

# Wind Power

When the winds of change blow, some people build walls and others build windmills.

—Chinese Proverb

Wind is air in motion, caused by the uneven heating of the earth's surface by the sun. Since the earth's surface is made up of land, desert, water and forest areas, the surface absorbs the sun's radiation differently.

During the day, air above the land heats more quickly than air above water. The hot air over the land expands and rises, and the heavier, cooler air over the body of water rushes in to take its place, creating local winds. At night, the winds are reversed because air cools more rapidly over land than over water.

Similarly, the large atmospheric winds that circle the earth are created because land near the equator is heated more by the sun than land near the north and South Poles.

People have been harvesting the power of the wind for centuries. Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electricity, windmills for mechanical power, windpumps for water pumping or drainage, or sails to propel ships.

The first use of wind power by humans was likely the use of sails for powering sailboats. Windmills were probably first used in Iran as long ago as 600 A.D. Ancient windmills had small sails that caught the wind to turn an axis that produced mechanical power to grind grain. By the 1100s Europeans were using windmills for grinding grain and pumping water from lowlands.

The American windmill was developed for farmers during the 1800s and 1900s. The wheels of these windmills were made from curved blades of wood or steel. They were mounted at the end of a horizontal shaft. This shaft was connected to a pump by a vertical rod sunk deep into the ground. The windmill blades moved to face the wind, which blew on them and produced enough mechanical power to pump water up from the ground. The groundwater ran through a horizontal water pipe after it came up from the ground. The farmer placed a large tank at the end of that pipe and kept it filled with water for the farm animals to drink. Some farm families also had windmills near their homes to provide water for household use.

Wind is a renewable energy source because we will never run out of it. Today we use wind energy to produce electricity with an updated version of the windmill—a wind turbine. While windmills in the past were mostly used to convert the wind's kinetic energy into mechanical power to grind grain or pump water, modern wind turbines are used primarily to generate electricity. The wind turns the turbine, which turns a generator producing electrical energy that can be stored in a battery or transmitted on wires. The energy produced by large wind turbines must be used immediately, since storing it in batteries is not economically practical.

Like old-fashioned windmills, today's wind turbines use blades to collect the wind's kinetic energy. The

## Kinetic and Potential Energy

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 is stored chemically, electrically or mechanically.

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 as described here.

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.

wind flows over the blades, causing lift, like the effect on airplane wings. This causes the blades to turn.

Wind power plants, or wind farms, are clusters of wind turbines used to produce electricity. A large wind farm usually has hundreds of wind machines in all shapes and sizes. Wind farm owners must carefully plan where to place their wind turbines. They have to consider how much the wind blows in an area, how close they are to electrical transmission lines and local zoning codes.

Wind farms also need lots of land. Just one large wind machine needs about two acres of land, so a wind power plant can take up hundreds of acres. Wind farms work well on farm land, because farmers can grow crops around the machines. Many farmers in Oklahoma, especially in the western part of the state, have installed wind turbines on their farms to take advantage of a different kind of harvest.

## Vocabulary

**absorb**—to transform (radiant energy) into a different form usually with a resulting rise in temperature

**atmosphere**—the whole mass of air surrounding the earth

**axis**—a straight line about which a body or geometric object rotates or may be conceived to rotate

**electricity**—a form of energy that is found in nature but that can be artificially produced by rubbing together two unlike things (as glass and silk), by the action of chemicals, or by means of a generator

**energy**—a source of usable power

**equator**—an imaginary circle around the earth everywhere equally distant from the North Pole and the South Pole

**expand**—to increase in size

**groundwater**—water within the earth that supplies wells and springs

**horizontal**—parallel to the horizon

**kinetic energy**—energy associated with motion

**mechanical**—made or operated by a machine, which is a combination of parts that transmit forces, motion, and energy to do some desired work

**motion**—an act or process of changing place or position

**power**—force or energy that is or can be applied to work

**pump**—a device that raises, transfers, delivers, or compresses fluids especially by suction or pressure or both

**radiation**—the process of giving off radiant energy in the form of waves or particles

**renewable**—capable of being replaced by natural ecological cycles or sound management procedures

**shaft**—a commonly cylindrical bar used to support rotating pieces or to transmit power or motion by rotation

**technology**—the application of science, especially to industrial or commercial objectives transmission

**vertical**—going straight up or down from a level surface

**wind**—a movement of air

**wind turbine**—a machine in which the kinetic energy of wind is converted to mechanical power by the impulse or reaction of the wind with a series of blades arrayed about the circumference of a wheel or cylinder

**windmill**—a mill or other machine that runs off the energy generated by a wheel of adjustable blades or slats rotated by the wind