

## 1.4 Types of RE sources:

True renewable energy sources are energy supplies that are refilled by natural processes at least as fast as we use them. All renewable energy comes, ultimately, from the sun. We can use the sun directly (as in solar heating systems) or indirectly (as in hydroelectric power, wind power, and power from biomass fuels). Renewable energy supplies can become exhausted if we use them faster than they become replenished: most of England's forests were cut down for fuel before the English started using coal. If used wisely, however, renewable energy supplies can last forever.

Types of renewable energy:

1. Solar energy
2. Wind energy
3. Hydro energy
4. Tidal energy
5. Geothermal energy
6. Biomass energy

### 1. SOLAR ENERGY

#### Solar Cells (or) Photovoltaic Cell

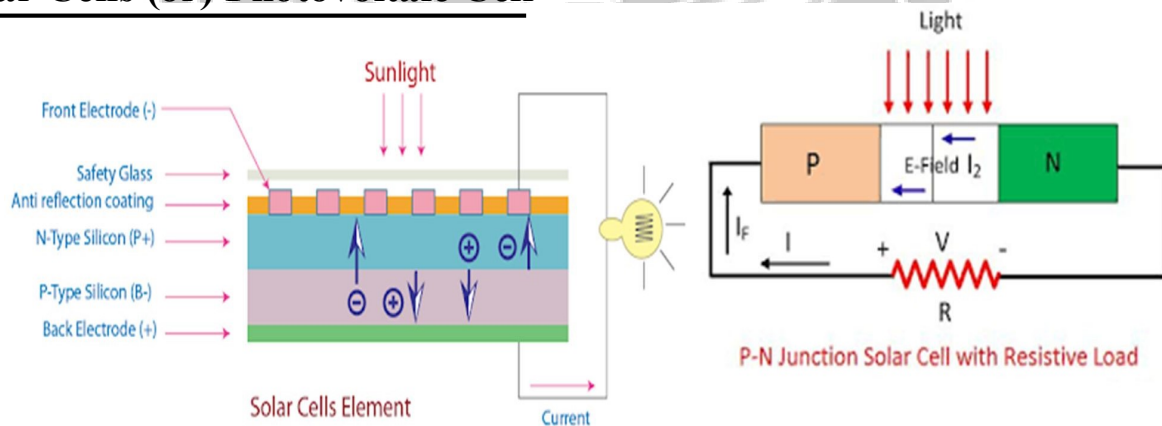


Figure: 1.4.1

[Source: "Renewable Energy Sources and Emerging Technologies" by D.P.Kothari, K.C Singal, RakeshRanjan, Page: 125]

- ❖ The direct conversion of solar energy into electricity is done by the photovoltaic effect. The basic unit of photovoltaic system is the solar cell. Solar cell is made from single crystal silicon

- ❖ The solar cell is a semi-conductor device. It generates voltage when sun light falls on it. the power obtained in day time is stored in solar batteries. The configuration of a solar cell to form a p-n junction semi-conductor is shown in Diagram.
- ❖ Silicon with added materials such as arsenic or phosphorus is called n type silicon, i.e., negatively charged silicon. The silicon with added materials such as boron is called p-type silicon, i.e., positively charged silicon.
- ❖ The charge distribution near the p-n junction gives rise to an electric field and hence a potential difference across the junction. If an external load is applied, this charge difference will drive a current through it. The current will flow so long as the sun light keeps generating the electron pairs.

### **Applications of Solar Cells**

- ❖ Used in remote, unmanned devices, where utility power is unavailable and batteries are impractical.
- ❖ They are used to operate calculators, irrigation pumps, TV station, satellite, rail-crossing signals, navigational signals, space craft, etc

## **2. Wind energy:**

### **Principle of Wind Mill**

- ❖ Wind is air in motion. Wind flow is created as an effect of solar beat. Winds are caused due to the absorption of solar energy on the earth surface and the rotation of earth about its own axis and around the sun.
- ❖ Because of this, alternate heating and cooling occurs. Thus, difference in pressure is Obtained and the air movement is caused. It is estimated that roughly 10 million MW of energy is continuously available in the earth's winds.
- ❖ Windmills are used for pumping water, grinding grains, etc. Interests in large scale power generations had developed over the past 50 years.

### **Types of Wind Mill**

Depending on the axis of rotation, wind mills are classified as follows.

- i) Horizontal Axis Type
- ii) Vertical Axis Type

The horizontal axis type has better performance than the vertical type

## Horizontal Axis Wind Mill

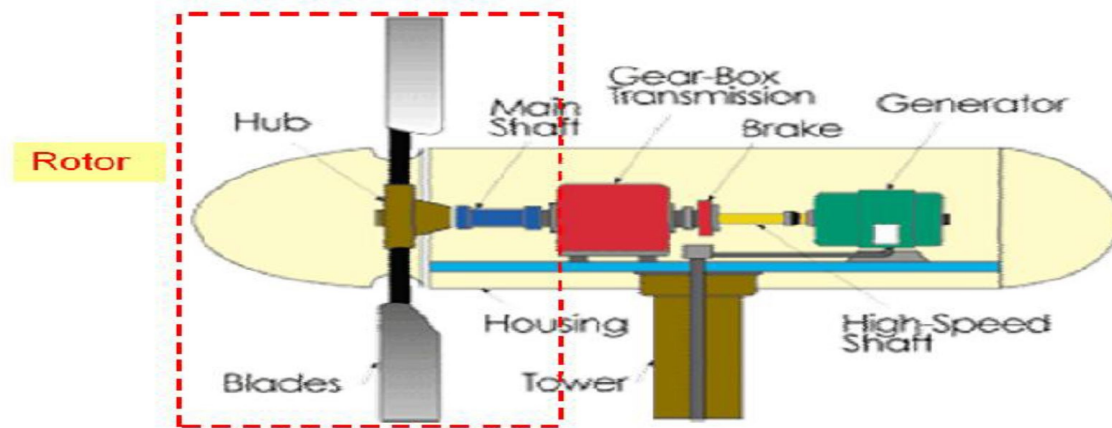


Figure:1.4.2

[Source: "Renewable Energy Sources and Emerging Technologies" by D.P.Kothari, K.C Singal, RakeshRanjan, Page: 126]

Horizontal axis single blade wind mill as shown in Diagram is of propeller type with counter-weight arrangement. The double blade type gives a better performance than single blade type.

- In the double-blade wind mill, the wind mill head is mounted on a bed plate attached on the top of the tower. The wind mill head accommodates a step-up gear box, control device and the generator.
- The blade rotor drives the generator through the transmission gear box. The two blades have thick cross section of an aerofoil, made of aluminium or sheet metal. The blades are set at right angles to the direction of the wind.
- The energy inherent in the moving air is converted into mechanical energy due to the dynamic action of air on the blades. This mechanical energy is transmitted to the generator, through the gear box. The output of the generator is connected to the load.
- With rotor, the tower is also subjected to the wind loads which may cause serious damage. Hence, the structure of the tower should also withstand the wind load
- The best sites for wind energy are found off-shore and along seacoast with no tall obstruction in the neighboring area. The lowest level of wind energy is found in plains. The present production of capacity of wind mills in Tamil Nadu is around 300 MW.

## Hydro energy

Hydropower plants convert the energy of flowing water into electricity. This is primarily done by damming rivers to create large reservoirs and then releasing water through turbines to produce electricity. Hydropower results in no emissions into the atmosphere but the process of damming a river can create significant ecological problems for water quality and for fish and wildlife habitat.

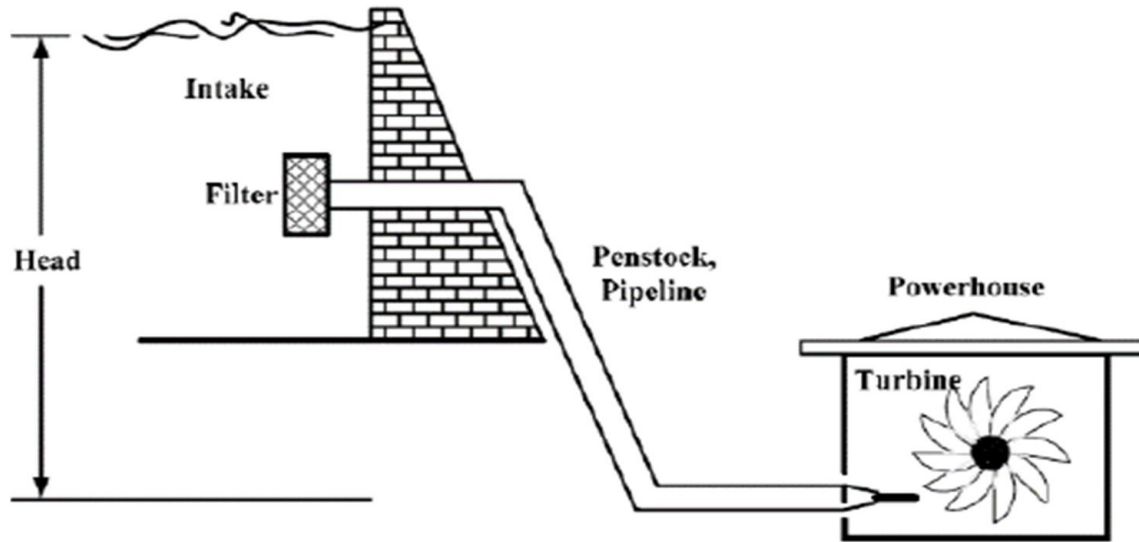


Figure: 1.4.3

[Source: "Renewable Energy Sources and Emerging Technologies" by D.P.Kothari, K.C Singal, RakeshRanjan, Page: 128]

## Tidal Energy:

Tidal power is extracted from the Earth's oceanic tides; tidal forces are periodic variations in gravitational attraction exerted by celestial bodies. These forces create corresponding motions or currents in the world's oceans. The magnitude and character of this motion reflects the changing positions of the Moon and Sun relative to the Earth, the effects of Earth's rotation, and local geography of the sea floor and coastlines

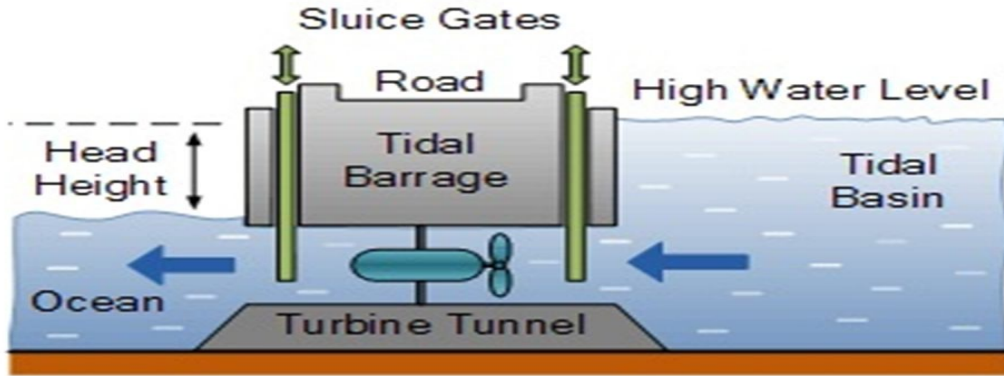


Figure: 1.4.4

[Source: "Renewable Energy Sources and Emerging Technologies" by D.P.Kothari, K.C Singal, RakeshRanjan, Page: 130]

### Geothermal energy:

Geothermal energy is heat derived within the sub-surface of the earth. Water and/or steam carry the geothermal energy to the Earth's surface. Depending on its characteristics, geothermal energy can be used for heating and cooling purposes or be harnessed to generate clean electricity. However, for electricity, generation high or medium temperature resources are needed, which are usually located close to tectonically active regions.

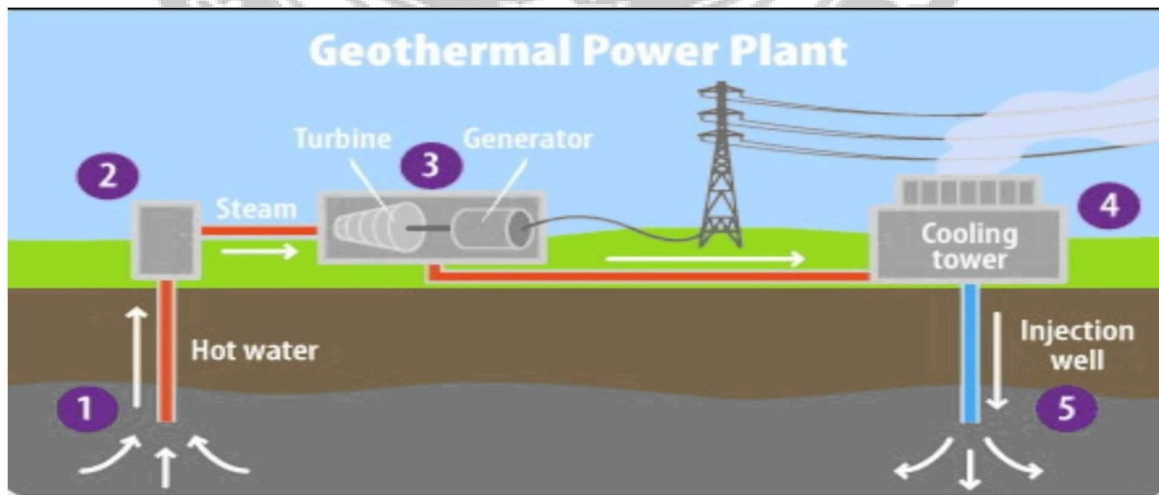


Figure: 1.4.5

[Source: "Renewable Energy Sources and Emerging Technologies" by D.P.Kothari, K.C Singal, RakeshRanjan, Page: 225]

**Biomass energy:**

This is the conversion of solid fuel made from plant materials into electricity. Although fundamentally, biomass involves burning organic materials to produce electricity, this is not burning wood, and nowadays this is a much cleaner, more energy-efficient process. By converting agricultural, industrial and domestic waste into solid, liquid and gas fuel, biomass generates power at a much lower economic and environmental cost.

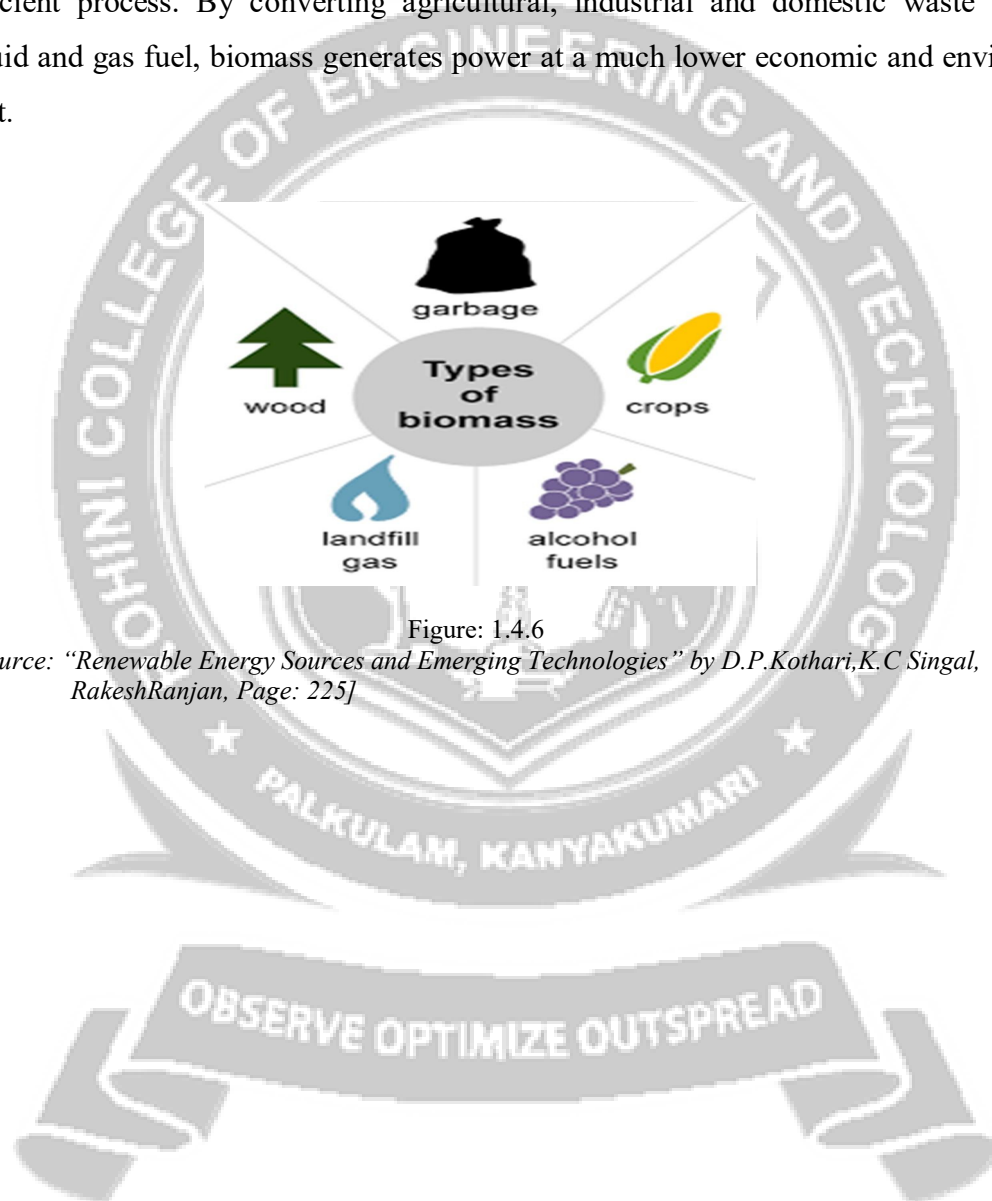


Figure: 1.4.6

[Source: "Renewable Energy Sources and Emerging Technologies" by D.P.Kothari, K.C Singal, RakeshRanjan, Page: 225]