Wind Energy and Wind Power

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Outline

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- Wind energy and wind power
  - Where does wind come from?
  - What is the wind energy?
  - Where does wind energy come from?
  - Wind power
- Application
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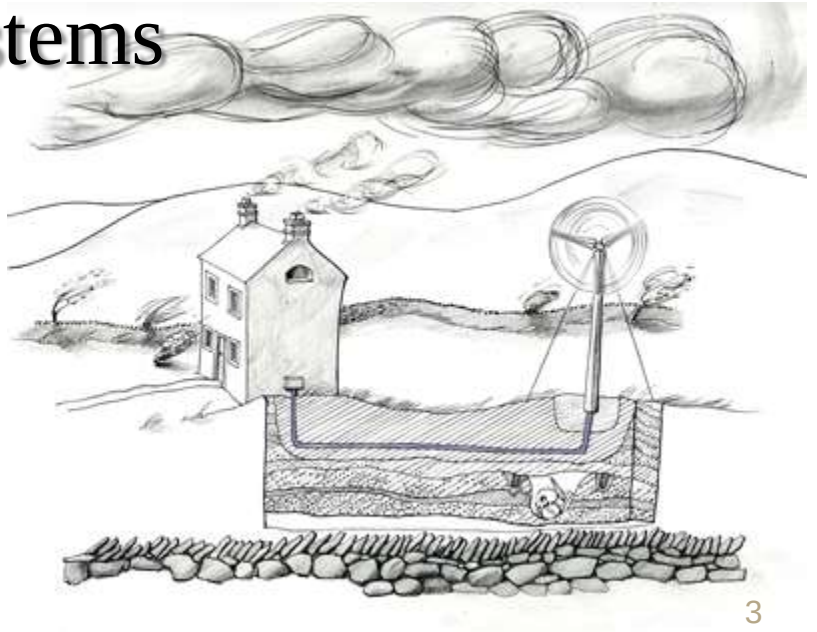
- Advantage and Disadvantage

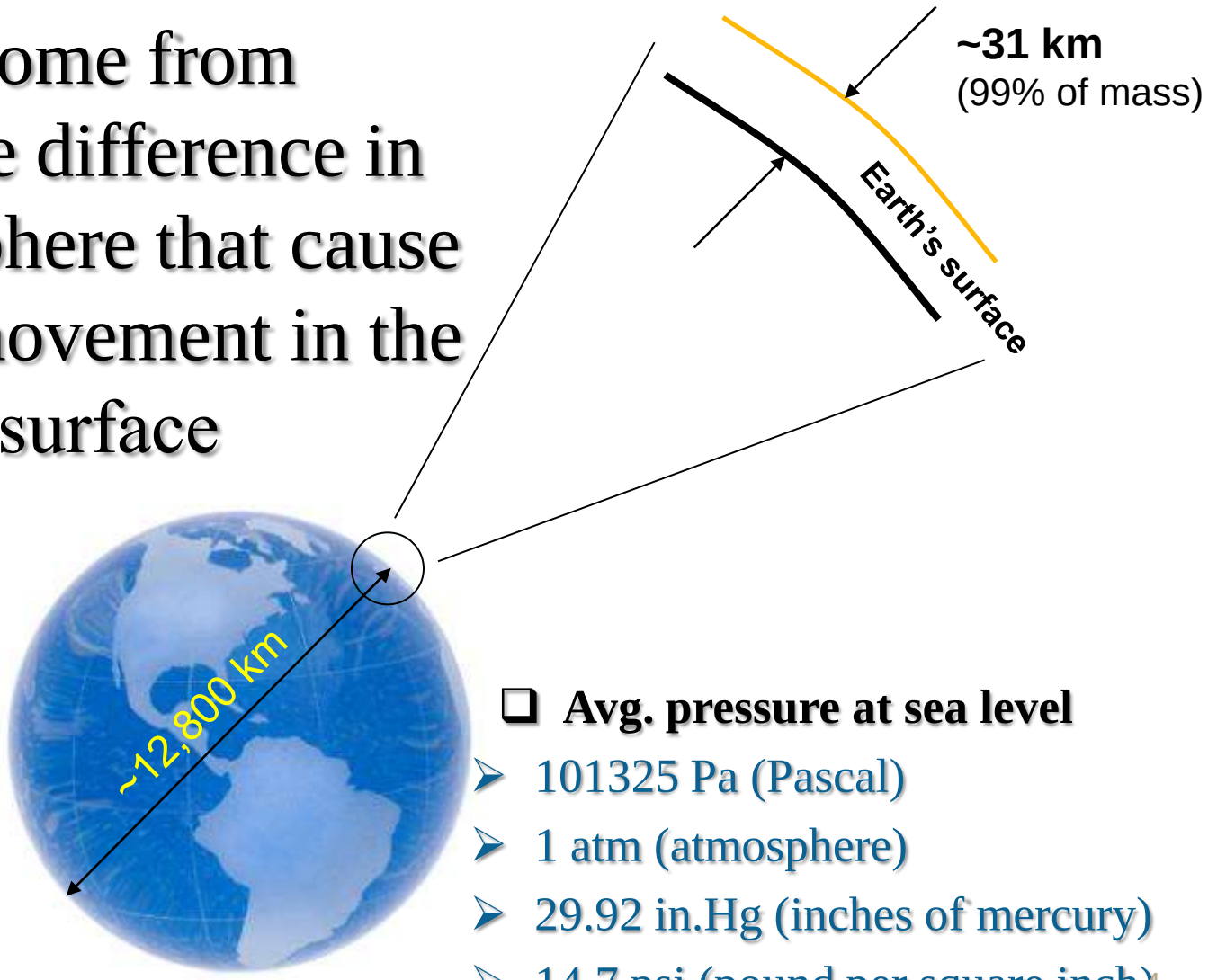
Introduction

- Free energy source
- Clean and plentiful source of energy
- Able to create energy in everywhere
- Suitable in remote areas and able to combine with other systems



Where does the wind come from?

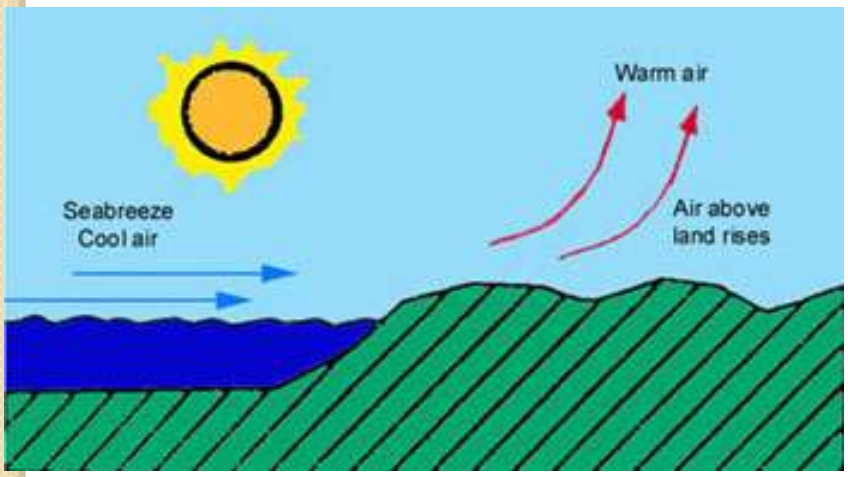
- **Wind** come from pressure difference in Atmosphere that cause gases movement in the Earth's surface

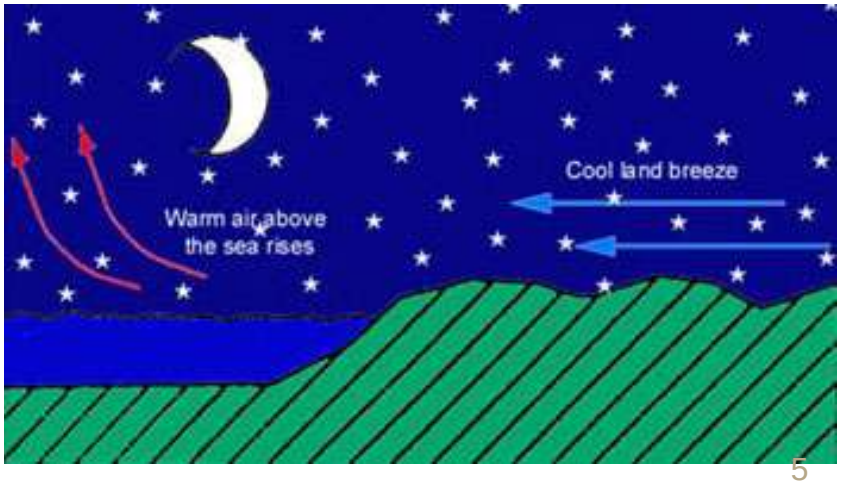


- **Avg. pressure at sea level**
  - 101325 Pa (Pascal)
  - 1 atm (atmosphere)
  - 29.92 in.Hg (inches of mercury)
  - 14.7 psi (pound per square inch)

Where does wind energy come from?

- Solar energy heats the Earth surface
- Unequal heating
- Warmer air rises
- Replacement of cooler dense air
- Wind circulation

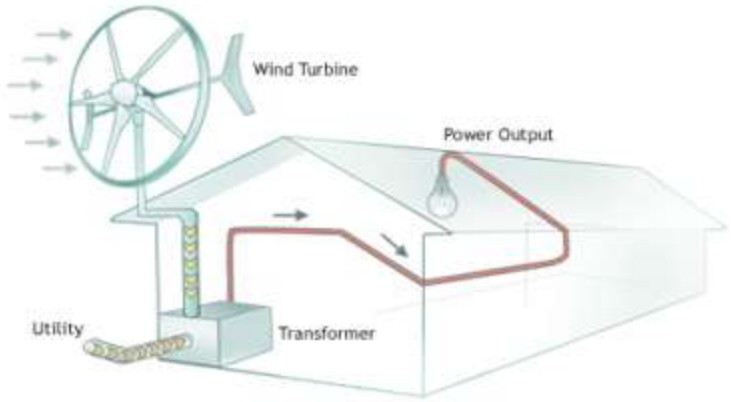


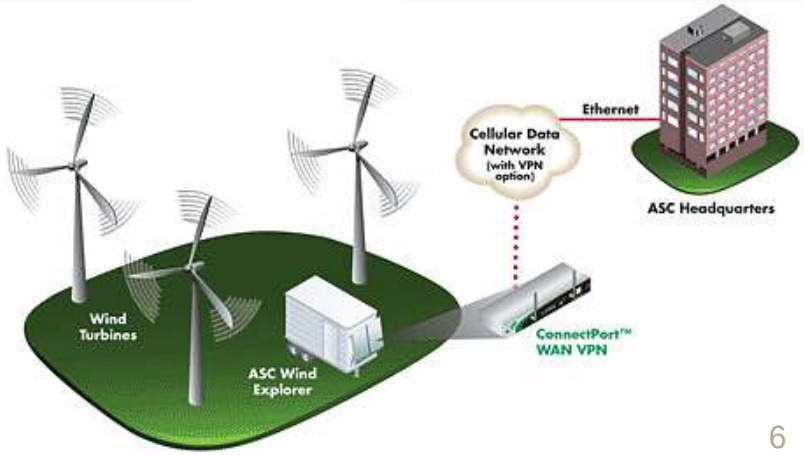


What is the wind energy?

- Wind movement causes enormous energy that can be converted by wind turbine to mechanical energy and then to electrical energy

Wind Movement → Mechanical Energy → Electrical Energy





Wind Power

- How much power can we extract from the wind?

Power = Work / time

Power = Kinetic Energy / time

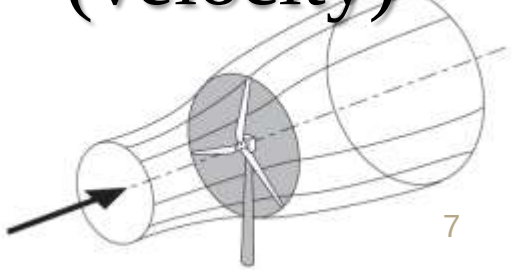
Power = 0.5(mass) × (velocity)^2 / time

But (mass/time) = density × area × velocity

(mass/time) = (kg/m^3) × (m^3) × (m/s^2)

Power = 0.5(density × area) × (velocity)^3

Power = $\rho AV^3/2$

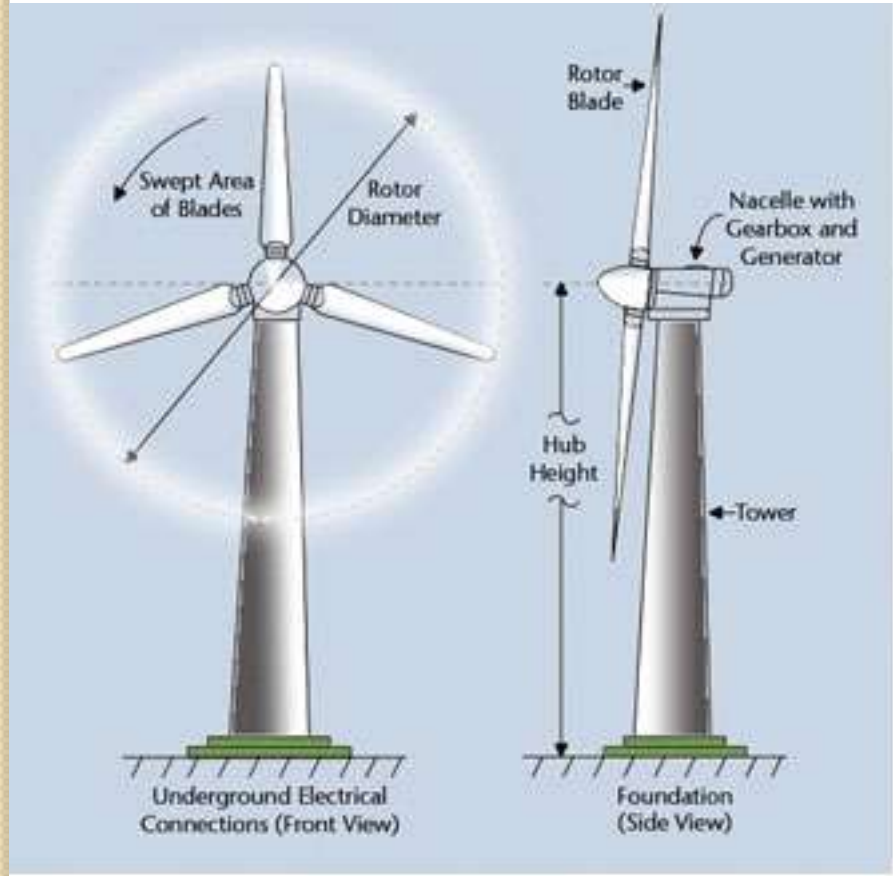


Wind power application

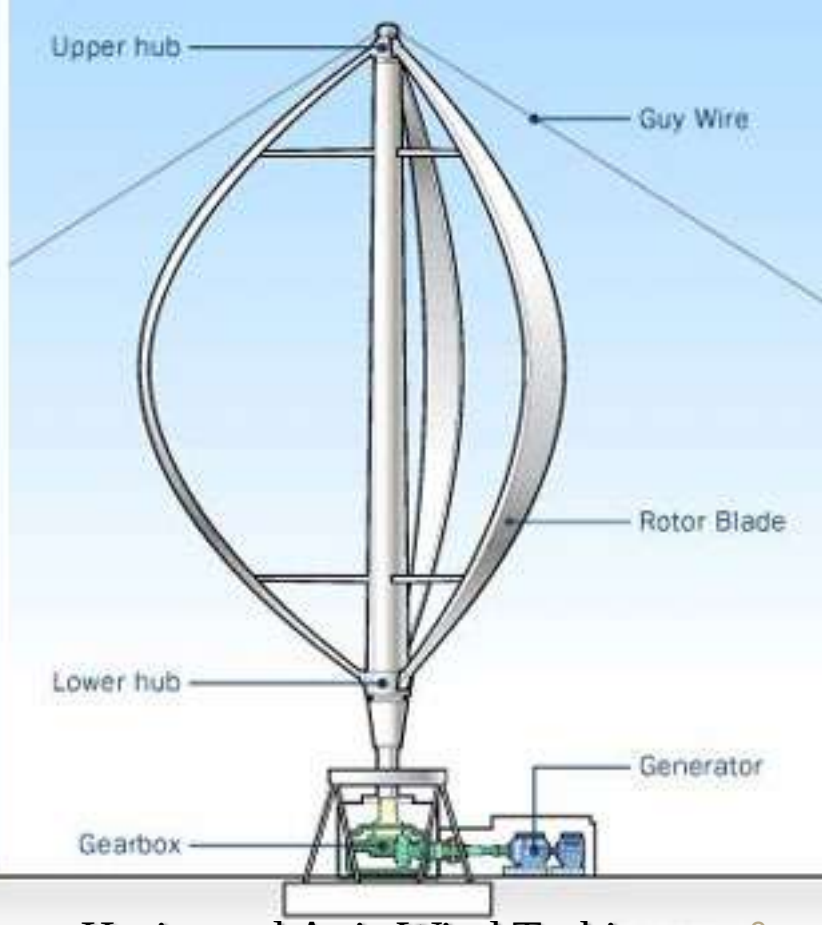
- Since 18th century, wind power has been utilized in sea transport, wind-mill, wind-pump and other

Wind Turbines

- Wind turbines can be divide into two types that base on the orientation of the rotor

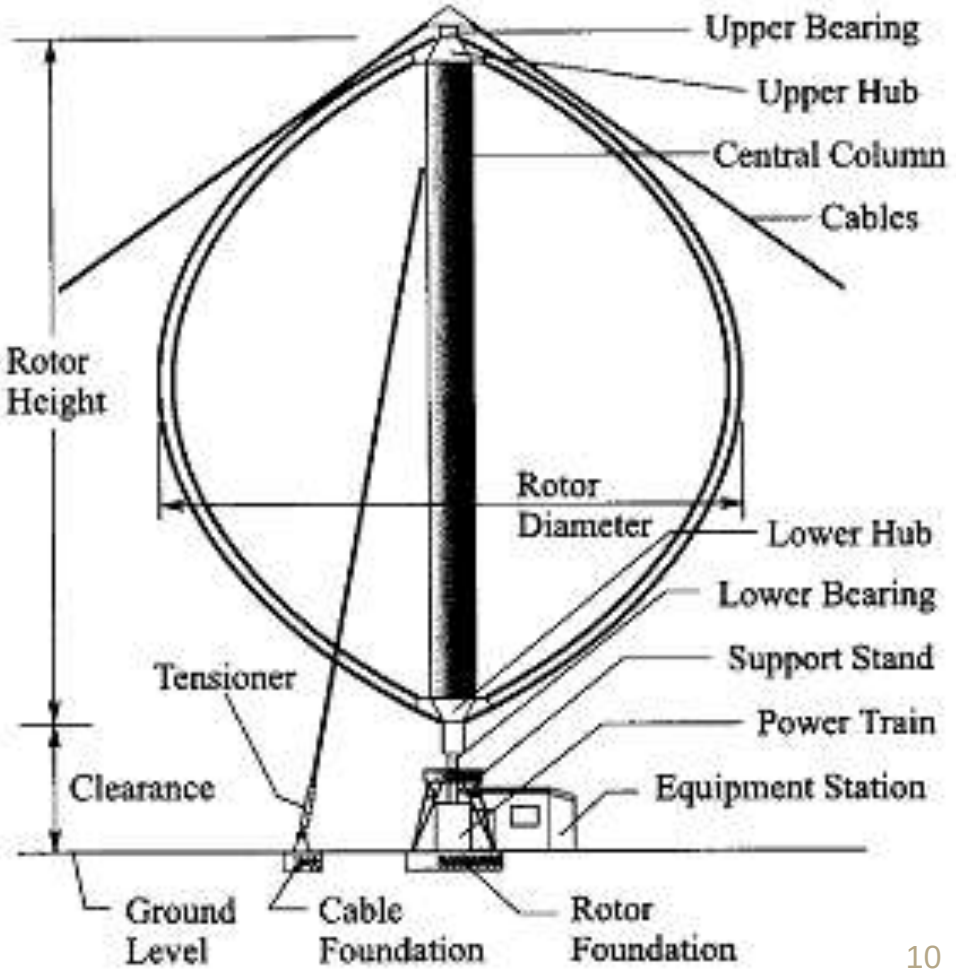


Vertical Axis Wind Turbine



Horizontal Axis Wind Turbine

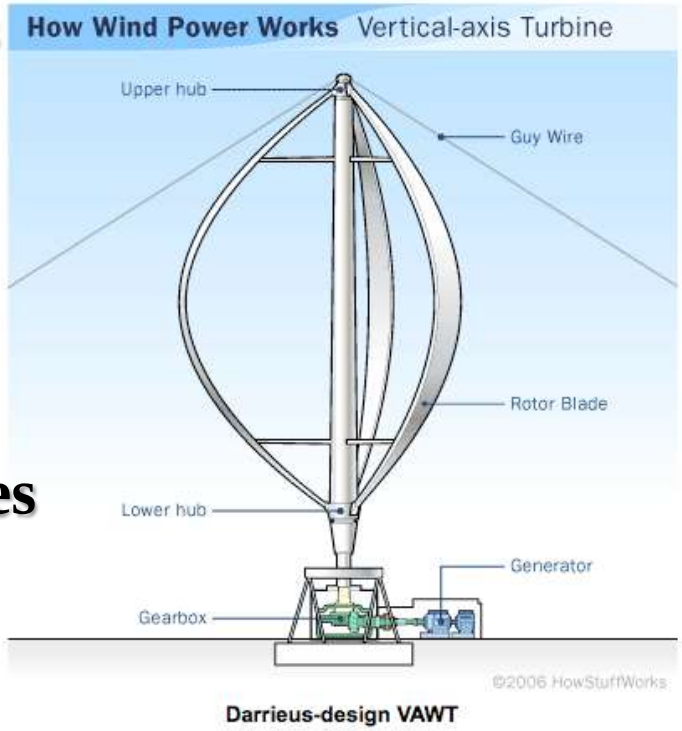
Vertical Axis Wind Turbine



Vertical Axis Wind Turbine (con't)

Advantages

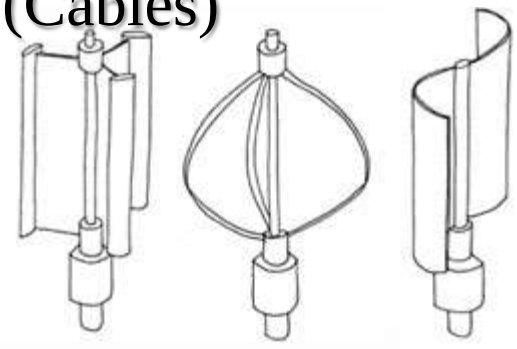
- Accepts wind from any angle
- Ease of maintenance
- Lighter weight tower



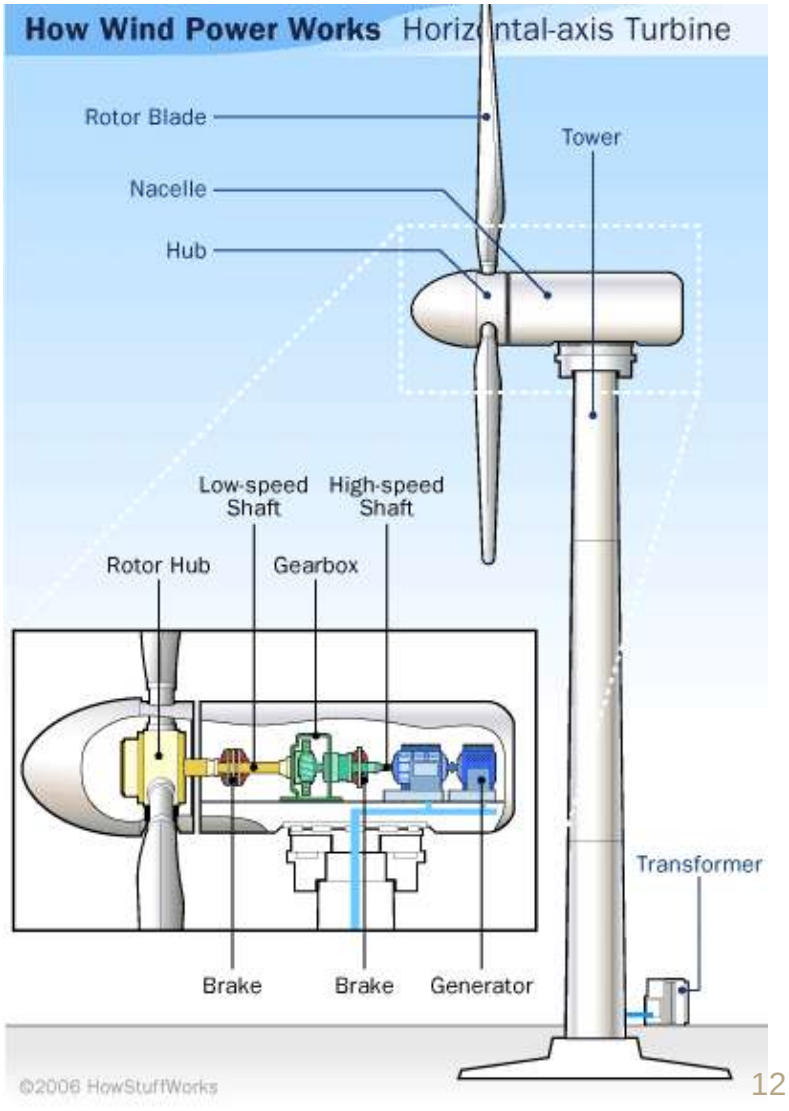
Darrieus-design VAWT

Disadvantages

- Require wind high velocity
- High force stresses blades
- Requires support at top of turbine rotor (Cables)
- Low performance
- Small sizes and shapes



Horizontal Axis Wind Turbine



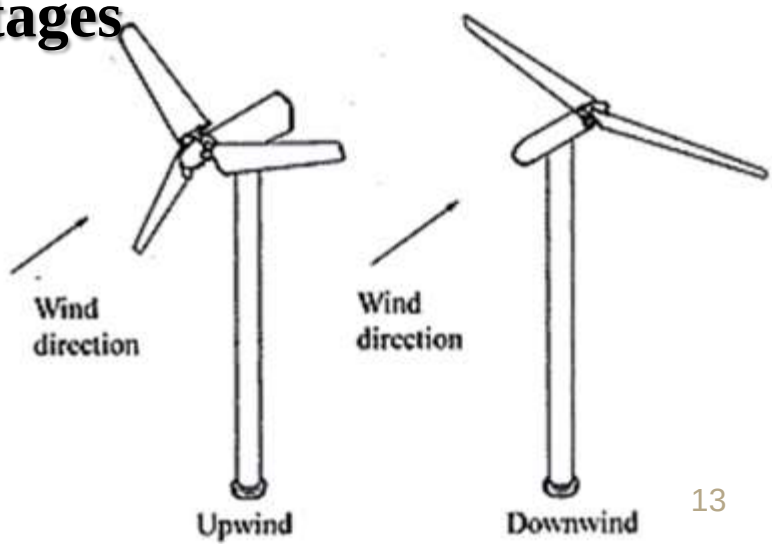
Horizontal Axis Wind Turbine (con't)

Advantages

- Advanced technology
- Economically viable
- Less components
- Many sizes and shapes

Disadvantages

- Costly
- Difficulty on maintenance
- Require large open area



Number of blades

- Increasing the number of blades tends to increase the aerodynamic efficiency
- Increasing the number of blades increases the cost (material and manufacturing)

Advantages of Wind Energy

- Free energy source.
- Environment friendly.
- High potential in remote areas
- Can be used directly as mechanic energy.
- Can be combined with solar energy
- High potential to generate energy on large scale.

Disadvantages of Wind Energy

- Requires expensive storage during peak production time.
- Unsteady energy source
- Requires large open areas
- Noise pollution problem and low efficiency
- wildlife impact and birds

Thank you for your attention

References

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