

ENERGY

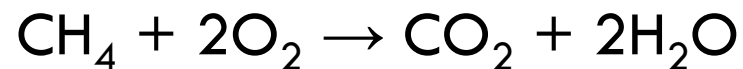
Energy is the capacity to do work or heat in the form of the movement of atoms and molecules.



Kinetic energy is contained in moving objects

Potential energy is stored energy

- A very important form of potential energy is chemical energy stored in the bonds of molecules and released, usually as heat, when chemical reactions occur. For example, in the case of methane, CH₄, in natural gas, when the methane burns,



the difference between the bond energies in the CO₂ and H₂O products and the CH₄ and O₂ reactants is released, primarily in the form of heat.

- The standard unit of energy is the *joule*, abbreviated J.
- A total of 4.184 J of heat energy will raise the temperature of 1 g of liquid water by 1°C. This amount of heat is equal to 1 *calorie* of energy (1 cal = 4.184 J), the unit of energy formerly used in scientific work.
- *Power* refers to energy generated, transmitted, or used per unit time. The unit of power is the watt.



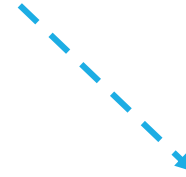
ENERGY SOURCES



Fossil fuels



Nuclear energy



Renewable energy

Sources of Energy Used in the Anthroposphere

- Before the 1800s, most of the energy used in the anthroposphere came from biomass produced during plant photosynthesis.

Exp:

- ✓ Houses were heated with wood.
- ✓ Soil was cultivated and goods and people moved by the power of animals or by humans themselves, obtaining their energy from food biomass.
- ✓ Wind drove sailing ships and windmills and falling water moved waterwheels.
- These sources were *renewable and sustainable*, with solar energy captured by photosynthesis to generate biomass, wind produced by temperature and pressure differences in solar-heated masses of atmospheric air, and flowing water moved as part of the solar-driven hydrologic cycle.

- Although coal from readily accessible deposits had long been used in small quantities for home heating, exploitation of this energy source grew rapidly after the invention of the steam engine around 1800.
- During the 1800s, coal became the predominant source of energy in the most countries that had readily accessible coal resources, a major shift from renewable biomass, wind, and water to a depletable resource that had to be dug from the ground.
- By 1900, petroleum had become a significant source of energy and by 1950 had surpassed coal as the United States' leading energy supply.
- Lagging behind petroleum, natural gas had become a significant energy supplier by 1950.

- By 1950, hydroelectric power was providing a part of energy used in the anthrosphere and still is.
- By around 1975, nuclear energy was supplying significant amounts of electricity and has maintained an appreciable share worldwide until the present.
- Miscellaneous renewable sources including geothermal and, more recently, solar and wind energy are making increasing contributions to total energy supply. Biomass still contributes significantly to the total of the sources of energy used.
- The major sources of energy for modern nations are fossil fuels, nuclear fuels, and hydropower. Non-hydro renewable energy sources, such as biomass, wind, geothermal, solar thermal, and photovoltaic power, account for only a small portion of current energy production.

How is Energy Supplied?

- Except for renewable energy sources, the main sources of energy are fossil and nuclear fuels, which are depletable minerals that must be extracted from the earth, refined as necessary, and transported to the end-user in amounts needed for the particular uses.
- While there are reserves of fossil and nuclear fuels that will last decades to centuries at current consumption rates, these are not extracted until they are needed for current consumption.
- Because fossil and nuclear fuel reserves are not uniformly distributed within or among the continents, some nations are fuel poor and others fuel rich. The quantities of fuel traded among nations is a significant fraction of overall energy production.

Energy Storage

- Like food, energy needs to be stored and transported from the time and place where it becomes available to that where it is to be used.
- Fossil and nuclear fuels, which store their energy in chemical or nuclear form indefinitely, are overwhelmingly the preferred form for storing and transporting energy.
- Electrical energy is easily transmitted from source to user, but there is no electrical storage capability in this system.
- Hydropower systems store energy for periods of days to years in their reservoirs. For most renewable energy sources, there is no inherent storage capability so they must be integrated into the electrical network.