

3.4 Geothermal Energy

- Geothermal energy is the heat contained in the rock and fluid that fills the fractures and pores within the rock in the earth crust.
- The shallow ground water and hot rock in deep earth's crust to magma at interior of the earth are examples of geothermal energy resources.
- Geothermal energy is called a renewable energy source because the water is replenished by rainfall, and the heat is continuously produced by the earth.
- Geothermal energy is a carbon free, renewable, sustainable form of energy that provides a continuous, uninterrupted supply of heat that can be used to heat homes and office buildings and to generate electricity.

To simplify, geothermal electricity consists of:

1. Locating a suitable geothermal reservoir (underground collection of hot water or steam).
2. Drilling a well to penetrate the hot underground water or vapor (geothermal fluid).
3. Extracting the hot fluid.

Formation of Geothermal Reservoirs

The most portion of magma retains in earth crust and its high temperature heats the surrounding rocks and subterranean water. This hot water comes out to earth surface through faults and cracks as hot springs or geysers. The hot water and steam trapped in permeable rocks under a layer of impermeable rocks and is known as a geothermal reservoir. These reservoirs can act as sources of geothermal energy with potential to generate electricity or direct use application.



People can capture geothermal energy through:

- i. **Geothermal power plants**, which use heat from deep inside the Earth to generate steam to make electricity.

- ii. **Geothermal heat pumps**, which tap into heat close to the Earth's surface to heat water or provide heat for buildings.

i. Geothermal power plants

1. Hot water is pumped from deep underground through a well under high pressure.
2. When the water reaches the surface, the pressure is dropped, which causes the water to turn into steam.
3. The steam spins a turbine, which is connected to a generator that produces electricity.
4. The steam cools off in a cooling tower and condenses back to water.
5. The cooled water is pumped back into the Earth to begin the process again.

ii. Geothermal heat pumps

- Geothermal heat pumps can do all sorts of things—from heating and cooling homes to warming swimming pools. These systems transfer heat by pumping water or a refrigerant (a special type of fluid) through pipes just below the Earth's surface.
- During the winter, the water or refrigerant absorbs warmth from the Earth, and the pump brings this heat to the building above. In the summer, some heat pumps can run in reverse and help cool buildings.

3.5 Ocean Energy

The ocean forms a vital source of energy. Ocean energy is obtained in various forms such as ocean tidal and wave energy, ocean thermal energy conversion etc.

i. Ocean Tidal and Wave Energy

Ocean tides, produced by gravitational force of sun and moon, contain enormous amount of energy. The high tide and low tide refer to the rise and fall, respectively of the water in the oceans.

ii. Ocean Thermal Energy Conversion (OTEC)

Energy from the sun heats the surface water of the ocean. In tropical regions, surface water can be much warmer than deep water. This temperature difference can be used to produce electricity and to desalinate ocean water.

3.6 Biomass

- ❖ Biomass energy, where solar energy is utilised indirectly, has been the major source of energy to human beings throughout the history of civilization.
- ❖ Biomass is any organic matter—wood, crops, seaweed, animal wastes—that can be used as an energy source.
- ❖ Biomass gets its energy from the sun. All organic matter contains stored energy from the sun. During a process called **photosynthesis**, sunlight gives plants the energy they need to convert water and carbon dioxide into oxygen and sugars.

Types of Biomass

Biomass fuel may be solid such as wood, animal dung, peat, charcoal etc. used for burning; liquid such as methanol or ethanol used in internal combustion engines of automobiles; or gas such as animal waste produced biogas: a mixture of gases mainly methane and some carbon dioxide produced in biogas digesters.

1. **Wood and Agricultural Products**
2. **Solid Waste**
3. **Landfill Gas and Biogas**
4. **Ethanol**

