Sources Of Energy

The capacity or ability to do work is called Energy.

Any substance or process or system which is capable of providing adequate amount of useful energy at a steady rate over a long period of time is called a Source of Energy.

The useful energy is the difference between output energy & input energy.

Useful Energy = Output Energy − Input Energy.

Characteristics of a Good Source of Energy :

1. The source should be convenient to use, use & transport.
2. It should be economical so that everybody can effort it.
3. It should be capable of producing adequate amount of useful energy.
4. The source of energy should be capable of delivering desired amount of energy at a steady rate for a long period of time.

Classification of Sources of Energy

Conventional Sources of Energy

- Non-renewable sources of Energy.
- Sources of energy which are present in nature in a limited quantity & cannot be replenished by any natural process.

  E.g. Coal, petroleum, natural gas.
- Have been accumulated in nature over a very long period of millions of years.

Non-Conventional Sources of Energy.

- Renewable sources of Energy.
- Sources of energy which are continuously produced in nature & can be replenished by any natural process.

  E.g. Solar Energy, wind Energy etc.
- Develop with in a relatively short period of time.

Conventional sources of Energy :

1. **Fossil Fuels** :- The fuels preserved under the earth's crust as the remains of plants and animals who had dield millions of year ago.
The process of formation of fossil fuels is called fossilisation.
Main kind of fossil fuels are :-

1. **Coal** It is complex mixture of compounds containing Carbon(C), Hydrogen(H), Oxygen(O), and smaller amount of Nitrogen(N) and Sulphur(S).
Used as source of heat energy in thermal power plant & as a fuel.
manufacturing of coke, coaltar and coal gas, synthetic petrol.

2. **Petroleum** It is a complex mixture of large number of organic compounds of different types mixed with saline water and silt.
It is a dark coloured, viscous, fluorescent liquid which occurs deep inside earth of the depth of about 1000m to 1500 m.
After refining many major fractions are obtained.
Uses in power stations, heating purposes, transportation, lubricants etc.

3. **Liquified Petroleum Gas (LPG)** LPG is petroleum gas which is liquified under pressure it consists mainly of butane (C_4H_{10}) with small amount of ethane (C_2H_6) and propane (C_3H_8). It is havier than air.
It burns without smoke and is polutionless & convinient to use. Its calorific Value is 50 kcal/g.

4. **Natural Gas** It is an important fossil fuel which is found near an oil source.
It is mixture of methane (CH_4)(95%), ethane (C_2H_4)(, propane (C_3H_8), butane (C_4H_{10}).
Components found in natural gas includes CO_2, helium, Nitrogen, H_2S.
Used as domestic & industrial fuel. & in manufacturing of fertilizers.
CNG (Compressed Natural Gas) is used as a fuel in transport as it is pollution free.

Advantages of fossil fuels

- Very easy to find & extremely efficient.
- generates thousands of job every year.
- fossil fuels are aviaible widely.

Disadvantages of fossil fuels

- Burning these causes Air pollution.
- These are not burn completely.
- Releases acidic oxides & greenhouse gases.

2. **Bio Mass** Fire wood and waste materials produced by the living beings and the dead material of living beings are used as a fuel or as a source of fuel which is called Biomass.

Biomass can be used as fuel by many ways :-

- Dry it out and burn it.
- Anaerobic degradation of biomass.
- Fermentation of biomass produces ethanol which is known as parental substitute for petrol and diesel.

3. **Biogas** It is a mixture of combustible gases produced by anaerobic degradation of biomass in the absence of air.

Composition of Biogas :- 1. Methane (CH_4) 50-75%
2. Carbondioxide (CO_2) 25-50%
4. Hydrogen Sulphide (H_2S) 0-3% 3. Hydrogen (H_2) 0-1% 5. Nitrogen (N_2) 0-10%

Biogas Plant

1. **Outlet Chamber or Overflow tank** : It is an outlet to take out the left over slurry. It is used as a manure as it is rich in nitrogenous compounds.
2. **Mixing Tank** : the mixture of animal dung and water is prepared called as slurry. In mixing tank, it is fed into the digester.
3. **Gas Tank** : It is stored in the gas tank just above the digester tank from which it is drawn out through pipes for use.
4. **Inlet Chamber** : It connects the mixing tank and the digester tank. It is having a slope to ensure smooth flow of slurry into the digester.
5. **Digester Tank** : It is a sealed chamber in which there is no oxygen. Here complex compounds is formed. This process takes a few days.

4. **Wind Energy** Flowing or moving air is called Wind.
Speed of wind may vary from 5-10 km/h (gentle) to 700-800 km/h.
The kinetic energy of moving air (wind) is called Wind Energy.

Advantages
- It is cheap and inexhaustible & does not cause any pollution.

Principle & Working : The design of the blades of a windmill is designed in such a way that a pressure difference is created between its different regions when wind strikes them. The rotation of motion of the blades is then utilised to perform mechanical work or to generate electricity.

Thermal Power Plant : In thermal power plants, large amount of fossil fuels are burnt everyday in power stations to heat up water to produce steam which further runs the turbine to generate electricity. Mostly, thermal power plants are set up near coal or oil fields.

Hydro Power Plant : A Hydroelectric power plant is an arrangement in which kinetic energy of flowing water is transformed into electrical energy.

The electric energy generated by hydroelectric plant is refferd to as hydroelectric energy.

Production

- As the water flows into reservoir from the catchment area, the kinetic energy of flowing water changes into the potential energy.
- The potential energy of water changes into kinetic energy. as the water is released through control valves.
- As the water flowing at a high speed strikes a blades of turbine, it converts kinetic energy into mechanical energy of turbine.
- The mechanical energy of turbine converts into mechanical energy of the armature which further changes into electric energy produced in the coils.
- This electricity is then transmitted to distant places through the overhead electric cables or wires.

Advantages of Hydel Power Plant	Disadvantages of Hydel Power Plant
▲ It is a cheap source of electricity.	▲ The initial investment is very high.
▲ It does not cause any kind of pollution.	▲ It is not available at all the places.
▲ It is renewable & inexhaustible source of energy.	▲ It damage the environment, cause population displacement.

Non-Conventional Sources of Energy

1. **Solar Energy** - The energy from the sun in the form of radiation is Solar Energy. It does not cause any pollution. & available free of cost. Available in abundance in a hot country.

The amount of energy reaching perpendicularly per square metre per second in outer-most boundary of the earth's atmosphere is refferd as Solar Constant. (i.e 1.4)

Harnessing solar Energy [Solar Energy converted directly into]

Direct Harnessing.

- Electricity → By Using Solar Cell.
- Heat Energy → Solar Cooker, Solar water heater

Indirect harnessing

- here it responsible for
1. Photosynthesis in plants.
2. Movement of wind.
3. Ocean thermal energy.

Solar Cell → Device which converts solar energy directly into electricity.

The phenomenon due to which light energy directly changes into electric energy, when light is incident on certain sensitive material is called a **Photovaltaic Effect.**

A typical solar cell consists of a 2cm-square piece of almost pure silicon. It consists of n-type and p-type silicon. It generates about 0.7W of electric power and 0.5-1V of voltage.

Solar Cooker → Solar cooker are painted black from outside and a large glass plate to trap solar radiations by green house effect.

Advantages
- Eco-friendly.
- Renewable
- Used in rural areas.
- Retains all nutrients in food due to slow cooking.

Disadvantages
- Silicon cells are expensive.
- Solar radiations are not uniform.
- Cannot be used to make all type of foods.

2. Energy from the Sea:

Tidal Energy: Up and down movement of sea water along the shore is called tide. The energy possessed by the rising and falling tidal water is known as tidal Energy.

To harness tidal energy, a huge dam (barrage) is constructed across narrow opening to the sea. During tides, the sea water moves in and out of the opening in the dam. The moving water runs the turbine fixed inside generates electricity.

→ It is clear, environmental friendly, cheap, harnessed almost throughout year.

→ The sites are very few for this & the rise & fall of water is not very large.

Wave Energy : The unequal solar heating of the earth generates wind and the wind blowing over water generates wave.

The energy possessed by the ocean and the sea waves is known as Wave Energy.

Devices used for harnessing ocean wave energy.

- Oscillating water columns.
- Focusing devices.

Ocean thermal Energy : The solar energy stored in the ocean in the form of heat is called Ocean thermal Energy. (OTE).

The process of Harnessing it is called OTEC (Ocean Thermal Energy Conservation) and devices used for the purpose are called OTEC power plants.

3. Geothermal Energy : The heat from the interior of earth can be utilized as a source of energy under certain favourable conditions that are created by natural process. It is known as geothermal energy.

Advantages
- It is non-polluting & eco-friendy.
- Can be harnessed all time.
- It is easily produce.

Disadvatages
- Available only at few places
- Requires deep drilling which is highly technical & expensive.

4. Nuclear Energy : Energy contained in the nucleus of an atom is called nuclear Energy. It is released during nuclear reactions.

A reaction in which the composition of the reacting nuclei changes to form new elements with a nuclear reactions & release of large amount of Energy is called nuclear reaction.

Nuclear reactions occur in two ways

Nuclear fission

- The reaction in which a heavy nucleus splits into two or more smaller nuclei, with the evolution of large amount of energy, when it is bombarded with slow moving neutrons, is called nuclear fission reaction.

- These are categorised in two ways :
  1. Uncontrolled Nuclear Fission reaction
  2. Controlled Nuclear Fission reaction

Nuclear fusion

- A reaction in which two or more lighter nuclei fuse to form a heavy nucleus and a large amount of energy is released, is called nuclear fusion reaction.
- Conditions for fusion reaction
  1. High temperature 2. High pressure.