MCN-201:
SUSTAINABLE ENGINEERING

Module 4

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Module 4

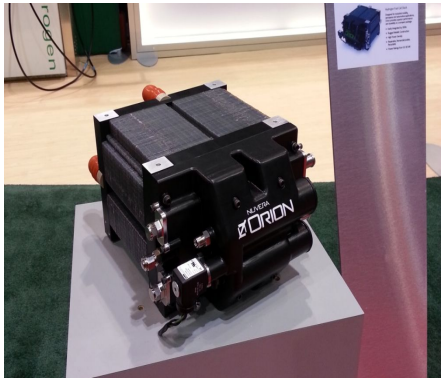
- ★ Resources and its utilisation: Basic concepts of Conventional and non-conventional energy
- ★ Solar energy
- ★ Fuel cells
- ★ Wind energy
- ★ Small hydro plants
- ★ Bio-fuels
- ★ Energy derived from oceans and Geothermal energy.

3. Fuel cells

- Fuel cells is an **electrochemical cell** that generates electrical energy from fuel via an electrochemical reaction.
- In a fuel cell, hydrogen and oxygen are combined to generate electricity, heat, and water.
- Fuel cells are used today in a range of applications, from providing power to homes and businesses, keeping critical facilities like hospitals, grocery stores, and moving a variety of vehicles including cars, buses, trucks, trains, and more.

These are 4 common categories of fuel cells:

- Proton Exchange Membrane (PEM) fuel cells
- Alkaline fuel cells
- Solid oxide fuel cells
- Phosphoric acid fuel cells

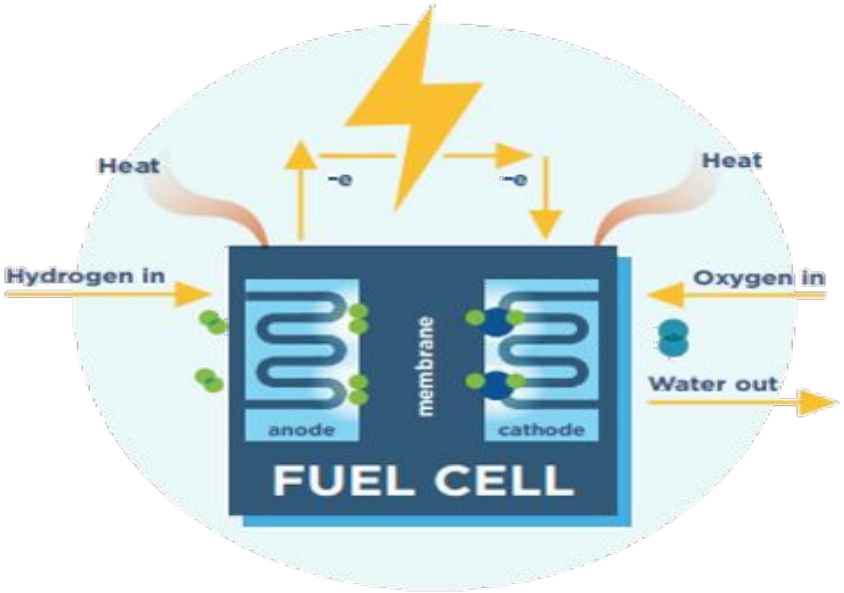


- A fuel cell is composed of an anode, cathode, and an electrolyte membrane. A typical fuel cell works by passing hydrogen through the anode of a fuel cell and oxygen through the cathode.

HOW FUEL CELLS WORK

A fuel cell is an electrochemical energy conversion device – it utilizes hydrogen and oxygen to generate electricity, heat, and water.

1. The hydrogen atoms enter at the anode.
2. The atoms are stripped of their electrons in the anode.
3. The positively charged protons pass through the membrane to the cathode and the negatively charged electrons are forced through a circuit, generating electricity.
4. After passing through the circuit, the electrons combine with the protons and oxygen from the air to generate the fuel cell's byproducts: water and heat.



Advantages

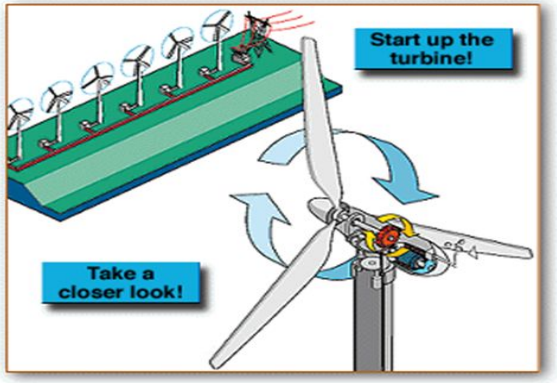
- ❏ Fuel cell systems are a clean, efficient, reliable, and quiet source of power.
- ❏ Fuel cells do not need to be periodically recharged like batteries, but instead continue to produce electricity as long as a fuel source is provided.
- ❏ Fuel cells are also scalable. This means that individual fuel cells can be joined with one another to form stacks. In turn, these stacks can be combined into larger systems.

Disadvantages

- ❏ Overall production cost is high.
- ❏ Hydrogen is very prone to catch fire, or even exploding

4. Wind energy

- Wind is a form of Solar energy
- Wind is caused by the uneven heating of the earth's surface and rotation of the Earth Wind
- Turbines convert the kinetic energy in the wind to mechanical power
- The wind turns the blades, which spin a shaft, Which connects to a generator.
- A generator can convert the mechanical power into electricity



What is Wind Energy?

- Wind energy is the converting of wind power to electrical power through the use of windmills or turbines.
- Electricity produced is sent to transformers where voltage is increased and sent to the power grid via transmission lines.

Advantages of Wind Power

- The wind blows day and night, which allows windmills to produce electricity throughout the day.
- Wind energy is a domestic, renewable source of energy that generates no pollution and has little environmental impact.
- The decreasing cost of wind power and the growing interest in renewable energy sources should ensure that wind power will become a viable energy source in worldwide.
- Produces no waste or greenhouse gases.
- Wind farms can be tourist attractions.
- A good method of supplying energy to remote areas.

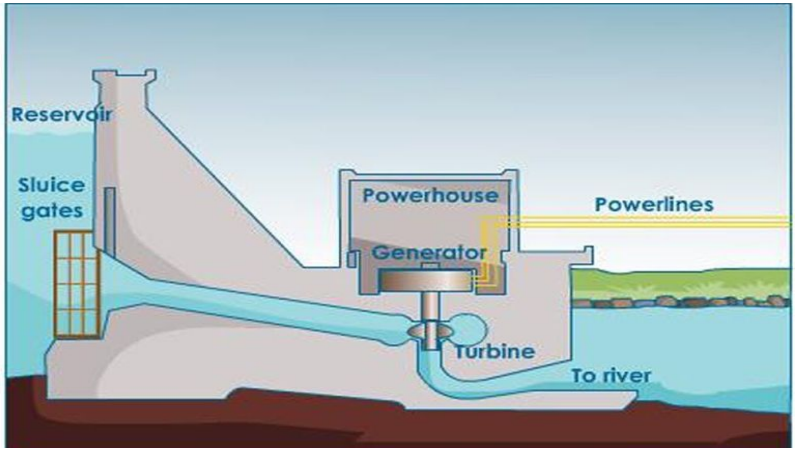
Disadvantages of Wind Power

- Suitable areas for wind farms are often near the coast, where land is expensive.
- The wind is not always predictable - some days have no wind.
- Can kill birds - migrating flocks tend to like strong winds.
- Can affect television reception if you live nearby.

5. Small hydro plants

★ **Hydroelectricity** refers to the electricity generated by hydropower; the production of electric power through the use of gravitational force of the falling or flowing water.

★ Hydropower is renewable, clean and non-polluting energy resource. Through hydropower, the energy in falling water is converted into electricity.



- Flowing water is directed to a turbine through a passage called “penstock”.
- The flowing water causes the turbine to rotate, converting the water’s kinetic energy to mechanical energy.
- The mechanical energy produced by the turbine is converted into electrical energy using a turbine generator.
- The electrical energy is then fed into gridlines to be used in homes industries etc.

Advantages of Hydropower Plants

- Water is available throughout the year
- Operational and maintenance cost is lower than other power plants
- The cost of fuel is nil
- Hydro Plants are made for multiple purposes
- The requirement of working staff is less. The cost of expenses is lower as compared to other plants.

Disadvantages of Hydropower Plants

- Embankment construction cost is high
- Land space requirement for set up is large
- Water must be abundant to continue the process
- Aquatic life is effected
- Embankment areas need to be evacuated for flood plains.