INTRODUCTION

What is Energy ?

Energy is a system's capacity to produce external activity.

Why is the study of Renewable energy necessary?

Due to ever-increasing use of fossil fuels & rapid depletion of natural resources have led to development of alternative sources of energy which are renewable & environment friendly.

Due to this the following pts are necessary :-

⇒ The demand of energy is increasing by leaps & bounds due to rapid industrialization & population growth & hence the conventional sources of energy will not be sufficient to meet the growing demand.

⇒ Conventional sources (except hydro) are non-renewable & are bound to finish up one day.

⇒ conventional sources (fossil fuels, nuclear) also cause pollution, thereby their use degrades the environment.

⇒ Large hydro resources affect wildlife, cause deforestation & pose various social problems.

Due to these reasons it has become imp. to explore & develop non-conventional energy resources to reduce too much dependence on conventional resources.

However, the present trend of developments of non-conventional sources indicate that these will serve as supplements rather than substitute for conventional sources for some more time to come.

Advantages of conventional or non-renewable sources

⇒ **Cost** – At present, these are cheaper than non-conventional energy sources.

⇒ **Security** — As storage is easy & convenient, by storing a certain qty, the energy availability can be ensured for certain period.

⇒ **Convenience** — These sources are very convenient to use as technology for their conversion & their use is universally available.

What are depletable & non-depletable energy sources

Energy sources can be broadly categorized as

Depletable	Non-depletable
→ The depletable sources include the fossil fuels (coal, oil & natural gas) & nuclear fuel.	→ The non-depletable sources include wood, forest residues, animal wastes, agricultural residues, solar radiation, wind, tidal, geothermal & hydropower.
→ Depletable or fossil fuels are a concentrated form of energy i.e. energy content per unit mass of fuel is high.	→ Non-depletable sources are dilute form of energy. ~~are re~~
→ These sources are non-renewable.	→ These sources are renewable.

Renewable Energy sources:-

Solar Energy (direct)

Solar energy can be utilized directly in more than one fashion. The major conversion methods are:

i) Solar thermal

ii) Solar photovoltaic conversion.

The main difficulty is that a solar energy is a dilute form of energy. Even in the hottest regions on the earth, the solar radiation flux available rarely exceeds 1 KW/m^2 which is a low value for technological utilization.

b) Large collecting areas are reqd in many applications & it involve excessive cost.

Wind Energy

This is a secondary form of solar energy. The potential for wind energy as a source of power is large.

Total energy available in the form of winds over the earth's surface is estimated to be 1.6×10^7 MW.

The problems associated with utilization of wind energy

a) Wind energy is a dilute form of energy, so the conversion machines have to be necessarily large.

b) Availability of energy varies considerly over a day & also with the season.

Biomass

Biomass refers to all organic matter except fossil fuels. When fixed carbon of organic materials trap solar energy, photosynthesis process occurs. This is the initial step for biomass formation. It is represented by the chemical reaction.

$$n CO_2 + n H_2O + \text{light energy} \xrightarrow{\text{chlorophyll}} (CH_2O)_n + nO_2$$

Carbohydrate is the primary product of photosynthesis. Each gram atom of carbon absorbed 470 KJ of solar energy. The major sources of biomass are agricultural residues, animal wastes, municipal wastes, forest residues, aquatic weeds etc. Biomass also contains some plant nutrients, such as nitrogen, phosphorous & potassium.

In India about 35% of the total annual energy consumption is obtained from biomass. About 73% of the total Indian population lives in villages. In rural India, biomass provides about 89% of the total energy needs, because of non-availability of cheaper commercial fuels. Burning of cattle dung cakes, wood & agricultural residues has been a traditional practice in rural India.