

Energy

Background

Scientists define energy as the ability to do work. Modern civilization is possible because we have learned how to change energy from one form to another and use it to do work for us and to live more comfortably.

Energy makes modern agriculture possible. It moves tractors and other farm machinery through the field and moves the trucks, trains and barges that carry agricultural products from the farm to the processing plant. It operates the machinery in the processing plant that turns agricultural products into the food we eat. It bakes bread in the oven and keeps meat frozen in the freezer until we are ready to eat it. It allows our bodies to grow and our minds to think.

All energy comes from the sun. It cannot be created or destroyed, but it can be converted from one form to another. The different forms of energy include light, heat, chemical energy, and motion. All forms of energy can be put into two categories: potential and kinetic.

Wind power is kinetic energy, the energy of motion. A spinning wheel (like a car wheel) or a projectile (like a thrown ball) are examples of kinetic energy. Potential energy is energy that is waiting to be used. It may be stored chemically, electrically or mechanically. Energy from oil and gas is potential energy.

The energy in your muscles is a form of chemical potential energy. (Think of a sprinter in the starting blocks). Potential energy can also be mechanical, as in a simple windmill. A roller coaster is an interaction between kinetic and potential energy. When the cart is at the top of a loop ready to fall, it has no kinetic energy but lots of potential energy (distance it can fall). At the bottom of the loop when the cart is going very fast it has lost all the potential energy and converted it to kinetic energy (speed). As the cart uses its momentum to go up the next “hill” it trades the kinetic energy back for potential energy. If it were not for things like air resistance and friction in the wheels, this process might go on forever.

POTENTIAL ENERGY

Potential energy comes in forms that are stored. There are several forms of potential energy.

- Chemical energy is energy stored in the bonds of atoms and molecules. Batteries, biomass, petroleum, natural gas, and coal are examples of stored chemical energy. Chemical energy is converted to thermal energy when we burn wood in a fireplace or burn gasoline in a car’s engine.
- Mechanical energy is energy stored in objects by tension. 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. Very large amounts of 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 energy stored in an object’s height. The higher and heavier the object, the more gravitational energy is stored. When you ride a bicycle down a steep hill and pick up speed, the gravitational energy is being converted to motion energy. Hydropower is another example of gravitational energy, where the dam “piles” up water from a river into a reservoir.

KINETIC ENERGY

Kinetic energy is motion—of waves, electrons, atoms, molecules, substances, and objects. Electricity, heat, light, motion, and sound are forms of kinetic 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. Sunshine is radiant energy, which provides the fuel and warmth needed by crops and makes life on Earth possible.

- Thermal energy, or heat, is the vibration and movement of the atoms and molecules within substances. As an object is heated up, its atoms and molecules move and collide faster. Geothermal energy is the thermal energy in the Earth.
- Motion energy is energy stored in the movement of objects. The faster they move, the more energy is stored. It takes energy to get an object moving, and energy is released when an object slows down. Wind is an example of motion energy. A dramatic example of motion is a car crash, when the car comes to a total stop and releases all its motion energy at once in an uncontrolled instant.
- Sound is the movement of energy through substances in longitudinal waves. Sound is produced when a force causes an object or substance to vibrate. The energy is transferred through the substance in a wave. Typically, the energy in sound is far less than other forms of energy.
- Electrical energy is delivered by tiny charged particles called electrons, typically moving through a wire. Lightning is an example of electrical energy in nature, so powerful that it is not confined to a wire.

Vocabulary

agriculture— the science or occupation of cultivating the soil, producing crops, and raising livestock

atom— the smallest particle of an element that has the properties of the element and can exist either alone or in combination, considered as a source of vast potential energy

barge— a broad flat-bottomed boat that is usually towed and used chiefly to transport goods in harbors and on rivers and canals

biomass— organic material that comes from plants and animals, and it is a renewable source of stored energy from the sun

bond— a means by which atoms, ions, or groups of atoms are held together in a molecule or crystal
chemical energy

civilization— an advanced stage (as in art, science, and government) of social development

convert— to change from one substance, form, use, or unit to another

electron— an elementary particle that has a negative charge of electricity and travels around the nucleus of an atom

energy— the capacity (as of heat, light, or running water) for doing work

kinetic energy— of or relating to the motions of material bodies and the forces and energy associated with them

longitudinal— placed or running lengthwise

molecule— the smallest particle of a substance having all the characteristics of the substance

motion— an act or process of changing place or position

mechanical energy— the energy associated with the motion and position of an object

nuclear energy— the energy released by the nucleus of an atom as the result of nuclear fission, nuclear fusion, or radioactive decay

nuclei— a central point, group, or mass of something

petroleum— an oily flammable liquid that may vary from almost colorless to black, is obtained from wells drilled in the ground, and is the source of gasoline, kerosene, fuel oils, and other products

potential energy— the amount of energy a thing (as a weight raised to a height or a coiled spring) has because of its position or because of the arrangement of its parts

processing plant— a factory where raw materials are treated or prepared by a special method, esp one where food is treated in order to preserve it

projectile— something (as a bullet or rocket) thrown or driven forward especially from or for use as a weapon

radiant energy— the energy of electromagnetic waves

thermal— of, relating to, caused by, or saving heat

wave— a disturbance similar to a wave in water that transfers energy progressively from point to point

windmill— a machine (as for pumping water) worked by the wind turning sails or vanes at the top of a tower