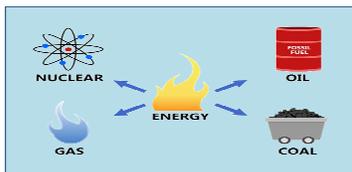


## 28B. NON-RENEWABLE SOURCES OF ENERGY



- Non-renewable resources once consumed, are lost forever. It comprises of the fossil fuel.
- There are three major forms of fossil fuels: Coal, oil and natural gas and on worldwide basis they provide approximately 90% of energy consumed.



### • Formation of Coal

- Coal is the result of plant material that grew in fresh water swamps approximately three hundred million years ago.
- As this plant material die it is accumulated as, peat which is also called as peat bog.
- The plant material accumulated under water, in the swamps decay was inhibited due to lack of oxygen.
- Sediments from the sea were deposited, over the peat.
- The weight of these sediments and the heat of the earth gradually changed the composition of the peat bog and coal is formed.
- Peat is changed into coal after being compressed for centuries by the weight of sediments.
- It first changes into a low-grade coal known as lignite (brown coal). The percentage of carbon in the lignite is higher than in peat.
- Continuous pressure and heat from the earth changes **lignite** into **bituminous** (soft coal).
- With more of heat and pressure **anthracite coal** (hard coal) would be formed which has the highest heat and carbon content.
- Accordingly energy content is greatest in anthracite coal and lowest in lignite. .
- The coal is used as a source of energy for domestic uses, locomotive engines, various types of furnaces in the industries, thermal power generation, extraction of metals and minerals, production of gas, tar etc. The type of coal determines its use.

- Fossil fuels are the remains of prehistoric plants, animals and microscopic organisms that lived and remain under the effect of intense heat and pressure underneath the earth's crust over long geological time and got transformed into fossil fuels.
- During the Carboniferous period 275-350 million years ago, conditions in the world were suitable for formation of large deposits of fossil fuels

### • COAL

- Coal is a solid fossil fuel and a sedimentary rock composed primarily of carbon.
- Three basic grades of coal are :
- lignite (brown coal),
- bituminous (soft coal) and
- anthracite (hard coal)
- Coal is formed from plants and vegetation buried, 'in situ' or drifted in from outside to a place, which got covered by deposits of sediments.

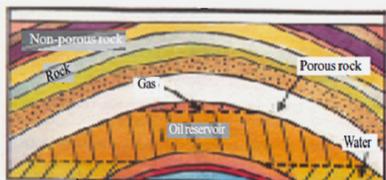
### • Problems

Coal is mined from both (i) surface mines, and (ii) underground mines.

Surface mining	Underground mining
<ul style="list-style-type: none"> <li>• Surface mining disrupts and drastically changes the natural landscape, destroys the natural vegetation and the habitat of many species.</li> <li>• Mining operations cause serious problems of air and noise pollution.</li> <li>• It may also causes soil erosion and silt loading that disrupts and pollute the aquatic ecosystems as well as ground water</li> </ul>	<ul style="list-style-type: none"> <li>• Underground mining may cause collapse of land in the mining areas during or after mining operations.</li> <li>• Some cases acid drains from the mine pollute long stretches of streams.</li> <li>• Coal fires in underground mines give out much smoke and hazardous fumes causing several respiratory diseases to people living nearby.</li> </ul>

- **PETROLEUM OR MINERAL OIL**

- Oil and gas were formed from the remains of plants and animals that once lived in the sea.
- For over millions of years these remains remained buried under mud and rock under great pressure and at high temperatures.
- Under these conditions marine biomass gradually changed into oil and gas.



- Some oil and gas makes its way to the earth's surface is escapes. Large amounts of oil and gas are trapped below ground in certain areas of rocks, forming oil reservoir
- Petroleum or crude oil is a thick dark liquid consisting of a mixture hundreds of combustible hydrocarbons along with small amounts of sulphur, oxygen and nitrogen impurities. It is also known as conventional oil or light oil.
- Deposits of crude oil and natural gas are usually trapped together under the sea floor or earth's crust on land.
- After it is extracted, crude oil is transported to a refinery by pipelines, trucks or ships (oil tanker).
- In refineries oil is heated and distilled to separate it into components with different boiling points.
- The important components are gases, gasoline, aviation fuel, kerosene, diesel oil, naphtha, grease and wax and asphalt.
- Some of the products of oil distillation are called petro-chemicals which are used as raw material for the manufacture of pesticides, plastics, synthetic fibers, paints and medicines etc.
- **NATURAL GAS**
- Natural gas (primarily consist of methane) is a mixture of 50 to 90% by volume of methane ( $\text{CH}_4$ ), the simplest hydrocarbon.

- It also contains small amounts of heavier gaseous hydrocarbons such as ethane ( $\text{C}_2\text{H}_6$ ), propane ( $\text{C}_3\text{H}_8$ ) and butane ( $\text{C}_4\text{H}_{10}$ ) and also small amounts of highly toxic hydrogen sulphide ( $\text{H}_2\text{S}$ ).

- **Conventional natural gas**

- These deposits can be tapped only through pipeline.
- Burning of associated natural gas results in waste of valuable energy resource with emission of carbon dioxide into the atmosphere from its burning.
- After processing the gas is piped or compressed into cylinders for use by consumers, production of petrochemicals and fertilizers.

- **Unconventional natural gas**

- It is very expensive to get natural gas from such unconventional sources but technology is being developed to extract the gases economically.
- When a natural gas field is tapped, propane and butane gases, present in natural gas are liquefied and removed as liquefied petroleum gas (LPG).
- LPG is stored in pressurized tanks or cylinders for use as cooking gas.
- The production and consumption demand of natural gas has been rising in India for both industrial and domestic uses.
- Methane being major component of natural gas happens to be a green house gas and its leakage contributes to global warming.
- It is a better fuel option or energy resource.
- Leakage of natural gas from pipelines, storage tanks and distribution tanks can cause explosion.

- **Problems associated with oil and gas**

- Methane being major component of natural gas and its leakage contributes to global warming.
- Leakage of natural gas from pipelines, storage tanks and distribution tanks can cause explosion.

- Extraction of oil and gas may cause sinking of land or subsidence. Oil also contaminates the oceans.
- About half of the oil that contaminates the ocean comes from natural seepage from offshore deposits.
- 20% of the oil contaminating the ocean comes from oil well, blowouts, pipeline breaks and tankers.
- Oil kills aquatic plants and animals.
- Combustion of oil and gas also cause air pollution.
- **Location of fossil fuel deposits in India**
  - India has large reserves of coal and lignite is found in West Bengal, Bihar, Orissa, MP, AP as well as in Assam and Tamil Nadu.
  - Some of the major oil reserves are located in West coast, Gujarat, Godavari and Krishna delta on the East coast, Assam and Rajasthan.

#### Uses of natural gas

1. Natural gas is a relatively clean fuel burns readily to produce large amount of heat and is used as the main fuel for domestic and industrial heating purposes.
2. CNG is being used as a fuel in transport vehicles (buses, trucks and cars) because it causes less pollution.
3. Natural gas is used as a source of hydrogen gas needed in fertilizer industry.
4. Natural gas is used as a source of carbon used in tyre industry.

- **Advantages of natural gas**
- Natural gas is a clear and environmental friendly fuel and used directly for cooking purpose in homes.
- It can be supplied directly to the homes and factories through a network of underground pipelines.
- Natural gas burns with smokeless flame and does not produce any poisonous gas or pollute the environment

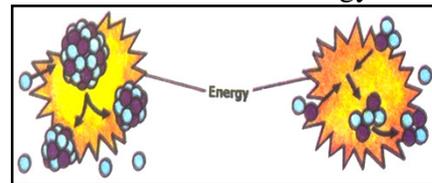
#### NUCLEAR ENERGY SOURCES

- Nuclear energy is the energy of the atomic nucleus.

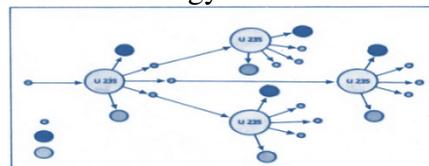
- Nuclear energy is generated by radioactive minerals through high technological methods.

#### Radioactive minerals

- Radioactive minerals are alternative to fossil fuels used for generating energy.
- Availability of ore of radioactive material is finite and limited and can generate large amounts of energy.
- Antoine Henri Becquerel discovered radioactivity in 1896, and the unit of radioactivity – Becquerel's (Bq).
- One Becquerel = 1 radioactive decay which is a very small amount.
- There are two methods through which radioactive minerals release energy:

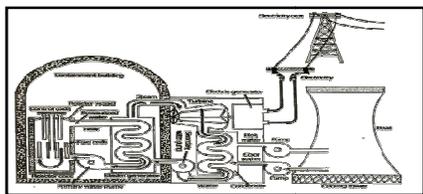


- **Left side shows Fission and right side shows fusion**
- i) **Nuclear fission:** In this process, the nucleus of heavy atom namely of uranium (U235) or plutonium (P239) breaks apart into smaller fragments, releasing an enormous amount of energy.
- ii) **Nuclear fusion:** In this process, small nucleus like those of isotopes of hydrogen, namely deuterium and tritium etc. fuse together to form heavier nuclei, releasing vast amounts of energy.



#### Nuclear fission showing chain reaction

- In the nuclear reactor, the rate of nuclear chain reaction is controlled and the heat generated is used to produce high pressure steam, which spins turbine that generate electricity



- Two other nuclear technologies for generating electricity from nuclear fuel in a safe and economic way have also been proposed, but so far they have not proved operationally successful.
- These are: (i) nuclear breeder reactor, (ii) fusion reactor.
- **(i) Nuclear breeder reactor**
- A nuclear reactor that can utilize between 40% and 70% of its nuclear fuel is called a breeder reactor.
- The nuclear reactors operating today use uranium very inefficiently.



- About 1% uranium is actually used to produce steam for generating electricity
- Breeder reactors convert more abundant Uranium-238 to Plutonium-239 or Thorium-232 to Uranium-233 fissionable isotopes, that can sustain a nuclear chain reaction.
- **(ii) Nuclear fusion reactor**
- In fusion two small atoms unite to form a large atom with the release of an enormous amount of energy.
- The energy produced by stars and the sun is the result of nuclear fusion.



- The advantage of using nuclear material for energy generation instead of coal and oil,
- It produces very little pollution.
- It requires less strip-mining as nuclear fuel have highly concentrated form of energy.
- The cost of transportation of nuclear fuels is much lower than that for coal and oil required for generation of an equivalent amount of energy.
- **Problems related to nuclear energy generation**
- Radioactive elements if not disposed properly cause radioactive pollution.
- The major problems associated with the generation of nuclear power are disposal of nuclear waste, contamination of environment with long lasting radioactive materials, thermal pollution.
- Health effects from exposure to low levels of radiation.
- High construction and maintenance costs, and reactor safety.
- Human or technical error that could result in a major accidents and vulnerability to sabotage, developing nuclear weapons by processing reactor waste.
- **Location of radioactive mineral ore in India**
- In India, monazite which is the main source of thorium, is found in commercial quantities on the Travancore coast between Kanya Kumari and Quilon,
- While uranite or pitchblende mineral of uranium is found in Gaya (Bihar), Ajmer (Rajasthan) and Nellore (Andhra Pradesh).



### Check Yourself

- Coal is formed of plants grow in water swamp and burned as peat bog. They could not decay due to unavailability of ----
  - O<sub>2</sub>
  - CO<sub>2</sub>
  - N<sub>2</sub>
  - NH<sub>3</sub>
- Mineral oil or petroleum is formed from remains of plants of millions of years ago on the earth on its---.
  - Land
  - Mountain
  - Forest
  - Sea and oceans
- LPG stored in cylinder for use as cooking gas contains liquefied ---.
  - Ethane and propane
  - Ethanol and methanol
  - Methane and butane
  - Propane and butane
- Unit which is used for measuring radioactivity is:
  - Calorie
  - Becquerel
  - Joule
  - Kelvin
- Nuclear energy may be obtained by breaking apart nuclei of heavy atoms like uranium. This is called:
  - Nuclear fission
  - Nuclear fusion
  - Nuclear reactor
  - Breeder reactor

Ans: 1.a      2.d      3.d      4.b      5.a



### Stretch Yourself

- Expand LPG, LNG, CNG
- In which part of India, coal reserves are found.
- Why do we consider fossil fuels as non-renewable sources of energy?
- How does lignite (brown coal) formed?
- What are the problems related with coal mining?



### Test Yourself

- Differentiate between resource and reserve.
- Mention the uses of petro-chemicals in different industries
- How does nuclear fission and nuclear fusion differ? Explain with the help of examples.
- Describe the principle of nuclear fission reactors.
- Most of the conventional energy sources are called inexhaustible or renewable energy sources. Explain in brief.