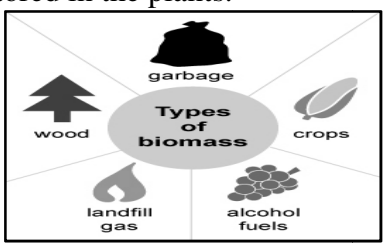
27B. IMPORTANCE OF ENERGY IN SOCIETY

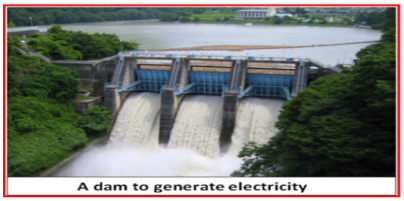
- Energy is essential for most activities of modern society. Its use or consumption is generally taken as an index of standard of living.
- We use energy in the form of fire wood, fossil fuels and electricity to make life comfortable and convenient
- **Energy is "The ability to do work"**
- Energy from the sun gives us light during the day. When we eat food, our bodies transform the energy stored in food into energy to do work. When we talk, run or walk, think or read we "burn" food energy in our body.
- There are laws which governs the energy
  - The **First law of thermodynamics deals with conservation of energy. It states that energy** cannot be created or destroyed but can only change from one form to another.
  - The **Second law of thermodynamics states that in every energy transformation,** some energy is always lost in the form of heat which is unavailable to do further useful work.
- Heat is one of the many forms that energy can take and heat is one form of energy into which all the other forms of energy can be fully converted.
- The unit of heat, the ***Calorie*** *(Cal) or Joule* is used to express the amounts of energy.
- A gram Calorie (c): It is the amount of heat required to raise the temperature of one gram of water through one degree centigrade (from 14.5^{o}C to 15.5^{o}C) and is the unit in which energy value of food or any other organic matter is expressed, although it is now being replaced by joules.
- Joule (J): A practical unit of work. It is the derived SI unit of energy/work, being the work done when a force of one Newton displaces the point by one metre.
- **SOURCES OF ENERGY**
  - Energy sources are broadly divided into two categories, namely:
  - Renewable (an energy source that we can use over and over again) and non- renewable sources (when the energy source cannot be reused)
  - Renewable sources are the term used to describe energy that comes from sources whose supplies are regenerative and virtually inexhaustible. These can be replenished in a short period of time. Some of the renewable sources are:
- **Solar energy**
  - The most common energy received on our planet (Earth) is the direct sun light.
  - Solar energy is inexhaustible and it comes to earth in the form of visible light and infrared radiation. We have always used the energy of the sun as far back as humans have existed on this planet.

  - Without sunlight life would not exist on our planet. Plants use sunlight to make food. Animals eat plants as food.
  - Decaying of plants, hundreds of millions of years ago produced fossil fuels - coal, oil and natural gas, thus what we use today is actually sunlight stored millions and millions of years ago.
  - Solar energy can be harnessed in a variety of ways to heat homes, heat water, grow plants and produce electricity.
  - Solar power includes active, passive, and photovoltaic technologies and practices.
- Biomass energy or bio energy is the energy from organic matter such as fire wood, twigs, dead plant parts, cattle dung, livestock manure and dead animal matter.

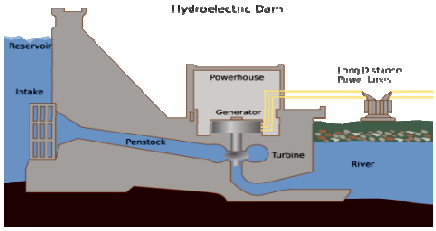
Plant leaves convert sunlight into chemical energy, which is stored in the plants.



- Animals that eat the plants store chemical energy in their bodies; some of it also remains in manure and other wastes.
- Biomass fuels are renewable because the raw materials can be produced simply by growing more crops or collecting more organic waste.
- The use of renewable energy is not new, traditionally wood has been as the main source of energy for thousands of years, ever since people started burning wood to cook food or to keep warm.
- Even today fire wood and crop residues form the largest biomass energy source and is used by rural communities and forest dwellers.
- Biogas can be produced from cattle dung, human faces and other organic waste by a process called "anaerobic digestion" in a Biogas plant.
- Biogas is a clean, non-polluting and low - cost fuel.
- Biomass fuels are obtained from agricultural wastes (crops), alcohol fuels, animal waste and municipal solid waste.
- **Bio-diesel**
  - Bio-diesel is obtained by trans-etherification of the vegetable oils.
  - Oil rich seeds of the wild plants rich in non-edible oils are the potential source of bio-diesel. Seeds of Pongamia, Jatropha, Neem are favorites for producing bio-diesel.
  - Consumer demand for clean renewable energy have stimulated growth in green power - solar, wind, geothermal steam, biomass, and hydroelectric sources of power.
- **Hydropower**
  - Flowing water creates energy that can be captured and turned into electricity. This is called **Hydroelectric Power or Hydropower. Hydro-energy from water is also a renewable** energy source.
  - Hydroelectric energy or hydropower is energy which is produced by the action of falling water turning a waterwheel, propeller or turbine.


A dam to generate electricity

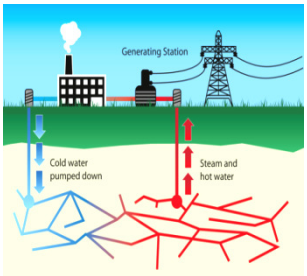
  - The most common type of hydroelectric power plant uses a dam on a river to store water in a reservoir.
- **Hydroelectric Power Plant**
  - Another type of hydroelectric power plant is called a pumped storage plant that can even store power.
  - The power is sent from a power grid into the electric generators. The generators then spin the turbines backward, which causes the turbines to pump water from a river or lower reservoir to an upper reservoir where the power is stored.
  - To use the power, the water is released from the upper reservoir back down into the river or lower reservoir.
  - This spins the turbines forward, activating the generators to produce electricity



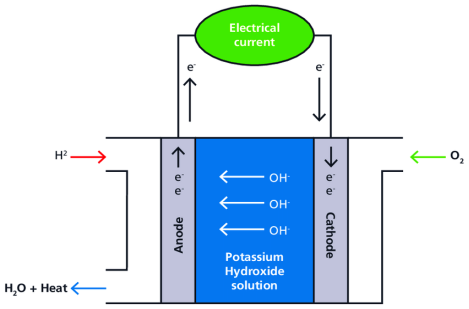
- **Wind Energy**
  - The kinetic energy of the wind can be changed into other forms of energy, either mechanical energy or electrical energy.
  - When a boat lifts a sail, it is using wind energy to push it through the water. This is one form of energy.
  - Farmers have been using wind energy for many years to pump water from wells using windmills.

- Wind energy is a clean renewable energy source produced by the daily cooling and heating patterns on the surface of the earth. Wind energy can be harnessed to produce electricity, pump water, grind grain and move sailing vessels.

- **Wave energy**
  - Oceans and sea waves are caused indirectly by solar energy. Wave energy is derived from wind energy, which is driven in turn from solar energy. Wave energy may be converted to mechanical energy and then to electricity.
- **Ocean thermal energy conversion**
  - Conversion of solar energy stored as heat in the ocean into electrical energy by making use of the temperature difference between the warm surface water and the colder deep water.
- **Geothermal Energy**
  - Geothermal energy refers to energy contained in underground rock and fluids. Thermal or heat energy deep within the earth may heat water or form steam.
  - Geothermal energy is used to power steam turbines and generate electricity, although it can be used to heat homes and other buildings. This heat is a result of the increase in temperature of the earth with increasing depth below the surface.
  - Geothermal energy is responsible for heating of water of hot water springs.



- (ix) **Fuel Cell Technology**
  - Fuel cells are devices that directly convert hydrogen into electricity.
  - To use hydrogen, it must be separated from these other elements. Hydrogen as a fuel is high in energy and a very promising clean fuel.



  - A fuel cell converts hydrogen (produced and stored) and oxygen from the air into electricity.
  - A machine that burns pure hydrogen produces energy and pure water without causing any pollution.
  - Fuel cells are a promising technology for use as a source of heat and electricity in buildings, and as an electrical power source for vehicles.
  - In the future, hydrogen could substitute electricity as an important energy carrier.
- **Non-renewable energy**
  - Non-renewable energy resources have limited amount of stocks available. The regeneration rate of non renewable energy resources is negligible when compared with the rate of consumption.
  - That is, non-renewable energy that we are using up cannot be recreated in a short period of time or at least, in our lifetime.
  - Fossil fuels are important energy resource.
  - Fossil fuels (coal, lignite, peat) are found under the ground and below the sea floor (petroleum etc.) in liquid and gaseous form.
  - Fossil fuels are the remains of ancient plant and animal life found on earth. Fossil fuel energy is released in the form of heat.

- **Oil (Petroleum)**
  - Oil is a liquid fossil fuel that is found under the ground and below the sea floor.
  - Fossil fuels were formed before and during the time of the dinosaurs when plants and animals died.
  - Oil and natural gas is formed by complex decay processes from microscopic life forms called phytoplankton (tiny plants called algae) which floated in the world's oceans million years ago.
  - Heat from the earth's interior and the weight of the overlying rocks gradually changed the energy containing substances in the buried phytoplankton into liquid hydrocarbon and gases.
  - Petroleum is one of our most vital resources.
  - We can save fossil fuels by conserving them and finding ways to harness energy from seemingly "endless sources," like the sun and the wind.
  - Oil is obtained by drilling deep wells into the ground and then pumping it out. Oil can be converted into gasoline. Both oil and gasoline are burned in automobiles and in aeroplanes. Our modern way of life is totally dependent on oil and gas. But oil industry experts estimate that current reserves will only last for about 40 year
- **Natural gas**
  - Natural gas is also fossil fuel that is a mixture of gases found under the ground. Natural Gas is collected and transported almost the same way as oil.
  - Natural gas burns in home furnaces and cooking ranges. It is now being used in cars and buses for transportation.
- **Coal**
  - Coal is the most common solid fossil fuel which was used as a primary source of energy in homes and industry.
  - It is found under the ground in solid form and have to be mined and transported for use. Our country has large coal reserves.
  - Coal is mostly carbon but contains small amounts of sulphur. It is formed from plants, mostly trees which grew millions of years ago in low lying swampy areas. When these trees died, they sank to the bottom of the swamps.
  - In the swamps they did not rot fully as there was no air. Partially decayed plant matter in swamps and bogs is called peat which has low heat content. These peats get covered by sand and mud as water subsides.
  - More material is deposited on them for years and the plant matter gets converted into coal under pressure and heat.
  - That is plant material get metamorphosed into coal in millions of years. This is the most plentiful fossil fuel but it is very polluting.
- **Nuclear energy**
  - Nuclear energy is liberated from a nuclear reaction, fission or fusion, or by radioactive decay.
  - In a conventional nuclear reactor, isotopes of uranium and plutonium undergo controlled nuclear fission.
  - The resulting heat produces steam that in turn, spins turbines to generate electricity. Large fuel supply, low immediate environmental impact, low emission of CO_2, low chances of accidents because of multiple safety systems make this energy a much wanted resource.
  - Nuclear energy produces highly radioactive materials that must be kept safely for thousands of years until their radioactivity falls to safe levels.
  - Management of the nuclear waste disposal, its vulnerability to terrorist attacks and misuse of the technology for making nuclear weapons make it a difficult choice and it remains world's slowest growing energy source.
- **WORRYING SIGNS**
  - Also we can not use fossil fuels forever as they are a non-renewable and finite resource. The International Energy Agency says the world will need almost 60% more energy in

2030, and fossil fuels will still meet most of its needs.

- Not everyone depends on the fossil fuels. Nearly a third of today's world population (6.1bn people) has no electricity or other modern energy supplies, and another third have only limited access.
- We can also get energy to do several jobs at once, as combined heat and power plants do. And we can use less of it by becoming energy-efficient.
- Cheap, available energy is essential for ending poverty: ending poverty is key to easing the pressures on the planet from the abjectly poor who have no choice but to eat the seed corn.
- Our energy use is unsustainable, but we already know what a benign alternative would look like.

Check Yourself

1. The SI unit of energy or work:
   a. Gram calorie
   b. Kilogram
   c. Metre/second
   d. Joule
2. Global warming and climate change have resulted from excessive use of :
   a. Biofuels
   b. Fossil fuels
   c. Hydropower
   d. Wind energy
3. Pick out renewable energy forms from the following?
   (i) Biomass, (ii) Oil, (iii) Petroleum, (iv) Biodiesel
   a. i ,iv,
   b. i. only
   c. ii and iii
   d. i and ii
4. Energy is released by radioactive decay is known as:
   a. Nuclear
   b. Wind
   c. Wave
   d. Solar
5. Out of the following which one is not a renewable source of energy?
   a. Bio diesel
   b. Wave energy
   c. Geothermal energy
   d. Nuclear energy

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

Stretch Yourself

1. Define energy
2. Classify different types of energy sources.
3. State the first law of thermodynamics
4. Why do we consider hydrogen as a clear energy?
5. Which fuel is used to propel rockets?

Test Yourself

1. Mention the process of coal formation in nature in brief.
2. Why do we consider sun is the ultimate source of energy?
3. State the reasons for depleting non-renewable sources of energy.
4. Classify energy sources with one example each.
5. Describe second law of thermodynamics with example.