

Teacher Background Information: An Energy History

At the beginning of human life, our ancestors relied on renewable sources of energy. The first human lived on solar energy stored in food and other plant parts. They ate fruits, vegetables, and animals (which ate plants and other animals). They burned wood from fallen trees. Even when people learned to broaden their energy base, using the wind to move ships and flowing water to drive their machines, early human civilization was still solar powered.

Energy Used Before 1880 (Wood)	Energy Used 1880 to 1915 (Coal)	Energy Used 1950 to 1985 (Oil and Natural Gas)	ENERGY REQUIRED FOR 2020 TO 2055 (Where will it come from?)
Energy Used 1915 to 1950 (Coal and Oil)			
ENERGY REQUIRED FOR THE YEARS 1985 TO 2020 (Oil, Gas, Coal, and ????)			ENERGY REQUIRED FOR THE YEARS 2055 TO 2090 (This chart assumes a 2% annual growth rate or a 35 year doubling time.)

The Energy History

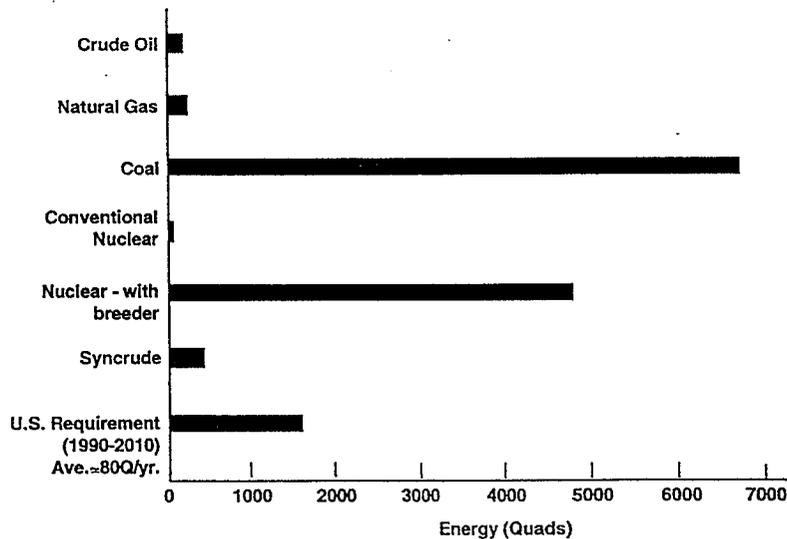
Even though the energy stored in fossil fuels was discovered early in human history, the fossil fuel age really began in England after 1700 with the Industrial Revolution. During that period, coal was used extensively for heating buildings and smelting iron. As the coal near the surface was used up and mines were dug deeper, problems with flooding arose. In response to the demand for power to pump water out of the mines, the steam engine was invented. These steam engines consumed even more coal. The use of the steam engine led to the discovery of a host of other industrial applications.

Wood alone accounted for about 90% of U.S. energy consumption in 1850. The average consumption in the frontier American home (mostly for heating) was 17.4 cords per year. (A *cord* is a 4 ft. By 4 ft. By 8 ft. stack.) The wood was used inefficiently, as it burned in fireplaces that allowed much heat to escape. Its total energy content is 2-4 times the average amount of energy used to heat a home today. Unfortunately, in those times, wood was the useful and readily available source of heat.

Most of the wood (140 million cords in 1850) was used for heating homes. Wood also was an important source of energy for the country's young industry and transportation system. Trains and steamboats burned 7-8 million cords of wood annually. Almost 2 million cords were turned into charcoal for smelting iron. This consumption of charcoal, about 750,000 tons, is now almost matched by the consumption of charcoal in outdoor barbecue grills.

Depletion of forests in Europe caused dependence on coal to come earlier than in the United States. Americans continued to rely on renewable resources - wind, water and wood - for many years.

The U.S. conversion to coal began at the end of the 1800s. Forests near cities had been cut down, and it became necessary to transport logs from far away. Wood, when burned, produces about 6.5 million Joules per pound. Coal has more than twice the energy density - 13.0 million Joules per pound. If you have to transport energy, want to carry as much per pound as you can. Therefore, because of its higher energy capability, coal replaced wood, and by 1910, accounted for about $\frac{3}{4}$ of the total energy used. Coal was used extensively by the railroad industry as a good source of energy.



Comparison of Nonrenewable Reserves

The use of petroleum products (oil and natural gas) began to grow during the 1920s, basically because it is easier to use and cleaner than coal, and also because it was easier and cheaper to transport by pipeline. By the end of World War II, the "petroleum age" had arrived and up until the present dominated world energy use. It now appears that this dominance of petroleum and products made from it may be drawing to a close. In 1991, the use of petroleum products dropped to less than 65% of the total, possibly signaling the beginning of a transition to a new dominant source.

The latest data (1994) on world energy use is still unclear, however, it indicates two small surges. Nuclear energy's contribution has grown from less than 1% in 1970, to about 8%; some analysts see this as indicative of the beginning of a nuclear age. Also, coal is showing a revival; it contributed 17% of the total in 1975, and rose to 23% in 1991.

The energy demands for the United States mirror those on the global level. The demand for energy is increasing and tending toward the use of newer and more environmentally acceptable energy sources. A graph of U.S. energy use in the past clearly reflects the U.S. economy as it has developed over this past century; the effects of the depression in the 1930s and the recessions in the 1950s and 1970s are clearly seen. Projections for future energy use reflect a healthy awareness of the physical and political limitations the United States must face as we plan for the future.

Americans primarily use the energy stored in oil and gas molecules to operate their society. These fuels are readily adapted to a variety of tasks - moving vehicles, heating homes, and running machines. Unfortunately, the domestic reserves of oil and gas are running low and as a result, there is a continuing interest in coal, especially for the generation of electric power. Because of environmental concerns, alternative energy sources are also being used. The two major alternatives are nuclear energy and hydropower, or energy from water. The potential of dammed water can be used in areas of the country where there are both rivers and hills or mountains. Of the total amount of primary energy utilized in the U.S. in 1991, hydropower represented about 4.0%.

Several features of nuclear energy make it attractive: it can lessen our dependence on fossil fuels and it does not cause obvious pollution, or add to the greenhouse effect. It is potentially an almost limitless source of energy and has the potential to help satisfy our enormous appetite for electricity. However, a number of social, political, economic and technical problems must be overcome. These include the long-term effects of exposure to low levels of radiation, the safe removal, transport and storage of both high and low-level waste over long time periods, and the ability to safeguard nuclear installations from terrorism. Unfortunately, until the public receives satisfactory solutions to these problems, nuclear energy will not move forward in the U.S.

All our energy sources are dwindling or problematic: Global reserves of petroleum are shrinking. Natural gas seems to be following a similar pattern but at a slower rate. Coal presents special challenges because it is a solid and because of environmental concerns. Nuclear energy has not been accepted by the public. The options left to use are:

- gasify and liquify coal;
- develop local energy options such as geothermal power, wind and tidal energy;
- use the Sun's energy to:
 - 1) heat and cool buildings;
 - 2) provide electricity;
 - 3) produce solid, liquid and gaseous fuels.

Some of the options available to use provide minimal amounts of energy. However, they should still be considered because they can be significant in terms of local needs. Others offer significant amounts of energy on a national scale. They all have a relatively small negative environmental effect. These options are always with us and only require that we have the will to change and develop the technology to take full advantage of them.