

## Sources of Energy

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- **Biomass** refers to those living and non living organic materials that can be used as sources of energy in the form of fuel.
- Some examples of biomass fuels are wood, crops, and organic garbage.
- Biomass fuel is a renewable source of energy.
- Gas made from the anaerobic digestion of agricultural and animal waste is called **biogas**.
- **Biodegradation** is the process of biological degradation of organic matter by bacteria and fungi.
- **A good fuel/source of energy**
  - That would do a large amount of work per unit volume or mass
  - Easily accessible
  - Easy to store and transport
  - Economical
- **Factors to be considered for choosing fuel**
  - How much heat it produces
  - Less smoke generation
  - Easy availability
- **Calorific value** is defined as the amount of heat energy obtained by burning one gram of a substance. The unit of calorific value is kJ/g.
- The **ignition temperature** of a substance is defined as the temperature at which the substance starts burning. It is measured in °C, °F, or K.
- **Non-renewable sources** of energy are those that are consumed at a rate faster than that at which they are replenished. Example: Fossil fuels.
- **Fossil fuels** – Coal, petroleum and natural gas
  - **Coal**: It is a non-renewable source of energy made up of complex compounds of carbon, hydrogen and oxygen along with some free carbon and compounds of nitrogen and sulphur.
  - **Petroleum**: It is a dark coloured viscous liquid also known as crude oil or black gold. It is a complex mixture of many hydrocarbons with water, salt, earth particles and other compounds of carbon, oxygen, nitrogen and sulphur. We obtain petroleum by drilling oil wells into earth's crust at its reservoirs. The petroleum extracted from wells has to be purified to obtain different useful components. The process of separating useful components from the crude oil is called refining and this process is done by fractional distillation in big refineries.
  - **Natural Gas**: The main constituents of natural gas are methane (upto to 95%), ethane and propane. It easily burns to produce heat.
- **Advantages** –
  - Easy availability
  - Generate heat that is easily converted into electricity

- **Renewable sources of energy** are those that are replenished at a rate faster than that at which they are consumed. Example:
  - **Solar energy** – Solar cooker, solar water heater (very efficient for small scale electricity production)
  - **Tidal energy, wave energy, ocean thermal energy**
  - **Geothermal energy** – Heat energy inside the earth
  - **Nuclear energy** – Not dependent on solar energy, never-ending source, very efficient source, more environment friendly.
- **Coal and petroleum**
  - They are non-renewable sources of energy.
  - Consumption of coal and petroleum has increased in the past few years due to rapid industrialization.
  - Burning of coal and petroleum releases toxic gases such as carbon monoxide, sulphur dioxide, nitrogen dioxide, and greenhouse gases such as carbon dioxide and methane.
  - Use of coal and petroleum can be reduced by using alternate sources of energy and switching over to cleaner bio fuels.
- **Sustainable Management**
  - Interests of all the stakeholders should be given a proper say.
  - Benefits of development should reach each and every individual and all generations.
- **Thermal power plant** – Coal and petroleum are burned to produce steam by heating water to spin a turbine.
- Thermal power plant - Non renewable source.
- **Hydro power plants** use the potential energy of water accumulated at a height to spin a turbine.
- **Hydro power plant** – (Renewable source)
- **Problems** – Limited places for construction (only Hilly areas)
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- Wind energy is the energy harnessed from wind. The kinetic energy of wind is converted into mechanical energy.
- **Windmill** converts wind energy into mechanical energy used for grinding stone or pumping water.
- **Advantages:**
  - Wind is freely available in nature
  - Air is a renewable and inexhaustible source of energy

- It reduces the cost of electricity produced
- Wind energy does not cause any pollution and is eco-friendly
- **Limitations:**
  - Wind farms can be established only at places where there is a continuous wind speed of over 10 mph
  - A wind farm requires a large area (about 2 hectares) to facilitate a 1 MW generation
  - Lack of energy storage facilities to provide energy back-up in the absence of wind
  - The initial cost of setting up a farm is quite high
- **Devices that use solar energy** - Solar cooker, solar water heater etc.
- **Photovoltaic cells or solar cells** converts solar energy into electric energy.
- **Solar cooker** helps in cooking food by converting solar energy into heat energy.
- **Solar water heater** heats water using solar energy.
- **Advantages of solar energy:**
  - It is a renewable source of energy
  - Solar radiations are abundantly available
  - Solar cell panels have no moving parts and hence require little maintenance.
- **Disadvantages of solar energy:**
  - Photovoltaic cells are not cost effective
  - A typical cell develops a voltage of 0.5 to 1 V and can produce about 0.7 W of electricity when exposed to the sun
  - Availability of special grade of silicon used to produce solar cells is limited
- **Tidal Energy:** Tides are the daily rise and fall of ocean levels relative to coastlines. They are a result of the gravitational forces of the moon and the sun on Earth, and also the revolution of the Earth. A large amount of energy is stored in tides. They can be used as renewable sources of energy to generate electricity.
- **Wave energy:** Ocean waves are caused by winds as they blow across the sea. Waves are a powerful source of energy. Electricity can also be produced from wave energy.
- **Ocean thermal energy:** Sunlight falls on oceans and seas. This causes the temperature of water on the surface to rise, while the temperature at the bottom remains comparatively cooler. Ocean thermal energy conversion plants use the warm surface-water to boil volatile liquids such as ammonia. Ammonia gas, thus produced, creates pressure and runs the turbine of the generator. This produces electricity. Cold water is pumped up to liquefy the gas. This creates a cycle for generating electricity.
- **Nuclear energy** – Not dependent on solar energy, never-ending source, very efficient source, more environment friendly.
- **Nuclear power plants** consist of nuclear reactors. These reactors use uranium rods as fuel and heat is generated by the process of nuclear fission.
- **Disadvantages of nuclear energy:**
  - Construction of nuclear power plants needs huge investments
  - Radioactive wastes such as used uranium are a dangerous hazard to the environment

- Nuclear energy can be used for negative purposes. Therefore, there is always a fear of misuse
- There is always a danger of leakage of radioactive material and radiations from nuclear power plants
- **Geothermal energy** – Heat energy inside the earth emerging due to high temperature in the Earth's interior.
- **Hot spot** – Spot where hot rocks known as magma heats the underground water to produce steam.
- **Hot spring** – an outlet for the underground heated water to reach the Earth .

#### **Applications:**

- For driving turbines of generators to produce electricity
- To heat buildings

#### **Advantages:**

- Fuel not required
- Energy is almost free
- Absence of polluting emissions
- No role in green house effect
- Geothermal power stations are small
- Minimal adverse impact on environment

#### **Disadvantages:**

- Commercially non feasible
- Hot spots are sparse
- Hazardous gases may emerge which are difficult to dispose
- Geothermal sites may deplete and lose its heat.