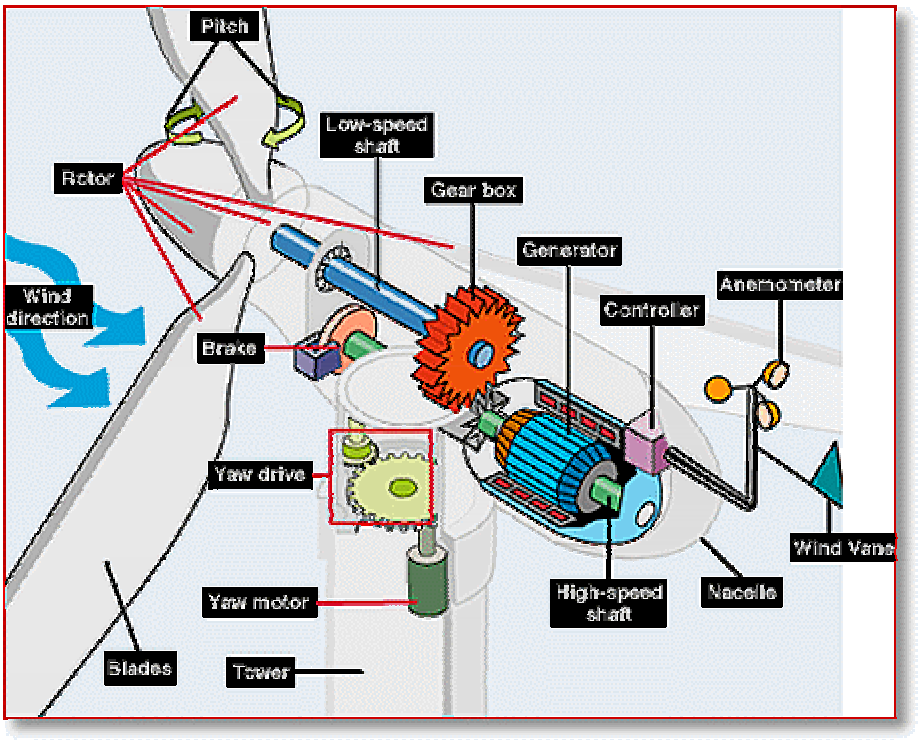

Anemometer: Measures the wind speed and transmits wind speed data to the controller.

Blades: Most turbines have either two or three blades. Wind blowing over the blades causes the blades to "lift" and rotate. Front-facing turbines normally have three blades.

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

Controller: The controller starts the machine at wind speeds of about 8 to 16 mph (13 to 26 km/h) and shuts off the machine at about 65 mph (105 km/h). Turbines cannot operate at wind speeds above about 65 mph (105 km/h) because their generators could overheat.

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 1,200 to 1,500 rpm, the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine, so 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 alternating current (ac) electricity.

High-speed shaft: Drives the generator.

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

Nacelle: The rotor attaches to the nacelle, which sits atop the tower and includes the gear box, low-speed and high-speed shafts, generator, controller, and brake. A cover protects the components inside the nacelle. Some nacelles are large enough for a technician to stand inside while working.

Pitch: 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.

Rotor: The blades and the hub together are called the rotor.

Tower: Towers are made from tubular steel (shown here) or steel lattice. Some taller towers may incorporate concrete over the lower portions of their height. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

Wind direction: This is an "upwind" turbine, so-called because it operates facing into the wind. Other turbines are designed to run "downwind," facing away from the wind.

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

Yaw drive: Upwind turbines 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, since the wind blows the rotor downwind.

Yaw motor: Powers the yaw drive.

FIGURE D-5 Major Components of a Modern HAWT (Source: EERE 2004c)