How do wind turbines work?

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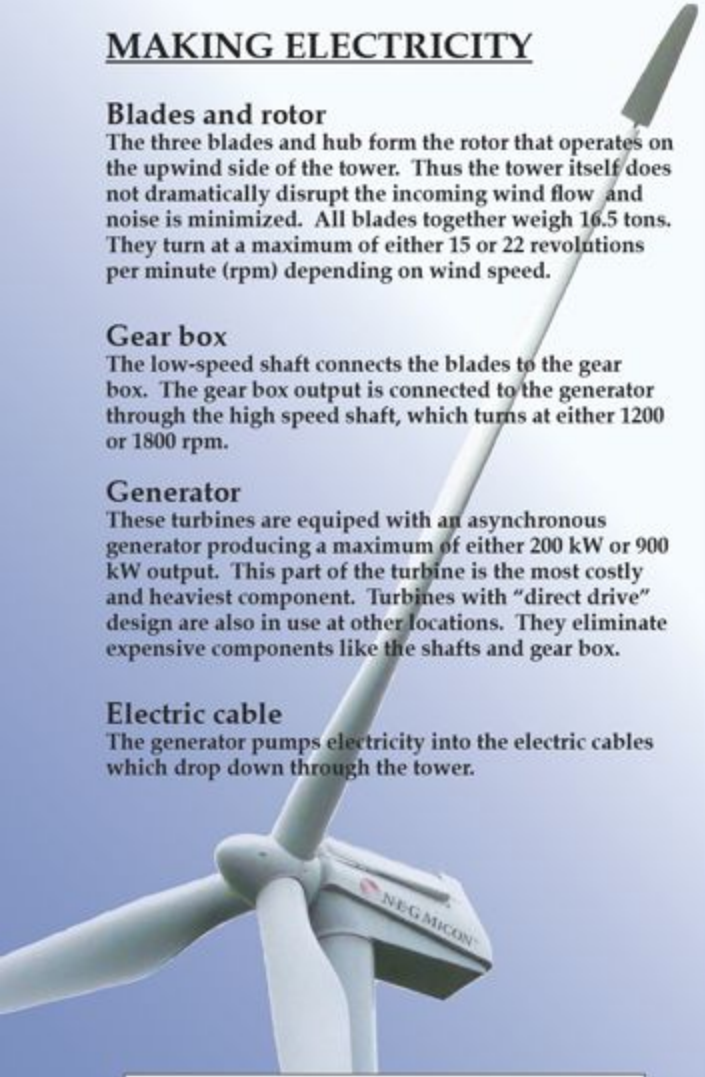
Blades and rotor
The three blades and hub form the rotor that operates on the upwind side of the tower. Thus the tower itself does not dramatically disrupt the incoming wind flow and noise is minimized. All blades together weigh 16.5 tons. They turn at a maximum of either 15 or 22 revolutions per minute (rpm) depending on wind speed.

Gear box
The low-speed shaft connects the blades to the gear box. The gear box output is connected to the generator through the high speed shaft, which turns at either 1200 or 1800 rpm.

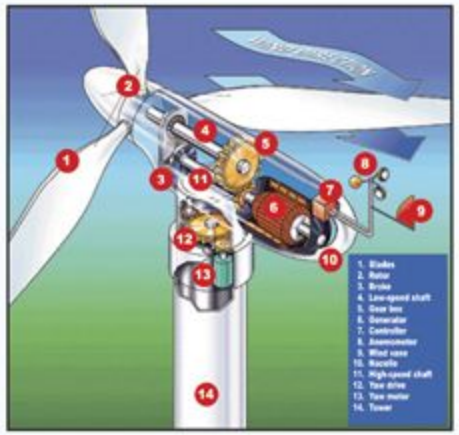
Generator
These turbines are equiped with an asynchronous generator producing a maximum of either 200 kW or 900 kW output. This part of the turbine is the most costly and heaviest component. Turbines with "direct drive" design are also in use at other locations. They eliminate expensive components like the shafts and gear box.

Electric cable
The generator pumps electricity into the electric cables which drop down through the tower.



Crystal Flash Energy of Grand Rapids, Michigan owns and operates these turbines. They sell the electricity to Consumers Energy.

You can support the development of wind energy by participating in a "green power" program.



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BLADE DESIGN

The wind turbine is designed for speed and efficiency using blades shaped like an airfoil.

The blades are "lift designed" so they work like airplane wings. The wind crossing over the blades causes them to lift and hence turn the rotor. This produces the relatively fast turning speed required to produce electricity. Wind turbines convert wind energy into electricity.

The windmill is designed for torque using blades that are flat or cup-shaped.

The name windmill originated from its initial job of milling grain. Windmill blades, as opposed to wind turbine blades, are designed on the "drag design" principle which produces more torque than speed. Windmills are located at the work site and convey the energy directly to the task.

CONTROLLING THE TURBINE

Controller
A computer controls the turbine. It accepts and analyzes data from sensors on the turbine and determines if there is any problem. In case of a shut down the computer will phone the site manager. The site manager can read the data streams, reset, and restart the turbine through a telephone connection from anywhere in the world.

Meteorological sensors
Wind speed is recorded with an anemometer which transmits the data to the controller. At about 8 mph the turbine starts. At about 56 mph the controller shuts off the turbine so it is not damaged by high winds. Two wind vanes direct the rotor into the wind by means of the yaw system.

Yaw system
Motors with gearing keep the blades facing into the wind.

Brake system
The turbine blades are designed with a slight twist which causes the blades to "stall" when the wind speed gets too high. The tips of the blades also can be turned by the controller to stop the blades (as seen in the photo to the far left). A huge hydraulic disk brake also stops and holds the blades.

The energy output from this turbine peaks at about 40 mph.

For a detailed explanation of the workings of wind turbines visit: www.windpower.org/composite-85.htm