

## **Week 48: Pat Brett, EcoPower – Wind Turbines: May 16<sup>th</sup>, 2024**

**How Do Wind Turbines Work?** Wind turbines work on a simple principle: instead of using electricity to make wind—like a fan—wind turbines use wind to make electricity. Wind turns the propeller-like blades of a turbine around a rotor, which spins a generator, which creates electricity.

Wind is a form of solar energy caused by a combination of three concurrent events:

1. The sun unevenly heating the atmosphere
2. Irregularities of the earth's surface
3. The rotation of the earth.

Wind flow patterns and speeds vary greatly across the United States and are modified by bodies of water, vegetation, and differences in terrain. Humans use this wind flow, or motion energy, for many purposes: sailing, flying a kite, and even generating electricity.

The terms "wind energy" and "wind power" both describe the process by which the wind is used to generate mechanical power or electricity. 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.

A wind turbine turns wind energy into electricity using the aerodynamic force from the rotor blades, which work like an airplane wing or helicopter rotor blade. When wind flows across the blade, the air pressure on one side of the blade decreases. The difference in air pressure across the two sides of the blade creates both lift and drag. The force of the lift is stronger than the drag and this causes the rotor to spin. The rotor connects to the generator, either directly (if it's a direct drive turbine) or through a shaft and a series of gears (a gearbox) that speed up the rotation and allow for a physically smaller generator. This translation of aerodynamic force to rotation of a generator creates electricity.

**Applications of Wind Turbines** Modern wind turbines can be categorized by where they are installed and how they are connected to the grid:

**Land-based wind turbines** range in size from 100 kilowatts to as large as several megawatts. Larger wind turbines are more cost effective and are grouped together into wind plants, which provide bulk power to the electrical grid.

**Offshore wind turbines** tend to be massive, and taller than the Statue of Liberty.

They do not have the same transportation challenges of land-based wind installations, as the large components can be transported on ships instead of on roads. These turbines are able to capture powerful ocean winds and generate vast amounts of energy.

When wind turbines of any size are installed on the "customer" side of the electric meter, or are installed at or near the place where the energy they produce will be used, they're called "**distributed wind**".