

MODULE 8 - RENEWABLE ENERGY RESOURCES: ENERGY AND ENVIRONMENT

OBJECTIVES

By the end of this session the students shall be able to learn about –

1. Non conventional resources or renewable resources such as solar energy, wind energy, hydroelectricity, geothermal energy and tidal energy.
2. Petro-cropping and petro-plantation.
3. Energy crisis and its solution by using non conventional sources to maximum extent.
4. Tropical countries like India should use solar energy to maximum extent as it is available in plenty.

SUMMARY

Energy is an important requirement for the progress of a nation. Energy resources are of two types – conventional and non conventional. These days most of the countries of the world specially the developing countries are facing the problems of energy crisis in view of the exhaustion of conventional resources like coal, petroleum, LPG, etc. Such countries should depend upon non conventional resources like solar energy, wind energy and hydroelectricity. In India, solar energy is available in plenty and it should be exploited to the maximum limit. It does not create any pollution problem. Non conventional sources cannot be used in all seasons e.g. solar energy not available in India during rainy season and cloudy weather. Under such situation we have to resort to the use of traditional resources like coal, petroleum and LPG.

Petro-cropping and petro-plantation are new devices to harness energy from plant and biomass. This can also solve energy requirement to considerable extent. Developing countries like China, India and several other countries of Asia who have the problem of population and poverty have to explore new resources which are non conventional.

India has plenty of sunlight available during most of the months. This energy should be used by using solar cookers and solar cells. Big cities in India should use biomass energy to overcome the problem of pollution.

TRANSCRIPTION

Introduction

In the first part of this program we have discussed about conventional or non-renewable sources of energy but in this part we shall be discussing about the non-conventional also called the non-traditional or alternative sources of energy. These sources of energy are renewable and will continue forever and therefore it is advisable to make maximum use of these forms of energy as when and wherever they are available.

Some of the important sources of this type of energy are:-

Solar Energy

As per saying in English "All life is bottled sunshine". Actually fuel wood and coal are indirect products of solar energy. Green plants have property to trap solar energy and convert it into wood through photosynthesis. India being a tropical country receives sunlight in plenty. Deserts of Rajasthan receive 20 megawatt solar energy per square km / hour. Solar energy is harnessed in the following ways:-

- A. Solar cooker: - It is a metal box which is black inside to absorb and retain heat. The lid has a big mirror (reflection surface) to reflect the heat from sun into the box. The box contains black painted utensils in which the food to be cooked is placed. Solar cookers are supplied at subsidized rate to make them more popular. Several families in India are using solar cookers. The food cooked maintains vitamins and other contents in safe limits. There is no problem of smoke but it is not popular in rural areas.
- B. Solar water heating: - It is a rectangular box with transparent cover that faces the sun, usually mounted on a flat roof. Small tubes run through the box carrying the water to be heated. The tubes are mounted on a metal absorber plate which is painted black to absorb sun's heat. The back and sides of box are insulated to hold in the heat. Heat build up in the collector and as the water passes through the tubes it too heats up. In Israel about 80% homes have solar water heater. In India several hospitals and nursing homes have solar water heating system to ensure supply of hot water. For this purpose provision is made right from the beginning during the construction of building. Domestic buildings can also have this provision at the time of construction.
- C. Photovoltaic cell or "photo cell" - This is a device to convert sun's light and not its heat to electricity. Photovoltaic cells or "photo cells" or "solar cells" are made up of two separate layers of silicon each of which contains an electric charge when light hits the cells the charges begin to move between the two layers and electricity

is produced. Solar cells are wired together to form a module. A module of about 40 cells is enough to power a light bulb. For generating more electricity several solar cells are wired together into an array to meet the electrical needs of a home or to run a motor to lift water for irrigation. At present photo cells are costly because Silicon crystals are costly but frequent use can bring down their cost. Some new materials such as amorphous silicon are being tested to reduce the cost.

Photovoltaic cells are used in calculators and watches.

They also provide power to satellites, street lights, highway lights, weather stations and other electrical systems located away from power lines.

Photovoltaic cells and other solar energy devices are eco-friendly because they do not pollute the environment. Japanese farmers are using solar cells to kill the insects in place of pesticides. Solar cells, of course, only work when the sun is shining and thus need batteries to store the electricity. Govt. of India has declared 150 villages as urjagrams. They have solar street lights run by photovoltaic cells.

- D. Solar thermal electric power: - Solar radiations can produce high temperatures, which can generate electricity. Deserts are considered as the most suitable sites to generate solar thermal electric power because they have low cloud levels of cover with little scattered radiations.
- E. Mirror energy: - In 1980s a major solar thermal electricity generation unit was built in California containing 700 parabolic mirrors, each with 2G reflectors, 1.5 meters in diameter, which focus the sun's energy to produce steam to generate electricity. We should remember that sun is the primary source in our lives. We use directly for warmth and drying food grains and other agricultural products. Indirectly we are using it to provide food, water, fuel and shelter. That's why sun is worshipped throughout the world. Historical sun temple in Konark of Orissa speaks of the respect of ancient Indian culture for sun.

Wind energy

Wind was ancient source of energy used for transportation of sailing ships. China, Afghanistan and Persia used wind mills in remote past to draw water from wells for irrigation and to run flour mills for grinding grains.

Denmark used wind mills to generate electricity in 20th century. These days Denmark and California have large wind mill turbine cooperatives which sell electricity to Government Grid

In Tamilnadu there are large wind farms which generate electricity to the tune of 850 megawatts.

In India the places on mountains and near coastal areas have high velocity of wind hence wind mills are installed in such places.

Wind power is basically the function of wind speed. Wind mill is fitted with 3 blades at its top which move due to wind currents. This energy enters in the generator with which these blades are connected. The generator converts wind energy to electrical energy.

Wind mills have been in use since long in the countries like Germany, America Denmark and Spain. In India they have been recently introduced.

In India there are 83 wind monitoring stations at Tamilnadu, Andhra Pradesh, Gujarat, Karnataka, Keral, M.P., Maharashtra and Lakshadweep. The electricity generated in India through wind mills being 3000 megawatts. The biggest wind energy project of Asia amounting to 150 megawatts is at Muppandal in Tamilnadu. The total capacity of wind energy of India is 20,000 megawatts.

India occupies 5th position in the world in respect of wind energy. The first 4 countries being Germany, USA, Denmark and Spain. Department of non-conventional sources of energy looks after wind energy programme.

The world capacity of wind energy by 2000 was 17500 megawatt.

Wind energy is free from pollution problems except bird kills and noise effect on TV reception.

Hydroelectricity

It is also called hydel power. The water of rivers is collected in big dams and allowed to fall on turbines. The energy causing the movement of turbines is converted to electricity.

World's first hydro electric power dam was built in 1882 in Appleton, Wisconsin (USA).

In India, the first hydroelectric power dam was built in late 1800s and early 1900s by Tatas in the western ghats of Maharashtra. Electricity produced was used to run cotton and textile mills in Bombay. High rain fall areas were selected and dams were built on rivers in Deccan plateau near foot hills.

In free India several dams have been built by Government. Bhakra nangal was built in Punjab and Hirakund in Orissa.

In Mysore a big dam was built on Krishna river under the engineering skills of Shri Vishweshwariya.

These days practically every state has one or more dams, Madhya Pradesh has Sardar sarowar dam, Bergi dam, Tawa dam Gandhisagar dam and Narmada sagar dam on Narmada river.

Dams supply electricity and water for irrigation. It is due to Bhakra Nangal dam that Punjab has become the grainary of wheat. Due to Narmada Sagar dam the future of Nimar (Khandwa and Khargone districts) is going to change in future. Agricultural land has already become costly in these places.

Dams are associated with the following problems:-

1. Resettlement of displaced person.
2. Loss of biodiversity
3. Salinity of soil
4. Sensitivity to earthquakes

Some social workers like Shri Chandi Prasad Bhatta, Shri Sunderlal Bahuguna, late Baba Amte and Shri Pandurang Hegde are opposing the construction of big dams. It is therefore advisable to construct small dams with small hydroelectric generation units.

China is following the practice of constructing small dams. There are 60,000 small dams in China generating 13250 mega watts electricity which meets out the demand of electricity in China to the extent of 30%.

Sweden, US, Italy and France have also developed small dams for electricity generation.

Biogas

Gas obtained by fermentation of biological waste material such as cattle and human excrete and water weeds like water Hyacinth, water lettuce, Salvinia, Hydrilla and duck weed.

Biogas obtained from cattle dung and human excrete and Piggery refuse is called Gobar gas. Gobar gas is mixture of 63% methane, 30% carbon dioxide, 4% Nitrogen and 1% Hydrogen sulphide along with traces of Hydrogen, Oxygen and Carbon monoxide. Out of these methane is about 63%. Methane being combustible is source of energy for cooking food or for getting converted to electricity. Methane was named as Marsh gas by 'VOLTA' in 1776 because it seen coming out from marshy places such as rice fields. It is also called 'Klar gas', 'Sewerage gas' 'Fool's gas' and 'Bio-fuel'.

A villager having 2 to 3 cattle heads can produce so much gobar gas that his cooking energy needs are fulfilled. About 10 types of gobar gas plants are available. Every gobar

gas plant has a digester. 5 to 6 Kg of cattle dung is mixed with a bucket of water and this mixture is entered in the digester of gobar gas plant. Fermentation takes place by bacteria and the gas is collected in a dome from which it is supplied to kitchen through a pipeline. In kitchen it can be converted to fire in a gas burner just like LPG.

Denmark produces 15000 mega watts electricity from 15 farmers cooperatives. One of the greatest merit of gobar gas is its versatility. Apart from cooking it can be used for lighting, power generation, running refrigerator or tube well pump etc.

The material left after the extraction gas from gobar or cattle waste is called spent slurry which is very good manure rich in NPK (Nitrogen Phosphorus and Potassium) which are designated as critical elements for the plant life. It also contains significant number of bacteria useful to crops.

Methane being insecticidal house flies and other insects also get repelled that's why not a single housefly can be seen near gobar gas plant in spite of the fact that it contains animal and human excreta.

Water weeds like water hyacinth, water lettuce, salvinia can be fermented to yield biogas. In this way obnoxious water weeds can be converted to energy and manure.

Countries like India and China are trying to install tens of thousands of biogas plants in villages.

In 1996 there were 2.18 million families in India using biogas. In China 20 million households are using biogas.

Biogas plant needs lot of space for its installation. Hence it is more popular in villages. People in big cities can not use it due to shortage of space.

By 2003 about 29 Lac gobar gas plants were installed in India.

Biogas is devoid of smell and burns with a blue flame without and smoke.

Energy from solid waste

Lot of solid waste is produced in cities every day in the form of food waste. Canning industry waste, Maize cobs after thrashing out grain, fish processing units & dairies (All together it is called municipal waste). This can also be decomposed and biogas liberated can be used for cooking food or converted to electricity.

London has a plant which makes 30 megawatts electricity a year from 4,20,000 tones of municipal waste which supplies power to 50,000 families. In Germany 25% of the landfills for garbage produce power from garbage. Japan uses 85% of its waste in similar way and France about 50%.

Delhi has a plant to produce 3.75 megawatts of electricity while Mumbai produces 6 megawatts electricity from solid waste. Some other places where solid waste is converted to electricity are –

- a. Tanuk – Andhra Pradesh
- b. Faizabad – U.P.
- c. Ankaleshwar – Gujarat
- d. Medhak – Andhra Pradesh
- e. Muktasar – Punjab
- f. Raisen – M.P.
- g. Belgam – Karnataka

Indore in Madhya Pradesh is also expected to install a plant in near future.

Bagasse left extracting juice from cane sugar plants in sugar factory can also be used to produce biogas.

Petro cropping and Petro Plantation

Molasses are the by products of sugar factory. Molasses contain 10 to 12% sugar. They are fermented by yeast and ethyl alcohol is obtained. Chemically alcohol has hydrocarbons and is inflammable hence can be used as fuel in place of petroleum. Brazil did this experiment successfully by making minor changes in carburetor. Petrol 50% and alcohol 50% make a fuel known as Gasohol. It can be directly used in the engine of automobiles. India has allowed mixing of Ethyl alcohol with petroleum to the extent of 5%.

Brazil and Japan have started cultivation of sugarcane for manufacture of fuel alcohol. Raising sugar cane crop to obtain fuel alcohol is called petro-cropping.

Petro-plantation – Melvin Calvin of California was awarded Nobel Prize in Chemistry in 1961 for the discovery Calvin cycle dealing with the dark reaction of photosynthesis. Later on he suggested that resin of *copaifera pubiflora* and milky latex of plants like *Euphorbia* are rich in hydrocarbons and can be used to replace petroleum. These days *Euphorbia Lathyris* is cultivated to obtain milky latex to be used as fuel.

Plantation of latex yielding trees to be used as fuel is called petro-plantation or “Dendrothermal energy plantation”.

Tidal, Wave power energy and Geothermal energy

The earth's surface is 70% water. Solar energy is absorbed by sea water and ocean currents are created by wind in the form of waves. Due to waves sea is never silent.

System which is very useful and at least it has been used at a few places like rann of Kutch in Gujarat as well as it is used in Rennes in France is what is called tidal power

generation. What is the principal of tidal power generation? The principal of tidal power generation is when there is high tide the water goes up, when there is low tide the water comes down. If the water at the even high tide is stored and brought in stages to the point when the water is in lowest pass through a turbine one can generate an electrical power. The next visual will make this clear a little clear. We see a basin one. This basin one gets fulfilled or rather filled at high tide, when the water level is high, as the water level is residing, one empties the basin one in to basin two through a turbine. This is during the high tide. Then during the low tide the basin two is left undisturbed and as the water comes down, you have water flowing from basin two to the sea through the turbine and therefore it generates power. Thus one sees the same thing happens when the water level is rising. Therefore one finds that one gets variable kind of a power generation during a tidal turbine but combine with a grade, this can be a useful option.

Another idea which is very interesting is wave energy because ultimately there is a lot of energy in the waves in the ocean the water raises through large heights and one would like to make use of it. One thing we have to remember in the wave motion. As it is on the surface of the ocean is that the waves travel horizontally while the water moves up and down and it this up and down motion of the wave of water which you will try to convert into energy. What we have is there is a rectangular floating platform which you see as a float here and this platform is floating on the surface of the water and as the surface of water goes up and down, this platform also goes up and down. It is guided by these of four pillars as you can see so that it maintains its position. Below these pillars we have floatation tanks which means there are tanks in which we fill compressed air or just air. The floatation tank stabilizes the platform which means it does not moves around. Now what happens is as the piston moves up and down, it is use to compress air and that air is filled under water floatation tank. The compressed air from the floatation tank moves a turbine which generates electrical power. So one we see's the floatation tank serves two purposes, it stabilizes the system and it stores air which can be used for electrical power generation, you can store it even for longer times and therefore guarantee for tides when the wave power is not much, we don't have much of waves.

At present India has only one plant in Tiruchendur in Tamilnadu producing 1 megawatt electricity per day. There are much more possibilities for India in this field.

Tidal power houses disturb tidal ecosystem of coastal region by disturbing water, birds and fishes.

The second interesting application we have is that it is known that as we go inside the earth, it gets hotter and hotter. The reason simply being is that the core of the earth consist of molten material at very high temperature and gives out heat. At many places in the world there are faults which results in steam and hot water coming out of the earth as a geyser. This occurs even a place which are very cold like Blue Foundland, Greenland

and there this steam and hot water is immediately useful for heating the buildings as well as for generating electricity through a wind turbine. The hot water is also used for heating the buildings as well as for other uses. At places where there is no natural geothermal energy in the form of steam and hot water what can be done is that we force water on the hot rocks which are below to give out steam and this gives us steam at a good temperature and pressure which can be used for many purposes. The use of geothermal energy is either as electricity or as a heat and for refrigeration purposes.

In India in Manikarna in Himachal Pradesh a cold storage and a power house are run by geothermal energy.

GLOSSARY

1. Renewable – Having cycle to repeat it.
2. Reflector - Mirror throwing back light
3. Turbine – Horizontal water wheel
4. Biodiversity – Varieties of plants and animals in a particular area
5. Fossil – Preserved in strata of earth
6. Biogas – Gas obtained from fermented biological waste
7. Gobar gas – Gas obtained from decomposed cattle dung
8. Versatility – Multiple uses
9. Molasses – Thick syrup which is by product of sugar industry
10. Tidal wave – Sea wave
11. Harness - Utilise
12. Exhaustion – On verge of getting finished

F.A.Q

Q.1 List 4 non conventional resources of energy.

Ans. 1. Solar energy

2. Wind energy
3. Hydroelectricity
4. Biogas

Q.2 What is petro-cropping?

Ans. To cultivate sugarcane crop to obtain alcohol to be used as a fuel in automobiles is called petro-cropping.

Q.3 What is petro-plantation?

Ans. To grow plants of *Euphorbia lathyris* to obtain latex to be used as fuel in automobiles is called petro-plantation.

Q.4 Name a liquid fossil?

Ans. Petroleum.

Q.5 Name a gas fossil?

Ans. LPG

Q.6 Which countries are earning petrodollars?

Ans. Gulf countries.

Q.7 Which radioactive element is used to generate electricity in nuclear power plant?

Ans. Uranium 235

Q.8 List 6 nuclear power plants of India.

Ans. 1. Tarapur (Mumbai)

2. Rawatbhata (Kota – Rajasthan)
3. Karkapar (Gujarat)
4. Karwar (Karnataka)
5. Kalpakkam (Tamilnadu)
6. Narora (U.P.)

Q.9 List 3 countries where leakage accidents took place in nuclear power plants?

- Ans. 1. U.S.A. – 3 mile Island 1979
2. Russia – Chernobyl - 1986
 3. Japan – Fukushima - 2011

Q.10 What damages are caused by the leakage in nuclear power houses?

- Ans. 1. Malignant thyroid cancer
2. Children born in future are crippled.

Q.11 Why sun is worshipped throughout the world?

- Ans. Sun is a primary source of energy for photosynthesis by green plants which are the primary producers and serve as food for herbivores, carnivores and omnivores including the human being.

Q.12 What are the advantages of cooking food in solar cooker?

- Ans. 1. It saves LPG.
2. Nutrients and vitamins remain safe as there is no risk of food getting burnt.

Q.13 List 5 devices using solar energy.

- Ans. 1. Solar cooker
2. Solar water heater

3. Photovoltaic cell
4. Solar thermal electric power
5. Mirror energy

Q.14 What is an Urjagram ?

Ans. The village using solar energy for street lights.

Q.15 What is the location of Sun temple in India?

Ans. Konark in Orissa.

Q.16 What are ancient uses of wind energy?

- Ans.
1. To draw water from wells for irrigation.
 2. To run flour mills for grinding grains.

Q.17 Which country uses wind mills to generate electricity?

Ans. Denmark

Q.18 Which areas in India can be used to harness wind energy?

- Ans.
1. Hilly region
 2. Coastal areas because velocity of wind is very high in these areas.

Q.19 Which place in India is well known for the biggest wind energy project in Asia?

Ans. Muppandal in Tamilnadu where 150 megawatts electricity is generated through wind mills.

Q.20 What is another name hydroelectricity?

Ans. Hydel power.

Q.21 Who initiated hydropower projects in India?

Ans. Tatas in Western ghats of Maharashtra to run textile mills in Bombay (Mumbai).

Q.22 Under whose guidance the dam on Krishna River was built in Mysore?

Ans. Shri Vishwashwariya a dedicated engineer of India.

Q.23 List 4 problems created by construction of big dams?

Ans. 1. Resettlement of displaced person

2. Loss of biodiversity

3. Increased salinity of soil

4. Sensitivity of earthquakes

Q.24 What is biogas?

Ans. Gas obtained by fermentation of biological waste such as animal and human excretes, water weeds and solid waste.

Q.25 What is chemical composition of biogas?

Ans. 1. Methane 63%

2. Carbondioxide 30%

3. Nitrogen 4%

4. Hydrogen sulphide 1%

5. Hydrogen, oxygen and carbon monoxide in traces.

Q.26 What is combustible components of biogas?

Ans. Methane.

Q.27 List 4 other names of biogas.

- Ans.
1. Marsh gas
 2. Gobar gas
 3. Fool's fire
 4. Klar gas

Q.28 When do we refer biogas as gober gas?

Ans. When it is obtained from cattle dung, animal and human excretes.

Q.29 List 3 characters of biogas?

- Ans.
1. Smell less
 2. Smokeless
 3. Has blue flame (more heat)

Q.30 List 3 uses of biogas.

- Ans.
1. Cooking
 2. Lighting
 - 3 Power generation

Q.31 What is solid waste ?

Ans. Waste produced in big cities in the form of food waste, vegetable waste, canning industry waste, waste from fish processing industries, slaughter houses and dairies.

Q.32 List some places in India which produce electricity from solid waste.

- Ans.
1. Delhi
 2. Tanuk (Andhra Pradesh)
 3. Faizabad (U.P.)
 4. Ankaleshwar (Gujarat)
 5. Muktasar (Punjab)
 6. Raisen (M.P.)
 7. Belgam (Karnataka)

Q.33 What is tidal wave energy ?

Ans. Energy obtained by locking the sea waves in a nassen cut and dropping them on turbines to generate electricity.

Q.34 List some places in India where tidal energy can be harvested?

- Ans.
1. Bay of Cutch
 2. Bay of Khambat
 3. Lakshadeep
 4. Andaman and Nikobar islands

Q.35 What is Geothermal energy?

Ans. Energy obtained by hot water of natural hot water springs.

Q.36 At which place in India Geothermal energy is harvested?

Ans. Manikarna of Kullu of Himachal Pradesh.

CASE STUDY- I

In 1981 a plane called “The Solar Challenger” flew from Paris to England in 5 hours 20 minutes. Its wings and tail were glued with 16000 solar cell. Thus this plane could complete its flight with the help of solar power.

In 1987 in Australia solar operated vehicles covered 3000 Kms.

The world’s first solar powered hospital is in Moli in Africa situated at the edge of Sahara desert. Due to desert area it gets plenty of sunlight. Panels of solar cells supply the power needed to run hospital equipment.

Japanese farmers are using photovoltaic operated insect killer in place of chemical pesticides.

Energy department of DAVV, Indore has building constructed in such a way that it gets maximum light from sun and also has photovoltaic devices to produce electricity to meet out the needs of the department.

There are more than 3000 buildings integrated photovoltaic systems in Germany. Japan has programme to build 70000 buildings with integrated photovoltaic devices.

CASE STUDY – II

Indian industries need most energy than other countries. To produce one ton of steel India spends 9.5 million Kilo calories while Italy spends 4.3 million Kilo calories and Japan spends 4.1 Kilo calories only.

An 18 watt CFL lamp can replace a standard 75 W incandescent bulb.