

## **CHAPTER 2** **Wind Energy**

### **Expected Outcomes**

Assess the technical feasibility of selecting and siting a single wind turbine. Components and characteristics of wind turbines, wind turbine aerodynamics.

# Wind Energy 2

# What is Wind Energy?

Winds are produced by the uneven heating of the atmosphere by the sun, and earth rotation. Wind flow patterns are changed by the vegetation, water bodies, and earth's terrain. Wind energy or wind power describes the process by which the wind power is extracted from air flow using wind turbine to generate mechanical energy or electrical energy. Mechanical energy can be used for specific tasks (wind pump for pumping water and sails).

# Mechanics of wind

- Pressure force
- Coriolis force
- Inertial force
- Frictional force

## Wind Energy uses

Wind energy use is about 2% of the domestic energy consumption

Expected to increase to about 20% over next two decades.

Denmark is the world leader

- produces wind power over 20% of the country's power

## ➤ Types of Wind energy:

- 1.- Planetary winds
- 2.- Local winds.

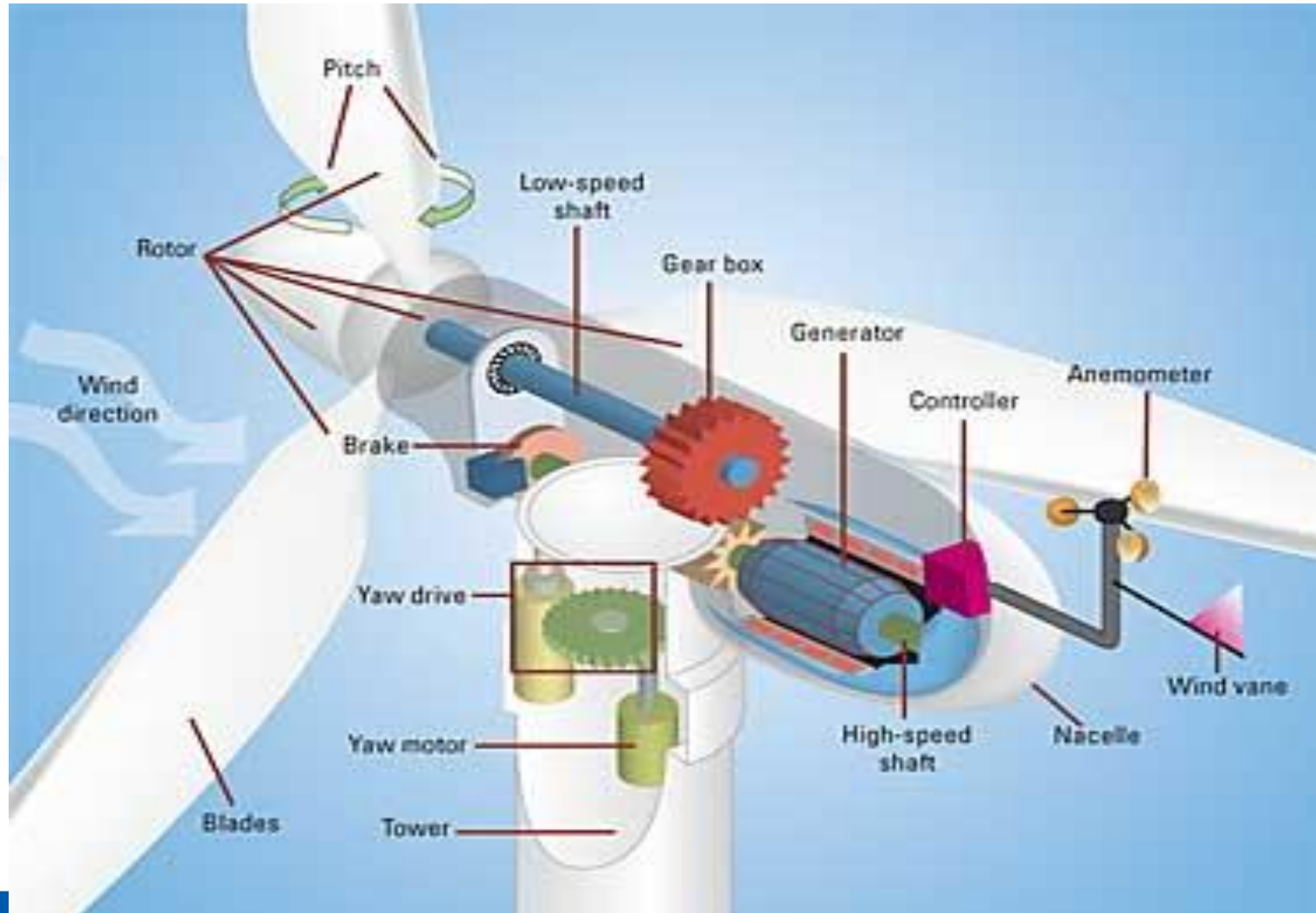
**Planetary winds** are caused due to greater heating of earth's surface near the equator as compared to solar heating near the north & south poles.

**Local winds** due to the local change of temperatures in coastal areas and these are also caused due to uneven heating in mountains along the slopes.

# **Wind Turbines**

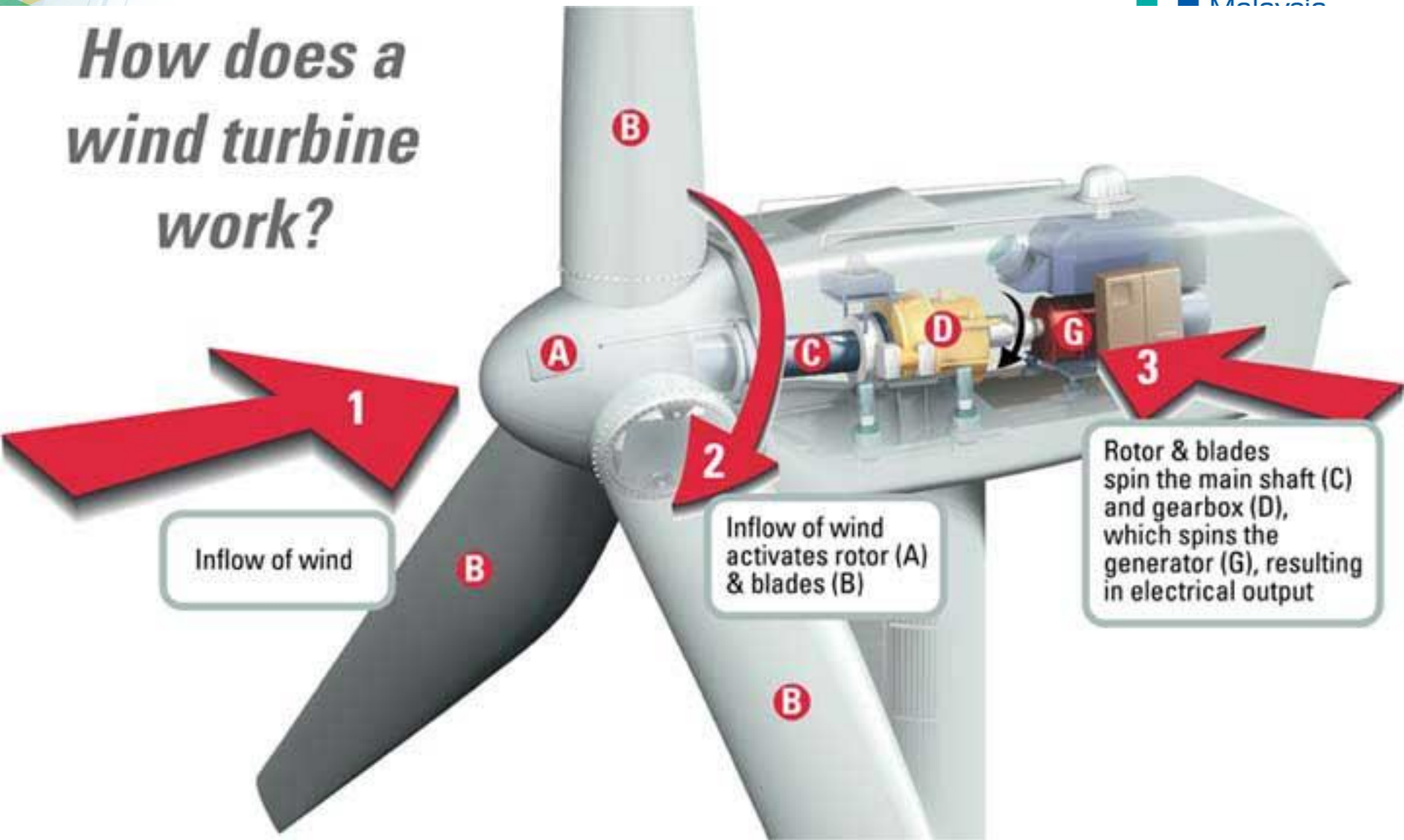
<http://energy.gov/eere/wind/how-does-wind-turbine-work>

**12/19/2015**





# How does a wind turbine work?



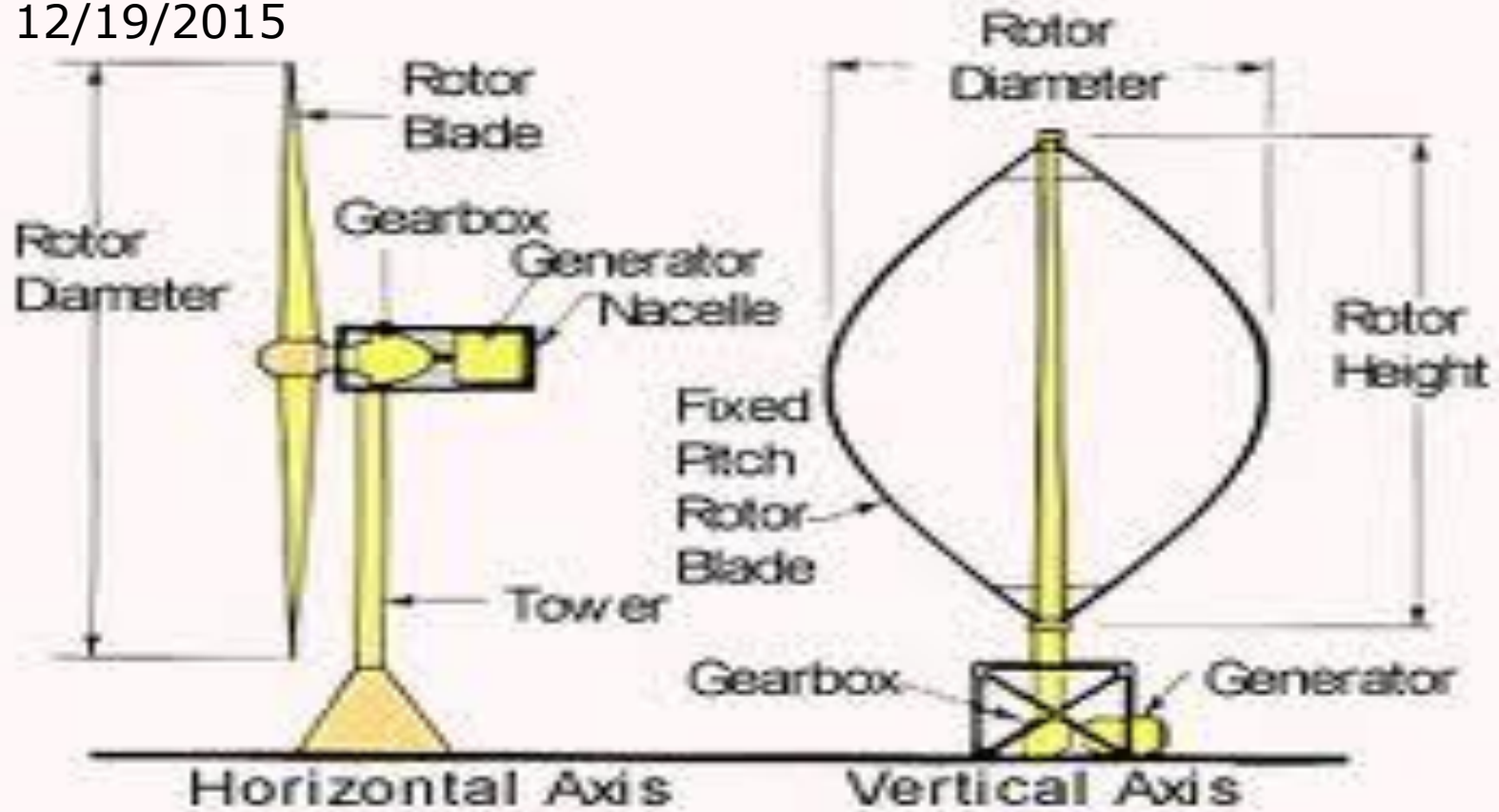
# How Wind Turbines Work

Wind turbines operate on a simple principle. The energy of the wind turns propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to generate electricity. Wind turbines are mounted on a tower to capture the most energy. A blade acts like an airplane wing. When the wind blows, a pocket of low-pressure air forms on the downwind side of the blade. The low-pressure air pocket then pulls the blade toward it, causing the rotor to turn. This is called lift. The lift force is much stronger than the front side of the blade wind force, which is called drag. The combination of drag and lift causes the rotor to spin like a propeller, and the rotating shaft spins a generator to generate electricity.

# Wind Turbine Types

<http://www.cbmjournal.com/content/2/1/8/figure/F2?highres=y>

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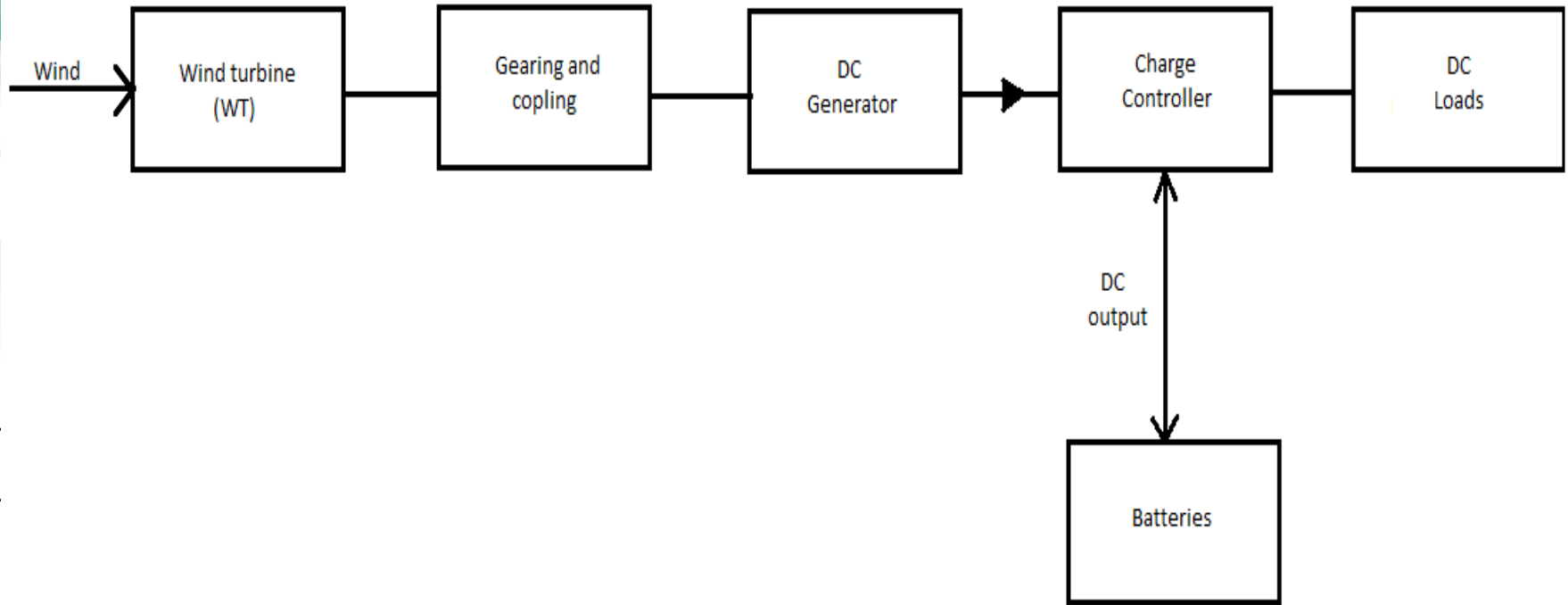
*Wind Turbine Configurations*

- Two types of *Modern wind turbines*:  
*the **horizontal-axis**, like the old-style farm windmills used for water pumping, and the **vertical-axis**.*

# Wind Turbine Size and Power Ratings

- Wind turbines are available in a different sizes.
- The largest turbine has blades that span more than the length of a cricket field, high 20 building stories, and can power 1,500 homes with electricity.

- *A small sized wind machine: rotors size between 10 and 25 feet in diameter*
- *30 feet Height and can provide the power of home or small industry.*



**power the batteries.**

# Total wind power

- The total wind power is equal to the incoming kinetic energy of the wind stream.



$$P = \frac{1}{8} \rho D^2 C^3$$

P=power

$\rho$ =Density of air(kg/m<sup>3</sup>)

D=Rotor diameter

C=Incoming wind  
velocity(m/s)



# Offshore wind power

Construction of [wind farms](#) in water bodies to produce [electricity](#). Offshore wind power generate higher electricity compare to on land because of stronger offshore wind power.

## **Economics and benefits:**

Offshore wind power can help to reduce air pollution, meet renewable electricity standards reduce energy imports, and greenhouse gases and create local business and jobs chances.

# economically viable

A report from a association of researchers from different universities, government and industry, places out several things needed in order to bring down cost of the offshore wind power plant to make more economically feasible:

- Improving wind performance models with new designs.
- Less weight of turbine materials
- Reducing problematic gearboxes
- By controlling's of turbine load and strategies
- To minimize typhoon and hurricane by new designs of turbine and rotor

# Advantages and Disadvantages of Wind-Generated Electricity

- **Renewable and Clean source of energy.**
- **No greenhouse gases from wind plants.**

# Cost and Intermittence

The pros and cons of wind power are still the subject of heated debate. There are two main arguments against wind power:

- High cost to produce wind power than the conventional electricity.
- Wind power is irregular because winds are uncontrollable and unpredictable.

# Environmental Concerns

- **Noise pollution by the rotor blades, aesthetics impacts, and birds having been killed by flying into the rotors.**

Thank you ...

