

# Introduction to Energy

## WHAT IS ENERGY?

Energy makes change; it does things for us. It moves cars along the road and boats over the water. It bakes a cake in the oven and keeps ice frozen in the freezer. It plays our favorite songs on the radio and lights our homes. Energy makes our bodies grow and allows our minds to think. Scientists define energy as the ability to do work.

## FORMS OF ENERGY

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

**POTENTIAL ENERGY** Potential energy is stored energy and the energy of position—gravitational energy. There are several forms of potential energy.

**Chemical Energy** is energy stored in the the bonds of atoms and molecules. It is the energy that holds these particles together. Biomass, petroleum, natural gas, and propane are examples of stored chemical energy.

**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.

**Nuclear Energy** is energy stored in the nucleus of an atom—the energy that holds the nucleus together. The energy can be released when the nuclei are combined or split apart. Nuclear power plants split the nuclei of uranium atoms in a process called **fission**. The sun combines the nuclei of hydrogen atoms in a process called **fusion**.

**Gravitational 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.

**Electrical Energy** is the movement of electrons.

Everything is made of tiny particles called atoms. Atoms are made of even smaller particles called electrons, protons, and neutrons. Applying a force can make some of the electrons move. Electrons moving through a wire is called electricity. Lightning is another example of electrical energy.

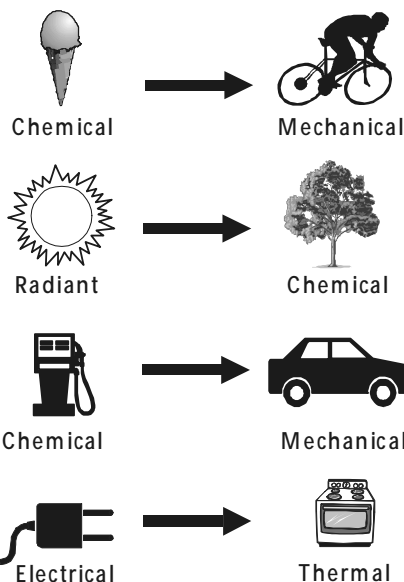
**Radiant Energy** is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Light is one type of radiant energy. Solar energy is an example of radiant energy.

**Thermal Energy**, or heat, is the internal energy in substances—the vibration and movement of the atoms and molecules within substances. 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** 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—the energy is transferred through the substance in a wave.

## Energy Transformations



## CONSERVATION OF ENERGY

To scientists, **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 change it from one form of energy into another.

A car engine burns gasoline, converting the chemical energy in gasoline into mechanical 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. 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.

In fact, 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. But your body isn't very efficient at converting food into useful work. Your body is less than five percent efficient most of the time. The rest of the energy is lost as heat. You can really feel that heat when you exercise!

## SOURCES OF ENERGY

We use many different energy sources to do work for us. Energy sources are classified into two broad groups—**renewable** and **nonrenewable**.







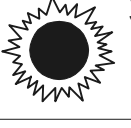


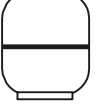
In the United States, most of our energy comes from nonrenewable energy sources. Coal, petroleum, natural gas, propane, and uranium are nonrenewable energy sources. They are used to make electricity, to heat our homes, to move our cars, and to manufacture all kinds of products.

These energy sources are called nonrenewable because their supplies are limited. Petroleum, for example, was formed millions of years ago from the remains of ancient sea plants and animals. We can't make more petroleum in a short time.

Renewable energy sources include biomass, geothermal energy, hydropower, solar energy, and wind energy. They are called renewable energy sources because they are replenished in a short time. Day after day, the sun shines, the wind blows, and the rivers flow. We use renewable energy sources mainly to make electricity.

Electricity is different from the other energy sources because it is a **secondary** source of energy. We have to use another energy source to make electricity. In the United States, coal is the number one energy source for generating electricity.

## 2000 ENERGY CONSUMPTION BY SOURCE

	<b>BIOMASS</b> <i>renewable</i> Heating, electricity, transportation	<b>3.6%</b>		<b>PETROLEUM</b> <i>nonrenewable</i> Transportation, manufacturing	<b>38.2%</b>
	<b>HYDROPOWER</b> <i>renewable</i> Electricity	<b>3.5%</b>		<b>COAL</b> <i>nonrenewable</i> Electricity, manufacturing	<b>22.5%</b>
	<b>GEOHERMAL</b> <i>renewable</i> Heating, electricity	<b>0.3%</b>		<b>NATURAL GAS</b> <i>nonrenewable</i> Heating, manufacturing, electricity	<b>22.0%</b>
	<b>SOLAR</b> <i>renewable</i> Light, heating, electricity	<b>&gt;0.1%</b>		<b>URANIUM</b> <i>nonrenewable</i> Electricity	<b>8.0%</b>
	<b>WIND</b> <i>renewable</i> Electricity	<b>&gt;0.1%</b>		<b>PROPANE</b> <i>nonrenewable</i> Manufacturing, heating	<b>1.8%</b>