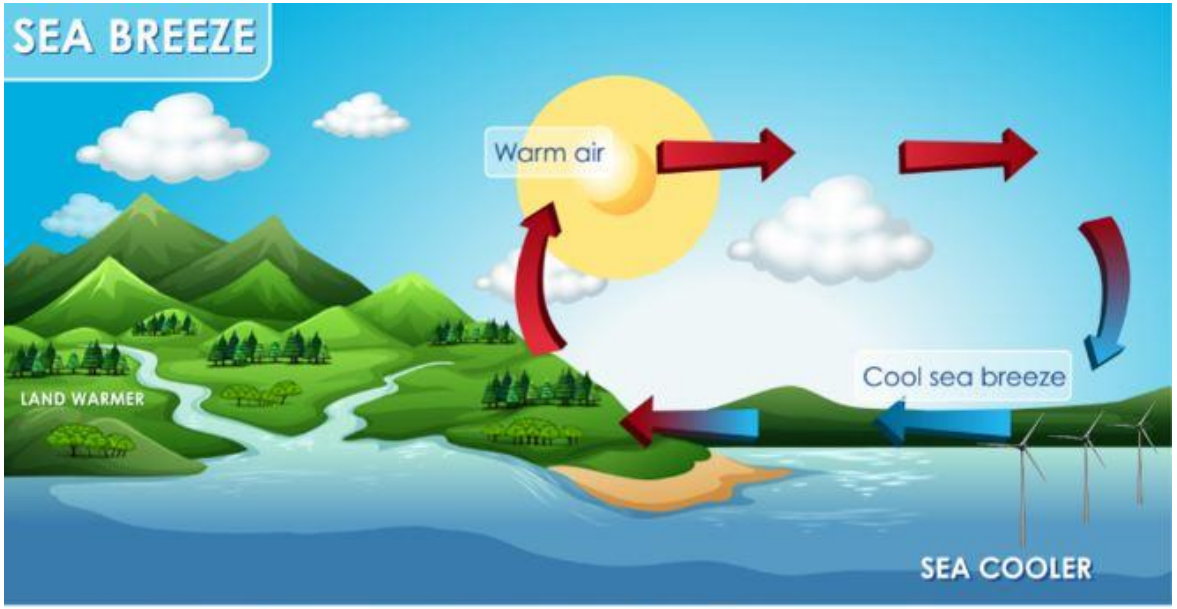
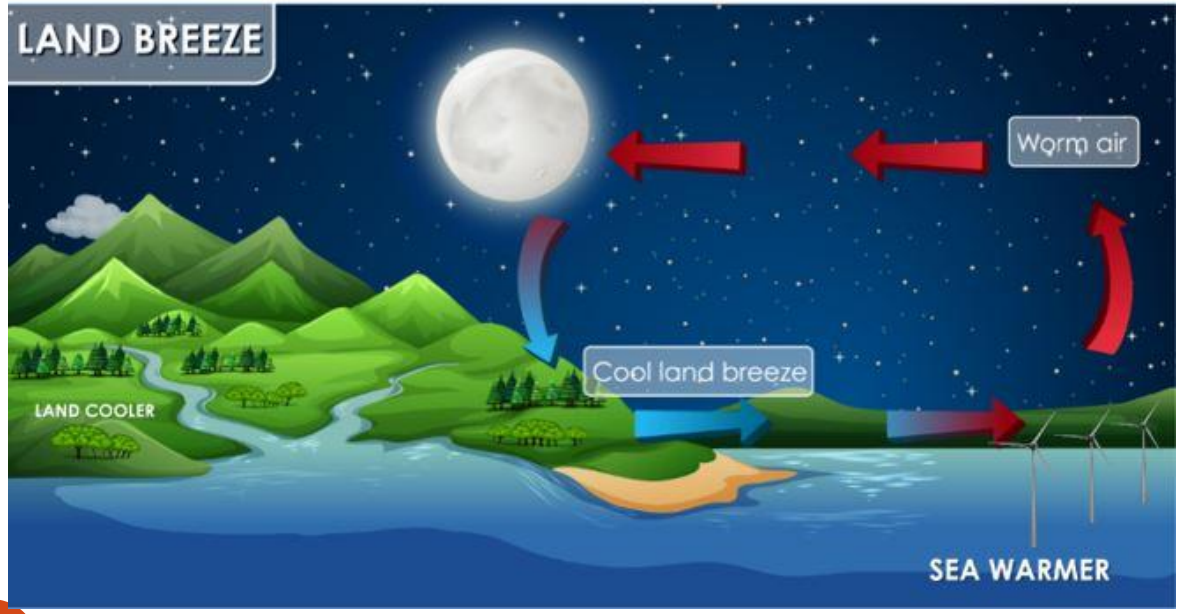
UNIT -3
Wind Energy & Biomass Energy

Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and muliblade system. Vertical axis- Savonius and darrieus types.

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies -fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft).

Formation of Wind





Types of wind energy

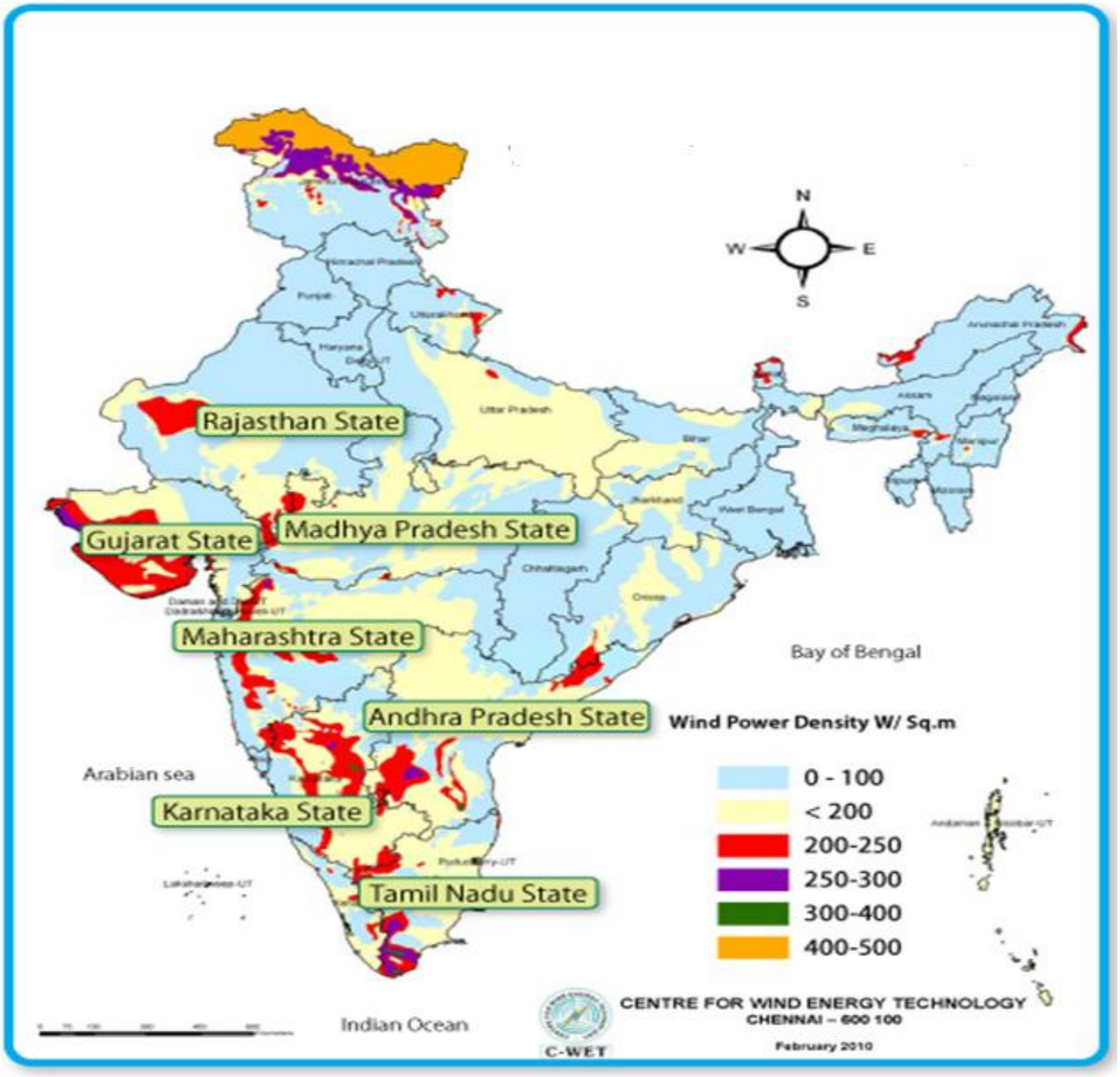
•Onshore wind energy

•Offshore wind energy

Properties or characteristics of wind energy

1. It is intermittent in nature
2. The wind power systems do not contribute any pollution to atmosphere
3. The utilization of wind energy for power generation does not consume any fuel and it is also free from transportation of fuel.
4. It is a renewable source of energy
5. It is available in dilute form
6. The availability of wind energy varies over a day and also with seasons. This necessiates the use of storage devices.
7. In a small scale, wind energy is cheaper. When produced on a large scale, it is competitive with conventional power generating systems.

Availability of wind energy in India



Wind velocity and power from wind

Due to motion of wind, it posses certain energy. The wind mills are the devices converts kinetic energy of the wind into mechanical energy. The out put from the wind mill depends upon

i) the wind speed

ii) the cross section of the wind swept by rotor and

iii) the overall conversion efficiency of the rotor, transmission system and generator or pump.

We know that

$$m = \rho AV$$

where m = Mass of air

ρ = Air density

A = Area through which air is traversing

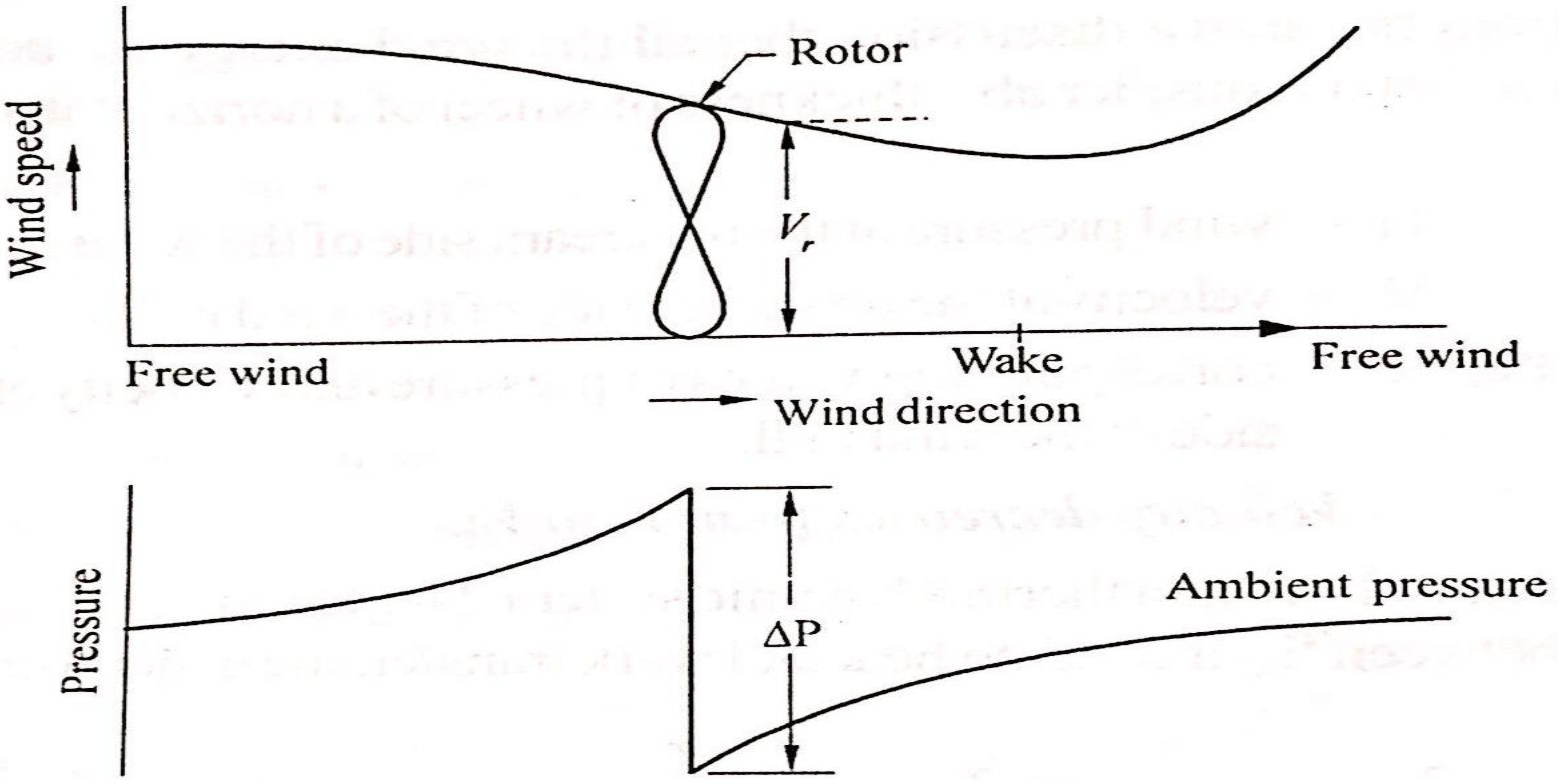
V = Wind speed

But kinetic energy, $KE = 1/2\ mV^2$

substitute the value of m in the above equation, we get

$$KE = \frac{1}{2} \rho A\, V.V^2$$

$$\therefore \quad KE = \frac{1}{2} \rho.A.V^3 \text{ Watts}$$



Variations of wind speed and pressure across wind rotor

$$\text{Power coefficient} = \frac{\text{Power of the windrotor}}{\text{Power available in the wind}}$$

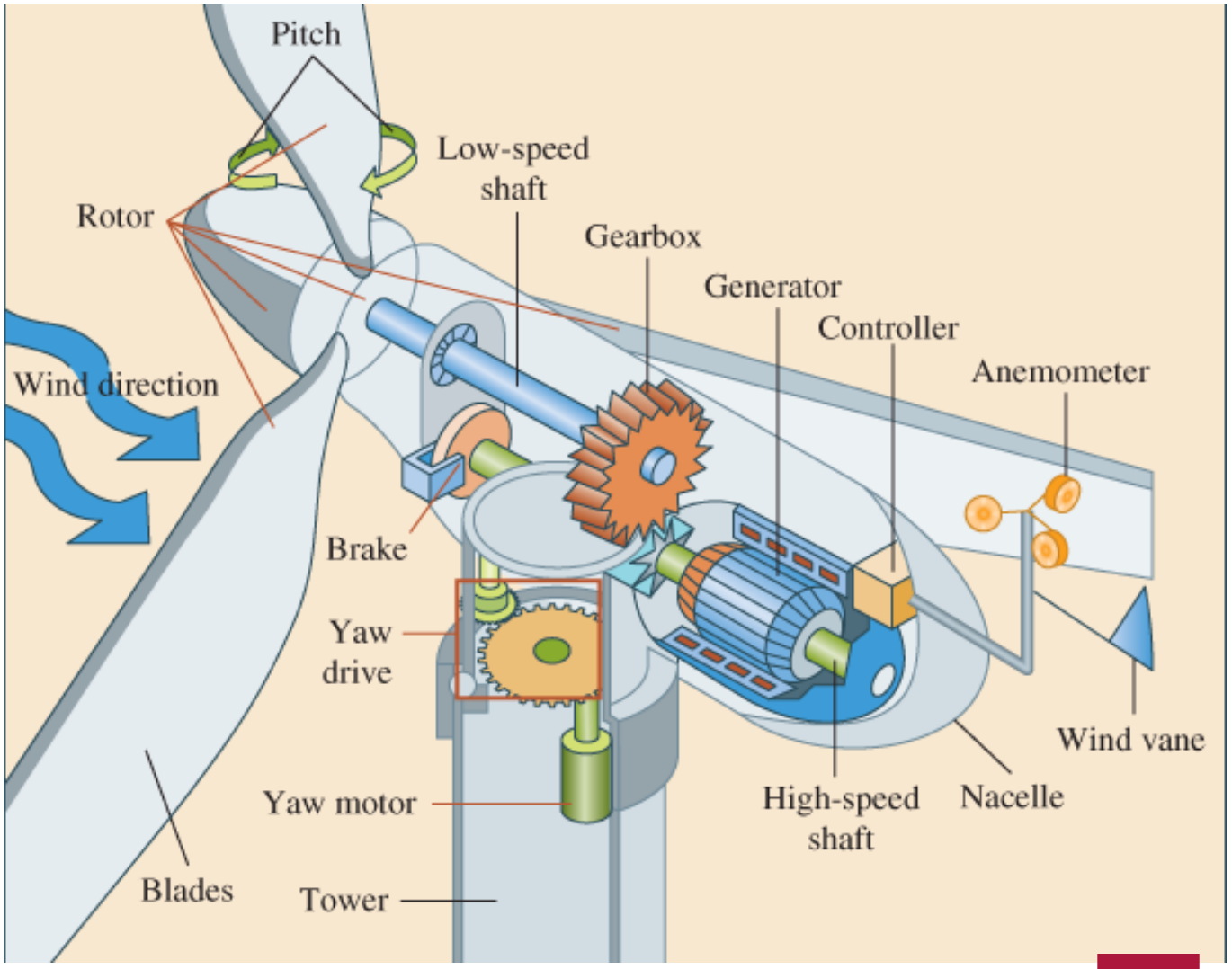
Maximum Power Coefficient is 0.593

Major problems associated with wind power

1. It's availability is not continuous ie intermittent. This makes the plant design difficult and it requires a storage system.
2. The power output is very low even with large sized wind mill rotors.
3. The use of special controls and suitable materials, and costly designs are essential to avoid smashing of the wind mill plants.
4. The wind mill has very low power coefficient and can have a maximum value of 0.593.
5. It is not economical to develop wind power on a large scale. The electricity generation, storage and distribution is much costlier.
6. Energy is available in very dilute form and large areas are needed to install wind mills.

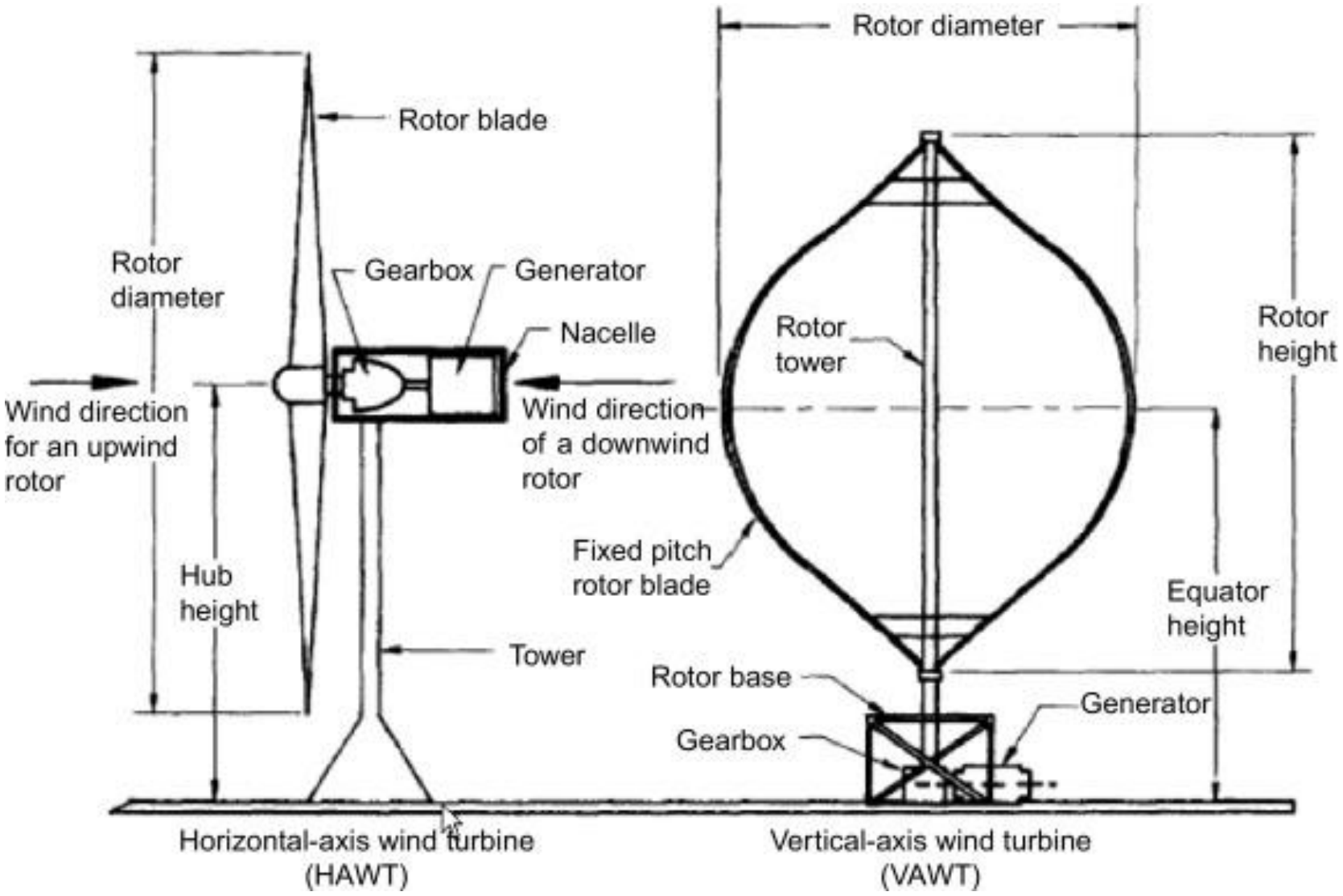
Failure of wind mill.mp4

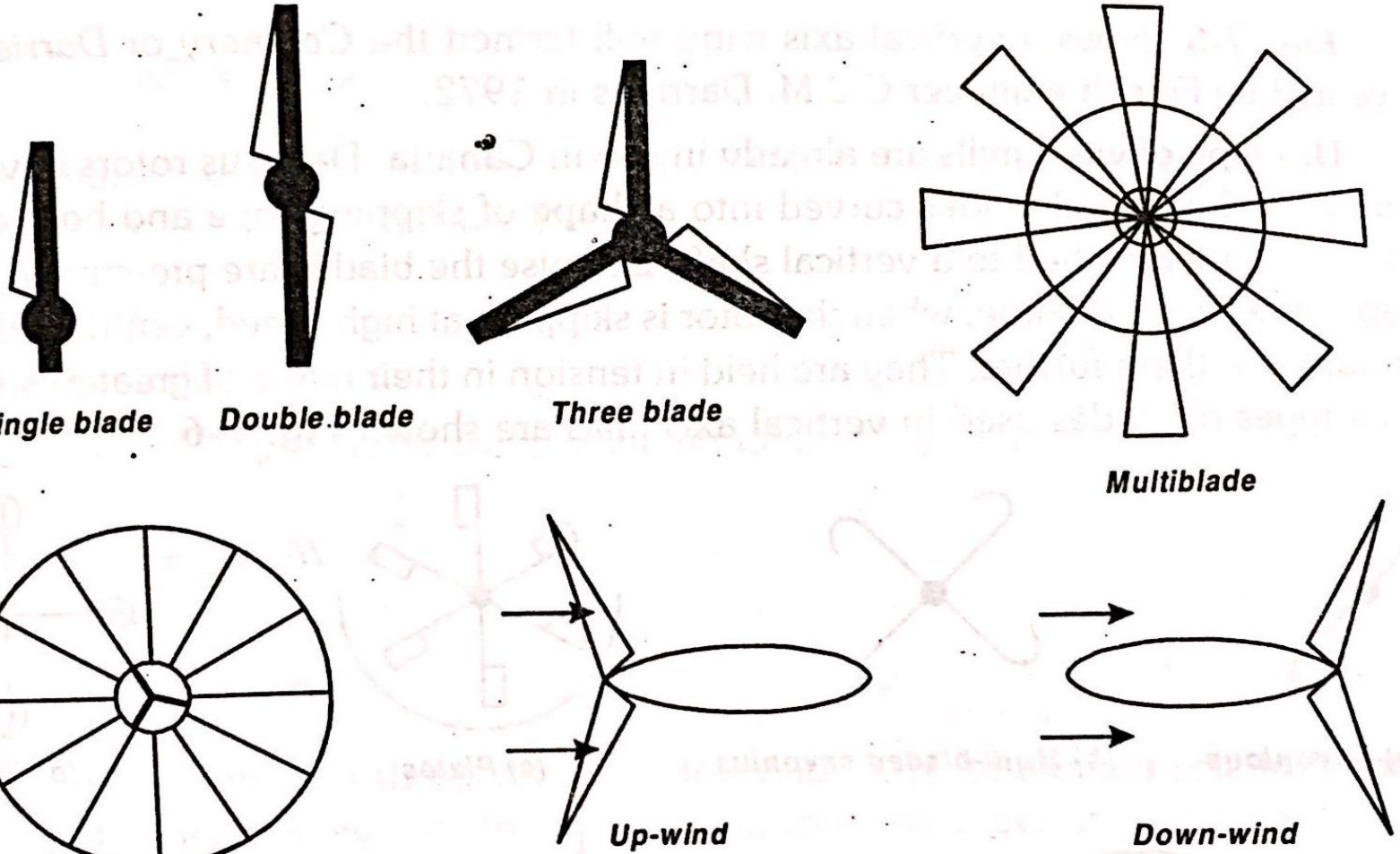
Components of wind Turbine



Horizontal wind mill.mp4

Classification of wind mill based on axis of rotation

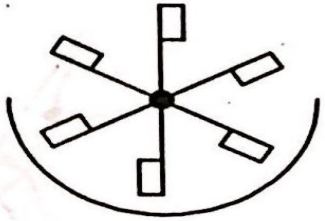




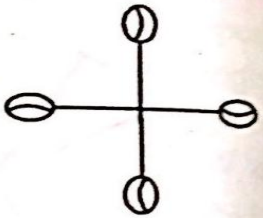
Types of blades for horizontal wind mills

(a) Savonious

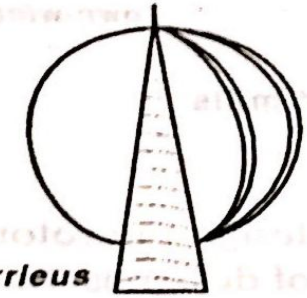
(b) Multi-bladed savonius



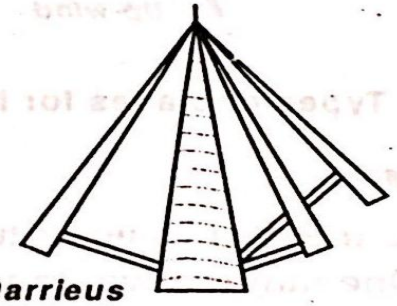
(c) Plates



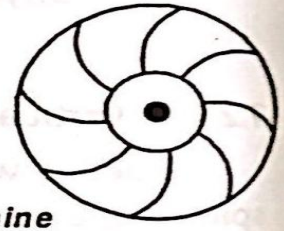
(d) Cupped



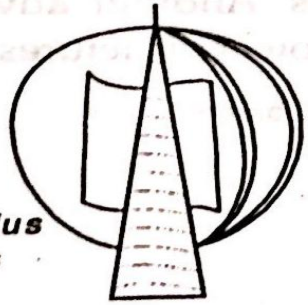
(a) ϕ - Darrieus



(f) D - Darrieus

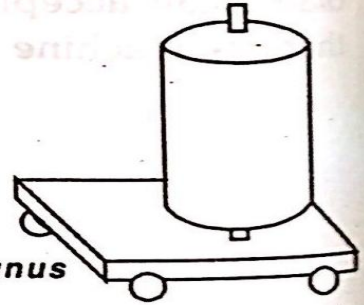


(g) Turbine



(h) Savonius
ϕ-Darrieus

(i) Split Savonius



(j) Magnus

Different blades for vertical axis wind mills

Vertical wind mill.mp4

Comparison Between VAWT & HAWT

Maglev vertical Axis Wind Turbine (MVAWT)	Horizontal Axis Wind Turbine (HAWT)
Can spin in light breezes (1 m/s)	High wind speed (>3 m/s)
No or less maintenance	Need of replacement of bearings, lubrications etc.
Configured to capture winds from any direction without any external control	Requires yaw mechanism turn turbine blades in direction of wind
Major components at ground level	At a height on tall towers
No massive tall tower construction	Requires tall tower
Cost/Kwh is less	Cost/KWh is more
Long life span	Less life span

Advantages

1) Wind energy is free inexhaustible and does not need transportation.
2) Erection time is less compared to other power plants.
3) It is simple with minimum operational expenditures.
4) It can be economically constructed at rural areas for power generation, water lifting, etc.
5) It does not pollute the environment in any manner as the conventional fossil fuel plants do.
6) During monsoon periods, when water level in reservoirs comes down, then wind power generated can be more economical than hydel power.

Inside of wind mill.mp4

Site selection consideration

1. **High annual average wind speed**
2. **Availability of anemometry data**
3. **Availability of wind V(t) curve at the proposed site.**
4. **Wind structure at the proposal site**
5. **Altitude of site**
6. **Land cost**
7. **Nature of ground**