

## Energy

- Ability to do work.
- Everything in the world is able to do the work because of the energy.
- Energy is capacity of doing work.
- Sun is the main source of energy.
- Energy is measure in joules (J) and kilojoule (kJ). (1kJ = 1000J)
- When anything happens in the physical world, energy is somehow involved.

**Forms of Energy:** There are different forms of energy.

- **Kinetic energy:** A moving object has Kinetic energy (K.E.). The faster an object moves, the greater it's K.E. A moving object has Kinetic energy (K.E.). The faster an object moves, the greater its K.E.  
Kinetic energy of an object can be calculated using the formula: Kinetic energy =  $\frac{1}{2} \times \text{mass} \times \text{speed}^2$  (K.E =  $\frac{1}{2} mv^2$ )
- **Potential energy:** If you lift an object upwards, you give it gravitational potential energy (g.p.e). The higher an object is above the ground, the greater its g.p.e. If you lift an object upwards, you give it gravitational potential energy (g.p.e). The higher an object is above the ground, the greater its g.p.e.  
Potential energy stored in an object can be calculated using the formula: Potential energy = mass  $\times$  gravity  $\times$  height. (PE = mgh)
- **Chemical energy (chemical potential energy):** Fuels such as coal or petrol are stores of chemical energy. When fuel burns, the store of energy released, usually as heat and light. Chemical energy is stored in our bodies and batteries also.
- **Strain energy (elastic potential energy):** If you stretch a rubber band, it becomes a store of strain energy. The band can give its energy to a paper pellet and send it flying across the room. Strain energy is the energy stored by an object that has been stretched or squashing in an elastic way.
- **Light energy:** Can be given from solar energy. Solar energy converted to light. Very hot objects glow brightly. They are giving out light energy. Light radiates outwards all around the hot object.
- **Sound energy:** Sound energy is produced due to vibrations. Any vibrating object is a source of sound.
- **Thermal energy (heat energy):** If you get close to a hot object, you may feel thermal (heat) energy coming from it. This is energy travelling from a hotter object to a colder object.
- **Electrical energy:** dams, HEP, solar power, generator, battery, chemical energy. An electric current is a good way of transferring energy from one place to another. It carries electrical energy. When the current flows through a component such as a heater, it gives up some of its energy.
- **Nuclear energy:** A close relation of chemical energy is nuclear energy. Uranium is an example of a nuclear fuel, which is a store of nuclear energy.
- **Wind energy:** Wind energy is caused due to the thermal energy of the sun. Huge convectional current set up in the atmosphere and wind is produced.

## Law of Conservation of Energy:

Energy cannot be created or destroyed but it can change from one form to another.

## Renewable energy sources:

- Renewable energy sources are energy sources that can be replenished over short period of time.
- e.g. solar energy, wind energy, hydro-energy, geothermal energy

## Non-Renewable energy sources:

- Non - renewable energy sources are the energy sources that cannot be replenished over short period of time.
- e.g. coal, fossil fuels, nuclear fuels

## Generating electricity using renewable energy sources

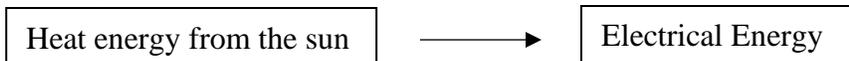
### Solar Energy:

Solar Energy is the energy from the Sun. The Sun is a big ball of heat and light resulting from nuclear fusion at its core. The nuclear reaction releases energy that travels outward to the surface of the Sun.

### Solar Panel:

Solar panels absorb energy from the sun and converted into electrical energy. Most solar energy is collected through photovoltaic cells, typically made of silicon that is a semiconductor. The sun's rays contain heat and radiations. When the rays hit the surface of the silicon cells, they cause a release of electrons that roam freely.

### Energy conversions take place in solar panel



### Block diagram of solar panel



Advantages	Disadvantages
Low running cost.	Low efficiency.
No major pollution.	Cover a large area & availability varies.
Renewable.	Less current produced.

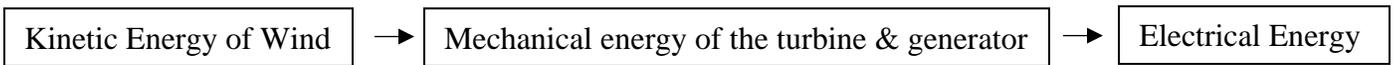
### Wind Energy:

Wind is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetation. Humans use this wind flow, or motion energy, for many purposes: sailing, flying a kite, and even generating electricity. In remote and exposed parts of the countries it is common to see many wind mills grouped together to form wind farms.

### Wind Turbines:

Wind turbines convert the kinetic energy in the wind into mechanical power. The generator in the wind turbine can convert this mechanical power into electricity.

**Energy conversions take place in wind mills**



**Block diagram of wind mills**



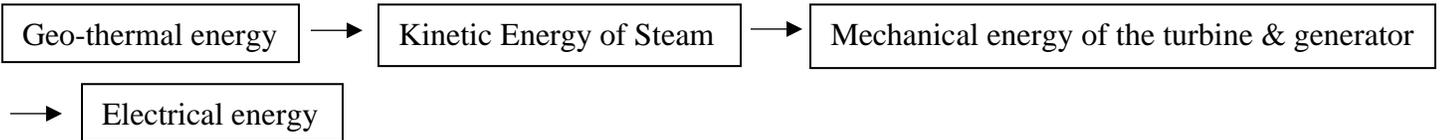
Advantages	Disadvantages
Low running cost.	Low efficiency/Irregular.
No major pollution.	Cover a large area & occupies space.
Renewable.	Less current produced.

**Geo-Thermal Energy:**

The heat from the earth's own molten core can be converted into electricity. This core consists primarily of extremely high temperature liquid rock known as magma. Temperature of the earth rises with increasing depth. The heat energy to keep cover at this temperature comes from the nuclear reaction which takes place in the core.

Cold water is pumped down a bore hole several kilometers deep into the hot granite rocks underground. Waters comes up through a second hole as steam at over 200°C. This high pressure steam can be used to drive a turbine and generate electricity.

**Energy conversions take place in geo-thermal energy**



**Block diagram of geothermal power station**

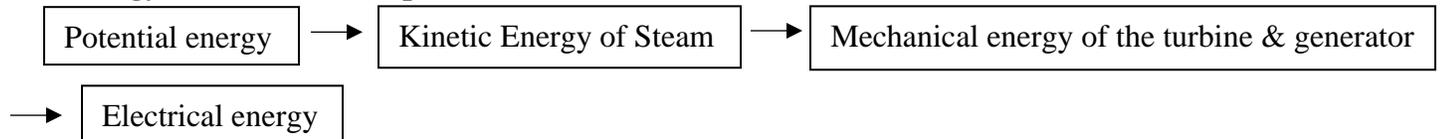


Advantages	Disadvantages
Low running cost.	Expensive.
High power can be generated.	Destroys land.
Renewable.	Pollutes.

**HEP:**

River and rain water fill up a lake behind dam. Water rushes down from the lake and spin the turbine. The turbine is connected to the generator, when the turbine rotates generator also rotates and produce electricity.

**Energy conversions take place in HEP**



**Block diagram of Hydro-Electric power station**



Advantages	Disadvantages
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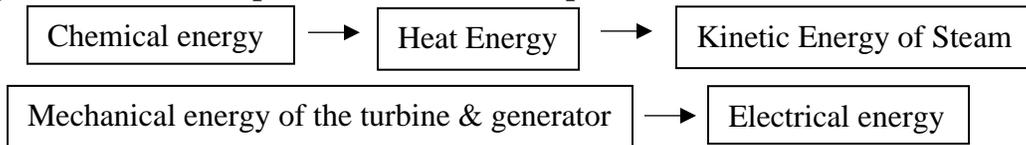
Low running cost.	Expensive.
High power can be generated.	Destroys natural land area.
Renewable.	Floods.

### Generating electricity using non-renewable energy sources

#### Fossil Fuel/Coal Power Station:

In thermal power station electricity is produced by burning non-renewable energy sources like coal, oil, natural gas. Thermal power stations have boiler, turbines and generator. We use these non-renewable energy sources (coal, oil, natural gas) as a fuel for the generation of heat energy by burning it. As the heat energy is transferred into the boiler the water in boiler starts to boil and evaporate the high pressurized steam. These high pressure steam passes to the turbine and it rotates as a result the generator is turned on and produce electricity. Once steam has passed through the turbines, it is cooled and condensed (turned back into a liquid) so that it can be fed back to the boiler and the process repeat.

#### Energy conversions take place in fossil fuel/coal power stations



#### Block diagram of Hydro-Electric power station

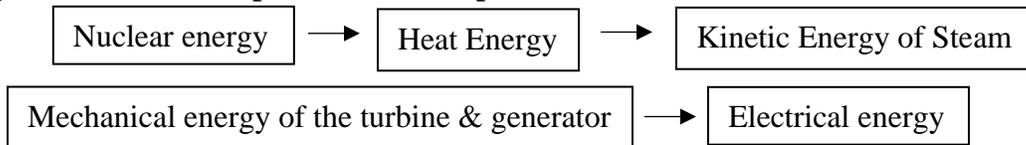


Advantages	Disadvantages
It requires less space to build up the power stations as compared to other types of generators.	It pollutes the atmosphere due to production of large amount of smoke and fumes. (air pollution, global warming, acid rain)
High power can be generated.	Higher cost of running (for buying fuels).

#### Nuclear Power Station:

In nuclear power stations uranium is used as a fuel. In the boiler the nuclear fuel (uranium) does not burn. But its energy is released by nuclear reaction (nuclear fission) which splits uranium atoms. Then the other process works as fuel power station.

#### Energy conversions take place in nuclear power stations



#### Block diagram of Hydro-Electric power station



Environmental Impact
It pollutes the atmosphere due to production of large amount of smoke and fumes.
It is dangerous to human body.
Radioactive material mix with water and water become radioactive.

#### Work:

Work is done whenever force is applied on an object and object move direction of force applied.  
Work can only be done if the object or system has energy. When work is done energy is transferred and this energy transfer is equals to work done.

Work done can be calculated using the following formula:

Work done = force  $\times$  distance moved ( $W = F \times d$ )

Unit of work done is joules.

**Power:**

Power is defined as the rate of doing work or rate of transferring energy. The more powerful a machine is, the quicker it does a fixed amount of work or transfer fixed amount of energy.

Power can be calculated using the following formula:

Power = work done/time taken ( $P=w/t$ )

Unit of power is watts (W) or joules/second (J/sec).

**Efficiency:**

An engine does useful work with some of the energy supplied to it, but the rest, is wasted as thermal energy & other forms. The more efficient an object, the lesser the energy wasted.

Efficiency can be calculated using the following formula:

Efficiency = useful energy output/energy input  $\times$  100

Efficiency = power output/power input  $\times$  100