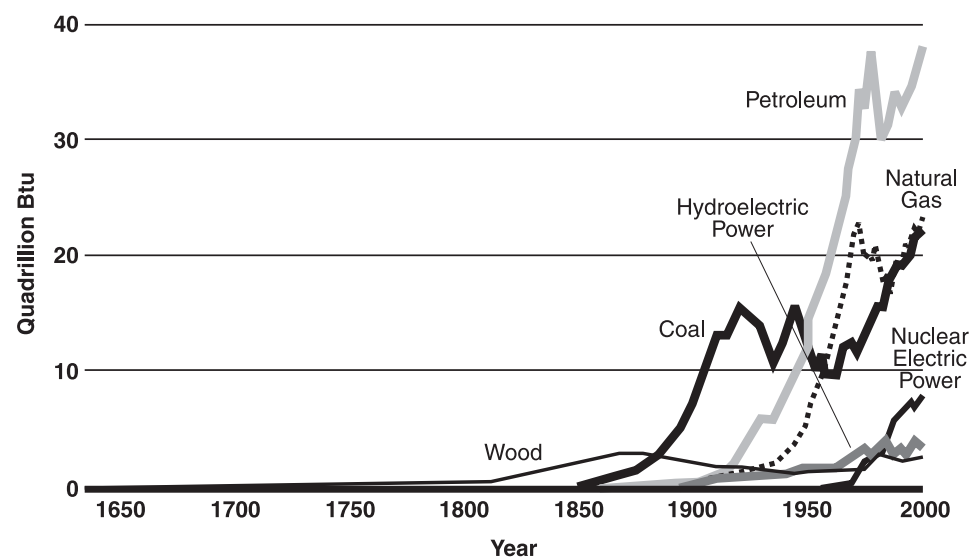


Changing Energy Sources: Development and Conversion

Janet Patton, CGREC

The history of civilization is linked to energy and its sources. The simplest forms of inanimate power — combustion, water and wind — are now transformed into new, more efficient energy sources. The coal that once heated homes and ran steam engines now generates 49 percent of the electricity used in the U.S. and also is used to produce synthetic natural gas. The windmills that milled grain have been transformed into huge power-generating wind turbines.

Energy consumption in the United States by source.



From: The Energy Information Administration, U.S. Department of Energy. Annual Energy Review, 2000.

The dramatic change from the use of draft animals and fuel wood to coal spurred the Industrial Revolution in the latter half of the 1800s. In the U.S., energy production quadrupled between 1880 and 1918. The petroleum industry grew quickly with the discovery of vast oil fields in 1901, and the increased production of automobiles in the 1910s and diesel locomotives in the 1930s and 1940s. The consumption of natural gas, first used for lighting and later for heating, rose quickly after World War II. Throughout this time, the demand for coal remained fairly steady until rising in the last 25 years.

Another major development in the early 20th century was the ability to transmit power over long distances using alternating current. Starting with hydroelectric dams in the 1890s, large electrical generating plants could be located far from manufacturing plants and consumers. The major sources of electrical energy in the U.S. today are coal (49 percent), natural gas (20 percent), nuclear energy (19 percent) and hydropower (7 percent).

Fossil fuels, forms of converted sunlight, are likely to dominate our energy mix well into the future. Worldwide supplies of petroleum, coal and natural gas are predicted to last at least 200 years at two times the current rate of use. Eventually, however, these fuels will become more difficult to extract or their use may be curtailed by environmental concerns. New ways of utilizing the sun's energy more directly in the form of biofuels and solar power are being developed. The 600 million gallons of petroleum per day that runs the transportation system in the U.S. eventually may be replaced by biofuels, electricity, natural gas and/or hydrogen.

Extending the graph to 2007, wood and wood-derived fuels still contribute 2.2 quadrillion Btu to the energy total. However, other biomass sources should be added: biofuels (ethanol from corn and biodiesel from soybeans), solid wastes and byproducts. Energy from all biomass sources accounted for 3.6 percent of the 101.6 quadrillion Btu consumed in the U.S. in 2007.

New, promising sources of biomass — perennial grasses, crop residues, trees, algae and animal wastes — are being researched. According to David Bransby, Auburn University, 30 percent of the oil imported yearly (about 17 percent of the total oil used) could be replaced with biofuels. Switchgrass, for example, has been shown to produce up to five times more energy than it takes to grow, and can yield up to 1,150 gallons of ethanol per acre. As a perennial species, switchgrass stores carbon in its roots, improves soil health and reduces erosion. Other grasses, such as those found on the native prairies of North Dakota, have potential for ethanol production and may yield as much ethanol per acre as corn in some areas. Crop residues and hay from CRP and marginal lands may provide feedstock for a cellulosic ethanol plant. Biodiesel from single-celled algae also is being studied because algae have the fastest growth rate of all plants and oil can make up to 60 percent of their biomass.

Our selection of energy sources must be based on many factors: economic, technological, political and environmental. The pros and cons of each source change through time as we have seen in the incredible progression of energy sources in the past 100 years. Our demand for energy is unabated. History has shown that with ingenuity, we can find new and innovative ways to produce energy in the future.

For more information, visit the CGREC Web site at www.ag.ndsu.edu/streeter.

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