An Introduction to Non-Conventional Energy Resources

The energy resources which are not generally accepted as source of energy or which are not common in use are known as non-conventional energy resources. These resources are renewable source of energy i.e. energy that can be renew means these can be used again and again in an endless manner on the basis of this it is also known as renewable resources of energy. These are available free in nature and are inexhaustible e.g. solar energy, wind energy, tidal energy, biomass energy, geothermal energy etc.

The boundary line between Conventional and Non-conventional energy resources are not rigid. The sources which are non conventional today may become conventional after few years. The non-conventional sources of energy like wind, tidal, solar etc were the conventional sources until the invention of steam engine. Man has used these sources for many centuries in propelling ships, driving windmills for grinding corn and pumping water etc. Because of the poor technologies then existing, the cost of harnessing energy from these sources was quite high. Also because of uncertainty of period of availability the difficulty of transporting this form of energy, to the place of its use are some factors which came in the way of its adoption or development.

Need of N.C.E.R: The problem of energy crisis, high cost of fossil fuel, increasing rate of green house gas has lead to the study and use of non-conventional energy resources in order to meet the growing energy requirements by developing new technologies that use energy efficiently and harness the renewable energy resources economically to ensure equal access to it by future generations.

Types of Non-Conventional Energy Resources: The various types of non-conventional energy resources are:

Solar Energy

The energy received on earth surface from sun in the form electromagnetic radiation is known as solar energy, it is clean, cheap and abundantly available renewable source of energy. The earth receives 1.6×10^{18} units of energy from the sun annually, which is 20,000 times the requirement of mankind on the earth.

Uses of solar energy:

- Can be use for cooking with the help of solar cooker.
- Use for water heating by using solar heater.
- Use for generation of electricity with the help of solar collector in solar thermal power plant.
- Use for generation of electricity by using solar cells in solar photovoltaic power plant.
- Residential cooling and heating by using solar collector.

Availability of solar energy: Sun radiates its energy in all directions of universe. Sun light received during day hours and clear sky has power density between 0.5 kw/m^2 and 1 kw/m^2. Solar energy varies with season, geographical location, day or night etc. Energy radiated by sun into space per year = 1.17×10^{31}kJ solar energy that reaches the earth = 5.4×10^{21} kJ/year.

Merits:

- Renewable
- Pollution free
- Noiseless operation
- Do not require any serious attention during the working solar energy equipments.

Demerits:

- Can be used only when sun shines.
- Large space is required for the collection of solar energy at useful rate.
- Solar cells produce small current.

Wind Energy

The energy which we receive from wind in the form of kinetic energy is known as wind energy. This kinetic energy of wind is converted into mechanical energy that can be utilized to perform useful work. The amount of energy contained in the wind at any instant is proportional to the wind speed at that instant.

Uses:

- Used for electricity generation
- Water pumping
- Grinding corn.

Availability: These are mainly located near the sea coast, island or a mountain cliff where strong winds are present. The energy available in the winds over the earth's surface is estimated to be 1.6 x 10^7 MW, which is of same order of magnitude as the present energy consumption on the earth. Its potential in India is estimated to be 2.5 x 10^4 MW. Unfortunately, the wind is neither strong nor steady in India. Gujarat, Rajasthan and south Indian states have better potential during March and September as the wind power can be developed economically only above the wind speed of 10 kmph.

Merits:

- Renewable source of energy.
- Does not cause pollution.
- Useful at remote places for electricity generation.
- On a small scale up to a few kilowatt system is less costly.

Demerits:

- Can be used only in places which are windy
- Large areas are needed to produce energy on large scale.
- It is not available regularly.
- Wind mills causes noise pollution.

Tidal Energy

The periodic rise and fall of the water level of sea due to gravitational effect of heavenly bodies like sun and moon on earth is called tide. When the water is above the MSL, it is called flood tide and when the water is below the MSL, it is known as ebb tide. These tides used to produce electrical power which is known as tidal power. A basin is filled during flow of tide and closed while tide recedes. The difference in the water head is used for rotation of turbine in the generator.

Availability: According to an estimate made by National Oceanographic and Atmospheric Administration, USA, the potential energy of tides is approximately 3 x 10^{11} MW out of which 1 x 10^6 MW exploitable energy is available on the sea coast.
More than fifty sites have been identified in the world for possible generation of tidal power. Some of the important sites are:

La Rance (France), Severn Barrage (UK), White sea (USSR), Passamaquoddy (USA), Gulf of Cambey (India) and Gulf of Kutch (India).The maximum tidal range in the Gulf of Cambey is about 10.8 m and is quite attractive for tidal plant. The Gulf of Kutch has a maximum tide of 7.5 m.

Merits:

- Renewable energy resource.
- Pollution free as it does not use any fuel.
- Less area is required because they are on bays.
- It is possible to predict to the amount of power and time at which it will be available throughout the year.

Demerits:

- Suitable to particular place only.
- Requires construction of huge hydraulic structure which makes it costlier.
- Navigation is obstructed.
- Supply of power depends upon the timing of tides, hence not continuous.

Biomass Energy

Organic matter produced from biological organism like plants (both terrestrial and aquatic and their derivatives) and animals is called biomass and the energy derived from biomass is known as biomass energy. Biomass may be classified into 3 categories: – ***Fuel wood***: obtained from trees, ***Organic waste***: It includes farm waste and urban waste and ***Photosynthesis fuel***: obtained from the plant like hyacinth, algae and grasses.

Uses:

- Direct combustion of solid biomass to generate heat energy. The heat generated by the burning of biomass can be used for space heating (e.g., heating of buildings), for cooking, and for heating water. It can also be used to boil water to generate steam, which in turn is used to run a turbine and electric generator to produce electricity in the same way that coal is used to generate electricity in a coal-fired power plant.
- Charcoal production from biomass and its combustion. When wood is heated in the absence of air or oxygen, the volatile matter is driven off of wood in a process called pyrolysis, and the remaining matter is called charcoal. Charcoal is almost pure carbon, with about twice the energy content per unit mass as the original wood.
- Production of liquid fuels from biomass such as ethanol from anaerobic fermentation of sugar and biodiesel from jatropha.
- Production of gaseous fuel from biogas plant. Biogas may be used for cooking, water heating, and electricity generation.

Availability: The current availability of biomass in India is estimated at about 500 million metric tonnes per year. Studies sponsored by the Ministry has estimated surplus biomass availability at about 120 – 150 million metric tonnes per annum covering agricultural and forestry residues corresponding to a potential of about 18,000 MW.

Merits:

- Renewable source of energy
- Biomass is a perennial and low polluting type of energy
- Cost of obtaining bio-energy through plantation is lesser than cost of obtaining energy from fossil fuels
- Growth of biomass consumes more co_2 than is released during combustion of biomass besides producing the atmosphere purifying oxygen as a by product of the photosynthesis process.

Demerits:

- Cultivation of bio fuels plants is controversial, since these plants are being cultivated in the place of food plants which may lead to food crisis.
- Seasonal variation in gas production due to lack of temperature control and poor insulation of the plant.

Geothermal Energy

The heat inside the earth is called geothermal energy. In some parts of world it is also known as geothermal hotspots, ground water gets heated by coming in contact with rocks heated by molten magma. When the hot water and steam find cracks in rocks, they force their way out to form huge fountains called *geysers*. In other places, hot water bubbles out in the form of a gentle *hot spring*.

Uses:

- Space heating
- Cooking
- Electrical power generation.

Availability: Total estimated geothermal energy reserve in earth is 4×10^{12} Exajoule out of which 2-10 Exajoule/year can be tapped for production of electricity.

Generally geothermal energy is available inside the earth at a depth more than about 80 km. In a few locations called geothermal field in the world the geothermal energy is available at depths of 300 m to 3 km. These fields are mainly found in countries like USA, USSR, Chile, Hungary. India has about 150 known geothermal sites having geothermal fluid of moderate and low temperature.

Merits:

- It renewable source of energy.
- Causes negligible pollution.
- More efficient power generation than wind and solar energy.

Demerits:

- Can be used only where there are natural geysers or beds of hot rocks close to surface.
- Special measures have to be adopted to deal with the salts and gases (like H_2S) which entrain inside the earth.

Magneto Hydro Dynamic

Magneto hydro dynamics (MHD) as the name implies, is concerned with the flow of a conducting fluid in the presence of magnetic field which generate electricity. The fluid may be gas at elevated temperature or liquid metal like sodium or potassium. An MHD generator is a device for converting heat energy of fluid directly into electrical energy. It works on Faraday's law of electromagnetic induction which states that when an electric conductor moves across a magnetic field a voltage is induced in it which produces an electric current.

Merits:

- Better utilization of fuel.
- The size of plant is considerably smaller than conventional fossil fuel plants.
- It can reach the full power level as soon as it is started.
- Suitable for peak power generation and emergency service.

Demerits:

- The use of fuel for generating heat makes the operation more expensive.
- Needs large magnets and this is a major expense.
- It suffers from reverse flow (short circuits) of electrons through the conducting fluids around the ends of magnetic field.

Ocean Energy

Ocean energy is hidden in thermal gradient, waves and tides which cover about three fourth of the earth. In tropical ocean like Indian ocean there becomes a temperature difference of nearly 20^0C between the warm surface water and deep cold water. This temperature difference is use for electric power generation. The generation of electricity is accomplish by OTEC(ocean thermal energy conversion) which uses hot surface water to generate steam of working fluid such as ammonia, generated steam is used to rotate turbine and which rotate the generator to produce electricity.

Availability: World's total estimated ocean energy reserves are about 130×10^6 MW, with the Indian Ocean having a thermal energy conversion potential of 50000 MW.

Merits:

- Inexhaustible sources of energy.
- Pollution free.

Demerits:

- It is costly and difficult.
- Corrosion of metal parts due to saline water.
- Salts get deposited in pipes and equipment, therefore maintenance is difficult.

M.N.R.E

The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. Initially a Department of Non-conventional Energy sources (DNES) was set up in India in 1982. This department was converted into Ministry of Non conventional Energy sources in 1992.The broad aim of the Ministry is to develop and deploy new and renewable energy for supplementing the energy requirements of the country. It adopted its current name in October 2006. The ministry is headquartered in New Delhi, India and governed by central government of India.

The Ministry is mainly responsible for research and development, intellectual property protection, and international cooperation, promotion, and coordination in renewable energy sources such as wind power, biogas, and solar power.

Functions:

- Policy making and planning for the development of new and renewable energy.
- Research and development for extraction of renewable energy.
- Promotion and demonstration of renewable energy.
- Providing financial incentives setting up of renewable energy source plants and equipments.

Missions:

- To bring in energy security.
- To increase the share of clean power.
- To increase renewable energy availability and access.
- To improve energy affordability.