Wind Turbines types and components

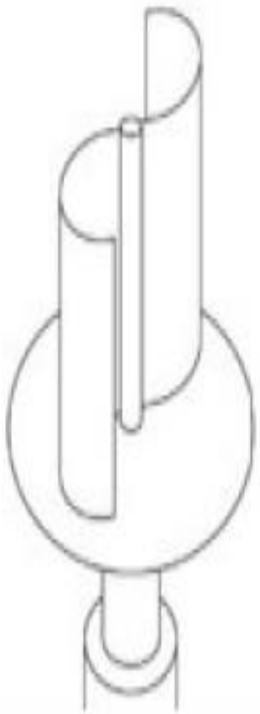
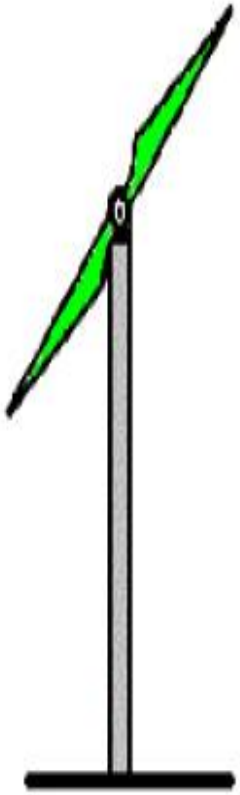
Types of wind turbines

There are mainly two types of wind turbine: horizontal axis and vertical axis. The horizontal axis wind turbine (HAWT) and the vertical axis wind turbine (VAWT) are classified or differentiated by the axis of rotation the rotor shafts.

Horizontal Axis Wind Turbines – Horizontal axis wind turbines, also known as HWAT type turbines have a horizontal rotor shaft and an electrical generator which is both located at the top of a tower.

Vertical Axis Wind Turbines – abbreviated as VAWTs, are designed with a vertical rotor shaft, a generator and gearbox which are placed at the bottom of the turbine, and a uniquely shaped rotor blade that is designed to harvest the power of the wind no matter which direction is it blowing.

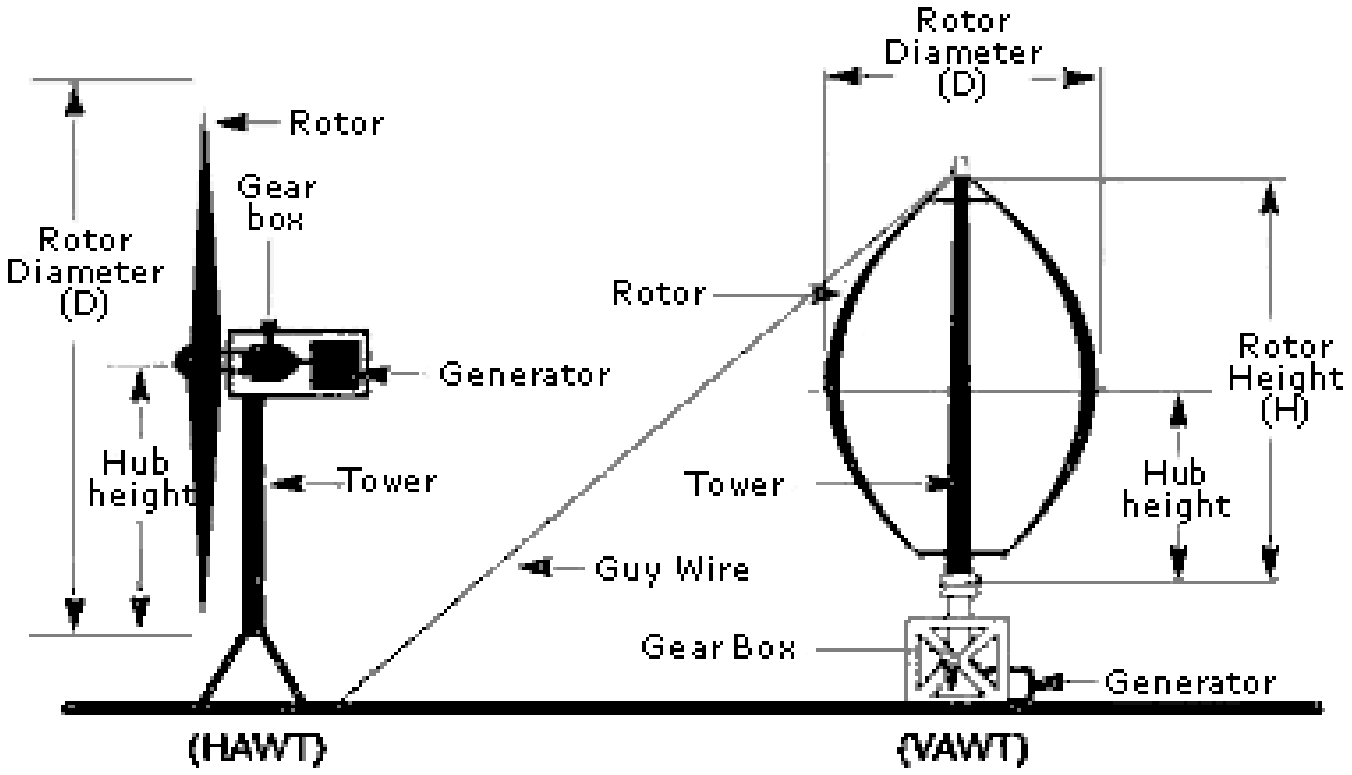
The first is the Darrieus wind turbine, which is designed to look like a modified egg beater. These turbines have very good efficiency, but poor reliability due to the massive amount of torque which they exert on the frame. Furthermore, they also require a small generator to get them started.

Savonius VAWT	Helical VAWT	Darrieus VAWT	3-blades HAWT	2 blades HAWT
				

Wind turbines, some types

Components of a wind turbine

Wind turbine usually has six main components: the rotor, the gearbox, the generator, the control and protection system, the tower and the foundation. These main components can be seen in the below figure.



Rotor – The rotor is an elegant aerofoil shaped blades which take the wind and aerodynamically converts its kinetic energy into mechanical energy through a connected shaft.

Gearbox – The gearbox alters the rotational velocity of the shaft to suit the generator.

Generator – The generator is a device that produces electricity when mechanical work is given to the system.

Control and Protection System – The protection system is like a safety feature that makes sure that the turbine will not be working under dangerous condition. This includes a brake system trigged by the signal of higher wind speeds to stop the rotor from movement under excessive wind guts.

Tower – The tower is the main shafts that connects the rotor to the foundation. It also raises the rotor high in the air where we can find stronger winds. With horizontal axis wind turbines, the tower houses the stairs to allow for maintenance and inspection.

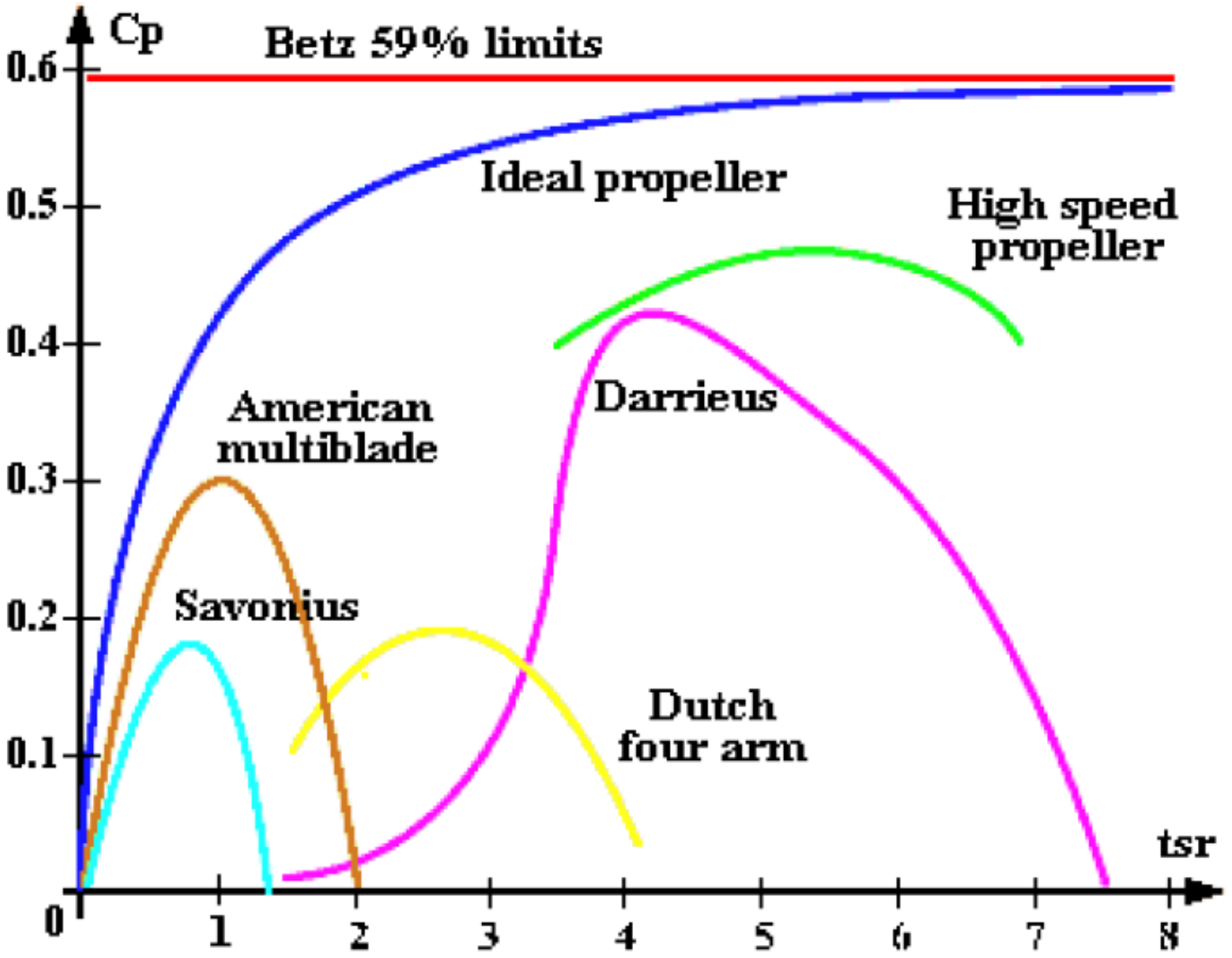
Foundation – The foundation or the base supports the entire wind turbine and make sure that it is well fixed onto the ground or the roof for small household wind turbines. This is usually consists of a solid concrete assembly around the tower to maintain its structural integrity.

In addition to the main components of a wind turbine, a wind energy generation system is shown in figure below, incorporating a charge controller, Battery and inverter so that the electricity is converted for use by house appliances and lights.

Relationship between wind speed and Rotor speed

The Tip Speed Ratio – (often known as the tsr) is of vital importance in the design of wind turbine generators. If the rotor of the wind turbine turns too slowly, most of the wind will pass undisturbed through the gap between the rotor blades. Conversely if the rotor turns too quickly, the blurring blades will appear like a solid wall to the wind. Therefore, wind turbines are designed with optimal tip speed ratios to extract as much power out of the wind as possible.

The optimum tip speed ratio depends on the number of blades in the wind turbine rotor. The fewer the number of blades, the faster the wind turbine rotor needs to turn to exact maximum power from the wind. A two-bladed rotor has an optimum tip speed ratio of around 6, a three- bladed rotor around 5, and a four-bladed rotor around 3. Figure show some of the common wind turbines and their respective efficiency against tip speed ratio (tsr).



Typical wind turbine efficiencies