Chapter - 14

Sources Of Energy

- Energy comes in different forms and one form can be converted into another.
- A source of energy is one which provide adequate amount of energy in a convenient form over a long period of time.

Need of energy :

- For making food
- For lightning
- For transport
- For running machines
- For industrial activities and agricultural work

Qualities of a Good Source of Energy

(i) Which would do a large amount of work per unit mass.

(ii) Cheap and easily available.

(iii) Easy to store and transport.

(iv) Safe to handle and use.

(v) Does not cause environmental pollution.

Fuels : The materials which are burnt to produce heat energy are known as fuels. *E.g.,* wood, coal, LPG, kerosene.

Characteristics of a Good Fuel

- High calorific value (give more heat per unit mass).
- Burn without giving out any smoke or harmful gases.

- Proper ignition temperature.
- Cheap and easily available.
- Easy to handle, safe to transport.
- Convenient to store.
- Burn smoothly.

Sources of Energy

Conventional Sources of Energy	Non-conventional Sources of Energy
• Fossil fuels (Coal, Petroleum)	• Solar energy (*e.g.,* solar cooker, solar cell panel)
• Thermal power plant	• Energy from the sea (tidal wave, OT energy)
• Hydro power plants	• Biomass-biogas plant • Wind energy
• Geothermal energy	• Nuclear energy

CONVENTIONAL SOURCES OF ENERGY

Sources of energy which are known to most of the people. *E.g.,* fossil fuels, bio mass etc.

I. FOSSIL FUELS :

- Fuels developed from the fossils *e.g.,* coal, petroleum.
- Take millions of years to form.
- Available in very limited amount.
- These are non-renewable sources of energy.

India has about 6% share in the world reserved coal, that may last 250 years more at the present rate of consumption.

Pollution Caused by Fossil Fuels

- Released oxides of carbon, nitrogen and sulphur (acidic in nature) which causes acid rain that damages trees, plants, reduces fertility of soil.
- Produces large amount of CO_2 in the atmosphere which causes green house effect leading to excessive heating of the earth.

Controlling Pollution Caused by Fossil Fuels

- Increasing the efficiency of the combustion process.

- Using various techniques to reduce the escape of harmful gases and ashes into the surroundings.

II. THERMAL POWER PLANT :

A power plant which uses heat energy to generate electricity.

- Burning of fossil fuels produces steam to run turbines.
- Set up (power plants) near the coal and oil fields to minimize the cost of transportation and production.
- Transmission of electricity is more efficient.

III. HYDRO POWER PLANTS :

- Convert the potential energy of falling water into electricity.
- Hydro power plants are associated with Dams.

Around 25% of our country's energy requirement is met by Hydro Power plants.

Advantages :

(i) No environmental pollution.

(ii) Flowing water is a renewable source of electric energy.

(iii) Construction of dams prevents flooding of rivers, provide water for irrigation.

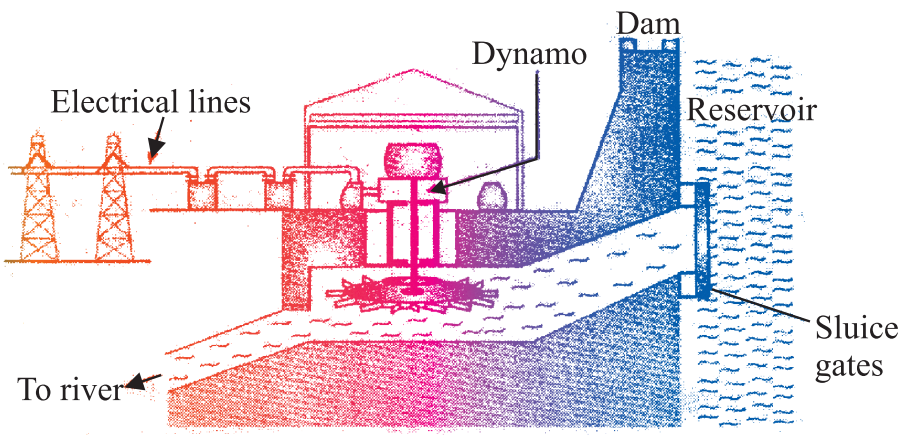
Disadvantages :

(i) Large areas of agricultural land, a vast variety of flora and fauna, human settlements get submerged in the water of reservoir formed by the dam.

(ii) Large ecosystems are destroyed.

(iii) Vegetation that submerged under water rots under anaerobic conditions and produces large amount of methane which is a green house gas.

(iv) Creates the problems of satisfactory rehabilitation of displaced people.



Production of hydroelectricity using water energy

Improvements in the Technology for Using Conventional Sources of Energy

I. BIOMASS :

The dead parts of plants and trees and the waste materials of animals and man are called **Biomass**.

(1) Wood : It is a biomass and used as a fuel for a long time.

Disadvantages :

- Produces a lot of smoke on burning.
- Do not produce much heat.
- Thus by improvement in technology we can improve the efficiency of traditional sources of energy.

For *e.g.,* wood can be converted into much better fuel called charcoal.

(2) Charcoal : When wood is burnt in limited supply of air, then water and other volatile materials gets removed and charcoal is formed.

$$\text{Wood} \xrightarrow{\text{Limited Supply of } O_2} \text{Charcoal}$$

Charcoal is better fuel than wood because :

(i) It has higher calorific value than wood.

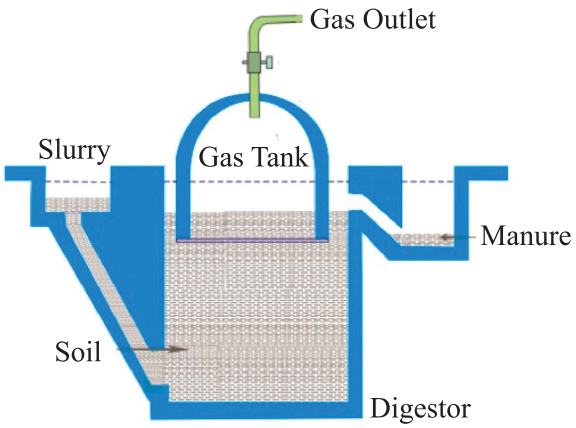
(ii) Does not produce smoke while burning.

(iii) It is a compact fuel, easy to handle and convenient to use.

(3) Cowdung : It is biomass but it is not good to burn cowdung directly as fuel because :

- produces lot of smoke.
- cowdung does not burn completely, produces lot of ash as residue.
- low calorific value.
- by making bio gas (or gobar gas) from cow dung, we get a smokeless fuel.

(4) Bio gas : It is produced in a biogas plant. Anaerobic micro organisms decomposes the complex compound of the cow dung + water slurry. It takes few day for the decomposition process and generate gases like methane, CO_2, hydrogen and hydrogen sulphide. Bio gas is stored in the gas tank above the digester from which they are drawn through pipes for use.



Bio gas Plant

Advantages of Bio gas :

(i) It is an excellent fuel as it contains upto 75% methane (CH_4).

(ii) It burns without smoke.

(iii) Leaves no residue like ash in wood & coal burning.

(iv) Heating capacity is high.

(v) It is also used for lighting.

(vi) Slurry left behind is used as excellent manure rich in nitrogen and phosphorus.

(vii) Safe and efficient method of waste disposal.

(5) Wind energy :

- Unequal heating of the landmass and water bodies by solar radiations generate air movement and causes wind to blow.
- Kinetic energy of the wind can be used :
  - * to generate electricity by turning the rotor of the turbine.
  - * to lift water from the well.
  - * to run the flour mills.
- But the output of a single wind mill is quite small so a number of windmills are erected over a large area called wind energy farm.
- The minimum wind speed for wind mill to serve as a source of energy is 15-20 KmPH.

Advantages :

(i) Eco-friendly.

(ii) Efficient source of renewable energy.

(iii) No recurring expenses for production of electricity.

Disadvantages :

(i) Wind energy farms need large area of land.

(ii) Difficulty in getting regular wind speed of 15-20 KmPH.

(iii) Initial cost of establishing wind energy farm is very high.

(iv) High level of maintenance of blades of wind mill.

- Denmark is called the 'Country of Winds'.
- India is ranked 5th in harnessing wind energy for the production of electricity.
- In India largest wind energy farm has been established near Kanyakumari in Tamil Nadu and it generates 380 MW of electricity.

Alternate or Non-conventional Sources of Energy

Day by day, our demand for energy increases, so there is a need for another source of energy.

Reasons for alternate sources of energy

(i) The fossil fuel reserves in the earth are limited which may get exhausted soon if we use them at the current rate.

(ii) Reduce the pressure on fossil fuels making them last for a much longer time.

(iii) To reduce the pollution level and to save the environment.

I. SOLAR ENERGY :

- Sun is the ultimate source of energy.
- Energy obtained from the sun is called solar energy.

$$\text{Solar constant} = 1.4 \text{ KJ/s/m}^2$$

Outer edge of the earth receives solar energy equal to 1.4 KJ/s/m^2 or 1.4 KW/m^2 [... 1 KJ/s = 1 KW]

Solar energy devices : Devices using solar energy are :

(i) Solar cooker

(ii) Solar water heater

(iii) Solar cells

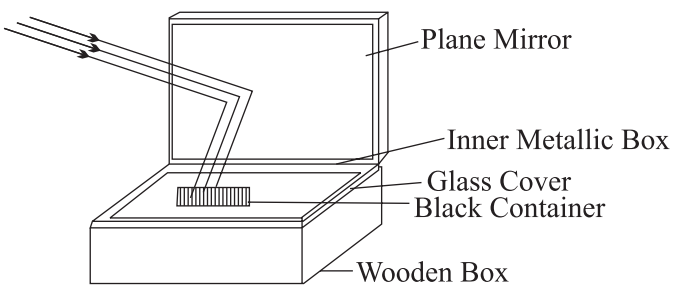
Solar heating devices :

- Use black painted surface because black surface absorbs more heat as compared to white or other surface.
- Use of glass plate because it allows infrared radiations to enter through it but does not allow the radiations to exit through it, causing more green house effect that result in increase in temperature.

(i) SOLAR COOKER

Box Type Solar Cooker : It consists of a rectangular box which is made up of wood or plastic which is painted dull black.

- Inner walls of the box are painted black to increase heat absorption.
- Solar cookers are covered with glass plate and have mirror to focus the rays of the sun and achieve higher temperature.
- Temperature inside the box increases 100ºC-140ºC in 2-3 hours.



Solar Cooker (Box Type)

Advantages :

(a) Save precious fuel like coal, LPG, kerosene.

(b) Does not produce smoke.

(c) Nutrients of food do not get destroyed while cooking.

(d) Upto four food items can be cooked at the same time.

Disadvantages :

(a) Solar cookers cannot be used during night.

(b) If the day sky is covered with clouds, even then solar cooker cannot be used.

(c) Direction of reflector of solar cooker changes from time to time to keep it facing the sun.

(d) Cannot be used for frying or baking purpose.

II. SOLAR CELL :

- Solar cells convert solar energy into electricity.
- A solar cell develops a voltage of 0.5-1 V and can produce about 0.7 W of electricity.
- A large number of solar cell are combined in an arrangement called solar cell panel

Advantages :

(a) Have no moving parts.

(b) Require little maintenance.

(c) Can work without any focusing device.

(d) Can be set up in remote and inacessible areas.

Disadvantages :

(a) Manufacturing is expensive.

(b) Availability of special grade silicon for making solar cells is limited.

(c) Silver wire for interconnection of cells is expensive.

Uses of Solar Cell :

(a) Artificial satellites and space probes use solar cells as the main source of energy.

(b) Radio, TV relay stations in remote locations use solar cell panels.

(c) Traffic signals, calculators and many toys are fitted with solar cells.

III. ENERGY FROM THE SEA

	Tidal Energy	Wave Energy	Ocean Thermal Energy
	Tidal Energy	**Wave Energy**	**Ocean Thermal Energy**
Working : (i)	The phenomenon of high and low tide give us tidal energy.	Kinetic energy of huge waves near sea shore is trapped to generate electricity.	The difference in the temperature of water at the surface and deeper section of ocean is used to obtain energy in ocean thermal energy conversion plants. (OTEC)

(ii)	It is harnessed by constructing a dam across the narrow opening of the sea.	Wave energy is used for rotation of turbine and production of electricity.	The warm surface water is used to boil volatile liquid ammonia. The vapours of the liquid are used to run the turbine of generator to produce electricity.
Disadvantage :	The location where such dams can be built are limited.	Wave energy is viable only where waves are very strong.	Efficient commercial exploitation is very difficult.

GEOTHERMAL ENERGY

- 'Geo' means 'earth' and 'thermal' means 'heat'.
- Geothermal energy is the heat energy from hot rocks present inside the earth.
- When underground water comes in contact with 'hot spot', steam is generated. Steam trapped in rocks is routed through pipes to a turbine and used to generate electricity.

Advantages :

(a) Economical to use geothermal energy.

(b) Does not cause any pollution.

Limitations :

(a) Geothermal energy is not available everywhere.

(b) Deep drilling in the earth to obtain geothermal energy is very difficult and expensive.

- In New Zealand and USA, there are no. of power plants based on geothermal energy are operational.

NUCLEAR ENERGY

- The energy released during a nuclear reaction is called nuclear energy.
- It can be obtained by two types of nuclear reactions :

(i) Nuclear fission

(ii) Nuclear fusion

(i) Nuclear Fission :

- 'Fission' means split up.

- The process in which the heavy nucleus of a radioactive atom (such as uranium, plutonium or thorium) split up into smaller nuclei when bombarded with low energy neutrons, is called nuclear fission.
- A tremendous amount of energy is produced.
- U-235 is used as a fuel in nuclear reactor in form of uranium rods.

Working : In a nuclear reactor self sustaining chain reaction releases energy at a controlled rate, which is used to produce steam and further generate electricity.

Major Nuclear Power Plants :

(a) Tarapur (Maharashtra)

(b) Rana Pratap Sagar (Rajasthan)

(c) Kalpakkam (Tamil Nadu)

(d) Narora (U. P.)

(e) Kakrapar (Gujrat)

(f) Kaiga (Karnataka)

(ii) Nuclear Fusion :

When two nuclei of light elements (like hydrogen) combine to form a heavy nucleus (like helium) and tremendous amount of energy is released is called nuclear fusion.

$$ {}_{1}^{2}H \text{ (deuterium)} + {}_{1}^{2}H \xrightarrow{\text{fusion}} {}_{2}^{3}He + {}_{0}^{1}n + Heat $$

- Very-very high temperature and pressure is needed for fusion.
- Hydrogen bomb is based on this phenomenon.
- Nuclear fusion is the source of energy in the sun and other stars.

Advantage :

(a) Production of large amount of useful energy from a very small amount of nuclear fuel.

(b) Does not produce green house gases like CO_2.

Limitations :

(a) Environmental contamination due to improper nuclear waste storage and its disposal.

(b) Risk of accidental leakage of harmful radiations.

(c) High cost of installation.

(d) Limited availability of nuclear fuel.

Environmental Consequences

Exploiting any source of energy disturbs the environment in some way or the other. Thus, the source we would choose depends upon following the factors :

(a) Ease of extracting energy from the source.

(b) Cost of extracting energy from the source.

(c) Efficiency of technology available to extract energy.

(d) The environmental damage caused by using that source.

In other words, no source of energy is said to be pollution free. Some source are cleaner than the other.

For example, solar cells may be pollution free but the assembly of the device would have cause some environmental damage.

How long will an energy resource last us ?

Sources of Energy

Non-renewable Sources of Energy	**Renewable Sources of Energy**
Sources that will get depleted some day. For example : Fossil fuel	Energy sources that can be regenerated and that will last for ever. For example : Wind energy, water energy.

QUESTIONS

VERY SHORT ANSWER TYPE QUESTIONS (1 Mark)

1. Give two examples of fossil fuels.
2. Write two characteristics of good fuel.
3. What do you mean by nuclear energy ?
4. Which country is known as 'Country of Winds' ?
5. Write the full form of CNG and LPG.
6. Name the main component of solar cell.

7. What do you mean by fuel ?
8. How charcoal is different from wood ?
9. Biogas is also known as gobar gas. Justify.
10. Name a device which can be used for cooking so as to save fuel.

SHORT ANSWER TYPE QUESTIONS (2 Marks)

1. Write two disadvantages of using fossil fuels.
2. What are solar panels ? Write three uses of solar panels.
3. Name four gases mainly present in bio gas.
4. Define nuclear fusion.
5. Write two limitations of using wind energy.
6. Write name of four nuclear power reactors located in India.
7. Write two uses/advantages of geothermal energy.
8. Why we pay attention towards alternative or non-conventional sources of energy ?
9. Write two advantages and two limitations of dams for the production of hydro electricity.

SHORT ANSWER TYPE QUESTIONS (3 Marks)

1. Charcoal is a better fuel than wood. Why ?
2. What is bio mass ? How does bio gas plant help to reduce the problem of pollution?
3. Write three advantages and three limitations of using solar cooker.
4. Why it is not possible to make use of solar cells to meet all our needs ? State three reasons.

LONG ANSWER TYPE QUESTIONS (5 Marks)

1. Why tidal energy do not become the main source of energy ?
2. What is OTEC ? Which two main points are necessary for its working ?
3. Bio gas is a boom for farmer. Why ?
4. Draw a diagram of bio gas plant.

VALUE BASED QUESTION

A school organized a study tour for its students to observe how do people in village use energy resources for their living. They observed that in one of the villages, people use wood and cow dung as a fuel while in the nearby village they saw modern technology

was used by the villagers for better sanitation and management of their bio-waste and sewage materials by establishing bio gas plant.

(a) If you compare the situation of both the villages, which practice would you prefer to be the best and why ?

(b) What are the advantages of this practice ?

(c) State the associated values which you would get from this excursion tour.

Hints to Long Answer Type Questions

1. (a) Few sites for building dams.
   (b) Rise and fall of water during tides is not high enough.
2. **OTEC :** Device used to harness ocean thermal energy.
   (a) Temperature difference of 20ºC or more.
   (b) Warm surface boil ammonia and vapours are used to run the turbine.
   (c) Minimum depth of water – 2000 m.
3. Bio gas is a boom as it is a
   (a) Clean and safe fuel.
   (b) Slurry left behind is a good manure.
4. See the diagram in text.