

Chapter 14: Sources of Energy (x)

Introduction

Total energy during the physical or chemical process is conserved. If energy can neither be created nor destroyed, then why should we have energy crisis?

As we know, energy comes in different forms and one form can be converted to another form. For example, if we drop a plate from height, potential energy is converted into sound energy when the plate hits the ground. When we burn a candle, chemical energy in the wax is converted to heat and light energy.

The total energy during physical or chemical processes remains the same, but we see that energy in the usable form is dissipated to the surroundings in less usable forms.

Hence, any source of energy we use, to do work, is consumed and cannot be used again.

What is a Good Source of Energy?

- (i) Which would do a large amount of work per unit volume or mass
- (ii) be easily available
- (iii) be easily stored and transported and
- (iv) perhaps most importantly, be economical.

Q.) What is a good fuel?

Ans) (i) Produces more heat per unit mass.
It has high calorific value.

(ii) Produces less harmful gases on combustion.

(iii) Is cheap and easily available.

(iv) Is easy to handle, safe to transport, and convenient to store.

Q.) If you could use any source of energy for heating your food, which one would you use and why?

Ans) We would use a microwave oven for heating the food as it heats uniformly and cleanly without any loss in its nutritional value.

CONVENTIONAL SOURCES OF ENERGY

When we cannot reuse a source of energy after using it once we call them "conventional sources of energy" or "non-renewable energy sources". These include coal, petroleum, natural gas and nuclear energy.

Fossil Fuels

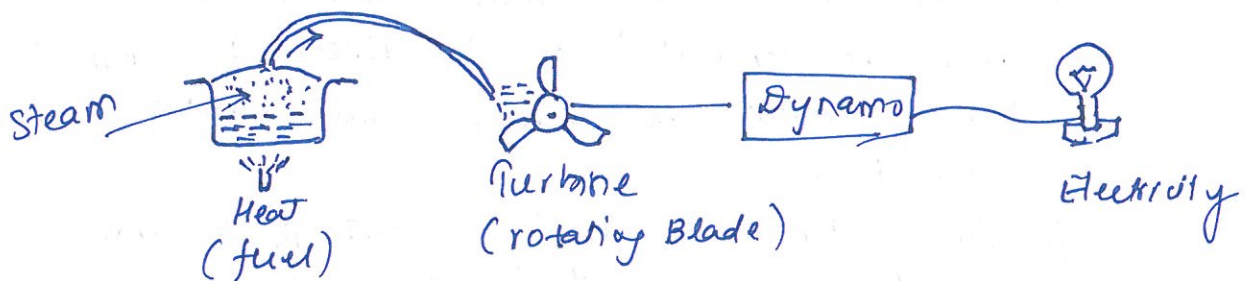
Fossil fuels are formed by natural process, such as anaerobic decomposition of buried dead organisms, containing energy. Fossil fuels are hydrocarbons, primarily coal, petroleum and natural gases, formed from the remains of dead plant and animals.

Disadvantages of fossil fuels:

- (i) The fossil fuels are non-renewed source of energy. If we continue consuming these sources at an alarming rate, we would soon run out of energy.
- (ii) Air pollution is caused by burning fossil fuels.
- (iii) Fossil fuel leads to acid rains due to presence of oxides of nitrogen and sulphur which affects our water and soil resources.
- (iv) CO_2 produced by burning fossil fuels produces greenhouse effect.

Fossil fuels besides being used for various purposes - in gas stove and vehicles, they are major fuel for generating electricity.

Thermo-electric Production



The moving fluid (steam) acts on the blades to spin them and impart energy to the rotor with speed which would turn the shaft of the dynamo and convert the mechanical energy into electrical energy.

Sources of energy can be harnessed to run the turbine and generate electricity in following ways:

(a) Thermal Power Plant

Large amount of fossil fuels are burnt every day in power stations to heat up water to produce steam which further runs the turbine to generate electricity.

The transmission of electricity is more efficient than transporting coal or petroleum over the same distance. Therefore, thermal power plants are set up near coal or oil fields.

(b) Hydro Power Plants.

Hydro power plants convert the P.E. of falling water into electricity. Hydro power plants are associated with dams. A quarter of our energy requirements in India is met by hydro power plants.

(i) In order to produce hydro electricity, high rise dams are constructed on the river to obstruct the flow of water and thereby collect water in larger reservoirs.

(ii) The water from the high level in the dam is carried through pipes, to the turbine, at the bottom of the dam.

(iii) Hydro power is a renewable source of energy.

Disadvantages of Hydro-Power Plants:

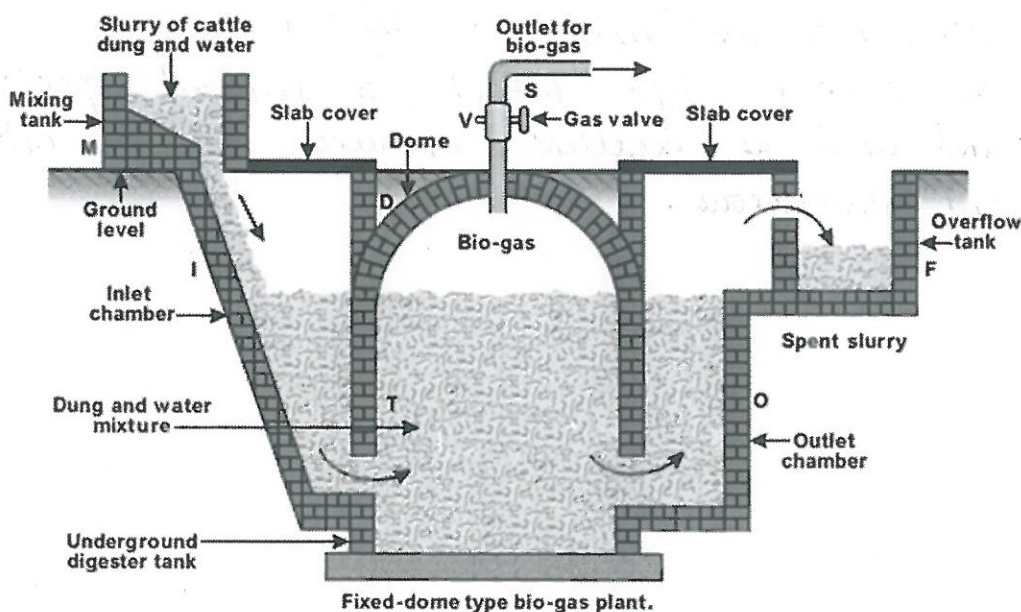
- (i) The dams can be constructed only in a limited number of places, like in hilly terrains.
- (ii) Large areas of agricultural land and human habitation are to be sacrificed as they get submerged.
- (iii) Large eco-systems are destroyed when submerged under the water in dams.
- (iv) Submerged vegetation gives rise to large amount of methane which is also a green-house gas.
- (v) It creates the problem of satisfactory rehabilitation of displaced people.

Improvements in the Technology for using Conventional Sources of Energy.

Bio-Mass is organic material that comes from plants and animals, and it is a renewable source of energy.

Bio-mass contains stored energy from the sun and it is renewable source of energy. When biomass is burned chemical energy in biomass is released as heat.

Bio-gas Plant



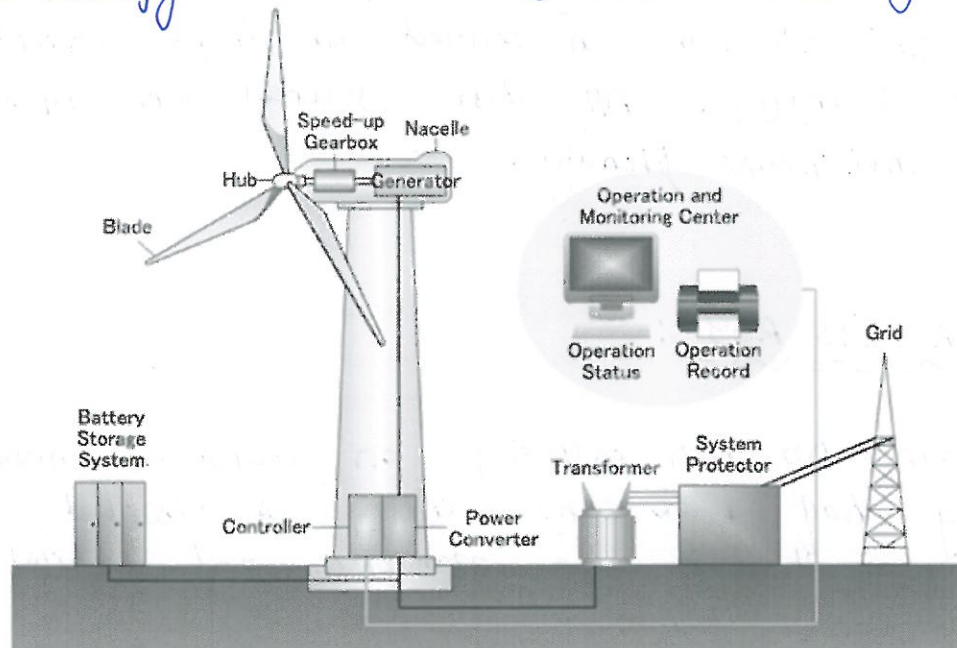
- (i) The bio-gas plant has a dome-like structure built with bricks.
- (ii) A slurry of cow-dung and water is made in the mixing tank from where it is fed into the digester.
- (iii) The digester is a sealed chamber in which there is no oxygen. Anaerobic micro-organisms that do not require oxygen decompose or break down complex compounds of the cow-dung slurry.
- (iv) It takes a few days for the decomposition process to be complete and generate gases like methane, CO_2 , H_2 and hydrogen sulphide.
- (v) The bio-gas is stored in the gas tank above the digester from which they are drawn through pipes for use.

Advantages of Bio-Gas :

- a) Bio-gas is an excellent fuel as it contains up to 75% methane.
- b) It burns without smoke, leaves no residue.
- c) Its heating capacity is high.
- d) Bio-gas is also used for lighting.
- e) The slurry left behind is removed periodically and used as excellent manure, rich in nitrogen and phosphorus.

WIND ENERGY

The K.E. of wind can be used to do work.
Wind energy is used to generate electricity.



To generate electricity, rotatory motion of the windmill is used to turn the turbine of the electric generator. Large number of windmills are erected over a large area, which is known as wind energy farm. The energy output of each windmill in a farm is coupled together to get electricity on a commercial scale.

Limitations in harnessing wind energy:

- (i) Wind farm can be established only in wind blowing areas of speed greater than 15 km/hr.
- (ii) There should be back-up facilities like storage cells in case there is no wind.
- (iii) Wind energy farms require large area of land.
- (iv) The initial cost of establishment is quite high.
- (v) Need high level of maintenance.



Alternative (OR) Non-Conventional Sources of Energy.

The energy derived from wind, tides, sun, geothermal heat and biomass is termed as non-conventional sources of energy. All these sources are renewable and environment friendly.

SOLAR ENERGY :

The Sun has been radiating an enormous amount of energy. Nearly half of the sun's energy is absorbed while passing through the atmosphere and the rest reaches the earth's surface.

A black surface absorbs more heat as compared to a white or a reflecting surface. Solar cookers and solar heaters use this property in their working.

Some solar cookers achieve a higher temperature by using mirrors to focus the rays of the sun. Solar cookers are covered with a glass plate (green house effect).

Q) What kind of mirror is used in a solar cooker?

Ans) A concave mirror would be best suited for use in solar cooker. It converges a large amount of Sun's heat radiation at its focus due to which a high temperature is produced around the focus area.

Advantages of using a solar cooker :

- (i) It cooks food without causing any kind of pollution.
- (ii) It is economical to use.
- (iii) It is easy to handle.
- (iv) The nutrients in the food do not get destroyed.

Disadvantages of using a solar cooker :

- (i) Solar cooker cannot be used at night and during cloudy weather.
- (ii) It takes more time to cook food.
- (iii) The direction to be changed continuously to face sun.
- (iv) It cannot be used for making chapatis and for frying purposes.

Solar Cell Panel :

A solar cell is a device which converts solar energy directly into electricity. A group of solar cells is called a solar cell panel. It consists of large number of solar cells joined together in a definite pattern.

It provides a lot of electric energy required by artificial satellites, water pumps, street lighting etc.

For joining the various solar cells in a solar panel, silver wires are used because silver metal is the best conductor of electricity.

Energy from Sea

(1) Tidal Energy

Due to gravitational pull of moon on the spinning earth, the level of water in the sea rises and falls which is called high and low tides and difference in sea-levels give us tidal energy.

Tidal energy is harnessed by constructing a dam across a narrow opening to the sea. A turbine fixed at the opening of the dam converts tidal energy to electricity.

(2) Wave Energy

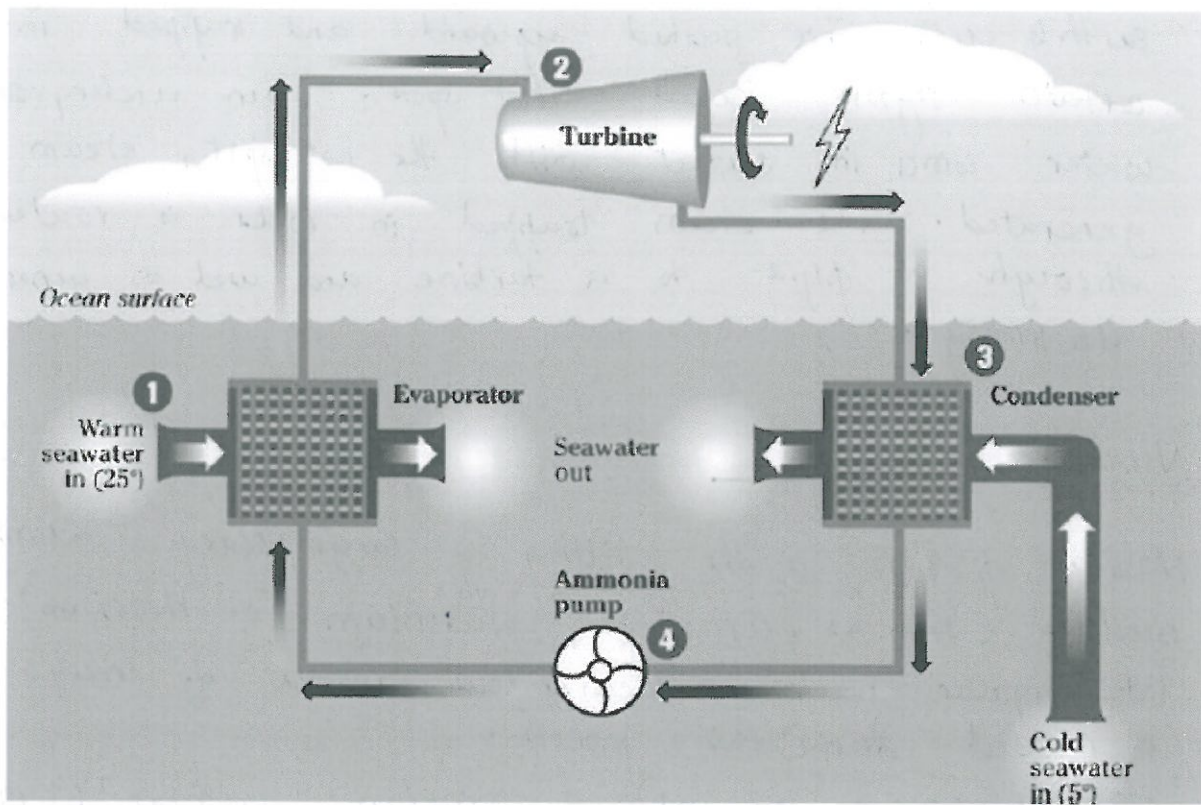
Wave power is produced by the up and down motion of floating devices placed on the surface of the ocean.

Wind produces waves, and then waves produce energy. As the waves travel across the ocean, high-tech devices capture the natural movements of ocean currents and the flow of swells to generate power.

(3) Ocean Thermal Energy

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(3) Ocean Thermal Energy:



The difference in temperature at the surface of sea or ocean and water at depths up to 2 km is exploited to obtain energy in ocean-thermal-energy.

- (1) The warm surface-water is used to boil a volatile liquid like ammonia.
- (2) The vapour of liquid are then used to run the turbine of generator.
- (3) The cold water from the depth of the ocean is pumped up and condense vapour again to liquid.

Geothermal Energy

Molten rocks formed in the deeper hot regions of earth's crust are pushed upward and trapped in certain regions called 'hot spots'. When underground water comes in contact with the hot spot, steam is generated. The steam trapped in rocks is routed through a pipe to a turbine and used to generate electricity.

Nuclear Energy

Nuclear fission is the splitting of large/heavy atomic nucleus (such as uranium, plutonium or thorium) into smaller nuclei. A tremendous amount of energy is released during this process.

The fission of an atom of uranium, produces 10 million times the energy produced by the combustion of an atom of carbon from coal.

In a nuclear reactor a low energy neutron is bombarded into a nucleus of uranium to cause uranium nucleus to split into lighter nuclei called daughter nuclei and this is a chain reaction.

The released energy can be used to produce steam and further generate electricity.

- Advantages :
- (1) It produces huge amount of energy.
 - (2) It does not produce gas like CO_2 or SO_2 .
No greenhouse effect.
 - (3) The nuclear power plant can go on producing electricity for two to three years at a stretch.
No need to put nuclear fuel again and again.

Environmental Consequences.

Q) What are the environmental consequences of the increasing demand for energy? What steps would you suggest to reduce energy consumption?

- Ans) (i) Burning of fossil fuels to meet the increasing demand for energy causes air pollution.
- (ii) Construction of dams on rivers to generate hydro-electricity destroys large ecosystems which get submerged under water in the dams. Further, large amount of methane (which is greenhouse gas) is produced when submerged vegetation rots under anaerobic conditions.

In order to reduce energy consumption:

- (i) Fossil fuels should be used with care and caution to derive maximum benefit out of them.
- (ii) Fuel saving devices such as pressure cooker etc should be used.
- (iii) Efficiency of energy sources should be maintained by getting them regularly serviced.
- (iv) And last of all, we should be economical in our energy consumption as energy saved is energy produced.

Q) What are the environmental consequences of using fossil fuels? Suggest the steps to minimise the pollution caused by various sources of energy including non-conventional sources of energy.

- Ans) (i) Air pollution: Burning of fossil fuels releases oxides and sulphides in the air and many other harmful gases like carbon monoxide, sulphur dioxide etc.

These cause various health problems and also lead to acid rain which further affects water and soil resources.

(ii) Greenhouse effect: On burning fossil fuels, a large amount of carbon dioxide is released into atmosphere. This is a greenhouse gas and does not allow the sun rays reflected from the earth surface to escape into the atmosphere. Thus, increasing the temperature of the atmosphere. This is called greenhouse effect which results in global warming.

Following steps can be taken to minimize pollution:

(i) Use of smokeless appliances.

(ii) Use of refined technology to increase the efficiency of combustion process and to reduce escape of harmful gases into the atmosphere.

(iii) Judicious use of energy.

How long will an energy source last us?

Non-renewable sources of energy:

Sources of energy that will get depleted some day are said to be exhaustible or non-renewable sources of energy. Example, fossil fuels.

Renewable sources of energy:

Energy sources that can be regenerated and can be used again and again are called renewable sources of energy. Example, Bio-mass

QUESTIONS

(1) Why are we looking at alternate sources of energy?

Ans) We are looking at alternate sources of energy because:

- (i) the fossil fuel reserves in the earth are limited which may get exhausted soon, if continued to be used at the current rate.
- (ii) the use of alternate sources of energy will reduce the pressure on fossil fuels making them last for a much longer time.
- (iii) the pollution being caused by burning of fossil fuels can be avoided by using alternate sources of energy.

(2) How has the traditional use of wind and water energy been modified for our convenience?

Ans) The traditional use of wind has been modified by using windmills and that of water by constructing hydroelectric power plants.

(3) What are the limitations of energy that can be obtained from the oceans?

- Ans)
- (i) Tidal energy is not likely to be a potential source of energy in the future because there are very few sites around the world which are suitable for building tidal dams.
 - (ii) Wave energy would be a viable proposition only where waves are very strong.
 - (iii) The energy potential from sea is quite large, but efficient commercial exploitation is difficult.

(4) Can any source of energy be pollution-free? Why or why not?

Ans) NO. any source of energy cannot be pollution free. Exploring any source of energy disturbs the environment in some or the other way. Only the degree and manner of pollution varies. In some cases, the actual operation of device like solar cell may be pollution free, but the assembly of the device could have caused some environmental damage.

(5) Hydrogen has been used as a rocket-fuel. Would you consider it a cleaner fuel than CNG? Why or why not?

Ans) Hydrogen is a cleaner fuel than CNG because the burning of hydrogen produces only water, which is completely harmless. The burning of CNG produces carbon dioxide and water.

(6) Compare and contrast fossil fuels and Sun as direct sources of Energy.

Fossil Fuels	Sun (Solar Energy)
(i) Fossil fuels are limited	(i) Solar energy is unlimited
(ii) Fossil fuels cause pollution	(ii) Pollution free
(iii) Can provide energy at any required time	(iii) becomes <u>unavailable</u> when sky is covered with clouds or during nights.

(7) Compare and contrast biomass and hydroelectricity as sources of energy.

Bio-Mass	Hydroelectricity
(i) Bio-mass is renewable only if trees are planted.	(i) Not the case with this
(ii) Energy can be obtained using a chulha or a gobar gas plant.	(ii) Requires construction of dams on rivers.
(iii) Pollution free only when converted into bio-gas	(iii) Pollution free.

(8) Name the main constituent of bio-gas.

Ans) Methane (75%)

(9) Give the names of two energy sources that you would consider to be exhaustible. Give reason.

Ans) Refr to note.

(10) Name two energy sources that you consider renewable. Give reason.

Ans) Refr to note.

(11) What are the limitations of extracting energy from
(i) wind (ii) waves (iii) tides

Refr to note.