



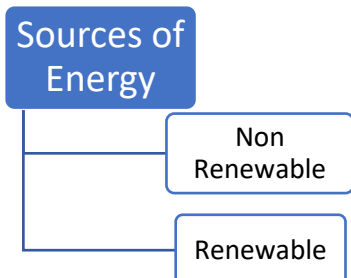
# PIET SANSKRITI SENIOR SECONDARY SCHOOL

## CLASS NOTES

### CHAPTER-14 SOURCES OF ENERGY

#### GRADE- X

**Source of energy:** A source of energy is one which can provide adequate amount of energy in a convenient form over a long period of time.



**Non-Renewable Sources Of Energy:** Those sources of energy which have accumulated in nature over a very, very long time and cannot be quickly replaced when exhausted are called non-renewable sources of energy.

For example: Fossil fuels (coal, petroleum, natural gas), and nuclear fuels (such as Uranium). They are dug out from the Earth. They are also called **exhaustible** sources of energy.

**Renewable Sources Of Energy:** Those sources of energy which are being produced continuously in nature and are inexhaustible, are called renewable sources of energy. For example: wood, hydroenergy, wind energy, solar energy, geothermal energy etc.

They are also called **inexhaustible** or **alternative** sources of energy.

#### **Qualities of a good source of energy:**

A good source of energy is one-

1. Which would do a large amount of work per unit mass (or per unit volume),
2. Which is cheap and easily available,
3. Which is easy to store and transport,
4. Which is safe to handle and use, and
5. Which does not cause environmental pollution

**Energy Crisis:** Energy crisis occurs when we all have a great need of fuel or electricity but does not have enough amounts of them. Since we know “Energy can neither be created nor destroyed”, so why do we face the energy crisis?

This is because, although energy cannot be destroyed, it can get converted from one form of energy to another. When we use a usable form of energy, it gets converted to an unusable form. This change is generally non reversible and hence energy crisis occurs.

Sources of energy can also be categorised into following categories:

1. Conventional sources of energy
2. Non-conventional sources of energy

**Conventional sources of energy:** Those sources which are being used since long time are called conventional sources of energy like coal, wood, wind etc.

**Non-conventional sources of energy:** Sources whose use has started only recently like sun, wave etc.

## Conventional sources of energy

### 1. Fuels

The materials which are burnt to produce heat energy are known as fuels. Eg.: wood, coal, LPG, kerosene etc.

*The amount of heat produced by burning a unit mass (1 gram) of the fuel completely is known as its calorific value. Common unit of measuring calorific value is kJ/g.*

*S.I. unit= J/kg*

*The minimum temperature to which a fuel must be heated so that it may catch fire and start burning, is known as its ignition temperature.*

#### Characteristics of an ideal fuel:

1. It should have a high calorific value.
2. It should have a proper ignition temperature.
3. It should be cheap and easily available.
4. It should burn without giving out any smoke or harmful gases.
5. It should be easy to handle, safe to transport, and convenient to store.
6. It should burn smoothly.

#### Fossil Fuels:

A natural fuel formed deep under the earth from the pre-historic remains of living organisms (like plants and animals) is called a fossil fuel. Example coal, petroleum and natural gas.

#### COAL:

Coal is a complex mixture of compounds of carbon, hydrogen and oxygen, and some free carbon. Small amounts of nitrogen and sulphur compounds are also present in coal. When coal is subjected to destructive distillation (by heating strongly in absence of air), then all the volatile material is removed from coal and coke is formed. Coke is 98% carbon. Coke is a better fuel than coal because it produces more heat and it does not produce smoke while burning.

#### Uses of coal:

1. As a fuel for heating purposes in homes and industries.
2. As a fuel in thermal power plants for generating electricity.
3. To make coke, which is then used as a reducing agent in the extraction of metals
4. In the manufacture of fuel gases like coal gas.
5. In the manufacture of petrol and synthetic natural gas.

#### PETROLEUM:

Petroleum means rock oil (petra=rock; oleum=oil). It is found under the crust of earth trapped in rocks. The crude oil petroleum is a complex mixture of several solid, liquid and gaseous hydrocarbons mixed with water, salt and earth particles. The fractional distillation of petroleum gives us the following fractions which can be used as fuels: petroleum gas, petrol (or gasoline), diesel, kerosene and fuel oil. Fuel oil is a better fuel than coal because it burns completely and does not leave any residue.

#### PETROLEUM GAS:

The main constituent of petroleum gas is butane though it also contains smaller amounts of propane and ethane. Liquefied Petroleum Gas (or LPG) consists mainly of

butane (alongwith smaller amounts of propane and ethane) which has been liquified by applying pressure.

Advantages of LPG:

1. LPG has a high calorific value (50kJ/g). So, it is a good fuel.
2. It burns with a smokeless flame and does not cause air pollution.
3. It does not produce any poisonous gases on burning.
4. It is easy to handle and convenient to store.
5. It is a very neat and clean domestic fuel.

Precautions for using LPG:

1. Before lighting a matchstick, we should make sure that there is no foul smell of the leaking gas in the kitchen, near the gas cylinder or the gas stove. If we smell gas leakage, the doors and windows should be opened at once to allow the gas to escape.
2. We should not use any hot flames near the gas cylinder.
3. We should never use a leaking gas cylinder.
4. When the gas is not being used, the valve of the gas cylinder and the knobs of the gas stove must be kept closed.

**NATURAL GAS**

Natural gas consists mainly of methane ( $\text{CH}_4$ ) (95%), with small quantities of ethane and propane. It occurs deep under the crust of the earth either alone or alongwith oil above the petroleum deposits. Natural gas is formed under the earth by the decomposition of vegetable matter lying under water. This decomposition is carried out by anaerobic bacteria in the absence of oxygen.

Uses of Natural Gas:

1. It is used as a domestic and industrial fuel.
2. It is used as a fuel in thermal power plants for generating electricity.
3. Compressed Natural Gas (CNG) is being used increasingly as a fuel in transport vehicles.

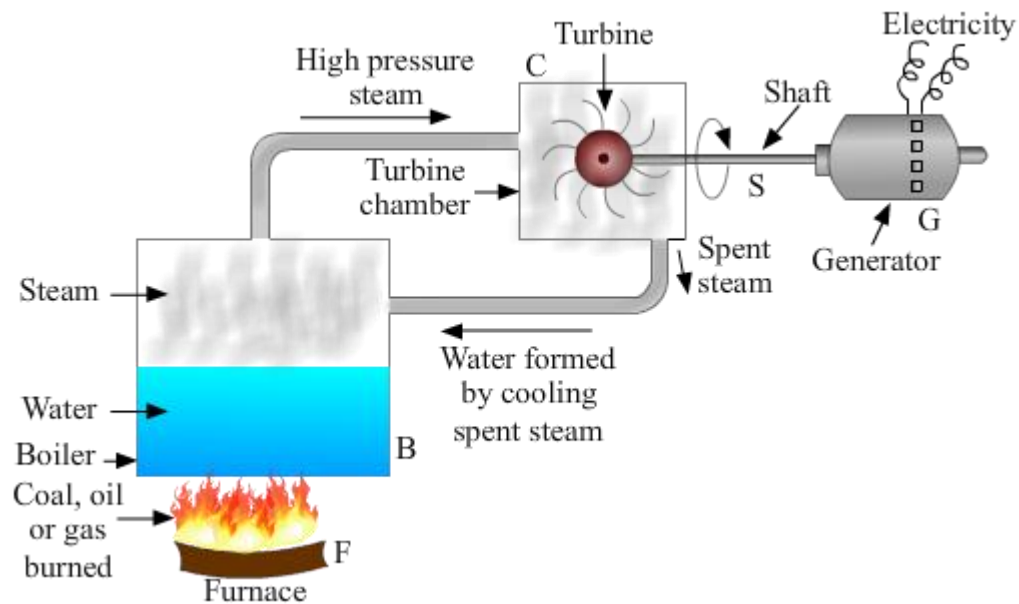
**Thermal Power Plant:**

A power plant in which the heat required to make steam to drive turbines (to make electricity) is obtained by burning fuels is called thermal power plant.

Working of a thermal power plant:

First the coal is burnt into the furnace of steam boiler. High pressure steam is produced in the boiler. In turbine, this steam force rotates the turbine blades. As the turbine turns, it causes the generator to do its work and create electricity.

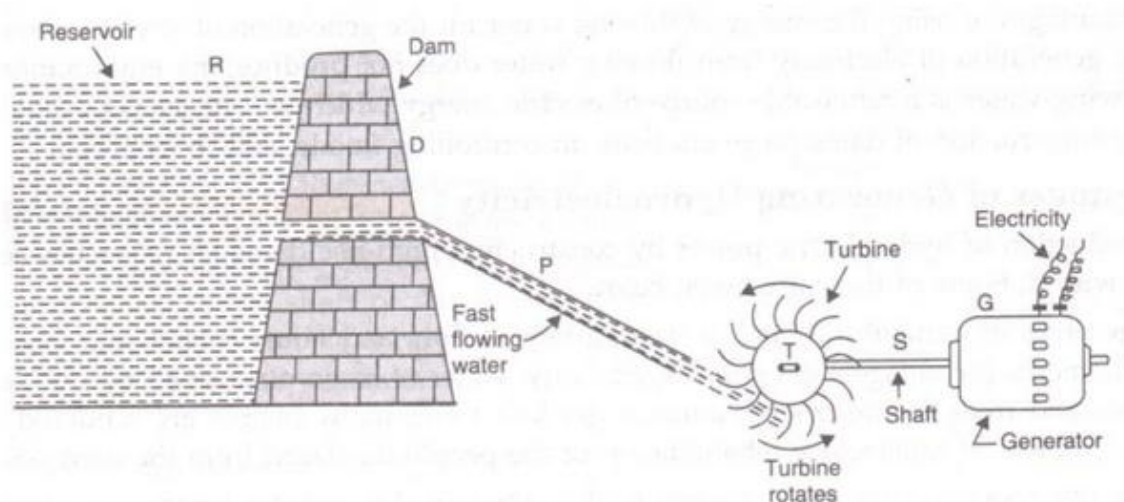
The transmission of electricity is more efficient than transporting coal or petroleum over the same distance. Therefore, many thermal power plants are set up near coal or oil fields.



## 2. Hydropower Plants:

A power plant that produces electricity by using flowing water to rotate a turbine, is called hydro-power plant.

Working:



Dam or reservoir is made over a river to collect water in large amount. Water coming at high speed rotates the turbine which in turn activates a generator to produce electricity. Some hydro-power plant just use a small canal to channel the river water through a turbine.

It is a renewable source of energy.

Disadvantages:

1. It can be established in certain locations only, depending upon the location of river, ocean etc. Moreover, it requires a large area to build a dam and results in rehabilitation of people.
2. Vegetation submerged below dam produces methane which leads to green house effect.

3. Due to construction of dam on the river, the fish in the downstream area do not get sufficient nutrient materials due to which the production of fish decreases rapidly.
4. Large ecosystems are destroyed when land is submerged under the water of reservoir of a dam. This also disturbs the ecological balance in the downstream area of the river.

### **3. Bio-Mass:**

Biomass is a source of energy that is directly obtained from the dead parts of plants and trees, and the waste material of animals. It produces less energy and releases lots of smoke. Biomass includes wood, agricultural waste, cow-dung (gobar) etc.

It is a renewable source of energy.

#### **WOOD AND CHARCOAL:**

When wood is burnt in limited oxygen, it loses water and other volatile substances, leaving charcoal behind.

The traditional use of wood as a fuel has many disadvantages, like:

1. The burning of wood produces a lot of smoke which pollutes the air
2. The calorific value of wood is low, being only 17kJ/g.

Due to improvement in technology, wood can be converted into a much better fuel called charcoal. Charcoal is a better fuel than wood because:

1. Charcoal has a higher calorific value than wood (33kJ/g).
2. Charcoal does not produce smoke while burning.
3. It is a compact fuel which is easy to handle and convenient to use.

#### **COW-DUNG AND BIOGAS:**

Cow-dung and agricultural waste is used to produce biogas/gobar-gas.

Cow-dung should not be used as a fuel directly because of the following reasons.

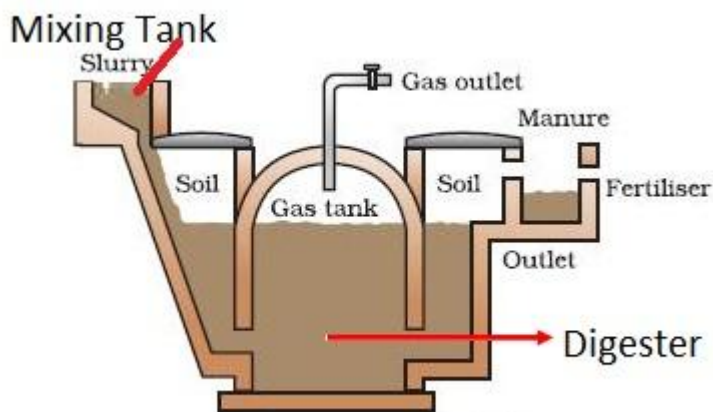
1. Cow-dung contains important nutrients (nitrogen and phosphorus), required by the soil to support crops. So, burning of cow-dung destroys useful manure.
2. Dung cakes produce a lot of smoke during burning which causes air pollution.
3. They do not burn completely, they produce a lot of ash as residue.
4. They have low calorific value.

Because of above disadvantages, it is better to prepare biogas using cow-dung.

Biogas is produced by the anaerobic degradation (in absence of oxygen) of animal wastes like cow-dung in the presence of water. It is a mixture of methane, carbon dioxide, hydrogen and hydrogen sulphide.

Production of biogas:

- Biogas plant is generally made of bricks.
- The various forms of biomass are mixed with equal quantity of water in the mixing tank. This forms the slurry.
- The slurry is fed into the digester through inlet chamber.
- Anaerobic micro-organisms decompose slurry to form methane(75%),CO<sub>2</sub>, H<sub>2</sub> and H<sub>2</sub>S gas. Gases are stored in chamber.
- These gases are called biogas.



Uses of Biogas:

1. Biogas is used as a fuel for cooking food.
2. It is used for lighting.
3. It is used as a fuel to run engines.
4. It is used for generating electricity.

It is a renewable source of energy.

#### 4. Wind Energy:

Moving air is called wind. The wind possesses kinetic energy. Traditionally, windmills have been used for grinding grains, to lift water from wells. But in modern times wind energy is used to generate electricity.

Working:

The energy in the wind turns the turbine blades around the rotor. A shaft connects the rotor to a generator. So when the rotor turns, it spins a generator to make electricity.

Advantages:

1. No pollution
2. Renewable
3. No recurring cost

Disadvantages:

1. Wind farms can only be established at those places where wind speed is greater than 15km/hr.
2. Wind turbine cannot work if there is no wind and wind speed is not so high. So we need to store a power backup.
3. Requires large area around 1MW-2Hectare land.
4. High set up cost.

#### Non-Conventional Sources of Energy:

##### 1. Solar Energy:

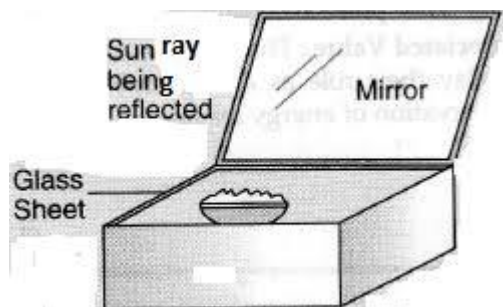
The energy obtained from the sun is called solar energy. The sun is the main source of energy for all living beings on the earth. Even the energy in the fossil fuels has come from the sun. It is renewable and non-conventional source of energy.

### Solar Energy Devices:

The devices which work by using solar energy are called solar energy devices. A device which gets heated by using sun's heat energy is called a solar heating device. Example: solar cooker, solar water heater. All the solar heating devices are in such a way that they help in collecting as much sun's heat rays as possible.

#### SOLAR COOKER:

The solar cooker is a device which is used to cook food by utilising the heat energy radiated by the sun. Interior of the cooker is usually black in colour as black colour absorbs most of the energy. Plane mirror or concave mirror is fixed at top side of cooker. On the other side a transparent glass is placed. The light reflected from the plane mirror concentrates the solar energy inside the solar cooker which generates enough heat to cook food.



#### SOLAR CELL PANEL:

A solar cell is a device which converts solar energy directly into electricity. A solar cell is usually made of silicon. A single solar cell can produce only a small amount of electricity. Thus, a solar cell panel consisting of a large number of solar cells joined together in a definite pattern is used.

(Uses, advantages and disadvantages: Do yourself)

### 2. Energy from the sea:

The oceans cover about 70% of the terrestrial area. They contain a lot of energy. Energies available from the sea are following:

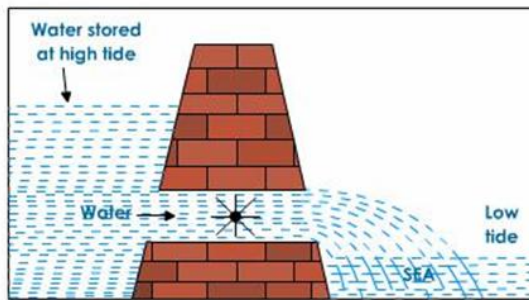
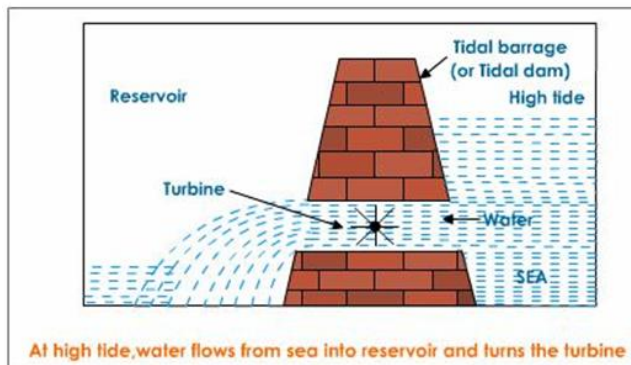
- a. Tidal energy
- b. Wave energy
- c. Ocean thermal energy

All of these are renewable and non-conventional.

#### a. TIDAL ENERGY:

The rise of sea water due to gravitational pull of the moon is called "high tide" whereas the fall of sea water is called "low tide". The tidal waves in the sea rise and fall twice a day.

Dams or reservoirs are built near seashores to collect the water which comes during a high tide. Turbines in the barrier generate electricity as the tide floods into the reservoir. Once the tide outside the barrier has receded, water retained can then be released through turbines into oceans, again generating electricity.



b. WAVE ENERGY:

Waves are created due to movement of wind on ocean surface. A variety of technologies have been proposed to capture the energy from waves. They can be used in several ways to rotate rotor of dynamo to generate electricity.

c. OCEAN THERMAL ENERGY:

The energy available due to the difference in temperature of water at the surface of the ocean and at deeper levels is called ocean thermal energy (OTE). A great advantage is that it can be used continuously 24 hours a day throughout the year.

**3. Geothermal Energy:**

Geothermal energy is the heat energy from hot rocks present inside the earth. This heat can be used as a source of energy to produce electricity. It is one of the few sources that don't come directly or indirectly from the solar energy.

(Write advantages and disadvantages yourself)

**4. Nuclear Energy:**

The energy released during a nuclear reaction is called nuclear energy. Nuclear energy can be obtained from two types of nuclear reactions:

- a. Nuclear fission
- b. Nuclear fusion

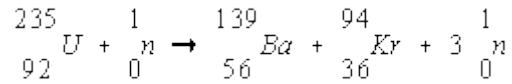
The nuclear energy is released mainly in the form of heat.

**NUCLEAR FISSION:**

The word 'fission' means to 'split up' into two or more parts. The process in which the heavy nucleus of a radioactive atom splits up into smaller nuclei when bombarded with low energy neutrons, is called nuclear fission. The energy produced during nuclear fission reactions is used to generate electricity at nuclear power plants.

Nuclear fission reaction:

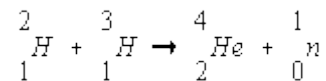




### NUCLEAR FUSION:

The word 'fusion' means 'to join' or 'to combine'. The process in which two nuclei of light elements combine to form heavy nucleus, is called nuclear fusion. A fusion is just the opposite of fission processes. The energy produced during nuclear fusion can not be controlled so far. So it can not be used to generate electricity.

Nuclear fusion reaction:



Advantages of nuclear energy:

1. It produces large amount of nuclear energy from small amount of fuel.
2. Once nuclear fuel is loaded into the reactor, the nuclear power plant can go on producing electricity for two to three years at a stretch.
3. It does not produce gases like CO<sub>2</sub> which produces green house effect.

Disadvantages:

1. The waste products of nuclear fission reactions are radioactive which keep on emitting harmful nuclear radiations for thousands of years. So its waste storage or disposal is very difficult.
2. There is risk of accidents in nuclear reactors which can lead to leakage of radioactive materials causing harm to plants, animals (including human beings).
3. High cost of installation
4. Low availability of uranium fuel.

### Environmental Consequences:

- No source of energy is pollution free. Its good to use sources with less pollution.
- Burning fossil fuels cause air pollution.
- Vegetation submerged below hydropower dam leads to green house effects.
- CNG creates much lesser pollution than petrol and diesel.
- LPG is the best choice for cooking purpose because it has a high calorific value and does not cause air pollution and ash.
- Sun is the ultimate source of energy.

