Energy

What is Energy?

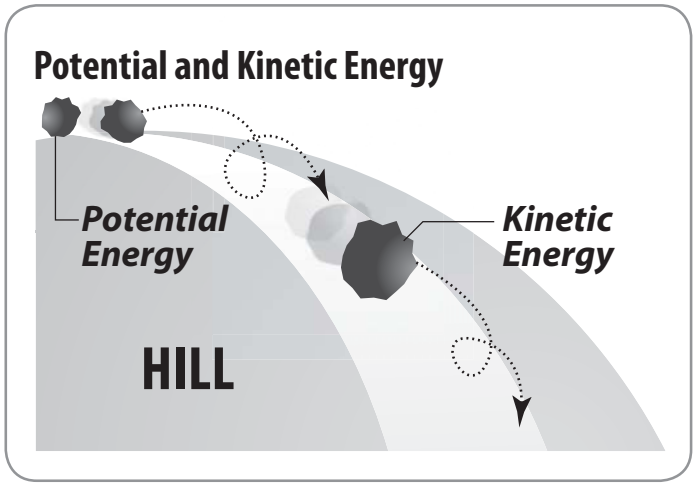
Wind is an energy source, but what exactly is energy? Energy makes change; it does things for us. We use energy to move cars along the road and boats over the water. We use energy to bake a cake in the oven and keep ice frozen in the freezer. We need energy to light our homes and keep them at a comfortable temperature. Energy helps our bodies grow and allows our minds to think. Scientists define energy as the ability to do work.

Energy is found in different forms, such as light, heat, motion, sound, and electricity. There are many forms of energy, but they can all be put into two general categories: potential and kinetic.

▪ Potential Energy

Potential energy is stored energy and the energy of position. There are several forms of potential energy, including:

- **Chemical energy** is energy that is stored in the bonds of atoms and molecules that holds these particles together. Biomass, petroleum, natural gas, and propane are examples of stored chemical energy.
- **Nuclear energy** is energy stored in the nucleus of an atom. The energy can be released when the nuclei are combined (fusion) or split apart (fission). In both fission and fusion, mass is converted into energy, according to Einstein's Theory, $E = mc^2$.
- **Stored mechanical energy** is energy stored in objects by the application of a force. Compressed springs and stretched rubber bands are examples of stored mechanical energy.
- **Gravitational potential energy** is the energy of position or place. A rock resting at the top of a hill contains gravitational potential energy. Hydropower, such as water in a reservoir behind a dam, is an example of gravitational potential energy.



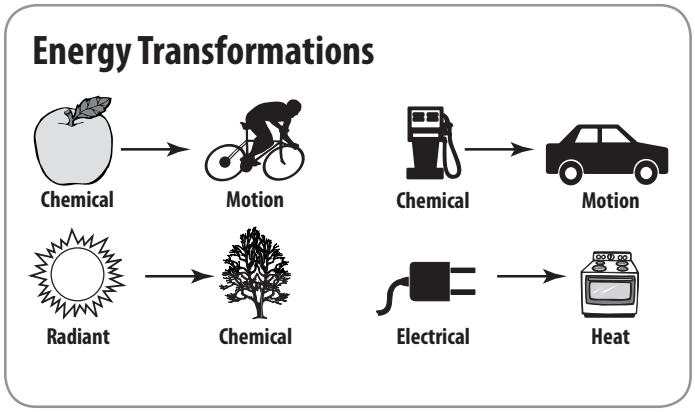
▪ Kinetic Energy

Kinetic energy is motion—the motion of waves, electrons, atoms, molecules, substances, and objects. There are several forms of kinetic energy, including:

- **Radiant energy** is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays, and radio waves. Light is one type of radiant energy. Solar energy is an example of radiant energy.
- **Thermal energy**, or heat, is the internal energy in substances—the vibration and movement of atoms and molecules within substances. The faster molecules and atoms vibrate and move within substances, the more energy they possess and the hotter they become. Geothermal energy is an example of thermal energy.
- **Motion energy** is the movement of objects and substances from one place to another. Objects and substances move when a force is applied according to **Newton's Laws of Motion**. Wind is an example of motion energy.
- **Sound energy** is the movement of energy through substances in longitudinal (compression/rarefaction) waves. Sound is produced when a force causes an object or substance to vibrate and the energy is transferred through the substance in a wave. Echoes and music are examples of sound energy.
- **Electrical energy** is the movement of electrons. Lightning and electricity are examples of electrical energy.

Conservation of Energy

Conservation of energy is not saving energy. The law of conservation of energy says that energy is neither created nor destroyed. When we use energy, it doesn't disappear. We simply change it from one form of energy into another. A car engine burns gasoline, converting the chemical energy in gasoline into motion energy. Solar cells change radiant energy into electrical energy. Energy changes form, but the total amount of energy in the universe stays the same.



Energy Efficiency

Energy **efficiency** is the amount of useful energy you get from a system compared to the energy input. A perfect, energy-efficient machine would change all the energy put in it into useful work—an impossible dream. Converting one form of energy into another form always involves a loss of usable energy, often as waste heat.

Most energy transformations are not very efficient. The human body is a good example. Your body is like a machine, and the fuel for your machine is food. Food gives you the energy to move, breathe, and think. Your body is very inefficient at converting food into useful work. Most energy in your body is released as heat.

Sources of Energy

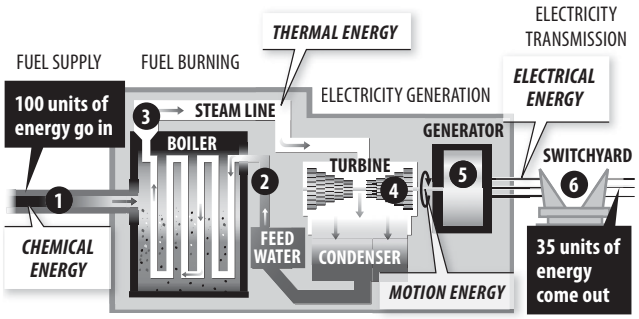
We use many different sources to meet our energy needs every day. They are usually classified into two groups—renewable and nonrenewable.

Wind is energy in motion—kinetic energy—and it is a renewable energy source. Along with wind, **renewable energy sources** include biomass, geothermal energy, hydropower, and solar energy. They are called renewable sources because they are replenished in a short time. Day after day, the sun shines, the wind blows, and the rivers flow. Renewable sources only make up nine percent of the United States' energy portfolio. We mainly use renewable energy sources to make electricity.

In the United States, almost 91 percent of our energy comes from **nonrenewable energy sources**. Coal, petroleum, natural gas, propane, and uranium are nonrenewable energy sources. They are used to make electricity, heat our homes, move our cars, and manufacture all kinds of products. They are called nonrenewable because their supplies are limited. Petroleum, for example, was formed hundreds of millions of years ago from the remains of ancient sea plants and animals. We cannot make more crude oil in a short time.

Efficiency of a Thermal Power Plant

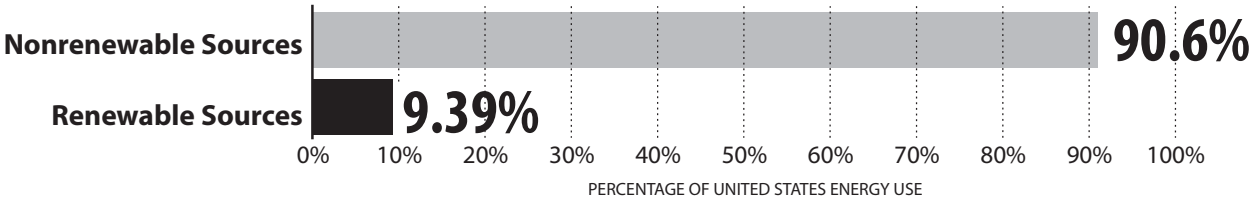
Most thermal power plants are about 35 percent efficient. Of the 100 units of energy that go into a plant, 65 units are lost as one form of energy is converted to other forms. The remaining 35 units of energy leave the plant to do usable work.



How a Thermal Power Plant Works

1. Fuel is fed into a boiler, where it is burned (except for uranium which is fissioned) to release thermal energy.
2. Water is piped into the boiler and heated, turning it into steam.
3. The steam travels at high pressure through a steam line.
4. The high pressure steam turns a turbine, which spins a shaft.
5. Inside the generator, the shaft spins a ring of magnets inside coils of copper wire. This creates an electric field, producing electricity.
6. Electricity is sent to a switchyard, where a transformer increases the voltage, allowing it to travel through the electric grid.

U.S. Consumption of Energy by Source, 2011



Nonrenewable Energy Sources and Percentage of Total Energy Consumption

PETROLEUM 34.67%
Uses: transportation, manufacturing

NATURAL GAS 25.57%
Uses: heating, manufacturing, electricity

COAL 20.22%
Uses: electricity, manufacturing

URANIUM 8.5%
Uses: electricity

PROPANE 1.64%
Uses: heating, manufacturing

Renewable Energy Sources and Percentage of Total Energy Consumption

BIOMASS 4.54%
Uses: heating, electricity, transportation

HYDROPOWER 3.26%
Uses: electricity

WIND 1.2%
Uses: electricity

GEOTHERMAL 0.23%
Uses: heating, electricity

SOLAR 0.16%
Uses: heating, electricity

Data: Energy Information Administration
NOTE: Sum of renewable and nonrenewable energy consumption does not equal 100% due to independent rounding.