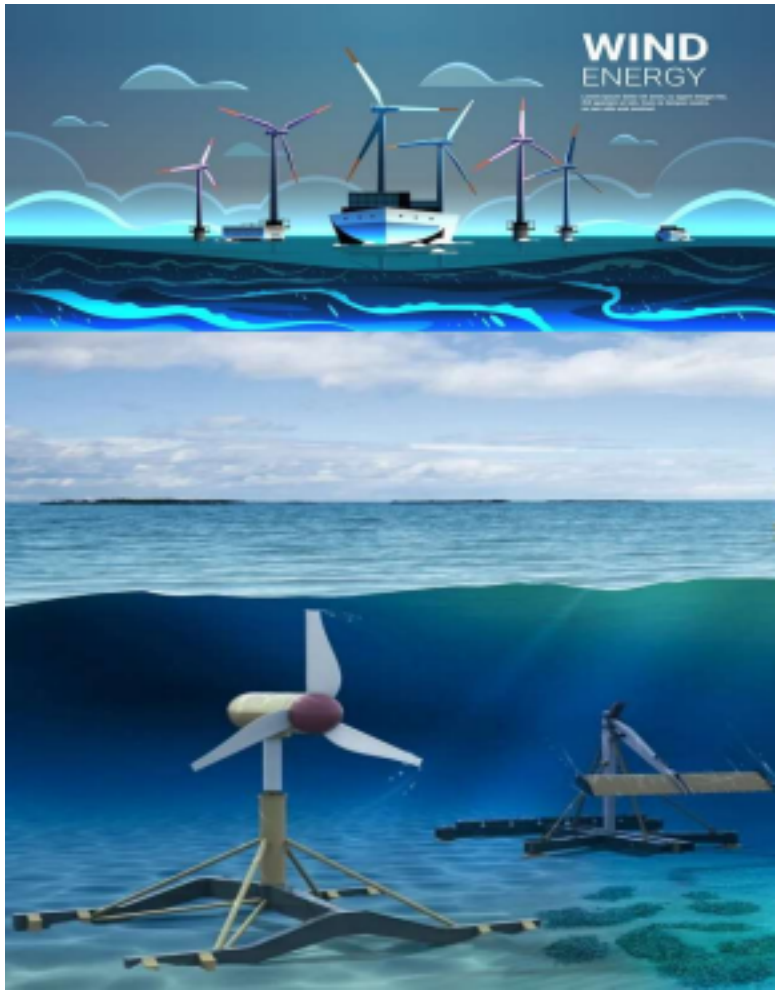
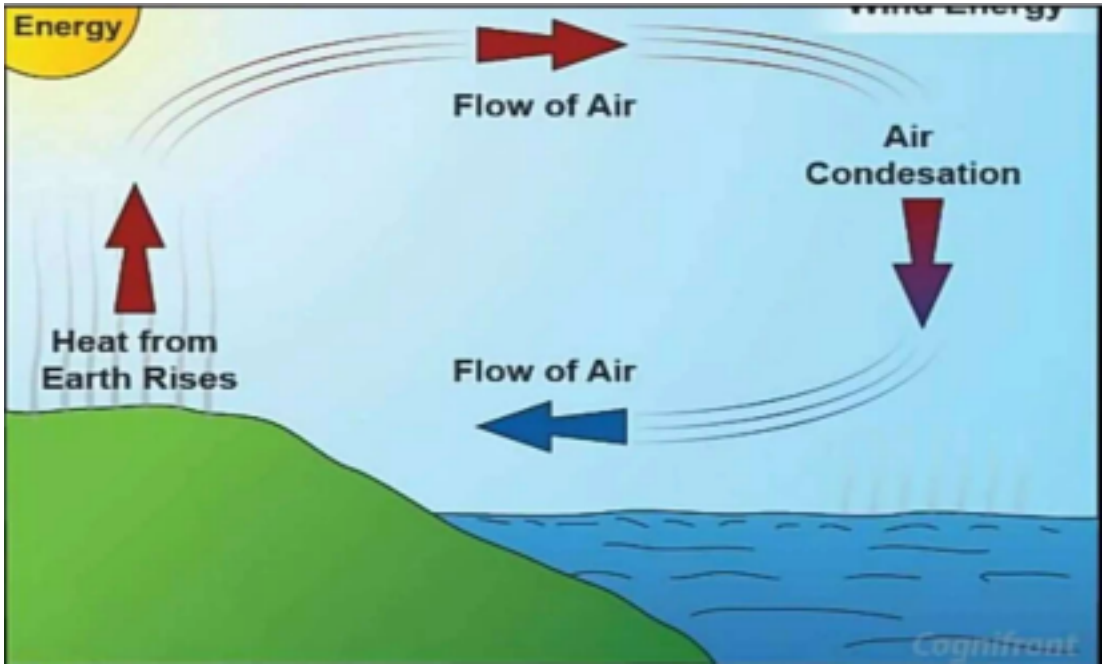


"We are like te~~nant farmers chopping down the fence around our house for fuel whe~~n we should beusing Nature's ~~inexhaustible sources of energy – sun, wind and tide."~~ ~~Th~~omas A. Edison

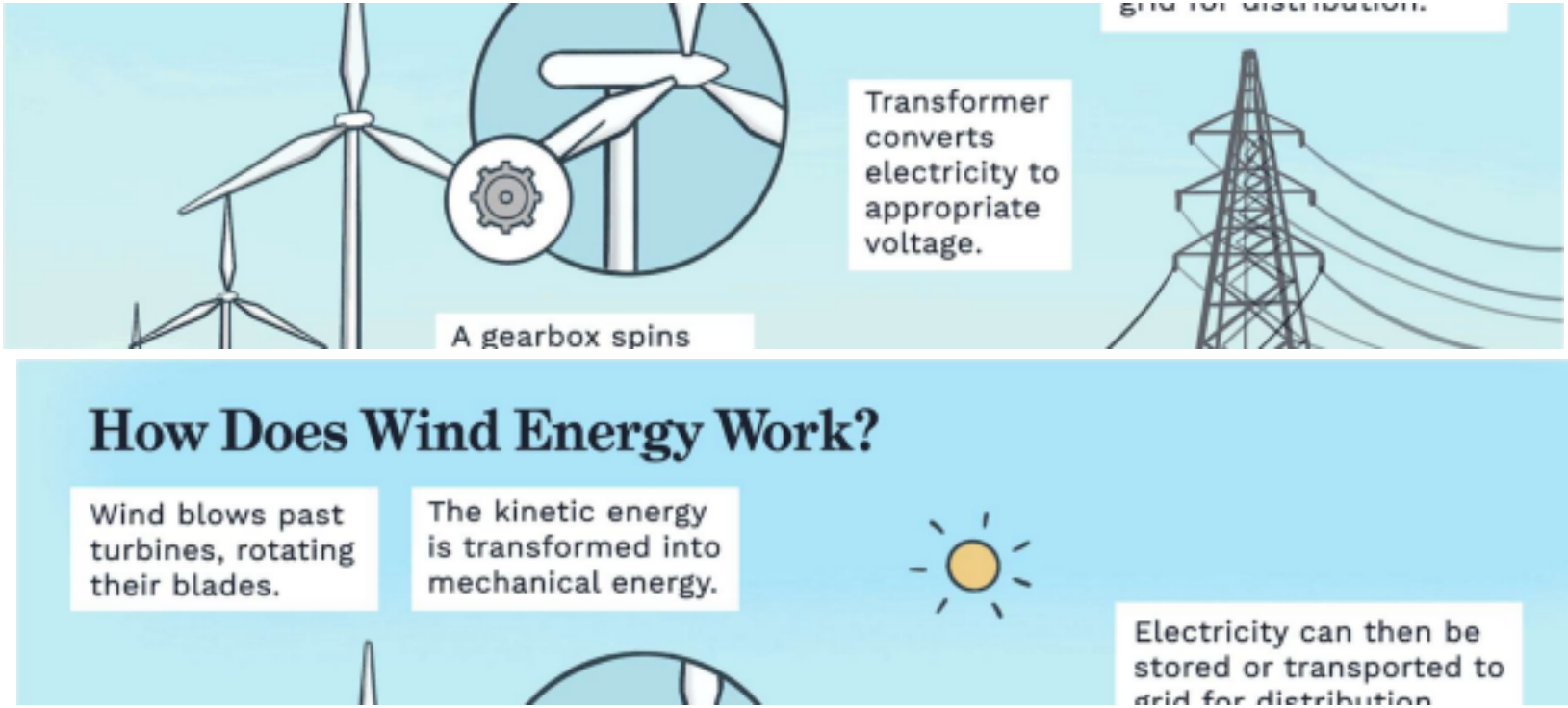
- It ~~invo~~lves using wind turbines to convertthe turning motion of

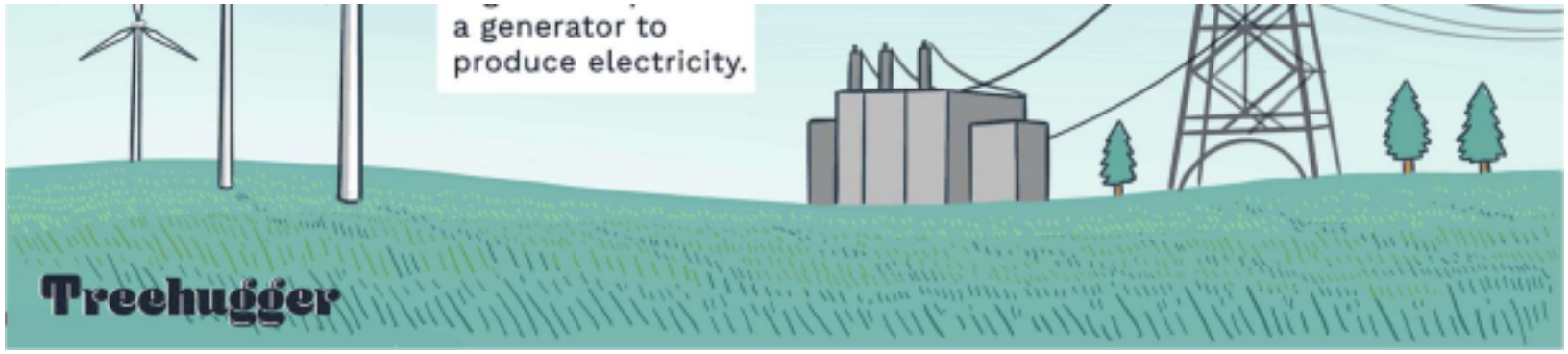
blades, pushed bymoving air (kinetic energy) into electrical energy (electricity).

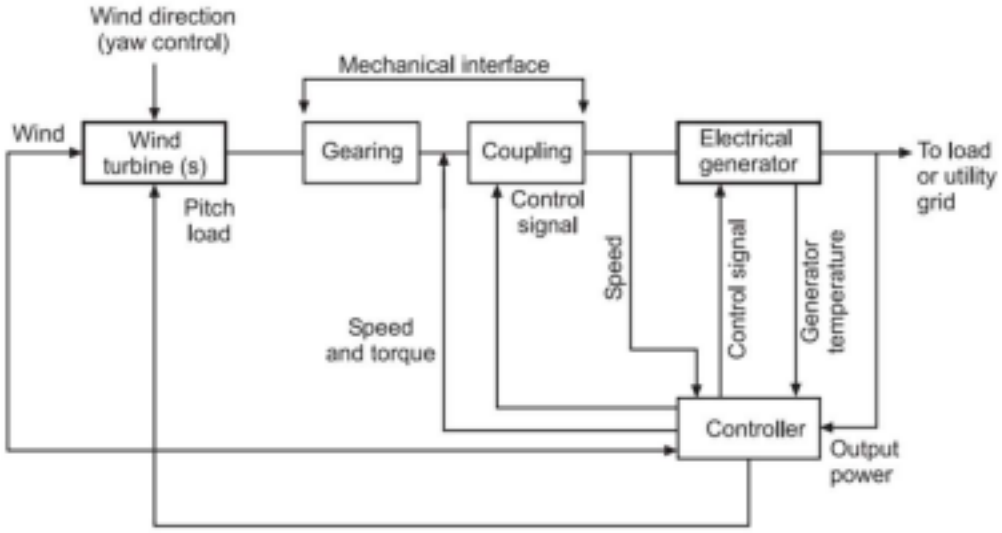
- Wind power or wind energy is a ~~form of~~ renewable energy that harnesses the power of the wind to generate electricity.

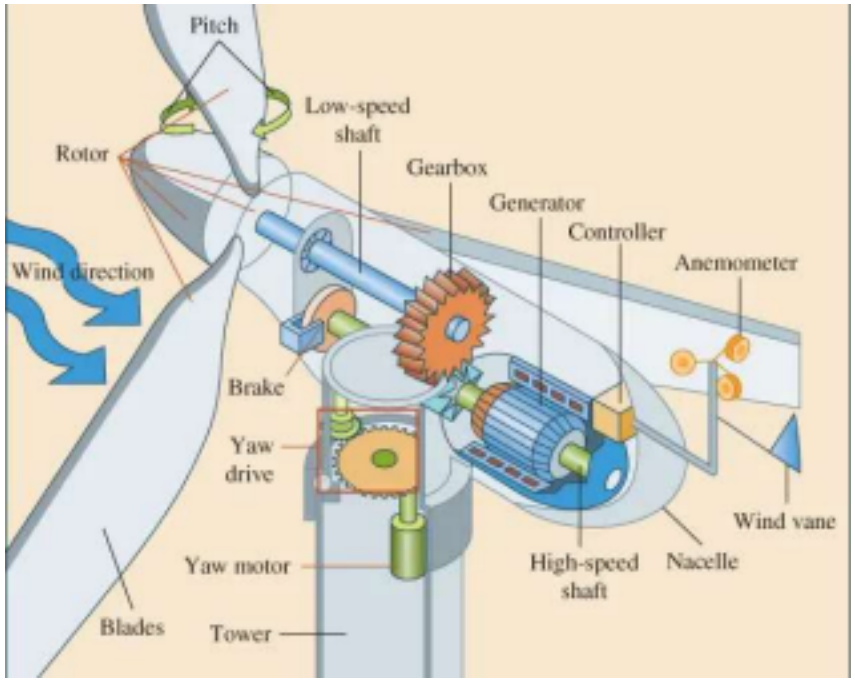


Wind energy is actually a byproduct of the sun. The sun's uneven heating of the atmosphere,the earth's irregular surfaces (mountains and valleys), and the planet's revolution around the sun all combine to create wind.


How Does Wind Energy Work?
Wind blows past turbines, rotating their blades.
The kinetic energy is transformed into mechanical energy.
Transformer converts electricity to appropriate voltage.
A gearbox spins
Electricity can then be stored or transported to


a generator to
produce electricity.
Treehugger


Wind direction
(yaw control)
Mechanical interface
Wind
Wind
turbine (s)
Gearing
Coupling
Electrical
generator
To load
or utility
grid
Pitch
load
Control
signal
Speed
Control signal
Generator
temperature
Speed
and torque
Controller
Output
power



5

The wind power can be computed by using concept of kinetics. A wind mill works on the principle of 'converting kinetic ~~energy of the wind to mecha~~nical energy'. A

μ_w ☾ Volume of air column passing through an area A per unit time

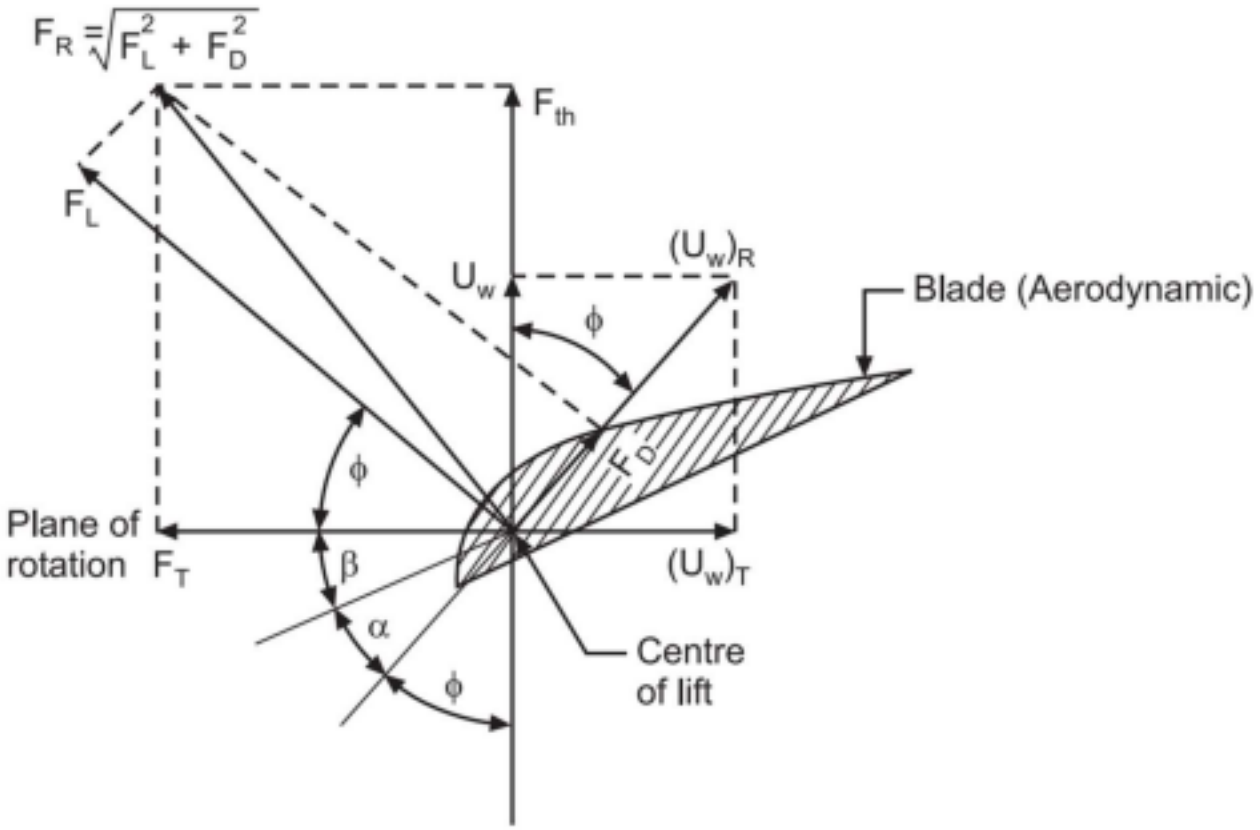
Power (P_{total}) available in wind = kinetic energy rate associated with the mass of moving air

Total Power available in wind per unit area:

μ_w ☾ Speed of free wind in unperturbed state

ρ ☾ Density of air,

$\rho A \mu_w$ ☾ Air mass flow rate, through area A,



- Commonly used ~~wind mills.~~
- It has two or th~~ree blades for economical reasons.~~
- Though the tw~~o blade design is most efficient, yet it~~

faces the diffic~~ulty of vibrations during orientation to~~ wind direction called ‘Yaw

control'.

- These machines are rated from 1 to 3 MW.

- High solidity turbines used for pumping the water because of high starting torque characteristics.
- Rotors are less efficient because of interference of blades in each other but they are less noisy

- It has hallow circular cylinder sliced in half and the halves are mounted on vertical shaft with a gap in between.
- Torque is produced by pressure difference between the two sides of the half facing the wind.
- This is quite efficiency but needs a large surface
- Advantages: Low cost, Operation at low wind velocity, No need of yaw and pitch control and Generator can be mounted at the ground level.
- Applications: Grinding grains, pumping water etc.

area.

- Needs much less surface area.
- Shaped like an egg beater and has two or three blades shaped like airfoils.

Characteristics of Darrieus rotor:

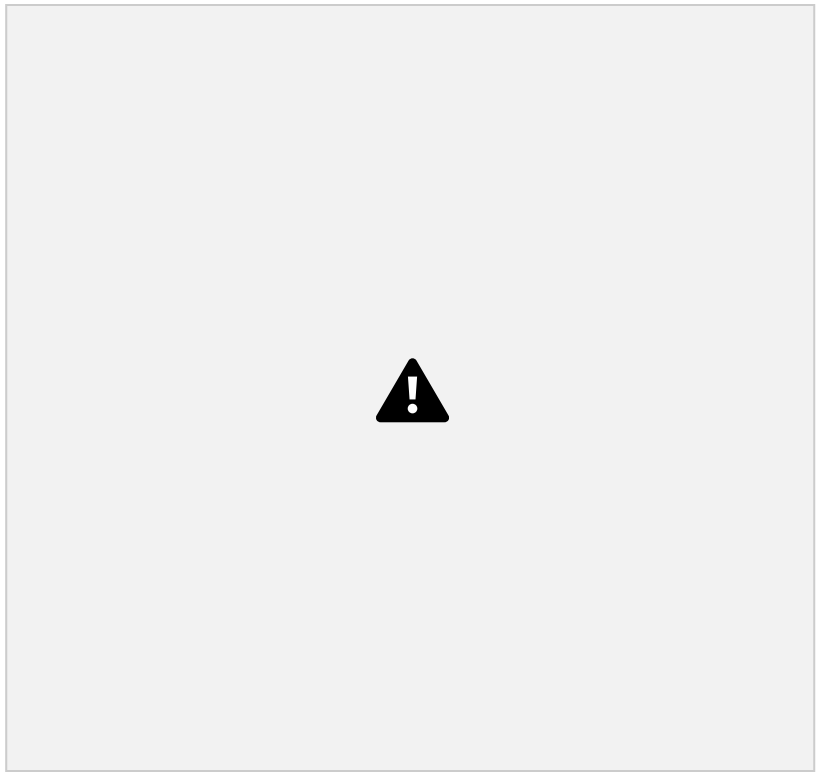
- (i) Not self starting, needs auxiliary starter.
- (ii) High speed.
- (iii) High efficiency
- (iv) Potentially low capital cost.
- The generator, gear box etc. are placed on the ground
- No need of yaw mechanism to turn the motor against the wind.

- Both the Savonius and Darrieus types are mounted on a vertical axis and hence they can run independently of the direction of wind.

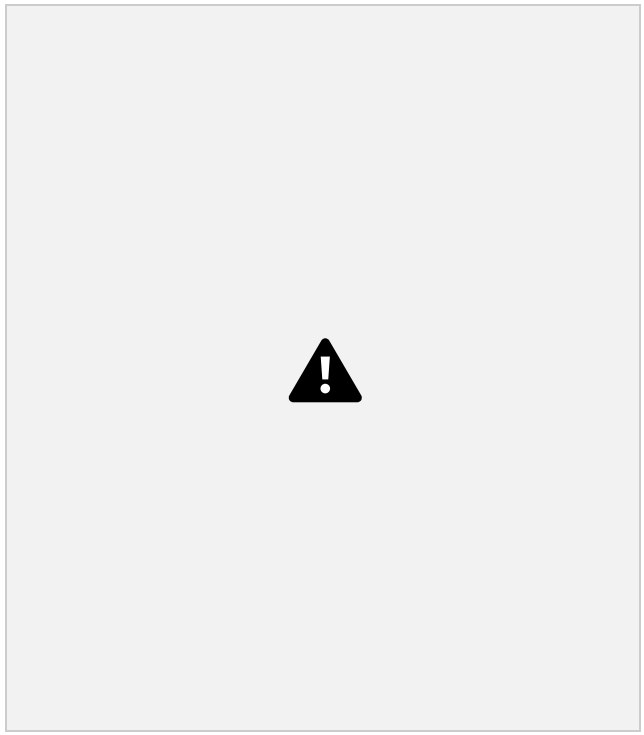
Advantages:

- The horizontal axis mills have to face the direction of the wind in order to generate power.

Dr Dheepanchakkravarthy A

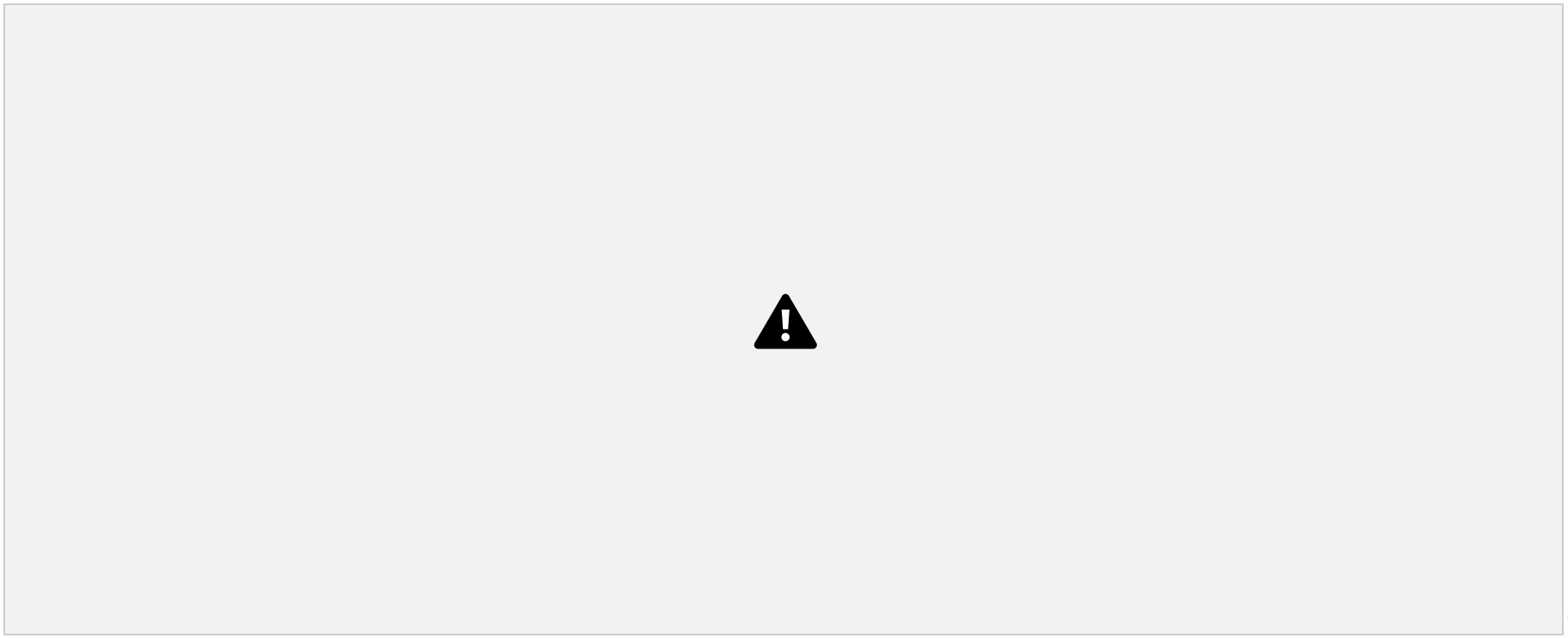


Clean and Green Energy

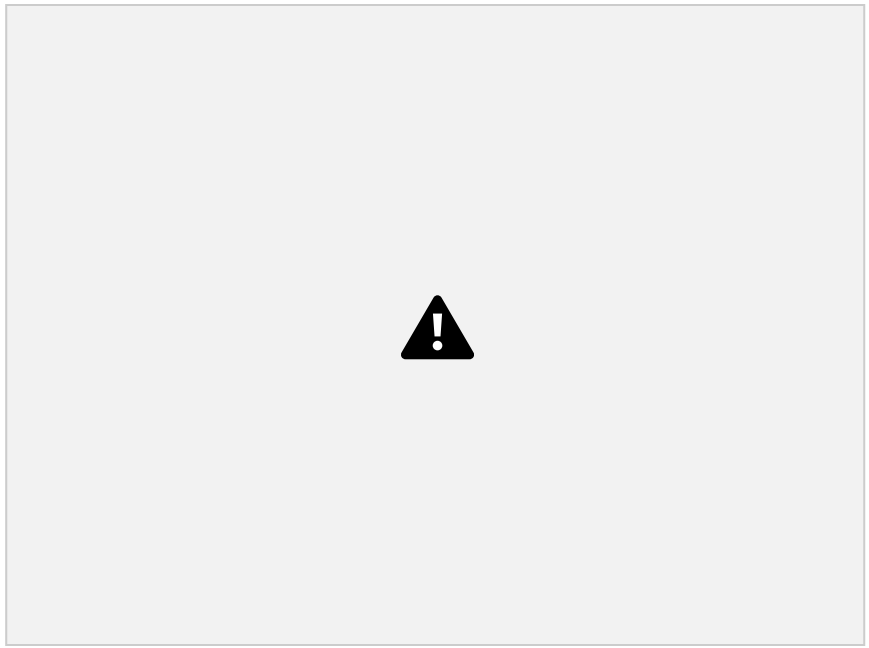


- The rotor is not subjected to continuous cyclic gravity loads since the blades do not turn end over end
- These machines would react to wind from any direction, therefore, they do not need yawing equipment to turn the rotor into the wind.

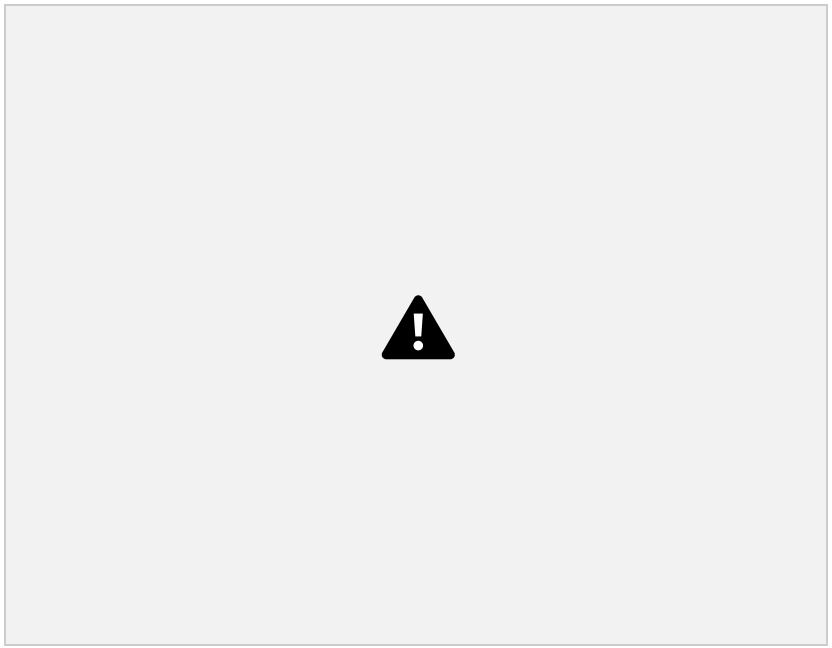
- Heavy components (e.g. gear box, generator) can be located at ground level these machines may need less structural support.
- The installation and maintenance are easy in this type of configuration.



Dr Dheepanchakkravarthy A



Clean and Green Energy



15 1. Applications Requiring Mechanical Power Wind pumps Heating

~~Navigation signal~~ To other small industries ~~Remote communication Farm cooperatives~~ For lifting water to a hill

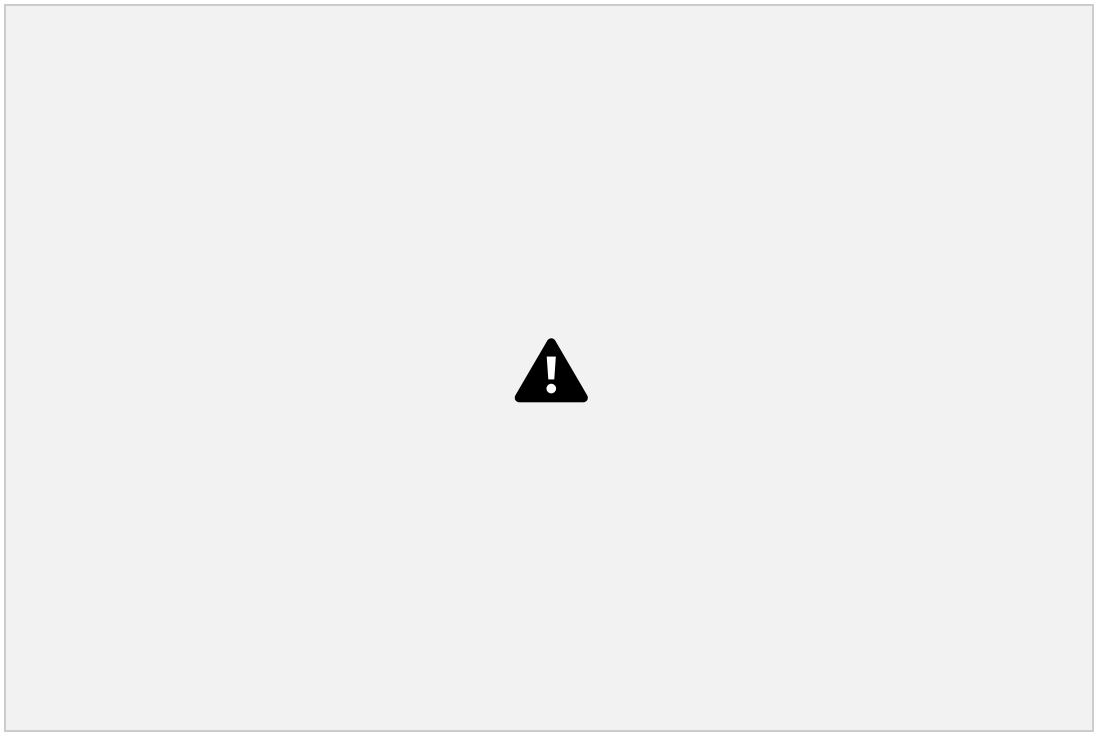
2. As Off Grid Electrical Power Source (To producing electrical power for)

Dheepanchakkravarthy A Space heating nd cooling	(Ex. Lighthouse) ~~Weather stations~~	Isolated populations ~~Commercial refrigeration Pumped storage~~	
Water heating			
Battery charging			
Domestic fan, light and small tools	Offshore oil drilling platforms	Desalination and	

- Large aero-generator~~s in the range of~~ few hundred kW t~~o few MW are~~ planned for supply~~ing power to a~~ utility grid.
- Large arrays of ~~aero-generators,~~

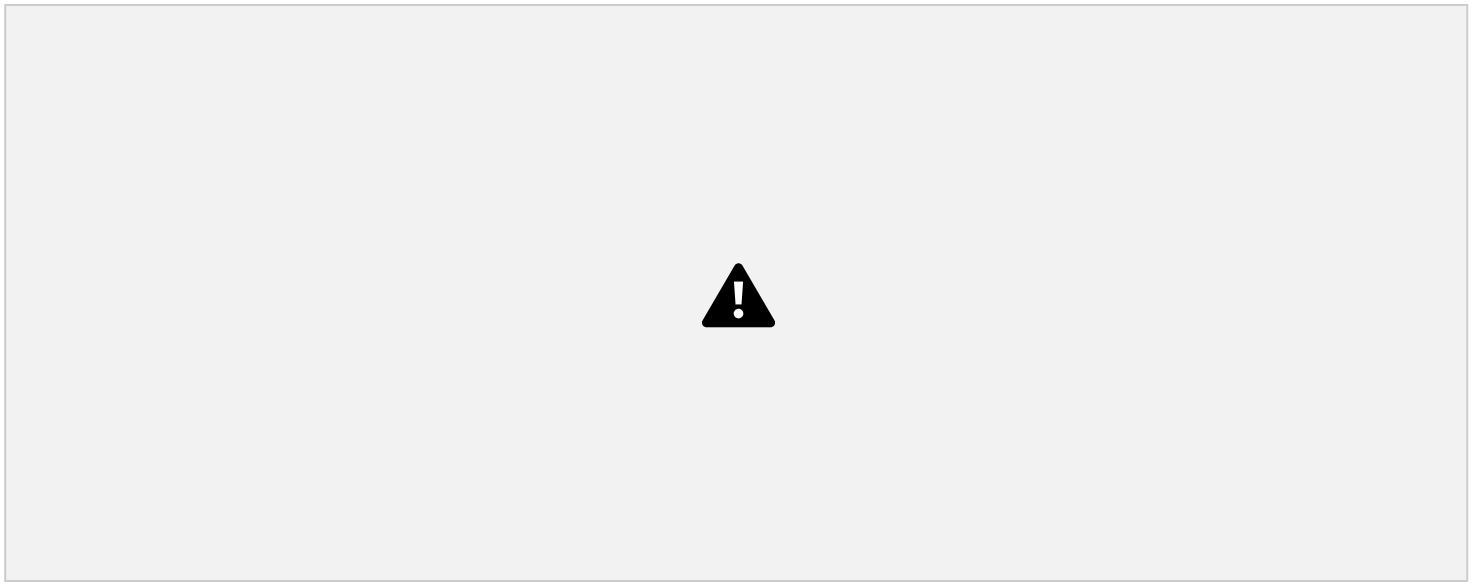
known as wind f~~arms are being~~
deployed in open plains or offshore in
shallow water for this purpose.

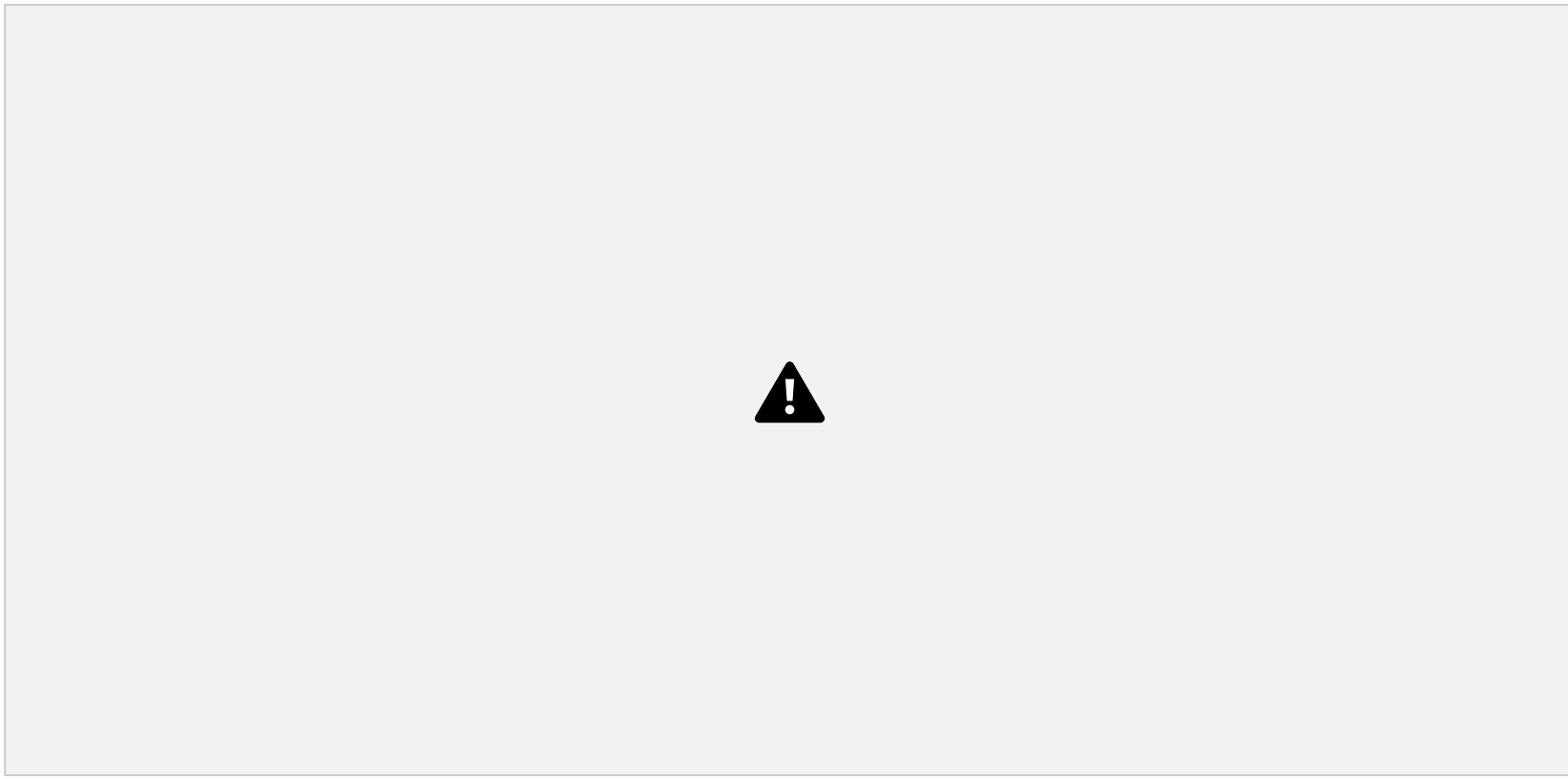
3. As Grid Connected Electrical Power Source



~~T~~idal energy is a form of power~~pr~~oduced by the natural rise andfall of tides

caused by the gravitational interaction between Earth, the sun, and the moon.



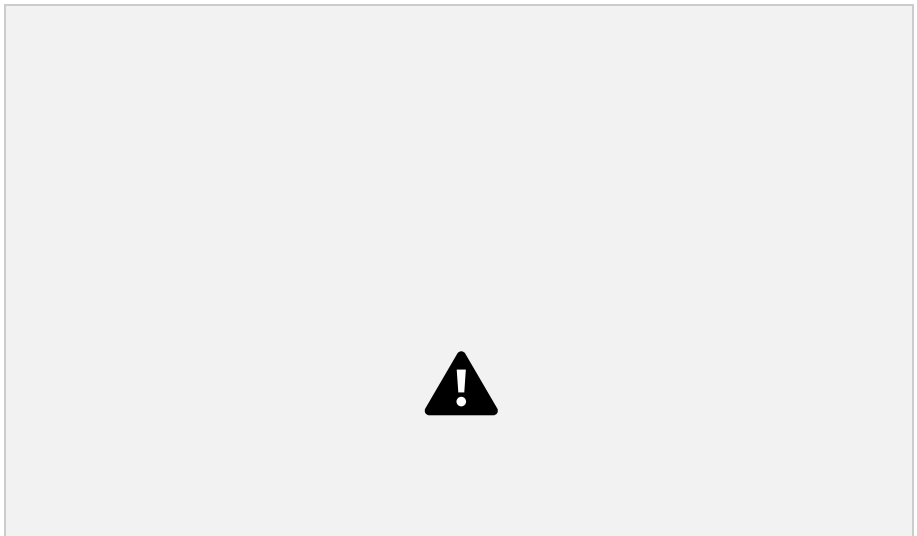


Wave energy (or wave power) isthe transport and capture of energy by ocean surface waves. Electricity generation,

water desalination, or pumping water.

- Wave energy comes from the interaction between the winds and surfaces of oceans.
- The energy available varies with the size and frequency of waves.
- It is estimated that about 50 kW ofpower is available for every metre width of true wave front

- It is relatively pollution free.
- It is a free and renewable energy source.
- After removal of power, the waves are in placed state.
- Wave-power devices do not require large land masses.
- Whenever there is a large wave activity, a string of devices have to be used.
- The system not only produces electricity but also protects coast lines from the destructive action of large



waves, minimises erosion and help create artificialharbour.

- Lack of depend~~ability.~~
- Relative scarci~~ty of accessible sites of la~~rg~~e wave activity.~~
- The construction~~ of conversion device~~s-is~~ relatively complicated.~~
- The devices ha~~ve to withstand enormou~~s p~~ower of stormy seas.~~
- There are unfa~~vourable economic fac~~tors~~ such as large capital inv~~estment and costs of repair, repla~~cement and maintenan~~ce