

# Renewable Sources of Energy

## # Solar Energy :-

- Solar energy is energy harnesses from the Sun's radiation and converted into electricity or heat.
- It is renewable source of energy.
- It is important clean, cheap and abundantly available renewable energy.
- Solar energy plays a crucial role in the transition to a sustainable energy future, offering a clean alternative to fossil fuel and helping to mitigate climate change.

## # How Solar energy works? :-

i) photovoltaic (PV) cells:- It convert sunlight directly into electricity. These are made from semiconductor materials (like silicon) that generate an electric current when exposed to sunlight.

ii) Solar Thermal System:-

use sunlight to produce heat, which can then be used directly for heating or to generate electricity through steam turbines.

## # Solar Collectors:—

Solar collectors are devices used to absorb solar radiation and convert it into heat, which can be used for water heating, space heating and even electricity generation.

## # Types of Solar collectors:—

- i) Flat-plate collectors
- ii) Evacuated Tube Collectors
- iii) Concentrating collectors.

### i) Flat plate collector:—

- The flat plate collector is usually made of galvanized or aluminium sheet.
- It is coated with special type of black paint.
- These are the most common type, consisting of a flat, dark coloured absorber plate that absorbs the sun's heat, which is then transferred to a (water & air) flowing through pipes attached to the plate.

ii) Evacuated Tube collector:—

- Comprise multiple glass tubes, each containing an absorber plate a heat pipe.
- The vacuum inside the tubes reduces heat loss; making these collectors more efficient than flat-plate collectors.

iii) Concentrating collectors:—

use mirrors or lenses to focus sunlight onto a small area, significantly increasing the heat's intensity. These are typically used in large-scale solar thermal power-plants.

# Advantage of Advanced Solar Collectors:—

i) Higher efficiency:— (Evacuated tube collector):— These have higher efficiency due to reduced heat loss. The vacuum inside the tube provides excellent insulation.

Concentrating collectors:—

By focusing sunlight they achieve much higher temperatures which can more efficiently to electricity.



## 2) Improved performance in diverse conditions:-

- Evacuated tube collectors perform better in colder and cloudy condition due to their superior insulation.
- Concentrating collectors can track the Sun's movement, maximizing solar gain throughout the day.

## 3) Space Efficiency:-

Concentrating collectors require less space per unit of energy produced, making them suitable for application where space is limited but high energy output is required.

## 4) Environmental Benefits:-

Advanced solar energy systems reduce greenhouse gas emissions and reliance on fossil fuels. They produce clean, renewable energy, contributing to the fight against climate change.

## 5) Job Creation:-

The growth of the solar industry creates jobs in manufacturing, installation, maintenance and research.

and development, boosting local economies.

6. Durability and longevity:-

Advanced materials and design in these collectors often result in longer lifespans and reduced maintenance compared to traditional flat-plate collectors.

# Solar water Heater:-

- Solar water heaters are primarily used for heating water for domestic and industrial application and they contribute to energy saving and environmental protection.

Uses

- Solar water heaters use the sun's energy to heat water for domestic, industrial or commercial use.
- They are a cost effective and environmentally friendly way to generate hot water.
- It is used for space heating.
- It is used in Hotels and Resorts, hospital & clinics for providing large quantities of hot water for guest rooms, Kitchens.
- It is used for industrial process, reducing the need for conventional energy source.

## # Solar Stills:-

Solar Stills is a device use solar energy to distill water, removing impurities and making it suitable for drinking. They operate on the principle of evaporation and condensation.

### Uses

- Solar Still are primarily used to purify water by removing salts, minerals, and other impurities.
- Solar Still can convert sea water into freshwater, providing a crucial resource for drinking and agriculture.
- Solar Still provide an eco-friendly option for water purification.
- Solar Still are useful in emergency and disaster scenarios where traditional water sources are contaminated or unavailable.

## # Biomass:-

Biomass is the fuel developed from organic matter wastes of living organism like plant waste, animal waste, forest waste and municipal wastes.

In biological terms, the word biomass refers to the organic plant matter, which is

converted into fuel and used as an energy source.  
→ Biomass is used for the production of electricity due to this biomass is control the use of fossil fuel.

### Uses

- Biomass is used as heating water.
- Biomass is used as fuel to generate electricity.
- Biomass is used as fuel in cooking and heating devices.
- Biomass is used as fuel for transportation.

### Advantage of Biomass

- i) Biomass is always and widely available as a renewable source of energy.
- ii) It is carbon neutral.
- iii) It reduces the overreliance of fossil fuels.
- iv) It is less expensive than fossil fuels.
- v) It reduces the garbage in landfills.

### # Thermal properties of Biomass:-

- 1) Moisture Content:- Biomass typically has high moisture content which can range from 10% to 60% depending on the type.

2) Calorific Value:-

Dry biomass generally has a higher calorific value compared to wet biomass. Typical calorific values for dry biomass range 15 to 20 MJ/kg.

3) Volatile matter:-

Biomass has a high volatile matter content, usually b/w 70% and 85%.

4) Ash Content:- Ash content refers to the inorganic residue left after complete combustion of biomass. It typically ranges from 0.5% to 10%.

5) Thermal degradation Behaviour:-

Thermal degradation starts at temperatures around 200°C and can go up to 600°C or higher depending on the biomass type and heating rate.

6) Energy Density:- Biomass has lower energy density compared to fossil fuels. This means larger volumes are needed to produce the same amount of energy.

## # Wind Energy: —

wind energy is a type of renewable sources of energy.

wind is used to produce electricity by converting the kinetic energy of air in motion into electricity.

In modern wind turbines, wind rotates the motor blades, which convert kinetic energy into rotational energy. This rotational energy is transferred by a shaft which to the generator, thereby producing electrical energy.

→ It is used for generating electricity.

→ windmill have traditionally been used for water pumping.

→ windmills were used to remove mill grain into flour.

• Current status of wind energy in India: →

wind power generation capacity in India has significantly increased in recent years.

As of 31 March 2024, the total installed wind power capacity was 45.887 gigawatts (GW).

India has the fourth largest installed wind power in the world.



# Different types of new sources of energy are:-

- i) Solar energy
- ii) Wind energy
- iii) Tidal energy
- iv) Ocean energy
- v) Hydrogen-energy
- vi) Geo-thermal energy
- vii) Biomass energy.

\* Tidal energy:-

Tidal energy is a renewable source of energy that is produced by the natural rise and fall of ocean tides and currents caused by the gravitational interaction b/w Earth, the Sun and the moon.

- It is inexhaustive source of energy.
- Tidal energy is a clean and sustainable source of energy since tides are predictable and constant.
- It is inexpensive to maintain.

# Environmental Benefits of Tidal energy:-

- i) low greenhouse gas emission:-  
Tidal energy minimize the produce of greenhouse gas emission compared to

fossil fuel.

(ii) predictable and Reliable:-

Tidal energy is highly predictable and tidal reliable.

(iii) minimal land use:- Tidal energy installation

Such as tidal barrages and underwater turbines require less land compared to solar or wind farms.

(iv) Some tidal energy structure can create new habitats for marine life.

v) Water quality Improvement:- Tidal energy project can potentially improve water quality in coastal areas by enhancing tidal flows, which can reduce stagnation and help disperse pollutants.

# Ocean energy:-

Ocean energy is the power generated from the sea, which can be transformed into electricity.

Ocean energy refers to the various forms of renewable energy harnessed from the ocean, which include tidal energy, wave energy, ocean thermal energy and salinity gradient energy.

### Renewable Energy

i) Renewable resources are inexhaustible or unlimited

ii) These resources do not cause any environmental pollution.

iii) The resources that can be renewed once they are consumed are called renewable source of energy.

iv) It is not affected by human activities.

v) These resources are less expensive.

vi) It can be easily maintained.

vii) eg - Solar energy, tidal energy, wind energy etc.

### Non-Renewable Energy

Non-renewable resources are exhaustible or limited.

These resources cause environmental pollution.

These resources that cannot be renewed once they are consumed are called non-renewable sources of energy.

It is affected by human activities.

These resources are very expensive.

These cannot be easily maintained, stored and transmitted.

eg - Coal, petroleum, natural gas etc.