Unit 5

Energy Sources

After studying this chapter the students will be able to:

- Describe energy sources (fossils fuels, hydrogen as fuel, nuclear energy, hydal, wind and solar energy).
- Explain conventional and non conventional energy sources, renewable and non renewable energy sources, measurement of energy (natural gas and electricity).
- Identify the role energy sources plays in the development of a country.
- Recognize that limited energy sources are available to Pakistan.
- Critically reflect on the nuclear energy usage in the world and its impact on the life on Earth.
- Compare the annual production of fossil fuels and alternate fuels in Pakistan with their consumption.
- Evaluate the ways of conservation and effective utilization of the available energy sources in Pakistan.
- Describe thermal pollution, fossil and nuclear pollution and fuel hazards.
- Analyze various factors existing around in their surroundings leading to thermal pollution, fossil fuel pollution and nuclear fuel hazards and to suggest remedial measures to overcome it.
- Suggest various methods of every source protection and manage and suggest a plan for Pakistan.

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Introduction

Energy is one of the most fundamental parts of our universe. We use energy to do work. Energy lights our cities, powers our vehicles, trains, planes and rockets. Energy warms our homes and , cooks our food. Energy from the sun gives us light during the day. Energy stored in plants is eaten by animals, giving them energy. Everything we do is related to energy in one way or another. Energy is defined as: "the ability to do work."When we eat, our bodies transform the energy stored in the food into energy to do work. Cars, planes, light bulbs, boats and machinery also transform energy into work. where does energy come from? There are many sources of energy. In this chapter we will discuss various aspects of energy, its kinds, conservation and management.

5.1 ENERGY SOURCES AND THEIR SIGNIFICANCE

There are many different ways in which the abundance of energy around us can be stored, converted, and extended for our use. To help understand the key energy sources that will

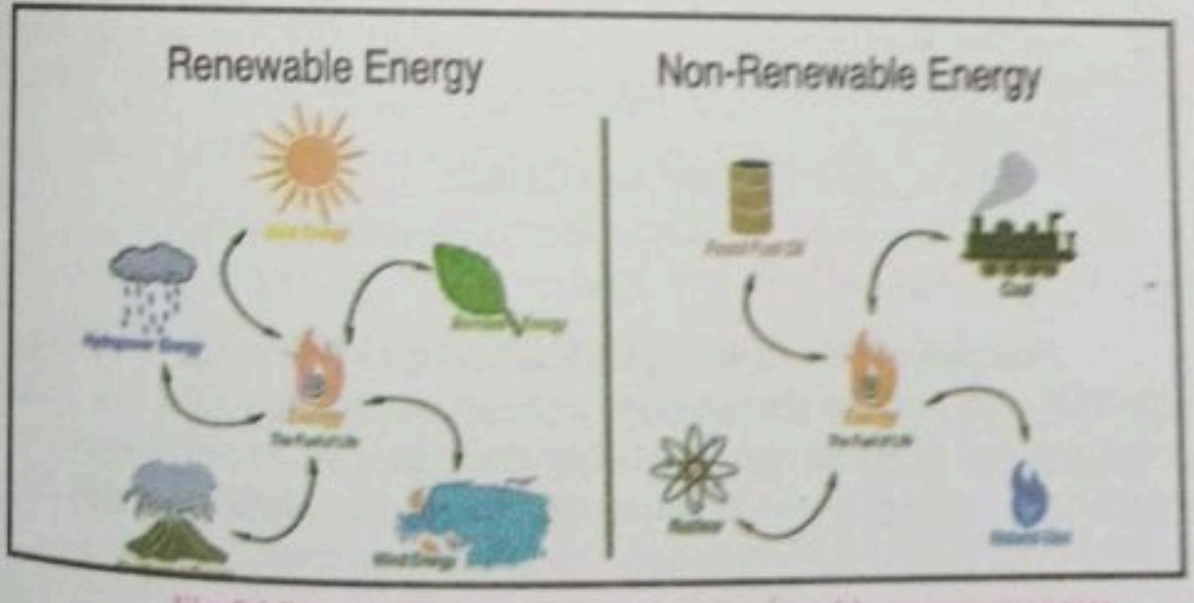

Fig:5.1 Some of the renewable and non-renewable energy resources

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play an important role in the world, the energy sources have been divided into two main categories: non renewable sources and renewable sources. Non renewable sources include the fossil fuels like coal, petroleum, and natural gas.

Conventional energy sources are typically fully developed and includes non renewable energy resources like fossil fuels as well as nuclear power while non-conventional sources which includes renewable energy resources like solar power, hydropower and wind power may be functional but are still undergoing development.

Fossil fuels are expensive and require established technologies that can produce energy round the clock. Non-conventional energy sources have a much smaller environmental impacts and they are renewable. Conventional sources of energy have a limited supply because eventually the nuclear elements and fossil fuels will be used up.

In addition, burning fossil fuels release significant amounts of greenhouse gases and contribute to environmental pollution. Non-conventional energy sources are still expensive and are often limited to producing energy only under certain circumstances such as sunny days for solar panels and windy days for windmills.

Let's study each source in detail.

5.1.1 FOSSIL FUELS

Fossil fuels have been widely used as a source of energy since the Industrial Revolution just before the dawn of the 20th century. Fossil fuels are relatively easy to use and it is easy to generate energy from it because they only require a simple direct combustion.

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However, a problem with fossil fuels is their environmental impact. Not only does their excavation from the ground significantly alters the environment, but their combustion leads to a great deal of air pollution. Although there are many different types of fossil fuels the most important are: coal, petroleum, and natural gas.

Fig 5.2 Plant and animal fossils preserved in the rocks are a source of fossil fuels

a. Coal

About 300 million years back, a large number of ferns and other prehistoric plants were common on the swamp-like earth. When those plants died and fell to the ground, they were covered with water and they slowly decomposed.

As decomposition took place in the absence of oxygen, much of the hydrogen content of the matter was eroded away, leaving a material rich in carbon.

The material was compressed over the years by sand and dirt, leaving the form of carbon known as coal. The nature of coal is such that the higher the carbon content, the more cleanly and brilliantly the coal burns.

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For Your Information

Coal Reserves of Pakistan

Thar desert gives a look of barren and dry harsh landscape. Hidden deep in it lies what can possible be called as black gold of Pakistan. Thar coal is one of the 5th largest coal reservoir in the world having a total of about 850 Trillion cubic feet of reserves which can possibly enable Pakistan to produce enough electricity to power the entire country.

The other states of coal, from lowest carbon content to highest, are "lignite," bituminous coal, and anthracite coal. If the coal is heated and compressed even more, the result is "graphite," almost completely pure carbon.

Coal is used extensively for the generation of electricity for running industries.

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b. Petroleum

Petroleum, or "crude oil," is a liquid fuel that is present in various locations throughout the world. It has many uses, from the generation of electricity to the manufacture of medicines, plastics, and other commercial items.

Much like coal, petroleum is formed from the remains of biodegraded organic material. When animals that lived in the sea millions of years ago died underwater, their remains were gradually covered by layers of very fine dirt known as "silt" on the ocean floor. Then, as the years passed, pressure from the layers built up and compressed the organic material, forming the oil.

Fig: 5.3 Seas have enormous quantities of oil and to drill that oil rigs are used. These rigs create holes to drill oil wells.

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c. Natural gas

Natural gas consists primarily of methane (CH_4). It is found associated with other hydrocarbon fuel. Natural gas is almost always found along with the deposits of petroleum.

When the petroleum is drilled, natural gas is also recovered. Wells with only natural gas also exist

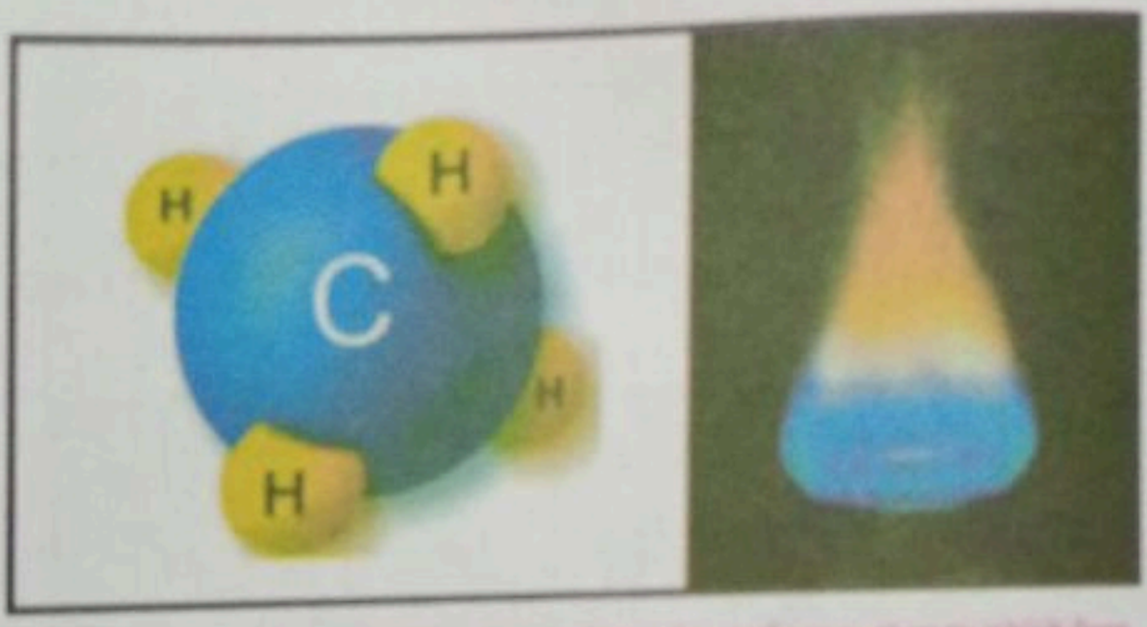

Fig: 5.4 Methane (CH_4) is chemically made up of one carbon to which four hydrogen atoms are attached. Blue colour in the flame indicates methane other colours in the flame represents condensates. Condensates could be Benzene, Toluene, Tar, Oil, Dust, Rust etc.

Many houses, offices, and other buildings are heated by natural gas heaters. The western hemisphere, Europe, and parts of Africa contain the largest natural gas deposits.

The gas is usually transported by pipelines. Compared to petroleum and coal, natural gas is relatively clean-burning because it contains only trace portions of sulfur and nitrogen.

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For Your Information

Sui Gas Field of Pakistan

The Sui is located at a distance of about 650kilometres (km) from Karachi in Dera Bugti, Balochistan. Sui is a major gas field of Pakistan. As a major production facility, Sui Gas Field (SGF) has the country's largest gas compressor station and a purification plant At the time of its discovery, SGF was considered among the largest natural gas fields in the world. Despite diminishing reserves over time, SGF still remains the highest natural gas producing field in Pakistan.

5.1.2 RENEWABLE ENERGY SOURCES

Due to diminishing fossil fuels renewable energy may become a major energy choice for the 21st century. Among the most important of these sources is wind, hydroelectric and solar. Renewable energy sources are environmentally clean and virtually inexhaustible.

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Their major drawbacks, however, are limited energy production (in most cases not suitable for large-scale power generation) as well as relative cost to build and maintain.

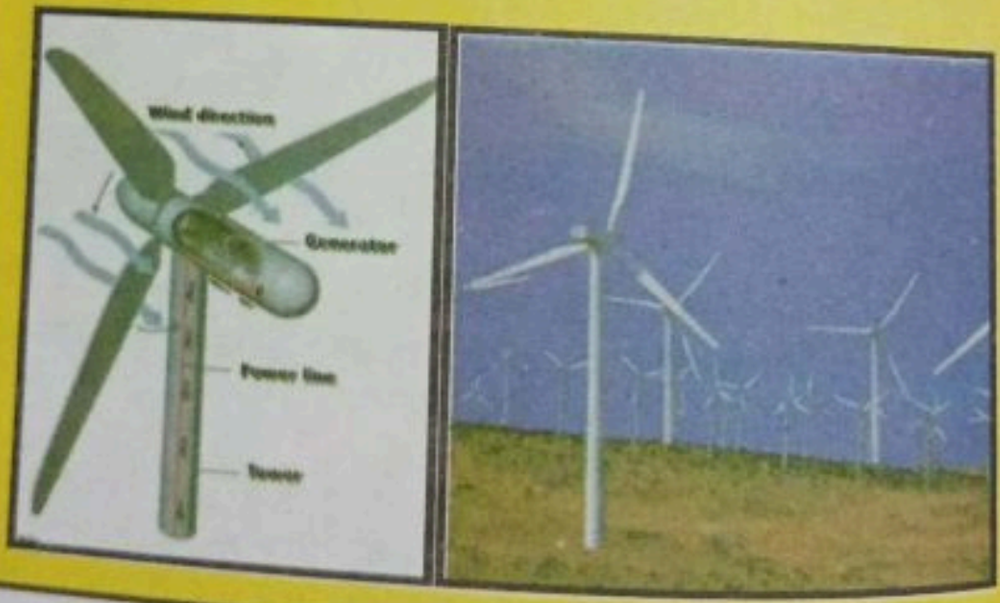
a. Wind energy

Wind has been used as a source of energy for centuries. About 3000 BC ago, people probably first used the force of moving air to push a boat with a sail through the water. This might have led to the invention of the windmills. These wind mills were first used in central Asia. Windmills were used in Europe more than 700 years ago to grind grains and pump water.

More recently wind power is used to turn wind turbines. In United States and Europe many wind farms routinely generate several mega watts of electricity a day.

Wind Power : Clean Way of Electricity Generation

Wind power is the fastest-growing energy source in the world. Turbines powered by wind are mounted on towers 100 or more feet above the ground, where the wind is faster and less turbulent.



In Pakistan efforts are being made to use wind energy for pumping water and producing electricity.

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b. Hydroelectric energy

Man has utilized the power of water for years. Hydroelectric systems make use of the energy in running water to create electricity.

In coal and natural gas systems, a fossil fuel is burned to heat water. The steam pressure from the boiling water turns "propellors" called turbines. These turbines spin coils of wire between magnets to produce electricity.

Hydropowered systems also make use of turbines to generate electrical power; however, they do so by using the energy in moving water to spin the turbines.

Ghazi Barotha Hydropower Project

Ghazi Barotha Hydropower Project is a unique power project. It has a generation capacity of 1450 MW and it consists of three main components. The Barrage, the Power Channel and the Power Complex. The Project utilizes the normal Tarbela Dam releases to provide year round maximum power generation.

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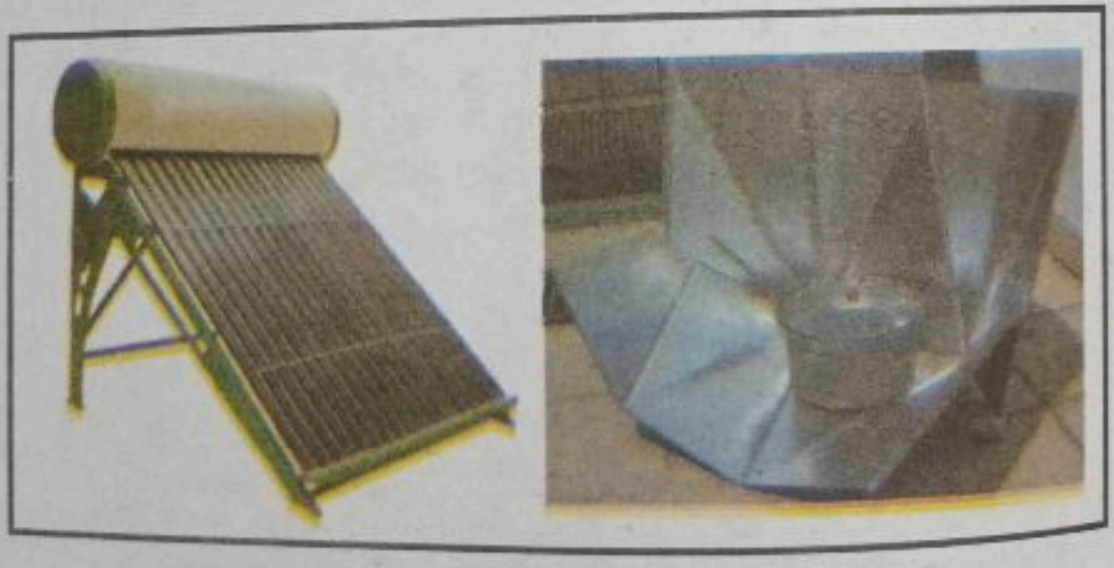
Water has kinetic energy when it flows from higher elevations to lower elevations. This energy spins the turbines and generates electricity.

In Pakistan hydroelectric power projects are contributing significantly to the cause of electricity production.

Although Pakistan has huge hydal power generation capacity mainly on river Indus but it has yet to exploit it to its maximum capacity. However, three main dams Tarbela, Mangla, and Warsak constructed for the purpose of generating electricity and irrigating agricultural land are vital for the energy sector in Pakistan.

c. Solar Energy

Most of the energy known to man is derived in some way from the sun. When we burn wood or other fuels, we actually release the stored energy of the sun. In fact, there would be no life on earth without the sun, which provides energy needed for the growth of plants, and indirectly, the existence of all animal life.



a. b.

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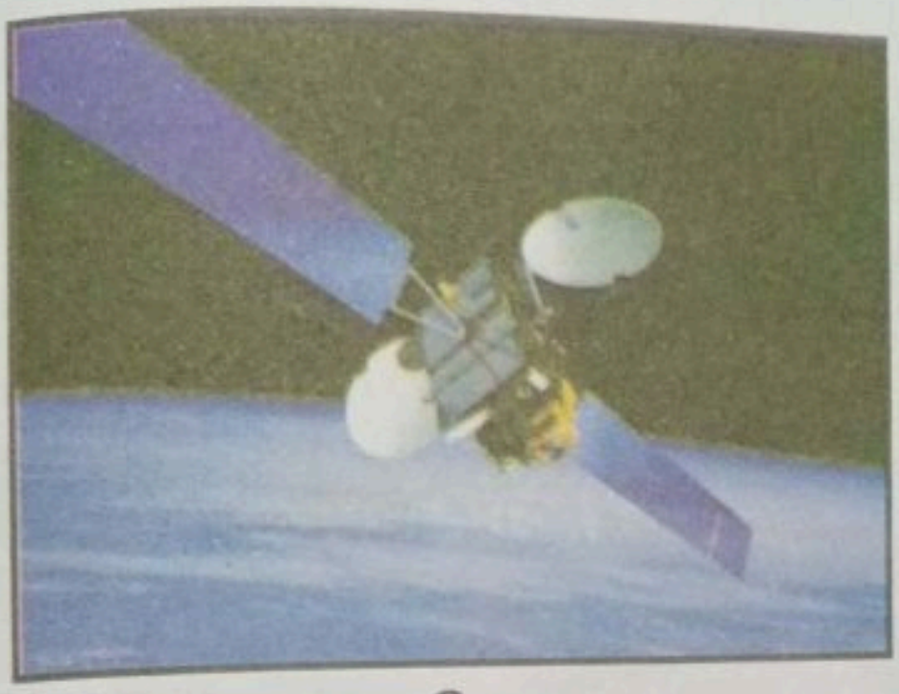

c.

Fig: 5.5 a. Solar geyser b. Solar cooker c. Solar panel powering artificial satellite in space

Nowadays electric current is obtained from sun's energy. A device called a solar cell can change the energy of sun light to electrical energy. Such solar cells are frequently used in calculators, watches etc.

Batteries made up of solar cells are used to run radios, television, equipments in artificial satellites going around the earth. Solar cookers, solar geysers and solar house heating system are successfully working by using solar energy

Solar power has an exciting future ahead of it. Because solar power utilizes the sunlight, a resource that is everywhere. Solar panels can be attached to moving objects, such as automobiles to power those objects. Solar powered cars are being experimented these days.

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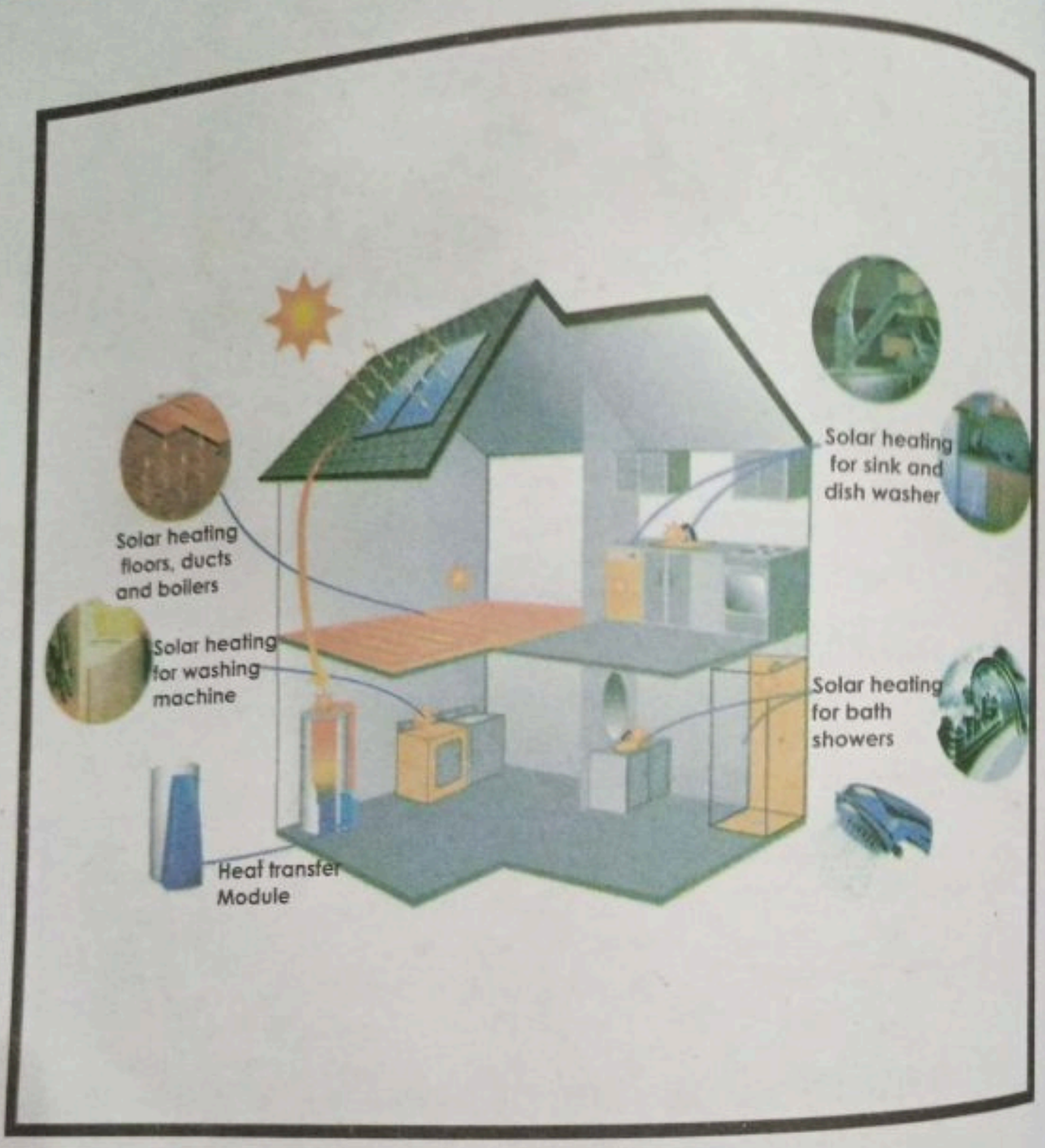

Fig: 5.6 Solar heating system for a house.

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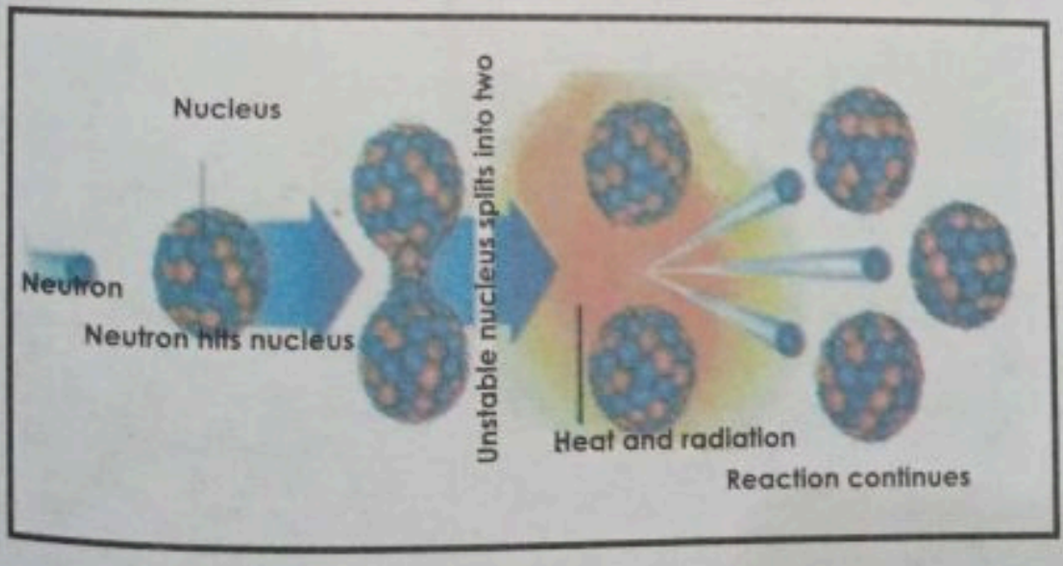
Do You Know?

There are two ways in which solar power can be converted to energy. The first, known as "solar thermal applications," involve using the energy of the sun to directly heat air or a liquid. The second, known as "photoelectric applications," involve the use of photovoltaic cells to convert solar energy directly to electricity.

5.1. 3 NUCLEAR ENERGY

The diminishing availability of natural resources such as coal, petroleum, and crude oil has left scientists searching for an energy alternative. Harnessing the power of the atom appears to be one of the solutions. Fission and fusion reaction are the two types of nuclear reaction with the help of which energy can be produced from an atom. Nuclear energy is the energy released from the nucleus of the atom when it is hit or bombarded by a slow moving atomic particle, called neutron. When the atom of Uranium 235 is hit by the neutron, it splits up into several parts. With the relsease of enormous amount of energy this process is known as nuclear fission. It is carried in specially designed nuclear reactors.



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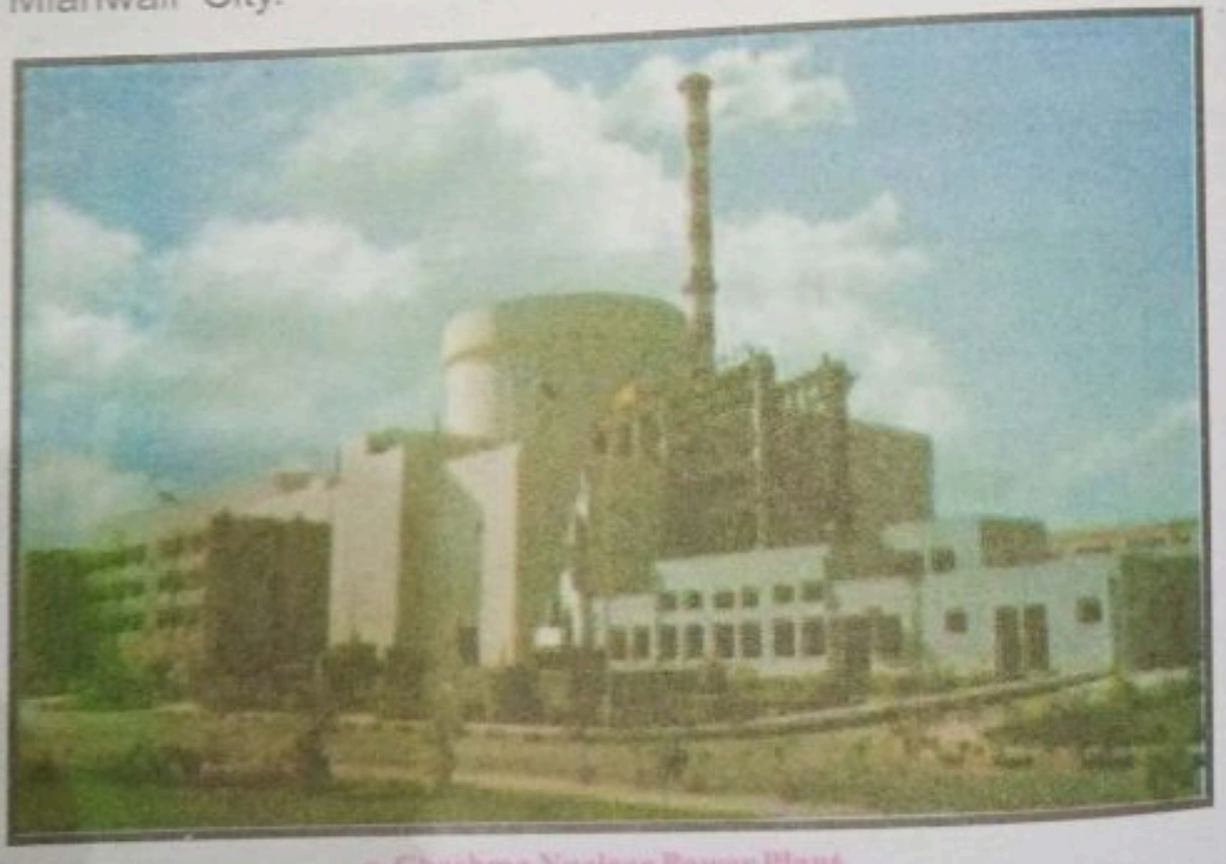
Cold water is pushed in the core of nuclear reactor, which carries away heat of the nuclear reactor and turns into steam. The steam is ejected into the steam turbine which begins to turn the generator to produces electricity.

In Pakistan Karachi Nuclear Power Plant (KANUPP) and Chashma Nuclear Power Plant (CHASNUPP-1) are the two main nuclear power plants which are producing electricity. KANUPP has a capacity to produce 137 Mega Watts of electricity. It is located at Paradise Point on the Arabian Sea Coast, about 15 miles to the west of Karachi.

CHASNUPP-1, the second nuclear power plant in Pakistan, was started in 1992 with the help of People's Republic of China. CHASNUPP-1 has a capacity of 325 Mega watt of electricity. The Plant is located in the province of Punjab near Chashma Barrage on the left bank of River Indus, 32 Km south of Mianwali City.



a. Chashma Nuclear Power Plant

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b. Karachi Nuclear Power Plant (KANUPP)
Fig: 5.8

5.1.4 HYDROGEN AS FUEL

Hydrogen is the simplest element. An atom of hydrogen consists of only one proton and one electron. It is also the most plentiful element in the universe but it is always present combined with other elements e.g Water (H_2O).

Hydrogen is also found in many organic compounds, notably the hydrocarbons that make up many of our fuels, such as gasoline, natural gas, methanol and propane.

Hydrogen can be separated from hydrocarbons through the application of heat - a process known as reforming. Currently, most hydrogen is made in this way from natural gas.

An electrical current can also be used to separate water into its components of oxygen and hydrogen. This process is known as electrolysis. Some algae and bacteria, using sunlight as their energy source, even give off hydrogen under certain conditions.

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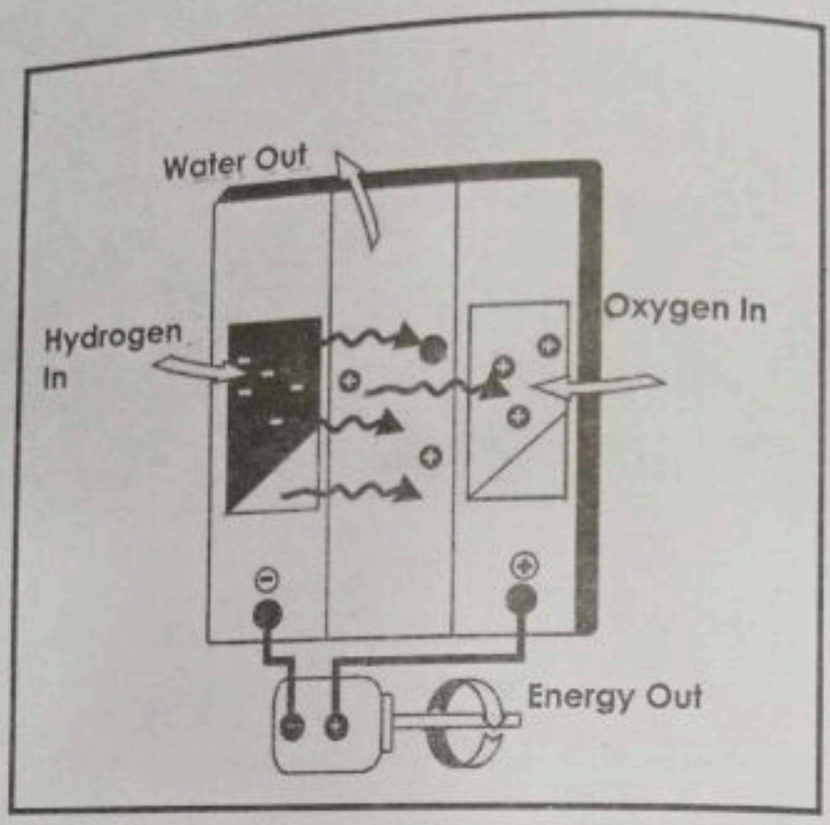

Fig: 5.9 Hydrogen fuel cell

A fuel cell combines hydrogen and oxygen to produce electricity, heat, and water. Fuel cells are often compared to batteries. Both convert the energy produced by a chemical reaction into usable electric power.

Fuel cells are useful to be used as a source of heat and electricity for buildings, and as an electrical power source for electric motors propelling vehicles.

Fuel cells operate best on pure hydrogen. But fuels like natural gas, methanol, or even gasoline can be reformed to produce the hydrogen required for fuel cells.

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Hydrogen Fuel in Space Shuttle

Hydrogen is high in energy, yet an engine that burns pure hydrogen produces almost no pollution. NASA has used liquid hydrogen since the 1970s to propel the space shuttle and other rockets into orbit. Hydrogen fuel cells power the shuttle's electrical systems, producing a clean byproduct - pure water, which is used by the crew for drinking.

5.3 MEASUREMENT OF ENERGY

Worldwide, two systems of units of measurement are commonly used today: the Metric System (Systeme International) and the British System. Energy can be converted into work. Energy can be represented by the following simple equation:

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Work = Force x Distance

Energy is defined as the ability to do work. However, work is defined as a force applied to some form of matter (object) multiplied by the distance that this object travels.

Physicists commonly describe force with a unit of measurement known as a newton (after Sir Isaac Newton). A newton is equal to the force needed to accelerate (move) a mass weighing one kilogram to a distance of one meter in one second in a vacuum with no friction. The work or energy required to move an object with the force of one newton over a distance of one meter is called a joule.

a. MEASUREMENT OF ELECTRICITY

Electric meter is connected with the live wire of main supply. Live wire is connected with the field coils of the meter. Inside the field coil, there is another coil, which can rotate about its axis. When current passes through meter, magnetic field is produced due to which coil inside the field rotates. The disc rotating along with coil can be seen from outside. The gears attached to the disc display meter reading on the dial. The reading is in kilowatt –hours (kW), which is simply called a unit.

Fig: 5.10 Electric Meter.

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b MEASUREMENT OF NATURAL GAS

Gas meter are installed to measure gas consumption. Natural gas is measured in cubic meter (m^3). The gas before entering the house passes through the gas meter, which turns a wheel. The gears attached to the wheel display the volume of the gas consumed on the dial. Now a days gas bills are being charged on the base of British thermal unit (BTU). It is also the unit of energy. One BTU is equal to 1055 joules.

Fig: 5.11 Gas meterl

5.3 ENERGY IN DEVELOPMENT OF A COUNTRY

Energy has become a fundamental aspect of human existence. The development of a country can be judged by the amount of energy it consumes. Generally we see that the developed country has larger demand for energy compared to a developing or under developed country.

Modern day industries cannot sustain their activities without uninterrupted energy supplies. This in turn, ensures the creation of employment opportunities which ultimately generate economic activities and increases the standard of life of a nation. Development in the fields of agriculture, health, education, industry etc require energy and lack of investment in terms of energy in these fields mean no development and low standard of life.

Access to energy is therefore a prerequisite for sustainable development.

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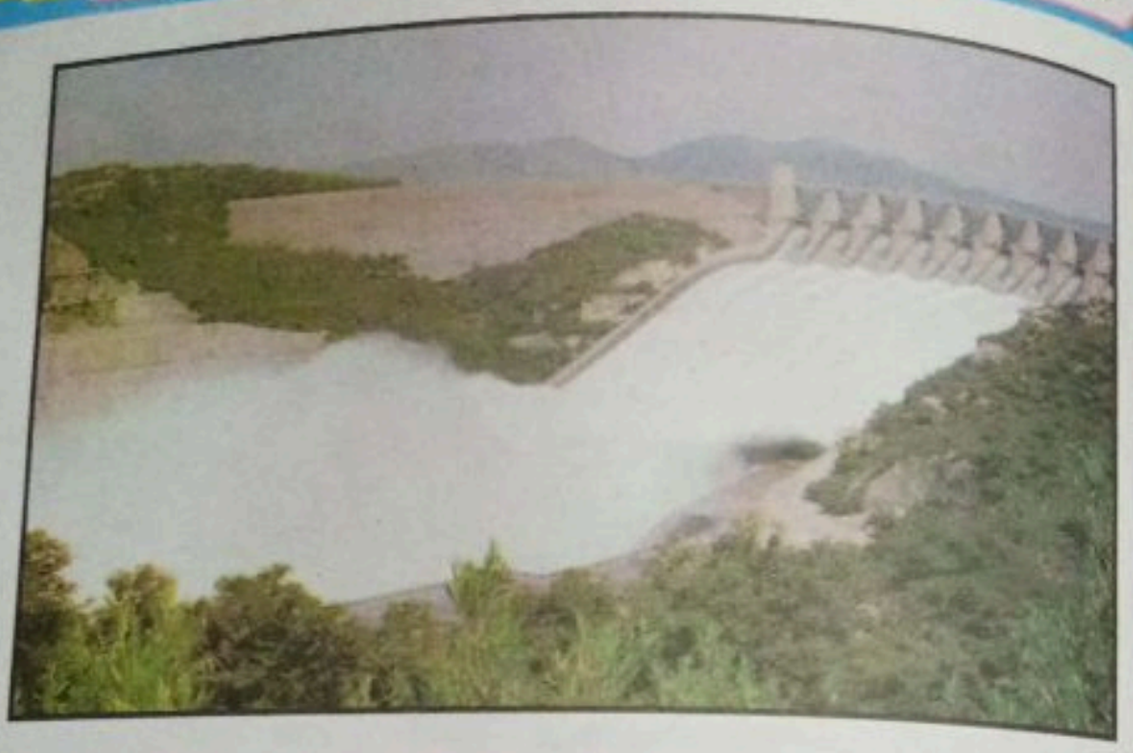

Fig: 5.12 Hydel power is still regarded as the cheapest source of energy

Pakistan's economy is growing steadily. This growth demands higher energy consumption. Pakistan mainly depends upon oil and gas resources to fulfill energy requirements. Indigenous resources of oil are not enough for the growing economy. As a result Pakistan has to import large quantities of oil and oil based products from Middle East countries.

Although Pakistan is blessed with a huge potential for hydel energy but proper planning and a clear strategy in this regard has yet to devised.

Pakistan total primary energy supply during the year 2007- 2008 was 62.88 MTOE (million tons of oil equivalent) more than 99% of this energy was supplied through conventional energy sources such as oil, gas, hydel and nuclear, etc. whereas less than 1% supplied through micro/mini renewable energy (RE). Today, only 55% of Pakistan's population has access to electricity.

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The nation is currently facing power supply shortage the worst to ever hit the country. The occurrence of prolonged and frequent power breakdowns has had a negative impact on industry operation, the economy and the livelihood of citizens in general.

While the energy shortage continues to grow, abundant indigenous sustainable energy resources such as wind, solar and biomass remain virtually untapped.

Currently, approximately 66% of power generation in Pakistan is derived from fossil fuels(primarily oil and gas) followed by hydroelectricity (30%) and nuclear energy (3%).

5.4 ENERGY AND ENVIRONMENT

Humans are always in search of different sources of energy to make their lives comfortable and stable but sometimes these sources of energies becomes hazardous to them and their environment.

Humans are at risk whether it is burning of fossil fuels or production of electricity through nuclear power plant. Emissions and contaminations all pose serious consequences on the lives of human.

In the following section we will see how production of energy from various sources affects our lives and what the possible remedial measures are in this regard.

Thermal pollution

The word therm means heat and heat is a form of energy. It is the kinetic energy associated with the motion of atoms and molecules. Thermal process is that process in which heat is produced or is converted into other forms of energy.

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In this process heat exchange between system and surrounding may occur. Combustion reaction is an example of thermal process.

In combustion reaction carbon dioxide (CO_2), water (H_2O), light and heat are produced. If oxygen supply to the reaction is insufficient, then carbon monoxide (CO) may also be produced. Certain fuels also contain sulphur.

When they burn, sulphur dioxide (SO_2) is given off. Coal and fuel oil contain upto 3% of sulphur and petrol about 0.05%. quite low concentration of SO_2 can damage the leaves of plants and stunt their growth and they can also make people's respiratory illness much worse.

Carbon monoxide (CO) is poisonous and can cause death, even if its concentration is in decimals. High concentration of CO_2 also has adverse effects on the environment. It helps in increasing the temperature of our atmosphere due to green house effect.

Fig: 5.12 Thermal pollution emitting from chimneys.

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Remedial measures

- Maximizing the efficiency of heat engines to minimize heat loss.
- Less burning of fossil fuels and avoiding energy wastages.
- Industries and factories should follow strict norms to reduce thermal pollution.
- Temperature of industrial waste water from power plants, paper industries, and cement industries should be reduced by the adoption of cooling ponds and towers.

Nuclear Fuel Hazards

Radioactive material emit certain radiation. These radiations have the ability to penetrate gases, liquids and even solids. The radiations are:

1) Alpha radiations
2) Beta radiations
3) Gamma radiations

Penetration power of these radiations is different due to their size, velocity and nature.

Controlled nuclear reactions are useful for humanity but when they are out of control or when they occur in open, they damage the whole area. These rays are carcinogenic (causing cancer) and also cause deformation in new born babies.

Remedial measures

To avoid such hazards care must be taken in performing nuclear reactions and disposing off nuclear wastes. The design of the nuclear reactor must include provisions for human (operator) error and equipment failure.

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Famous accidents of civil nuclear power generation

The three significant accidents in the 50-year history of civil nuclear power generation are:

Three Mile Island (USA 1979) where the reactor was severely damaged but radiation was contained and there were no adverse health or environmental consequences.

Chernobyl (Ukraine 1986) on 26 April 1986, reactor no. 4 of the Chernobyl nuclear power station exploded. One hundred times more radiation was released than by the atom bombs dropped over Hiroshima and Nagasaki.

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Famous accidents of civil nuclear power generation

Fukushima (Japan 2011) Fukushima Daiichi nuclear power plant, 150 miles northeast of Tokyo, was severely damaged by the earthquake and tsunami the world's worst nuclear accident in 25 years.

In any nuclear reactor some sort of cooling is necessary. Generally nuclear reactors use water as a coolant. However some reactors which cannot use water use sodium or sodium salts. There is a series of physical barriers between the radioactive core and the environment.

5.5 ENERGY COSUMPTION AND CONSERVATION

After obtaining preliminary information, you would have realized the value and importance of energy in modern society. You may have also noticed that conventional sources of energy are limited. Exploitation of non –conventional energy sources is still in initial stages of research and development. The fuel that burns in factories, transport vehicles or perform other activities is mainly obtained from the underground deposits in the form of coal, oil, natural gas and other similar raw forms. These deposits are rapidly decreasing.

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The rapid growth in population increases the pressure on the use of resources. The excessive and unwise use of resources affects the environment. After all, one day, all the resources of energy will be exhausted. It is, therefore, highly important for us to avoid wastage of energy and conserve energy by taking suitable steps at our homes, schools, industries and offices etc.

Conservation of energy in homes

To conserve energy at homes, we must put off the electrical appliances and close gas and water valves, when not required. We should use electrical appliances that use comparatively lesser energy e.g. tube lights, energy saver bulb etc. We should design our homes such that we get maximum benefits of sun light and proper ventilation.

Conservation of energy in schools

We must take steps to minimize energy consumption, like designing schools such that it is properly ventilated and get maximum benefits of the sun light.

Conservation of energy in industries

Industries play an important role in the development of a country. These industries run with consumption of energy. Although they need huge amount of energy but consumption of energy could be minimized by better management, reuse of by products and proper maintenance of machinery.

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KEY POINTS

- Energy is defined as: "the ability to do work."
- Energy sources have been divided into two main categories: non renewable energy sources and renewable energy sources.
- The renewable energy sources are solar, wind, hydroelectric, biomass, and geothermal power.
- Non renewable sources include the fossil fuels like coal, petroleum, and natural gas.
- Fossil fuels are relatively easy to use and it is easy to generate energy from it because they only require a simple direct combustion.
- When prehistoric plants died and fell to the ground, they were slowly decomposed in the absence of oxygen. The material was compressed over the years by sand and dirt, leaving the form of carbon known as coal.
- Petroleum is formed from the remains of biodegraded organic material.
- Natural gas consists primarily of methane and is found associated with other hydrocarbon fuel.
- Nuclear energy is the energy released from the nucleus of the atom when it is hit or bombarded by a slow moving atomic particle, called neutron.
- Two systems of units of measurement are commonly used today. These are Metric System (Systeme International) and the British System.
- The development of a country can be judged by the amount of energy it consumes. Generally we see that the developed country has larger demand for energy compared to a developing or under developed country.

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KEY POINTS

- Thermal process is that process in which heat is produced or is converted into other forms of energy.
- Radio active materials emit certain radiation which has the ability to penetrate gases, liquids and even solids.
- To avoid wastage of energy and conserve energy by taking suitable steps at our homes, schools, industries and offices etc.
- To conserve energy at homes, we must put off the electrical appliances and close gas and water valves, when not required. We should use electrical appliances that use comparatively lesser energy.

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EXERCISE

A. Select the correct answers for the following questions.

1. Fuel formed under the earth's surface by the decomposition of organic matter is called _____
   a. Organic fuel
   b. Biogas
   c. Fossil fuel
   d. Inorganic fuel

2. Which of the following causes the least pollution when burnt?
   a. Petrol
   b. Diesel
   c. Coal
   d. Natural gas

3. Which of these is not a renewable source of energy?
   a. The sun
   b. Natural gas
   c. Wind
   d. Ocean tidal energy

4. A solar cell is made up of
   a. Silicon
   b. Teflon
   c. Titanium
   d. Magnesium

5. A solar cell converts _____
   a. Heat energy into electrical energy
   b. Solar energy into electrical energy
   c. Heat energy into light energy
   d. Solar energy into light energy

6. The fuel used in the nuclear reactor is _____
   a. Cadmium
   b. Uranium
   c. Radium
   d. Thorium

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EXERCISE

7. The state of coal, with lowest carbon content is _____

a. Bituminous coal
b. Anthracite coal
c. Lignite,
d. None of these

8. A unit of electricity means

a. Megawatt
b. Nanowatt
c. Kilowatt hour
d. Joule

9. Which of the following problems is associated with the burning of coal?

a. Acid rain
b. Carbon dioxide emissions
c. Ash with toxic metal impurities
d. All of these

10. Solar energy stored in material such as wood, grain, sugar, and municipal waste is called _____.

a. Fossil fuels
b. Biomass
c. Geothermal energy
d. Natural gas

11. The world faces an energy crisis because _____.

a. World demand for energy will increase
b. World oil production will peak and begin to decline
c. Shortages and the resulting escalation of prices can shock the economic and political order.
d. All of the above

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EXERCISE

12. A fuel cell combines hydrogen and _____ to produce electricity, heat, and water.

a. Carbon
b. Oxygen
c. Uranium
d. Silicon

13. Fossils are the

a. Dead remains of living organism
b. Coal mines
c. Kind of natural resource
d. Living beings

14. Petroleum is mixture of

a. Petrol
b. Diesel
c. Petroleum gas
d. All of these

15. Burning of fossil fuel causes

a. Air pollution
b. Global warming
c. Both (a) & (b)
d. None of these

B. Answer the following questions.

1. What would happen if there was no electricity?
2. What is Overuse of electricity?
3. What are the advantages and disadvantages of using petroleum?
4. Give two examples of ways to conserve energy at home?

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EXERCISE

5. What is a conventional source of energy?

6. What is the importance of conserving energy?

7. What is mmbtu?

8. Describe various types of fossil fuels.

9. Write short note on the following:

   a. Coal as fossil fuel
   b. Petroleum
   c. Wind as source of energy

10. Write in detail the nature and utility of any two non conventional sources of energy?

11. Compare renewable energy sources with non-renewable sources.

12. Differentiate between conventional energy sources and non-conventional energy sources.

13. Briefly write the process of formation of fossil fuels.

14. Describe the role of energy in the development of a country.

15. How critical is hydel power generation for Pakistan. Discuss.

16. Nuclear power is regarded as one of the strategy for fulfilling the gaps of power shortages. How Pakistan has been able to use nuclear technology successfully and what hazards are associated with the use of nuclear energy?

NOT FOR SALE

Glossary

acid. A compound that yields hydrogen ions (H^+) when in aqueous solution. Acids have a sour taste and turn blue litmus red.

alcohol. Organic compound used in gums, resins, dyes and perfumes. Fermentation produces ethanol not alcohol.

alkali. A base that is soluble in water.

atomic number. The number of protons in an atom.

atomic symbol. The letters representing each of the elements.

atomic weight. Sum of number of protons and neutrons in the nucleus.

atoms. Composite particles of protons, neutrons and electrons. The smallest part of a substance that can take part in a chemical reaction.

base. A compound that yields hydroxide (OH^-) ions when in aqueous solution. Bases have a bitter taste, feel greasy, soapy and turn red litmus blue.

boiling point. The temperature at which a liquid starts boiling.

bond. A chemical link between atoms.

carbohydrates. The major energy source within plants and animals: sugars, starches and glucose polymers.

carbon. The basic element in all organic compounds.

catalyst. A substance that reduces the activation energy of a reaction.

cell. The smallest independent part of an organism.

chain reaction. Polymerisation initiated by the bonding of a free radical with a monomer.

charge. The amount of unbalanced electricity in a system. Either positive or negative.

chemical (empirical) formula. The ratio of elements in a substance. For example: the chemical formula of common salt is NaCl, sodium and chlorine in a ratio of 1:1.

chemical reaction. The transformation of substances by the rearrangement of their atoms.

chromosomes. Thread like structures found in the nucleus of the cell and carrier of hereditary material.

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Glossary

compound. A substance containing more than one element.

conduction. Heat or electricity transfer through molecular interaction, eg: heat passing along a metal bar.

DNA: Deoxyribonucleic acid. Twisted helical polymer chains. See chromosomes.

electric current. A flow of electrons through a conductor, the amount of the current is proportional to the rate of electron flow.

electrons. Negatively charged atomic particles spinning around the nucleus in its orbits.

electromagnetic waves. Waves with both an electric and magnetic component. They are: radio, micro, infra-red, visible light, ultraviolet, X rays and gamma rays. .

element. A substance composed of atoms all with the same atomic number. A substance that cannot be split chemically into smaller substances.

energy. The capacity to do work. Work is done by transferring energy from one form to another. For example the chemical energy in a fuel is converted to thermal energy as it burns.

exothermic reaction. A reaction from which heat is lost eg: combustion.

fats. Molecules of fatty acids or glycerol. Used as a food store, insulation and for shock absorption.

fecundity. The ability to breed.

field. A region in space that is defined by a vector function. Common fields are: gravitational, electric and magnetic.

fission. Splitting the nucleus of an atom into smaller nuclei.

force. An action (transfer of energy) that will accelerate a body in the direction of the applied force. See Newtons Laws of Motion.

fusion. 1. Change of state of a substance from a solid to a liquid. 2. The joining together of two atomic nuclei.

gene. A unit of inheritance. A section of DNA. comprising a sequence of four bases: adenine, guanine, cytosine and thymine.

heat. The internal energy of a body (substance).

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Glossary

hydrocarbon. Compounds containing only hydrogen and carbon atoms.

ingots. Mass of metal cast into a convenient shapes

inheritance. The features of an organism are determined by a set of chromosomes. These originate in the parents and are passed on to an offspring during fertilisation. It follows then that since chromosomes are inherited, all the features of an organism must be inherited.

isotope. An element that has more or less neutrons than normal. Many isotopes are radioactive.

kinetic energy. The energy possessed by a body in motion.

mass. The quantity of matter in a body.

metals. Elements characterised by their opacity, malleability and thermal and electrical conductivity.

molecular formula. The number and types of atom in a molecule. For example the molecular formula of methane is CH_4 one atom of carbon and four atoms of hydrogen.

molecule. A group of atoms bonded together. It is the smallest part of a substance that retains the chemical properties of the whole.

monomers. Small molecules that link together to form a polymer.

neutralization. A reaction in which the characteristics of an acid or base disappear.

neutrons. Particles with no charge forming part of an atomic nuclei.

noble gases. Elements with zero valency. They form group 0 in the periodic table and are non-reactive.

organic compounds. Substances that contain Carbon.

ozone. An isotope of oxygen that blocks ultra-violet radiation. Normally found in the stratosphere.

pathogenic. Capable of causing disease

pH Scale. The strength of acids and bases. Pure water has a pH value of 7, acids have a lower value and bases higher.

phase changes. Freezing or boiling.

photosynthesis. The conversion of water and carbon-dioxide by plants into glucose and oxygen. Light is used as an energy source.

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Glossary

polymerisation. The repetitive bonding of small molecules (monomers) to produce large molecules (polymers).

polymers. Long chain molecules such as PVC, nylon or DNA produced by the polymerisation of monomers.

potential energy. Amount of usable energy within a body at rest.

power. Amount of work done per second.

products. The substances produced in a chemical reaction.

proteins. Amino acid polymers with specific biological functions, especially the growth, regeneration and repair of cells.

radiation. 1. Transfer of heat between bodies without a change in the temperature of the intervening medium. 2. Any release of energy from its source.

radioactivity. The spontaneous release of energy from atomic nuclei.

reactants. The substances that take part in a chemical reaction.

reproduction. Reproduction is the process by which a new organism is produced.

resistance. Opposition to current flow in a conductor.

respiration. The production of energy by the oxidisation of glucose.

skepticism. A doubting or questioning attitude or state of mind;

temperature. How hot one body is when compared to another.

weight. The gravitational force exerted on a mass.

work. The amount of energy transferred to a system.

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