5 More about Energy

You already have a fair idea about energy, its forms and sources. In this chapter, we will study the sources of energy in some detail. However, let us first recall what you know already.

Energy is the ability to do work. The SI unit of energy is the same as the unit of work, i.e., the joule (J). Energy and work are closely related. Energy can be converted into work, and work can be converted into energy. For example, electrical energy can be converted into the work involved in rotating the blades of a fan or a food processor. And the work done in compressing the spring of a wind-up toy is stored in it as potential energy.

(a) (b)

Fig. 5.1 (a) Electrical energy is converted into the work of rotating the blades of a food processor. (b) The work done in compressing the spring of a wind-up toy is stored in it as potential energy.

Energy can exist in many forms, and one form of energy can change into another form. This is very useful for us. For example, we can use the chemical energy stored in batteries because it can be converted into electrical energy, which can then be converted into light, sound, the kinetic energy of the moving parts of appliances, and so on. In fact, if you look around you, you will notice that the utilisation of energy always involves energy transformations, or the change of one form of energy into another.

For us, the most useful form of energy is electrical energy. Hence, we usually convert other forms of energy into electrical energy. The main advantages of using electrical energy are as follows.

1. It can be converted easily into other forms of energy.

2. It can be transported easily.
3. It does not cause pollution (though the generation of electricity may).

SOURCES OF ENERGY

Right from the time when man first learnt how to light a fire, progress has been driven by the utilisation of energy. From meeting all his need for energy by burning firewood, to harnessing the energy of wind and water, to tapping fossil fuels and generating electricity, man has come a long way in making use of energy resources. Let us now discuss the sources of energy available to us in some detail.

Our present sources of energy can be divided into two broad groups—renewable and nonrenewable. Renewable sources are those which can be replaced by natural processes. There is no risk of exhausting our supply of these sources. Nonrenewable sources are those which cannot be replaced easily by natural processes. We are likely to run out of these in less than 200 years if we use them at the rate at which we are right now.

Fig. 5.2 The utilisation of energy usually involves energy transformations. In a motorcycle, for example, the chemical energy of fuel changes to heat energy, which changes to the kinetic energy of the vehicle.

Nonrenewable Sources of Energy

Coal, petroleum and natural gas, together called fossil fuels, are at present our chief source of energy. They meet about 85% of the world's energy requirement and generate about two thirds of the electricity we use. Any substance that produces usable energy is called a fuel. Most fuels produce energy when they are burnt. Nuclear fuels, which we will discuss later, are an exception. Fossils are the remains of plants and animals preserved between layers of rock. Coal, petroleum and natural gas are called fossil fuels because they were formed from the remains of plants and animals buried millions of years ago. Our present supply of these fuels took millions of years to form. Hence, if we use them up, we will have nothing left.

Nuclear fuels are minerals. Since our supply of minerals is also not endless, most people consider nuclear energy to be a nonrenewable source of energy.

Coal

Plants that died a long time ago and were buried under swampy land formed coal. Over time, these plant remains got buried deeper and deeper. The action of bacteria and the pressure of layers of rocks and soil slowly converted the carbohydrates present in the plants into almost pure carbon. The process of conversion of plant remains into coal is called carbonisation. As you have learnt in your chemistry lessons, the lowest grade of coal is peat, while the highest grade of coal is anthracite.

Coal is used as a fuel and in the production of coke and coal gas, besides other things. A large portion of the coal produced the world over is used for the generation of electricity in thermal power stations. In a thermal power station, fossil fuels are used to produce steam, which is then used to turn turbines and generate electricity.

Fig. 5.3 In a thermal power station, fossil fuels are burnt to produce steam, which is used to generate electricity.

Petroleum and natural gas

These fuels are often found together. They were formed by the decomposition of marine organisms that died and settled on the sea bed and were later buried under layers of mud (sediments). Petroleum or crude oil is usually found trapped above a layer of impervious (nonporous) rock and is extracted by drilling a well through rocks. When oil is 'struck', or found, it is pumped out and refined, or processed.

Natural gas is mostly found trapped above crude oil. One advantage of natural gas is that it can be piped or supplied directly from an oil field. The other advantage is that it causes far less pollution than the other fossil fuels. It is therefore called a 'clean' fuel and is used extensively to run public transport in some places.

Fig. 5.4 Compressed natural gas (CNG) is used to run public transport to reduce pollution.

Petroleum is a mixture of hydrocarbons (compounds of hydrogen and carbon) with different boiling points. The refining of petroleum consists of separating the components of this mixture. In a refinery, crude oil is heated to about 400°C, and the vapour is then fed into a cooling tower. The tower is fitted with shelves at different levels. As the vapour climbs up the tower, it cools, and the different components condense at different levels, in order of decreasing boiling point. The gas that remains uncondensed is called petroleum gas. Liquid petroleum gas (LPG) is used widely as a cooking fuel. The other fuels derived from petroleum are petrol, kerosene, diesel and fuel oil.

Disadvantages of fossil fuels

The disadvantages of fossil fuels are that they are nonrenewable and cause pollution. The extraction, processing and use of fossil fuels pollute soil, water and air. We will only discuss air pollution caused by the burning of fossil fuels.

1. Fossil fuels contain carbon, so on burning, they produce carbon dioxide. Carbon dioxide traps heat. Scientists believe that the excessive use of fossil fuels has led to an increase in the amount of carbon dioxide in the air, and hence an increase in temperature the world over. This is called global warming. It is feared that global warming may lead to the melting of the polar ice caps, and drastic changes in climate patterns.

2. The burning of fossil fuels produces carbon monoxide when the supply of air is insufficient. Carbon monoxide is a poisonous gas that can cause suffocation, and even death.
3. The carbon and sulphur present in fossil fuels (especially coal) are converted into oxides when these fuels are burnt. The presence of oxides of sulphur and nitrogen in the air causes respiratory diseases. When these oxides dissolve in rain, they form acids, which come down as acid rain. Acid rain harms plants, pollutes the soil and causes corrosion of metals and stones. The Taj Mahal is one of the many monuments that are threatened by acid rain.

Fig. 5.5 The harmful emissions from vehicles increase if they are not maintained properly.

4. Unburnt carbon particles called soot and ash released into the air by the burning of fossil fuels cause respiratory diseases.

The concern over the pollution caused by fossil fuels and the shortage of these fuels has led to a worldwide movement to tap alternative sources of energy. Another step being taken to reduce pollution is to switch to cleaner fuels like CNG, LPG and unleaded petrol. Lead used to be added to petrol to prevent what is called knocking, or thumping in engines. However, it is very poisonous, so it is being replaced by other substances in most countries. Vehicles are also being designed to reduce emissions that cause pollution. Some cars, for example, have catalytic converters that convert harmful gases into carbon dioxide, nitrogen and water. Vehicles that run partially or entirely on electricity (produced by cells) are also gaining popularity.

Fig. 5.6 Electric scooter

Nuclear energy

There are two ways by which energy can be derived from the nuclei of atoms. Either a heavy nucleus can be made to split into two lighter nuclei or two light nuclei can be made to join up and form a heavier nucleus. The first process is called nuclear fission, while the second is called nuclear fusion.

The protons and neutrons that make up the nucleus of an atom are normally bound together by forces called nuclear forces. This makes the nucleus very stable and does not allow it to split. However, the nuclei of some heavy elements, such as uranium, can be made to split. One way of doing this is to bombard such nuclei with neutrons. When a uranium nucleus absorbs a neutron, it splits into two lighter nuclei. Two or three neutrons and a large amount of energy are released in this nuclear reaction.

The neutrons released by the fission of one uranium nucleus are absorbed by other uranium nuclei, which also split, releasing more neutrons and energy. This way, the fission of one uranium

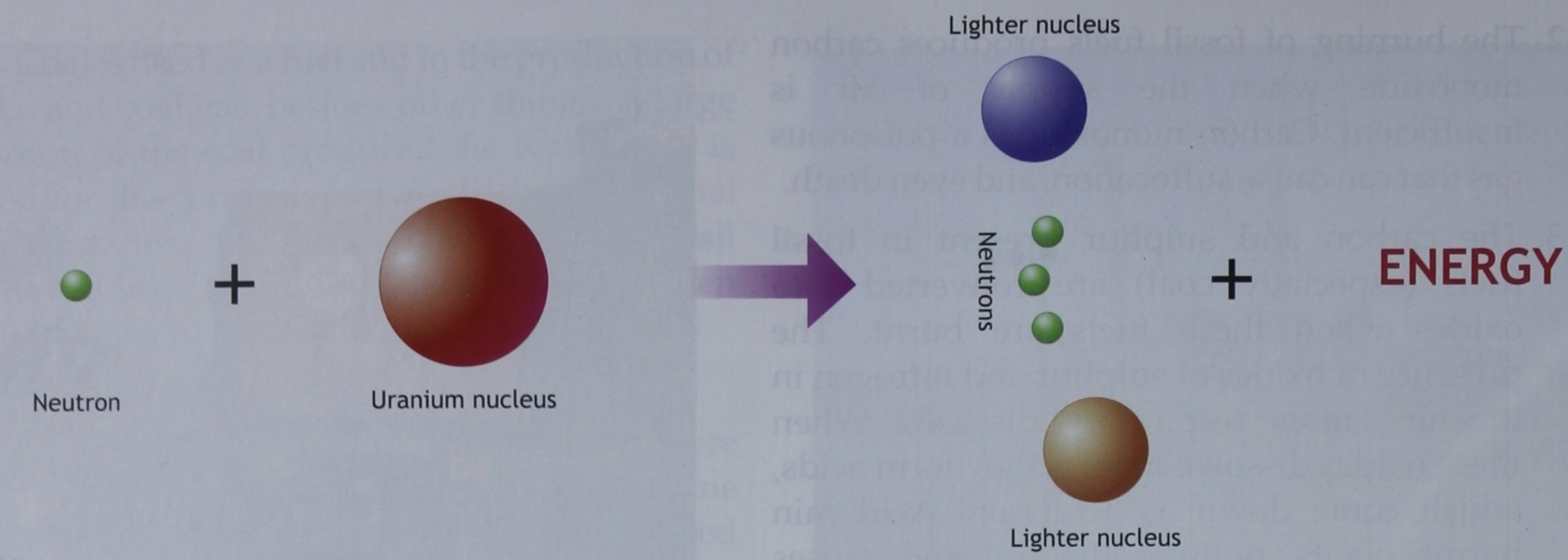


Fig. 5.7 After absorbing a neutron, the uranium nucleus splits into two lighter nuclei.

nucleus leads to the fission of more and more nuclei, setting up what is called a chain reaction. The chain reaction leads to the release of a huge amount of energy in a very short time and causes an enormous explosion. This, in principle, is how an atom bomb works.

In a nuclear reactor, the fission of uranium takes place in a more controlled manner so that an explosion does not occur. Figure 5.8 is a representation of a nuclear power plant. Notice that the nuclear reactor has rods of fuel (uranium) interspersed with control rods. These control rods are made of a material that can absorb neutrons, and thus, slow down the chain reaction. The energy released by the nuclear reaction in a reactor is used to produce steam, which is used to generate electricity.

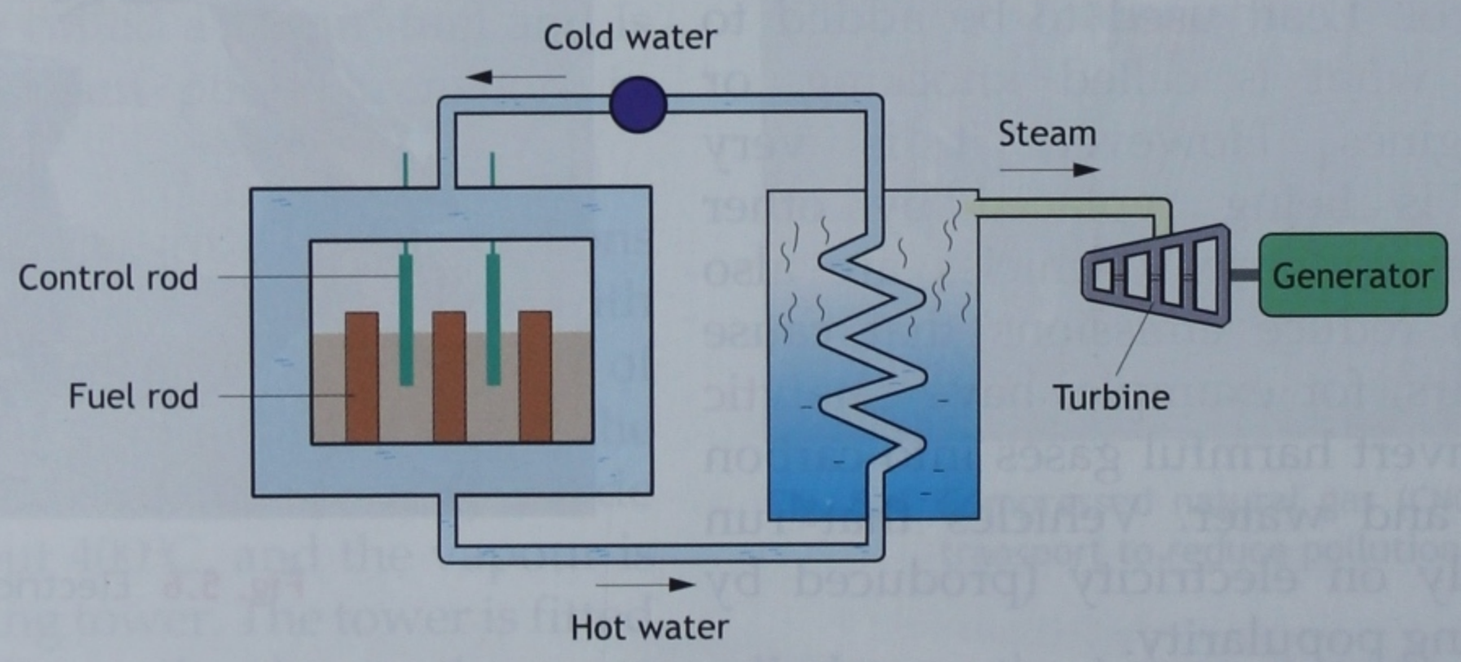


Fig. 5.8 The heat produced by controlled fission is used to produce steam in a nuclear power plant.

Nuclear fusion The source of the sun's energy is nuclear fusion. You know that the sun is made up mostly of hydrogen. At the core of the sun, hydrogen nuclei fuse, or join together, to form helium nuclei. Four hydrogen nuclei are needed to form one helium nucleus. A huge amount of energy is released during this nuclear reaction.

If we could trap the sun's source of energy, we would have a perfect solution to the energy crisis that the world is facing. Hydrogen is abundantly available in the form of water. However, the problem lies in inducing hydrogen nuclei to come together. This can happen at very high temperatures or under some other special conditions. Though we have managed to produce these conditions in the laboratory and succeeded in using fusion to make the hydrogen bomb, we have not yet managed to tap fusion for the generation of electricity.

Disadvantages of nuclear energy One of the disadvantages of nuclear energy is that it is expensive. It takes a lot of money to set up a nuclear reactor. Besides, it takes a long time for a nuclear power station to become fully operational. The other and graver problem is that nuclear reactors generate nuclear waste, which emit dangerous radiation. This radiation can cause various diseases, including cancer. It can also cause alterations in the genes, so that children born of parents exposed to the radiations can suffer from diseases and deformities. Besides, any accident in a nuclear reactor can have disastrous consequences. This happened, for example, in Chernobyl (Ukraine), in 1986. There was an explosion in the reactor, which affected countries all over Europe and parts of North America.

India has nuclear power plants in Narora (Uttar Pradesh), Tarapur (Maharashtra), Kalpakkam (Tamil Nadu), Rana Pratap Sagar (Rajasthan), Kakrapar (Gujarat) and Kaiga (Karnataka). It generates about 3360 MW of nuclear power, which is about 3% of the total power generated in the country.

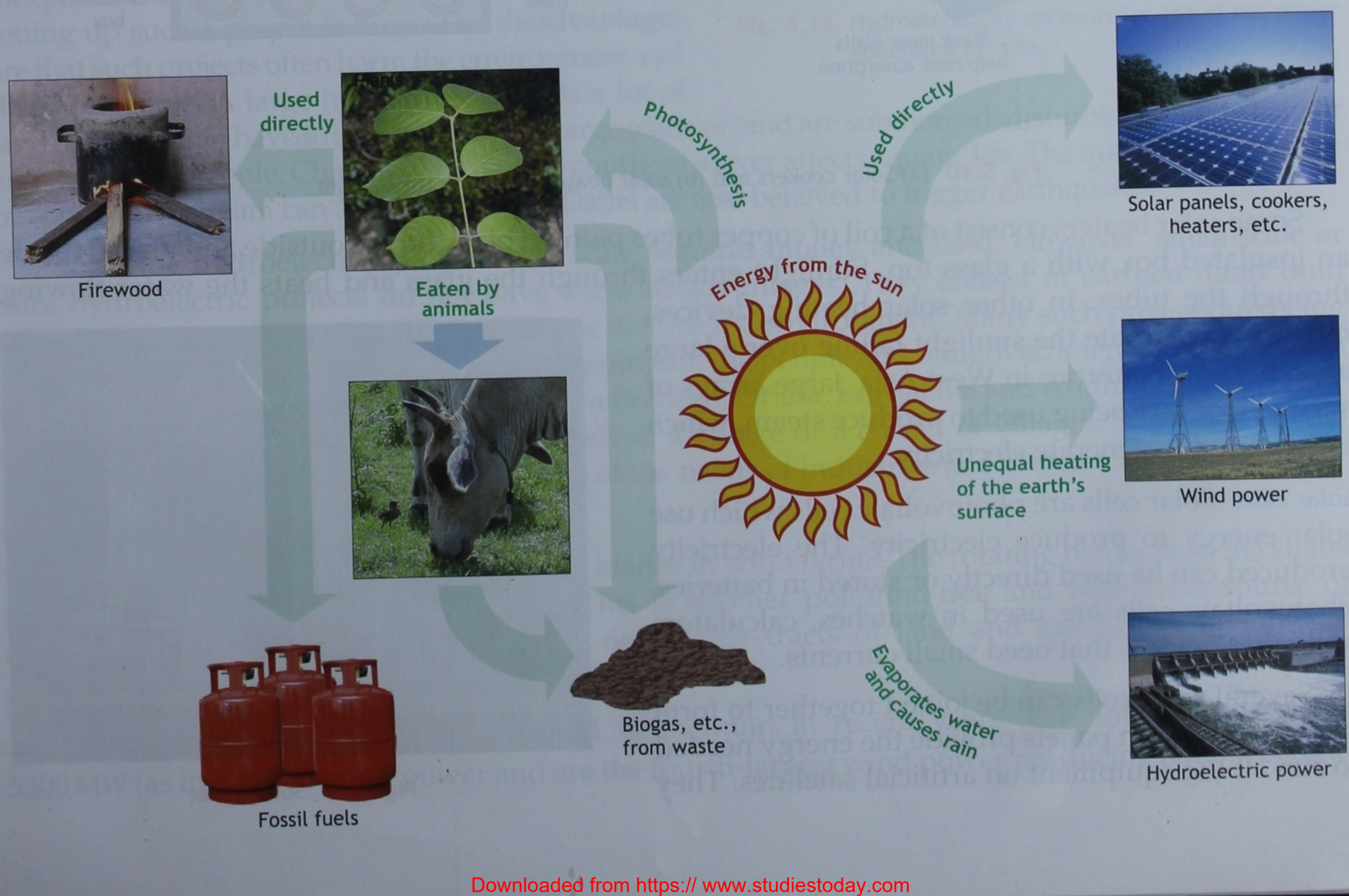
Renewable Sources of Energy

The sun is our primary source of energy (Figure 5.9). Solar energy is renewable, as long as the sun shines. So are most of the other sources of energy derived from it, except fossil fuels. Nuclear energy, which we have discussed, and geothermal energy are two sources of energy that are not derived from the sun.

Solar energy

The heat of the sun has been used to dry clothes and preserve food for centuries. Now we make better use of it in cooking and heating devices. We also use solar energy to generate electricity. Besides, most of our energy sources are derived from solar energy. The energy stored in fossil fuels comes from the

Fig. 5.9 The sun is our primary source of energy.



carbohydrates stored in the bodies of organisms that died long ago. Carbohydrates, as you know, are manufactured by green plants and algae with the help of solar energy. The energy from firewood and plant and animal waste is also derived from photosynthesis. As for wind energy, winds are caused by differences in the surface temperature due to the differential heating of the earth's surface. Even hydroelectricity is derived from solar energy. The heat of the sun evaporates water and causes rain, which renews the supply of water in the reservoirs that store water for the generation of hydroelectricity.

Solar heating devices The amount of solar energy falling on the earth in a day is many times more than the amount of energy we need in a year. The problem is that this energy is diffused or spread out over a large area. What solar heating devices do is concentrate the energy of the sun.

A solar cooker is essentially an insulated box with a glass top. The box and the cooking containers placed inside it are painted black to ensure maximum absorption of heat. Sunlight enters through the glass top, which also reflects the heat radiated from the box back into the box. A plane mirror attached to the top of the box improves the efficiency of the cooker by reflecting sunlight on to it.

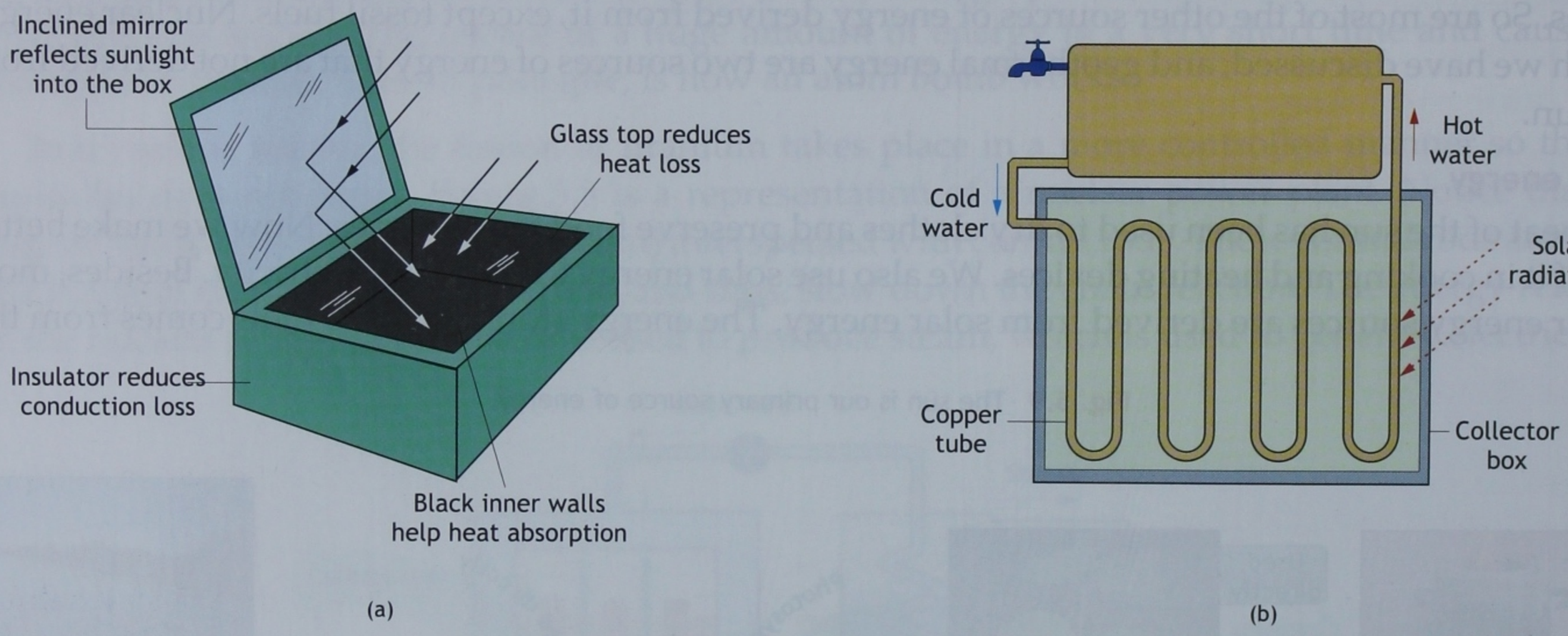


Fig. 5.10 (a) Solar cookers and (b) solar heaters concentrate sunlight.

Some solar heaters consist of a coil of copper tubes painted black on the outside and placed inside an insulated box with a glass top. Sunlight enters through the glass and heats the water flowing through the tubes. In other solar heating devices, mirrors concentrate the sunlight falling over a large area. In some countries in West Asia, large arrays of such mirrors are being used to produce steam, which is then used to generate electricity.

Solar cells Solar cells are photovoltaic cells which use solar energy to produce electricity. The electricity produced can be used directly or stored in batteries. Photovoltaic cells are used in watches, calculators and other devices that need small currents.

Several solar cells can be joined together to form solar panels. Such panels provide the energy needed to run all the equipment on artificial satellites. They

Fig. 5.11 Solar panel

are also used to provide energy in remote areas which do not have access to other sources of energy. The reason why they have not yet become a popular source of energy is their cost. However, efforts are on to make them less expensive, and the rising cost of fossil fuels and the dangers of pollution are making more people opt for solar energy. Offices, hotels, community centres and other large establishments are beginning to meet at least a part of their energy needs with the help of rooftop solar panels. Of course, solar energy can be used only in places which get a lot of sunlight throughout the year.

Hydroelectric power

Electricity produced by making use of the energy of flowing water is called hydroelectricity or hydroelectric power. In a large-scale hydroelectric project, a dam is built across a river at a height. The potential energy of this water stored at a height is used to turn turbines connected to generators which produce electricity.

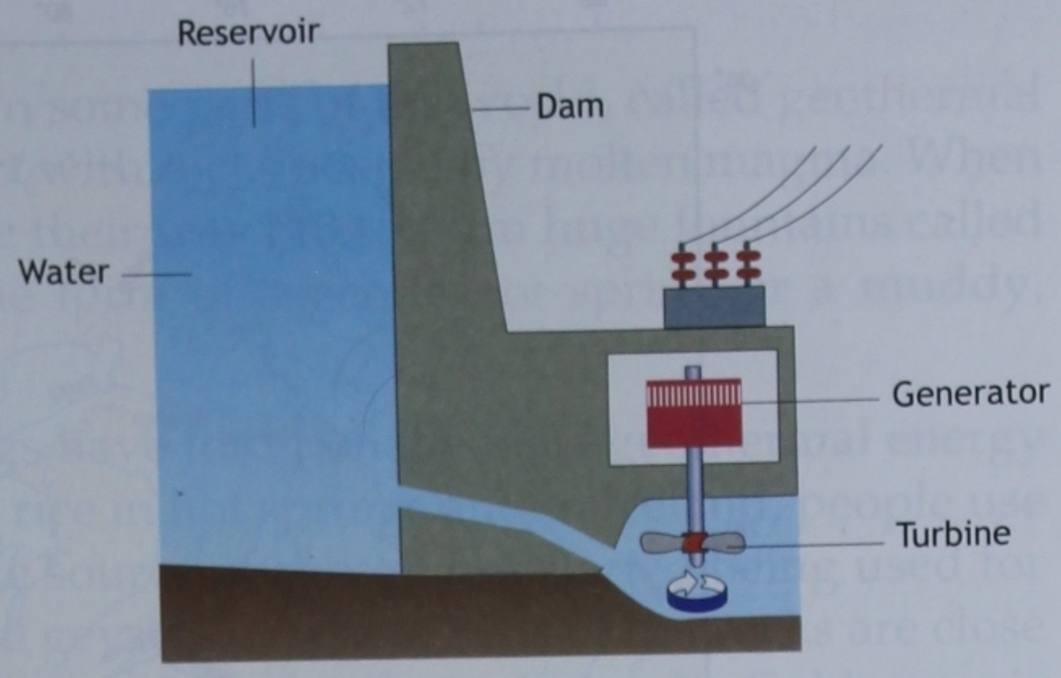


Fig. 5.12 The potential energy of water stored at a height is used in hydroelectric power plants.

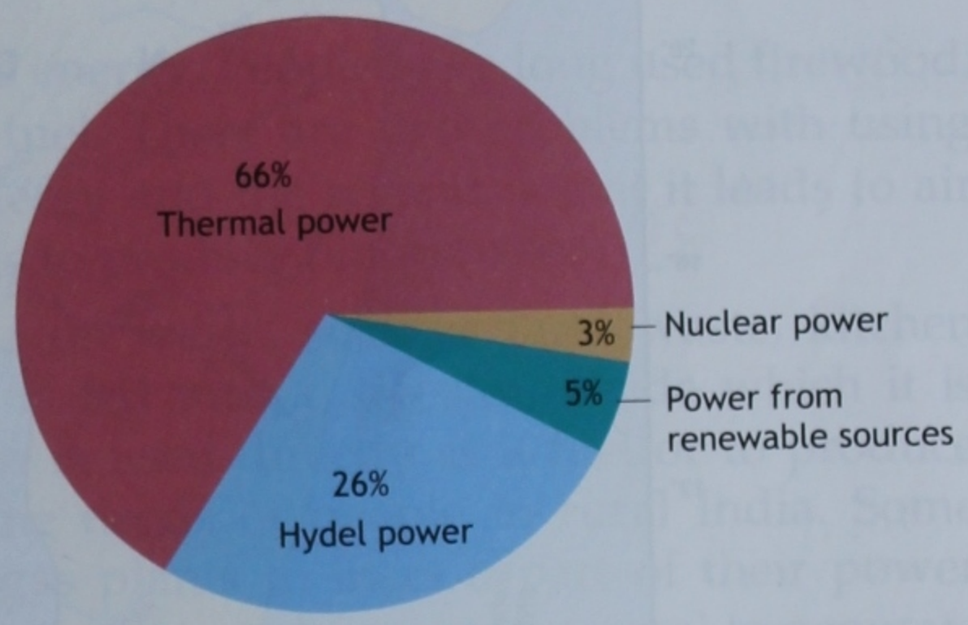


Fig. 5.13 Hydroelectricity accounts for 26% of the power generated in India.

The advantages of using this source of energy is that it is renewable, pollution-free and comparatively inexpensive in the long run, though the initial cost of setting up such a project is huge. The disadvantages are that such projects often harm the environment and displace people. A large hydel project needs a lot of land. Forests often have to be cut down and large tracts of land are submerged, disturbing wildlife habitat and displacing people. Changing the natural course of a river affects aquatic life. The quality and quantity of water downstream can also get affected. Dams are also believed to trigger earthquakes.

Producing hydroelectricity on a large scale requires money and land. However, small-scale or mini hydroelectric projects do not have these disadvantages. They consist of earthen dams built across ravines and natural slopes and do not disturb the environment. Many such projects are being undertaken with the cooperation of the government, the people and nongovernmental organisations (NGOs) in the states of Maharashtra, Madhya Pradesh, Orissa, Karnataka and Andhra Pradesh. They produce enough electricity to meet the needs of a village or a cluster of villages. Some mini hydel projects are also being set up to meet a part of the needs of industries and towns.

Wind power

The energy of the wind is used to turn huge blades in wind farms. The rotating blades turn the shafts of generators which produce electricity. This is another pollution-free and renewable source of energy. The problem is that wind farms need large tracts of land and can be set up only in permanently windy places, such as coastal areas.

The Indian wind initiative has gained momentum in recent years. We now generate over 5300 MW (as in 2008) of wind power and are the fourth-largest wind power producing nation, behind

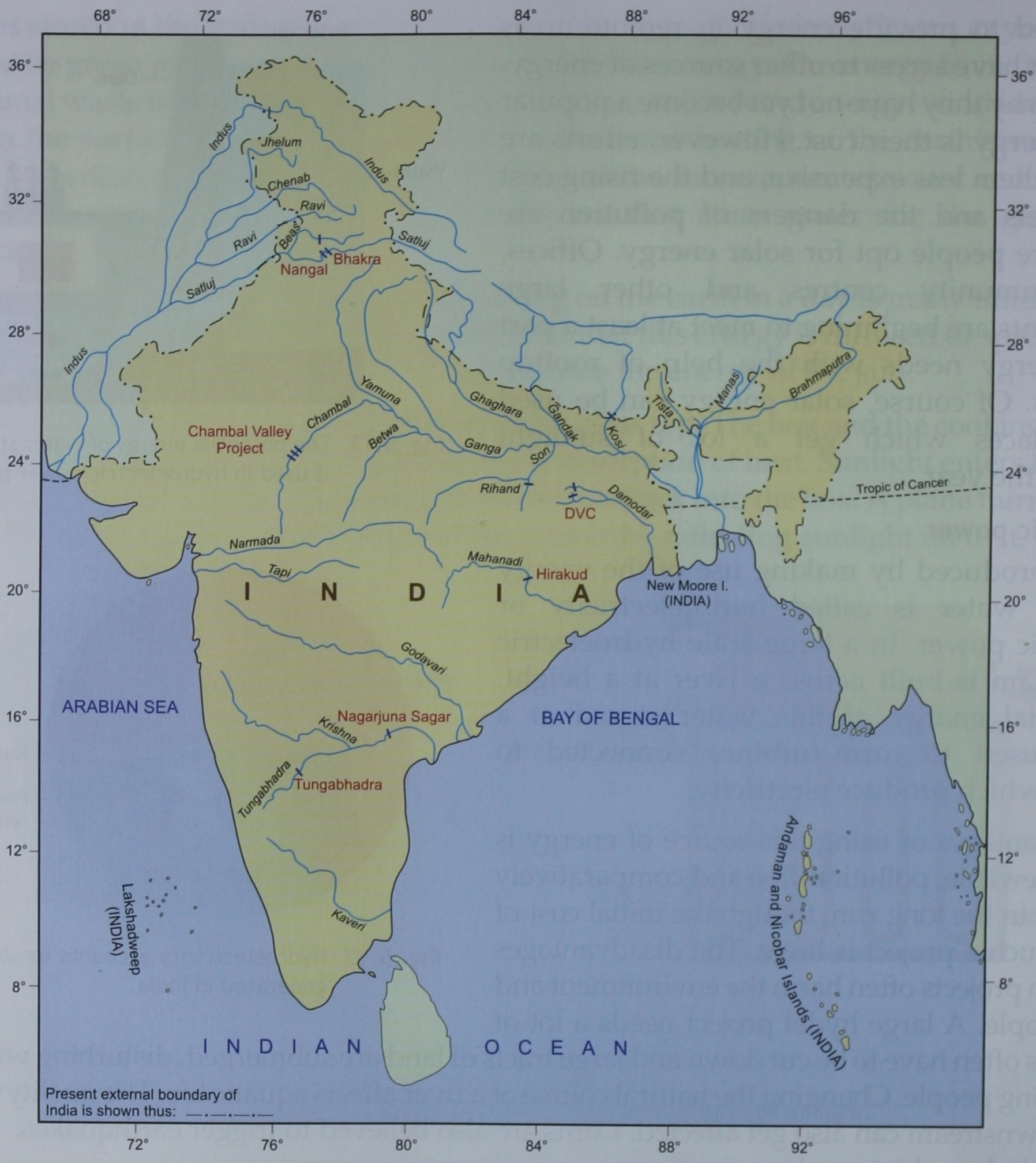


Fig. 5.14 Some hydroelectric projects in India

Germany, Spain and the US. Within India, Tamil Nadu is the leading wind power producer. Some other states with large wind energy projects are Gujarat, Maharashtra, Andhra Pradesh and Karnataka. Many government-owned and privately run establishments are now investing in wind farms to meet at least a part of their energy requirements. The Integral Coach Factory in Chennai, for example, is planning to meet most of its energy requirement with the help of a 10-MW wind farm.

Fig. 5.15 Wind farm

Geothermal energy

The heat inside the earth is called geothermal energy. In some parts of the world, called geothermal hotspots, groundwater 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 or a muddy, bubbling slush.

People living near hot springs or visiting hot springs have traditionally used geothermal energy for cooking. At Yamunotri, for example, pilgrims cook rice in hot springs and in Iceland, people use hot springs to do their baking. Recently, this renewable source of energy has started being used for heating and generating electricity in places with natural geysers or where beds of hot rocks are close enough to the surface. In places with hot rocks, two shafts are drilled to the bed of rocks. Cold water is pumped in through one shaft and hot water and steam taken out through the other. Iceland, New Zealand and the USA are leading the world in the utilisation of geothermal energy.

Biomass energy

Energy derived from plants and animals is called biomass energy. People have long used firewood, dry leaves and twigs, farm waste and animal dung as fuel. There are two problems with using biomass directly as fuel. One is that it wastes a lot of energy and the second is that it leads to air pollution. A more sensible way of using biomass energy is to produce biogas.

Biogas This is a fuel produced by the action of bacteria on waste, such as farm waste, kitchen waste, sewage and animal excreta. The waste material is fed into a digester, inside which it is decomposed by bacteria. The gas released in the process is used directly as a fuel or to produce electricity. Biogas is increasingly being used to meet the needs of people in rural India. Some industries, such as sugar mills, are also setting up biogas plants to meet a part of their power requirement. Sugar mills use bagasse (waste left after juice is extracted from sugar cane) to generate biogas. The residue left after biogas is produced from waste, called slurry, can be used as manure.

Biofuel This is the name used for fuel extracted from plants and algae. Among the plants used widely for the production of biofuel are corn, palm and sugar cane. However, this has led to a worldwide controversy, since biofuel plants are being cultivated in the place of food plants, which may ultimately lead to a food crisis. In India, the plant cultivated for biofuel is *Jatropha*, a very hardy plant that thrives on dry, infertile land. Hence, at the moment, it is not competing with food plants. On the other hand, it is bringing income to the rural poor who do not have agricultural land.

Fig. 5.16 Biogas holder in a sewage treatment plant

Fig. 5.17 *Jatropha* seedlings

Hydrogen fuel

Hydrogen is often referred to as 'future fuel'. It is present all around us—in water, in waste, in almost everything. The most attractive thing about using hydrogen as a fuel is that it is pollution-free. The only thing it produces on burning is water. There are two major problems with using hydrogen. One is the difficulty in separating it from the compounds in which it is present. The other is the fact that it can cause explosions, and hence, must be stored with care. However, efforts are on to produce vehicles that are powered by hydrogen fuel cells.

Tidal energy

Tides can also be used to generate electricity. In a tidal power plant, water accumulates behind a dam at high tide and this is then used to generate electricity, as in a hydroelectric plant. France is one of the countries that has tapped this source with success. India is setting up a tidal energy project in the Sunderbans and is exploring possibilities in Gujarat.

Table 5.1 Energy sources, their advantages and disadvantages

Energy source	Advantages	Disadvantages
Fossil fuels	1. Convenient for the production of energy on a large scale	1. Not renewable
	2. Can be carried from the place of production to wherever needed	2. Cause pollution
Hydel power	1. Renewable, low cost once set up	1. Large-scale projects are expensive and need land
	2. Can be used to generate electricity on a large scale as well as on a small scale	2. Large dams can disturb environmental balance and displace people
	3. Does not cause pollution	3. Can be generated only where rivers flow down the slopes of hills
Solar energy	1. Renewable	1. Can be used only when the sun shines
	2. Does not cause pollution	2. Solar cells produce small currents, and solar panels are expensive
	3. Heating and cooking devices are quite cheap	
Wind energy	1. Renewable	1. Can be used only in places which are windy
	2. Does not cause pollution	2. Large areas are needed to produce energy on a large scale
Geothermal energy	1. Renewable	1. Can be used only where there are natural geysers or beds of hot rocks close to the surface
	2. Does not cause pollution	
Biomass energy	1. Renewable	1. Has not yet been used to produce energy on a large scale
	2. Inexpensive	2. Cultivation of biofuels is controversial
	3. Does not cause much pollution	
Nuclear energy	1. Very small amount produces a large amount of energy	1. Comparatively expensive
	2. Can be used to produce energy on a large scale	2. Produces dangerous wastes and radiation

MANAGEMENT OF ENERGY

The major problem that the world is facing right now is how to cut down the consumption of fossil fuels without slowing down development. Transport, industries and power generation are still heavily dependent on fossil fuels. And fossil fuels, as you know, are nonrenewable and cause pollution. Thus, governments, scientists and technologists are trying very hard to find ways of utilising renewable sources of energy and reducing wasteful consumption of fossil fuels. Let us see what steps we (as individuals) can take to help conserve energy.

1. The first step, obviously, is to stop wasting energy. Using fans, lights, geysers, coolers and other electrical devices only when necessary can save energy. We can make use of sunlight for working during the day and design houses and offices so that they are naturally ventilated.
2. Forming car pools and using public transport can save fossil fuels. Walking or cycling to cover short distances is also a good idea.
3. The proper maintenance of vehicles and machines not only saves fuel but also reduces pollution.
4. One can choose to use vehicles and appliances that are energy-efficient and cause less pollution. For example, one can choose to use tubelights and CFLs instead of electric bulbs. In fact there is a movement all over the world to phase out electric bulbs. Similarly, one can choose to buy products from manufacturers who are taking energy conservation measures.
5. Reducing wastage of cooking fuel is another way of saving energy. Using a vessel that is large enough to cover the flame saves fuel, so does covering cooking vessels and using pressure cookers. Scientists of the Department of Nonconventional Energy sources have designed an improved *chulha* for the rural and urban poor. It burns fuel more efficiently and has a chimney that takes smoke out of the kitchen.
6. Everything from the pumping and purification of water to the manufacture of things we use every day requires energy. We could help save energy by not wasting, and reusing and recycling things.

(a) (b)

Fig. 5.18 (a) Pressure cookers save fuel. (b) CFLs save electricity.

POINTS TO REMEMBER

- Energy is the ability to do work. The SI unit of energy is the joule (J). Energy can be converted into work and work can be converted into energy.
- Energy exists in many forms. One form of energy can change into another form. The utilisation of energy usually involves energy transformations. For us, the most convenient form of energy is electrical energy, so we convert the energy derived from various sources into electrical energy.
- Our sources of energy can be classified into renewable and nonrenewable. Renewable sources can be replaced easily by natural processes. Nonrenewable sources cannot be replaced easily by natural processes.
- Coal, petroleum and natural gas, formed from the decomposition of plants and animals that died millions of years ago, are called fossil fuels. Fossil fuels are nonrenewable and cause pollution.
- The splitting of a heavy nucleus into two lighter nuclei is called nuclear fisson. In a nuclear power station, the heat generated by controlled fission is used to generate electricity.
- The joining together of two or more light nuclei to form a heavier nucleus is called nuclear fusion. Nuclear fusion is the source of the sun's energy. It has not yet been used to generate power.
- The sun is our primary source of energy. All our sources of energy except nuclear and geothermal are derived from it. Solar energy is concentrated for cooking and heating in solar cookers and heaters. It is converted into electricity in photovoltaic cells.
- Electricity generated by utilising the potential energy of water stored at a height is called hydroelectricity. This is a renewable, pollution-free and comparatively inexpensive way of generating power.
- In wind farms, wind energy is used to turn the blades of huge fans, which help to turn the shafts of generators.
- Beds of rocks heated by geothermal energy, natural geysers and hot springs can be used for cooking, heating and generating electricity.
- Water stored behind dams during high tides can be used to generate electricity.
- Energy derived from plants and animals is called biomass energy. Plant and animal waste can be converted into biogas by the action of bacteria. Some plants can yield biofuel, which can be used instead of fossil fuels.
- We can conserve energy by reducing wastage, choosing energy-efficient vehicles and appliances, changing our lifestyle and recycling and reusing things.

EXERCISE

Short-Answer Questions

1. Give one example each of energy being converted into work and work being converted into energy.
2. Why are fossil fuels considered a nonrenewable source of energy? Name three fossil fuels.
3. What are renewable sources of energy? Name any three.
4. What is the sun's source of energy?
5. Mention two disadvantages of using wind energy to generate electricity.

Long-Answer Questions

1. Explain briefly how power is generated in a nuclear power plant. What are the disadvantages of nuclear energy?
2. What are the disadvantages of using fossil fuels?
3. How is the sun our primary source of energy?

4. How is hydroelectricity produced? What are its advantages and disadvantages?
5. (a) What is biomass energy? What is the best way of using it?
   (b) What are biofuels? What is the problem with cultivating biofuels on a large scale?
6. Mention three steps we (as individuals) can take to conserve energy.

Objective Questions

Choose the correct option.

1. The fission of uranium is induced by the absorption of
   (a) protons (b) electrons
   (c) neutrons (d) hydrogen atoms
2. The two sources of energy that are not derived from solar energy are
   (a) nuclear and geothermal
   (b) nuclear and hydroelectric
   (c) nuclear and thermal
   (d) wind and geothermal
3. Which of the following is called a clean fuel?
   (a) Petrol (b) Diesel
   (c) Kerosene (d) Natural gas
4. Catalytic converters convert
   (a) biomass into energy
   (b) harmful emissions into harmless gases
   (c) solar energy into electricity
   (d) plants into biofuel
5. The process by which the remains of plants change into coal is called
   (a) fermentation (b) carbonification
   (c) sedimentation (d) carbonisation

Fill in the blanks.

1. A thermal power station uses the energy of ..... to generate electricity.
2. The worldwide increase in temperature caused by the emission of carbon dioxide is called ..... .
3. Petroleum is a mixture of ..... .
4. Photovoltaic cells produce electricity from ..... .
5. In a hydroelectric power station the ..... energy of water stored at a height is used to generate electricity.

Write true or false.

1. Fossil fuels generate about two thirds of the world's electric power.
2. Unleaded petrol should not be used.
3. The heat in the interior of the earth is called geothermal energy.
4. Diesel and fuel oil are derived from natural gas.
5. The emission of carbon dioxide causes acid rain.
6. Nuclear fusion has been used successfully in hydrogen fuel cells.

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