RENEWABLE ENERGY

World currently relies heavily on coal, oil and natural gas for its energy. Fossil fuels are nonrenewable, that is, they draw on finite resources that will eventually dwindle, becoming too expensive or too environmentally damaging to retrieve. In contrast, renewable energy resources are constantly replenished and will never run out. Types of renewable energy :

- Solar
- Wind
- Hydropower
- Geothermal
- Ocean
- Biomass

Why is renewable energy important

- Today we primarily use fossil fuels to heat and power our homes and fuel our cars. It's convenient to use coal, oil, and natural gas for meeting our energy needs, but we have a limited supply of these fuels on the Earth. We're using them much more rapidly than they are being created. Eventually, they will run out.
- Because of safety concerns and waste disposal problems, the United States will retire much of its nuclear capacity by 2020.
- In the meantime, the nation's energy needs are expected to grow by 33 percent during the next 20 years.

- Renewable energy;

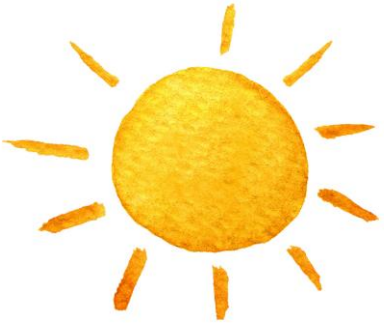
- reduce carbon emissions
- clean the air
- prevent global warming of planet earth

- The renewable energy is defined by USEPA as the resources that rely on fuel sources that restore themselves over short periods of time and do not diminish. These energy sources are also non–conventional sources of energy.

Characteristics of a Renewable Energy Sources

- Renewable energy sources are regenerated in natural processes.
- It can be used indefinitely.
- These are available in great amount or abundant in nature.
- It develops in a relatively short period of time.

3.1 Solar Energy



The solar energy is,

- provided by sun by the nuclear fusion reactions.
- generally transformed into thermal or electric energy using solar devices.
- however, available during sunshine hours, and the demand of thermal or electric energy may also exist during non-sunshine hours. Also, the maximum availability of solar energy may not coincide exactly with the demand of thermal or electric energy.

The availability of solar energy is sometime low for several days due to cloudy days, resulting in the substantial lowering of the output of thermal and electric energy from the solar radiation.

- Solar power is an ideal source of energy that is unlimited in supply, widely available, and inexpensive. It does not add to the earth's total heat burden or produce chemical air and water pollutants. On a global basis, utilization of only a small fraction of solar energy reaching the earth could provide for all energy needs.

- Solar energy technologies can be generally divided into two categories:

i. Solar Thermal Systems

ii. Solar Electric or Photovoltaic (PV) Systems

The Components of a PV Cell

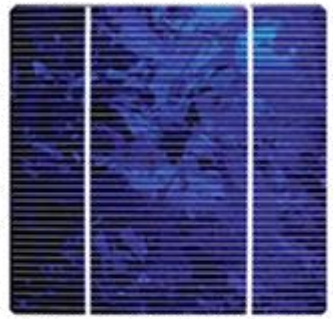
- The most important components of a PV cell are two layers of semiconductor material commonly composed of silicon crystals. On its own, crystallized silicon is not a very good conductor of electricity, but when impurities are intentionally added—a process called *doping*—the stage is set for creating an electric current.
- The bottom layer of the PV cell is usually doped with boron, which bonds with the silicon to facilitate a positive charge (P), while the top layer is doped with phosphorus, which bonds with the silicon to facilitate a negative charge (N).
- When sunlight enters the cell, its energy knocks electrons loose in both layers. Because of the opposite charges of the layers, the electrons want to flow from the n-type layer to the p-type layer. But the electric field at the P-N junction prevents this from happening.

- There are three basic types of solar cells:

Single-crystal cells are made in long cylinders and sliced into thin wafers. While this process is energy-intensive and uses more materials, it produces the highest-efficiency cells, those able to convert the most incoming sunlight to electricity. Modules made from single-crystal cells can have efficiencies of up to 23 percent in some laboratory tests. Single-crystal accounts for a little over one third of the global market for PV.

Mono

Polycrystalline cells are made of molten silicon cast into ingots then sliced into squares. While production costs are lower, the efficiency of the cells is lower too—with top module efficiencies close to 20 percent. Polycrystalline cells make up around half of the global PV market.



Poly

Thin film cells involve spraying or depositing materials (amorphous silicon, cadmium-telluride, or other) onto glass or metal surfaces in thin films, making the whole module at one time instead of assembling individual cells. This approach results in lower efficiencies, but can be lower cost. Thin film cells are around ten percent of the global PV market.

Thin Film

3.2 Wind Energy

- The wind power is one of the indirect solar energy technologies. The wind is the air in motion resulting from the pressure gradient caused by solar radiation.
- About 2% of the solar radiation reaching the earth's surface is converted to kinetic energy. The kinetic energy of the wind is utilized directly or converted to mechanical energy or used for electricity generation.
- Apart from its use for grinding grains and pumping water by wind mills, wind turbines are familiar for electricity generation.
- When gigantic fans, raised on tall towers, are rotated by the wind, its energy can be used for generation of electricity.

The nature of the terrain, degree of cloud cover and angle of the sun plays important role in wind generation of an area. Various factors affect the distribution of wind energy are as follows:

i. The chain of mountains channelizes the air currents.
ii. The hills, trees and building act as obstructions and change the direction of airflow.
iii. The frictional effect of the surface determines the wind speed. This is the reason why wind speed is quite high at seashore as frictional effect is less on smooth surface or sea surface.
iv. Climatic disturbances resulting from rains affect wind speed.
v. Topography of an area also affects wind speed, for example, wind can speed up when passing through narrow gap such as mountains gap.

- Wind power by its nature is variable (or intermittent), therefore some form of storage or back-up is inevitably involved. This may be through:

i. connection to an electricity grid system, which may be on a large or small (mini-grid) scale;

ii. incorporating other electricity producing energy systems (from conventional generating stations through diesel generators to other renewable energy systems);

iii. the use of storage systems such as batteries or, for mechanical systems, storage via water held in a tank.

3.3 Hydro Power

- Hydropower refers to the conversion of energy from flowing water into electricity. It is considered a renewable energy source because the water cycle is constantly renewed by the sun.
- To understand the water power, we need to know about water cycle.
  1. The cycle begins with solar heat.
  2. Solar heat evaporates water.
  3. Water vapour rises, condenses and forms clouds.
  4. Precipitation from clouds, as rain or snow.
  5. Solar heat evaporates water and begins the cycle again.

- The potential for energy production in a hydropower plant is determined by the following parameters, which are dependent on the hydrology, topography and design of the power plant:

1. The amount of water available;
2. Water loss due to flood spill, bypass requirements or leakage;
3. The difference in head between upstream intake and downstream outlet;
4. Hydraulic losses in water transport due to friction and velocity change;
5. The efficiency in energy conversion of electromechanical equipment.

How Hyrdoelectric Power Works?

- Firstly, you have the place where the electricity is produced, usually called *the electricity plant*.
- Secondly, you need a reservoir where vast quantities of water can be stored.
- Finally, a dam is required that can be opened or shut off to control the flow of the water. The water behind the dam will flow in, and push against a turbine.

This powers a generator which creates the electricity. The amount of electricity produced depends entirely on how much water is in the system.