



**W**e use various forms of energy like heat, light, electricity for various purposes. **Another name for energy is power** though some people use power especially for electrical energy as they are habituated to the use of it in the urban areas. Common resources of power are petrol, diesel and gas while coal is used extensively for producing electricity at thermal power plants. In order to meet demand, electricity is supplied from a network called **grid**.

With the advent of science and technology the **life styles** are changing very fast. Life of rich families in the cities may be more comfortable but it depends on many gadgets all of which need lot of energy. Thus, the whole situation has created a wide gap between demand and supply of power. We also need power for cooking, agriculture, industries, transport and communication.

Power resources may be broadly categorised as conventional and non-conventional resources. **Conventional sources of energy** are those which have been in common use for a long time. Firewood, coal, petroleum, natural gas and hydel power are included in conventional sources. However, conventional sources are now those which are exhaustible. Thus, hydel power is excluded from it and nuclear power included in it. Non-conventional energy sources are solar energy, wind energy, tidal energy, geothermal energy and biogas which are renewable and cleaner alternatives. So, they are also called alternative sources of energy.

Firewood and fossil fuels are the two **main conventional energy sources**. Firewood is obtained by cutting trees of the forest and fossil fuels are extracted from the earth. **The rate of the formation** of forests or fossil fuels underground is much lesser than their rate of consumption by the evergrowing population today. So, the main conventional energy sources are exhaustible. That is why nuclear fuels which are also exhaustible are included in the conventional sources. However, nuclear fuels are not conventional in the old sense. But the world have been using nuclear energy for many decades, so they can be taken as conventional.

## Firewood

In our country more than fifty per cent of the energy used by the villagers comes from firewood, dung cakes and agricultural plant residues. These are used for cooking and heating. But burning of these fuels is harmful to the environment including human beings.

## Fossil Fuels

Remains of plants and animals which were buried under the earth for millions of years got converted by the heat and pressure into **fossil fuels**. Fossil fuels such as coal, petroleum and natural gas are the main conventional energy sources.

## Coal

The coal which we are using today was formed millions of years ago when giant ferns and swamps got buried under the layers of earth. They turned into sedimentary rocks under pressure as layer upon layer were formed. Coal is found in the layers of sedimentary rocks. The thickness and quality of those layers depend on the nature of the forests that got buried to form this coal millions of years ago.

Coal is the most abundantly found fossil fuel. The world's largest coal reserves were formed about 300 million years ago. The quality of coal varies depending on the carbon content.

Type of Coal	Carbon Content	Characteristics
Peat	50 to 60%	High moisture content, burns with difficulty and emits a lot of smoke
Lignite	70 to 75%	Soft brown coal, plenty of moisture.
Bituminous	70 to 75%	black coal
Anthracite	90 to 95%	It burns without smoke.

The largest coal reserves of the world today are found in Russia and USA. The leading coal producers of the world are China, USA, Germany, Russia, South Africa and France. The chief areas of India producing coal are Raniganj, Jharia, Dhanbad and Bokaro. These lie in the states of West Bengal, Bihar and Jharkhand. Other coal producing states are Orissa, Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Tamil Nadu and Maharashtra. India has total reserve of about 16,000 crore metric tonnes of coal.

Coal is used as domestic fuel, in industries such as iron and steel, steam engines and to generate electricity. Electricity from coal is called **thermal power**. Coal is burnt to heat water to produce steam which moves the turbines of the generator.

## Petroleum

Petroleum is a thick black liquid. Petroleum means rock oil (petra=rock, oleum=oil). Remains of marine organisms (animals) were buried,



*A Thermal Power Station*

decomposed and converted into oil and gas under heat and pressure of overlying rocks. Mineral oil and natural gas are generally found in sedimentary rocks that were once under shallow seas. Thus, oil is found between the layers of rocks.

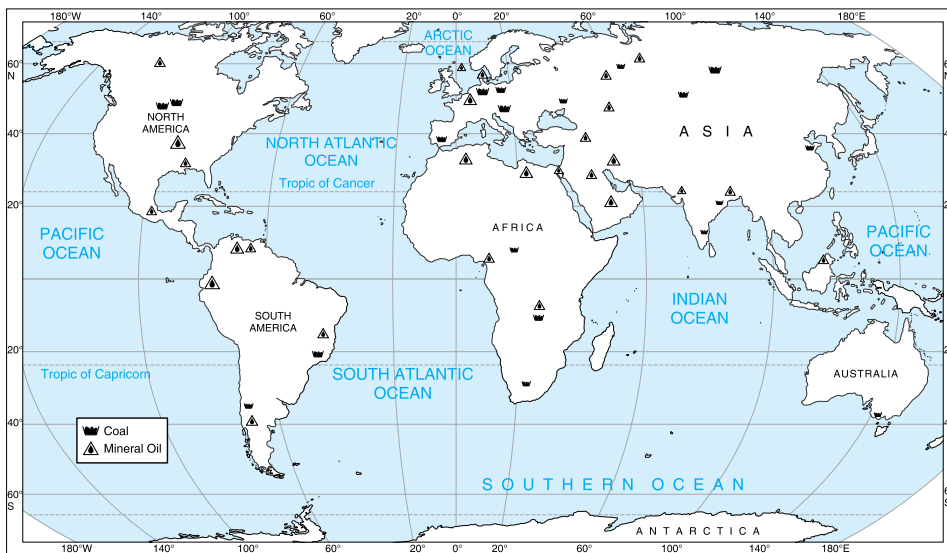
The world has a total oil reserve of about 1,000 billion barrels. Barrel is a unit of measurement of oil equal to 159 litres. Two-third of this supply lies in the Persian Gulf (West Asia) and surrounding areas. Saudi Arabia has the largest reserves. The chief petroleum producing countries are Saudi Arabia, Iran, Iraq and Qatar. The other major producers are USA, Russia, Venezuela and Algeria. The leading producers in India are Digboi in Assam, Bombay High in Mumbai and the deltas of Krishna and Godavari rivers.

Petroleum is drilled from oil fields often located in off-shore and coastal areas. This is then refined to produce a variety of products like petrol, kerosene, diesel, lubricant and wax. Petroleum is called Black Gold as its derivatives are very valuable.

## Natural Gas

Natural gas is found with petroleum deposits and is released when crude oil is brought to surface. Russia, Norway, UK and the Netherlands are the major producers of natural gas. In India, Jaisalmer, Krishna Godavari delta, Tripura and some areas off shore in Mumbai have natural gas reserves.

Natural gas is used as a domestic and industrial fuel, cleaner and cheaper than oil. It is cleaner as it causes less pollution than petrol and diesel. Thus, it is a popular ecofriendly automobile fuel. It is sold as CNG (Compressed Natural Gas) in cylinders. The gas we use in our kitchens is called LPG (Liquified Petroleum Gas).

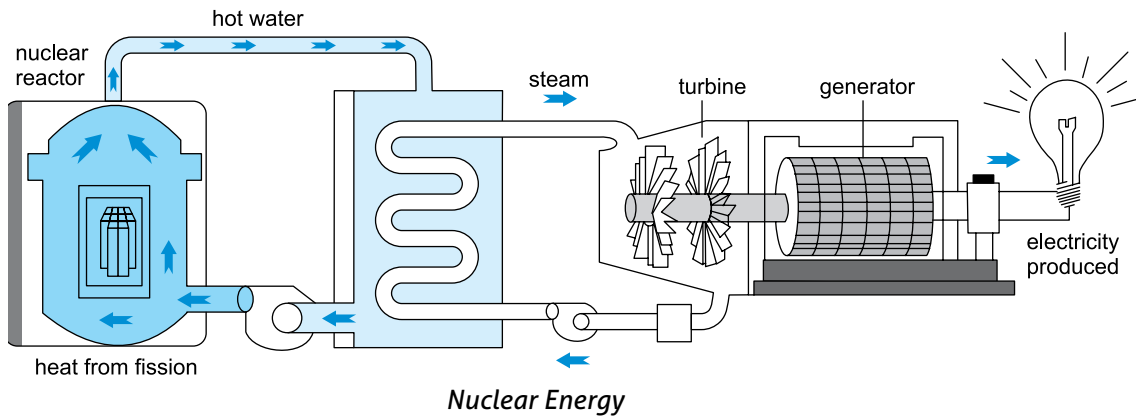


World : Distribution of Mineral Oil and Coal

## Nuclear Fuel

Fission or disintegration of radioactive elements like uranium and thorium release enormous energy in the form of heat. The process is controlled in nuclear reactors. This energy is used to heat water, produce steam and move the turbines to produce electricity. The energy stored in the nuclei of atoms of naturally occurring radioactive elements is released by fission. Nuclear fuel is called fuel as it releases energy but it does not burn like wood or fossil fuels.

The greatest producers of nuclear power are USA and Europe. In India large uranium deposits occur in Jharkhand and Rajasthan. Thorium is found in large quantities in the Monazite sands of Kerala. The nuclear power stations of India are located in Tarapur in Maharashtra, Kaiga in Karnataka, Kalpakkam in Tamil Nadu, Ranapratap Sagar near Kota in Rajasthan and Narora in Uttar Pradesh.



### **Need for Using Non-conventional Resources of Power**

The reserves of fossil fuels and nuclear fuels are limited. They pollute the environment. If the present rate of consumption of fossil fuels continues, the reserves of these fuels will get exhausted. Later or sooner nuclear fuels will be exhausted. Both are non-renewable. Nuclear fuels are very expensive and generate radioactive waste which is most harmful to humans and all living organisms and non-living environment too. Therefore, there is need for using non-conventional sources such as solar energy, wind energy, tidal energy which are inexhaustible and renewable.

#### **Solar Energy**

It is Sun's energy which is the ultimate source of all energy forms on Earth including fossil fuels. Sun's energy is called solar energy. Sun's heat and light energy is felt by us every day. Solar energy is the most abundant and inexhaustible source of energy. It is the most promising source of energy provided its technology is perfected .


Sunshine is trapped by the solar (photovoltaic) cells to produce electricity. Many of these cells are joined into solar panels to generate power. Low voltage gadgets like bulbs, electric tubes, etc. can work on it. Heat, direct from the sunshine can be used directly in solar heaters (for water), solar dryers (for grapes, etc.) and solar cookers. Solar energy has a huge potential especially in tropical countries that have abundant sunshine.



*Solar Panels to trap solar energy*

#### **Wind Energy**

Windmills have been used for grinding grain and lifting water for irrigation since ancient times. Now high speed winds rotate the windmill which is connected to a generator to produce electricity. Wind farms having hundreds of such windmills are located in coastal



regions and mountain passes where strong and steady winds blow. However, variation of wind speed and direction are its drawbacks. Wind farms are established in Netherlands, Germany, Denmark, Spain, UK and USA. In India, the states of Gujarat, Maharashtra, Tamil Nadu and Orissa have a good potential for wind energy because of steady high speed winds. Wind is an inexhaustible source of energy.

### Hydel Power



*Hydel Power*

Hydel Power or hydroelectricity is generated from the force of falling water. It is a clean, non-polluting source which gives electricity at a much cheaper cost than other sources. As long as there is water flowing in rivers hydel power is inexhaustible. Only the initial cost of setting up the plant, turbines and transmission tower is higher. Rain water or river water stored in dams is made to fall from heights. The falling water flows through pipes inside the dam over turbine blades placed at the bottom of the dam. The moving blades then turn the generator to produce electricity. The water discharged after moving the turbine blades is used for irrigation.

One-fourth of the world's electricity is hydel power. The leading producers of hydel power in the world are Paraguay, Brazil, Norway and China. In India, consequent to building of dams across many rivers hydel power plants have been established. Some Important hydel power stations in India are Bhakra Nangal, Gandhi Sagar, Nagarjun Sagar and Damodar Valley Project. However, displacement of large number of local community for the construction of dams is always under controversy.

### Geothermal Energy

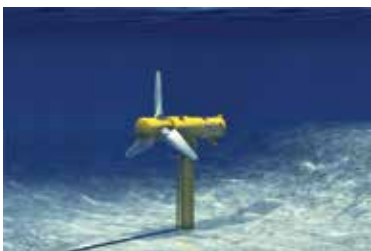


*Geothermal Energy*

The temperature in the interior of the Earth rises steadily with depth. The inside water becomes hot which may come out in the form of hot springs at some places. This heat energy obtained from the Earth is called geothermal energy. It can be used to generate power. USA has the world's largest geothermal power plants followed by New Zealand, Iceland, Philippines and central America. In India, geothermal plants are located in Manikaran in Himachal Pradesh and Puga Valley in Ladakh.

### Tidal Energy

Energy generated from tides is called tidal energy. To use it dams are built at narrow openings of the sea. During high tides the energy of the tides is used to turn the turbine installed in the dam to generate electricity. Russia, France and the Gulf of Kachchh in India have huge tidal mill farms.



*Biogas*

### Biogas

Animal dung, dead plants, kitchen waste, etc. can be decomposed by bacteria to produce biogas. Basically biogas is a mixture of methane and carbon dioxide. The remaining waste is a good organic manure. like LPG, biogas is an excellent fuel for cooking and lighting.



## Conservation of Energy

We have seen that conventional sources of energy are exhaustible. Most of the non-conventional sources are in the stages of development. To harness solar energy, wind energy, etc. is difficult as well as costly. Therefore, we must save the available forms of energy. When we save electricity we save equivalent amount of coal in thermal power plant. Switch off the appliance when not in use. Use cycle or public transport instead of bike or car. Maximise the use of natural breeze and light by keeping the windows open. Cook food in a pressure cooker. Do not use a big utensil to cook small amount of food. Soak the dal or rice for sometime before cooking it.

**Energy saved is energy generated.**



### Key Words

- » Power : energy.
- » Conventional Sources of Energy : in common use for a long time, exhaustible.
- » Non-conventional sources of Energy : inexhaustible or renewable.
- » Fossil Fuels : remains of plants and animals buried under earth for millions of years and converted by heat and pressure.
- » Thermal Power : electricity produced from coal.
- » Solar Energy : energy of the Sun.
- » Hydel Power : electricity generated from the force of falling water.
- » Geothermal Energy : heat energy obtained from the Earth.
- » Biogas : gas produced from the decomposition of animal dung and dead plants by the bacteria.

## SUMMARY

- ▶ We need power or energy for cooking, gadgets, industries, agriculture, transport and communication.
- ▶ Conventional sources of energy are those which have been in common use for a long time and which are exhaustible. For example, firewood, coal, petroleum, natural gas, nuclear fuel.
- ▶ Burning of firewood is harmful for the environment including humans.
- ▶ Trees buried under the layers of earth for millions of years by the heat and pressure converted into coal.
- ▶ Remains of marine organisms buried, decomposed and converted into oil and gas under heat and pressure of overlying rocks.
- ▶ Fissions of radioactive elements release enormous power in the form of heat. This energy is used to heat water to produce steam for moving the turbine of the electricity generator.
- ▶ The reserves of fossil fuels and nuclear fuels are limited. They produce pollution. Nuclear fuels are very expensive. Therefore, we need for using non-conventional sources such as solar energy, wind energy which are inexhaustible and/or renewable.
- ▶ Sunshine is trapped by the solar cells to generate electricity.
- ▶ High speed winds rotate the windmill which is connected to a generator to produce electricity.
- ▶ Hydel power is generated from the force of falling water.
- ▶ Hot springs give out the geothermal energy.
- ▶ During high tide the energy of the tides is used to turn the turbine installed in the dam.
- ▶ Animal dung, dead plants, kitchen waste, etc. can be decomposed by bacteria to produce biogas.



## Exercise Time

### A. Tick (✓) the only correct choice amongst the following :

- This is an exhaustible source of energy
  - Wind
  - Sunshine
  - Uranium
  - Biogas
- This brown coal has 70 to 75% carbon
  - Peat
  - Lignite
  - Bituminous
  - Anthracite
- Electricity from coal is called
  - nuclear power
  - thermal power
  - hydel power
  - tidal power
- This country has the largest reserves of petroleum
  - Saudi Arabia
  - USA
  - Qatar
  - Russia
- This nuclear fuel is found in Monazite sands of Kerala
  - Uranium
  - Calcium
  - Thorium
  - Petroleum

### B. Fill in the blanks :

- Energy saved is energy \_\_\_\_\_.
- The best quality of coal with 90% to 95% carbon is \_\_\_\_\_.
- The \_\_\_\_\_ cells convert sunlight directly into electricity.
- Wind energy is inexhaustible and \_\_\_\_\_.
- \_\_\_\_\_ is much cheaper than electricity produced by any other sources.

### C. Match the Following :

- |                          |                  |
|--------------------------|------------------|
| 1. Wind energy           | a. Bhakra Nangal |
| 2. Hydel power           | b. Narora        |
| 3. Geothermal energy     | c. Gujarat       |
| 4. Nuclear power station | d. Bombay High   |
| 5. Petroleum             | e. Manikaran     |

### D. Write true (T) or False (F) against the following statements in given brackets :

- Hydroelectricity is a non-pollutant way of generating electricity.
- India is the greatest producer of nuclear power.
- To harness solar energy or wind energy is difficult as well as costly.
- Thermal power is a fuel for the future.
- Basically biogas is a mixture of oxygen and carbon dioxide.

### E. Define the terms :

- |                                     |                      |
|-------------------------------------|----------------------|
| 1. Conventional Resources of Energy | 2. Geothermal Energy |
| 3. Biogas                           | 4. Fossil Fuels      |
| 5. Thermal Power                    | 6. Hydel Power       |

### F. Identify the following :

- Resources which have been in common use for a long time
- Remains of plants and animals buried under earth for millions of years
- The type of coal that burns without smoke
- A unit of measuring oil equal to 159 litres
- It is called fuel but it does not burn like wood, coal, oil or gas



**G. Answer in one word or one phrase :**

1. Name one fossil fuel.
2. Name one inexhaustible source of energy.
3. What is solar energy ?
4. What do wind farms produce ?
5. What is electricity produced from coal called ?

**H. Answer these question briefly :**

1. Which non-conventional source of energy would you suggest for  
(a) rural area  
(b) coastal area  
(c) arid region ?
2. Why is petroleum called "black gold" ?
3. How is hydel power generated ? Why is it better than electricity produced by other means ?
4. What are wind farms ? What are they set up for ?
5. How was petroleum produced under earth ?
6. What are the uses of solar energy ?
7. What are fossil fuels ? How were they formed ?
8. How is electricity produced using nuclear fuel ?

**I. Differentiate between :**

1. Hydel Power and Thermal Power
2. Natural Gas and Biogas
3. Thermal Power and Nuclear Power
4. Conventional and Non-conventional Sources of Energy

**J. Answer these questions in detail :**

1. What are the conventional sources of energy ? Describe each in brief.
2. How was coal formed in nature ? Describe the different varieties of coal.
3. What is the need for non-conventional sources of energy ? Describe three sources.

**PROJECT WORK**

1. Design a poster highlighting energy conservation tips you would take for your school. Display it on your bulletin board.
2. Make a list of different electric gadgets at your home, quantity (number) of each being used, approximate number of working hours of each and quantity (number) actually needed.
3. Make a project report on the alternative sources of energy available in India.
4. Hold a classroom discussion on the topic – "Energy Resources of Tomorrow."