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Renewable Energy Resources

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***Abstract*-- Due to many disadvantages faced with fossil based energy resources in many sectors whether industries or domestic sectors are using renewable energy resources like solar wind, water, biomass, water etc. These sources are inexhaustible and can be used for upcoming generations. These resources may generate less pollution like fossil fuels. All sectors still need to adopt these resources. Presently using many resources for making electricity and other applications and in the future their advanced applications will be more beneficial for the growth of energy sector.**

***Keywords*-- energy resources, types, applications, natural resources, energy.**

I. INTRODUCTION

Our earth is full of energy sources and these energy resources are used for heating, cooking, transportation and manufacturing and electricity purposes. Various forms of energy are available which can be transfer to one form to another form. These are:

1. Chemical Energy
2. Thermal Energy
3. Mechanical Energy
4. Electrical Energy

Chemical Energy: Chemical energy stored in substances like fuels (coal, oil, charcoal), organic matter etc. Chemical energy can be converted in electric energy or thermal energy through burning.

Thermal Energy: It can be used in industrial process and can be converted into mechanical and electrical energy through heat engines and by the use of boiler and turbine respectively.

Mechanical Energy: Kinetic energy and potential energy can be convert into mechanical energy through turbine. Mechanical energy used in transportation, agriculture, processing and industrial processes and it can further convert into electrical energy through generator.

Electrical Energy: Flow of current causes electrical energy which can be used as in transformation, agricultural processing and other industrial processes.

Various types of energy resources are available on earth on the basis their generation, storage and cycling energy resources can be classified in two types –

(1) Non-Renewable resources
(2) Renewable Resources

(1) *Non-Renewable Resources:* These resources are available in limited amount. These are mostly fossil fuels which are available in limited amount and likely to be exhausted one day. Ones have gone no replacement as a result of unsustainable use. These are development in longer period of time. Example coal, petroleum, natural gas etc.

(2) *Renewable Resources:* These resources can reproduce themselves in nature, can be harvested continuously through a sustain proper planning and management. These are mostly biomass based and are available in unlimited amount in nature.

These can be renewed over relatively short period of time. Example fuel wood, obtained from forest, solar energy, wind energy, water energy and geothermal energy

Renewable and non-renewable resources are also known as conventional and non-conventional energy resources.

These resources can be classified as –

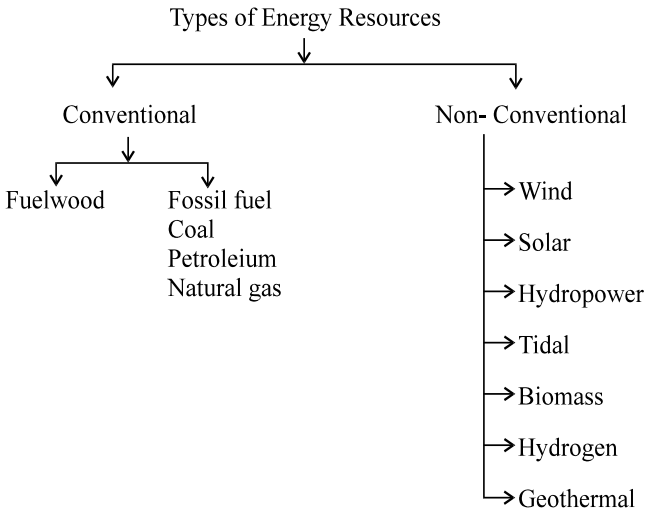

Fig. 1.1: Classification of energy sources

Renewable energy and farming are a winning combination. Wind, solar, and biomass energy can be harvested forever, providing farmers with a long-term source of income.

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Renewable technologies are now supplying or supplementing many on-farm energy requirements, from water pumping to space heating. Increasingly, farmers and ranchers are selling energy (e.g., electricity generated from wind turbines, biofuels, and products from biomass).

II. Classification Of Energy Sources

Energy is a kind of natural resource. Various types of energy resources are available on the earth. As per the requirement and demand we are using the various resources of energy from a long time. Renewable energy sources, such as biomass, geothermal resources, sunlight, water, and wind, are natural resources that can be converted into clean, usable energy. Although some disadvantages are also associated with the uses of energy resources. These resources are:

1. Wind Energy

Wind is caused when the earth's surface is heated unevenly by the sun. Wind energy can be used to generate electricity. Through Wind mill wind energy converts kinetic energy of wind into useful mechanical energy for pumping water from wells, and can also produce electcity.

In India satisfactory wind speed are recorded from April – September. Some areas where the annual energy wind speed range from 3-6 km/sec. include region in Gujarat, Jodhpur, Sikar, Bihar, Port blare Tamil Nadu, Maharashtra are suitable for wind energy generation. Gujarat alone has an estimated wind power potential of 5000 mw. The total estimated potential of wind energy in India is 45000 mw. The total energy harnessed at present is 6270.2 mw.

Advantages of wind energy:

- No need of electrical power fuel.
- Installation is possible in remote areas.
- Useful for minor irrigation and drinking water requirement.
- Cost effective because after installation maintenance cost.
- Inexhaustible.
- Pollution free.
- Wind energy can reduce our dependence on fossil fuel.

Disadvantages of Wind Energy:

- Vibration from wind mill may produce objectionable noise. Wind mill may inter fair radio and TV bread cost wind mill kill birds.
- Small blades of turbine are not more efficient than big blades.
- It is not pare vial energy source.

2. Solar Energy

Solar energy refers to energy that is collection from sunlight. Solar energy can be applied in many applications like photovoltaic solar cells, Generate hydrogen using photo electrochemical cells, generate electricity using concentrated solar power, Heat building, directly, through passive solar building design, Heat foodstuffs, through solar oven or solar cookers, Heat water or air for domestic hot water and space heating needs using solar thermal panels and Solar air conditioning etc.

Solar energy can be generated through active and passive systems.

(1) Active Solar System

Active solar system converts the solar energy into another useful form such as electricity. Active system concentrates the energy before converting into another form of energy. It requires mechanical power, usually pumps and other apparatus to circulate water or other fluids from solar. Active system concentrates the solar energy on flat plate or parabolic collectors. Maximum solar applications are based on active system.

(2) Passive Solar System

Passive solar system use solar directly without concentration and conversion into other form of energy. Direct use of solar energy for manufacturing of common salts, drying of corals and other food grains, preparation of distilled water from saline water and building heating system from the use of solar energy.

Advantage

- Inexhaustible
- Pollution free

Disadvantages

- Expensive to build solar power stations.
- Needs a very large area of solar panels to get a sufficient amount of power.
- Affected by weather .

3. Nuclear Energy

Nuclear energy can be generated by two type of process

(A) *Nuclear fission process:* In this process splitting of heavy element into two light elements with high amount of energy.

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1gm. Of Ur on fission give 8.1×10^{10} Joul of energy. Fission is essentially not spontaneous process. It is initiated when neutron, are bombarded and are captured by certain isotopes of Ur (Ur^{233} and Ur^{235} and Pu^{239}). On an average 2.5 neutrons are produced from each Ur atom. Some of their neutron can be captured by other fissionable item releasing more energy producing more neutrons and creating a nuclear chain reaction. Control and self sustained nuclear chain reaction occur in a nuclear reaction.

(B) Nuclear Fusion Process: The fusion of two nuclei of light element to produce a heavier element also in this process released tremendous quantity of energy. Nuclear fusion requires deuterium and tritium.

But fusion reaction is occurring only at temperature of the order of 5200 million degrees Celsius. Such reactions are called thermonuclear fusion reaction.

Control and self sustained nuclear chain reaction occurs in a nuclear reactor is a pressure vessel design to contain and provide for fission fuel in a self sustain and a control manner. The heat produced by fission is extracted and used for turning water into steam which drive to turbine which operates the generator to produce electric power.

Advantages –

- Inexhaustible
- Nuclear power plants are not associated with any significant quantity of primary pollutants such as CO2, SOX etc.
- High energy

Disadvantages –

- Main pollutant related to nuclear power plant is radioactive waste which is health hazard.
- Expensive.
- Fusion reaction is required high temperature.

4. Geothermal Energy

Geothermal energy is the heat energy stored beneath the earth surface in hot water steam and hot rocks. The main source of this energy is the decay of radioactive Ur, Th and K. Very small surface of earth is covered by mental, a low thermal conductivity material which is well constructed to retain this heat. Inside the earth the temperature is rises with depth. The temperature gradient is 30º C/km. The temperature of the earth center is 6000ºC.

Active geological process transport earth energy and concentrated it close to the surface in some locations producing hyper thermal areas with temperature gradient 70º C/km. Geothermal energy can either be used directly for such purposes as building heating or it can be used to produce electricity.

Four basic types of geothermal reservoirs –

1. Hyper thermal fluid reservoir.
2. Geopressurized brine
3. Magma (Hot molten rock)
4. Hot dry rock

Advantages of Geothermal Energy

- It does not produce any pollution and does not contribute to the greenhouse effect.
- No. fuel is required.
- After building a geothermal power station, the energy is almost free.
- Geothermal systems are more energy efficient, environmentally clean, cost effective and can work continuously.

Disadvantages of Geothermal Energy

- Geothermal power station building requires a specific type of area, such as with hot rocks of a suitable type, which is a limiting factor.
- Hazardous gases and minerals may come up from underground which can be difficult to safely dispose off.

5. Energy from Ocean

A mass moving water posses kinetic energy and the movement of water can be either vertical (Water fall) or horizontal (tides). The mechanical energy which can be derived from both this movement is called hydro energy.

The ocean contains two types of energy –

a. Thermal energy – Thermal energy from the sun heat and mechanical energy from tides and waves.
b. OTEC is used for many applications including electricity generation.

5.1 Tidal Energy and Wave Energy (Horizontal Energy)

The gravitational effect and relation of earth result in periodically water level changes in the sea known as tides. Twice a day actually every 12 hour, 25 minutes the H_2O level in the sea rises (High tides) and quarter day later it retires (low tide). These changes are called tidal change.

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In the open sea these changes are about 1 mt. but it certain in coastal regions like the bays (Sea shore) and estuaries the range can reach as large as 20 mt. Actually this energy (tidal energy) comes from moon which generates the tide as it rotated around the earth.

To harness tidal power dams are build. The cross entrance to a bay or estuary creating a reservoir. When the water level raises the potential energy increases and may be stored by damming the high tide water. This potential energy can be converted into kinetic energy and kinetic energy change into mechanical energy by turbine which is converted into electrical energy by generator.

Change in tide level can be harnessed as a source of energy by building a barrage similar to a dam across a bay and allowing the incoming and outgoing tides to spin turbines that produce electricity.

Tidal Barrages – A huge (called a 'barrage') is built across a river estuary. When the tide goes in and out, water flows through tunnels in the dam.

The rise and fall of the tides can be used to turn a turbine or it can be used to rush air through a pipe, which then turns a turbine.

Advantages –

- It is a renewable source which uses an inexpensive source (water) to generate power.
- It does not product pollution.
- It is a reliable source of energy (tides are predictable).
- It is highly efficient.
- The biggest advantage of tidal power besides being inexhaustible, it than it is completely independent of the uncertainly of precipitation even it continuous dry season will have no effect on the tidal power generation.
- Tidal power generation is free from pollution as it does not use any fuel and also do not produce any unhealthy waste like gases, ashes or refuse.
- These power plants do not require large area of valuable land because they are installed on the sea shores and water to avoid siltation.
- Turbines are located in the deepest.

Disadvantages –

- The fundamental drawback of generating tidal power is the variability in output caused by variation in the tidal range.
- Sea water is corrosive and it may create problem of machinery corrosion.
- Construction in sea or in estuaries is found difficult.
- Cost is not favorable compare to the other sources of energy.
- It is technically feasible only in region where the tidal range exceeds 3 mt. but the economical viability is limited to regions where the range is at least 5 mt.
- The main drawback of the system is that power generation has to be discontinued for about 50 minutes.
- It is expensive to construct tidal barrages.
- Power is generated where there is little demand for electricity.
- Barrages may affect the tidal level, may affect navigation and cause flooding of shoreline.
- Barrages may affect aquatic ecosystem.
- There are problems associated with the transportation of hydroelectricity.

5.2 Tidal Power in India

The most attractive tidal power sites are the Gulf of Kutch and Gulf of Combay where the maximum tidal range is the order of 8 mt and 11 mt respectively. The techno-economic feasibility of the Gulf of Kutch scheme was taken up by the Central electricity authority Government of India which an install capacity in the range of 800 to 1000 mw. Another potential site is Sunderban with a maximum tidal range of 5 mt. and an average tidal range of 3 mt. Other useful sites for tidal power plants are located in Gujarat States and West Bengal States. Survey of other sites in Orissa, Tamil Nadu, Kerala, Karnataka, Maharashtra and Andaman-Nicobar etc.

The estimated tidal power potential in India about 15000 mw.

The total estimated ocean power potential in India is about 50,000 mw.

5.3 Energy from Water – Hydro energy or Hydropower

Hydropower can be harnessed from flowing and falling water (vertical movement of water). Water stored at a height behind the dams has a lot of *potential* energy which is converted into mechanical and electrical energy. Nowadays hydroelectric power stations provide nearly 20% of the world's electricity.

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A dam is built to trap water, usually in a valley, where there is an existing lake. Gravitational potential energy is stored in the water above the dam. Water is then allowed to flow through tunnels in the dam. This water turns the turbines and thus drives generators. After this the water flows down the river as normal.

Advantages –

- Once the dam is built the energy is virtually free.
- No waste or pollution is produced.
- It is much more reliable than wind, solar or wave energy.
- Electricity can be generated constantly.

Disadvantages –

- It is very expensive to build dams.
- Building a large dam will flood a large area causing problems for the residents of that area.
- A dam also causes great impact on the environment and has adverse effects on the flora and fauna.

5.4 Ocean Thermal Energy Conversion (OTEC)

The oceans and seas absorb solar radiation. There exists a temperature difference between the surface and deep ocean waters. Ocean thermal energy conversion plants convert the solar energy stored as heat into electrical energy by making use of this temperature difference.

Ocean thermal energy conversion is a method for generating electricity which uses the temperature difference that exists between deep and shallow waters to run a heat engine.

This process is based on the thermodynamic principle which states that if a heat source (warm ocean surface water) is available at a higher temperature and a heat sink (deep cold water) at a lower temperature it is possible to utilize the temperature difference to convert part of the heat taken up from the source into mechanical energy by connecting the turbine to a generator. The residual heat is discharged to the sink is at a lower temperature. A heat engine is a thermodynamic device placed between a high temperature reservoir and low temperature reservoir. As heat flows from one to the other, the engine converts some of the heat energy to work energy. This principle is used in steam turbines.

Advantages –

- It is a renewable source of energy.
- OTEC power plants can be placed offshore on floating platforms; they do not need to be built on land.

Disadvantages –

- **OTEC** power plants are more expensive to build than other type of power plants.
- The best sites for OTEC are often located far the nations and population centres that need more electricity.

6. Hydrogen Energy

Hydrogen is produced from water which can be split into gaseous H_2 and O_2 by an electrical process called electrolysis, hydrogen can also be produced from natural gas and biomass resources.

Hydrogen gas can be used like natural gas. It can be burnt to heat building, cook food and produced electricity in power plants. H_2 can also be used as fuel in automobiles, in a jet air craft's (liquid H_2 etc.)

7. Biomass Energy

India is a land of village where the energy required for domestic purpose such as a cooking is met from dried woods, twigs and leaves of plants and other dried organic matter such as cow dung. This organic matter called as biomass is available freely as waste. Biomass consists from two words **Bio** means living (Plants and animals) and **mass** means material. It contains stored energy from the sun. The biomass is fast renewable forms of energy and available freely as waste and discarded matters.

Biomass includes all plants, plant residues, waster, wood, marine and fresh water algae, herbaceous plants, agricultural and forest residues. It also includes biodegradable organic materials from various industries. Biomass can also be produced from petro plants. Seeds of petro plants contain oil, with can be used as a substitute of diesel in vehicles and industries. The total biomass potential in India is 21000 mw. At present we are generating 1195.83 mw. Biomass energy generates the energy from various ways as shown in the figure 1:2

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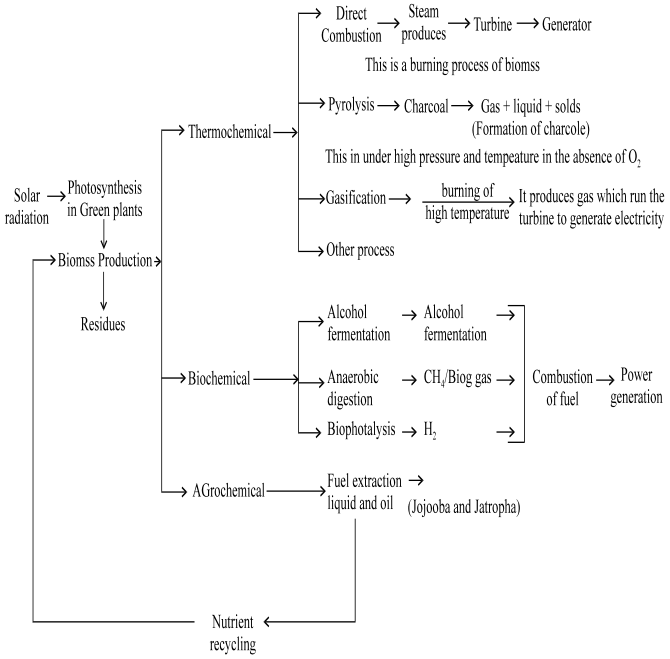

Fig. 1.2: Biomass Energy

Advantages of Biomass Energy

- Biomass is very abundant.
- It is cheap.
- It is easy to convert it into a high energy fuel such as alcohol or gas.
- It may also use areas of unused agricultural land.
- It saves space in landfills by reusing waste products.
- Along with this, growing agricultural crop for energy production help in stabilizing the soil, reduce soil erosion caused by air and water, controls flooding and enhances wildlife habitat.

Disadvantages

- Burning of biomass produces greenhouse gas.
- Generated
- Solid wastes
- Foul smell is present in production of biogas.

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