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United States Energy Industry Overview*

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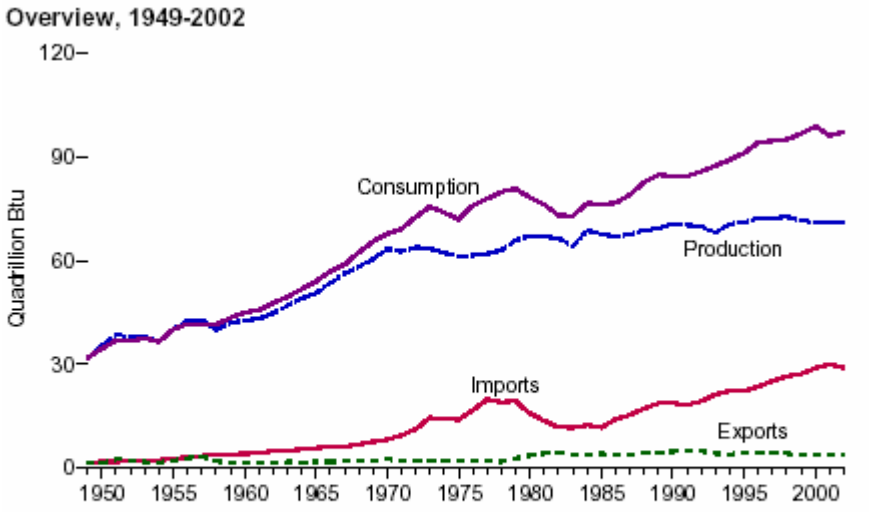
* All statistical information and graphs for this writing was obtained from the *Annual Energy Review 2002* and the *Annual Energy Outlook 2004 with Projections to 2025* from the Energy Information Administration of the U.S. Department of Energy.

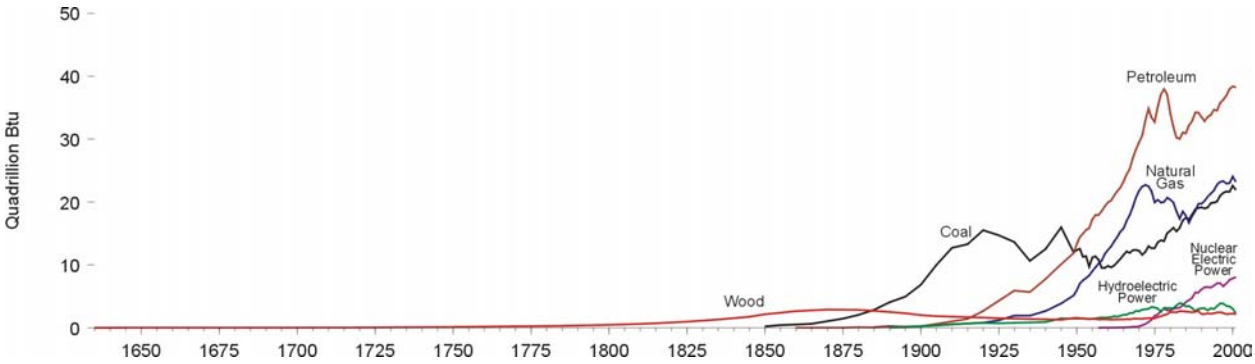
Energy Usage

Since the mid 1950s, domestic usage of energy has exceeded the domestic production levels of all energy used by industry, transportation, commercial and residential users. With the exception of a brief rollback in the late 1970s and early 1980s domestic consumption continues to outpace consumption despite additional technology that has created new energy resources and improved the production efficiencies of traditional energy supplies.



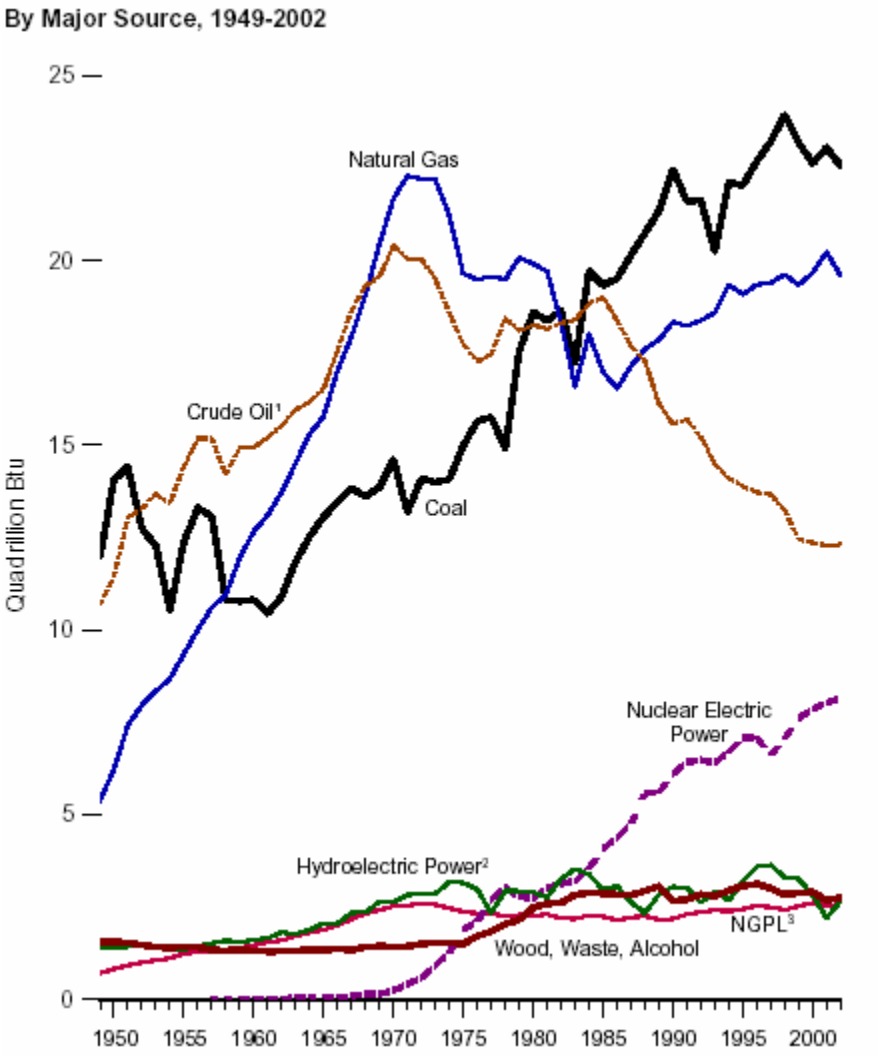
Energy Flow, 2002
(Quadrillion Btu)

Most energy produced in the United States comes from fossil fuels -- coal, natural gas, and crude oil. Coal, the leading source at the middle of the 20th century, was surpassed by crude oil and natural gas for many years, but again became the leading source of energy in the mid-1980s, used primarily for electric generation.



Energy Consumption by Source

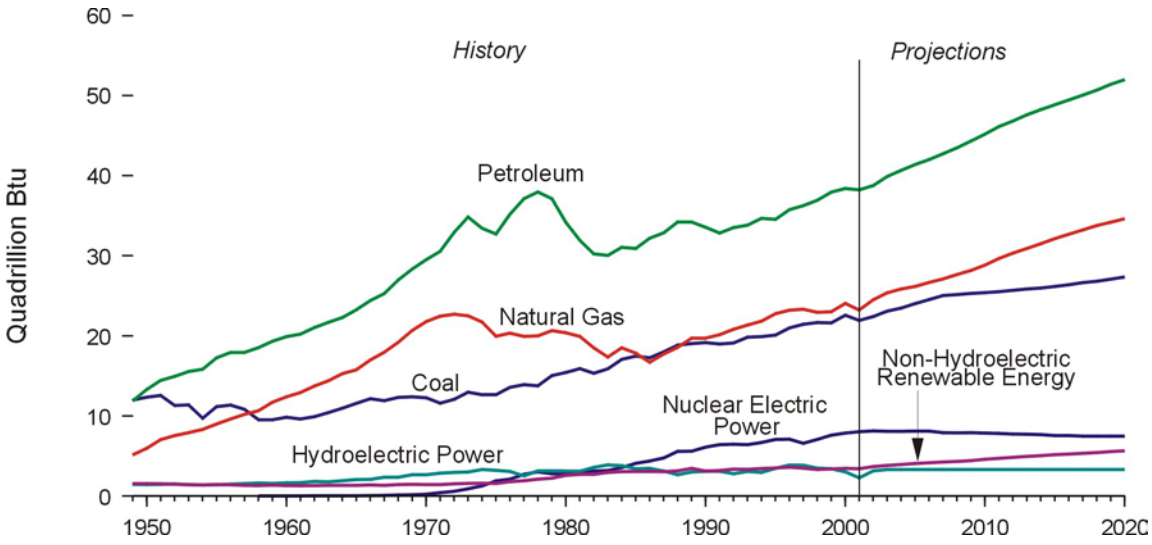
By Major Source, 1949-2002



Energy Production by Source
Since the 1950s, the United States has imported more energy than it exported. In 2002, the United States imported 29.4 quadrillion Btu of energy and exported 3.65 quadrillion Btu. Most imported energy was in the form of petroleum. In recent years, natural gas imports have grown, primarily from Canada. Exported energy was primarily in the form of coal until the late 1970s when petroleum exports expanded.

Most net generation of electricity came from coal. In fact, in 2002, fossil fuels (coal, petroleum, and natural gas) accounted for 81 percent of all net generation, while nuclear electric power contributed 11 percent, and renewable energy resources eight percent, with most of the net generation for renewable energy resources was derived from hydroelectric power.

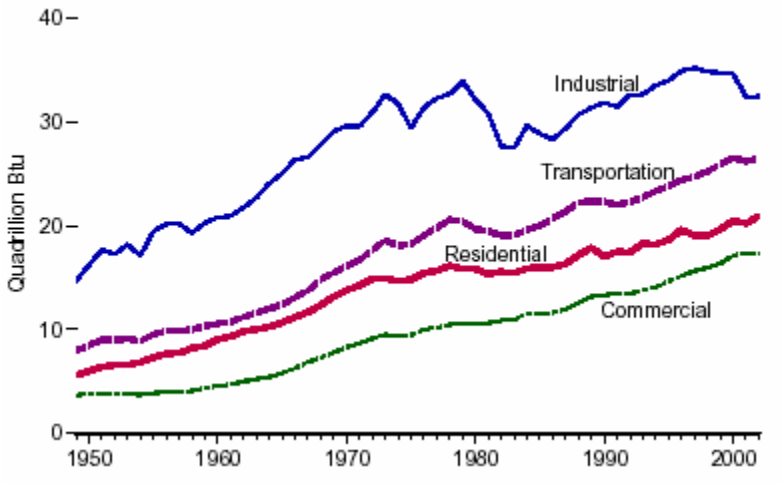
Energy History and Outlook



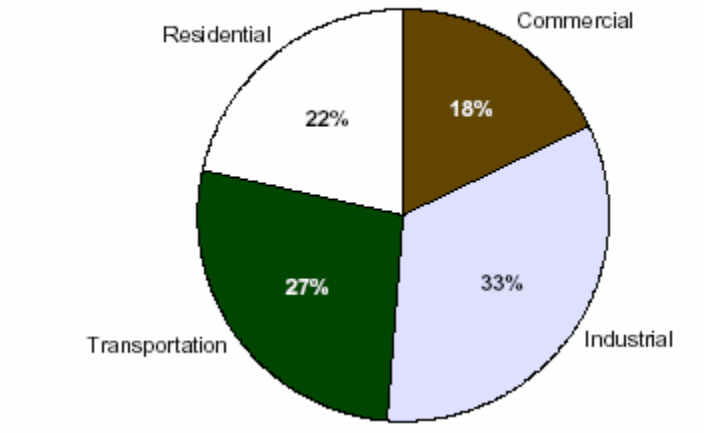
Energy Consumption by Sector
The main four sectors of energy consumption are relatively evenly divided in terms of percentages of consumption. Industrial uses lead the energy consumption sectors with 33 percent of the demand followed by transportation at 27 percent, residential at 22 percent and commercial applications using 18 percent.

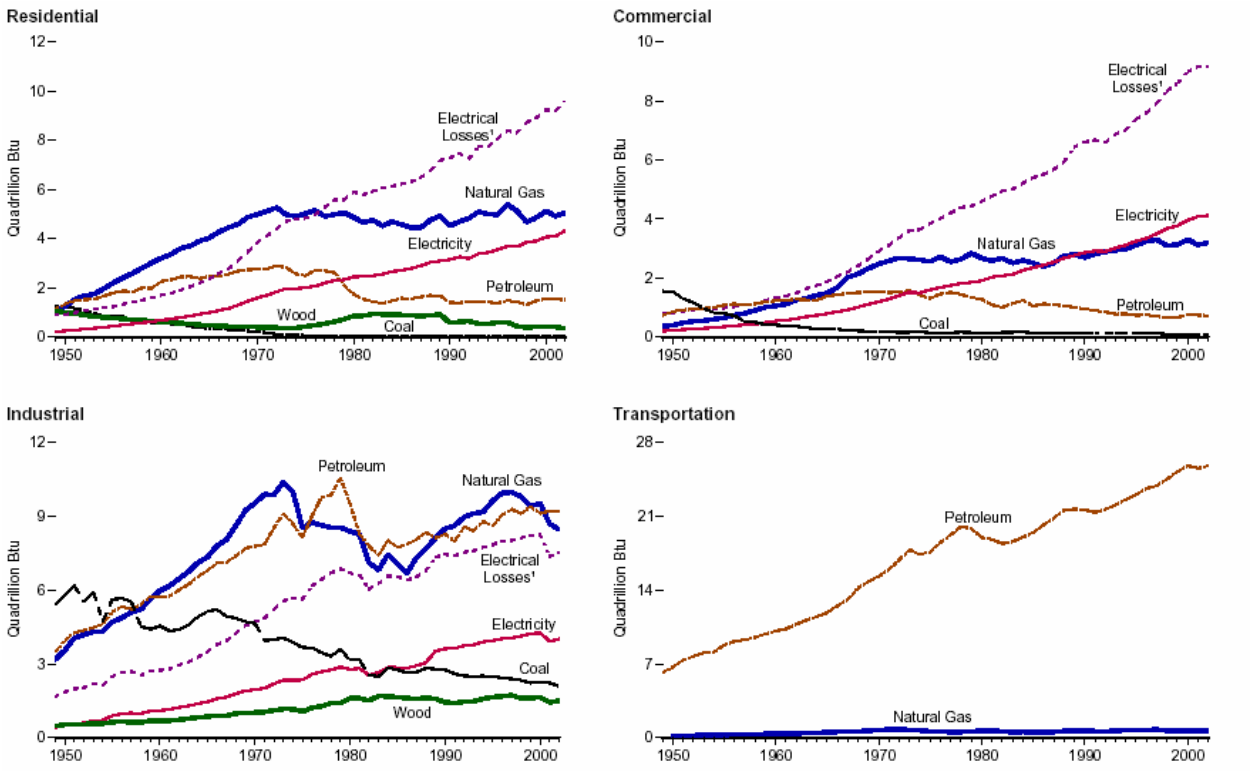
The industrial sector of the economy used the largest share of energy and showed the greatest volatility. Steep drops occurred in 1975 and 1980-83 in response to high oil prices.

Total Consumption by End-Use Sector, 1949-2002



End-Use Sector Shares of Total Consumption, 2002





Energy Sources:

Natural Gas

Production

U.S. natural gas production and consumption were close to balance through 1986. When consumption began to outpace production, imports of natural gas rose to meet requirements. Consumption in 2002 was 23.1 trillion cubic feet (Tcf), production at 19.6 Tcf, and net imports at 3.4 Tcf.

Gas well productivity, measured as gross withdrawals per day per well, peaked in 1971, and then fell until the mid-1980s. Productivity remained steady after 1985.

Consumption

Net imports as a share of consumption registered in the 4-to-5 percent range in the 1970s and early 1980s. Net imports measured 4.2 percent of consumption in 1986, which was followed by consumption increases that outpaced production growth. Net imports in 2002 accounted for 16 percent of consumption.

The industrial sector was both the largest consuming sector of natural gas and the greatest volatility sector over the years due to variability in industrial output. The electric power sector accounted for nearly one-fourth of all natural gas consumption in 2002.

Forecast
Average wellhead natural gas prices are expected to decrease to $3.90 per thousand cubic feet (2002 dollars) in 2025. The 2025 wellhead price is projected to reach $3.83 per thousand cubic feet in the low growth case and $4.50 per thousand cubic feet in the high growth case. Technically recoverable natural gas resources are expected to be adequate to support the production increases projected in the three cases. As gas resources are depleted, wellhead prices are expected to increase, and a larger portion of U.S. natural gas consumption is projected to be met by foreign supplies and by production from Alaska.

As a result of technological improvements and rising natural gas prices, natural gas production from unconventional sources (tight sands, shale, and coalbed methane) is projected to increase more rapidly than conventional production. Lower 48 states unconventional gas production is projected to grow from 5.4 trillion cubic feet in 2001 to 9.5 trillion cubic feet in 2025, increasing from 28 percent of the total U.S. production to 36 percent in 2025. Production of lower 48 nonassociated (NA) conventional natural gas is projected to grow from 10.8 trillion cubic feet in 2001 to 12.9 trillion cubic feet in 2020 and then decline to 12.5 trillion cubic feet in 2025.

Between 2002 and 2025, with increased drilling activity in deep waters, offshore natural gas production is projected to increase gradually from 5.3 trillion cubic feet in 2001 to 5.7 trillion cubic feet in 2025; however, the share of total U.S. production declines from 27 percent in 2001 to 21 percent by 2025.

The projections for domestic natural gas consumption in 2025 range from 31.8 trillion cubic feet per year in the low economic growth case to 37.5 trillion cubic feet in the high economic growth case, as compared with 22.6 trillion cubic feet in 2001. Natural gas consumption for electricity generation is projected to increase from 5.3 trillion cubic feet in 2001 to 10.6 trillion cubic feet in 2025, an average annual growth rate of 2.9 percent.

Petroleum
Production
When U.S. domestic production of petroleum peaked at 11.7 million barrels per day in 1970, net imports stood at 3.2 million barrels per day. As domestic production declined, consumption grew. In 1998, net imports surpassed domestic production. In 2002, domestic production was 5.7 million barrels per day and net imports were 9.1 million barrels per day.

Crude oil production peaked in the U.S. lower 48 States at 9.4 million barrels per day in 1970. As production fell, Alaska's production came on line and helped supply U.S. needs. Alaskan production peaked at 2.0 million barrels per day in 1988, and then fell to less than half the peak rate by 2001.

Consumption
Over the second half of the 20th century, transportation was the largest consuming sector of petroleum and the one showing the greatest expansion. In 2002, 13.1 million barrels per day of petroleum products were consumed for transportation purposes, accounting for 66 percent of all petroleum used.

Motor gasoline is the single largest petroleum product consumed in the United States. Its consumption stood at 8.84 million barrels per day in 2002, 44 percent of all petroleum consumption.

The refiner acquisition composite (domestic and foreign) cost of crude oil in nominal (unadjusted for inflation) dollars peaked at $35 per barrel in 1981. The price fell dramatically over the years that followed, reaching $18 per barrel in 1999. It jumped to $28 per barrel in 2000 and then declined again to $24 per barrel in 2002.

Americans paid an average of 65¢ per gallon for motor gasoline in 1978. The 2002 average price of $1.44 was 130 percent higher than the 1978 rate but, adjusted for inflation, it was four percent higher.

Forecast
Projected U.S. petroleum consumption varies with the projected crude oil price, but the largest variation is seen for different assumptions about economic growth. Total consumption in 2025 ranges from 26.9 million to 31.8 million barrels per day in the low and high growth cases, respectively

Domestic petroleum supply is projected to increase from its 2002 level of 8.9 million barrels per day to 9.4 million barrels per day in 2025. Although U.S. crude oil production falls off, refinery gain and production of natural gas plant liquids are projected to increase. Domestic supply in 2025 is projected to total 9.0 million barrels per day in the low oil price case and to rise to 10.0 million barrels per day in the high oil price case.

The greatest variation in petroleum consumption levels is seen across the economic growth cases, with a projected increase of 12.1 million barrels per day over the 2002 level in the high growth case, compared with a projected increase of only 7.2 million barrels per day in the low growth case.

In 2002, net imports of petroleum accounted for 55 percent of domestic petroleum consumption. Increasing dependence on petroleum imports is projected, reaching 68 percent in 2025.

U.S. petroleum consumption is projected to increase by 9.5 million barrels per day between 2002 and 2025. Most of the increase is in the transportation sector, which accounted for two-thirds of U.S. petroleum use in 2001.

Coal
Production
Unlike petroleum or natural gas, domestic supplies of coal nearly always outpaced U.S. consumption of the resource at 1,069 metric short tons. Coal exports peaked at 113 million short tons in 1981. In 2002, the United States exported 43 million short tons, over a third of it to Canada.

Consumption
In the 1950s, most coal was consumed in the industrial sector, many homes were still heated by coal, and the transportation sector consumed coal in steam-driven trains and ships. By the 1960s, most coal was used for generating electricity and by 2002 the electric power sector's share stood at 92 percent of all coal consumption.

Forecast
Domestic coal demand is projected to increase from 1,090 million tons in 2002 to 1,444 million tons in 2025, because of projected growth in coal use for electricity generation. Total coal demand in other domestic end-use sectors is projected to remain relatively constant.

Coal consumption for electricity generation is projected to increase from 985 million tons in 2002 to 1,350 million tons in 2025 as the utilization of existing coal-fired generation capacity increases and, in later years, new capacity is added. The average utilization rate is projected to increase from 69 percent in 2002 to 83 percent in 2025. Because coal consumption (in tons) per kilowatt-hour generated is higher for subbituminous and lignite than for bituminous coals, the shift to western coal is projected to increase the tonnage per kilowatt-hour of generation in the Midwest and Southeast regions. In the East, generators are expected to shift to lower sulfur Appalachian bituminous coals that contain more energy (Btu) per ton.

Although coal is projected to maintain its fuel cost advantage over both oil and natural gas, gas-fired generation is expected to be the most economical choice for construction of new power generation units in most situations, when capital, operating, and fuel costs are considered. Between 2005 and 2025, rising natural gas costs, increasing demand for electricity, and retirements of existing fossil-fired steam capacity are projected to result in increasing demand for coal-fired baseload capacity.

Hydroelectric
Production and Consumption
Hydroelectric power generates about 10 percent of the nation's energy. Just 62 percent (3.5 quadrillion Btu) of renewable energy was used to generate electricity in 2001. Two-thirds (2.4 quadrillion Btu) of this energy was provided by hydropower. Within the electric power sector, nearly three-fourths of consumption was for hydropower in 2001.

Forecast
Despite the net addition of 560 megawatts of new capacity by 2025, environmental and other requirements are projected to limit conventional hydroelectric generation to 306 billion kilowatthours in 2025— 5.3 percent of generation and 5.8 percent of sales.

Nuclear
Production
Over the latter part of the last century, nuclear electric power played a key role in meeting the Nation's rapidly growing electricity requirement. In 2002, 20 percent of all U.S. electricity came from nuclear electric.

Capacity factors measure actual power generation as a share of maximum possible output. Factors for the industry were in the 50-to-60 percent range through the 1980s, but improved to 89 percent by 2002.

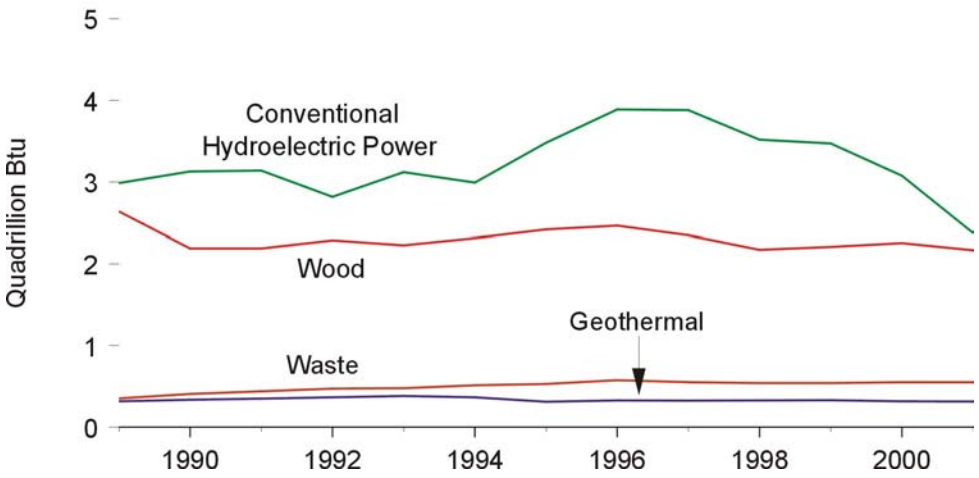
A total of 259 nuclear electric power units have been ordered over the history of the industry in the United States. The last new orders were placed in 1978. Of the 259 orders, 177 advanced to the issuance of construction permits and, of those, 132 gained full-power operating licenses. Out of the 132 units that were granted full-power operating licenses, over time 28 were shut down permanently. The largest number of units ever operable in the United States was 112 in 1990. From 1998 through 2002, 104 units were operable.

Consumption
By operating at nearly 90 percent of capacity, the U.S. nuclear industry continues to supply one fifth of the Nation's total energy supply.

Forecast
Primarily because of the relatively favorable economics of competing technologies, no new nuclear facilities are expected to be built through 2025; however, fewer expected nuclear retirements (as a result of life extensions), uprating of existing capacity, and an expectation of higher natural gas prices lead to a projection of more nuclear capacity than 2002. Total U.S. capacity increases from 98.1 gigawatts (electric) in 2000 to 99.6 gigawatts in 2025. This results because capacity uprates of 4.2 gigawatts by 2016 exceed the 2.8 gigawatts of retirements over the projection period.

Renewables
Production
Renewable energy consumption increased more than 11 percent in 2002 to 5.9 quadrillion Btu. As a result, renewable energy's share of U.S. energy consumption is 6 percent. Biomass energy itself rose to 2.9 quadrillion Btu in 2002. Many areas of renewable consumptions remained relatively stable in 2002 including biomass, geothermal and solar, however increases did occurred with wind and biofuels. 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.



Renewable Energy Consumption by Source

Consumption
Total U.S. renewable energy consumption, which stood at about seven quadrillion Btu per year from 1995 to 1999, fell in 2000 and 2001and has rebound in 2001 back to 5.9 quadrillion BTU. Conventional hydroelectric power, which accounted for about half of the total, declined steeply in 2000 and 2001 recovered back to a 2.9 quadrillion Btu contributor. Wood was the next largest source of renewable energy, followed by waste and geothermal. Smaller quantities came from alcohol fuels, solar, and wind.

Most renewable energy was consumed by the electric power sector to generate electricity. After 1958, the industrial sector was the second largest consuming sector of renewable energy, mostly black liquor, a by-product of paper production. Residential sector usage of renewable energy (mostly wood) was the third largest consuming sector.

Although renewable energy is usually associated with electricity, only 62 percent of renewable energy was consumed to generate electricity in 2002. Most of the remainder was for useful thermal output, while 3 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.

Biomass was the leading provider of renewable energy in 2002 with 2.9 quadrillion Btu. Wood and wood wastes provided three-fourths (2.2 quadrillion Btu) of biomass consumed for energy in 2002.

Most biomass consumed in the industrial sector is black liquor, a waste product of the paper-making process. Consumption of industrial wood/wood waste, which includes black liquor, amounted to approximately 1.6 quadrillion Btu in 2002.

Forecast
Despite improvements and incentives, grid-connected generators that use renewable fuels (including wind, heat and other end-use generators) are projected to remain minor contributors to U.S. electricity supply, increasing from nearly 300 billion kilowatthours of generation in 2002 to 495 billion kilowatthours in 2025. Despite the net addition of 560 megawatts of new capacity by 2025, environmental and other requirements are projected to limit conventional hydroelectric generation to 306 billion kilowatthours in 2025— 5.3 percent of generation and 5.8 percent of sales.

In addition to biomass, significant increases are projected for both geothermal energy and wind power capacity from 2001 to 2025.

Geothermal capacity, all located in western States, is projected to increase to 5.6 gigawatts, supplying 37 billion kilowatthours of electricity (0.6 percent of total generation) in 2025. Wind capacity increases by nearly 300 percent, to 12.0 gigawatts in 2025, much of it in response to State mandates. Generation from wind plants is projected to increase more rapidly than capacity, from less than six billion kilowatthours in 2001 to more than 36 billion in 2025, reflecting both a full year's output from capacity that entered service in mid-2001 and expected improvement in the productivity of future wind turbines. Despite expected significant near-term growth, mid-term prospects for wind power expansion are uncertain, depending on future cost and performance, transmission availability, extension of the Federal production tax credit and other incentives, energy security and public interest, and environmental preferences.

Electricity generation from municipal solid waste, including waste combustion and landfill gas, is projected to increase by 12 billion kilowatthours from 2002 to 2025, to nearly 34 billion kilowatthours. No new waste-burning capacity is expected, but landfill gas capacity is projected to increase by 1.1 gigawatts.

Solar technologies overall are not expected to make significant contributions to U.S. grid-connected electricity supplies through 2025. In total, grid-connected photovoltaic and solar thermal generators are projected to supply about four billion kilowatthours (0.07 percent of total generation) in 2025.

American Energy Outlook projects additions of 19 gigawatts of new renewable generating capacity through 2025, including 14 gigawatts in the electric power sector, four gigawatts in end-use combined heat and power, and 0.9 gigawatts in small-scale end-use applications. In the electric power sector, 5.2 gigawatts is projected as a result of state mandates (wind power 3.7 gigawatts, landfill gas 0.6 gigawatts, geothermal 0.4 gigawatts, solar thermal 0.09 gigawatts, solar photovoltaics three megawatts) and the rest from commercial projects. Projected commercial projects include 0.08 gigawatts of central-station solar thermal and 0.3 gigawatts of grid-connected central-station photovoltaic capacity that is assumed to be built for testing, demonstration, environmental, and other reasons.