

Renewable Energy Trends 2003

With Preliminary Data For 2003

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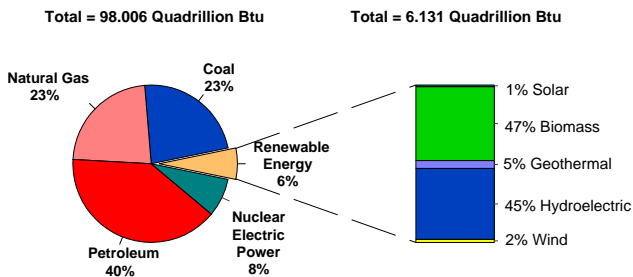
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Overview

Renewable energy consumption in 2003 grew 3 percent to 6.1 quadrillion Btu (Table 1). More than half of the increase came from a 4 percent gain in conventional hydropower, which contributed 104 trillion Btu more to consumption than it did in 2002. A 3 percent increase in biomass accounted for most of the remaining growth. Wind, geothermal, and solar energy consumption changed only modestly. Overall, renewable energy contributed 6 percent of the Nation's total energy supply (Figure 1).

At 6.1 quadrillion Btu, renewable energy consumption in 2003 was at essentially the same level it was in 1989, the year the Energy Information Administration (EIA) first began tracking "non-utility" electricity facilities (Table B1 and Figure 2). Renewable energy consumption peaked in the mid-1990s at 7.1 quadrillion Btu, or 7.5 percent of total US energy, owing largely to record hydropower output. After its peak in 1997, hydropower production declined for 5

Figure 1. The Role of Renewable Energy Consumption in the Nation's Energy Supply, 2003

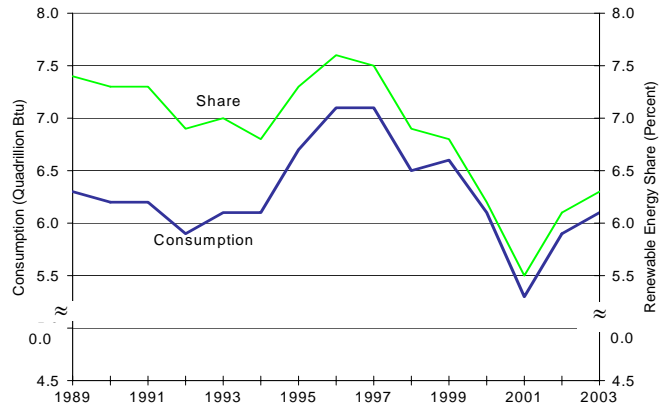


Source: Table 1 of this report

consecutive years and has been at normal or below-normal levels since 2000. Industrial and residential biomass consumption have declined slowly, while geothermal output has remained static. Wind and solar photovoltaics have expanded rapidly in recent years, but their share of the total is so small that this growth has not affected the renewable industry trend significantly.

Biomass energy consumption presented a complex picture in 2003. Although overall consumption rose 3 percent, there was great disparity among the components. Industrial and electric power sector biomass consumption declined 1 and 2 percent, respectively, compared to 2002 (Table 2). These two sectors account for over three-fourths of total biomass consumption. However, consumption during 2003 grew so fast in the smaller residential and transportation sectors, 15 and 41 percent, respectively, that their growth more than offset the major sector declines. Ethanol use increased from 133

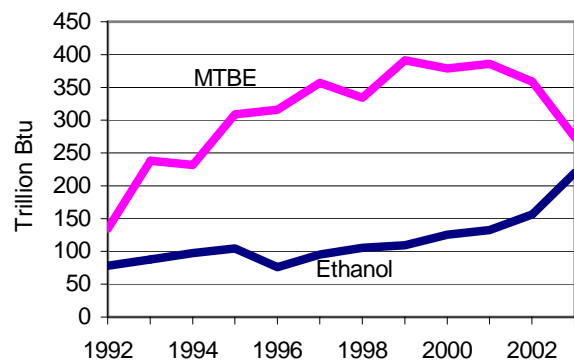
Figure 2. Historical Renewable Energy Consumption, 1989-2003



Source: Table B1 of this report

trillion Btu in 2001 to 156 trillion Btu in 2002 and surged to 220 trillion Btu in 2003 (Figure 2). Since ethanol's primary use is as an oxygenate in reformulated gasoline, its demand is tied to reformulated gasoline output and as a replacement for the other oxygenate additive, MTBE. Originally, MTBE was the overwhelming choice for oxygenating gasoline. Over the past few years, however, several states have passed bans on MTBE due to fears of groundwater contamination from leaky tanks.¹ As a result, MTBE consumption has declined since 2001, from 313 trillion Btu to 277 trillion Btu in 2002 and to 225 trillion Btu in 2003 (Figure 3).

Figure 3. Ethanol and MTBE Consumption in the Transportation Sector, 1992-2003



Sources: Ethanol: Table B1 of this report. MTBE: 1992-2001: Energy Information Administration, Alternatives to Traditional Transportation Fuels, 2003. Estimated Data (Washington, DC, February 2004), Table 10. (See: http://www.eia.doe.gov/cneaf/alternate/page/datatables/atf1-13_03.html). MTBE: 2002 and 2003: Energy Information Administration, Petroleum Supply Monthly February 2003, DOE/EIA-0109(2003/02) (Washington, DC, February 2003), Tables 34 and D3, and Office of Oil and Gas, unpublished data.

¹For a discussion of states which have banned MTBE, see <http://www.eia.doe.gov/oiaf/servicepr/mtbeban/table1.html>.

Geothermal energy consumption has remained largely unchanged for 5 years, as very little new generating capacity has come on line. During 2000, nearly 600 net megawatts of geothermal capacity were retired, and little new capacity has come on line since (Table 5). Non-electric applications represent only a tiny fraction of total geothermal energy consumption.

Wind energy consumption grew 3 percent during 2003 to 108 trillion Btu, far below the double-digit growth experienced in the last few years. The EIA and industry sources document a major increase in capacity at the end of 2003 in anticipation of the expiration of the production tax credit. However, the full effect of these plants on generation levels will not be felt until 2004 when they are in full operation and are reporting to the EIA.

Solar energy maintained its contribution of about 63 trillion Btu in 2003, as solar thermal energy consumption declined while photovoltaic use expanded.

The electric power sector (excluding industrial and commercial combined heat and power (CHP) plants) consumed the most renewable energy in 2003 of any energy use sector, using nearly 60 percent, or 3.6 quadrillion Btu, of total renewable energy consumption. Three-fourths of electric power sector renewable consumption is water for hydropower. The industrial sector is heavily dominated (over 95 percent) by biomass; specifically, wood and wood waste. Residential renewable energy consumption is also heavily dominated by biomass. Residential wood consumption has generally been declining over the past 15 years. Despite a 15 percent increase to 359 trillion Btu, 2003 residential consumption equals just 62 percent of its 1990 value. Commercial sector consumption experienced a 15 percent rate of growth in 2003, bringing consumption near levels of the late 1990's and 2000. As mentioned previously, ethanol consumption in the transportation sector surged during 2003.

Electricity generation (including generation from CHPs) accounted for 4.1 quadrillion Btu, or two-thirds of total renewable energy consumption in 2003 (Table 3). Over 90 percent of this amount came from biomass and water for hydropower. Renewable energy was also consumed for space heating, process heat, and steam (Table 6).

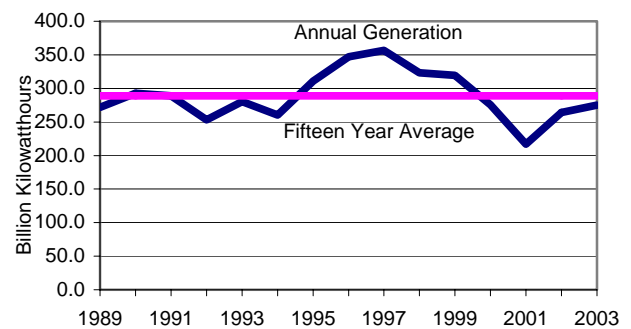
Renewable net electricity generation amounted to nearly 360 billion kilowatthours in 2003, up 2 percent from 2002 (Table 4). Ninety percent came from the electric power sector; its 322 billion kilowatthours was also up 2 percent from 2002. Industrial sector generation was essentially flat.

Geothermal generation dropped 9 percent between 2002 and 2003. The majority of geothermal generation comes from 21 plants at The Geysers field in California, one of the largest

geothermal fields in the world. Production at The Geysers fell sharply about 10 years ago because of a decline in underground pressure to produce steam. As a result, The Geysers, which have a total rated capacity of 1,650 megawatts, are currently achieving (according to industry measurements) an average annual net capacity of only 862 megawatts. The Santa Rosa Geysers Recharge Project, which became operative in December 2003, is designed to enhance steam production and produce 85 megawatts of additional generating capacity from this field by pumping about 11 million gallons of tertiary-treated wastewater daily into The Geysers geothermal reservoir.² The wastewater comes from the Santa Rosa regional sewage treatment plant and other cities through a 41-mile underground pipeline. The project also mitigates a major wastewater disposal problem. The project's final cost was just over \$200 million.

Hydroelectric generation, largely in the electric power sector, rose 4 percent and accounted for over three-fourths of renewable electricity generation in 2003. Despite increasing 27 percent since 2001, hydroelectric generation remains slightly below its average over the past 15 years (Figure 4). Generation from biomass in 2003 varied by detailed fuel category, with wood/wood waste-based generation declining 4 percent, but generation from "other biomass" jumping 17 percent.

Figure 4. Historical Hydroelectric Generation Compared to 15 Year Average for 1989-2003



Sources: 1989-1998: Energy Information Administration, Annual Energy Review 2002, DOE/EIA-0384(2002) (Washington, DC, October 2003), Table 8.2a. 1999-2003 Table 4 of this report.

There was a net addition of 560 megawatts of renewable electric generating capacity in 2003 (Table 5). Of this amount, 438 megawatts was additional wind capacity, and 110 megawatts was biomass. Industry sources indicate the increase for wind was closer to a total of 1,700 megawatts, but some new plants were not yet reporting to EIA.³ At nearly 97,000 megawatts of capacity, renewable energy provided 10 percent of the 2003 total net summer electric generating

²For information on this project, see http://www.energy.ca.gov/reports/2003-03-01_500-02-078V1.PDF and http://www.corporate-ir.net/ireve/ir_site.zhtml?ticker=CPN&script=411&layout=6&item_id=475360.

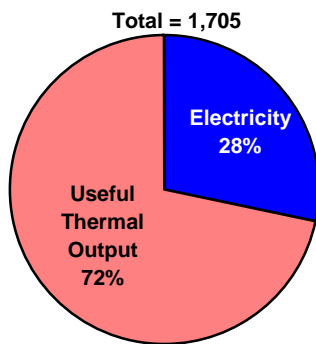
³See American Wind Energy Association News Release, "Boom: 2003 Close to Best Year Ever for New Wind Installations; Bust: Expiration of Key Incentive Lowers Hopes for 2004." January 22, 2004. See the website: <http://www.awea.org/news/news040122r03.html> (june 30, 2004).

capacity. Note that a considerable amount of renewable capacity typically operates at lower capacity factors than large baseload coal, gas, and nuclear plants.

Use of renewable energy for space heat, steam, and process heat grew 8 percent in 2003 to 2 quadrillion Btu (Table 6). Over 60 percent of this energy was consumed in the industrial sector. Over 95 percent of total non-electric renewable energy consumption, and nearly 97 percent of industrial sector non-electric consumption, is biomass. Most of the 1.1 quadrillion Btu of “Wood” consumed in the industrial sector for non-electric energy is a paper mill wood waste product, black liquor. Residential biomass use grew 15 percent in 2003, due mostly to a colder winter than in 2002. Commercial sector biomass use grew similarly. As mentioned previously, transportation sector non-electric consumption growth was rapid at 41 percent, due to increased ethanol usage as an oxygenate in gasoline.

A detailed examination of total biomass energy consumption reveals some interesting points. First, twice as much biomass was used for space, steam, and process heat (1.9 quads) as for electricity production in 2003. This contrasts with all other renewables, which are largely or entirely used to generate electricity. Since the industrial sector has by far the greatest demand for process heat and steam, the majority of total biomass (59 percent) was consumed there in 2003.

Figure 5. Industrial Biomass Energy Consumption by End Use, 2002 (Trillion Btu)



Source: Table 8 of this report.

Second, about 72 percent (1.2 quadrillion Btu) of industrial biomass was used for steam and process heat (also known as “useful thermal output”) in 2002 (Tables 8 and B3 and Figure 5). In addition to the Paper and Allied Products industry, the Lumber industry used a significant amount of biomass (248

trillion Btu) in 2002 to produce useful thermal output (Table 8). (Data for 2003 is not presently available for these detailed categories.) Third, after growing strongly between 2001 and 2002, waste and other biomass declined in 2003 by 3 and 7 percent, respectively (Table 7). Over half of biomass waste was consumed by independent power producers in 2002 (Table 9).

The Pacific “contiguous” (i.e., continental) Census Division generated nearly half, or 170 billion kilowatthours, of all renewable electricity in 2002 (Table B2). This included 144 billion kilowatthours of hydropower. Four other divisions (East South Central, Middle Atlantic, Mountain, and South Atlantic) generated roughly 30 billion kilowatthours each. The Pacific Contiguous division, which includes California and Washington, dominated generation from all renewable fuels except biomass. Black liquor- and wood/wood waste solids-based electricity were concentrated in the South Atlantic, South Central and Pacific Contiguous divisions (Table B4). New England also had substantial generation from black liquor.

Ninety-six electricity generating plants burned both biomass and coal in 2002 (Table B5). Plants for which biomass is only a small fraction of coal consumption are generally “co-firing” plants attempting to reduce emissions without making major retrofit investments. The remainder are genuine dual- or multi-fired plants consuming fuels based upon availability, demand, and price. For example, paper mills frequently require more energy than is available from the quantity of black liquor produced in the paper-making process.

State developments in renewable electricity generation complemented national trends in 2002. Washington, Oregon, California, and Montana (in descending order of importance) experienced major increases in hydroelectric generation as they recovered from the 2001 drought in the West (Tables C3 and C6). The net increase in renewable electric capacity was modest, less than 500 MW, led by expansion of wind in California, Iowa, and Texas and hydroelectric power in South Dakota and Tennessee (Tables C9 and C12). The western states and New York dominated hydroelectric capacity, while California was the leader in non-hydro electric capacity, with 30 percent of the national non-hydro total.

According to the Database of State Incentives for Renewable Energy (DSIRE), 18 states have renewable portfolio standards or state mandates with varying degrees of commitment to develop renewable energy in the future⁴ (Table C14). The list includes recently added Colorado, Florida and Maryland.

⁴ DSIRE is funded by the US Department of Energy and maintained by the North Carolina Solar Center.