How does a wind turbine work?

Associated Electric Cooperative Inc.

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Power supply facts

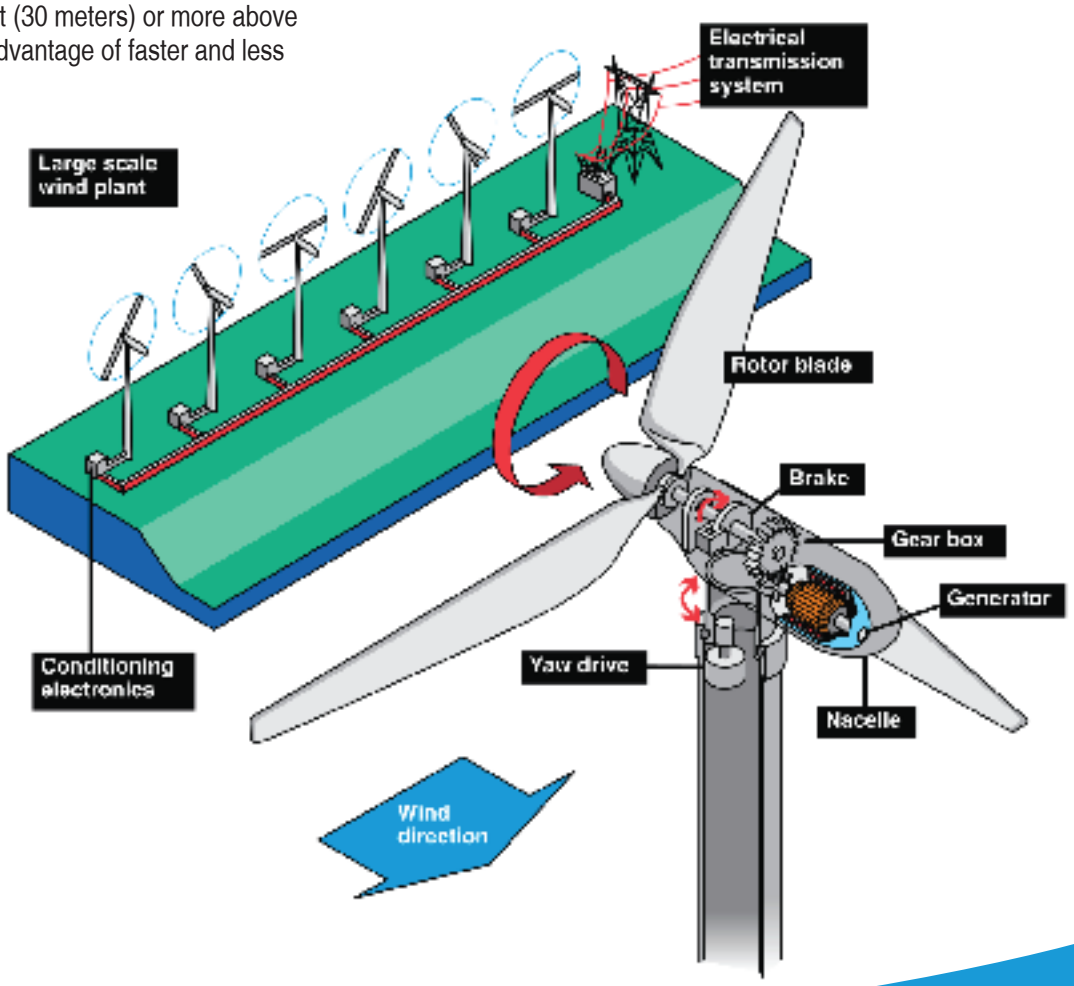
Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water), or a generator can convert this mechanical power into electricity.

Simply stated, a wind turbine works the opposite of a fan.

Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity. The wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity.

Wind turbines are mounted on a tower to capture the most energy. At 100 feet (30 meters) or more above ground, they can take advantage of faster and less turbulent wind.

Wind turbines can be used to produce electricity for a single home or building, or they can be connected to an electricity grid for more widespread electricity distribution.



Source: U.S. Department of Energy, www.energy.gov

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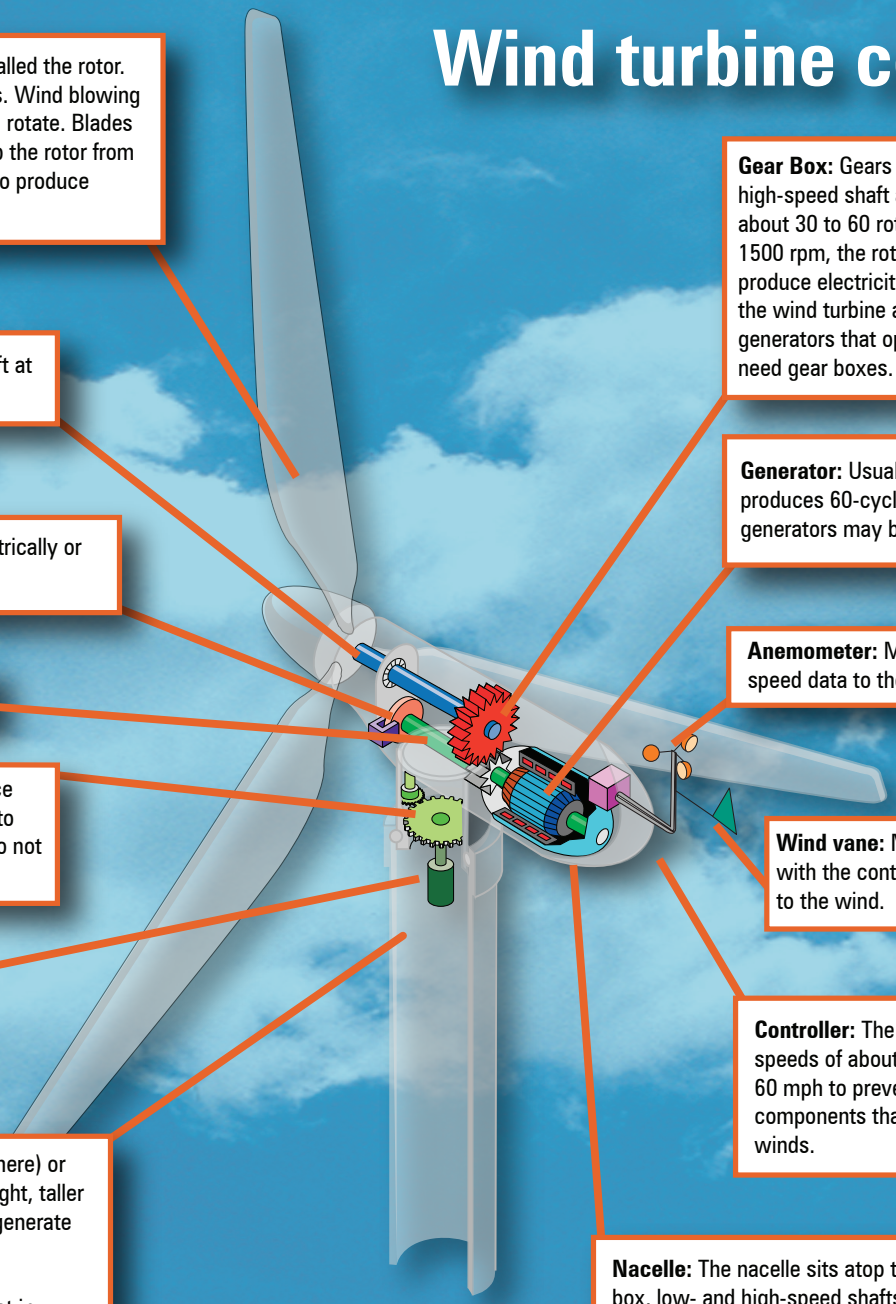
Wind turbine components



Rotor: The blades and the hub together are called the rotor. Most turbines have either two or three blades. Wind blowing over the blades causes the blades to "lift" and rotate. Blades are turned, or pitched, out of the wind to keep the rotor from turning in winds that are too high or too low to produce electricity.

Low-speed shaft: The rotor turns the low-speed shaft at about 30 to 60 rotations per minute.

Brake: A brake can be applied mechanically, electrically or hydraulically to stop the rotor in emergencies.

High-speed shaft: Drives the generator.

Yaw drive: Upwind turbines, like those at Bluegrass Ridge, face into the wind; the yaw drive is used to keep the rotor facing into the wind as the wind direction changes. Downwind turbines do not require a yaw drive; the wind blows the rotor downwind.

Yaw motor: Powers the yaw drive.

Tower: Towers are made from tubular steel (shown here) or steel lattice. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

The towers at Bluegrass Ridge are more than 260 feet in height and weigh nearly 200 tons.

Gear Box: Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1200 to 1500 rpm, the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and do not need gear boxes.

Generator: Usually an off-the-shelf induction generator that produces 60-cycle AC electricity. However, other types of generators may be used.

Anemometer: Measures the wind speed and transmits wind speed data to the controller.

Wind vane: Measures the wind direction and communicates with the controller to orient the turbine properly with respect to the wind.

Controller: The controller starts up the machine at wind speeds of about 9 mph and shuts off the machine at about 60 mph to prevent damage to the blades, tower and other components that might be caused by the force of high speed winds.

Nacelle: The nacelle sits atop the tower and contains the gear box, low- and high-speed shafts, generator, controller and brake. Some nacelles are large enough for a helicopter landing.

Source: U.S. Department of Energy