

# **Renewable Energy Annual 2001**

## **With Preliminary Data For 2001**

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# 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<sup>th</sup> 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.

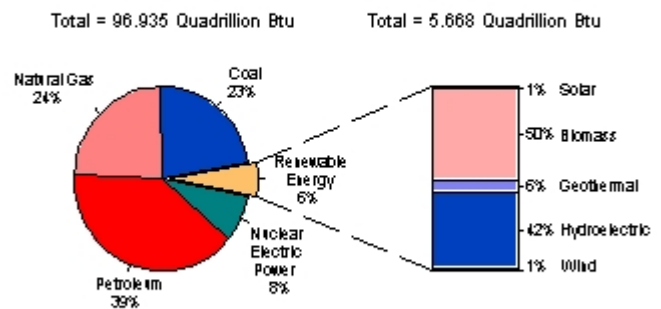
Renewable electric generating capacity increased modestly in 2001, rising from 94,938 megawatts in 2000 to 96,741 megawatts in 2001 (Table 5). Wind power provided most of the 1,803-megawatt capacity increase.

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
<b>Renewable Energy</b>	<b>7.306</b>	<b>6.771</b>	<b>6.778</b>	<b>6.451</b>	<b>5.668</b>
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.

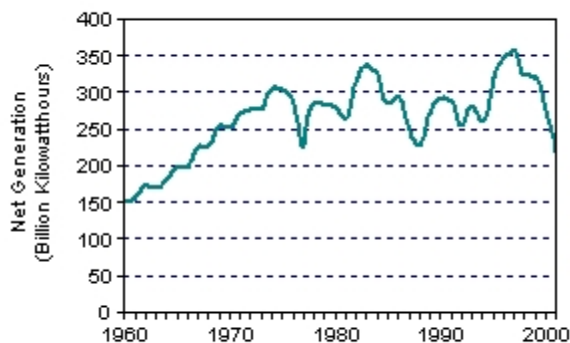
## Geothermal Heat Pumps

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**



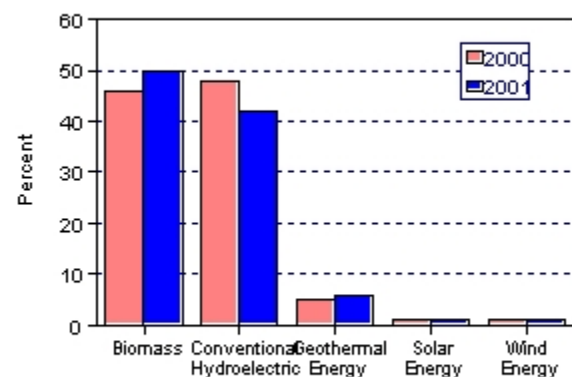
Notes: Excludes imports. Before 1990 includes pumped storage.

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**

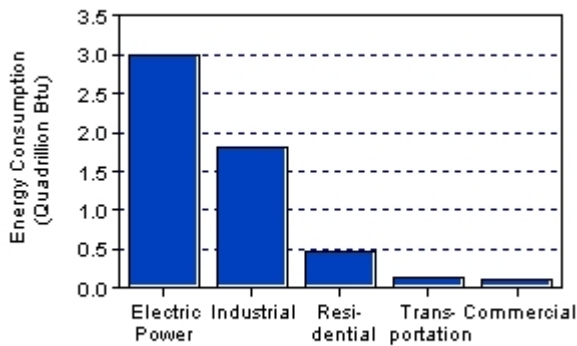


Source: Table 1 of this report.

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).<sup>1</sup> 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.

<sup>1</sup> 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.

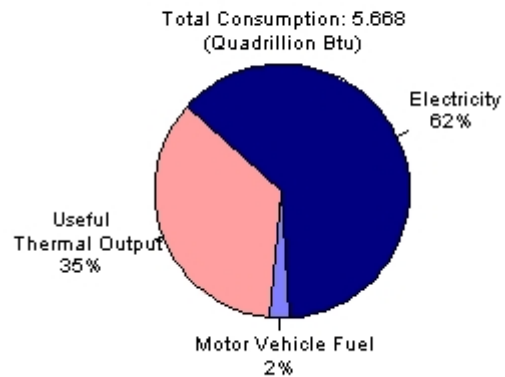
Just 62 percent (3.5 quadrillion Btu) of renewable energy was used to generate electricity in 2001, (Table 3). Two-thirds (2.4 quadrillion Btu) of this energy was provided by hydropower, while biomass contributed 22 percent (0.8 quads). Within the electric power sector, nearly three-fourths of consumption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

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



Source: Tables 3 and 6 of this report.

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
<b>Total Energy Consumption</b> .....	<b>94.957</b>	<b>95.326</b>	<b>96.957</b>	<b>99.302</b>	<b>96.935</b>
<b>Fossil Fuels</b> .....	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 <sup>a</sup> .....	23.327	22.934	23.008	24.042	23.224
Petroleum <sup>b</sup> .....	36.266	36.934	37.960	38.404	38.232
Electricity Net Imports <sup>c</sup> .....	0.107	0.047	0.091	0.082	0.049
<b>Nuclear Electric Power</b> .....	<b>6.597</b>	<b>7.068</b>	<b>7.610</b>	<b>7.862</b>	<b>8.028</b>
<b>Hydroelectric Pumped Storage</b> <sup>d</sup> .....	<b>-0.041</b>	<b>-0.046</b>	<b>-0.062</b>	<b>-0.057</b>	<b>-0.090</b>
<b>Renewable Energy</b> .....	<b>7.306</b>	<b>6.771</b>	<b>6.778</b>	<b>6.451</b>	<b>5.668</b>
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

<sup>a</sup> Includes supplemental gaseous fuels.

<sup>b</sup> Petroleum products supplied, including natural gas plant liquids and crude oil burned as fuel.

<sup>c</sup> Electricity net imports from fossil fuels. May include some nuclear-generated electricity.

<sup>d</sup> 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
<b>Total</b> .....	<b>7.306</b>	<b>6.771</b>	<b>6.778</b>	<b>6.451</b>	<b>5.668</b>
<b>Residential</b> .....	<b>0.506</b>	<b>0.459</b>	<b>0.486</b>	<b>0.503</b>	<b>0.475</b>
Biomass .....	0.433	0.387	0.414	0.433	0.407
Geothermal .....	0.008	0.008	0.009	0.009	0.009
Solar <sup>a</sup> .....	0.065	0.065	0.064	0.061	0.059
<b>Commercial</b> .....	<b>0.113</b>	<b>0.111</b>	<b>0.114</b>	<b>0.109</b>	<b>0.098</b>
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 <sup>b</sup> .....	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
<b>Industrial</b> .....	<b>1.976</b>	<b>1.841</b>	<b>1.830</b>	<b>1.869</b>	<b>1.816</b>
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 <sup>b</sup> .....	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
<b>Transportation</b>					
Alcohol Fuels <sup>c</sup> .....	<b>0.096</b>	<b>0.105</b>	<b>0.110</b>	<b>0.126</b>	<b>0.133</b>
<b>Electric Power</b> <sup>d</sup> .....	<b>4.375</b>	<b>4.032</b>	<b>4.034</b>	<b>3.579</b>	<b>2.987</b>
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 <sup>b</sup> .....	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
<b>Net Renewable Energy Imports</b> .....	<b>0.241</b>	<b>0.221</b>	<b>0.205</b>	<b>0.266</b>	<b>0.159</b>

<sup>a</sup> Includes small amounts of distributed solar thermal and photovoltaic energy used in the commercial, industrial and electric power sectors.

<sup>b</sup> Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

<sup>c</sup> Ethanol primarily derived from corn.

<sup>d</sup> 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
<b>Total</b> .....	<b>5.052</b>	<b>4.672</b>	<b>4.657</b>	<b>4.261</b>	<b>3.541</b>
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 <sup>a</sup> .....	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
<b>Commercial</b> .....	<b>0.035</b>	<b>0.034</b>	<b>0.035</b>	<b>0.028</b>	<b>0.027</b>
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 <sup>a</sup> .....	0.004	0.003	0.004	0.005	0.005
Conventional Hydroelectric .....	0.001	0.001	0.001	0.001	0.001
<b>Industrial</b> .....	<b>0.439</b>	<b>0.417</b>	<b>0.422</b>	<b>0.421</b>	<b>0.402</b>
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 <sup>a</sup> .....	0.012	0.012	0.008	0.009	0.011
Conventional Hydroelectric .....	0.058	0.055	0.049	0.042	0.037
<b>Electric Power <sup>b</sup></b> .....	<b>4.337</b>	<b>4.000</b>	<b>3.996</b>	<b>3.547</b>	<b>2.953</b>
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 <sup>a</sup> .....	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
<b>Net Renewable Energy Imports</b> .....	<b>0.241</b>	<b>0.221</b>	<b>0.205</b>	<b>0.266</b>	<b>0.159</b>
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

<sup>a</sup> Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

<sup>b</sup> 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 California 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
<b>Total</b> .....	<b>457,181,198</b>	<b>422,093,324</b>	<b>419,006,721</b>	<b>382,512,277</b>	<b>312,767,216</b>
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 <sup>a</sup> .....	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
<b>Commercial</b> .....	<b>2,505,414</b>	<b>2,493,233</b>	<b>2,527,119</b>	<b>2,111,620</b>	<b>2,063,254</b>
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 <sup>a</sup> .....	349,720	314,292	350,851	383,761	404,897
Conventional Hydroelectric .....	120,192	120,468	114,663	99,749	99,749
<b>Industrial</b> .....	<b>34,792,639</b>	<b>33,920,823</b>	<b>33,505,006</b>	<b>33,626,304</b>	<b>32,361,740</b>
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 <sup>a</sup> .....	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
<b>Electric Power</b> <sup>b</sup> .....	<b>396,338,061</b>	<b>364,010,011</b>	<b>362,926,906</b>	<b>320,742,117</b>	<b>262,853,221</b>
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 <sup>a</sup> .....	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
<b>Net Renewable Energy Imports</b> .....	<b>23,545,084</b>	<b>21,669,257</b>	<b>20,047,690</b>	<b>26,032,236</b>	<b>15,489,001</b>
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

<sup>a</sup> Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

<sup>b</sup> 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 California Energy Commission.



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

Source	R1997	R1998	R1999	2000	P2001
<b>Total</b> .....	<b>778,649</b>	<b>775,868</b>	<b>785,927</b>	<b>812,667</b>	<b>854,655</b>
<b>Renewable Total</b> .....	<b>94,766</b>	<b>94,599</b>	<b>95,339</b>	<b>94,939</b>	<b>96,741</b>
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
<b>Nonrenewable Total</b> .....	<b>683,884</b>	<b>681,269</b>	<b>690,587</b>	<b>717,728</b>	<b>757,914</b>

<sup>a</sup> 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
<b>Total</b> .....	<b>2.254</b>	<b>2.099</b>	<b>2.121</b>	<b>2.190</b>	<b>2.127</b>
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 <sup>a</sup> .....	0.093	0.079	0.074	0.077	0.084
Alcohol Fuels <sup>b</sup> .....	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
<b>Residential</b> .....	<b>0.506</b>	<b>0.459</b>	<b>0.486</b>	<b>0.503</b>	<b>0.475</b>
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 <sup>b c</sup> .....	0.065	0.065	0.064	0.061	0.059
<b>Commercial</b> .....	<b>0.078</b>	<b>0.077</b>	<b>0.079</b>	<b>0.082</b>	<b>0.072</b>
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 <sup>a</sup> .....	0.002	0.001	0.001	0.001	0.001
Geothermal .....	0.006	0.007	0.007	0.008	0.008
<b>Industrial</b> .....	<b>1.537</b>	<b>1.425</b>	<b>1.408</b>	<b>1.448</b>	<b>1.414</b>
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 <sup>a</sup> .....	0.089	0.076	0.069	0.072	0.079
Geothermal .....	0.003	0.003	0.004	0.004	0.005
<b>Transportation</b>					
Alcohol Fuels <sup>b</sup> .....	<b>0.096</b>	<b>0.105</b>	<b>0.110</b>	<b>0.126</b>	<b>0.133</b>
<b>Electric Power</b> <sup>c d</sup> .....	<b>0.038</b>	<b>0.032</b>	<b>0.038</b>	<b>0.032</b>	<b>0.034</b>
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 <sup>a</sup> .....	0.002	0.003	0.004	0.004	0.004

<sup>a</sup> Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

<sup>b</sup> Ethanol primarily derived from corn.

<sup>c</sup> Includes small amounts of distributed solar thermal and photovoltaic energy used in the commercial, industrial, and electric power sectors.

<sup>d</sup> 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
<b>Total</b> .....	<b>2,996</b>	<b>2,823</b>	<b>2,860</b>	<b>2,934</b>	<b>2,854</b>
<b>Wood Energy Total</b> .....	<b>2,349</b>	<b>2,175</b>	<b>2,210</b>	<b>2,257</b>	<b>2,170</b>
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 <sup>a</sup> .....	137	137	138	134	140
<b>Waste Energy Total</b> .....	<b>551</b>	<b>542</b>	<b>540</b>	<b>552</b>	<b>551</b>
MSW/Landfill Gas .....	425	430	435	441	434
Commercial .....	51	50	49	41	40
Industrial .....	83	92	94	105	104
Electric Power <sup>a</sup> .....	290	288	292	295	290
Other Biomass <sup>b</sup> .....	126	112	105	111	117
Commercial .....	6	5	5	6	6
Industrial .....	101	88	77	81	90
Electric Power <sup>a</sup> .....	19	20	23	23	21
<b>Alcohol Fuels <sup>c</sup></b>					
<b>Transportation</b> .....	<b>96</b>	<b>105</b>	<b>110</b>	<b>126</b>	<b>133</b>

<sup>a</sup> Includes electric utilities and independent power producers.

<sup>b</sup> Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

<sup>c</sup> 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	
<b>Total</b> .....	<b>1,822.103</b>	<b>378.751</b>	<b>1,443.352</b>	<b>29,491</b>
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 <sup>a</sup> .....	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 <sup>b</sup> .....	30.471	0.382	30.089	31
Nonspecified <sup>c</sup> .....	102.854	-	102.854	-

<sup>a</sup> Lumber biomass energy consumption includes a small amount of sludge waste, which was less than 50 billion Btu.

<sup>b</sup> Other includes Apparel; Petroleum Refining; Rubber and Misc. Plastic Products; Transportation Equipment; Stone, Clay, Glass, and Concrete Products; Furniture and Fixtures; and related industries.

<sup>c</sup> 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				
	Commercial	Industrial	Electric Power		Total
			Electric Utilities	Independent Power Producers	
<b>Total</b> .....	<b>47</b>	<b>186</b>	<b>14</b>	<b>305</b>	<b>552</b>
MSW and Landfill Gas .....	41	105	10	285	441
MSW .....	39	48	NA	227	NA
Landfill Gas .....	2	57	NA	58	NA
Other Biomass <sup>a</sup> .....	6	81	4	20	111

<sup>a</sup> 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.

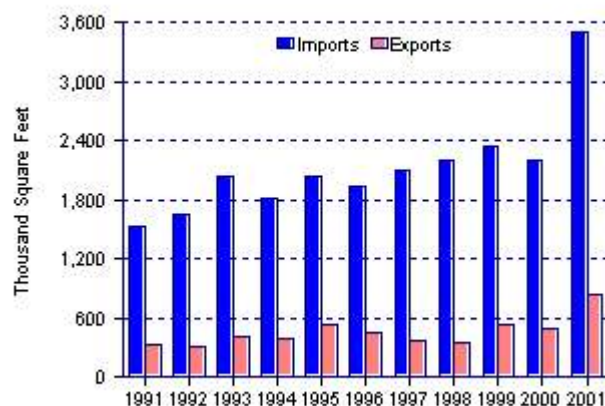
### Solar Thermal Collector Manufacturing Activities

Total shipments of solar thermal collectors<sup>2</sup> 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).

<sup>2</sup> 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 5. Import and Export Shipments of Solar Thermal Collectors, 1991-2001**



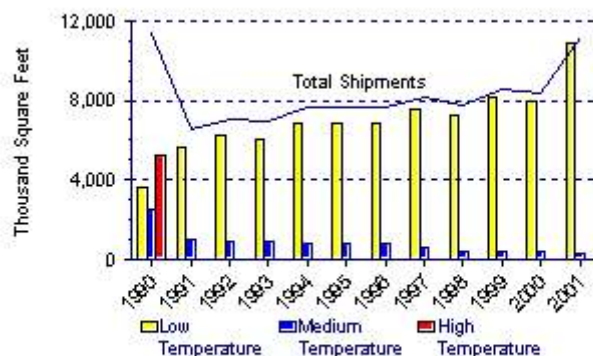
Notes: Total shipments as reported by respondents include all domestic and export shipments and may include imports that subsequently were shipped to domestic or foreign customers.

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

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.

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



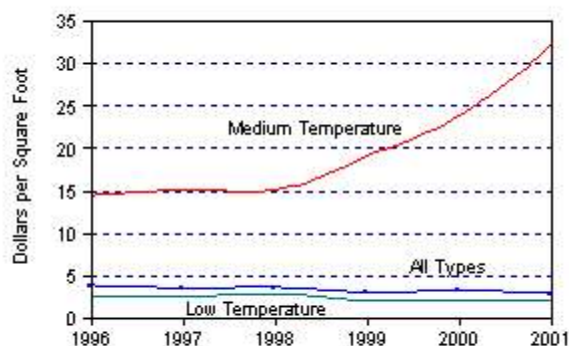
Source: Energy Information Administration, Form EIA-63A, "Annual Solar Thermal Collector Manufacturers Survey."

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

**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."

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).

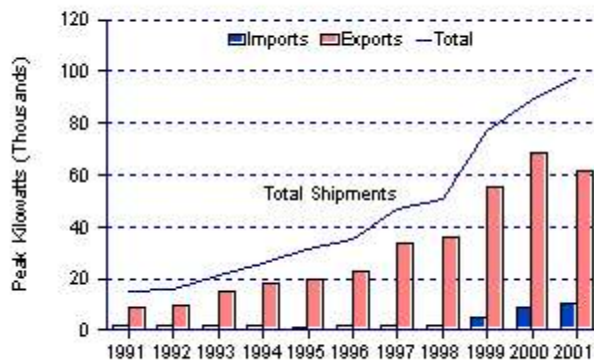
## Photovoltaic Module and Cell Manufacturing Activities <sup>3</sup>

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 distributors, 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.

<sup>3</sup> 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.

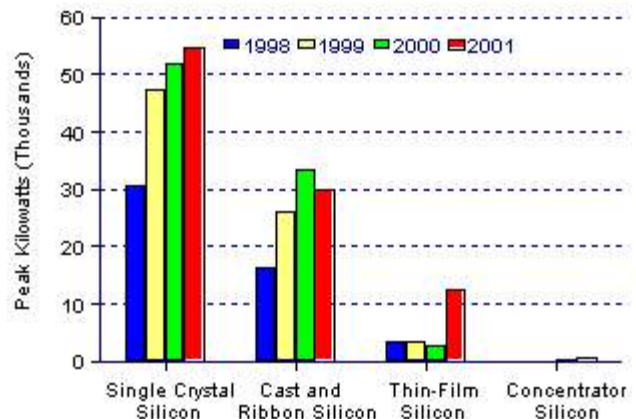
Source: Energy Information Administration, Form EIA-63B, "Annual Photovoltaic Module/Cell Manufacturers Survey."

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<sup>4</sup> 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

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



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

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

<sup>4</sup> 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 on to 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.<sup>5</sup>

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<sup>6</sup> 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).

<sup>5</sup> 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.

<sup>6</sup> 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 <sup>a</sup> (Peak Kilowatts)	Solar Thermal Collectors <sup>a</sup> (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
<b>Total .....</b>	<b>143,708</b>	<b>69,484</b>

<sup>a</sup> 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 <sup>a</sup> (Thousand Square Feet)		
		Total <sup>b</sup>	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

<sup>a</sup> Includes imputation of shipment data to account for nonrespondents.

<sup>b</sup> 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 <sup>a, c</sup>
	Total Shipments <sup>a, b</sup>	Average per Manufacturer	Total Shipments <sup>a</sup>	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

<sup>a</sup> Includes imputation of shipment data to account for nonrespondents.

<sup>b</sup> Includes shipments of solar thermal collectors to the government, including some military, but excluding space applications.

<sup>c</sup> 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
<b>Origin</b>				
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	*
<b>Top Five Total</b> .....	<b>6,144</b>	<b>74</b>	<b>7,681</b>	<b>69</b>
<b>Other States</b> .....	<b>9</b>	<b>0</b>	<b>7</b>	<b>*</b>
<b>Imported</b> .....	<b>2,201</b>	<b>26</b>	<b>3,502</b>	<b>31</b>
<b>U.S. Total</b> .....	<b>8,354</b>	<b>100</b>	<b>11,189</b>	<b>100</b>
<b>Destination<sup>a</sup></b>				
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
<b>Top Five Total</b> .....	<b>7,200</b>	<b>86</b>	<b>9,224</b>	<b>82</b>
<b>Other States</b> .....	<b>658</b>	<b>8</b>	<b>1,126</b>	<b>10</b>
<b>Exported</b> .....	<b>496</b>	<b>6</b>	<b>840</b>	<b>8</b>
<b>U.S. Total</b> .....	<b>8,354</b>	<b>100</b>	<b>11,189</b>	<b>100</b>

<sup>a</sup> 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
<b>Shipments to United States/Territories</b>	<b>10,349,303</b>
<b>Exports</b>	<b>839,822</b>
<b>Total Shipments</b>	<b>11,189,125</b>

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
<b>Asia and the Middle East</b>	
India .....	0.4
Japan .....	0.2
Philippines .....	0.1
Taiwan .....	1.1
<b>Total .....</b>	<b>1.9</b>
<b>Europe</b>	
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
<b>Total .....</b>	<b>31.0</b>
<b>North America</b>	
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
<b>Total .....</b>	<b>56.8</b>
<b>South America</b>	
Bolivia .....	0.4
Brazil .....	8.3
Chile .....	1.3
Ecuador .....	0.3
Peru .....	0.2
<b>Total .....</b>	<b>10.4</b>
<b>Total .....</b>	<b>100.0</b>

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 <sup>a</sup> .....	173	288
<b>Total .....</b>	<b>8,354</b>	<b>11,189</b>

<sup>a</sup> 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
<b>Total .....</b>	<b>8,354</b>	<b><sup>a</sup>27,393</b>	<b>3.28</b>	<b>11,189</b>	<b>32,438</b>	<b>2.9</b>

<sup>a</sup> 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	2001 Total	2000 Total
	Liquid/Air	Air	Liquid						
	Metallic and Nonmetallic		ICS/Ther- mosiphon	Flat-Plate (Pumped)	Evacuated Tube	Concentrator	Parabolic Dish/Trough		
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 <sup>a</sup> . . . . .	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 <sup>b</sup> . . . . .	0	0	0	0	0	0	0	0	0
Total . . . . .	10,919	4	81	181	2	*	2	11,189	8,354

<sup>a</sup> Other market sector includes shipments of solar thermal collectors to sectors such as government, including the military but excluding space applications.

<sup>b</sup> 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
<b>Total .....</b>	<b>26</b>	<b>26</b>

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
<b>Total .....</b>	<b>76,787</b>	<b>88,221</b>	<b>97,666</b>

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 <sup>a</sup> (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 .....	<sup>b</sup> 19	97,666	10,204	61,356

<sup>a</sup> Does not include shipments of cells and modules for space/satellite applications.

<sup>b</sup> 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
W wholesale Distributors .....	39,629	50,568	59,799
Retail Distributors .....	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 <sup>a</sup> .....	1,619	2,553	1,787
<b>Total</b> .....	<b>76,787</b>	<b>88,221</b>	<b>97,666</b>

<sup>a</sup> 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 <sup>a</sup> .....	0	0	0	0	0	0
<b>Total</b> .....	<b>76,787</b>	<b>88,221</b>	<b>97,666</b>	<b>100</b>	<b>100</b>	<b>100</b>

<sup>a</sup> 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 W att)		Value (Thousand Dollars)	2001 Average Price (Dollars per Peak W att)	
		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 <sup>a</sup> .....	0	--	--	0	--	--
<b>Total</b> .....	<b>269,855</b>	<b>3.46</b>	<b>2.4</b>	<b>304,810</b>	<b>3.42</b>	<b>2.46</b>

<sup>a</sup> 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 <sup>a</sup>	Thin-Film Silicon	Concentrator Silicon	Other	2001 Total	2000 Total
<b>Market</b>						
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 <sup>b</sup> . . . . .	5,375	353	0	0	5,728	4,417
Other <sup>c</sup> . . . . .	451	120	0	0	571	4,690
<b>Total . . . . .</b>	<b>84,651</b>	<b>12,541</b>	<b>474</b>	<b>0</b>	<b>97,666</b>	<b>88,221</b>
<b>End Use</b>						
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 <sup>d</sup> . . . . .	5,778	490	0	0	6,268	12,153
Health . . . . .	2,931	272	0	0	3,203	2,742
Other <sup>e</sup> . . . . .	549	92	0	0	641	3,028
<b>Total . . . . .</b>	<b>84,651</b>	<b>12,541</b>	<b>474</b>	<b>0</b>	<b>97,666</b>	<b>88,221</b>

<sup>a</sup> Includes single-crystal and cast and ribbon types.

<sup>b</sup> Includes Federal, State, local governments, excluding military.

<sup>c</sup> Other includes shipments that are manufactured for private contractors for research.

<sup>d</sup> Original equipment manufacturer.

<sup>e</sup> 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)

Item	Type							
	Crystalline Silicon		Thin-Film Silicon		Concentrator Silicon		Total	
	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
<b>Total . . . . .</b>	<b>67,460</b>	<b>56,559</b>	<b>837</b>	<b>4,622</b>	<b>86</b>	<b>174</b>	<b>68,382</b>	<b>61,356</b>

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
<b>Africa</b>		
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
<b>Total .....</b>	<b>2,931.7</b>	<b>4.8</b>
<b>Asia and the Middle East</b>		
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
<b>Total .....</b>	<b>9,869.7</b>	<b>16.1</b>
<b>Australia</b>		
Australia .....	799.7	1.3
New Zealand .....	1.1	*
<b>Total .....</b>	<b>800.8</b>	<b>1.3</b>
<b>Europe</b>		
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
<b>Total .....</b>	<b>39,167.5</b>	<b>63.8</b>

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

Country	Peak Kilowatts	Percent of U.S. Exports
<b>North America</b>		
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	*
<b>Total .....</b>	<b>4,600.0</b>	<b>7.6</b>
<b>South America</b>		
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	*
<b>Total .....</b>	<b>3,938.9</b>	<b>6.4</b>
<b>Other .....</b>	<b>46.8</b>	<b>0.1</b>
<b>Total U.S. Exports .....</b>	<b>61,355.7</b>	<b>100.0</b>

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
<b>Noncollector System</b>		
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,<sup>7</sup> 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
<b>Totals .....</b>	<b>31,385</b>	<b>37,434</b>	<b>38,266</b>	<b>R41,679</b>	<b>35,581</b>

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
<b>Totals .....</b>	<b>112,970</b>	<b>141,556</b>	<b>141,446</b>	<b>R191,651</b>	<b>164,191</b>

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."

<sup>7</sup> 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](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
<b>Total .....</b>	<b>7,808</b>	<b>26,219</b>	<b>1,554</b>	<b>35,581</b>

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
<b>Total .....</b>	<b>7,808</b>	<b>26,219</b>	<b>1,554</b>	<b>35,581</b>

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 non-utility 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
<b>Total</b> .....	<b>6.441</b>	<b>6.228</b>	<b>6.275</b>	<b>6.122</b>	<b>6.393</b>	<b>6.390</b>	<b>6.950</b>	<b>7.442</b>	<b>7.306</b>	<b>6.771</b>	<b>6.778</b>	<b>6.451</b>	<b>5.668</b>
<b>Residential Sector</b> ....	<b>0.976</b>	<b>0.642</b>	<b>0.677</b>	<b>0.711</b>	<b>0.616</b>	<b>0.607</b>	<b>0.667</b>	<b>0.667</b>	<b>0.506</b>	<b>0.459</b>	<b>0.486</b>	<b>0.503</b>	<b>0.475</b>
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 <sup>a</sup> .....	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
<b>Commercial Sector</b> ...	<b>0.061</b>	<b>0.071</b>	<b>0.072</b>	<b>0.081</b>	<b>0.084</b>	<b>0.086</b>	<b>0.092</b>	<b>0.110</b>	<b>0.113</b>	<b>0.111</b>	<b>0.114</b>	<b>0.109</b>	<b>0.098</b>
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 <sup>b</sup> .....	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
<b>Industrial Sector</b> .....	<b>1.812</b>	<b>1.671</b>	<b>1.625</b>	<b>1.672</b>	<b>1.697</b>	<b>1.844</b>	<b>1.905</b>	<b>1.971</b>	<b>1.976</b>	<b>1.841</b>	<b>1.830</b>	<b>1.869</b>	<b>1.816</b>
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 <sup>b</sup> .....	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
<b>Transportation Sector</b>													
Alcohol Fuels <sup>c</sup> .....	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
<b>Electric Power Sector</b> .	<b>3.351</b>	<b>3.653</b>	<b>3.684</b>	<b>3.360</b>	<b>3.662</b>	<b>3.420</b>	<b>3.889</b>	<b>4.305</b>	<b>4.375</b>	<b>4.032</b>	<b>4.034</b>	<b>3.579</b>	<b>2.987</b>
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 <sup>b</sup> .....	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
<b>Independent Power</b>													
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 <sup>b</sup> .....	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
<b>Electricity Trade</b>													
<b>Total Net Imports</b> ....	<b>0.171</b>	<b>0.110</b>	<b>0.153</b>	<b>0.219</b>	<b>0.246</b>	<b>0.337</b>	<b>0.293</b>	<b>0.313</b>	<b>0.241</b>	<b>0.221</b>	<b>0.205</b>	<b>0.266</b>	<b>0.159</b>
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
<b>Electricity Trade</b> (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

<sup>a</sup> Includes small amounts of distributed solar thermal and photovoltaic energy used in the commercial, industrial and electric power sectors.

<sup>b</sup> Municipal solid waste, landfill gases, agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

<sup>c</sup> 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: 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:** 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 <sup>a</sup>	Solar	Wind	Wood/Wood Waste	Total
<b>Total . . . . .</b>	<b>14,093,158</b>	<b>275,572,599</b>	<b>20,304,947</b>	<b>2,827,839</b>	<b>493,375</b>	<b>5,593,261</b>	<b>37,594,867</b>	<b>356,480,046</b>
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

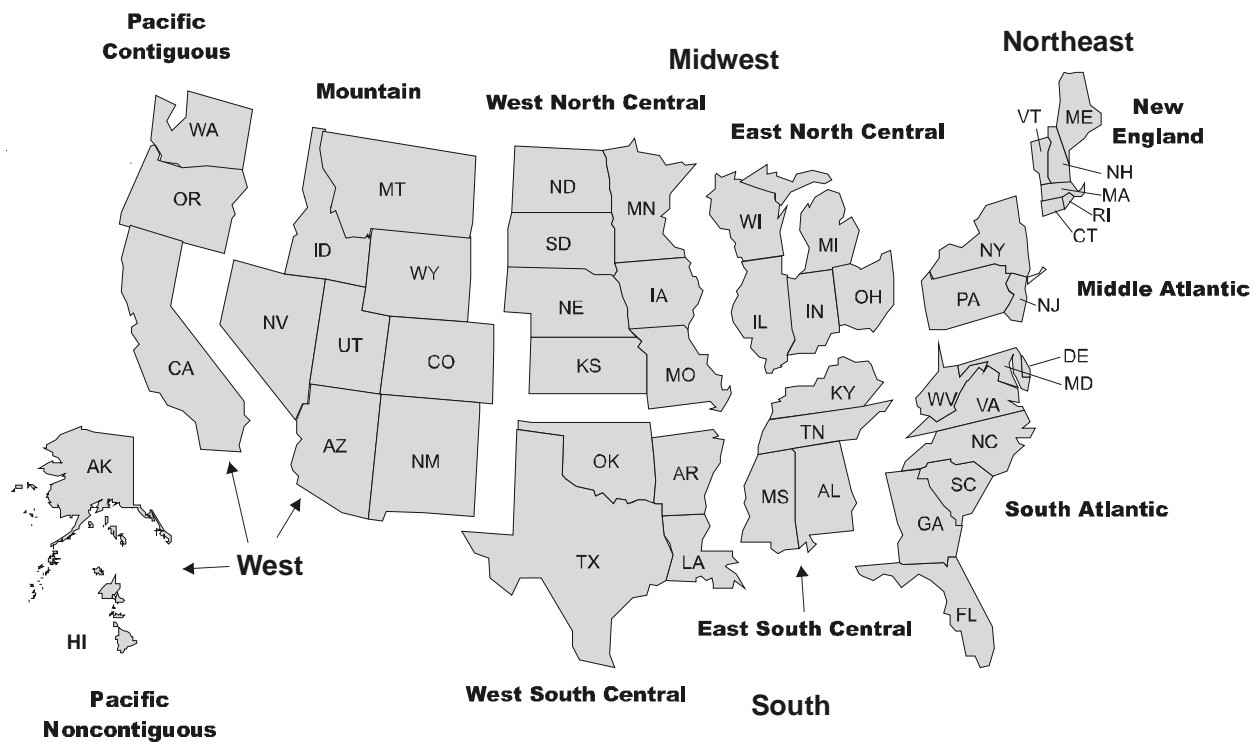
<sup>a</sup> Agriculture byproducts/crops, sludge waste, tires, and other biomass solids, liquids and gases.

-- = 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	
<b>Total</b>		<b>1,822.103</b>	<b>378.751</b>	<b>1,443.352</b>	<b>29,491</b>
<b>Agriculture, Forestry and Mining</b>	<b>Agricultural Byproducts/Crops</b>	<b>10.252</b>	<b>3.189</b>	<b>7.063</b>	<b>239</b>
<b>Manufacturing</b>	<b>Total</b>	<b>1,708.997</b>	<b>375.561</b>	<b>1,333.436</b>	<b>29,253</b>
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 <sup>a</sup>	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 <sup>b</sup>	Total	30.471	0.382	30.089	31
<b>Nonspecified <sup>c</sup></b>	<b>Total</b>	<b>102.854</b>	<b>NA</b>	<b>102.854</b>	<b>NA</b>
	Landfill Gas	56.49	NA	56.490	NA
	Municipal Solid Waste	46.364	NA	46.364	NA

Notes:

<sup>a</sup> Lumber biomass energy consumption includes a small amount of sludge waste less than 50 billion Btu.

<sup>b</sup> Other includes Apparel; Petroleum Refining; Rubber and Misc. Plastic Products; Transportation Equipment; Stone, Clay, Glass, and Concrete Products; Furniture and Fixtures; and related industries.

<sup>c</sup> 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
<b>Total</b> .....	<b>2,044,061</b>	<b>6,389,211</b>	<b>842,845</b>	<b>491,105</b>	<b>1,972,026</b>	<b>2,246,201</b>	<b>188,445</b>	<b>9,097,249</b>	<b>546,271</b>	<b>5,673,735</b>	<b>29,491,148</b>
Agricultural Byproduct/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	Connectiv 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 RomeRome	Rome	411,764,666	21,808,170	13,727,400	28.49	62.95	8.56
GA	International Paper Co	Linerboard Mill	Augusta	498,823,676	37,424,125	31,702,590	12.85	84.71	2.44
GA	International Paper Co	International Paper Augusta Mill	Augusta	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	Savannah	238,260,211	9,197,489	5,795,120	19.86	63.01	17.13
GA	Southeast Paper Mfg Co Inc	SP Newsprint Co	Macon	382,179,574	7,325,456	1,263,174	46.33	17.24	36.43
HI	Hawaiian Cornl & Sugar Co Ltd	Hawaiian Cornl&Sugar Co	Dublin	209,169,486	6,818,304	4,512,186	21.60	66.18	12.22
IA	Ag Processing Inc	AG Processing Inc	Puunene Maui	42,455,274	1,570,100	19,720	98.74	1.26	0.00
IA	IES Utilities Inc	6th Street	Eagle Grove	209,975,000	6,512,277	499,492	63.83	7.67	28.50
IA	University of Iowa	University of Iowa Main Power Plant	Linn	107,904,402	3,004,639	37,700	98.65	1.25	0.10
IL	Archer Daniels Midland Co	Decatur	Iowa City	1,058,409,443	32,068,442	720,000	97.66	2.25	0.10
IL	Dynegy Midwest Generation Inc	Baldwin Energy Complex	Decatur	10,228,674,903	111,211,000	1,345,000	98.67	1.21	0.12
LA	IPC-Louis	Louisiana Mill	Baldwin	473,462,821	19,354,330	14,508,450	3.42	74.96	21.61
LA	IPC-Mansfield Mill	Mansfield Mill	Bastrop	724,889,190	24,224,719	19,696,865	3.42	81.31	16.74
MD	Westvaco Corp	Luke Mill	Mansfield	431,504,823	17,426,372	6,706,370	1.95	38.48	1.86
ME	Champion International Corp	Bucksport Maine	Luke	593,167,281	8,174,937	2,043,726	26.88	25	48.12
ME	Mead Corp	Rumford Cogeneration Co	Bucksport	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	Rumford	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	Pottlatch Corp	Pottlatch 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	St Louis	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-Columbia	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 International 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 Greenridge	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	Johnsontown Mill	Johnsontown	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 Waupun 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
<b>Total</b>				<b>58,365,815,252</b>	<b>1,415,282,073</b>	<b>667,677,950</b>			

Note: State abbreviations are documented on the United States Postal Service website: [http://www.usps.com/nscs/lookups/usps\\_abbreviations.htm](http://www.usps.com/nscs/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)

	RGeothermal	RHydroelectric Conventional	RMSW/ Landfill Gas	ROther Biomass <sup>a</sup>	RSolar	RWind	RWood/Wood Waste	RTotal
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
<b>Total .....</b>	<b>14,827,014</b>	<b>314,663,060</b>	<b>18,010,070</b>	<b>1,482,986</b>	<b>495,082</b>	<b>4,487,999</b>	<b>8,960,707</b>	<b>362,926,918</b>

<sup>a</sup> 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)

	RHydroelectric Conventional	RMSW/Landfill Gas	ROther Biomass <sup>a</sup>	RWood/Wood Waste	RTotal
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 .....	--	--	--	--	--
<b>Total .....</b>	<b>4,872,971</b>	<b>2,062,452</b>	<b>1,016,676</b>	<b>28,080,028</b>	<b>36,032,127</b>

<sup>a</sup> 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 <sup>a</sup>	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
<b>Total .....</b>	<b>14,827,014</b>	<b>319,536,031</b>	<b>20,072,522</b>	<b>2,499,662</b>	<b>495,082</b>	<b>4,487,999</b>	<b>37,040,735</b>	<b>398,959,045</b>

<sup>a</sup> 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 <sup>a</sup>	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
<b>Total .....</b>	<b>14,093,158</b>	<b>271,337,695</b>	<b>18,672,936</b>	<b>1,635,624</b>	<b>493,375</b>	<b>5,593,261</b>	<b>8,916,074</b>	<b>320,742,123</b>

<sup>a</sup> 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 <sup>a</sup>	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 .....	--	--	--	--	--
<b>Total .....</b>	<b>4,234,904</b>	<b>1,632,011</b>	<b>1,192,215</b>	<b>28,678,793</b>	<b>35,737,923</b>

<sup>a</sup> 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 <sup>a</sup>	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
<b>Total .....</b>	<b>14,093,158</b>	<b>275,572,599</b>	<b>20,304,947</b>	<b>2,827,839</b>	<b>493,375</b>	<b>5,593,261</b>	<b>37,594,867</b>	<b>356,480,046</b>

<sup>a</sup> 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 <sup>a</sup>	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
<b>Total .....</b>	<b>2,846</b>	<b>78,264</b>	<b>2,811</b>	<b>190</b>	<b>389</b>	<b>2,252</b>	<b>1,838</b>	<b>88,590</b>

<sup>a</sup> 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)

	RHydroelectric Conventional	RMSW/Landfill Gas	ROther Biomass <sup>a</sup>	RWood/Wood Waste	RTotal
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 .....	--	--	--	--	--
<b>Total .....</b>	<b>1,129</b>	<b>403</b>	<b>261</b>	<b>4,957</b>	<b>6,750</b>

<sup>a</sup> 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 <sup>a</sup>	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
<b>Total .....</b>	<b>2,846</b>	<b>79,393</b>	<b>3,214</b>	<b>451</b>	<b>389</b>	<b>2,252</b>	<b>6,795</b>	<b>95,339</b>

<sup>a</sup> 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 <sup>a</sup>	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
<b>Total .....</b>	<b>2,793</b>	<b>78,247</b>	<b>3,064</b>	<b>226</b>	<b>386</b>	<b>2,377</b>	<b>1,728</b>	<b>88,821</b>

<sup>a</sup> 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 <sup>a</sup>	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 .....	--	--	--	--	--
<b>Total .....</b>	<b>1,112</b>	<b>317</b>	<b>275</b>	<b>4,413</b>	<b>6,117</b>

<sup>a</sup> 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 <sup>a</sup>	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
<b>Total .....</b>	<b>2,793</b>	<b>79,359</b>	<b>3,381</b>	<b>502</b>	<b>386</b>	<b>2,377</b>	<b>6,141</b>	<b>94,939</b>

<sup>a</sup> 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		
	RTotal State Generation	RPercent Renewable	RPercent 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
<b>Total .....</b>	<b>3,694,809,828</b>	<b>10.8</b>	<b>2.1</b>	<b>3,802,123,848</b>	<b>9.4</b>	<b>2.1</b>

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.<sup>8</sup> 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.”<sup>9</sup> 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)<sup>10</sup>).

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

<sup>8</sup> Even if stock data are only approximate, conventional energy stocks are normally a small percentage of production.

<sup>9</sup> Prior to 1998, this report was called the Form EIA-867, “Annual Nonutility Power Producer Report.”

<sup>10</sup> 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).<sup>11</sup> 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

<sup>11</sup> 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.<sup>12</sup> The RECS estimate of residential biomass energy consumption has a relative standard error of 10.3 percent.<sup>13</sup> 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 ground-water 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.

## 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

**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.

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

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

<sup>13</sup> 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 that 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. Oberstar (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-Subtitle 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.<sup>14</sup> 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.<sup>15</sup> 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).

To derive these estimates, EIA conducted a thorough review of relevant historical nonutility electric power

**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.

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 rationale behind the changes and new methodologies described above is found in the *Annual Energy Review 2001*, Appendix H.<sup>16</sup>

<sup>14</sup> 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.

<sup>15</sup> 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.

<sup>16</sup> 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](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/ema/ 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](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](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.<sup>17</sup>

### 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](mailto:dollieb@adeca.state.al.us)  
[http://www.adeca.state.al.us/adeca/pages/pages\\_stm/Science\\_Technology\\_Energy\\_STE.stm](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](mailto: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](mailto: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](mailto:RCA_mail@rca.state.ak.us)  
<http://www.state.ak.us/rca/>

### American Samoa

#### State Energy Office

Reupena Tataloa, Director  
Territorial Energy Office

<sup>17</sup>This information was excerpted from: Energy Information Administration, *Energy Information Directory, 2001*, DOE/EIA-0205(2001) (Washington, DC, 4<sup>th</sup> 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/asmsom/oa.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](mailto: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](mailto: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](mailto: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](mailto: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. 16<sup>th</sup> 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/delaware.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](mailto:clintonde@aol.com)  
<http://www.dccenergy.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@dccpsc.org](mailto:dflores@dccpsc.org)  
<http://www.dccpsc.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](mailto: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](mailto: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](mailto: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](mailto:pburks@gefa.org)  
[http://www.gefa.org/energy\\_program.html](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](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: [gapscc@psc.state.ga.us](mailto:gapscc@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](mailto: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](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/TEC/HASMT/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  
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# 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:

$$(x_n / x_1)^{1/n} ,$$

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 Gas:** Biogas 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,  $\text{CH}_3\text{-CH}_2\text{OH}$ ): 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 azeotrope 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 lose 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<sub>4</sub>) 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 acetone, 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, blow-

ers, 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 kilowatt-hour 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 waterborne vehicles. Vehicles whose primary purpose is not transportation (e.g., construction cranes and bulldozers, farming vehicles, and warehouse tractors and forklifts) are classified in the sector of their primary use.

**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.