

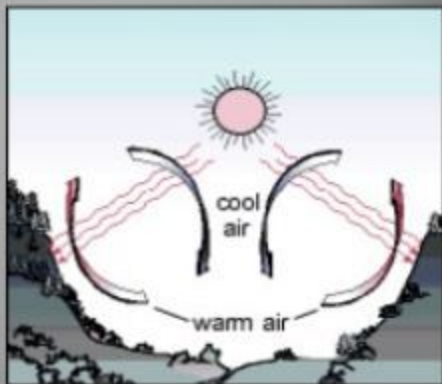
**SIR CHHOTU RAM INSTITUTE OF
ENGINEERING AND TECHNOLOGY**
DEPARTMENT OF MECHANICAL ENGINEERING
RENEWABLE ENERGY RESOURCES (BT-806)
NOTES ON WIND ENERGY

What Makes Wind ?

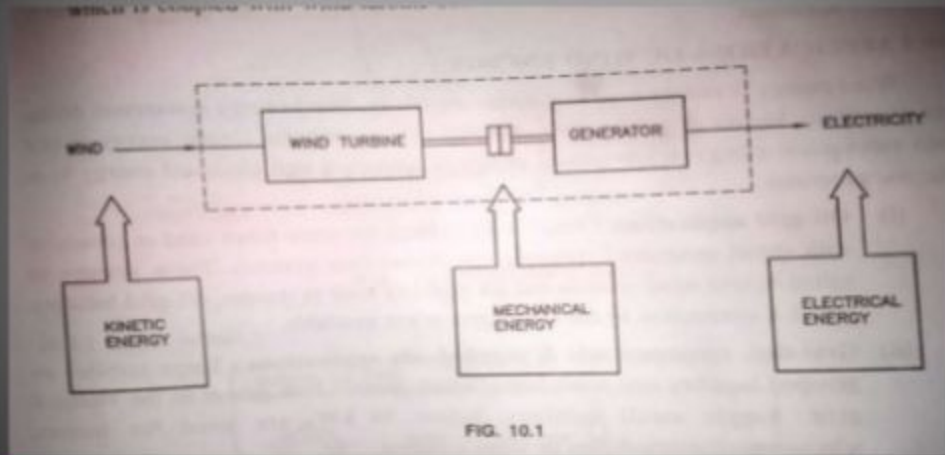
- ❑ Wind energy is created when the atmosphere is heated unevenly by the Sun, some patches of air become warmer than others.
- ❑ These warm patches of air rise, other air rushes in to replace them – thus, wind blows.



- ❑ The wind is a by-product of solar energy. Approximately 2% of the sun's energy reaching the earth is converted into wind energy.
- ❑ The surface of the earth heats and cools unevenly, creating atmospheric pressure zones that make air flow from high- to low-pressure areas.



→ ENERGY CONVERSION IN WIND POWER PLANTS



→ Wind Turbines

- ❖ “rotary engine in which the kinetic energy of a moving fluid is converted into mechanical energy by causing a bladed rotor rotate”
- ❖ opposite of a fan
- ✓ Turbine blades spin from the wind and make energy, instead of Using energy to make wind
- ✓ Wind rotates the turbine blade
- ✓ Spins a shaft connected to a generator
- ✓ The spinning of the shaft in the generator makes electricity

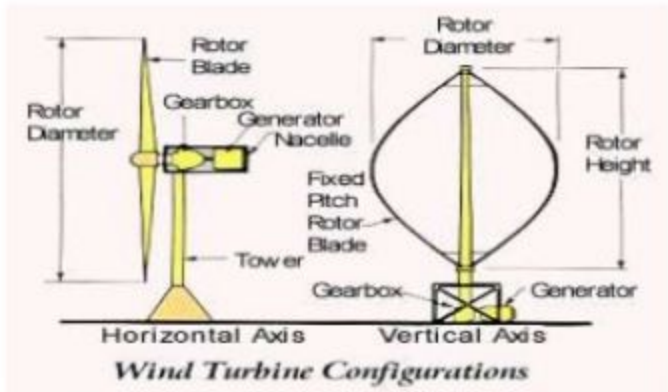
→ Wind Turbine

- ❑ A wind turbine extracts energy from moving air by slowing the wind down, and transferring this energy into a spinning shaft, which usually turns a generator to produce electricity.
- ❑ The power in the wind that's available for harvest depends on both the wind speed and the area that's swept by the turbine blades.



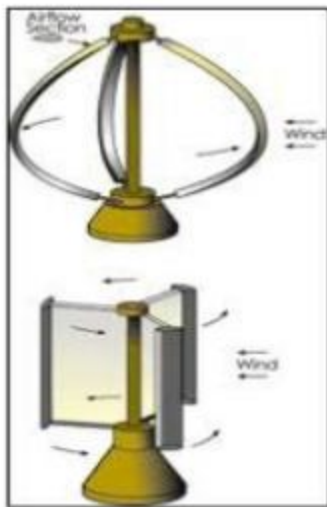
→ Two Types Turbines:-

- ▶ Horizontal Axis Wind Turbines
- ▶ Vertical Axis Wind Turbines



→ Vertical Axis Turbines:-

- ▶ Although vertical axis wind turbines have existed for centuries, they are not as common as their horizontal counterparts.
- ▶ The main reason for this is that they do not take advantage of the higher wind speeds at higher elevations above the ground as well as horizontal axis turbines.



→ Advantages of Vertical Axis Machines:-

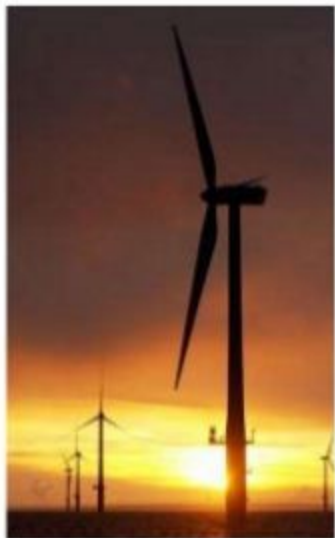
- ▶ The generator and gearbox can be placed on the ground
- ▶ The structure is usually simpler.
- ▶ You do not need a yaw (pointing) mechanism to turn the rotor against the wind.
- ▶ These are easier for hobbyists to build – little detailed knowledge of aerodynamics is needed for simple designs.

→ Disadvantages of Vertical Axis Machines:-

- ▶ These structures are low to the ground, where wind speeds are lowest.
- ▶ The overall efficiency is much lower than horizontal axis machines.
- ▶ Most vertical axis machines are not self starting.
- ▶ Many vertical axis machines require guy wires which greatly increase the structural footprint.
- ▶ Maintenance is usually more difficult.
 - For example, replacement of the generator typically requires disassembly of the entire machine.

→ Horizontal Axis Turbine:-

- ▶ This is the most common wind turbine design. In addition to being parallel to the ground, the axis of blade rotation is parallel to the wind flow.
- ▶ Some machines are designed to operate in an upwind mode, with the blades upwind of the tower. In this case, a tail vane is usually used to keep the blades facing into the wind.
- ▶ Other designs operate in a downwind mode so that the wind passes the tower before striking the blades.



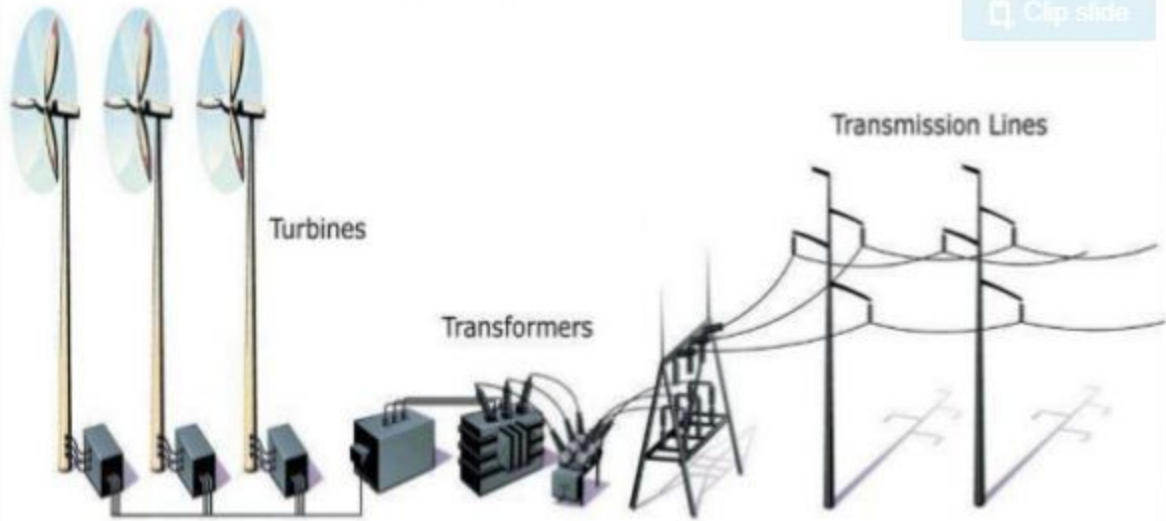
→ Advantages of Horizontal Axis Machines:-

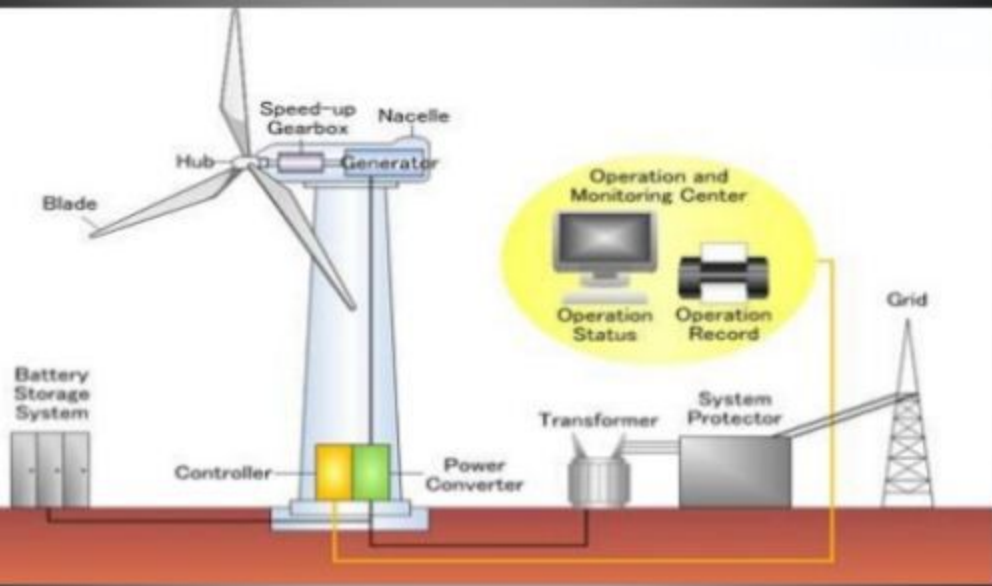
- ▶ The efficiency is higher than that of vertical axis machines.
- ▶ They are easier to mount high enough to avoid much of the ground effect.
- ▶ They are self starting.
- ▶ They are less expensive.
- ▶ The technology is better developed.
- ▶ They are available commercially.



→ Disadvantages of Horizontal Axis Machines:-

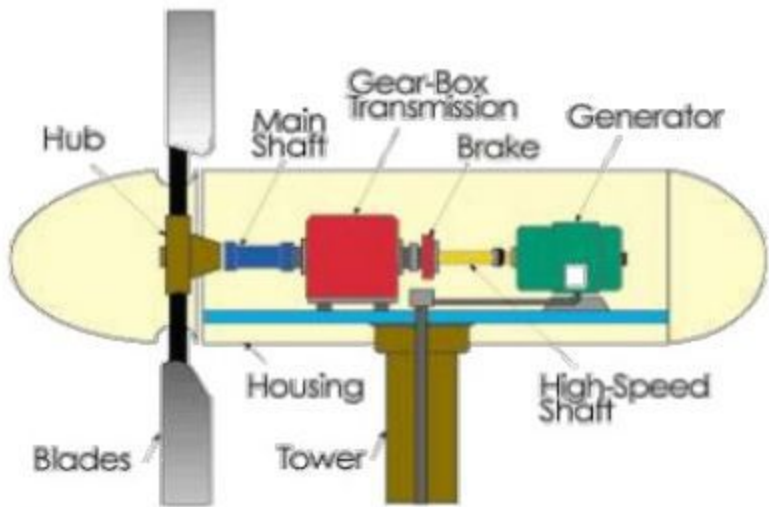
- ▶ Many of the important parts that require maintenance are high off the ground.
- ▶ A yaw mechanism must be in place to turn the turbine into the wind.





→ Parts Operating In Wind Turbine:-

Clip slide



→ **Rotor:-** The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor usually consists of two or more wooden, fiberglass or metal blades (new design) which rotate about an axis (horizontal or vertical) at a rate determined by the wind speed and the shape of the blades. The blades are attached to the hub, which in turn is attached to the main shaft.



→ **Shaft:-** Two different shafts turn the generator. One is used for low speeds while another is used in high speeds.



→ **Gear Box:-** Gears connect the high and low speed shafts and increase the rotational speeds from about 10-60 rotations per minute to about 1200-1800 rpm, the rotational speed required by most generators to produce power.



→ Generator:-

- ❖ The generator is what converts the turning motion of a wind turbine's blades into electricity. Inside this component, coils of wire are rotated in a magnetic field to produce electricity.
- ❖ Different generator designs produce either alternating current (AC) or direct current (DC), and they are available in a large range of output power ratings. The generator's rating, or size, is dependent on the length of the wind turbine's blades because more energy is captured by longer blades.



→ **Controller:-** Turns the blades on at 8-16 mph and shuts them down around 65 to prevent any high wind damage.

→ **Tower:-** Tall tubular metal shaft. The taller the tower, the more power produced.



→ Site Selection:-

→ **Selecting an appropriate site is key to the success of any renewable-energy project, financially and technically.**

- ▶ How good is the wind resource on the site?
- ▶ How much does electricity cost, and is there enough demand for the power?
- ▶ Who has site control?
- ▶ Are there other potential barriers based on utility rules?
- ▶ Are there permitting, zoning, or other related barriers?

→ **ADVANTAGES OF WIND POWER:-**

1. The wind is free and with modern technology it can be captured efficiently.
2. Once the wind turbine is built the energy it produces does not cause greenhouse gases or other pollutants.
3. Although wind turbines can be very tall each takes up only a small plot of land. This means that the land below can still be used. This is especially the case in agricultural areas as farming can still continue.
4. Many people find wind farms an interesting feature of the landscape.

5. Remote areas that are not connected to the electricity power grid can use wind turbines to produce their own supply.
6. Wind turbines have a role to play in both the developed and third world.
7. Wind turbines are available in a range of sizes which means a vast range of people and businesses can use them. Single households to small towns and villages can make good use of range of wind turbines available today.



→ DISADVANTAGES OF WIND POWER:-

1. The strength of the wind is not constant and it varies from zero to storm force. This means that wind turbines do not produce the same amount of electricity all the time. There will be times when they produce no electricity at all.
2. Many people feel that the countryside should be left untouched, without these large structures being built. The landscape should be left in its natural form for everyone to enjoy.
3. Wind turbines are noisy. Each one can generate the same level of noise as a family car travelling at 70 mph.

4. Many people see large wind turbines as unsightly structures and not pleasant or interesting to look at. They disfigure the countryside and are generally ugly.
5. When wind turbines are being manufactured some pollution is produced. Therefore wind power does produce some pollution.
6. Large wind farms are needed to provide entire communities with enough electricity. For example, the largest single turbine available today can only provide enough electricity for 475 homes, when running at full capacity. How many would be needed for a town of 100 000 people?