WIND ENERGY DEVELOPMENT IN INDIA

- The wind powerprogrammer in India wasinitiated towardsthe endof the Sixth Plan, in 1983- 84.
- In India, the wind energyprogrammer is managed and implemented by the Ministry of New and Renewable Energy sources, Government of India. The wind power potential in India is 49,130 MW as per the official estimates in the Indian Wind Atlas (2010) bythe Centre for Wind energyTechnology.
- The potential is calculated with respect to 2% land availability at windy locations and pertains to a 50 meter hub height level of the wind turbines.
- A total capacity of 17365.03 MW has been established up to March 31, 2012 in the country. India is now the fifth largest wind power producer in the world, after USA, Germany, Spain andChina.

Table 3.1 Thebreak-upofprojectsimplementedinprominentwind potentialstates

Sr No.	State	Potential (MW)	Installed capacity (MW)
1	Andhra Pradesh	5394	245.50
2	Gujarat	10609	2,966.30
3	Karnataka	8591	1,933.50
4	Kerala	790	35.1
5	Madhya Pradesh	920	376.40
6	Maharashtra	5439	2,733.30
7	Rajasthan	5005	2,070.70
8	Tamil Nadu	5374	6,987.60
9	Others	7008	3.2
	Total	**49130**	**17351.50**

Classification of wind machines:

Wind energy is an indirect source of solar energy conversion and can be utilized to run wind mill, which in turn drives a generator to produce electricity.

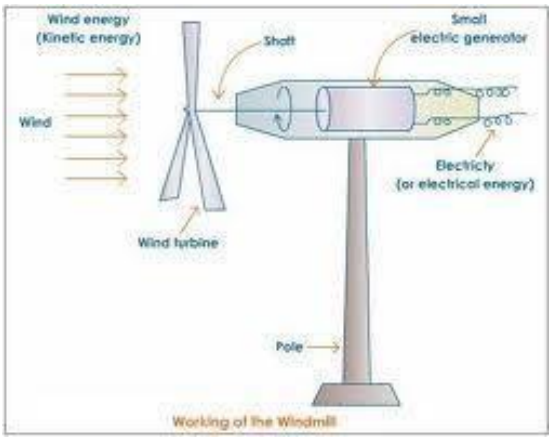


Fig 3.5 wind machine

Wind machines are generally classified in terms of the orientation of the axis of rotation of their rotors as ***horizontal axis machines*** *&* ***vertical axis machines.***

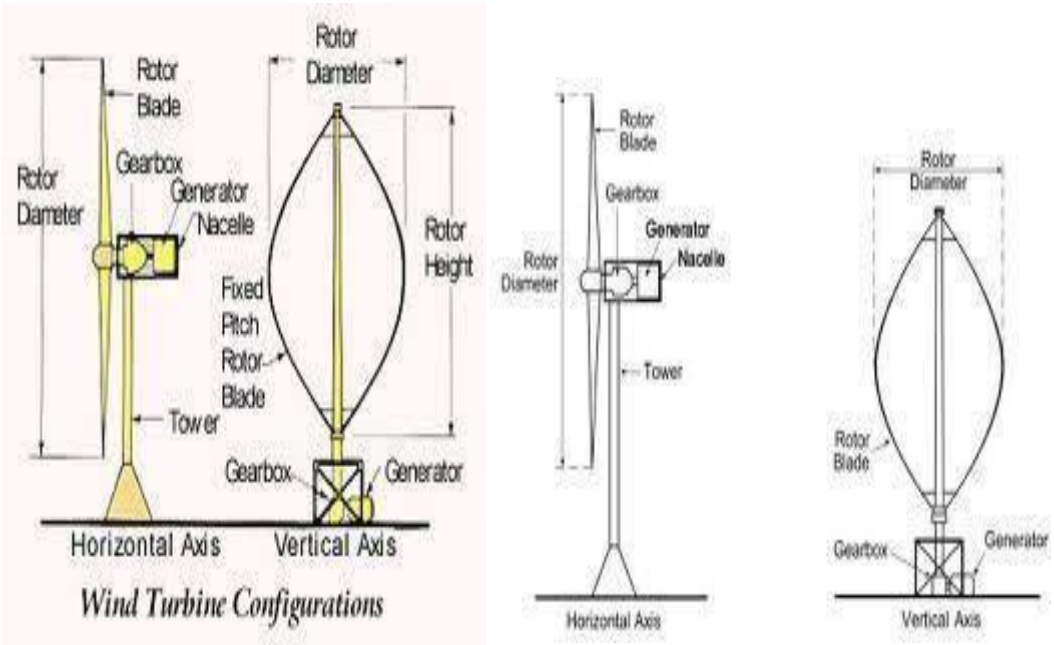
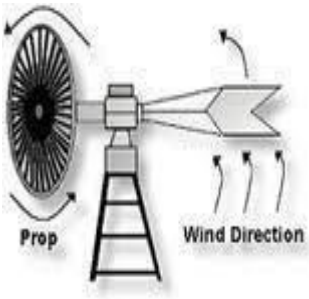
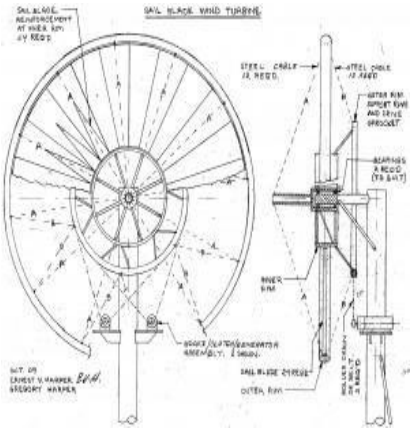


Fig3.6 Vertical axis machines

In a ***horizontal axis machine***, the rotor axis is horizontal and is continuously adjusted in a horizontal plane so that it is parallel to the direction of the wind stream. These machines have to face the direction of the wind in order to generate power. Eg: - Multi blade type, Propeller type & Sail type wind mills.





Multi blade type Propeller type Sail type

In a ***vertical axis machine***, the rotor axis is vertical and fixed, and it is □ r to both the surface of the earth and the wind stream. These machines run independently of the direction of the wind because they rotate about a vertical axis. Eg:- Savonius type & Darrieus type wind mills(Designed in 1920 and patented in 1931).

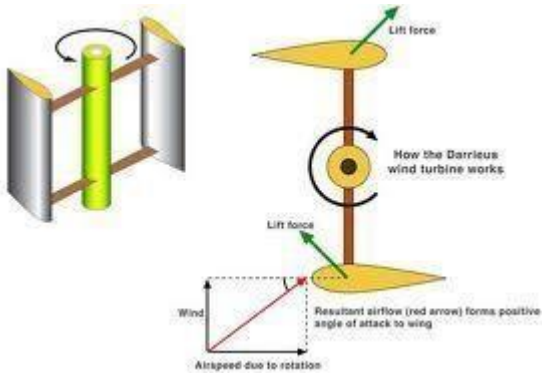
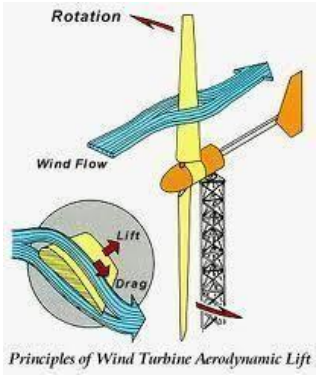
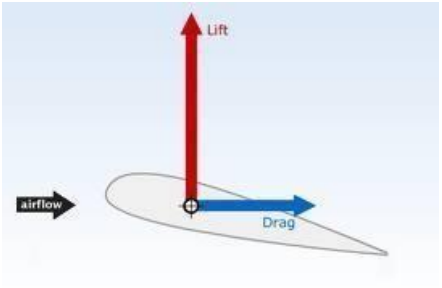


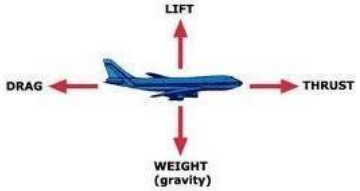
Fig.3.6 Savonius type Darrieus type

Lift Force and Drag Force:

- The extraction of power and hence energy from the wind depends on creating certain forces and applying them to rotate or to translate a mechanism.
- There are two primary mechanisms for producing forces from the wind namely *lift force* and *drag force.*







- Lift force act perpendicular to the air flow while drag force act parallel to the direction of air flow.
- Lift force is produced by changing the velocity of the air stream flowing over either side of the lifting surface (aerofoil): *speeding up of the air flow causes the pressure to drop while slowing the air flow down leads to increase in pressure.*
- In other words, any change in velocity generates a pressure difference across the lifting surface. This pressure difference produces a force that begins to act on a high pressure side and moves towards the low pressure side of the aerofoil.
- A good aerofoil should have more lift/drag ratio. For efficient operation, a wind turbine blade needs to function with as much lift and as little drag as possible because the drag force dissipates the energy.