |
| Tires | 23,763 | 11,436 | 14,649 | -- | 29,885 | -- | -- | 35,981 | -- | 44,185 | 159,900 |
| Wood/Wood Waste Liquids | 441 | 16,736 | 83,897 | -- | 92,053 | 90,969 | -- | 98,931 | 677 | 300,499 | 684,203 |
| Wood/Wood Waste Solids | 514,375 | 2,332,106 | 87,266 | 230,989 | 1,100,104 | 1,276,284 | -- | 2,177,000 | 272,290 | 1,572,270 | 9,562,683 |

-- = Not Applicable.

Note: Totals may not add due to independent rounding.

Sources: Energy Information Administration, Form EIA-860B, “Annual Electric Generator Report - Nonutility.”

## Table B5. Net Generation and Fuel Consumption at Power Plants Consuming Coal and Biomass by State and Plant Name, 2000

| State | Company Name | Plant Name | City/County | Net Electricity Generation (kilowatthours) | Energy Consumed (million Btu) | Biomass Energy Consumed (million Btu) | Percent of Energy Consumed from Coal | Percent of Energy Consumed from Biomass | Percent of Energy Consumed from Other |
|---|---|---|---|---|---|---|---|---|---|
| AL | Georgia-Pacific Corp | Naheola Mill | Pennington | 446,748,673 | 15,363,373 | 11,228,648 | 15.53 | 73.09 | 11.39 |
| AL | Gulf States Paper Corp | Gulf States Paper Corp | Demopolis | 161,835,808 | 11,113,719 | 8,480,690 | 11.80 | 76.31 | 11.89 |
| AL | International Paper Co | Courtland Mill | Courtland | 800,903,414 | 39,373,023 | 25,024,160 | 7.38 | 63.56 | 29.07 |
| AL | International Paper Co | International Paper Co | Prattville | 463,519,237 | 20,917,190 | 15,519,000 | 8.96 | 74.19 | 16.85 |
| AL | International Paper Co | Mobile Mill | Mobile | 392,680,818 | 16,270,280 | 8,514,730 | 27.36 | 52.33 | 20.30 |
| AL | MacMillan Bloedel Packaging | Weyerhaeuser Pine Hill Operations | Pine Hill | 492,945,038 | 17,312,133 | 14,175,970 | 3.74 | 81.88 | 14.37 |
| AL | Mobile Energy Service Holdings | Mobile Energy Services Co LLC | Mobile | 548,761,000 | 12,578,042 | 3,264,233 | 30.84 | 25.95 | 43.20 |
| AL | Smurfit-Stone Corp | Smurfit Stone Corp | Brewton | 299,901,691 | 6,878,360 | 6,562,160 | 0.04 | 95.40 | 4.56 |
| AL | U S Alliance Corp | U S Alliance Coosa Pines | Coosa Pines | 234,566,719 | 16,344,865 | 8,981,000 | 43.78 | 54.95 | 1.27 |
| AR | Georgia-Pacific Corp | Ashdown | Ashdown | 835,775,644 | 31,610,500 | 23,306,610 | 11.26 | 73.73 | 15.01 |
| CA | POSDEF Power Co LP | Port of Stockton District Energy Facility | Stockton | 320,637,819 | 4,080,200 | 9,180 | 80.86 | 0.22 | 18.91 |
| CA | Stockton Cogen Co | Stockton CoGen Co | Stockton | 476,721,656 | 5,874,490 | 316,210 | 48.27 | 5.38 | 46.34 |
| CT | Connecticut Resource Recv Auth | Mid Connecticut Facility | Hartford | 508,440,390 | 8,113,172 | 8,007,240 | 1.19 | 98.69 | 0.11 |
| DE | Conectiv Delmarva Gen Inc | Edge Moor | Wilmington | 988,309,045 | 9,997,394 | 190,556 | 72.40 | 1.91 | 25.69 |
| FL | Champion International Corp | Pensacola Florida | Cantonment | 477,295,056 | 19,094,246 | 12,955,394 | 11.86 | 67.85 | 20.29 |
| FL | Jefferson Smurfit Corp | Jefferson Smurfit Corp | Fernandina Beach | 554,870,559 | 20,429,589 | 12,272,780 | 32.23 | 60.07 | 7.69 |
| FL | Lakeland (City Of) | Mcintosh | Polk | 3,198,418,000 | 32,712,663 | 278,058 | 76.71 | 0.85 | 22.44 |
| FL | Stone Container Corp | Stone Container Corp Panama City Mill | Panama City | 219,407,115 | 7,510,310 | 3,521,870 | 23.87 | 46.89 | 29.24 |
| GA | Durango-Georgia Paper Co | Durango-Georgia Paper Co | St Marys | 249,545,387 | 10,499,972 | 2,303,532 | 38.69 | 21.94 | 39.38 |
| GA | Georgia-Pacific Corp | Cedar Springs | Cedar Springs | 619,308,848 | 25,291,560 | 17,970,980 | 20.99 | 71.06 | 7.95 |
| GA | Inland Paperboard & Pack'g Inc | Inland Paperboard Packaging Rome Linerboard Mill | Rome | 411,764,666 | 21,808,170 | 13,727,400 | 28.49 | 62.95 | 8.56 |
| GA | International Paper Co | International Paper Augusta Mill | Augusta | 498,823,676 | 37,424,125 | 31,702,590 | 12.85 | 84.71 | 2.44 |
| GA | International Paper Co | International Paper Co Savannah | Savannah | 1,056,992,646 | 30,058,285 | 16,347,831 | 32.19 | 54.39 | 13.43 |
| GA | Riverwood Internatl USA Inc | Riverwood International USA Inc | Macon | 238,260,211 | 9,197,489 | 5,795,120 | 19.86 | 63.01 | 17.13 |
| GA | Southeast Paper Mfg Co Inc | SP Newsprint Co | Dublin | 382,179,574 | 7,325,456 | 1,263,174 | 46.33 | 17.24 | 36.43 |
| HI | Hawaiian Coml & Sugar Co Ltd | Hawaiian Coml&Sugar Co | Puunene Maui | 209,169,486 | 6,818,304 | 4,512,186 | 21.60 | 66.18 | 12.22 |
| IA | Ag Processing Inc | AG Processing Inc | Eagle Grove | 42,455,274 | 1,570,100 | 19,720 | 98.74 | 1.26 | 0.00 |
| IA | IES Utilities Inc | 6th Street | Linn | 209,975,000 | 6,512,277 | 499,492 | 63.83 | 7.67 | 28.50 |
| IA | University of Iowa | University of Iowa Main Power Plant | Iowa City | 107,904,402 | 3,004,639 | 37,700 | 98.65 | 1.25 | 0.10 |
| IL | Archer Daniels Midland Co | Decatur | Decatur | 1,058,409,443 | 32,068,442 | 720,000 | 97.66 | 2.25 | 0.10 |
| IL | Dynegy Midwest Generation Inc | Baldwin Energy Complex | Baldwin | 10,228,674,903 | 111,211,000 | 1,345,000 | 98.67 | 1.21 | 0.12 |
| LA | IPC-Louis | Louisiana Mill | Bastrop | 473,462,821 | 19,354,330 | 14,508,450 | 3.42 | 74.96 | 21.61 |
| LA | IPC-Mansfield Mill | Mansfield Mill | Mansfield | 724,889,190 | 24,224,719 | 19,696,865 | 1.95 | 81.31 | 16.74 |
| MD | Westvaco Corp | Luke Mill | Luke | 431,504,823 | 17,426,372 | 6,706,370 | 59.66 | 38.48 | 1.86 |
| ME | Champion International Corp | Bucksport Maine | Bucksport | 593,167,281 | 8,174,937 | 2,043,726 | 26.88 | 25 | 48.12 |
| ME | Mead Corp | Rumford Cogeneration Co | Rumford | 651,984,086 | 8,133,674 | 3,125,769 | 51.83 | 38.43 | 9.74 |
| ME | S D Warren Co | S D Warren Co 2 | Westbrook | 415,687,727 | 7,088,611 | 3,452,736 | 39.12 | 48.71 | 12.17 |

See footnotes at end of table.

## Table B5. Net Generation and Fuel Consumption at Power Plants Consuming Coal and Biomass by State and Plant Name, 2000 (Continued)

| State | Company Name | Plant Name | City/County | Net Electricity Generation (kilowatthours) | Energy Consumed (million Btu) | Biomass Energy Consumed (million Btu) | Percent of Energy Consumed from Coal | Percent of Energy Consumed from Biomass | Percent of Energy Consumed from Other |
|---|---|---|---|---|---|---|---|---|---|
| MI | International Paper Co | Quinnesec Michigan | Norway | 199,684,937 | 11,268,610 | 9,733,300 | 0.80 | 86.38 | 12.82 |
| MI | Louisiana Pacific Co | Louisiana Pacific Corp | Alpena | 49,433,141 | 1,814,724 | 801,000 | 49.41 | 44.14 | 6.45 |
| MI | Mead Paper Corp | Mead Paper | Escanaba | 704,367,681 | 20,051,844 | 13,472,852 | 22.15 | 67.19 | 10.66 |
| MI | S D Warren Co | S D Warren Co 1 Muskegon | Muskegon | 258,041,059 | 9,356,886 | 2,814,588 | 51.47 | 30.08 | 18.45 |
| MI | Smurfit-Stone Container Corp | Smurfit Stone Container Corp | Ontonagon | 91,803,412 | 3,076,646 | 161,504 | 84.19 | 5.25 | 10.56 |
| MI | TES Filer City Station LP | TES Filer City Station | Filer City | 495,332,213 | 6,244,199 | 289,058 | 95.37 | 4.63 | 0.00 |
| MI | Wyandotte (City Of) | Wyandotte | Wayne | 251,886,000 | 3,754,893 | 99,870 | 92.39 | 2.66 | 4.95 |
| MN | International Paper Co | Sartell Mill | Sartell | 123,936,462 | 3,366,997 | 555,364 | 72.10 | 16.49 | 11.40 |
| MN | Lake Superior Paper Co | Duluth Paper Mill | Duluth | 38,718,035 | 1,232,146 | 1,163,626 | 4.72 | 94.44 | 0.84 |
| MN | Minnesota Power/Blandin Energy | Rapids Energy Center | Grand Rapids | 137,428,630 | 4,539,000 | 2,465,000 | 13.88 | 54.31 | 31.81 |
| MN | Potlatch Corp | Potlatch Corp Minnesota Pulp Paper Board Div | Cloquet | 307,906,862 | 14,653,824 | 11,745,784 | 0.57 | 80.16 | 19.28 |
| MO | Ameren-Union Electric | Sioux | St Charles | 4,877,280,000 | 52,496,324 | 1,067,200 | 91.17 | 2.03 | 6.80 |
| MO | Anheuser-Busch Inc | Anheuser Busch Inc St Louis Brewery | St Louis | 91,353,186 | 4,028,404 | 334,126 | 85.14 | 8.29 | 6.56 |
| MO | Hercules Inc | Hercules Inc Missouri Chemical Works | Louisiana | 73,751,506 | 2,587,600 | 4,600 | 98.66 | 0.18 | 1.16 |
| MO | University of Missouri-Columba | University of Missouri Columbia Power Plant | Columbia | 135,218,589 | 3,709,933 | 56,250 | 90.48 | 1.52 | 8.00 |
| NC | Blue Ridge Paper Products Inc | Canton North Carolina | Canton | 323,304,690 | 20,852,190 | 9,073,260 | 51.62 | 43.51 | 4.87 |
| NC | Champion International Corp | Roanoke Rapids North Carolina | Roanoke Rapids | 161,371,501 | 12,022,130 | 7,955,750 | 24.26 | 66.18 | 9.57 |
| NC | Corn Products Internationl Inc | Corn Products Winston Salem | Winston Salem | 46,393,340 | 2,668,621 | 2,443,267 | 7.11 | 91.56 | 1.33 |
| NC | International Paper Co-Riegel | International Paper Riegelwood Mill | Riegelwood | 472,941,081 | 28,580,279 | 20,204,250 | 0.76 | 70.69 | 28.54 |
| NC | Weyerhaeuser Co | Plymouth NC | Plymouth | 774,834,678 | 25,505,276 | 16,981,390 | 27.84 | 66.58 | 5.58 |
| NY | AES Greenridge LLC | AES Greenidge | Dresden | 1,141,865,394 | 12,534,180 | 571,200 | 93.56 | 4.56 | 1.88 |
| NY | Black River Ltd Partnership | Black River Power LLC Electric Generation Facility | Fort Drum | 440,548,668 | 5,370,878 | 31,302 | 99.07 | 0.58 | 0.35 |
| NY | Trigen-Syracuse Energy Corp | Trigen Syracuse Energy Corp | Syracuse | 308,515,036 | 7,064,750 | 11,730 | 99.41 | 0.17 | 0.43 |
| OH | Mead Corp | Mead Paper Division | Chillicothe | 599,100,152 | 49,238,216 | 40,238,569 | 17.86 | 81.72 | 0.42 |
| PA | International Paper Co | Erie Mill | Erie | 204,746,379 | 9,245,200 | 4,715,700 | 32.49 | 51.01 | 16.51 |
| PA | International Paper Co | Lock Haven Mill | Lock Haven | 137,300,563 | 4,632,858 | 494,304 | 89.33 | 10.67 | 0.00 |
| PA | Northeastern Power Co | Kline Township Cogen Facil | McAdoo | 444,884,759 | 8,287,803 | 42,975 | 99.26 | 0.52 | 0.22 |
| PA | P H Glatfelter Co | P H Glatfelter Co | Spring Grove | 575,663,036 | 15,197,490 | 7,065,400 | 52.79 | 46.49 | 0.72 |
| PA | Williamette Industries Inc | Johnsonburg Mill | Johnsonburg | 221,645,582 | 8,016,127 | 4,626,336 | 41.78 | 57.71 | 0.51 |
| SC | International Paper Co | Georgetown Mill | Georgetown | 508,689,405 | 21,101,336 | 16,383,122 | 12.20 | 77.64 | 10.16 |
| SC | Stone Container Corp | Stone Container Corp Florence Mill | Florence | 693,291,985 | 20,679,969 | 12,319,764 | 24.82 | 59.57 | 15.61 |
| SC | Union Camp Corp | Eastover Facility | Eastover | 754,893,752 | 19,526,000 | 14,206,400 | 20.21 | 72.76 | 7.03 |
| TN | Bowater Newsprint Calhoun | Bowater Newsprint Calhoun Operations | Calhoun | 500,559,255 | 18,047,139 | 14,403,880 | 18.45 | 79.81 | 1.74 |

See footnotes at end of table.

## Table B5. Net Generation and Fuel Consumption at Power Plants Consuming Coal and Biomass by State and Plant Name, 2000 (Continued)

| State | Company Name | Plant Name | City/County | Net Electricity Generation (kilowatthours) | Energy Consumed (million Btu) | Biomass Energy Consumed (million Btu) | Percent of Energy Consumed from Coal | Percent of Energy Consumed from Biomass | Percent of Energy Consumed from Other |
|---|---|---|---|---|---|---|---|---|---|
| TN | Tenneco Packaging | Packaging Corp of America | Counce | 330,917,459 | 8,619,871 | 6,226,920 | 22.46 | 72.24 | 5.30 |
| TN | Willamette Industries Inc | Willamette Industries Kingsport Mill | Kingsport | 137,946,289 | 8,385,500 | 6,546,400 | 16.46 | 78.07 | 5.47 |
| VA | Bassett Furniture Industl Inc | Bassett Table Co | Bassett | 1,748,910 | 149,890 | 146,250 | 2.43 | 97.57 | 0.00 |
| VA | Bassett Furniture Industl Inc | J D Bassett Manufacturing Co | Bassett | 1,837,180 | 175,790 | 169,910 | 3.34 | 96.66 | 0.00 |
| VA | Georgia-Pacific Corp | Big Island | Big Island | 58,852,221 | 5,464,179 | 2,284,558 | 22.67 | 41.81 | 35.52 |
| VA | LG&E Westmoreland Altavista | LG&E Westmoreland Altavista | Altavista | 323,034,093 | 4,068,094 | 76,640 | 96.48 | 1.88 | 1.64 |
| VA | LG&E Westmoreland Southampton | LG&E Westmoreland Southampton | Franklin | 306,626,717 | 4,360,075 | 26,772 | 94.97 | 0.61 | 4.41 |
| VA | Smurfit-Stone Container Corp | St Laurent Paper Products Corp | West Point | 562,426,442 | 21,215,940 | 15,137,480 | 16.29 | 71.35 | 12.36 |
| VA | Southeastern Public Serv Auth | SPSA Power Plant | Portsmouth | 217,510,600 | 5,054,650 | 4,725,000 | 5.96 | 93.48 | 0.56 |
| VA | Stone Container Corp | Stone Container Corp Hopewell Mill | Hopewell | 311,079,965 | 10,129,960 | 7,639,750 | 23.38 | 75.42 | 1.20 |
| VA | Union Camp Corp | Printing & Communication Papers Franklin Mill | Franklin | 595,918,012 | 28,964,958 | 17,545,550 | 18.30 | 60.58 | 21.13 |
| VA | Westvaco Corp | Covington Facility | Covington | 578,743,182 | 37,575,430 | 21,172,800 | 37.99 | 56.35 | 5.66 |
| WA | City of Tacoma | City of Tacoma Steam Plant | Tacoma | 129,745,260 | 3,307,500 | 2,841,253 | 13.02 | 85.90 | 1.07 |
| WA | Weyerhaeuser Co | Longview WA | Longview | 278,184,199 | 18,130,308 | 12,893,460 | 10.80 | 71.12 | 18.08 |
| WI | Fraser Paper Co | Fraser Paper Inc | Park Falls | 33,502,824 | 895,940 | 540,000 | 39.73 | 60.27 | 0.00 |
| WI | Georgia-Pacific Corp | Nekoosa Mill | Nekoosa | 187,071,543 | 7,330,444 | 3,677,670 | 34.94 | 50.17 | 14.89 |
| WI | International Paper Co | Thilmany Pulp Paper | Kaukauna | 192,604,394 | 7,605,172 | 3,492,040 | 48.54 | 45.92 | 5.54 |
| WI | Madison Gas & Elec Co | Blount St | Dane | 456,964,000 | 5,887,081 | 308,826 | 79.14 | 5.25 | 15.61 |
| WI | Mosinee Paper Corp | Wausau Mosinee Paper Corp Pulp&Paper Division | Mosinee | 128,847,765 | 4,295,540 | 2,498,113 | 33.94 | 58.16 | 7.90 |
| WI | Northern States Power Co | Bay Front | Ashland | 264,282,000 | 4,194,031 | 1,690,194 | 51.23 | 40.30 | 8.46 |
| WI | Packaging Corp of America | Packaging Corp of America Tomahawk Mill | Tomahawk | 126,940,748 | 15,673,827 | 12,604,500 | 16.64 | 80.42 | 2.94 |
| WI | State of Wisconsin | UW Madison Charter St Plant | Madison | 50,517,211 | 4,947,000 | 438,870 | 67.51 | 8.87 | 23.62 |
| WI | State of Wisconsin | Waupun Correctional Inst Central Generating Plant | Waupun | 4,519,143 | 324,795 | 65,601 | 79.80 | 20.20 | 0.00 |
| WI | Stora Enso North America | Biron Mill | Wisconsin Rapids | 228,710,809 | 5,053,740 | 241,800 | 93.02 | 4.78 | 2.20 |
| WI | Stora Enso North America | Niagara Mill | Niagara | 109,816,173 | 3,243,668 | 342,815 | 67.61 | 10.57 | 21.82 |
| WI | Stora Enso North America | Whiting Mill | Stevens Point | 21,607,769 | 1,556,817 | 194,304 | 75.76 | 12.48 | 11.76 |
| WI | Stora Enso North America | Wisconsin Rapids Pulp Mill | Wisconsin Rapids | 370,178,249 | 23,170,829 | 18,368,985 | 13.92 | 79.28 | 6.80 |
| WI | Wisconsin Pwr & Lgt Co | Edgewater | Sheboygan | 4,697,294,000 | 46,394,665 | 677,700 | 98.40 | 1.46 | 0.14 |
| WV | Monongahela Power Co | Willow Is | Pleasants | 1,485,800,000 | 15,587,896 | 183,937 | 98.66 | 1.18 | 0.16 |
| **Total** | | | | **58,365,815,252** | **1,415,282,073** | **667,677,950** | | | |

Note: State abbreviations are documented on the United States Postal Service website: http://www.usps.com/ncsc/lookups/usps_abbreviations.htm.
Source: Energy Information Administration, Form EIA-767, “Steam Electric Plant Operation and Design Report”and Form EIA-8608, “Annual Electric Generator Report - Nonutility.”

## Table B6. Average Heat Content of Selected Biomass Fuels

| Fuel Type | Heat Content | Units |
|---|---|---|
| Agricultural Byproducts | 8.248 | Million Btu/Short Ton |
| Black Liquor | 11.758 | Million Btu/Short Ton |
| Digester Gas | 0.619 | Million Btu/Thousand Cubic Feet |
| Landfill Gas | 0.490 | Million Btu/Thousand Cubic Feet |
| Methane | 0.841 | Million Btu/Thousand Cubic Feet |
| Municipal Solid Waste | 9.945 | Million Btu/Short Ton |
| Paper Pellets | 13.029 | Million Btu/Short Ton |
| Peat | 8.000 | Million Btu/Short Ton |
| Railroad Ties | 12.618 | Million Btu/Short Ton |
| Sludge Waste | 7.512 | Million Btu/Short Ton |
| Sludge Wood | 10.071 | Million Btu/Short Ton |
| Solid Byproducts | 25.830 | Million Btu/Short Ton |
| Spent Sulfite Liquor | 12.720 | Million Btu/Short Ton |
| Tires | 26.865 | Million Btu/Short Ton |
| Utility Poles | 12.500 | Million Btu/Short Ton |
| Waste Alcohol | 3.800 | Million Btu/Barrel |
| Wood/Wood Waste | 9.961 | Million Btu/Short Ton |

Source: Energy Information Administration, Form EIA-860B (1999), "Annual Electric Generator Report - Nonutility 1999."

## Appendix C

# Renewable Electric Generation, Capacity, and Market Share by State for 1999 and 2000

**Table C1. Renewable Electric Power Sector Net Generation by Source and State, 1999**
(Thousand Kilowatthours)

| | R**Geothermal** | R**Hydroelectric Conventional** | R**MSW/ Landfill Gas** | R**Other Biomass**[a] | R**Solar** | R**Wind** | R**Wood/Wood Waste** | R**Total** |
|---|---|---|---|---|---|---|---|---|
| Alabama | -- | 7,759,602 | -- | -- | -- | -- | 480,392 | 8,239,994 |
| Alaska | -- | 816,608 | -- | -- | -- | -- | -- | 816,608 |
| Arizona | -- | 9,758,817 | -- | -- | -- | -- | -- | 9,758,817 |
| Arkansas | -- | 2,694,334 | -- | -- | -- | -- | -- | 2,694,334 |
| California | 13,045,715 | 40,726,104 | 1,646,577 | 439,827 | 494,996 | 3,229,953 | 2,495,872 | 62,079,044 |
| Colorado | -- | 1,562,485 | -- | -- | -- | -- | -- | 1,562,485 |
| Connecticut | -- | 421,962 | 1,413,420 | 210,894 | -- | -- | -- | 2,046,276 |
| Delaware | -- | -- | -- | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- | -- | -- | -- |
| Florida | -- | 140,175 | 3,030,194 | 308,585 | -- | -- | 455,734 | 3,934,688 |
| Georgia | -- | 2,731,244 | 16,729 | -- | -- | -- | -- | 2,747,973 |
| Hawaii | 210,857 | 44,746 | 351,102 | 12,347 | -- | 16,494 | -- | 635,546 |
| Idaho | -- | 13,499,151 | -- | -- | -- | -- | 42,249 | 13,541,400 |
| Illinois | -- | 138,842 | 553,892 | 107,161 | -- | -- | -- | 799,895 |
| Indiana | -- | 406,974 | 86,895 | -- | -- | -- | -- | 493,869 |
| Iowa | -- | 945,622 | 74,441 | -- | -- | 326,354 | -- | 1,346,417 |
| Kansas | -- | 12,367 | -- | -- | -- | -- | -- | 12,367 |
| Kentucky | -- | 2,556,572 | -- | -- | -- | -- | -- | 2,556,572 |
| Louisiana | -- | 801,826 | -- | 81,254 | -- | -- | -- | 883,080 |
| Maine | -- | 2,452,517 | 242,974 | 75,236 | -- | -- | 1,367,117 | 4,137,844 |
| Maryland | -- | 1,424,197 | 602,514 | -- | -- | -- | -- | 2,026,711 |
| Massachusetts | -- | 962,830 | 1,913,840 | 483 | -- | -- | 97,449 | 2,974,602 |
| Michigan | -- | 1,432,206 | 487,498 | 90,397 | -- | -- | 1,013,232 | 3,023,333 |
| Minnesota | -- | 906,434 | 712,946 | -- | -- | 485,692 | -- | 2,105,072 |
| Mississippi | -- | -- | -- | -- | -- | -- | -- | -- |
| Missouri | -- | 1,853,065 | 47,283 | 2,541 | -- | -- | -- | 1,902,889 |
| Montana | -- | 13,822,062 | -- | -- | -- | -- | -- | 13,822,062 |
| Nebraska | -- | 1,719,030 | -- | 6,991 | -- | -- | -- | 1,726,021 |
| Nevada | 1,414,912 | 2,827,671 | -- | -- | -- | -- | -- | 4,242,583 |
| New Hampshire | -- | 1,211,655 | 240,767 | -- | -- | -- | 798,832 | 2,251,254 |
| New Jersey | -- | 17,303 | 1,349,242 | -- | -- | -- | -- | 1,366,545 |
| New Mexico | -- | 242,710 | -- | 11,013 | -- | -- | -- | 253,723 |
| New York | -- | 24,647,919 | 2,042,237 | -- | -- | -- | 337,836 | 27,027,992 |
| North Carolina | -- | 2,499,871 | 81,034 | -- | -- | -- | 315,975 | 2,896,880 |
| North Dakota | -- | 2,609,159 | -- | -- | -- | -- | -- | 2,609,159 |
| Ohio | -- | 423,031 | -- | -- | -- | -- | 46,428 | 469,459 |
| Oklahoma | -- | 3,175,399 | -- | -- | -- | -- | -- | 3,175,399 |
| Oregon | -- | 45,639,050 | 92,410 | -- | -- | 84,792 | 235,410 | 46,051,662 |
| Pennsylvania | -- | 1,946,598 | 1,778,297 | 4,810 | -- | -- | 185,082 | 3,914,787 |
| Rhode Island | -- | 6,050 | 114,192 | -- | -- | -- | -- | 120,242 |
| South Carolina | -- | 1,686,218 | -- | -- | -- | -- | -- | 1,686,218 |
| South Dakota | -- | 6,677,303 | -- | -- | -- | -- | -- | 6,677,303 |
| Tennessee | -- | 7,150,413 | 19,200 | -- | -- | -- | 146 | 7,169,759 |
| Texas | -- | 1,120,206 | 43,469 | -- | 86 | 319,960 | -- | 1,483,721 |
| Utah | 155,530 | 1,255,142 | 8,169 | -- | -- | -- | -- | 1,418,841 |
| Vermont | -- | 1,175,328 | -- | -- | -- | 13,604 | 376,528 | 1,565,460 |
| Virginia | -- | 669,176 | 727,404 | 2,822 | -- | -- | 168,415 | 1,567,817 |
| Washington | -- | 96,691,437 | 187,669 | 7,403 | -- | -- | 330,420 | 97,216,929 |
| West Virginia | -- | 497,465 | -- | -- | -- | -- | -- | 497,465 |
| Wisconsin | -- | 1,733,959 | 145,675 | 121,222 | -- | -- | 213,590 | 2,214,446 |
| Wyoming | -- | 1,170,225 | -- | -- | -- | 11,150 | -- | 1,181,375 |
| **Total** | **14,827,014** | **314,663,060** | **18,010,070** | **1,482,986** | **495,082** | **4,487,999** | **8,960,707** | **362,926,918** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.
-- = Not applicable.
R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

**Table C2. Renewable Commercial and Industrial Sector Net Generation by Source and State, 1999**
(Thousand Kilowatthours)

| | R**Hydroelectric Conventional** | R**MSW/Landfill Gas** | R**Other Biomass**[a] | R**Wood/Wood Waste** | R**Total** |
|---|---|---|---|---|---|
| Alabama | -- | 5,335 | 8,995 | 3,802,227 | 3,816,557 |
| Alaska | -- | -- | -- | -- | -- |
| Arizona | -- | -- | 4,784 | -- | 4,784 |
| Arkansas | -- | -- | 5,227 | 1,560,532 | 1,565,759 |
| California | 10,563 | 59,603 | 236,639 | 973,831 | 1,280,636 |
| Colorado | -- | -- | 31,772 | -- | 31,772 |
| Connecticut | -- | 481,663 | -- | -- | 481,663 |
| Delaware | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- |
| Florida | -- | -- | 196,618 | 1,613,627 | 1,810,245 |
| Georgia | 19,930 | 11,584 | 18,799 | 3,165,459 | 3,215,772 |
| Hawaii | 70,156 | -- | 213,146 | -- | 283,302 |
| Idaho | -- | -- | -- | 430,436 | 430,436 |
| Illinois | 3,252 | -- | 34,531 | 266 | 38,049 |
| Indiana | -- | 39,083 | -- | -- | 39,083 |
| Iowa | -- | -- | 16,136 | 606 | 16,742 |
| Kansas | -- | -- | -- | -- | -- |
| Kentucky | -- | -- | -- | 12,409 | 12,409 |
| Louisiana | -- | -- | 44,464 | 2,734,598 | 2,779,062 |
| Maine | 1,303,439 | 170,260 | 39,290 | 1,732,016 | 3,245,005 |
| Maryland | -- | 11,920 | 40 | 171,088 | 183,048 |
| Massachusetts | 11,738 | -- | 23,797 | -- | 35,535 |
| Michigan | 26,127 | 397,383 | 4,103 | 727,259 | 1,154,872 |
| Minnesota | 272,499 | 17,424 | 251 | 493,027 | 783,201 |
| Mississippi | -- | -- | -- | 1,436,967 | 1,436,967 |
| Missouri | -- | -- | 11,643 | -- | 11,643 |
| Montana | -- | -- | -- | 49,946 | 49,946 |
| Nebraska | -- | -- | 9,211 | -- | 9,211 |
| Nevada | -- | -- | -- | -- | -- |
| New Hampshire | 199,627 | -- | -- | 87,398 | 287,025 |
| New Jersey | -- | -- | 16,009 | -- | 16,009 |
| New Mexico | -- | -- | -- | -- | -- |
| New York | 104,399 | 215,491 | -- | 242,243 | 562,133 |
| North Carolina | 1,184,315 | -- | 11,620 | 1,228,876 | 2,424,811 |
| North Dakota | -- | -- | 5,564 | -- | 5,564 |
| Ohio | -- | -- | -- | 591,953 | 591,953 |
| Oklahoma | -- | 1,603 | -- | 160,524 | 162,127 |
| Oregon | -- | -- | -- | 185,572 | 185,572 |
| Pennsylvania | -- | 225,259 | 30,010 | 534,577 | 789,846 |
| Rhode Island | -- | -- | -- | -- | -- |
| South Carolina | 1,133 | 60,577 | -- | 1,376,131 | 1,437,841 |
| South Dakota | -- | -- | -- | -- | -- |
| Tennessee | 651,544 | 14,702 | 4,846 | 689,635 | 1,360,727 |
| Texas | -- | -- | 30,996 | 1,126,536 | 1,157,532 |
| Utah | -- | -- | -- | -- | -- |
| Vermont | 20,368 | -- | -- | 15,389 | 35,757 |
| Virginia | 12,511 | 339,887 | 3,325 | 1,454,443 | 1,810,166 |
| Washington | 297,945 | -- | 11,751 | 798,891 | 1,108,587 |
| West Virginia | 432,790 | -- | -- | -- | 432,790 |
| Wisconsin | 250,635 | 10,678 | 3,109 | 683,566 | 947,988 |
| Wyoming | -- | -- | -- | -- | -- |
| **Total** | **4,872,971** | **2,062,452** | **1,016,676** | **28,080,028** | **36,032,127** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.
-- = Not applicable.
R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-860B, "Annual Electric Generator Report - Nonutility."

## Table C3. Total Renewable Net Generation by Source and State, 1999

(Thousand Kilowatthours)

| | RGeothermal | RHydroelectric Conventional | RMSW/ Landfill Gas | ROther Biomass[a] | RSolar | RWind | RWood/Wood Waste | RTotal |
|---|---|---|---|---|---|---|---|---|
| Alabama | -- | 7,759,602 | 5,335 | 8,995 | -- | -- | 4,282,619 | 12,056,551 |
| Alaska | -- | 816,608 | -- | -- | -- | -- | -- | 816,608 |
| Arizona | -- | 9,758,817 | -- | 4,784 | -- | -- | -- | 9,763,601 |
| Arkansas | -- | 2,694,334 | -- | 5,227 | -- | -- | 1,560,532 | 4,260,093 |
| California | 13,045,715 | 40,736,667 | 1,706,180 | 676,466 | 494,996 | 3,229,953 | 3,469,703 | 63,359,680 |
| Colorado | -- | 1,562,485 | -- | 31,772 | -- | -- | -- | 1,594,257 |
| Connecticut | -- | 421,962 | 1,895,083 | 210,894 | -- | -- | -- | 2,527,939 |
| Delaware | -- | -- | -- | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- | -- | -- | -- |
| Florida | -- | 140,175 | 3,030,194 | 505,203 | -- | -- | 2,069,361 | 5,744,933 |
| Georgia | -- | 2,751,174 | 28,313 | 18,799 | -- | -- | 3,165,459 | 5,963,745 |
| Hawaii | 210,857 | 114,902 | 351,102 | 225,493 | -- | 16,494 | -- | 918,848 |
| Idaho | -- | 13,499,151 | -- | -- | -- | -- | 472,685 | 13,971,836 |
| Illinois | -- | 142,094 | 553,892 | 141,692 | -- | -- | 266 | 837,944 |
| Indiana | -- | 406,974 | 125,978 | -- | -- | -- | -- | 532,952 |
| Iowa | -- | 945,622 | 74,441 | 16,136 | -- | 326,354 | 606 | 1,363,159 |
| Kansas | -- | 12,367 | -- | -- | -- | -- | -- | 12,367 |
| Kentucky | -- | 2,556,572 | -- | -- | -- | -- | 12,409 | 2,568,981 |
| Louisiana | -- | 801,826 | -- | 125,718 | -- | -- | 2,734,598 | 3,662,142 |
| Maine | -- | 3,755,956 | 413,234 | 114,526 | -- | -- | 3,099,133 | 7,382,849 |
| Maryland | -- | 1,424,197 | 614,434 | 40 | -- | -- | 171,088 | 2,209,759 |
| Massachusetts | -- | 974,568 | 1,913,840 | 24,280 | -- | -- | 97,449 | 3,010,137 |
| Michigan | -- | 1,458,333 | 884,881 | 94,500 | -- | -- | 1,740,491 | 4,178,205 |
| Minnesota | -- | 1,178,933 | 730,370 | 251 | -- | 485,692 | 493,027 | 2,888,273 |
| Mississippi | -- | -- | -- | -- | -- | -- | 1,436,967 | 1,436,967 |
| Missouri | -- | 1,853,065 | 47,283 | 14,184 | -- | -- | -- | 1,914,532 |
| Montana | -- | 13,822,062 | -- | -- | -- | -- | 49,946 | 13,872,008 |
| Nebraska | -- | 1,719,030 | -- | 16,202 | -- | -- | -- | 1,735,232 |
| Nevada | 1,414,912 | 2,827,671 | -- | -- | -- | -- | -- | 4,242,583 |
| New Hampshire | -- | 1,411,282 | 240,767 | -- | -- | -- | 886,230 | 2,538,279 |
| New Jersey | -- | 17,303 | 1,349,242 | 16,009 | -- | -- | -- | 1,382,554 |
| New Mexico | -- | 242,710 | -- | 11,013 | -- | -- | -- | 253,723 |
| New York | -- | 24,752,318 | 2,257,728 | -- | -- | -- | 580,079 | 27,590,125 |
| North Carolina | -- | 3,684,186 | 81,034 | 11,620 | -- | -- | 1,544,851 | 5,321,691 |
| North Dakota | -- | 2,609,159 | -- | 5,564 | -- | -- | -- | 2,614,723 |
| Ohio | -- | 423,031 | -- | -- | -- | -- | 638,381 | 1,061,412 |
| Oklahoma | -- | 3,175,399 | 1,603 | -- | -- | -- | 160,524 | 3,337,526 |
| Oregon | -- | 45,639,050 | 92,410 | -- | -- | 84,792 | 420,982 | 46,237,234 |
| Pennsylvania | -- | 1,946,598 | 2,003,556 | 34,820 | -- | -- | 719,659 | 4,704,633 |
| Rhode Island | -- | 6,050 | 114,192 | -- | -- | -- | -- | 120,242 |
| South Carolina | -- | 1,687,351 | 60,577 | -- | -- | -- | 1,376,131 | 3,124,059 |
| South Dakota | -- | 6,677,303 | -- | -- | -- | -- | -- | 6,677,303 |
| Tennessee | -- | 7,801,957 | 33,902 | 4,846 | -- | -- | 689,781 | 8,530,486 |
| Texas | -- | 1,120,206 | 43,469 | 30,996 | 86 | 319,960 | 1,126,536 | 2,641,253 |
| Utah | 155,530 | 1,255,142 | 8,169 | -- | -- | -- | -- | 1,418,841 |
| Vermont | -- | 1,195,696 | -- | -- | -- | 13,604 | 391,917 | 1,601,217 |
| Virginia | -- | 681,687 | 1,067,291 | 6,147 | -- | -- | 1,622,858 | 3,377,983 |
| Washington | -- | 96,989,382 | 187,669 | 19,154 | -- | -- | 1,129,311 | 98,325,516 |
| West Virginia | -- | 930,255 | -- | -- | -- | -- | -- | 930,255 |
| Wisconsin | -- | 1,984,594 | 156,353 | 124,331 | -- | -- | 897,156 | 3,162,434 |
| Wyoming | -- | 1,170,225 | -- | -- | -- | 11,150 | -- | 1,181,375 |
| **Total** | **14,827,014** | **319,536,031** | **20,072,522** | **2,499,662** | **495,082** | **4,487,999** | **37,040,735** | **398,959,045** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.

-- = Not applicable.

R=Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

**Table C4. Renewable Electric Power Sector Net Generation by Source and State, 2000**
(Thousand Kilowatthours)

| | Geothermal | Hydroelectric Conventional | MSW/ Landfill Gas | Other Biomass[a] | Solar | Wind | Wood/Wood Waste | Total |
|---|---|---|---|---|---|---|---|---|
| Alabama | -- | 5,817,631 | -- | -- | -- | -- | 142,414 | 5,960,045 |
| Alaska | -- | 1,001,819 | -- | -- | -- | -- | -- | 1,001,819 |
| Arizona | -- | 8,354,216 | -- | -- | -- | -- | -- | 8,354,216 |
| Arkansas | -- | 2,370,483 | -- | -- | -- | -- | -- | 2,370,483 |
| California | 12,308,471 | 38,325,758 | 1,808,535 | 390,896 | 493,334 | 3,518,023 | 2,454,181 | 59,299,198 |
| Colorado | -- | 1,454,415 | -- | 7,056 | -- | -- | -- | 1,461,471 |
| Connecticut | -- | 526,312 | 1,956,675 | 196,460 | -- | -- | -- | 2,679,447 |
| Delaware | -- | -- | 18,838 | -- | -- | -- | -- | 18,838 |
| District of Columbia | -- | -- | -- | -- | -- | -- | -- | -- |
| Florida | -- | 86,769 | 3,030,124 | 404,522 | -- | -- | 400,589 | 3,922,004 |
| Georgia | -- | 2,459,222 | 7,482 | -- | -- | -- | -- | 2,466,704 |
| Hawaii | 262,053 | 43,216 | 349,904 | -- | -- | 17,003 | -- | 672,176 |
| Idaho | -- | 10,966,695 | -- | -- | -- | -- | 39,075 | 11,005,770 |
| Illinois | -- | 141,631 | 611,019 | 266,135 | -- | -- | -- | 1,018,785 |
| Indiana | -- | 588,276 | 88,146 | -- | -- | -- | -- | 676,422 |
| Iowa | -- | 904,010 | 70,700 | -- | -- | 493,820 | -- | 1,468,530 |
| Kansas | -- | 15,332 | -- | -- | -- | -- | -- | 15,332 |
| Kentucky | -- | 2,324,568 | -- | -- | -- | -- | -- | 2,324,568 |
| Louisiana | -- | 532,290 | -- | 63,767 | -- | -- | -- | 596,057 |
| Maine | -- | 2,294,743 | 241,599 | 101,192 | -- | -- | 1,409,375 | 4,046,909 |
| Maryland | -- | 1,732,619 | 628,293 | -- | -- | -- | -- | 2,360,912 |
| Massachusetts | -- | 1,052,851 | 2,049,540 | 223 | -- | -- | 122,107 | 3,224,721 |
| Michigan | -- | 1,400,804 | 690,365 | 64,215 | -- | -- | 1,044,637 | 3,200,021 |
| Minnesota | -- | 683,872 | 772,606 | -- | -- | 724,524 | -- | 2,181,002 |
| Mississippi | -- | -- | -- | -- | -- | -- | -- | -- |
| Missouri | -- | 599,920 | 73,095 | -- | -- | -- | -- | 673,015 |
| Montana | -- | 9,623,257 | -- | -- | -- | -- | -- | 9,623,257 |
| Nebraska | -- | 1,500,724 | -- | 6,606 | -- | -- | -- | 1,507,330 |
| Nevada | 1,370,791 | 2,429,468 | -- | -- | -- | -- | -- | 3,800,259 |
| New Hampshire | -- | 1,244,367 | 244,270 | -- | -- | -- | 785,276 | 2,273,913 |
| New Jersey | -- | 14,036 | 1,350,148 | -- | -- | -- | -- | 1,364,184 |
| New Mexico | -- | 221,152 | -- | 8,464 | -- | -- | -- | 229,616 |
| New York | -- | 24,818,618 | 1,992,364 | 512 | -- | 10,345 | 382,674 | 27,204,513 |
| North Carolina | -- | 2,191,697 | 98,144 | -- | -- | -- | 371,686 | 2,661,527 |
| North Dakota | -- | 2,122,561 | -- | -- | -- | -- | -- | 2,122,561 |
| Ohio | -- | 583,048 | 26,849 | -- | -- | -- | 44,023 | 653,920 |
| Oklahoma | -- | 2,276,933 | -- | -- | -- | -- | -- | 2,276,933 |
| Oregon | -- | 38,115,630 | 95,300 | -- | -- | 66,699 | 268,490 | 38,546,119 |
| Pennsylvania | -- | 2,290,232 | 1,733,746 | 3,974 | -- | 9,813 | 194,376 | 4,232,141 |
| Rhode Island | -- | 4,867 | 115,239 | -- | -- | -- | -- | 120,106 |
| South Carolina | -- | 1,532,632 | -- | -- | -- | -- | -- | 1,532,632 |
| South Dakota | -- | 5,715,508 | -- | -- | -- | -- | -- | 5,715,508 |
| Tennessee | -- | 5,876,058 | 29,227 | -- | -- | -- | 146 | 5,905,431 |
| Texas | -- | 828,963 | 60,440 | -- | 41 | 492,146 | -- | 1,381,590 |
| Utah | 151,843 | 746,125 | 9,110 | -- | -- | -- | -- | 907,078 |
| Vermont | -- | 1,200,923 | -- | -- | -- | 12,249 | 329,760 | 1,542,932 |
| Virginia | -- | 699,405 | 105,498 | 1,883 | -- | -- | 334,960 | 1,141,746 |
| Washington | -- | 80,160,637 | 205,290 | 29,348 | -- | -- | 429,353 | 80,824,628 |
| West Virginia | -- | 698,216 | -- | 14,432 | -- | -- | -- | 712,648 |
| Wisconsin | -- | 1,754,151 | 210,390 | 75,939 | -- | 2,728 | 162,952 | 2,206,160 |
| Wyoming | -- | 1,011,035 | -- | -- | -- | 245,911 | -- | 1,256,946 |
| **Total** | **14,093,158** | **271,337,695** | **18,672,936** | **1,635,624** | **493,375** | **5,593,261** | **8,916,074** | **320,742,123** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.

-- = Not applicable.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

**Table C5. Renewable Commercial and Industrial Sector Net Generation by Source and State, 2000**
(Thousand Kilowatthours)

| | Hydroelectric Conventional | MSW/Landfill Gas | Other Biomass[a] | Wood/Wood Waste | Total |
|---|---|---|---|---|---|
| Alabama | -- | 4,018 | 24,994 | 3,904,739 | 3,933,751 |
| Alaska | -- | -- | -- | -- | -- |
| Arizona | -- | -- | 4,583 | -- | 4,583 |
| Arkansas | -- | -- | 7,455 | 1,586,581 | 1,594,036 |
| California | 8,028 | 129,091 | 281,810 | 1,119,320 | 1,538,249 |
| Colorado | -- | -- | 12,328 | -- | 12,328 |
| Connecticut | -- | -- | -- | -- | -- |
| Delaware | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- |
| Florida | -- | 7,223 | 189,444 | 1,658,444 | 1,855,111 |
| Georgia | 21,575 | 9,749 | 72,109 | 3,015,459 | 3,118,892 |
| Hawaii | 60,242 | -- | 188,445 | -- | 248,687 |
| Idaho | -- | -- | -- | 444,183 | 444,183 |
| Illinois | 2,197 | -- | 31,237 | -- | 33,434 |
| Indiana | -- | 41,736 | -- | -- | 41,736 |
| Iowa | -- | -- | 17,862 | -- | 17,862 |
| Kansas | -- | -- | -- | -- | -- |
| Kentucky | -- | -- | -- | 12,293 | 12,293 |
| Louisiana | -- | -- | 31,116 | 2,697,569 | 2,728,685 |
| Maine | 1,296,072 | 179,517 | 58,562 | 1,831,623 | 3,365,774 |
| Maryland | -- | 10,504 | 33 | 179,580 | 190,117 |
| Massachusetts | 12,308 | -- | 24,948 | -- | 37,256 |
| Michigan | 26,875 | 340,375 | 3,830 | 746,172 | 1,117,252 |
| Minnesota | 247,511 | 16,909 | 7,707 | 522,348 | 794,475 |
| Mississippi | -- | -- | 218 | 1,680,086 | 1,680,304 |
| Missouri | -- | -- | 9,758 | -- | 9,758 |
| Montana | -- | -- | -- | 46,923 | 46,923 |
| Nebraska | -- | -- | 9,908 | -- | 9,908 |
| Nevada | -- | -- | -- | -- | -- |
| New Hampshire | 182,847 | -- | -- | 77,112 | 259,959 |
| New Jersey | -- | -- | 14,166 | -- | 14,166 |
| New Mexico | -- | -- | -- | -- | -- |
| New York | 90,954 | 234,873 | 3,863 | 257,651 | 587,341 |
| North Carolina | 946,119 | -- | 11,232 | 1,292,505 | 2,249,856 |
| North Dakota | -- | -- | 7,975 | -- | 7,975 |
| Ohio | -- | -- | -- | 576,519 | 576,519 |
| Oklahoma | -- | 2,431 | -- | 145,756 | 148,187 |
| Oregon | -- | -- | -- | 272,867 | 272,867 |
| Pennsylvania | -- | 220,650 | 70,292 | 497,612 | 788,554 |
| Rhode Island | -- | -- | -- | -- | -- |
| South Carolina | 858 | 62,534 | 6,147 | 1,351,052 | 1,420,591 |
| South Dakota | -- | -- | -- | -- | -- |
| Tennessee | 520,151 | 7,415 | 2,163 | 760,698 | 1,290,427 |
| Texas | -- | -- | 65,734 | 1,152,246 | 1,217,980 |
| Utah | -- | -- | -- | -- | -- |
| Vermont | 20,167 | -- | -- | 17,763 | 37,930 |
| Virginia | 12,578 | 355,483 | 4,067 | 1,342,209 | 1,714,337 |
| Washington | 102,252 | -- | 16,029 | 811,545 | 929,826 |
| West Virginia | 452,687 | -- | -- | -- | 452,687 |
| Wisconsin | 231,483 | 9,503 | 14,200 | 677,938 | 933,124 |
| Wyoming | -- | -- | -- | -- | -- |
| **Total** | **4,234,904** | **1,632,011** | **1,192,215** | **28,678,793** | **35,737,923** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.
-- = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-860B, "Annual Electric Generator Report - Nonutility."

## Table C6. Total Renewable Net Generation by Source and State, 2000

(Thousand Kilowatthours)

| | Geothermal | Hydroelectric Conventional | MSW/ Landfill Gas | Other Biomass[a] | Solar | Wind | Wood/Wood Waste | Total |
|---|---|---|---|---|---|---|---|---|
| Alabama | -- | 5,817,631 | 4,018 | 24,994 | -- | -- | 4,047,153 | 9,893,796 |
| Alaska | -- | 1,001,819 | -- | -- | -- | -- | -- | 1,001,819 |
| Arizona | -- | 8,354,216 | -- | 4,583 | -- | -- | -- | 8,358,799 |
| Arkansas | -- | 2,370,483 | -- | 7,455 | -- | -- | 1,586,581 | 3,964,519 |
| California | 12,308,471 | 38,333,786 | 1,937,626 | 672,706 | 493,334 | 3,518,023 | 3,573,501 | 60,837,447 |
| Colorado | -- | 1,454,415 | -- | 19,384 | -- | -- | -- | 1,473,799 |
| Connecticut | -- | 526,312 | 1,956,675 | 196,460 | -- | -- | -- | 2,679,447 |
| Delaware | -- | -- | 18,838 | -- | -- | -- | -- | 18,838 |
| District of Columbia | -- | -- | -- | -- | -- | -- | -- | -- |
| Florida | -- | 86,769 | 3,037,347 | 593,966 | -- | -- | 2,059,033 | 5,777,115 |
| Georgia | -- | 2,480,797 | 17,231 | 72,109 | -- | -- | 3,015,459 | 5,585,596 |
| Hawaii | 262,053 | 103,458 | 349,904 | 188,445 | -- | 17,003 | -- | 920,863 |
| Idaho | -- | 10,966,695 | -- | -- | -- | -- | 483,258 | 11,449,953 |
| Illinois | -- | 143,828 | 611,019 | 297,372 | -- | -- | -- | 1,052,219 |
| Indiana | -- | 588,276 | 129,882 | -- | -- | -- | -- | 718,158 |
| Iowa | -- | 904,010 | 70,700 | 17,862 | -- | 493,820 | -- | 1,486,392 |
| Kansas | -- | 15,332 | -- | -- | -- | -- | -- | 15,332 |
| Kentucky | -- | 2,324,568 | -- | -- | -- | -- | 12,293 | 2,336,861 |
| Louisiana | -- | 532,290 | -- | 94,883 | -- | -- | 2,697,569 | 3,324,742 |
| Maine | -- | 3,590,815 | 421,116 | 159,754 | -- | -- | 3,240,998 | 7,412,683 |
| Maryland | -- | 1,732,619 | 638,797 | 33 | -- | -- | 179,580 | 2,551,029 |
| Massachusetts | -- | 1,065,159 | 2,049,540 | 25,171 | -- | -- | 122,107 | 3,261,977 |
| Michigan | -- | 1,427,679 | 1,030,740 | 68,045 | -- | -- | 1,790,809 | 4,317,273 |
| Minnesota | -- | 931,383 | 789,515 | 7,707 | -- | 724,524 | 522,348 | 2,975,477 |
| Mississippi | -- | -- | -- | 218 | -- | -- | 1,680,086 | 1,680,304 |
| Missouri | -- | 599,920 | 73,095 | 9,758 | -- | -- | -- | 682,773 |
| Montana | -- | 9,623,257 | -- | -- | -- | -- | 46,923 | 9,670,180 |
| Nebraska | -- | 1,500,724 | -- | 16,514 | -- | -- | -- | 1,517,238 |
| Nevada | 1,370,791 | 2,429,468 | -- | -- | -- | -- | -- | 3,800,259 |
| New Hampshire | -- | 1,427,214 | 244,270 | -- | -- | -- | 862,388 | 2,533,872 |
| New Jersey | -- | 14,036 | 1,350,148 | 14,166 | -- | -- | -- | 1,378,350 |
| New Mexico | -- | 221,152 | -- | 8,464 | -- | -- | -- | 229,616 |
| New York | -- | 24,909,572 | 2,227,237 | 4,375 | -- | 10,345 | 640,325 | 27,791,854 |
| North Carolina | -- | 3,137,816 | 98,144 | 11,232 | -- | -- | 1,664,191 | 4,911,383 |
| North Dakota | -- | 2,122,561 | -- | 7,975 | -- | -- | -- | 2,130,536 |
| Ohio | -- | 583,048 | 26,849 | -- | -- | -- | 620,542 | 1,230,439 |
| Oklahoma | -- | 2,276,933 | 2,431 | -- | -- | -- | 145,756 | 2,425,120 |
| Oregon | -- | 38,115,630 | 95,300 | -- | -- | 66,699 | 541,357 | 38,818,986 |
| Pennsylvania | -- | 2,290,232 | 1,954,396 | 74,266 | -- | 9,813 | 691,988 | 5,020,695 |
| Rhode Island | -- | 4,867 | 115,239 | -- | -- | -- | -- | 120,106 |
| South Carolina | -- | 1,533,490 | 62,534 | 6,147 | -- | -- | 1,351,052 | 2,953,223 |
| South Dakota | -- | 5,715,508 | -- | -- | -- | -- | -- | 5,715,508 |
| Tennessee | -- | 6,396,209 | 36,642 | 2,163 | -- | -- | 760,844 | 7,195,858 |
| Texas | -- | 828,963 | 60,440 | 65,734 | 41 | 492,146 | 1,152,246 | 2,599,570 |
| Utah | 151,843 | 746,125 | 9,110 | -- | -- | -- | -- | 907,078 |
| Vermont | -- | 1,221,090 | -- | -- | -- | 12,249 | 347,523 | 1,580,862 |
| Virginia | -- | 711,983 | 460,981 | 5,950 | -- | -- | 1,677,169 | 2,856,083 |
| Washington | -- | 80,262,889 | 205,290 | 45,377 | -- | -- | 1,240,898 | 81,754,454 |
| West Virginia | -- | 1,150,903 | -- | 14,432 | -- | -- | -- | 1,165,335 |
| Wisconsin | -- | 1,985,634 | 219,893 | 90,139 | -- | 2,728 | 840,890 | 3,139,284 |
| Wyoming | -- | 1,011,035 | -- | -- | -- | 245,911 | -- | 1,256,946 |
| **Total** | **14,093,158** | **275,572,599** | **20,304,947** | **2,827,839** | **493,375** | **5,593,261** | **37,594,867** | **356,480,046** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.

-- = Not applicable.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Energy Information Administration, Form EIA-759, "Monthly Power Plant Report," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

## Table C7. Renewable Electric Power Sector Net Summer Capacity by Source and State, 1999
(Megawatts)

| | RGeothermal | RHydroelectric Conventional | RMSW/ Landfill Gas | ROther Biomass[a] | RSolar | RWind | Rwood/Wood Waste | RTotal |
|---|---|---|---|---|---|---|---|---|
| Alabama | -- | 3,007 | -- | -- | -- | -- | 125 | 3,133 |
| Alaska | -- | 374 | -- | -- | -- | * | -- | 374 |
| Arizona | -- | 2,705 | -- | -- | 1 | -- | -- | 2,706 |
| Arkansas | -- | 1,394 | -- | -- | -- | -- | -- | 1,394 |
| California | 2,575 | 10,309 | 243 | 57 | 387 | 1,558 | 425 | 15,554 |
| Colorado | -- | 644 | -- | -- | -- | -- | -- | 644 |
| Connecticut | -- | 148 | 124 | 29 | -- | -- | -- | 301 |
| Delaware | -- | -- | -- | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- | -- | -- | -- |
| Florida | -- | 47 | 484 | 70 | -- | -- | 131 | 732 |
| Georgia | -- | 2,369 | 2 | -- | -- | -- | -- | 2,371 |
| Hawaii | 33 | 13 | 62 | -- | -- | 9 | -- | 117 |
| Idaho | -- | 2,681 | -- | -- | -- | -- | 12 | 2,692 |
| Illinois | -- | 32 | 103 | -- | -- | -- | -- | 135 |
| Indiana | -- | 59 | 12 | -- | -- | -- | -- | 70 |
| Iowa | -- | 136 | 6 | -- | -- | 194 | -- | 337 |
| Kansas | -- | 3 | -- | -- | -- | -- | -- | 3 |
| Kentucky | -- | 808 | -- | -- | -- | -- | -- | 808 |
| Louisiana | -- | 182 | -- | 13 | -- | -- | -- | 195 |
| Maine | -- | 530 | 33 | -- | -- | -- | 291 | 854 |
| Maryland | -- | 531 | 122 | -- | -- | -- | -- | 653 |
| Massachusetts | -- | 257 | 269 | -- | -- | * | 37 | 564 |
| Michigan | -- | 264 | 80 | -- | -- | 1 | 161 | 506 |
| Minnesota | -- | 150 | 130 | * | -- | 267 | 61 | 608 |
| Mississippi | -- | -- | -- | -- | -- | -- | -- | -- |
| Missouri | -- | 543 | -- | -- | -- | -- | -- | 543 |
| Montana | -- | 2,730 | -- | -- | -- | -- | -- | 2,730 |
| Nebraska | -- | 162 | -- | 1 | -- | 2 | -- | 165 |
| Nevada | 203 | 1,053 | -- | -- | -- | -- | -- | 1,256 |
| New Hampshire | -- | 412 | 28 | -- | -- | -- | 100 | 540 |
| New Jersey | -- | 13 | 188 | -- | -- | -- | -- | 200 |
| New Mexico | -- | 82 | -- | 2 | -- | -- | -- | 84 |
| New York | -- | 4,151 | 313 | -- | -- | -- | 38 | 4,502 |
| North Carolina | -- | 1,501 | 14 | -- | -- | -- | 47 | 1,561 |
| North Dakota | -- | 518 | -- | -- | -- | -- | -- | 518 |
| Ohio | -- | 164 | 90 | -- | -- | -- | 7 | 260 |
| Oklahoma | -- | 782 | -- | -- | -- | -- | -- | 782 |
| Oregon | -- | 9,113 | 37 | 3 | -- | 25 | 49 | 9,228 |
| Pennsylvania | -- | 703 | 236 | 11 | -- | -- | 28 | 978 |
| Rhode Island | -- | 4 | 15 | -- | -- | -- | -- | 19 |
| South Carolina | -- | 1,295 | -- | -- | -- | -- | -- | 1,295 |
| South Dakota | -- | 1,806 | -- | -- | -- | -- | -- | 1,806 |
| Tennessee | -- | 2,230 | 3 | -- | -- | -- | 7 | 2,240 |
| Texas | -- | 693 | 5 | -- | 1 | 173 | -- | 872 |
| Utah | 35 | 269 | 1 | -- | -- | -- | -- | 305 |
| Vermont | -- | 286 | -- | -- | -- | 1 | 72 | 358 |
| Virginia | -- | 755 | 127 | -- | * | -- | 86 | 968 |
| Washington | -- | 21,476 | 35 | 4 | -- | -- | 132 | 21,647 |
| West Virginia | -- | 133 | -- | -- | -- | -- | -- | 133 |
| Wisconsin | -- | 452 | 48 | -- | -- | 12 | 30 | 542 |
| Wyoming | -- | 298 | -- | -- | -- | 10 | -- | 308 |
| **Total** | **2,846** | **78,264** | **2,811** | **190** | **389** | **2,252** | **1,838** | **88,590** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.

-- = Not applicable.

R = Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.

* = Less than one-half megawatt.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Energy Information Administration, Form EIA-860A, "Annual Electric Generator Report - Utility," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

**Table C8. Renewable Commercial and Industrial Sector Net Summer Capacity by Source and State, 1999**
(Megawatts)

| | R**Hydroelectric Conventional** | R**MSW/Landfill Gas** | R**Other Biomass**[a] | R**Wood/Wood Waste** | R**Total** |
|---|---|---|---|---|---|
| Alabama | -- | -- | -- | 617 | 617 |
| Alaska | -- | -- | -- | -- | -- |
| Arizona | -- | -- | -- | -- | -- |
| Arkansas | -- | -- | 2 | 252 | 254 |
| California | 5 | 3 | 50 | 193 | 250 |
| Colorado | -- | -- | 5 | -- | 5 |
| Connecticut | -- | 91 | -- | -- | 91 |
| Delaware | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- |
| Florida | -- | -- | 74 | 308 | 382 |
| Georgia | 7 | 5 | -- | 711 | 724 |
| Hawaii | 14 | -- | 85 | -- | 99 |
| Idaho | -- | -- | -- | 119 | 119 |
| Illinois | 1 | -- | 3 | -- | 4 |
| Indiana | -- | 6 | -- | -- | 6 |
| Iowa | -- | -- | 3 | -- | 3 |
| Kansas | -- | -- | -- | -- | -- |
| Kentucky | -- | -- | -- | 4 | 4 |
| Louisiana | -- | -- | 5 | 537 | 542 |
| Maine | 246 | 28 | -- | 403 | 677 |
| Maryland | -- | 4 | -- | 3 | 6 |
| Massachusetts | 5 | -- | 16 | -- | 21 |
| Michigan | 5 | 67 | -- | 98 | 169 |
| Minnesota | 51 | 4 | -- | 112 | 166 |
| Mississippi | -- | -- | -- | 263 | 263 |
| Missouri | -- | -- | -- | -- | -- |
| Montana | -- | -- | -- | 10 | 10 |
| Nebraska | -- | -- | 2 | -- | 2 |
| Nevada | -- | -- | -- | -- | -- |
| New Hampshire | 31 | -- | -- | 1 | 32 |
| New Jersey | -- | -- | -- | -- | -- |
| New Mexico | -- | -- | -- | -- | -- |
| New York | 26 | 40 | -- | 27 | 93 |
| North Carolina | 358 | 1 | -- | 248 | 606 |
| North Dakota | -- | -- | 9 | -- | 9 |
| Ohio | -- | -- | -- | 24 | 24 |
| Oklahoma | -- | 16 | -- | 60 | 76 |
| Oregon | -- | -- | -- | 131 | 131 |
| Pennsylvania | -- | 30 | -- | -- | 30 |
| Rhode Island | -- | -- | -- | -- | -- |
| South Carolina | 1 | 13 | -- | 191 | 205 |
| South Dakota | -- | -- | -- | -- | -- |
| Tennessee | 170 | 7 | -- | 4 | 181 |
| Texas | -- | -- | 7 | 137 | 144 |
| Utah | -- | -- | -- | -- | -- |
| Vermont | 5 | -- | -- | 4 | 9 |
| Virginia | 4 | 83 | -- | 337 | 424 |
| Washington | 44 | -- | -- | 123 | 167 |
| West Virginia | 104 | -- | -- | -- | 104 |
| Wisconsin | 52 | 7 | -- | 42 | 101 |
| Wyoming | -- | -- | -- | -- | -- |
| **Total** | **1,129** | **403** | **261** | **4,957** | **6,750** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.
-- = Not applicable.
R = Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.
* = Less than one half megawatt.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-860B, "Annual Electric Generator Report - Nonutility."

## Table C9. Total Renewable Net Summer Capacity by Source and State, 1999

(Megawatts)

| | RGeothermal | RHydroelectric Conventional | RMSW/ Landfill Gas | ROther Biomass[a] | RSolar | RWind | RWood/Wood Waste | RTotal |
|---|---|---|---|---|---|---|---|---|
| Alabama | -- | 3,007 | -- | -- | -- | -- | 742 | 3,749 |
| Alaska | -- | 374 | -- | -- | -- | 0 | -- | 374 |
| Arizona | -- | 2,705 | -- | -- | 1 | -- | -- | 2,706 |
| Arkansas | -- | 1,394 | -- | 2 | -- | -- | 252 | 1,648 |
| California | 2,575 | 10,314 | 245 | 106 | 387 | 1,558 | 617 | 15,804 |
| Colorado | -- | 644 | -- | 5 | -- | -- | -- | 649 |
| Connecticut | -- | 148 | 215 | 29 | -- | -- | -- | 392 |
| Delaware | -- | -- | -- | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- | -- | -- | -- |
| Florida | -- | 47 | 484 | 144 | -- | -- | 439 | 1,114 |
| Georgia | -- | 2,376 | 7 | -- | -- | -- | 711 | 3,095 |
| Hawaii | 33 | 28 | 62 | 85 | -- | 9 | -- | 216 |
| Idaho | -- | 2,681 | -- | -- | -- | -- | 130 | 2,811 |
| Illinois | -- | 33 | 103 | 3 | -- | -- | -- | 139 |
| Indiana | -- | 59 | 18 | -- | -- | -- | -- | 76 |
| Iowa | -- | 136 | 6 | 3 | -- | 194 | -- | 340 |
| Kansas | -- | 3 | -- | -- | -- | -- | -- | 3 |
| Kentucky | -- | 808 | -- | -- | -- | -- | 4 | 812 |
| Louisiana | -- | 182 | -- | 18 | -- | -- | 537 | 737 |
| Maine | -- | 776 | 61 | -- | -- | -- | 694 | 1,531 |
| Maryland | -- | 531 | 126 | -- | -- | -- | 3 | 659 |
| Massachusetts | -- | 262 | 269 | 16 | -- | -- | 37 | 586 |
| Michigan | -- | 268 | 147 | -- | -- | 1 | 259 | 675 |
| Minnesota | -- | 200 | 134 | 0 | -- | 267 | 173 | 774 |
| Mississippi | -- | -- | -- | -- | -- | -- | 263 | 263 |
| Missouri | -- | 543 | -- | -- | -- | -- | -- | 543 |
| Montana | -- | 2,730 | -- | -- | -- | -- | 10 | 2,740 |
| Nebraska | -- | 162 | -- | 4 | -- | 2 | -- | 167 |
| Nevada | 203 | 1,053 | -- | -- | -- | -- | -- | 1,256 |
| New Hampshire | -- | 443 | 28 | -- | -- | -- | 101 | 573 |
| New Jersey | -- | 13 | 188 | -- | -- | -- | -- | 200 |
| New Mexico | -- | 82 | -- | 2 | -- | -- | -- | 84 |
| New York | -- | 4,176 | 353 | -- | -- | -- | 65 | 4,594 |
| North Carolina | -- | 1,859 | 14 | -- | -- | -- | 294 | 2,168 |
| North Dakota | -- | 518 | -- | 9 | -- | -- | -- | 527 |
| Ohio | -- | 164 | 90 | -- | -- | -- | 31 | 284 |
| Oklahoma | -- | 782 | 16 | -- | -- | -- | 60 | 858 |
| Oregon | -- | 9,113 | 37 | 3 | -- | 25 | 180 | 9,359 |
| Pennsylvania | -- | 703 | 266 | 11 | -- | -- | 28 | 1,008 |
| Rhode Island | -- | 4 | 15 | -- | -- | -- | -- | 19 |
| South Carolina | -- | 1,296 | 13 | -- | -- | -- | 191 | 1,499 |
| South Dakota | -- | 1,806 | -- | -- | -- | -- | -- | 1,806 |
| Tennessee | -- | 2,400 | 10 | -- | -- | -- | 11 | 2,421 |
| Texas | -- | 693 | 5 | 7 | 1 | 173 | 137 | 1,016 |
| Utah | 35 | 269 | 1 | -- | -- | -- | -- | 305 |
| Vermont | -- | 290 | -- | -- | -- | 1 | 76 | 367 |
| Virginia | -- | 758 | 209 | -- | 0 | -- | 424 | 1,392 |
| Washington | -- | 21,521 | 35 | 4 | -- | -- | 255 | 21,814 |
| West Virginia | -- | 238 | -- | -- | -- | -- | -- | 238 |
| Wisconsin | -- | 504 | 55 | -- | -- | 12 | 72 | 643 |
| Wyoming | -- | 298 | -- | -- | -- | 10 | -- | 308 |
| **Total** | **2,846** | **79,393** | **3,214** | **451** | **389** | **2,252** | **6,795** | **95,339** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.

-- = Not applicable.

R = Revised. Definitions of the electric power, industrial, and commercial sectors are changed and electricity data is revised. See Appendix F for details.

* = Less than one half megawatt.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Energy Information Administration, Form EIA-860A, "Annual Electric Generator Report - Utility," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

**Table C10. Renewable Electric Power Sector Net Summer Capacity by Source and State, 2000**
(Megawatts)

| | Geothermal | Hydroelectric Conventional | MSW/ Landfill Gas | Other Biomass[a] | Solar | Wind | Wood/Wood Waste | Total |
|---|---|---|---|---|---|---|---|---|
| Alabama | -- | 3,014 | -- | -- | -- | -- | -- | 3,014 |
| Alaska | -- | 396 | -- | -- | -- | 0 | -- | 396 |
| Arizona | -- | 2,705 | -- | -- | 1 | -- | -- | 2,706 |
| Arkansas | -- | 1,395 | -- | -- | -- | -- | -- | 1,395 |
| California | 2,529 | 10,306 | 262 | 57 | 384 | 1,541 | 427 | 15,506 |
| Colorado | -- | 644 | -- | 14 | -- | 15 | -- | 673 |
| Connecticut | -- | 142 | 215 | 29 | -- | -- | -- | 386 |
| Delaware | -- | -- | -- | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- | -- | -- | -- |
| Florida | -- | 47 | 484 | 70 | -- | -- | 124 | 725 |
| Georgia | -- | 2,333 | 2 | -- | -- | -- | -- | 2,335 |
| Hawaii | 33 | 13 | 62 | -- | -- | 12 | -- | 119 |
| Idaho | -- | 2,695 | -- | -- | -- | -- | 6 | 2,701 |
| Illinois | -- | 32 | 103 | 21 | -- | -- | -- | 156 |
| Indiana | -- | 59 | 26 | -- | -- | -- | -- | 84 |
| Iowa | -- | 136 | 6 | -- | -- | 197 | -- | 339 |
| Kansas | -- | 3 | -- | -- | -- | -- | -- | 3 |
| Kentucky | -- | 814 | -- | -- | -- | -- | -- | 814 |
| Louisiana | -- | 182 | -- | 13 | -- | -- | -- | 195 |
| Maine | -- | 469 | 33 | -- | -- | -- | 291 | 793 |
| Maryland | -- | 531 | 122 | -- | -- | -- | -- | 653 |
| Massachusetts | -- | 250 | 290 | -- | -- | 0 | 46 | 586 |
| Michigan | -- | 261 | 114 | -- | -- | 1 | 161 | 536 |
| Minnesota | -- | 149 | 145 | 0 | -- | 271 | 92 | 657 |
| Mississippi | -- | -- | -- | -- | -- | -- | -- | -- |
| Missouri | -- | 543 | -- | -- | -- | -- | -- | 543 |
| Montana | -- | 2,734 | -- | -- | -- | -- | -- | 2,734 |
| Nebraska | -- | 162 | -- | 1 | -- | 3 | -- | 166 |
| Nevada | 196 | 1,053 | -- | -- | -- | -- | -- | 1,248 |
| New Hampshire | -- | 412 | 28 | -- | -- | -- | 100 | 540 |
| New Jersey | -- | 13 | 199 | -- | -- | -- | -- | 211 |
| New Mexico | -- | 82 | -- | 2 | -- | -- | -- | 84 |
| New York | -- | 4,348 | 307 | -- | -- | 18 | 38 | 4,711 |
| North Carolina | -- | 1,501 | 20 | -- | -- | -- | 47 | 1,568 |
| North Dakota | -- | 497 | -- | -- | -- | -- | -- | 497 |
| Ohio | -- | 164 | 94 | -- | -- | -- | 7 | 264 |
| Oklahoma | -- | 793 | -- | -- | -- | -- | -- | 793 |
| Oregon | -- | 9,142 | 37 | 3 | -- | 25 | 37 | 9,245 |
| Pennsylvania | -- | 700 | 259 | 11 | -- | 10 | 28 | 1,008 |
| Rhode Island | -- | 4 | 15 | -- | -- | -- | -- | 19 |
| South Carolina | -- | 1,296 | -- | -- | -- | -- | -- | 1,296 |
| South Dakota | -- | 1,678 | -- | -- | -- | -- | -- | 1,678 |
| Tennessee | -- | 2,230 | 5 | -- | -- | 2 | 7 | 2,243 |
| Texas | -- | 697 | 8 | -- | 1 | 173 | -- | 880 |
| Utah | 35 | 269 | 1 | -- | -- | -- | -- | 305 |
| Vermont | -- | 285 | -- | -- | -- | 1 | 72 | 357 |
| Virginia | -- | 758 | 130 | -- | -- | -- | 85 | 972 |
| Washington | -- | 21,417 | 39 | 4 | -- | -- | 132 | 21,592 |
| West Virginia | -- | 135 | -- | -- | -- | -- | -- | 135 |
| Wisconsin | -- | 463 | 58 | 2 | -- | 12 | 29 | 564 |
| Wyoming | -- | 298 | -- | -- | -- | 96 | -- | 394 |
| **Total** | **2,793** | **78,247** | **3,064** | **226** | **386** | **2,377** | **1,728** | **88,821** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.
-- = Not applicable
* = Less than one half megawatt.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-860A, "Annual Electric Generator Report - Utility," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

**Table C11. Renewable Commercial and Industrial Sector Net Summer Capacity by Source and State, 2000**
(Megawatts)

| | Hydroelectric Conventional | MSW/Landfill Gas | Other Biomass[a] | Wood/Wood Waste | Total |
|---|---|---|---|---|---|
| Alabama | -- | -- | -- | 457 | 457 |
| Alaska | -- | -- | -- | -- | -- |
| Arizona | -- | -- | -- | -- | -- |
| Arkansas | -- | -- | 2 | 346 | 348 |
| California | 5 | 13 | 56 | 210 | 284 |
| Colorado | -- | -- | 5 | -- | 5 |
| Connecticut | -- | -- | -- | -- | -- |
| Delaware | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- |
| Florida | -- | -- | 74 | 386 | 460 |
| Georgia | 7 | 5 | -- | 489 | 502 |
| Hawaii | 13 | -- | 83 | -- | 96 |
| Idaho | -- | -- | -- | 119 | 119 |
| Illinois | 1 | -- | 3 | -- | 4 |
| Indiana | -- | 6 | -- | -- | 6 |
| Iowa | -- | -- | 3 | -- | 3 |
| Kansas | -- | -- | -- | -- | -- |
| Kentucky | -- | -- | -- | 4 | 4 |
| Louisiana | -- | -- | 5 | 286 | 291 |
| Maine | 242 | 28 | -- | 336 | 607 |
| Maryland | -- | 4 | -- | 3 | 6 |
| Massachusetts | 5 | -- | 16 | -- | 21 |
| Michigan | 5 | 67 | -- | 124 | 195 |
| Minnesota | 51 | 4 | -- | 102 | 156 |
| Mississippi | -- | -- | -- | 263 | 263 |
| Missouri | -- | -- | -- | -- | -- |
| Montana | -- | -- | -- | 10 | 10 |
| Nebraska | -- | -- | 2 | -- | 2 |
| Nevada | -- | -- | -- | -- | -- |
| New Hampshire | 31 | -- | -- | 16 | 47 |
| New Jersey | -- | -- | 1 | -- | 1 |
| New Mexico | -- | -- | -- | -- | -- |
| New York | 18 | 40 | -- | -- | 58 |
| North Carolina | 359 | -- | -- | 125 | 484 |
| North Dakota | -- | -- | 9 | -- | 9 |
| Ohio | -- | -- | -- | 8 | 8 |
| Oklahoma | -- | 16 | -- | 60 | 76 |
| Oregon | -- | -- | -- | 131 | 131 |
| Pennsylvania | -- | 30 | -- | 56 | 86 |
| Rhode Island | -- | -- | -- | -- | -- |
| South Carolina | 1 | 12 | -- | 219 | 232 |
| South Dakota | -- | -- | -- | -- | -- |
| Tennessee | 170 | 7 | -- | 5 | 181 |
| Texas | -- | -- | 9 | 168 | 177 |
| Utah | -- | -- | -- | -- | -- |
| Vermont | 5 | -- | -- | 4 | 9 |
| Virginia | 4 | 83 | 6 | 269 | 361 |
| Washington | 44 | -- | -- | 161 | 205 |
| West Virginia | 104 | -- | -- | -- | 104 |
| Wisconsin | 48 | 3 | -- | 57 | 107 |
| Wyoming | -- | -- | -- | -- | -- |
| **Total** | **1,112** | **317** | **275** | **4,413** | **6,117** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.
-- = Not applicable.
* = Less than one half megawatt.
Note: Totals may not equal sum of components due to independent rounding.
Sources: Energy Information Administration, Form EIA-860B, "Annual Electric Generator Report - Nonutility."

## Table C12. Total Renewable Net Summer Capacity by Source and State, 2000

(Megawatts)

| | Geothermal | Hydroelectric Conventional | MSW/ Landfill Gas | Other Biomass[a] | Solar | Wind | Wood/Wood Waste | Total |
|---|---|---|---|---|---|---|---|---|
| Alabama | -- | 3,014 | -- | -- | -- | -- | 457 | 3,471 |
| Alaska | -- | 396 | -- | -- | -- | * | -- | 396 |
| Arizona | -- | 2,705 | -- | -- | 1 | -- | -- | 2,706 |
| Arkansas | -- | 1,395 | -- | 2 | -- | -- | 346 | 1,743 |
| California | 2,529 | 10,311 | 275 | 113 | 384 | 1,541 | 637 | 15,791 |
| Colorado | -- | 644 | -- | 18 | -- | 15 | -- | 678 |
| Connecticut | -- | 142 | 215 | 29 | -- | -- | -- | 386 |
| Delaware | -- | -- | -- | -- | -- | -- | -- | -- |
| District of Columbia | -- | -- | -- | -- | -- | -- | -- | -- |
| Florida | -- | 47 | 484 | 144 | -- | -- | 510 | 1,185 |
| Georgia | -- | 2,341 | 7 | -- | -- | -- | 489 | 2,837 |
| Hawaii | 33 | 26 | 62 | 83 | -- | 12 | -- | 215 |
| Idaho | -- | 2,695 | -- | -- | -- | -- | 125 | 2,819 |
| Illinois | -- | 33 | 103 | 24 | -- | -- | -- | 159 |
| Indiana | -- | 59 | 32 | -- | -- | -- | -- | 91 |
| Iowa | -- | 136 | 6 | 3 | -- | 197 | -- | 343 |
| Kansas | -- | 3 | -- | -- | -- | -- | -- | 3 |
| Kentucky | -- | 814 | -- | -- | -- | -- | 4 | 818 |
| Louisiana | -- | 182 | -- | 18 | -- | -- | 286 | 486 |
| Maine | -- | 711 | 61 | -- | -- | -- | 627 | 1,399 |
| Maryland | -- | 531 | 126 | -- | -- | -- | 3 | 659 |
| Massachusetts | -- | 255 | 290 | 16 | -- | * | 46 | 607 |
| Michigan | -- | 265 | 181 | -- | -- | 1 | 285 | 732 |
| Minnesota | -- | 200 | 149 | * | -- | 271 | 194 | 813 |
| Mississippi | -- | -- | -- | -- | -- | -- | 263 | 263 |
| Missouri | -- | 543 | -- | -- | -- | -- | -- | 543 |
| Montana | -- | 2,734 | -- | -- | -- | -- | 10 | 2,744 |
| Nebraska | -- | 162 | -- | 4 | -- | 3 | -- | 168 |
| Nevada | 196 | 1,053 | -- | -- | -- | -- | -- | 1,248 |
| New Hampshire | -- | 443 | 28 | -- | -- | -- | 115 | 587 |
| New Jersey | -- | 13 | 199 | 1 | -- | -- | -- | 212 |
| New Mexico | -- | 82 | -- | 2 | -- | -- | -- | 84 |
| New York | -- | 4,366 | 347 | -- | -- | 18 | 38 | 4,769 |
| North Carolina | -- | 1,860 | 20 | -- | -- | -- | 171 | 2,051 |
| North Dakota | -- | 497 | -- | 9 | -- | -- | -- | 506 |
| Ohio | -- | 164 | 94 | -- | -- | -- | 15 | 272 |
| Oklahoma | -- | 793 | 16 | -- | -- | -- | 60 | 869 |
| Oregon | -- | 9,142 | 37 | 3 | -- | 25 | 168 | 9,376 |
| Pennsylvania | -- | 700 | 289 | 11 | -- | 10 | 84 | 1,094 |
| Rhode Island | -- | 4 | 15 | -- | -- | -- | -- | 19 |
| South Carolina | -- | 1,297 | 12 | -- | -- | -- | 219 | 1,528 |
| South Dakota | -- | 1,678 | -- | -- | -- | -- | -- | 1,678 |
| Tennessee | -- | 2,400 | 12 | -- | -- | 2 | 11 | 2,425 |
| Texas | -- | 697 | 8 | 9 | 1 | 173 | 168 | 1,057 |
| Utah | 35 | 269 | 1 | -- | -- | -- | -- | 305 |
| Vermont | -- | 289 | -- | -- | -- | 1 | 76 | 366 |
| Virginia | -- | 761 | 212 | 6 | -- | -- | 354 | 1,334 |
| Washington | -- | 21,461 | 39 | 4 | -- | -- | 293 | 21,797 |
| West Virginia | -- | 240 | -- | -- | -- | -- | -- | 240 |
| Wisconsin | -- | 511 | 61 | 2 | -- | 12 | 86 | 671 |
| Wyoming | -- | 298 | -- | -- | -- | 96 | -- | 394 |
| **Total** | **2,793** | **79,359** | **3,381** | **502** | **386** | **2,377** | **6,141** | **94,939** |

[a] Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.

-- = Not applicable.

* = Less than one half megawatt.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Energy Information Administration, Form EIA-860A, "Annual Electric Generator Report - Utility," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

## Table C13. Renewable Market Share of Net Generation by State, 1999 and 2000

(Thousand Kilowatthours)

| | 1999 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | R**Total State Generation** | R**Percent Renewable** | R**Percent Nonhydro Renewable** | **Total State Generation** | **Percent Renewable** | **Percent Nonhydro Renewable** |
| Alabama | 120,657,508 | 10.0 | 3.6 | 124,405,340 | 8.0 | 3.3 |
| Alaska | 5,802,308 | 14.1 | -- | 6,156,525 | 16.3 | -- |
| Arizona | 83,893,173 | 11.6 | * | 88,946,577 | 9.4 | * |
| Arkansas | 46,553,939 | 9.2 | 3.4 | 43,875,766 | 9.0 | 3.6 |
| California | 188,319,223 | 33.6 | 12.0 | 208,099,817 | 29.2 | 10.8 |
| Colorado | 39,521,288 | 4.0 | 0.1 | 44,167,016 | 3.3 | * |
| Connecticut | 28,596,898 | 8.8 | 7.4 | 32,967,570 | 8.1 | 6.5 |
| Delaware | 6,851,738 | -- | -- | 5,987,451 | 0.3 | 0.3 |
| District of Columbia | 230,003 | -- | -- | 144,374 | -- | -- |
| Florida | 187,263,426 | 3.1 | 3.0 | 191,815,840 | 3.0 | 3.0 |
| Georgia | 117,338,745 | 5.1 | 2.7 | 123,877,413 | 4.5 | 2.5 |
| Hawaii | 10,403,926 | 8.8 | 7.7 | 10,593,403 | 8.7 | 7.7 |
| Idaho | 14,436,648 | 96.8 | 3.3 | 11,910,442 | 96.1 | 4.1 |
| Illinois | 163,410,520 | 0.5 | 0.4 | 178,496,081 | 0.6 | 0.5 |
| Indiana | 121,764,501 | 0.4 | 0.1 | 127,819,516 | 0.6 | 0.1 |
| Iowa | 38,801,481 | 3.5 | 1.1 | 41,542,010 | 3.6 | 1.4 |
| Kansas | 42,070,230 | -- | -- | 44,815,905 | -- | -- |
| Kentucky | 92,681,908 | 2.8 | * | 93,006,083 | 2.5 | * |
| Louisiana | 89,941,753 | 4.1 | 3.2 | 92,865,635 | 3.6 | 3.0 |
| Maine | 12,673,929 | 58.3 | 28.6 | 14,047,947 | 52.8 | 27.2 |
| Maryland | 51,685,621 | 4.3 | 1.5 | 51,145,380 | 5.0 | 1.6 |
| Massachusetts | 40,575,392 | 7.4 | 5.0 | 38,697,881 | 8.4 | 5.7 |
| Michigan | 103,239,715 | 4.0 | 2.6 | 104,209,594 | 4.1 | 2.8 |
| Minnesota | 48,519,379 | 6.0 | 3.5 | 51,423,339 | 5.8 | 4.0 |
| Mississippi | 34,844,972 | 4.1 | 4.1 | 37,614,563 | 4.5 | 4.5 |
| Missouri | 73,815,710 | 2.6 | 0.1 | 76,593,939 | 0.9 | 0.1 |
| Montana | 31,419,334 | 44.2 | 0.2 | 26,451,828 | 36.6 | 0.2 |
| Nebraska | 30,055,751 | 5.8 | 0.1 | 29,109,863 | 5.2 | 0.1 |
| Nevada | 30,532,131 | 13.9 | 4.6 | 35,484,915 | 10.7 | 3.9 |
| New Hampshire | 16,189,247 | 15.7 | 7.0 | 15,031,499 | 16.9 | 7.4 |
| New Jersey | 56,803,421 | 2.4 | 2.4 | 58,085,215 | 2.4 | 2.3 |
| New Mexico | 32,521,856 | 0.8 | * | 34,022,020 | 0.7 | * |
| New York | 146,280,866 | 18.9 | 1.9 | 138,079,075 | 20.1 | 2.1 |
| North Carolina | 117,357,615 | 4.5 | 1.4 | 122,274,356 | 4.0 | 1.5 |
| North Dakota | 31,417,403 | 8.3 | * | 31,311,196 | 6.8 | * |
| Ohio | 142,330,431 | 0.7 | 0.4 | 149,060,280 | 0.8 | 0.4 |
| Oklahoma | 54,865,359 | 6.1 | 0.3 | 55,571,957 | 4.4 | 0.3 |
| Oregon | 56,848,347 | 81.3 | 1.1 | 51,789,975 | 75.0 | 1.4 |
| Pennsylvania | 194,528,045 | 2.4 | 1.4 | 201,687,980 | 2.5 | 1.4 |
| Rhode Island | 6,376,881 | 1.9 | 1.8 | 5,971,545 | 2.0 | 1.9 |
| South Carolina | 90,233,508 | 3.5 | 1.6 | 93,346,240 | 3.2 | 1.5 |
| South Dakota | 10,557,027 | 63.2 | -- | 9,697,337 | 58.9 | -- |
| Tennessee | 93,320,137 | 9.1 | 0.8 | 95,838,584 | 7.5 | 0.8 |
| Texas | 358,944,744 | 0.7 | 0.4 | 377,742,365 | 0.7 | 0.5 |
| Utah | 36,784,628 | 3.9 | 0.4 | 36,609,074 | 2.5 | 0.4 |
| Vermont | 5,703,593 | 28.1 | 7.1 | 6,303,014 | 25.1 | 5.7 |
| Virginia | 73,897,611 | 4.6 | 3.6 | 77,189,370 | 3.7 | 2.8 |
| Washington | 117,084,018 | 84.0 | 1.1 | 108,236,880 | 75.5 | 1.4 |
| West Virginia | 94,692,596 | 1.0 | -- | 92,865,176 | 1.3 | * |
| Wisconsin | 58,538,854 | 5.4 | 2.0 | 59,644,417 | 5.3 | 1.9 |
| Wyoming | 43,632,491 | 2.7 | * | 45,494,280 | 2.8 | 0.5 |
| **Total** | **3,694,809,828** | **10.8** | **2.1** | **3,802,123,848** | **9.4** | **2.1** |

Agriculture byproducts/crops, sludge waste, tires and other biomass solids, liquids and gases.

-- = Not applicable.

* = Less than .05 percent.

R = Revised.

Note: Totals may not equal sum of components due to independent rounding.

Form EIA-759, "Monthly Power Plant Report," and Form EIA-860B, "Annual Electric Generator Report - Nonutility."

# Appendix D

# Renewable Energy Data Limitations

This appendix provides information about the quality of renewable energy data presented in this report. Information pertinent to renewable energy source data quality, in general, is presented first, followed by discussion of electric and non-electric data sources by fuel type.

Renewable energy projects pose special challenges when attempting to collect complete information on them. One challenge is the dispersed nature of many renewable energy forms, such as a photovoltaic (PV) system for generating electricity that may operate in a stand-alone fashion in a remote location. If the facility is not connected to an electricity grid, there is no Federal regulatory requirement to report its operating information. Tracking down hundreds or thousands of such facilities, each with a small power output, can be extremely challenging.

Another challenge involves tracking renewable energy supplies. Conventional energy supplies, such as petroleum, are easily tracked because the distribution networks (usually pipelines) are limited and well-defined. This permits one to make reasonable assumptions about fuel consumption, assuming stocks can be reasonably estimated.[8] The same cannot be said for many renewable energy supplies. Often a large number of energy consumers must be surveyed in order to make reasonable inferences about renewable energy consumption. Wood, for example, is gathered by tens of thousands of entities—millions if residential use is considered—for fuel uses not reportable for regulatory purposes. Thus, obtaining accurate data on wood energy consumption would entail conducting large end use consumption surveys.

Finally, some renewable energy sources are byproducts (such as pulping liquor) of non-energy processes. To track such uses, information must be solicited from respondents not generally in the energy supply chain.

## Electricity

As noted in Chapter 1, 52 percent of renewable energy consumption measured by EIA is used to produce electric power. It is, therefore, important to examine the coverage quality of EIA renewable electricity data. Between 1998 and 2000, EIA renewable electricity generation was derived from two principal sources: Form EIA-759, "Monthly Power Plant Report," and Form-EIA-860B, "Annual Electric Generator Report - Nonutility."[9] Form EIA-759 was sent to all electric utilities, while the EIA-860B was required of all nonutility generating plants exceeding 1 megawatt capacity. (This includes plants which meet Federal Energy Regulatory Commission [FERC] standards as a "qualifying facility" [QF], as well as independent power producers [IPPs]).

Beginning in 2001, the source for renewable electricity generation is Form EIA-906, "Power Plant Report." The EIA-906 is required from all regulated and unregulated electric power plants exceeding 1 Megawatt. For generation capacity, the source is Form EIA-860, "Annual Electric Generator Report." Because of the difficulty in surveying off-grid electric applications, not all of them were captured here (although they may be covered in EIA's Manufacturing Energy Consumption Survey (MECS)[10]).

Because electric utilities are easily identified and have mandatory regulatory reporting requirements, complete coverage of utility-generated electricity is usually assured. As part of the electric power industry

[8] Even if stock data are only approximate, conventional energy stocks are normally a small percentage of production.

[9] Prior to 1998, this report was called the Form EIA-867, "Annual Nonutility Power Producer Report."

[10] Because the MECS is based on the Bureau of the Census' Annual Survey of Manufacturers, EIA does not know the identity of MECS respondents.

restructuring, some utilities are selling off generating assets. Every effort is made to assure that the new owner picks up reporting on the appropriate EIA survey. In contrast, nonutilities (i.e., QFs and IPPs) are required only to file regulatory reports at the time of their intention to become a grid electricity-producing facility. Over time, QF ownerships and locations change frequently. These factors, combined with the large number of QF applications, make tracking these facilities difficult. Accordingly, EIA has developed the 1 Megawatt capacity threshold, below which nonutilities are not surveyed.

The EIA is currently undertaking an extensive effort to improve its coverage of renewable energy facilities. EIA is comparing its list of renewable electric generating plants with the National Renewable Energy Laboratory's "Renewable Electric Plant Information System" (REPiS).[11] Firms found to be covered by REPIS but not responding to EIA's electricity surveys (exceeding 1 megawatt) will be added.

# Non-Electric Renewable Energy Consumption

## Overview

The primary application for renewable energy other than making electricity is creating heat for industrial processes, buildings, or water. Most non-electric consumption data are gathered on two EIA consumption surveys: the Manufacturing Energy Consumption Survey (MECS), and the Residential Energy Consumption Survey (RECS). MECS is based on the U.S. Bureau of the Census' Census of Manufacturing. As far as renewable energy is concerned, MECS provides consumption estimates of total industrial energy and various categories of biomass, including wood. MECS data was used from the 1991, 1994, and 1998 surveys. EIA will field the MECS survey again in early 2003 for 2002 consumption data.

RECS is based on an area probability sample of households selected by EIA. For renewable energy, it provides estimates of residential wood energy consumption. RECS data was available for 1990, 1993, and 1997. During intervening years, EIA estimated energy consumption by assessing industry trends, housing developments, and changes in weather conditions.

There are three other non-electric applications for renewable energy: solar heating, alcohol transportation fuels, and geothermal energy. Solar energy for non-electric applications is derived from the EIA Solar Collector Manufacturing Survey, Form EIA-63A/B (formerly CE-63A/B). The survey does not collect energy "consumption" data, but rather production statistics on various types of solar and photovoltaic energy units. EIA applies additional assumptions regarding their application to estimate the amount of heat energy derived from installed solar/PV panels. Alcohol fuel consumption information is provided by the Form EIA-819M, "Monthly Oxygenate Telephone Report," and Form EIA-814, "Monthly Imports Report." Geothermal non-electric energy information is taken from data provided by the Oregon Institute of Technology, Geo-Heat Center.

## Biomass

Wood is the principal component of biomass energy. Information on non-electric wood energy consumption is derived from the MECS and RECS sample surveys.

Although some questions about MECS coverage have been raised, no formal analysis of current data exists to support this concern. According to 1983 U.S. Forest Service statistics on wood harvested for fuelwood, the Pulp and Paper Industry subgroup of the Forest Products Industry group consumed only 42 percent of total sector wood energy, not including black liquor (a byproduct fuel). MECS surveys the smaller-populated Pulp and Paper Industry intensively but only randomly samples the larger-populated remainder of the Forest Products Industry. For a variety of reasons, it is difficult to trace wood energy supply to wood consumed for energy. RECS covers wood consumption only for the primary residence of those surveyed; thus, wood consumption by second homes is omitted. This could cause residential wood energy consumption to be understated by about 5 percent, but EIA has adjusted the data presented in this report to avoid the undercount.

Of the nearly 2.9 quads of biomass energy estimated to have been consumed in 2001, roughly three-fourths

[11] See http://www.eren.doe.gov/repis/ (November 6, 2002).

represents estimates linked to RECS and MECS. For MECS, 1998 estimated industrial biomass consumption has an appropriate relative standard error of 3 percent.[12] The RECS estimate of residential biomass energy consumption has a relative standard error of 10.3 percent.[13] Estimates of industrial and residential biomass energy consumption made for subsequent years, are also subject to nonsampling error. Nonsampling error also is present in the estimates of biomass energy consumption made for the agricultural and mining sectors.

Cross-checks of Form EIA-819M information on alcohol fuels with data from the Bureau of Alcohol, Tobacco, and Firearms and the U.S. Department of Transportation have not revealed any major deficiencies in the Form EIA-819M data.

## Geothermal

EIA does not collect data on non-electric applications of geothermal energy such as crop drying and groundwater heat pumps. A study prepared for the U.S. Department of Energy by the Oregon Institute of Technology, Geo-Heat Center, indicated that non-electric uses of geothermal energy amounted to nearly 22.5 trillion Btu in 2001 (Table D1). Sixty percent of this energy was provided by geothermal heat pumps.

**Table D1. Geothermal Direct Use of Energy and Heat Pumps, 1990-2001**
(Quadrillion Btu)

| | Direct Use | Heat Pumps | Total |
|---|---|---|---|
| 1990 | 0.0048 | 0.0054 | 0.0102 |
| 1991 | 0.0050 | 0.0060 | 0.0110 |
| 1992 | 0.0051 | 0.0067 | 0.0118 |
| 1993 | 0.0053 | 0.0072 | 0.0125 |
| 1994 | 0.0056 | 0.0076 | 0.0132 |
| 1995 | 0.0058 | 0.0083 | 0.0141 |
| 1996 | 0.0059 | 0.0093 | 0.0152 |
| 1997 | 0.0061 | 0.0101 | 0.0162 |
| 1998 | 0.0063 | 0.0115 | 0.0178 |
| 1999 | 0.0079 | 0.0114 | 0.0193 |
| 2000 | 0.0084 | 0.0122 | 0.0206 |
| 2001 | 0.0090 | 0.0135 | 0.0225 |

Source: John Lund, Oregon Institute of Technology, Geo-Heat Center (Klamath Falls, Oregon, March 2002), unpublished data.

## Wind, Solar, and Photovoltaics

EIA does not collect information on direct energy uses of wind (e.g., water-pumping). No comprehensive source of such information is known.

The solar manufacturing data collected on Forms EIA-63A and EIA-63B are subject to various limitations including: (1) coverage (the list of respondents may not be complete or, on the other hand, there may be double counting); (2) nonresponse (some of those surveyed may not respond, or they may not provide all the information requested); and (3) adjustments (errors may be made in estimating values for missing data).

EIA collects solar data only on terrestrial systems; it does not collect data on satellite and military applications. The total value of U.S. photovoltaic shipments in 2001 according to the Forms EIA-63A and EIA-63B was $305 million. Based on anecdotal information for 2000, shipments ranging from about $195 million to $215 million went for satellite applications. Military applications cannot be estimated due to classified information and budgetary accounting. These figures do not include possible inventories held by distributors, retailers, and installers.

The universe of solar / PV survey respondents is a census of those U.S.-based companies involved in manufacturing and / or importing solar collectors and photovoltaic cells and modules. Care has been taken to establish the survey frames accurately. The frames of potential respondents are compiled from previous surveys and from information in the public domain. However, because the solar collector and photovoltaic cell and module industries are subject to sporadic entry and exit of manufacturers and importers, the frame may exclude some small companies that have recently entered or reentered the industry. From 1993 through 2001, EIA received reports from all known potential respondents.

## Geothermal Heat Pump Manufacturing Activity

In 1997, the EIA began collecting information on geothermal heat pumps using its new survey the Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey." The principal data collected are the

[12] Energy Information Administration, http: / / www.eia.doe.gov / emeu / mecs / contents.html (November 6, 2002). EIA fields the MECS survey as Form EIA-846.

[13] 5. Energy Information Administration, Residential Energy Consumption Survey, DOE / EIA-0632(97) (Washington, DC, November 1997).

number and type of heat pumps shipped and their capacity ratings.

The data collected on Form EIA-902 are subject to various sources of error. These sources are: (1) coverage (the list of respondents may not be complete or, on the other hand, there may be double counting); (2) non-response (all that are surveyed may not respond or may not provide all information requested); (3) respondents (respondents may commit errors in reporting the data); (4) processing (the data collection agency may omit or incorrectly transcribe a submission); (5) concept (the data collection elements may not measure the items they were intended to measure); and (6) estimation (errors may be made in estimating values for missing data). Because the survey is a census survey, the estimates shown in this report are not subject to sampling error. Although it is not possible to present estimates of nonsampling error, precautionary steps were taken at each stage of the survey design to minimize the possible occurrence of these errors.

In order to improve accuracy and the quality of data collected from U.S. geothermal heat pump manufacturers in 1999, EIA modified the Form EIA-902 by adding a new data element which requested respondents to report all ARI-320 heat pumps that were shipped in 1999, as well as the number of ARI-320 geothermal heat pump units that were manufactured to be connected to ground, ground water, or surface water connection for heat exchange. This modification clarifies for the manufacturer the type of ARI-320 applications manufacturers should report as geothermal and would separate out units that would be connected to a boiler / cooling tower. Respondents were asked to report the total number of heat pumps shipped and the number of only the ARI-320 geothermal heat pumps shipped. ARI-320 units may be connected either to a "boiler / cooling tower" configuration or ground / ground water. Ground / ground water connections are geothermal applications, while boiler / cooling tower configurations are traditional water-to-water exchange uses.

An additional modification to the Form EIA-902 was to combine both the ARI-325 and ARI-330 units into one reporting category. Many ARI-325 geothermal heat pumps are dual-rated to qualify as ARI-330 units. Which rating is appropriate depends on the installed application, information not necessarily known when the manufacturer shipped the unit. Therefore, the sum of ARI-325 and ARI-330 units may be regarded as an accurate total, whereas manufacturers would estimate the number of units in each category based upon heuristic information.

## Appendix E

# Renewable Energy Federal Legislation: *107th Session of the U.S. Congress*

Listed are the bills in chronological order (by date of introduction) in the U.S. Congress for the Senate first and the House second. All information reproduced here has been abstracted from the Library of Congress Internet site at http://thomas.loc.gov/home/thomas2.html and updated as of September 22, 2002. For more information about these proposals and their status, access this site.

## Senate Bills

### S. 188 - (No Title)

**Introduced:** January 25, 2001 by Senator Susan M. Collins (Republican)
**Purpose:** To amend the Internal Revenue Code of 1986 to modify the tax credit for electricity produced from certain renewable resources.
**Summary:** Electricity produced from biomass will cover: (1) any organic material from a plant which is planted exclusively for the purpose of being used at a qualified facility to produce electricity; (2) any forest-related resources, such as mill residues, precommercial thinnings, slash, and brush; (3) urban sources including waste pallets, crates, and dunnage, manufacturing and construction wood wastes (other than pressure-treated, chemically-treated, or painted wood wastes), and landscape or right-of-way tree trimmings; and (4) agriculture sources, including orchard tree crops, vineyard, grain legumes, sugar and other crop by-products or residues.
**Current Status:** Referred to the Senate Committee on Finance on January 25, 2001.

### S. 207 - (No Title)

**Introduced:** January 30, 2001 by Senator Bob Smith (Republican)
**Purpose:** To amend the Internal Revenue Code of 1986 to provide incentives to introduce new technologies to reduce energy consumption in buildings.
**Summary:** Amends the Internal Revenue Code to establish, for a limited time period, deductions and credits for commercial and residential properties using specified energy efficient construction or reconstruction materials or technologies, including solar energy. Sets forth provisions concerning: (1) allocation of deductions for public property; and (2) property financed by subsidized energy financing. Requires the Secretary of Energy to establish specified certification and compliance procedures.
**Current Status:** Referred to the Senate Committee on Finance on January 30, 2001.

### S. 249 - Renewable Energy Development Incentives Act

**Introduced:** February 6, 2001 by Senator Harry M. Reid (Democrat)
**Purpose:** To amend the Internal Revenue Code of 1986 to expand the credit for electricity produced from certain renewable resources.
**Summary:** The Renewable Energy Development Incentives Act amends the Internal Revenue Code respecting the renewable resource credit to: (1) include alternative resources (solar, biomass, incremental

hydropower, and geothermal); (2) provide an increased credit for certain co-production facilities, and for qualified facilities on Indian and Alaskan Native Indian lands; (3) provide credit transferability; (4) require facility compliance with pollution laws; and (5) eliminate the January 1, 2020, place-in-service date for purposes of qualified facility eligibility.

**Current Status:** Referred to the Senate Committee on Finance on February 6, 2001.

### S. 293 - Home Energy Assistance Tax Act

**Introduced:** February 8, 2001 by Senator Tom Harkin (Democrat)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide a refundable tax credit against increased residential energy costs and for other purposes.

**Summary:** The Home Energy Assistance Tax Act amends the Internal Revenue Code to allow: (1) a tax credit to 50 percent of increased residential energy (solar energy property is equipment which uses solar energy to generate electricity or to provide hot water for use in a structure) costs; (2) a deduction for certain energy efficient property (solar energy / photovoltaics) used in business; and (3) a credit to an individual equal to the sum of a determined amount for a qualified energy property placed in service and a credit amount for a new highly efficient principal residence.

**Current status:** Referred to the Senate Committee on Finance on February 8, 2001.

### S. 352 - Energy Emergency Response Act of 2001

**Introduced:** February 15, 2001 by Senator Jeff Bingaman (Democrat)

**Purpose:** A bill to increase the authorization of appropriations for low-income energy assistance, weatherization, and state energy conservation grant programs, and to expand the use of energy savings performance contracts.

**Summary:** The Energy Emergency Response Act of 2001 amends the following Acts to provide increased funding through FY 2005 for energy programs: (1) the Low-Income Home Energy Assistance Act of 1981(for home energy grants); (2) the Energy Conservation and Production Act (for weatherization assistance); and (3) the Energy Policy and Conservation Act (for State energy conservation grants). Amends the National Energy Conservation Policy Act (NECPA) to: (1) mandate that each Federal agency undertake a comprehensive review of practicable measures for increasing energy and water conservation, and for using renewable energy sources; (2) allow as an approved benefit ancillary to an energy savings or performance contract those savings resulting from reduced operation and maintenance costs at replacement facilities; and (3) repeal the termination dates governing the authority to enter into energy savings performance contracts (thus extending such authority indefinitely).

**Current Status:** Referred to the Committee on Energy and Natural Resources on July 13, 2001.

### S. 388 - National Energy Security Act of 2001

**Introduced:** February 26, 2001 by Senator Frank Murkowski (Republican)

**Purpose:** To protect the energy and security of the United States and decrease America's dependency on foreign oil sources to 50 percent by the year 2011 by enhancing the use of renewable energy resources, conserving energy resources, improving energy efficiencies, and increasing domestic energy supplies, improve environmental quality by reducing emissions of air pollutants and greenhouse gases.

**Summary:** Section 710: Residential Renewable Energy Grant Program. The National Energy Security Act of 2001 establishes Federal grant programs for (1) local governmental use of alternative fuel vehicles; and (2) residential renewable energy. Renewable Energy systems include property that uses solar thermal, solar photovoltaic, wind, biomass, hydroelectric or geothermal energy to create electricity, heat or other forms of useful energy.

The Secretary of Energy shall develop and implement a grant program to offset a portion of the total cost of certain eligible residential renewable energy systems. Grants will be awarded for any (1) new installation of an eligible residential renewable energy system for an existing dwelling unit; (2) purchase of an existing dwelling unit with an eligible residential renewable energy system that was installed prior to the date of the enactment of the Residential Renewable Energy Grant Program; (3)

addition to or augmentation of an existing eligible residential renewable energy system installed on a dwelling unit prior to the date of enactment of the Residential Renewable Energy Grant Program, provided than any such addition or augmentation results in additional electricity, heat or other useful energy and (4) construction of a new home or rental property which includes an eligible residential renewable energy system.

**Current Status:** Committee on Energy and Natural Resources. Hearings held on July 26, 2001.

## S. 465 - Residential Solar Energy Tax Credit

**Introduced:** March 6, 2001 by Senator Wayne Allard (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to allow a credit for residential solar energy property.

**Summary:** The Residential Solar Energy Tax Credit amends the Internal Revenue Code to allow a limited tax credit through tax year 2006 for residential solar energy property equal to the sum of: (1) 15 percent of the taxpayer's qualified photovoltaic property expenditures during the taxable year; and (2) 15 percent of the taxpayer's qualified solar water heating property expenditures during the same year.

**Current Status:** Referred to the Senate Committee on Finance on March 6, 2001.

## S. 530 - Bipartisan Renewable, Efficient Energy with Zero Effluent (BREEZE) Act

**Introduced:** March 14, 2001 by Senator Charles E. Grassley (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide a 5-year extension of the credit for producing electricity from wind.

**Summary:** The Bipartisan Renewable, Efficient Energy with Zero Effluent (BREEZE) Act amends the Internal Revenue Code of 1986 to provide a 5-year extension of the credit for producing electricity from wind.

**Current Status:** Referred to the Senate Committee on Finance on March 14, 2001.

## S. 597 - Comprehensive and Balanced Energy Policy Act of 2001

**Introduced:** March 22, 2001 by Senator Jeff Bingaman (Democrat)

**Purpose:** To provide for a comprehensive and balanced national energy policy.

**Summary:** Title IV-Renewables and Distributed Generation

The Comprehensive and Balanced Energy Policy Act of 2001 directs the Secretary of Energy shall publish an assessment of all renewable energy resources (wind, biomass, geothermal, solar thermal, photovoltaic, fuel cells and hydroelectricity) available within the United States no later than one year after the date of the enactment of this title, and each year thereafter. The report shall contain (1) a detailed inventory describing the available amount and characteristics of solar, wind, biomass, geothermal, hydroelectric and other renewable energy sources and (2) other information that the Secretary of Energy would deem useful in developing renewable energy resource, including descriptions of surrounding terrain, population and load centers, nearby energy infrastructure, location of energy and water resources, and available estimates of the costs needed to develop each resource.

**Current Status:** Referred to the Senate Committee on Energy and Natural Resources. Committee consideration and Markup Session held on August 2, 2001.

## S. 596 - Energy Security and Tax Incentive Policy Act of 2001

**Introduced:** March 22, 2001 by Senator Jeff Bingaman (Democrat)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide tax incentives to encourage the production and use of efficient energy sources.

**Summary:** Section 25C. Residential Solar, Wind, and Fuel Cell Energy Property. The Energy Security and Tax Incentive Policy Act of 2001 allows for an individual credit against the tax imposed for the taxable year an amount equal to the sum of (1) 15 percent of the qualified photovoltaic property expenditures: (2) 15 percent of the qualified solar water heating property expenditures; (3) 30 percent of the qualified wind energy property expenditures and (4) 20 percent for the qualified fuel cell property expenditures. The credit shall not exceed $2000 for each system of solar energy property.

**Current Status:** Referred to the Senate Committee on Finance on March 22, 2001.

### S. 756 - Growing Renewable Energy for Emerging Needs (GREEN) Act

**Introduced:** April 23, 2001 by Senator Charles E. Grassley (Republican)
**Purpose:** To amend the Internal Revenue Code of 1986 to extend and modify the credit for electricity produced from biomass.
**Summary:** The Growing Renewable Energy for Emerging Needs (GREEN) Act amends the Internal Revenue Code respecting the credit for electricity produced from certain renewable resources to: (1) extend the credit; (2) expand the scope of qualifying closed-loop facilities; and (3) make qualifying biomass (other than closed-loop biomass) and biomass facilities eligible for the credit.
**Current Status:** Referred to the Senate Committee on Finance on April 24, 2001.

### S. 968 - Healthy and High Performance Schools Act of 2001

**Introduced:** May 5, 2001 by Senator Hillary Rodham Clinton (Democrat)
**Purpose:** To establish Healthy and High Performance Schools Program in the Department of Education.
**Summary:** The Healthy and High Performance Schools Act of 2001 will assist local educational agencies in the production of high performance elementary school and secondary school buildings that are healthful, productive, energy-efficient, and environmentally sound. Renewable resources such as day lighting, solar, wind, geothermal, hydropower, and biomass power in a building already designed to be energy efficient can help meet the building's energy needs without added emissions.
**Current Status:** Referred to the Senate Committee on Health, Education, Labor and Pensions on May 25, 2001.

### S. 845 - (No Title)

**Introduced:** May 8, 2001 by Senator Michael D. Crapo (Republican)
**Purpose:** To amend the Internal Revenue Code of 1986 to include agricultural and animal waste sources as a renewable energy resource.
**Summary:** Amends the Internal Revenue Code to include within the scope of the credit for electricity produced from certain renewable resources: (1) electricity produced from agricultural and animal waste; and (2) certain agricultural and animal waste facilities and combined production facilities (production of electricity from agricultural and animal waste and other biobased products).
**Current Status:** Referred to the Senate Committee on Finance on May 8, 2001.

### S. 1058 - Biodiesel Renewable Fuels Act

**Introduced:** June 19, 2001 by Senator Tim Hutchinson (Republican)
**Purpose:** To amend the Internal Revenue Code of 1986 to provide tax relief for farmers.
**Summary:** The Biodiesel Renewable Fuels Act amends the Internal Revenue Code to allow a tax credit of between 3 and 20 cents per gallon for soy or specified vegetable-based biodiesel fuel mixtures.
**Current Status:** Referred to the Senate Committee on Finance on June 19, 2001.

### S. 1131 - Clean Power Plant and Modernization Act of 2001

**Introduced:** June 28, 2001 by Senator Patrick J. Leahy (Democrat)
**Purpose:** To require that all fossil fuel-fired electric utility generating units operating in the United States (in order to meet new review requirements) to promote alternative energy and clean energy sources such as solar, wind, biomass, and fuel cells.
**Summary:** (Section 6) Extension of Renewable Energy Production Credit
(Section 12) Renewable and Clean Power Generator Technologies
The Clean Power Plant and Modernization Act of 2001 qualifies certain solar or geothermal power facilities for the renewable energy tax credit and extends the date by which eligible facilities must have been placed in service. Under the Renewable Energy and Energy Efficiency Technology Act of 1989,

the Secretary of Energy shall fund research and development programs and commercial demonstration projects and partnerships to demonstrate the commercial viability and environmental benefits of electric power generation from: biomass (excluding unseparated municipal solid waste), geothermal, solar and wind technologies and fuel cells.

The act qualifies certain solar or geothermal power facilities for the renewable energy tax credit and extends the date by which eligible facilities must have been placed in service. The act also directs the Secretary of energy to: (1) fund programs and partnerships to demonstrate the commercial viability and environmental benefits of power generation from biomass, geothermal, solar and wind technologies and from fuel cells.

**Current Status**: Referred to Senate Committee on Finance on June 28, 2001.

## S. 1211 - Renewable Energy Production Incentive Reform Act

**Introduced:** July 20, 2001 by Senator Maria Cantwell (Democrat)

**Purpose:** To reauthorize and revise the Renewable Energy Production Incentive program.

**Summary:** The Renewable Energy Production Incentive Reform Act will amend the Energy Policy Act of 1992 to modify renewable energy production incentive payments guidelines. The Secretary of Energy will be prohibited from establishing criteria or procedures that have the effect of assigning incentive payment applications to higher or lower priority for eligibility or allocation of appropriated funds on the basis of the energy source proposed. A qualified renewable energy facility has been redefined as: (1) one owned by certain tax-exempt electricity generating cooperatives (certain public utilities, governmental entities or Indian tribal government) and (2) one in which electricity is generated by landfill gas or incremental hydropower.

**Current Status:** Referred to the Senate Committee on Energy and Natural Resources on July 20, 2001.

## S. 1219 - Providing Opportunities With Effluent Renewable (POWER) Act

**Introduced:** July 23, 2001 by Senator Charles E. Grassley (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to include swine and bovine waste nutrients as a renewable energy resource for the renewable electricity production tax.

**Summary:** The Providing Opportunities With Effluent Renewable (POWER) Act amends the Internal Revenue Code of 1986 to include swine and bovine waste nutrients as a renewable energy resource for the renewable electricity production credit.

**Current Status:** Referred to the Senate Committee on Finance on July 23, 2001.

## S. 1333 - Renewable Energy and Energy Efficiency Investment Act of 2001

**Introduced:** August 2, 2001 by Senator James M. Jeffords (Independent)

**Purpose:** To enhance the benefits of the national electric system by encouraging and supporting State programs for renewable energy sources, universal electric service, affordable electric service, and energy conservation and efficiency.

**Summary:** (Section 6) Renewable Energy Generation Standards.
The Renewable Energy and Energy Efficiency Investment Act of 2001 directs the Secretary of Energy to establish a National Electric Systems Board. The Board will in turn establish the National Electric Systems Benefit Fund to provide matching funds to States for the support of State systems benefit programs relating to renewable energy. Prescribes the amount of electricity which each supplier shall generate each year by renewable energy sources according to a mandatory renewable energy timetable. Prescribes guidelines for a program to issue, monitor the sale or exchange of, and track renewable energy credits.

Renewable energy sources are wind, biomass, landfill gas, geothermal, solar thermal and photovoltaic.

Not later than April 1 of each year, each retail electric supplier shall submit to the Secretary renewable energy credits in an amount equal to the required annual percentage of the retail electric supplier's total amount of kilowatt-hours of electricity sold to consumers during the previous calendar year.

No State shall be precluded from requiring additional renewable energy generation in the State under any renewable energy program conducted by the State.

Of the total amount of electricity sold by each retail electric supplier during a calendar year, the amount generated by renewable energy sources shall be not less than the percentage specified per calendar year and percent in that calendar year: (a) 2002 / 2.5 percent; (b) 2003 / 3percent; (c) 2004 / 4 percent; (d) 2005 / 5percent; (e) 2006 / 6 percent through calendar year 2020 and thereafter at 20 percent.

**Current Status:** Referred to Senate Committee on Energy and Natural Resources on August 2, 2001 .

### S. 1566 - Renewable Energy Incentive Act

**Introduced:** October 18, 2001 by Senator Harry M. Reid (Democrat)
**Purpose:** The Renewable Energy Incentive Act amends the Internal Revenue Code of 1986 to modify and expand the credit for electricity produced from renewable resources and waste products.
**Summary:** The Renewable Energy Incentive Act amends the Internal Revenue Code of 1986 respecting the renewable resource credit to include alternative resources (solar, open loop biomass, incremental hydropower, incremental geothermal, geothermal, and landfill gas).
**Current Status:** Referred to the Committee on Finance on October 18, 2001.

### S. 1810 - Home and Farm Wind Energy Systems Act of 2001

**Introduced:** December 12, 2001 by Senator Richard J. Durbin (Democrat)
**Purpose:** To amend the Internal Revenue code of 1986 to provide credits for individuals and businesses for the installation of certain wind energy properties.
**Summary:** The Home and Farm Wind Energy Systems Act of 2001 amends the Internal Revenue Code to allow a limited credit for amounts paid for qualified wind energy property from which at least 50 percent of the energy produced is consumed on site.
**Current Status:** Referred to the Committee on Finance on December 12, 2001.

### S. 1832 - (No Title)

**Introduced:** December 14, 2001 by Senator Blanche Lincoln (Democrat)
**Purpose:** To amend the Internal Revenue Code of 1986 to modify the credit for the production of electricity from renewable resources to include production of energy from agricultural and animal waste.
**Summary:** Amends the Internal Revenue Code to modify the credit for production of electricity from renewable resources to include production of energy from agricultural and animal waste, including by-products and associated materials. Limits such credit to facilities placed in service after 2001 and before 2007.
**Current Status:** Referred to the Committee on Finance on December 14, 2001.

### S. 1979 - Energy Tax Incentives Act of 2002

**Introduced:** March 1, 2002 by Senator Max Baucus (Democrat)
**Purpose:** To provide energy tax incentives.
**Summary:** The Energy Tax Incentives Act of 2002 amends the Internal Revenue Code to extend and modify the renewable electricity production tax credit to include credits for electricity produced from biomass, swine and bovine waste nutrients, geothermal energy, and solar energy.
Title I. Extension and Modification of Renewable Electricity Production Tax Credit
Section 101. 5-Year Extension of Credit for Producing Electricity from Wind and Poultry Waste
Section 102. Credit for Electricity Produced from Biomass

Section 103. Credit for Electricity Produced from Swine, and Bovine Waste Nutrients, Geothermal Energy and Solar Energy

**Current Status:** Placed on Senate Legislative Calendar under General Order. Calendar No.320 on March 1, 2002.

### S. 1930 - Wind Energy Promotion Act of 2002

**Introduced:** February 11, 2002 by Senator Kent Conrad (Democrat)

**Purpose:** To promote the production of energy from wind.

**Summary:** The Wind Energy Promotion Act of 2002 directs the Secretary of Agriculture, acting through the Rural Business Cooperative Service, to establish a competitive grants and low-interest loans program to assist in establishing new farmer or rancher cooperatives (or other rural business ventures) to construct wind energy facilities. The Wind Energy Promotion Act would also amend the Food Security Act of 1985 to authorize the Secretary to permit an owner or operator of certain land enrolled in the conservation reserve program to install wind turbines on the land. Directs the Secretary of Energy to conduct a research, demonstration, and technology deployment program to enhance the use of wind energy. Mandates periodic Federal agency review of regulations and standards that act as barriers to market entry for wind energy technologies. Instructs the Secretary of Energy to conduct a feasibility study pertaining to a combined wind and hydropower demonstration project involving wind energy generated by Indian tribes. Instructs the Secretary of the Interior to develop guidelines for a pilot program for the development of wind energy on Federal land. Directs the Secretaries of the Interior and of Agriculture to consider development of wind energy in revisions of land and resource management plans under their respective jurisdictions. Instructs the Secretary of Energy to conduct an assessment of wind energy resources and transmission capacity.

**Current Status:** Referred to the Committee on Finance on February 11, 2002.

### S. 2792 - (No Title)

**Introduced:** July 25, 2002 by Senator Carl Levin (Democrat)

**Purpose:** To amend the Solid Waste Disposal Act to authorize the Administrator of the Environmental Protection Agency to carry out certain authorities relating to the importation of municipal solid waste under the Agreement Concerning the Transboundary Movement of Hazardous Waste between the United States and Canada.

**Summary:** To prohibit any person from importing, transporting, or exporting municipal solid waste (MSW), for final disposal or incineration, in violation of the Agreement Concerning the Transboundary Movement of Hazardous Waste between the United States and Canada, signed at Ottawa on October 28, 1986. Directs the Administrator of the Environmental Protection Agency to perform the functions of the Designated Authority of the United States with respect to the importation and exportation of MSW under the Agreement and to implement and enforce the Agreement. Sets forth factors for consideration in the Administrator's determinations of whether to consent to importation. Provides procedures for issuance of compliance orders, assessment of civil penalties, and conduct of public hearings.

**Current Status:** Referred to the Committee on Environment and Public Works on July 25, 2002.

## House Bills

### H.R. 30 - National Resource Governance Act of 2001

**Introduced:** January 2, 2001 by Congressman George W. Gekas (Republican)

**Purpose:** To establish a commission to review and explore ways for the United States to become energy self-sufficient by 2011.

**Summary:** The National Resource Governance Act of 2001 will establish the National Energy Self-Sufficiency Commission which will explore alternative sources of energy such as ethanol, solar power, wind

energy, and other forms of alternative power sources. The alternative power sources along with traditional power sources (coal, natural gas) will be evaluated with regards to: (1) the dramatic rise in energy prices, which could lead to significant harm to particular sectors of the economy; (2) an affordable domestic energy supply which is vital to the continued growth and vitality of the Nation's economy; (3) an uninterrupted supply of oil and other energy that is necessary to protect the United States national security interests; and (4) the United States continued dependence on foreign sources of energy, particularly on the Organization of Petroleum Exporting Countries (OPEC), for the majority of its petroleum and energy needs is harmful to our national security and will not guarantee lower fuel prices and protect our economy.

**Current Status:** Referred to the House Subcommittee on Energy and Air Quality on February 7, 2001.

### H.R. 269 - WIND (Winning in New Development) for Electricity Act

**Introduced**: January 30, 2001 by Congressman Bob Filner (Democrat)

**Purpose:** To amend the Internal Revenue Code of 1986 to promote the development of domestic wind energy resources.

**Summary:** The Winning in New Development (WIND) Electricity Act amends the Internal Revenue Code to promote the development of domestic wind energy resources by (1) providing a permanent extension of credit for electricity, (2) providing a 10-year extension of the renewable energy production incentive for wind-powered generation facilities, and (3) providing a nondiscriminatory transmission service for wind generation facilities.

**Current Status:** Referred to the House subcommittee on Energy and Air Quality on February 14, 2001.

### H.R. 683 - Energy Emergency Response Act of 2001

**Introduced:** February 14, 2001 by Congressman Edward J. Markey (Democrat)

**Purpose:** To increase the authorization of appropriations for low-income energy assistance, weatherization, and State energy conservation grant programs, and to expand the use of energy savings performance contracts.

**Summary:** Federal Energy Management Reviews (Section 4). The Energy Emergency Response Act of 2001 amends the National Energy Conservation Policy Act to mandate that each Federal agency undertake a comprehensive review of practicable measures for increasing energy and water conservation, and for using renewable energy sources. Each Federal agency not later than 180 days after completing the review, shall implement measures to achieve not less than 50 percent of the potential efficiency and renewable savings identified in the review.

**Current Status:** Referred to the House Subcommittee on Education Reform on April 20, 2001.

### H.R. 778 - (No Title)

**Introduced:** February 28, 2001 by Congressman Randy Cunningham (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide incentives to introduce new technologies to reduce energy consumption in buildings.

**Summary:** Amends the Internal Revenue Code to establish, for a limited time period, deductions and credits for commercial and residential properties using specified energy efficient construction or reconstruction materials or technologies, including solar energy. Sets forth provisions concerning: (1) allocation of deductions for public property; (2) property financed by subsidized energy financing. Requires the Secretary of Energy to establish specified certification and compliance procedures.

**Current Status:** Referred to the House Committee on Ways and Means on February 28, 2001.

### H.R. 876 - (No Title)

**Introduced:** March 6, 2001 by Congressman Mark Foley (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide a 5-year extension of the credit for electricity produced from wind.

**Summary:** (Section 1). A 5-year extension of credit for electricity produced from wind is extended from 2002 to 2007.

**Current Status:** Referred to the House Committee on Ways and Means on March 6, 2001.

### H.R. 954 - Home Energy Generation Act

**Introduced:** March 8, 2001 by Congressman Jay Inslee (Democrat)

**Purpose:** To amend the Federal Power Act to promote energy independence and self-sufficiency by providing for the use of net metering by certain small electric energy generation systems.

**Summary:** The Home Energy Generation Act, which amends the Federal Power Act, mandates that: (1) each retail electric supplier make available an electric energy meter capable of net metering to certain retail customers that have installed an energy generation unit intended for net metering; and (2) rates, charges, and contract terms for electric energy sales to customer-generators be the same as those that would be applicable if the customer-generator did not own or operate a qualified generation unit and use a net metering system.

Electric generation units qualify for net metering if: (a) it is a fuel cell or uses as its energy source either solar, wind, or biomass, (b) has a generating capacity of not more than 100 kilowatts, (c) is located on premises that are owned, operated, leased, or otherwise controlled by the customer-generator, (d) operates in parallel with the retail electric supplier, (e) is intended primarily to offset part or all of the customer-generator's requirements for electricity.

**Current Status:** Referred to the House Subcommittee on Energy and Air Quality on March 14, 2001.

### H.R. 983 - (No Title)

**Introduced:** March 13, 2001 by Congresswoman Mary Bono (Republican)

**Purpose:** To require the Secretary of Energy to assign the same priority to providing renewable energy production incentive payments for landfill gas facilities as the same priority assigned to providing such payments for other biomass facilities.

**Summary:** To require the Secretary of Energy to assign the same priority to providing renewable energy production incentive payments for landfill gas facilities as the same priority assigned to providing such payments for other biomass facilities.

**Current Status:** Referred to the House Subcommittee Energy and Air Quality on March 20, 2001.

### H.R. 1129 - High Performance Schools Act of 2001

**Introduced:** March 20, 2001 by Congressman Mark Udall (Democrat)

**Purpose:** To establish the High Performance Schools Program in the Department of Energy.

**Summary:** The High Performance Schools Act of 2001 establishes the High Performance Schools Program in the Department of Energy which will be administered by the Secretary of Energy. The Secretary of Energy through the High Performance Schools Program make grants to: (1) school districts for new and existing school buildings; (2) to State energy offices to administer the High Performance Schools Program to school districts and (3) to State energy offices to promote participation by school districts in the High Performance Schools Program. Renewable energy sources (solar, wind, geothermal, hydroelectric, biomass) used will be: daylighting, passive solar heating, photovoltaics, wind, geothermal, hydropower, and biomass power in a building already designed to be low energy can help meet the building's energy needs without added emissions. High performance school buildings, are school buildings in which design, construction, operation, and maintenance, maximize the use of renewable energy and energy efficient practices. The building is cost-effective on a life cycle basis, uses affordable, environmentally preferable, durable materials that enhance indoor air environmental quality, protects and conserves water, and optimizes site potential.

**Current Status:** Referred to the House Subcommittee on Education Reform on May 30, 2001.

## H.R. 1657 - Biomass Energy Equity Act of 2001

**Introduced:** May 1, 2001 by Congressman Wally Herger (Republican)
**Purpose:** To amend the Internal Revenue Code of 1986 to extend and modify the credit for electricity produced from biomass.
**Summary:** The Biomass Energy Equity Act of 2001 amends the Internal Revenue Code respecting the credit for electricity produced from certain renewable resources to: (1) extend the credit; (2) expand the scope of the qualifying close-loop facilities; and (3) make qualifying biomass (other than closed-loop biomass) and biomass facilities eligible for the credit.
**Current Status:** Referred to the House Committee on Ways and Means on May 1, 2001.

## H.R. 1863 - (No Title)

**Introduced:** May 16, 2001 by Congressman Dave Camp (Republican)
**Purpose:** To amend the Internal Revenue Code of 1986 to expand the credit for electricity produced from certain renewable resources to energy produced from landfill gas.
**Summary:** Credit for electricity produced from certain renewable resources expanded to include energy produced from landfill gas. The bill is amended from 2002 to 2004.
**Current Status:** Referred to the House Committee on Ways and Means on May 16, 2001.

## H.R. 1969 - Residential Solar Energy Act of 2001

**Introduced:** May 23, 2001 by Congressman Jim McDermott (Democrat)
**Purpose:** To amend the Internal Revenue Code of 1986 to provide an interest-free source of capital to cover the costs of installing residential solar energy equipment.
**Summary:** The Residential Solar Energy Act of 2001 amends the Internal Revenue Code to allow a credit to holders of Residential Solar Energy Bonds.

(Section 30B), Credit to Holders of Residential Solar Energy Bonds. Residential Solar Energy Bonds are issued if (a) 95 percent or more of the proceeds are to be used to make qualified solar energy loans; (b) the bond is issued by a qualified utility; (c) the issuer designates the bond for the purpose stated by this section.

Qualified Solar Energy Loans are any loans without interest to the owner of any qualified residential property for the purchase and installation of photovoltaic cells on property if (a) the excess of the electricity produced by the photovoltaic cells over the electricity consumed at the residential property is transmitted from the property for use by others; (b) the net electricity produced or consumed at the residential property is metered; (c) the owner receives a credit against future electricity consumption for the excess; (d) the principal amount of the loan is payable in equal installments over 15 years; and (e) there is a specified and approved list of photovoltaic cell equipment and installers.

The national Residential Solar Energy Bond limitations shall be allocated by the Secretary of Energy during 2002, 2003, 2004 and 2005 to qualified utilities.
**Current Status:** Referred to the House Committee on Ways and Means on May 23, 2001.

## H.R. 2000 - Renewable Energy from Agricultural Products (REAP) Act

**Introduced:** May 24, 2001 by Congressman Jim Nussle (Republican)
**Purpose:** To encourage the use of agricultural products in producing renewable energy.
**Summary:** The Renewable Energy from Agricultural Products (REAP) Act amends the Internal Revenue Code respecting the credit for electricity produced from certain renewable resources to: (1) extend the credit; (2) expand the scope of qualifying closed-loop facilities; (3) make qualifying biomass (other than closed-loop biomass) and biomass facilities eligible for the credit; and (4) include electricity produced

from agricultural and animal waste within the credit. Establishes a reduced excise tax rate for qualified biodiesel mixtures.

**Current Status:** Referred to the House Subcommittee on Technology and Procurement Policy on June 6, 2001.

### H.R. 2076 - Residential Solar Energy Tax Credit

**Introduced:** June 6, 2001 by Congressman J.D. Hayworth (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to allow a credit for residential **solar energy property.**

**Summary:** The Residential Solar Energy Tax Credit amends the Internal Revenue Code to allow a limited tax credit through tax year 2006 for residential solar energy property equal, to the sum of (1) 15% of the taxpayers' qualified photovoltaic property expenditures during the taxable year, and (2) 15% of the taxpayer's qualified solar water heating property expenditures during the same year.

**Current Status:** Referred to the House Committee on Ways and Means on June 6, 2001.

### H.R. 2079 - (No Title)

**Introduced:** June 6, 2001 by Congressman Jim McDermott (Democrat)

**Purpose:** To amend the Internal Revenue Code of 1986 to impose a windfall profits tax on electric generating facilities having excess profits.

**Summary:** Amends the Internal Revenue Code to impose (on sellers) a windfall profits tax on electric generating facilities having excess profits. Exempts electricity produced from renewable sources from such tax. Expresses the sense of Congress that such tax should be used to: (1) reduce taxes for consumers and moderate the impact of high prices on small businessmen; and (2) encourage alternative energy source development through research tax credits.

**Current Status:** Referred to the House Committee on Ways and Means on June 6, 2001.

### H.R. 2108 - Energy Security and Tax Incentive Policy Act of 2001

**Introduced:** June 7, 2001 by Congressman Robert T. Matsui (Democrat)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide tax incentives to encourage the production and use of efficient energy sources.

**Summary:** The Energy Security and Tax Incentive Policy Act of 2001 amends the Internal Revenue Code of 1986 to provide tax incentives to encourage the production and use of efficient energy resources in residential energy systems. The residential energy systems are photovoltaic, solar water heating, wind energy, and fuel cells.

(Section 203). Credit for Residential Solar, Wind, and Fuel Cell Energy Property. Allowance of credit shall be (a) 15 percent of the qualified photovoltaic property expenditures, (b) 15 percent of the qualified solar water heating property expenditures, (c) 30 percent of the qualified wind energy property expenditures, and (d) 20 percent for the qualified fuel cell property expenditures.

(Section 302). Modifications to Credit for Electricity Produced from Renewable and Waste Resources. Alternate resources include solar, biomass (other than closed loop biomass), municipal solid waste, incremental hydropower, geothermal, landfill gas, and steel cogeneration.

**Current Status:** Referred to the House Committee on Ways and Means on June 7, 2001.

### H.R. 2184 - Preserving Our World's Energy and Resources Act of 2001

**Introduced:** June 14, 2001 by Congressman Eliot L. Engel (Democrat)

**Purpose:** To amend the International Revenue Code of 1986 to expand the energy credit to include investment in property which produces energy from certain renewable sources and expenditures for cool roofing.

**Summary:** Preserving Our World's Energy and Resources Act of 2001 amends the Internal Revenue Code to include as energy property for purposes of claiming the energy (investment) credit equipment which uses wind to generate electricity and cool roof property.

Allows a nonrefundable personal credit for qualified renewable resource property (solar, wind, and geothermal) and qualified cool roof property.

Amends the Federal Power Act to require retail electric suppliers to comply with specified requirements concerning net metering.

**Current Status:** Referred to the House Subcommittee on Energy and Air Quality June 25, 2001.

### H.R. 2179 - Renewable Energy Act for Credit on Taxes

**Introduced:** June 14, 2001 by Congresswoman Susan A. Davis (Democrat)

**Purpose:** To amend the Internal Revenue Code of 1986 to allow a refundable credit for expenditures for renewable energy property.

**Summary:** The Renewable Energy Act for Credit on Taxes amends the Internal Revenue Code to allow a refundable limited credit through tax year 2006 for expenditures for qualifying renewable energy property (solar water heating, photovoltaic, wind energy, or fuel cell properties) installed on or in connection with a U.S.-sited residential or nonresidential structure.

**Current Status:** Referred to the House Committee on Ways and Means on June 14, 2001.

### H.R. 2190 - Renewable Energy Production Incentive Reform Act

**Introduced:** June 14, 2001 by Congresswoman Karen McCarthy (Democrat)

**Purpose:** To reauthorize and revise the Renewable Energy Production Incentive Program.

**Summary**: The Renewable Energy Production Incentive Reform Act amends the Energy Policy Act of 1992 to modify renewable energy production incentive payment guidelines to prohibit the Secretary of Energy from establishing criteria or procedures that have the effect of assigning to incentive payment applications a higher or lower priority for eligibility or allocation of appropriated funds on the basis of the energy source proposed.

Redefines a qualified renewable energy facility as one: (1) owned by certain tax-exempt electricity-generating cooperatives, certain public utilities, governmental entities, or an Indian tribal government; and (2) which may involve electricity generation by landfill gas or incremental hydropower. Repeals the requirement that a facility be owned by a State or local government or instrumentality, or by a nonprofit electrical cooperative.

Extends through FY 2013 the deadline for first use of a facility eligible for incentive payments.

**Current Status:** Referred to the House Subcommittee on Energy and Air Quality on June 25, 2001.

### H.R. 2233 - (No Title)

**Introduced:** June 19, 2001 by Congressman Jerrold Nadler (Democrat)

**Purpose:** To assist municipalities and local communities to explore and determine options for the alternative provision of electricity and to create new public power systems.

**Summary:** (Section 2). Community Power Investment Revolving Fund. Established in the Treasury of the United States a revolving loan fund to be known as the "Community Power Investment Revolving Loan Fund." The Secretary of Energy may make loans from the 'Community Power Investment Revolving Loan Fund' to State or local government, including any municipality. The loan can be used for (Section D), incentives for new renewable energy resources, including research and development programs, purchases from alternative energy providers, and construction of new generation facilities.

**Current Status:** Referred to the Subcommittee on Energy and Air Quality on July 6, 2001.

### H.R. 2322 - Home and Farm Wind Energy Systems Act of 2001

**Introduced:** June 26, 2001 by Congressman J.C. Watts, Jr. (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide credits for individuals and businesses for the installation of certain wind energy systems.

**Summary:** The Home and Farm Wind Energy Systems Act of 2001 amends the Internal Revenue Code to allow a limited credit for amounts paid for qualified wind energy property from which at least 50 percent of the energy produced is consumed on site.

**Current Status:** Referred to the House Committee on Ways and Means on June 26, 2001.

## H.R. 2324 - Renewable Energy and Energy Efficiency Act of 2001

**Introduced:** June 26, 2001 by Congresswoman Lynn C. Woolsey (Democrat)

**Purpose:** To establish a balanced energy program for the United States that unlocks the potential of renewable energy and energy efficiency.

**Summary:** The Renewable Energy and Energy Efficiency Act of 2001 declares that it shall be the policy of the United States that its research, development, demonstration, and commercial applications programs be designed to enable 20 percent of domestic energy generated from stationary sources to be generated from nonhydropower renewable energy sources by the year 2020.

Prescribes research and development program goals to implement such policy in connection with enhanced: (1) energy efficiency; (2) renewable energy; and (3) biomass energy and related chemical research.

Directs the Secretary of Energy to: (1) submit to Congress an assessment of renewable energy resources available for commercial application; (2) commission an independent assessment of innovative financing techniques to facilitate construction of new renewable energy and energy efficiency facilities that might not otherwise be built in a competitive market; (3) provide assistance to private sector entities for the commercial application of renewable energy and energy efficiency technologies; and (4) establish an education and outreach program on renewable energy and energy efficiency technologies.

Requires the Director of the Office and Science and Technology Policy to oversee a review of each Federal agency's regulations and policies for emerging renewable energy and energy efficiency technologies and processes.

**Current Status:** Referred to the House Subcommittee on Energy on July 5, 2001.

## H.R. 2392 - Clean Energy Incentives Act

**Introduced:** June 28, 2001 by Congressman Jay Inslee (Democrat)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide, expand, or extend tax incentives for renewable energy and alternative electric energy, alternative fuels and alternative fuel vehicles, energy efficiency and conservation, and demand management and distributive energy generation.

**Summary:** The Clean Energy Incentives Act amends the Internal Revenue Code, with respect to renewable energy. Provides for: (1) a 5-year extension for the renewable resource credit for qualified facilities; (2) alternative resources (solar, biomass, incremental hydropower and geothermal, and geothermal energy) to qualify for the renewable resource credit; (3) a credit for public utilities and other tax exempt organizations; and (4) an energy efficient commercial building deduction.

Provides tax credits for the following: (1) property to convert waste to fuel; (2) construction of new highly energy efficient homes; (3) distributed energy generation and demand property (specified solar, geothermal, energy efficient building, and other property) used in business; (10) distributed energy generation and demand property (specified photovoltaic, solar water heating, wind energy, fuel cell, and energy efficient property) used in residences; and (11) energy management systems using residential real time metering systems.

**Current Status:** Referred to the House Committee on Ways and Means on June 28, 2001.

## H.R. 2407 - Federal Photovoltaic Utilization Act

**Introduced:** June 28, 2001 by Congressman James L. Obestar (Democrat)

**Purpose:** To amend the Public Buildings Act of 1959 to direct the Administrator of General Services to provide for the procurement of photovoltaic solar electric systems for use in public buildings, and for other purposes.

**Summary:** The Federal Photovoltaic Utilization Act amends the Public Buildings Act of 1959 to authorize the Administrator of General Services to establish a photovoltaic energy commercialization program for the procurement and installation of photovoltaic solar electric systems for electric production in new and existing public buildings, with a purpose of attaining the goal of 20,000 systems in public buildings contained in the Federal Government's Million Solar Roof Initiative of 1997. Requires the Administrator and the Secretary of Energy to jointly establish a photovoltaic solar energy systems evaluation program to evaluate such systems required in public hearings.

**Current Status:** House Subcommittee on Economic Development, Public Buildings and Emergency Management held on August 1, 2001.

## H.R. 2412 - Tribal Energy Self-Sufficiency Act

**Introduced:** June 28, 2001 by Congressman Nick J. Rahall (Democrat)

**Purpose:** To establish programs to improve energy development on Indian lands.

**Summary:** Title I-(Section 107), Transmission of Wind Power from Indian Lands
Title II-(Section 202), Amendment to Renewable Energy Production Incentive Program
Title II-(Section 203), Renewable Energy Study
Title II-(Section 204), Loan Guarantees
Title II-(Section 205)-Net Metering for Indian Tribes
Title II- (Section 605)-Net Metering for Renewable Energy on Indian Reservations
Title II-(Section 206)-Transmitting Electric Power to and from Indian Reservations
(1) The Tribal Energy Self-Sufficiency Act amends the Indian Financing Act of 1974 to authorize appropriations, exempt from certain limitations, for Indian electric energy development, including electric generation, transmission, and distribution. (2) Requires the Western Area Power Administration to set up electric power transmission facilities for the development of wind power generation on certain Indian lands. (3) Amends the Public Utility Regulatory Policies Act of 1978 to make net metering available for renewable energy on Indian reservations. (4) Amends the Internal Revenue Code to (a) extend the credit for electricity produced from certain renewable resources to solar power, non-closed loop biomass, incremental hydropower, geothermal energy, and fuel cells on Indian lands.

**Current Status:** Referred to the Subcommittee on Domestic Monetary Policy, Technology and Economic Growth on July 20, 2001.

## H.R. 2436 - Energy Security Act

**Introduced:** July 10, 2001 by Congressman James V. Hansen (Republican)

**Purpose:** To provide secure energy supplies for the people of the United States.
Title III: Geothermal Energy Development

**Summary:** The Energy Security Act amends the Geothermal Steam Act of 1970 to reduce the maximum royalty from 15 percent to 8 percent. Exempt from royalties: (1) geothermal energy leases during the first three years of commercial production of heat or energy from a facility whose production commences within five-year period after enactment of this Act; and (2) qualified expansion of geothermal energy.

(Sec. 302) Substitutes an annual fee based upon the scale of development and utilization for any royalty or rental for leases for development and direct utilization of low temperature geothermal resources.

(Sec. 303) Prohibits issuance of a geothermal lease for lands withdrawn or acquired in aid of the Department of Agriculture if the Secretary of Agriculture determines that no terms or conditions would be sufficient to protect them adequately under the National Forest Management Act of 1976.

(Sec. 304) Requires the Secretary of the Interior to issue final determinations on pending noncompetitive geothermal lease applications within 90 days after enactment of this Act.

(Sec. 305) Opens public lands under military jurisdiction for geothermal steam and associated resources development and utilization without the need for further Federal action.
Provides for closure of such lands in the event of a national emergency, or for national defense, or security purposes.

(Sec. 307) Directs the Secretary of the Interior to report to Congress on the status and applicability of all moratoria and withdrawals from leasing in connection with known geothermal resource areas.

(Sec. 308) Amends the Geothermal Steam Act of 1970 to direct the Secretary of the Interior to reimburse lessees, operators, operating rights owners, and lease applicants for their costs incurred in complying with documentation requirements of the National Environmental Policy Act of 1969.

**Current Status:** House preparation for floor: Placed on the Union Calendar, Calendar No.95 on July 25, 2001.

## H.R. 2496 - Distributed Power Hybrid Energy Act

**Introduced:** July 12, 2001 by Congressman Mark Udall (Democratic)

**Purpose:** To direct the Secretary of Energy to develop and implement a strategy for research, development, demonstration, and commercial application of distributed power hybrid energy systems.

**Summary:** The Distributed Power Hybrid Energy Act directs the Secretary of Energy to develop a distributed power hybrid system strategy. The power hybrid system will involve two or more independent electric energy sources (usually 10 megawatts or less). The system will be close to a residential, commercial, or industrial load centers. The act defines distributed power to include fuel cells, solar electric system, wind energy systems, biomass power systems, and geothermal power systems. Renewable energy resources have the potential to help diversify the Nation's energy portfolio with few adverse environmental effects.

**Current Status:** Referred to House Subcommittee Energy on July 17, 2001.

## H.R. 2511 - Energy Tax Policy Act of 2001

**Introduced:** July 17, 2001 by Congressman Jim McCrery (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to provide tax incentives to encourage energy conservation, energy reliability, and energy production.
Title I: Conservation
(Section 101): Credit for Residential Solar Energy Property
(Section 202): Extension and Expansion of Credit for Electricity Produced from Renewable Resources
(Section 25D): NonBusiness Qualified Stationary Fuel Cell Power plant

**Summary:** The Energy Tax Policy Act of 2001 allows a credit of up to $2,000 annually each for qualified photovoltaic property expenditures and qualified solar water heating property expenditures; (2) the act also extends the placed-in service date for wind facilities and closed-loop biomass facilities to facilities placed in service after December 31, 1993 (December 31, 1992, in the case of closed-loop biomass facilities) and before January 1, 2007; (3) as well as provides a ten-percent credit for the purchase of qualified stationary fuel cell power plants for businesses and individuals. Prohibits the credit from exceeding $1,000 for each kilowatt of capacity.

**Current Status:** House preparation for floor: Placed on the Union Calendar, Calendar No. 93 on July 24, 2001.

## H.R. 2587 - Energy Advancement and Conservation Act of 2001

**Introduced:** July 23, 2001 by Congressman W. J. Tauzin (Republican)

**Purpose:** To enhance energy conservation, provide for security and diversity in the energy supply for the American people.
(Section 701): Assessment of Renewable Energy Resources

**Summary:** The Energy Advancement and Conservation Act of 2001 directs the Secretary of Energy to publish an assessment by the National Laboratories of all renewable energy resources available within the United States. The report shall contain a detailed inventory describing the available amount and characteristics of solar, wind, biomass, geothermal, hydroelectric and other renewable energy sources. The report will also contain other information the Secretary of Energy believes will be useful in developing renewable resources: description of surrounding terrain, population and load centers, nearby energy infrastructure, location of energy and water resources, and available estimates of the cost needed to develop each resource.

**Current Status:** Supplemental report filed by the Committee on Energy and Commerce on August 1, 2001.

## H.R. 4 - Securing America's Future Energy Act (SAFE) of 2001

**Introduced:** July 27, 2001 by Congressman W. J. Tauzin (Republican)

**Purpose:** To enhance energy conservation, research, and development and to provide for security and diversity in the energy supply for the American people.

**Summary:** Securing America's Future Energy Act of 2001 takes all actions necessary in the areas of conservation, efficiency, alternative sources, technology development, and domestic production to reduce the U.S. dependence on foreign energy sources from 56 percent to 45 percent by January 1, 2012. The act would also seek to reduce US dependence on Iraqi energy sources from 700,000 barrels per day to 250,000 barrels per day by January 1, 2012.

Title VI-Renewable Energy: Directs the Secretary to publish an assessment by the National Laboratories of all renewable energy resources available within the US

(Sec. 602) Amends the Energy Policy Act of 1992 to prohibit the Secretary from establishing criteria or procedures governing renewable energy production incentives that effectively assign a higher or lower priority for eligibility or allocation of appropriated funds on the basis of the energy source proposed.

(Sec. 603) Instructs the Secretary to study and report to Congress on the feasibility of providing guarantees for loans by private banking and investment institutions for facilities for processing and conversion of municipal solid waste and sewage sludge into fuel ethanol and other commercial byproducts.

(Sec. 604) Directs the Administrator and the Secretary to conduct a joint feasibility study and report to Congress on development of a requirement that motor vehicle fuel sold or introduced into commerce by a refiner, blender, or importer, be composed of a quantity of renewable fuel, measured in gasoline-equivalent gallons, including: (1) evaluation of the use of a banking and trading credit system; and (2) desirability of requiring an increasing percentage of renewable fuel to be phased in over a 15-year period.

Title VIII, Division B: Comprehensive Energy Research and Technology Act of 2001 Enumerates goals for energy research, development, demonstration and commercial application programs targeting the following areas: (1) energy conservation and efficiency with respect to the building technology, state, and community sector, the industry sector, power technologies, and the transportation sector; (2) renewable energy targeting hydrogen research, bioenergy, geothermal technology development, hydropower, concentrating solar power, photovoltaic energy systems, solar building technology research, wind energy systems, electric energy systems and storage, international renewable energy

and renewable energy production incentive programs, and renewable program support; (3) nuclear energy; (4) fossil energy; and (5) science.

Subtitle B: Distributed Power Hybrid Energy Systems
Directs the Secretary to develop and transmit to Congress a strategy for distributed power hybrid systems which, in part, provides for development of a research, demonstration, and commercial application program to ensure reliability, efficiency, and environmental integrity of distributed energy resources, focusing on technology gaps and barriers that hamper the use of such systems.

(Sec. 2124) Directs the Secretary to: (1) develop and implement a comprehensive research, development, demonstration, and commercial application program to improve energy efficiency, reliability, and environmental responsibility in high power density industries, such as data centers, server farms, telecommunications facilities, and heavy industry; (2) award competitive, merit-based grants to consortia of private sector entities for micro-cogeneration energy technology development; and (3) work with standards development organizations toward the development of voluntary consensus standards for distributed energy systems.

Title II: Renewable Energy-Subtile A: Renewable Hydrogen
Robert S. Walker and George E. Brown, Jr. Hydrogen Energy Act of 2001

Amends the Spark M. Matsunaga Hydrogen Research, Development, and Demonstration Act of 1990 to revise its purposes to include the development of a hydrogen production methodology that minimizes adverse environmental impacts, including efficient and cost-effective production from renewable resources.

Subtitle C: Department of Energy Authorization of Appropriations
Authorizes appropriations through FY 2004 for Renewable Energy operation and maintenance (including wave powered electric generation). Bars the use of such appropriations for either Departmental Energy Management Program or Renewable Indian Energy Resources.

Division C: Energy Tax Policy Act of 2001
Allows an annual credit of up to $2,000 each for certain portions of qualified photovoltaic property expenditures and qualified solar water heating property expenditures.

(Sec. 3102) Extends the placed-in-service date for wind facilities and closed-loop biomass facilities to facilities placed in service after December 31, 1993 (December 31, 1992, in the case of closed-loop biomass facilities) and before January 1, 2007.

(Sec. 3103) Provides a ten-percent credit (up to $1,000 for each kilowatt of capacity) for the purchase of qualified stationary fuel cell power plants for businesses and individuals.

(Sec. 3114) Allows the personal energy credits added by this Act (the residential solar energy property credit and the energy efficient improvements to existing homes credit) to offset both the regular tax and the alternative minimum tax.

Title III: Geothermal Energy Development
Amends the Geothermal Steam Act of 1970 to reduce the maximum royalty from 15 percent to 8 percent, and eliminate any minimum royalty. Exempts from royalties: (1) geothermal energy leases during the first three years of commercial production of heat or energy from a facility whose production commences within the five-year period after enactment of this Act; and (2) qualified expansion geothermal energy.

(Sec. 6302) Substitutes an annual fee based upon the scale of development and utilization for any royalty or rental for leases for development and direct utilization of low temperature geothermal resources.

(Sec. 6303) Prohibits issuance of a geothermal lease for lands withdrawn or acquired in aid of the Department of Agriculture if the Secretary of Agriculture, after consultation with any Regional Forester having administrative jurisdiction over the lands concerned, determines that no terms or conditions would be sufficient to protect them adequately under the National Forest Management Act of 1976. Requires the Secretary to include in the record of decision for such determination any written statement prepared by a Regional Forester consulted by the Secretary, or an explanation why such statement is not included.

(Sec. 6304) Requires the Secretary of the Interior to issue final determinations on pending noncompetitive geothermal lease applications within 90 days after enactment of this Act.

(Sec. 6305) Opens public lands under military jurisdiction for geothermal steam and associated resources development and utilization without the need for further Federal action. Provides for closure of such lands in the event of a national emergency, or for national defense or security purposes.

(Sec. 6307) Directs the Secretary of the Interior to report to Congress on the status and applicability of all moratoria and withdrawals from leasing in connection with known geothermal resource areas.

(Sec. 6308) Amends the Geothermal Steam Act of 1970 to authorize the Secretary of the Interior to reimburse, through royalty credits, lessees, operators, operating rights owners, and lease applicants for their costs incurred in complying with documentation requirements of the National Environmental Policy Act of 1969.

**Current Status:** The Speaker appointed a conferee for consideration of the House bill and Senate amendment, and modifications committed to conference. Conference held on July 25, 2002.

## H.R. 2478 - Comprehensive Renewable Energy and Energy Efficiency Act of 2001

**Introduced:** July 31, 2001 by Congresswoman Lynn C. Woolsey (Democrat)

**Purpose:** To establish a balanced energy program for the United States that unlocks the potential of renewable energy and energy efficiency.
Title I: Research, Development and Demonstration
(Section 101): Enhanced renewable energy research, development, and demonstrations
(Section 103): Biomass energy and related chemical research, development, and demonstration
Title III: Regulatory Provisions
(Section 302): Net metering
(Section 303): Renewable energy portfolio standards
Subtitle B: Residential Energy Systems
(Section 513): Credit for residential solar, wind, and fuel cell energy property
Subtitle C: Electricity Facilities and Production
(Section 522): Modifications to credit for electricity produced from renewable and waste products
(Section 525): Credit for investment in additional plant capacity for existing renewable resources facilities producing electricity.

**Summary:** The Comprehensive Renewable Energy and Energy Efficiency Act of 2001 sets forth a statutory framework to implement U.S. policy for research, development, demonstration and commercial applicant programs. The act is designed to enable 20 percent of domestic energy from stationary sources to be generated from nonhydropower renewable energy resources by 2020. The act prescribes requirement programs in renewable energy, for energy efficiency, and biomass energy. The research, development, and demonstration program to enhance renewable energy will include:

Wind Power - Reduce the cost of wind electricity by 50 percent, so that wind power can be widely competitive with fossil-fuel based electricity in a restructured electric environment.
Photovoltaics - Pursue research, development, and demonstration that would lead to photovoltaic system prices of $3,000 per kilowatt by January 1, 2003 and $1,500 per kilowatt by January 1, 2006.
Solar Thermal Electric Systems - Strengthen ongoing research, development, and demonstration combining high-efficiency and high temperature receivers with advanced storage and power cycles. The goal is to make solar-only power widely competitive with fossil-fuel power by 2015.
Geothermal Energy - Continue work in hydrothermal systems, and reactivate research, development, and demonstration on advanced concepts. Top priority will be given to high-grade hot dry-rock geothermal energy.
Hydrogen Based Energy Systems - Support research, development, and demonstration on hydrogen-using and hydrogen-producing technologies.

The research, development, and demonstration program to enhance biomass energy will include:
Biomass Based Power Systems - Enable commercialization of integrated power-generating technologies that employ gas turbine and fuel cells integrated with biomass.
Biofuels - Accelerate research, development, and demonstration on advanced enzymatic hydrolysis technology for making ethanol from cellulosic feedstock. The goal is to produce between 2010 and 2015 ethanol from energy crops that would be fully competitive with the price of gasoline as a neat fuel, in either internal combustion engines or fuel cell vehicles.

**Current Status:** Referred to House Subcommittee on Energy and Air Quality on July 31, 2001.

## H.R. 2774 - Renewable Energy Loan Guarantee Act of 2001

**Introduced:** August 2, 2001 by Congressman Rick Larsen (Democrat)
**Purpose:** To establish a loan guarantee program for renewable energy source facilities.
**Summary:** The Renewable Energy Loan Guarantee Act of 2001 establishes the Renewable Energy Source Facility Guaranteed Loan Program. The program may guarantee loans provided for qualified renewable energy source facilities by private banking and investment institutions. The facility will generate electricity energy for sale in, or affecting, interstate commerce using solar, wind, biomass landfill gas, incremental hydropower or geothermal.
**Current Status:** Referred to the House Subcommittee on Domestic Monetary Policy, Technology and Economic Growth on August 24, 2001.

## H.R. 2834 - FHA Energy Efficiency Act

**Introduced:** September 5, 2001 by Congressman Robert. E. Andrews (Democrat).
**Purpose:** To amend section 526 of the National Housing Act to provide that any certification of a property for meeting energy efficiency requirements for mortgage insurance under such Act shall be conducted by an individual certified by an accredited home energy rating system provider.
**Summary:** The FHA Energy Efficiency Act amends the National Housing Act to direct the Secretary of Housing and Urban Development to require that, with respect to residential housing subject to a mortgage insured under the Act, any approval or certification for meeting energy efficiency or conservation criteria, or any approval or certification required with respect to energy conserving improvements or any solar energy system, be conducted only by an individual certified by a home energy rating system provider accredited to conduct such ratings by: (1) the Home Energy Ratings System Council; (2) the Residential Energy Services Network; or (3) another appropriate national organization.
**Current Status:** Referred to the Subcommittee on Housing and Community Opportunity on September 14, 2001.

## H.R. 2871 - Export-Import Bank Reauthorization Act of 2001

**Introduced:** September 10, 2001 by Congressman Doug Bereuter (Republican).
**Purpose:** To reauthorize the Export-Import Bank of the United States.

**Summary:** The Export-Import Bank Reauthorization Act of 2001 amends the Export-import Bank Act of 1945 to require the Export-import Bank of the United States (Bank), in providing loans, guarantees, insurance, and credits for the export of goods and services, imports, and the exchange of commodities and services between the United States (including its territories or possessions) and other foreign countries, to ensure that such financing is contributing to maintaining or increasing employment of US workers.
(Section 13). Renewable Energy Resources. Promotes the export of goods and services related to renewable energy sources.
(Section 21). The Export-import Bank of the United States, should extend credit for renewable energy projects (solar, wind, biomass, fuel cell, landfill gas, geothermal) of not less than 5 percent for transactions.

**Current Status:** Passed / agreed to in House on May 1, 2002.

### H.R. 3089 - Renewable and Distributed Energy Net Metering Act

**Introduced:** October 11, 2001 by Congressman Lee Terry (Republican).

**Purpose:** To amend the Federal Power Act to promote energy security, environmental protection, electricity price stability, and electric reliability by providing for the use of net metering by certain small electric energy generation systems.

**Summary:** The Renewable and Distributed Energy Net Metering Act mandates that each State, electric utility not regulated by a State, and Federal power marketing agency consider establishing a net metering program, or modifying an existing program, to meet certain minimum Federal standards. Instructs the Federal Energy Regulatory Commission to establish such standards for each such entity that has not established a net metering program conforming to such standards within two years after enactment of this Act.

**Current Status:** Referred to the Subcommittee on Energy and Air Quality on October 29, 2001.

### H.R. 3099 - Biofuels Energy Independence Act of 2001

**Introduced:** October 11, 2001 by Congresswoman Marcy Kaptur (Democrat)

**Purpose:** To provide for a Biofuels Feedstocks Energy Reserve, and to authorize the Secretary of Agriculture to make and guarantee loans for the production, distribution, development, and storage of biofuels.

**Summary:** The Biofuels Energy Independent Act of 2001 authorizes the Secretary of Agriculture to administer a Biofuels Feedstocks Energy Reserve to: (1) provide feedstocks in furtherance of biofuel-based energy production; and (2) support the biofuels energy industry when production is at risk due to reductions in feedstocks or commodity prices. Sets forth related provisions respecting commercial commodity purchases, release of commodity stocks, and storage payments.
Authorizes the Secretary to make and guarantee loans for biofuel production, distribution, development, and storage.

**Current Status:** Referred to the Subcommittee on Farm Commodities and Risk Management on November 16, 2001.

### H.R. 3274 - Comprehensive Energy Conservation Act for the 21st Century

**Introduced:** November 11, 2001 by Congressman Bernard Sanders (Independent)

**Purpose:** To provide assistance to those individuals most affected by high energy prices and to promote and accelerate energy conservation investments in the United States.

**Summary:** (Section 605), Federal Renewable Portfolio Standard. The Comprehensive Energy Conservation Act for the 21st Century amends the Public Utility Regulatory Policies Act of 1978 to set forth a Federal renewable portfolio standard that requires every retail electric supplier to submit Renewable Energy Credits to the Secretary of Energy according to prescribed annual percentages of the total electric energy sold by the supplier to electric consumers during the calendar year.

**Current Status:** Referred to the Subcommittee on Education Reform on March 6, 2002.

## H.R. 3406 - Electric Supply and Transmission Act

**Introduced:** December 5, 2001 by Congressman Joe Barton (Republican)

**Purpose:** To benefit consumers and enhance the Nation's energy security by removing barriers to the development of competitive markets for electric power, providing for the reliability and increased capacity of the Nation's electric transmission networks, promoting the use of renewable and alternative sources of electric power generation.

**Summary:** (Section 102(b)). Federal Standards for State Net Metering Programs. The State Net Metering Program would encourage private investments in renewable and unconventional energy resources; enhance the diversity of the Nation's electricity supply by increasing reliance on a wide range of renewable and other environmentally sound distributed generation technologies; and protect the environment by promoting clean energy sources. The generating unit meeting the requirements will qualify for net metering if the unit is a fuel cell or uses as its energy source either solar, wind or biomass.

**Current Status**: Referred to the Subcommittee on Water and Power on December 19, 2001.

## H.R. 4668 - Renewable Fuel Equity Act

**Introduced:** May 7, 2002 by Congressman Duncan Hunter (Republican)

**Purpose:** To amend the Internal Revenue Code of 1986 to expand the renewable resources production tax credit to include additional forms of renewable energy, and to expand the investment tax credit to include equipment used to produce electricity from renewable resources.

**Summary:** Amends the Internal Revenue Code to expand the renewable resources credit to include geothermal and solar energy, incremental hydropower and biomass (other than closed-loop biomass).

Set forth qualifying dates of service for facilities using such means to produce electricity.

Expands the investment tax credit to include equipment used to produce electricity from certain renewable resources.

Increases, from 10 to 20 percent, the “energy percentage” used to determine the energy credit in the case of energy property having a total installed electrical generating capacity of less than one megawatt that is placed in service before January 1, 2007.

**Current Status:** Referred to the House Committee on Ways and Means on May 7, 2002.

## H.R. 5159 - State Waste Empowerment and Enforcement Provision Act of 2002

**Introduced:** July 18, 2002 by Congresswoman Jo Ann Davis (Republican)

**Purpose:** To authorize States to regulate the receipt and disposal of out-of-State municipal solid waste.

**Summary:** The State Waste Empowerment and Enforcement Provision Act of 2002 amends the Solid Waste Disposal Act to authorize a State to limit, place restrictions on, or otherwise regulate out-of-state municipal solid waste received or disposed of annually at each landfill or incinerator in the State, except, until two years after enactment of this Act, to the extent that a host community agreement (between an owner or operator of a landfill or incinerator and an affected local government) specifically authorizes such receipt.

**Current Status:** Referred to the Subcommittee on Environment and Hazardous Materials on July 29, 2002.

# Appendix F

# Revisions to EIA Methodology for Presenting Sectors and Estimating Electric Power Producers' Energy Consumption

The EIA has reorganized the way it presents data on electric power producers to reflect the changing structure of the electric power industry. Previously, electric utilities were presented as a separate sector and nonutilities were included in the industrial sector. EIA has now created an electric power sector, which includes all entities whose primary purpose of business is the production and sale of electricity, i.e., all electric utilities and independent power producers. [14] The remaining nonutilities are assigned to the industrial or commercial sectors, depending on the primary purpose of their business. This report recasts data for generation, capacity, and energy consumption according to the revised sectoral definitions.

To improve accuracy, the EIA has also changed its methodology for estimating biomass energy consumption for electricity generation. Previously, EIA applied the fossil fuel equivalent heat rate to biomass net generation to estimate biomass energy consumption for electricity generation.[15] Now, EIA uses estimates based on individual power plant fuel consumption data reported on the EIA electric power surveys. This method applies to all nonutility producers from 1989 forward and electric utilities starting in 2001. Since most of the power producers using biomass are nonutilities, this has resulted in a significant difference. Power producers are less efficient in generating electricity from biomass than previously estimated (Table F1).

**Table F1. Comparison of Estimates of Biomass Energy Consumption for Generating Electricity, 1997-1999**

| | Prior | Current | Difference |
|---|---|---|---|
| 1997 . . . . . | 567 | 823 | 256 |
| 1998 . . . . . | 548 | 807 | 259 |
| 1999 . . . . . | 596 | 822 | 226 |

Sources: Prior: Energy Information Administration, *Renewable Energy Annual 2000*, DOE/EIA-0603(2001) (Washington, DC, March 2001), Table 3. Current: Table 3 of this report.

To derive these estimates, EIA conducted a thorough review of relevant historical nonutility electric power plant operating data. This resulted in revisions for 1989-2000 to plant capacity, electricity generation, energy consumption, and useful thermal output. Historical data provided in this report is therefore significantly revised. Because energy consumption at combined-heat-and-power (CHP) plants is not disaggregated, EIA also developed a methodology for dividing plant energy consumption between energy for electricity generation and energy for useful thermal output. The division assumes that CHP plants are on average 80 percent efficient in producing useful thermal output.

A detailed explanation of the rational behind the changes and new methodologies described above is found in the *Annual Energy Review 2001*, Appendix H.[16]

[14] For a detailed description of the sectors by North American Classification System (NAICS) see Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384(2001) (Washington, DC, October 2002), Appendix G.

[15] The heat rate for fossil-fuel steam electric plants is estimated as 10,201 Btu/kilowatthour for 2000. See Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384(2001) (Washington, DC, October 2002), Table A6.

[16] See Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384(2001) (Washington, DC, October 2002), Appendix H.

## Appendix G

# Selected List of Internet Addresses: Renewable Energy Information by Resource

The list of addresses that follow are current as of Fall 2002. This list should provide a useful start in a search for renewable energy information.

### General: Renewables

U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy
http://www.eren.doe.gov

DOE Renewable Energy Regional Offices
http://www.eren.doe.gov/rso.html

Energy Information Administration
http://www.eia.doe.gov

Database of State Incentives for Renewable Energy
http://www.dsireusa.org

Renewable Energy Policy Project
http://www.crest.org

International Energy Agency
Renewable Energy
http://www.iea.org

National Renewable Energy Laboratory
NREL Publications Database
http://www.nrel.gov/publications

National Renewable Energy Laboratory Analysis
The Bottom Line - Financial Models
http://www.nrel.gov/analysis/financial_models.html

National Association of Regulatory Utility Commissioners (NARUC)
http://www.naruc.org

California Energy Commission
http://www.energy.ca.gov

Green Energy News
http://www.nrglink.com

Renewable Resource Data Center
http://rredc.nrel.gov

DOE Green Power Network
http://www.eren.doe.gov/greenpower

State Renewable Energy News
http://www.nrel.gov/analysis/emaa/projects/sren

Interstate Renewable Energy Council
http://www.irecusa.org

Renewable Energy Businesses and Organizations in the World
http://energy.sourceguides.com/index.shtml

### Biomass: Wood

Regional Wood Energy Development Programme in Asia
http://www.rwedp.org

Forest Industry Network
World-wide directory of forestry, logging, harvesting, saw milling equipment, etc. companies and related information.
http://www.forestindustry.com

Wood Products Council
http://www.woodinfo.org

American Forest and Paper Association
http://www.afandpa.org

### Biomass: Biofuels

U.S. Department of Agriculture Biofuels Information
http://www.nal.usda.gov/ttic/biofuels.htm

DOE BioPower Program
http://www.eren.doe.gov/biopower

American Bioenergy Association
http://www.biomass.org

DOE Alternative Fuels Data Center
http://www.afdc.doe.gov

DOE National Biofuels Program
http://www.biofuels.nrel.gov/

Short-Rotation Woody Crops (SRWC) Operations Working Group: a private and public partnership between wood products companies, equipment manufacturers, utility companies, the U.S. Forest Service, the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL), the National Council of the Paper Industry for Air and Stream Improvement (NCASI) and university researchers.
http://www.woodycrops.org

## Municipal Solid Waste

U.S. Environmental Protection Agency (EPA), Office of Solid Waste
http://www.epa.gov/osw

The Solid Waste Association of North America
http://www.swana.org

EPA, Municipal Solid Waste: Basic Facts
http://www.epa.gov/epaoswer/non-hw/muncpl/facts.htm

## Waste-to-Energy

Integrated Waste Services Association
http://www.wte.org

## Geothermal

Idaho National Engineering and Environmental Laboratory Geothermal Energy Web Site
http://geothermal.id.doe.gov

Geo-Heat Center, Oregon Institute of Technology, Geothermal Information and Technology Transfer
http://geoheat.oit.edu

International Geothermal Association
http://iga.igg.cnr.it/index.php

California Energy Commission's Geothermal Program
http://www.energy.ca.gov/geothermal/index.html

Geothermal Energy Association
http://www.geo-energy.org

Geothermal Resources Council
http://www.geothermal.org

DOE Geothermal Energy Program
http://www.eren.doe.gov/geothermal

## Wind

Danish Wind Industry Association
http://www.windpower.dk/core.htm

Wind Info Resources on the Net
http://www.afm.dtu.dk/wind/bookmark.html

British Wind Energy Association
http://www.bwea.com

European Wind Energy Association
http://www.ewea.org

German Wind Energy Association
http://www.wind-energie.de

German Wind Energy Institute
Wind Energy Use in Germany
http://www.dewi.de/statistics.html

Riso National Laboratory Denmark
Wind Energy Department
http://www.risoe.dk/vea

American Wind Energy Association
http://www.awea.org

Windpower Monthly News Magazine
http://www.wpm.co.nz

DOE Wind Energy Program
http://www.eren.doe.gov/wind

DOE Wind Energy Topics
http://www.eren.doe.gov/RE/wind.html

National Renewable Energy Laboratory's National Wind Technology Center
http://www.nrel.gov/wind

Wind Powering America
http://www.eren.doe.gov/windpoweringamerica

## Solar Energy

International Solar Energy Society
http://www.ises.org

## Solar Thermal

ASME (American Society of Mechanical Engineers) Solar Energy Division
http://www.asme.org/divisions/solar/index.html

The International Society for Optical Engineering Publications: Solar Radiation and Solar Thermal Systems
http://www.spie.org/web/abstracts/oepress/MS54.html

Sandia National Laboratories
National Solar Thermal Test Facility
http://www.sandia.gov/Renewable_Energy/solarthermal/nsttf.html

## Solar Photovoltaic

DOE National Center For Photovoltaics
http://www.nrel.gov/ncpv

PV WEB SITES
http://www.pvpower.com/pvsites.html

BP Solar
http://www.bpsolar.com

NASA Photovoltaic and Space Environments Branch
http://powerweb.lerc.nasa.gov/pvsee

Advancing Photovoltaic Technology at NREL's Outdoor Test Facility
http://www.nrel.gov/lab/pao/otf.html

Million Solar Roofs Initiative
http://www.millionsolarroofs.org

Solar Electric Power Association
http://www.solarelectricpower.org

Sandia National Laboratories Photovoltaics Program
http://www.sandia.gov/pv

PV Energy Systems, Inc.
http://www.pvenergy.com

Photovoltaic Insider's Report
http://www.pvinsider.com

### Fuel Cells

DOE Office of Fossil Energy
Electric Power R&D: Fuel Cell Technology
http://www.fe.doe.gov/coal_power/fuelcells/index.shtml

The Hydrogen & Fuel Cell Letter
http://www.hfcletter.com

U.S. Fuel Cell Council
http://www.usfcc.com

# Appendix H

# State Energy Agencies

The following lists the State Energy Office (or equivalent), the Public Utility Commission (or equivalent), and the State Geologist (when available) for each State, the District of Columbia, Puerto Rico, and Territories. [17]

## Alabama

**State Energy Office**
Terri Adams, Division Director
Department of Economic and
Community Affairs
Science Technology and Energy Division
P.O. Box 5690
Montgomery, AL 36103-5690
(334) 242-5292
Fax: (334) 242-0552
e-mail: dollieb@adeca.state.al.us
http://www.adeca.state.al.us/adeca/pages/pages_stm/Science_Technology_Energy_STE.stm

**State Geologist**
Donald F. Oltz
Geological Survey of Alabama
420 Hackberry Lane (W.B. Jones Hall)
University of Alabama
P.O. Box 869999
Tuscaloosa, AL 35486-6999
(205) 349-2852
Fax: (205) 349-2861
e-mail: info@state.al.us
http://www.gsa.state.al.us

**Public Service Commission**
Walter L. Thomas, Jr., Secretary
P.O. Box 991
Montgomery, AL 36101-0991
(334) 242-5868
Fax: (334) 242-0207
http://www.psc.state.al.us

## Alaska

**Alaska Energy Authority**
Peter Crimp
813 West Northern Lights Blvd.
Anchorage, AK 99503
(907) 269-4631
Fax: (907) 269-3044
e-mail: Pcrimp@aidea.org
http://www.aidea.org/aea.htm

**State Geologist**
Milton A. Wiltse, State Geologist and Director
Department of Natural Resources
Division of Alaska Geological and
Geophysical Survey
794 University Avenue, Suite 200
Fairbanks, AK 99709-3645
(907) 451-5005
Fax: (907) 451-5050

**Alaska Regulatory Commission**
G. Nanette Thompson, Chair
701 West 8th Avenue, Suite 300
Anchorage, AK 99501
(907) 276-6222
Fax: (907) 276-0160
e-mail: RCA_mail@rca.state.ak.us
http://www.state.ak.us/rca/

## American Samoa

**State Energy Office**
Reupena Tataloa, Director
Territorial Energy Office

[17]This information was excerpted from: Energy Information Administration, *Energy Information Directory, 2001*, DOE/EIA-0205(2001) (Washington, DC, 4th Quarter 2001); National Association of State Energy Officials (NASEO), http://www.naseo.org/members/states.htm, (February 19, 2002); American Association of State Geologists, http://www.kgs.ukans.edu/AASG/AASG.html, (February 19, 2002); National Association of Regulatory Utility Commissioners (NARUC), http://www.naruc.org/resources/state.html, (February 19, 2002).

American Samoa Government
Samoa Energy House, Tauna
P.O. Box PPB
Pago Pago, American Samoa 96799
011 (684) 699-1101
Fax: 011 (684) 699-2835
http://www.naseo.org/members/states/asmsomoa.htm

## Arizona

**State Energy Office**
Arizona Energy Office
Craig Marks, Energy Coordinator
Arizona Department of Commerce
3800 North Central Avenue, Suite 1200
Phoenix, AZ 85012
(602) 280-1402
Fax: (602) 280-1445
e-mail: craigm@azcommerce.com
http://www.commerce.state.az.us/energy.htm

**State Geologist**
Larry D. Fellows, State Geologist and Director
Arizona Geological Survey
416 W. Congress Street, Suite 100
Tucson, AZ 85701-1315
(520) 770-3500
Fax: (520) 770-3505
e-mail: Larry.Fellows@azgs.az.gov
http://www.azgs.state.az.us

**Corporation Commission**
William A. Mundell, Chairman
Arizona Corporation Commission
1200 W. Washington
Phoenix, AZ 85007-2996
(602) 542-3931
Fax: (602) 542-3977
http://www.cc.state.az.us/index.htm

## Arkansas

**State Energy Office**
Arkansas Energy Office
Chris Benson, Director
Arkansas Industrial Development Commission
One Capitol Mall
Little Rock, AR 72201
(501) 682-7377
Fax: (501) 682-2703
e-mail: INFO@1-800-ARKANSAS.com
http://www.aedc.state.ar.us/Energy

**State Geologist**
William V. Bush, Director and State Geologist
Arkansas Geological Commission
3815 West Roosevelt Road
Little Rock, AR 72204
(501) 296-1877
Fax: (501) 663-7360

**Public Service Commission**
Sandra L. Hochstetter, Chairman
Arkansas Public Service Commission
1000 Center Street
Little Rock, AR 72203-0400
(501) 682-2051
Fax: (501) 682-2572
http://www.state.ar.us/psc

## California

**State Energy Commission**
California Energy Commission
William J. Keese, Chairman
1516 Ninth Street, MS#32
Sacramento, CA 95814
(916) 654-4287
Fax: (916) 654-4420
e-mail: energyia@energy.ca.gov
http://www.energy.ca.gov

**State Geologist**
James F. Davis
Department of Conservation
Division of Mines and Geology
801 K Street, MS 12-01
Sacramento, CA 95814-3529
(916) 445-1825
Fax: (916) 445-5718
http://www.consrv.ca.gov/dmg/index.htm

**California Public Utilities Commission**
Loretta M. Lynch, President
505 Van Ness Avenue
San Francisco, CA 94102
(415) 703-2782
Fax: (415) 703-1758
http://www.cpuc.ca.gov

## Colorado

**State Energy Office**
Rick Grice, Director
Governor's Office of Energy Management and Conservation

225 E. 16th Ave., Suite 650
Denver, CO 80203
(303) 894-2383
Fax: (303) 894-2388
e-mail: oemc@state.co.us
http://www.state.co.us/oemc

**State Geologist**
Vicki Cowart, State Geologist and Director
Colorado Geological Survey
1313 Sherman Street, Room 715
Denver, CO 80203
(303) 866-2611
Fax: (303) 866-2461
e-mail: vicki.cowart@state.co.us
http://165.127.86.111/survey.html

**Public Utilities Commission**
Raymond Gifford, Chairman
Colorado Department of Regulatory Agencies
Public Utilities Commission
1580 Logan Street, OL 2
Denver, CO 80203
(303) 894-2000
Fax: (303) 894-2065
e-mail: puc@dora.state.co.us
http://www.dora.state.co.us/puc/

## Connecticut

**State Energy Office**
Allan Johanson
Connecticut State Office of Policy and Management
Energy Research and Policy Development
Unit
450 Capitol Avenue, MS-52ENR
Hartford, CT 06106-1308
(860) 418-6297
Fax: (860) 418-6495
e-mail: allan.johanson@po.state.ct.us
http://www.opm.state.ct.us/

**State Geologist**
Ralph S. Lewis
Connecticut Geological and Natural History Survey
Department of Environmental Protection
Environmental and Geographic Information
Center
79 Elm Street, Store Level
Hartford, CT 06106-5127
(860) 424-3540
Fax: (860) 424-4058
http://dep.state.ct.us/cgnhs

**Department of Public Utility Control**
Donald W. Downes, Chairman
10 Franklin Square
New Britain, CT 06051
(860) 827-1553
Fax: (860) 827-2613
e-mail: dpuc.information@po.state.ct.us
http://www.state.ct.us/dpuc

## Delaware

**State Energy Office**
Energy Office
Charlie T. Smisson, Jr.
Energy Program Administrator
Division of Facilities Management
149 Transportation Circle
Dover, DE 19901
(302) 739-5644
Fax: (302) 739-6148
e-mail: csmission@state.de.us
http://www.naseo.org/members/states/delawar
e.htm

**State Geologist**
Robert R. Jordan, State Geologist and Director
Delaware Geological Survey
University of Delaware
DGS Building
Newark, DE 19716-7501
(302) 831-2833
Fax: (302) 831-3579
e-mail: rrjordan@UDel.edu
http://www.udel.edu/dgs

**Delaware Public Service Commission**
Arnetta McRae, Chair
861 Silver Lake Boulevard
Cannon Building, Suite 100
Dover, DE 19904
(302) 739-4247
Fax: (302) 739-4849
e-mail: karen.nickerson@State.DE.US
http://www.state.de.us/delpsc

## District of Columbia

**D.C. Energy Office**
Charles J. Clinton, Director
District of Columbia Energy Office
2000 14th Street, N.W., Suite 300E
Washington, DC 20009
(202) 673-6700
Fax: (202) 673-6725

e-mail: clintonde@aol.com
http://www.dcenergy.org

**Public Service Commission**
Angel M. Cartagena, Jr. (Esq.), Chairman
1333 H Street, NW
Washington, DC 20005
(202) 626-5100
Fax: (202) 393-1389
e-mail: dflores@dcpsc.org
http://www.dcpsc.org

## Florida

**State Energy Office**
State Energy Program
Alexander Mack, Director
Department of Community Affairs
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 488-2475
Fax: (850) 488-7688
e-mail: alexander.mack@dca.state.fl.us
http://www.dca.state.fl.us/fhcd/programs/sep/index.htm

**State Geologist**
Walter Schmidt, Bureau Chief
Florida Geological Survey
Gunter Building MS#720
903 W. Tennessee Street
Tallahassee, FL 32304-7700
(850) 488-4191
Fax: (850) 488-8086
e-mail: walt.schmidt@dep.state.fl.us
http://www.dep.state.fl.us/geology/

**Public Service Commission**
E. Leon Jacobs, Chairman
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850
(850) 413-6100
Fax: (850) 511-0809
e-mail: contact@psc.state.fl.us
http://www.floridapsc.com

## Georgia

**State Energy Office**
Paul Burks, Executive Director
Division of Energy Resources
Georgia Environmental Facilities Authority
Equitable Building
100 Peachtree Street, N.W., Suite 2090
Atlanta, GA 30303
(404) 656-0939
Fax: (404) 656-6416
Fax: (404) 656-7970 (Division of Energy Resources)
e-mail: pburks@gefa.org
http://www.gefa.org/energy_program.html

**State Geologist**
William H. McLemore, State Geologist and Branch Chief
Georgia Geologic Survey Branch
19 Martin Luther King Jr. Drive, Room 400
Atlanta, GA 30334
(404) 656-3214
Fax: (404) 657-8379
http://www.dnr.state.ga.us/dnr/environ/aboutepd_files/branches_files/gsb.htm

**Public Service Commission**
David Burgess, Chairman
244 Washington Street
Atlanta, GA 30334
(404) 656-4501
Fax: (404) 656-2341
e-mail: gapsc@psc.state.ga.us
http://www.psc.state.ga.us/

## Guam

**Energy Office**
Fred P. Camacho, Director
Guam Energy Office
Pacific Energy Resources Center
548 N. Marine Drive
Tamuning, Guam 96911
(671) 477-0538
Fax: (671) 477-0589
http://www.guamenergy.com

## Hawaii

**State Energy Office**
Carilyn O. Shon, Branch Chief,
Energy Conservation Branch
Energy, Resources, and Technology Division
Hawaii State Department of Business, Economic Development, and Tourism
P.O. Box 2359
Honolulu, HI 96804-2359
(808) 587-3807
Fax: (808) 587-3820
e-mail: cshon@dbedt.hawaii.gov
http://www.hawaii.gov/dbedt/ert/energy.html

**State Geologist**
Andrew Monden
Hawaii Geological Survey
Department of Land and Natural Resources
Division of Water and Land Development
P.O. Box 373
Honolulu, HI 96809
(808) 587-0230
Fax: (808) 587-0283

**Public Utilities Commission**
Dennis Yamada, Chairman
465 S. King Street, #103
Honolulu, HI 96813
(808) 586-2020
Fax: (808) 586-2066
e-mail: hipuc@lava.net

## Idaho

**State Energy Office**
Robert W. Hoppie, Division Administrator
Idaho Department of Water Resources
Energy Division
1301 North Orchard Street
Boise, ID 83706
(208) 327-7900
Fax: (208) 327-7866
http://www.idwr.state.id.us/energy/Staff/Default.htm

**State Geologist**
Earl H. Bennett, State Geologist and Director
Idaho Geological Survey
Morrill Hall, Third Floor
University of Idaho
Moscow, ID 83843-3014
(208) 885-7991
Fax: (208) 885-5826
e-mail: bennett@uidaho.edu
http://www.idahogeology.org

**Public Utilities Commission**
Randy Lobb, Administrator
Utilities Division
P.O. Box 83720
Boise, ID 83720-0074
(208) 334-0350
Fax: (208) 334-3762
e-mail: rlobb@puc.state.id.us
http://www.puc.state.id.us

## Illinois

**Department of Commerce and Community Affairs**
Mitch Beaver, Deputy Director
Bureau of Energy and Recycling
607 East Adams Street
Springfield, IL 62701
(217) 785-2009
Fax: (217) 785-2618
e-mail: MBEAVER@commerce.state.il.us
http://www.commerce.state.il.us/resource_efficiency/Energy/energy.htm

**State Geologist**
William W. Shilts, Chief
Illinois State Geological Survey
121 Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820-6964
(217) 333-5111
Fax: (217) 244-7004
e-mail: shilts@isgs.uiuc.edu
http://www.isgs.uiuc.edu/isgshome.html

**Illinois Commerce Commission**
Richard L. Mathias, Chairman
II Commerce Commission
527 E. Capitol Avenue
Springfield, IL 62701
(217)782-7295
FAX: (217)524-0673
http://www.icc.state.il.us/

## Indiana

**Indiana Department of Commerce**
Phil Powlick, Ph.D., Program Manager
Energy Policy Division
One North Capitol, Suite 700
Indianapolis, IN 46204
(317) 232-8940
Fax: (317) 232-8995
e-mail: ppowlick@commerce.state.in.us
http://www.state.in.us/doc/energy

**State Geologist**
John C. Steinmetz, Director and
State Geologist
Indiana Geological Survey
611 N. Walnut Grove

Bloomington, IN 47405
(812) 855-5067
Fax: (812) 855-2862
e-mail: jsteinm@indiana.edu
http://adamite.igs.indiana.edu/indsurv/about/

**Utility Regulatory Commission**
302 West Washington Street, Room E-306
Indianapolis, IN 46204
(317) 232-2700
Fax: (317) 232-6758
http://www.ai.org/iurc/index.html

## Iowa

**State Energy Office**
Sharon Tahtinen, Bureau Chief
Energy Bureau
Energy and Geological Resources Division
Iowa Department of Natural Resources
Wallace State Office Building
East 9th & Grand Avenue
Des Moines, IA 50319
(515) 281-7066
Fax: (515) 281-6794
e-mail: sharon.tahtinen@dnr.state.ia.us
http://www.naseo.org/members/states/iowa.htm

**State Geologist**
Donald L. Koch, State Geologist
Geological Survey Bureau
109 Trowbridge Hall
Iowa City, IA 52242-1319
(319) 335-1575
Fax: (319) 335-2754
e-mail: Don.Koch@dnr.state.ia.us
http://www.state.ia.us/dnr/egd

**Iowa Utilities Board**
Diane Munns, Chairman
350 Maple Street
Des Moines, IA 50319-0069
(515) 281-5979
Fax: (515) 281-5329
e-mail: iub@max.state.ia.us
http://www.state.ia.us/government/com/util/util.htm

## Kansas

**State Energy Office**
Jim Ploger, Energy Program Manager
Energy Programs
Kansas Corporation Commission
1500 S.W. Arrowhead Road
Topeka, KS 66604-4027
(785) 271-3349
Fax: (785) 271-3268
http://www.kcc.state.ks.us/energy/energy.htm

**State Geologist**
M. Lee Allison, Director and State Geologist
Kansas Geological Survey
University of Kansas
1930 Constant Avenue
Lawrence, KS 66047-3726
(785) 864-3965
Fax: (785) 864-5317
http://www.kgs.ukans.edu/kgs.html

**Corporation Commission**
John Wine, Chair
Kansas Corporation Commission
1500 SW Arrowhead Road
Topeka, KS 66604-2425
(785) 271-3100
Fax: (785) 271-3354
http://www.kcc.state.ks.us

## Kentucky

**State Energy Office**
John H. Davies, Director
Kentucky Division of Energy
663 Teton Trail
Frankfort, KY 40601
(502) 564-7192
Fax: (502) 564-7484
e-mail: kyenergy@mail.state.ky.us
http://www.nr.state.ky.us/nrepc/dnr/energy/dnrdoe.html

**State Geologist**
James C. Cobb
Kentucky Geological Survey
228 Mining and Mineral Resources Building
University of Kentucky
Lexington, KY 40506-0107
(859) 257-5500
Fax: (859) 257-1147

**Public Service Commission**
Martin J. Huelsmann, Chairman
P.O. Box 615
211 Sower Boulevard
Frankfort, KY 40602-0615
(502) 564-3940
Fax: (502) 564-3460
http://www.psc.state.ky.us

## Louisiana

**State Energy Office**
Paula Ridgeway, Supervisor
Louisiana Department of Natural Resources
Energy Section
P.O. Box 94396
LaSalle Office Building
617 North Third Street
Baton Rouge, LA 70802-5428
(225) 342-2133
Fax: (225) 342-1397
e-mail: paular@dnr.state.la.us
http://www.dnr.state.la.us/SEC/EXECDIV/TECHASMT/ENERGY/index.htm

**State Geologist**
Louisiana Geological Survey
Louisiana State University
Baton Rouge, LA 70803
(225) 578-5833
Fax: (225) 578-5983
http://www.lgs.lsu.edu/index1.htm

**Public Service Commission**
Lawrence C. St. Blanc, Secretary
One American Place, Suite 1630
Baton Rouge, LA 70821-9154
(225) 342-4427
Fax: (225) 342-4087
e-mail: joanh@lpsc.org
http://www.lpsc.org

**Mail letters to:**
P.O. Box 91154
Baton Rouge, LA 70821-9154

## Maine

**State Energy Office**
Ronald B. Lovaglio, Commissioner
Department of Conservation
286 Water Street
Key Bank Plaza
Augusta, ME
(207) 287-2656
Fax: (207) 287-5701

**Mailing Address:**
59 State House Station
Augusta, ME 04333-0022

**State Geologist**
Robert G. Marvinney
Maine Geological Survey
22 State House Station
Augusta, ME 04333-0022
(207) 287-2801
Fax: (207) 287-2353
e-mail: mgs@state.me.us
http://www.state.me.us/doc/nrimc/mgs/mgs.htm

**Public Utilities Commission**
Thomas L. Welch, Chairman
242 State Street
18 State House Station
Augusta, ME 04333-0018
(207) 287-3831
Fax: (207) 287-1039
http://www.state.me.us/mpuc

## Maryland

**State Energy Office**
Frederick H. Hoover, Jr., Director
Maryland Energy Administration
1623 Forest Drive, Suite 300
Annapolis, MD 21403
(410) 260-7655
Fax: (410) 974-2250
e-mail: mea@energy.state.md.us
http://www.energy.state.md.us

**State Geologist**
Emery T. Cleaves, Director
Maryland Geological Survey
2300 St. Paul Street
Baltimore, MD 21218-5210
(410) 554-5500
Fax: (410) 554-5502
e-mail: ecleaves@mgs.dnr.md.go
http://www.mgs.md.gov/index.html

**Public Service Commission**
Felecia L. Greer, Executive Secretary
William Donald Schaefer Tower
6 St. Paul Street, 16th Floor
Baltimore, MD 21202-6806
(410) 767-8067
Fax: (410) 333-6495
e-mail: mpsc@psc.state.md.us
http://www.psc.state.md.us/psc/home.htm

## Massachusetts

**State Energy Office**
David L. O'Connor, Commissioner
Massachusetts Division of Energy Resources

70 Franklin Street, 7th floor
Boston, MA 02110 - 1313
(617) 727-4732
Fax: (617) 727-0030
e-mail: DOER.Energy@State.MA.US
http://www.state.ma.us/doer/home.htm

**State Geologist**
Executive Office of Environmental Affairs
Bob Durand, Secretary
251 Causeway Street, 9th floor
Boston, MA 02114
(617)626-1000
Fax: (617)626-1181
e-mail: env.internet@state.ma.us
http://www.state.ma.us/envir/eoea.htm

**Department of Telecommunications and Energy**
James Connelly, Esq., Chairman
One South Station
Boston, MA 02110
(617) 305-3500
Fax: (617) 723-8812
e-mail: maxine.teixeira@state.ma.us
http://www.state.ma.us/dpu/

## Michigan

**State Energy Office**
R. Thomas Martin, Director
Energy Office
Michigan Department of Consumer and Industry Services
6545 Mercantile Way
P.O. Box 30221
Lansing, MI 48909
(517) 241-6228
Fax: (517) 241-6229
http://www.cis.state.mi.us/opla/eo/

**State Geologist**
Harold R. Fitch, State Geologist and Division Chief
Department of Environmental Quality
Geological Survey Division
P.O. Box 30256, (525 W. Allegan Street)
Lansing, MI 48909
(517) 241-1515
Fax: (517) 241-1595
e-mail: fitchh@michigan.gov
http://www.deq.state.mi.us/gsd/

**Public Service Commission**
Laura Chappelle, Chairman
Michigan Public Service Commission
6545 Mercantile Way, Suite 7
Lansing, MI 48911
(517) 241-6180
Fax: (517) 241-6181
e-mail: mpsc.webmaster@michigan.gov
http://cis.state.mi.us/mpsc

**Mailing Address:**
Public Service Commission
P.O. Box 30221
Lansing, MI 48909

## Minnesota

**State Energy Office**
Linda Taylor, Deputy Commissioner
MN Department of Commerce
Energy Division
85 7th Place East, Suite 600
St. Paul, MN 55101-3165
(651) 296-4026
Fax: (651) 297-7891
e-mail: energy.info@state.mn.us
http://www.commerce.state.mn.us/pages/EnergyMain.htm

**State Geologist**
Anthony C. (Tony) Runkel, Chief Geologist
Minnesota Geological Survey
University of Minnesota
2642 University Avenue
St. Paul, MN 55114-1057
(612) 627-4780
Fax: (612) 627-4778
e-mail: mgs@tc.umn.edu
http://www.geo.umn.edu/mgs/index.html

**Public Utilities Commission**
Janet Gonzalez, Energy
121 Seventh Place East, Suite 350
St. Paul, MN 55101-2147
(651) 296-1336
Fax: (651) 297-7073
e-mail: janet.gonzalez@state.mn.us
http://www.puc.state.mn.us

## Mississippi

**State Energy Office**
Mississippi Energy Division
Mississippi Development Authority
P. O. Box 850
Jackson, MS 39205-0850
(601) 359-6600
Fax: (601) 359-6642

e-mail: enrgydiv@mississippi.org
http://www.mississippi.org/programs/energy/energy_overview.htm

**State Geologist**
S. Cragin Knox
Office of Geology
Mississippi Department of Environmental Quality
P.O. Box 20307
Jackson, MS 39289-1307
(601) 961-5500
Fax: (601) 961-5521
e-mail: Cragin_Knox@deq.state.ms.us
http://www.deq.state.ms.us/newweb/homepages.nsf

**Mississippi Public Service Commission**
Brian U. Ray, Executive Secretary
P.O. Box 1174
Jackson, MS 39215-1174
(601) 961-5434
Fax: (601) 961-5469
http://www.psc.state.ms.us/executive/exec-sec.htm

## Missouri

**State Energy Office**
Missouri Department of Natural Resources
Energy Center
P.O. Box 176
Jefferson City, MO 65102-0176
(573) 751-4000
Fax: (573) 751-6860
e-mail: energy@mail.dnr.state.mo.us
http://www.dnr.state.mo.us/de/homede.htm

**State Geologist**
Mimi Garstang, Division Director and State Geologist
Department of Natural Resources
Division of Geology and Land Survey
P.O. Box 250
Rolla, MO 65402
(573) 368-2100
Fax: (573) 368-2111
e-mail: dnrdgls@mail.dnr.state.mo.us
http://www.dnr.state.mo.us/dgls

**Public Service Commission**
Kelvin L. Simmons, Chair
Public Information Office
Governor Office Building
200 Madison Street
P. O. Box 360
Jefferson City, MO 65102-0360
(573) 751-3234
Fax: (573) 526-7341
e-mail: pscinfo@mail.state.mo.us
http://www.psc.state.mo.us

## Montana

**State Energy Office**
Art Compton, Administrator
Department of Environmental Quality
Planning, Prevention and Assistance Division
1520 East Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901
(406) 444-6754
Fax: (406) 444-6836
e-mail: acompton@state.mt.us
http://www.naseo.org/members/states/montana.htm

**State Geologist**
Edmond G. Deal, Director and State Geologist
Montana Bureau of Mines and Geology
Montana Tech of the University of Montana
1300 West Park Street
Main Hall
Butte, MT 59701-8997
(406) 496-4180
Fax: (406) 496-4451
e-mail: pubsales@mtech.edu
http://www.mbmg.mtech.edu/bureau.htm

**Public Service Commission**
Gary Feland, Chairman
1701 Prospect Avenue
P.O. Box 202601
Helena, MT 59620-2601
(406) 444-6199
Fax: (406) 444-7618
e-mail: Gfeland@state.mt.us
http://psc.state.mt.us

## Nebraska

**State Energy Office**
Nebraska Energy Office
Bonnie Ziemann, Assistant Director for Operations
P.O. Box 95085
1111 "O" Street, Suite 223
Lincoln, NE 68509-5085
(402) 471-2867
Fax: (402) 471-3064

bziemann@mail.state.ne.us
http://www.nol.org/home/NEO/

**State Geologist**
Dave Becker, Chair
State of Nebraska Board of Geologists
P.O. Box 94844
Lincoln, NE 68509-4844
(402) 471-8383
Fax: (402) 471-0787
e-mail: geology@nol.org
http://www.geology.state.ne.us/board/nbg.htm

**Public Service Commission**
Andy Pollock, Executive Director
300 The Atrium
1200 N Street, P. O. Box 94927
Lincoln, NE 68509-4927
(402) 471-3101
Fax: (402) 471-0254
http://www.doc.state.ne.us/directory.htm#pubsvscom

## Nevada

**State Energy Office**
Dave McNeil, Administrator
Nevada State Energy Office
727 Fairview Drive, Suite F
Carson City, NV 89701
(775) 687-5975
Fax: (775) 687-4914
e-mail: dmcneil@dbi.state.nv.us
http://energy.state.nv.us

**State Geologist**
Jonathan G. Price, Director
Nevada Bureau of Mines and Geology, Mail Stop 178
University of Nevada, Reno
Reno, NV 89557-0088
(775) 784-6691, Ext. 126
Fax: (775) 784-1709
e-mail: jprice@unr.edu
http://www.nbmg.unr.edu

**Public Utilities Commission of Nevada**
Donald L. Soderberg, Chairman
1150 E. William Street
Carson City, NV 89701
(775) 775-6007
Fax: (775) 775-6110
e-mail: puccompliance@puc.state.nv.us
http://puc.state.nv.us

## New Hampshire

**State Energy Office**
Governor's Office of Energy and Community Service
Joseph Broyles, Energy Program Manager
57 Regional Drive
Concord, NH 03301-8519
(603) 271-8341
Fax: (603) 271-2615
http://www.state.nh.us/governor/energycomm/sep/html

**State Geologist**
Eugene L. Boudette
New Hampshire Geological Survey
Department of Environmental Sciences
Box 2008
Concord, NH 03302-2008
(603) 271-3406
Fax: (603) 271-7894
http://www.state.nh.us/des/descover.htm

**Public Utilities Commission**
Thomas B. Getz, Chairman
8 Old Suncook Road
Concord, NH 03301-7319
(603) 271-2431
Fax: (603) 271-3878
http://www.puc.state.nh.us

## New Jersey

**State Geologist**
Karl Muessig, Ph.D.
New Jersey Geological Survey
Department of Environmental Protection
29 Arctic Parkway
P.O. Box 427
Trenton, NJ 08625
(609) 292-1185
Fax: (609) 633-1004
http://www.state.nj.us/dep/njgs/

**New Jersey Board of Public Utilities**
Frederich F. Butler, Acting President
2 Gateway Center, 8th Floor
Newark, NJ 07102
(973) 648-2026
Fax: (973) 648-4195
http://www.bpu.state.nj.us

**Division of Energy**
Frank Perrotti, Director
Two Gateway Center, 9th Floor
Newark, NJ 07102

(973) 648-3621
Fax: (973) 648-2467
http://www.bpu.state.nj.us/wwwroot/energy/energy.htm

## New Mexico

**State Energy Office**
Chris Wentz, Director
Energy Conservation & Management Division
Energy, Minerals and Natural Resources Department
1220 S Street
Francis Drive
Santa Fe, NM 87505
(505) 476-3310
Fax: (505) 476-3322
e-mail: cwentz@state.nm.us
http://www.emnrd.state.nm.us/ecmd/

**State Geologist**
Dr. Peter A. Scholle
New Mexico Bureau of Mines and Mineral Resources
Division of New Mexico Tech
Institute of Mining and Technology
801 Leroy Place
Socorro, NM 87801-4796
(505) 835-5420
Fax: (505) 835-6333
e-mail: bureau@gis.hmt.edu
http://geoinfo.nmt.edu

**Public Regulation Commission**
S. Vincent Martinez, Chief of Staff
1120 Paseo De Peralta
P.O. Box 1269
Santa Fe, NM 87504
(505) 827-6942
Fax: (505) 827-4068
http://www.nmprc.state.nm.us/

## New York

**State Energy Office**
Energy Research and Development Authority
Paul DeCotis, Program Director, Energy Analysis
Corporate Plaza West
286 Washington Avenue Ext.
Albany, NY 12203-6399
(518) 862-1090
Fax: (518) 862-1091
e-mail: pad@nyserda.org
http://www.nyserda.org/energyinfo.html

**State Geologist**
Robert H. Fakundiny
New York Geological Survey
State Museum
3140 Cultural Education Center
Albany, NY 12230
(518) 486-2002
Fax: (518) 486-3696
e-mail: rfakundi@mail.nysed.gov
http://www.nyserda.org/energyinfo.html

**Public Service Commission**
Maureen O. Helmer, Chairman
3 Empire State Plaza
Albany, NY 12223-1350
(518) 474-7080
Fax: (518) 474-0421
e-mail: web@dps.state.ny.us
http://www.dps.state.ny.us

## North Carolina

**State Energy Office**
Larry Shirley, Director
Energy Division
North Carolina Department of Administration
1340 Mail Service Center

Raleigh, NC 27699
(919) 733-1889
Fax: (919) 733-2953
e-mail: larry.shirley@ncmail.net
http://www.naseo.org/members/states/north_carolina.htm

**State Geologist**
North Carolina Geological Survey
Division of Land Resources
1612 Mail Service Center
Raleigh, NC 27699-1612
(919) 733-2423
Fax: (919) 715-0900
e-mail: Jeff.Reid@ncmail.net
http://www.geology.enr.state.nc.us

**Utilities Commission**
Jo Anne Sanford, Chair
430 North Salisbury Street
Dobbs Building
Raleigh, NC 27603-5918
(919) 733-7328
Fax: (919) 733-7300
http://www.ncuc.commerce.state.nc.us

**Mailing Address:**
4325 Mail Service Center
Raleigh, NC 27699-4325

## North Dakota

**State Energy Office**
Kim Christianson
Energy Program Manager
Division of Community Services
400 East Broadway, Suite 50
P.O. Box 2057
Bismarck, ND 58502-2057
(701) 328-4137
Fax: (701) 328-5320
e-mail: dcs@state.nd.us
http://www.state.nd.us/dcs/Energy/default.html

**State Geological Survey**
John P. Bluemle, State Geologist and Director
North Dakota Geological Survey
1016 E. Calgary Ave.
Bismarck ND 58501
(701) 328-8000
Fax: (701) 328-8010
e-mail: jbluemle@state.nd.us
http://www.state.nd.us/ndgs/

**Mailing Address:**
600 East Boulevard Avenue
Bismarck, ND 58505-0840

**Public Service Commission**
Susan E. Wefald, President
600 E. Boulevard, Dept 408
Bismarck, ND 58505-0480
(701) 328-2400
Fax: (701) 328-2410
e-mail: ndpsc@oracle.psc.state.nd.us
http://pc6.psc.state.nd.us/

## Ohio

**State Energy Office**
Tom Maves, Renewable Energy Specialist
Ohio Department of Development
Community Development Division
Office of Energy Efficiency
77 S. High Street, 26th Floor
Columbus, OH 43216-1001
(614) 466-8425
Fax: (614) 466-1864
e-mail: tmaves@odod.state.oh.us
http://www.odod.state.oh.us/cdd/oee/

**State Geologist**
Thomas M. Berg, Chief
Division of Geological Survey
Ohio Department of Natural Resources
4383 Fountain Square Drive
Columbus, OH 43224-1362
(614) 265-6576
Fax: (614) 447-1918
e-mail: geo.survey@dnr.state.oh.us
http://www.ohiodnr.com/geosurvey/

**Public Utilities Commission**
Alan R. Schriber, Chairman
180 E. Broad Street
Columbus, OH 43215-3793
(614) 466-4294
Fax: (614) 644-9546
e-mail: webmaster@puc.state.oh.us
http://www.puc.state.oh.us

## Oklahoma

**State Energy Office**
Linda Stinnett
Oklahoma Department of Commerce
Office of Community Development
Energy Programs
900 N. Stiles/P.O. Box 26980
Oklahoma City, OK 73126-0980
(405) 815-5352
Fax: (405) 815-5344
e-mail: pat_schallenberg@odoc.state.ok.us
http://www.odoc.state.ok.us/index.html

**State Geologist**
Charles J. Mankin, Director
Oklahoma Geological Survey
100 East Boyd, Room N-131
Norman, OK 73019-0628
(405) 325-3031
Fax: (405) 325-7069
e-mail: cjmankin@ou.edu
http://www.ou.edu/special/ogs-pttc

**Oklahoma Corporation Commission**
Denise A. Bode, Chairman
2101 North Lincoln Boulevard
Oklahoma City, OK 73105
(405) 521-2211
Fax: (405) 521-3336
e-mail: d.bode@occmail.occ.state.ok.us
http://www.occ.state.ok.us/

**Mailing Address:**
P.O. Box 52000-2000
Oklahoma City, OK 73152-2000

## Oregon

**State Energy Office**
John Savage, Director
Oregon Office of Energy
625 Marion Street NE
Salem, OR 97301
(503) 378-4040
Fax: (503) 373-7806
e-mail: energy.in.internet@state.or.us
http://www.energy.state.or.us

**State Geologist**
John D. Beaulieu, Director and State Geologist
Oregon Department of Geology and Mineral Industries
800 NE Oregon Street, Suite 965
Portland, OR 97232
(503) 731-4100
Fax: (503) 731-4066
e-mail: john.beaulieu@dogami.state.or.us
http://www.oregongeology.com/

**Public Utility Commission**
Roy Hemmingway, Chairman
550 Capitol Street, N.E. Suite 215
Salem, OR 97301-2551
(503) 378-6611
Fax: (503) 378-5505
e-mail: puc.commission@state.or.us
http://www.puc.state.or.us/

## Pennsylvania

**State Energy Office**
Department of Environmental Protection
David Hess, Secretary
400 Market Street
P.O. Box 2357
Harrisburg, PA 17105-2357
http://www.dep.state.pa.us

**State Geologist**
Jay B. Parrish, PG
Bureau of Topographic and Geologic Survey
Department of Conservation and Natural Resources
3240 Schoolhouse Rd.
Middletown, PA 17057
(717) 702-2017
Fax: (717) 702-2065
e-mail: ra-askdcnr@state.pa.us
http://www.dcnr.state.pa.us/emaildcnr.htm

**Public Utility Commission**
Glen R. Thomas, Chairman
Commonwealth Keystone Building
400 North Street
Harrisburg, PA 17120
(717) 783-1740
Fax: (717) 787-2545
e-mail: CHAIRMAN@puc.state.pa.us
http://puc.paonline.com/

Mailing Address:
P.O. Box 3265
Harrisburg, PA 17105-3265

## Puerto Rico

**Energy Office**
Guillermo Riera, Administrator
Energy Affairs Administration
Department of Natural and Environmental Resources
P.O. Box 9066600, Puerto de Tierra
San Juan, PR 00936-6600
(787) 724-8777, Ext. 4015
Fax: (787) 721-3089
e-mail: gmriera@mail.caribe.net
http://www.naseo.org/members/states/puerto_rico.htm

## Rhode Island

**State Energy Office**
Janice McClanaghan, Chief
Rhode Island State Energy Office
1 Capitol Hill, 2nd floor
Providence, RI 02908
(401) 222-3370
Fax: (401) 222-1260
e-mail: riseo@ids.net
http://www.riseo.state.ri.us/Default.htm

**State Geologist**
John C. Boothroyd
Rhode Island Geological Survey
9 East Alumni Ave.,
314 Woodward Hall
University of Rhode Island
Kingston, RI 02881
(401) 874-2191
Fax: (401) 874-2190

e-mail: rigsurv@etal.uri.edu
http://www.uri.edu/cels/gel_home/ri_geological_survey.htm

**Public Utilities Commission**
Elia Germani, Chairman
89 Jefferson, Blvd.
Warwick, RI 02888
(401) 941-4500
http://www.ripuc.state.ri.us

## South Carolina

**State Energy Office**
Mitchell M. Perkins, Director
1201 Main Street, Suite 600
Columbia, SC 29201
(803) 737-8030
Fax: (803) 737-9846
http://www.state.sc.us/energy/public/contact.htm

**State Geologist**
C. W. Clendenin, Jr.
South Carolina Geological Survey
5 Geology Road
Columbia, SC 29212-3549
(803) 896-7708
Fax: (803) 896-7695

**Public Service Commission**
William "Bill" Saunders, Chairman
P.O. Drawer 11649
Columbia, SC 29211
(803) 896-5200
Fax: (803) 896-5246
e-mail: bill.saunders@psc.state.sc.us
http://www.psc.state.sc.us

## South Dakota

**State Energy Program**
Chris Braendlin, Commissioner
Governor's Office of Economic Development
711 East Wells Avenue
Pierre, SD 57501-3369
(605) 773-5032
Fax: (605) 773-3256

**State Geologist**
Derric Iles
South Dakota Geological Survey
Department of Environment and Natural Resources
Akeley-Lawrence Science Center, USD
414 East Clark Street
Vermillion, SD 57069-2390
(605) 677-5227
Fax: (605) 677-5895
http://www.sdgs.usd.edu

**Public Utilities Commission**
Jim Burg, Chairman
Capitol Building, 1st floor
500 East Capitol
Pierre, SD 57501-5070
(605) 773-3201
Fax: (605) 773-3809
http://www.state.sd.us/puc/puc.htm

## Tennessee

**State Energy Office**
Cynthia Oliphant, Director
Tennessee Department of Economic and Community Development
Energy Division
William R. Snodgrass TN Tower
312 8th Avenue North, 9th Floor
Nashville, TN 37243-0405
(615) 741-2994
Fax: (615) 741-5070
e-mail: energydivision@mail.state.tn.us
http://www.state.tn.us/ecd/energy.htm

**State Geologist**
Ronald P. Zurawski
Department of Environment and Conservation
Geology Division
13th Floor, L&C Tower
401 Church Street
Nashville, TN 37243-0445
(615) 532-1500
Fax: (615) 532-1517
http://www.state.tn.us/environment/tdg

**Tennessee Regulatory Authority**
Dan McCormac, Chief
Energy & Water Division
460 James Robertson Parkway
Nashville, TN 37243-0505
(615) 741-2904
Fax: (615) 741-5015
e-mail: dmccormac@mail.state.tn.us
http://www.state.tn.us.tra/energy.htm

## Texas

**State Energy Office**
State Energy Conservation Office
Renewable Energy Demonstration Program
Pam Groce
Texas Comptroller of Public Accounts
P. O. Box 13528
Capitol Station
Austin, TX 78711-3528
(512) 463-1889
e-mail: pam.groce@cpa.state.tx.us
http://www.seco.cpa.state.tx.us/index.html

**State Geologist**
Scott W. Tinker, Director
Bureau of Economic Geology
The University of Texas at Austin
Austin, TX 78712
(512) 471-1524
Fax: (512) 471-0140
Sigrid Clift, Public Information Geologist
(512) 471-0320
e-mail: sigrid.clift@beg.utexas.edu
http://www.beg.utexas.edu/

**Public Utility Commission of Texas**
Rebecca Klein, Commissioner
1701 N. Congress Ave.
P.O. Box 13326
Austin, TX 78711-3326
(512) 936-7000
Fax: (512) 936-7003
e-mail: customer@puc.state.tx.us
http://www.puc.state.tx.us

## U.S. Virgin Islands

**Energy Office**
Victor Somme, III, Director
Virgin Islands Energy Office
45 Mars Hill
Frederiksted, VI 00840
(340) 773-3450
Fax: (340) 772-2133
e-mail: vieo0441@viaccess.net
http://www.vienergy.org/index.htm

**Public Utilities Commission**
P. O. Box 40
Charlotte Amalie
St. Thomas, VI 00804
(340) 778-1010
Fax: (340) 778-0302

## Utah

**State Energy Office**
State of Utah Department of Natural Resources
Utah Energy Office
Michael Glenn, Manager
324 South State Street, Suite 500
Salt Lake City, UT 84111
(801) 538-5428
Fax: (801) 538-8660
e-mail: nroerp.mglenn@state.ut.us
http://www.nr.utah.gov/energy/home.htm

**State Geologist**
Dave Tabet, Geologic Manager
Utah Geological Survey
1594 West North Temple
P.O. Box 146100
Salt Lake City, UT 84114-6100
(801) 537-3300
Fax: (801) 537-3400
e-mail: nrugs.dtabet@state.ut.us
http://geology.utah.gov

**Public Service Commission**
Stephen F. Mecham, Chairman
Heber M. Wells Bldg., 4th floor
160 East 300 South
Salt Lake City, UT 84111
(801) 530-6716
Fax: (801) 530-6796
e-mail: bstroud@utah.gov
http://www.psc.state.ut.us

## Vermont

**Department of Public Service**
Scudder Parker, Director
Energy Efficiency Division
112 State Street, Drawer 20
Montpelier, VT 05620-2601
(802) 828-4009
Fax: (802) 828-2342
e-mail: vtdps@psd.state.vt.us
http://www.state.vt.us/psd/ee/ee.htm

**State Geologist**
Laurence R. Becker
Vermont Agency of Natural Resources
Vermont Geological Survey
103 South Main Street, Laundry Building
Waterbury, VT 05671-0301
(802) 241-3608
Fax: (802) 241-3273
http://www.anr.state.vt.us/geology/vgshmpg.htm

**Public Service Board**
Michael H. Dworkin, Chairman
112 State Street
Chittenden Bank Building
Drawer 20
Montpelier, VT 05620-2701
(802) 828-2358
Fax: (802) 828-3351
http://www.state.vt.us/psb

## Virginia

**State Energy Office**
John W. Warren, Director
Division of Energy
Department of Mines, Minerals and Energy
202 N. Ninth Street, 8th Floor
Richmond, VA 23219
(804) 692-3216
Fax: (804) 692-3238
e-mail: jww@mme.state.va.us
http://www.mme.state.va.us/de

**State Geologist**
Stanley Johnson
Department of Mines, Minerals and Energy
Division of Mineral Resources
P.O. Box 3667
Charlottesville, VA 22903
(434) 951-6342
Fax: (434) 951-6365
e-mail: sjohnson@geology.state.va.us
http://www.mme.state.va.us/Dmr/home.dmr.html

**State Corporation Commission**
Kenneth J. Schrad, Director
Division of Information Resources
Tyler Building, 1300 E. Main Street
Richmond, VA 23219
(804) 371-9141
Fax: (804) 371-9211
e-mail: kschrad@scc.state.va.us
http://www.state.va.us/scc

**Mailing Address:**
P.O. Box 1197
Richmond, VA 23218

## Washington

**Energy Policy Group**
Tony Usibelli, Assistant Director
OTED Energy Policy Division
925 Plum Street, SE, Bldg. #4
P.O. Box 43173
Olympia, WA 98504-3173
(360) 956-2096
Fax: (360) 956-2180
e-mail: tonyu@epcted.wa.gov
http://www.energy.cted.wa.gov

**State Geologist**
Ronald F. Teissere
Washington State Department of Natural Resources
Division of Geology and Earth Resources
1111 Washington Street SE, Room 148
PO Box 47007
Olympia, WA 98504-7007
(360)902-1450
e-mail: geology@wadnr.gov
http://www.wa.gov/dnr/htdocs/ger/index.html

**Utilities and Transportation Commission**
Marilyn Showalter, Chairwoman
WUTC
1300 S. Evergreen Park Drive SW
Olympia, WA 98504-7250
(360) 664-1160
Fax: (360) 586-1150
http://www.wutc.wa.gov

**Mailing Address:**
Washington UTC
P.O. Box 47250
Olympia, WA 98504-7250

## West Virginia

**State Energy Office**
Jeff Herholdt, Manager
West Virginia Development Office
Energy Efficiency Program
Building 6, Room 645
Charleston, WV 25305-0311
(304) 558-0350
Fax: (304) 558-0362
e-mail: jherholdt@wvdo.org
http://www.wvdo.org/community/eep.htm

**State Geologist**
Carl J. Smith, Acting Director and State Geologist
West Virginia Geological and Economic Survey
P.O. Box 879
Morgantown, WV 26507-0879
(304) 594-2331
Fax: (304) 594-2575
e-mail: info@geosrv.wvnet.edu
http://www.wvgs.wvnet.edu/

**Public Service Commission**
James D. Williams, Chairman
201 Brooks Street
Charleston, WV 25301
(304) 340-0300
Fax: (304) 340-0325
http://www.psc.state.wv.us

## Wisconsin

**State Energy Office**
Division of Energy
P.O. Box 7868
Madison, WI 53707-7868
(608) 266-8234
Fax: (608) 267-6931
e-mail: energy@doa.state.wi.us
http://www.doa.state.wi.us/depb/boe/index.asp

**State Geologist**
James M. Robertson, Director and State Geologist
Wisconsin Geological and Natural History Survey
3817 Mineral Point Road
Madison, WI 53705-5100
(608) 262-1705
Fax: (608) 262-8086
e-mail: jmrober@facstaff.wisc.edu
http://www.uwex.edu/wgnhs

**Public Service Commission**
Ave M. Bie, Chairperson
610 North Whitney Way
P.O. Box 7854
Madison, WI 53707-7854
(608) 266-5481
Fax: (608) 266-3957
e-mail: sandra.paske@psc.state.wi.us
http://psc.wi.gov

## Wyoming

**State Energy Office**
State of Wyoming Energy Program
John Nunley, Manager
214 W. 15th Street
Cheyenne, WY 82002
(307) 777-2804
Fax: (307) 777-2837
e-mail: jnunle@state.wy.us
http://www.wyomingbusiness.org/wbc/internal.cfm?colorScheme=993300&area=energy&areaID=8&navTree=0,342&navDetailID=342&parentNavDetailID=0

**State Geologist**
Lance Cook
Wyoming State Geological Survey
P.O. Box 3008
Laramie, WY 82071
(307) 766-2286
Fax: (307) 766-2605
e-mail: wsgs@wsgs.uwyo.edu
http://www.wsgsweb.uwyo.edu

**Public Service Commission**
Steve Ellenbecker, Chairman
Hansen Building
2515 Warren Avenue, Suite 300
Cheyenne, WY 82002
(307) 777-7427
Fax: (307) 777-5700
e-mail: sellen@state.wy.us
http://psc.state.wy.us

# Glossary

**Alcohol Fuels:** Alcohol can be blended with gasoline for use as transportation fuel. It may be produced from a wide variety of organic feedstock. The common alcohol fuels are methanol and ethanol. Methanol may be produced from coal, natural gas, wood and organic waste. Ethanol is commonly made from agricultural plants, primarily corn, containing sugar.

**Alternating Current (AC):** An electric current that reverses its direction at regularly recurring intervals, usually 50 or 60 times per second.

**Amorphous Silicon:** An alloy of silica and hydrogen, with a disordered, noncrystalline internal atomic arrangement, that can be deposited in thin-layers (a few micrometers in thickness) by a number of deposition methods to produce thin-film photovoltaic cells on glass, metal, or plastic substrates.

**Annualized Growth Rates:** Calculated as follows:

$$(x_n / x_1)^{1/n} \quad ,$$

where $x$ is the value under consideration and $n$ is the number of periods.

**Air-Conditioning & Refrigeration Institute (ARI) - 320, 325, 330:** ARI heat pump classifications: 320 refers to a water-source heat pump; 325 refers to a ground water-source heat pump; 330 refers to a ground source closed-loop heat pump.

**Availability Factor:** A percentage representing the number of hours a generating unit is available to produce power (regardless of the amount of power) in a given period, compared to the number of hours in the period.

**Biomass:** Organic nonfossil material of biological origin constituting a renewable energy source.

Bioenergy: Useful, renewable energy produced from organic matter, which may either be used directly as a fuel or processed into liquids and gases.

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

**Biomass gas (Biogas):** A medium Btu gas containing methane and carbon dioxide, resulting from the action of microorganisms on organic materials such as a landfill.

**Black Liquor (Pulping Liquor)** : The alkaline spent liquor removed from the digesters in the process of chemically pulping wood. After evaporation, the liquor is burned as a fuel in a recovery furnace that permits the recovery of certain basic chemicals.

**Capacity Factor:** The ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full-power operation during the same period.

**Capacity, Gross:** The full-load continuous rating of a generator, prime mover, or other electric equipment under specified conditions as designated by the manufacturer. It is usually indicated on a nameplate attached to the equipment.

**Capacity, Net Summer:** See Net Summer Capacity.

**Capital Cost:** The cost of field development and plant construction and the equipment required for the generation of electricity.

**Cast Silicon:** Crystalline silicon obtained by pouring pure molten silicon into a vertical mold and adjusting the temperature gradient along the mold volume during cooling to obtain slow, vertically-advancing crystallization of the silicon. The polycrystalline ingot thus formed is composed of large, relatively parallel, interlocking crystals. The cast ingots are sawed into wafers for further fabrication into photovoltaic cells. Cast-silicon wafers and ribbon-silicon sheets fabricated into cells are usually referred to as polycrystalline photovoltaic cells.

**Cogeneration:** See combined heat and power.

**Combined Cycle:** An electric generating technology in which electricity is produced from otherwise lost waste heat exiting from one or more gas (combustion) turbines. The exiting heat is routed to a conventional boiler or to a heat recovery steam generator for utilization by a steam turbine in the production of electricity. Such designs increase the efficiency of the electric generating unit.

**Combined Heat and Power (CHP) Plant:** A plant designed to produce both heat and electricity from a single heat source. *Note:* This term is being used in place of the term "cogenerator" that was used by EIA in the past. CHP better describes the facilities because some of the plants included do not produce heat and power in a sequential fashion and, as a result, do not meet the legal definition of cogeneration specified in the Public Utility Regulatory Policies Act (PURPA).

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

**Concentrator**: A reflective or refractive device that focuses incident insolation onto an area smaller than the reflective or refractive surface, resulting in increased insolation at the point of focus.

**Conventional hydroelectric (hydropower) plant:** A plant in which all of the power is produced from natural streamflow as regulated by available storage.

**Digester Ga:** Biogass that is produced using a digester which is an airtight vessel or enclosure in which bacteria decomposes biomass in water to produce biogas.

**Direct Current (DC):** An electric current that flows in a constant direction. The magnitude of the current does not vary or has a slight variation.

**Electric power sector:** An energy-consuming sector that consists of electricity only and combined heat and power(CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public--i.e., North American Industry Classification System 22 plants.

**Electric Utility:** A corporation, person, agency, authority, or other legal entity or instrumentality aligned with distribution facilities for delivery of electric energy for use primarily by the public. Included are investor-owned electric utilities, municipal and State utilities, Federal electric utilities, and rural electric cooperatives. A few entities that are tariff based and corporately aligned with companies that own distribution facilities are also included. *Note:* Due to the issuance of FERC Order 888 that required traditional electric utilities to functionally unbundle their generation, transmission, and distribution operations, "electric utility" currently has inconsistent interpretations from State to State.

**Electric Utility Restructuring:** The introduction of competition into at least the generation phase of electricity production, with a corresponding decrease in regulatory control.

**Emissions:** Anthropogenic releases of gases to the atmosphere. In the context of global climate change, they consist of radiatively important greenhouse gases (e.g., the release of carbon dioxide during fuel combustion).

**Energy Crops:** Crops grown specifically for their fuel value. These include food crops such as corn and sugarcane, and nonfood crops such as poplar trees and switchgrass. Currently, two energy crops are under development: short - rotation woody crops, which are fast - growing hardwood trees harvested in five to eight years, and herbaceous energy crops, such as perennial grasses, which are harvested annually after taking two to three years to reach full productivity.

**Ethanol** (also known as Ethyl Alcohol or Grain Alcohol, $CH_3$-$CH_2OH$)**:** A clear, colorless flammable oxygenated hydrocarbon with a boiling point of 173.5 degrees Fahrenheit in the anhydrous state. However it readily forms a binary azetrope with water, with a boiling point of 172.67 degrees Fahrenheit at a composition of 95.57 percent by weight ethanol. It is used in the United States as a gasoline octane enhancer and oxygenate (maximum 10 percent concentration). Ethanol can be used in higher concentrations (E85) in vehicles designed for its use. Ethanol is typically produced chemically from ethylene, or biologically from fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. The

lower heating value, equal to 76,000 Btu per gallon, is assumed for estimates in this report.

**Evacuated Tube:** In a solar thermal collector, an absorber tube, which is contained in an evacuated glass cylinder, through which collector fluids flows.

**Flat Plate Pumped:** A medium-temperature solar thermal collector that typically consists of a metal frame, glazing, absorbers (usually metal), and insulation and that uses a pump liquid as the heat-transfer medium: predominant use is in water heating applications.

**Fuel Cells:** One or more cells capable of generating an electrical current by converting the chemical energy of a fuel directly into electrical energy. Fuel cells differ from conventional electrical cells in that the active materials such as fuel and oxygen are not contained within the cell but are supplied from outside.

**Fuelwood:** Wood and wood products, possibly including coppices, scrubs, branches, etc., bought or gathered, and used by direct combustion.

**Generation (Electricity):** The process of producing electric energy from other forms of energy; also, the amount of electric energy produced, expressed in watthours (Wh).

*Gross Generation:* The total amount of electric energy produced by the generating units at a generating station or stations, measured at the generator terminals.

*Net Generation:* Gross generation less the electric energy consumed at the generating station for station's use.

**Geothermal Energy:** As used at electric power plants, hot water or steam extracted from geothermal reservoirs in the Earth's crust that is supplied to steam turbines at electric power plants that drive generators to produce electricity.

**Geothermal Plant:** A plant in which a turbine is driven either from hot water or by natural steam that derives its energy from heat found in rocks or fluids at various depths beneath the surface of the earth. The fluids are extracted by drilling and/or pumping.

**Giga:** One billion.

**Green Pricing/Marketing:** In the case of renewable electricity, green pricing represents a market solution to the various problems associated with regulatory valuation of the nonmarket benefits of renewables. Green pricing programs allow electricity customers to express their willingness to pay for renewable energy development through direct payments on their monthly utility bills.

**Grid:** The layout of an electrical distribution system.

**Hardwoods**: Usually broad-leaved and deciduous trees.

**Heat Pump**: A year-round heating and air-conditioning system employing a refrigeration cycle. In a refrigeration cycle, a refrigerant is compressed (as a liquid) and expanded (as a vapor) to absorb and reject heat. The heat pump transfers heat to a space to be heated during the winter period and by reversing the operation extracts (absorbs) heat from the same space to be cooled during the summer period. The refrigerant within the heat pump in the heating mode absorbs the heat to be supplied to the space to be heated from an outside medium (air, ground or ground water) and in the cooling mode absorbs heat from the space to be cooled to be rejected to the outside medium.

**Heat Pump (Air Source):** An air-source heat pump is the most common type of heat pump. The heat pump absorbs heat from the outside air and transfers the heat to the space to be heated in the heating mode. In the cooling mode the heat pump absorbs heat from the space to be cooled and rejects the heat to the outside air. In the heating mode when the outside air approaches 32° F or less, air-source heat pumps loose efficiency and generally require a back-up (resistance) heating system.

**Heat Pump (Geothermal):** A heat pump in which the refrigerant exchanges heat (in a heat exchanger) with a fluid circulating through an earth connection medium (ground or ground water). The fluid is contained in a variety of loop (pipe) configurations depending on the temperature of the ground and the ground area available. Loops may be installed horizontally or vertically in the ground or submersed in a body of water.

**Heat Pump (efficiency):** The efficiency of a heat pump, that is, the electrical energy to operate it, is directly related to temperatures between which it operates. Geothermal heat pumps are more efficient than conventional heat pumps or air conditioners that use the outdoor air since the ground or ground water a few feet below the earth's surface remains relatively constant throughout the year. It is more efficient in the winter to draw heat from the relatively warm ground than from the atmosphere where the air temperature is much colder, and in summer transfer waste heat to the

relatively cool ground than to hotter air. Geothermal heat pumps are generally more expensive ($2,000-$5,000) to install than outside air heat pumps. However, depending on the location geothermal heat pumps can reduce energy consumption (operating cost) and correspondingly, emissions by more than 20 percent compared to high-efficiency outside air heat pumps. Geothermal heat pumps also use the waste heat from air-conditioning to provide free hot water heating in the summer.

**High-Temperature Collector:** A solar thermal collector designed to operate at a temperature of 180 degrees Fahrenheit or higher.

**Incentives:** Subsidies and other Government actions where the Governments's financial assistance is indirect.

**Independent Power Producer (IPP):** A corporation, person, agency, authority, or other legal entity or instrumentality that owns or operates facilities for the generation of electricity for use primarily by the public, and that is not an **electric utility**.

**Internal Collector Storage (ICS):** A solar thermal collector in which incident solar radiation is absorbed by the storage medium.

**Industrial Sector:** An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods. The industrial sector encompasses the following types of activity: manufacturing (NAICS codes 31-33); agriculture, forestry, and fisheries (NAICS code 11); mining, including oil and gas extraction (NAICS code 21); natural gas transmission (NAICS code 2212); and construction (NAICS code 23). Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting. Fossil fuels are also used as raw material inputs to manufactured products. *Note:* This sector includes generators that produce electricity and/or useful thermal output primarily to support the above-mentioned industrial activities.

**Kilowatt (kW):** One thousand watts of electricity (See Watt).

**Kilowatthour (kWh):** One thousand watthours.

**Landfill Gas:** Gas that is generated by decomposition of organic material at landfill disposal sites. Landfill gas is approximately 50 percent methane.

**Levelized Cost:** The present value of the total cost of building and operating a generating plant over its economic life, converted to equal annual payments. Costs are levelized in real dollars (i.e., adjusted to remove the impact of inflation).

**Liquid Collector:** A medium-temperature solar thermal collector, employed predominantly in water heating, which uses pumped liquid as the heat-transfer medium.

**Low-Temperature Collectors:** Metallic or nonmetallic solar thermal collectors that generally operate at temperatures below 110 degrees Fahrenheit and use pumped liquid or air as the heat transfer medium. They usually contain no glazing and no insulation, and they are often made of plastic or rubber, although some are made of metal.

**Marginal Cost:** The change in cost associated with a unit change in quantity supplied or produced.

**Medium-Temperature Collectors:** Solar thermal collectors designed to operate in the temperature range of 140 degrees to 180 degrees Fahrenheit, but that can also operate at a temperature as low as 110 degrees Fahrenheit. The collector typically consists of a metal frame, metal absorption panels with integral flow channels (attached tubing for liquid collectors or integral ducting for air collectors), and glazing and insulation on the sides and back.

**Megawatt (MW):** One million watts of electricity (See Watt).

**Methane:** A colorless, flammable, odorless hydrocarbon gas ($CH_4$) which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a greenhouse gas.

**MTBE:** Methyl Tertiary Butyl Ether is a fuel oxygenate produced by reacting methanol with isobutylene.

**MSW (Municipal Solid Waste):** Residential solid waste and some nonhazardous commercial, institutional, and industrial wastes.

**Net Photovoltaic Cell Shipment:** The difference between photovoltaic cell shipments and photovoltaic cell purchases.

**Net Photovoltaic Module Shipment:** The difference between photovoltaic module shipments and photovoltaic module purchases.

**Net summer capacity:** The maximum output, commonly expressed in megawatts (MW), that generating equipment can supply to system load, as demonstrated by a multi-hour test, at the time of summer peak demand (period of May 1 through October 31). This output reflects a reduction in capacity due to electricity use for station service or auxiliaries.

**Nonutility Generation:** Electric generation by nonutility power producers to supply electric power for industrial, commercial, and military operations, or sales to electric utilities. See **Nonutility Power Producer**.

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

**Operation and Maintenance (O&M) Cost:** Operating expenses are associated with operating a facility (i.e., supervising and engineering expenses). Maintenance expenses are that portion of expenses consisting of labor, materials, and other direct and indirect expenses incurred for preserving the operating efficiency or physical condition of utility plants that are used for power production, transmission, and distribution of energy.

**Other Biomass:** This category of biomass energy includes: agricultural byproducts/crops (agricultural byproducts, straw); other biomass gas (digester gas, methane); other biomass liquids (fish oil, liquid acetonitrite, waste, tall oil, waste alcohol); other biomass solids (medical waste, solid byproducts; sludge waste and tires.

**Paper Pellets**: paper compressed and bound into uniform diameter pellets to be burned in a heating stove.

**Parabolic Dish:** A high-temperature (above 180 degrees Fahrenheit) solar thermal concentrator, generally bowl-shaped, with two-axis tracking.

**Parabolic Trough:** A high-temperature (above 180 degrees Fahrenheit) solar thermal concentrator with the capacity for tracking the sun using one axis of rotation.

**Passive Solar:** A system in which solar energy alone is used for the transfer of thermal energy. Pumps, blowers, or other heat transfer devices that use energy other than solar are not used.

**Peak Watt:** A manufacturer's unit indicating the amount of power a photovoltaic cell or module will produce at standard test conditions (normally 1,000 watts per square meter and 25 degrees Celsius).

**Peat:** Peat consists of partially decomposed plant debris. It is considered an early stage in the development of coal. Peat is distinguished from lignite by the presence of free cellulose and a high moisture content (exceeding 70 percent). The heat content of air-dried peat (about 50 percent moisture) is about 9 million Btu per ton. Most U.S. peat is used as a soil conditioner. The first U.S. electric power plant fueled by peat began operation in Maine in 1990.

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

**Photovoltaic (PV) Module:** An integrated assembly of interconnected photovoltaic cells designed to deliver a selected level of working voltage and current at its output terminals, packaged for protection against environment degradation, and suited for incorporation in photovoltaic power systems.

Process Heating: The direct process end use in which energy is used to raise the temperature of substances involved in the manufacturing process.

**Production Tax Credit (PTC)**: an inflation - adjusted 1.5 cents per kilowatthour payment for electricity produced using qualifying renewable energy sources.

**Public Utility Regulatory Policies Act of 1978 (PURPA)**: One part of the National Energy Act, PURPA contains measures designed to encourage the conservation of energy, more efficient use of resources, and equitable rates. Principal among these were suggested retail rate reforms and new incentives for production of electricity by cogenerators and users of renewable resources.

**Pumped-storage hydroelectric plant:** A plant that usually generates electric energy during peak load periods by using water previously pumped into an elevated storage reservoir during off-peak periods when excess generating capacity is available to do so. When additional generating capacity is needed, the water can

be released from the reservoir through a conduit to turbine generators located in a power plant at a lower level.

**Quadrillion Btu**: Equivalent to 10 to the 15th power Btu.

**Qualifying Facility (QF):** A cogeneration or small power production facility that meets certain ownership, operating, and efficiency criteria established by the Federal Energy Regulatory Commission (FERC) pursuant to the Public Utility Regulatory Policies Act of 1978 (PURPA). (See the Code of Federal Regulations, Title 18, Part 292.)

**Renewable Energy Resources:** Energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include: biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action.

**Renewable Portfolio Standard (RPS)** : a mandate requiring that renewable energy provide a certain percentage of total energy generation or consumption.

**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.

**Ribbon Silicon:** Single-crystal silicon derived by means of fabricating processes that produce sheets or ribbons of single-crystal silicon. These processes include edge-defined film-fed growth, dendritic web growth, and ribbon-to-ribbon growth.

**Roundwood:** Wood cut specifically for use as a fuel.

**Silicon:** A semiconductor material made from silica, purified for photovoltaic applications.

**Single Crystal Silicon (Czochralski):** An extremely pure form of crystalline silicon produced by the Czochralski method of dipping a single crystal seed into a pool of molten silicon under high vacuum conditions and slowly withdrawing a solidifying single crystal boule rod of silicon. The boule is sawed into thin wafers and fabricated into single-crystal photovoltaic cells.

**Sludge:** A dense, slushy, liquid-to-semifluid product that accumulates as an end result of an industrial or technological process designed to purify a substance. Industrial sludges are produced from the processing of energy-related raw materials, chemical products, water, mined ores, sewerage, and other natural and man-made products. Sludges can also form from natural processes, such as the run off produced by rain fall, and accumulate on the bottom of bogs, streams, lakes, and tidelands.

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

**Solar Thermal Collector:** A device designed to receive solar radiation and convert it into thermal energy. Normally, a solar thermal collector includes a frame, glazing, and an absorber, together with the appropriate insulation. The heat collected by the solar thermal collector may be used immediately or stored for later use.

**Solar Thermal Collector, Special:** An evacuated tube collector or a concentrating (focusing) collector. Special collectors operate in the temperature (low concentration for pool heating) to several hundred degrees Fahrenheit (high concentration for air conditioning and specialized industrial processes).

**Spent liquor:** The liquid residue left after an industrial process; can be a component of waste materials used as fuel.

**Spent Sulfite Liquor**: end product of pulp and paper manufacturing processes that contains lignins and has a high moisture content; often re-used in recovery boilers. Similar to black liquor.

**Subsidy:** Financial assistance granted by the Government to firms and individuals.

**System Benefits Charge (SBC):** A non-bypassable fee on transmission interconnection; funds are allocated among public purposes, including the development and demonstration of renewable energy technologies.

**Tall oil:** The oily mixture of rosin acids, fatty acids, and other materials obtained by acid treatment of the alkaline liquors from the digesting (pulping) of pine wood.

**Thermosiphon System:** A solar collector system for water heating in which circulation of the collection fluid

through the storage loop is provided solely by the temperature and density difference between the hot and cold fluids.

**Thin-Film Silicon**: a technology in which amorphous or polycrystalline material is used to make photovoltaic (PV) cells.

**Transmission System (Electric):** An interconnected group of electric transmission lines and associated equipment for moving or transferring electric energy in bulk between points of supply and points at which it is transformed for delivery over the distribution system lines to consumers, or is delivered to other electric systems.

**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 water-borne 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.

**Turbine:** A machine for generating rotary mechanical power from the energy of a stream of fluid (such as water, steam, or hot gas). Turbines convert the kinetic energy of fluids to mechanical energy through the principles of impulse and reaction, or a mixture of the two.

**Useful Thermal Output:** The thermal energy made available for use in any industrial or commercial process or used in any heating or cooling application, i.e., total thermal energy made available for processes and applications other than electrical generation.

**Watt (Electric):** The electrical unit of power. The rate of energy transfer equivalent to 1 ampere of electric current flowing under a pressure of 1 volt at unity power factor.

**Watt (Thermal):** A unit of power in the metric system, expressed in terms of energy per second, equal to the work done at a rate of 1 joule per second.

**Watthour (Wh):** The electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electric circuit steadily for 1 hour.

**Wind energy:** Energy present in wind motion that can be converted to mechanical energy for driving pumps, mills, and electric power generators. Wind pushes against sails, vanes, or blades radiating from a central rotating shaft.

**Wind power plant:** A group of wind turbines interconnected to a common utility system through a system of transformers, distribution lines, and (usually) one substation. Operation, control, and maintenance functions are often centralized through a network of computerized monitoring systems, supplemented by visual inspection. This is a term commonly used in the United States. In Europe, it is called a generating station.

**Wood/Wood Waste:** This category of biomass energy includes: black liquor; wood/wood waste liquids (red liquor, sludge wood, spent sulfite liquor); wood/wood waste solids (peat, paper pellets, railroad ties, utility poles, wood/wood waste).

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

**Wood pellets:** Sawdust compressed into uniform diameter pellets to be burned in a heating stove.