Chapter 9

Energy and Power Resources

Learning Outcomes

- Exploring sources of energy
- Differentiating between renewable and non-renewable energy resources
- Discussing characteristics of solar power, hydro power and wind power
- Explaining the distribution of energy resources among sections of society
- Stating ways to conserve energy resources

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Thinking Cap

How do you think electricity is produced? For what purpose is it required?

Sources of Energy

ANM

Energy is important for activities, right from small household tasks to complex industrial processes. In other words, it is the ability to do work. An energy source can be defined as something that a person or organisation can use to produce heat, power or electricity. A naturally-occurring substance that stores energy is known as fuel. Energy sources are mainly of two types—renewable and non-renewable.

Renewable Energy Sources

Renewable sources refer to those energy sources that originate in nature and can be replenished. These can be used repeatedly. These sources include solar energy (obtained from sunlight), wind energy (obtained from wind), hydropower (obtained from water sources) and geothermal energy (obtained from the heat of the Earth). Some important renewable energy sources are as follows:

Solar Power

Solar power is derived from solar energy, which is a freely available source originating from sunlight. It is one of the most important non-conventional sources of energy because it is non-polluting. Sunlight gives us solar power with the use of solar panels. These. panels are made of thin semi-conducting materials. When the solar panels are exposed to sunlight, they absorb

Solar panels

heat and light from the sun, which are then converted into electric current. Solar power can be used for cooking and heating water. It can also be used for street lighting, water pumping, desalinating salty water, charging electronics such as electronic calculators and watches, and powering traffic and railway signals.

Hydropower

The energy produced from falling or flowing water under the force of gravity is called hydropower. It is generated at hydroelectric plants. It is also called water power or hydroelectric power. Flowing water from reservoirs, such as rivers, dams and lakes turn the wheels of large turbines in hydro-electric plants to generate electricity.

Hydroelectric dam

> Apart from rivers, dams and lakes, hydropower is also generated from tides. The generation of electricity using the force of tides is known as tidal power.

Wind Power

The difference in pressure between areas on Earth's surface causes winds. Wind is widely available and free for use. A windmill is a type of machine that converts wind energy into electricity. It is made up of three large blades attached to a turbine. The turbine is linked to a generator. When wind blows, it turns the blades of the windmill and the connected turbine converts the wind energy to electrical energy. The leading producers of wind power are China, the USA, Germany, Spain and India.

Wind farm

Geothermal Energy

Geothermal energy is the heat from the Earth. It is clean and sustainable. Its sources range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called **magma**. Mostly, energy is derived from hot springs. A geothermal

Geothermal power plant, Reykjanes, Iceland

power plant works by tapping into steam or hot water reservoirs underground; the heat is used to drive an electrical generator. India has such plants in Parvati Valley, Manikaran, Himachal Pradesh and Leh.

Non-renewable Energy Sources

Non-renewable sources refer to those energy sources that are finite and may run out in the future, if used at a fast rate. Fossil fuels are widely used non-renewable sources of energy. The process of extracting these resources is harmful to the environment. For example, fossil fuels undergo combustion, which releases harmful gases like sulphur dioxide and carbon monoxide. These gases can cause acid rain and global warming. Hence, non-renewable sources of energy lead to pollution.

The widely used non-renewable sources of energy are coal and petroleum.

Coal

Coal is a black or brownish-black sedimentary rock containing large amounts of carbon. Coal is formed when plant matter is buried under layers of sediments for millions of years. The intense pressure and heat transform the plant matter into coal. The amount of carbon in the coal determines the amount of heat it produces.

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Did you know?

Commercial coal mining in India started in 1774 in Raniganj, West Bengal, on the banks of the Damodar river. It was started by M/s Sumner and Suetonius Grant Heatly of the East India Company.

Based on the amount of carbon present, coal is classified into the following types:

Opencast coal mine

- **Anthracite:** It is the best quality of coal containing between 86 per cent and 97 per cent carbon. This type of coal is mostly used in the metal industry.
- **Bituminous:** It contains between 45 per cent and 86 per cent carbon. This type of coal is used to generate electricity. It is used as a fuel and in iron and steel industries.
- **Lignite:** It contains between 25 per cent and 35 per cent carbon and is a poor-quality coal. It has low heating values. It is used in the production of electricity.
- **Peat:** It has low percentage of carbon. It is an under-developed form of coal and contains high amounts of water. Hence, it produces less heat and a lot of smoke on burning.

Petroleum

Petroleum is a liquid fossil fuel. It is also known as crude oil. It takes millions of years to produce petroleum from the remains of plants and animals. It is found in underground rock formations. It is refined to produce petrol, diesel and kerosene. It is used as a fuel in cars. The top crude oil producers in the world are Saudi Arabia, the USA, Russia, China and Iran.

Hydroelectric Projects in India

SVID

India is the third-largest country with respect to the number of dams and the fifth-largest producer of hydro-electric power in the world. It has more than 4,800 completed dams. Some important dams in India are Bhakra-Nangal Dam, Farakka Barrage, Sardar Sarovar Dam, and Idukki Dam. Hydroelectricity projects are built over dams to fulfil the need of electricity. Hydro-electric projects play an important role in electricity generation in India.

Some major hydroelectric projects in India are listed in the table on the next page.

Map showing hydroelectric power plants in India

	Name of Project	River	State	Description
1.	Koyna Hydroelectric Project	Koyna River	Maharashtra	It is the largest completed hydroelectric power plant in India. Its total electricity generating capacity is 1,960 megawatts.
2.	Tehri Hydroelectric Complex	Bhagirathi River	Uttarakhand	The Tehri dam is the highest dam in India. It generates about 1,000 megawatts of hydroelectricity.
3.	Srisailam Hydroelectric Project	Krishna River	Andhra Pradesh and Telangana	It is the third-largest dam in India. It is the second-largest hydroelectric station in India. It generates 1,670 megawatts of hydroelectricity.
4.	Nathpa Jhakri Hydroelectric Project	Satluj River	Himachal Pradesh	It is built on the Nathpa Jhakri Dam for production of hydroelectric power. It generates 1,500 megawatts of hydroelectricity.
5.	Sardar Sarovar	Narmada River	Gujarat	It is a part of the Narmada Valley Project. Its total capacity of generating electricity is 1,450 megawatts.

ACTIVITY

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Find out information on the hydroelectric power stations in Himachal Pradesh. On which rivers are these hydroelectric power plants located?

Conservation of Energy and Power Resources

With rapid increase in population and industrialisation, the demand for energy is also rising. However, energy resources are limited. To fulfil the gap between demand and supply, the supply and generation of energy and power resources should be increased or their demand should be decreased. We are largely dependent on non-renewable resources for our energy needs. Overuse of these resources may exhaust them in a few years. Hence, the use of these energy sources need to be controlled. This can be achieved by conservation and careful use of available energy and power resources. Conservation of energy and power resources is aimed to reduce demand, protect and restore supplies and increase the use of alternative energy.

Methods that can be used for conservation of energy and power resources are as follows:

Prohibit Wastage of Resources

- Turn off lights, fans and other electronic devices when not in use.
- Avoid opening the refrigerator frequently. Also, defrost your refrigerator regularly because frost increases energy consumption.
- Use washing machines and dishwashers only when fully loaded. Replace ordinary light bulbs with LED or compact fluorescent light (CFL) bulbs. LED or CFL bulbs consume about 80 per cent less energy than ordinary light bulbs.
- Replace cooking in open utensils with a pressure cooker. It not only reduces energy usage but also saves on cooking time.

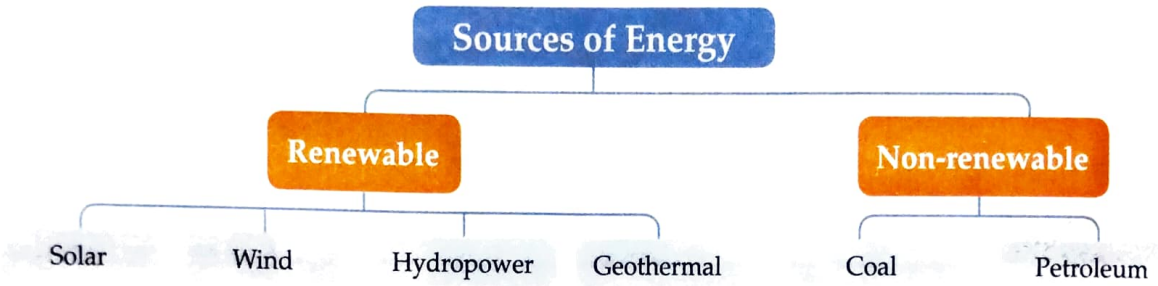
Use of Alternative Energy Resource

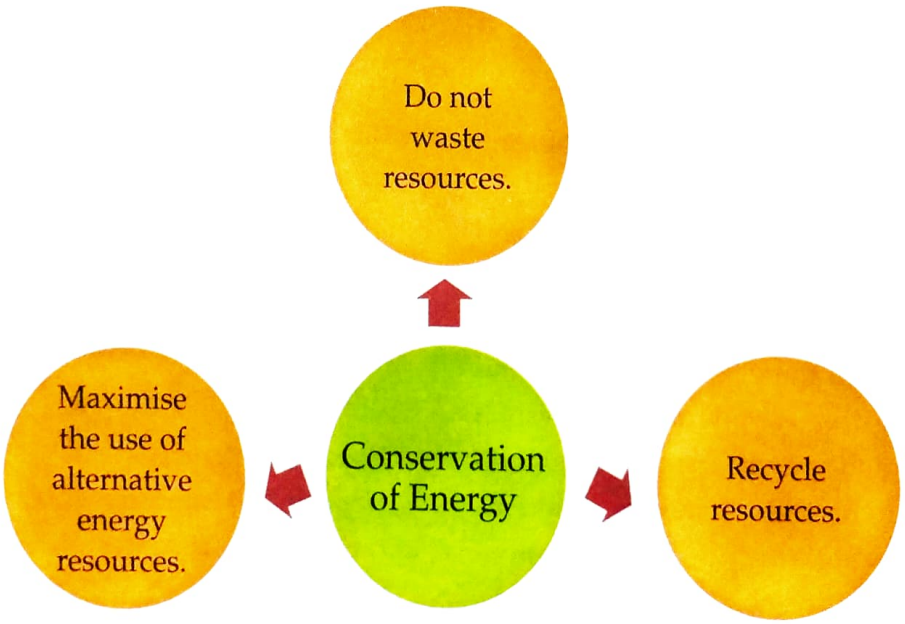
Use renewable energy sources such as solar energy, wind energy, tidal energy, etc. The government should promote their use on a large scale.

Recycling Resources

Promote recycling and reuse of waste, such as paper, metals, plastics, etc. Most recycling processes require less energy when compared to manufacturing a new product. Recycling also helps conserve natural resources. Wherever possible, repair and reuse things.

AT A GLANCE





EXERCISE

A. Fill in the blanks.

1. _____ are made up of thin semi-conducting materials.
2. The generation of electricity using the force of tides is known as _____ power.
3. Fossil fuels are widely used _____ sources of energy.
4. Bituminous coal contains about _____ carbon.

5. Srisailam Hydroelectric Project is built over the _____ River.

B. Choose the correct answer.

1. What is India's rank with respect to the number of dams?
   - ☐ 3
   - ☐ 5
   - ☐ 7
   - ☐ 9
2. What is the electricity generation capacity of Jhakra Power House?
   - ☐ 1960 megawatts
   - ☐ 1450 megawatts
   - ☐ 1500 megawatts
   - ☐ 1670 megawatts
3. Which hydroelectric project is located over the Bhagirathi River?
   - ☐ Koyna Hydroelectric Project
   - ☐ Tehri Hydroelectric Complex
   - ☐ Jhakra Power House
   - ☐ Sardar Sarovar
4. Which of the following is a non-renewable source of energy?
   - ☐ solar power
   - ☐ wind power
   - ☐ tidal power
   - ☐ petroleum
5. Which part of a windmill converts wind energy to electrical energy?
   - ☐ blades
   - ☐ turbines
   - ☐ solar panels
   - ☐ tower

C. Match the following.

Hydroelectric Project		State	
1.	Koyna Hydroelectric Project	a.	Uttarakhand
2.	Tehri Hydroelectric Complex	b.	Andhra Pradesh and Telangana
3.	Srisailam Hydroelectric Project	c.	Gujarat
4.	Jhakra Power House	d.	Maharashtra
5.	Sardar Sarovar	e.	Himachal Pradesh

D. State whether true or false.

1. Solar panels are used to produce hydropower.
2. Combustion of fossil fuels releases sulphur dioxide and carbon monoxide gases.
3. Petroleum is refined to produce petrol, diesel and kerosene.
4. Peat is the best quality coal.
5. Jhakra Power House is built over the Krishna River.

E. Answer in one or two sentences.

1. What are the uses of solar power?
2. How is hydropower generated?
3. Name the countries that lead in wind power production.

4. Name top crude oil producers of the world.
5. Name important dams in India.

F. Answer in a paragraph or two.

1. Write a note on solar power.
2. How will you classify coal on the basis of its carbon content?
3. Explain non-renewable sources of energy.
4. Write a note on major hydroelectric projects in India.
5. Explain methods of conservation of energy and power resources.

Picture Study

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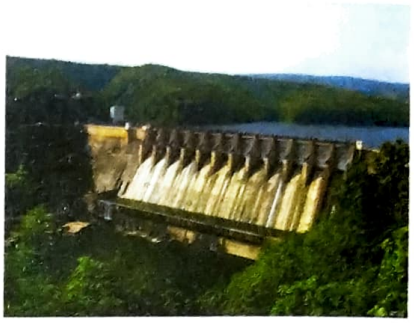
This is a picture of Srisailam Dam.



1. Find out which state of India is it located in and on which river it is built.
2. Find out its rank among hydroelectric power stations in India.
3. Which is the largest completed hydroelectric power plant in India?

Integrate

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Use of biofuels is one of the most important strategies helping us counter the limited crude oil supply. In India, a bioethanol program was launched to introduce petroleum with an ethanol blend. The ethanol is produced from the Jatropha plant seeds. In 2005, India produced around 1.6 billion litres of ethanol to become the world's fourth-largest producer. List other strategies being implemented under the energy policy of India.

Life Skills

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A hydroelectric project involves construction of a hydroelectric dam with a run-of-the-river plant to generate electricity. Such a project generally includes a large reservoir, taking up vast areas of land. This negatively affects local forest, wildlife habitat and agricultural activities. The aquatic system of the river is also considerably affected. Discuss the impact of a famous large-scale hydroelectric project on the environment and life of people living nearby.

Project

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Search for more information and images of renewable sources of energy on the Internet. Create a digital presentation on the advantages of using renewable energy sources.

Enrichment Worksheet 3

A. Organise yourselves in teams of four. The first team can gather information on industrial air pollution, the second group can gather information about industrially produced land pollution, the third group can gather information on industrially generated water pollution and the fourth group can gather information on industrially caused noise pollution. Write what you found out below.

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B. Imagine that your family and you are engaged in a traditional handicraft making industry. What industry do you want to be a part of? Write a diary entry here about how you work, who the employees are, where you sell your products, and what means of production you use.

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C. Using the Internet, find out more about how a hydropower plant works. Mention some new things you learnt below.

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