

## 29B. RENEWABLE SOURCES OF ENERGY-1

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### ENERGY SOURCES

The energy sources can be categorised according to periods of usage-

(a) Conventional source of energy, which is easily available and has been in usage for long time.

(b) Non conventional source of energy, that are other than the usual or that are different from those in common practice

Conventional		Non conventional
Conventional non-renewable energy	Conventional renewable energy	
Mostly fossil fuels found under the ground. Coal, oil, natural gas etc. are the examples.	Mostly non-fossil fuels seen above the ground.  Fire wood, cattle dung from vegetable wastes, wood charcoal etc. are the examples.	1. Solar energy 2. Hydro power 3. Wind energy 4. Nuclear energy 5. Hydrogen energy 6. Geothermal energy 7. Bio gas 8. Tidal energy 9. Bio-fuel

- **Renewable or Non-Conventional Sources of Energy**
- The rapidly depleting fossil fuel sources of energy and escalating demand of energy have made it necessary to look for alternative sources of energy that are known as renewable or inexhaustible.

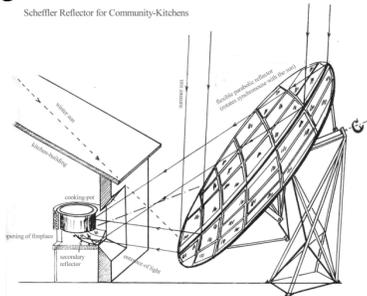
### • SOLAR ENERGY

- Sun is an abundant source of energy and it is inexhaustible.
- Solar energy supports all life on earth and is the basis for almost every form of energy we use. The sun makes plants grow, which are burned as fuel or rot in swamps and are compressed underground for millions of years to become coal and oil.
- Heat from the sun causes temperature differences between areas, causing the wind to blow.
- Water evaporates due to heat of the sun, vapours are carried to high elevations, and when the water vapours condense it precipitate as rainfall.
- The water rushes down towards the sea through rivers, to turbines for generating electricity. However direct solar energy can be used as heat, light, and electricity through the use of solar cells.
- Solar energy use can be classified as:
  - i) **Direct solar energy use**; solar energy is captured directly as sunlight and used for heating, generating electricity and cooling.
  - ii) **Indirect use of solar energy** derived from natural processes driven by the sun, for example wind, biomass, waves, hydroelectric power.
- **Direct Solar Energy**
- Direct use of solar energy can be used by various devices through systems that may be-
  - a) passive,
  - b) active
  - c) photovoltaic systems
- (a) **Passive solar energy**
  - Earliest uses of solar energy were passive in nature such as to evaporate sea water for producing salt and for drying food and clothes, which is still being used for these purposes.

- The more recent passive uses of solar energy is for cooking, heating, cooling and for the day lighting of homes and buildings.
- The effectiveness of passive solar energy depends on good building design; it requires no mechanical means.

- **Passive use of solar energy for cooking**

- When sunrays fall on a dark surface, it is absorbed and transformed into heat energy. Glass is bad conductor of heat but if a shallow glass covered chamber painted black inside and insulated all around is exposed to sun for some time the inside temperature exceeds upto 100o C and the food is cooked.
- Solar cooker takes 5-6 hours to cook food. It is the device for direct use of renewable source of energy.
- In Indian conditions with plentiful sunshine we can use a solar box cooker for cooking of food.
- **The great advantage of solar cooking** is its convenience because the food will never get overcooked or burnt.



- The food cooked in the solar cooker is also tenderer and retains most of the nutritive values.
- **Disadvantage of such cooking** is that it is a slow process and take longer time in cooking. Not suitable on cloudy days.
- World's largest solar steam cooking system is operating in the Brahmakumaris' Ashram at Mount Abu in India.
- The solar energy is concentrated by a battery of concentrators or mirrors to

convert water into superheated steam. The system can cook for 10,000 people.

- **Passive Use of Solar Energy for day lighting**

- Day lighting is using natural sunlight to light building interiors.
- Day lighting technologies are designed to maximize natural light for illuminating the interior of buildings, in the form of core lighting when the building may have a central atrium to allow entry of maximum sunlight.
- The most recent technology is hybrid solar lighting which collects sunlight and sends it through optical fibres into buildings where it is combined with electric light in "hybrid" light fixtures.
- There are sensors in the room which keep a steady lighting level by adjusting the electric lights based on the sunlight available. This new generation of lighting combines both electric and solar power.
- **Advantage of passive solar systems** is that they are maintenance free.
- There are no operating costs. Results in substantial saving on electric bills
- **Disadvantages** are that Passive solar heating, cooling and lighting system can be used only in specially designed buildings.

- (b) **Active use of solar energy**

- Active solar heating and cooling systems rely on solar collectors which are usually mounted on roofs.
- Such systems also require pumps and motors to move the fluids or blow air by fan in order to deliver the captured heat.
- The main application of these systems is to provide hot water, primarily for domestic use. Active solar heating is extensively used in India, Japan, Israel, Australia and Southern United States having sunny climate.

- **Solar energy to produce electricity**

- Solar energy is used to generate high temperature heat or electricity.

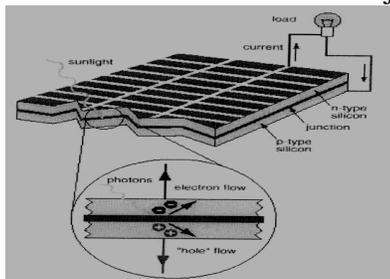
- Solar collectors in deserts can produce high temperature heat to spin turbines for producing electricity.
- Solar thermal systems can collect and transform radiant energy received from the sun into high temperature thermal (heat) energy, which can be used directly or converted into electricity.
- Huge arrays of computer-controlled mirrors called heliostats track the sun and focus sunlight on a central heat collection tower.
- **The disadvantage** is that the costs of such devices are high.

- **Solar Energy for Cooling**

- A solar collector can also be used for cooling.
- In this system, energy from the sunlight powers a small heat engine similar to an electric motor of a refrigerator.
- The heat engine drives a piston that compresses a special vapour into a liquid; the liquid then re vapourizes and draws heat out of the surrounding air.

- (c) **Solar Cells or Photovoltaic Technology**

- Solar energy can be converted directly into electrical energy by photovoltaic (PV) cells commonly called solar cells.
- Photovoltaic cells are made of silicon and other materials. When sunlight strikes the silicon atoms it causes electrons to eject.



- A typical solar cell is a transparent wafer that contains a very thin semi conductor,
- Sunlight energizes and causes electrons in the semiconductor to flow, creating an electrical current.
- Solar cells can provide electricity to remote villages.

- India is the world's largest market for solar cells.

- **Indirect Solar Energy**

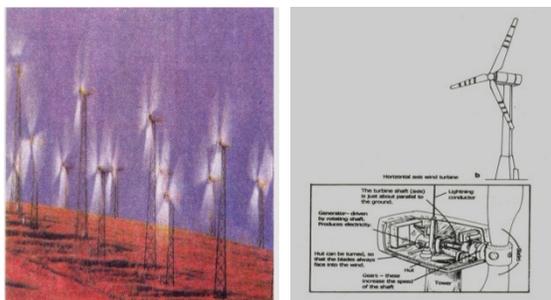
- (a) Wind energy,
- (b) Tidal energy,
- (c) Hydroelectric energy and
- (d) Biomass energy

- (a) **Wind energy**

- About 2% of the sunlight striking the earth is converted into the kinetic energy of moving air called wind.
- The uneven absorption of the solar radiation by the earth's surface causes differences of temperature, density and pressure which produce air movements at local, regional and global levels powered by wind energy.
- The kinetic energy of the wind can be harnessed by converting it into mechanical energy or electrical energy using suitable devices.
- As early as 4000 - 3500 BC, the first sailing ship and wind mills were developed by harnessing wind energy.
- The wind has been used to power ships, grind grains, pump water for irrigation and do other types of work



- Wind turbines, like wind mills are mounted on a tower to capture the most of the wind energy. Wind mills can be used to drive generators to producing electricity.
- To produce electricity wind is used to turn the shaft of a turbine which is attached to a generator that produces electricity.
- Thus wind turbines transform wind energy into mechanical power which can be used to generate electricity.

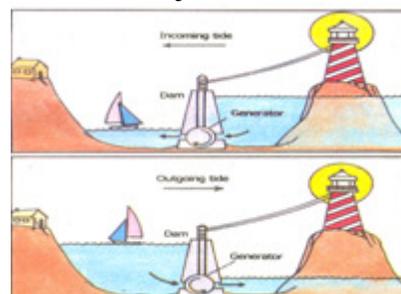


- Five nations - USA, Germany, Denmark, Spain and India - account for 80% of the world's installed wind energy capacity.
- India is the fifth largest producer of wind power in the world. Andhra Pradesh generates maximum energy through wind power. Tamil Nadu, Gujarat, Karnataka, Kerala, Madhya Pradesh and Maharashtra are also being generating energy through wind.
- Wind mill used for generating electricity showing details of shaft

- **Tidal energy**

- The energy of tides is harnessed as they flow in and out. The mean tidal range must be greater than 5 metres to produce energy.
- The tidal power is harnessed by building a dam across the entrance to a bay or estuary creating a reservoir. As the tide rises, water is initially prevented from entering the bay.
- When tides are high and water is sufficient to run the turbines, the dam is opened and water flows through it into the reservoir, turning the blades of turbines and generating electricity.
- The dam is then opened to run the turbines (which are reversible), electricity is produced as the water is let out of the reservoir.
- The dams built to harness the tidal power adversely affect the vegetation and wildlife.
- There are forty tidal plants producing electricity. One in France is the only commercial power station operating in the world.

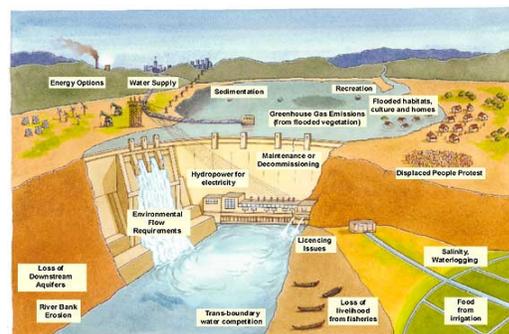
- In India a major power project is proposed to be set up in the Hanthal Creek in the Gulf of Kutch in Gujarat.



**Fig. Tidal power station**

- **Hydropower/Hydroelectric Energy**

- Generation of electricity by using the force of falling water is called **hydro electricity or hydel power**.
- Dams are built to store water at a higher level; which is made to fall to rotate turbines that generate electricity.
- The basic principle behind hydropower energy is the damming of rivers to create artificial in waterfalls; sometimes natural waterfalls are also used.
- The falling water is used to turn the turbines that drive electrical generators.
- **Greatest advantages** of hydropower is that it is cheaper and cleaner than thermal or nuclear power.
- **Disadvantages of Hydropower** is that building of dam disturbs and damages the natural habitats and some of them are lost forever.
- Human habitations also get disturbed making people homeless.
- Figure shows environmental effects of hydropower.





### Check Yourself

1. Out of the following, one is not a conventional source of energy:
  - a. Solar energy
  - b. Coal
  - c. Oil
  - d. Petroleum
2. Out of the following is not a passive use of solar energy.
  - a. Solar
  - b. Day lighting
  - c. Hybrid solar lighting
  - d. PV cells
3. Tidal power is harnessed by
  - a. Building a dam for use as reservoir across entrance of bay or estuary.
  - b. Increasing the frequency of tides in the ocean
  - c. collecting water during low tide from the ocean
  - d. using turbine to move with tides
4. Hydel power is the generation of electricity by using force of:
  - a. Surface water waves
  - b. Quietly flowing water
  - c. Falling water
  - d. Tidal water
5. A thin wafer like semi-conductor called PV cell produces electricity from:
  - a. Ocean thermal energy
  - b. Wind energy
  - c. Wave energy
  - d. Solar energy

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



### Stretch Yourself

1. Give example of conventional non-renewable energy.
2. Energy received from the sun is known as-----.
3. Mention the deriving source of tidal energy.
4. Give one point difference between conventional and non-conventional sources of energy.



### Test Yourself

1. How does solar energy used in cooking? Explain
2. Mention the uses of PV cells.
3. Why does considered wind energy as indirect solar energy?
4. Explain the process of generation of hydel power.
5. Mention the disadvantages of hydro power.